

High Performance Relays, Contactors, Solenoids and Power Distribution Units

## Note:

Some of the products shown in this catalog are controlled under the U.S. International Traffic and Arms Regulations (ITAR), and may not be exported from the United States without proper authorization by the U.S. Department of State.

Please consult with your local TE Connectivity sales representative regarding this requirement as it varies by part number.


TE Connectivity has extensive capabilities in the design and manufacture of relays, contactors, solenoids and power distribution units for demanding, high performance applications.

We offer components for switching currents from dry circuit to more than 1,000 amps, voltages up to 70 kV and frequencies up to 6 GHz . Whether you need commercial off-the-shelf products, components that must meet stringent military specifications or highly specialized, customdesigned products, look to TE Connectivity to meet your requirements.
A wide range of contact configurations, enclosure types and mounting styles are offered. These robust models are designed to withstand
the rigors of high shock, vibration and acceleration encountered in aerospace, defense and marine applications. Our custom high performance solenoids produce from a few ounces force to 100 pounds of force at a one-inch stroke.

Other products, such as power controllers, protective relays and time delay relays conveniently combine multiple functions into a single package and are specifically designed for operation in extremes of temperature, shock, vibration and altitude.

## Need more information?

Technical Support is staffed with specialists well versed in all TE Connectivity products. They can provide you with:

- Technical Support
- Catalogs
- Technical Documents
- Product Samples
- TE Connectivity Authorized Distributor Locations

High Performance Relays, Contactors, Solenoids and Power Distribution Units

## Introduction

## Section 1

## Low Signal Relays

TE Connectivity CII brand low signal electromechanical relays are designed and built to perform under the most demanding environmental conditions in military, aerospace and commercial applications. Relays are rated from signal level up to 10 amps switching in a variety of package sizes, mounting configurations, and termination options. There are both nonlatching and latching designs. Standard, bifilar, and sensitive coils are available with optional diode suppression. Relays are qualified to MIL-PRF-39016, MIL-R-5757, MIL-PRF28776, MS27245, and MS27247.

## Section 2

## High Frequency, Low Signal Relays

TE MW Series relays are noted for their improved signal repeatability and RF switching capabilities to the 6 GHz microwave range in a hermetically sealed, subminiature package. Excellent signal isolation, stable insertion loss, and low VSWR are provided. Standard versions are available for applications ranging from wireless communications to precision high-speed test equipment. High performance versions are available for even more demanding environmental conditions.

## Section 3

## High Vibration Relays

TE High Vibration MAV and MSV Series TO-5 relays are designed to withstand vibration levels to 380 G's at 200 Hz . The small footprint and low profile offer the customer considerable space savings and permits high density packaging without sacrificing quality performance. Relays are available as standard or sensitive with a variety of coil voltages. The high shock and vibration ratings of MAV and MSV series make them well suited for the rigorous demands of military and aerospace usage.

## Section 4

## High Reliability Relays and Contactors for Space Applications

TE offers a variety of relay solutions for hi-reliability and space environments. Our space products begin as relays manufactured to established QPL mil specs, then receiving additional processing and testing tailored to the customer's specific application needs.
Clean room construction, highly controlled processes, tracking and serialization of data, quality audits throughout the manufacturing cycle, along with extensive product testing, assure our customers that their hi-reliability standards and requirements will be met or exceeded.

## Section 5

## Mid-Range Relays

TE CII brand Mid-range relays offer critical size and weight savings in aircraft applications by providing efficient power switching in a compact package. Relays vary in size from the compact 5 amp package all the way up to a 50 amp version in a 1 inch cube enclosure.
Our balanced force design provides the benefit of consistently high contact pressure, reduced bounce, and less arching leading to extended contact life. A variety of coil options are available which allow the AC or DC control.
Terminal styles include socket pins, solder pins, and solder hooks. Each series comes with a variety of mounting options. Relays are qualified to MIL-PRF-6106, MIL-PRF83536, and M83726 time delay relays.

## Section 6

## Lightweight AC and DC Contactors/Relays and Sensing Devices

TE offers some of the lightest, smallest and most efficient AC and DC contactors available today for aerospace commercial and military electrical power systems. These contactors are available in multiple contact configurations, current/voltage ratings, auxiliary contact configurations, and mounting styles.
TE prides itself in having the technical experience, knowledge and ability
to offer their customers products that meet and exceed their demanding requirements.
HARTMAN AC and DC contactors are light weight and environmentally (gasket) sealed. Hermetically sealed enclosures are available for the most severe environmental conditions or altitudes above 50,000 feet. Multiple main contact configurations and auxiliary contact configurations are available. AC and DC contactors are designed to meet the applicable requirements of MIL-PRF6106 and/or specific customer specifications.
TE also has Sensing and Protective Devices available with various functions, including current monitoring, reverse current protection, over/under voltage protection, over/under frequency protection, automatic drop-out for starting applications and three-phase remote power controllers with various over current trip functions.
TE offers HARTMAN brand products that are designed for use in the Space Industry. The NSeries relays offer highly reliable switching for 115 Volt AC and 28 Vdc circuits. These units are available with multiple contact configurations, latching or non-latching operating modes, and with current ratings up to 100 amperes and are designed to meet the requirements of MIL-PRF6106. Because they are ITAR restricted, they are not shown in this catalog.

Introduction (Continued)

## Section 7

## Lightweight DC Relays and Contactors

TE KILOVAC DC contactors deliver the switching performance demanded by aerospace and defense applications. These lightweight contactors offer continuous current ratings up to 500 amps at 900 Volts DC in very compact packages. Standard and customized individual contactors are available, as well as customdesigned, fully-qualified main power and high voltage distribution assemblies.

## Section 8

## Time Delay Relays

Our broad line of time delay relays includes delay-on-operate, fixed and adjustable; delay-on-release, fixed \& adjustable; and interval timers with relay or solid state outputs. All are hermetically sealed with a variety of package \& mounting configurations. Contact ratings range from 2 to 10A, with MIL qualification on 10A versions. Also available are MIL approved subminiature digital timing modules.

## Section 9

Sensors
Our versatile line of sensors includes AC \& DC voltage sensors, and AC frequency and phase sensors. All are hermetically sealed, with a variety of mounting options, and relay contact outputs.

## Section 10

## Solid State Relays

The product line includes both AC and DC versions, with output ratings up to 25 A . AC relays rated at $2 \mathrm{~A}, 10 \mathrm{~A}$, \& 25A feature zero voltage turn-on for reduced EMI. DC relays are offered with ratings up to 2A in several miniature hermetically sealed package configurations, some with optional isolated status lines and/or short circuit protection.

## Section 11

## Protective Relays

TE Protective Relays are designed and manufactured in compliance with UL, CSA, IEEE, military and customer specifications. These relays are in use on applications such as portable generators, automatic transfer switches, irrigation pumps, refineries, oil fields, aircraft, ships and nuclear submarines. A long list of TE protective relays are fully qualified by the military for use in ground support equipment, aircraft and

Navy ships high-shock applications. These are managed in the DOD supply system under NSN classes 5945 and 6110.

## Section 12

## Specialty Relays

TE AGASTAT brand relays feature unmatched accuracy and reliability in a pneumatic timer. Representing over 50 years of research and development in this specialized field, TE AGASTAT brand relays offer unprecedented economy and reliability under severe operating conditions. Voltages range from 6 to 550 VAC/VDC and timing ranges from 0.1 seconds to 60 minutes.
Relays are available in off and on delay models as commercial and nuclear qualified. A broad line of general purpose, time delay, and magnetic latching control relays are also offered.
In addition to our AGASTAT brand relays, TE MDR rotary relays provide good durability and excellent resistance to shock and vibration in specialized applications. Relays are rated up to 10 amps switching, 4 to 24 poles, latching option, and are available in 2 sizes ( $2-1 / 2$ and 4 inch diameters). MDR relays are also offered as commercial grade.

## Section 13

## Solenoids

Our solenoids are designed and manufactured on a custom basis to precisely meet your demanding high performance actuation requirements.

## Section 14

## Power Distribution Units

TE HARTMAN AC and DC power distribution units (PDUs) and KILOVAC DC PDUs are designed, built and qualified to meet your specific requirements serving both the commercial and military industries.
Allow us to apply our significant expertise in integrating bus-bar and plug-in contactors, relays, sensors, monitors, circuit breakers, shunts, generator control units and other components into compact, lightweight power distribution units.
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## Miscellaneous Information

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1MA, 1MAD, 1MADD

Electrical Characteristics
Contact Arrangement -
1 Form C (SPDT)
Contact Material -
Stationary -
Gold/platinum/palladium/silver alloy (gold plated)
Moveable -
Gold/platinum/palladium/silver alloy (gold plated)
Contact Resistance -
Before Life - 100 milliohms max.
(measured @ 10 mA @ 6 Vdc )
After Life - 200 milliohms max.
(measured @ 1 A @ 28 Vdc)
Mechanical Life Expectancy -
1 million operations
Coil Voltage - 5 to 26.5 Vdc
Coil Power — 512 mW max. @ $25^{\circ} \mathrm{C}$
Duty Cycle - Continuous
Pick-up Voltage - Approximately
$50 \%$ of nominal coil voltage
Pick-up Sensitivity -
100 mW max. @ $25^{\circ} \mathrm{C}$

Single Pole, Electrically Held, 1 Amp and Less

| 1MA | 1MAD | 1MADD |
| :---: | :---: | :---: |
| Standard TO-5 <br> High Performance Relay Qualified to | Standard TO-5 <br> Diode Suppressed High Performance Relay | Standard TO-5 Diode Suppressed/Protected High Performance Relay |
| MIL-R-39016/7 | Qualified to MIL-R-39016/23 | Qualified to MIL-R-39016/24 |
|  |  |  |
|  | Terminal View | Terminal View |
| Product Facts <br> - Hermetically sealed <br> ■ High shock \& vibration ratings | Product Facts | Product Facts |
|  | - Suppression diode |  |
|  | - Hermetically sealed | protection diodes |
|  | ■ High shock \& vibration | - Hermetically sealed |
| - Spreader pad■ Excellent RF switching | ratings | ■ High shock \& vibration |
|  | ■ Spreader pad | ratings |
|  | ■ Excellent RF switching | - Spreader pad |
|  |  | ■ Excellent RF switching |

Contact Ratings

| Contact <br> Load | Type | Operations <br> MINd. |
| :--- | :--- | ---: |
| 1.0 A @ 28 Vdc | Resistive | 100,000 |
| $250 \mathrm{~mA} @ 115 \mathrm{Vac}, 60 \mathrm{~Hz} \& 400 \mathrm{~Hz}$ | Resistive (case not grounded) | 100,000 |
| $100 \mathrm{~mA} @ 115 \mathrm{Vac}, 60 \mathrm{~Hz} \mathrm{\&} \mathrm{400} \mathrm{Hz}$ | Resistive | 100,000 |
| 0.2 A @ 28 Vdc | Inductive (0.32 Henry) | 100,000 |
| 0.1 A @ 28 Vdc | Lamp | 100,000 |
| $30 \mu \mathrm{~A} \mathrm{@} \mathrm{50} \mathrm{mVdc}$ | Low Level | $1,000,000$ |
| 0.1 A @ 28 Vdc | Intermediate Current | 50,000 |




1MA/1MAD/1MADD Header

1MA/1MAD/1MADD Enclosure

## Single Pole, Electrically Held, 1 Amp and Less (Continued)

1MA, 1MAD, 1MADD
(Continued)

## Operating Characteristics

Timing -
Operate Time - 2.0 ms max.
Release Time -
1MA - 2.0 ms max
1MAD/1MADD - 4.0 ms max.
(suppression diode, suppression/ steering diodes)
Contact Bounce - 1.5 ms max
Dielectric Withstanding Voltage -
Between Open Contacts -
500 Vrms 60 Hz
Between Adjacent Contacts 500 Vrms 60 Hz
Between Contacts \& Coil 500 Vrms 60 Hz

## Insulation Resistance -

10,000 megohms @ 500 Vdc
1,000 megohms @ 500 Vdc
(coil to case @ $+125^{\circ} \mathrm{C}$ )

## Environmental Characteristics

Temperature Range -
$-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Weight
0.08 oz. (2.27 grms)
0.09 oz. (2.52 grms) with spreader pad attached
Vibration Resistance -
30 G's, 10 to $3,000 \mathrm{~Hz}$
Shock Resistance -
75 G's, $6 \pm 1 \mathrm{~ms}$ max.
QPL Approval -
MIL-R-39016/7 (J1MA)
MIL-R-39016/23 (J1MAD)
MIL-R-39016/24 (J1MADD)

## Semiconductor Characteristics

## Diode -

100 Vdc peak inverse voltage (PIV)
1.0 Vdc max. transient voltage

Coil Data

| Nom. Coil Voltage (Vdc) | Coil Resistance in Ohms $\pm 10 \%$ @ $25^{\circ} \mathrm{C}$ (Note 1) | Coil Circuit Current mA (Max.) (Note 1\&2) | Coil Circuit Current mA (Min.) (Note 1\&2) | Pickup Voltage Vdc (Max.) @ $25^{\circ} \mathrm{C}$ (Note 2) | Base Turn On Current mA (Max.) @ $25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) @ $125^{\circ} \mathrm{C}$ (Note 2) | Base Turn On Current mA (Max.) @ $125^{\circ} \mathrm{C}$ | Drop-Out Voltage Vdc (Min.) @ $25^{\circ} \mathrm{C}$ (Note 2) | Drop-Out Voltage Vdc (Min.) @-65 C (Note 2) | Nom. Coil Power (mW) @ $25^{\circ} \mathrm{C}$ |  | Coil Desig. |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1MA/1MAD |  |  |  |  |  |  |  |  |  |  |  |  |
| 5.0 | 63 | n/a | n/a | 2.8 | n/a | 3.7 | n/a | 0.23 | 0.15 | 397 | 6.0 | 5 |
| 6.0 | 125 | n/a | n/a | 3.5 | n/a | 4.5 | n/a | 0.28 | 0.18 | 288 | 8.0 | 6 |
| 9.0 | 280 | n/a | n/a | 5.3 | n/a | 6.8 | n/a | 0.54 | 0.35 | 289 | 12.0 | 9 |
| 12.0 | 500 | n/a | n/a | 7.0 | n/a | 9.0 | n/a | 0.63 | 0.40 | 288 | 16.0 | 12 |
| 18.0 | 1,130 | n/a | n/a | 10.5 | n/a | 13.5 | n/a | 0.91 | 0.58 | 287 | 24.0 | 18 |
| 26.5 | 2,000 | n/a | n/a | 14.2 | n/a | 18.0 | n/a | 1.37 | 0.89 | 351 | 32.0 | 26 |
| 1MADD |  |  |  |  |  |  |  |  |  |  |  |  |
| 5.0 | 50 | 100.0 | 72.7 | 3.5 | n/a | 4.5 | n/a | 0.23 | 0.15 | 500 | 6.0 | 5 |
| 6.0 | 98 | 62.4 | 46.3 | 4.1 | n/a | 5.5 | n/a | 0.28 | 0.18 | 367 | 8.0 | 6 |
| 9.0 | 280 | 33.7 | 25.9 | 6.3 | n/a | 7.8 | n/a | 0.54 | 0.35 | 289 | 12.0 | 9 |
| 12.0 | 500 | 25.6 | 20.0 | 8.0 | n/a | 10.0 | n/a | 0.63 | 0.40 | 288 | 16.0 | 12 |
| 18.0 | 1,130 | 17.2 | 13.6 | 11.6 | n/a | 14.5 | n/a | 0.91 | 0.58 | 287 | 24.0 | 18 |
| 26.5 | 2,000 | 14.4 | 11.5 | 15.4 | n/a | 19.0 | n/a | 1.37 | 0.89 | 351 | 32.0 | 26 |

Notes: 1. Coil resistance not directly measurable. Coil current should be within limits shown when tested at nominal voltage at $25^{\circ} \mathrm{C}$ for 5 seconds max. 2. Set base current at 3 mA to 15 mA during measurements.

## Ordering Instructions

Catalog-selected Relays: The catalog number is derived by choosing the proper CODE for each of the relay characteristics in the order in which the codes are listed

| Specifying a Part Number Example*: | Type | Terminal | Diodes | Coils | Spreader/Mounting Pads |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1MA | C | D | -26 | S |

* The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15.


1MS, 1MSD, 1MSDD

## Electrical Characteristics

Contact Arrangement -
1 Form C (SPDT)
Contact Material -
Stationary -
Gold/platinum/palladium/silver alloy (gold plated)
Moveable -
Gold/platinum/palladium/silver alloy (gold plated)
Contact Resistance -
Before Life - 100 milliohms max
(measured @ 10 mA @ 6 Vdc )
After Life - 200 milliohms max.
(measured @ 1 A @ 28 Vdc)
Mechanical Life Expectancy -
1 million operations
Coil Voltage - 5 to 40 Vdc
Coil Power — 506 mW max. @ $25^{\circ} \mathrm{C}$
Duty Cycle - Continuous
Pick-up Voltage - Approximately
$50 \%$ of nominal coil voltage
Pick-up Sensitivity 40 mW max. @ $25^{\circ} \mathrm{C}$

Single Pole, Electrically Held, 1 Amp and Less (Continued)

1MS
Sensitive TO-5
High Performance Relay
Qualified to
MIL-R-39016/10


Terminal View
Product Facts
■ Hermetically sealed
■ High shock \& vibration ratings

- Spreader pad

■ Excellent RF switching

1MSD
Sensitive TO-5 Diode Suppressed High Performance Relay Qualified to MIL-R-39016/25


Terminal View
Product Facts
$\square$ Suppression diode
$\square$ Hermetically sealed
$\square$ High shock \& vibration
ratings
$\square$ Spreader pad
$\square$ Excellent RF switching

1MSDD
Sensitive TO-5 Diode Suppressed/Protected High Performance Relay

Qualified to MIL-R-39016/26


Terminal View
Product Facts
■ Suppression \& protection diodes

- Hermetically sealed

■ High shock \& vibration ratings
■ Spreader pad
■ Excellent RF switching

Contact Ratings

| Contact <br> Load | Type | Operations <br> MINd. |
| :--- | :--- | ---: |
| 1.0 A @ 28 Vdc | Resistive | 100,000 |
| $250 \mathrm{~mA} @ 115 \mathrm{Vac}, 60 \mathrm{~Hz} \& 400 \mathrm{~Hz}$ | Resistive (case not grounded) | 100,000 |
| $100 \mathrm{~mA} @ 115 \mathrm{Vac}, 60 \mathrm{~Hz} \& 400 \mathrm{~Hz}$ | Resistive | 100,000 |
| 0.2 A @ 28 Vdc | Inductive $(0.32$ Henry) | 100,000 |
| 0.1 A @ 28 Vdc | Lamp | 100,000 |
| $30 \mu \mathrm{~A} @ 50 \mathrm{mVdc}$ | Low Level | $1,000,000$ |
| 0.1 A @ 28 Vdc | Intermediate Current | 50,000 |



## Single Pole, Electrically Held, 1 Amp and Less (Continued)

1MS, 1MSD, 1MSDD
(Continued)

## Operating Characteristics

Timing -
Operate Time - 4.0 ms max.
Release Time -
MSS - 2.5 ms max
1MSD/1MSDD - 7.5 ms max.
(suppression diode, suppression/ steering diodes)
Contact Bounce - 1.5 ms max
Dielectric Withstanding Voltage Between Open Contacts -
500 Vrms 60 Hz
Between Adjacent Contacts 500 Vrms 60 Hz Between Contacts \& Coil 500 Vrms 60 Hz
Insulation Resistance -
10,000 megohms @ 500 Vdc
1,000 megohms @ 500 Vdc
(coil to case @ $+125^{\circ} \mathrm{C}$ )

## Environmental Characteristics

Temperature Range -
$-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Weight
0.10 oz. (2.84 grms)
0.11 oz. (3.09 grms) with spreader pad attached
Vibration Resistance -
30 G's, 10 to $3,000 \mathrm{~Hz}$
Shock Resistance -
75 G's, $6 \pm 1 \mathrm{~ms}$ max.
QPL Approval -
MIL-R-39016/10 (J1MS)
MIL-R-39016/25 (J1MSD)
MIL-R-39016/26 (J1MSDD)

## Semiconductor Characteristics

## Diode -

100 Vdc peak inverse voltage (PIV)
1.0 Vdc max. transient voltage


Spreader \& Mounting Pads

Coil Data

| Nom. Coil Voltage (Vdc) | Coil Resistance in Ohms $\pm 10 \% @ 25^{\circ} \mathrm{C}$ (Note 1) | Coil Circuit Current mA (Max.) (Note 1\&2) | Coil Circuit Current mA (MINd.) (Note 1\&2) | Pickup Voltage Vdc (Max.) @ $25^{\circ} \mathrm{C}$ (Note 2) | Base Turn On Current mA (Max.) <br> @ $25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) @ $125^{\circ} \mathrm{C}$ (Note 2) | Base Turn On Current mA (Max.) <br> @ $125^{\circ} \mathrm{C}$ | Drop-Out Voltage Vdc (MINd.) $@ 25^{\circ} \mathrm{C}$ (Note 2) | Drop-Out Voltage Vdc (MINd.) $@-65^{\circ} \mathrm{C}$ (Note 2) | Nom. Coil Power (mW) @ $25^{\circ} \mathrm{C}$ |  | Coil Desig. |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1MS/1MSD |  |  |  |  |  |  |  |  |  |  |  |  |
| 5.0 | 125 | n/a | n/a | 2.8 | n/a | 3.7 | n/a | 0.23 | 0.15 | 200 | 8.0 | 5 |
| 6.0 | 255 | n/a | n/a | 3.5 | n/a | 4.5 | n/a | 0.28 | 0.18 | 141 | 11.0 | 6 |
| 9.0 | 630 | n/a | n/a | 5.3 | n/a | 6.8 | n/a | 0.54 | 0.35 | 129 | 12.0 | 9 |
| 12.0 | 1,025 | n/a | n/a | 7.0 | n/a | 9.0 | n/a | 0.63 | 0.40 | 140 | 22.0 | 12 |
| 18.0 | 2,300 | n/a | n/a | 10.5 | n/a | 13.5 | n/a | 0.91 | 0.59 | 141 | 24.0 | 18 |
| 26.5 | 4,000 | n/a | n/a | 14.2 | n/a | 18.0 | n/a | 1.37 | 0.89 | 176 | 45.0 | 26 |
| 32.0 | 6,500 | n/a | n/a | 18.7 | n/a | 24.0 | n/a | 1.59 | 1.0 | 158 | 57.0 | 32 |
| 40.0 | 11,000 | n/a | n/a | 23.3 | n/a | 30.0 | n/a | 2.0 | 1.3 | 145 | 75.0 | 40 |
| 1MSDD |  |  |  |  |  |  |  |  |  |  |  |  |
| 5.0 | 100 | 50.0 | 36.3 | 3.5 | n/a | 4.5 | n/a | 0.23 | 0.15 | 250 | 8.0 | 5 |
| 6.0 | 200 | 30.6 | 22.7 | 4.1 | n/a | 5.5 | n/a | 0.28 | 0.18 | 180 | 11.0 | 6 |
| 9.0 | 630 | 15.0 | 11.5 | 6.3 | n/a | 7.8 | n/a | 0.54 | 0.35 | 129 | 16.0 | 9 |
| 12.0 | 1,025 | 12.5 | 9.7 | 8.0 | n/a | 10.0 | n/a | 0.63 | 0.40 | 140 | 22.0 | 12 |
| 18.0 | 2,300 | 8.5 | 6.7 | 11.6 | n/a | 14.5 | n/a | 0.91 | 0.58 | 141 | 33.0 | 18 |
| 26.5 | 4,000 | 7.2 | 5.7 | 15.4 | n/a | 19.0 | n/a | 1.37 | 0.89 | 176 | 45.0 | 26 |
| 32.0 | 6,500 | 5.4 | 4.3 | 17.0 | n/a | 21.0 | n/a | 1.5 | 0.95 | 158 | 57.0 | 32 |
| 40.0 | 11,000 | 4.0 | 3.2 | 22.0 | n/a | 27.0 | n/a | 2.0 | 1.28 | 145 | 75.0 | 40 |

Notes: 1. Coil resistance not directly measurable. Coil current should be within limits shown when tested at nominal voltage at $25^{\circ} \mathrm{C}$ for 5 seconds max.
2. Set base current at 3 mA to 15 mA during measurements.

## Ordering Instructions

Catalog-selected Relays: The catalog number is derived by choosing the proper CODE for each of the relay characteristics in the order in which the codes are listed.

| Specifying a Part Number Example: | Type | Terminal | Diodes | Coils | Spreader/Mounting Pads |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | 1MS | C | D | -26 | S |

* The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15.


# Single Pole, Electrically Held, 1 Amp and Less (Continued) 

1MAT
1MAT
Standard TO-5
Diode Suppressed/
Transistor Driven
High Performance Relay
Qualified to
MIL-R-28776/5


Terminal View

## Product Facts

- Transistor driver \& suppression diode

■ Hermetically sealed
■ High shock \& vibration ratings

- Spreader pad

■ Excellent RF switching

## Electrical Characteristics

Contact Arrangement -
1 Form C (SPDT)
Contact Material -
Stationary -
Gold/platinum/palladium/silver alloy (gold plated)
Moveable -
Gold/platinum/palladium/silver alloy (gold plated)

## Contact Resistance -

Before Life - 100 milliohms max (measured @ 10 mA @ 6 Vdc)
After Life — 200 milliohms max.
(measured @ 1 A @ 28 Vdc)
Mechanical Life Expectancy -
1 million operations
Coil Voltage - 5 to 26.5 Vdc
Coil Power — 512 mW max. @ $25^{\circ} \mathrm{C}$
Duty Cycle - Continuous
Pick-up Voltage - Approximately
$50 \%$ of nominal coil voltage
Pick-up Sensitivity -
100 mW max. @ $25^{\circ} \mathrm{C}$
Contact Ratings

| Contact Load | Type | Operations MINd. |
| :---: | :---: | :---: |
| 1.0 A @ 28 Vdc | Resistive | 100,000 |
| 250 mA @ $115 \mathrm{Vac}, 60 \mathrm{~Hz}$ \& 400 Hz | Resistive (case not grounded) | 100,000 |
| 100 mA @ $115 \mathrm{Vac}, 60 \mathrm{~Hz}$ \& 400 Hz | Resistive | 100,000 |
| 0.2 A @ 28 Vdc | Inductive (0.32 Henry) | 100,000 |
| 0.1 A @ 28 Vdc | Lamp | 100,000 |
| $30 \mu \mathrm{~A}$ @ 50 mVdc | Low Level | 1,000,000 |
| 0.1 A @ 28 Vdc | Intermediate Current | 50,000 |




1MAT Header

## Single Pole, Electrically Held, 1 Amp and Less (Continued)

1MAT (Continued)

## Operating Characteristics

Timing -
Operate Time -2.0 ms max.
Release Time -
4.0 ms max.

Contact Bounce - 1.5 ms max
Dielectric Withstanding Voltage -
Between Open Contacts -
500 Vrms 60 Hz
Between Adjacent Contacts -
500 Vrms 60 Hz
Between Contacts \& Coil 500 Vrms 60 Hz
Insulation Resistance -
10,000 megohms @ 500 Vdc 1,000 megohms @ 500 Vdc (coil to case @ $+125^{\circ} \mathrm{C}$ )

| Environmental Characteristics | Semiconductor Characteristics |
| :---: | :---: |
| Temperature Range -$-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ | Diode - <br> 100 Vdc peak inverse voltage (PIV) |
| Weight - | 1.0 Vdc max. transient voltage |
| 0.08 02. (2.27 grms) | Transistor - |
| 0.09 oz. (2.52 grms) with spreader pad attached | 0.3 Vdc MINd . base turn off voltage; 6.0 Vdc min. emitter-base breakdown |
| Vibration Resistance - <br> 30 G's, 10 to $3,000 \mathrm{~Hz}$ | voltage ( $\mathrm{BV}_{\text {EBO }}$ ) @ $25^{\circ} \mathrm{C}$; 80.0 Vdc min. collector-base breakdown |
| Shock Resistance 75 G's, $6 \pm 1 \mathrm{~ms}$ max. | voltage ( $\mathrm{BV}_{\text {CBO }}$ @ $2^{\circ} 5^{\circ} \mathrm{C}$ \& $\mathrm{C}_{\mathrm{C}}=100 \mu \mathrm{~A}$ |
| QPL Approval -MIL-R-28776/5 (J1MAT) |  |



Spreader \& Mounting Pads

Coil Data

| Nom. Coil Voltage (Vdc) | Coil Resistance in Ohms $\pm 10 \%$ @ $25^{\circ} \mathrm{C}$ (Note 1) | Coil Circuit Current mA (Max.) (Note 1\&2) | Coil Circuit Current mA (MINd.) (Note 1\&2) | Pickup Voltage Vdc (Max.) @ $25^{\circ} \mathrm{C}$ (Note 2) | Base Turn On Current mA (Max.) <br> @ $25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) @ 1255 (Note 2) | Base Turn On Current mA (Max.) @ $125^{\circ} \mathrm{C}$ | Drop-Out Voltage Vdc (MINd.) @ $25^{\circ} \mathrm{C}$ (Note 2) | Drop-Out Voltage Vdc (MINN.) $@-65^{\circ} \mathrm{C}$ (Note 2) | Nom. Coil Power (mW) @ $25^{\circ} \mathrm{C}$ |  | Coil Desig. |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1MAT |  |  |  |  |  |  |  |  |  |  |  |  |
| 5.0 | 63 | 89.6 | 66.6 | 3.0 | 0.60 | 3.9 | 2.38 | 0.24 | 0.15 | 397 | 5.8 | 5 |
| 6.0 | 125 | 55.5 | 42.0 | 3.8 | 0.42 | 5.2 | 1.60 | 0.31 | 0.18 | 288 | 8.0 | 6 |
| 9.0 | 280 | 38.1 | 28.0 | 5.6 | 0.27 | 7.8 | 1.07 | 0.47 | 0.35 | 289 | 12.0 | 9 |
| 12.0 | 500 | 28.1 | 20.9 | 7.2 | 0.21 | 10.0 | 0.80 | 0.62 | 0.40 | 288 | 16.0 | 12 |
| 18.0 | 1,130 | 18.8 | 13.8 | 10.7 | 0.12 | 14.5 | 0.53 | 0.94 | 0.58 | 287 | 24.0 | 18 |
| 26.5 | 2,000 | 15.5 | 11.5 | 14.4 | 0.10 | 19.0 | 0.40 | 1.25 | 0.89 | 351 | 32.0 | 26 |

Notes: 1. Coil resistance not directly measurable. Coil current should be within limits shown when tested at nominal voltage at $25^{\circ} \mathrm{C}$ for 5 seconds max.
2. Set base current at 3 mA to 15 mA during measurements.

## Ordering Instructions

Catalog-selected Relays: The catalog number is derived by choosing the proper CODE for each of the relay characteristics in the order in which the codes are listed.

| Specifying a Part Number Example: | $\underline{\text { Type }}$ | Terminal | Diodes | Coils | $\underline{S}$ | Spreader/Mounting Pads |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |

[^0]
# Single Pole, Electrically Held, 1 Amp and Less (Continued) 

1MST
1MST
Sensitive TO-5 Diode Suppressed/ Transistor Driven High Performance Relay
Qualified to MIL-R-28776/4


Terminal View

## Product Facts

- Transistor driver \& suppression diode
■ Hermetically sealed
■ High shock \& vibration ratings
- Spreader pad

■ Excellent RF switching

## Electrical Characteristics

Contact Arrangement -
1 Form C (SPDT)
Contact Material -
Stationary -
Gold/platinum/palladium/silver alloy (gold plated)
Moveable -
Gold/platinum/palladium/silver alloy (gold plated)

## Contact Resistance -

Before Life - 100 milliohms max. (measured @ 10 mA @ 6 Vdc)
After Life — 200 milliohms max.
(measured @ 1 A @ 28 Vdc)
Mechanical Life Expectancy -
1 million operations
Coil Voltage - 5 to 40 Vdc
Coil Power — 506 mW max. @ $25^{\circ} \mathrm{C}$
Duty Cycle - Continuous
Pick-up Voltage - Approximately
$50 \%$ of nominal coil voltage
Pick-up Sensitivity 40 mW max. @ $25^{\circ} \mathrm{C}$

## Contact Ratings

| Contact <br> Load | Type | Operations <br> Min. |
| :--- | :--- | ---: |
| 1.0 A @ 28 Vdc | Resistive | 100,000 |
| $250 \mathrm{~mA} \mathrm{@} \mathrm{115} \mathrm{Vac} 60 \mathrm{~Hz} \& 400 Hz$, | Resistive (case not grounded) | 100,000 |
| $100 \mathrm{~mA} @ 115 \mathrm{Vac}, 60 \mathrm{~Hz} \mathrm{\&} \mathrm{400} \mathrm{Hz}$ | Resistive | 100,000 |
| 0.2 A @ 28 Vdc | Inductive (0.32 Henry) | 100,000 |
| 0.1 A @ 28 Vdc | Lamp | 100,000 |
| $30 \mu \mathrm{~A} @ 50 \mathrm{mVdc}$ | Low Level | $1,000,000$ |
| 0.1 A @ 28 Vdc | Intermediate Current | 50,000 |




1MST Header

1MST Enclosure

## Single Pole, Electrically Held, 1 Amp and Less (Continued)

1MST (Continued)

## Operating Characteristics

Timing -
Operate Time -
3.5 ms max.

Release Time -
7.5 ms max.

Contact Bounce - 1.5 ms max
Dielectric Withstanding Voltage -
Between Open Contacts -
500 Vrms 60 Hz
Between Adjacent Contacts -
500 Vrms 60 Hz
Between Contacts \& Coil -
500 Vrms 60 Hz
Insulation Resistance -
10,000 megohms @ 500 Vdc
1,000 megohms @ 500 Vdc
(coil to case @ + $125^{\circ} \mathrm{C}$ )

## Environmental Characteristics

Temperature Range -
$-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Weight -
0.10 oz. (2.84 grms)
0.11 oz. (3.09 grms) with spreader pad attached
Vibration Resistance -
30 G's, 10 to $3,000 \mathrm{~Hz}$
Shock Resistance -
75 G's, $6 \pm 1 \mathrm{~ms}$ max.
QPL Approval -
MIL-R-28776/4 (J1MST)

## Semiconductor Characteristics

## Diode -

100 Vdc peak inverse voltage (PIV) 1.0 Vdc max. transient voltage

## Transistor -

0.3 Vdc min. base turn off voltage; 6.0 Vdc min. emitter-base breakdown voltage ( $\mathrm{BV}_{\text {EBO }}$ ) @ $25^{\circ} \mathrm{C}$; 80.0 Vdc min. collector-base breakdown voltage $\left(\mathrm{BV}_{\text {CBO }}\right) @ 25^{\circ} \mathrm{C} \& \mathrm{I}_{\mathrm{C}}=100 \mu \mathrm{~A}$


Spreader \& Mounting Pads

Coil Data

| Nom. Coil Voltage (Vdc) | Coil Resistance in Ohms $\pm 10 \%$ @ $25^{\circ} \mathrm{C}$ (Note 1) | Coil Circuit Current mA (Max.) (Note 1\&2) | Coil Circuit Current mA (Min.) (Note 1\&2) | Pickup Voltage Vdc (Max.) <br> @ $25^{\circ} \mathrm{C}$ <br> (Note 2) | Base Turn On Current mA (Max.) @ $25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) @ $125^{\circ} \mathrm{C}$ (Note 2) | Base Turn On Current mA (Max.) @ $125^{\circ} \mathrm{C}$ | Drop-Out Voltage Vdc (Min.) <br> @ $25^{\circ} \mathrm{C}$ <br> (Note 2) | Drop-Out Voltage Vdc (Min.) @ -65응 (Note 2) | Nom. Coil Power (mW) @ $25^{\circ} \mathrm{C}$ |  | Coil Desig. |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1MST |  |  |  |  |  |  |  |  |  |  |  |  |
| 5.0 | 125 | 47.8 | 34.7 | 2.6 | 0.28 | 3.6 | 1.20 | 0.22 | 0.15 | 200 | 8.0 | 5 |
| 6.0 | 255 | 27.7 | 21.2 | 3.5 | 0.20 | 4.8 | 0.78 | 0.28 | 0.18 | 141 | 11.0 | 6 |
| 9.0 | 630 | 16.8 | 11.8 | 5.4 | 0.13 | 7.8 | 0.48 | 0.54 | 0.35 | 129 | 16.0 | 9 |
| 12.0 | 1,025 | 13.6 | 10.1 | 6.6 | 0.10 | 10.0 | 0.39 | 0.63 | 0.41 | 140 | 22.0 | 12 |
| 18.0 | 2,300 | 9.1 | 6.7 | 9.8 | 0.07 | 14.5 | 0.26 | 0.91 | 0.58 | 141 | 33.0 | 18 |
| 26.5 | 4,000 | 7.7 | 5.7 | 12.8 | 0.05 | 19.0 | 0.20 | 1.37 | 0.89 | 176 | 45.0 | 26 |
| 32.0 | 6,500 | 5.8 | 4.2 | 18.7 | 0.04 | 24.0 | 0.16 | 1.60 | 1.00 | 158 | 57.0 | 32 |
| 40.0 | 11,000 | 4.3 | 3.1 | 23.3 | 0.03 | 30.0 | 0.13 | 2.10 | 1.30 | 145 | 75.0 | 40 |

Notes: 1. Coil resistance not directly measurable. Coil current should be within limits shown when tested at nominal voltage at $25^{\circ} \mathrm{C}$ for 5 seconds max.
2. Set base current at 3 mA to 15 mA during measurements.

## Ordering Instructions

Catalog-selected Relays: The catalog number is derived by choosing the proper CODE for each of the relay characteristics in the order in which the codes are listed.

| Specifying a Part Number Example: | $\underline{\text { Type }}$ | $\underline{\text { Terminal }}$ | Diodes | $\underline{\text { Coils }}$ | $\underline{T}$ | Spreader/Mounting Pads |
| :--- | :--- | :--- | :---: | :---: | :---: | :---: |

* The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15. to change.


## MA, MAD, MADD

## Electrical Characteristics

Contact Arrangement -
2 Form C (DPDT)
Contact Material -
Stationary -
Gold/platinum/palladium/silver alloy (gold plated)
Moveable -
Gold/platinum/palladium/silver alloy (gold plated)

## Contact Resistance -

Before Life - 100 milliohms max
(measured @ 10 mA @ 6 Vdc )
Atter Life - 200 milliohms max.
(measured @ $1 \mathrm{~A} @ 28 \mathrm{Vdc}$ )
Mechanical Life Expectancy -
1 million operations
Coil Voltage -
5 to $30 \mathrm{Vdc}(\mathrm{MA} / \mathrm{MAD})$
5 to 26.5 Vdc (MADD)
Coil Power - 675 mW max. @ $25^{\circ} \mathrm{C}$
Duty Cycle - Continuous
Pick-up Voltage - Approximately
$50 \%$ of nominal coil voltage
Pick-up Sensitivity -
130 mW max. @ $25^{\circ} \mathrm{C}$

Double Pole, Electrically Held, 1 Amp and Less

| MA | MAD | MADD |
| :---: | :---: | :---: |
| Standard TO-5 <br> High Performance Relay Qualified to | Standard TO-5 Diode Suppressed High Performance Relay | Standard TO-5 Diode Suppressed/Protected High Performance Relay |
| MIL-R-39016/9 | Qualified to MIL-R-39016/15 | Qualified to MIL-R-39016/20 |
| Clol |  |  |
| Terminal View | Terminal View | Terminal View |
| Product Facts <br> - Hermetically sealed <br> - High shock \& vibration ratings <br> - Spreader pads <br> - Excellent RF switching | Product Facts <br> - Suppression diode <br> - Hermetically sealed <br> - High shock \& vibration ratings <br> ■ Spreader pads <br> - Excellent RF switching | Product Facts <br> - Suppression \& protection diodes <br> - Hermetically sealed <br> - High shock \& vibration ratings <br> - Spreader pads <br> ■ Excellent RF switching |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

## Contact Ratings

| Contact Load | Type | Operations Min. |
| :---: | :---: | :---: |
| 1.0 A @ 28 Vdc | Resistive | 100,000 |
| 250 mA @ $115 \mathrm{Vac}, 60 \mathrm{~Hz}$ \& 400 Hz | Resistive (case not grounded) | 100,000 |
| 100 mA @ $115 \mathrm{Vac}, 60 \mathrm{~Hz}$ \& 400 Hz | Resistive | 100,000 |
| 0.2 A @ 28 Vdc | Inductive (0.32 Henry) | 100,000 |
| 0.1 A @ 28 Vdc | Lamp | 100,000 |
| $30 \mu \mathrm{~A} @ 50 \mathrm{mVdc}$ | Low Level | 1,000,000 |
| 0.1 A @ 28 Vdc | Intermediate Current | 50,000 |




Notes: 1. Coil resistance not directly measurable. Coil current should be within limits shown when tested at nominal voltage at $25^{\circ} \mathrm{C}$ for 5 seconds max.
2. Set base current at 3 mA to 15 mA during measurements.

## Ordering Instructions

Catalog-selected Relays: The catalog number is derived by choosing the proper CODE for each of the relay characteristics in the order in which the codes are listed.

| Specifying a Part Number Example: | Type | Terminal | Diodes | Ground Pins | Coils | Spreader/Mounting Pads |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | MA | C | D | G | -26 | S |

*The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15.

| Catalog 5-1773450-5 | Dimensions are shown for <br> reference purposes only. |
| :--- | :--- |
| Revised 3-13 | Specifications subject |
| to change. |  | unless otherwise specified.

MS, MSD, MSDD

## Electrical Characteristics

Contact Arrangement -
2 Form C (DPDT)
Contact Material -
Stationary -
Gold/platinum/palladium/silver alloy (gold plated)
Moveable -
Gold/platinum/palladium/silver alloy (gold plated)

## Contact Resistance -

Before Life - 100 milliohms max
(measured @ 10 mA @ 6 Vdc )
After Life - 200 milliohms max.
(measured @ 1 A @ 28 Vdc)
Mechanical Life Expectancy -
1 million operations
Coil Voltage - 5 to 48 Vdc
Coil Power — 565 mW max. @ $25^{\circ} \mathrm{C}$
Duty Cycle - Continuous
Pick-up Voltage - Approximately
$50 \%$ of nominal coil voltage
Pick-up Sensitivity -
60 mW max. @ $25^{\circ} \mathrm{C}$

Double Pole, Electrically Held, 1 Amp and Less (Continued)

| MS | MSD | MSDD |
| :---: | :---: | :---: |
| Sensitive TO-5 <br> High Performance Relay Qualified to | Sensitive TO-5 <br> Diode Suppressed High Performance Relay | Sensitive TO-5 Diode Suppressed/Protected High Performance Relay |
| MIL-R-39016/11 | Qualified to MIL-R-39016/16 | Qualified to MIL-R-39016/21 |
| Collol |  |  |
| Terminal View | Terminal View | Terminal View |
| Product Facts <br> - Hermetically sealed <br> - High shock \& vibration ratings <br> - Spreader pads <br> - Excellent RF switching | Product Facts Suppression diode <br> - Hermetically sealed <br> - High shock \& vibration ratings <br> - Spreader pads <br> - Excellent RF switching | Product Facts <br> - Suppression \& protection diodes <br> - Hermetically sealed <br> - High shock \& vibration ratings <br> - Spreader pads <br> ■ Excellent RF switching |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

Contact Ratings

| Contact <br> Load | Type | Operations <br> Min. |
| :--- | :--- | ---: |
| 1.0 A @ 28 Vdc | Resistive | 100,000 |
| $250 \mathrm{~mA} @ 115 \mathrm{Vac}, 60 \mathrm{~Hz} \& 400 \mathrm{~Hz}$ | Resistive (case not grounded) | 100,000 |
| $100 \mathrm{~mA} @ 115 \mathrm{Vac}, 60 \mathrm{~Hz} \mathrm{\&} \mathrm{400} \mathrm{Hz}$ | Resistive | 100,000 |
| 0.2 A @ 28 Vdc | Inductive (0.32 Henry) | 100,000 |
| 0.1 A @ 28 Vdc | Lamp | 100,000 |
| $30 \mu \mathrm{~A} \mathrm{@} \mathrm{50} \mathrm{mVdc}$ | Low Level | $1,000,000$ |
| 0.1 A @ 28 Vdc | Intermediate Current | 50,000 |



Enclosure


Notes: 1. Coil resistance not directly measurable. Coil current should be within limits shown when tested at nominal voltage at $25^{\circ} \mathrm{C}$ for 5 seconds max. 2. Set base current at 3 mA to 15 mA during measurements.

Ordering Instructions Catalog-selected Relays: The catalog number is derived by choosing the proper CODE for each of the relay characteristics in the order in which the codes are listed.

| Specifying a Part Number Example: | Type | Terminal | Diodes | Ground Pins | Coils | Spreader/Mounting Pads |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | MS | C | D | G | -26 | S |
| * The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15. |  |  |  |  |  |  |

Double Pole, Electrically Held, 1 Amp and Less (Continued)


Terminal View
Product Facts

- Hermetically sealed

■ Spreader Pads
■ Excellent RF switching

## Electrical Characteristics

Contact Arrangement -
2 Form C (DPDT)
Contact Material -
Stationary -
Gold/platinum/palladium/silver alloy (gold plated)
Moveable -
Gold/platinum/palladium/silver alloy (gold plated)
Contact Resistance -
Before Life - 100 milliohms max. (measured @ 10 mA @ 6 Vdc ) After Life - 200 milliohms max. (measured @ 1 A @ 28 Vdc) Mechanical Life Expectancy 1 million operations

HMD, HSD
Standard / Sensitive TO-5
Diode Suppressed Commercial Relay


Terminal View
Product Facts
■ Suppression Diode
■ Hermetically sealed

- Spreader Pads

■ Excellent RF switching

## Electrical Characteristics

## Coil Voltage -

5 to $30 \mathrm{Vdc}(\mathrm{HM} / \mathrm{HMD})$
5 to $48 \mathrm{Vdc}(\mathrm{HS} / \mathrm{HSD})$
Coil Power -
HM/HMD - 675 mW max. @ $25^{\circ} \mathrm{C}$ HS/HSD — 565 mW max. @ $25^{\circ} \mathrm{C}$
Duty Cycle - Continuous
Pick-up Voltage - Approximately $70 \%$ of nominal coil voltage

## Pick-up Sensitivity -

HM/HMD - 180 mW max. @ $25^{\circ} \mathrm{C}$ HS/HSD - 90 mW max. @ $25^{\circ} \mathrm{C}$


Header

Contact Ratings

| Contact <br> Load | Type | Operations <br> Min. |
| :--- | :--- | ---: |
| $1.0 \mathrm{~A} @ 28 \mathrm{Vdc}$ | Resistive | 100,000 |
| $250 \mathrm{~mA} @ 115 \mathrm{Vac}, 60 \mathrm{~Hz} \& 400 \mathrm{~Hz}$ | Resistive (Case not grounded) | 100,000 |
| $100 \mathrm{~mA} @ 115 \mathrm{Vac}, 60 \mathrm{~Hz} \& 400 \mathrm{~Hz}$ | Resistive | 100,000 |
| 0.2 A @ 28 Vdc | Inductive $(0.32$ Henry) | 100,000 |
| 0.1 A @ 28 Vdc | Lamp | 100,000 |
| $30 \mu \mathrm{~A} \mathrm{@} 50 \mathrm{mVdc}$ | Low Level | $1,000,000$ |

## Double Pole, Electrically Held, 1 Amp and Less (Continued)

HM, HMD, HS, HSD
(Continued)
Operating Characteristics
Timing -
Operate Time -
HM/HMD - 4.0 ms max.
HS/HSD - 6.0 ms max.
Release Time -
HM - 3.0 ms max.
HS - 3.0 ms max.
HMD -6.0 ms max.
(suppression diode)
HSD - 7.5 ms max.
(suppression diode)
Dielectric Withstanding Voltage -
Between Open Contacts -
350 Vrms 60 Hz
Between Adjacent Contacts -
350 Vrms 60 Hz
Standard Coil Data

|  | Nom. Coil Voltage (Vdc) | Coil Resistance in Ohms $\pm 20 \%$ @ $25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (max.) <br> @ $25^{\circ} \mathrm{C}$ | $\begin{aligned} & \text { Nom. Coil } \\ & \text { Power } \\ & (\mathrm{mW}) \\ & \text { @ } 25^{\circ} \mathrm{C} \end{aligned}$ | Max. Coil Voltage | Coil Desig. |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| HM/HMD | 5.0 | 50 | 3.6 | 500 | 5.8 | 5 |
|  | 6.0 | 98 | 4.2 | 367 | 8.0 | 6 |
|  | 9.0 | 220 | 6.5 | 368 | 12.0 | 9 |
|  | 12.0 | 390 | 8.4 | 369 | 16.0 | 12 |
|  | 18.0 | 880 | 13.0 | 368 | 24.0 | 18 |
|  | 26.5 | 1,560 | 17.0 | 450 | 32.0 | 26 |
|  | 30.0 | 2,500 | 22.0 | 360 | 36.0 | 30 |
| HS/HSD | 5.0 | 100 | 3.5 | 250 | 7.5 | 5 |
|  | 6.0 | 200 | 4.5 | 180 | 10.0 | 6 |
|  | 9.0 | 400 | 6.8 | 203 | 15.0 | 9 |
|  | 12.0 | 850 | 9.0 | 169 | 20.0 | 12 |
|  | 18.0 | 1,600 | 13.5 | 203 | 30.0 | 18 |
|  | 26.5 | 3,300 | 18.0 | 213 | 40.0 | 26 |
|  | 36.0 | 6,500 | 24.0 | 199 | 57.0 | 36 |
|  | 48.0 | 11,000 | 32.0 | 209 | 75.0 | 48 |

Between Contacts \& Coil -
350 Vrms 60 Hz
Insulation Resistance -
1,000 megohms @ 500 Vdc

## Environmental Characteristics

Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$

## Weight -

HM/HMD -
0.09 oz. (2.55 gms)
0.099 oz. ( 2.80 gms ) w/ spreader pad

HS/HSD -
0.12 oz. ( 3.40 gms )
0.129 oz. ( 3.45 gms ) w/ spreader pad

Vibration Resistance -
10 G's, 10 to 500 Hz
Shock Resistance -
30 G's, $6 \pm 1 \mathrm{~ms}$

Semiconductor Characteristics Diode -
100 Vdc peak inverse voltage (PIV)
1.0 Vdc max. transient voltage


Spreader and Mounting Pads
Ordering Instructions
Catalog-selected Relays: The catalog number is derived by choosing the proper CODE for each of the relay characteristics in the order in which the codes are listed.

| Specifying a Part Number Example: | Type | Diodes | Ground Pin | Spreader/Mounting Pads | Coils | Terminals |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | HM | D | X |  | 3 | -26 | B |

MGA, MGAD, MGADD

Electrical Characteristics
Contact Arrangement 2 Form C (DPDT)
Contact Material -
Stationary -
Gold/platinum/palladium/silver (gold plated)
Moveable -
Gold/platinum/palladium/silver (gold plated)
Contact Resistance -
Before Life - 100 milliohms max. (measured @ 10 mA @ 6 Vdc) After Life - 200 milliohms max. (measured @ 1 A @ 28 Vdc )
Mechanical Life Expectancy -
1 million operations
Coil Voltage - 5 to 26.5 Vdc
Coil Power - 660 mW max. @ $25^{\circ} \mathrm{C}$
Duty Cycle - Continuous
Pick-up Voltage - Approximately $50 \%$ of nominal coil voltage Pick-up Sensitivity 130 mW max. @ $5^{\circ} \mathrm{C}$

Double Pole, Electrically Held, 1 Amp and Less (Continued)

| MGA | MGAD | MGADD |
| :---: | :---: | :---: |
| Standard . 100 Grid High Performance Relay Qualified to | Standard . 100 Grid <br> Diode Suppressed High Performance Relay | Standard . 100 Grid Diode Suppressed/Protected High Performance Relay |
| MIL-R-39016/17 | Qualified to MIL-R-39016/18 | Qualified to MIL-R-39016/19 |
|  |  |  |
| Terminal View | Terminal View | Terminal View |
| Product Facts <br> - Hermetically sealed <br> - High shock \& vibration ratings <br> - Mounting pads <br> - Excellent RF switching | Product Facts <br> ■ Suppression diode <br> - Hermetically sealed <br> - High shock \& vibration ratings <br> - Mounting pads <br> - Excellent RF switching | Product Facts <br> - Suppression \& protection diodes <br> - Hermetically sealed <br> ■ High shock \& vibration ratings <br> - Mounting pads <br> - Excellent RF switching |


| Contact Load | Type | Operations Min. |
| :---: | :---: | :---: |
| 1.0 A @ 28 Vdc | Resistive | 100,000 |
| 250 mA @ $115 \mathrm{Vac}, 60 \mathrm{~Hz}$ \& 400 Hz | Resistive (case not grounded) | 100,000 |
| 100 mA @ $115 \mathrm{Vac}, 60 \mathrm{~Hz}$ \& 400 Hz | Resistive | 100,000 |
| 0.2 A @ 28 Vdc | Inductive (0.32 Henry) | 100,000 |
| 0.1 A @ 28 Vdc | Lamp | 100,000 |
| $30 \mu \mathrm{~A} @ 50 \mathrm{mVdc}$ | Low Level | 1,000,000 |
| 0.1 A @ 28 Vdc | Intermediate Current | 50,000 |


$\qquad$

## Double Pole, Electrically Held, 1 Amp and Less (Continued)

MGA, MGAD, MGADD
(Continued)

## Operating Characteristics

Timing -
Operate Time -2.0 ms max.
Release Time -
MGA - 1.5 ms max
MGAD/MGADD - 4.0 ms max
(suppression diode, protection/ suppression diodes)
Contact Bounce - 1.5 ms max
Dielectric Withstanding Voltage -
Between Open Contacts -
500 Vrms 60 Hz
Between Adjacent Contacts -
500 Vrms 60 Hz
Between Contacts \& Coil 500 Vrms 60 Hz
Insulation Resistance -
10,000 megohms min. @ 500 Vdc
1,000 megohms @ 500 Vdc
(coil to case @ $+125^{\circ} \mathrm{C}$ )

## Environmental Characteristics

Temperature Range -
$-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Weight -
0.09 oz. (2.55 gms)
0.129 oz. ( 3.45 gms ) w/ mounting pad attached
Vibration Resistance -
30 G's, 10 to $3,000 \mathrm{~Hz}$
Shock Resistance -
75 G's, $6 \pm 1 \mathrm{~ms}$ max.
QPL Approval -
MIL-R-39016/17 (JMGA)
MLL-R-39016/18 (JMGAD)
MIL-R-39016/19 (JMGADD)

## Semiconductor Characteristics

 Diode -100 Vdc peak inverse voltage (PIV)
1.0 Vdc max. transient voltage


MGA/MGAD/MGADD Mounting Pad

Coil Data

| Nom. Coil Voltage (Vdc) | Coil Resistance in Ohms $\pm 10 \%$ @ $25^{\circ} \mathrm{C}$ (Note) | Coil Circuit Current mA (Max.) (Note) | Coil Circuit Current mA (Min.) (Note) | Pickup Voltage Vdc (Max.) @ $25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) @ $125^{\circ} \mathrm{C}$ | Drop-Out Voltage Vdc (Min.) @ $25^{\circ} \mathrm{C}$ | Drop-Out Voltage Vdc (Min.) @ $-65^{\circ} \mathrm{C}$ | Nom. Coil Power (mW) @ $25^{\circ} \mathrm{C}$ |  | Coil Desig. |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| MGA/MGAD |  |  |  |  |  |  |  |  |  |  |
| 5.0 | 50 | n/a | n/a | 2.7 | 3.5 | 0.22 | 0.14 | 500 | 5.8 | 5 |
| 6.0 | 98 | n/a | n/a | 3.5 | 4.5 | 0.28 | 0.18 | 367 | 8.0 | 6 |
| 9.0 | 220 | n/a | n/a | 5.3 | 6.8 | 0.54 | 0.35 | 368 | 12.0 | 9 |
| 12.0 | 390 | n/a | n/a | 7.0 | 9.0 | 0.63 | 0.41 | 369 | 16.0 | 12 |
| 18.0 | 880 | n/a | n/a | 10.5 | 13.5 | 0.91 | 0.59 | 368 | 24.0 | 18 |
| 26.5 | 1,560 | n/a | n/a | 14.2 | 18.0 | 1.37 | 0.89 | 450 | 32.0 | 26 |
| MGADD |  |  |  |  |  |  |  |  |  |  |
| 5.0 | 39 | 128.2 | 93.2 | 3.2 | 4.0 | 0.6 | 0.6 | 641 | 5.8 | 5 |
| 6.0 | 78 | 78.3 | 58.3 | 4.0 | 5.0 | 0.7 | 0.7 | 462 | 8.0 | 6 |
| 9.0 | 220 | 42.9 | 33.0 | 6.3 | 7.8 | 0.9 | 0.8 | 368 | 12.0 | 9 |
| 12.0 | 390 | 32.8 | 25.6 | 8.0 | 10.0 | 1.1 | 0.9 | 369 | 16.0 | 12 |
| 18.0 | 880 | 22.1 | 17.5 | 11.5 | 14.5 | 1.4 | 1.1 | 368 | 24.0 | 18 |
| 26.5 | 1,560 | 18.5 | 14.8 | 15.2 | 19.0 | 1.8 | 1.4 | 450 | 32.0 | 26 |

Note: Coil resistance not directly measurable. Coil current should be within limits shown when tested at nominal voltage at $25^{\circ} \mathrm{C}$ for 5 seconds max.

## Ordering Instructions

Catalog-selected Relays: The catalog number is derived by choosing the proper CODE for each of the relay characteristics in the order in which the codes are listed.

| Specifying a Part Number Example: | Type | Terminals | Diodes | Ground Pins | Coils | Mounting Pads |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | MGA | C | D | G | -26 | W |

* The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15.

MGS, MGSD, MGSDD

Electrical Characteristics
Contact Arrangement 2 Form C (DPDT)
Contact Material -
Stationary -
Gold/platinum/palladium/silver (gold plated)
Moveable -
Gold/platinum/palladium/silver (gold plated)
Contact Resistance -
Before Life - 100 milliohms max. (measured @ 10 mA @ 6 Vdc ) After Life - 200 milliohms max. (measured @ 1 A @ 28 Vdc ) Mechanical Life Expectancy 1 million operations
Coil Voltage - 5 to 48 Vdc
Coil Power - 565 mW max. @ $25^{\circ} \mathrm{C}$
Duty Cycle - Continuous
Pick-up Voltage - Approximately $50 \%$ of nominal coil voltage Pick-up Sensitivity 60 mW max. @ $25^{\circ} \mathrm{C}$

Double Pole, Electrically Held, 1 Amp and Less (Continued)


Contact Ratings

| Contact Load | Type | Operations Min. |
| :---: | :---: | :---: |
| 1.0 A @ 28 Vdc | Resistive | 100,000 |
| 250 mA @ $115 \mathrm{Vac}, 60 \mathrm{~Hz}$ \& 400 Hz | Resistive (case not grounded) | 100,000 |
| 100 mA @ $115 \mathrm{Vac}, 60 \mathrm{~Hz}$ \& 400 Hz | Resistive | 100,000 |
| 0.2 A @ 28 Vdc | Inductive (0.32 Henry) | 100,000 |
| 0.1 A @ 28 Vdc | Lamp | 100,000 |
| $30 \mu \mathrm{~A} @ 50 \mathrm{mVdc}$ | Low Level | 1,000,000 |
| 0.1 A @ 28 Vdc | Intermediate Current | 50,000 |




MGS/MGSD/MGSDD Enclosure


MGS/MGSD/MGSDD Header
$\qquad$

## Double Pole, Electrically Held, 1 Amp and Less (Continued)

MGS, MGSD, MGSDD
(Continued)

## Operating Characteristics

Timing -
Operate Time - 4.0 ms max.
Release Time -
MGS - 2.0 ms max
MGSD/MGSDD - 7.5 ms max
(suppression diode, protection/ suppression diodes
Contact Bounce - 1.5 ms max.

## Dielectric Withstanding Voltage -

Between Open Contacts -
500 Vrms 60 Hz
Between Adjacent Contacts -
500 Vrms 60 Hz
Between Contacts \& Coil -
500 Vrms 60 Hz
Insulation Resistance -
10,000 megohms min. @ 500 Vdc 1,000 megohms @ 500 Vdc (coil to case @ $+125^{\circ} \mathrm{C}$ )

## Environmental Characteristics

Temperature Range -
$-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Weight
0.09 02. (2.55 gms)
0.129 oz. ( 3.45 gms ) w/ mounting pad attached
Vibration Resistance -
30 G's, 10 to $3,000 \mathrm{~Hz}$
Shock Resistance -
75 G's, $6 \pm 1 \mathrm{~ms}$ max.
QPL Approval -
MLL-R-39016/41 (JMGS)
MIL-R-39016/42 (JMGSD)
MIL-R-39016/43 (JMGSDD)


MGS/MGSD/MGSDD Mounting Pad

Coil Data

## Semiconductor Characteristics

 Diode -100 Vdc peak inverse voltage (PIV)
1.0 Vdc max. transient voltage

| Nom. Coil Voltage (Vdc) | $\begin{gathered} \text { Coil } \\ \text { Resistance } \\ \text { in Ohms } \\ \pm 10 \% \text { @ } 25^{\circ} \mathrm{C} \\ \text { (Note) } \\ \hline \end{gathered}$ | Coil Circuit Current mA (Max.) (Note) | Coil Circuit Current mA (Min.) (Note) | Pickup Voltage Vdc (Max.) @ $25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) @ $125^{\circ} \mathrm{C}$ | Drop-Out Voltage Vdc (Min.) @ $25^{\circ} \mathrm{C}$ | Drop-Out Voltage Vdc (Min.) @ -65 ${ }^{\circ}$ C | Nom. Coil Power (mW) @ $25^{\circ} \mathrm{C}$ | $\begin{gathered} \text { Max. } \\ \text { Coil } \\ \text { Voltage } \end{gathered}$ | $\begin{gathered} \text { Coil } \\ \text { Desig. } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| MGS/MGSD |  |  |  |  |  |  |  |  |  |  |
| 5.0 | 100 | n/a | n/a | 2.6 | 3.5 | 0.23 | 0.12 | 250 | 7.5 | 5 |
| 6.0 | 200 | n/a | n/a | 3.4 | 4.5 | 0.28 | 0.18 | 180 | 10.0 | 6 |
| 9.0 | 400 | n/a | n/a | 4.85 | 6.8 | 0.55 | 0.35 | 203 | 15.0 | 9 |
| 12.0 | 800 | n/a | n/a | 7.0 | 9.0 | 0.64 | 0.41 | 180 | 20.0 | 12 |
| 18.0 | 1,600 | n/a | n/a | 9.8 | 13.5 | 0.92 | 0.59 | 203 | 30.0 | 18 |
| 26.5 | 3,200 | n/a | n/a | 14.0 | 18.0 | 1.4 | 0.89 | 219 | 40.0 | 26 |
| 36.0 | 6,500 | n/a | n/a | 20.0 | 27.0 | 1.8 | 1.25 | 199 | 57.0 | 36 |
| 48.0 | 11,000 | n/a | n/a | 25.8 | 36.0 | 2.4 | 1.60 | 209 | 75.0 | 48 |
| MGSDD |  |  |  |  |  |  |  |  |  |  |
| 5.0 | 64 | 78.1 | 56.8 | 2.9 | 3.7 | 0.8 | 0.7 | 391 | 7.5 | 5 |
| 6.0 | 125 | 48.9 | 36.3 | 4.0 | 4.8 | 0.9 | 0.8 | 288 | 10.0 | 6 |
| 9.0 | 400 | 23.6 | 18.1 | 6.1 | 8.0 | 1.1 | 0.9 | 203 | 15.0 | 9 |
| 12.0 | 800 | 16.0 | 12.5 | 7.8 | 11.0 | 1.3 | 1.0 | 180 | 20.0 | 12 |
| 18.0 | 1,600 | 12.2 | 9.6 | 11.3 | 14.5 | 1.5 | 1.1 | 203 | 30.0 | 18 |
| 26.5 | 3,200 | 9.0 | 7.2 | 15.2 | 19.0 | 1.7 | 1.3 | 219 | 40.0 | 26 |
| 36.0 | 6,500 | 6.1 | 4.9 | 21.7 | 27.2 | 2.3 | 1.7 | 199 | 57.0 | 36 |
| 48.0 | 11,000 | 4.8 | 3.9 | 27.8 | 34.8 | 2.8 | 2.0 | 209 | 75.0 | 48 |

Note: Coil resistance not directly measurable. Coil current should be within limits shown when tested at nominal voltage at $25^{\circ} \mathrm{C}$ for 5 seconds max.

## Ordering Instructions

Catalog-selected Relays: The catalog number is derived by choosing the proper CODE for each of the relay characteristics in the order in which the codes are listed.

| Specifying a Part Number Example: | Type | Terminals | Diodes | Ground Pins | Coils | Mounting Pads |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | MGS | C | D | G | -26 | W |

* The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15.


Contact Ratings

| Contact <br> Load | Type | Operations <br> Min. |
| :--- | :--- | ---: |
| 1.0 A @ 28 Vdc | Resistive | 100,000 |
| $250 \mathrm{~mA} \mathrm{@} \mathrm{115} \mathrm{Vac} 60 Hz \& 400 Hz$, | Resistive (Case not grounded) | 100,000 |
| $100 \mathrm{~mA} @ 115 \mathrm{Vac}, 60 \mathrm{~Hz} \mathrm{\&} \mathrm{400} \mathrm{Hz}$ | Resistive | 100,000 |
| 0.2 A @ 28 Vdc | Inductive (0.32 Henry) | 100,000 |
| 0.1 A @ 28 Vdc | Lamp | 100,000 |
| $30 \mu \mathrm{~A} @ 50 \mathrm{mVdc}$ | Low Level | $1,000,000$ |

## Double Pole, Electrically Held, 1 Amp and Less (Continued)

HC, HCD, HCS, HCSD
(Continued)
Operating Characteristics
Timing -
Operate Time -
HC/HCD - 4.0 ms max.
HCS/HCSD - 6.0 ms max.
Release Time -
HC - 3.0 ms max.
HCS -3.0 ms max.
HCD - 6.0 ms max.
(suppression diode)
HCSD - 7.5 ms max.
(suppression diode)
Dielectric Withstanding Voltage -
Between Open Contacts -
350 Vrms 60 Hz
Between Adjacent Contacts -
Standard Coil Data

|  | Nom. Coil Voltage (Vdc) | Coil Resistance in Ohms $\pm 20 \%$ @ $25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) <br> @ $25^{\circ} \mathrm{C}$ | $\begin{aligned} & \text { Nom. Coil } \\ & \text { Power } \\ & (\mathrm{mW}) \\ & \text { @ } 25^{\circ} \mathrm{C} \end{aligned}$ | Max. <br> Coil Voltage | Coil Desig. |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| HC/HCD | 5.0 | 64 | 3.8 | 391 | 5.8 | 5 |
|  | 6.0 | 98 | 4.9 | 367 | 8.0 | 6 |
|  | 9.0 | 220 | 7.0 | 368 | 12.0 | 9 |
|  | 12.0 | 400 | 9.0 | 360 | 16.0 | 12 |
|  | 18.0 | 880 | 14.0 | 368 | 24.0 | 18 |
|  | 26.5 | 1,600 | 18.0 | 439 | 32.0 | 26 |
| HCS/HCSD | 5.0 | 100 | 3.5 | 250 | 7.5 | 5 |
|  | 6.0 | 200 | 4.5 | 180 | 10.0 | 6 |
|  | 9.0 | 400 | 6.8 | 203 | 15.0 | 9 |
|  | 12.0 | 800 | 9.0 | 180 | 20.0 | 12 |
|  | 18.0 | 1,600 | 13.5 | 203 | 30.0 | 18 |
|  | 26.5 | 3,200 | 18.0 | 219 | 40.0 | 26 |
|  | 36.0 | 6,500 | 24.0 | 199 | 57.0 | 36 |
|  | 48.0 | 11,000 | 32.0 | 209 | 75.0 | 48 |

350 Vrms 60 Hz
Between Contacts \& Coil -
350 Vrms 60 Hz
Insulation Resistance -
1,000 megohms @ 500 Vdc

## Environmental Characteristics

Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$

## Weight -

HC/HCD -
0.09 oz. ( 2.55 gms )

HCS/HCSD -
0.15 oz. ( 4.30 gms )

Vibration Resistance -
10 G's, 10 to 500 Hz
Shock Resistance -
30 G's, $6 \pm 1$ ms

## Semiconductor Characteristics

## Diode -

100 Vdc peak inverse voltage (PIV)
1.0 Vdc max. transient voltage


## Ordering Instructions

Catalog-selected Relays: The catalog number is derived by choosing the proper CODE for each of the relay characteristics in the order in which the codes are listed.

| Specifying a Part Number Example: | Type | Diodes | Ground Pin | Mounting Pads | Coils | Terminals |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | HC | D | X | 3 | -26 | B |

## Double Pole, Electrically Held, 1 Amp and Less (Continued)

## MAT

MAT
Standard TO-5 Diode Suppressed/ Transistor Driven High Performance Relay

Qualified to MIL-R-28776/1


Terminal View

## Product Facts

■ Transistor driver \& suppression diode
■ Hermetically sealed
■ High shock \& vibration ratings

Spreader pads
■ Excellent RF switching

## Electrical Characteristics

Contact Arrangement -
2 Form C (DPDT)
Contact Material -
Stationary -
Gold/platinum/palladium/silver alloy (gold plated)
Moveable -
Gold/platinum/palladium/silver alloy
(gold plated)

## Contact Resistance -

Before Life - 100 milliohms max
(measured @ 10 mA @ 6 Vdc)
After Life - 200 milliohms max.
(measured @ 1 A @ 28 Vdc)
Mechanical Life Expectancy -
1 million operations
Coil Voltage - 5 to 26.5 Vdc
Coil Power — 675 mW max. @ $25^{\circ} \mathrm{C}$
Duty Cycle - Continuous
Pick-up Voltage - Approximately
$50 \%$ of nominal coil voltage
Pick-up Sensitivity -
130 mW max. @ $25^{\circ} \mathrm{C}$


Enclosure

Contact Ratings

| Contact Load | Type | Operations Min. |
| :---: | :---: | :---: |
| 1.0 A @ 28 Vdc | Resistive | 100,000 |
| 250 mA @ $115 \mathrm{Vac}, 60 \mathrm{~Hz}$ \& 400 Hz | Resistive (case not grounded) | 100,000 |
| 100 mA @ $115 \mathrm{Vac}, 60 \mathrm{~Hz}$ \& 400 Hz | Resistive | 100,000 |
| 0.2 A @ 28 Vdc | Inductive (0.32 Henry) | 100,000 |
| 0.1 A @ 28 Vdc | Lamp | 100,000 |
| $30 \mu \mathrm{~A} @ 50 \mathrm{mVdc}$ | Low Level | 1,000,000 |
| 0.1 A @ 28 Vdc | Intermediate Current | 50,000 |

## Double Pole, Electrically Held, 1 Amp and Less (Continued)

| MAT (Continued) | Operating Characteristics <br> Timing - <br> Operate Time - 2.0 ms max. <br> Release Time - 7.5 ms max. <br> Contact Bounce - 1.5 ms max <br> Dielectric Withstanding Voltage - <br> Between Open Contacts - <br> 500 Vrms 60 Hz <br> Between Adjacent Contacts - <br> 500 Vrms 60 Hz <br> Between Contacts \& Coil - <br> 500 Vrms 60 Hz <br> Insulation Resistance - <br> 10,000 megohms @ 500 Vdc <br> 1,000 megohms @ 500 Vdc <br> (coil to case @ $+125^{\circ} \mathrm{C}$ ) | Environmental Characteristics <br> Temperature Range - $-65^{\circ} \mathrm{C} \text { to }+125^{\circ} \mathrm{C}$ <br> Weight - <br> 0.09 02. (2.55 grms) <br> 0.10 oz. (2.80 grms) with spreader pad attached <br> Vibration Resistance - <br> 30 G's, 10 to $3,000 \mathrm{~Hz}$ <br> Shock Resistance - <br> 75 G's, $6 \pm 1 \mathrm{~ms}$ max. <br> QPL Approval - <br> MIL-R-28776/1 (JMAT) | Semiconductor Characteristics <br> Diode - <br> 100 Vdc peak inverse voltage (PIV) 1.0 Vdc max. transient voltage <br> Transistor - <br> 0.3 Vdc min. base turn off voltage; <br> 6.0 Vdc min. emitter-base breakdown voltage ( $\mathrm{BV}_{\text {EBO }}$ ) @ $25^{\circ} \mathrm{C}$; <br> 80.0 Vdc min. collector-base breakdown voltage ( $\mathrm{BV}_{\text {СВо }}$ ) @ $25^{\circ} \mathrm{C}$ \& $\mathrm{I}_{\mathrm{C}}=100 \mu \mathrm{~A}$ |
| :---: | :---: | :---: | :---: |



Spreader \& Mounting Pads

Coil Data

| Nom. Coil Voltage (Vdc) | Coil Resistance in Ohms $\pm 10 \%$ @ $25^{\circ} \mathrm{C}$ (Note 1) | Coil Circuit Current mA (Max.) (Note 1\&2) | Coil Circuit Current mA (Min.) (Note 1\&2) | Pickup Voltage Vdc (Max.) @ $25^{\circ} \mathrm{C}$ (Note 2) | Base Turn On Current mA (Max.) @ $25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) @ 125 (Note 2) | Base Turn On Current mA (Max.) <br> @ $125^{\circ} \mathrm{C}$ | ```Drop-Out Voltage Vdc (Min.) @ 25'C (Note 2)``` | $\begin{gathered} \text { Drop-Out } \\ \text { Voltage } \\ \text { Vdc (Min.) } \\ \text { @ }-65^{\circ} \mathrm{C} \\ \text { (Note 2) } \\ \hline \end{gathered}$ | Nom. Coil Power (mW) @ $25^{\circ} \mathrm{C}$ | $\begin{gathered} \text { Max. } \\ \text { Coil } \\ \text { Voltage } \end{gathered}$ | $\begin{gathered} \text { Coil } \\ \text { Desig. } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| MAT |  |  |  |  |  |  |  |  |  |  |  |  |
| 5.0 | 50 | 112.1 | 82.2 | 2.7 | 0.75 | 3.5 | 3.00 | 0.22 | 0.14 | 500 | 5.8 | 5 |
| 6.0 | 98 | 69.9 | 52.9 | 3.5 | 0.55 | 4.5 | 2.04 | 0.28 | 0.18 | 367 | 8.0 | 6 |
| 9.0 | 220 | 47.4 | 35.3 | 5.3 | 0.36 | 6.8 | 1.36 | 0.54 | 0.35 | 368 | 12.0 | 9 |
| 12.0 | 390 | 35.8 | 26.6 | 7.0 | 0.27 | 9.0 | 1.03 | 0.63 | 0.41 | 369 | 16.0 | 12 |
| 18.0 | 880 | 24.0 | 17.9 | 10.5 | 0.16 | 13.5 | 0.68 | 0.91 | 0.59 | 368 | 24.0 | 18 |
| 26.5 | 1,560 | 19.8 | 14.7 | 14.2 | 0.13 | 18.0 | 0.50 | 1.37 | 0.89 | 450 | 32.0 | 26 |

Notes: 1. Coil resistance not directly measurable. Coil current should be within limits shown when tested at nominal voltage at $25^{\circ} \mathrm{C}$ for 5 seconds max.
2. Set base current at 3 mA to 15 mA during measurements.

## Ordering Instructions

Catalog-selected Relays: The catalog number is derived by choosing the proper CODE for each of the relay characteristics in the order in which the codes are listed.

| Specifying a Part Number Example: | Type | Terminal | Diodes | Ground Pins | Coils | Spreader/Mounting Pads |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | MA | C | T | G | -26 | S |

* The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15.

| Catalog 5-1773450-5 Revised 3-13 <br> www.te.com | Dimensions are shown for reference purposes only. Specifications subject to change. | Dimensions are in millimeters unless otherwise specified. | USA: +1 8005226752 <br> Asia Pacific: +8604008206015 UK: +44 800267666 | For additional support numbers please visit www.te.com |
| :---: | :---: | :---: | :---: | :---: |

## Double Pole, Electrically Held, 1 Amp and Less (Continued)

## MST

MST
Sensitive TO-5 Diode Suppressed/ Transistor Driven High Performance Relay
Qualified to MIL-R-28776/3


Terminal View

## Product Facts

- Transistor driver \& suppression diode
■ Hermetically sealed
■ High shock \& vibration ratings

Spreader pads
■ Excellent RF switching

Electrical Characteristics
Contact Arrangement -
2 Form C (DPDT)
Contact Material -
Stationary -
Gold/platinum/palladium/silver alloy (gold plated)
Moveable -
Gold/platinum/palladium/silver alloy
(gold plated)

## Contact Resistance -

Before Life - 100 milliohms max
(measured @ 10 mA @ 6 Vdc)
After Life - 200 milliohms max.
(measured @ 1 A @ 28 Vdc)
Mechanical Life Expectancy -
1 million operations
Coil Voltage - 5 to 48 Vdc
Coil Power — 565 mW max. @ $25^{\circ} \mathrm{C}$
Duty Cycle - Continuous
Pick-up Voltage - Approximately
$50 \%$ of nominal coil voltage
Pick-up Sensitivity 60 mW max. @ $25^{\circ} \mathrm{C}$

Contact Ratings

| Contact <br> Load | Type | Operations <br> Min. |
| :--- | :--- | ---: |
| 1.0 A @ 28 Vdc | Resistive | 100,000 |
| $250 \mathrm{~mA} \mathrm{@} 115 \mathrm{Vac}, 60 \mathrm{~Hz} \& 400 \mathrm{~Hz}$ | Resistive (case not grounded) | 100,000 |
| $100 \mathrm{~mA} @ 115 \mathrm{Vac}, 60 \mathrm{~Hz} \& 400 \mathrm{~Hz}$ | Resistive | 100,000 |
| 0.2 A @ 28 Vdc | Inductive $(0.32$ Henry) | 100,000 |
| 0.1 A @ 28 Vdc | Lamp | 100,000 |
| $30 \mu \mathrm{~A} @ 50 \mathrm{mVdc}$ | Low Level | $1,000,000$ |
| 0.1 A @ 28 Vdc | Intermediate Current | 50,000 |



Enclosure

## Double Pole, Electrically Held, 1 Amp and Less (Continued)

Operating Characteristics
Timing -
Operate Time - 4.0 ms max.
Release Time -7.5 ms max.
Contact Bounce - 1.5 ms max
Dielectric Withstanding Voltage -
Between Open Contacts -
500 Vrms 60 Hz
Between Adjacent Contacts -
500 Vrms 60 Hz
Between Contacts \& Coil -
500 Vrms 60 Hz
Insulation Resistance -
10,000 megohms min. @ 500 Vdc
1,000 megohms @ 500 Vdc
(coil to case @ $+125^{\circ} \mathrm{C}$ )

Environmental Characteristics
Temperature Range -
$-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Weight -
0.12 oz. (3.40 grms)
0.13 oz. ( 3.45 grms ) with spreader pad attached
Vibration Resistance -
30 G's, 10 to $3,000 \mathrm{~Hz}$
Shock Resistance -
75 G's, $6 \pm 1 \mathrm{~ms}$ max.
QPL Approval -
MIL-R-28776/3 (JMST)

## Semiconductor Characteristics

Diode -
100 Vdc peak inverse voltage (PIV) 1.0 Vdc max. transient voltage

## Transistor -

0.3 Vdc min. base turn off voltage; 6.0 Vdc min. emitter-base breakdown voltage ( $\mathrm{BV}_{\text {EBO }}$ ) @ $25^{\circ} \mathrm{C}$; 80.0 Vdc min. collector-base breakdown voltage ( $\mathrm{BV}_{\text {CBO }}$ ) @ $25^{\circ} \mathrm{C} \& \mathrm{I}_{\mathrm{C}}=100 \mu \mathrm{~A}$


Spreader \& Mounting Pads

Coil Data

| Nom Coil Voltage (Vdc) | Coil Resistance in Ohms $\pm 10 \%$ @ $25^{\circ} \mathrm{C}$ (Note 1) | Coil Circuit Current mA (Max.) <br> (Note 1\&2) | Coil Circuit Current mA (Min.) (Note 1\&2) | Pickup Voltage Vdc (Max.) @ $25^{\circ} \mathrm{C}$ (Note 2) | Base Turn On Current mA (Max.) @ $25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) @ 125 (Note 2) | Base Turn On Current mA (Max.) @ $125^{\circ} \mathrm{C}$ | Drop-Out Voltage Vdc (Min.) @ $25^{\circ} \mathrm{C}$ (Note 2) | Drop-Out Voltage Vdc (Min.) @ -65 C (Note 2) | Nom. Coil Power (mW) @ $25^{\circ} \mathrm{C}$ |  | Coil Desig. |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| MST |  |  |  |  |  |  |  |  |  |  |  |  |
| 5.0 | 100 | 59.3 | 43.5 | 2.8 | 0.37 | 3.6 | 1.50 | 0.22 | 0.14 | 250 | 7.0 | 5 |
| 6.0 | 200 | 35.4 | 26.4 | 3.8 | 0.25 | 4.8 | 1.00 | 0.28 | 0.18 | 180 | 10.0 | 6 |
| 9.0 | 400 | 25.8 | 19.7 | 5.2 | 0.18 | 7.8 | 0.75 | 0.54 | 0.35 | 203 | 15.0 | 9 |
| 12.0 | 850 | 16.7 | 12.2 | 7.4 | 0.12 | 11.0 | 0.47 | 0.63 | 0.41 | 169 | 20.0 | 12 |
| 18.0 | 1,600 | 13.1 | 9.7 | 10.0 | 0.09 | 14.5 | 0.38 | 0.91 | 0.59 | 203 | 30.0 | 18 |
| 26.5 | 3,300 | 9.5 | 6.9 | 14.2 | 0.06 | 19.0 | 0.24 | 1.37 | 0.89 | 213 | 40.0 | 26 |
| 36.0 | 6,500 | 6.4 | 4.8 | 20.0 | 0.034 | 27.0 | 0.17 | 1.80 | 1.25 | 199 | 57.0 | 36 |
| 48.0 | 11,000 | 5.1 | 3.7 | 25.8 | 0.026 | 36.0 | 0.13 | 2.40 | 1.60 | 209 | 75.0 | 48 |

Notes: 1 . Coil resistance not directly measurable. Coil current should be within limits shown when tested at nominal voltage at $25^{\circ} \mathrm{C}$ for 5 seconds max.
2. Set base current at 3 mA to 15 mA during measurements.

## Ordering Instructions

Catalog-selected Relays: The catalog number is derived by choosing the proper CODE for each of the relay characteristics in the order in which the codes are listed

| Specitying a Part Number Example: | Type | Terminal | Diodes | Ground Pins | Coils | Spreader/Mounting Pads |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | MS | C | T | G | -26 | S |

* The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15.

| Catalog 5-1773450-5 Revised 3-13 <br> www.te.com | Dimensions are shown for reference purposes only. Specifications subject to change. | Dimensions are in millimeters unless otherwise specified. | USA: +1 8005226752 <br> Asia Pacific: +8604008206015 UK: +44 800267666 | For additional support numbers please visit www.te.com |
| :---: | :---: | :---: | :---: | :---: |

## Double Pole, Electrically Held, 1 Amp and Less (Continued)

## MGAT

MGAT
Standard . 100 Grid Diode
Suppressed/MOSFET Driven
High Performance Relay
Qualified to
MIL-R-28776/6


> Terminal View

Product Facts
■ MOSFET driver, zener \& suppression diodes
■ Hermetically sealed
■ High shock \& vibration ratings
■ Mounting pads
■ Excellent RF switching

## Electrical Characteristics

Contact Arrangement 2 Form C (DPDT)
Contact Material -
Stationary -
Gold/platinum/palladium/silver (gold plated)
Moveable -
Gold/platinum/palladium/silver (gold plated)

## Contact Resistance -

Contact Ratings

| Contact <br> Load | Type | Operations <br> Min. |
| :--- | :--- | ---: |
| 1.0 A @ 28 Vdc | Resistive | 100,000 |
| $250 \mathrm{~mA} \mathrm{@} \mathrm{115} \mathrm{Vac} 60 \mathrm{~Hz} \& 400 Hz$, | Resistive (case not grounded) | 100,000 |
| $100 \mathrm{~mA} @ 115 \mathrm{Vac}, 60 \mathrm{~Hz} \& 400 \mathrm{~Hz}$ | Resistive | 100,000 |
| 0.2 A @ 28 Vdc | Inductive $(0.32$ Henry) | 100,000 |
| 0.1 A @ 28 Vdc | Lamp | 100,000 |
| $30 \mu \mathrm{~A} @ 50 \mathrm{mVdc}$ | Low Level | $1,000,000$ |
| 0.1 A @ 28 Vdc | Intermediate Current | 50,000 |

Before Life - 100 milliohms max. (measured @ 10 mA @ 6 Vdc ) After Life — 200 milliohms max. (measured @ 1 A @ 28 Vdc)
Mechanical Life Expectancy 1 million operations
Coil Voltage - 5 to 26.5 Vdc
Coil Power — 660 mW max. @ $25^{\circ} \mathrm{C}$ Duty Cycle - Continuous
Pick-up Voltage - Approximately $50 \%$ of nominal coil voltage
Pick-up Sensitivity -
130 mW max. @ $25^{\circ} \mathrm{C}$



MGAT Enclosure


MGAT Header

## Double Pole, Electrically Held, 1 Amp and Less (Continued)

## MGAT (Continued)

## Operating Characteristics

Timing -
Operate Time -2.0 ms max.
Contact Bounce - 1.5 ms max.
Dielectric Withstanding Voltage -
Between Open Contacts -
500 Vrms 60 Hz
Between Adjacent Contacts -
500 Vrms 60 Hz
Between Contacts \& Coil 500 Vrms 60 Hz
Insulation Resistance -
10,000 megohms min. @ 500 Vdc 1,000 megohms @ 500 Vdc (coil to case @ $+125^{\circ} \mathrm{C}$ )

## Environmental Characteristics

Temperature Range -
$-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Weight
0.09 oz. (2.55 gms)
0.129 oz. ( 3.45 gms ) w/ mounting pad attached
Vibration Resistance -
30 G's, 10 to $3,000 \mathrm{~Hz}$
Shock Resistance -
75 G's, $6 \pm 1 \mathrm{~ms}$ max.
QPL Approval -
MIL-R-28776/6 (JMGAT)

## Semiconductor Characteristics

 Diode -100 Vdc peak inverse voltage (PIV)
1.0 Vdc max. transient voltage

## Zener Diode -

$20 \mathrm{Vdc} \pm 3$ Vdc over temperature range MOSFET -
0.5 Vdc min. gate turn-off voltage
4.3 Vdc max. gate turn-on voltage


MGAT Mounting Pad

Coil Data

| Nom. Coil Voltage (Vdc) | Coil Resistance in Ohms $\pm 10 \%$ @ $25^{\circ} \mathrm{C}$ (Note) | Coil Circuit Current mA (Max.) (Note) | Coil Circuit Current mA (Min.) (Note) | Pickup Voltage Vdc (Max.) @ $25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) @ $125^{\circ} \mathrm{C}$ | Drop-Out Voltage Vdc (Min.) @ $25^{\circ} \mathrm{C}$ | Drop-Out Voltage Vdc (Min.) @ $-65^{\circ} \mathrm{C}$ | Nom. Coil Power (mW) @ $25^{\circ} \mathrm{C}$ |  | Coil Desig. |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| MGAT |  |  |  |  |  |  |  |  |  |  |
| 5.0 | 39 | 132.3 | 96.5 | 2.9 | 3.5 | 0.23 | 0.13 | 641 | 5.8 | 5 |
| 6.0 | 78 | 83.9 | 60.3 | 3.5 | 4.5 | 0.32 | 0.18 | 462 | 8.0 | 6 |
| 9.0 | 220 | 47.1 | 33.1 | 5.3 | 6.8 | 0.48 | 0.27 | 368 | 12.0 | 9 |
| 12.0 | 390 | 36.1 | 24.9 | 7.1 | 9.0 | 0.65 | 0.36 | 369 | 16.0 | 12 |
| 18.0 | 880 | 24.1 | 16.1 | 10.6 | 13.5 | 0.97 | 0.54 | 368 | 24.0 | 18 |
| 26.5 | 1,560 | 19.9 | 12.9 | 14.2 | 18.0 | 1.30 | 0.72 | 450 | 32.0 | 26 |

Note: Coil resistance not directly measurable. Coil current should be within limits shown when tested at nominal voltage at $25^{\circ} \mathrm{C}$ for 5 seconds max.

## Ordering Instructions

Catalog-selected Relays: The catalog number is derived by choosing the proper CODE for each of the relay characteristics in the order in which the codes are listed.

| Specifying a Part Number Example: | Type | Terminals | Diodes | Ground Pins | Coils | Mounting Pads |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | MGA | C | T | G | -26 | W |

* The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15.



## Double Pole, Electrically Held, 1 Amp and Less (Continued)

## MGST

MGST
Sensitive . 100 Grid Diode
Suppressed/MOSFET Driven
High Performance Relay
Qualified to
MIL-R-28776/7


> Terminal View

Product Facts
■ MOSFET driver, zener \& suppression diodes
■ Hermetically sealed
■ High shock \& vibration ratings
■ Mounting pads
■ Excellent RF switching

## Electrical Characteristics

## Contact Arrangement -

 2 Form C (DPDT)Contact Material -
Stationary -
Gold/platinum/palladium/silver (gold plated)
Moveable -
Gold/platinum/palladium/silver (gold plated)

## Contact Resistance -

Contact Ratings

| Contact <br> Load | Type | Operations <br> Min. |
| :--- | :--- | ---: |
| 1.0 A @ 28 Vdc | Resistive | 100,000 |
| $250 \mathrm{~mA} \mathrm{@} \mathrm{115} \mathrm{Vac} 60 \mathrm{~Hz} \& 400 Hz$, | Resistive (case not grounded) | 100,000 |
| $100 \mathrm{~mA} @ 115 \mathrm{Vac}, 60 \mathrm{~Hz} \& 400 \mathrm{~Hz}$ | Resistive | 100,000 |
| 0.2 A @ 28 Vdc | Inductive $(0.32$ Henry) | 100,000 |
| 0.1 A @ 28 Vdc | Lamp | 100,000 |
| $30 \mu \mathrm{~A} @ 50 \mathrm{mVdc}$ | Low Level | $1,000,000$ |
| 0.1 A @ 28 Vdc | Intermediate Current | 50,000 |

Before Life - 100 milliohms max. (measured @ 10 mA @ 6 Vdc ) After Life — 200 milliohms max. (measured @ 1 A @ 28 Vdc)
Mechanical Life Expectancy 1 million operations
Coil Voltage - 5 to 26.5 Vdc
Coil Power — 565 mW max. @ $25^{\circ} \mathrm{C}$
Duty Cycle - Continuous
Pick-up Voltage - Approximately 50\% of nominal coil voltage
Pick-up Sensitivity -
60 mW max. @ $25^{\circ} \mathrm{C}$


MGST


$$
\rightarrow \quad .370(9.40) \text { MAX } \quad \leftarrow^{-.001} 9 \text { PINS }
$$

MGST Enclosure


MGST Header

## Double Pole, Electrically Held, 1 Amp and Less (Continued)

Operating Characteristics
Timing -
Operate Time -4.0 ms max.
Release Time -7.5 ms max.
Contact Bounce - 1.5 ms max.
Dielectric Withstanding Voltage -
Between Open Contacts -
500 Vrms 60 Hz
Between Adjacent Contacts -
500 Vrms 60 Hz
Between Contacts \& Coil -
500 Vrms 60 Hz
Insulation Resistance -
10,000 megohms min. @ 500 Vdc
1,000 megohms @ 500 Vdc
(coil to case @ $+125^{\circ} \mathrm{C}$ )

| Environmental Characteristics | Semiconductor Characteristics |
| :---: | :---: |
| Temperature Range -$-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ | Diode - <br> 100 Vdc peak inverse voltage (PIV) |
| Weight - | 1.0 Vdc max. transient voltage |
| 0.09 oz. (2.55 gms) | Zener Diode - |
| 0.129 oz. ( 3.45 gms ) w/ mounting pad attached | $20 \mathrm{Vdc} \pm 3 \mathrm{Vdc}$ over temperature range MOSFET - |
| Vibration Resistance 30 G's, 10 to $3,000 \mathrm{~Hz}$ | 0.5 Vdc min. gate turn off voltage 4.3 Vdc max. gate turn on voltage |
| Shock Resistance - <br> 75 G's, $6 \pm 1 \mathrm{~ms}$ max. |  |
| QPL Approval -MIL-R-28776/7 (JMGST) |  |



MGST Mounting Pad

## Coil Data

| Nom. Coil Voltage (Vdc) | $\begin{gathered} \text { Coil } \\ \text { Resistance } \\ \text { in Ohms } \\ \pm 10 \% @ 25^{\circ} \mathrm{C} \\ \text { (Note) } \\ \hline \end{gathered}$ | Coil Circuit Current mA (Max.) (Note) | Coil Circuit Current mA (Min.) (Note) | Pickup Voltage Vdc (Max.) <br> @ $25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) @ $125^{\circ} \mathrm{C}$ | Drop-Out Voltage Vdc (Min.) <br> @ $25^{\circ} \mathrm{C}$ | Drop-Out Voltage Vdc (Min.) @ -65ㅇ | Nom. Coil Power (mW) @ $25^{\circ} \mathrm{C}$ | $\begin{gathered} \text { Max. } \\ \text { Coil } \\ \text { Voltage } \end{gathered}$ | Coil Desig. |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| MGST |  |  |  |  |  |  |  |  |  |  |
| 5.0 | 100 | 56.0 | 43.0 | 2.9 | 4.0 | 0.23 | 0.13 | 250 | 5.6 | 5 |
| 6.0 | 200 | 33.0 | 27.0 | 3.5 | 4.9 | 0.32 | 0.18 | 180 | 8.0 | 6 |
| 9.0 | 400 | 26.4 | 17.8 | 5.3 | 7.3 | 0.48 | 0.27 | 203 | 12.0 | 9 |
| 12.0 | 800 | 17.7 | 11.3 | 7.1 | 9.8 | 0.65 | 0.36 | 180 | 16.0 | 12 |
| 18.0 | 1,600 | 13.8 | 8.4 | 10.6 | 14.6 | 0.97 | 0.54 | 203 | 24.0 | 18 |
| 26.5 | 3,200 | 10.2 | 5.8 | 14.2 | 19.5 | 1.30 | 0.72 | 219 | 32.0 | 26 |

Note: Coil resistance not directly measurable. Coil current should be within limits shown when tested at nominal voltage at $25^{\circ} \mathrm{C}$ for 5 seconds max.

## Ordering Instructions

Catalog-selected Relays: The catalog number is derived by choosing the proper CODE for each of the relay characteristics in the order in which the codes are listed.

| Specifying a Part Number Example: | $\frac{\text { Type }}{}$ | $\frac{\text { Terminals }}{\mathrm{C}}$ | $\frac{\text { Diodes }}{\mathrm{T}}$ | $\frac{\text { Ground Pins }}{\mathrm{G}}$ | $\frac{\text { Coils }}{-26}$ | Mounting Pads <br> MGS | W |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |

* The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15.

| Catalog 5-1773450-5 | Dimensions are shown for <br> reference purposes only. |
| :--- | :--- |
| Revised 3-13 | Specifications subject |
| to change. |  |

SMGA, SMGAD, SMGADD

Electrical Characteristics
Contact Arrangement 2 Form C (DPDT)
Contact Material -
Stationary -
Gold/platinum/palladium/silver (gold plated)
Moveable -
Gold/platinum/palladium/silver (gold plated)
Contact Resistance -
Before Life - 100 milliohms max. (measured @ 10 mA @ 6 Vdc ) After Life - 200 milliohms max.
(measured @ 1 A @ 28 Vdc )
Mechanical Life Expectancy -
1 million operations
Coil Voltage - 5 to 26.5 Vdc
Coil Power-660 mW max. @ $25^{\circ} \mathrm{C}$
Duty Cycle - Continuous
Pick-up Voltage - Approximately $50 \%$ of nominal coil voltage Pick-up Sensitivity 130 mW max. @ $25^{\circ} \mathrm{C}$

Double Pole, Electrically Held, 1 Amp and Less (Continued)


Contact Ratings

| Contact <br> Load | Type | Operations <br> Min. |
| :--- | :--- | ---: |
| $1.0 \mathrm{~A} @ 28 \mathrm{Vdc}$ | Resistive | 100,000 |
| $250 \mathrm{~mA} @ 115 \mathrm{Vac}, 60 \mathrm{~Hz} \& 400 \mathrm{~Hz}$ | Resistive (case not grounded) | 100,000 |
| $100 \mathrm{~mA} @ 115 \mathrm{Vac}, 60 \mathrm{~Hz} \& 400 \mathrm{~Hz}$ | Resistive | 100,000 |
| 0.2 A @ 28 Vdc | Inductive $(0.32$ Henry) | 100,000 |
| 0.1 A @ 28 Vdc | Lamp | 100,000 |
| $30 \mu \mathrm{~A} @ 50 \mathrm{mVdc}$ | Low Level | $1,000,000$ |
| 0.1 A @ 28 Vdc | Intermediate Current | 50,000 |

## Double Pole, Electrically Held, 1 Amp and Less (Continued)

SMGA, SMGAD, SMGADD
(Continued)

## Operating Characteristics

Timing -
Operate Time -2.0 ms max.
Release Time -
SMGA - 1.5 ms max.
SMGAD/SMGADD - 4.0 ms max.
(suppression diode, protection/ suppression diodes)
Contact Bounce - 1.5 ms max.
Dielectric Withstanding Voltage -
Between Open Contacts -
500 Vrms 60 Hz
Between Adjacent Contacts -
500 Vrms 60 Hz
Between Contacts \& Coil -
500 Vrms 60 Hz
Insulation Resistance -
10,000 megohms min. @ 500 Vdc
1,000 megohms @ 500 Vdc
(coil to case @ $+125^{\circ} \mathrm{C}$ )

Environmental Characteristics
Temperature Range -
$-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Weight -
0.09 oz. (2.55 gms)

Vibration Resistance -
30 G's, 10 to $3,000 \mathrm{~Hz}$
Shock Resistance -
75 G's, $6 \pm 1 \mathrm{~ms}$ max.

Semiconductor Characteristics Diode -
100 Vdc peak inverse voltage (PIV)
1.0 Vdc max. transient voltage

Coil Data

| Nom. Coil Voltage (Vdc) | Coil Resistance in Ohms $\pm 10 \% @ 25^{\circ} \mathrm{C}$ (Note) | Coil Circuit Current mA (Max.) (Note) | Coil Circuit Current mA (Min.) (Note) | Pickup Voltage Vdc (Max.) @ $25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) @ $125^{\circ} \mathrm{C}$ | Drop-Out Voltage Vdc (Min.) @ $25^{\circ} \mathrm{C}$ | Drop-Out Voltage Vdc (Min.) @ -65․ | Nom. Coil Power (mW) <br> @ $25^{\circ} \mathrm{C}$ | $\begin{aligned} & \text { Max. } \\ & \text { Coil } \\ & \text { Voltage } \end{aligned}$ | $\begin{gathered} \text { Coil } \\ \text { Desig. } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| SMGA/SMGAD |  |  |  |  |  |  |  |  |  |  |
| 5.0 | 50 | n/a | n/a | 2.7 | 3.5 | 0.22 | 0.14 | 500 | 5.8 | 5 |
| 6.0 | 98 | n/a | n/a | 3.5 | 4.5 | 0.28 | 0.18 | 367 | 8.0 | 6 |
| 9.0 | 220 | n/a | n/a | 5.3 | 6.8 | 0.54 | 0.35 | 368 | 12.0 | 9 |
| 12.0 | 390 | n/a | n/a | 7.0 | 9.0 | 0.63 | 0.41 | 369 | 16.0 | 12 |
| 18.0 | 880 | n/a | n/a | 10.5 | 13.5 | 0.91 | 0.59 | 368 | 24.0 | 18 |
| 26.5 | 1,560 | n/a | n/a | 14.2 | 18.0 | 1.37 | 0.89 | 450 | 32.0 | 26 |
| SMGADD |  |  |  |  |  |  |  |  |  |  |
| 5.0 | 39 | 128.2 | 93.2 | 3.2 | 4.0 | 0.6 | 0.6 | 641 | 5.8 | 5 |
| 6.0 | 78 | 78.3 | 58.3 | 4.0 | 5.0 | 0.7 | 0.7 | 462 | 8.0 | 6 |
| 9.0 | 220 | 42.9 | 33.0 | 6.3 | 7.8 | 0.9 | 0.8 | 368 | 12.0 | 9 |
| 12.0 | 390 | 32.8 | 25.6 | 8.0 | 10.0 | 1.1 | 0.9 | 369 | 16.0 | 12 |
| 18.0 | 880 | 22.1 | 17.5 | 11.5 | 14.5 | 1.4 | 1.1 | 368 | 24.0 | 18 |
| 26.5 | 1,560 | 18.5 | 14.8 | 15.2 | 19.0 | 1.8 | 1.4 | 450 | 32.0 | 26 |

Note: Coil resistance not directly measurable. Coil current should be within limits shown when tested at nominal voltage at $25^{\circ} \mathrm{C}$ for 5 seconds max.

## Ordering Instructions

Catalog-selected Relays: The catalog number is derived by choosing the proper CODE for each of the relay characteristics in the order in which the codes are listed.

| Specifying a Part Number Example: | Type <br> SMGA | Diode <br> $D$ | $\underline{-26}$ |
| :--- | :---: | :---: | :---: |


| Catalog 5-1773450-5 | Dimensions are shown for <br> reference purposes only. |
| :--- | :--- |
| Revised 3-13 | Specifications subject <br> to change. |
| www.te.com | then |

SMGS, SMGSD, SMGSDD

Electrical Characteristics
Contact Arrangement 2 Form C (DPDT)
Contact Material -
Stationary -
Gold/platinum/palladium/silver (gold plated)
Moveable -
Gold/platinum/palladium/silver (gold plated)
Contact Resistance -
Before Life - 100 milliohms max. (measured @ 10 mA @ 6 Vdc ) After Life - 200 milliohms max. (measured @ 1 A @ 28 Vdc )
Mechanical Life Expectancy -
1 million operations
Coil Voltage - 5 to 48 Vdc
Coil Power - 565 mW max. @ $25^{\circ} \mathrm{C}$
Duty Cycle - Continuous
Pick-up Voltage - Approximately
$50 \%$ of nominal coil voltage
Pick-up Sensitivity -
130 mW max. @ $25^{\circ} \mathrm{C}$

Double Pole, Electrically Held, 1 Amp and Less (Continued)

| SMGS | SMGSD | SMGSDD |
| :---: | :---: | :---: |
| Sensitive . 100 Grid Surface Mount High Performance Relay | Sensitive . 100 Grid Diode Suppressed Surface Mount High Performance Relay | Sensitive . 100 Grid Diode Suppressed/Protected Surface Mount |
| Designed to MIL-R-39016/41 | Designed to MIL-R-39016/42 | High Performance Relay <br> Designed to <br> MIL-R-39016/43 |
|  |  |  |
| Terminal View | Terminal View | Terminal View |
| Product Facts <br> - Hermetically sealed <br> ■ High shock \& vibration ratings <br> - Surface mount leads <br> - Excellent RF switching | Product Facts Suppression diode <br> - Hermetically sealed <br> ■ High shock \& vibration ratings <br> ■ Surface mount leads <br> ■ Excellent RF switching | Product Facts <br> - Suppression \& protection diodes <br> - Hermetically sealed <br> ■ High shock \& vibration ratings <br> - Surface mount leads <br> ■ Excellent RF switching |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

Contact Ratings

| Contact Load | Type | Operations Min. |
| :---: | :---: | :---: |
| 1.0 A @ 28 Vdc | Resistive | 100,000 |
| 250 mA @ $115 \mathrm{Vac}, 60 \mathrm{~Hz}$ \& 400 Hz | Resistive (case not grounded) | 100,000 |
| 100 mA @ $115 \mathrm{Vac}, 60 \mathrm{~Hz}$ \& 400 Hz | Resistive | 100,000 |
| 0.2 A @ 28 Vdc | Inductive (0.32 Henry) | 100,000 |
| 0.1 A @ 28 Vdc | Lamp | 100,000 |
| $30 \mu \mathrm{~A} @ 50 \mathrm{mVdc}$ | Low Level | 1,000,000 |
| 0.1 A @ 28 Vdc | Intermediate Current | 50,000 |

## Double Pole, Electrically Held, 1 Amp and Less (Continued)

SMGS, SMGSD, SMGSDD
(Continued)

## Operating Characteristics

Timing -
Operate Time - 4.0 ms max.
Release Time -
SMGS - 2.0 ms max.
SMGSD/SMGSDD — 7.5 ms max.
(suppression diode, protection/ suppression diodes)
Contact Bounce - 1.5 ms max.
Dielectric Withstanding Voltage -
Between Open Contacts -
500 Vrms 60 Hz
Between Adjacent Contacts -
500 Vrms 60 Hz
Between Contacts \& Coil -
500 Vrms 60 Hz
Insulation Resistance -
10,000 megohms min. @ 500 Vdc
1,000 megohms @ 500 Vdc
(coil to case @ $+125^{\circ} \mathrm{C}$ )

## Environmental Characteristics

Temperature Range -
$-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Weight -
0.09 oz. (2.55 gms)

Vibration Resistance -
30 G's, 10 to $3,000 \mathrm{~Hz}$
Shock Resistance -
75 G's, $6 \pm 1 \mathrm{~ms}$ max.


Recommended Solder Pad Layout

## Semiconductor Characteristics

## Diode -

100 Vdc peak inverse voltage (PIV)
1.0 Vdc max. transient voltage

## Coil Data

| Nom. Coil Voltage (Vdc) | Coil Resistance in Ohms $\pm 10 \%$ @ $25^{\circ} \mathrm{C}$ (Note) | Coil Circuit Current mA (Max.) (Note) | Coil Circuit Current mA (Min.) (Note) | Pickup Voltage Vdc (Max.) @ $25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) @ $125^{\circ} \mathrm{C}$ | Drop-Out Voltage Vdc (Min.) @ $25^{\circ} \mathrm{C}$ | Drop-Out Voltage Vdc (Min.) @ $-65^{\circ} \mathrm{C}$ | Nom. Coil Power (mW) @ $25^{\circ} \mathrm{C}$ |  | Coil Desig. |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| SMGS/SMGSD |  |  |  |  |  |  |  |  |  |  |
| 5.0 | 100 | n/a | n/a | 2.6 | 3.5 | 0.23 | 0.12 | 250 | 7.5 | 5 |
| 6.0 | 200 | n/a | n/a | 3.4 | 4.5 | 0.28 | 0.18 | 180 | 10.0 | 6 |
| 9.0 | 400 | n/a | n/a | 4.85 | 6.8 | 0.55 | 0.35 | 203 | 15.0 | 9 |
| 12.0 | 800 | n/a | n/a | 7.0 | 9.0 | 0.64 | 0.41 | 180 | 20.0 | 12 |
| 18.0 | 1,600 | n/a | n/a | 9.8 | 13.5 | 0.92 | 0.59 | 203 | 30.0 | 18 |
| 26.5 | 3,200 | n/a | n/a | 14.0 | 18.0 | 1.4 | 0.89 | 219 | 40.0 | 26 |
| 36.0 | 6,500 | n/a | n/a | 20.0 | 27.0 | 1.8 | 1.25 | 199 | 57.0 | 36 |
| 48.0 | 11,000 | n/a | n/a | 25.8 | 36.0 | 2.4 | 1.60 | 209 | 75.0 | 48 |
| SMGSDD |  |  |  |  |  |  |  |  |  |  |
| 5.0 | 64 | 78.1 | 56.8 | 2.9 | 3.7 | 0.8 | 0.7 | 391 | 7.5 | 5 |
| 6.0 | 125 | 48.9 | 36.3 | 4.0 | 4.8 | 0.9 | 0.8 | 288 | 10.0 | 6 |
| 9.0 | 400 | 23.6 | 18.1 | 6.1 | 8.0 | 1.1 | 0.9 | 203 | 15.0 | 9 |
| 12.0 | 800 | 16.0 | 12.5 | 7.8 | 11.0 | 1.3 | 1.0 | 180 | 20.0 | 12 |
| 18.0 | 1,600 | 12.2 | 9.6 | 11.3 | 14.5 | 1.5 | 1.1 | 203 | 30.0 | 18 |
| 26.5 | 3,200 | 9.0 | 7.2 | 15.2 | 19.0 | 1.7 | 1.3 | 219 | 40.0 | 26 |
| 36.0 | 6,500 | 6.1 | 4.9 | 21.7 | 27.2 | 2.3 | 1.7 | 199 | 57.0 | 36 |
| 48.0 | 11,000 | 4.8 | 3.9 | 27.8 | 34.8 | 2.8 | 2.0 | 209 | 75.0 | 48 |

Note: Coil resistance not directly measurable. Coil current should be within limits shown when tested at nominal voltage at $25^{\circ} \mathrm{C}$ for 5 seconds max.

## Ordering Instructions

Catalog-selected Relays: The catalog number is derived by choosing the proper CODE for each of the relay characteristics in the order in which the codes are listed.

| Specifying a Part Number Example: | $\underline{\text { Type }}$ | $\underline{\text { Diode }}$ | $\underline{D}$ |
| :--- | :---: | :---: | :---: |
|  | SMGS | $D$ | -26 |


| Catalog 5-1773450-5 | Dimensions are shown for <br> Revised 3-13 |
| :--- | :--- |
| reference purposes only. <br> Specifications subject |  |
| www.te.com | to change. |

## SHC, SHCD, SHCS, SHCSD <br> 

Double Pole, Electrically Held, 1 Amp and Less (Continued)

SHC, SHCS
Standard / Sensitive . 100 Grid Surface Mount Commercial Relay


Terminal View
Product Facts

- Hermetically sealed

■ Excellent RF switching

SHCD, SHCSD
Standard / Sensitive
. 100 Grid Surface Mount Diode Suppressed Commercial Relay


Terminal View

Product Facts

- Suppression Diode
- Hermetically sealed
- Excellent RF switching


## Electrical Characteristics

Contact Arrangement -
2 Form C (DPDT)
Contact Material -
Stationary -
Gold/platinum/palladium/silver alloy
(gold plated)
Moveable -
Gold/platinum/palladium/silver alloy (gold plated)
Contact Resistance -
Before Life - 100 milliohms max.
(measured @ 10 mA @ 6 Vdc )
After Life - 200 milliohms max.
(measured @ 1 A @ 28 Vdc)
Mechanical Life Expectancy -
1 million operations
Coil Voltage -
5 to $26.5 \mathrm{Vdc}($ SHC/SHCD)
5 to 48 Vdc (SHCS/SHCSD)

## Coil Power -

SHC/SHCD - 660 mW max. @ $25^{\circ} \mathrm{C}$
SHCS/SHCSD — 565 mW max. @ $25^{\circ} \mathrm{C}$
Duty Cycle - Continuous
Pick-up Voltage - Approximately
$70 \%$ of nominal coil voltage
Pick-up Sensitivity -
SHC/SHCD - 180 mW max. @ $25^{\circ} \mathrm{C}$
SHCS/SHCSD — 90 mW max. @ $25^{\circ} \mathrm{C}$

Contact Ratings

| Contact <br> Load | Type | Operations <br> Min. |
| :--- | :--- | :---: |
| $1.0 \mathrm{~A} @ 28 \mathrm{Vdc}$ | Resistive | 100,000 |
| $250 \mathrm{~mA} @ 115 \mathrm{Vac}, 60 \mathrm{~Hz} \& 400 \mathrm{~Hz}$ | Resistive (Case not grounded) | 100,000 |
| $100 \mathrm{~mA} @ 115 \mathrm{Vac}, 60 \mathrm{~Hz} \& 400 \mathrm{~Hz}$ | Resistive | 100,000 |
| 0.2 A @ 28 Vdc | Inductive (0.32 Henry) | 100,000 |
| 0.1 A @ 28 Vdc | Lamp | 100,000 |
| $30 \mu \mathrm{~A} \mathrm{@} 50 \mathrm{mVdc}$ | Low Level | $1,000,000$ |

CII Low Signal Relays
Double Pole, Electrically Held, 1 Amp and Less (Continued)
SHC, SHCD, SHCS, SHCSD
(Continued)
Operating Characteristics
Timing -
Operate Time -
SHC/SHCD - 4.0 ms max.
SHCS/SHCSD - 6.0 ms max.
Release Time -
SHC - 3.0 ms max.
SHCS - 3.0 ms max.
SHCD - 6.0 ms max.
(suppression diode)
SHCSD - 7.5 ms max.
(suppression diode)
Dielectric Withstanding Voltage -
Between Open Contacts -
350 Vrms 60 Hz
Between Adjacent Contacts -
350 Vrms 60 Hz
Between Contacts \& Coil -
350 Vrms 60 Hz
Insulation Resistance -
1,000 megohms @ 500 Vdc

## Environmental Characteristics

Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Weight -
SHC/SHCD -
0.09 02. (2.55 gms)

SHCS/SHCSD -
0.15 oz. ( 4.30 gms )

Vibration Resistance -
10 G's, 10 to 500 Hz
Shock Resistance -


SHC/SHCD Enclosure
30 G's, $6 \pm 1$ ms

Standard Coil Data

|  | Nom. Coil Voltage (Vdc) | $\begin{gathered} \hline \text { Coil } \\ \text { Resistance } \\ \text { in Ohms } \\ \pm 20 \% @ 25^{\circ} \mathrm{C} \\ \hline \end{gathered}$ | Pickup Voltage Vdc (Max.) @ $25^{\circ} \mathrm{C}$ |  | Max. <br> Coil <br> Voltage | Coil Desig. |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| SHC/SHCD | 5.0 | 64 | 3.8 | 391 | 5.8 | 5 |
|  | 6.0 | 98 | 4.9 | 367 | 8.0 | 6 |
|  | 9.0 | 220 | 7.0 | 368 | 12.0 | 9 |
|  | 12.0 | 400 | 9.0 | 360 | 16.0 | 12 |
|  | 18.0 | 880 | 14.0 | 368 | 24.0 | 18 |
|  | 26.5 | 1,600 | 18.0 | 439 | 32.0 | 26 |
| SHCS/SHCSD | 5.0 | 100 | 3.5 | 250 | 7.5 | 5 |
|  | 6.0 | 200 | 4.5 | 180 | 10.0 | 6 |
|  | 9.0 | 400 | 6.8 | 203 | 15.0 | 9 |
|  | 12.0 | 800 | 9.0 | 180 | 20.0 | 12 |
|  | 18.0 | 1,600 | 13.5 | 203 | 30.0 | 18 |
|  | 26.5 | 3,200 | 18.0 | 219 | 40.0 | 26 |
|  | 36.0 | 6,500 | 24.0 | 199 | 57.0 | 36 |
|  | 48.0 | 11,000 | 32.0 | 209 | 75.0 | 48 |



SHC/SHCD/SHCS/SHCSD Header


Recommended Solder Pad Layout

## Ordering Instructions

Catalog-selected Relays: The catalog number is derived by choosing the proper CODE for each of the relay characteristics in the order in which the codes are listed.

| Specifying a Part Number Example: | Type | Diodes | $\underline{C o i l s}$ |
| :--- | :---: | :---: | :---: |
|  | SHC | $D$ | -26 |


| Catalog 5-1773450-5 | Dimensions are shown for <br> reference purposes only. |
| :--- | :--- |
| Revised 3-13 | Sepifications subject <br> to change. |
| www.te.com | en |

Electrical Characteristics
Contact Arrangement -
2 Form C (DPDT)
Contact Material -
Stationary -
Hardened silver alloy
Moveable -
Gold plated hardened silver alloy
Contact Resistance -
Before Life - 50 milliohms max.
(measured at $10 \mathrm{~mA} @ 6 \mathrm{Vdc}$ )
After Life - 100 milliohms max.
(measured @ 2 A @ 28 Vdc)
Mechanical Life Expectancy -
50 million operations
Coil Voltage -
5 to 48 Vdc (HFW)
6 to $26.5 \mathrm{Vdc}(\mathrm{HMB})$
5 to 36 Vdc (HMS)
Coil Power- 1.4 watts max. @ $25^{\circ} \mathrm{C}$
Duty Cycle - Continuous
Pick-up Voltage - Approximately
$50 \%$ of nominal coil voltage
Pick-up Sensitivity @ $25^{\circ} \mathrm{C}$ -
145 to 260 mW (HFW)
325 mW (HMB)
100 to 125 mW (HMS)

Double Pole, Electrically Held, 2 Amps and Less

| HFW | HMB | HMS |
| :---: | :---: | :---: |
| Standard Half Size High Performance Relay | Bifilar Half Size High Performance Relay | Sensitive Half Size High Performance Relay |
| Qualified to MIL-R-39016/6 | Qualified to MIL-R-39016/22 | Qualified to MIL-R-39016/44 |
|  |  |  |
| BLLUE EEAD | blue bead | BLLUE BEAD |
|  |  |  |
| Terminal View | Terminal View | Terminal View |
| Product Facts | Product Facts | Product Facts |
| - Hermetically sealed | - Hermetically sealed | - Hermetically sealed |
| - Up to 2 amps switching | - Up to 2 amps switching | - Up to 2 amps switching |
| High shock \& vibration ratings | High shock \& vibration ratings | High shock \& vibration ratings |
| - Optional terminals \& mounting styles | - Optional terminals \& mounting styles | - Optional terminals \& mounting styles |
| - Excellent RF switching | - Excellent RF switching | - Excellent RF switching |

## Contact Ratings

| Contact Load | Type | Operations Min. |
| :---: | :---: | :---: |
| 2 A @ 28 Vdc | Resistive | 100,000 |
| 0.75 A @ 28 Vdc | Inductive (200mH) | 100,000 |
| 0.1 A @ 115 Vac, 60 Hz \& 400 Hz | Resistive | 100,000 |
| 0.3 A @ $115 \mathrm{Vac}, 60 \mathrm{~Hz}$ \& 400 Hz | Resistive | 100,000 |
| 0.1 A @ 28 Vdc | Intermediate | 50,000 |
| 0.160 A @ 28 Vdc | Lamp | 100,000 |
| $30 \mu \mathrm{~A}$ @ 50 mVdc | Low Level | 1,000,000 |

## RF Performance

| Frequency (MHz) | RF Losses (dB) | VSWR | Isolation (dB) |
| :---: | :---: | :---: | :---: |
| 100 | 0.1 | $1.17: 1$ | 40 |
| 500 | 0.3 | $1.19: 1$ | 28 |
| 1000 | 0.4 | $1.19: 1$ | 23 |

## Double Pole, Electrically Held, 2 Amps and Less (Continued)

HFW, HMB, HMS (Continued)

## Operating Characteristics

Timing -
Operate Time -
4.0 ms max. (HFW)
5.0 ms max. (HMB)
6.0 ms max. (HMS)

Release Time -
4.0 ms max. (HFW)
5.0 ms max. (HMB/HMS)

Contact Bounce - 2.0 ms max.
Dielectric Withstanding Voltage -
Between Open Contacts -
500 Vrms 60 Hz
Between Adjacent Contacts -
1000 Vrms 60 Hz
Between Contacts \& Coil 1000 Vrms 60 Hz
Insulation Resistance -
10,000 megohms min. @ 500 Vdc

Environmental Characteristics
Temperature Range -
$-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Weight - 0.46 oz. ( 13 gms max.)
Vibration Resistance -
HFW/HMB/HMS -
Standard - 20 G's, 10 to 2,000 Hz HFW/HMB -
QPL - 30 G's, 10 to 3,000 Hz HMS -
QPL - 20 G's, 10 to 2,500 Hz

## Shock Resistance -

100 G's, $6 \pm 1$ ms
50 G's, $11 \pm 1 \mathrm{~ms}$ (HMS)
QPL Approval -
MIL-R-39016/6 (HFW)
MIL-R-39016/22 (HMB)
MIL-R-39016/44 (HMS)


Mounting Styles

## Standard Coil Data

|  | Nom. Coil Voltage (Vdc) | Coil Resistance in Ohms $\pm 10 \% @ 25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) <br> @ $25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Min.) @ $125^{\circ} \mathrm{C}$ | Drop-out Voltage Vdc (Min.) <br> @ $25^{\circ} \mathrm{C}$ | Drop-out Voltage Vdc (Min.) @ $-65^{\circ} \mathrm{C}$ | Nom. Coil Power (mW) <br> @ $25^{\circ} \mathrm{C}$ | Max. Coil Voltage | Coil Desig. |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| HFW | 5.0 | 27 | 2.7 | 3.8 | 0.29 | 0.21 | 926 | 6.0 | L |
|  | 6.0 | 40 | 3.2 | 4.5 | 0.35 | 0.25 | 900 | 7.5 | F |
|  | 12.0 | 160 | 6.4 | 9.0 | 0.7 | 0.5 | 900 | 15.0 | G |
|  | 26.5 | 700 | 13.5 | 18.0 | 1.5 | 1.0 | 1003 | 32.0 | K |
| HMB | 6.0 | 40 | 3.6 | 4.8 | 0.35 | 0.25 | 900 | 7.5 | F |
|  | 12.0 | 160 | 7.2 | 9.6 | 0.7 | 0.5 | 900 | 15.0 | G |
|  | 26.5 | 700 | 15.0 | 20.0 | 1.5 | 1.0 | 1003 | 32.0 | K |
| HMS | 5.0 | 47 | 2.2 | 3.2 | 0.21 | 0.12 | 532 | 7.0 | S001 |
|  | 6.0 | 75 | 2.75 | 4.0 | 0.27 | 0.17 | 480 | 9.0 | S002 |
|  | 12.0 | 310 | 5.6 | 8.0 | 0.55 | 0.35 | 465 | 20.0 | S003 |
|  | 26.5 | 1,030 | 11.4 | 16.5 | 1.1 | 0.7 | 682 | 35.0 | S004 |
|  | 30.0 | 1,620 | 14.3 | 21.0 | 1.4 | 0.9 | 556 | 44.0 | S005 |
|  | 36.0 | 2,640 | 18.0 | 26.0 | 1.8 | 1.1 | 491 | 56.0 | S006 |
| Other | 6-8 | 60 | 3.5 | 4.85 | 0.35 | 0.22 | 817 | 9.0 | A |
| (avail. for HFW | 12-15 | 320 | 6.8 | 9.42 | 0.68 | 0.44 | 570 | 21.0 | B |
| relays only) | 18.0 | 520 | 9.5 | 13.16 | 0.95 | 0.62 | 623 | 27.0 | J |
|  | 26.5-32 | 1,250 | 14.0 | 19.4 | 1.5 | 0.98 | 684 | 42.0 | D |
|  | 40.0 | 2,700 | 21.3 | 29.5 | 2.1 | 1.37 | 593 | 61.0 | H |
|  | 48.0 | 3,500 | 25.5 | 35.3 | 2.5 | 1.63 | 658 | 70.0 | E |

Specifying a Part Number Example:
Type
HFW

Terminals
12

Mountings
30

Coils
K

Features
00 (n/a HMS)

* The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15.

| Catalog 5-1773450-5 Revised 3-13 | Dimensions are shown for reference purposes only. Specifications subject | Dimensions are in millimeters unless otherwise specified. | USA: +1 8005226752 <br> Asia Pacific: +86 04008206015 UK: +44 800267666 | For additional support numbers please visit www.te.com |
| :---: | :---: | :---: | :---: | :---: |
| www.te.com | to change. |  |  |  |

## Double Pole, Electrically Held, 2 Amps and Less (Continued)

Long-life Half size Industrial Relay Type 3SCV (2PDT)<br>\section*{Product Facts}<br>■ 100,000,000 operations at low-level<br>■ Hermetic seal



The 3SCV is an exceptionally long life relay for low level applications which is designed for industrial applications such as business machines and computer peripheral equipment. The design is such that the phenomenon of sticking contacts is all but eliminated. Because of its low contact resistance and its ability to handle overloads the 3SCV relay is well suited for applications which have previously required reed devices.

Electrical Characteristics
Contacts - 2 Form C
Contact Resistance -
0.050 ohms; 0.100 ohms after life test

Life - $105-2 \mathrm{~A} 28$ volts DC, 115 volts
AC (not grounded, resistive)
0.5 A

Low-level - 100,000,000 operations

- 50 AA at 50 mV Peak AC or DC

Sensitivity - 340 mW
Operating Characteristics
Operate Time - 6 ms max.
Release Time - 4 ms max.
Contact Bounce - 2 ms max.
Enclosure - All welded, hermetically sealed
Terminals - Weldable and solderable
Dielectric Strength — 500 volts rms at sea level
Insulation Resistance - 1,000 megohm min.
Environmental Characteristics
Weight - 0.30 oz.
Vibration - 10G, $10-2000 \mathrm{~Hz}$
Shock - 50 G 6ms, $1 / 2$ sine
Temperature - $-14^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
See page 1-39 for Mounting Forms, Terminals and Circuit Diagrams.

Coil Table (All Values DC)* 340 mW Sensitivity: (Code 1)

| Coil <br> Code <br> Letter | Coil Resistance <br> at 25C (ohms) | Voltage Calibrated, CODE: 5 |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |

## Ordering Instructions

Catalog-selected Relays: The catalog number is derived by choosing the proper CODE for each of the six relay characteristics in the order in which the codes are listed.

Example: The relay selected in this example is a 2PDT half size relay, voltage calibrated, two-hole side bracket mounting, solder hook header, 700 ohms coil resistance, and 340 mW sensitivity. By choosing the proper code for each of these relay characteristics, the catalog number is identified as 3 SCV5042H1. The letter R following sensitivity code indicates relay received 5000 operation miss-test. Ex. 3SCV5042H1R.
 to change.
Dimensions are in millimeters
unless otherwise specified. unless otherwise specified.

## Mounting Forms (3SCV)

Mounting
Code


## Header and Connection Diagrams



Header Types

| Type | $Z$ <br> Dim. | Header <br> Code |
| :--- | :---: | :---: |
| Solder hook | 0.16 | 2 |
| Straight pin (socket <br> or PCB type) | 0.19 | 4 |



CODE: 2



Product Facts
■ Hermetically sealed
■ Up to 2 amps switching
■ Economical configuration
■ Optional terminals \& mounting styles

01


## Ordering Instructions

Catalog-selected Relays: The catalog number is derived by choosing the proper CODE for each of the six relay characteristics in the order in which the codes are listed.

| Specifying a Part Number Example: | Type | Terminals | Mountings | Coils | Features |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | HFC | 12 | 30 | K | 00 |

## Double Pole, Electrically Held, 2 Amps and Less (Continued)

. 150 Grid-space Relays
Type 3SBC (2PDT) Standard
135 mW 2PDT
50 mW (Form AB)
1 PNC-1 PNO

## Product Facts

■ Low profile... only 0.32 inches high

- Internal diode for coil transient suppression and transistor driven models available
■ Qualified to MIL-R-39016/13
- RF designs available


The . 150 Grid-space relay - only 0.32 inches high saves space in electronic packaging. The pin spacing allows you to insert the relay with no intermediate pin spreaders as well as meet applicable military specifications.

Electrical Characteristics
Contact Ratings -
DC resistive -2 amps at 28 volts
(50,000 operations)
1 Amp @ 28 V ( 100,000 operations) DC inductive - 0.5 amps at 28 volts, 200 mH
AC resistive - 0.5 amps at 115 volts AC - 0.125 amps at 115 volts (case grounded)
Low-level - $50 \mu \mathrm{~A}$ at 50 mV
Peak AC or DC
Contact Resistance -
0.050 ohms max.; 0.150 ohms after life test
Life - 100,000 operations at rated loads listed; 1,000,000 operations at low-level loads

Operating Characteristics
Operate Time - 4 ms max.
Release Time - 4 ms max.
Contact Bounce - 1.5 ms
Dielectric Strength -
500 volts rms at sea level;
350 volts rms at 70,000 feet and above
Insulation Resistance - 1,000
megohm min. over temperature range
Environmental Characteristics
Vibration - 30G, to 3000 Hz
Shock - 100 G at 11 ms
Temperature - $-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
See page 1-44 for Mounting Forms, Terminals and Circuit Diagrams.

Coil Table Type 3SBC (All Values DC)*2PDT, 135 mW Sensitivity: (Code 1)

| Coil Code Letter | Coil Resistance @ 25C (ohms) | Voltage Calibrated, Code 5 |  |  |  |  | Current Calibrated, Code 6 |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Suggested Source Volts $\dagger$ | Max. Operate Volts <br> @ 25C | Release Voltage Range @ 25C |  | Max. <br> Continuous Current @ 125 C (mA) | Max. <br> Operate Current @ 25C (mA) | Release Current Range @ 25C (mA) |  |
|  |  |  |  | Max. | Min. |  |  | Max. | Min. |
| A | $44 \pm 10 \%$ | 3.5-6.2 | 2.4 | 1.45 | 0.26 | 87.0 | 54.5 | 32.7 | 6.00 |
| B | $56 \pm 10 \%$ | 4.0-7.0 | 2.7 | 1.6 | 0.3 | 77.0 | 48.3 | 28.6 | 5.30 |
| D | $140 \pm 10 \%$ | 6.4-12.0 | 4.4 | 2.6 | 0.5 | 50.3 | 31.4 | 18.5 | 3.60 |
| E | $210 \pm 10 \%$ | 8.0-16.0 | 5.4 | 3.2 | 0.6 | 40.0 | 25.7 | 15.4 | 2.80 |
| L | $650 \pm 10 \%$ | 13.6-24.0 | 9.5 | 5.6 | 1.0 | 22.9 | 14.3 | 8.6 | 1.54 |
| K | 1350 $\pm 10 \%$ | 20.0-35.0 | 13.5 | 8.1 | 1.5 | 15.5 | 10.0 | 6.0 | 1.10 |
| N | $2245 \pm 10 \%$ | 26.0-46.0 | 17.1 | 10.5 | 1.9 | 12.0 | 7.6 | 4.7 | 0.84 |

Coil-Data (All Values DC)* Type 3SBC Form AB 50 mW Sensitivity non mil spec: (Code 2)

| Coil Code Letter | Coil Resistance @ 25C (ohms) | Voltage Calibrated, Code 5 |  |  |  |  | Current Calibrated, Code 6 |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Suggested Source Volts $\dagger$ | Max. Operate Volts <br> @ 25C | Release Voltage Range @ 25C |  | Max. Continuous Current @ 125C (mA) | Max. Operate Current <br> @ 25C (mA) | Release Current Range @ 25C (mA) |  |
|  |  |  |  | Max. | Min. |  |  | Max. | Min. |
| B | $56 \pm 10 \%$ | 2.6-7.0 | 1.8 | 1.1 | 0.16 | 46.5 | 29.1 | 18.2 | 3.30 |
| C | $85 \pm 10 \%$ | 3.3-9.5 | 2.3 | 1.4 | 0.20 | 38.7 | 24.2 | 15.1 | 2.70 |
| D | $140 \pm 10 \%$ | 4.3-12.0 | 2.9 | 1.8 | 0.27 | 30.4 | 19.0 | 11.9 | 2.10 |
| E | $210 \pm 10 \%$ | 5.3-14.0 | 3.6 | 2.2 | 0.33 | 24.8 | 15.5 | 9.7 | 1.75 |
| F | $360 \pm 10 \%$ | 6.7-19.0 | 4.5 | 2.8 | 0.41 | 18.9 | 11.8 | 7.2 | 1.30 |
| G | $510 \pm 10 \%$ | 8.2-23.0 | 5.6 | 3.5 | 0.51 | 15.8 | 9.9 | 6.2 | 1.10 |
| H | $775 \pm 10 \%$ | 10.0-26.0 | 6.8 | 4.2 | 0.62 | 12.8 | 8.0 | 5.0 | 0.90 |
| K | $1350 \pm 10 \%$ | 13.2-35.0 | 9.0 | 5.6 | 0.82 | 9.8 | 6.1 | 3.8 | 0.68 |
| N | 2245 $\pm 10 \%$ | 16.8-46.0 | 11.4 | 7.1 | 1.00 | 7.4 | 4.6 | 2.9 | 0.52 |

*Values listed are factory test and inspection data. User should allow for meter variations.
$\dagger$ At nominal resistance plus 10\%.
$\ddagger$ Applicable over the operating temperature range in circulating air.

See Page 1-42 for ordering instructions.

* The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15.

| Catalog 5-1773450-5 | Dimensions are shown for |
| :--- | :--- |
| Revised 3-13 | reference purposes only. <br>  <br> Specifications subject <br> to change. |

Dimensions are in millimeters unless otherwise specified. to change.

For additional support numbers Asia Pacific: +86 04008206015 please visit www.te.com UK: +44 800267666

## Double Pole, Electrically Held, 2 Amps and Less (Continued)

. 150 Grid-space Hybrid Relays
Single Diode, Dual Diode
Type 3SBC (2PDT)
135 mW

## Product Facts

■ Low profile... only 0.32 inches high

■ 50 milliwatt forms available
■ Qualified to MIL-R-39016/37
■ Qualified to MIL-R-39016/38
■ RF designs available


The hybrid . 150 Grid-space relay — only 0.32 inches high - saves space in electronic packaging. The pin spacing allows you to insert the relay with no intermediate pin spreader.

## Electrical Characteristics

Contact Ratings -
DC resistive -2 amps at 28 volts
(50,000 operations)
1 Amp @ 28 V ( 100,000 operations)
DC inductive - 0.5 amps at 28 volts,
200 mH
AC resistive - 0.5 amps at 115 volts
AC -0.125 amps at 115 volts (case grounded)
Low-level - $50 \mu \mathrm{~A}$ at 50 mV
Peak AC or DC
Contact Resistance -
0.050 ohms max.; 0.150 ohms after life test
Life - 100,000 operations at rated loads listed; 1,000,000 operations at low-level loads

Operating Characteristics
Operate Time - 4 ms max.
Release Time - 6 ms max.
Contact Bounce - 1.5 ms
Dielectric Strength (Note 1) -
500 volts rms at sea level; 350 volts rms at 70,000 feet and above Insulation Resistance (Note 1) 1,000 megohm min. over temperature range
Environmental Characteristics
Vibration - 30G, to 3000 Hz
Shock - 100 G at 11 ms
Temperature - $-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Semiconductor Characteristics at $25^{\circ} \mathrm{C}$
Diode -
Max. Negative Transient - 1.0 volt Breakdown Voltage — 100 VDC @ $10 \mu \mathrm{~A}$ Max. Leakage Current-1 $1 \mu$ @ 50 VDC
See page 1-44 for Mounting Forms, Terminals and Circuit Diagrams.

Coil Table Single Diode (All Values DC)*(2DPT), 135 mW Sensitivity: (Code 5)

| Coil Code Letter | $\begin{aligned} & \text { Coil } \\ & \text { Resistance } \\ & \text { (a 25C } \\ & \text { (ohms) } \end{aligned}$ | Voltage Calibrated, Code 5 |  |  |  | Current Calibrated, Code 6 |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Suggested Source Volts $\dagger$ | Max.Operate OpertsVold (a) 25C | Release Voltage Range (a 25C |  | Max. Continuous Current (a) $125 \mathrm{C}(\mathrm{mA})$ | Max. Operate Current (a 25 C (mA) | Release Current Range (a. 25C (mA) |  |
|  |  |  |  | Max. | Min. |  |  | Max. | Min. |
| A | $44 \pm 10 \%$ | 3.5-6.2 | 2.4 | 1.45 | 0.26 | 87.0 | 54.5 | 32.7 | 6.00 |
| B | $56 \pm 10 \%$ | 4.0-7.0 | 2.7 | 1.6 | 0.3 | 77.0 | 48.3 | 28.6 | 5.30 |
| D | 140 $\pm 10 \%$ | 6.4-12.0 | 4.4 | 2.6 | 0.5 | 50.3 | 31.4 | 18.5 | 3.60 |
| E | $210 \pm 10 \%$ | 8.0-16.0 | 5.4 | 3.2 | 0.6 | 40.0 | 25.7 | 15.4 | 2.80 |
| L | $650 \pm 10 \%$ | 13.6-24.0 | 9.5 | 5.6 | 1.0 | 22.9 | 14.3 | 8.6 | 1.54 |
| K | $1350 \pm 10 \%$ | 20.0-35.0 | 13.5 | 8.1 | 1.5 | 15.5 | 10.0 | 6.0 | 1.10 |
| N | $2245 \pm 10 \%$ | 26.0-46.0 | 17.1 | 10.5 | 1.9 | 12.0 | 7.6 | 4.7 | 0.84 |

Coil Table Dual Diode (All Values DC)*(2DPT), 135 mW Sensitivity: (Code 6)

|  | $* *$ |  |  |  |  |  |  |  |
| ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: | ---: |
| A | $44 \pm 10 \%$ | $3.9-7.0$ | 3.4 | 2.0 | 0.37 | 98.2 | 77.3 | 45.5 |
| B | $56 \pm 10 \%$ | $4.6-8.0$ | 3.7 | 2.2 | 0.41 | 89.8 | 8.4 |  |
| D | $140 \pm 10 \%$ | $7.8-12.0$ | 5.4 | 3.2 | 0.6 | 52.4 | 38.1 | 3.6 |
| E | $210 \pm 10 \%$ | $9.3-16.0$ | 6.4 | 3.8 | 0.7 | 41.4 | 30.5 | 18.1 |
| L | $650 \pm 10 \%$ | $15.0-24.0$ | 10.5 | 6.2 | 1.1 | 23.6 | 3.3 |  |
| K | $1350 \pm 10 \%$ | $21.0-35.0$ | 14.5 | 8.7 | 1.6 | 16.0 | 9.3 |  |
| N | $2245 \pm 10 \%$ | $27.0-46.0$ | 18.1 | 10.9 | 2.0 | 12.1 | 10.7 | 6.4 |

## Ordering Instructions

Example: The relay selected in the example is a FORM AB .150-grid relay, current calibrated, end bracket mounting with 0.13 -inch solder hook header, 210 ohms coil resistance, and 50 mW sensitivity. By choosing the proper code for each of these relay characteristics, the catalog number is
3SBC6131E2. The letter R following sensitivity code indicates relay received 5000 operation miss-test. Ex. 3SBC6131E2R.

Note: Relays specified by catalog numbers (per above directions) are general use items controlled by catalog specifications. Relays to be controlled by customer drawings or relays having requirements not covered in this publication - will be assigned special catalog numbers upon request.

*The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15

[^1]```
USA: +1 }800522675
Asia Pacific: +8604008206015
UK: +44 800267666
```


## Double Pole, Electrically Held, 2 Amps and Less (Continued)

## . 150 Grid-space Long-life Relays Type 3SCC (2PDT) 170 mW

## Product Facts

■ 100,000,000 operations low-level signal loads

■ RF designs available
■ Low profile - 0.32 height
■ Hermetic seal
■ High reliability
■ Performance tested


The . 150 Grid relay, the smallest (. 320 inches high) 2 Amp rated relay available in commercial and military qualified models, is now available in the long life version. Capable of over 100,000,000 mechanical operations at low level and signal load, the . 150 Grid relay provides the simplicity of relays for circuit design, the low circuit resistance of precious metal contact systems, and the long life processing that has made CII relays the standard for quality and reliability.

## Electrical Characteristics

Contact Ratings -
DC resistive -2 amps at 28 volts (50,000 operations)
1 Amp @ 28 V ( 100,000 operations) DC inductive - 0.5 amps at 28 volts, 200 mH
AC resistive - 0.5 amps at 115 volts AC -0.125 amps at 115 volts (case grounded)
Low-level - $50 \mu \mathrm{~A}$ at 50 mV
Peak AC or DC
Contact Resistance -
0.050 ohms max.; 0.150 ohms after life test
Life - 100,000 operations at rated loads listed; 1,000,000 operations at low-level loads

Operating Characteristics
Operate Time - 4 ms max.
Release Time - 4 ms max.
Contact Bounce - 1.5 ms
Dielectric Strength -
500 volts rms at sea level; 350 volts rms at 70,000 feet and above Insulation Resistance - 1,000
megohm min. over temperature range
Environmental Characteristics
Vibration - 30G, to 3000 Hz
Shock - 100 G at 11 ms
Temperature - $-40^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
See page 1-44 for Mounting Forms, Terminals and Circuit Diagrams.

Coil Table Type 3SCC (All Values DC)* 2 PDT Relay - 170mW Sensitivity: (Code 1)

| Coil <br> Code Letter | Coil Resistance @ 25C (ohms) | Voltage Calibrated, Code 5 |  |  |  | Current Calibrated, Code 6 |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Suggested Source Volts $\dagger$ | Max. Operate Volts @25C | Release Voltage Range @ 25C |  | Max. Continuous Current @ 125C (mA) | Max. Operate Current @ 25C (mA) | Release Current Range @ 25C (mA) |  |
|  |  |  |  | Max. | Min. |  |  | Max. | Min. |
| A | $44 \pm 10 \%$ | 3.5-6.2 | 2.7 | 1.45 | 0.26 | 87.0 | 61.4 | 32.7 | 6.00 |
| B | $56 \pm 10 \%$ | 4.0-7.0 | 3.1 | 1.6 | 0.3 | 77.0 | 55.4 | 28.6 | 5.30 |
| D | $140 \pm 10 \%$ | 6.4-12.0 | 4.9 | 2.6 | 0.5 | 50.3 | 35.0 | 18.5 | 3.60 |
| E | $210 \pm 10 \%$ | 8.0-16.0 | 5.9 | 3.2 | 0.6 | 40.0 | 28.0 | 15.4 | 2.80 |
| L | $650 \pm 10 \%$ | 13.6-24.0 | 10.5 | 5.6 | 1.0 | 22.9 | 16.2 | 8.6 | 1.54 |
| K | $1350 \pm 10 \%$ | 20.0-35.0 | 15.1 | 8.1 | 1.5 | 15.5 | 11.2 | 6.0 | 1.10 |
| N | $2245 \pm 10 \%$ | 26.0-46.0 | 19.5 | 10.5 | 1.9 | 12.0 | 8.7 | 4.7 | 0.84 |

*Values listed are factory test and inspection data. User should allow for meter variations.
$\dagger$ Applicable over the operating temperature range in circulating air.

## Ordering Instructions

Example: The relay selected in the example is a 2PDT .150-grid relay, current calibrated, end bracket mounting with 0.13 -inch solder hook header, 210 ohms coil resistance, and 175 mW sensitivity. By choosing the proper code for each of these relay characteristics, the catalog number is 3SCC6131E1. The letter R following sensitivity code indicates relay received 5000 operation miss-test. Ex.
3SCC6131E1R.

Note: Relays specified by catalog numbers (per above directions) are general use items controlled by catalog specifications. Relays to be controlled by customer drawings or relays having requirements not covered in this publication - will be assigned special catalog numbers upon request.


| Catalog 5-1773450-5 | Dimensions are shown for <br> reference purposes only. |
| :--- | :--- |
| Revised 3-13 | Specifications subject |
| www.te.com | to change. |

Dimensions are in millimeters
unless otherwise specified.

## Mounting Forms

(3SBC, 3SCC)
(Vibration note with each form is acceleration from 55 to 3000 Hz )

No Mount

| Mounting Code | Vibration |
| :---: | :---: |
| 00 | 30 g |

End Bracket

| Mounting Code | Vibration |
| :---: | :---: |
| 13 | 30 g |



Side Bracket

| Mounting Code | Vibration |
| :---: | :---: |
| 25 | 30 g |

*Assumes relay held securely by potting or other means

## Header and Connection

 Diagrams| Header and Connection Diagrams | Header Types |  |  | $\rightarrow$ |
| :---: | :---: | :---: | :---: | :---: |
|  | TYPE | Z <br> DIMENSION | $\begin{aligned} & \text { HEADER } \\ & \text { CODE } \end{aligned}$ | $\int_{\text {CODE: }} \frac{\square z \pm .020}{1}$ |
|  | Solder hook | 0.13 | 1 | 3 |
|  | Straight pin | 0.12 | 8 | 020 \% |
|  | Straight pin | 0.19 | 4 | $2 \pm .020$ |
|  | Straight pin | 0.25 | 5 | di |

## Header Types



All dimensions in inches

| TOLERANCES |  |
| :--- | ---: |
| (Unless otherwise specified) |  |
| Hundredths | $\pm 0.020$ |
| Thousandths | $\pm 0.005$ |



## Double Pole, Electrically Held, 2 Amps and Less (Continued)

Crystal-Can Relays
Type 3SAE (2PDT) Type 3SAC (2PDT)

## Product Facts

■ Small lightweight crystal-can type
■ 0.25 cubic inch, 0.60 ounces
■ Power or low-level switching
■ 20G to 2000 Hz vibration capability


The TE Connectivity line of crystal-can relays is backed by years of experience and millions of relays operating in the field.

Electrical Characteristics
Contact Ratings -
DC resistive - 2 amps at 28 volts
DC inductive - 1 amp at 28 volts, L/R < . 025
Low-level - $50 \mu \mathrm{~A}$ at 50 mV
Peak AC or DC
AC resistive - 1.0 amp at 115 volts, case not grounded
AC resistive - 0.25 amps at 115 volts,
case grounded
Contact Resistance -
0.050 ohms max. initial; 0.100 ohms max. after life test

Life - 100,000 operations at rated load; 1,000,000 at low-level

Operating Characteristics
Operate Time - 6 ms max.
Release Time - 5 ms max.
Contact Bounce - 2.5 ms
Dielectric Strength -
1,000 volts rms at sea level;
700 volts rms across contact gaps;
350 volts rms at 70,000 feet
Insulation Resistance -
1,000 megohm min. except coil to case 500 min . at $125^{\circ} \mathrm{C}$
Environmental Characteristics
Vibration - Depends upon mounting forms
Shock - 50 G at 11 ms
Temperature - $-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
See page 1-46 for Mounting Forms, Terminals and Circuit Diagrams.

## Coil Table (All Values DC)* Type 3SAE 330 mW Sensitivity: (Code 1)

| $\begin{array}{c}\text { Coil } \\ \text { Code } \\ \text { Letter }\end{array}$ | $\begin{array}{c}\text { Voltage Calibrated, CODE: } 5 \\ \text { Resistance } \\ \text { at 25C (Ohms) }\end{array}$ |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | $\begin{array}{c}\text { Coil } \\ \text { Source } \\ \text { Volts } \dagger\end{array}$ | $\begin{array}{c}\text { Maximum } \\ \text { Operate } \\ \text { Volts at 25C }\end{array}$ | $\begin{array}{c}\text { Release Voltage } \\ \text { at 25C }\end{array}$ |  |  |
|  | $22 \pm 10 \%$ | $3.9-5.9$ | 2.7 | 1.4 | 0.29 |
| B | $34 \pm 10 \%$ | $4.8-7.4$ | 3.3 | 1.7 | 0.36 |
| C | $53 \pm 10 \%$ | $6.2-9.2$ | 4.2 | 2.2 | 0.46 |
| D | $92 \pm 10 \%$ | $8.0-12.0$ | 5.4 | 2.8 | 0.60 |
| E | $146 \pm 10 \%$ | $10.2-15.0$ | 6.9 | 3.6 | 0.76 |
| F | $215 \pm 10 \%$ | $12.3-18.5$ | 8.3 | 4.3 | 0.92 |
| H | $342 \pm 10 \%$ | $15.4-23.0$ | 10.4 | 5.4 | 1.16 |
| K | $552 \pm 10 \%$ | $20.0-29.5$ | 13.5 | 7.0 | 1.50 |
| L | $814 \pm 10 \%$ | $25.0-36.0$ | 16.9 | 8.8 | 1.88 |
| M | $1180 \pm 10 \%$ | $30.0-43.0$ | 20.5 | 10.6 | 2.28 |
| N | $1278 \pm 15 \%$ | $31.0-41.5$ | 21.3 | 11.0 | 2.36 |
| P | $1800 \pm 15 \%$ | $38.0-49.0$ | 25.8 | 13.3 | 2.86 |
| R | $2530 \pm 15 \%$ | $43.0-58.5$ | 29.0 | 15.0 | 3.22 |
| S | $2950 \pm 15 \%$ |  |  |  |  |$)$

Coil Table (All Values DC)* Type 3SAC 200 mW Sensitivity: (Code 2)

| Coil <br> Code <br> Letter | Coil <br> Resistance <br> at 25C (Ohms) | Maximum <br> Operate <br> Current at <br> 25C (mA) | Maximum <br> Continuous <br> Current at <br> 125C (mA) | Release Current <br> at 25C (mA) |  |
| :---: | ---: | :---: | :---: | :---: | :---: |
|  |  | Max | Min |  |  |
|  | $184 \pm 10 \%$ | 32.0 | 65.0 | 16.5 | 3.53 |
| B | $292 \pm 10 \%$ | 25.6 | 51.5 | 13.3 | 2.84 |
| C | $430 \pm 10 \%$ | 20.8 | 42.5 | 10.8 | 2.31 |
| D | $684 \pm 10 \%$ | 16.4 | 33.5 | 8.5 | 1.80 |
| E | $1104 \pm 10 \%$ | 13.2 | 26.5 | 6.9 | 1.46 |
| F | $1628 \pm 10 \%$ | 11.2 | 21.7 | 5.8 | 1.24 |
| H | $2360 \pm 15 \%$ | 9.4 | 16.8 | 4.9 | 1.04 |
| K | $2556 \pm 15 \%$ | 9.0 | 16.2 | 4.7 | 0.99 |
| L | $3600 \pm 15 \%$ | 7.7 | 13.5 | 4.1 | 0.86 |
| M | $5060 \pm 15 \%$ | 6.2 | 11.5 | 3.3 | 0.69 |
| N | $5900 \pm 15 \%$ | 6.2 | 10.5 | 3.3 | 0.71 |
| P | $10000 \pm 20 \%$ | 4.5 | 7.5 | 2.4 | 0.50 |
| R | $10340 \pm 20 \%$ | 4.8 | 7.4 | 2.5 | 0.54 |

*Values listed are factory test and inspection values. User should allow for meter variations.
$\dagger$ Applicable over the operating temperature range in circulating air.

## Ordering Instructions

Example: The relay selected in this example is a 2PDT crystal-can relay, voltage calibrated, two-hole side bracket mounting solder hook header, 552 ohms coil resistance, and 330 mW sensitivity. By choos-
ing the proper code for each of these relay characteristics, the catalog number is identified as 3SAE5041K1. The letter R following sensitivity code indicates relay received 5000 operation miss-test. Ex. 3SAE5041K1R.
 to change.

## Mounting Forms (3SAC, 3SAE)

(Vibration note with each form is acceleration from 55 to 2000 Hz )


Flange Mount, 2 in-line holes

| Mount- <br> ing <br> Code | A Dim. <br> (Max) | $X$ <br> Dim. | Vibra- <br> tion | Relay <br> Type |
| :---: | :---: | :---: | :---: | :---: |
| 13 | 0.875 | 0.125 | 15 g | 3 SAE |
| 13 | 1.187 | 0.125 | 10 g | 3 SAC |
| 14 | 0.875 | 0.375 | 20 g | 3 SAE |
| 14 | 1.187 | 0.455 | 15 g | 3 SAC |



Four-hole Flange

| Mount- <br> ing <br> Code | A <br> Dim. <br> (Max) | $X$ <br> Dim. | Vibra- <br> tion | Relay <br> Type |
| :---: | :---: | :---: | :---: | :---: |
| 01 | 0.875 | 0.125 | 15 g | 3 3SAE |
| 01 | 1.187 | 0.125 | 10 g | 3 3SAC |
| 02 | 0.875 | 0.375 | 20 g | 3 3SAE |
| 02 | 1.187 | 0.455 | 15 g | 3SAC |



Side Studs

| Mount- <br> ing <br> Code | Dim. <br> (Max) | $C$ <br> Dim. | Xim. <br> Dibra- | Relay <br> tion |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 07 | 0.875 | 0.488 | 0.375 | 20 g | 3 SAE |
| 07 | 1.187 | 0.800 | 0.375 | 15 g | 3 SAC |
| 08 | 0.875 | 0.488 | 0.250 | 20 g | 3 SAE |
| 08 | 1.187 | 0.800 | 0.250 | 15 g | $3 S A C$ |



Header and Connection Diagrams


Header Types

| Type | Z Dim. | Header <br> Code |
| :--- | :---: | :---: |
| Solder hook | 0.19 | 2 |
| Straight pin (socket or <br> PCB type) | 0.19 | 4 |
| Straight pin | 2.99 | 8 |

CODE: 1
$\overbrace{0}^{2 \pm 020}$


CODES: 4, 8

# Double Pole, Magnetic Latching, 2 Amps and Less 

LS

## LS

## Magnetic Latching Half Size High Performance Relay <br> DESIGNED to <br> MIL-R-39016/45



## Electrical Characteristics

## Contact Arrangement -

2 Form C (DPDT)

## Contact Material -

Stationary -
Gold plated hardened silver alloy Moveable -
Gold plated hardened silver alloy
Contact Resistance -
Before Life - 50 milliohms max.
(measured at 10 mA @ 6 Vdc )
After Life - 100 milliohms max. (measured @ 2 A @ 28 Vdc)
Mechanical Life Expectancy -
1 million operations min.
Coil Voltage - 5 to 48 Vdc
Coil Power - 1.0 watts max.
Duty Cycle - Continuous
Pick-up Voltage - Approximately
$50 \%$ of nominal coil voltage
Pick-up Sensitivity — 170 mW

Contact Ratings

| Contact <br> Load | Type | Operations <br> Min. |
| :--- | :--- | ---: |
| 2 A @ 28 Vdc | Resistive | 100,000 |
| $0.3 \mathrm{~A} \mathrm{@} \mathrm{115} \mathrm{Vac} 60 \mathrm{~Hz} \& 400 Hz$, | Resistive | 100,000 |
| 0.75 A @ 28 Vdc | Inductive $(200 \mathrm{mH})$ | 100,000 |
| 0.1 A @ 28 Vdc | Intermediate | 50,000 |
| 0.160 A @ 28 Vdc | Lamp | 100,000 |
| $30 \mu \mathrm{~A} \mathrm{@} 50 \mathrm{mVdc}$ | Low Level | $1,000,000$ |

RF Performance

| Frequency (MHz) | RF Losses (dB) | VSWR | Isolation (dB) |
| :---: | :---: | :---: | :---: |
| 100 | 0.1 | $1.15: 1$ | 38 |
| 500 | 0.3 | $1.19: 1$ | 31 |
| 1000 | 0.6 | $1.32: 1$ | 45 |

## Double Pole, Magnetic Latching, 2 Amps and Less (Continued)

## LS (Continued)

Operating Characteristics
Timing -
Set-Reset Time - 5.0 ms max.
Contact Bounce -
2.0 ms max.
Dielectric Withstanding Voltage -
Between Open Contacts -
500 Vrms 60 Hz
Between Adjacent Contacts -
1000 Vrms 60 Hz
Between Contacts and Coil -
1000 Vrms 60 Hz
Insulation Resistance --
10,000 megohms min. @ 500 Vdc

Environmental Characteristics
Temperature Range -
$-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Weight - . 46 oz ( 13 gms ) max.
Vibration Resistance -
Standard - 20 G's, 10 to $2,000 \mathrm{~Hz}$
QPL Equiv. - 30 G's, 10 to $2,500 \mathrm{~Hz}$
Shock Resistance -
100 G's, $6 \pm 1$ ms
QPL Equivalent -
MIL-R-39016/45


B


LS Terminals


Standard Coil Data

| Nom. Coil Voltage (Vdc) | Coil Resistance in Ohms $\pm 10 \% @ 25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) @ $25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) @ $125^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Min.) @ $25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Min.) @ $-65^{\circ} \mathrm{C}$ | Nom. Coil Power (mW) <br> @ $25^{\circ} \mathrm{C}$ | Max. Coil Voltage | Coil Desig. |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 5.0 | 45 | 2.7 | 3.8 | 1.6 | 1.0 | 556 | 6.7 | 5 |
| 6.0 | 63 | 3.25 | 4.5 | 2.0 | 1.3 | 571 | 8.0 | 6 |
| 12.0 | 254 | 6.5 | 9.0 | 4.0 | 2.6 | 567 | 16.0 | 12 |
| 26.5 | 1,000 | 13.0 | 18.0 | 8.0 | 5.2 | 702 | 32.0 | 24 |
| 48.0 | 3,800 | 26.0 | 36.0 | 16.0 | 10.4 | 606 | 64.0 | 48 |

## Ordering Instructions

Catalog-selected Relays: The catalog number is derived by choosing the proper CODE for each of the six relay characteristics in the order in which the codes are listed.

| Specifying a Part Number Example: | Type | Mountings | Contacts | Coils | Terminals |
| :--- | :---: | :---: | :---: | :---: | :---: |
|  | LS | BW- | $2 \mathrm{C}-$ | 24 | B |

## Double Pole, Magnetic Latching, 2 Amps and Less (Continued)

## Magnetic Latching, Grid Space, Relay <br> Type 3SDM (2PDT)

## Product Facts

■ Suitable for pulse operation

- No hang up feature

■ MIL-R-39016 type

- Special contact and coil wiring available


This magnetic latching relay maintains the high reliability attributes of the aerospace proven CII 3SAM relay family. By reducing the size of the coil and maintaining the contact system of the 3SAM, we can now offer a smaller 2 amp rated magnetic latching relay. The pulse operation can provide multiple hundred thousand operations in power saving circuits. The on or off
circuits are maintained using no power until there is a need to switch the contacts. Suitable for matrix switches or relay trees, these versatile relays have contact systems capable of reliability switching high power or very low level signals in the same package. The relay's unique circuit prevents it from ever hanging up in an off-center or neutral position.

## Electrical Characteristics

Contact Ratings -
DC resistive -2 amps at 28 volts
Low-level - $50 \mu \mathrm{~A}$ at 50 mV DC or peak AC
Contact Resistance -
0.050 ohms initial;
0.100 ohms after life test (High level)
0.150 ohms after life test (Low level)

Life -
100,000 operations at rated load;
1,000,000 operations at low-level
Operating Characteristics
Operate Time - 4 ms
Reset Time - 4 ms
Contact Bounce - 2 ms
Dielectric Strength -
1,000 volts at sea level;
500 volts across contact gap and
500 volts coil to case
Insulation Resistance -
1,000 megohms min.

## Environmental Characteristics

 Vibration -Sine - 30G; 55 to 3000 Hz Random - $0.4 \mathrm{G}^{2} / \mathrm{Hz} ; 100$ to $1,000 \mathrm{~Hz}$
Shock - 150 G at 11 ms , half-sine wave
Temperature $-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$


| Catalog 5-1773450-5 | Dimensions are shown for <br> reference purposes only. |
| :--- | :--- |
| Revised 3-13 | Specifications subject <br> to change. |
| www.te.com |  | to change.

## CII Low Signal Relays

## Double Pole, Magnetic Latching, 2 Amps and Less (Continued)

## Mounting Forms (3SDM)


Header:

| Type | Z <br> Dimensions | Header <br> Code |
| :---: | :---: | :---: |
| Straight Pin <br> (socket or <br> PCB Type) | $0.19+/-.020$ | 4 |
| Solder Hook | $0.16+/ .020$ | 2 |



CODE 4


Sensitivity and Modification: $\mathbf{2 9 0} \mathbf{~ m W ~ S e n s i t i v i t y ~}$

| Sensitivity <br> Code | Modification <br> (see eonnection <br> diagrams at right) |
| :---: | :---: |
| 1 | No Diode |
| 5 | Single Diode |

(Terminal View)
(+ on blue bead
closes as shown


SCHEMATIC DIAGRAM TERMINAL VIEW CODE 1

## Relay Characteristic Catalog Number

Example: The relay selected is a 2PDT magnetic-latching relay, voltage calibrated, 2-hole end bracket mount, solder hook header, 500 ohm coil, and 290 mW sensitivity. 3SDM5132H1



SCHEMATIC DIAGRAM TERMINAL VIEW WITH DIODE CODE 5

## Ordering Instructions

Type 3SDM relays can be ordered by specifying the correct catalog number. This number is derived by choosing the proper CODE for each of the six relay characteristics in the order in which the codes are listed in the example. The letter R following the sensitivity code indicates relay received 5,000 operations miss-test.

## Double Pole, Magnetic Latching, 2 Amps and Less (Continued)

Magnetic Latching, Grid-space, Relays
Type 3SAM (2PDT)

## Product Facts

■ Special shock designs up to 700 G, 1 ms
■ Suitable for pulse operation
■ No hang up feature on low power pulses
■ Qualified to MIL-R-39016/32
■ Special wiring is available


This relay has "memory" in that the contact positions do not change when coil power is removed. Switching is accomplished by applying power to the applicable coil (dual coil) or with the applicable polarity (single coil). The low switching power requirements are further enhanced by its ability to operate from capacitor discharge or other pulses or through its own contacts for batteries or similarly limited supplies.

## Electrical Characteristics

Contact Ratings -
DC resistive - 2 amps at 28 volts
DC inductive - 0.5 amps at 28 volts, 200 mH
AC resistive — 1 amp at 115 volts
(single coil), case not grounded
AC resistive - 0.25 amps at 115 volts
(dual coil), case not grounded
Low-level - $50 \mu \mathrm{~A}$ at 50 mV
Peak AC or DC
Contact Resistance -
0.050 ohms initial;
0.100 ohms after life test

Life -
100,000 operations at rated load; 1,000,000 at low-level

Operating Characteristics
Operate Time - 4 ms
Release Time - 4 ms
Contact Bounce - 2 ms
Dielectric Strength -
1,000 volts rms at sea level; 700 volts rms across contact gap Insulation Resistance 1,000 megohm min.

Environmental Characteristics
Vibration - 30 G , to $3,000 \mathrm{~Hz}$
Shock - 150 G at 11 ms
Temperature - $-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
See page 1-52 for Mounting Forms, Terminals and Circuit Diagrams.

Coil Table (All Values DC) Single Coil 50 mW Sensitivity: (Code: 1)

| Coil <br> Code <br> Letter | Current Calibrated, CODE: 6 |  |  |
| :---: | :---: | :---: | :---: |
|  | Coil <br> Resistance <br> $@ 25 C$ | Max Operate <br> and Reset <br> Current (mA) <br> (Ohms) | Suggested <br> Source <br> Voltage $\dagger$ |
|  |  |  |  |
| A | $16.4 \pm 10 \%$ | 55.2 | $1.8-4.8$ |
| B | $40 \pm 10 \%$ | 35.3 | $2.7-7.5$ |
| C | $96 \pm 10 \%$ | 22.8 | $4.2-11.0$ |
| D | $164 \pm 10 \%$ | 17.4 | $5.5-15.0$ |
| E | $260 \pm 10 \%$ | 13.9 | $7.0-19.0$ |
| F | $400 \pm 10 \%$ | 11.2 | $8.5-23.0$ |
| H | $600 \pm 10 \%$ | 9.2 | $11.0-29.0$ |
| K | $960 \pm 10 \%$ | 7.2 | $13.0-37.0$ |
| L | $1350 \pm 10 \%$ | 6.1 | $16.0-43.0$ |
| M | $1950 \pm 10 \%$ | 5.1 | $19.0-52.0$ |
| N | $3000 \pm 15 \%$ | 4.1 | $25.0-64.0$ |
| P | $4800 \pm 15 \%$ | 3.3 | $32.0-81.0$ |
| R | $8200 \pm 20 \%$ | 2.5 | $43.0-99.0$ |

$\dagger$ Applicable over the operating temperature range in circulating air. $\ddagger$ Initial or inspection value. Allow 20\% increase in value of maximum pickup during rated life.

Coil Table (All Values DC) Dual Coil 75 mW Sensitivity: (Code: 2)

| Coil <br> Code <br> Letter | Current Calibrated, CODE: 6 |  |  |
| :---: | :---: | :---: | :---: |
|  | Coil Resistance @25C For Each Coil (Ohms) | Max $\ddagger$ Operate Current For Each Coil (mA) | Suggested Source Voltage For Each Coil $\dagger$ |
| $\begin{aligned} & \mathrm{A} \\ & \mathrm{~B} \\ & \mathrm{C} \\ & \mathrm{D} \\ & \hline \end{aligned}$ | $\begin{gathered} 8.2 \pm 10 \% \\ 20 \pm 10 \% \\ 48 \pm 10 \% \\ 82 \pm 10 \% \end{gathered}$ | $\begin{aligned} & 95.8 \\ & 61.2 \\ & 39.5 \\ & 30.2 \end{aligned}$ | $\begin{aligned} & 1.5-2.6 \\ & 2.3-4.1 \\ & 3.6-6.3 \\ & 4.7-8.3 \end{aligned}$ |
| $\begin{aligned} & \mathrm{E} \\ & \mathrm{~F} \\ & \mathrm{H} \\ & \mathrm{~K} \\ & \hline \end{aligned}$ | $\begin{aligned} & 130 \pm 10 \% \\ & 200 \pm 10 \% \\ & 300 \pm 10 \% \\ & 480 \pm 10 \% \end{aligned}$ | $\begin{aligned} & 24.0 \\ & 19.4 \\ & 15.8 \\ & 12.5 \\ & \hline \end{aligned}$ | $\begin{array}{r} 6.0-10.0 \\ 7.4-13.0 \\ 9.0-16.0 \\ 12.0-20.0 \\ \hline \end{array}$ |
| $\begin{aligned} & L \\ & M \\ & N \\ & \mathrm{P} \\ & \mathrm{R} \end{aligned}$ | $\begin{array}{r} 675 \pm 10 \% \\ 975 \pm 10 \% \\ 1500 \pm 15 \% \\ 2400 \pm 15 \% \\ 4100 \pm 20 \% \end{array}$ | $\begin{array}{r} 10.6 \\ 8.8 \\ 7.1 \\ 5.6 \\ 4.3 \end{array}$ | $\begin{aligned} & 14.0-24.0 \\ & 16.0-29.0 \\ & 21.0-35.0 \\ & 27.0-44.0 \\ & 37.0-55.0 \end{aligned}$ |

$\dagger$ Applicable over the operating temperature range in circulating air. $\ddagger$ Initial or inspection value. Allow 20\% increase in value of maximum pickup during rated life.

## Ordering Instructions

Example: The relay selected in this example is a 2PDT magnetic latching relay, current calibrated, fourhole end bracket mounting, solder hook header, 1500 ohms coil resistance, and 75 mW sensitivity. By choosing the proper code for each
of these relay characteristics, the catalog number is identified as 3SAM6014N2. The letter R following sensitivity code indicates relay received 5000 operation miss-test. Ex. 3SAM6014N2R.


* The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15.

Mounting Forms (3SAM)
(Vibration note with each form is acceleration from 55 to 3000 Hz )

## No Mount

| Mounting <br> Code | Vibration* |
| :---: | :---: |
| 00 | $30 g$ |



Two-hole
End Bracket

| Mounting <br> Code | $X$ <br> Dim. | Vibra- <br> tion |
| :---: | :---: | :---: |
| 13 | 0.125 | 30 g |
| 14 | 0.250 | 30 g |
| 15 | 0.450 | 30 g |



All dimensions in inches

| TOLERANCES <br> (unless <br> otherwise <br> specified) |  |
| :--- | :---: |
| Hundredths | $\pm 0.020$ |
| Thousandths | $\pm 0.005$ |

Top Studs

| Mounting <br> Code | $X$ <br> Dim. | Vibra- <br> tion |
| :---: | :---: | :---: |
| 10 | 0.250 | 30 g |
| 11 | 0.375 | 30 g |




Side Studs

| Mounting <br> Code | $X$ <br> Dim. | Vibra- <br> tion |
| :---: | :---: | :---: |
| 07 | 0.250 | 30 g |
| 08 | 0.375 | 30 g |



Four-hole Side Bracket

| Mounting <br> Code | Vibration |
| :---: | :---: |
| 06 | 30 g |

Four-hole End Bracket

| Mounting <br> Code | $\mathbf{X}$ <br> Dim. | Vibra- <br> tion |
| :---: | :---: | :---: |
| 01 | 0.125 | 30 g |
| 02 | 0.250 | 30 g |
| 03 | 0.450 | 30 g |



## Header and Connection Diagrams

CODES: 2, 5

## Single Coil

(Terminal View)
( + on blue bead closes as shown)


## Header Types

| Type | Z | Header Code |  |
| :---: | :---: | :---: | :---: |
|  |  | Single | Dual |
| Solder hook | 0.16 | 1 | 4 |
| Straight pin <br> (socket or <br> PCB type) | 0.19 | 2 | 5 |



## Four Pole, Electrically Held, 2 Amps and Less

SR

## SR

Four Pole Half Size
High Performance Relay
Qualified to
MIL-R-39016/40


Terminal View

## Product Facts

■ Hermetically sealed
■ Up to 2 amps switching
■ High shock \& vibration ratings

■ Optional terminals \& mounting styles

■ 4 form C Hi-density design

## Electrical Characteristics

Contact Arrangement -
4 Form C (4PDT)
Contact Material -
Stationary -
Gold plated hardened silver alloy
Moveable -
Gold plated hardened silver alloy

## Contact Resistance -

Before Life - 50 milliohms max.
Contact Ratings

| Contact <br> Load | Type | Operations <br> Min. |
| :--- | :--- | ---: |
| 2 A @ 28 Vdc | Resistive | 100,000 |
| $0.3 \mathrm{~A} \mathrm{@} \mathrm{115} \mathrm{Vac} 60 \mathrm{~Hz} \& 400 Hz$, | Resistive | 100,000 |
| 0.75 A @ 28 Vdc | Inductive $(200 \mathrm{mH})$ | 100,000 |
| 0.1 A @ 28 Vdc | Intermediate | 50,000 |
| 0.2 A @ 28 Vdc | Lamp | 100,000 |
| $10 \mu \mathrm{~A} \mathrm{@} 50 \mathrm{mV}$ | Low Level | $1,000,000$ |

After Life - 100 milliohms max.
(measured @ 2 A @ 28 Vdc)
Mechanical Life Expectancy -
1 million operations min.
Coil Voltage - 6 to 26.5 Vdc
Coil Power - 2.6 watts max. @ $25^{\circ} \mathrm{C}$
Duty Cycle - Continuous
Pick-up Voltage - Approximately
$50 \%$ of nominal coil voltage
Pick-up Sensitivity — 475 mW

## Four Pole, Electrically Held, 2 Amps and Less (Continued)

SR (Continued)

| Operating Characteristics | Environmental Characteristics |
| :--- | :--- |
| Timing - | Temperature Range - |
| Operate Time -5.0 ms max. | $-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ |
| Release Time -5.0 ms max. | Weight - |
| Contact Bounce -5 ms max | 0.28 oz. (7.8 grms) |
| Dielectric Withstanding Voltage - | Vibration Resistance - |
| Between Open Contacts - | 15 G's, 10 to $2,000 \mathrm{~Hz}$ |
| 350 Vrms 60 Hz | Shock Resistance - |
| Between Adjacent Contacts - | 100 G's, $6 \pm 1 \mathrm{~ms}$ |
| 500 Vms 60 Hz | QPL Approval - |
| Between Contacts \& Coil - | MIL-R- $39016 / 40$ |



B


SR Terminals


Standard Coil Data

| Nom. Coil Voltage (Vdc) | Coil Resistance in Ohms $\pm 10 \% @ 25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) <br> @ $25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) <br> @ $125^{\circ} \mathrm{C}$ | Drop-out Voltage Vdc (Min.) @ $25^{\circ} \mathrm{C}$ | Drop-out Voltage Vdc (Min.) @ -65 ${ }^{\circ} \mathrm{C}$ | Nom. Coil Power (W) <br> @ $25^{\circ} \mathrm{C}$ | Max. Voltage | Coil Desig. |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 5.0 | 20 | 2.75 | 3.8 | 0.35 | 0.23 | 1.25 | 6.0 | 5 |
| 6.0 | 25 | 3.5 | 4.5 | 0.45 | 0.3 | 1.44 | 8.0 | 6 |
| 12.0 | 100 | 6.5 | 9.0 | 0.9 | 0.6 | 1.44 | 15.0 | 12 |
| 26.5 | 390 | 14.0 | 18.0 | 1.8 | 1.2 | 1.8 | 32.0 | 24 |

Specifying a Part Number Example:


Mountings
BW-
Contacts
4C-
Coils
24

Terminals
B

* The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15.


## Four Pole, Electrically Held, 2 Amps and Less (Continued)

. 150 Grid-space Relays
Type 3SBH (4PDT)

## Product Facts

■ Low profile... only 0.32 inches high
■ Long life version available
■ Qualified to MIL-R-39016/14


This . 150 four pole double throw Grid-space relay is the companion to the two pole 3SBC type shown on page 1-41. It also features the same . 150 inch pin spacing that allows you to insert the relay with no intermediate pin spreaders. There is adequate clearance for conductors to reach all pins. It is a very compact 4 pole double throw 2 ampere relay.

## Electrical Characteristics

Contact Ratings -
DC resistive -2 amps at 28 volts
DC inductive - 0.5 amps at 28 volts,
200 mH
AC resistive - 0.5 amps at 115 volts, 400 or 60 Hz (enclosure isolated from ground, or enclosure and movable contact at same potential)
AC - 0.125 amps at 115 volts
(enclosure at line potential with respect to movable contact)
Low-level — low-level operation at 50 millivolts, $30 \mu \mathrm{~A}, 33$ ohm miss level

## Contact Resistance -

0.050 ohms max.;
0.150 ohms after life test

Life -
100,000 operations at rated loads listed; 1,000,000 operations at low-level loads

## Operating Characteristics

Operate Time - 4 ms max.
Release Time - 4 ms max.
Contact Bounce - 1.5 ms
Dielectric Strength -
500 volts rms at sea level; 350 volts rms at 70,000 feet
Insulation Resistance -
1,000 megohms min. over temperature range
Environmental Characteristics
Vibration - 30 G , to $3,000 \mathrm{~Hz}$
Shock - 100 G at 11 ms
Temperature - $-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
See page 1-57 for Mounting Forms, Terminals and Circuit Diagrams.

Coil Table (All Values DC)* Type 3SBH, 4 Pole Relay - 250 mW Sensitivity: (Code 1)

| SENSITIVITY CODE: 1 |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Coil Code Letter | Coil Resistance at 25 C ohms | Voltage Calibrated, Code: 5 |  |  |  |
|  |  | Suggested Source Volts $\dagger$ | Maximum Operate Volts at 25C | Release Voltage Range at 25 C |  |
|  |  |  |  | Max. | Min. |
| B | $28 \pm 10 \%$ | 4.0-7.0 | 2.7 | 1.6 | 0.3 |
| D | $73 \pm 10 \%$ | 6.0-11.0 | 4.2 | 2.5 | 0.4 |
| E | $115 \pm 10 \%$ | 8.0-14.0 | 5.4 | 3.2 | 0.6 |
| G | $280 \pm 10 \%$ | $12-22.0$ | 8.4 | 5.0 | 0.8 |
| H | $430 \pm 10 \%$ | $15-26.0$ | 10.3 | 6.0 | 1.0 |
| K | $720 \pm 10 \%$ | $20-35.0$ | 13.5 | 8.1 | 1.5 |
| N | $1040 \pm 10 \%$ | 26-46.0 | 17.5 | 10.5 | 1.9 |

*Values listed are factory test and inspection values. User should allow for meter variations.
$\dagger$ Applicable over the operating temperature range in circulating air.

## Ordering Instructions

Catalog-selected Relays: The catalog number is derived by choosing the proper CODE for each of the six relay characteristics in the order in which the codes are listed.

Example: The relay selected in this example is a 4PDT . 150 -grid relay, voltage calibrated, end bracket mounting, 0.13 inch solder hook header, 720 ohms coil resistance, and 250 mW sensitivity. By choosing the proper code for each of these relay characteristics, the catalog number is identified as 3 SBH5131K1. The letter R following sensitivity code indicates relay received 5000 operation miss-test. Ex. 3SBH5131K1R.


* The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15.

| Catalog 5-1773450-5 | Dimensions are shown for | Dimensions are in millimeters | USA: +1 8005226752 | For additional support numbers |
| :--- | :--- | :--- | :--- | :--- |
| Revised 3-13 | reference purposes only. | unless otherwise specified. | Asia Pacific: +8604008206015 |  |
| www.te.com | Specifications subject |  | UK: +44800267666 |  |
| please visit www.te.com |  |  |  |  |

## Four Pole, Electrically Held, 2 Amps and Less (Continued)

. 150 Grid-space Hybrid Relays
Type 3SBH (4PDT)

## Product Facts

■ Low profile... only 0.32 inches high
■ Long life version available
■ Qualified to MIL-R-39016/53 \& 54


The 4PDT . 150 Grid-space hybrid relays are advanced designs of the standard high reliability 4PDT . 150 Gridspace relays. In the single diode version, the relay coilback electromotive force is suppressed to prevent circuit/component damage. With the dual diode version, a steering diode is added to the coil circuit, along with the suppression diode. This
steering diode prevents operation of the relay by reverse polarity voltages and protects the suppression diode. The single diode version is qualified to MIL-R-39016/53 and the dual diode is qualified to MIL-R-39016/54.

## Electrical Characteristics

Contact Ratings -
DC resistive -2 amps at 28 volts
DC inductive - 0.5 amps at 28 volts, 200 mH
AC resistive - 0.5 amps at 115 volts, 400 or 60 Hz (enclosure isolated from ground, or enclosure and movable contact at same potential) AC - 0.125 amps at 115 volts (enclosure at line potential with respect to movable contact) Low-level - $50 \mu \mathrm{~A}$ at 50 mV

## Contact Resistance -

0.050 ohms max.;
0.150 ohms after life test

Life - 100,000 operations at rated loads listed; 1,000,000 operations at low-level loads

Operating Characteristics
Operate Time - 4 ms max.
Release Time - 6 ms max.
Contact Bounce - 2.0 ms
Dielectric Strength (Note 1) -
500 volts rms at sea level; 350 volts rms at 70,000 feet Insulation Resistance (Note 1) 1,000 megohms min. over temperature range
Semiconductor Characteristics at $25^{\circ} \mathrm{C}$
Max. Negative Transient - 1 volt
Breakdown Voltage -
100 Vdc @ $10 \mu \mathrm{Amin}$.
Max. Leakage Current $1 \mu \mathrm{~A}$ @ 50 Vdc
Note 1: Tests for dielectric withstanding voltage and insulation resistance should be made with "coil terminals" shorted together to avoid unnecessary electrical stress to semiconductor elements.

See page 1-57 for Mounting Forms, Terminals and Circuit Diagrams.

Coil Table (All Values DC)* Type 3SBH, 4 Pole Relay - 250 mW Sensitivity: (Code 5 single diode, Code 6 dual diodes)

| Single Diode |  | SENSITIVITY CODE: 5 |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Coil Code Letter | Coil Resistance at 25 C ohms | Voltage Calibrated, Code: 5 |  |  |  |
|  |  | Suggested Source Volts $\dagger$ | Maximum Operate Volts at 25C | Release Voltage Range at 25C |  |
|  |  |  |  | Max. | Min. |
| B | $28 \pm 10 \%$ | 4.0-7.0 | 2.7 | 1.6 | 0.3 |
| D | $73 \pm 10 \%$ | 6.0-11.0 | 4.2 | 2.5 | 0.4 |
| E | $115 \pm 10 \%$ | 8.0-14.0 | 5.4 | 3.2 | 0.6 |
| G | $280 \pm 10 \%$ | $12-22.0$ | 8.4 | 5.0 | 0.8 |
| H | $430 \pm 10 \%$ | $15-26.0$ | 10.3 | 6.0 | 1.0 |
| K | $720 \pm 10 \%$ | $20-35.0$ | 13.5 | 8.1 | 1.5 |
| N | $1040 \pm 10 \%$ | 26-46.0 | 17.5 | 10.5 | 1.9 |
| Dual Diode |  | SENSITIVITY CODE: 6 |  |  |  |
| B | $28 \pm 10 \%$ | 4.0-7.0 | 3.7 | 2.3 | 0.5 |
| D | $73 \pm 10 \%$ | 6.0-11.0 | 5.2 | 3.2 | 0.6 |
| E | $115 \pm 10 \%$ | 8.0-14.0 | 6.4 | 3.9 | 0.8 |
| G | $280 \pm 10 \%$ | 12.0-22.0 | 9.4 | 5.7 | 1.0 |
| H | $430 \pm 10 \%$ | $15-26.0$ | 11.3 | 6.7 | 1.2 |
| K | $720 \pm 10 \%$ | $20-35.0$ | 14.5 | 8.8 | 1.7 |
| N | $1040 \pm 10 \%$ | $26-46.0$ | 18.1 | 11.1 | 2.1 |

[^2] to change.

## CII Low Signal Relays

## Four Pole, Electrically Held, 2 Amps and Less (Continued)

## Mounting Forms (3SBH)

(Vibration note with each form is acceleration from 55 to 3000 Hz )

Header Types

| Type | Z <br> Dimension | Header <br> Code |
| :---: | :---: | :---: |
| Solder hook | 0.13 | 1 |
| Straight pin | 0.12 | 8 |
| Straight pin <br> Socket or <br> PCB type) | 0.19 | 4 |
| Straight pin | 0.25 | 5 |

No Mount

| Mounting Code | Vibration ${ }^{\star}$ |
| :---: | :---: |
| 00 | 30 g |

*Assumes relay held securely by potting or other means.


End Bracket

| Mounting Code | Vibration |
| :---: | :---: |
| 13 | 30 g |



All dimensions in inches

| TOLERANCES |  |
| :--- | ---: |
| (Unless otherwise specified) |  |
| Hundredths <br> Thousandths | $\pm 0.020$ |
| 0.005 |  |

Header and Connection Diagrams


CODE 5
CODE 6


CODE1


CODE 5 \& 6


Terminals .020 dia

## Ordering Instructions

Catalog-selected Relays: The catalog number is derived by choosing the proper CODE for each of the six relay characteristics in the order in which the codes are listed.

Example: The relay selected in this example is a 4PDT .150-grid relay, voltage calibrated, end bracket mounting, 0.13 inch solder hook header, 720 ohms coil resistance, and 250 mW sensitivity. By choosing the proper code for each of these relay characteristics, the catalog number is identified as 3SBH5131K5. The letter R following sensitivity code indicates relay received 5000 operation miss-test. Ex. 3SBH5131K5R.


## Four Pole, Electrically Held, 2 Amps and Less (Continued)

Long-life . 150 Grid-space Relays
100,000,000 Operations At Low Levels
Type 3SDH (4PDT)

## Product Facts

■ Long life at low level or signal loads
■ Low profile... only 0.32 inches high


The 3SDH relay is designed for 100,000,000 operations at low levels. It is a four pole double throw Grid-space relay. The 0.150 inch pin spacing allows the user to insert the relay with no intermediate pin spreaders. There is adequate clearance for conductor to reach all pins.

## Electrical Characteristics

Contact Ratings -
DC resistive -2 amps at 28 volts, (DC 100,000 operations)
DC inductive - 0.3 amp at 28 volts,
(L/R not greater than 0.008)
AC resistive - 0.5 amp at 115 volts,
400 or 60 Hz (enclosure isolated from
ground, or enclosure and movable
contact at same potential)
AC resistive - 0.125 amp at 115 volts (enclosure at line potential with respect to movable contact)
Low-level - $50 \mu \mathrm{~A}$ at 50 mV
Peak AC or DC
Contact Resistance -
0.050 ohms max.
0.150 ohms after life test

Life - 100,000 operations at rated Ioads listed; 100,000,000 operations at low-level loads

Operating Characteristics
Operate Time @ $+25^{\circ} \mathrm{C}$ -
4 ms max.
Release Time @ $+\mathbf{2 5}^{\circ} \mathrm{C}$ -
4 ms max.
Contact Bounce @ $+25^{\circ} \mathbf{C}-1.5 \mathrm{~ms}$
Dielectric Strength -
500 volts rms at sea level; 350 volts rms at 70,000 feet Insulation Resistance 1,000 megohms min. over temperature range

Environmental Characteristics
Vibration - 30 G , to $3,000 \mathrm{~Hz}$
Shock - 100 G at 11 ms
Temperature - $-40^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
See page 1-59 for Mounting Forms, Terminals and Circuit Diagrams.

Coil Table (All Values DC)*Type 3SDH, 4 Pole Relay-210mW Sensitivity: (Code 1)

| SENSITIVITY CODE: 1 |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Coil Code Letter | Coil <br> Resistance at 25 C ohms | Voltage Calibrated, Code: 5 |  |  |  |
|  |  | Suggested Source Volts $\dagger$ | Maximum Operate Volts at 25C | Release Voltage Range at 25C |  |
|  |  |  |  | Max. | Min. |
| B | $28 \pm 10 \%$ | 4.0-7.0 | 3.0 | 1.6 | 0.3 |
| D | $73 \pm 10 \%$ | 6.0-11.0 | 4.8 | 2.5 | 0.4 |
| E | $115 \pm 10 \%$ | 8.0-14.0 | 5.9 | 3.2 | 0.6 |
| G | $280 \pm 10 \%$ | 12 -22.0 | 9.3 | 5.0 | 0.8 |
| H | $430 \pm 10 \%$ | 15 -26.0 | 11.5 | 6.0 | 1.0 |
| K | $720 \pm 10 \%$ | $20-35.0$ | 14.9 | 8.1 | 1.5 |
| N | $1040 \pm 10 \%$ | $26-46.0$ | 17.9 | 10.5 | 1.9 |

[^3]
## CII Low Signal Relays

## Four Pole, Electrically Held, 2 Amps and Less (Continued)

Mounting Forms (3SDH)
(Vibration note with each form is acceleration from 55 to 3000 Hz )

Header Types

| Type | Z <br> Dimension | Meader <br> Code |
| :---: | :---: | :---: |
| Solder hook | 0.13 | 1 |
| Straight pin | 0.12 | 8 |
| Straight pin <br> socket or <br> PCB type) | 0.19 | 4 |
| Straight pin | 0.25 | 5 |

No Mount

| Mounting Code | Vibration* |
| :---: | :---: |
| 00 | 30 g |

*Assumes relay held securely by potting or other means.


End Bracket

| Mounting Code | Vibration |
| :---: | :---: |
| 13 | 30 g |



All dimensions in inches

| TOLERANCES |  |
| :--- | ---: |
| (Unless otherwise specified) |  |
| Hundredths <br> Thousandths | $\pm 0.020$ |
| 0.005 |  |

Header and Connection Diagrams


CODE 5
CODE 6


CODE1


CODE 5 \& 6


Terminals .020 dia

## Ordering Instructions

Catalog-selected Relays: The catalog number is derived by choosing the proper CODE for each of the six relay characteristics in the order in which the codes are listed.

Example: The relay selected in this example is a 4PDT . 150-grid relay, voltage calibrated, end bracket mounting, 0.13 inch solder hook header, 720 ohms coil resistance, and 210 mW sensitivity. By choosing the proper code for each of these relay characteristics, the catalog number is identified as 3 SDH5131K1. The letter R following sensitivity code indicates relay received 5000 operation miss-test. Ex. 3SDH5131K1R.


## Four Pole, Magnetic Latching, 2 Amps and Less

. 150 Grid-space Magnetic Latching Relays Type 3SBM (4PDT)

## Product Facts

■ Low profile... only 0.32 inches high

- Internal diode for coil transient suppression available

■ Qualified to MIL-R-39016/31

- Suitable for low pulse operation - 2 ms at rated voltage


The Type 3SBM relay adds magnetic latching capability to the popular and growing family of .150-grid relays. This relay has memory in that the contact positions do not change when coil power is removed. Switching is accomplished by applying power to the applicable coil (dual coil) or with the applicable polarity (single coil). The low switching power requirements are further enhanced by its ability to operate from capacitor discharge or other pulses or through its own contacts from batteries or similarly limited supplies.

Electrical Characteristics
Operate Sensitivity-
Single-coil form, 100 mW ,
Dual-coil form, 180 mW
Contact Arrangement-
4-pole double-throw (4C)
Contact Ratings -
DC resistive -2 amps at 28 volts
DC inductive - 0.5 amp at 28 volts, 200 mH
AC resistive - 0.5 amp at 115 volts (enclosure isolated from ground, or enclosure and movable contact at same potential)
AC - 0.125 amp at 115 volts
(enclosure at line potential with respect
to movable contact)
Low-level - $50 \mu \mathrm{~A}$ at 50 mV
Peak AC or DC
Contact Resistance -
0.050 ohms max.;
0.150 ohms after life tests

Life -
100,000 operations at rated loads listed; 1,000,000 operations at low-level loads

Operating Characteristics
Operate Time - 4 ms max.
Release Time - 4 ms max.
Contact Bounce - 1.5 ms
Dielectric Strength -
500 volts rms at sea level; 350 volts rms at 70,000 feet and above Insulation Resistance -
1,000 megohms min. over temperature range
Environmental Characteristics
Vibration - $30 \mathrm{G}, 55$ to $3,000 \mathrm{~Hz}$
Shock - 150 G at 11 ms
Temperature - $-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
See page 1-62 for Mounting Forms, Terminals and Circuit Diagrams.

## Coil Table (All Values DC)*

| Coil <br> Code <br> Letter | SINGLE COIL, SENSITIVITY 1, (100 mW ) |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | $\begin{gathered} \text { Coil } \\ \text { Resistance } \\ @ 25 \mathrm{C} \text { (0hms) } \\ \pm 10 \% \end{gathered}$ | Maximum Set-Reset Values |  | Suggested Source Volts + |
|  |  | $\begin{gathered} \text { Calibration } \\ \text { Code 5 } \\ \text { Voltage (Volts) } \end{gathered}$ | Calibration Code 6 Current (mA) |  |
| $N$ | 57 | 2.4 | 42 | 3.6-8.5 |
| R | 256 | 5.1 | 20 | 7.6-18 |
| T | 830 | 9.1 | 11 | 14-32 |
| v | 1700 | 13.0 | 7.7 | 20-46 |
| w | 3250 | 18.0 | 5.5 | 28-63 |


| Coil Code Letter | DUAL COIL, SENSITIVITY CODE 2, (180 mW) |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | $\begin{gathered} \text { Coil } \\ \text { Resistance } \\ @ 25 \mathrm{C} \text { (Ohms) } \\ \pm 10 \% \end{gathered}$ | Maximum Set-Reset Values |  | Suggested Source Volts $\ddagger$ |
|  |  | $\begin{array}{\|c\|} \hline \text { Calibration } \\ \text { Code } 5 \\ \text { Voltage (Volts) } \end{array}$ | $\begin{aligned} & \text { Calibration } \\ & \text { Code } 6 \\ & \text { Current }(\mathrm{mA}) \end{aligned}$ |  |
| H | 10 | 1.4 | 135 | 2.0- 3.7 |
| N | 37 | 2.6 | 70 | 3.8-7.2 |
| R | 145 | 5.2 | 35 | 7.6-14.5 |
| T | 450 | 9.0 | 20 | 14-25 |
| v | 975 | 13.5 | 13.5 | 20-35 |
| w | 2140 | 20.0 | 9.2 | 30-54 |

*Values listed are factory test and inspection values. User should allow for meter variations.
$\dagger$ Applicable over the operating temperature range in circulating air.

## Ordering Instructions

Type 3SBM relays can be ordered by specifying the correct catalog number. This number is derived by choosing the proper CODE for each of the six relay characteristics in the order in which the codes are listed.

Example: The relay selected in this example is a dual coil, current calibrated, four-hole end bracket mounting, solder hook header, 37 ohms coil resistance, and 180 mW sensitivity. By choosing the proper code for each of these relay characteristics, the catalog number is identified as 3SBM6131N2. The letter R following sensitivity code indicates relay received 5000 operation miss-test. Ex. 3SBM6131N2R.

Relay Characteristic
Catalog No.


* The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15.

Dimensions are shown for reference purposes only. Specifications subject to change.

Dimensions are in millimeters unless otherwise specified.

## Four Pole, Magnetic Latching, 2 Amps and Less (Continued)

. 150 Grid-space Hybrid Magnetic Latching Relays Single Diode, Dual Diode Type 3SBM (4PDT)

## Product Facts

■ Low profile... only 0.32 inches high
■ Suitable for pulse operation
■ Qualified to MIL-R-39016/35
■ Qualified to MIL-R-39016/36


The dual coil version of the 3SBM magnetic latching relay is now available with coil transient suppression with or without blocking diodes for reverse polarity protection. This hybrid magnetic latching relay is an addition to the growing family of .150 grid relays. The diode method is employed to limit the back EMF generated when the coil circuit is opened in order to protect other circuit components such as semiconductors. The contact load
capabilities of the 3SBM as well as the memory feature of the latching function are both maintained.
Electrical Characteristics
Contact Arrangement-
4-pole double-throw (4C)
Operate Sensitivity-
Single-coil form, 100 mW ,
Dual-coil form, 180 mW per coil
Contact Ratings -
DC resistive -2 amps at 28 volts
DC inductive - 0.5 amp at 28 volts, 200 mH
AC resistive — 0.5 amp at 115 volts (enclosure isolated from ground, or enclosure and movable contact at same potential)
AC - 0.125 amp at 115 volts
(enclosure at line potential with respect to movable contact)
Low-level - $50 \mu \mathrm{~A}$ at 50 mV
Peak AC or DC
Contact Resistance -
0.050 ohms max.:
0.150 ohms after life test

Life - 100,000 operations at rated loads listed; 1,000,000 operations at low-level loads

Operating Characteristics
Operate Time - 4 ms max.
Release Time - 4 ms max.
Contact Bounce - 1.5 ms
Dielectric Strength (Note 1) -
500 volts rms at sea level; 350 volts rms at 70,000 feet and above Insulation Resistance (Note 1) 1,000 megohms min. over temperature range
Environmental Characteristics
Vibration - 30 G, 55 to $3,000 \mathrm{~Hz}$
Shock - 150 G at 11 ms
Temperature - $-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Semiconductor Characteristics at $25^{\circ} \mathrm{C}$
Max. Negative Transient - 1 volt Breakdown Voltage - 100 Vdc min. Max. Leakage Current $1 \mu \mathrm{~A} @ 50 \mathrm{Vdc}$
Note 1: Tests for dielectric withstanding voltage and insulation resistance should be made with "coil terminals" shorted together to avoid unnecessary electrical stress to semiconductor elements.

See page 1-62 for Mounting Forms, Terminals and Circuit Diagrams.

## Coil Table Single Diode (All Values DC)*

| Coil <br> Code <br> Letter | Dual Coil, Sensitivity Code 5 ( 180 mW ) |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | $\begin{gathered} \text { Coil } \\ \text { Resistance } \\ @ \quad 25 \mathrm{C} \text { (ohms) } \\ \pm 10 \% \end{gathered}$ | MAX. SET-RESET VALUES |  | Suggested Source Volts $\dagger$ |
|  |  | Calibration <br> Code 5 <br> Voltage (Volts) | Calibration Code 6 Current (mA) |  |
| H | 10 | 1.4 | 135 | 2.0-3.7 |
| N | 37 | 2.6 | 70 | 3.8-7.2 |
| R | 145 | 5.2 | 35 | 7.6-14.5 |
| T | 450 | 9.0 | 20 | 14-25 |
| V | 975 | 13.5 | 3.5 | 20-35 |
| W | 2140 | 20.0 | 9.2 | 30-54 |

Coil Table Dual Diode (All Values DC)*

| Coil <br> Code <br> Letter | Dual Coil, Sensitivity Code 6 (180 mW) |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | CoilResistance25 C (ohms)$\pm 10 \% * *$ | max. SEt-reset values |  | Suggested Source Volts $\dagger$ |
|  |  | Calibration Code 5 Voltage (Volts) | $\begin{aligned} & \text { Calibration } \\ & \text { Code } 6 \\ & \text { Current }(\mathrm{mA}) \end{aligned}$ |  |
| H | 10 | 2.4 | 135 | 2.6-4.1 |
| N | 37 | 3.6 | 70 | 3.8-7.2 |
| R | 145 | 6.2 | 35 | 7.6-14.5 |
| T | 450 | 10.0 | 20 | 14.0-25.0 |
| V | 975 | 14.5 | 13.5 | 20.0-35.0 |
| W | 2140 | 21.0 | 9.2 | 30.0-45.0 |

*Values listed are factory test and inspection values. User should allow for meter variations.
$\dagger$ Applicable over the operating temperature range in circulating air.
**Coil resistance cannot be measured by conventional bridge.

Note: See page 1-60 for ordering instructions.

[^4]| Catalog 5-1773450-5 | Dimensions are shown for | Dimensions are in millimeters | USA: +1 8005226752 | For additional support numbers please visit www.te.com |
| :---: | :---: | :---: | :---: | :---: |
| Revised 3-13 | reference purposes only. | unless otherwise specified. | Asia Pacific: +86 04008206015 |  |
|  | Specifications subject |  | UK: +44 800267666 |  |
| www.te.com | to change. |  |  |  |

Asia Pacific: +86 04008206015
UK: +44 800267666

Four Pole, Magnetic Latching, 2 Amps and Less (Continued)

Mounting Forms (3SBM)
(Vibration note with each form is acceleration from 55 to 3000 Hz )


No Mount

| Mounting Code | Vibration* |
| :---: | :---: |
| 00 | 30 g |

*Assumes relay held securely by potting or other means.


End Bracket

| Mounting Code | Vibration |
| :---: | :---: |
| 13 | 30 g |

ALL DIMENSIONS IN INCHES

| TOLERANCES |  |
| :---: | :---: |
| Unless otherwise specified: |  |
| Hundredths | $\pm 0.020$ |
| Thousandths | $\pm 0.005$ |



CODES: 4,5,8


CODE 1

(Terminal numbers for reference only)
CODE 5
Single Diode


CODE 2


CODE 6 Dual Diode


Dimensions are shown for reference purposes only. Specifications subject

## Six Pole, Electrically Held, 2 Amps and Less

SS

## SS

Six Pole Half Size
High Performance Relay
Designed to
MIL-R-39016



Terminal View

## Product Facts

- Hermetically sealed

■ Up to 2 amps switching
■ High shock \& vibration ratings

■ Optional terminals \& mounting styles

■ 6 form C Hi-density design

## Electrical Characteristics

Contact Arrangement -
6 Form C (6PDT)
Contact Material -
Stationary -
Gold plated hardened silver alloy
Moveable -
Gold plated hardened silver alloy

## Contact Resistance -

Before Life - 50 milliohms max.
Contact Ratings

| Contact <br> Load | Type | Operations <br> Min. |
| :--- | :--- | ---: |
| 2 A @ 28 Vdc | Resistive | 100,000 |
| $0.3 \mathrm{~A} \mathrm{@} \mathrm{115} \mathrm{Vac} 60 \mathrm{~Hz} \& 400 Hz$, | Resistive | 100,000 |
| 0.75 A @ 28 Vdc | Inductive $(200 \mathrm{mH})$ | 100,000 |
| 0.1 A @ 28 Vdc | Intermediate | 50,000 |
| 0.2 A @ 28 Vdc | Lamp | 100,000 |
| $10 \mu \mathrm{~A} \mathrm{@} 50 \mathrm{mV}$ | Low Level | $1,000,000$ |

After Life - 100 milliohms max.
(measured @ 2 A @ 28 Vdc)
Mechanical Life Expectancy -
1 million operations min.
Coil Voltage - 5 to 26.5 Vdc
Coil Power - 2.6 watts max. @ $25^{\circ} \mathrm{C}$
Duty Cycle - Continuous
Pick-up Voltage - Approximately
$50 \%$ of nominal coil voltage
Pick-up Sensitivity - 475 mW

Dimensions are shown for reference purposes only. Specifications subject to change.

## Six Pole, Electrically Held, 2 Amps and Less (Continued)

## SS (Continued)

Operating Characteristics
Timing -
Operate Time -5.0 ms max.
Release Time - 5.0 ms max.
Contact Bounce - 5.0 ms max Dielectric Withstanding Voltage Between Open Contacts 350 Vrms 60 Hz
Between Adjacent Contacts 500 Vrms 60 Hz
Between Contacts \& Coil 500 Vrms 60 Hz
Insulation Resistance 1,000 megohms min. @ 500 Vdc

Environmental Characteristics
Temperature Range -
$-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Weight -
0.28 oz. (7.8 grms)

Vibration Resistance -
15 G's, 10 to $2,000 \mathrm{~Hz}$
Shock Resistance -
100 G's, $6 \pm 1$ ms
QPL Equivalent -
MIL-R-39016


SS Terminals


Standard Coil Data

| Nom. Coil Voltage (Vdc) |  | Pickup Voltage Vdc (Max.) <br> @ $25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) @ $125^{\circ} \mathrm{C}$ | Drop-out Voltage Vdc (Min.) <br> @ $25^{\circ} \mathrm{C}$ | Drop-out Voltage Vdc (Min.) @ $-65^{\circ} \mathrm{C}$ | Nom. Coil Power (W) <br> @ $25^{\circ} \mathrm{C}$ |  | Coil Desig |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 5.0 | 20 | 2.75 | 3.8 | 0.35 | 0.23 | 1.25 | 6.0 | 5 |
| 6.0 | 25 | 3.5 | 4.5 | 0.45 | 0.3 | 1.44 | 8.0 | 6 |
| 12.0 | 100 | 6.5 | 9.0 | 0.9 | 0.6 | 1.44 | 15.0 | 12 |
| 26.5 | 390 | 14.0 | 18.0 | 1.8 | 1.2 | 1.8 | 32.0 | 24 |

Specifying a Part Number Example: Type

## SS

Mountings
BW-

Contacts
6C-

Coils
24

Terminals
B

## Double Pole, Electrically Held, 5 Amps and Less

HFW4A, HFW5A

## Electrical Characteristics

Contact Arrangement -
2 Form C (DPDT)
Contact Material -
Stationary -
Hardened silver alloy
Moveable -
Gold plated hardened silver alloy

## Contact Resistance -

Before Life - 50 milliohms max.
(measured at $10 \mathrm{~mA} @ 6 \mathrm{Vdc}$ )
After Life - 100 milliohms max.
(measured @ $2 \mathrm{~A} @ 28 \mathrm{Vdc}$ )
Mechanical Life Expectancy -
50 million operations
Coil Voltage -
5 to 48 Vdc (HFW4A)
5 to $26.5 \mathrm{Vdc}(H F W 5 \mathrm{~A})$
Coil Power - 1.4 watts max. @ $25^{\circ} \mathrm{C}$
Duty Cycle - Continuous
Pick-up Voltage - Approximately
$50 \%$ of nominal coil voltage
Pick-up Sensitivity @ $25^{\circ} \mathrm{C}$ -
145 to 260 mW

## HFW4A, HFW5A

Standard Half Size
High Performance Relay
Designed to
MIL-R-39016/6



## Product Facts

■ Hermetically sealed
■ Up to 5 amps switching
■ High shock \& vibration ratings
■ Optional terminals \& mounting styles
■ Excellent RF switching

Contact Ratings

| Contact <br> Load | Type | Operations <br> Min. |
| :--- | :--- | ---: |
| $4 \mathrm{~A} \mathrm{@} \mathrm{28} \mathrm{Vdc} \mathrm{(HFW4A)}$ | Resistive | 100,000 |
| $5 \mathrm{~A} \mathrm{@} \mathrm{28} \mathrm{Vdc} \mathrm{(HFW5A)}$ | Resistive | 100,000 |
| 0.75 A @ 28 Vdc | Inductive $(200 \mathrm{mH})$ | 100,000 |
| $0.1 \mathrm{~A} \mathrm{@} 115 \mathrm{Vac}, 60 \mathrm{~Hz} \& 400 \mathrm{~Hz}$ | Resistive | 100,000 |
| $0.3 \mathrm{~A} \mathrm{@} \mathrm{115} \mathrm{Vac} 60 \mathrm{~Hz} \& 400 Hz$, | Resistive | 100,000 |
| 0.1 A @ 28 Vdc | Intermediate | 50,000 |
| 0.160 A @ 28 Vdc | Lamp | 100,000 |
| $30 \mu \mathrm{~A} \mathrm{@} 50 \mathrm{mVdc}$ | Low Level | $1,000,000$ |

RF Performance

| Frequency (MHz) | RF Losses (dB) | VSWR | Isolation (dB) |
| :---: | :---: | :---: | :---: |
| 100 | 0.1 | $1.17: 1$ | 40 |
| 500 | 0.3 | $1.19: 1$ | 28 |
| 1000 | 0.4 | $1.19: 1$ | 23 |

## Double Pole, Electrically Held, 5 Amps and Less (Continued)

## HFW4A, HFW5A (Continued)

## Operating Characteristics

Timing -
Operate Time - 4.0 ms max.
Release Time - 4.0 ms max
Contact Bounce - 2.0 ms max.
Dielectric Withstanding Voltage -
Between Open Contacts -
500 Vrms 60 Hz
Between Adjacent Contacts -
1000 Vrms 60 Hz
Between Contacts \& Coil -
1000 Vrms 60 Hz
Insulation Resistance -
10,000 megohms min. @ 500 Vdc

Environmental Characteristics
Temperature Range -
$-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Weight - 0.46 oz. ( 13 gms max.)
Vibration Resistance 20 G's, 10 to $2,000 \mathrm{~Hz}$
Shock Resistance -
100 G's, $6 \pm 1 \mathrm{~ms}$



Terminals


Mounting Styles

## Standard Coil Data

|  | Nom. Coil Voltage (Vdc) | Coil Resistance in Ohms $\pm 10 \%$ @ $\mathbf{2 5}^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) <br> @ $25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Min.) <br> @ $125^{\circ} \mathrm{C}$ | Drop-out Voltage Vdc (Min.) @ $25^{\circ} \mathrm{C}$ | Drop-out Voltage Vdc (Min.) @ $-65^{\circ} \mathrm{C}$ | Nom. Coil Power (mW) <br> @ $25^{\circ} \mathrm{C}$ | Max. Coil Voltage | Coil Desig |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| HFW4A/HFW5A | 5.0 | 27 | 2.7 | 3.8 | 0.29 | 0.21 | 926 | 6.0 | L |
|  | 6.0 | 40 | 3.2 | 4.5 | 0.35 | 0.25 | 900 | 7.5 | F |
|  | 12.0 | 160 | 6.4 | 9.0 | 0.7 | 0.5 | 900 | 15.0 | G |
|  | 26.5 | 700 | 13.5 | 18.0 | 1.5 | 1.0 | 1003 | 32.0 | K |
| Other | 6-8 | 60 | 3.5 | 4.85 | 0.35 | 0.22 | 817 | 9.0 | A |
| (avail. for | 12-15 | 320 | 6.8 | 9.42 | 0.68 | 0.44 | 570 | 21.0 | B |
| HFW4A | 18.0 | 520 | 9.5 | 13.16 | 0.95 | 0.62 | 623 | 27.0 | J |
| relays only) | 26.5-32 | 1,250 | 14.0 | 19.4 | 1.5 | 0.98 | 684 | 42.0 | D |
|  | 40.0 | 2,700 | 21.3 | 29.5 | 2.1 | 1.37 | 593 | 61.0 | H |
|  | 48.0 | 3,500 | 25.5 | 35.3 | 2.5 | 1.63 | 658 | 70.0 | E |


| Specifying a Part Number Example: | Type <br> HFW5A | Terminals <br> 12 | Mountings <br> 30 | Coils <br> K | Features <br> 00 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |



Product Facts
■ Hermetically sealed
■ Up to 5 amps switching
■ Economical configuration
■ Optional terminals \& mounting styles

01


## Standard Coil Data

| Nom. Coil <br> Voltage <br> (Vdc) | Coil <br> Resistance <br> in Ohms <br> $\pm 20 \% ~ @ ~ 25 ~$ | Pickup <br> Voltage <br> Vdc (Max.) <br> @ 25 | Pickup <br> Voltage <br> Vdc (Max.) <br> @ 85 | Nom. Coil <br> Power <br> (W) | Max. <br> Coil <br> Voltage | Coil <br> Desig. |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 5.0 | 27 | 3.0 | 3.7 | .92 | 6.0 | L |
| 6.0 | 40 | 3.6 | 4.5 | .90 | 7.5 | F |
| 12.0 | 160 | 7.2 | 8.9 | .90 | 15.0 | G |
| 26.5 | 700 | 16.0 | 19.7 | 1.00 | 32.0 | K |



Terminals

Mounting Styles

| Specifying a Part Number Example: | Type | Terminals | Mountings | Coils | Features |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | HFC5A | 12 | 30 | K | 00 |


| Catalog 5-1773450-5 | Dimensions are shown for <br> reference purposes only. <br> Revised 3-13 |
| :--- | :--- |
| Specifications subject  <br> www.te.com to change. |  |


| Dimensions are in millimeters | USA: +1 8005226752 |
| :--- | :--- |
| unless otherwise specified. | Asia Pacific: +8604008206015 |
|  | UK: +44800267666 |

For additional support numbers Asia Pacific: +86 04008206015 please visit www.te.com UK: +44 800267666

## Double Pole, Electrically Held, 5 Amps and Less (Continued)



## Product Facts

■ Hermetically sealed
■ Up to 5 amps switching
■ High shock \& vibration ratings
■ Optional terminals \& mounting options

■ Excellent RF switching

Electrical Characteristics
Contact Arrangement 2 Form C
Contact Material -
Stationary -
Bifurcated hardened silver alloy
Moveable -
Gold plated hardened alloy
Contact Resistance -
Before Life - 50 milliohms max. (measured at 10 mA @ 6 Vdc )
After Life - 100 milliohms max.
(measured @ 2 mA @ 28 Vdc )
Mechanical Life Expectancy -
50 million operations
Coil Voltage -
6.3 to 110 Vdc (FW, FWSA)
1.8 to 40 Vdc (SF)
2.8 to 40 Vdc (SFSA)

Coil Power - 1.5 watts max. @ $25^{\circ} \mathrm{C}$
Duty Cycle - Continuous
Pick-up Voltage - Approximately
50\% of nominal coil voltage
Pick-up Sensitivity -
250 mW (FW, FWSA)
40 mW (SF)
80 mW (SF5A)


## Operating Characteristics

Operate Time -
15 ms max. (SF)
$5 \mathrm{~ms}($ FW, FWSA))
6 ms max. (MLL-R-5757/10)
Release Time -
10 ms max. (SF)
5 ms max. (FW, FWSA)
6 ms max. (MLL-R-5757/10)
Contact Bounce - 2 ms max.
Dielectric Withstanding Voltage -
Between Open Contacts -
500 Vrms 60 Hz
Between Adjacent Contacts -
1,000 Vrms 60 Hz
Between Contacts and Coil -
1,000 Vrms 60 Hz
Insulation Resistance -
10,000 megohms min @ 500 Vdc

2


Environmental Characteristics
Temperature Range -
$-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Weight -
0.6 oz. max. (FW, FWSA)
0.7 oz. max. (SF 6)
1.1 oz. max. (SF/SF 5A)

Vibration Resistance -
Standard -
20 G's, 10 to 2000 Hz (FW, FWSA)
15 G's, 10 to 2000 Hz (SF)
QPL -
20 G's, 10 to 2000 Hz
Shock Resistance -
100 G's, $6 \pm 1$ ms
QPL Approval -
MIL-R-5757/10 (FW only)
QPL Equivalent -
MLL-R-5757/13 (SF only)

3


Terminals
RF Performance

| Frequency (MHz) | RF Losses (dB) | VSWR | Isolation (dB) |
| :---: | :---: | :---: | :---: |
| 100 | 0.1 | $1.17: 1$ | 40 |
| 250 | 0.2 | $1.18: 1$ | 33 |
| 500 | 0.3 | $1.19: 1$ | 28 |
| 750 | 0.4 | $1.19: 1$ | 25 |
| 1,000 | 0.4 | $1.19: 1$ | 23 |

## Contact Ratings

| Contact Load | Type | Operations Min. |
| :---: | :---: | :---: |
| 5 A @ 28 Vdc (FW5A/SF5A) | Resistive | 100,000 |
| $3 \mathrm{~A} @ 28 \mathrm{Vdc}$ (FW) | Resistive | 100,000 |
| 2 A @ 28 Vdc (SF) | Resistive | 100,000 |
| 1 A @ $115 \mathrm{Vac}, 60 \mathrm{~Hz}$ \& 400 Hz (FW) | Resistive | 100,000 |
| 0.3 A @ $115 \mathrm{Vac}, 60 \mathrm{~Hz}$ \& 400 Hz (SF) | Resistive | 100,000 |
| 1 A @ 28 Vdc | Inductive (200 mH) | 100,000 |
| 0.1 A @ 28 Vdc | Lamp | 100,000 |
| $10 \mu \mathrm{~A} @ 50 \mathrm{mVdc}$ | Low Level | 1,000,000 |
| 75 WATTS @ 50 MHz (FW) | RF | 10,000,000 |

## Double Pole, Electrically Held, 5 Amps and Less (Continued)

FW, FW5A Coil Data

| Nom. Voltage (Vdc) | Coil Resistance in Ohms $\pm 10 \% @ 25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) @ $25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) @ $125^{\circ} \mathrm{C}$ | Drop-out Voltage Vdc (Min.) @ $25^{\circ} \mathrm{C}$ | Drop-out Voltage Vdc (Min.) @ -65ํ. | Nom. Coil Power (W) <br> @ $25^{\circ} \mathrm{C}$ | $\begin{gathered} \text { Max. } \\ \text { Coil } \\ \text { Voltage } \end{gathered}$ | Coil Desig. |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 6.3 | 35 | 3.2 | 4.4 | 0.35 | 0.23 | 1.13 | 7.9 | A |
| 12.6 | 200 | 6.8 | 9.4 | 0.74 | 0.49 | . 79 | 15.8 | D |
| 17.6 | 340 | 8.9 | 12.3 | 0.97 | 0.64 | . 91 | 22.0 | E |
| 26.5 | 675 | 13.5 | 18.7 | 1.47 | 0.96 | 1.04 | 33.1 | G |
| 32.0 | 975 | 15.5 | 21.5 | 1.69 | 1.1 | 1.05 | 40.0 | H |
| 48.0 | 2,450 | 25.0 | 34.7 | 2.73 | 1.8 | . 94 | 60.0 | L |
| 56.0 | 3,150 | 30.0 | 41.6 | 3.27 | 2.1 | 1.00 | 70.0 | M |
| 75.0 | 5,000 | 38.0 | 52.7 | 4.14 | 2.7 | 1.13 | 93.8 | N |
| 110.0 | 9,100 | 51.0 | 70.7 | 5.56 | 3.6 | 1.33 | 137.5 | R |

## SF5/SF6 Coil Data

| Nom. Coil <br> Voltage <br> $($ Vdc $)$ | Nom. <br> Current <br> $(\mathbf{m A})$ | Coil <br> Resistance <br> in Ohms <br> $\pm \mathbf{1 0 \% @ 2 5}{ }^{\circ} \mathbf{C}$ | Pickup <br> Current <br> $(\mathbf{m A )}$ <br> $@ \mathbf{2 5} \mathbf{C}$ | Nom. Coil <br> Power <br> $(\mathbf{m W})$ <br> $@ \mathbf{2 5} \mathbf{C}$ | Coil <br> Desig. |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1.8 | 90.0 | 20 | 45.0 | 162 | A |
| 9.0 | 18.0 | 500 | 9.0 | 162 | E |
| 12.6 | 12.6 | 1,000 | 6.5 | 159 | F |
| 16.5 | 11.0 | 1,500 | 5.2 | 182 | G |
| 18.0 | 9.0 | 2,000 | 4.5 | 162 | H |
| 20.0 | 8.0 | 2,500 | 4.0 | 160 | J |
| 26.5 | 5.3 | 5,000 | 2.8 | 140 | W |
| 36.0 | 4.5 | 8,000 | 2.3 | 162 | L |
| 40.0 | 4.0 | 10,000 | 2.0 | 160 | Y |

SF5A Coil Data

| Nom. Coil <br> Voltage <br> $($ Vdc $)$ | Nom. <br> Current <br> $(\mathbf{m A})$ | Coil <br> Resistance <br> in Ohms <br> $\pm \mathbf{1 0 \% @ 2 5}{ }^{\circ} \mathbf{C}$ | Pickup <br> Current <br> $(\mathbf{m A )}$ <br> $@ \mathbf{2 5} \mathbf{C}$ | Nom. Coil <br> Power <br> $(\mathbf{m W})$ <br> $@ \mathbf{2 5} \mathbf{C}$ | Coil <br> Desig. |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 2.8 | 140.0 | 20 | 65.0 | 392 | A |
| 4.0 | 80.0 | 50 | 41.6 | 320 | B |
| 12.0 | 24.0 | 500 | 12.5 | 288 | E |
| 18.0 | 18.0 | 1,000 | 9.3 | 324 | F |
| 26.5 | 10.6 | 2,500 | 5.6 | 281 | J |
| 40.0 | 8.0 | 5,000 | 4.0 | 320 | W |

NOTE:
FW/FW5A = . 875 (22.23) Max.
SF6 = . 900 (22.86) Max SF5/SF5A5 = 1.281 (32.54) Max.





Type
Type
FW
SF
SF5A

SF


Mounting Styles

| Series |  | Termina |
| :---: | :---: | :---: |
|  |  | 1 |
| 5 |  | 1 |
| 5 |  | 1 |
| 6 |  | 1 |




20
20
20
20


Features
00
00
00
00

* The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15.
C
Single Pole, Half Size
High Performance Relay


Terminal View

## Single Pole, Electrically Held, 10 Amps and Less

| Electrical Characteristics | Duty Cycle - Continuous | Environmental Characteristics |
| :---: | :---: | :---: |
| Contact Arrangement 1 Form C (SPDT) | Pick-up Voltage - Approximately $50 \%$ of nominal coil voltage | Temperature Range -$-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ |
| Contact Material - <br> Stationary - Hardened silver alloy <br> Moveable - Hardened silver alloy | Pick-up Sensitivity - 260 mW <br> Operational Characteristics | Weight - 0.28 oz. (8 grams) max. Vibration Resistance 20 G's, 10 to $2,000 \mathrm{~Hz}$ |
| Contact Resistance Before Life - 50 Milliohms max. (measured at $10 \mathrm{~mA} @ 6 \mathrm{Vdc}$ ) After Life - 100 Milliohms max. (measured @1 A @28 Vdc) | Operate Time - 5.0 ms max. <br> Release Time -5.0 ms max. <br> Contact Bounce - 5.0 ms max. <br> Dielectric Withstanding Voltage - <br> Between Open Contacts - | Shock Resistance - 100 G's, $6 \pm 1 \mathrm{~ms}$ Designed To — MLL-R-39016 |
| Contact Rating - <br> Contact Load - 10 A 28 Vdc <br> Type — Resistive <br> Operations min. 50,000 | 500 Vrms 60 Hz <br> Between Adjacent Contacts - <br> 1000 Vrms 60 Hz <br> Between Contacts and Coils - |  |
| Mechanical Life Expectancy 1 million operations min. | 1000 Vrms 60 Hz <br> Insulation Resistance - |  |
| Coil Voltage - 6 to 26.5 Vdc <br> Coil Power - 1.4 watts max. @ $25^{\circ} \mathrm{C}$ | 1,000 megohms min. @ 500 Vdc |  |

## Product Facts

■ Hermetically sealed
■ Up to 10 amps switching
■ High shock \& vibration ratings
■ Optional terminals \& mounting styles


A


B


Terminals

## Standard Coil Data

| Nom. Voltage (Vdc) | Coil Resistance in Ohms $\pm 10 \% @ 25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) @ $25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) @ $125^{\circ} \mathrm{C}$ | Drop-out Voltage Vdc (Min.) @ $25^{\circ} \mathrm{C}$ | Drop-out Voltage Vdc (Min.) @ $-65^{\circ} \mathrm{C}$ | Nom. Coil Power (W) <br> @ $25^{\circ} \mathrm{C}$ | $\begin{gathered} \text { Max. } \\ \text { Coil } \\ \text { Voltage } \end{gathered}$ | Coil Desig |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 6.0 | 40 | 3.5 | 4.5 | 0.45 | 0.3 | . 9 | 8.0 | 6 |
| 12.0 | 160 | 6.5 | 9.0 | 0.9 | 0.6 | . 9 | 15.0 | 12 |
| 26.5 | 700 | 14.0 | 18.0 | 1.8 | 1.2 | 1.0 | 32.0 | 24 |

Specifying a Part Number Example: Type

Mountings
BW-

Contacts
1C-

Coils
24

Terminals
B

Catalog 5-1773450-5
Revised 3-13

Dimensions are shown for reference purposes only. Specifications subject to change.

## Double Pole, Electrically Held, 10 Amps and Less

07
Two Pole 10 Amp High Performance Relay

Qualified to
MIL-R-5757/23
MS 27245 \& MS 27247

## Product Facts

■ Hermetically sealed
■ Up to 10 amps switching
■ High shock \& vibration ratings
■ Optional terminals \& mounting styles
■ DC, AC \& diode-suppressed coils


## Operating Characteristics

Operate Time -
Std - 10 ms max.
QPL - 15 ms max.
AC Coil - 15 ms max.
Release Time -
Std - 10 ms max.
QPL - 15 ms max.
AC Coil - 20 ms max.
Contact Bounce -
Std - 5 ms max. (N.O. and N.C.)
QPL — 2 ms max. (N.O.)
QPL - 5 ms max. (N.C.)
Dielectric Withstanding Voltage -
Environmental Characteristics
Temperature Range -
$-65^{\circ} \mathrm{C}$ TO $+125^{\circ} \mathrm{C}$
Weight - 1.302 ( 37 gms ) max.
Vibration Resistance -
Standard - 30 G's, 10 to $2,000 \mathrm{~Hz}$ QPL - 20 G's, 10 to 2,000 Hz

## Shock Resistance -

100 G's, $6 \pm 1$ ms
QPL Approval -
MIL-R-5757/23
MS 27245
MS 27247

Contact Ratings

| Contact <br> Load | Type | Operations <br> Min. |
| :--- | :--- | ---: |
| $10 \mathrm{~A} @ 28 \mathrm{Vdc}$ | Resistive | 100,000 |
| $3 \mathrm{~A} @ 115 \mathrm{~V}, 60 \mathrm{~Hz}$ | Resistive | 50,000 |
| $5 \mathrm{~A} @ 115 \mathrm{~V}, 400 \mathrm{~Hz}$ | Resistive | 50,000 |
| $6 \mathrm{~A} @ 28 \mathrm{Vdc}$ | Inductive | 50,000 |
| $2 \mathrm{~A} @ 115 \mathrm{~V}, 60 \mathrm{~Hz}$ | Inductive | 50,000 |
| $2.5 \mathrm{~A} @ 115 \mathrm{~V}, 400 \mathrm{~Hz}$ | Inductive | 50,000 |
| $1 \mathrm{~A} @ 28 \mathrm{Vdc}$ | Lamp | 50,000 |
| $0.5 \mathrm{~A} @ 115 \mathrm{~V}, 60 \mathrm{~Hz}$ | Lamp | 50,000 |
| $0.8 \mathrm{~A} @ 115 \mathrm{~V}, 400 \mathrm{~Hz}$ | Lamp | 50,000 |
| $3 \mathrm{~A} @ 28 \mathrm{Vdc}$ | Motor | 50,000 |
| $1.5 \mathrm{~A} @ 115 \mathrm{~V}, 60 \mathrm{~Hz}$ | Motor | 50,000 |
| $3 \mathrm{~A} @ 115 \mathrm{~V}, 400 \mathrm{~Hz}$ | Motor | 50,000 |

*All ratings grounded case

Terminal View


Terminal View


Terminals

500 Vrms 60 Hz
Between Adjacent Contacts -
1000 Vrms 60 Hz
Between Contacts and Coil -
1000 Vrms 60 Hz
Insulation Resistance -
1,000 megohms min. @ 500 Vdc


CII Low Signal Relays
Double Pole, Electrically Held, 10 Amps and Less (Continued)
Coil Data

| Nom. Coil Voltage (Vdc) | Coil Resistance in Ohms $\pm 10 \% @ 25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) <br> @ $25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) @ $125^{\circ} \mathrm{C}$ | Drop-out Voltage Vdc (Min.) @ $25^{\circ} \mathrm{C}$ | Drop-out Voltage Vdc (Min.) @ $-65^{\circ} \mathrm{C}$ | Nom. Coil Power (mW) @ $25^{\circ} \mathrm{C}$ | Max. Coil Voltage | Coil Desig. | Environmental |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 6.0 | 19 | 3.6 | 4.5 | 0.4 | 0.25 | 1.89 | 9.0 | AA | Temperature <br> $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$ <br> Vibration <br> 20G's, 10 to $2,000 \mathrm{~Hz}$ |
| 12.0 | 75 | 7.2 | 9.0 | 0.9 | 0.5 | 1.92 | 16.0 | AB |  |
| 26.5 | 300 | 14.4 | 18.0 | 1.8 | 1.0 | 2.34 | 32.0 | AC |  |
| 48.0 | 1,200 | 29.0 | 36.0 | 3.6 | 2.0 | 1.92 | 52.0 | AD |  |
| 120.0 | 7,600 | 72.0 | 90.0 | 9.0 | 5.0 | 1.89 | 122.0 | AE | Shock <br> 50G's, 11 ms |
| 115 Vac 400 Hz | 1,200 | 72.0 | 90.0 | 10.0 | 5.0 | n/a | n/a | AR |  |
| $115 \mathrm{Vac} 60-400 \mathrm{~Hz}$ | 7,600 | 72.0 | 90.0 | 10.0 | 5.0 | n/a | n/a | AS |  |
| 6.0 | 19 | 3.3 | 4.5 | 0.4 | 0.25 | 1.89 | 9.0 | BA | $\begin{aligned} & \text { Temperature } \\ & -65^{\circ} \mathrm{C} \text { to }+125^{\circ} \mathrm{C} \end{aligned}$ |
| 12.0 | 75 | 6.5 | 9.0 | 0.9 | 0.5 | 1.92 | 16.0 | BB |  |
| 26.5 | 300 | 13.0 | 18.0 | 1.8 | 1.0 | 2.34 | 32.0 | BC | Vibration <br> 20G's, 10 to $2,000 \mathrm{~Hz}$ |
| 48.0 | 1,200 | 26.0 | 36.0 | 3.6 | 2.0 | 1.92 | 52.0 | BD |  |
| 120.0 | 7,600 | 66.0 | 90.0 | 9.0 | 5.0 | 1.89 | 122.0 | BE | Shock 50G's, 11 ms |
| 115 Vac 400 Hz | 1,200 | 75.0 | 90.0 | 10.0 | 5.0 | n/a | n/a | BR |  |
| $115 \mathrm{Vac} 60-400 \mathrm{~Hz}$ | 7,600 | 75.0 | 90.0 | 10.0 | 5.0 | n/a | n/a | BS |  |
| 6.0 | 19 | 3.7 | 5.0 | 0.4 | 0.25 | 1.89 | 9.0 | CA | $\begin{aligned} & \text { Temperature } \\ & -65^{\circ} \mathrm{C} \text { to }+125^{\circ} \mathrm{C} \end{aligned}$ |
| 12.0 | 75 | 7.4 | 10.0 | 0.9 | 0.5 | 1.92 | 16.0 | CB |  |
| 26.5 | 300 | 14.7 | 20.0 | 1.8 | 1.0 | 2.34 | 32.0 | CC | Vibration <br> 30 G 's, 10 to $2,000 \mathrm{~Hz}$ |
| 48.0 | 1,200 | 29.4 | 40.0 | 3.6 | 2.0 | 1.92 | 52.0 | CD |  |
| 120.0 | 7,600 | 74.0 | 100.0 | 9.0 | 5.0 | 1.89 | 122.0 | CE | Shock <br> 100G's, 6ms |
| 115 Vac 400 Hz | 1,200 | 80.0 | 100.0 | 10.0 | 5.0 | n/a | n/a | CR |  |
| $115 \mathrm{Vac} 60-400 \mathrm{~Hz}$ | 7,600 | 80.0 | 100.0 | 10.0 | 5.0 | n/a | n/a | CS |  |



0



Specifying a Part Number Example:

Note:
A07 = . 895 max (22.73), Schematic 3 only B07 $=1.010$ max (25.66), Schematic 3 only B07 $=1.234 \max (31.35)$, Schematics 2, $4 \& 5$ only

07 Mounting Styles

| Type | Ratings | $\frac{\text { Mountings }}{3}$ |
| :---: | :---: | :---: |



* The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15.

Catalog 5-1773450-5
Revised 3-13
Revised 3-13
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Dimensions are shown for
reference purposes only.
Specifications subject
to change.

Dimensions are in millimeters unless otherwise specified.



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## Double Pole, Electrically Held, 1 Amp and Less

MW3 / MW4 / MW6 / MW3HP / MW4HP / MW6HP Series Relays
Microwave Switching, Hermetically Sealed, DPDT
Product Facts
■ Excellent signal isolation, stable insertion loss and Iow VSWR

- Provide repeatable RF performance at frequencies up to the 3 GHz . level (MW3/MW3HP), 4 GHz . level (MW4/MW4HP) \& 6 GHz. level (MW6/MW6HP)
- Standard versions for applications ranging from wireless communications to precision high-speed test equipment
■ High performance (HP) versions for use under more demanding environmental conditions

■ Standard or sensitive (S) coils are offered in a range of DC input voltages
■ 2 Form C (DPDT) contacts rated low-level to 1 amp
■ Extended mechanical life expectancy of 10 million operations
■ Robust, hermetically sealed enclosure

These CII relays provide microwave frequency switching in a hermetically sealed, subminiature package.
Both standard and high performance models are offered in 3 GHz ., 4 GHz . and 6 GHz . types.
Standard models (MW3, MW4 and MW6) perform in temperature ranges from $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$ and withstand 10G vibration and 30G shock.

High performance models (MW3HP, MW4HP and MW6HP) offer extended temperature ratings of $-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ while providing 30G's vibration and 100G's shock (75G's for MW3) environmental ratings.
All are available with either standard or sensitive DC coils. Nominal coil power is $367-500 \mathrm{~mW}$ (model dependent) for standard coils and 169-250mW for sensitive coils.

Signal isolation is 18 dB at 6 GHz. (MW6/MW6HP), 18dB at 4 GHz . (MW4/MW4HP), and 22 dB at 3 GHz . (MW3/MW3HP).
Insertion loss is 0.38 dB for MW6/MW6HP, 0.27 dB for MW4/MW4HP, and 0.36dB for MW3/MW3HP.
VSWR is a low 1.30:1 @ 6GHz. for MW6/MW6HP, 1.36:1 @ 4GHz. for MW4/MW4HP, and 1.24:1 @ 3GHz. for MW3/MW3HP.

## Microwave Switching, Hermetically Sealed, DPDT <br> MW3 \& MW3HP Models <br> 3 GHz. Switching

## Electrical Characteristics

Contact Arrangement -
2 Form C (DPDT)
Contact Resistance -
Before life - 100 milliohms, max.
(measured @ 10 mA @ 6 VDC)
After life - 200 milliohms, max.
(measured @ 1 A @ 28 VDC)

## Mechanical Life Expectancy -

10 million operations
Coil Voltages -
5, 12, 18 \& 26.5 VDC (MW3)
5, 6, 9, 12, 18 \& 26.5 VDC (MW3HP)
Coil Power (mW max. @ $25^{\circ} \mathrm{C}$ ) -

| MW3 | MW3S | MW3HP | MW3HPS |
| :---: | :---: | :---: | :---: |
| 675 | 565 | 673 | 563 |

Duty Cycle - Continuous
Pick-up Voltage -
MW3 - Approx 70\% of nominal.
MW3HP — Approx 50\% of nominal.
Pick-up Sensitivity (mW max. @ $25^{\circ} \mathrm{C}$ ) -

| MW3 | MW3S | MW3HP | MW3HPS |
| :---: | :---: | :---: | :---: |
| 180 | 90 | 146 | 68 |

## Operating Characteristics

Operate Time (ms max.) -

| MW3 | MW3S | MW3HP | MW3HPS |
| :---: | :---: | :---: | :---: |
| 4.0 | 6.0 | 2.0 | 4.0 |

Release Time (ms max.)
MW3 MW3S MW3HP MW3HPS

| 3.0 | 3.0 | 1.5 | 2.0 |
| :--- | :--- | :--- | :--- |

Bounce Time (ms max.) MW3 MW3S MW3HP MW3HPS

Dielectric Withstanding Voltage -
Between Open Contacts,
Between Adjacent Contacts and Between
Contacts and Coil -
MW3 types - $350 \mathrm{Vrms}, 60 \mathrm{~Hz}$.
MW3HP types - $500 \mathrm{Vrms}, 60 \mathrm{~Hz}$.
Insulation Resistance -
1,000 megohms @ 500 VDC

## Environmental Characteristics

## Contact Ratings

| Contact <br> Load | Type | Operations <br> Min. |
| :--- | :--- | ---: |
| $1.0 \mathrm{~A} @ 28 \mathrm{VDC}$ | Resistive | 100,000 |
| $200 \mathrm{~mA} \mathrm{@} \mathrm{28VDC}(300 \mathrm{mH})^{\star}$ | Inductive | 100,000 |
| $30 \mu \mathrm{~A} @ 50 \mathrm{mVDC}$ | Low Level | $10,000,000$ |

* The inductive rating is only applicable to high performance models (MW3HP and MW3HPS).

Coil Data

| MW3 Models |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Nominal Coil Voltage (VDC) | Coil Resistance In Ohms <br> $\pm 20 \%$ @ $5^{\circ} \mathrm{C}$ | Pickup Voltage VDC (Max.) @ $25^{\circ} \mathrm{C}$ | Nominal Coil Power $(\mathrm{mW}) @ 25^{\circ} \mathrm{C}$ |  | Maximum Coil Voltage | Coil Desig. |
| Standard Coil |  |  |  |  |  |  |
| 5.0 | 50 | 3.6 | 500 |  | 5.8 | 5 |
| 12.0 | 390 | 8.4 | 369 |  | 16.0 | 12 |
| 18.0 | 880 | 13.0 | 368 |  | 24.0 | 18 |
| 26.5 | 1,560 | 17.0 | 450 |  | 32.0 | 26 |
| Sensitive Coil |  |  |  |  |  |  |
| 5.0 | 100 | 3.5 | 250 |  | 7.5 | 5 |
| 12.0 | 850 | 9.0 | 169 |  | 20.0 | 12 |
| 18.0 | 1,600 | 13.5 | 203 |  | 30.0 | 18 |
| 26.5 | 3,300 | 18.0 | 213 |  | 40.0 | 26 |
| MW3HP (High Performance) Models |  |  |  |  |  |  |
| Nominal Coil Voltage (VDC) | Coil Res. Pickup V <br> in Ohms <br> VDC (Max.) <br> $\pm 10 \% @ 25^{\circ} \mathrm{C}$ <br> $@ 25^{\circ} \mathrm{C}$  | Release V VDC (Max.) $@ 25^{\circ} \mathrm{C}$ | Release V No <br> VDC (Min.) Coil <br> @ $25^{\circ} \mathrm{C}$ $(\mathrm{mW})$ | ominal <br> il Power <br> N) @ $25^{\circ} \mathrm{C}$ | Maximum Coil Voltage | Coil Desig |
| Standard Coil |  |  |  |  |  |  |
| 5.0 | $50 \quad 2.7$ | 1.4 | 0.22 | 500 | 5.8 | 5 |
| 6.0 | 98 3.5 | 2.0 | 0.28 | 367 | 8.0 | 6 |
| 9.0 | 2205.3 | 3.0 | 0.54 | 368 | 12.0 | 9 |
| 12.0 | 390 7.0 | 4.0 | 0.63 | 369 | 16.0 | 12 |
| 18.0 | $880 \quad 10.5$ | 6.0 | 0.91 | 368 | 24.0 | 18 |
| 26.5 | 1,560 14.2 | 8.0 | 1.37 | 450 | 32.0 | 26 |
| Sensitive Coil |  |  |  |  |  |  |
| 5.0 | $100 \quad 2.6$ | 1.4 | 0.23 | 250 | 7.5 | 5 |
| 6.0 | 2003.4 | 2.0 | 0.28 | 180 | 10.0 | 6 |
| 9.0 | $400 \quad 4.85$ | 3.0 | 0.55 | 203 | 15.0 | 9 |
| 12.0 | $850 \quad 7.0$ | 4.0 | 0.64 | 169 | 20.0 | 12 |
| 18.0 | 1,600 9.8 | 6.0 | 0.92 | 203 | 30.0 | 18 |
| 26.5 | 3,300 14.0 | 8.0 | 1.4 | 213 | 40.0 | 26 |

Temperature Range -
MW3 types - $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$.
MW3HP types $-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$.
Weight -
MW3, MW3HP: 0.09 oz. ( 2.55 g )
MW3S, MW3HPS: 0.12 oz. (3.40 g).

## Vibration Resistance -

MW3 types - 10 G's, 10-500 Hz.
MW3HP types - 30 G's, 10-3,000 Hz
Shock Resistance -
MW3 types - 30 G's, $6 \pm 1$ ms
MW3HP types - 75 G's, $6 \pm 1 \mathrm{~ms}$.

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| :---: | :---: | :---: | :---: | :---: |
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|  | Specifications subject |  | UK: +44800 267666 |  |
| www.te.com | to change. |  |  |  |

## Double Pole, Electrically Held, 1 Amp and Less (Continued)

## Microwave Switching, Hermetically Sealed, DPDT

MW3 \& MW3HP Models, 3 GHz . Switching (Continued)

Insertion Loss \& VSWR: NO Contacts


Insertion Loss \& VSWR: NC Contacts


Isolation


Test Conditions

Test Board - 0.031" double sided copper clad, PTFE based laminate.
Connections - Relay header is soldered to ground place. Relay terminals are soldered to through holes. SMA connectors are soldered to circuit traces.

Temperature - Room ambient.
Signal Strength -0 dBm .
Notes:

1. Unused terminals were terminated with 50 ohm impedance load. 2. All readings are typical.

## Header



Ground Pin

$$
\text { Position "G" } \quad \text { Position "E" }
$$

For other ground pin configurations consult factory.
Header and Terminal Finish:
Nickel plated on MW3 \& MW3S. Tin-lead plated on MW3HP \& MW3HPS.

Part Numbering System


Wiring Diagram


Terminal View

## Microwave Switching,

Hermetically Sealed, DPDT
MW4 \& MW4HP Models
4 GHz. Switching
Electrical Characteristics
Contact Arrangement -
2 Form C (DPDT)
Contact Resistance -
Before life - 100 milliohms, max.
(measured @ 10 mA @ 6 VDC)
After life - 200 milliohms, max.
(measured @ 1 A @ 28 VDC)
Mechanical Life Expectancy -
10 million operations
Coil Voltages -
5, 12, 18 \& 26.5 VDC (MW4)
5, 6, 9, 12, 18 \& 26.5 VDC (MW4HP)
Coil Power (mW max. @ $25^{\circ} \mathrm{C}$ ) -

| MW4 | MW4S | MW4HP | MW4HPS |
| :---: | :---: | :---: | :---: |
| 675 | 565 | 673 | 563 |

Duty Cycle - Continuous
Pick-up Voltage -
MW4 - Approx 70\% of nominal.
MW4HP - Approx 50\% of nominal.
Pick-up Sensitivity (mW max. @ $25^{\circ} \mathrm{C}$ ) -

| MW4 | MW4S | MW4HP | MW4HPS |
| :---: | :---: | :---: | :---: |
| 180 | 90 | 123 | 68 |

## Operating Characteristics

Operate Time (ms max.) -

| MW4 | MW4S | MW4HP | MW4HPS |
| :---: | :---: | :---: | :---: |
| 4.0 | 6.0 | 2.0 | 4.0 |

Release Time (ms max.)
MW4 MW4S MW4HP MW4HPS

| 3.0 | 3.0 | 1.5 | 2.0 |
| :--- | :--- | :--- | :--- |

Bounce Time (ms max.) MW4 MW4S MW4HP MW4HPS

Dielectric Withstanding Voltage -
Between Open Contacts,
Between Adjacent Contacts and Between
Contacts and Coil -
MW4 types - $350 \mathrm{Vrms}, 60 \mathrm{~Hz}$.
MW4HP types - $500 \mathrm{Vrms}, 60 \mathrm{~Hz}$.
Insulation Resistance -
1,000 megohms @ 500 VDC

## Environmental Characteristics

## Contact Ratings

| Contact <br> Load | Type | Operations <br> Min. |
| :--- | :--- | ---: |
| $1.0 \mathrm{~A} @ 28 \mathrm{VDC}$ | Resistive | 100,000 |
| $200 \mathrm{~mA} \mathrm{@} \mathrm{28VDC}(300 \mathrm{mH})^{\star}$ | Inductive | 100,000 |
| $30 \mu \mathrm{~A} @ 50 \mathrm{mVDC}$ | Low Level | $10,000,000$ |

* The inductive rating is only applicable to high performance models (MW4HP and MW4HPS).

Coil Data

| MW4 Models |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Nominal Coil Voltage (VDC) | $\begin{gathered} \hline \text { Coil Resis } \\ \text { In Ohr } \\ \pm 20 \% @ \\ \hline \end{gathered}$ | s.  <br> $25^{\circ} \mathrm{C}$ P <br>   | Pickup Voltage VDC (Max.) @ $25^{\circ} \mathrm{C}$ | $\begin{array}{r} \text { Nomir } \\ \text { Coil Po } \\ (\mathrm{mW}) \text { @ } \end{array}$ | nal wer $25^{\circ} \mathrm{C}$ |  | Maximum Coil Voltage | Coil Desig. |
| Standard Coil |  |  |  |  |  |  |  |  |
| 5.0 | 50 |  | 3.6 | 500 |  |  | 5.8 | 5 |
| 12.0 | 390 |  | 8.4 | 369 |  |  | 16.0 | 12 |
| 18.0 | 880 |  | 13.0 | 368 |  |  | 24.0 | 18 |
| 26.5 | 1,56 |  | 17.0 | 450 |  |  | 32.0 | 26 |
| Sensitive Coil |  |  |  |  |  |  |  |  |
| 5.0 | 100 |  | 3.5 | 250 |  |  | 7.5 | 5 |
| 12.0 | 850 |  | 9.0 | 169 |  |  | 20.0 | 12 |
| 18.0 | 1,600 |  | 13.5 | 203 |  |  | 30.0 | 18 |
| 26.5 | 3,300 |  | 18.0 | 213 |  |  | 40.0 | 26 |
| MW4HP (High Performance) Models |  |  |  |  |  |  |  |  |
| Nominal Coil Voltage (VDC) | $\begin{gathered} \text { Coil Res. } \\ \text { in Ohms } \\ \pm 10 \% @ 25^{\circ} \mathrm{C} \\ \hline \end{gathered}$ | $\begin{gathered} \hline \text { Pickup V } \\ \text { VDC (Max.) } \\ \text { @25ㄷ. } \end{gathered}$ | $\begin{gathered} \hline \text { Release V } \\ \text { VDC (Max.) } \\ \text { @25 } \end{gathered}$ | Release V VDC (Min.) @ $25^{\circ} \mathrm{C}$ |  | minal Power <br> @ $25^{\circ} \mathrm{C}$ |  Maximum <br> Coil  <br> Voltage  | Coil Desig |
| Standard Coil |  |  |  |  |  |  |  |  |
| 5.0 | 50 | 2.7 | 1.4 | 0.22 |  | 500 | 5.8 | 5 |
| 6.0 | 98 | 3.5 | 2.0 | 0.28 |  | 367 | 8.0 | 6 |
| 9.0 | 220 | 5.3 | 3.0 | 0.54 |  | 368 | 12.0 | 9 |
| 12.0 | 390 | 7.0 | 4.0 | 0.63 |  | 369 | 16.0 | 12 |
| 18.0 | 880 | 10.5 | 6.0 | 0.91 |  | 368 | 24.0 | 18 |
| 26.5 | 1,560 | 14.2 | 8.0 | 1.37 |  | 450 | 32.0 | 26 |
| Sensitive Coil |  |  |  |  |  |  |  |  |
| 5.0 | 100 | 2.6 | 1.4 | 0.23 |  | 250 | 7.5 | 5 |
| 6.0 | 200 | 3.4 | 2.0 | 0.28 |  | 180 | 10.0 | 6 |
| 9.0 | 400 | 4.85 | 3.0 | 0.55 |  | 203 | 15.0 | 9 |
| 12.0 | 850 | 7.0 | 4.0 | 0.64 |  | 169 | 20.0 | 12 |
| 18.0 | 1,600 | 9.8 | 6.0 | 0.92 |  | 203 | 30.0 | 18 |
| 26.5 | 3,300 | 14.0 | 8.0 | 1.4 |  | 213 | 40.0 | 26 |

Temperature Range -
MW4 types - $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$.
MW4HP types - $-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$.
Weight -
MW4, MW4HP: 0.09 oz. ( 2.55 g )
MW4S, MW4HPS: 0.12 oz. ( 3.40 g ).

## Vibration Resistance -

MW4 types - 10 G's, 10-500 Hz.
MW4HP types - 30 G's, $10-3,000 \mathrm{~Hz}$
Shock Resistance -
MW4 types - 30 G's, $6 \pm 1 \mathrm{~ms}$.
MW4HP types - 100 G's, $6 \pm 1 \mathrm{~ms}$.

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| :--- |

## Double Pole, Electrically Held, 1 Amp and Less (Continued)

## Microwave Switching, Hermetically Sealed, DPDT

MW4 \& MW4HP Models4 GHz. Switching (Continued)

Insertion Loss \& VSWR: NO Contacts


Insertion Loss \& VSWR: NC Contacts


## Isolation

## Test Conditions

Test Board - 0.031 " double sided copper clad, PTFE based laminate.
Connections - Relay header is soldered to ground place. Relay terminals are soldered to through holes. SMA connectors are soldered to circuit traces.

Temperature - Room ambient.
Signal Strength — 0 dBm .
Notes:

1. Unused terminals were terminated
with 50 ohm impedance load.
2. All readings are typical.

## Enclosures



MW4 / MW4HP

Header


Header and Terminal Finish:
Gold plated

Part Numbering System

## Typical Part Number

Series:
MW4 $=4 \mathrm{GHz}$. switching relay
MW4HP = High performance 4 GHz . switching relay
Coil Sensitivity:
Leave Blank = Standard Coil $\quad$ S = Sensitive Coil
Coil Designator:

| Coii Designator: <br> $12=5 V D C$$\quad 6=6 \mathrm{VDC}$ |  |
| :--- | :--- |
| $12=12 \mathrm{VDC}$ | $9=9 \mathrm{VDC}$ |
| +6 and 9 volt coil only available on high performance models. |  |
| Terminal Length: |  |
| $A=0.750$ in $(19.05 \mathrm{~mm})$ |  |
| $B=1.50$ in $(38.105 \mathrm{~mm})-$ only available on high performance models |  |
| $P=0.187 \pm 0.010$ in $(4.75 \pm 0.25 \mathrm{~mm})$ |  |

2-6

Wiring Diagram


Terminal View
$12=12 \mathrm{VDC} \quad 18=18 \mathrm{VDC} \quad 26=26.5 \mathrm{VDC}$
$\dagger 6$ and 9 volt coil only available on high performance models.
Terminal Length:
$\mathrm{B}=1.50$ in ( 38.105 mm ) - only available on high performance models
$P=0.187 \pm 0.010$ in ( $4.75 \pm 0.25 \mathrm{~mm}$ )

## Microwave Switching, Hermetically Sealed, DPDT <br> MW6 \& MW6HP Models <br> 6 GHz. Switching

## Electrical Characteristics

Contact Arrangement -
2 Form C (DPDT)
Contact Resistance -
Before life - 100 milliohms, max.
(measured @ 10 mA @ 6 VDC)
After life - 200 milliohms, max.
(measured @ 1 A @ 28 VDC)
Mechanical Life Expectancy -
10 million operations
Coil Voltages -
5, 12, 18 \& 26.5 VDC (MW6)
5, 6, 9, 12, 18 \& 26.5 VDC (MW6HP)
Coil Power (mW max. @ $25^{\circ} \mathrm{C}$ ) -

| MW6 | MW6S | MW6HP | MW6HPS |
| :---: | :---: | :---: | :---: |
| 675 | 565 | 673 | 563 |

Duty Cycle - Continuous
Pick-up Voltage -
MW6 - Approx 70\% of nominal.
MW6HP — Approx 50\% of nominal.
Pick-up Sensitivity (mW max. @ $25^{\circ} \mathrm{C}$ ) -

| MW6 | MW6S | MW6HP | MW6HPS |
| :---: | :---: | :---: | :---: | :---: |
| 180 | 90 | 123 | 68 |

## Operating Characteristics

Operate Time (ms max.) -

| MW6 | MW6S | MW6HP | MW6HPS |
| :---: | :---: | :---: | :---: |
| 4.0 | 6.0 | 2.0 | 4.0 |

Release Time (ms max.) MW6 MW6S MW6HP MW6HPS $\begin{array}{llll}3.0 & 3.0 & 1.5 & 2.0\end{array}$
Bounce Time (ms max.) MW6 MW6S MW6HP MW6HPS

Dielectric Withstanding Voltage -
Between Open Contacts,
Between Adjacent Contacts and
Between Contacts and Coil -
MW6 types - 350 Vrms, 60 Hz .
MW6HP types - $500 \mathrm{Vrms}, 60 \mathrm{~Hz}$.
Insulation Resistance -
1,000 megohms @ 500 VDC

## Environmental Characteristics

## Contact Ratings

| Contact <br> Load | Type | Operations <br> Min. |
| :--- | :--- | ---: |
| $1.0 \mathrm{~A} @ 28 \mathrm{VDC}$ | Resistive | 100,000 |
| $200 \mathrm{~mA} @ 28 \mathrm{VDC}(300 \mathrm{mH})^{*}$ | Inductive | 100,000 |
| $30 \mu \mathrm{~A} @ 50 \mathrm{mVDC}$ | Low Level | $10,000,000$ |

* The inductive rating is only applicable to high performance models (MW6HP and MW6HPS).

Coil Data

| MW6 Models |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Nominal Coil Voltage (VDC) | Coil Resistance In Ohms $\pm 20 \%$ @ $25^{\circ} \mathrm{C}$ |  | Pickup Voltage VDC (Max.) @ $25^{\circ} \mathrm{C}$ |  | nal wer $25^{\circ} \mathrm{C}$ |  | Maximum Coil Voltage | Coil Desig. |
| Standard Coil |  |  |  |  |  |  |  |  |
| 5.0 | 50 |  | 3.6 | 500 |  |  | 5.8 | 5 |
| 12.0 | 390 |  | 8.4 | 369 |  |  | 16.0 | 12 |
| 18.0 | 880 |  | 13.0 | 368 |  |  | 24.0 | 18 |
| 26.5 | 1,560 |  | 17.0 | 450 |  |  | 32.0 | 26 |
| Sensitive Coil |  |  |  |  |  |  |  |  |
| 5.0 | 100 |  | 3.5 | 250 |  |  | 7.5 | 5 |
| 12.0 | 850 |  | 9.0 | 169 |  |  | 20.0 | 12 |
| 18.0 | 1,600 |  | 13.5 | 203 |  |  | 30.0 | 18 |
| 26.5 | 3,300 |  | 18.0 | 213 |  |  | 40.0 | 26 |
| MW6HP (High Performance) Models |  |  |  |  |  |  |  |  |
| Nominal Coil Voltage (VDC) | $\begin{gathered} \text { Coil Res. } \\ \text { in Ohms } \\ \pm 10 \% @ 25^{\circ} \mathrm{C} \\ \hline \end{gathered}$ | Pickup V VDC (Max.) @ $25^{\circ} \mathrm{C}$ | Release V VDC (Max.) $@ 25^{\circ} \mathrm{C}$ | $\begin{gathered} \text { Release V } \\ \text { VDC (Min.) } \\ \text { @ } 25^{\circ} \mathrm{C} \\ \hline \end{gathered}$ |  | minal Power @ $25^{\circ} \mathrm{C}$ |  Maximum <br> Coil <br> C <br> Voltage | Coil Desig. |
| Standard Coil |  |  |  |  |  |  |  |  |
| 5.0 | 50 | 2.7 | 1.4 | 0.22 |  | 500 | 5.8 | 5 |
| 6.0 | 98 | 3.5 | 2.0 | 0.28 |  | 367 | 8.0 | 6 |
| 9.0 | 220 | 5.3 | 3.0 | 0.54 |  | 368 | 12.0 | 9 |
| 12.0 | 390 | 7.0 | 4.0 | 0.63 |  | 369 | 16.0 | 12 |
| 18.0 | 880 | 10.5 | 6.0 | 0.91 |  | 368 | 24.0 | 18 |
| 26.5 | 1,560 | 14.2 | 8.0 | 1.37 |  | 450 | 32.0 | 26 |
| Sensitive Coil |  |  |  |  |  |  |  |  |
| 5.0 | 100 | 2.6 | 1.4 | 0.23 |  | 250 | 7.5 | 5 |
| 6.0 | 200 | 3.4 | 2.0 | 0.28 |  | 180 | 10.0 | 6 |
| 9.0 | 400 | 4.85 | 3.0 | 0.55 |  | 203 | 15.0 | 9 |
| 12.0 | 850 | 7.0 | 4.0 | 0.64 |  | 169 | 20.0 | 12 |
| 18.0 | 1,600 | 9.8 | 6.0 | 0.92 |  | 203 | 30.0 | 18 |
| 26.5 | 3,300 | 14.0 | 8.0 | 1.4 |  | 213 | 40.0 | 26 |

Temperature Range -
MW6 types - $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$.
MW6HP types - $-65^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$.
Weight -
MW6, MW6HP: 0.09 oz. ( 2.55 g )
MW6S, MW6HPS: 0.12 oz. ( 3.40 g ).

## Vibration Resistance -

MW6 types - 10 G's, 10-500 Hz.
MW6HP types - 30 G's, 10-3,000 Hz
Shock Resistance -
MW6 types - 30 G's, $6 \pm 1 \mathrm{~ms}$
MW6HP types - 100 G's, $6 \pm 1 \mathrm{~ms}$.

## Double Pole, Electrically Held, 1 Amp and Less (Continued)

## Microwave Switching, Hermetically Sealed, DPDT

MW6 \& MW6HP Models 6 GHz. Switching (Continued)

Insertion Loss \& VSWR: NO Contacts


Insertion Loss \& VSWR: NC Contacts


## Isolation



Test Conditions

Test Board - 0.031" double sided copper clad, PTFE based laminate. Connections - Relay header is soldered to ground place. Relay terminals are soldered to through holes. SMA
connectors are soldered to circuit traces.

Temperature — Room ambient.
Signal Strength — 0 dBm .
Notes:

1. Unused terminals were terminated with 50 ohm impedance load.
2. All readings are typical.

## Enclosures



MW6 / MW6HP

Part Numbering System


Header


Header and Terminal Finish: Gold plated

CII High Vibration Applications

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MAV, MAVD, MAVDD

Electrical Characteristics
Contact Arrangement -
2 Form C (DPDT)
Contact Material -
Stationary -
Gold/platinum/palladium/silver alloy
(Gold plated)
Moveable -
Gold/platinum/palladium/silver alloy (Gold plated)

## Contact Resistance -

Before Life - 100 milliohms max. (measured @ 10 mA @ 6 Vdc ) After Life - 200 milliohms max.
(measured @ 1 A @ 28 Vdc )
Mechanical Life Expectancy -
1 million operations
Coil Voltage - 5 to 26.5 Vdc
Coil Power - 820 mW max. @ $25^{\circ} \mathrm{C}$
Duty Cycle - Continuous
Pick-up Voltage - Approximately $70 \%$ of Nominal Coil Voltage
Pick-up Sensitivity - 370 mW max. @ $25^{\circ} \mathrm{C}$

Double Pole, Electrically Held, 1 Amp and Less

| MAV | MAVD | MAVDD |
| :---: | :---: | :---: |
| Standard <br> High Vibration TO-5 High Performance Relay | Standard | Standard |
|  | High Vibration T0-5 | High Vibration TO-5 |
|  | Diode Suppressed | Diode |
|  | High Performance Relay | Suppressed/Protected High Performance Relay |
|  |  |  |
|  |  |  |
|  | $\rightarrow$ | O ${ }^{\text {x1 }}$ |
|  | $\bigcirc \square^{82}$ | ${ }^{+2 \mathrm{O}} \square^{\mathrm{B2}}$ |
|  | ${ }^{10} 0 \rightarrow 4{ }^{+81}$ |  |
|  | ${ }^{3} \mathrm{O}--_{-}{ }^{83}$ | ${ }_{3} \mathrm{O}-\square^{\text {¢ }}$ |
| Terminal View | Terminal View | Terminal View |
| Product Facts <br> - Hermetically sealed <br> - Extreme shock \& vibration ratings <br> - Spreader pads | Product Facts <br> - Suppression diode <br> - Hermetically sealed <br> - Extreme shock \& vibration ratings <br> - Spreader pads | Product Facts |
|  |  |  |
|  |  | protection diodes |
|  |  | - Hermetically sealed |
|  |  | - Extreme shock \& vibration |
|  |  | ratings |
|  |  | - Spreader pads |

## Contact Ratings

| Contact <br> Load | Type | Operations <br> Min. |
| :--- | :--- | ---: |
| 1.0 A @ 28 Vdc | Resistive | 100,000 |
| $250 \mathrm{~mA} @ 115 \mathrm{Vac}, 60 \mathrm{~Hz} \& 400 \mathrm{~Hz}$ | Resistive (Case not grounded) | 100,000 |
| $100 \mathrm{~mA} @ 115 \mathrm{Vac}, 60 \mathrm{~Hz} \& 400 \mathrm{~Hz}$ | Resistive | 100,000 |
| 0.2 A @ 28 Vdc | Inductive $(0.32$ Henry) | 100,000 |
| 0.1 A @ 28 Vdc | Lamp | 100,000 |
| $30 \mu \mathrm{~A} @ 50 \mathrm{mVdc}$ | Low Level | $1,000,000$ |
| 0.1 A @ 28 Vdc | Intermediate Current | 50,000 |



## Double Pole, Electrically Held, 1 Amp and Less (Continued)

| MAV, MAV <br> (Continued) | D, MAVDD |  | ating Chara <br> ate Time - <br> ase Time - <br> -1.5 ms max <br> / MAVDD - <br> ession diode, <br> in diodes) <br> act Bounce - <br> ctric Withsta <br> en Open Contac <br> rms 60 Hz <br> en Adjacent Co <br> rms 60 Hz <br> en Contacts an <br> vms 60 Hz <br> ation Resista <br> megohms mi <br> megohms @ 5 <br> $5^{\circ} \mathrm{C}$ ) <br> ronmental <br> erature Rang <br> to $+125^{\circ} \mathrm{C}$ <br> ht - <br> z. (2.55 grms) <br> z. (2.80 grms) <br> d | eristics <br> ms max. <br> ms max. ppression/ <br> .5 ms max. ding Voltage - <br> acts - <br> Coil - <br> - <br> @ 500 Vdc <br> Vdc (coil to case <br> aracteristics <br> h spreader pad | Vibratio 100 G's, 250 G's, 350 G's, 380 G's, Shock 150 G's, | Resistance <br> $2,000 \mathrm{~Hz}$ <br> + - 5 Hz <br> + +- 5 Hz <br> + - 5 Hz <br> stance - <br> 1 ms max. |  | Semicondu <br> Diode - <br> 100 Vdc peak 1.0 Vdc max. $\square$ <br> unting Pads | tor Char <br> verse volta nsient volta | eristics <br> PIV) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Coil Data |  |  |  |  |  |  |  |  |  |  |
| Nom. Coil Voltage (Vdc) | Coil Resistance in 0 hm $\pm 0 \%$. (Note (N | Coil Circuit Current mA (Max.) (Note 1) | Coil Circuit Current mA (Min.) (Note 1) | Pickup Voltage Vdc (Max.) @ $25^{\circ} \mathrm{C}$ |  | Drop-Out Voltage Vdc (Min.) $@ 25^{\circ} \mathrm{C}$ | Drop-Out Voltage <br>  | Nom. Coil Power @ $25^{\circ} \mathrm{C}$ <br> @ $25^{\circ}$ | $\begin{gathered} \text { Max. } \\ \text { Coil } \\ \text { Voltage } \end{gathered}$ | Coil Desig. |
| MAV |  |  |  |  |  |  |  |  |  |  |
| 5.0 | 50 | n/a | n/a | 3.5 | 4.6 | 0.22 | 0.14 | 500 | 5.8 | 5 |
| 6.0 | 70 | n/a | n/a | 4.0 | 5.5 | 0.28 | 0.18 | 514 | 8.0 | 6 |
| 9.0 | 155 | n/a | n/a | 5.9 | 8.2 | 0.54 | 0.35 | 523 | 12.0 | 9 |
| 12.0 | 235 | n/a | n/a | 8.0 | 11.0 | 0.63 | 0.41 | 613 | 16.0 | 12 |
| 18.0 | 610 | n/a | n/a | 11.9 | 16.5 | 0.91 | 0.59 | 531 | 24.0 | 18 |
| 26.5 | 1,130 | n/a | n/a | 15.9 | 22.0 | 1.37 | 0.89 | 621 | 32.0 | 26 |
| MAVD |  |  |  |  |  |  |  |  |  |  |
| 5.0 | 33 | n/a | n/a | 3.5 | 4.6 | 0.22 | 0.14 | 758 | 5.8 | 5 |
| 6.0 | 44 | n/a | n/a | 4.0 | 5.5 | 0.28 | 0.18 | 818 | 8.0 | 6 |
| 9.0 | 125 | n/a | n/a | 5.9 | 8.2 | 0.54 | 0.35 | 648 | 12.0 | 9 |
| 12.0 | 215 | n/a | n/a | 8.0 | 11.0 | 0.63 | 0.41 | 670 | 16.0 | 12 |
| 18.0 | 470 | n/a | n/a | 11.9 | 16.5 | 0.91 | 0.59 | 689 | 24.0 | 18 |
| 26.5 | 1,050 | n/a | n/a | 15.9 | 22.0 | 1.37 | 0.89 | 669 | 32.0 | 26 |
| MAVDD |  |  |  |  |  |  |  |  |  |  |
| 5.0 | 33 | 126.4 | 92.8 | 3.5 | 4.6 | 0.6 | 0.6 | 758 | 5.8 | 5 |
| 6.0 | 44 | 122.6 | 90.4 | 4.0 | 5.5 | 0.7 | 0.7 | 818 | 8.0 | 6 |
| 9.0 | 125 | 73.4 | 54.3 | 5.9 | 8.2 | 0.9 | 0.8 | 648 | 12.0 | 9 |
| 12.0 | 215 | 59.4 | 37.8 | 8.0 | 11.0 | 1.1 | 0.9 | 670 | 16.0 | 12 |
| 18.0 | 470 | 42.0 | 31.3 | 11.9 | 16.5 | 1.4 | 1.1 | 689 | 24.0 | 18 |
| 26.5 | 1,050 | 28.3 | 21.3 | 15.9 | 22.0 | 1.8 | 1.4 | 669 | 32.0 | 26 |

N, MAVD, MAVDD
(Continued)

Operating Characteristics

Release Time -
MAVD / MAVDD - 4.0 ms max.
(suppression diode, suppression/
stang dodes)
Dielectric Withstanding Voltage -
cen Open Contacts -
500 Vrms 60 Hz
Contacts -
500 Vrms 60 Hz
500 Vrms 60 Hz
Insulation Resistance -
0,000 megohms min. @ 500 Vdc
1,000 megohms @ 500 Vdc (coil to case $+125^{\circ} \mathrm{C}$

Environmental Characteristics
emperature Range -

Weight -
0.10 oz. (2.80 grms) with spreader pad attached

## (1)

250 Gs,170 1 -5
380 Gs 170 +1-5
Shock Resistance -
150 G's, $11 \pm 1 \mathrm{~ms}$ max.

## Semiconductor Characteristics

 Diode -100 Vdc peak inverse voltage (PIV)
1.0 Vdc max. transient voltage



Spreader \& Mounting Pads

Note: 1. Coil resistance not directly measurable in MAVDD series.
Coil current should be within limits shown when tested at nominal voltage at $25^{\circ} \mathrm{C}$ for 5 seconds maximum.

## HOW TO SPECIFY A PART NUMBER

For our standard catalog High Performance products, the
Part Number begins with the series designator shown below.

| Speciifying a Part Number Example: | Series | Terminals | Diodes | Ground Pins | Coils | Spreader/ Mounting Pads |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | MAV | C | D | G | -26 | S |

Dimensions are in millimeters unless otherwise specified.

## MSV, MSVD

Double Pole, Electrically Held, 1 Amp and Less (Continued)

| MSV | MSVD |
| :---: | :---: |
| Sensitive | Sensitive |
| High Vibration TO-5 | High Vibration TO-5 <br> Digh Performance Relay <br> Diode Suppressed <br> High Performance Relay |



Terminal View
Product Facts
■ Hermetically sealed
■ Extreme shock \& vibration ratings
■ Spreader pads


Terminal View

## Product Facts

- Suppression diode

■ Hermetically sealed
■ Extreme shock \& vibration ratings
■ Spreader pads

Electrical Characteristics
Contact Arrangement -
2 Form C (DPDT)
Contact Material -
Stationary -
Gold/platinum/palladium/silver alloy
(Gold plated)
Moveable -
Gold/platinum/palladium/silver alloy (Gold plated)

## Contact Resistance -

Before Life - 100 milliohms max. (measured @ 10 mA @ 6 Vdc ) After Life - 200 milliohms max. (measured @ 1 A @ 28 Vdc) Mechanical Life Expectancy 1 million operations
Coil Voltage - 5 to 26.5 Vdc
Coil Power - 370 mW max. @ $25^{\circ} \mathrm{C}$
Duty Cycle - Continuous
Pick-up Voltage - Approximately $70 \%$ of Nominal Coil Voltage
Pick-up Sensitivity - 155 mW max. @ $25^{\circ} \mathrm{C}$

Contact Ratings

| Contact Load | Type | Operations Min. |
| :---: | :---: | :---: |
| 1.0 A @ 28 Vdc | Resistive | 100,000 |
| 250 mA @ $115 \mathrm{Vac}, 60 \mathrm{~Hz}$ \& 400 Hz | Resistive (Case not grounded) | 100,000 |
| 100 mA @ $115 \mathrm{Vac}, 60 \mathrm{~Hz}$ \& 400 Hz | Resistive | 100,000 |
| 0.2 A @ 28 Vdc | Inductive (0.32 Henry) | 100,000 |
| 0.1 A @ 28 Vdc | Lamp | 100,000 |
| $30 \mu \mathrm{~A} @ 50 \mathrm{mVdc}$ | Low Level | 1,000,000 |
| 0.1 A @ 28 Vdc | Intermediate Current | 50,000 |




MSV/MSVDD Header to change.

## Double Pole, Electrically Held, 1 Amp and Less (Continued)

## MSV, MSVD (Continued)

## Environmental Characteristics

Temperature Range -
$-65^{\circ} \mathrm{C}$ to $+122^{\circ} \mathrm{C}$
Weight
0.09 oz. (2.55 grms)
0.10 oz. (2.80 grms) with spreader pad attached
Vibration Resistance -
100 G's, $10-2,000 \mathrm{~Hz}$
250 G's, 140 +/- 5 Hz
350 G's, 170 +/- 5 Hz
380 G's, 200 +/- 5 Hz
Shock Resistance -
150 G's, $11 \pm 1 \mathrm{~ms}$ max.

Semiconductor Characteristics

## Diode -

100 Vdc peak inverse voltage (PIV)
1.0 Vdc max. transient voltage



w

Spreader \& Mounting Pads

Coil Data

| Nom. Coil Voltage (Vdc) | Coil Resistance in Ohms $\pm 10 \% @ 25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) <br> @ $25^{\circ} \mathrm{C}$ | Pickup Voltage Vdc (Max.) @ $125^{\circ} \mathrm{C}$ | Drop-Out Voltage Vdc (Min.) <br> @ $25^{\circ} \mathrm{C}$ | Drop-Out Voltage Vdc (Min.) @ -65 ${ }^{\circ} \mathrm{C}$ | Nom. Coil Power (mW) @ $25^{\circ} \mathrm{C}$ | Max. Coil Voltage | Coil Desig. |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| MSV / MSVD |  |  |  |  |  |  |  |  |
| 5.0 | 80 | 3.5 | 4.6 | 0.22 | 0.14 | 313 | 5.8 | 5 |
| 6.0 | 120 | 4.0 | 5.5 | 0.28 | 0.18 | 300 | 8.0 | 6 |
| 9.0 | 240 | 5.9 | 8.2 | 0.54 | 0.35 | 338 | 12.0 | 9 |
| 12.0 | 480 | 8.0 | 11.0 | 0.63 | 0.41 | 300 | 16.0 | 12 |
| 18.0 | 950 | 11.9 | 16.5 | 0.91 | 0.59 | 341 | 24.0 | 18 |
| 26.5 | 1,900 | 15.9 | 22.0 | 1.37 | 0.89 | 370 | 32.0 | 26 |

## HOW TO SPECIFY A PART NUMBER

For our standard catalog High Performance products, the Part Number begins with the series designator shown below.

| Specifying a Part Number Example: | Series | Terminals | Diodes | Ground <br> Pins | Spreader/ <br> Coils | Mounting Pads |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | MSV | C | D | $G$ | -26 | S |

## Engineering Notes

High Reliability Space Relays and Contactors

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## Product Testing



TE's CII High Reliability Space Relay products begin as relays manufactured to MIL-Spec requirements. They then receive additional processing and testing to particular customer specifications.
All operations and processes are documented as required by MIL-STD-790. Each operation and process has an accompanying route sheet that allows tracking of all materials and processes associated with an order. For those who require additional information, we can serialize, track and document the data for individual relays.
In addition to quality audits throughout the manufacturing process, our High Reliability Space relays are extensively tested to assure that your High Reliability standards and requirements are met or exceeded.
Our High Reliability Space Relay products are tested 100\% for Group A parameters and then subjected to additional testing including: PIND, Small Particle
Cleaning, Random, Vibration, and X-Ray. Group $B$ and $C$ testing is done for lot integrity based on MIL-R-39016. These test profiles are tailored to your individual requirements.
Destructive testing is often performed, based on the actual application of the device. On a "standard" QPL relay, this testing is performed periodically, and performance is assumed for the period of manufacture. In the High Reliability Space

## CII High Reliability Space Relays



Relay, this performance is proven for each relay lot based on the testing and documentation of each serialized relay.


## Clean Room

All of our High Reliability Space Relay products are manufactured in a temperature and humidity controlled environment utilizing a clean room area for sub-assemblies. All final assembly, intermediate testing, small particle cleaning, pre-cap inspection, and sealing is
performed in an integrated, Class 1000 clean room that is temperature and humidity controlled in accordance with Federal Standard 209E. Temperature, humidity and air particle counts are monitored for precise control to ensure the integrity of the internal relay environment. Specifications subject to change.

For additional support numbers
please visit www.te.com

## CII High Reliability Space Relays (Continued)

## Products

- Half Size Non-Latching

Available in 2, 4 and 6 Form C configurations, low level to 5 amp switching.

## - Half Size Latching

Available in 2 and 4 Form C configurations, low level to 2 amp switching.

## - One Fifth Non-Latching

2 Form C, low level 2 amp switching.

## ■ T0-5/.100 Grid

Available in 2 Form C, round and square outlines, low level to 1 amp switching, military qualified, optional spreader and mounting pads, ground pins, internal diodes, transistors, and hybrid assemblies.

## Services

Our engineering staff, with over 100 years of combined experience in aerospace and High Reliability mil-spec relays, will help you
find the right product
for your needs. Our High Reliability Space Relays Department experts are crosstrained within their respective cells to achieve maximum quality and consistency. In addition, team and SPC training utilizing ISO 9000 concepts is given regularly.

## Applications

■ Space Satellites (telecommunications)
■ Weather Tracking
■ Surveillance
Infrared Observation Instrumentation
Missile Systems
■ Torpedo Guidance Circuits
CII High Reliability Space Relays customers include ITT's HIRS/3 and AVHRR/3 instruments designed for
 the Polar Orbiting
Environmental Satellite (POES) and McDonnell Douglas's Delta Launch II and III Vehicles.


For additional support numbers please visit www.te.com

## Kilovac Space Relays

The KILOVAC brand of lightweight relays and contactors handle highpower DC or high-voltage DC requirements for the space industry.
They are available hermetically sealed, with a variety of electrical configurations, power ratings, voltage ratings, and mounting styles to make your electrical system more reliable and capable.
The photo to the right shows "representative samples" of our Kilovac brand relays and contactors for space applications.

Contact TE Connectivity for more information.


Products shown in photo as listed below:

Back Row - 270Vdc SpaceRated Contactors:

AP150X - 150A
AP90X - 90A
AP350X - 350A

Middle Row - Space-Rated Contactors:

MAP200 -
Available in Form $X$ (Electrically Held) and Form $P$ (Latching) configurations.
Available in Vertical-Mount (shown) and HorizontalMount configurations.

## MAP100 -

Available in Form X (Electrically Held) and Form P (Latching) configurations.
Available in Horizontal-
Mount (shown) and VerticalMount configurations.

## Front Row - Space-Rated Relays:

AP10 - 10A, 270Vdc
Available in Form A (SPSTNO) and Form B (SPST-NC) configurations.
Available in Panel-Mount (shown), PCB-Mount, and Chassis-Mount (unpotted).
K41R — 5kVdc
SPDT-Latching configuration (SPST-Latching as well as SPST-NO, SPST-NC, and SPDT Electrically-Held configurations also available)
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## TD2 Series Time Delay Relay

## Product Facts

- Qualified to:

MIL-PRF-83726/28
MIL-PRF-83726/29
MIL-PRF-83726/30
MIL-PRF-83726/31

- Fixed delay on operate, fixed delay on release, adjustable delay on operate \& adjustable delay on release
- Meets or exceeds electrostatic discharge MIL-STD-1686 Class Non-Sensitive
■ Welded hermetically sealed enclosure occupies about 1 in $^{3}$ ( $16.4 \mathrm{~cm}^{3}$ )
- 10A, 2 form C (DPDT) output contacts


TD2 series time delay relays are available for delay on operate or delay on release operation. Either can be supplied as fixed or resistor adjustable types. Both military and commercial versions are offered.

These products consist of solid state timing circuits controlling our FCA-210 series relays, providing 2 Form C (DPDT) output contacts rated 10 amps. The internal timing circuit uses an R/C controlled oscillator with a program-
mable digital pulse counter, gating a semiconductor switch to operate the relay. Timing is independent of whether the controlling voltage is a ramp or step function.

For the adjustable models the user specifies a one decade range in seconds, within which the required delay will be set. This range is programmed internally at the time of manufacture. The required delay is obtained by calculating the oscillator timing resistor as
follows and connecting it externally to terminals 1D 3D as below.
$R_{\text {EXT }}=\left[\left(T_{1} / T_{0}\right)-1\right] 100 \mathrm{~K}$ Ohms
$\mathrm{T}_{0}=$ Minimum time of selected decade in seconds.
T1 = Required time delay. EXAMPLE
Selected Range $=3-30 \mathrm{sec}$
Required Time $=15 \mathrm{sec}$
$R_{\text {EXT }}=[(15 / 3)-1] 100 \mathrm{~K}=$ 400K

## Timing Action and Terminal Wiring

Delay On Operate:
The time delay starts on the application of input voltage to X1-X2. The timing circuit energizes the end of the time delay period.


Fixed Model


Adjustable Model EXT. RESISTOR $1 / 4$ WATT MIN.


Delay On Release:
The input voltage is continuous to $\mathrm{X} 1-\mathrm{X} 2$. When the control voltage is applied to C1-X2 the timing circuit and the relay are both energized. The time delay starts when the control voltage is shut off.


Fixed Model


Adjustable Model


Terminal designations shown in the diagrams above are for reference only. They do not appear on the relay header.

## Specifications



## NOTES

1. The accuracy requirement applies to any combination of operating temperature and voltage. Add $\pm 10 \mathrm{~ms}$ for timing less than one second.
2. Recycle time to assure that the next timing cycle will be completed. Units can be recycled during timing and after time-out: Delay on operate models - Power must be OFF the input at least 10 ms . Delay on release models - Power must be ON the control terminal at least 10 ms .
3. Transient specifications are based on a maximum duty cycle of $1 / 50$.
4. All wired terminals must be connected together during this test. Dielectric withstanding voltage and insulation resistance are measured between all mutually insulated wired terminals and between all these terminals and case.
5. Inductive loads must be diode suppressed.

# TD2 Series Time Delay Relay (Continued) 

## Outline Dimensions

The standard terminal types and enclosures are illustrated below with dimensions expressed as inches $\pm 0.010$ and (millimeters $\pm 0.25$ ).

## Terminals

All terminals on 0.200 (5.4) centers.


## Enclosures

All Enclosures have cupro-nickel cans bright acid tin/lead plated after assembly to terminal headers.


For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.

## TD2 Series Time Delay Relay (Continued)

## Part Numbering System Mil-Spec Types



## Commercial Types

NOTE: Commercial versions are available with timing ranges outside of .1 to 600 sec . range.
For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.

| Catalog 5-1773450-5 | Dimensions are shown for | Dimensions are in millimeters | USA: +18005226752 | For additional support numbers |
| :--- | :--- | :--- | :--- | :--- |
| Revised 3-13 | reference purposes only. | unless otherwise specified. | Asia Pacific: +8604008206015 | please visit www.te.com |
| www.te.com | Specifications subject <br> to change. |  | UK: +44800267666 |  |

## FCB-205 Series, 5 Amperes, DPDT



Product Facts

- Hermetically Sealed
- All Welded Construction
- Balanced Force
- Permanent Magnet Drive
- Contacts rated low level to 5 Amps VDC and 115/200 VAC $400 \mathrm{~Hz}, 3$ Phase
$\square$ Weight .54 ounces max. ( 15.4 grams)
- Qualified to M83536/1, /2

The Series FCB-205 relay is a polarized single-side stable design, where the flux from a permanent magnet provides the armature holding force in the deactivated state, and its flux path is switched and combined with the coil flux in the operated state. This results in appreciably
increased contact pressure in both states over that of a spring return nonpolar design. We also manufacture other forms of the FCB relay:
FCB-405-5 Amp 4PDT Relay

Contact Rating - Amperes Ratings Are Continuous Duty

| Type of <br> Load | Life (Min.) <br> Cycles x 10 | 28 VDC | $\mathbf{1 1 5 V A C}$ <br> $\mathbf{4 0 0 H z}$ | 115/200VAC <br> $\mathbf{4 0 0 H z}, \mathbf{3 \emptyset}$ |
| :---: | :---: | :---: | :---: | :---: |
| Resistive | 100 | 5 | 5 | 5 |
| Inductive | 20 | 3 | 5 | 5 |
| Motor | 100 | 2 | 3 | 3 |
| Lamp | 100 | 1 | 1 | 1 |

*60 Hz loads rated for 10,000 operations
Low Level Switching Capability: With contacts operating a load of 10 to 50 microamperes at 10 to 50 millivolts, the contact resistance miss detection level shall be 100 ohms max. Cycling rate is 1 to 12 per second, for 100,000 operations.

Overload Current - 20 AMPS DC, 30 AMPS 400 Hz
Rupture Current - 25 AMPS DC, 40 AMPS 400 Hz
Contact Make Bounce - 1.0 MILLISECOND AT NOMINAL VOLTAGE
Max. Contact Drop at 5 Amps - INITIAL 0.100 VOLTS
End of Life - 0.125 VOLTS

General Specifications
Temperature Rating -
$-70^{\circ} \mathrm{C} \mathrm{TO}+125^{\circ} \mathrm{C}$
Altitude - 300,000 Feet
Shock* -
Z, Y, \& X Enclosures -
200 g for 6 mS
W \& M Enclosures (Stud Mtg.) -
100 g for 6 mS
T Enclosure (Socket Mounted in Track) -
50 g for 11 mS
Vibration, Sinusoidal*
Z, Y, \& X Enclosures -
0.12 DA 10 to $70 \mathrm{~Hz}, 30 \mathrm{~g} 70-3000 \mathrm{~Hz}$

W \& M Enclosures (Stud Mtg.) -
0.12 DA 10 to $57 \mathrm{~Hz}, 20 \mathrm{~g} 57-3000 \mathrm{~Hz}$

T Enclosure (Socket Mounted in Track) -
0.06 DA 10 to $57 \mathrm{~Hz}, 10 \mathrm{~g} 57$ to 500 Hz ,

20 g 500 to 3000 Hz
Vibration, Random* -
Z, Y, \& X Enclosures -
$0.4 \mathrm{~g} 2 / \mathrm{Hz} 50-2000 \mathrm{~Hz}$
T, W \& M Enclosures -
$0.2 \mathrm{~g} / \mathrm{Hz} 50-2000 \mathrm{~Hz}$
Dielectric Strength -
At Sea Level -
All circuits to ground and circuit to
circuit - 1000 V rms
Coil to ground - 1000 V rms
At 80,000 Feet - 250 V rms
Insulation Resistance -
Initial ( 500 VDC ) - $100 \mathrm{M} \Omega$ Min.
After Life or Environmental Tests $50 \mathrm{M} \Omega \mathrm{Min}$.
Operate Time at Nominal
Voltage - 4 ms or less
Release Time at Nominal
Voltage - 4 ms or less

* Max. contact opening under vibration or shock 10 microseconds


## Coil Data

| Coil <br> Code | Nominal <br> Voltages | Freq. <br> Hz | DC Res. <br> (B) | Over Temperature Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 6 | DC | $20 \Omega$ | Pickup or <br> Below Volts | Dropout or <br> Above Volts | Must Hold <br> Voltage (C) |
| 2 | 12 | DC | $95 \Omega$ | 9.5 | 0.3 | 2.5 |
| 3 | 28 | DC | $500 \Omega$ | 9.0 | 0.75 | 7.5 |
| $4(\mathrm{~A})$ | 28 | DC | $500 \Omega$ | 18.0 | 1.5 | 7.0 |
| 5 | 48 | DC | $1600 \Omega$ | 36.0 | 1.5 | 7.0 |

A. CODE 4 COILS HAVE BACK EMF SUPPRESSION TO 42 VOLTS MAX.
B. DC COIL RESISTANCE $\pm 10 \%$ AT $25^{\circ} \mathrm{C}$
C. RELAY WILL STAY IN PICKED-UP STATE DOWN TO MUST HOLD VOLTAGES SHOWN.
D. MAX. OVERVOLTAGE: 6 \& 12 VDC COILS $120 \%$ OF NOMINAL; ALL OTHERS $110 \%$ OF NOMINAL.

## FCB-205 Series, 5 Amperes, DPDT (Continued)

Below are shown the standard terminal types and the enclosures available. Specify the assembly as indicated under How To Order. Dimensions are shown in inches $\pm .010$ and (Millimeters $\pm .25$ ).

## Terminals



Enclosures
All Enclosures have Cupro-Nickel Cans bright acid tin/lead plated after assembly to terminal headers.
Dimensions: Inches $\pm .010(\mathrm{~mm} \pm .25)$
Enclosure "T" is for use with track mounted sockets and requires socket pin terminals, but no gasket. The gasket is included in the socket assembly.


*Metric threads available, To specify use $M$ in place of $W$


(REFERENCE ONLY)


NOTE: FOR USE WITH TRACK MOUNT PER MIL-R-6106/23
** MEASURED FROM SURFACE OF HEADER

Dimensions are shown for reference purposes only. Specifications subject to change.

## Terminal Wiring

## DC Coils



NOTE: Polarity must be observed with DC coil supply. Relay is polarized with a permanent magnet and will not operate or be damaged by reverse polarity.
Diodes used in transient suppression and in AC rectifier circuits have peak inverse voltage rating of 600 VDC minimum. Zener diodes have a minimum rating of 1 watt. Terminal designations are for reference only and do not appear on the header.

## Transient Suppression



TERMINAL VIEW

HOW TO ORDER

FCB-205-A Y 4
RELAY TYPE
TERMINALS (Socket Pins)
ENCLOSURE (With Flanges)
COIL (28 VDC With Transient Suppression).

* The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15.

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CII Mid-Range Relays

Product Facts

- Hermetically Sealed
- All Welded Construction
- Balanced Force
- Permanent Magnet Drive
- Contacts rated low level to 5 Amps 28 VDC and 115/200 VAC $400 \mathrm{~Hz}, 3$ Phase
■ Weight . 93 ounces max. (26.4 grams)

■ Qualified to M83536/5 \& /6


## FCB-405 Series, 5 Amperes, 4PDT

The Series FCB-405 relay is a polarized single-side stable design, where the flux from a permanent magnet provides the armature holding force in the deactivated state, and its flux path is switched and combined with the coil flux in the operated state. This results in appreciably

Contact Rating - Amperes Ratings Are Continuous Duty

| Type of <br> Load | Life (Min.) <br> Cycles $\mathbf{~ 1 0 3}$ | $\mathbf{2 8}$ VDC | $\mathbf{1 1 5 V A C}$ <br> $\mathbf{4 0 0 H z}$ | $\mathbf{1 1 5 / 2 0 0 V A C}$ <br> $\mathbf{4 0 0 H z}-\mathbf{3 \varnothing}$ |
| :---: | :---: | :---: | :---: | :---: |
| Resistive | 100 | 5 | 5 | 5 |
| Inductive | 20 | 3 | 5 | 5 |
| Motor | 100 | 2 | 3 | 3 |
| Lamp | 100 | 1 | 1 | 1 |

Low Level Switching Capability: With contacts operating a load of 10 to 50 microamperes at 10 to 50 millivolts, the contact resistance miss detection level shall be 100 ohms max. Cycling rate is 1 to 12 per second, for 100,000 operations.

Overload Current - 20 AMPS DC, 30 AMPS 400Hz
Rupture Current - 25 AMPS DC, 40 AMPS 400 Hz
Contact Make Bounce - 1.0 MILLISECOND AT NOMINAL VOLTAGE
Max. Contact Drop at 5 Amps - INITIAL 0.100 VOLTS
End of Life - 0.125 VOLTS
increased contact pressure in both states over that of a spring return nonpolar design. We also manufacture other versions of this relay:
FCB-205 - 5 Amp DPDT Relay

General Specifications
Temperature Rating -
$-70^{\circ} \mathrm{C} \mathrm{TO}+125^{\circ} \mathrm{C}$
Altitude - 300,000 Feet
Shock* -
Z \& Y Enclosures -
200 g for 6 mS
W, X \& M Enclosures -
100 g for 6 mS
T Enclosure (In Track) -
50 g for 11 mS
Vibration, Sinusoidal* -
Z \& Y Enclosures -
$30 \mathrm{~g} 70-3000 \mathrm{~Hz}$
W, X \& M Enclosures -
$20 \mathrm{~g} 70-3000 \mathrm{~Hz}$
T Enclosure (Socket Mounted in Track) -
$20 \mathrm{~g} 500-3000 \mathrm{~Hz}$
Vibration, Random* -
Z \& Y Enclosures -
$0.4 \mathrm{~g} / \mathrm{Hz} 50-2000 \mathrm{~Hz}$
T, W, X \& M Enclosures -
$0.2 \mathrm{~g} 2 / \mathrm{Hz} 50-2000 \mathrm{~Hz}$
Dielectric Strength -
At Sea Level -
All circuits to ground and circuit to circuit - 1000 V rms
Coil to ground - 1000 V rms
At 80,000 Feet - 250 V rms
Insulation Resistance -
Initial ( 500 VDC ) - $100 \mathrm{M} \Omega$ Min.
After Life or Environmental Tests $50 \mathrm{M} \Omega \mathrm{Min}$.
Operate Time at Nominal
Voltage - 6 ms or less
Release Time at Nominal
Voltage - 6 ms or less

* Max. contact opening under vibration or shock 10 microseconds


## Coil Data

| Coil <br> Code | Nominal <br> Voltages | Freq. <br> Hz | DC Res. <br> (B) | Over Temperature Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | 6 | DC | $25 \Omega$ | Pickup or <br> Below Volts | Dropout or <br> Above Volts | Must Hold <br> Voltage (C) |
| 2 | 12 | DC | 7.5 | 0.3 | 2.5 |  |
| 3 | 28 | DC | $400 \Omega$ | 9.0 | 0.75 | 7.5 |
| $4(\mathrm{~A})$ | 28 | DC | $400 \Omega$ | 18.0 | 1.5 | 7.0 |
| 5 | 48 | DC | $1275 \Omega$ | 18.0 | 1.5 | 7.0 |

A. CODE 4 COILS HAVE BACK EMF SUPPRESSION TO 42 VOLTS MAX.
B. DC COIL RESISTANCE $\pm 10 \%$ AT $25^{\circ} \mathrm{C}$
C. RELAY WILL STAY IN PICKED-UP STATE DOWN TO MUST HOLD VOLTAGES SHOWN.
D. MAX. OVERVOLTAGE: 6 \& 12 VDC COILS 120\% OF NOMINAL; ALL OTHERS 110\% OF NOMINAL. to change.

CII Mid-Range Relays
FCB-405 Series, 5 Amperes, 4PDT (Continued)
Below are shown the standard terminal types and the enclosures available. Specify the assembly as indicated under How To Order. Dimensions are shown in inches $\pm .010$ and (Millimeters $\pm .25$ ).

## Terminals



PIN TERMINALS ARE GOLD PLATED


CODE



## Solder Pin Terminals

PIN TERMINALS TIN/LEAD PLATED

Enclosures

## CODE <br> "C"

Solder Hook Terminals
HOOK TERMINALS TIN/LEAD PLATED


CODE


## Terminal Wiring

## DC Coils



DC Coils with Transient Suppression


NOTE: Polarity must be observed with DC coil supply. Relay is polarized with a permanent magnet and will not operate or be damaged by reverse polarity.
Diodes used in transient suppression and in AC rectifier circuits have peak inverse voltage rating of 600 VDC minimum. Zener diodes have a minimum rating of 1 watt. Terminal designations are for reference only and do not appear on the header.


TERMINAL VIEW

FCB-405-A Y 4

RELAY TYPE


TERMINALS (Socket Pins) $\qquad$
ENCLOSURE (With Flanges)
COIL (28 VDC With Transient Suppression).

* The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15.

CII Mid-Range Relays


Product Facts

- Hermetically Sealed
- All Welded Construction
- Balanced Force
- Permanent Magnet Drive

■ Contacts - Silver Cadmium Oxide with Gold Plating
■ Coils for DC, 50 to 400 Hz and 400 Hz AC

■ Weight 1.6 ounces max. (45.4 grams)

■ Qualified to M83536/9, /10

NOTE: Only DC Coil Models are QPL Approved.

## FCA-210 Series, 10 Amperes, DPDT

The Series FCA-210 relay is a polarized single-side stable design, where the flux from a permanent magnet provides the armature holding force in the deactivated state, and its flux path is switched and combined with the coil flux in the operated state. This results in appreciably increased contact pressure in both states over that of a spring return nonpolar design. We also
manufacture other versions of this relay:
FCA-410 - 10 Ampere 4PDT Relay
FCA-610 - 10 Ampere 6 PDT Relay

## Available:

FCA-215 - 15 Ampere DPDT Relay, Has the same specifications as the
FCA-210 except is rated at 15 amps. (Commercial Only)

General Specifications
Temperature Rating -
$-70^{\circ} \mathrm{C} T 0+125^{\circ} \mathrm{C}$
Altitude - 300,000 Feet
Shock* -
Z, Y, \& X Enclosures -
200 g for 6 mS
W \& M Enclosures (Stud MItg.) -
100 g for 6 mS
Vibration, Sinusoidal* -
Z, Y, \& X Enclosures -
$30 \mathrm{~g} \mathrm{33-3000Hz}$
W \& M Enclosures (Stud Mtg.) $20 \mathrm{~g} 33-3000 \mathrm{~Hz}$
Vibration, Random* -
Z, Y, \& X Enclosures $0.4 \mathrm{~g} 2 / \mathrm{Hz} 50-2000 \mathrm{~Hz}$
W \& M Enclosures (Stud Mitg.) -
$0.2 \mathrm{~g} / \mathrm{Hz} 50-2000 \mathrm{~Hz}$
Dielectric Strength -
At Sea Level -
All circuits to ground and circuit to
circuit - 1250 V rms
Coil to ground - 1000 V rms
At 80,000 Feet - 350 V rms

## Insulation Resistance -

Initial ( 500 VDC ) - $100 \mathrm{M} \Omega$ Min. After Life or Environmental Tests $50 \mathrm{M} \Omega \mathrm{Min}$.

## Operate Time at Nominal

Voltage -
DC Relays - 10 ms or less
AC Relays - 15 ms or less

## Release Time at Nominal

Voltage -
DC Relays - 10 ms or less
AC Relays - 50 ms or less

* Max. contact opening under vibration
or shock 10 microseconds


## Coil Data

| Coil <br> Code | Nominal <br> Voltages | Freq. <br> Hz | DC Res. <br> AC Amps (B) | Over Temperature Range <br> Pickup or <br> Below VoltsDropout or <br> Above Volts |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | 6 | DC | $20 \Omega$ | 4.5 | 0.3 | Must Hold <br> Voltage (C) |
| 2 | 12 | DC | $80 \Omega$ | 9.0 | 0.75 | 4.5 |
| 3 | 28 | DC | $320 \Omega$ | 18.0 | 1.5 | 7.0 |
| $4(\mathrm{~A})$ | 28 | DC | $320 \Omega$ | 18.0 | 1.5 | 7.0 |
| 5 | 48 | DC | $920 \Omega$ | 32.0 | 2.5 | 14.0 |
| 6 | 28 | 400 Hz | 180 mA | 22.0 | 1.25 | 10.0 |
| 7 | 28 | $50 / 400 \mathrm{~Hz}$ | 100 mA | 22.0 | 1.25 | 10.0 |
| 8 | 115 | 400 Hz | 40 mA | 90.0 | 5.0 | 40.0 |
| 9 | 115 | $50 / 400 \mathrm{~Hz}$ | 30 mA | 95.0 | 5.0 | 40.0 |

A. CODE 4 COILS HAVE BACK EMF SUPPRESSION TO 42 VOLTS MAX.
B. DC COIL RESISTANCE $\pm 10 \%$ AT $25^{\circ} \mathrm{C}$; AC COIL MAX. CURRENT AT NOMINAL VOLTAGE.
C. RELAY WILL STAY IN PICKED-UP STATE DOWN TO MUST HOLD VOLTAGES SHOWN.
D. MAX. OVERVOLTAGE: 6 \& 12 VDC COILS 120\% OF NOMINAL; ALL OTHERS 110\% OF NOMINAL.
E. COILS AVAILABLE FOR OTHER VOLTAGES AND FOR AC 50/60HZ.

## FCA-210 Series, 10 Amperes, DPDT (Continued)

Below are shown the standard terminal types and the enclosures available. Specify the assembly as indicated under How To Order. Dimensions are shown in inches $\pm .010$ and (Millimeters $\pm .25$ ).

## Terminals

SOCKET PINS ARE GOLD PLATED POLARIZING PINS ARE TIN/LEAD PLATED CIRCUIT BOARD PINS ARE TIN/LEAD PLATED DIMENSIONS EXCEPT AS NOTED:
INCHES $\pm .010$ (MILLIMETERS $\pm .25$ )


CODE Solder Hook Terminals
"C"
HOOK TERMINALS TIN/LEAD PLATED



## Enclosures

All Enclosures have Cupro-Nickel Cans bright acid tin/lead plated after assembly to terminal headers.
Dimensions: Inches $\pm .010$ ( $\mathrm{mm} \pm .25$ )
"A" AC Coils 1.125 in. (28.57) Max DC Coils 1.010 in. (25.65) Max.



CII Mid-Range Relays
FCA-210 Series, 10 Amperes, DPDT (Continued)

## Terminal Wiring

DC Coils with
Transient Suppression


DC Coils


AC Coils
115 VAC
115 VAC



NOTE: Polarity must be observed with DC coil supply. Relay is polarized with a permanent magnet and will not operate or be damaged by reverse polarity.
Diodes used in transient suppression and in AC rectifier circuits have peak inverse voltage rating of 600 VDC minimum. Zener diodes have a minimum rating of 1 watt.
Terminal designations are for reference only and do not appear on the header.


TERMINAL VIEW

HOW TO ORDER
FCA-215-
FCA-210-A Y 4

RELAY TYPE
TERMINALS (Socket Pins, DC Coil)
ENCLOSURE (With Flanges)
COIL (28 VDC With Transient Suppression).
NOTE: Only DC coil models are QPL Approved

* The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15.

CII Mid-Range Relays


## Product Facts

■ Hermetically Sealed
■ All Welded Construction

- Balanced Force

■ Permanent Magnet Drive
■ Contacts - Silver Cadmium Oxide with Gold Plating
■ Coils for DC, 50 to 400 Hz and 400 Hz AC

■ Weight 1.6 ounces max. (45.4 grams)

## FCA-212 Series, 12 Amperes, DPDT

The Series FCA-212 relay is a polarized single-side stable design, where the flux from a permanent magnet provides the armature holding force in the deactivated state, and its flux path is switched and combined with the coil flux in the operated state. This
results in appreciably increased contact pressure in both states over that of a spring return nonpolar design. We also
manufacture other versions of this relay:
FCA-412 - 12 Amp 4PDT Relay

Contact Rating - Amperes Ratings Are Continuous Duty

| Type of <br> Load | Life (Min.) <br> Cycles $\mathbf{~} \mathbf{1 0}^{\mathbf{3}}$ | $\mathbf{2 8}$ VDC | $\mathbf{1 1 5 V A C}$ <br> $\mathbf{4 0 0 H z}$ | $\mathbf{\mathbf { 1 1 5 / 2 0 0 V A C ~ 3 Ø }}$ |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Resistive | 100 | 12 | 12 | 12 | 2.5 |
| Inductive | 20 | 8 | 8 | 8 | 2.5 |
| Motor | 100 | 4 | 4 | 4 | 2.0 |
| Lamp | 100 | 2 | 2 | 2 | 1 |

*60 Hz loads rated for 10,000 operations
Overload Current - 40 AMPS DC, 60 AMPS 400 Hz
Rupture Current - 50 AMPS DC, 80 AMPS 400 Hz
Contact Make Bounce - 1 MILLISECOND AT NOMINAL VOLTAGE
Max. Contact Drop at 12 Amps - INITIAL 0.150 VOLTS
End of Life - 0.175 VOLTS

General Specifications
Temperature Rating -
$-70^{\circ} \mathrm{C} \mathrm{TO}+125^{\circ} \mathrm{C}$
Altitude - 300,000 Feet
Shock* -
$\mathrm{Z}, \mathrm{Y}$, \& X Enclosures -
200 g for 6 mS
W \& M Enclosures (Stud MItg.) -
100 g for 6 mS
Vibration, Sinusoidal* -
Z, Y, \& X Enclosures -
$30 \mathrm{~g} \mathrm{33-3000Hz}$
W Enclosure -
$20 \mathrm{~g} \mathrm{33-3000Hz}$
Vibration, Random* -
Z, Y, \& X Enclosures -
$0.4 \mathrm{~g} 2 / \mathrm{Hz} 50-2000 \mathrm{~Hz}$
W \& M Enclosures (Stud Mtg.) -
$0.2 \mathrm{~g} / \mathrm{Hz} 50-2000 \mathrm{~Hz}$
Dielectric Strength -
At Sea Level -
All circuits to ground and circuit to
circuit - 1250 V rms
Coil to ground - 1000 V rms
At 80,000 Feet - 350 V rms

## Insulation Resistance -

Initial ( 500 VDC ) - $100 \mathrm{M} \Omega$ Min. After Life or Environmental Tests $50 \mathrm{M} \Omega \mathrm{Min}$.

## Operate Time at Nominal

Voltage -
DC Relays - 10 ms or less
AC Relays - 15 ms or less
Release Time at Nominal

## Voltage -

DC Relays - 10 ms or less
AC Relays - 50 ms or less

* Max. contact opening under vibration or shock 10 microseconds


## Coil Data

| Coil Code | Nominal Voltages | Freq. Hz | DC Res. AC Amps (B) | Over Temperature Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Pickup or Below Volts | Dropout or Above Volts | Must Hold Voltage (C) |
| 1 | 6 | DC | $20 \Omega$ | 4.5 | 0.3 | 2.5 |
| 2 | 12 | DC | $80 \Omega$ | 9.0 | 0.75 | 4.5 |
| 3 | 28 | DC | $320 \Omega$ | 18.0 | 1.5 | 7.0 |
| 4 (A) | 28 | DC | $320 \Omega$ | 18.0 | 1.5 | 7.0 |
| 5 | 48 | DC | $920 \Omega$ | 32.0 | 2.5 | 14.0 |
| 6 | 28 | 400 Hz | 180 mA | 22.0 | 1.25 | 10.0 |
| 7 | 28 | $50 / 400 \mathrm{~Hz}$ | 100 mA | 22.0 | 1.25 | 10.0 |
| 8 | 115 | 400 Hz | 40 mA | 90.0 | 5.0 | 40.0 |
| 9 | 115 | $50 / 400 \mathrm{~Hz}$ | 30 mA | 95.0 | 5.0 | 40.0 |

A. CODE 4 COILS HAVE BACK EMF SUPPRESSION TO 42 VOLTS MAX.
B. DC COIL RESISTANCE $\pm 10 \%$ AT $25^{\circ} \mathrm{C}$; AC COIL MAX. CURRENT AT NOMINAL VOLTAGE.
C. RELAY WILL STAY IN PICKED-UP STATE DOWN TO MUST HOLD VOLTAGES SHOWN.
D. MAX. OVERVOLTAGE: 6 \& 12 VDC COILS $120 \%$ OF NOMINAL; ALL OTHERS $110 \%$ OF NOMINAL
E. COILS AVAILABLE FOR OTHER VOLTAGES AND FOR AC $50 / 60 \mathrm{HZ}$.

[^5]Below are shown the standard terminal types and the enclosures available. Specify the assembly as indicated under How To Order. Dimensions are shown in inches $\pm .010$ and (Millimeters $\pm .25$ ).

## Terminals

SOCKET PINS ARE GOLD PLATED POLARIZING PINS ARE TIN/LEAD PLATED CIRCUIT BOARD PINS ARE TIN/LEAD PLATED DIMENSIONS EXCEPT AS NOTED:
INCHES $\pm .010$ (MILLIMETERS $\pm .25$ )


CODE
"C"

## Solder Hook Terminals





Catalog 5-1773450-5
Revised 3-13

Dimensions are shown for reference purposes only. Specifications subject to change.

CII Mid-Range Relays
FCA-212 Series, 12 Amperes, DPDT (Continued)

## Terminal Wiring



NOTE: Polarity must be observed with DC coil supply. Relay is polarized with a permanent magnet and will not operate or be damaged by reverse polarity.
Diodes used in transient suppression and in AC rectifier circuits have peak inverse voltage rating of 600 VDC minimum. Zener diodes have a minimum rating of 1 watt.
Terminal designations are for reference only and do not appear on the header.


TERMINAL VIEW

HOW TO ORDER

RELAY TYPE
TERMINALS (Socket Pins, DC Coil) $\qquad$
ENCLOSURE (With Flanges) $\qquad$
COIL (28 VDC With Transient Suppression). $\qquad$

| Catalog 5-1773450-5 | Dimensions are shown for | Dimensions are in millimeters | USA: +18005226752 | For additional support numbers |
| :--- | :--- | :--- | :--- | :--- | :--- |
| Revised 3-13 | reference purposes only. | unless otherwise specified. | Asia Pacific: +8604008206015 | please visit www.te.com |
| www.te.com | Specifications subject |  | UK: +44800 267666 |  |
| to change. |  |  |  |  |

## Product Facts

■ Hermetically Sealed

- All Welded Construction
- Balanced Force
- Permanent Magnet Drive

■ 4PDT switching in one inch cube
■ Contacts - Silver Cadmium
Oxide with Gold Plating
■ Coils for DC and AC
Coils for DC and AC
50 to 400 Hz or 400 Hz
■ Weight 2.72 ounces max. (77 grams max.)
■ Qualified to M83536/15, /16


## FCA-410 Series, 10 Amperes, 4PDT

The Series FCA-410 relay is a polarized single-side stable design, where the flux from a permanent magnet provides the armature holding force in the deactivated state, and its flux path is switched and combined with the coil flux in the operated state. This results in appreciably increased contact pressure in both states over that of a spring return nonpolar
design. We also manufacture 2-pole and 6 -pole versions of this relay.
FCA-210 - 10 Amp DPDT Relay
FCA-610 - 10 Amp 6PDT Relay

## Available

FCA-415 - 15 Amp 4PDT, Has the same specifications as the FCA-410 except is rated at 15 amps . (Commercial Only)

Contact Rating - Amperes
Ratings Are Continuous Duty

| Type of <br> Load | Life (Min.) <br> Cycles x 103 | $\mathbf{2 8}$ VDC | 120VAC <br> $\mathbf{4 0 0 H z}$ | $\mathbf{1 2 0 / 2 0 0 V A C}$ |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Resistive | 100 | 10 | 10 | 10 | 2.5 |
| Inductive | 20 | 8 | 8 | 8 | 2.5 |
| Motor | 100 | 4 | 4 | 4 | 2.0 |
| Lamp | 100 | 2 | 2 | 2 | 1.0 |

* 60 Hz loads rated for 10,000 operations

Overload Current - 40 AMPS DC, 60 AMPS 400Hz
Rupture Current - 50 AMPS DC, 80 AMPS 400 Hz
Contact Make Bounce - 1 MILLISECOND AT NOMINAL VOLTAGE
Max. Contact Drop at 10 Amps - INITIAL 0.100 VOLTS
End of Life - 0.125 VOLTS

General Specifications
Temperature Rating -
$-70^{\circ} \mathrm{C} \mathrm{TO}+125^{\circ} \mathrm{C}$
Altitude - 300,000 Feet
Shock* -
Z \& Y Enclosures -
200 g for 6 mS
W, X \& M Enclosures -
100 g for 6 mS
Vibration, Sinusoidal* -
Z \& Y Enclosures -
0.12 DA 10 to 70 Hz

30 g 70 to 3000 Hz
W, X \& M Enclosures -
0.12 DA 10 to 57 Hz

20 g 57 to 3000 Hz
Vibration, Random* -
Z \& Y Enclosures -
$0.4 \mathrm{~g} 2 / \mathrm{Hz} 50-2000 \mathrm{~Hz}$
W, X \& M Enclosures $0.2 \mathrm{~g} / \mathrm{Hz} 50-2000 \mathrm{~Hz}$

## Dielectric Strength -

At Sea Level -
All circuits to ground and circuit to
circuit - 1250 V rms
Coil to ground - 1000 V rms
At 80,000 Feet - 350 V rms
Insulation Resistance -
Initial ( 500 VDC ) - $100 \mathrm{M} \Omega$ Min.
After Life or Environmental Tests $50 \mathrm{M} \Omega \mathrm{Min}$.

## Operate Time at Nominal

Voltage -
DC Relays - 15 ms or less
AC Relays - 20 ms or less
Release Time at Nominal
Voltage -
DC Relays - 15 ms or less
AC Relays - 50 ms or less

* Max. contact opening under vibration or shock 10 microseconds

Coil Data

| Coil <br> Code | Nominal <br> Voltages | Freq. <br> Hz | DC Res. <br> AC Amps (B) | Over Temperature Range   <br> 1  $\quad 6$ | DC | $18 \Omega$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Pickup or <br> Below Volts | Dropout or <br> Above Volts | Must Hold <br> Voltage (C) |  |  |  |  |
| 2 | 12 | DC | $70 \Omega$ | 9.5 | 0.3 | 2.5 |
| 3 | 28 | DC | $290 \Omega$ | 18.0 | 0.75 | 4.5 |
| $4(\mathrm{~A})$ | 28 | DC | $290 \Omega$ | 18.0 | 1.5 | 7.0 |
| 5 | 48 | DC | $865 \Omega$ | 32.0 | 2.5 | 7.0 |
| 6 | 28 | 400 Hz | 225 mA | 22.0 | 14.0 |  |
| 7 | 28 | $50 / 400 \mathrm{~Hz}$ | 120 mA | 22.0 | 1.25 | 10.0 |
| 8 | 115 | 400 Hz | 40 mA | 90.0 | 5.0 | 10.0 |
| 9 | 115 | $50 / 400 \mathrm{~Hz}$ | 30 mA | 95.0 | 5.0 | 40.0 |

A. CODE 4 COILS HAVE BACK EMF SUPPRESSION TO 42 VOLTS MAX.
B. DC COIL RESISTANCE $\pm 10 \%$ AT $25^{\circ} \mathrm{C}$; AC COIL MAX. CURRENT AT NOMINAL VOLTAGE.
C. RELAY WILL STAY IN PICKED-UP STATE DOWN TO MUST HOLD VOLTAGES SHOWN.
D. MAX. OVER-VOLTAGE: 6 \& 12 VDC COILS $120 \%$ OF NOMINAL; ALL OTHERS $110 \%$ OF NOMINAL.
E. COILS AVAILABLE FOR OTHER VOLTAGES AND FOR AC $50 / 60 \mathrm{HZ}$.

NOTE: Only DC Coil Models are QPL Approved.

## FCA-410 Series, 10 Amperes, 4PDT (Continued)

Below are shown the standard terminal types and the enclosures available. Note that the pin configuration for coil connections is determined by the coil supply voltage. Specify the assembly as indicated under How To Order. Dimensions are shown in inches $\pm .010$ and (Millimeters $\pm .25$ ) except as noted.

## Terminals

Terminals on 0.200 centers
Coil terminals: $\mathrm{X} 1-\mathrm{X} 2$.
Socket Pins are Gold Plated
Circuit Board Pins are Tin/Lead Plated.
CODE "A"
Socket Pins-All DC Coils


CODE "B"
Circuit Board Pins-All DC Coils


CODE "D"

## Socket Pins-115 VAC Coils



## Enclosures

All Enclosures have cupro-Nickel cans bright acid tin/lead plated after assembly to terminal headers.


CODE



CODE

*Metric threads available,To specify use (M) in place of W Specifications subject

Terminals (Continued)

CODE "E"
Socket Pins- 28 VAC Coils


CODE "F"
Circuit Board Pins-115 VAC Coils

## CODE "G"

Circuit Board Pins- 28 VAC Coils

Terminal Wiring
A \& B Pin Terminal All DC Coils

C Hook Terminal All AC \& DC Coils



Transient Suppression
Cir.


E \& G Pin Terminal 28 VAC Coils


NOTE: Polarity must be observed with DC coil supply. Relay is polarized with a permanent magnet and will not operate or be damaged by reverse polarity.
Diodes used in transient suppression and in AC rectifier circuits have peak inverse voltage rating of 600 VDC minimum. Zener diodes have a minimum rating of 1 watt. Terminal designations are for reference only and do not appear on the header.


HOW TO ORDER

TERMINAL VIEW
FCA-415-
FCA-410 A Y 4

RELAY TYPE
TERMINALS (Socket Pins)
ENCLOSURE (With Flanges)
COIL (28 VDC With Transient Suppression).

## NOTE: Only DC coil models are QPL Approved

* The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15.


Product Facts

- Hermetically Sealed

■ All Welded Construction

- Balanced Force
- Permanent Magnet Drive
- Contacts - Silver Cadmium Oxide with Gold Plating
■ Coils for DC, 50 to 400 Hz and 400 Hz AC

■ Weight 1.6 ounces max. (45.4 grams)

■ Qualified to M6106/19, M83536/36, /37

## FCA-125 Series, 25 Amperes, SPDT

The Series FCA-125 relay is a polarized single-side stable design, where the flux from a permanent magnet provides the armature holding force in the deactivated state, and its flux path is switched and combined with the coil flux in the operated state.

Contact Rating - Amperes Ratings Are Continuous Duty

| Type of <br> Load | Life (Min.) <br> Cycles $\mathbf{x} \mathbf{1 0}^{\mathbf{3}}$ | $\mathbf{2 8}$ VDC | $\mathbf{1 1 5 V A C}$ <br> $\mathbf{4 0 0 H z}$ | $\mathbf{1 1 5 V A C}$ <br> $\mathbf{6 0 H z}$ |
| :---: | :---: | :---: | :---: | :---: |
| Resistive | 50 | 25 | 25 | 10 |
| Inductive | 10 | 12 | - | 10 |
| Inductive | 20 | - | 15 | - |
| Motor | 50 | 10 | 10 | 8 |
| Lamp | 50 | 5 | 5 | - |

*60 Hz loads rated for 10,000 operations

Overload Current - 50 AMPS DC, 80 AMPS 400Hz
Rupture Current - 60 AMPS DC, 100 AMPS 400 Hz
Contact Make Bounce -1 MILLISECOND AT NOMINAL VOLTAGE
Max. Contact Drop at 25 Amps - INITIAL 0.150 VOLTS
End of Life - 0.175 VOLTS

This results in appreciably increased contact pressure in both states over that of a spring return nonpolar design. We also manufacture other versions of this relay:
FCA-325-25 Ampere 3PDT Relay
FCAC-325-25 Ampere 3PST-NO Relay with 2 amp SPDT auxiliary

General Specifications
Temperature Rating -
$-70^{\circ} \mathrm{C} \mathrm{TO}+125^{\circ} \mathrm{C}$
Altitude - 300,000 Feet
Shock* -
$\mathrm{Z}, \mathrm{Y}$, \& X Enclosures -
200 g for 6 mS
W \& M Enclosures (Stud MItg.) -
100 g for 6 mS
Vibration, Sinusoidal* -
Z, Y, \& X Enclosures -
$30 \mathrm{~g} \mathrm{33-3000Hz}$
W \& M Enclosures (Stud MItg.) -
$20 \mathrm{~g} \mathrm{33-3000Hz}$
Vibration, Random* -
$Z, Y, \& X$ Enclosures -
$0.4 \mathrm{~g} 2 / \mathrm{Hz} 50-2000 \mathrm{~Hz}$
W \& M Enclosures (Stud Mitg.) -
$0.2 \mathrm{~g} / \mathrm{Hz} 50-2000 \mathrm{~Hz}$
Dielectric Strength -
At Sea Level -
All circuits to ground and circuit to
circuit - 1250 V rms
Coil to ground - 1000 V rms
At 80,000 Feet - 350 V rms

## Insulation Resistance -

Initial ( 500 VDC ) - $100 \mathrm{M} \Omega$ Min. After Life or Environmental Tests $50 \mathrm{M} \Omega \mathrm{Min}$.

## Operate Time at Nominal

Voltage -
DC Relays - 10 ms or less
AC Relays - 15 ms or less
Release Time at Nominal
Voltage -
DC Relays - 10 ms or less
AC Relays - 50 ms or less

* Max. contact opening under vibration or shock 10 microseconds


## Coil Data

| Coil <br> Code | Nominal <br> Voltages | Freq. <br> Hz | DC Res. <br> AC Amps (B) | Over Temperature Range <br>  <br> Pelow or Volts |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | 6 | DC | $20 \Omega$ | Dropout or <br> Above Volts | Must Hold <br> Voltage (C) |  |
| 2 | 12 | DC | $80 \Omega$ | 9.5 | 0.3 | 2.5 |
| 3 | 28 | DC | $320 \Omega$ | 18.0 | 0.75 | 4.5 |
| $4(\mathrm{~A})$ | 28 | DC | $320 \Omega$ | 18.0 | 1.5 | 7.0 |
| 5 | 48 | DC | $920 \Omega$ | 32.0 | 2.5 | 7.0 |
| 6 | 28 | 400 Hz | 180 mA | 22.0 | 1.25 | 14.0 |
| 7 | 28 | $50 / 400 \mathrm{~Hz}$ | 100 mA | 22.0 | 1.25 | 10.0 |
| 8 | 115 | 400 Hz | 40 mA | 90.0 | 5.0 | 40.0 |
| 9 | 115 | $50 / 400 \mathrm{~Hz}$ | 30 mA | 95.0 | 5.0 | 40.0 |

A. CODE 4 COILS HAVE BACK EMF SUPPRESSION TO 42 VOLTS MAX.
B. DC COIL RESISTANCE $\pm 10 \%$ AT $25^{\circ} \mathrm{C}$; AC COIL MAX. CURRENT AT NOMINAL VOLTAGE.
C. RELAY WILL STAY IN PICKED-UP STATE DOWN TO MUST HOLD VOLTAGES SHOWN.
D. MAX. OVERVOLTAGE: 6 \& 12 VDC COILS $120 \%$ OF NOMINAL; ALL OTHERS $110 \%$ OF NOMINAL
E. COILS AVAILABLE FOR OTHER VOLTAGES AND FOR AC 50/60HZ.

NOTE: Only DC Coil Models are QPL Approved. to change.

## FCA-125 Series, 25 Amperes, SPDT (Continued)

Below are shown the standard terminal types and the enclosures available. Specify the assembly as indicated under How To Order. Dimensions are shown in inches $\pm .010$ and (Millimeters $\pm .25$ ).

## Terminals



Socket Pins - All AC Coils
PIN TERMINALS ARE GOLD PLATED


CODE
"B"
Solder Pin Terminals


PIN TERMINALS TIN/LEAD PLATED


## Enclosures

> All Enclosures have cupro-Nickel cans bright acid tin/lead plated after assembly to terminal headers.

Dimensions: Inches $\pm .010(\mathrm{~mm} \pm .25)$
"A" - AC Coils 1.125 in. (31.91) Max
DC Coils 1.010 in. (28.65) Max..



CODE"

## Solder Hook Terminals

 HOOK TERMINALS TIN/LEAD PLATED
*Metric threads available.
Metric threads available.
To specify use Mlin place of $W$ ]

FCA-125 Series, 25 Amperes, SPDT (Continued)

## Terminal Wiring

## DC COILS



DC COILS WITH TRANSIENT SUPPRESSION


AC COILS


NOTE: Polarity must be observed with DC coil supply.
Relay is polarized with a permanent magnet and will not operate or be damaged by reverse polarity.

Diodes used in transient suppression and in AC rectifier circuits have peak inverse voltage rating of 600 VDC minimum. Zener diodes have a minimum rating of 1 watt.

Terminal designations are for reference only and do not appear on the header.


TERMINAL VIEW

HOW TO ORDER

FCA-125-A Y 4

RELAY TYPE
TERMINALS (Socket Pins, DC Coil)
ENCLOSURE (With Flanges)
COIL (28 VDC With Transient Suppression).
NOTE: Only DC coil models are QPL Approved

* The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15.

CII Mid-Range Relays


## Product Facts

■ Hermetically Sealed
■ All Welded Construction

- Balanced Force
- Permanent Magnet Drive

■ Contacts - Silver Cadmium Oxide with Gold Plating
■ Coils for DC, 50 to 400 Hz and 400 Hz AC

■ Weight 2.89 ounces max. (82 grams)

■ Qualified to M83536/32, /33

## FCA-325 Series, 25 Amperes, 3PDT

The Series FCA-325 relay is a polarized single-side stable design, where the flux from a permanent magnet provides the armature holding force in the deactivated state, and its flux path is switched and combined with the coil flux in the operated state.

| Contact Rating - Amperes Ratings Are Continuous Duty |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Type of Load | Life (Min.) Cycles x $10^{3}$ | 28 VDC | $\begin{gathered} \text { 115VAC } \\ 400 \mathrm{~Hz} \end{gathered}$ | 115/200VAC |  |
|  |  |  |  | 400Hz-30 | $60 \mathrm{~Hz}-30^{*}$ |
| Resistive | 50 | 25 | 25 | 25 | 2.5 |
| Inductive | 10 | 12 | - | - | 2.5 |
| Inductive | 20 | - | 15 | 15 | - |
| Motor | 50 | 10 | 10 | 10 | 2.0 |
| Lamp | 50 | 5 | 5 | 5 | 1.0 |
| *60 Hz loads rated for 10,000 operations |  |  |  |  |  |
| Overload Current - 50 AMPS DC, 80 AMPS 400Hz |  |  |  |  |  |
| Rupture Current - 60 AMPS DC, 100 AMPS 400Hz |  |  |  |  |  |
| Contact Make Bounce -1 MILLISECOND AT NOMINAL VOLTAGE |  |  |  |  |  |
| Max. Contact Drop at 25 Amps - INITIAL 0.150 VOLTS |  |  |  |  |  |
| End of Life - 0.175 VOLTS |  |  |  |  |  |

Contact Rating - Amperes Ratings Are Continuous Duty
*60 Hz loads rated for 10,000 operations
Overload Current - 50 AMPS DC, 80 AMPS 400Hz
Rupture Current - 60 AMPS DC, 100 AMPS 400 Hz
Contact Make Bounce - 1 MILLISECOND AT NOMINAL VOLTAGE
Max. Contact Drop at 25 Amps - INITIAL 0.150 VOLTS
End of Life - 0.175 VOLTS

This results in appreciably increased contact pressure in both states over that of a spring return nonpolar design. We also manufacture other versions of this relay:
FCA-125-25 Amp SPDT Relay
FCAC-325-25 Ampere 3PST-NO Relay with 2 amp SPDT auxiliary

Temperature Rating -
$-70^{\circ} \mathrm{C} \mathrm{TO}+125^{\circ} \mathrm{C}$
Altitude - 300,000 Feet
Shock* -
Z, Y, \& V Enclosures -
200 g for 6 mS
W, X \& M Enclosures -
100 g for 6 mS
Vibration, Sinusoidal* -
Z, Y, \& V Enclosures -
$30 \mathrm{~g} \mathrm{33-3000Hz}$
W, X \& M Enclosures -
$20 \mathrm{~g} 33-3000 \mathrm{~Hz}$
Vibration, Random* -
Z, Y, \& V Enclosures $0.4 \mathrm{~g} 2 / \mathrm{Hz} 50-2000 \mathrm{~Hz}$
W, X \& M Enclosures -
$0.2 \mathrm{~g} / \mathrm{Hz} 50-2000 \mathrm{~Hz}$
Dielectric Strength -
At Sea Level -
All circuits to ground and circuit to
circuit - 1250 V rms
Coil to ground - 1000 V rms
At 80,000 Feet - 350 V rms

## Insulation Resistance -

Initial ( 500 VDC ) - $100 \mathrm{M} \Omega$ Min. After Life or Environmental Tests $50 \mathrm{M} \Omega \mathrm{Min}$.

## Operate Time at Nominal

 Voltage -DC Relays - 15 ms or less
AC Relays - 20 ms or less
Release Time at Nominal
Voltage -
DC Relays - 15 ms or less
AC Relays - 50 ms or less

* Max. contact opening under vibration or shock 10 microseconds

Coil Data

| Coil <br> Code | Nominal <br> Voltages | Freq. <br> Hz | DC Res. <br> AC Amps (B) | Over Temperature Range <br> $\quad$Pickup or <br> Below Volts |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 6 | DC | $18 \Omega$ | Dropout or <br> Above Volts | Must Hold <br> Voltage (C) |  |
| 2 | 12 | DC | 7.5 | 0.3 | 2.5 |  |
| 3 | 28 | DC | $290 \Omega$ | 9.0 | 0.75 | 7.5 |
| $4(\mathrm{~A})$ | 28 | DC | $290 \Omega$ | 18.0 | 1.5 | 7.0 |
| 5 | 48 | DC | $865 \Omega$ | 18.0 | 1.5 | 7.0 |
| 6 | 28 | 400 Hz | 225 mA | 22.0 | 2.5 | 14.0 |
| 7 | 28 | $50 / 400 \mathrm{~Hz}$ | 120 mA | 22.0 | 1.25 | 10.0 |
| 8 | 115 | 400 Hz | 40 mA | 90.0 | 1.25 | 10.0 |
| 9 | 115 | $50 / 400 \mathrm{~Hz}$ | 30 mA | 95.0 | 5.0 | 40.0 |

A. CODE 4 COILS HAVE BACK EMF SUPPRESSION TO 42 VOLTS MAX.
B. DC COIL RESISTANCE $\pm 10 \%$ AT $25^{\circ} \mathrm{C}$; AC COIL MAX. CURRENT AT NOMINAL VOLTAGE.
C. RELAY WILL STAY IN PICKED-UP STATE DOWN TO MUST HOLD VOLTAGES SHOWN.
D. MAX. OVER-VOLTAGE: 6 \& 12 VDC COILS 120\% OF NOMINAL; ALL OTHERS $110 \%$ OF NOMINAL.
E. COILS AVAILABLE FOR OTHER VOLTAGES AND FOR AC $50 / 60 \mathrm{HZ}$.

NOTE: Only DC Coil Models are QPL Approved.

Below are shown the standard terminal types and the enclosures available. Specify the assembly as indicated under How To Order. Dimensions are shown in inches $\pm .010$ and (Millimeters $\pm .25$ ).

## Terminals



## CODE <br> "C"

## Solder Hook Terminals

hook terminals tin/LEAD PLATED




CODE

*Metric threads available,To specify use $M$ in place of $W$

## Terminal Wiring

DC Coils


NOTE: Polarity must be observed with DC coil supply.
Relay is polarized with a permanent magnet and will not operate or be damaged by reverse polarity.
Diodes used in transient suppression and in AC rectifier circuits have peak inverse voltage rating of 600 VDC minimum. Zener diodes have a minimum rating of 1 watt.
Terminal designations are for reference only and do not appear on the header.

## DC Coils with Transient Suppression



AC Coils


TERMINAL VIEW

HOW TO ORDER

RELAY TYPE

TERMINALS (Socket Pins, DC Coil) $\qquad$

ENCLOSURE (With Flanges)
COIL (28 VDC With Transient Suppression).

## NOTE: Only DC coil models are QPL Approved

* The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15.



## Product Facts

■ Hermetically Sealed
■ All Welded Construction

- Balanced Force
- Permanent Magnet Drive

■ Contacts - Silver Cadmium Oxide with Gold Plating
■ Coils for DC, 50 to 400 Hz and 400 Hz AC

■ Weight 2.89 ounces max. (82grams)

## FCAC-325 Series, 25 Amperes, 3PST-NO with 2 Amp SPDT Auxiliary Contacts

The Series FCAC-325 relay is a polarized single-side stable design, where the flux from a permanent magnet provides the armature holding force in the deactivated state, and its flux path is switched and combined with the coil flux in the operated state. This results in appreciably increased contact pressure

Contact Rating - Amperes Ratings Are Continuous Duty

| Type of Load | Life (Min.) Cycles x103 | 28 VDC |  | $\begin{gathered} \hline \text { 115VAC } \\ 400 \mathrm{~Hz} \end{gathered}$ |  | $\begin{gathered} \text { 115/200VAC } \\ 400 \mathrm{~Hz}-3 \emptyset \end{gathered}$ | $\begin{gathered} \text { 115/200VAC } \\ 60 \mathrm{~Hz}-3 \emptyset^{\star} \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Main | Aux. | Main | Aux. |  |  |
| Resistive | 50 | 25 | 2 | 25 | 2 | 25 | 2.5 |
| Inductive | 10 | 12 | 1 | - | - | - | 2.5 |
| Inductive | 20 | - | - | 15 | 1 | 15 | - |
| Motor | 50 | 10 | - | 10 | - | 10 | 2.0 |
| Lamp | 50 | 5 | . 5 | 5 | . 5 | . 5 | 1.0 |

*60 Hz loads rated for 10,000 operations

Overload Current - 50 AMPS DC, 80 AMPS 400 Hz
Rupture Current - 60 AMPS DC, 100 AMPS 400 Hz
Contact Make Bounce - 1 MILLISECOND AT NOMINAL VOLTAGE
Auxiliary Contact Bounce - 4 MILLISECONDS MAX.
Max. Contact Drop at 25 Amps - INITIAL 0.150 VOLTS
End of Life - 0.175 VOLTS

General Specifications
Temperature Rating -
$-70^{\circ} \mathrm{C} \mathrm{TO}+125^{\circ} \mathrm{C}$
Altitude - 300,000 Feet
Shock* -
Z, Y, \& V Enclosures -
200 g for 6 mS
W, X \& M Enclosures -
100 g for 6 mS
Vibration, Sinusoidal* -
Z, Y, \& VEnclosures -
$30 \mathrm{~g} \mathrm{33-3000Hz}$
W, X \& M Enclosures -
$20 \mathrm{~g} 33-3000 \mathrm{~Hz}$
Vibration, Random* -
Z, Y, \& V Enclosures $0.4 \mathrm{~g} 2 / \mathrm{Hz} 50-2000 \mathrm{~Hz}$
W, X \& M Enclosures -
$0.2 \mathrm{~g} / \mathrm{Hz} 50-2000 \mathrm{~Hz}$
Dielectric Strength -
At Sea Level -
All circuits to ground and circuit to
circuit - 1250 V rms
Coil to ground - 1000 V rms
At 80,000 Feet - 350 V rms
Insulation Resistance -
Initial ( 500 VDC ) - $100 \mathrm{M} \Omega$ Min. After Life or Environmental Tests $50 \mathrm{M} \Omega \mathrm{Min}$.

## Operate Time at Nominal

Voltage -
DC Relays - 15 ms or less AC Relays - 10 ms or less

## Release Time at Nominal

Voltage -
DC Relays - 15 ms or less
AC Relays - 50 ms or less

* Max. contact opening under vibration or shock 10 microseconds


## Coil Data

| Coil Code | Nominal Voltages | Freq. Hz | DC Res. AC Amps (B) | Over Temperature Range |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Pickup or Below Volts | Dropout or Above Volts | Must Hold Voltage (C) |
| 1 | 6 | DC | $18 \Omega$ | 4.5 | 0.3 | 2.5 |
| 2 | 12 | DC | $70 \Omega$ | 9.0 | 0.75 | 4.5 |
| 3 | 28 | DC | $290 \Omega$ | 18.0 | 1.5 | 7.0 |
| 4 (A) | 28 | DC | $290 \Omega$ | 18.0 | 1.5 | 7.0 |
| 5 | 48 | DC | $865 \Omega$ | 32.0 | 2.5 | 14.0 |
| 6 | 28 | 400 Hz | 225 mA | 22.0 | 1.25 | 10.0 |
| 7 | 28 | 50/400Hz | 120 mA | 22.0 | 1.25 | 10.0 |
| 8 | 115 | 400 Hz | 40 mA | 90.0 | 5.0 | 40.0 |
| 9 | 115 | $50 / 400 \mathrm{~Hz}$ | 30 mA | 95.0 | 5.0 | 40.0 |

A. CODE 4 COILS HAVE BACK EMF SUPPRESSION TO 42 VOLTS MAX.
B. DC COIL RESISTANCE $\pm 10 \%$ AT $25^{\circ} \mathrm{C}$; AC COIL MAX. CURRENT AT NOMINAL VOLTAGE.
C. RELAY WILL STAY IN PICKED-UP STATE DOWN TO MUST HOLD VOLTAGES SHOWN.
D. MAX. OVERVOLTAGE: 6 \& 12 VDC COILS $120 \%$ OF NOMINAL; ALL OTHERS $110 \%$ OF NOMINAL
E. COILS AVAILABLE FOR OTHER VOLTAGES AND FOR AC $50 / 60 \mathrm{HZ}$.

## FCAC-325 Series (Continued)

Below are shown the standard terminal types and the enclosures available. Specify the assembly as indicated under How To Order. Dimensions are shown in inches $\pm .010$ and (Millimeters $\pm .25$ ).

## Terminals

## CODE "A"

Socket Pin Terminals Pin Terminals are Gold Plated






CODE "B"
Solder Pin Terminals
Pin Terminals are Tin/Lead Plated


All Enclosures have cupro-Nickel cans bright acid tin/lead plated after assembly to terminal headers.

Dimensions: Inches $\pm .010(\mathrm{~mm} \pm .25)$
For socket pin terminals: specify " $Y$ " enclosures with DC coils and "V" enclosures with AC coils.


CODE "C"
Solder Hook Terminals Hook Terminals are Tin/Lead Plated

*Metric threads available, To specify us $\Phi$ D in place otW

## Terminal Wiring

DC COILS WITH
TRANSIENT SUPPRESSION


AC COILS


NOTE: Polarity must be observed with DC coil supply. Relay is polarized with a permanent magnet and will not operate or be damaged by reverse polarity.

Diodes used in transient suppression and in AC rectifier circuits have peak inverse voltage rating of 600 VDC minimum. Zener diodes have a minimum rating of 1 watt.

Terminal designations are for reference only and do not appear on the header.


TERMINAL VIEW

HOW TO ORDER

FCAC-325-A Y 4

RELAY TYPE


TERMINALS (Socket Pins, DC Coil)
ENCLOSURE (With Flanges and DC Coil)
COIL (28 VDC With Transient Suppression)

## FCA-150 Series, 50 Amps, 1PST/NO (DM) Relay

Product Facts
■ Non-latching relay
■ Balanced force design

- Corrosion protected metal enclosure

■ All welded hermetically sealed enclosure occupies about 1 in ${ }^{3}$ ( $16.4 \mathrm{~cm}^{3}$ )
■ 1 Form X (SPST-NO-DM)
■ 6, 12 and 28 Vdc coils
■ Weight: 90 grams

- Designed and built in accordance to MIL-PRF-6106


The FCA-150 series relay is a polarized, single-side stable design, where the flux from a permanent magnet provides the armature holding force in the deactivated state, and its flux path is switched and combined
with the coil flux in the operated state. This results in appreciably increased contact pressure in both states over that of a spring return non-polar design.

1 Form X (SPST-NO-DM) configuration with main contacts rated 50 Amps.

Specifications


CII Mid-Range Relays
FCA-150 Series, 50 Amps, 1PST/NO (DM) Relay (Continued)

| Specifications |  |
| :--- | ---: |
| Electrical Data | 100 megohms, minimum, at 500 Vdc, between each pin and case |
| Initial Insulation Resistance (note 1) | 50 megohms, minimum, at 500 Vdc, between each pin and case |
| Insulation Resistance After Life or Environmental Test (note 1) |  |
| Dielectric Strength At Sea Level | $1,250 \mathrm{Vrms}, 60 \mathrm{~Hz}$. |
| Contacts to Ground and Between Contacts | $1,000 \mathrm{Vrms}, 60 \mathrm{~Hz}$. |
| Coil to Ground | $500 \mathrm{Vrms}, 60 \mathrm{~Hz}$ |
| Dielectric Strength at 80,000 ft (25,000m), All Points (note 4) |  |
| Environmental Data | $-70^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ |
| Ambient Temperature Range, Operating | 300,000 feet |
| Altitude | $50 \mathrm{G} \mathrm{\prime s}, 11 \mathrm{~ms}$. |
| Shock Resistance | $20 \mathrm{G} \mathrm{\prime s}, 75-3000 \mathrm{~Hz}$. |
| Vibration Resistance, Sinusoidal |  |
| Mechanical Data | $3.2 \mathrm{oz} .(90 \mathrm{~g}) \mathrm{Max}$. |
| Approximate Weight |  |

## NOTES

1. All wired terminals must be connected together during this test. Dielectric withstanding voltage and insulation resistance are measured between all mutually insulated wired terminals and between all these terminals and case.

## Terminals

## CODE "B"

## Solder Pin Terminals Tin/Lead Plated



CODE "C"
Solder Hook Terminals Tin/Lead Plated


## CODE "K"

## Terminal Shield



## FCA-150 Series, 50 Amps, 1PST/NO (DM) Relay (Continued)

## Outline Dimensions

The standard terminal types and enclosures are illustrated below with dimensions in inches $\pm 0.010$ and (millimeters $\pm 0.25$ ).

## Enclosures



CODE
"X"


CODE
"R"


CODE
"Z"


## Terminal Wiring

DC Coils
DC Coils with Transient Suppression


NOTE: Polarity must be observed with DC coil supply. Relay is polarized with a permanent magnet and will not operate or be damaged by reverse polarity.
Diodes used in transient suppression and in AC rectifier circuits have peak inverse voltage rating of 600 VDC minimum. Zener diodes have a minimum rating of 1 watt. Terminal designations are for reference only and do not appear on the header.


TERMINAL VIEW

## How to Order



| Catalog 5-1773450-5 | Dimensions are shown for | Dimensions are in millimeters | USA: +1 8005226752 | For additional support numbers please visit www.te.com |
| :---: | :---: | :---: | :---: | :---: |
| Revised 3-13 | reference purposes only. | unless otherwise specified. | Asia Pacific: +86 04008206015 |  |
|  | Specifications subject |  | UK: +44 800267666 |  |
| www.te.com | to change. |  |  |  |

## Product Facts

■ Non latching hermetically sealed relay

- Balanced force design

■ Hermetically sealed, corrosion protected metal can

- All welded construction
- 6, 12 and 28 Vdc coils available.
■ Weight 90 grams
- Designed and built in accordance to MIL-PRF-6106



## Specifications

| General Characteristics |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| Temperature range |  | $-70^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ |  |  |
| Altitude |  | 300,000 feet |  |  |
| Dielectric strength at sea level <br> - Contacts to ground and between contacts <br> - Coil to ground |  | $\begin{aligned} & 1250 \text { Vrms / } 60 \mathrm{~Hz} \\ & 1000 \text { Vrms / } 60 \mathrm{~Hz} \end{aligned}$ |  |  |
| Dielectric strength at altitude 25000 m (80,000 ft) (all points) |  | $500 \mathrm{Vrms} / 60 \mathrm{~Hz}$ |  |  |
| Initial insulation resistance at 500 Vdc |  | $100 \mathrm{M} \Omega \mathrm{min}$. |  |  |
| Initial insulation after life or environmental test |  | $50 \mathrm{M} \Omega$ min. |  |  |
| Sinusoidal vibration |  | $20 \mathrm{~g} / 75$ to 3000 Hz |  |  |
| Shock |  | $50 \mathrm{~g} / 11 \mathrm{~ms}$ |  |  |
| Operate time at nominal voltage |  | 15 ms max. |  |  |
| Release time |  | 15 ms max. |  |  |
| Bounce time |  | 1 ms max. |  |  |
| Contact voltage drop at nominal current -initial value -after life |  | 150 mV max. <br> 175 mV max. |  |  |
| Coil Data |  |  |  |  |
| Coil Code | 1 | 2 | 3 | 4(A) |
| Nominal Operating Voltage (Vdc) | 6 | 12 | 28 | 28 |
| Maximum Operating Voltage (Vdc) | 7.3 | 14.5 | 29 | 29 |
| Maximum Pick-Up Voltage at $+125^{\circ} \mathrm{C}$ | 4.5 | 9 | 18 | 18 |
| Maximum Pick-Up Voltage at $+125^{\circ} \mathrm{C}$, continuous current test (Vdc) | 5.7 | 11.25 | 22.5 | 22.5 |
| Drop-Out Voltage at OTR | 0.3-2.5 | 0.75-4.5 | 1.5-7.0 | 1.5-7.0 |
| Maximum Coil Current at $+25^{\circ} \mathrm{C}(\mathrm{mA})$ | . 50 | . 26 | . 15 | . 15 |
| Back EMF Suppressed to (Vdc) | N/A | N/A | N/A | -42 |
| Coil Resistance | $18 \Omega$ | $70 \Omega$ | $290 \Omega$ | $290 \Omega$ |

For other coil voltages, consult factory.

CII Mid-Range Relays
FCA-150NC Series, 50 Amps, 1PST/NC (DB) Relay (Continued)
Contact Electrical Characteristics

| Contact Type | Rated Current | Rated Voltage |
| :---: | :---: | :---: |
| Main Contact | 50 A | 28 Vdc |
| Minimum Operating cycles | Contact rating per pole and load type | Load Currents in Amps |
|  | Main Contact | 50 |
| 50,000 cycles | Resistive load | 20 |
| 20,000 cycles | Inductive load (L/R=5ms) | 20 |
| 20,000 cycles | Motor load | 200 |
| 50 cycles | Resistive overload |  |
| 100,000 cycles | No Load |  |

All endurance ratings are subject to validation - consult factory

## Terminals

## CODE "B"

Solder Pin Terminals
Tin/Lead Plated


CODE "C"
Solder Hook Terminals Tin/Lead Plated


## CODE "K"

## Terminal Shield



## Outline Dimensions

The standard terminal types and enclosures are illustrated below with dimensions in inches $\pm 0.010$ and (millimeters $\pm 0.25$ ).

Enclosures


## CODE

"Z"


## CODE <br> "X"

CODE
CODE
"R"


FCA-150NC Series, 50 Amps, 1PST/NC (DB) Relay (Continued)

## Terminal Wiring

DC Coils


DC Coils with Transient Suppression


NOTE: Polarity must be observed with DC coil supply. Relay is polarized with a permanent magnet and will not operate or be damaged by reverse polarity.
Diodes used in transient suppression and in AC rectifier circuits have peak inverse voltage rating of 600 VDC minimum. Zener diodes have a minimum rating of 1 watt.
Terminal designations are for reference only and do not appear on the header.


TERMINAL VIEW

## FCA - 150NC

RELAY TYPE
TERMINALS
ENCLOSURE
COIL $\qquad$

| Catalog 5-1773450-5 | Dimensions are shown for <br> reference purposes only. |
| :--- | :--- |
| Revised 3-13 | Specifications subject |
| www.te.com | to change. |

## Product Facts

■ Non-latching relay
■ Balanced force design

- Corrosion protected metal enclosure

■ All welded hermetically sealed enclosure occupies about 1 in $^{3}$ ( $16.4 \mathrm{~cm}^{3}$ )

- 1 Form C (SPDT) auxiliary contact
■ 6, 12 and 28 Vdc coils
■ Weight: 90 grams
■ Designed and built in accordance to MIL-PRF-6106


The FCAC-150 series relay is a polarized, single-side stable design, where the flux from a permanent magnet provides the armature holding force in the deactivated state, and its flux path is switched and combined
with the coil flux in the operated state. This results in appreciably increased contact pressure in both states over that of a spring return non-polar design.

A 1 form C (SPDT) auxiliary contact set rated 2 amps is available.

Specifications

| Auxiliary Contact Data |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| Contact Form | 1 Form X (SPDT-NO-DM) with 1 Form C (SPDT) Auxiliary |  |  |  |
| Contact Rating in Amps (Continuous Duty) |  |  |  |  |
| Type of Load | Life (Min.) Cycles | 28 Vdc | 115 Vac 400 Hz |  |
| Resistive | 50,000 | 50 | 50 |  |
| Inductive (L/R=5ms) | 20,000 | 20 | 20 |  |
| Motor | 20,000 | 20 | 20 |  |
| None | 100,000 | - | - |  |
| Coil Data |  |  |  |  |
| Coil Code | 1 | 2 | 3 | 4(A) |
| Nominal Operating Voltage (Vdc) | 6 | 12 | 28 | 28 |
| Maximum Operating Voltage (Vdc) | 7.3 | 14.5 | 29 | 29 |
| Maximum Pick-Up Voltage at $+125^{\circ} \mathrm{C}$ | 4.5 | 9 | 18 | 18 |
| Maximum Pick-Up Voltage at $+125^{\circ} \mathrm{C}$, continuous current test (Vdc) | 5.7 | 11.25 | 22.5 | 22.5 |
| Drop-Out Voltage at OTR | 0.3-2.5 | 0.75-4.5 | 1.5-7.0 | 1.5-7.0 |
| Maximum Coil Current at $+25^{\circ} \mathrm{C}(\mathrm{mA})$ | . 50 | . 26 | . 15 | . 15 |
| Back EMF Suppressed to (Vdc) (max) | N/A | N/A | N/A | -42 |
| Coil Resistance $\pm 10 \%$ | $18 \Omega$ | $70 \Omega$ | $290 \Omega$ | $290 \Omega$ |

CII Mid-Range Relays
FCAC-150 Series, 50 Amps, 1PST/NO (DM) with 1PDT Auxiliary Contacts (Continued)

| Specifications |  |
| :--- | ---: |
| Electrical Data |  |
| Initial Insulation Resistance (note 1) | 100 megohms, minimum, at 500 Vdc, between each pin and case |
| Insulation Resistance After Life or Environmental Test (note 1) | 50 megohms, minimum, at 500 Vdc, between each pin and case |
| Dielectric Strength At Sea Level | $1,250 \mathrm{Vrms}, 60 \mathrm{~Hz}$. |
| Contacts to Ground and Between Contacts | $1,000 \mathrm{Vrms}, 60 \mathrm{~Hz}$. |
| Coil to Ground | $500 \mathrm{Vrms}, 60 \mathrm{~Hz}$ |
| Dielectric Strength at 80,000 ft (25,000m), All Points (note 4) |  |
| Environmental Data | $-70^{\circ} \mathrm{C} \mathrm{to} \mathrm{+125}^{\circ} \mathrm{C}$ |
| Ambient Temperature Range, Operating | $300,000 \mathrm{feet}$ |
| Altitude | $50 \mathrm{G} \mathrm{\prime s}, 11 \mathrm{~ms}$. |
| Shock Resistance | $20 \mathrm{G} \mathrm{\prime s}, 75-3000 \mathrm{~Hz}$. |
| Vibration Resistance, Sinusoidal |  |
| Mechanical Data | 3.2 oz. (90g) Max. |
| Approximate Weight |  |

## NOTES

1. All wired terminals must be connected together during this test. Dielectric withstanding voltage and insulation resistance are measured between all mutually insulated wired terminals and between all these terminals and case.

## Terminals

CODE "B"

## Solder Pin Terminals

Tin/Lead Plated


## CODE "C"

## Solder Hook Terminals

Tin/Lead Plated


CODE "K"
Terminal Shield


## Outline Dimensions

The standard terminal types and enclosures are illustrated below with dimensions in inches $\pm 0.010$ and (millimeters $\pm 0.25$ ).

## Enclosures



FCAC-150 Series, 50 Amps, 1PST/NO (DM) with 1PDT Auxiliary Contacts (Continued)

## Terminal Wiring

DC Coils


NOTE: Polarity must be observed with DC coil supply. Relay is polarized with a permanent magnet and will not operate or be damaged by reverse polarity.
Diodes used in transient suppression and in AC rectifier circuits have peak inverse voltage rating of 600 VDC minimum. Zener diodes have a minimum rating of 1 watt. Terminal designations are for reference only and do not appear on the header.

## DC Coils with Transient Suppression




TERMINAL VIEW

## How to Order



| Catalog 5-1773450-5 | Dimensions are shown for | Dimensions are in millimeters | USA: +1 8005226752 | For additional support numbers please visit www.te.com |
| :---: | :---: | :---: | :---: | :---: |
| Revised 3-13 | reference purposes only. | unless otherwise specified. | Asia Pacific: +86 04008206015 |  |
|  | Specifications subject |  | UK: +44 800267666 |  |
| www.te.com | to change. |  |  |  |

## Selection and Application Guide

## This selection and application guide is suggested practices from ARP (Aerospace Recommended Practice) 4005 Concerning proper performance of relays.

## Caution:

The use of any coil voltage less than the rated coil voltage may compromise the operation of the relay. Choosing the proper relay depends primarily on matching the relay to the load, power supply, and environment. Selection should be limited to items that meet the following requirements:
A. Contacts must be rated for the load. Current rating, type of load (resistive, lamp, motor, inductive, and so forth), impedance range, voltage rating, $D C$ or $A C$, frequency, single phase or polyphase, polyphase load balance, and type of switching or transfer should all be considered. Each of the following switching and transfer functions places a different requirement on each of the relay contacts and must be considered when selecting a relay with the proper contact rating:
(1) On-Off Switching - DC, single phase or polyphase
(2) Motor Reversing (AC or DC)
(3) Transferring load between phases of same source
(4) Transferring load between unsynchronized AC sources
B. Power supply characteristics must be taken into account. Voltage regulation, variations in frequency, ripples and spikes, as well as steady state conditions, should be included. If more than one power supply is involved, not only must each be suitable but interaction between them also should be investigated.
C. Coil (or coils) should be rated so as to have proper operation under all anticipated conditions.
D. Consideration of environmental conditions anticipated throughout the service of life, as well as those expected during storage and transportation before installing the relays in equipment, is mandatory. Electrical parameters, environmental factors, mechanical stresses, and compatibility are among the categories for which the relay must be reviewed.
E. The circuit in which the relay is used, the interlocking feature employed, the wiring harness, and the associated components should all be reviewed for assuring mutual suitability.
F. Relays should be hard wired whenever possible, to avoid the need for additional contact points associated with the relay plug-in socket arrangement. (Plug-in types should be considered for quick turnaround times).
G. To permit "safe" isolation of relay circuit in the OFF condition, and better eliminate an electrical shock hazard, an electromechanical switching device should be placed between the positive terminal of the power source and relay coil.
H. Proper transistor control of the relay coil requires a stable $\mid r e f e r e n c e ~ v o l t a g e . ~ T h i s ~ c a n ~ b e ~ d o n e ~ b y ~ c o n n e c t i n g ~ t h e ~ p l u s ~$ side of the coil to the positive side of the power source, the minus side of the relay coil to the collector of an NPN transistor, the emitter of the transistor to the grounded side of the power source, and the transistor base to the control voltage. For example, see MIL-R-28776/1.
I. Any switching device controlling the relay coil circuit must be capable of withstanding, without damage, the sum of the maximum coil circuitry voltage and the peak value of transient voltage that results when the coil circuit is opened; for example, a switch controlling a relay coil that is supplied with a 28 V DC line and subjected to a transient voltage suppressed to 42 V must be capable of withstanding $28 \mathrm{~V}+$ 42 V or a 70 V surge without damage.
J. In selecting solid state electronic switching devices to control relay coil circuits, care must be used in selecting a solid state device with a leakage current (in the "off state") that is sufficiently low to permit the relay to drop out.
K. Control of the relay coil circuit by other than step-function switching may invalidate published relay performance properties such as pickup and dropout voltages, pickup, dropout, and bounce times.

CII Mid-Range Relays

| NOTE: <br> TE Connectivity Does Not Manufacture Relay Sockets. | Cross Reference - Socket to Relay |  |  |
| :---: | :---: | :---: | :---: |
|  | Military Socket P/N <br> M12883/40-01 <br> M12883/40-05 <br> M12883/40-07 <br> M12883/40-11 <br> M12883/40-13 <br> M12883/40-17 <br> M12883/40-19 <br> M12883/40-23 | Relay Part Number $\begin{aligned} & \text { M83536/15-022 } \\ & \text { M83536/16-006, 014, 031, } 034 \end{aligned}$ | Relay Type 4 Pole, 10 Amp |
| This Socket to Relay cross reference is provided for additional design assistance. Several of TE Authorized Distributors carry relay sockets for your convenience. Relay sockets come with a variety of profiles, mounting styles, and mounting hardware options, so please contact the relay socket supplier of your choice or one of our Authorized Distributors who carry relay sockets for additional information. | M12883/40-02 <br> M12883/40-08 <br> M12883/40-14 <br> M12883/40-20 | FCA-410-DY8 (Catalog Version) FCA-410-DY9 (Catalog Version) | 4 Pole, 10 Amp, AC |
|  | M12883/41-01 <br> M12883/41-04 <br> M12883/41-06 <br> M12883/41-09 <br> M12883/41-11 <br> M12883/41-14 <br> M12883/41-16 <br> M12883/41-19 | $\begin{aligned} & \text { M83536/9-006, 015, 024, 035 } \\ & \text { M83536/10-006, 015, 024, 034, } 038 \end{aligned}$ | 2 Pole, 10 Amp |
|  | M12883/41-02 <br> M12883/41-07 <br> M12883/41-12 <br> M12883/41-17 | FCA-210-DY8 (Catalog Version) FCA-210-DY9 (Catalog Version) | 2 Pole, 10 Amp, AC |
|  | $\begin{aligned} & \text { M12883/44-01 } \\ & \hline \overline{\text { M12883/45-01 }} \end{aligned}$ | M83536/5-006, 014, 022, 030 <br> M83536/6-006, 014, 022, 032 <br> M83536/1-006, 015, 024, 033 <br> M83536/2-006, 015, 024, 035 | 4 Pole, 5 Amp <br> 2 Pole, 5 Amp |
|  | M12883/47-01 <br> M12883/47-04 <br> M12883/47-07 <br> M12883/47-10 | FCA-610-AY3 (Catalog Version) FCA-610-AY4 (Catalog Version) | 6 Pole, 10 Amp |
|  | M12883/47-02 <br> M12883/47-05 <br> M12883/47-08 <br> M12883/47-11 | FCA-610-DY8 (Catalog Version) | 6 Pole, 10 Amp AC |
|  | M12883/48-01 <br> M12883/48-02 <br> M12883/48-03 <br> M12883/48-04 | $\begin{aligned} & \text { M83536/32-003L } \\ & \text { M83536/33-003L } \end{aligned}$ | 3 Pole, 25 Amp |
|  | M12883/48-05 <br> M12883/48-06 <br> M12883/48-07 <br> M12883/48-08 | FCA-325-AV8 (Catalog Version) FCA-325-AV9 (Catalog Version) | 3 Pole, 25 Amp AC |
|  | M12883/52-01 | M83536/2-028 | 2 Pole, 5 Amp Track Mount |
|  | M12883/52-02 | M83536/6-025 | 4 Pole, 5 Amp Track Mount |
|  | M12883/55-01 <br> M12883/55-02 | M6106/19-004, 007, 012, 017, 022 | 1 Pole, 25 Amp |

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## Engineering Notes

## DH-14 and DHR-14 Series Contactors, Rated up to 25 Amps, 115/200 VAC, 400 Hz

## Product Facts

- 3PDT

■ Hermetically sealed

- Auxiliary contacts available
- Meets many requirements of MIL-PRF-6106


| Performance Data | General Characteristics | le |
| :---: | :---: | :---: |
| Electrical Characteristics <br> Contact Arrangement - 3PDT <br> Rated Operating Voltage 115/200 VAC, 400 Hz | Temperature Range -$-55^{\circ} \mathrm{C}+0+71^{\circ} \mathrm{C}$ | VAC 400 Hz - AC Continuous (Type A, See diagram below) |
|  | Operating Cycles (Life) at Rated | Vdc - Continuous or continuous with |
|  | Resistive Load, Min. - 50,000 cycles | suppression (See diagram B \& C below) Operating Voltage, Nom. - |
| $\begin{aligned} & \text { Resistive Rating }-25 \mathrm{Amps} \\ & \text { Inductive Rating }-20 \mathrm{Amps} \\ & \text { Motor Rating }-15 \mathrm{Amps} \end{aligned}$ | Operating Cycles (Life) <br> Mechanical, Min. - 100,000 cycles | VAC 400 Hz - 115 VAC <br> Vdc - 28 Vdc |
|  | Dielectric Strength - <br> All Circuits to Ground - 1,500 Vrms Circuit to Circuit - 1,500 Vrms Coil to Ground and Aux. Contacts 1,000 Vrms | Pickup Voltage @ $25^{\circ}$ C, Max. - <br> VAC 400 Hz - 95 VAC <br> Vdc - 18 Vdc <br> Dropout Voltage @ $25^{\circ} \mathrm{C}$, Max. - <br> VAC 400 Hz - 25 VAC <br> Vdc — 1.5 to 7 Vdc |
|  | 100 megohm min. <br> Altitude - $80,000 \mathrm{ft}$. | Coil Resistance $\pm 20 \%$ @ $25^{\circ} \mathrm{C}$ <br> VAC 400 Hz - N/A <br> Vdc - 290 Ohms |

Coil Characteristics
Coil Type


A - AC Continuous


B - Continuous


For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## DH-14 and DHR-14 Series Contactors, Rated up to 25 Amps, $115 / 200 \mathrm{VAC}, 400 \mathrm{~Hz}$ (Continued)



Mounting Style A


Mounting Style B

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

Mounting Style C


## DH-14 and DHR-14 Series Contactors, Rated up to 25 Amps, 115/200 VAC, 400 Hz (Continued)

Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1


Circuit Configuration 2


Circuit Configuration 4

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE Connectivity <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| DH-14B | Hermetically Sealed | C | B | 4 | $1-1616522-4$ |
| DH-14B-3 | Hermetically Sealed | A | C | 1 | $1616037-1$ |
| DH-14CE | Hermetically Sealed | A | C | 2 | $1616017-1$ |
| DHR-14B | Hermetically Sealed | A | A | 3 | $1-1616037-2$ |
| DHR-14BA | Hermetically Sealed | B | A | 3 | $1-1616037-3$ |

## DHR-18 Series, Rated up to 30 Amps, 115 VAC, 400 Hz

Product Facts<br>■ 3PDT, Center off<br>■ Hermetically sealed



## Performance Data

Electrical Characteristics
Contact Arrangement - 3PDT, Center Off
Rated Operating Voltage $115 \mathrm{VAC}, 400 \mathrm{~Hz}$
Resistive Rating - 30 Amps
Inductive Rating - 20 Amps
General Characteristics
Operating Temperature $-71^{\circ} \mathrm{C}$
Weight, Max. - 1402.
Coil Characteristics
Duty Cycle - Continuous
Coil Rating - $115 \mathrm{VAC}, 400 \mathrm{~Hz}$
Pickup Voltage, Max. - 90 Vdc, Hot
Dropout Voltage - $45 \pm 20 \mathrm{Vdc}$
Current at $115 \mathrm{Vdc} \& 5^{\circ} \mathrm{C}$ 0.28 Amp max.


Circuit Configurations (Consult factory for other available circuit configurations)

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| DHR-18-1 | Hermetically Sealed | A | Continuous | 1 | $1616050-9$ |



For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

# D7, DH7, DHR7, DR7 Series, Rated up to 50 Amps, 115/200 VAC, 400 Hz 

```
Product Facts
■ 3PDT and 3PST NO
■ Gasket sealed or Hermetically sealed
■ Auxiliary contacts available
- Meets many requirements of MIL-PRF-6106
```



## Performance Data

Electrical Characteristics
Contact Arrangement - 3PDT and 3PST N0
Rated Operating Voltage 115/200 VAC, $400 \mathrm{~Hz}, 3$ phase Resistive Rating - 50 Amps Inductive Rating - 50 Amps
Motor Rating - 30 Amps
Lamp Rating - 15 Amps

| General Characteristics | Coil Characteristics |
| :---: | :---: |
| Temperature Range -$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$ | Duty Cycle - <br> VAC 400 Hz - AC Continuous (Type A |
| Operating Cycles (Life) at Rated Resistive Load, Min. 50,000 cycles | \& E, See diagram below) <br> Vdc - Continuous (Type B, See dia- <br> gram below) |
| Operating Cycles (Life) <br> Mechanical, Min. - 100,000 cycles | Vdc - Continuous with suppression <br> (Type C \& D, See diagram below) |
| Dielectric Strength - <br> All Circuits to Ground - 1,500 Vrms <br> Circuit to Circuit — 1,500 Vrms | Operating Voltage, Nom. - <br> VAC 400 Hz - 115 VAC <br> $\mathrm{Vdc}-28 \mathrm{Vdc}$ |
| Coil to Ground and Aux. Contacts 1,000 Vrms | Pickup Voltage @ $25^{\circ} \mathrm{C}$, Max. VAC 400 Hz - 75 VAC |
| Insulation Resistance, Initial 100 megohm min. | Vdc - 18 Vdc Dropout Voltage @ $25^{\circ} \mathrm{C}$, Max. |
| $\begin{aligned} & \text { Altitude - } \\ & \text { D7, DR7 - } 50,000 \mathrm{ft} \end{aligned}$ | $\begin{aligned} & \text { VAC } 400 \mathrm{~Hz}-12 \text { to } 38 \mathrm{VAC} \\ & \text { Vdc }-1 \text { to } 7 \mathrm{Vdc} \end{aligned}$ |
| DH7, DHR7 - $80,000 \mathrm{ft}$ <br> Weight, Max. - . 94 to 1.20 lbs | Coil Resistance $\pm 20 \%$ @ $25^{\circ} \mathrm{C}$ VAC 400 Hz - 505 Ohms Vdc - 126 Ohms |
|  | Coil Current @ $25^{\circ} \mathrm{C}$, Max. - <br> VAC 400 Hz -. 065 Amp <br> Vdc - 28 Amp |

General Characteristics
Temperature Range -
Operating Cycles (Life) at Rated
Resistive Load, Min. -
50,000 cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
Gircuits to Ground - $1,500 \mathrm{Vrms}$
Circuit to Circuit - 1,500 Vrms
1,000 Vrms
Insulation Resistance, Initial -
100 megohm min.
Altitude -
, 0000 ft
DH7, DHRT - 80,000 ft
Weight, Max. - . 94 to 1.20 lbs

## Coil Characteristics

Duty Cycle -
\& E, See diagram below)
Vdc - Continuous (Type B, See diagram below)
Vdc - Continuous with suppression
Type C \& D, See diagram below) Operating Voltage, Nom. VAC 400 Hz - 115 VAC

Pickup Voltage @ $25^{\circ} \mathrm{C}$, Max. VAC $400 \mathrm{~Hz}-75$ VAC

Dropout Voltage @ $25^{\circ} \mathrm{C}$, Max. VAC 400 Hz - 12 to 38 VAC
dc - 1 to 7 VdC
.
AC 400 Hz - 505 Ohms

Coil Current @ $25^{\circ}$ C, Max. -
Vdc - 28 Amp

Coil Type


For factory-direct application
assistance, phone 419-521-9500 or fax 419-526-2749.

D7, DH7, DHR7, DR7 Series, Rated up to 50 Amps, $115 / 200 \mathrm{VAC}, 400 \mathrm{~Hz}$ (Continued)

.437 MAX LUG DIA


Mounting Style A


Mounting Style C



Mounting Style B


Mounting Style D

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## D7, DH7, DHR7, DR7 Series, Rated up to 50 Amps, $115 / 200 \mathrm{VAC}, 400 \mathrm{~Hz}$ (Continued)



Mounting Style G


For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.

## D7, DH7, DHR7, DR7 Series, Rated up to 50 Amps,

$115 / 200 \mathrm{VAC}, 400 \mathrm{~Hz}$ (Continued)


Mounting Style I


Mounting Style K
For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.


## D7, DH7, DHR7, DR7 Series, Rated up to 50 Amps, $115 / 200 \mathrm{VAC}, 400 \mathrm{~Hz}$ (Continued)

Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1


## Circuit Configuration 5



Circuit Configuration 9


Circuit Configuration 13


Circuit Configuration 2


Circuit Configuration 6


Circuit Configuration 10


Circuit Configuration 14


Circuit Configuration 3


Circuit Configuration 7


Circuit Configuration 11


Circuit Configuration 15


Circuit Configuration 4


Circuit Configuration 8


Circuit Configuration 12


Circuit Configuration 16

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.


Circuit Configuration 17


Circuit Configuration 18

D7, DH7, DHR7, DR7 Series, Rated up to 50 Amps,
115/200 VAC, 400 Hz (Continued)

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | ---: |
| D-7BS | Gasket/Vented | A | C | 1 | $1616036-1$ |
| D-7M | Gasket/Vented | B | C | 2 | $1616016-2$ |
| D-7GR-2 | Gasket/Vented | C | B | 3 | $1616036-3$ |
| D-7GRZ | Gasket/Vented | D | C | 4 | $1616036-5$ |
| DH-7BB | Hermetically Sealed | A | B | 5 | $1616037-7$ |
| DH-7N | Hermetically Sealed | B | B | 6 | $1616017-9$ |
| DH-7ZG-1 | Hermetically Sealed | C | C | 7 | $1-1616017-1$ |
| DHR-7ZG | Hermetically Sealed | C | A | 8 | $1-1616017-2$ |
| DR-7VC | Hermetically Sealed | B | A | 9 | $1616018-1$ |
| D-7GR | Gasket/Vented | E | B | 10 | $1616036-2$ |
| D-7GR-3 | Gasket/Vented | F | B | 11 | $1616036-4$ |
| D-7MA | Gasket/Vented | G | B | 12 | $1616016-3$ |
| D-7MM | Gasket/Vented | H | C | 18 | $1616016-4$ |
| DH-7GR | Hermetically Sealed | E | C | 11 | $1616037-9$ |
| DH-7ZAB | Hermetically Sealed | H | D | 13 | $1-1616037-1$ |
| DHR-7B | Hermetically Sealed | I | E | 14 | $1-1616037-6$ |
| DHR-7BE | Hermetically Sealed | J | A | 15 | $1-1616037-7$ |
| DHR-7K | Hermetically Sealed | K | E | 16 | $1616522-2$ |
| DHR-7M | Hermetically Sealed | L | E | 17 | $1616518-2$ |

# D18, DH18 and DHR18 Series, Rated up to 50 Amps, 115/200 VAC, 400 Hz 

## Product Facts

■ 3PDT, Center off
■ Gasket sealed or Hermetically sealed
■ Meets many requirements of MIL-PRF-6106


For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## General Characteristics <br> Temperature Range -

 $-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$Operating Cycles (Life) at Rated Resistive Load, Min. -
50,000 cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - 1,500 Vrms
Circuit to Circuit - 1,500 Vrms
Coil to Ground and Aux. Contacts 1,000 Vrms
Insulation Resistance, Initial -
100 megohm min

## Altitude -

D-18-50,000 ft.
DH-18, DHR-18 - 80,000 ft.
Weight, Max. - . 94 to 1.50 lbs

Performance Data
Electrical Characteristics
Contact Arrangement - 3PDT
Center Off
Rated Operating Voltage 115/200 VAC, 400 Hz

Resistive Rating - 50 Amps
Inductive Rating - 50 Amps
Motor Rating - 30 Amps
Lamp Rating - 15 Amps
Rupture Rating - 400 Amps

Sinusoidal Vibration -
$10 \mathrm{G} @ 70$ to $2,000 \mathrm{~Hz}$
Shock, Max. - 25 G
Operate Time @ Nom. Voltage,
Max. - 35 msec
Release Time @ Nom. Voltage,
Max. - 15 msec
Bounce Time @ Nom. Voltage,
Max. - 5 msec

## Coil Characteristics

Duty Cycle -
AC Continuous (Type E, See diagram below)
DC Continuous (Type A-D, See diagram below)
Operating Voltage, Nom. - 28 Vdc
Pickup Voltage @ $25^{\circ} \mathrm{C}$, Max. -
Coil Type A — 18 Vdc
Coil Type B — 15 Vdc
Dropout Voltage @ $25^{\circ} \mathrm{C}$, Max. -
Coil Type A — 1.5 to 7 Vdc
Coil Type B - 2.5 to 6.5 Vdc
Coil Resistance $\pm 20 \%$ @ $25^{\circ} \mathrm{C}$ 175 Ohms
Coil Current @ $25^{\circ}$ C, Max. . 175 Amp

Coil Type



assistance, phone 419-521-9500 or
fax 419-526-2749.

# D18, DH18 and DHR18 Series Contactors, Rated up to 50 Amps, 115/200 VAC, 400 Hz (Continued) 



Mounting Style A


For factory-direct application
assistance, phone 419-521-9500 or


Mounting Style B

## D18, DH18 and DHR18 Series Contactors, Rated up to 50 Amps, 115/200 VAC, 400 Hz (Continued)

Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1


Circuit Configuration 2


Circuit Configuration 3


Circuit Configuration 6
Circuit Configuration 5
-


Circuit Configuration 7

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| D-18 | Gasket/Vented | A | A | 1 | $1616048-1$ |
| D-180A | Gasket/Vented | D | C | 6 | $1616048-2$ |
| D-18AA | Gasket/Vented | A | B | 2 | $1616048-3$ |
| D-18F | Gasket/Vented | A | B | 3 | $1616048-4$ |
| D-18ZZC | Gasket/Vented | B | D | 4 | $1-1616957-3$ |
| DH-18 | Hermetically Sealed | A | A | 1 | $1616050-1$ |
| DH-18Y | Hermetically Sealed | A | A | 7 | $1616524-3$ |
| DR-18E-5 | Gasket/Vented | C | E | 5 | $1616099-1$ |

For factory-direct application
assistance, phone 419-521-9500 or fax 419-526-2749.

## Product Facts

■ 3PST NO, Double break
■ Hermetically sealed

- Auxiliary contacts available

■ Meets many requirements of MIL-PRF-6106


| Performance Data | General Characteristics | Coil Characteristics |
| :---: | :---: | :---: |
| Electrical Characteristics <br> Contact Arrangement - 3PST NO, <br> Double Break | Temperature Range - | Duty Cycle - Continuous |
|  | Operating Cycles (Life) at Rated | Operating Voltage, Nom. 28 Vdc |
| Rated Operating Voltage 28 Vdc or $115 / 200 \mathrm{VAC}, 400 \mathrm{~Hz}$, 3 phase <br> Resistive Rating - 50 Amps Inductive Rating - <br> 115/200 VAC, $400 \mathrm{~Hz}, 3$ phase 50 Amps <br> At $28 \mathrm{Vdc}-25 \mathrm{Amps}$ | Resistive Load, Min. 100,000 cycles | Pickup Voltage, Max. 18 Vdc |
|  | Operating Cycles (Life) <br> Mechanical, Min. - 200,000 cycles | Dropout Voltage - 1.5 to 7 Vdc |
|  | Dielectric Strength - <br> All Circuits to Ground - 1,500 Vrms Circuit to Circuit - 1,500 Vrms Coil to Ground and Aux. Contacts 1,000 Vrms | Coil Current, Holding, Max. - 0.5 Amp |
| Motor Rating - 50 Amps | Insulation Resistance, Initial 100 megohm min. |  |
|  | Weight, Max. - 1.20 lbs Impact Shock - 5 G |  |
|  | Close Time @ 28 Vdc and $25^{\circ} \mathrm{C}$, Max. - 25 msec |  |
|  | Release Time @ 28 Vdc and $25^{\circ} \mathrm{C}$, Max. - 10 msec |  |

Coil Type


B - Continuous w/Suppression

For factory-direct application
assistance, phone 419-521-9500 or fax 419-526-2749.


A - Continuous

## BH-316 Series, Rated up to $50 \mathrm{Amps}, 115 / 200 \mathrm{VAC}, 400 \mathrm{~Hz}$ or 28 Vdc (Continued)



For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.


Mounting Style C

## BH-316 Series, Rated up to 50 Amps, 115/200 VAC, 400 Hz or 28 Vdc (Continued)

Circuit Configurations (Consult factory for other available circuit configurations)


| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| $\mathrm{BH}-316$ | Hermetically Sealed | A | Continuous | 2 | $1616008-4$ |
| $\mathrm{BH}-316 \mathrm{~A}$ | Hermetically Sealed | A | Continuous | 1 | $1616008-5$ |
| $\mathrm{BH}-316 \mathrm{D}$ | Hermetically Sealed | A | Continuous | 1 | $1616008-6$ |
| $\mathrm{BH}-316 \mathrm{C}$ | Hermetically Sealed | B | Continuous | 3 | $1-1616520-0$ |

## Product Facts

- TPST NO and TPDT NC

■ Gasket sealed or Hermetically sealed
■ 115/200 VAC, 400 Hz , 3 phase

- Auxiliary contacts available
- Meets the requirements of MIL-PRF-6106



## Performance Data

Electrical Characteristics
Contact Arrangement TPST NO and TPDT NC
Rated Operating Voltage 115/200 VAC, $400 \mathrm{~Hz}, 3$ phase
Current, Resistive - 60 Amps
Current, Inductive - 60 Amps
Current, Motor - 60 Amps
Current, Rupture - 600 Amps

General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. -
50,000 cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - 1,500 Vrms
Circuit to Circuit - 1,500 Vrms
Coil to Ground and Aux. Contacts 1,000 Vrms
Altitude Max. $-50,000 \mathrm{ft}$.
Weight, Nominal - 1.50 to 2.0 lbs

## Coil Characteristics

Duty Cycle - Continuous or
continuous with suppression
Operating Voltage, Nom. - 28 Vdo
Pickup Voltage, Max. @ $85^{\circ} \mathrm{C}$ 18 Vdc
Dropout Voltage, Max. -
1.5 to 7 Vdc

Coil Current @ 29 Vdc Max. @
$25^{\circ} \mathrm{C}-0.5 \mathrm{Amps}$
Inrush - 5 Amps

Coil Type


For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.



Mounting Style B

Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1


Circuit Configuration 2


Circuit Configuration 3


Circuit Configuration 4

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| B-138S | Gasket/Vented | B | B | 2 | $1616002-5$ |
| B-138XEH | Gasket/Vented | A | C | 4 | $1616028-3$ |
| B-138BH | Gasket/Vented | A | A | 1 | $1616028-1$ |
| B-138XAH | Gasket/Vented | A | A | 3 | $1616028-2$ |

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## Product Facts

■ 3PDT NO, Center off
■ Gasket sealed or Hermetically sealed
■ 115/200 VAC, 400 Hz , 3 phase

- Auxiliary contacts available
- Meets the requirements of MIL-PRF-6106


Performance Data
Electrical Characteristics Contact Arrangement 3PDT NO, Center Off
Rated Operating Voltage 115/200 VAC, $400 \mathrm{~Hz}, 3$ phase
Current, Resistive - 60 Amps
Current, Inductive - 60 Amps
Current, Motor - 60 Amps
Current, Rupture - 600 Amps

General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+120^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. -
50,000 cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - 1,500 Vrms
Circuit to Circuit — 1,500 Vrms
Coil to Ground and Aux. Contacts 1,000 Vrms
Insulation Resistance, Initial 100 megohm min.
Altitude Max. - $50,000 \mathrm{ft}$.
Weight, Nominal - 1.50 to 2.31 lbs
Sinusoidal Vibration -
$10 \mathrm{G} @ 70$ to $2,000 \mathrm{~Hz}$
Shock, Max. - 15G

## Coil Characteristics

Duty Cycle - Continuous
(Type A or B, See diagram below)
Operating Voltage, Nom. - 28 Vdo
Pickup Voltage, Max. @ $85^{\circ} \mathrm{C}$ 18 Vdc

Dropout Voltage, Max. -
1.5 to 7 Vdc

Coil Current @ 29 Vdc Max. @
$25^{\circ} \mathrm{C}$ - 0.35 Amps
Inrush - 5 Amps

Coil Type


C - Continuous w/Suppression

For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.


Mounting Style A
Mounting Style B

Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1


Circuit Configuration 2


MECHANICAL INTERLOCK
Circuit Configuration 3

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | ---: |
| B-140AP-1 | Gasket/Vented | B | Continuous | 3 | $1616043-7$ |
| B-140BH | Gasket/Vented | A | Continuous | 1 | $1616043-9$ |
| B-140V | Gasket/Vented | A | Continuous | 2 | $1-1616043-0$ |

For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.

## Product Facts

■ 3PDT
■ Hermetically sealed

- Auxiliary contacts available
- Meets many requirements of MIL-PRF-6106



## Performance Data

Electrical Characteristics
Contact Arrangement - 3PDT
Rated Operating Voltage 115/200 VAC, $400 \mathrm{~Hz}, 3$ phase
Resistive Rating - 60 Amps
General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. -
50,000 cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - 1,500 Vrms
Circuit to Circuit - 1,500 Vrms
Coil to Ground and Aux. Contacts 1,000 Vrms
Altitude - $80,000 \mathrm{ft}$
Weight, Max. - .91 lbs
Coil Characteristics
Duty Cycle - Continuous
Operating Voltage, Nom. - 28 Vdc
Pickup Voltage @ $25^{\circ}$ C, Max. 18 Vdc
Dropout Voltage @ $25^{\circ} \mathrm{C}$, Max. 1.5 to 7 Vdc

Coil Resistance $\pm 20 \%$ @ $25^{\circ} \mathrm{C}$ 126 Ohms
Coil Current @ $\mathbf{2 5}^{\circ} \mathrm{C}$, Max. 28 Amp


## Mounting Style A

Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| DH-7BC | Hermetically Sealed | A | Continuous | 1 | $1616037-8$ |

Product Facts

- 3PDT NO

■ Gasket sealed or Hermetically sealed
■ Auxiliary contacts available

- Meets many requirements of MIL-PRF-6106



## Performance Data

Electrical Characteristics
Contact Arrangement - 3PDT N0
Rated Operating Voltage -
115/200 VAC, $400 \mathrm{~Hz}, 3$ phase
Resistive Rating - 100 Amps
Inductive Rating - 100 Amps

## General Characteristics

Temperature Range -$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated Resistive Load, Min. -
50,000 cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - 1,500 Vrms
Circuit to Circuit - 1,500 Vrms
Coil to Ground and Aux. Contacts 1,000 Vrms
Insulation Resistance, Initial 100 megohm min.

## Altitude -

D-25-50,000 ft.
DH-25, DHR-25 - 80,000 ft.
Weight, Max. -2.20 to 2.75 lbs
Sinusoidal Vibration -
$10 \mathrm{G} @ 70$ to $2,000 \mathrm{~Hz}$
Shock, Max. - 25 G
Operate Time @ Nom. Voltage,
Max. - 35 msec
Release Time @ Nom. Voltage,
Max. - 35 msec
Bounce Time @ Nom. Voltage, Max. -5 msec

Coil Characteristics
Duty Cycle -
VAC 400 Hz - AC (Type A, See diagram below)
Vdc - Continuous (Type B, See diagram below)
Vdc - Continuous with suppression
(Type C, See diagram below)
Operating Voltage, Nom. -
VAC 400 Hz - 115 VAC
Vdc - 28 Vdc
Pickup Voltage @ $25^{\circ} \mathrm{C}$, Max. VAC 400 Hz - 103.5 VAC
Vdc - 18 Vdc
Dropout Voltage @ $25^{\circ} \mathrm{C}$, Max. VAC 400 Hz - 5 to 45 VAC
Vdc - 1.5 to 7 Vdc
Coil Resistance $\pm 20 \%$ @ $25^{\circ} \mathrm{C}$ -
VAC 400 Hz - N/A
Vdc - 175 Ohms

Coil Type

A - AC

B - Continuous


For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.

| Catalog 5-1773450-5 | Dimensions are shown for | Dimensions are in millimeters | USA: +1 800 5226752 |
| :--- | :--- | :--- | :--- |
| Revised 3-13 | reference purposes only. <br> inless otherwise specified. | Asia Pacific: +8604008206015 <br> Specifications subject <br> to change. |  |
| www.te.com |  |  |  |

For additional support numbers please visit www.te.com

## D25, DH25 and DHR25 Series, Rated up to 100 Amps , <br> $115 / 200 \mathrm{VAC}, 400 \mathrm{~Hz}$ (Continued)



For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.


Mounting Style C

## D25, DH25 and DHR25 Series, Rated up to 100 Amps ,

$115 / 200 \mathrm{VAC}, 400 \mathrm{~Hz}$ (Continued)
Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1


Circuit Configuration 2


Circuit Configuration 3


Circuit Configuration 4

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | ---: |
| D-25BD | Gasket/Vented | A | B | 1 | $1616034-3$ |
| DH-25B | Hermetically Sealed | C | B | 4 | $1616037-2$ |
| DH-25BA | Hermetically Sealed | B | B | 2 | $1616037-3$ |
| DHR-25BG | Hermetically Sealed | A | A | 3 | $1-1616037-5$ |

## D25 and DH25 Series, Rated up to 120 Amps, 115/200 VAC, 400 Hz

## Product Facts

■ 3PST NO
■ Gasket sealed or Hermetically sealed
■ Auxiliary contacts available
■ Meets many requirements of MIL-PRF-6106


Performance Data
Electrical Characteristics
Contact Arrangement - 3PST NO
Rated Operating Voltage 115/200 VAC, $400 \mathrm{~Hz}, 3$ phase
Resistive Rating - 120 Amps
Inductive Rating - 120 Amps
Motor Rating - 100 Amps
Rupture Rating - 1,000 Amps

| General Characteristics | Coil Characteristics |
| :---: | :---: |
| Temperature Range -$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$ | Duty Cycle - <br> Vdc - Continuous (Type A, |
| Operating Cycles (Life) at Rated Resistive Load, Min. 50,000 cycles | See diagram below) <br> Vdc - Continuous with suppression <br> (Type B, See diagram below) |
| Operating Cycles (Life) <br> Mechanical, Min. - 100,000 cycles | Operating Voltage, Nom. 28 Vdc |
| Dielectric Strength - <br> All Circuits to Ground - 1,500 Vrms | Pickup Voltage @ $\mathbf{2 5}^{\circ}$ C, Max. 18 Vdc |
| Circuit to Circuit - 1,500 Vrms Coil to Ground and Aux. Contacts - | Dropout Voltage @ $25^{\circ} \mathrm{C}$, Max. 1.5 to 7 Vdc |
| 1,000 Vrms | Coil Resistance $\pm 20 \%$ @ $25^{\circ} \mathrm{C}$ - |
| $\begin{aligned} & \text { Altitude - } \\ & \text { D-25-50,000 ft. } \\ & \text { DH-25-80,000 ft. } \end{aligned}$ | 113 Ohms |
| Weight, Max. -2.10 lbs |  |

## Coil Type

Coil Characteristics
Duty Cycle -
,
dee iagram below
(Type B, See diagram below)
Operating Voltage, Nom. -
28 Vdc
18 Vdc
Dropout Voltage @ $25^{\circ} \mathrm{C}$, Max. 1.5 to 7 Vdc

Coil Resistance $\pm 20 \%$ @ $\mathbf{2 5}^{\circ} \mathrm{C}$ 113 Ohms

DH-25 - 80,000 ft
Weight, Max. - 2.10 lbs

## D25 and DH25 Series, Rated up to 120 Amps, <br> 115/200 VAC, 400 Hz (Continued)



Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1
Circuit Configuration 2


| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| D-25CF | Gasket/Vented | A | A | 1 | $1616015-1$ |
| DH-25CU | Hermetically Sealed | B | B | 2 | $1616017-4$ |

For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.

## Product Facts

■ 3PDT, Center off
■ Hermetically sealed

- Auxiliary contacts available

■ Meets many requirements of MIL-PRF-6106
factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## Performance Data

Electrical Characteristics
Contact Arrangement -
3PDT, Center Off
Rated Operating Voltage 115/200 VAC, $400 \mathrm{~Hz}, 3$ phase
Resistive Rating - 100 Amps
General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. -
50,000 cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - 1,500 Vrms
Circuit to Circuit - 1,500 Vrms
Coil to Ground and Aux. Contacts 1,000 Vrms

Altitude - $50,000 \mathrm{ft}$
Weight, Max. -2.31 lbs
Coil Characteristics
Duty Cycle - Continuous
Operating Voltage, Nom. - 28 Vdc
Pickup Voltage @ $71^{\circ} \mathrm{C}$, Max. 18 Vdc
Dropout Voltage, Max. -
1.5 to 7 Vdc

Coil Resistance $\pm 20 \%$ @ $25^{\circ} \mathrm{C}$ 160 Ohms


Circuit Configurations (Consult factory for other available circuit configurations)


| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| D-31C | Gasket/Vented | A | Continuous | 1 | $1616049-1$ |

## D-31, DH-31, and DHL-31 Series, Rated up to 120 Amps, 115/200 VAC, 400 Hz

## Product Facts

- 3PDT, Center off
- Gasket sealed or Hermetically sealed
- Auxiliary contacts available
- Meets many requirements of MIL-PRF-6106



## Performance Data

Electrical Characteristics
Contact Arrangement 3PDT, Center Off
Rated Operating Voltage $115 / 200 \mathrm{VAC}, 400 \mathrm{~Hz}, 3$ phase
Resistive Rating - 120 Amps
Inductive Rating - 120 Amps
Motor Rating - 80 Amps
Rupture Rating - 1,000 Amps

| General Characteristics | Coil Characteristics |
| :---: | :---: |
| Temperature Range - | Duty Cycle - |
| $-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$ | Continuous (Type A, See diagram below) |
| Operating Cycles (Life) at Rated | Continuous with suppression |
| Resistive Load, Min. - | (Type B or Type C, See diagram below) |
| 50,000 cycles | Operating Voltage, Nom. - 28 Vdc |
| Operating Cycles (Life) | Pickup Voltage @ $25^{\circ} \mathrm{C}$, Max. |
| Mechanical, Min. - 100,000 cycles | Coil Type A and C-18 Vdc |
| Dielectric Strength - | Coil Type B - 15 Vdc |
| All Circuits to Ground - 1,500 Vrms | Dropout Voltage @ $25^{\circ} \mathrm{C}$, Max. - |
| Circuit to Circuit-1,500 Vrms | Coil Type A and C - 1.5 to 7 Vdc |
| Coil to Ground and Aux. Contacts - | Coil Type B - 2 to 7 Vdc |
| 1,000 Vrms | Coil Resistance $\pm 20 \%$ @ $25^{\circ} \mathrm{C}$ |
| Altitude - | Coil Type A - N/A |
| D-31-50,000 ft | Coil Type B - 100 Ohms |
| DH-31, DHL-31-70,000 ft | Coil Type C - 132 Ohms |
| Weight - 2.60 lbs | Coil Current @ $25^{\circ} \mathrm{C}$, Max. . 350 Amp |

Temperature Range -
Operating Cycles (Life) at Rated
Resistive Load, Min. -
50,000 cycles
operating Cycles (Life)
Dielectric Strength -
All Circuits to Ground - 1,500 Vrms
Circuit to Circuit - 1,500 Vrms
Coil to Ground and Aux. Contacts 1,00

D-31 - $50,000 \mathrm{ft}$
DH-31, DHL-31 - 70,000 ft
Weight - 2.60 lbs

Coil Characteristics
Duty Cycle -

Continuous with suppression
(Type B or Type C, See diagram below)
Operating Voltage, Nom. - 28 Vdc
Pickup Voltage @ $25^{\circ} \mathrm{C}$, Max. -

- 18 V V

Dropout Voltage @ $25^{\circ} \mathrm{C}$, Max. -
Coil Type A and C - 1.5 to 7 Vdc
Coil Type B — 2 to 7 Vdc
Coil Resistance $\pm 20 \%$ @ $25^{\circ} \mathrm{C}$ -
ype A — N/A
coil type B — 1000 hms
Coil Current @ $25^{\circ}$ C, Max. -
. 350 Amp

Coil Type


D-31, DH-31, and DHL-31 Series, Rated up to 120 Amps,
$115 / 200 \mathrm{VAC}, 400 \mathrm{~Hz}$ (Continued)


For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.


## D-31, DH-31, and DHL-31 Series, Rated up to 120 Amps, 115/200 VAC, 400 Hz (Continued)

Circuit Configurations (Consult factory for other available circuit configurations)



Circuit Configuration 2


Circuit Configuration 4

Circuit Configuration 4


| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| D-31DB | Gasket/Vented | A | B | 1 | $1616049-2$ |
| D-31TH | Gasket/Vented | C | A | 5 | $1616524-5$ |
| DH-31A | Hermetically Sealed | A | A | 2 | $1616050-4$ |
| DH-31DA | Hermetically Sealed | A | B | 3 | $1616050-5$ |
| DH-31DAA | Hermetically Sealed | A | A | 3 | $1616050-6$ |
| DHL-31B | Hermetically Sealed | B | D | 4 | $1616050-8$ |

## Product Facts <br> ■ 3PDT, Side stable <br> ■ Gasket sealed



## Performance Data

Electrical Characteristics
Main Contacts -
Contact Arrangement 3PDT, Side Stable
Rated Operating Voltage 115/200 VAC, 400 Hz
Resistive Rating - 125 Amps
Inductive Rating - 100 Amps
Motor Load - 60 Amps
Rupture Rating - 600 Amps
Overload Rating - 600 Amps
Auxiliary Contacts -
Contact Arrangement - 2PDT
Voltage - 28 Vdc or $115 \mathrm{VAC}, 400 \mathrm{~Hz}$
Resistive Rating - 3 Amps
General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{F}$ to $+71^{\circ} \mathrm{F}$
Altitude, Max. - $50,000 \mathrm{ft}$
Weight, Nominal - 2.75 lbs

## Coil Characteristics

Duty Cycle - Continuous
Operating Voltage, Nom. - 28 Vdc
Pickup Voltage @ $25^{\circ} \mathrm{C}$, Max. 18 Vdc
Dropout Voltage @ $25^{\circ} \mathrm{C}$ 2.5 to 7 Vdc

Coil Resistance @ $25^{\circ} \mathrm{C}$ -
113 Ohms $\pm 20 \%$


Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| D-25BAH | Gasket/Vented | A | Continuous | 1 | $1616034-2$ |

## B309 Series, Rated up to 130 Amps, 115 VDC

Product Facts
$\square$ 3PST N0, Single break main
$\quad$ contacts
$\square$ 2PDT Auxiliary contacts
(note 1)
$\square$ Gasket sealed
$\square$
Meets many requirements
of MIL-PRF-6106

## Performance Data

Electrical Characteristics
Contact Arrangement -
3PST NO, Single Break
Rated Operating Voltage -
115 VDC
Resistive Currant Rating - 130
Amps (see note 2)
Rupture Rating - 1300 Amps (see note 3)
General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Minimum Electrical Cycles -
50,000
Minimum Mechanical Cycles -
100,000 @ 32.5 A
Dielectric Strength - 1500 Vrms
Altitude - $50,000 \mathrm{ft}$
Weight, Max. - 1.35 lbs
Duty Cycle - Continuous
(Electronically Economized)
Coil Operating Voltage - 28 Vdc
Drop Out Voltage - 1.5 to 7 Vdc

$-1 T E M$
$-1 T E M$
7


| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil | Type | Circuit <br> Config. |
| :---: | :---: | :---: | :---: | :---: | :---: |
| B309A | Gasket Sealed | A | Continuous, | TE <br> Part Number |  |

## NOTES

1. Other aux contact configurations available. Consult Factory.
2. Units with current ratings to 175 A are available. Consult Factory.
3. Units with rupture ratings to 1750A are available. Consult Factory.

For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.

## Product Facts

■ 3PDT, Magnetic latching
■ Gasket sealed

- Auxiliary contacts available
- Meets many requirements of MIL-PRF-6106


## Performance Data

Electrical Characteristics
Contact Arrangement - 3PDT,
Magnetic Latching
Rated Operating Voltage -
115/200 VAC, 400 Hz
Resistive Rating - 175 Amps
General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. -
50,000 cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - 1,500 Vrms
Circuit to Circuit - 1,500 Vrms
Coil to Ground and Aux. Contacts 1,000 Vrms
Insulation Resistance, Initial 100 megohm min.
Altitude - $50,000 \mathrm{ft}$.
Weight, Max. - 2.44 lbs
Coil Characteristics
Duty Cycle - Continuous,
self-deenergizing
Operating Voltage, Max. - 30 Vdc
Close Voltage @ 15 to 30 Vdc -
Resistance - $4.4+10 \%$ Ohms
Current - 5 Amp Max.
Trip Voltage @ 15 to 30 Vdc -
Resistance - $5.0+10 \%$ Ohms
Current - 5 Amp Max.


Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> B451 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Gasket/Vented | A | Continuous, <br> Self-Deenergizing | 1 | $1616023-3$ |  |

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

For additional support numbers please visit www.te.com

```
Product Facts
■ 3PST NO, Double break
\squareGasket sealed
■ 235/440 VAC, 50-60 Hz, 3 phase
■ Auxiliary contacts available
- Meets many requirements of MIL-PRF-6106
```



## Performance Data

## Electrical Characteristics

Contact Arrangement - 3PST NO, Double Break
Rated Operating Voltage 253/440 VAC, $50-60 \mathrm{~Hz}, 3$ phase Current, Resistive - 175 Amps
Current, Inductive -
B312DB - 70 Amps
Current, Motor - 150 Amps
Current, Rupture - $1,500 \mathrm{Amps}$

General Characteristics
Temperature Range -$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated Resistive Load, Min. -
50,000 cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - 1,500 Vrms
Circuit to Circuit - 1,500 Vrms
Coil to Ground and Aux. Contacts 1,000 Vrms
Weight, Max. - 3.0 lbs

Coil Characteristics
Duty Cycle - Continuous, economizing
Operating Voltage, Nom. - 28 Vdc
Pickup Voltage - 18 Vdc
Dropout Voltage -
B312DB - 1.5 to 7 Vdc
B312CH - 1 to 7 Vdc

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

| Catalog 5-1773450-5 | Dimensions are shown for | Dimensions are in millimeters | USA: +1 800 5226752 |
| :--- | :--- | :--- | :--- |
| Revised 3-13 | reference purposes only. | unless otherwise specified. | Asia Pacific: +8604008206015 |
|  | Specifications subject |  | UK: +44 800 267666 |
| www.te.com | to change. |  |  |



Mounting Style A

Circuit Configurations (Consult factory for other available circuit configurations)


| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| B-312DB | Gasket/Vented | A | Continuous, <br> Economizing | 1 | $1616004-7$ |

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

Lightweight, High Performance

## Product Facts

- 3PST NO, Side stable

■ Gasket sealed
■ Buss bar mount

Circuit Configurations
(Consult factory for other available circuit configurations)


Circuit Configuration 1


| Performance Data | General Characteristics | Coil Characteristics |
| :--- | :--- | :--- |
| Electrical Characteristics | Temperature Range - | Duty Cycle - Continuous, |
| Contact Arrangement - | $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$ | economizing |
| 3PST NO, Side Stable | Operating Cycles (Life) at Rated | Operating Voltage, Nom. - 28 Vdc |
| Rated Operating Voltage - | Resistive Load, Min. - | Pickup Voltage - 18 Vdc |
| $115 / 230$ VAC, 230/460 VAC | 50,000 cycles | Dropout Voltage - |
| $400-800 \mathrm{~Hz}$ | Operating Cycles (Life) | 1.0 to 7 Vdc |
| Resistive Rating -175 Amps | Mechanical, Min. -100,000 cycles |  |
|  | Weight, Max. -1.25 lbs |  |



For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| KA175B3C | Gasket/Vented | A | Continuous, <br> Economizing | 1 | $2-1616960-7$ | to change.

## SA136F Series, Rated up to 175 Amps, 240/416 VAC

Product Facts<br>- 3PST NO, Side stable<br>■ Gasket/Vented sealed



Performance Data
Electrical Characteristics
Main Contacts -
Contact Arrangement - 3PST NO,
Double Break
Rated Operating Voltage 240/416 VAC, $50 / 60 / 400 \mathrm{~Hz}$
Resistive Rating - 240 Amps
Rupture Rating - 2400 Amps
Auxiliary Contacts - 1SPST NO
Contact Arrangement - 4PST NC
Voltage, Nom. - 28 Vdc
Resistive Rating - 5 Amps, 28 Vdc ; 10 Amps, 120 VAC

## General Characteristics

Operating Cycles (Life) at Rated
Resistive Load, Min. - 50,000
cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Weight, Max. - 2.8 lbs
Coil Characteristics
Duty Cycle - Continuous,
economizing
Operating Voltage, Nom. -24 Vdc
Pickup Voltage, Max. - 18 Vdc
Dropout Voltage - 1 to 10 Vdc
Coil Resistance - 240A
Rupture - 2400A


Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> SA136F |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Gasket/Vented | A | Continuous | 1 | $1616948-7$ |  |

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

For additional support numbers please visit www.te.com

Product Facts<br>■ 3PST NO<br>■ Gasket sealed<br>■ 115 VAC, 400 Hz

## B-312 Series, Rated up to 200 Amps, 115 VAC, 400 Hz



## Performance Data

## Electrical Characteristics

## Main Contacts -

Contact Arrangement - 3PST N0, Double Break
Rated Operating Voltage 115 VAC, 400 Hz
Resistive Rating - 200 Amps
Inductive Rating - 200 Amps
Rupture Rating - 2000 Amps
Auxiliary Contacts -
Contact Arrangement - 4PST NC
Voltage, Nom. - 28 Vdc or 115 VAC, 400 Hz
Resistive Rating - 5 Amps
General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. - 50,000
cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Weight, Max. - 3 lbs
Coil Characteristics
Duty Cycle - Continuous,
economizing
Operating Voltage, Nom. - 28 Vdc
Dropout Voltage - 1 to 7 Vdc

Pickup Voltage, Max. - 18 Vdc Circuit Configurations (Consult factory for other available circuit
 configurations)

Coil Resistance -
Pickup - $120 \mathrm{hms} \pm 20 \%$
Holding - 60 Ohms $\pm 20 \%$


Circuit Configuration 1

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| B-312CV | Gasket/Vented | A | Continuous, <br> Economizing | 1 | $1616004-5$ |

```
Product Facts
■ 3PDT, Center off, double break
■ Gasket sealed
```

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## Performance Data

Electrical Characteristics
Main Contacts -
Contact Arrangement - 3PDT, Center Off, Double Break
Rated Operating Voltage 120/208 VAC, 400 Hz
Resistive Rating - 260 Amps
Inductive Rating - 260 Amps
Rupture Rating - 2600 Amps
Auxiliary Contacts -
Contact Arrangement -
4PST NO, 2PST NC
Resistive Rating - 5 Amps
Inductive Rating - 5 Amps
Lamp Rating - 5 Amps
General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated Resistive Load - 50,000 cycles
Operating Cycles (Life)
Mechanical - 100,000 cycles
Altitude Max. - 40,000 ft.
Weight-5 lbs
Coil Characteristics
Duty Cycle - Continuous,
economizing
Operating Voltage, Nom. - 28 Vdc
Pickup Voltage, Max. - 18 Vdc
Dropout Voltage -
R-S Coil - 14 Vdc
W-H Coil - 7 Vdc


Circuit Configurations (Consult factory for other available circuit configurations)


| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> B-393T |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Gasket/Vented | A | Continuous, <br> Economizing | 1 | $1616044-5$ |  |

## B-429 Series, 260/350 Amps, 115/200 VAC or 120/208 VAC

## Product Facts

■ 3PST NO, Double break
■ Gasket sealed

- Auxiliary contacts available
- Meets many requirements of MIL-PRF-6106



## Coil Characteristics

Duty Cycle - Continuous, economized with suppression (Type A or B, See diagram below) Operating Voltage, Nom. - 28 Vdo Pickup Voltage, Max. -
Coil Type A - 15 Vdc
Coil Type B — 18 Vdc
Dropout Voltage, Max. -
Coil Type A — 1.5 to 10 Vdc
Coil Type B — 1 to 7 Vdc
Coil Current Inrush -
Coil Type A - 6 Amps
Coil Type B — 2.7 Amps
Coil Current Holding -
Coil Type A - 0.6 Amps
Coil Type B -0.56 Amps

Coil Type


A - Continuous, Economized with Suppression

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

B - Continuous, Economized with Suppression



For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.


## B-429 Series, 260/350 Amps, 115/200 VAC or 120/208 VAC (Continued)

Circuit Configurations (Consult factory for other available circuit configurations)


| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| B-429W | Gasket/Vented | B | B | 3 | $1616005-6$ |
| B-429-1 | Gasket/Vented | A | A | 1 | $1616005-1$ |
| B-429CA | Gasket/Vented | A | B | 2 | $1616005-4$ |

## Product Facts

■ 3PST, Double break, magnetic latching
■ Gasket sealed
■ Auxiliary contacts available

- Meets many requirements of MIL-PRF-6106


## B-430 Series, Rated up to 275 Amps, 115/200 VAC, 400 Hz



| Performance Data | General Characteristics | Coil Characteristics |
| :---: | :---: | :---: |
| Electrical Characteristics | Temperature Range -$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$ | Duty Cycle - <br> B-430-1 - Cont |
| Contact Arrangement - 3PST, Double Break, Magnetic Latching | Operating Cycles (Life) at Rated Resistive Load, Min. - | self-deenergizing (Type A, See diagram below) |
| Rated Operating Voltage 115/200 VAC, $400 \mathrm{~Hz}, 3$ phase <br> Resistive Rating - 275 Amps <br> Interrupt Rating - 2,000 Amps | 50,000 cycles | B-430Z - Continuous, |
|  | Operating Cycles (Life) <br> Mechanical, Min. - 100,000 cycles | self-deenergizing with suppression (Type B, See diagram below) |
|  | Dielectric Strength - <br> All Circuits to Ground - 1,500 Vrms <br> Circuit to Circuit - 1,500 Vrms <br> Coil to Ground and Aux. Contacts 1,000 Vrms | Operating Voltage Close, @ $85^{\circ} \mathrm{C}$ - <br> Min. - 15 Vdc <br> Max. - B-430-1 — 28 Vdc <br> B-430Z - 29 Vdc <br> Operating Voltage Trip, @ $85^{\circ} \mathrm{C}$ - |
|  | Insulation Resistance, Initial 100 megohm min. | $\begin{aligned} & \text { Min. }-15 \mathrm{Vdc} \\ & \text { Max. - B-430-1—28 Vdc } \\ & \text { B-430Z-29 Vdc } \end{aligned}$ |
|  | Altitude - 45,000 ft. <br> Weight, Max. - 4.0 lbs | Coil Current Closing, Max. 6 Amps |
|  |  | Coil Current Trip, Max. - 6 Amps |

## Coil Type



A - Continuous, Self-Deenergizing


B - Continuous, Self-Deenergizing with Suppression

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## B-430 Series, Rated up to $275 \mathrm{Amps}, 115 / 200 \mathrm{VAC}, 400 \mathrm{~Hz}$ (Continued)



Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 2

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | PE <br> P-430-1 |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Gasket/Vented | A | A | 1 | $1616023-1$ |  |
| B-430Z | Gasket/Vented | B | B | 2 | $1616023-2$ |

## Product Facts

■ 3PDT, Magnetic latching
■ Gasket sealed

- Auxiliary contacts available
- Meets many requirements of MIL-PRF-6106


Performance Data
Electrical Characteristics
Contact Arrangement - 3PDT, Magnetic Latching
Rated Operating Voltage 115/200 VAC, $400 \mathrm{~Hz}, 3$ phase
Resistive Rating, Continuous 500 Amps
Inductive Rating - 500 Amps
Interrupt Rating - 6,500 Amps

General Characteristics
Temperature Range -
$-54^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. -
50,000 cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - 1,500 Vrms
Circuit to Circuit - 1,500 Vrms
Coil to Ground and Aux. Contacts -
1,000 Vrms
Insulation Resistance, Initial -
100 megohm min.
Altitude - $45,000 \mathrm{ft}$.
Weight, Max. - 4.5 lbs

## Coil Characteristics

Duty Cycle - Continuous, self-deenergizing
Close Voltage -
Min. - 15 Vdc
Max. - 29 Vdc
Trip Voltage -
Min. - 15 Vdc
Max. - 29 Vdc

For factory-direct application
assistance, phone 419-521-9500 or fax 419-526-2749.


Circuit Configurations (Consult factory for other available circuit configurations)


For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| B-484 | Gasket/Vented | A | Continuous, <br> Self-Deenergizing | 1 | $1616023-4$ |
| B-484C | Gasket/Vented | B | Continuous, <br> Self-Deenergizing | 1 | $1616023-5$ |

Cross Reference

| Main Current Rating | AC/DC | Rating | Main <br> Contact Config. | Operating Mode | Aux. <br> Contact <br> Config. | Coil Voltage (VDC) | Seal Type | Duty Cycle | Coil Trans. Voltage | Hartman Part No. | $\begin{gathered} \text { TE } \\ \text { Part No. } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 25 | AC | 115 | 3PDT | Side Stable | - | 28 | Hermetic | Cont. | - | DH-14B | 1-1616522-4 |
|  |  | 115 | 3PDT | Side Stable | - | 115 V | Hermetic | Cont. | - | DHR-14B | 1-1616037-2 |
|  |  | 115/200 | 3PDT | Side Stable | - | 28-31 | Hermetic | Cont. | 42 | DH-14B-3 | 1616037-1 |
|  |  | 115/200 | 3PDT | Side Stable | - | 115 V | Hermetic | Cont. | - | DHR-14BA | 1-1616037-3 |
|  |  | 115/200 | 3PST NO | Side Stable | - | 28 | Hermetic | Cont. | 42 | DH-14CE | 1616017-1 |
| 30 | AC | 115 | 3PDT | Center Off | - | 115 V | Hermetic | Cont. | - | DHR-18-1 | 1616050-9 |
| 50 | AC | 115 | DPDT | Side Stable | - | 115 V | Hermetic | Cont. | - | DHR-7K | 1616522-2 |
|  |  | 115 | 3PDT | Side Stable | SPST NO | 28 | Hermetic | Cont. | - | DH-7BB | 1616037-7 |
|  |  | 115/200 | 3PDT | Side Stable | DPDT | 18-32 | Hermetic | Cont. | 50 | DH-7ZAB | 1-1616037-1 |
|  |  | 120/208 | 3PDT | Side Stable | - | 115 V | Hermetic | Cont. | - | DHR-7B | 1-1616037-6 |
|  |  | 120/208 | 3PDT | Side Stable | - | 115 V | Hermetic | Cont. | - | DHR-7BE | 1-1616037-7 |
|  |  | 115 | 3PST | Center Off | - | 28 | Gasket/Vented | Cont. | 20 | D-18F | 1616048-4 |
|  |  | 115/200 | 3PDT | Center Off | - | 28 | Gasket/Vented | Cont. | - | D-18 | 1616048-1 |
|  |  | 115/200 | 3PDT | Center Off | SPST NO <br> Each Side | 28 | Gasket/Vented | Cont. | - | D-180A | 1616048-2 |
|  |  | 115/200 | 3PDT | Center Off | - | 28 | Gasket/Vented | Cont. | 45 | D-18AA | 1616048-3 |
|  |  | 115/200 | 3PDT | Center Off | 6PDT | 28 | Gasket/Vented | Cont. | 45 | D-18ZZC | 1-1616957-3 |
|  |  | 115 | 3PDT | Center Off | - | 28 | Hermetic | Cont. | - | DH-18 | 1616050-1 |
|  |  | 115/200 | 3PDT | Center Off | - | 28-30 | Hermetic | Cont. | - | DH-18Y | 1616524-3 |
|  |  | 115 | SPDT | Center Off | - | 35 | Gasket/Vented | Cont. | - | DR-18E-5 | 1616099-1 |
| 50 | AC | 115/200 | 3PST | Side Stable | - | 28 | Gasket/Vented | Cont. | 50 | D-7M | 1616016-2 |
|  |  | 115/230 | SPST | Side Stable | - | 28 | Gasket/Vented | Cont. | - | D7MA | 1616016-3 |
|  |  | 115/200 | 3PST NC | Side Stable | SPDT | 28 | Gasket/Vented | Cont. | 45 | D-7MM | 1616016-4 |
|  |  | 115/200 | 3PST NO | Side Stable | SPST NO SPST NC | 115 | Gasket/Vented | Cont. | - | DR-7VC | 1616018-1 |
|  |  | 115 | 3PST NO | Side Stable | SPST NO | 28 | Hermetic | Cont. | - | DH-7N | 1616017-9 |
|  |  | 115 | 3PST NO | Side Stable | SPST NO(2) SPST NC | 28 | Hermetic | Cont. | 50 | DH-7ZG-1 | 1-1616017-0 |
|  |  | 115 | 3PST NO | Side Stable | - | 120 V | Hermetic | Cont. | - | DHR-7M | 1616518-2 |
|  |  | 115 | 3PST NO | Side Stable | DPST NC SPST NO | 115 V | Hermetic | Cont. | - | DHR-7ZG | 1-1616017-2 |
|  |  | 115/200 | 3 3PT | Side Stable | SPDT | 28-30 | Hermetic | Cont. | 50 | DH-7GR | 1616037-9 |
|  |  | 115/200 | 3PDT | Side Stable | SPDT | 28 | Gasket/Vented | Cont. | 45 | D-7GRZ | 1616036-5 |
|  |  | 115/208 | 3PDT | Side Stable | - | 18-30 | Gasket/Vented | Cont. | - | D-7BS | 1616036-1 |
|  |  | 115/208 | 3PDT | Side Stable | SPDT | 28 | Gasket/Vented | Cont. | - | D-7GR | 1616036-2 |
|  |  | 115/208 | SPDT | Side Stable | SPDT | 28 | Gasket/Vented | Cont. | - | D-7GR-2 | 1616036-3 |
|  |  | 115/208 | 3PDT | Side STable | SPDT | 28 | Gasket/Vented | Cont. | 45 | D-7GR-3 | 1616036-4 |
|  |  | 115 | 3PDT | Side Stable | SPST NC | 18-30 | Hermetic | Cont. | - | DH-7BC | 1616037-8 |
| 50 | AC | 115 | 3PST NO | Side Stable | - | 28 | Hermetic | Cont. | - | BH-316 | 1616008-4 |
|  |  | 115 | 3PST N0 | Side Stable | 1NO, 1NC | 28 | Hermetic | Cont. | - | BH-316A | 1616008-5 |
|  |  | 115 | 3PST NO | Side Stable | , | 28 | Hermetic | Cont. | 45 | BH-316C | 1-1616520-0 |
|  |  | 115/200 | TPST NO | Side Stable | - | 28 | Hermetic | Cont. | - | BH-316D | 1616008-6 |
| 60 | AC | 200 | 3PDT | Side Stable | SPDT | 28 | Gasket/Vented | Cont. | - | B-138BH | 1616028-1 |
|  |  | 200 | 3PDT | Side Stable | DPDT | 28 | Gasket/Vented | Cont. | - | B-138XAH | 1616028-2 |
|  |  | 115/200 | 3PDT | Side Stable | DPDT | 28 | Gasket/Vented | Cont. | 42 | B-138XEH | 1616028-3 |
|  |  | 200 | 3PDT | Center Off | SPST NO | 28 | Gasket/Vented | Cont. | - | B-140V | 1-1616043-0 |
|  |  | 115/200 | 3PDT NO | Center Off | DPST NC | 28 | Gasket/Vented | Cont. | - | B-140BH | 1616043-9 |
|  |  | 120/208 | 3PDT NO | Center Off | 6PDT | 28 | Gasket/Vented | Cont. | 75 | B-140AP-1 | 1616043-7 |
|  |  | 115/200 | 3PST NO | Side Stable | 4PDT | 28 | Gasket/Vented | Cont. | 45 | B-138S | 1616002-5 |

For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.

| Cross Reference (Continued) |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Main Current Rating | AC/DC | Rating | Main <br> Contact Config. | Operating Mode | Aux. <br> Contact Config. | Coil Voltage (VDC) | Seal Type | Duty Cycle | Coil Trans. Voltage | Hartman Part No. | $\begin{gathered} \text { TE } \\ \text { Part No. } \end{gathered}$ |
| 100 | AC | 115/200 | 3PDT | Side Stable | SPST NC | 28 | Gasket/Vented | Cont. | - | D-25BD | 1616034-3 |
|  |  | 115/200 | 3PDT | Side Stable | - | 28 | Hermetic | Cont. | - | DH-25B | 1616037-2 |
|  |  | 115/200 | 3PDT NC | Side Stable | DPDT | 28 | Hermetic | Cont. | - | DH-25BA | 1616037-3 |
|  |  | 115/200 | 3PDT | Side Stable | - | 115 | Hermetic | Cont. | - | DHR-25BG | 1-1616037-5 |
|  |  | 115/200 | 3PDT | Center Off | - | 28 | Gasket/Vented | Cont. | - | D-31C | 1616049-1 |
| 120 | AC | 115/200 | 3PDT | Center Off | 5PST NC | 28 | Gasket/Vented | Cont. | - | D-31TH | 1616524-5 |
|  |  | 115/208 | 3PDT | Center Off | 6PDT | 28 | Gasket/Vented | Cont. | 42 | D-31DB | 1616049-2 |
|  |  | 115/208 | 3PDT | Center Off | 4PDT | 18-30 | Hermetic | Cont. | 42 | DH-31DAA | 1616050-6 |
|  |  | 115/200 | 3PDT | Center Off | 6PDT | 28 | Hermetic | Cont. | - | DH-31A | 1616050-4 |
|  |  | 115/208 | 3PDT | Center Off | 4PDT | 18-30 | Hermetic | Cont. | 42 | DH-31DA | 1616050-5 |
|  |  | 115/200 | 3PDT | Center Off Latching | 6PDT | 18-30 | Hermetic | Cont. | 50 | DHL-31B | 1616050-8 |
|  |  | 115/200 | 3PST NO | Side Stable | (1)SPST NC <br> (1) SPDT | 28 | Gasket/Vented | Cont. | - | D-25CF | 1616015-1 |
|  |  | 115/200 | 3PST N0 | Side Stable | (1)SPST NO <br> (1) SPST NC | 28 | Hermetic | Cont. | 42 | DH-25CU | 1616017-4 |
| 125 | AC | 115/200 | 3PDT | Side Stable | DPDT | 28 | Gasket/Vented | Cont. | 45 | D-25BAH | 1616034-2 |
| 130 | AC | 115/200 | 3PST NO | - | 3PST N0 | 28 | Gasket | Cont.Econ | - | B309A | 1-1616975-7 |
| 175 | AC | 115/200 | 3PST | Mag Latching | 6PDT | 15-30 | Gasket/Vented | Cont. | 42 | B-451 | 1616023-3 |
| 175 | AC | 253/440 | 3PST NO | - | DPDT | 28 | Gasket/Vented | Cont.Econ. | 45 | B-312DB | 1616004-7 |
|  |  | 115 | 3PST NO | Side Stable | 2PDT | 28 | Gasket/Vented | Cont. Econ. | - | SA-136F | 1616948-7 |
|  |  | 115/200 | 3ST NO | Side Stable | 2DT | 28 | Gasket | Cont. Econ. | 42 | KA175B3C | 2-1616960-7 |
| 200 | AC | 115 | 3PST NO | - | 4PST NC | 28 | Gasket/Vented | Cont. Econ. | 45 | B-312CV | 1616004-5 |
| 260 | AC | 120/208 | 3PDT | Center Off | $\begin{aligned} & \hline \text { 4PST NO } \\ & \text { 2PST NC } \\ & \hline \end{aligned}$ | 28 | Gasket/Vented | Cont. Econ. | 45 | B-393T | 1616044-5 |
|  |  | 115/200 | 3PST N0 | Side Stable | (5)SPST NO <br> (9 SPST NC | 28 | Gasket/Vented | Cont. Econ. | 45 | B-429W | 1616005-6 |
| 275 | AC | 115/200 | 3PST | Mag Latching | (7)SPST NO <br> (7)2PST NC | 28 | Gasket/Vented | Cont. Econ. | 45 | B-430-1 | 1616023-1 |
|  |  | 115/200 | 3PST | Mag Latching | $\begin{aligned} & \text { (12)SPST NO } \\ & (14 \text { SPST NC } \end{aligned}$ | ${ }^{28}$ | Gasket/Vented | Cont. Econ. | 45 | B-430Z | 1616023-2 |
| 275 | AC | 115/200 | 3PST NO | Side Stable | (8)SPST NO | 28 | Gasket/Vented | Cont. Econ | 45 | B-429-1 | 1616005-1 |
| 350 | AC | 120/208 | 3PST NO | Side Stable | 4SPDT | 28 | Gasket/Vented | Cont. | 45 | B-429CA | 1616005-4 |
| 500 | AC | 115/200 | 3PST | Mag Latching | $\begin{aligned} & \text { (12)SPST NO } \\ & \text { (14)2PST NC } \end{aligned}$ | $0$ | Gasket/Vented | Cont. | 45 | B-484 | 1616023-4 |
|  |  | 115/200 | 3PST | Mag Latching | $\begin{aligned} & \text { (12)SPST NO } \\ & \text { (14 SPST NC } \end{aligned}$ | $15-29$ | Gasket/Vented | Cont. | 45 | B-484C | 1616023-5 |

For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.

| Catalog 5-1773450-5 | Dimensions are shown for <br> reference purposes only. | Dimensions are in millimeters <br> unless otherwise specified. | USA: +18005226752 <br> Asia Pacific: +8604008206015 | For additional support numbers <br> Revised 3-13 |
| :--- | :--- | :--- | :--- | :--- |
| Specifications subject <br> to change. |  | UK: +44 800 267666 |  |  | to change.

## K Series Connectors

## Product Facts

■ Light weight
■ Small package size
■ Small footprint

- Easy to package in panel assemblies
- Buss bar mount or chassis mount
- Designed to meet the applicable portions of MIL-PRF-6106
■ 10X rupture current


TE HARTMAN brand of K Series contactors offer outstanding performance and reliability in a highly efficient package. The HARTMAN brand K-Series are among the smallest and lightest 200-1000 ampere DC contactors available in the aerospace industry.

These highly flexible buss bar mounted or chassis mounted units are designed for either continuous or start duty applications in the DC power distribution systems of military and commercial aircraft and ground vehicles.

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## K Series, Rated up to 200 Amps, 28 Vdc

```
Product Facts
■ SPST NO, Double break
■ Buss bar or chassis mount
    available
■ Gasket sealed
■ Auxiliary contacts available
■ Meets many requirements
    of MIL-PRF-6106
```

Coil Type


A - Electronic Economized with Suppression


Performance Data
Electrical Characteristics
Contact Arrangement -
SPST NO, Double Break
Rated Operating Voltage 28 Vdc
Resistive Rating - 200 Amps
Rupture Rating - 2,000 Amps
Rupture Rating - 2,000 Amps

## General Characteristics

Temperature Range -
$-40^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. - 50,000
cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - 1,500 Vrms
Circuit to Circuit - 1,500 Vrms
Coil to Ground and Aux. Contacts -
1,000 Vrms
Insulation Resistance, Initial -
100 megohm min.
Altitude Max. - $50,000 \mathrm{ft}$.
Weight, Max. - .31-. 41 lbs

## Coil Characteristics

Duty Cycle -
AC (Type A, See diagram below),
Economized (Type B, See diagram below), Economized with suppression (Type C, See diagram below), Continuous or Intermittent (Type D \& F, See diagram below), Continuous or Intermittent with suppression (Type E \& G, See diagram below)
Operating Voltage, Nom. 28 Vdc
Pickup Voltage @ $2 \mathbf{2 0}^{\circ} \mathrm{C}$, Max. 18 Vdc

## Circuit Configurations

(Consult factory for other available circuit configurations)
A1


ECONOMIZER
Circuit Configuration 1

Circuit Configuration 2

|  | HARTMAN Part Number | Construction Type | $\begin{gathered} \text { Mounting } \\ \text { Style } \\ \hline \end{gathered}$ | $\begin{aligned} & \text { Coil } \\ & \text { Type } \end{aligned}$ | Circuit Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | K200A1C | Gasket | B | A | 2 | 5-1616970-9 |
|  | K200B3C02 | Gasket | A | A | 1 | 4-1616968-7 |
| For factory-direct application assistance, phone 419-521-9500 or | K200B1C | Gasket | C | A | 2 | 6-1616970-0 |
| fax 419-526-2749. | K200A3C | Gasket | E | A | 1 | 8-1616977-1 |

## K Series, Rated up to 200 Amps, 28 Vdc (Continued)



Mounting Style A


For factory-direct application
Mounting Style B assistance, phone 419-521-9500 or fax 419-526-2749.

## K Series, Rated up to 200 Amps, 28 Vdc (Continued)



Mounting Style C


For factory-direct application
Mounting Style E assistance, phone 419-521-9500 or fax 419-526-2749.


## K Series, Rated up to 400 Amps, 28 Vdc



## Product Facts

■ SPST NO, Double break
■ Buss bar or chassis mount design

■ Gasket sealed

- Auxiliary contacts available

■ Meets many requirements of MIL-PRF-6106

## Performance Data

Electrical Characteristics
Contact Arrangement -
SPST NO, Double Break
Rated Operating Voltage -
28 Vdo
Resistive Rating - 400 Amps
Overload Rating - 3,200 Amps
Rupture Rating - 4,000 Amps

General Characteristics
Temperature Range -
$-40^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. - 50,000
cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - 1,250 Vrms
Circuit to Circuit - 1,250 Vrms
Coil to Ground and Aux. Contacts 1,000 Vrms
Altitude, Max. - $50,000 \mathrm{ft}$.
Weight, Max. - . $59-.75 \mathrm{lbs}$

## Coil Characteristics

Duty Cycle -
Economized with suppression (Type A,
See diagram below), Continuous (Type
B, See diagram below), Intermittent
(Type C, See diagram below)
Operating Voltage, Nom. -
28 Vdc
Pickup Voltage @ $250^{\circ} \mathrm{C}$, Max. -
18 Vdc - Economized and continuous duty coil
12 Vdc - Intermittent duty coil
Dropout Voltage, Max. -
7 Vdc - Economized and continuous
duty
5 Vdc - Intermittent duty coil

Coil Type

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.


A - Economized with Suppression


B - Continuous


C- Intermittent

| HARTMAN Part Number | Construction Type | $\begin{gathered} \hline \text { Mounting } \\ \text { Style } \\ \hline \end{gathered}$ | $\begin{aligned} & \text { Coil } \\ & \text { Type } \\ & \hline \end{aligned}$ | Circuit Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| K4001A3C | Gasket Sealed | F | A | 4 | 6-1616968-5 |
| K4001B3C | Gasket Sealed | A | A | 4 | 4-1616959-0 |
| K400A1D | Gasket Sealed | B | C | 1 | - |
| K400A1F | Gasket Sealed | B | B | 1 | 6-1616945-7 |
| K400A4C1 | Gasket Sealed | K | A | 2 | 6-1616965-1 |
| K400B1D | Gasket Sealed | E | C | 1 | 8-1616968-4 |
| K400B1F | Gasket Sealed | E | B | 1 | 2-1616921-3 |
| K400B3C05 | Gasket Sealed | C | A | 6 | 7-1616941-3 |
| K400B712C | Gasket Sealed | D | A | 7 | 5-1616946-6 |
| K4001B7C | Gasket Sealed | A | A | 5 | 4-1616959-8 |
| K4001A7C | Gasket Sealed | F | A | 5 | 6-1616970-7 |
| K4001B2C | Gasket Sealed | A | A | 3 | 6-1616970-8 |
| K4001A2C | Gasket Sealed | F | A | 3 | 6-1616970-6 |
| K400A1F1 | Gasket Sealed | G | B | 1 | 4-1616964-5 |

## K Series, Rated up to 400 Amps, 28 Vdc (Continued)



For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.

## K Series, Rated up to 400 Amps, 28 Vdc (Continued)



For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.
Mounting Style K

## K Series, Rated up to 400 Amps, 28 Vdc (Continued)

Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1


Circuit Configuration 2


Circuit Configuration 3


Circuit Configuration 6
AI


Circuit Configuration 4


Circuit Configuration 7

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

| Catalog 5-1773450-5 | Dimensions are shown for <br> reference purposes only. | Dimensions are in millimeters <br> unless otherwise specified. | USA: +1 8005226752 <br> Revised 3-13 Pacific: +8604008206015 | For additional support numbers <br> please visit www.te.com |
| :--- | :--- | :--- | :--- | :--- |
| www.te.com | Specifications subject <br> to change. |  |  |  |



## Product Facts

■ SPST NO, Double break

- Buss bar or chassis mount designs

■ Gasket sealed
■ Multiple auxiliary contact choices

- Meets many requirements of MIL-PRF-6106


## Performance Data

Electrical Characteristics
Main Contacts -
Contact Arrangement SPST NO, Double Break Rated Operating Voltage 28 Vdc
Resistive Rating - 500 Amps
Rupture Rating - 5,000 Amps
Auxiliary Contacts -
Aux. Contact Arrangement 3 SPDT
Rated Operating Voltage - 28 Vdc
Resistive Rating - 5 Amps
Lamp Rating - 1 Amps
Low Level-1mA@28 Vdo

General Characteristics
Temperature Range -$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated Resistive Load - 50,000 cycles
Operating Cycles (Life)
Mechanical - 100,000 cycles
Altitude - $50,000 \mathrm{ft}$
Weight, Max. - 88 lbs
Operate Time @ $18 \mathrm{Vdc} \& 85^{\circ} \mathrm{C}$, Max. - 45 msec
Dropout Time @ 32 Vdc, Max. 25 msec

Coil Characteristics
Duty Cycle - Continuous, economizing
Operating Voltage, Nom. 28 Vdc
Pickup Voltage, Max. - 18 Vdc
Dropout Voltage - 1 to 7 Vdc
Inrush - 5 Amps
Hold @ 32 Vdc \& - $55^{\circ} \mathrm{C}$ -
0.272 mA max.

## Coil Type



A - Economized with
Suppression

For factory-direct application
assistance, phone 419-521-9500 or fax 419-526-2749.

## K Series, Rated up to 500 Amps, 28 Vdc (Continued)



Mounting Style A


Mounting Style B

## K Series, Rated up to 500 Amps, 28 Vdc (Continued)

Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1


Circuit Configuration 2


Circuit Configuration 3

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| K500B2C | Gasket Sealed | A | A | 1 | $7-1616927-0$ |
| K500A2C | Gasket Sealed | B | A | 1 | $4-1616951-4$ |
| K500B3C | Gasket Sealed | A | A | 2 | $7-1616970-0$ |
| K500A3C | Gasket Sealed | B | A | 2 | $6-1616970-9$ |
| K500B7C01 | Gasket Sealed | A | A | 3 | $9-1616965-0$ |
| K500A7C01 | Gasket Sealed | B | A | 3 | $2-1616970-8$ |

K Series, Rated up to 500 Amps, 28 Vdc - Time Delay

## Product Facts

■ SPST NO, Double break
■ Delay on operator or release
■ Chassis Mount (bus bar mount available)
■ Gasket sealed

- Meets many requirements of MIL-PRF-6106

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## Performance Data

Electrical Characteristics
Contact Arrangement -
SPST NO, Double Break
Rated Operating Voltage 28 VDC
Resistive Rating - 500A
Rupture Rating - 5000A
Delay on operate or release - See note 1

General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Minimum Electrical Cycles 50,000
Minimum Mechanical Cycles -
100,000 @ 125A
Dielectric Strength - 1000 Vrms
Altitude - $50,000 \mathrm{ft}$
Weight, Max. - 1.0 lbs
Duty Cycle — Intermittent or
Continuous (See note 2)
Operating Voltage Range - $21-32$ Vdc
Drop Out Voltage - 1 to 7 Vdc


NOTES

1. Delay can be tailored to meet customer need. Consult Factory.
2. Intermittent duty coil is recommended for starting applications where significant control voltage sags are possible. Consult factory to specify correct coil duty for your application.

## K-1000 Series, Rated up to 1,000 Amps, 28 Vdc

Product Facts
■ SPST NO, Double break
■ Gasket sealed

- Meets many requirements of MIL-PRF-6106


## Performance Data

Electrical Characteristics
Contact Arrangement -
SPST NO, Double Break
Rated Operating Voltage - 28 Vdc
Resistive Rating - $1,000 \mathrm{Amps}$
General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load - 50,000 cycles
Operating Cycles (Life)
Mechanical - 100,000 cycles
Weight, Max. - 2.75 lbs
Coil Characteristics
Duty Cycle - Continuous,
economizing
Operating Voltage, Nom. - 28 Vdc
Pickup Voltage, Max. @25ㄷ 18 Vdc
Dropout Voltage - 1 to 8 Vdc
Current, Inrush, Max. @ 30 Vdc 7.0 Amps

Current, Hold, Max. @ 30 Vdc 1.0 Amps


Circuit Configurations (Consult factory for other available circuit configurations)


| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| K-1000A1F03 | Gasket Sealed | A | Continuous | 1 | $4-1616966-1$ |

For factory-direct application
assistance, phone 419-521-9500 or fax 419-526-2749.

## Cross Reference

| Main Current Rating | AC/DC | Rating | Main Contact Config. | Operating Mode | Aux. <br> Contact Config. | Coil Voltage | Seal <br> Type | Duty Cycle | Coil Trans. Voltage (VDC) | Hartman Part No. | TE <br> Part No. |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 200 | DC | 28 | SPST NO | Side Stable | 2PDT | 28 | Gasket | Cont. Econ. | 42 | K200A1C | 5-1616970-9 |
|  |  | 28 | SPST NO | Side Stable | 2PDT | 28 | Gasket | Cont. Econ. | 42 | K200B3C02 | 4-1616968-7 |
|  |  | 28 | SPST NO | Side Stable | 2PDT | 28 | Gasket | Cont. Econ. | 42 | K200B1C | 6-1616970-0 |
|  |  | 28 | SPST NO | Side Stable | 2PDT | 28 | Gasket | Cont. Econ. | 42 | K200A3C | 8-1616977-1 |
| 400 | DC | 28 | SPST NO | Side Stable | 2PDT | 28 | Gasket | Cont. Econ. | 42 | K4001A3C | 6-1616968-5 |
|  |  | 28 | SPST NO | Side Stable | 2PDT | 28 | Gasket | Cont. Econ. | 42 | K4001B3C | 4-1616959-0 |
|  |  | 28 | SPST NO | Side Stable | None | 28 | Gasket | Intermittent | - | K400A1D | - |
|  |  | 28 | SPST NO | Side Stable | None | 28 | Gasket | Continuous | - | K400A1F | 6-1616945-7 |
|  |  | 28 | SPST NO | Side Stable | 1PST N0 | 28 | Gasket | Cont. Econ. | 42 | K400A4C1 | 6-1616965-1 |
|  |  | 28 | SPST NO | Side Stable | None | 28 | Gasket | Intermittent | - | K400B1D | 8-1616968-4 |
|  |  | 28 | SPST NO | Side Stable | None | 28 | Gasket | Continuous | - | K400B1F | 2-1616921-3 |
|  |  | 28 | SPST NO | Side Stable | 2PDT | 28 | Gasket | Cont. Econ. | 42 | K400B3C05 | 7-1616941-3 |
|  |  | 28 | SPST | Side Stable | 3PDT | 28 | Gasket | Cont. Econ. | 42 | K4001B7C | 4-1616959-8 |
|  |  | 28 | SPST | Side Stable | 3PDT | 28 | Gasket | Cont. Econ. | 42 | K4001A7C | 6-1616970-7 |
|  |  | 28 | SPST | Side Stable | 1PDT | 28 | Gasket | Cont. Econ. | 42 | K4001B2C | 6-1616970-8 |
|  |  | 28 | SPST | Side Stable | 1PDT | 28 | Gasket | Cont. Econ. | 42 | K4001A2C | 6-1616970-6 |
|  |  | 28 | SPST | Side Stable | None | 28 | Gasket | Continuous | - | K400A1F1 | 4-1616964-5 |
|  |  | 28 | SPST NO | Side Stable | $\begin{gathered} \hline \text { 3PDT, 1PST } \\ \text { NO, 1PST NC } \\ \hline \end{gathered}$ | ${ }^{28}$ | Gasket | Cont. Econ. | 42 | K400B712C | 5-1616946-6 |
| 500 | DC | 28 | SPST NO | Side Stable | 1PDT | 28 | Gasket | Cont. Econ. | 42 | K500B2C | 7-1616927-0 |
|  |  | 28 | SPST NO | Side Stable | 2PDT | 28 | Gasket | Cont. Econ. | 42 | K500B3C | 7-1616970-0 |
|  |  | 28 | SPST NO | Side Stable | 2PDT | 28 | Gasket | Cont. Econ. | 42 | K500A3C | 6-1616970-9 |
|  |  | 28 | SPST NO | Side Stable | 1PDT | 28 | Gasket | Cont. Econ. | 42 | K500A2C | 4-1616951-4 |
|  |  | 28 | SPST NO | Side Stable | 3PDT | 28 | Gasket | Cont. Econ. | 42 | K500A7C01 | 2-1616970-8 |
|  |  | 28 | SPST NO | Side Stable | 3PDT | 28 | Gasket | Cont. Econ. | 42 | K500B7C01 | 9-1616965-0 |
| 1000 | DC | 28 | SPST NO | Side Stable | N/A | 28 | Gasket | Continuous | - | K1000A1F03 | 4-1616966-1 |

For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.

## DH-14 and DH-21 Series, Rated up to 25 Amps, 28 Vdc

## Product Facts

■ SPDT, 1 NO, 1 NC, Double Break

- Hermetically Sealed
- DH21 Series has magnetically latched contacts
- Meets many requirements of MIL-PRF-6106



## Performance Data

Electrical Characteristics Contact Arrangement SPDT, 1 NO, 1 NC, Double Break Rated Operating Voltage 28 Vdc
Resistive Rating - 25 Amps
Inductive Rating - 25 Amps
Motor Rating - 15 Amps

General Characteristics
Temperature Range -$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. - 50,000
cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - 1,250 Vrms
Circuit to Circuit - 1,250 Vrms
Coil to Ground and Aux. Contacts -
1,000 Vrms
Altitude Max. - 80,000 ft.
Weight - . 39 lbs

## Coil Characteristics

Duty Cycle -
Continuous (Type A, See diagram below), Continuous with suppression (Type B, See diagram below) or Intermittent (Type C)
Operating Voltage, Nom. 28 Vdc
Pickup Voltage @ $25^{\circ} \mathrm{C}$, Max. 18 Vdc
Dropout Voltage @ $25^{\circ} \mathrm{C}$, Max. 1.0 to 7 Vdc

Coil Type


A - Continuous


B - Continuous with Suppression


C - Intermittent

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

| Catalog 5-1773450-5 | Dimensions are shown for <br> reference purposes only. |
| :--- | :--- |
| Revised 3-13 | Specifications subject <br> to change. |
| www.te.com | to |




Mounting Style B


For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.


Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1


Circuit Configuration 2


| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| DH-14A | Hermetically Sealed | A | A | 1 | $1616089-1$ |
| DH-14AL | Hermetically Sealed | B | A | 2 | $1616089-2$ |
| DH-14AT | Hermetically Sealed | A | B | 3 | $1616089-3$ |
| DH-21N* | Hermetically Sealed | C | C | 4 | $1616026-2$ |

*DH21N is a magnetically latched unit. Contacts will remain in position until the opposing coil is pulsed.

## Product Facts

■ 2 SPST, 1 NO, 1 NC
■ DH-18 Series are center-off double-throw units

■ Gasket Sealed or Hermetically Sealed
■ Auxiliary contacts available
■ Meets many requirements of MIL-R-6106


## Performance Data

Electrical Characteristics
Contact Arrangement 2 SPST, 1 NO, 1 NC, Electrically Latched
Rated Operating Voltage 28 Vdc
Resistive Rating - 50 Amps
Inductive Rating - 25 Amps

General Characteristics
Temperature Range -$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. - 50,000
cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - 1,500 Vrms
Circuit to Circuit - 1,500 Vrms
Coil to Ground and Aux. Contacts -
1,000 Vrms
Altitude Max. - $50,000 \mathrm{ft}$.
Weight - .72 to .94 lbs

## Coil Characteristics

Duty Cycle -
Continuous (Type A, See diagram below) or Continuous with suppression (Type B, See diagram below) or Continuous (Type C)

Operating Voltage, Nom. 28 Vdc
Pickup Voltage @ $\mathbf{2 5}^{\circ}$ C, Max. 18 Vdc
Dropout Voltage @ $25^{\circ} \mathrm{C}$, Max. 1.5 to 7 Vdc

Coil Current @ $25^{\circ} \mathrm{C}$, Max. 0.28 Amp

Coil Type


A - Continuous


B - Continuous with Suppression

assistance, phone 419-521-9500 or fax 419-526-2749.

## D-7, DH-7 and DH-18 Series, Rated up to 50 Amps, 28 Vdc (Continued)



Mounting Style B


Mounting Style C


For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.

## D-7, DH-7 and DH-18 Series, Rated up to 50 Amps, 28 Vdc (Continued)



Mounting Style E

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## D-7, DH-7 and DH-18 Series, Rated up to 50 Amps, 28 Vdc (Continued)

## Circuit Configurations (Consult factory for other available circuit configurations)



| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| D-7AC | Gasket Sealed | A | A | 1 | $1616088-1$ |
| D-7LHB | Gasket Sealed | C | A | 2 | $1616064-1$ |
| DH-18DA $^{*}$ | Hermetically Sealed | D | C | 3 | $1616050-2$ |
| DH-7ATK | Hermetically Sealed | B | B | 4 | $1616089-7$ |
| DH-7MN | Hermetically Sealed | A | A | 5 | $1616103-2$ |
| DH-7TB | Hermetically Sealed | E | A | 6 | $1-1616089-3$ |

## Product Facts

■ SPST NO, Double Break or SPDT Double Break
■ Gasket Sealed
■ Auxiliary contacts available

- Meets many requirements of MIL-PRF-6106

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## Performance Data

Electrical Characteristics
Main Contact Configuration -A-1077DD - SPST NO A-1077S — SPDT
Rated Operating Voltage 28 Vdc
Main Contact Rating -
Resistive Rating - 100 Amps
Inductive Rating - 100 Amps
Motor Rating - 100 Amps
Interrupt Rating - 1,200 Amps
Auxiliary Contacts -
Resistive Rating 5 Amp, 28 VAC/115 VAC

## Coil Characteristics

Coil Characteristics
Duty Cycle - Continuous
Operating Voltage, Max. — 32 Vdc
Operating Voltage, Min. -24 Vdc
Pickup Voltage @ $\mathbf{2 5}^{\circ} \mathrm{C}$, Max. 16.5 Vdc

Dropout Voltage - 1 to 7 Vdc

| General Characteristics | Coil Characteristics |
| :---: | :---: |
| Temperature Range -$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$ | Coil Characteristics |
| Operating Cycles (Life) at Rated Resistive Load, Min. 50,000 cycles | Operating Voltage, Max. - 32 Vdc Operating Voltage, Min. - 24 Vdc |
| Operating Cycles (Life) <br> Mechanical, Min. - 100,000 cycles | Pickup Voltage @ $25^{\circ} \mathrm{C}$, Max. 16.5 Vdc |
| Dielectric Strength - <br> All Circuits to Ground - 1,250 Vrms Circuit to Circuit - 1,250 Vrms Coil to Ground and Aux. Contacts 1,000 Vrms | Dropout Voltage - 1 to 7 Vdc |
| Altitude, Max. - $50,000 \mathrm{ft}$. |  |
| Weight, Max. - 1.5 to 2 lbs |  |

Operating Cycles (Life) at Rated
Resistive Load, Min. -
50,000 cycles
perating Cycles (Life)
00,000 cycles
All Circuits to Ground - 1,250 Vrms
Circuit to Circuit - 1,250 Vrms
Coil to Ground and Aux. Contacts ,000 Vrms

Whin, Max. -50,00 .
Weight, Max. - 1.5 to 2 lbs

## A-1077 Series, Rated up to 100 Amps, 28 Vdc (Continued)



Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| A-1077DD | Gasket Sealed | A | Continuous | 1 | $1616055-3$ |
| A-1077S | Gasket Sealed | B | Continuous, <br> w/ Suppression | 2 | $1616081-3$ |

For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.


## Product Facts

■ SPDT, Center Off, Double Break
■ Gasket Sealed, Vented
■ Meets many requirements of MIL-PRF-6106

## D-31 Series, Rated up to 100 Amps, 28 Vdc



## Performance Data

Electrical Characteristics
Main Contacts -
Main Contact Configuration SPDT, Center Off, Double Break
Voltage, Nom. - 28 Vdc
Resistive Rating - 100 Amps
Inductive Rating - 100 Amps
Motor Rating - 80 Amps
Overload Rating - 800 Amps
Rupture Rating - 1,000 Amps
Auxiliary Contacts -
Aux. Contact Configuration SPST, NO
Voltage, Nom. - $115 \mathrm{VAC}, 400 \mathrm{~Hz}$
or 28 Vdc
Resistive Rating - 3 Amp
Inductive Rating - 3 Amp
Lamp Rating - 1 Amp


Mounting Style A

## Coil Characteristics

Duty Cycle - Continuous
Coil Data, X Coil -
Operating Voltage, Nominal $115 \mathrm{VAC}, 400 \mathrm{~Hz}$
Pickup Voltage @ $25^{\circ} \mathrm{C}$, Max., Initial - $75 \mathrm{VAC}, 400 \mathrm{~Hz}$
Dropout Voltage @ $25^{\circ} \mathrm{C}$ -
12 V to 38 V
Coil Resistance $\pm 20 \%$ @ $25^{\circ} \mathrm{C}$ 655 Ohms
Coil Current @ $25^{\circ} \mathrm{C}$ -
. 050 Amp DC AV @ 115 VAC, 400 Hz
Coil Data, Y Coil -
Operating Voltage, Nominal 28 Vdc
Pickup Voltage @ $25^{\circ} \mathrm{C}$, Max., Initial - 15 VDC
Dropout Voltage @ $25^{\circ} \mathrm{C}$ -
2.0 V to 6.5 V

Coil Resistance $\pm 20 \%$ @ $25^{\circ} \mathrm{C}$ 163 Ohms
Coil Current @ $25^{\circ} \mathrm{C}$ -
. 215 Amp Max. @ 28 Vdc

Circuit Configurations
(Consult factory for other available circuit configurations)


Circuit Configuration 1

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| D-31BAA | Gasket/Vented | A | Continuous | 1 | $1616097-1$ |

## Product Facts

■ 2PST, Center Off, Double Break
■ Gasket Sealed, Vented

- Meets many requirements of MIL-PRF-6106


## D-32A Series, Rated up to 100 Amps, 28 Vdc



## Performance Data

Electrical Characteristics
Main Contacts -
Main Contact Configuration 2PST, Center Off

Voltage, Nom. - 28 Vdc
Resistive Rating - 100 Amps
Inductive Rating - 100 Amps
Motor Rating - 80 Amps
Lamp Rating - 50 Amps
Overload Rating - 800 Amps
Rupture Rating - 1,000 Amps
Auxiliary Contacts -
Aux. Contact Configuration SPST
Voltage, Nom. - 28 Vdc
Resistive Rating - 0.1 Amps
Inductive Rating - 0.1 Amps
Lamp Rating - 0.1 Amps

## General Characteristics

Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. -
50,000 cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - $1,250 \mathrm{Vrms}$
Circuit to Circuit - 1,250 Vrms
Coil to Ground and Aux. Contacts -
1,000 Vrms
Altitude - $50,000 \mathrm{ft}$.
Weight, Max. - 1.9 lbs


## Coil Characteristics

Duty Cycle - Continuous with
suppression
Operating Voltage, Nom. - 28 Vdo
Operating Voltage, Max. - 30 Vdc
Pickup Voltage, Max. - 18 Vdc
Dropout Voltage, Max. -
1.5 to 7.5 Vdc

Hold Voltage - 8.0 Vdc
Coil Resistance $\pm 10 \%$ @ $77^{\circ} \mathrm{F}$ 163 Ohms
Coil Current @ $77^{\circ} \mathrm{F}$ \& 30 Vdc , Max. - 0.215 Amp

Circuit Configurations
(Consult factory for other available circuit configurations)


For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| D-32A | Gasket/Vented | A | Continuous <br> w/ Suppression | 1 | $1616097-2$ | to change.

## Product Facts

■ SPDT, 1 NO, 1 NC, Double Break
■ Gasket Sealed or Hermetically Sealed

- Meets many requirements of MIL-PRF-6106


General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. - 50,000
cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - 1,250 Vrms
Circuit to Circuit - 1,250 Vrms
Coil to Ground and Aux. Contacts 1,000 Vrms
Altitude Max. - 80,000 ft.
Weight -1.81 lbs

## Performance Data

Electrical Characteristics
Contact Arrangement SPDT, 1 NO, 1 NC, Double Break Rated Operating Voltage 28 Vdo
Resistive Rating - 100 Amps
ductive Rating - 100 Amps

Interrupt Rating - 600 Amps

Coil Characteristics
Duty Cycle -
Continuous
Operating Voltage, Max. - 32 Vdc
Operating Voltage @ $21^{\circ} \mathrm{C}$, Min. 18 Vdc
Dropout Voltage @ $25^{\circ} \mathrm{C}$, Max. 1.0 to 7 Vdc

Coil Resistance $\pm 20 \%$ @ $25^{\circ} \mathrm{C}$ 180 Ohms

Circuit Configurations
(Consult factory for other available circuit configurations)


| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| DH-25EA | Hermetically Sealed | A | Continuous | 1 | $1616089-4$ |

For factory-direct application
assistance, phone 419-521-9500 or fax 419-526-2749.

## Product Facts

■ SPDT, Center Off

- Hermetically Sealed


| Performance Data | Aux. Contact Configuration - <br> SPST, N0 |
| :--- | :--- |
| Electrical Characteristics | Resistive Rating -5 Amp |
| Main Contacts - | Inductive Rating -5 Amp |
| Main Contact Arrangement - | General Characteristics |
| SPDT, Center Off | Temperature Range - |
| Rated Operating Voltage - | $-55^{\circ} \mathrm{C}$ to $+120^{\circ} \mathrm{C}$ |
| 28 Vdc | Operating Cycles (Life) at Rated |
| Resistive Rating -100 Amps | Resistive Load, Min. $-50,000$ |
| Inductive Rating -100 Amps | cycles |
| Motor Rating -100 Amps | Weight -1 lb 1302 |
| Inrush, Max. -500 Amps |  |
| Auxiliary Contacts - |  |

Coil Characteristics
Duty Cycle - Continuous
Operating Voltage, Nom. -
Coil X1-X2 ( $120 \mathrm{~V}, 400 \mathrm{~Hz}$ ) -
Pickup 100 V Max. Hot
Dropout $25 \mathrm{~V} \pm 20 \mathrm{~V}$
Nom. Resistance 1050 Ohms $\pm 10 \%$
Coil Y1-Y2 (28 Vdc) -
Pickup 20 Vdc Max. Hot
Dropout 1.5 to 7 Vdc
Nom. Resistance 163 Ohms $\pm 10 \%$
Coil Current @ Nom. 120 V -
X1-X2 - 0.12 Amp at $25^{\circ} \mathrm{C}$
Coil Current @ Nom. 28 Vdc -
Y1-Y2 - 0.19 Amp at $25^{\circ} \mathrm{C}$


Mounting Style A


Circuit Configuration 1
Circuit Configurations
(Consult factory for other available circuit configurations)


| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| DHR-31BA | Hermetically Sealed | A | Continuous | 1 | $1616098-1$ | to change.

## Product Facts

■ SPST NO, Double Break or SPDT Double Break
■ Gasket Sealed
■ Auxiliary contacts available

- Meets many requirements of MIL-PRF-6106


For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## Performance Data

Electrical Characteristics Contact Arrangement SPST NO, Double Break or SPDT Double Break
Rated Operating Voltage 28 Vdc
Resistive Rating - 200 Amps
Inrush Rating - 800 Amps

| General Characteristics | Coil Characteristics |
| :---: | :---: |
| Temperature Range - | Duty Cycle - Continuous |
| $-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$ | Operating Voltage, Max. - |
| Operating Cycles (Life) at Rated | 32 Vdc |
| Resistive Load, Min. - 50,000 cycles | Operating Voltage, Nom. 24 Vdc |
| Operating Cycles (Life) <br> Mechanical, Min. - 100,000 cycles | Pickup Voltage @ $25^{\circ} \mathrm{C}$, Max. 16.5 Vdc |
| Dielectric Strength - <br> All Circuits to Ground - 1,250 Vrms <br> Circuit to Circuit - 1,250 Vrms <br> Coil to Ground and Aux. Contacts - <br> 1,000 Vrms | Dropout Voltage - 1.0 to 7 Vdc |
| Weight - 1.50 to 1.90 lbs |  |



For factory-direct application assistance, phone 419-521-9509upting Style A


Mounting Style B



For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.


Mounting Style E

## A1077 Series, Rated up to 200 Amps, 28 Vdc (Continued)

Circuit Configurations (Consult factory for other available circuit configurations)


| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| A-1077D | Gasket Sealed | A | Intermittent | 1 | $1616055-2$ |
| A-1077F | Gasket Sealed | B | Continuous | 1 | $1616055-4$ |
| A-1077G | Gasket Sealed | C | Continuous | 2 | $1616055-5$ |
| A-1077V | Gasket Sealed | D | Continuous | 1 | $1616055-6$ |
| A-1077W | Gasket Sealed | E | Continuous | 3 | $1616081-4$ |

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

Product Facts

- SPST NC, Double Break

■ Gasket Sealed

- Auxiliary contacts available
- Meets many requirements of MIL-PRF-6106

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## A876 Series, Rated up to 200 Amps, 28 Vdc



## Performance Data

Electrical Characteristics
Main Contacts -
Main Contact Configuration SPST NC, Double Break
Rated Operating Voltage 28 Vdc
Resistive Rating - 200 Amps
Inrush, Carry Only - 900 Amps
Auxiliary Contacts -
Aux. Contact Configuration DPST NO
Voltage, Nom. - 28 Vdc
Resistive Rating - 5 Amps

## General Characteristics

Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. - 50,000
cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - 1,250 Vrms
Circuit to Circuit - 1,250 Vrms Coil to Ground and Aux. Contacts 1,000 Vrms
Weight - 3.00 lbs
Coil Characteristics
Duty Cycle - Intermittent
Operating Voltage - 24 to 30 Vdc
Pickup Voltage, Max. - 18 Vdc
Dropout Voltage - 1 to 7 Vdc
Coil Resistance $\pm \mathbf{2 0} \%$ @ $25^{\circ} \mathrm{C}$ 19.7 Ohms


Mounting Style A

Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| A-876K | Gasket/Vented | A | Intermittent | 1 | $1616059-1$ | to change.

## Product Facts <br> ■ Gasket Sealed <br> ■ Auxiliary contacts available <br> - Meets many requirements of MIL-PRF-6106

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.


## Performance Data

## Electrical Characteristics

 Contact Arrangement SPST NO, Double Break or SPDT Double Break
## Rated Operating Voltage -

 28 VdcResistive Rating - 230 Amps
Inrush Rating - 600 Amps
General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. - 50,000
cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - 1,250 Vrms
Circuit to Circuit - 1,250 Vrms
Coil to Ground and Aux. Contacts -
1,000 Vrms
Weight - 1.90 lbs
Coil Characteristics
Duty Cycle - Continuous
Operating Voltage, Max. -
30 Vdc
Operating Voltage, Nom. -
24 Vdc
Pickup Voltage @ $\mathbf{2 5}^{\circ}$ C, Max. 16.5 Vdc

Dropout Voltage - 0.5 to 7 Vdc


Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| A-1077B | Gasket Sealed | A | Continuous | 1 | $1616081-1$ |

## Product Facts

■ SPST NO, Double Break
■ Gasket Sealed

- Auxiliary contacts available
- Meets many requirements of MIL-PRF-6106


Performance Data
Electrical Characteristics
Contact Arrangement -
SPST NO, Double Break
Rated Operating Voltage -
28 Vdc
Resistive Rating - 300 Amps
Motor Load - 300 Amps
Rupture Rating - 3,000 Amps

General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. - 50,000
cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - 1,250 Vrms
Circuit to Circuit — 1,250 Vrms
Coil to Ground and Aux. Contacts 1,000 Vrms
Altitude Max. - $50,000 \mathrm{ft}$.
Weight -2.00 lbs

## Coil Characteristics

Duty Cycle -
DC Continuous or Intermittent or Continuous or Intermittent with suppression
Operating Voltage, Nom. 28 Vdc
Pickup Voltage @ $25^{\circ} \mathrm{C}$, Max. 16 Vdc
Dropout Voltage @ $25^{\circ} \mathrm{C}$ 1.5 to 5 Vdc

Coil Current, Max., Holding -
Coil Type A - 0.4 Amp
Coil Type B — 0.625 Amp

For factory-direct application
assistance, phone 419-521-9500 or fax 419-526-2749.

## A-770 and AR-770 Series, Rated up to 300 Amps, 28 Vdc (Continued)



Mounting Style A


Mounting Style C
For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.


Mounting Style D


Mounting Style E


Mounting Style G


Mounting Style F


For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.

## A-770 and AR-770 Series, Rated up to 300 Amps, 28 Vdc (Continued)



## Mounting Style K



For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

Circuit Configurations (Consult factory for other available circuit configurations)



Circuit Configuration 9


Circuit Configuration 10


Circuit Configuration 11


Circuit Configuration 12

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :--- | :---: | :--- | :---: | :---: | :---: |
| A-770AM | Gasket/Vented | A | Continuous | 1 | $3-1616058-1$ |
| A-770N | Gasket/Vented | B | Continuous | 2 | $3-1616058-3$ |
| A-770RF | Gasket/Vented | C | Continuous | 3 | $3-1616058-4$ |
| A-770RG | Gasket/Vented | D | Intermittent | 4 | $3-1616058-5$ |
| A-770RN | Gasket/Vented | E | Continuous w/Supp. | 5 | $3-1616058-8$ |
| A-770RSS | Gasket/Vented | F | Continuous w/Supp. | 6 | $3-1616058-9$ |
| A-770RV | Gasket/Vented | G | Intermittent w/Supp. | 7 | $1616530-7$ |
| A-770W | Gasket/Vented | H | Continuous | 8 | $4-1616058-1$ |
| A-770WA-2 | Gasket/Vented | I | Intermittent | 9 | $4-1616058-2$ |
| A-770WA-3 | Gasket/Vented | J | Intermittent | 10 | $4-1616058-3$ |
| A-77OWF | Gasket/Vented | K | Continuous | 11 | $4-1616058-4$ |
| AR-770W | Gasket/Vented | L | Continuous | 12 | $1616063-1$ |

## 6-89

Dimensions are shown for reference purposes only. Specifications subject to change.

## Product Facts

■ SPST NO, DPST NC, Double break
■ Gasket sealed
■ Meets many requirements of MIL-PRF-6106
■ Designed for series/parallel starting systems

## A-848 Series, Rated up to 300 Amps, 24/48 Vdc



## Performance Data

Electrical Characteristics
Contact Arrangement SPST NO, DPST NC, Double Break
Rated Operating Voltage 24/48 Vdc
Resistive Rating - 300 Amps
Inrush for 30 sec - $1,100 \mathrm{Amps}$ Inrush - 700 Amps

General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. - 50,000
cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - $1,250 \mathrm{Vrms}$
Circuit to Circuit - 1,250 Vrms Coil to Ground and Aux. Contacts 1,000 Vrms
Weight - 3.5 lbs
Coil Characteristics
Duty Cycle - Intermittent
Operating Voltage, Max. 31 Vdc
Operating Voltage, Min. 18 Vdc
Pickup Voltage @ $25^{\circ} \mathrm{C}$, Max.,
Initial - 12 Vdc
Dropout Voltage - 1.5 to 7 Vdc


Circuit Configurations (Consult factory for other available circuit configurations)

Circuit Configuration 1
Circuit Configuration 1


$$
\square
$$

Circuit

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| A-848KH | Gasket/Vented | A | Intermittent | 1 | $1616082-2$ |
| A-848KH-2 | Gasket/Vented | A | Intermittent | 1 | $1616082-4$ |

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

Dimensions are shown for reference purposes only. Specifications subject to change.

## Product Facts

■ DPST NO, Double break and DPDT Double break
■ Gasket sealed
■ Auxiliary contacts available

- Meets many requirements of MIL-PRF-6106

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## A-848 Series, Rated up to 300 Amps, 28 Vdc



## Performance Data

Electrical Characteristics
Contact Arrangement -
A-848MAS/MLS: DPST N0, Double Break
A-848KLC: DPDT Double Break
Rated Operating Voltage 28 Vdc
Resistive Rating - 300 Amps, A-848KLC - 200 Amps

## General Characteristics

Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. - 50,000
cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - 1,250 Vrms
Circuit to Circuit - 1,250 Vrms
Coil to Ground and Aux. Contacts 1,000 Vrms
Weight - 3.00 lbs

Coil Characteristics
Duty Cycle - Continuous
Operating Voltage, Nom. 28 Vdc
Pickup Voltage, Max. - 18 Vdc
Dropout Voltage -
$9 \mathrm{Vdc}(12 \mathrm{Vdc} \mathrm{Hot})$
Coil Current, Inrush, Max. 3.0 Amp

Coil Current, Holding, Max. 0.35 Amp

Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1


Circuit Configuration 2


Circuit Configuration 3

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| A-848MAS | Gasket/Vented | A | Continuous w/Supp., <br> Economizing | 1 | $1616102-2$ |
| A-848MLS | Gasket/Vented | B | Continuous w/Supp., <br> Economizing | 2 | $1616102-3$ |
| A-848KLC | Gasket/Vented | C | Continuous, <br> Economizing | 3 | $1616082-6$ |


| Catalog 5-1773450-5 | Dimensions are shown for <br> reference purposes only. |
| :--- | :--- |
|  | Specifications subject |
| www.te.com | to change. |

For additional support numbers


For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## Product Facts

■ SPDT NO, SPST NC
■ Hermetically sealed

- Auxiliary contacts available
- Meets many requirements of MIL-PRF-6106


Performance Data
Electrical Characteristics
Contact Arrangement -
SPDT, Double Break
Rated Operating Voltage 30 Vdc
Resistive Rating - 300 Amps Carry Only for 30 sec - 1,000 Amps
Carry Only, Inrush - 1,500 Amps
Rupture Rating - 3,000 Amps

## General Characteristics

Temperature Range -$-65^{\circ} \mathrm{C}$ to $+120^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated Resistive Load, Min. - 50,000 cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - $1,250 \mathrm{Vrms}$
Circuit to Circuit - 1,250 Vrms
Coil to Ground and Aux. Contacts 1,000 Vrms
Altitude, Max. - 50,000 ft.
Weight, Max. - 2.88 lbs

## Coil Characteristics

Duty Cycle — Intermittent, 3 minutes max.
Operating Voltage, Max. - 30 Vdc
Pickup Voltage, Max. Hot - 20 Vdc
Dropout Voltage - 0.5 to 5 Vdc

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

AH-965 Series, Rated up to 300 Amps, 30 Vdc (Continued)


Circuit Configurations (Consult factory for other available circuit configurations)


| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> AH-965H |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Hermetically Sealed | A | Intermittent | 1 | $1616084-1$ |  |
| AH-965M | Hermetically Sealed | B | Continuous w/ <br> External 25 Ohm/25 Watt <br> Resistor Connected | 2 |  |

For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.

## A-400 Series, Rated up to 400 Amps, 28 Vdc

## Product Facts <br> ■ SPST NO, Double break <br> ■ Gasket sealed <br> - Auxiliary contacts available <br> - Meets many requirements of MIL-PRF-6106



## Performance Data

## Electrical Characteristics

Contact Arrangement -
SPST NO, Double Break
Rated Operating Voltage 28 Vdc
Resistive Rating - 400 Amps
Inductive Rating - 100 Amps Inrush Rating -
A-400B, A-400D, A400DB-1 - 1,200 Amps
A-400A, A-400AA, A-400L and A-400S - 1,500 Amps
Rupture Rating - 4,000 Amps

General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. - 50,000
cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - $1,250 \mathrm{Vrms}$
Circuit to Circuit - 1,250 Vrms
Coil to Ground and Aux. Contacts -
1,000 Vrms
Altitude, Max. - 50,000 ft.
Weight - 1.26 to 1.48 lbs

## Coil Characteristics

Duty Cycle - Intermittent with
Suppression, or Continuous with Suppression
Operating Voltage, Nom. -A-400A, A-400AA, A-400B, A-400D, A400DB-1, A-400DC, A-400G, A-400G-2, A-400L, A-400S - 28 Vdc
Operating Voltage, Max. -
A-400A, A-400AA, A-400B, A-400D,
A400DB-1, A-400L, A-400S - 30 Vdc
A-400G, A-400G-2 - 31 Vdc
A-400DC - 32 Vdc
Pickup Voltage, Max. -
A-400A, A-400AA, A-400L - 14 Vdc
A-400B, A-400D, A400DB-1 - 18 Vdc
A-400DC - Normal - 14 Vdc
High Temp. - 18 Vdc
A-400G - Normal - 15 Vdc
High Temp. - 19 Vdc
A-400G-2 - Normal - 10 Vdc
High Temp. -12.5 Vdc
A-400S - +X to -X2 - 18 Vdc
+Y 1 to $-\mathrm{Y} 2-13 \mathrm{Vdc}$
Dropout Voltage -
A-400L - 0.5 to 4 Vdc
A-400A, A-400AA, - 1 to 5 Vdc
A-400B, A-400D, A400DB-1 1 to 7 Vdc
A-400DC, A-400G, A-400G-2 -
1.0 Vdc Min.

A-400S - +X to -X2 - 1 to 7 Vdo
+Y 1 to -Y2 - 0.5 to 5 Vdc

For factory-direct application
assistance, phone 419-521-9500 or fax 419-526-2749.

For additional support numbers please visit www.te.com

A-400 Series, Rated up to 400 Amps, 28 Vdc (Continued)


Mounting Style C


Mounting Style D
For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.



For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## A-400 Series, Rated up to $400 \mathrm{Amps}, 28$ Vdc (Continued)

Circuit Configurations (Consult factory for other available circuit configurations)


For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | ---: |
| A-400A | Gasket/Vented | A | Intermittent | 1 | $1-1616530-6$ |
| A-400AA | Gasket/Vented | B | Intermittent | 2 | $1616056-2$ |
| A-400B | Gasket/Vented | C | Continuous | 3 | $1616056-4$ |
| A-400D | Environ. | D | Continuous | 4 | $1616056-5$ |
| A-400DB1 | Environ. | E | Continuous | 5 | $1-1616964-3$ |
| A-400DC | Gasket/Vented | F | Continuous | 6 | $1616056-6$ |
| A-400G | Gasket/Vented | G | Intermittent | 7 | $1616056-8$ |
| A-400G2 | Gasket/Vented | G | Intermittent | 8 | $6-1616949-1$ |
| A-400L | Gasket/Vented | I | Intermittent | 9 | $1-1616530-5$ |
| A-400S | Gasket/Vented | J | Continuous/ <br> Intermittent | 10 | $1616056-9$ |

## A-703 and AH-703 Series, Rated up to 400 Amps, 28 Vdc*

## Product Facts <br> ■ SPST NO, Double break <br> ■ Gasket sealed or Hermetically sealed <br> ■ Auxiliary contacts available <br> - Meets many requirements of MIL-PRF-6106

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

Weight - 2.12 to 2.88 lbs
Pickup Time, @ Nom. Voltage,
Max. - 35 msec
Dropout Time, @ Nom. Voltage,
Max. - 35 msec
Bounce Time, @ Nom. Voltage,
Max. - . 004 msec
Coil Characteristics
Duty Cycle -
Intermittent (Type A, See diagram
below), Intermittent with suppression
(Type B, See diagram below),
Continuous, economized (Type C,
See diagram below) or Continuous, economized with suppression (Type D, See diagram below)
Operating Voltage -
28 Vdc Nominal
Pickup Voltage @ $\mathbf{2 5}^{\circ}$ C, Max. -
A-703B - 8 Vdc
A-703DBH - 10 Vdc
A-703, A-703CD, A-703CSM, A-703D,
A-703FA, A-703FB, A-703FSS,
A-703ZS - 12 Vdc
A-703T - 13 Vdc
AH-703F, A-703E, A-703G-1, A-703GC,
A-703GS, A-703R, AH-703F - 16 Vdc

Dropout Voltage -
A-703B - 0.5 to 3 Vdc
A-703CD, A-703FA, A-703FB 0.5 to 5 Vdc

A-703T - 0.5 to 6 Vdc
A-703, A-703CSM, A-703D, A-703FSS,
A-703ZS - 0.5 to 7 Vdc
A-703DBH, A-703E, A-703R -
1.0 to 7 Vdc

AH-703F, A-703G-1, A-703GC, A-
703GS, AH-703F - 1.5 to 7 Vdc

## General Characteristics

Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated Resistive Load, Min. - 50,000
cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - 1,250 Vrms
Circuit to Circuit — 1,250 Vrms
Coil to Ground and Aux. Contacts 1,000 Vrms

## A-703 and AH-703 Series, Rated up to 400 Amps, 28 Vdc (Continued)



Mounting Style B


Mounting Style C


Mounting Style D

For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.


Mounting Style F

For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.

## A-703 and AH-703 Series, Rated up to 400 Amps, 28 Vdc (Continued)

Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 5


Circuit Configuration 2


Circuit Configuration 6


Circuit Configuration 3


Circuit Configuration 7



Circuit Configuration 4



For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## A-703 and AH-703 Series, Rated up to 400 Amps, 28 Vdc (Continued)

Circuit Configurations (Consult factory for other available circuit configurations)


| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | Part Number |
| :---: | :---: | :---: | :---: | :---: | ---: |
| A-703 | Gasket/Vented | A | Continuous, Economized | 1 | $1616058-1$ |
| A-703CD | Gasket/Vented | C | Intermittent | 2 | $1616058-6$ |
| A-703CSM | Gasket/Vented | D | Intermittent | 15 | $1616058-7$ |
| A-703D | Gasket/Vented | D | Intermittent | 3 | $1616058-8$ |
| A-703DBH | Gasket/Vented | D | Intermittent | 3 | $1-1616058-0$ |
| A-703E | Gasket/Vented | D | Continuous, Economized | 4 | $1-1616058-1$ |
| A-703FA | Gasket/Vented | D | Intermittent w/Supp. | 5 | $1-1616058-2$ |
| A-703FB | Gasket/Vented | D | Intermittent | 6 | $1-1616058-3$ |
| A-703FSS | Gasket/Vented | D | Intermittent w/Supp. | 7 | $1-1616058-4$ |
| A-703G-1 | Gasket/Vented | D | Continuous, Economized | 8 | $1-1616058-5$ |
| A-703GC | Gasket/Vented | D | Continuous, Economized | 19 | $1-1616058-6$ |
| A-703B | Gasket/Vented | E | Intermittent | 10 | $1616058-3$ |
| A-703GS | Gasket/Vented | D | Continuous, Economized <br> w/Supp. | 11 | $1-1616058-7$ |
| A-703R | Gasket/Vented | D | Continuous, Economized <br> w/Supp. | 12 | $1-1616058-9$ |
| A-703T | Gasket/Vented | D | Intermittent w/Supp. | 13 | $2-1616058-0$ |
| A-703ZS | Gasket/Vented | A | Continuous, Economized <br> w/Supp. | 14 | $2-1616058-2$ |
| AH-703F | Hermetically Sealed | F | Continuous, Economized <br> w/Supp. | 16 | $1616061-1$ |

For factory-direct application
assistance, phone 419-521-9500 or fax 419-526-2749.

## A-981 Series, Rated up to 400 Amps, 28 Vdc

## Product Facts

■ SPDT, Double break or SPST NO, SPST NC
■ Gasket sealed

- Auxiliary contacts available
- Meets many requirements of MIL-PRF-6106



## Performance Data

Electrical Characteristics
Contact Arrangement SPDT, Double Break or SPST NO, SPST NC
Rated Operating Voltage 28 Vdc
Resistive Rating - 400 Amps Inrush for 30 sec - 1,000 Amps inrush - 1,500 Amps

## General Characteristics

Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. - 50,000
cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - 1,250 Vrms
Circuit to Circuit — 1,250 Vrms
Coil to Ground and Aux. Contacts 1,000 Vrms
Weight, Max. - 3.2 lbs

Coil Characteristics
Duty Cycle -Continuous with suppression
Operating Voltage, Max. - 31 Vdc
Operating Voltage, Min. - 17 Vdc
Pickup Voltage, Max. - 18 Vdc
Dropout Voltage @ $25^{\circ} \mathrm{C}$ 1 to 10 Volts
Coil Current, Inrush, Max. 4.5 Amp

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

For additional support numbers please visit www.te.com

## A-981 Series, Rated up to 400 Amps, 28 Vdc (Continued)



Mounting Style A
Mounting Style B

Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1


Circuit Configuration 2

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| A-981S | Gasket/Vented | A | Continuous, <br> Economizing w/Supp. | 1 | $1616083-7$ |
| A-981P | Gasket/Vented | B | Continuous, <br> Economizing w/Supp. | 2 | $1616083-6$ |

For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.

Product Facts
■ SPST NO, Quad. break
■ Gasket sealed

- Auxiliary contacts available
- Meets many requirements of MIL-PRF-6106

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## Performance Data

Electrical Characteristics Main Contacts -
Contact Arrangement SPST NO, Quad. Break Rated Operating Voltage 50 Vdc
Resistive Rating - 500 Amps
Auxiliary Contacts -
Aux. Contact Arrangement -
SPDT, SPST NC
Rated Operating Voltage - 38 Vdc
Resistive Rating - 5 Amps
General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load - 50,000 cycles
Operating Cycles (Life)
Mechanical - 100,000 cycles
Weight, Max. - 4 lb 8 oz.
Coil Characteristics
Duty Cycle - Continuous, economizing
Operating Voltage, Nom. -
$35-39 \mathrm{Vdc}$
Pickup Voltage @ $\mathbf{2 5}^{\circ}$ C, Max. 20 V
Resistance @ $25^{\circ} \mathrm{C}$ -
Pickup - 27 Ohm $\pm 20 \%$
Hold - $1110 \mathrm{hm} \pm 20 \%$
Suppression, Peak, Max. - 50 V


Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| A-792SFS | Gasket/Vented | A | Continuous, <br> Economizing w/Supp. | 1 | $1616101-2$ |

## A-712 Series, Rated up to 600 Amps, 28 Vdc

## Product Facts

■ SPST NO, Double break
■ Gasket sealed

- Meets requirements of MIL-PRF-6106

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.


Performance Data
Electrical Characteristics
Contact Arrangement -
SPST NO, Double Break
Rated Operating Voltage 28 Vdc
Resistive Rating - 600 Amps

## General Characteristics

Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load - 50,000 cycles
Operating Cycles (Life)
Mechanical - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - 1,250 Vrms
Circuit to Circuit — 1,250 Vrms
Coil to Ground and Aux. Contacts 1,000 Vrms
Weight, Max. - $3.00 \mathrm{lbs}-3 \mathrm{lbs} 70 z$.

Coil Characteristics
Duty Cycle - Continuous or Intermittent
Operating Voltage, Max. -29 Vdc
Coil Voltage, Nom. - 24-28 Vdc
Pickup Voltage, Max. - 18 Vdc
Dropout Voltage - 1 to 5 Vdc
Coil Current, Hold, Max. 0.6 Amp


## A-712 Series, Rated up to 600 Amps, 28 Vdc (Continued)



Mounting Style B


Mounting Style C
Circuit Configurations (Consult factory for other available circuit configurations)


For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| A-712AB | Gasket/Vented | A | Continuous | 1 | $2-1616058-3$ |
| A-712AF | Gasket/Vented | A | Intermittent | 1 | $2-1616058-4$ |
| A-712J | Gasket/Vented | B | Continuous | 2 | $2-1616058-6$ |
| A-712W | Gasket/Vented | C | Continuous, Economizing | 3 | $6-1616032-3$ |

Dimensions are shown for reference purposes only. Specifications subject to change.

## A-882 Series, Rated up to 600 Amps, 28/48 Vdc

Product Facts
■ 2PDT, Double break
■ Gasket sealed

- Auxiliary contacts available
- Meets many requirements of MIL-PRF-6106



## Performance Data

## Electrical Characteristics

Main Contacts -
Contact Arrangement -
2PDT, Double Break
Rated Operating Voltage 28/48 Vdc
Resistive Rating - 600 Amps
Resistive for 30 sec - $1,000 \mathrm{Amps}$
Motor Rating - 1,500 Amps, Inrush only
Auxiliary Contacts -
Aux. Contact Arrangement SPST NO

Resistive Rating - 5 Amps
Inductive Rating - 5 Amps
General Characteristics
Temperature Range -
$-65^{\circ} \mathrm{C}$ to $+160^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. - 50,000
cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - 1,250 Vrms
Circuit to Circuit - 1,250 Vrms
Coil to Ground and Aux. Contacts 1,000 Vrms
Altitude, Max. - $50,000 \mathrm{ft}$
Weight - 8.75 lbs
Coil Characteristics
Duty Cycle — Intermittent
Operating Voltage, Max. - 29 Vdc
Operating Voltage, Min. - 18 Vdc
Pickup Voltage, Max., Hot — 18 Vdc
Dropout Voltage, Max., Hot — 7 Vdc
Coil Current, Max. @ $70^{\circ} \mathrm{F}$ -
8 Amps
Coil Current, Max. @ -65²F-
9.6 Amps


Circuit Configurations (Consult factory for other available circuit configurations)


For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| A-882DL | Gasket/Vented | A | Intermittent | 1 | $1616102-6$ |

## A-931 Series, Rated up to 600 Amps, 28 Vdc

Product Facts
■ SPST NC, Double break
■ Gasket sealed

- Auxiliary contacts available
- Meets many requirements of MIL-PRF-6106



## Performance Data

Electrical Characteristics Main Contacts -
Contact Arrangement SPST NC, Double Break Rated Operating Voltage - 28 Vdc Resistive Rating - 600 Amps Inrush for 30 sec - 1,000 Amps Inrush for 5 min - 800 Amps Auxiliary Contacts -
Aux. Contact Arrangement DPST
Rated Operating Voltage - 28 Vdc
Resistive Rating - 5 Amps
General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. - 50,000
cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Strength -
All Circuits to Ground - $1,250 \mathrm{Vrms}$
Circuit to Circuit - 1,250 Vrms
Coil to Ground and Aux. Contacts 1,000 Vrms
Weight, Max. -3.00 lbs
Coil Characteristics
Duty Cycle - Continuous,
economizing
Operating Voltage, Max. - 30 Vdc
Operating Voltage, Min. - 18 Vdc
Pickup Voltage, Initial, Max. @ $71^{\circ} \mathrm{C}-10 \mathrm{Vdc}$
Dropout Voltage - 1 to 7 Vdc
Resistance, Inrush $\pm \mathbf{2 0 \%}$ @ $25^{\circ} \mathrm{C}$ -
3 Ohm
Resistance, Hold $\pm 20 \% @ 25^{\circ} \mathrm{C}$ 80 ohm


Circuit Configurations (Consult factory for other available circuit configurations)


| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> A-931F |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Gasket/Vented | A | Continuous, <br> Economizing w/Supp. | 1 | $1616060-1$ |  |

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749. to change.

## Product Facts

■ SPDT, Double break or 1PST NO, 1PST NC
■ Gasket sealed

- Auxiliary contacts available
- Meets many requirements of MIL-PRF-6106


## A-981 Series, Rated up to 600 Amps, 28/48 Vdc



Performance Data
Electrical Characteristics
Contact Arrangement SPST NC, Double Break or 1PST NO, 1PST NC
Rated Operating Voltage - 28 Vdc
Resistive Rating - 600 Amps
Inrush for 30 sec - $1,000 \mathrm{Amps}$
Motor Rating - 1,500 Amps, Inrush only

General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. - 50,000
cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Weight, Max. -
A-981E-4 lbs 502
A-981K — 4.5 lbs

Coil Characteristics

## Duty Cycle -

A-981E - Continuous
A-981K — Continuous, economizing
Operating Voltage -
A-981E - 28 Vdc
A-981K — 24 Vdc min. to 30 Vdc max.
Pickup Voltage -
A-981E - 18 Vdc max. hot A-981K — 16 Vdc max. initial @ $25^{\circ} \mathrm{C}$
Dropout Voltage -
A-981E - 10 Vdc max. hot
A-981K — 1 to 10 Vdc


For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.

## A-981 Series, Rated up to 600 Amps , 28/48 Vdc (Continued)

Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1


Circuit Configuration 2

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| A-981E | Gasket/Vented | A | Continuous, <br> Economizing | 1 | $1616083-1$ |
| A-981K | Gasket/Vented | B | Continuous, <br> Economizing | 2 | $1616083-2$ |

## Cross Reference

| Main Current Rating | AC/DC | Rating | Main Contact Config. | Operating Mode | Aux. Contact Config. | Coil Voltage (VDC) | Seal Type | Duty Cycle | Coil Trans. Voltage | Hartman Part No. | $\begin{gathered} \text { TE } \\ \text { Part No. } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 25 | DC | 28 | $\begin{aligned} & \hline \text { SPDT NO } \\ & \text { SPDT NC } \end{aligned}$ | Side Stable | - | 30 | Hermetic | Cont. | - | DH-14A | 1616089-1 |
|  |  | 28 | SPDT NO SPDT NC | Side Stable | - | 30 | Hermetic | Cont. | - | DH-14AL | 1616089-2 |
|  |  | 28 | $\begin{aligned} & \hline \text { SPDT NO } \\ & \text { SPDT NC } \end{aligned}$ | Side Stable | - | 30 | Hermetic | Cont. | 42 | DH-14AT | 1616089-3 |
|  |  | 3 | $\begin{aligned} & \hline \text { SPDT NO } \\ & \text { S\{DT NC } \\ & \hline \end{aligned}$ | Side Stable | - | 28 | Hermetic | Intermittent | - | DH-21N | 1616026-2 |
| 50 | DC | 28 | $\begin{aligned} & \hline \text { SPST NO } \\ & \text { SPST NC } \end{aligned}$ | Side Stable | - | 28 | Gasket/Vented | Cont. | - | D-7AC | 1616088-1 |
|  |  | 28 | SPST NO | Side Stable | DPDT | 28 | Gasket/Vented | Cont. | - | D-7LHB | 1616064-1 |
|  |  | 28 | 4PDT | Center Off | - | 28 | Hermetic | Cont. | - | DH-18DA | 1616050-2 |
|  |  | 28 | SPST NO SPST NC | Side Stable | DPDT | 18-30 | Hermetic | Cont. | 50 | DH-7ATK | 1616089-7 |
|  |  | 28 | 2PST NO | Side Stable | - | 28 | Hermetic | Cont. | - | DH-7MN | 1616103-2 |
|  |  | 28 | $\begin{aligned} & \hline \text { SPST NO } \\ & \text { SPST NC } \\ & \hline \end{aligned}$ | Side Stable | (2)SPST NO | 28 | Hermetic | Cont. | - | DH-7TB | 1-1616089-3 |
| 100 | DC | 28 | SPST NO | Side Stable | SPDT | 24-32 | Gasket | Cont. | - | A-1077DD | 1616055-3 |
|  |  | 28 | SPDT | Side Stable | 1NO, 1NC | 24-30 | Gasket | Cont. | 45 | A-1077S | 1616081-3 |
| 100 | DC | 28 | SPDT | Center Off | SPST NO | 115VAC | Gasket/Vented | Cont. | - | D-31BAA | 1616097-1 |
|  |  | 28 | (2)SPST | Center Off | SPST NO | 28 | Gasket/Vented | Cont. | 45 | D-32A | 1616097-2 |
|  |  | 28 | $\begin{aligned} & \hline \text { 1PST NO } \\ & \text { 1PST NC } \\ & \hline \end{aligned}$ | Side Stable | - | 18-22.5 | Hermetic | Cont. | - | DH-25EA | 1616089-4 |
|  |  | 28 | SPDT | Center Off | SPST NO | 28 | Hermetic | Cont. | - | DHR-31BA | 1616098-1 |
| 200 | DC | 28 | SPST NO | Side Stable | DPDT | 24-30 | Gasket | Int. | - | A-1077D | 1616055-2 |
|  |  | 28 | SPST NO | Side Stable | DPDT | 24-30 | Gasket | - | - | A-1077F | 1616055-4 |
|  |  | 28 | SPST NO | Side Stable | - | 24-30 | Gasket | Cont. | - | A-1077G | 1616055-5 |
|  |  | 28 | SPST NO | Side Stable | DPDT | 24-30 | Gasket | Cont. | - | A-1077V | 1616055-6 |
|  |  | 28 | SPST NO | Side Stable | DPDT | 24-30 | Gasket | Cont. | - | A-1077W | 1616081-4 |
| 200 | DC | 28 | SPST NC | Side Stable | DPST NO | 24-30 | Gasket/Vented | Int. | - | A-876K | 1616059-1 |
| 230 | DC | 28 | SPDT | Side Stable | DPDT | 24-30 | Gasket | Cont. | - | A-1077B | 1616081-1 |
| 300 | DC | 28 | SPST NO | Side Stable | SPDT | 28 | Gasket/Vented | Cont. | - | A-770AM | 3-1616058-1 |
|  |  | 29 | SPST NO | Side Stable | SPST NO | 28 | Gasket/Vented | Cont. | - | A-770N | 3-1616058-3 |
|  |  | 28 | SPST NO | Side Stable | - | 24 | Gasket/Vented | Cont. | - | A-770RF | 3-1616058-4 |
|  |  | 28 | SPST NO | Side Stable | Form Z | 24-30 | Gasket/Vented | Int. | - | A-770RG | 3-1616058-5 |
|  |  | 28 | SPST NO | Side Stable | Form Z SPST NC | 24-30 | Gasket/Vented | Cont. | 45 | A-770RN | 3-1616058-8 |
|  |  | 28 | SPST NO | Side Stable | $\begin{aligned} & \hline \text { Form Z } \\ & \text { SST NC } \\ & \hline \end{aligned}$ | 24-30 | Gasket/Vented | Cont. | 45 | A-770RSS | 3-1616058-9 |
|  |  | 28 | SPST NO | Side Stable | Form Z | 16-32 | Gasket/Vented | Int. | 80 | A-770RV | 1616530-7 |
|  |  | 28 | SPST NO | Side Stable | SPDT | 28 | Gasket/Vented | Cont. | - | A-770W | 4-1616058-1 |
|  |  | 28 | SPST NO | Side Stable | 2PST NO | 28 | Gasket/Vented | Int. | 42 | A-700WA-2 | 4-1616058-2 |
|  |  | 28 | SPST NO | Side Stable | DPST NO SPS NC | 28 | Gasket/Vented | Int. | - | A-770WA-3 | 4-1616058-3 |
|  |  | 28 | SPST NO | Side Stable | 3PDT | 28 | Gasket/Vented | Cont. | 42 | A-770WF | 4-1616058-4 |
|  |  | 28 | SPST NO | Side Stable | SPDT | 115 VAC | Gasket/Vented | Cont. | - | AR-770W | 0-1616063-1 |

For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.

Dimensions are shown for reference purposes only. Specifications subject to change.

Cross Reference (Continued)

| Main <br> Current <br> Rating | AC/DC | Rating | Main Contact Config. | Operating Mode | Aux. Contact Config. |  | Seal <br> Type | Duty Cycle | Coil Trans. Voltage | Hartman Part No. | TE Part No. |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 300 | DC | 24/48 | DPDT NC <br> SPDT NO | Side Stable | SPST NO | 24-30 | Gasket/Vented | Int. | - | A-848KH | 1616082-2 |
|  |  | 24/48 | DPST NC <br> SPST NO | Side Stable | SPST NO | 24-30 | Gasket/Vented | Int. | - | A-848KH-2 | 1616082-4 |
|  |  | 28 | DPST NO | Side Stable | DPST NO DPST NC | 28 | Gasket/Vented | Cont. | 45 | A-848MAS | 1616102-2 |
|  |  | 28 | DPST NO | Side Stable | 3PST NC | 24-30 | Gasket/Vented | Cont. Econ. | 50 | A-848MLS | 1616102-3 |
|  |  | 28 | DPST NO | Side Stable | 3PST NC | 24-30 | Gasket/Vented | Cont. Econ. | 50 | A-848KLC | 0-1616082-6 |
| 300 | DC | 30 | SPDT | Side Stable | SPDT | 30 | Hermetic | Int. | - | AH-965H | 1616084-1 |
|  |  | 30 | SPDT | Side Stable | 3PDT | 28 | Hermetic | Cont. | 45 | AH-965M | 1616084-2 |
| 400 | DC | 28 | SPST NO | Side Stable | SPDT | 28 | Gasket/Vented | Int. | 45 | A-400A | 1-1616530-6 |
|  |  | 28 | SPST NO | Side Stable | - | 28 | Gasket/Vented | Int. | 45 | A-400AA | 1616056-2 |
|  |  | 28 | SPST NO | Side Stable | DPDT | 28 | Gasket/Vented | Cont. | 45 | A-400B | 1616056-4 |
|  |  | 28 | SPST NO | Side Stable | (1)SPST NO <br> (1)SPST NC | 28 | Environ. | Cont. | 45 | A-400D | 1616056-5 |
|  |  | 28 | SPST NO | Side Stable | (1)SPST NO <br> (1)SPST NC | 28 | Environ. | Cont. | 45 | A-400DB1 | 1-1616964-3 |
|  |  | 28 | SPST NO | Side Stable | SPDT | 28 | Gasket/Vented | Cont. | 45 | A-400DC | 1616056-6 |
|  |  | 28 | SPST NO | Side Stable | DPST NO SPST NC | 28 | Gasket/Vented | Int. | 45 | A-400G | 1616056-8 |
|  |  | 28 | SPST NO | Side Stable | $\begin{aligned} & \text { DPST NO } \\ & \text { SPST NC } \\ & \hline \end{aligned}$ | 28 | Gasket/Vented | Int. | 45 | A-400G2 | 6-1616949-1 |
|  |  | 28 | SPST NO | Side Stable | DPST NO DPST NC | 28 | Gasket/Vented | Int. | 45 | A-400L | 1-1616530-5 |
|  |  | 28 | SPST NO | Side Stable | DPST NO SPST NC | 28 | Gasket/Vented | Cont/Int | 45 | A-400S | 1616056-9 |
| 400 | DC | 28 | SPST NO | Side Stable | SPDT | 24-30 | Gasket/Vented | Cont. Econ. | - | A-703 | 1616058-1 |
|  |  | 28 | SPST NO | Side Stable | - | 24-30 | Gasket/Vented | Int. | - | A-703CD | 1616058-6 |
|  |  | 36/40 | SPST NO | Side Stable | SPST NO | 24-30 | Gasket/Vented | Int. | 50 | A-703CSM | 1616058-7 |
|  |  | 28 | SPST NO | Side Stable | Form Z | 24-30 | Gasket/Vented | Int. | - | A-703D | 1616058-8 |
|  |  | 28 | SPST NO | Side Stable | Form Z | 18-31 | Gasket/Vented | Int. | - | A-703DBH | 1-1616058-0 |
|  |  | 28 | SPST NO | Side Stable | Form Z | 24-30 | Gasket/Vented | Cont. Econ. | - | A-703E | 1-1616058-1 |
|  |  | 28 | SPST NO | Side Stable | Form Z SPST NC | 24-30 | Gasket/Vented | Int. | 45 | A-703FA | 1-1616058-2 |
|  |  | 28 | SPST NO | Side Stable | Form Z SPST NC | 24-30 | Gasket/Vented | Int. | - | A-703FB | 1-1616058-3 |
|  |  | 28 | SPST NO | Side Stable | Form Z SPST NC | 24-30 | Gasket/Vented | Int. | 45 | A-703FSS | 1-1616058-4 |
|  |  | 28 | SPST NO | Side Stable | Form Z SPST NC | 18-31 | Gasket/Vented | Cont. Econ. | - | A-703G-1 | 1-1616058-5 |
|  |  | 28 | SPST NO | Side Stable | Form Z SPDT <br> Form Z | 18-31 | Gasket/Vented | Cont. Econ. | - | A-703GC | 1-1616058-6 |
|  |  | 28 | SPST NO | Side Stable | SPST NC | 24-30 | Gasket/Vented | Int. | - | A-703B | 1616058-3 |
|  |  | 28 | SPST NO | Side Stable | Form Z SPST NC | 18-31 | Gasket/Vented | Cont. Econ. | 45 | A-703GS | 1-1616058-7 |
|  |  | 28 | SPST NO | Side Stable | Form Z | 24-30 | Gasket/Vented | Cont. Econ. | 45 | A-703R | 1-1616058-9 |
|  |  | 28 | SPST NO | Side Stable | SPST NO SPST NC | 24-30 | Gasket/Vented | Int. | 45 | A-703T | 2-1616058-0 |
|  |  | 28 | SPST NO | Side Stable | SPST NO Form Z | 18-24 | Gasket/Vented | Cont. Econ. | 45 | A-703ZS | 1-1616058-2 |
|  |  | 28 | SPST NO | Side Stable | 1Form Z <br> 1Form Y | 18-31 | Hermetic | Cont. Econ. | - | AH-703F | 1616061-1 |

For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.

| Cross Reference (Continued) |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Main Current Rating | AC/DC | Rating | Main Contact Config. | Operating Mode | Aux. Contact Config. | Coil Voltage (VDC) | Seal Type | Duty Cycle | Coil Trans. Voltage | Hartman Part No. | $\begin{gathered} \text { TE } \\ \text { Part No. } \end{gathered}$ |
| 400 | DC | 28 | SPDT | Side Stable | Form Z | 17-31 | Gasket/Vented | Int. | 45 | A-981S | 1616083-7 |
|  |  | 28 | 1PST NO 1PST NC | Side Stable | 3PDT | 24-30 | Gasket/Vented | Cont. Econ. | - | A-981P | 1616083-6 |
| 500 | DC | 50 | SPST NO | Side Stable | $\begin{gathered} \text { SPDT } \\ \text { SPST NC } \end{gathered}$ | 38 | Gasket/Vented | Cont. Econ. | 50 | A-792SFS | 1616101-2 |
| 600 | DC | 29 | SPST NO | Side Stable | - | 24-28 | Gasket/Vented | Cont. | - | A-712AB | 2-1616058-3 |
|  |  | 29 | SPST NO | Side Stable | - | 24-28 | Gasket/Vented | Int. | - | A-712AF | 2-1616058-4 |
|  |  | 29 | SPST NO | Side Stable | - | 24-28 | Gasket/Vented | Cont. | - | A-712J | 2-1616058-6 |
|  |  | 29 | SPST NO | Side Stable | $\begin{gathered} \hline \text { SPST NO } \\ \text { SPDT } \\ \hline \end{gathered}$ | 24-28 | Gasket/Vented | Cont. | - | A-712W | 6-1616058-3 |
| 600 | DC | 28/48 | DPDT | Side Stable | SPST NO | 29 | Gasket/Vented | Int. | - | A-882DL | 1616102-6 |
|  |  | 28 | SPST NC | Side Stable | DPST NO | 18-30 | Gasket/Vented | Cont. Econ. | 45 | A-931F | 1616060-1 |
|  |  | 28 | SPDT | Side Stable | SPST NO | 28 | Gasket/Vented | Cont. | - | A-981E | 1616083-1 |
|  |  | 28 | SPST NO SPST NC | Side Stable | - | 24-30 | Gasket/Vented | Cont. Econ. | - | A-981K | 1616083-2 |

For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.


## A-772 Series Battery Contactor - Discharge Overload, Rated up to 200 Amps, 28 Vdc

## Product Facts

■ SPST NO
■ Gasket sealed

- Auxiliary contacts available

■ Limits overload current duration

## Performance Data

Electrical Characteristics
Main Contacts -
Contact Arrangement SPST NO
Rated Operating Voltage - 28 Vdc
Resistive Rating - 200 Amps
Auxiliary Contacts -
Aux. Contact Arrangement SPST NC
Rated Operating Voltage - 28 Vdc
Resistive Rating - 5 Amps
General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load - 50,000 cycles
Operating Cycles (Life)
Mechanical - 100,000 cycles
Electrical- $50,000 \mathrm{~min}$.
Weight, Max. - 2 lbs. 130 oz


Coil Characteristics
Duty Cycle - Continuous
Operating Voltage, Max. - 30 V
Operating Voltage, Min. -24 V
Pickup Voltage @ $\mathbf{2 5}^{\circ} \mathrm{C}$, Max. 16 V
Dropout Voltage - 1 to 7 V
Overload Sensor
Type - Latching
Polarized - Discharge
Trip - 300 Amps $\pm 10 \%$
Time Delay - 900 to $1,100 \mathrm{msec}$
Sensor Contacts, Aux.
Sensor Contact Arrangement SPST NO
Rated Operating Voltage - 28 Vdc
Resistive Rating - 3 Amps
Reset Rating, Max. - 18 V


Mounting Style A

Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| A-772XTB | Gasket/Vented | A | Continuous | 1 | $1616545-1$ |

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

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Product Facts
■ SPDT
■ Gasket sealed
■ Meets many requirements
    of MIL-PRF-6106
```



Performance Data
Electrical Characteristics Indicator Contact Arrangement SPDT
Rated Operating Voltage - 28 Vdc Resistive Rating - 1 Amp

General Characteristics
Dielectric Strength -
1,000 Vrms, 60 Hz
Insulation Resistance @ 500 Vdc
\& $20^{\circ} \mathrm{C}$ \& 50\% R.H. (Max.)-
1,000 megohm min.
Weight, Max. - $80 z$

Coil Characteristics<br>Duty Cycle - Continuous<br>Control Power - 28 Vdc<br>Sensor Input - $400 \mathrm{~Hz} \pm 100 \mathrm{~Hz}$<br>Pickup Current - $14 \pm 2$ Amps<br>Dropout Current $-7 \pm 1$ Amp<br>Continuous Sensor Current -<br>25 Amp, max.



Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| E-387C-1 | Gasket/Vented | A | Continuous | 1 | $2-1616126-3$ |

For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.

## Product Facts

■ SPST NO
■ Gasket sealed

- Auxiliary contacts available



## Performance Data

Electrical Characteristics
Main Contacts -
Contact Arrangement - SPST NO
Rated Operating Voltage - 28 Vdc
Resistive Rating - 100 Amps
Resistive Rating at 1 min. 200 Amps
Interrupting Capacity 4,500 Amps

Reverse Current Setting* -
2 to 6 Amps
Differential Voltage for Pickup -
$.85 \pm .15 \mathrm{~V}$
Auxiliary Contacts -
Aux. Contact Arrangement SPST NC, SPST NO
Resistive Rating - 5 Amps
Inductive Rating - 2 Amps
Lamp Rating - 1 Amps

General Characteristics
Weight, Max. - 3 lbs 1 oz
Coil Characteristics
Duty Cycle - Continuous
*Over a Voltage Range of $27.5 \pm$ 2.5 Vdc

Circuit Configurations (Consult factory for other available circuit configurations)

factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| A-700BU | Gasket/Vented | A | Continuous | 1 | $1616109-6$ |

## A-700 Series Cutout - Reverse Current, Rated up to 200 Amps, 28 Vdc

Product Facts<br>■ SPST NO<br>■ Gasket sealed<br>- Meets many requirements of MIL-PRF-6106

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.


## Performance Data

Electrical Characteristics
Contact Arrangement - SPST NO
Rated Operating Voltage - 28 Vdc
Current Rating, Continuous -
200 Amps
Current Rating at 15 sec. -
1,000 Amps
Current Rating at 1 min. -
500 Amps
Current Rating at 5 min. 300 Amps
Interrupting Capacity -
4,500 Amps
Reverse Current Setting* -
6 to 17 Amps
Differential Voltage for Pickup -
$.85 \pm .15 \mathrm{~V}$
General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. - 50,000
cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Electrical- $50,000 \mathrm{~min}$.
Weight, Max. - 2 lbs $150 z$
Coil Characteristics
Duty Cycle - Continuous
*Over a Voltage Range of $27.5 \pm 2.5$
Vdc and Calibrated at $12 \pm 1 \mathrm{Amp}$ $R C$ at $28 \mathrm{Vdc} \& 25^{\circ} \mathrm{C} \pm 5^{\circ} \mathrm{C}$


Mounting Style A
Circuit Configurations (Consult factory for other available circuit configurations)


IS DE-ENERGIZED
Circuit Configuration 1

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| A-700AQ-4 | Gasket/Vented | A | Continuous | 1 | $1616109-4$ |

## Product Facts

■ SPST NO, Double break
■ Gasket sealed

- Meets many requirements of MIL-PRF-6106


Performance Data
Electrical Characteristics
Contact Arrangement -
SPST NO, Double Break
Rated Operating Voltage - 28 Vdc
Resistive Rating - 300 Amps
Reverse Current Dropout 9 to 25 Amps
Differential Pickup - $5 \pm .15$

General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. - 50,000
cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Electrical - 50,000 min.
Dielectric Strength -
All Circuits to Ground - 1,250 Vrms
Circuit to Circuit - 1,250 Vrms
Coil to Ground and Aux. Contacts -
500 Vrms

Weight, Max. -
A-700AAP - 2.9 lbs
A-700ZC-7, A-700ZG - 2.5 lbs
Coil Characteristics
Duty Cycle - Continuous
Duty Cycle when using "APP" Intermittent
Nom. Coil Voltage - 24 to 30 Vdc
Pickup Voltage, Max. - 18 Vdc
Dropout Voltage - 0.5 to 7.0 Vdc


Mounting Style A


Mounting Style B

For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.

## A-700 Series Cutout - Reverse Current, Rated up to 300 Amps,

28 Vdc (Continued)
Circuit Configurations (Consult factory for other available circuit configurations)


| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| A-700AAP | Gasket/Vented | A | Continuous | 1 | $1616109-1$ |
| A-700ZC-7 | Gasket/Vented | A | Continuous | 2 | $1616109-7$ |
| A-700ZG | Gasket/Vented | B | Continuous | 3 | $1616109-9$ |

Product Facts
■ SPST NO, Double break
■ Gasket sealed

- Meets many requirements of MIL-C-5026 and MIL-PRF-6106


## A-701 Series Cutout — Reverse Current, Rated up to 400 Amps, 28 Vdc



## Performance Data

Electrical Characteristics
Contact Arrangement -
SPST NO, Double Break
Rated Operating Voltage - 28 Vdc
Resistive Rating - 400 Amps
Resistive for 30 sec. - $1,000 \mathrm{Amps}$ Inrush Rating - $1,500 \mathrm{Amps}$ Reverse Current Dropout -
A-701D - 25 to 50 Amps
A-701C - 18 to 35 Amps

General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. - 50,000
cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Electrical - $50,000 \mathrm{~min}$.
Dielectric Strength -
All Circuits to Ground - 1,250 Vrms
Circuit to Circuit - 1,250 Vrms
Coil to Ground and Aux. Contacts 500 Vrms
Differential Pickup $-0.5 \pm .15 \mathrm{Vdc}$

Weight, Max. -
A-701D - 3 lbs 1002 A-701C - 4 lbs
Coil Characteristics
Duty Cycle - Continuous, economizing
Duty Cycle when using "APP"on A-701D or "GMG" on A-701C Intermittent
Nom. Coil Voltage - 24 to 30 Vdc
Pickup Voltage, Max. -
A-701D - 15 Vdc
A-701C - 12 Vdc
Dropout Voltage - 0.5 to 7.0 Vdc


For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.

## A-701 Series Cutout - Reverse Current, Rated up to 400 Amps,

28 Vdc (Continued)
Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1


Circuit Configuration 2

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| A-701D | Gasket/Vented | A | Continuous, <br> Economizing | 1 | $1-1616109-1$ |
| A-701C | Gasket/Vented | B | Continuous, <br> Economizing | 2 | $1-1616109-0$ |

# A-702 Series Cutout - Reverse Current, Rated up to 600 Amps, 28 Vdc 

## Product Facts <br> ■ SPST NO <br> ■ Gasket sealed

## Performance Data <br> Electrical Characteristics <br> Contact Arrangement - <br> SPST NO, Double Break <br> Rated Operating Voltage - 28 Vdc <br> Resistive Rating - 600 Amps <br> Reverse Current Dropout - <br> 18 to 35 Amps <br> Differential Pickup - $.5 \pm .15$

| General Characteristics | Coil to Ground and Aux. Contacts - |
| :--- | :--- |
| Temperature Range - | 500 Vrms |
| $-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$ | Weight, Max. -3.9 lbs. |
| Operating Cycles (Life) at Rated | Coil Characteristics |
| Resistive Load, Min. $-50,000$ | Duty Cycle - Continuous |
| cycles | Duty Cycle when using "APP" - |
| Operating Cycles (Life) | Continuous |
| Mechanical, Min. $-100,000$ cycles | Nom. Coil Voltage -24 to 30 Vdc |
| Electrical $-50,000$ min. | Pickup Voltage, Max. -18 Vdc |
| Dielectric Strength - | Dropout Voltage -0.5 to 7.0 Vdc |
| All Circuits to Ground $-1,250$ Vrms |  |
| Circuit to Circuit $-1,250$ Vrms |  |

Circuit Configurations (Consult factory for other available circuit configurations)


Mounting Style A

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## B-188 Series External Power Monitor, 115 VAC, 400 Hz

Product Facts
■ SPST
■ Gasket Sealed

- Over/under frequency protection

Over/under voltage protection

■ Dust tight

## Performance Data

Electrical Characteristics
Contact Arrangement - SPST
Rated Operating Voltage -
$115 \mathrm{VAC} / 28 \mathrm{Vdc}, 3$ phase, 400 Hz
Resistive Rating - 3 Amps
General Characteristics
Operating Temperature Range -$-54^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$

## Dielectric Strength -

Leakage current will not exceed . 001
Amps when unit is subjected to test of
Para. 4.6.2 of MIL-E-24021A
Altitude - 0-40,000 ft
Weight, Max. -. 75 lb
Sinusoidal Vibration -
5-15.5 CPS $\pm 0.13$ G,
15.5-54 CPS 0.01 inch DA,
$54-500 \mathrm{CPS} \pm 1.5 \mathrm{G}$
Shock, Max. - 10 G $30 \pm 1 \mathrm{~ms}$


Operation - Contacts will remain as shown (off condition) until input power is anywhere within the "on" zone. Contacts will revert to off condition whenever input voltage and/or frequency is above the high side or below the low side "off". Limits for time intervals exceeding the transient period Limits -
"On" zone -
"On" zone voltage limits 100 to 120 volts rms all phases
"On" zone frequency limits 380 to 420 CPS
"Off" limits -
High side voltage "off" limits $131 \pm 5$ volts $3 \varnothing$ (highest of 30 ) High side frequency "off" limits $425 \pm 5$ CPS
Low side frequency "off" limits $375 \pm 5$ CPS
Voltage Transient Limits -
High Side - above limit 2 but below limit 1 of Fig. 2 MIL-STD704, 30 (highest of 30)
Low Side — below limit 3 Fig. 2
MIL-STD-704
Over and Under frequency time
delay $3 \pm 1 \mathrm{sec}$
Output rating SPST 3 AMP Ind. 28 V
DC/115 V 400 CPS


Circuit Configurations (Consult factory for other available circuit configurations)

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| B-188MA-1 | Gasket/Vented | A | N/A | 1 | $1616114-7$ | to change.

## Product Facts

■ SPST NO, Double break
■ Gasket sealed

- Auxiliary contacts available
- Meets many requirements of MIL-PRF-6106

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## A-711 Series Relay, Automatic Dropout, Rated up to 600 Amps, 29 Vdc



## Performance Data

Electrical Characteristics
Contact Arrangement -
SPST NO, Double Break
Operating Voltage, Max. - 29 Vdc
Resistive Rating - 600 Amps
Pickup Voltage, Max. - 17 Vdc Dropout Voltage, Max. - 14 Vdc, except for A - 711 which is 1 to 5 Vdc
Pickup Current, Max. - 490 Amps Dropout Current at any Contactor Voltage - $150 \pm 15$ Amps, except for A-711R which is S1-135 $\pm 15 \mathrm{Amps}$ and S2 $-235 \pm 20 \mathrm{Amps}$

## General Characteristics

Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. - 25,000
cycles
Operating Period, Max. - 3 min.
Weight, Max. -
A-711JF, A-711JF - 3 lbs $130 z$
A-711Z - 3 lbs 602
A-711R - 3 lbs 502

Coil Characteristics
Duty Cycle - Intermittent
Coil Current, Max. -
A-711AJ, A-711JM - 2 Amps
A-7112 - 0.6 Amp
A-711R — 1.0 Amp
Coil Voltage, Nom. - 28 Vdc
Signal Resistor - $200 \mathrm{hm} \pm 10 \%$, 20 W
Coil Res., "C" Term. to "GND" $360 \mathrm{hm} \pm 10 \%$

assistance, phone 419-521-95boupting Style A
fax 419-526-2749.


Mounting Style B

## A-711 Series Relay, Automatic Dropout, Rated up to 600 Amps,

 29 Vdc (Continued)Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1


Circuit Configuration 2


Circuit Configuration 3


Circuit Configuration 4

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| A-711JF | Gasket/Vented | A | Intermittent | 1 | $1-1616109-6$ |
| A-711JM | Gasket/Vented | A | Intermittent | 2 | $1-1616109-7$ |
| A-711Z | Gasket/Vented | B | Intermittent | 3 | $6-1616071-3$ |
| A-711R | Gasket/Vented | A | Intermittent | 4 | $1-1616109-8$ |

## Product Facts <br> ■ SPST NO, Double break <br> - Gasket sealed <br> - Auxiliary contacts available <br> - Meets many requirements of MIL-PRF-6106

## Performance Data

Electrical Characteristics
Main Contacts -
Contact Arrangement -
SPST NO, Double Break
Operating Voltage, Nom. - 28 Vdc
Resistive Rating - 200 Amps
Inrush Rating - 300 Amps
Pickup Current -
VR-21-24V
I- 25 Amp Max.
SR - 18 V Max.
MC - 18 V Max.
Dropout Current -
I-5 Amp Min.
SR-18 $\pm 3 \mathrm{~V}$
MC - 1 to 7 V
Auxiliary Contacts -
Aux. Contact Arrangement -
SPST NO, SPST NC
Rated Operating Voltage - 28 Vdc
Resistive Rating - 5 Amps

General Characteristics
Temperature Range -$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. - 50,000
cycles
Operating Cycles (Life)
Mechanical - 100,000 cycles
Altitude, Max. - $50,000 \mathrm{ft}$
Weight, Max. - 4 lbs $80 z$
Coil Characteristics
Duty Cycle - Continuous
Coil Voltage, Nom. - 24 to 30 Vdc


Mounting Style A
Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1


| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| A-957CSD | Gasket/Vented | A | Continuous | 1 | $1616110-6$ |
| A-957G | Gasket/Vented | A | Continuous | 2 | $1616110-8$ |

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## Product Facts

■ SPST NO, Double break
■ Gasket sealed

- Meets many requirements of MIL-PRF-6106



## Performance Data

Electrical Characteristics
Contact Arrangement -
SPST NO, Double Break
Operating Voltage, Nom. 24/30 Vdc
Resistive Rating - 300 Amps
Inrush Rating - 800 Amps
Pickup Current -
VR - $21-24 \mathrm{Vdc}$
Current - 25 Amp Max.
SR - 18 V Max.
Main Contactor - 18 V Max.
Dropout Current -
Current - 5 Amp Min.
SR-18 $\pm 3 \mathrm{~V}$
Main Contactor - 12 V Max.
General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. - 50,000
cycles
Operating Cycles (Life)
Mechanical - 100,000 cycles
Weight, Max. - 3.5 lbs configurations)

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| A-957E | Gasket/Vented | A | Continuous | 1 | $1616110-7$ |

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

Coil Characteristics
Duty Cycle - Continuous
Coil Voltage, Nom. - 24 to 30 Vdc


Circuit Configurations (Consult factory for other available circuit


For additional support numbers please visit www.te.com to change.

## Product Facts

■ SPST NO, Double break

- Gasket sealed
- Auxiliary contacts available
- Meets many requirements of MIL-PRF-6106

Performance Data
Electrical Characteristics
Main Contacts -
Contact Arrangement -
SPST NO, Double Break
Operating Voltage, Nom. - 28 Vdc
Resistive Rating - 350 Amps
Pickup Current -
VR - $21-24 \mathrm{~V}$
I-25 Amp Max.
SR - 18 V Max.
MC - 18 V Max.
Dropout Current -
I - 5 Amp Min.
SR - $18 \pm 3 \mathrm{~V}$
MC - 1 to 7 V
Auxiliary Contacts -
Aux. Contact Arrangement -
SPDT
Rated Operating Voltage - 28 Vdc
Resistive Rating - 5 Amps
General Characteristics
Ambient Temperature Range -
$-30^{\circ} \mathrm{F}$ to $+220^{\circ} \mathrm{F}$
Altitude, Max. - 50,000 ft
Weight, Max. - 4 lbs 8 oz
Coil Characteristics
Duty Cycle - Continuous
Coil Voltage, Nom. - 24 to 30 Vdc


Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| A-957CA | Gasket/Vented | A | Continuous | 1 | $1616110-5$ |

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

Dimensions are shown for reference purposes only. Specifications subject
www.te.com to change.

## Product Facts <br> ■ SPST NC <br> ■ Environmentally sealed <br> - Meets many requirements of MIL-PRF-6106

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.


## Performance Data

## Electrical Characteristics

 Contact Arrangement — SPST NC Contact Rating @ 120 Vdc 0.1 AmpRated Operating Voltage - 28 Vdc
Sensing Current Rating - 2 Amps, continuous
Pickup Max. - 1 Amp DC
Dropout Min. - 0.4 Amp
Operating Voltage, Nom. 28 Vdc
General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Altitude, Max. - $50,000 \mathrm{ft}$
Weight, Max. - 1.250 z


Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Duty <br> Cycle | Circuit <br> Config. | Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Q-50Y | Environmentally <br> Sealed | A | Continuous | 1 | $1-1616131-2$ |

## Product Facts

■ SPDT
■ Environmentally sealed

- Meets many requirements of MIL-PRF-6106



## Performance Data

Electrical Characteristics
Contact Arrangement - SPDT
Contact Rating @ 28 Vdc 0.25 Amp

Lamp Load @ 28 Vdc - 0.080 Amp
Rated Operating Voltage - 28 Vdc
Sensing Current Rating - 3.5
Amps, continuous
Pickup Max. — 2 Amp DC
Dropout Min. - 0.8 Amp
General Characteristics
Temperature Range -$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Altitude, Max. - $50,000 \mathrm{ft}$
Weight, Max. - 1.2502


Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Duty <br> Cycle | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Q-50F | Environmentally <br> Sealed | A | Continuous | 1 | $1616131-9$ |

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## Product Facts

■ SPDT
■ Environmentally sealed

- Meets many requirements of MIL-PRF-6106


Performance Data
Electrical Characteristics
Contact Arrangement - SPST NC
Contact Rating @ 28 Vdc -
0.25 Amp

Rated Operating Voltage - 28 Vdc
Sensing Current Rating - 6.25
Amps, continuous
Lamp Load - 0.080 Amp
Pickup Max. -
Q50BB - 2.5 Amps DC
Q50BD - 2.0 Amps DC
Q50E - 3.5 Amps DC
Dropout Min. -
Q50BD - 0.8 Amps DC
Q50BB - 1.0 Amps DC
Q50E - 1.4 Amps DC

General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Altitude, Max. - $50,000 \mathrm{ft}$
Weight, Max. - 1.2502

Circuit Configurations
(Consult factory for other available circuit configurations)


Circuit Configuration 1

Mounting Style A

|  | HARTMAN Part Number | Construction Type | Mounting Style | Coil <br> Type | Circuit Config. | TE Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Q-50BB | Environmentally Sealed | A | Continuous | 1 | 1616131-5 |
| For factory-direct application | Q-50E | Environmentally Sealed | A | Continuous | 1 | 1616131-8 |
| assistance, phone 419-521-9500 or fax 419-526-2749. | Q-50BD | Environmentally Sealed | A | Continuous | 1 | 1616131-6 |

## Product Facts <br> ■ SPST NO <br> ■ Environmentally sealed <br> - Meets many requirements of MIL-PRF-6106



## Performance Data

Electrical Characteristics
Contact Arrangement - SPST NO
Contact Rating @ 28 Vdc 0.25 Amp

Lamp Load @ 28 Vdc - 0.08 Amp
Rated Operating Voltage - 28 Vdc
Sensing Current Rating - 20 Amps, continuous, max.
Pickup Max. -
3.5 Amps DC

Dropout Min. - 0.5 Amp
General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Altitude, Max. - $50,000 \mathrm{ft}$
Weight, Max. - 1.2502



Mounting Style A

Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Duty <br> Cycle | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Q-50A | Environmentally <br> Sealed | A | Continuous | 1 | $1616131-1$ |

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## Q-50 Series Relay, Current Indicator, Rated up to 15 Amps, 28 Vdc

## Product Facts <br> ■ SPDT <br> ■ Environmentally sealed <br> - Meets many requirements of MIL-PRF-6106

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.


## Performance Data

## Electrical Characteristics

Contact Arrangement - SPDT
Contact Rating @ 28 Vdc 0.25 Amp

Lamp Load @ 28 Vdc 0.10 Amp

Rated Operating Voltage - 28 Vdc
Sensing Current Rating - 15 Amps
DC, continuous, max.
Pickup Max. -
3.2 Amps DC

Dropout Min. - 1.2 Amps
General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Altitude, Max. - $50,000 \mathrm{ft}$
Weight, Max. - 1.2502


Mounting Style A

Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Duty <br> Cycle | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Q-50CC | Environmentally <br> Sealed | A | Continuous | 1 | $1616131-7$ |

## Q-50 Series Relay, Current Indicator, Rated up to 16 Amps, 28 Vdc

## Product Facts <br> ■ SPST NC <br> ■ Environmentally sealed <br> - Meets many requirements of MIL-PRF-6106



Performance Data
Electrical Characteristics
Contact Arrangement -
Q50S - SPST NC
Q50Z - SPDT
Contact Rating @ 28 Vdc 0.25 Amp

Lamp Load @ 28 Vdc -
0.10 Amp

Rated Operating Voltage - 28 Vdc
Sensing Current Rating - 16 Amps
DC, continuous, max.
Pickup Max. - 3 Amps DC
Dropout Min. - 1.2 Amps
General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Altitude, Max. - $50,000 \mathrm{ft}$
Weight, Max. - 1.250 oz


Mounting Style A



Mounting Style B

$$
\text { Circuit Configuration } 1
$$

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Duty <br> Cycle | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Q-50S | Environmentally <br> Sealed | A | Continuous | 1 | $1-1616131-1$ |
| Q-50Z | Environmentally <br> Sealed | A | Continuous | 2 | $1-1616131-3$ |



For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## Product Facts

■ SPST NC or SPST NO
■ Environmentally sealed

- Meets many requirements of MIL-PRF-6106


Performance Data
Electrical Characteristics
Contact Arrangement SPST NC, SPST NO or SPDT
Contact Rating @ 28 Vdc -
Q-50AB-2 - 0.2 Amp
Q-50J, -0.25 Amp Q-50AG - 1.0 Amp
Q-50AB-1 — 1 Amp switching, and
2 Amps carry
Q50AC - 2 Amp
Lamp Load @ 28 Vdc -
Q-50AC, Q-50AB-2 - 0.08 Amp
Q-50J, Q-50AG - 0.20 Amp
Operating Voltage, Nom. - 28 Vdc
Sensing Current Rating -
20 Amps continuous, max. except for
Q-50AB-1 and Q-50AB-2 which are 10

| d 15 Amps max. for 3 sec | General Characteristics |
| :---: | :---: |
| Q50AC 2 Amps continuous 10 Amps max. for 5 seconds | Temperature Range -$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$ |
| Pickup Max. | Altitude, Max. - |
| Q-50AC - 0.3 Amp | Q-50J, Q-50AB-1-50,000 ft |
| Q-50AB-1, Q-50AB-2 - 1.5 Amp | Q-50AC, Q-50AG, Q-50AB-2 |
| Q-50J - 3.5 Amps DC | 60,000 ft |
| Q-50AG - 6 Amps DC $\pm 20 \%$ | Weight, Max. - 1.2502 |

Dropout Min. -
Q-50AC - 0.1 Amp
Q-50J - 0.5 Amp
Q-50AB-1, Q-50AB-2 - less than 1 Amp
Q-50AG - 2.4 Amp


Mounting Style A


Mounting Style B

For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749. to change.

## Q-50 Series Relay, Current Indicator, Rated up to 20 Amps, <br> 28 Vdc (Continued)

Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1


Circuit Configuration 2


Circuit Configuration 3

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Duty <br> Cycle | Circuit <br> Config. | Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Q-50J | Environmentally <br> Sealed | A | Continuous | 1 | $1-1616131-0$ |
| Q-50AC | Environmentally <br> Sealed | B | Continuous | 2 | $1616131-4$ |
| Q-50AG | Environmentally <br> Sealed | A | Continuous | 1 | $1616540-7$ |
| Q-50AB-1 | Environmentally <br> Sealed | A | Continuous | 1 | $1616131-2$ |
| Q-50AB-2 | Environmentally <br> Sealed | A | Continuous | 3 | $1616131-3$ |

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## QR-50 Series Relay, AC Current Indicator, Rated up to 5 Amps, 115 VAC

```
Product Facts
■ SPST NC
■ Environmentally sealed
- Meets many requirements of MIL-PRF-6106
```



## Performance Data

Electrical Characteristics
Contact Arrangement - SPST NC
Resistive Rating @ 28 Vdc -
25 Amp
Lamp Load @ 28 Vdc - . 10 Amp
Sensing Current Rating -
5 Amp, AC continuous
General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Altitude - $50,000 \mathrm{ft}$
Weight, Max. - 25 lbs
Operating Voltage, Nom. -
115 Vrms, $325-600 \mathrm{~Hz}$
Pickup Max. -
$95 \mathrm{MA}, \mathrm{AC}$
Dropout Min. -
47 MA AC


Mounting Style A

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Duty <br> Cycle | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| QR-50V | Environmentally |  |  |  |  |
| Sealed | A | Continuous | 1 | $1616132-3$ |  |

Circuit Configurations (Consult factory for other available circuit configurations)


## Product Facts <br> ■ SPDT <br> ■ Environmentally sealed <br> - Meets many requirements of MIL-PRF-6106

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## Performance Data

Electrical Characteristics
Contact Arrangement — SPDT
Resistive Rating @ 28 Vdc 25 Amp
Lamp Load @ 28 Vdc — . 08 Amp
Operating Voltage, Nom. -
115 VAC, 1 Phase, 400 Hz

## Pickup Max. -

6 Amp, AC
Dropout Min. -
2.4 Amp, AC

Sensing Current Rating -
15 Amp, AC Continuous

## General Characteristics

Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Altitude - $50,000 \mathrm{ft}$
Weight, Max. - . 19 lbs
Sinusoidal Vibration 10 G to 500 Hz


Mounting Style A

Circuit Configurations (Consult factory for other available circuit configurations)


| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Duty <br> Cycle | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| QR-50H | Environmentally <br> Sealed | A | Continuous | 1 | $1616132-1$ |

Product Facts<br>■ DPDT<br>■ Gasket sealed<br>- Meets many requirements of MIL-PRF-6106

Performance Data
Electrical Characteristics
Contact Arrangement - DPDT
Resistive Rating @ $28 \mathrm{Vdc}-$
10 Amps
Inductive Rating - 5 Amps
Lamp Load -1.5 Amps
Rated Operating Voltage, Nom. -
$115 \mathrm{~V}, 400 \mathrm{~Hz}$
Pickup Voltage
(All 3 Phases Up) — $85-90$ Volts
Dropout Voltage (3 Phase -
Lowest of 3 ) $-75-80$ Volts

Circuit Configurations
(Consult factory for other available circuit configurations)


Circuit Configuration 1

## General Characteristics

Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+71^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. -
10,000 cycles
Weight, Max. - 100 oz.
Operating Voltage, Max. 124 VAC


HARTMAN Sensors and Protective Devices
For factory-direct application
assistance, phone 419-521-9500 or

For factory-direct application ssistance, phone 419-521-9500 or fax 419-526-2749.

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Duty <br> Cycle | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| E-316C | Gasket/Vented | A | Continuous | 1 | $1-1616126-4$ |

## Product Facts <br> ■ 2PDT <br> ■ Solder sealed, hermetically sealed <br> - Meets many requirements of MIL-PRF-6106

## E-311PB Series Relay, Undervoltage with Time Delay

## Performance Data

Electrical Characteristics
Main Contacts -
Contact Arrangement - 2PDT
Operating Voltage, Nom. - 28 Vdc
Resistive Rating - 10 Amps
Inductive Rating - 6 Amps
Motor Rating - 3 Amps
Lamp Rating - 1 Amps
Pickup Time, Max. - 125 msec
Contact Bounce, Max. - 3 msec
Operating Voltage, Max. - 36 Vdc
Operating Voltage, Nom. - 28 Vdc
Pickup Voltage - $24.5 \pm 0.5 \mathrm{Vdc}$
Dropout Voltage - $21.5 \pm 0.5 \mathrm{Vdc}$
Dropout Time Delay - 200-400
mill liseconds when the relay is in the energized position and the voltage drops below $21.5 \pm 0.5 \mathrm{Vdc}$ and above 15 Vdc .
The relay will remain energized for 200 to 400 milliseconds before de-energizing when the voltage drops below 15
Vdc. Time delay is 30 Ms max.
Operating Current, Max.
@ $25^{\circ} \mathrm{C}$ - 150 milliamp

## General Characteristics

Ambient Temperature Range -$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. -
100,000 cycles
Dielectric Withstanding Voltage -
1,000 Vrms, $60 \mathrm{~Hz}, 1$ mil/Amp max. leakage
Insulation Resistance @
500 Vdc - 100 megohm min.
Altitude - $80,000 \mathrm{ft}$
Weight, Max. - . 25 lbs
Sinusoidal Vibration -
060 DA @ 5 to 80 Hz
20 G TM 80 to 2000 Hz
Shock for 11 msec, $1 / 2$ Sine, 3
Axes - 30 G


Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Duty <br> Cycle | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| E-311PB | Hermetically Sealed | A | Continuous | 1 | $1-1616126-1$ |

For additional support numbers please visit www.te.com

## E-329 Series Relay, Voltage Sensing

## Product Facts <br> ■ 3PDT <br> ■ Solder sealed cover, hermetically sealed contacts <br> ■ Meets many requirements of MIL-PRF-6106



## Performance Data

Electrical Characteristics
Contact Arrangement - 3PDT
Rated Operating Voltage 28 Vdc , and 155 Vac 400 Hz
Resistive Rating - 10 Amps
Inductive Rating - 8 Amps
Motor Rating - 4 Amps
Lamp Rating - 2 Amps
Pickup Time, Max. - 70 msec
Contact Bounce, Max. - 3 msec
Dropout Time Delay -
200-400 msec when the relay is in the energized position and the voltage drops below $104 \pm 2$ Vrms and above $88 \pm 4$ Vrms. The relay will remain energized for 200-400 msec before deenergizing. When the voltage drops below $88 \pm 4$ Vrms no time delay is required. When the voltage drops to 30 volts or less the relay will de-energize 50 msec max.
Operating Voltage, Nom. 115 VAC, RMS L-N Operating Voltage, Max. 122 VAC, RMS L-N
Operating Frequency - $400 \pm 20 \mathrm{~Hz}$
Pickup Voltage - $109 \pm 2$ Vrms
Dropout Voltage - $104 \pm 2$ Vrms
Operating Current, Max. @ $25^{\circ} \mathrm{C}$ 100 milliamp

## General Characteristics

Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Resistive Load, Min. -
100,000 cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Dielectric Withstanding Voltage -
1,000 Vrms, 60 Hz
nsulation Resistance @ 500 Vdc -
1,000 megohm min.
Altitude - 0-80,000 ft
Weight, Max. - 1002
Shock for 11 msec, 1/2 Sine, 3 Axis - 30 G


Circuit Configurations (Consult factory for other available circuit configurations)


For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Duty <br> Cycle | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| E-329E | Hermetically Sealed | A | Continuous | 1 | $1-1616126-9$ | to change.

## RA-3100 Series Remote Power Controller, Rated up to 60 Amps, 115/208 VAC

Product Facts<br>■ 3PST NO<br>■ Gasket sealed

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.


## Performance Data

Electrical Characteristics Contact Arrangement - 3PST N0 Rated Operating Voltage $115 / 208 \mathrm{VAC}, 400-610 \mathrm{~Hz}, 3$ phase
Resistive Rating - 50 Amp
Motor Rating - 30 Amp
Rupture Rating - 1000 Amp Closing Time, Max., Override at $28 \mathrm{Vdc}-35 \mathrm{msec}$
Opening Time, Max., Override at $28 \mathrm{Vdc}-25 \mathrm{msec}$
Contact Bounce, Max. - 3 msec
Coil Characteristics
Duty Cycle - Continuous,
economizing
Operating Voltage, Max. - 32 Vdc
Operating Voltage @ $85^{\circ} \mathrm{C}$, Min. 18 Vdc
Trip Time @ 60 Amp Current $+\mathbf{1 0 \%}$ - 2.0 to 3.0 sec
Trip Time @ 75 Amp Current +10\% -1.0 to 1.9 sec
Trip Time @ 95 Amp Current +10\% —. 2 to .9 sec
Trip Time @ 200+ Amp Current $+10 \%$ - 0.01 to 0.1 sec

## General Characteristics

Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Altitude - 50,000 ft
Weight, Max. - 1.55 lbs


Circuit Configurations (Consult factory for other available circuit configurations)


| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> RA-3100H |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Gasket/Vented | A | Continuous, <br> Economizing | 1 | $1616539-3$ |  |

## RA-3100 Series Remote Power Controller, Rated up to 70 Amps, 115/208 VAC

Product Facts<br>■ 3PST NO<br>■ Gasket sealed



## Performance Data

Electrical Characteristics
Contact Arrangement - 3PST NO
Rated Operating Voltage -
115/208 VAC, $400-610 \mathrm{~Hz}, 3$ phase
Resistive Rating - 70 Amp
Motor Rating - 70 Amp
Rupture Rating - 1,000 Amp
Coil Characteristics
Duty Cycle - Continuous,
economizing
Operating Voltage, Max. - 32 Vdc
Operating Voltage @ $85^{\circ} \mathrm{C}$, Min. 18 Vdc
Trip Time @ 70 Amp Current $+10 \%$ - 3.0 to 5.0 sec
Trip Time @ 87 Amp Current +10\% - 2.0 to 2.9 sec

Trip Time @ 111 Amp Current $+\mathbf{1 0 \%}$ - 1.0 to 1.8 sec
Trip Time @ 200 Amp Current $+\mathbf{1 0 \%}$ - 0.25 to 0.5 sec

## General Characteristics

Operating Temperature Range -$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Altitude - $50,000 \mathrm{ft}$ max.
Weight, Max. -1.55 lb
Sinusoidal Vibration -
038 DA from 10 to 50 Hz
10 g from 55 to 2000 Hz
Shock, Max. - 9 G max for 10-12 ms
Load, Min. - 50,000 cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles


NOTE: FOR PROPER OPERATION, PIN A
RECUIRES 18 TO 28 VDC


Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| RA-3100F | Gasket/Vented | A | Continuous, <br> Economizing | 1 | $1616133-2$ |

## RA-3100 Series Remote Power Controller, Rated up to 100 Amps, 115/208 VAC

## Product Facts

■ 3PST NO
■ Gasket sealed
■ Auxiliary contacts available
■ Meets many requirements of MIL-PRF-6106

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.

## Performance Data

Electrical Characteristics
Contact Arrangement - 3PST NO
Rated Operating Voltage -
115/208 VAC, $400-610 \mathrm{~Hz}, 3$ phase
Resistive Rating - 100 Amp
Motor Rating - 100 Amp
Rupture Rating - 1,000 Amp
Closing Time, Max., at 28 Vdc 35 msec
Opening Time, Max., at 28 Vdc 25 msec
Contact Bounce, Max. - 3 msec
Coil Characteristics
Duty Cycle - Continuous,
economizing
Operating Voltage, Max. - 32 Vdc
Operating Voltage @ $85^{\circ} \mathrm{C}$, Min. 18 Vdc
Coil Current, Inrush Max.@ $25^{\circ} \mathrm{C}$ -
6. 0 Amps

Coil Current, Hold Max.@ $25^{\circ} \mathrm{C}$ 0.5 Amps

Trip Time @ 28 Amp Current $+10 \%$ -
RA-3100M - 1.0 to 1.50 sec
Trip Time @ 151 Amp Current 10\% —RA-3100D - 3.0 to 5.0 Sec .
Trip Time @ 185 Amp Current $10 \%$-RA-3100D - 2 to 2.9 Sec
Trip Time @ 237 Amp Current $+10 \%$-RA-3100D - 1 to 2.5 Sec .
General Characteristics
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated Load, Min. - 50,000 cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Altitude - $50,000 \mathrm{ft}$
Weight, Max. -1.55 lbs

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> RA-3100D |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Gasket/Vented | A | Continuous, <br> Economizing | 1 | $1616133-1$ |  |
| RA-3100M | Gasket/Vented | A | Continuous, <br> Economizing | 1 | $1616133-5$ |



NOTE: FOR PROPER OPERRTION, PIN A


Mounting Style A
Circuit Configurations (Consult factory for other available circuit configurations)


Circuit Configuration 1

## RA-3100 Series Remote Power Controller, Rated up to 110 Amps, 115/208 VAC

```
Product Facts
■ 3PST NO
■ Gasket sealed
- Auxiliary contacts available
- Meets many requirements of MIL-PRF-6106
```


## Performance Data

Electrical Characteristics
Contact Arrangement - 3PST NO
Rated Operating Voltage -
115/208 VAC, 400-610 Hz, 3 phase
Resistive Rating -
RA-3100J-1 - 110 Amp
RA-3100L - 50 Amp

## Motor Rating -

RA-3100J01-110 Amp
RA-3100L - 50 Amp
Rupture Rating -
RA-3100J-1-1,100 Amp
RA-3100L 500 Amp
Shock for 10-12 msec - 50 G
Closing Time, Max., Override at $28 \mathrm{Vdc}-35 \mathrm{msec}$
Opening Time, Max., Override at $28 \mathrm{Vdc}-25 \mathrm{msec}$
Contact Bounce, Max. - 3 msec
Coil Characteristics
Duty Cycle - Continuous,
economizing
Operating Voltage, Max. - 32 Vdc
Operating Voltage @ $85^{\circ} \mathrm{C}$, Min. 18 Vdc
Coil Current, Inrush Max.@ $25^{\circ} \mathrm{C}$ -
6.0 Amps

Coil Current, Hold Max.@ $25^{\circ} \mathrm{C}$ 0.5 Amps

Trip Time @ 165 Amp Current
$+\mathbf{1 0 \%}$ - 8.0 to 10.0 sec
Trip Time @ 330 Amp Current $+10 \%$ -
RA-3100J-1-1.2 to 2.0 sec
Trip Time @ 550 Amp Current $+10 \%$ -
RA-3100J-1 -0.34 to 0.65 sec
Trip Time @ 1100 Amp Current $+10 \%$ -
RA-3100J-1 -0.07 to 0.20 sec

For factory-direct application assistance, phone 419-521-9500 or fax 419-526-2749.


Trip Time @ 60 Amp Current $+10 \%$ -

RA-3100L - 8.0 to 10.0 sec
Trip Time @ 150 Amp Current $+10 \%$ -

RA-3100L - 4.0 to 6.0 sec
Trip Time @ 300 Amp Current $+10 \%$ -

RA-3100L - 2.0 to 3.0 sec
Trip Time @ 500 Amp Current $+10 \%$ -
RA-3100L - 0.07 to 0.20 sec

## General Characteristics

Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Operating Cycles (Life) at Rated
Load, Min. - 50,000 cycles
Operating Cycles (Life)
Mechanical, Min. - 100,000 cycles
Altitude - $60,000 \mathrm{ft}$
Weight, Max. -1.55 lbs


NOTE: FOR PROPER OPERATION. PIN A
REQUIRES 18 TO 28 VDC


Circuit Configurations (Consult factory for other available circuit configurations)

| Catalog 5-1773450-5 | Dimensions are shown for <br> reference purposes only. |
| :--- | :--- |
| Revised 3-13 | Specifications subject <br> to change. |
| www.te.com |  |

## Product Facts

- DPDT
- Gasket sealed
- Meets many requirements of MIL-PRF-6106

| Performance Data | General Characteristics |
| :---: | :---: |
| Electrical Characteristics <br> Contact Arrangement - DPDT <br> Operating Voltage, Nom. - 28 Vdc <br> Resistive Rating - 10 Amps <br> Inductive Rating - 2 Amps | Operating Ambient Temperature Range $--55^{\circ} \mathrm{F}$ to $+165^{\circ} \mathrm{F}$ |
|  | Altitude - 50,000 tt |
|  | Weight, Max. - 15.502 |
|  | Coil Characteristics |
|  | Duty Cycle - Continuous Input to Sensor, Nom. $120 \mathrm{~V}, 400 \mathrm{~Hz}$ |
|  | Operating Characteristic Contacts A1-A2, B1-B2 will close if the AC input voltage is above $106 \pm 2$ VAC Contacts A1-A2, B1-B2 will open if the AC input voltage falls below $106 \pm$ 2 VAC . |



Mounting Style A

For factory-direct application

| HARTMAN <br> Part Number | Construction <br> Type | Mounting <br> Style | Coil <br> Type | Circuit <br> Config. | TE <br> Part Number |
| :---: | :---: | :---: | :---: | :---: | :---: |
| E-308TA | Gasket/Vented | A | Continuous | 1 | $1616126-6$ |

assistance, phone 419-521-9500 or fax 419-526-2749.

## Cross Reference



For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.

| Cross Reference (Continued) |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Main Current Rating | AC/DC | Rating | Main <br> Contact Config. | Operating Mode | Aux. <br> Contact Config. | Coil Voltage (VDC) | Seal <br> Type | Coil Trans. Voltage | Hartman Part No. | $\begin{gathered} \text { TE } \\ \text { Part No. } \end{gathered}$ |
| 100 | AC | 115/208 | 3PST NO | Side Stable | SPDT | 18-32 | Gasket/Vented | Cont. Econ. | RA-3100M | 1616133-5 |
|  |  | 115/208 | 3PST NO | Side Stable | SPDT | 18-32 | Gasket/Vented | Cont. Econ. | RA-3100D | 1616133-1 |
| 110 | AC | 115/208 | 3PST NO | Side Stable | SPDT | 18-32 | Gasket/Vented | Cont. Econ. | RA-3100J-1 | 1616133-3 |
| 50 | AC | 115/208 | 3PST NO | Side Stable | SPDT | 18-32 | Gasket/Vented | Cont. Econ. | RA-3100L | 1616133-4 |
| 60 | AC | 115/208 | 3PST NO | Side Stable | SPDT | 18-32 | Gasket/Vented | Cont. Econ. | RA-3100H | 1616539-3 |
| 70 | AC | 115/208 | 3PST NO | Side Stable | SPDT | 18-32 | Gasket/Vented | Cont. Econ. | RA-3100F | 1616133-2 |
| 10 | DC | 28 | DPDT | Side Stable | - | 120 V | Gasket/Vented | Cont. | E-308TA | 1616126-6 |

For factory-direct application
assistance, phone 419-521-9500 or
fax 419-526-2749.
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## KILOVAC High Voltage DC Contactors Quick Reference Guide

| Product Series | (MAP) Aerospace Military |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | MAP101 | MAP100 | MAP200 | MAP201 |
| Main Contact Data |  |  |  |  |  |
| Continuous Current | A | 100 | 100 | 500 | 350 |
| Contact Voltage Range | Vdc | 12-900 | 12-900 | 12-900 | 12-900 |
| Electrical Life at Rated Current, 270 Vdc, Resistive Load | Cycles | 25,000 | 15,000 | 1,000 | 5,000 |
| Overload (Make/Break) @ 350 Vdc | A | 2,000/2,000 | 500/1,500 | 650/2,000 | 2,000/2,000 |
| Rupture (Break only) @ 350 Vdc | A | 2,000 | 1,500 | 2,000 | 2,000 |
| Contact Arrangement |  | SPST | SPST | SPST | SPST |
| Contact Form |  | Latch | X (NO) or Latch | X (NO) | X (NO) |
| Contact Resistance @ Rated Current | milliohms | 0.75 | 0.5 | 0.2 | 0.3 |
| Auxiliary Contact Data |  |  |  |  |  |
| Contact Form/Quantity of Sets (Max.) |  | Form A/1 | Form A/1 | Form A/1 | Form A/1 |
| Current Rating @ 30 Vdc (Ag/Au), Max. | A | 2.0/0.1 | 2.0/0.1 | 2.0/0.1 | 2.0/0.1 |
| Minimum Signal Level | Vdc/mAdc | Ag 6V/15mA $\mathrm{Au} 5 \mathrm{~V} / 5 \mathrm{~mA}$ | Ag 6V/15mA $\mathrm{Au} 5 \mathrm{~V} / 5 \mathrm{~mA}$ | Ag 6V/15mA $\mathrm{Au} 5 \mathrm{~V} / 5 \mathrm{~mA}$ | Ag 6V/15mA $\mathrm{Au} 5 \mathrm{~V} / 5 \mathrm{~mA}$ |
| Dielectric Withstanding Voltage |  |  |  |  |  |
| Contacts to Coil to All Other Points | Vrms | 1,500 | 1,500 | 2,200 | 2,200 |
| Insulation Resistance |  |  |  |  |  |
| Initially @ 500 Vdc | megohms | 100 | 100 | 100 | 100 |
| At End of Life @ 500 Vdc | megohms | 50 | 50 | 50 | 50 |
| Environmental Data |  |  |  |  |  |
| Operating Temperature Range | ${ }^{\circ} \mathrm{C}$ | -55 to +85 | -55 to +85 | -55 to +85 | -55 to +85 |
| Storage Temperature Range | ${ }^{\circ} \mathrm{C}$ | -65 to +125 | -65 to +125 | -65 to +125 | -65 to +125 |
| Shock, 11 ms , $1 / 2$ Sine | G's | 20 | 20 | 20 | 20 |
| Vibration, Sine ( $55-2,000 \mathrm{~Hz}$ ) | G's | 20 | 20 | 20 | 20 |
| Coil Transient Suppression |  | No | X, Yes/Latch, No | Yes | Yes |
| Mechanical Data |  |  |  |  |  |
| Operate Time @ $25^{\circ} \mathrm{C}$ (Including Bounce), Max./Typ. | ms | 40/20 | 40/20 | 40/20 | 40/20 |
| Release Time, Max. | ms | 15 | 15 | 15 | 15 |
| Bounce Time, Max. | ms | 5 | 5 | 5 | 5 |
| Mechanical Life, Min. | Cycles | 100,000 | 100,000 | 100,000 | 100,000 |
| Weight (Nominal) | lb. (kg) | 0.79 (.35) | 0.79 (.35) | 0.95 (.43) | 0.95 (.43) |
| Coil Voltage (Nominal) | Vdc | 28 | 28 | 28 | 28 |

Note: Consult TE Connectivity for complete specifications, detailed performance characteristics and additional models.

For factory-direct application assistance,
dial 800-253-4560, ext. 2055, or
805-220-2055.

Dimensions are shown for
reference purposes only.
Specifications subject
to change.

KILOVAC High Voltage DC Contactors
KILOVAC High Voltage DC Contactors Quick Reference Guide (Continued)

| (CAP)Aerospace Commercial |  |  | $(\mathrm{EV})$OEM/Commercial \&Electric Vehicle |  |  |  | (LEV)Industrial Commercial |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| CAP202 | CAP200 | CAP100 | EV200A | EV200B | EV200P | EV100 | LEV100 | LEV200 |
| 300 | 500 | 100 | 500 | 500 | 500 | 100 | 100 | 500 |
| 12-900 | 12-900 | 12-900 | 12-900 | 12-900 | 12-900 | 12-900 | 900 | 12-900 |
| 10,000 | 1,000 | 6,000 | 1,000 | 500 | 500 | 6,000 | 6,000 | 1,000 |
| 650/2,000 | 650/2,000 | 600/1000 | 650/2000 | 650/1000 | 650/1000 | 600/1000 | 600/1000 | 650/2000 |
| 2,000 | 2,000 | 1000 | 2000 | 1000 | 1000 | 1000 | 1000 | 1000 |
| DPST | SPST | SPST | SPST | SPST | SPST | SPST | SPST | SPST |
| 2X (NO) | X (NO) | X ( NO ) | X(NO) | Y(NC) | X (LATCH) | X(NO) | X(NO) | X(NO) |
| 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Form C/4 | Form A/2 | Form C/1 | Form A/1 | Form A/1 | Form A/1 | None | Form X/1 | Form X/1 |
| 2.0/0.1 | 2.0/0.1 | 2.0/0.1 | 2.0/0.1 | 2.0/0.1 | 2.0/0.1 | 2.0/0.1 | 2.0/0.1 | 2.0/0.1 |
| Ag 6V/15mA $\mathrm{Au} 5 \mathrm{~V} / 5 \mathrm{~mA}$ | $\mathrm{Ag} 6 \mathrm{~V} / 15 \mathrm{~mA}$ $\mathrm{Au} 5 \mathrm{~V} / 5 \mathrm{~mA}$ | Ag 6V/15mA Au 5V/5mA | $\mathrm{Ag} 6 \mathrm{~V} / 15 \mathrm{~mA}$ Au 5V/5mA | $\mathrm{Ag} 6 \mathrm{~V} / 15 \mathrm{~mA}$ $\mathrm{Au} 5 \mathrm{~V} / 5 \mathrm{~mA}$ | $\mathrm{Ag} 6 \mathrm{~V} / 15 \mathrm{~mA}$ $\mathrm{Au} 5 \mathrm{~V} / 5 \mathrm{~mA}$ | - | - | Ag 6V/15mA $\mathrm{Au} 5 \mathrm{~V} / 5 \mathrm{~mA}$ |
| 2,200 | 2,200 | 2,200 | 2,200 | 2,200 | 2,200 | 2,200 | 2,000 | 2,200 |
| 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| -55 to +85 | -55 to +85 | -55 to +85 | -40 to +85 | -40 to +60 | -40 to +85 | -40 to +85 | -40 to +85 | -40 to +85 |
| -65 to +125 | -65 to +125 | -65 to +125 | -65 to +125 | -65 to +125 | -65 to +125 | -65 to +125 | -65 to +125 | -65 to +125 |
| 30 | 20 | 20 | 20 | $\begin{gathered} 30 \text { (Closed)/ } \\ 10 \text { (Open) } \\ \hline \end{gathered}$ | 30 | 20 | 20 | 20 |
| 20 | 20 | 20 | 20 | 10 | 20 | 20 | 20 | 20 |
| Yes | Yes | Yes | Yes | Yes | No | Yes | No | No |
| 40/20 | 40/20 | 25/15 | 25/15 | 25/15 | 25/15 | 25/15 | 25/15 | 25 |
| 15 | 15 | 10 | 12 | 15 | 15 | 15 | 10 | 15 |
| 5 | 5 | 5 | 7 | 5 | 5 | 5 | 5 | 5 |
| 100,000 | 100,000 | 100,000 | 1,000,000 | 100,000 | 100,000 | 1,000,000 | 1,000,000 | 100,000 |
| 1.3 (.59) | 0.95 (.43) | 6.70 (190) | 0.95 (.43) | 0.95 (.43) | . 99 (.53) | . 28 (.130) | 0.42 (.19) | 1.3 (.60) |
| 28 | 28 | 28 | 9-36 | 12/24 | 12/24 | 9-36 | 12/24/48 | 12/24/48 |

805-220-2055.

## Product Facts

- Dual contact material (copper/moly) designed for high current make and interrupt military aerospace, ground vehicle and naval applications
■ Hermetically sealed, intrinsically safe, operates in explosive/harsh environments with no oxidation or contamination of coils or contacts, during long periods of nonoperation
■ Comes standard with 1 SPST-NO Aux. contact

■ Not position sensitive, can be mounted in any orientation
■ RoHS versions available

## KILOVAC MAP101 Series Contactor with 1 Form A (SPST-NO) Contacts Rated up to 100 Amps, 12-900 Vdc Dual Contact Material (Cu/Mo)

## Coil Data

Coil Voltage, Nominal/ Max 28/ 32 Vdc
Coil Resistance @ $25^{\circ} \mathrm{C}$ -
Contacts Close Coil - $18 \Omega$
Contacts Open Coil - $13 \Omega$
Pick Up/ Drop Out (Max) -
$16 \operatorname{Vdc}\left(-55^{\circ} \mathrm{C}\right.$ to $\left.+25^{\circ} \mathrm{C}\right)$
$18 \mathrm{Vdc}\left(+25^{\circ} \mathrm{C}\right.$ to $\left.+85^{\circ} \mathrm{C}\right)$
Coil Current (Max) @ 32Vdc/
$-40^{\circ} \mathrm{C}-4.0 \mathrm{~A}$
Coil Current On Time (Minimum
Required to Latch) - 40 ms
Main Contacts -
Operate Time (Max) — 40 ms
Operate Bounce (Max) - 5 ms
Release Time - 25 ms
Auxiliary Contacts Operate/
Release -Within $\pm 5 \mathrm{~ms}$ of main

Physical Data
Contact Arrangement -
Main Contacts -
SPST-Latching (form X)
1X Auxiliary Contact -SPST-NO (form A)
Dimensions - See drawing
Weight, Nominal -
0.35 Kg (12.35 oz)

## Environmental Data

Shock, 11ms $1 / 2$ Sine
(Operating) - $20 \mathrm{G}_{\text {peak }}$
Sine Vibration, 20 Gpeak -$55-2000 \mathrm{~Hz}$
Random Vibration, 14.06 Grms $15 \mathrm{~Hz}(.002 \mathrm{G} 2 / \mathrm{Hz}), 100 \mathrm{~Hz}(.002 \mathrm{G} / \mathrm{Hz})$, $450 \mathrm{~Hz}(.12 \mathrm{G} / \mathrm{Hz}), 900 \mathrm{~Hz}(.12 \mathrm{G} / \mathrm{Hz})$, $2000 \mathrm{~Hz}(.083 \mathrm{G} 2 / \mathrm{Hz}$ )
Operating Temperature Range -$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$

## Electrical Data

Voltage Rating -
Main Contacts (max) — 400 Vdc
Auxiliary Contacts - 30 Vdc
Current Rating, Continuous -
Main Contacts 1 - 100 A
Auxiliary Contacts - 3 A
Contact Resistance -
Main Contacts -
$100 \mathrm{~m} \Omega$ max @ 1 amp
$0.75 \mathrm{~m} \Omega \mathrm{max} @$ rated current
Auxiliary Contacts -
$200 \mathrm{~m} \Omega$ max
Electric Life at Rated Current 270
Vdc, Resistive Load -
25,000 cycles
Mechanical Life - 1 million cycles
Dielectric Withstand Voltage -
Terminal to Terminal/ Terminals to Coil 1 mA max @ 1,300Vrms

Insulation Resistance -
Terminal to Terminal/ Terminals to Coil -
$100 \mathrm{M} \Omega$ min @ 500Vdc new
$50 \mathrm{M} \Omega$ min @ 500 Vdc end of life
Note:
${ }^{1}$ Continuous current rating is affected by conductors attached. Keep terminals below $150^{\circ} \mathrm{C}$ max continuous.

Ordering Information


For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

## KILOVAC MAP101 Series Contactor (Continued)

## Outline Dimensions



Connector Pin-Out

| 1 | Not Connected |
| :---: | :--- |
| 2 | Aux. NO |
| 3 | Close Return |
| 4 | Close Return |
| 5 | +28 Vdc |
| 6 | Aux. Com. |
| 7 | Open Return |
| 8 | Open Return |
| 9 | +28 V |



For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

## Product Facts

- Solid copper contacts designed for high current carry military aerospace, ground vehicle and naval applications
■ Hermetically sealed, intrinsically safe, operates in explosive/harsh environments with no contact oxidation or contamination of coil or contacts, during long periods of non- operation

■ Comes standard with 1 SPST-NO Aux. contact

- Not position sensitive, can be mounted in any orientation

■ RoHS versions available

## KILOVAC MAP100 Series Contactor with 1 Form A (SPST-NO) Contacts Rated up to 100 Amps, 12-900 Vdc



Physical Data
Contact Arrangement -
Main Contacts -
SPST-Latching (or NO Form X)
1X Auxiliary Contact -
SPST-NO (form A)
Dimensions - See drawing
Weight, Nominal -
0.35 Kg (12.35 oz)

## Environmental Data

Shock, 11ms $1 / 2$ Sine
(Operating) - $20 \mathrm{G}_{\text {peak }}$
Sine Vibration, 20 Gpeak -$55-2000 \mathrm{~Hz}$
Random Vibration, 14.06 Grms $15 \mathrm{~Hz}(.002 \mathrm{G} 2 / \mathrm{Hz}), 100 \mathrm{~Hz}(.002 \mathrm{G} 2 / \mathrm{Hz})$, $450 \mathrm{~Hz}(.12 \mathrm{G} / \mathrm{Hz}), 900 \mathrm{~Hz}(.12 \mathrm{G} / \mathrm{Hz})$, $2000 \mathrm{~Hz}(.083 \mathrm{G} 2 / \mathrm{Hz}$ )
Operating Temperature Range -$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$

## Electrical Data

Voltage Rating -
Main Contacts (max) — 400 Vdc
Auxiliary Contacts - 30 Vdc
Current Rating, Continuous -
Main Contacts 1 - 100 A
Auxiliary Contacts - 3 A
Contact Resistance -
Main Contacts -
$100 \mathrm{~m} \Omega$ max @ 1 amp
$0.75 \mathrm{~m} \Omega$ max @ rated current
Auxiliary Contacts -
$200 \mathrm{~m} \Omega$ max
Electrical Life at Rated Current, 270 Vdc, Resistive Load 15,000 cycles
Mechanical Life - 1 million cycles
Dielectric Withstand Voltage -
Terminal to Terminal/ Terminals to Coil 1 mA max @ 1,300Vrms

## Coil Data

Coil Voltage, Nominal/ Max 28/ 32 Vdc
Coil Resistance @ $25^{\circ} \mathrm{C}$ -
Contacts Close Coil - $18 \Omega$
Contacts Open Coil - $13 \Omega$
Pick Up/ Drop Out (Max) -
$16 \operatorname{Vdc}\left(-55^{\circ} \mathrm{C}\right.$ to $\left.+25^{\circ} \mathrm{C}\right)$
$18 \mathrm{Vdc}\left(+25^{\circ} \mathrm{C}\right.$ to $\left.+85^{\circ} \mathrm{C}\right)$
Coil Current (Max) @ 32Vdc/
$-40^{\circ} \mathrm{C}-4.0 \mathrm{~A}$
Coil Current On Time (Minimum
Required to Latch) - 40 ms
Main Contacts -
Operate Time (Max) — 40 ms
Operate Bounce (Max) - 5 ms
Release Time - 25 ms
Auxiliary Contacts Operate/
Release -Within $\pm 5 \mathrm{~ms}$ of main

Insulation Resistance -
Terminal to Terminal/ Terminals to Coil -
$100 \mathrm{M} \Omega$ min @ 500 Vdc new
$50 \mathrm{M} \Omega$ min @ 500 Vdc end of life
Note:
1 Continuous current rating is
affected by conductors attached.
Keep terminals below $150^{\circ} \mathrm{C}$ max continuous.

Ordering Information
$\mathrm{E}=$ side mount with $2 x \# 8$
10-32 Female Power Terminals


For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

## KILOVAC MAP100 Series Contactor (Continued)

## Outline Dimensions



Connector Pin-Out

| 1 | Not Connected |
| :--- | :--- |
| 2 | Aux. NO |
| 3 | Close Return |
| 4 | Close Return |
| 5 | +28 Vdc |
| 6 | Aux. Com. |
| 7 | Open Return |
| 8 | Open Return |
| 9 | +28 V |



For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

## KILOVAC MAP200 Series Contactor with 1 Form A (SPST-NO) Contacts Rated up to 500 Amps, 12-900 Vdc

## Product Facts

■ Designed to be the smallest, lightest weight, lowest cost sealed contactor in the industry with its current rating for military aerospace, ground vehicle and naval, high current applications

■ Built-in coil economizer (models requiring external economizer also available)
■ Optional auxiliary contact for easy monitoring of power contact position

■ Hermetically sealed intrinsically safe, operates in explosive/harsh environments with no oxidation or contamination of coil or contacts, including long periods of nonoperation
■ Versatile coil and power connections
■ RoHS versions available

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055


## Performance Data

Contact Arrangement, Power
Contacts - 1 Form A (SPST-NO)
Rated Operating Voltage -12-900 VDC
Continuous (Carry) Current,
Typical — $500 \mathrm{~A} @ 85^{\circ} \mathrm{C}, 400 \mathrm{mcm}$ conductors
Consult Factory for required conductors
for higher currents
Make/Break Current at Various
Voltages 1 - See graph next page
Break Current at 320VDC 1 -
2,000 A, 1 cycle
Contact Resistance, Typ.
(@200A) - 0.2 mohms
Load Life - See graph next page
Mechanical Life - 1 million cycles
Contact Arrangement, Auxiliary
Contacts - 1 Form A (SPST-NO)
Aux. Contact Current, Max. -
2A @ 30VDC / 3A @ 125VAC
Aux. Contact Current, Min. 100mA @ 8V
Aux. Contact Resistance, Max. -
0.417 ohms @ 30VDC /

150 ohms @ 125VAC
Dielectric Withstanding Voltage -
2,200 Vrms @ sea level
Insulation Resistance @ 500VDC -
100 megohms ${ }^{2}$
Shock, 11ms 1/2 Sine, Peak,
Operating - 20 G
Vibration, Sine, $50-2000 \mathrm{~Hz}$.,
Peak - 20 G
Operating Temperature -
$55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Weight, Nominal — . 95 lb . (. 43 kg )
Notes:
1 Main power contacts
250 at end of life

| Coil Operating Voltage (Valid Over Temperature Range) |  |
| :--- | :---: |
| Voltage (Will Operate) | $18-32 \mathrm{VDC}$ |
| Voltage (Max.) | 32VDC |
| Pickup (Close) Voltage Max. | 18 VDC |
| Hold Voltage (Min.) | 10 VDC |
| Dropout (Open) Voltage (Min.) | 2 VDC |
| Inrush Current (Max.) | 4.5 A |
| Holding Current (Avg.) | 0.5 A |
| Inrush Time (Max.) | 100 ms |

## Ordering Information



Coil Voltage:
R = 28 Vdc , Mechanical Economizer
S $=28 \mathrm{Vdc}$, Electrical Cut-throat Economizer
Coil Wire Length: $\qquad$
A $=15.3$ in ( 390 mm )
D = Coil connector on relay (requires option "E" or " $X$ " in next step).

Coil Terminal Connector: $\qquad$
$\mathrm{N}=$ No connector
$E=9$-pin subminiature " $D$ " plug mounted on contactor housing
X = Special configuration (consult factory)
Mounting \& Power Terminals: $\qquad$
A = Bottom Mount \& Male M8 x 1.25 Thread Terminals
B = Bottom Mount \& Female 1/4-20 Thread Terminals
D = Bottom Mount \& Female M6 x 1 Thread Terminals

## KILOVAC MAP200 Series (Continued)

## Outline Dimensions



MAP200HR D-Sub
Pin Out
Coil+ = Pin 2
Coil - = Pin 6
Aux. COM $=$ Pin 8
Aux. $\mathrm{NO}=\operatorname{Pin} 4$
MAP200AR
Coil+ $=$ Pin 2
Coil $-=$ Pin 6

Estimated Make \& Break Power Switching Ratings


NOTES:

1) For resistive loads with 300 HH maximum inductance. Consult factory for inductive loads.
2) Estimates based on extrapolated data. User is encouraged to confirm performance in application.
3) End of life when dielectric strength between terminals falls below 50 megohms @ 500 VDC .
4) The maximum make current is 650 A to avoid contact welding.

For factory-direct application assistance,
dial 800-253-4560, ext. 2055, or
805-220-2055.

## KILOVAC MAP201 Series Contactor with 2 Form A (SPST-NO) Contacts Rated up to $350 \mathrm{Amps}, 12-900$ Vdc Dual Contact Material (Cu/Mo)

## Product Facts

■ Designed to be the smallest, lightest weight, lowest cost sealed contactor in the industry with its current rating for military aerospace
■ Built-in coil economizer (models requiring external economizer also available)
■ Optional auxiliary contact for easy monitoring of power contact position
■ Hermetically sealed intrinsically safe, operates in explosive/harsh environments with no oxidation or contamination of coil or contacts, including long periods of non-operation

- Versatile coil and power connections

■ RoHS versions available

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.


## Coil Data

Coil Voltage, Nominal/ Max 28/ 32 Vdc
Pick Up (Max) - 16 Vdc
Inrush Current @ 28Vdc (Max) 3.5 A

Inrush Time (Max) — 100 ms
Hold Current (Max) — 0.32 A
Drop Out - 4 to 10 Vdc
Main Contacts -
Operate Time (Max) - 18 ms
Operate Bounce (Max) - 5 ms
Release Time - 18 ms
Auxiliary Contacts Operate/
Release - Within $\pm 5 \mathrm{~ms}$ of main

Physical Data
Contact Arrangement -
Power Contacts -
SPST-NO (form X)
2X Auxiliary Contacts 1 -SPST-NO (form A)
Dimensions - See drawing
Weight, Nominal - $0.45 \mathrm{Kg}(0.99 \mathrm{lb})$
Environmental Data
Shock, 11ms $1 / 2$ Sine
(Operating) - $20 \mathrm{G}_{\text {peak }}$
Sine Vibration, $20 \mathrm{G}_{\text {peak }}$ -$55-2000 \mathrm{~Hz}$
Random Vibration, 14.06 Grms -
$15 \mathrm{~Hz}(.002 \mathrm{G} 2 / \mathrm{Hz}), 100 \mathrm{~Hz}(.002 \mathrm{G} / \mathrm{Hz})$, $450 \mathrm{~Hz}(.12 \mathrm{G} 2 / \mathrm{Hz}), 900 \mathrm{~Hz}(.12 \mathrm{G} / \mathrm{Hz})$, $2000 \mathrm{~Hz}(.083 \mathrm{G} 2 / \mathrm{Hz})$
Operating Temperature Range -$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$

## Electrical Data

Voltage Rating -
Main Contacts (max) — 400 Vdc Auxiliary Contacts - 30 Vdc
Current Rating, Continuous -
Main Contacts 2-300 A
Auxiliary Contacts - 3 A
Contact Resistance -
Main Contacts 3 -
$100 \mathrm{~m} \Omega$ max @ 1 amp
$0.3 \mathrm{~m} \Omega$ max @ rated current
Auxiliary Contacts -
$200 \mathrm{~m} \Omega$ max
Hot Switching Performance
(Polarity Sensitive) -
600A make/ 265A break @ $\pm 270 \mathrm{Vdc}$ -
11,000 cycles
550A make/ break @ $\pm 360 \mathrm{Vdc}$ -
100 cycles
2000A capacitive make - 100 cycles
2000A make/ break @ +360Vdc 5 cycles
1000A make/ break @ -360Vdc 2 cycles
Mechanical Life - 1 million cycles
Dielectric Withstand Voltage -
Terminal to Terminal/ Terminals to Coil -
1mA max @ 2,200Vrms
nsulation Resistance -
Terminal to Terminal/ Terminals to Coil $100 \mathrm{M} \Omega$ min @ 500 Vdc

## Notes:

${ }^{1}$ Two form A available with electronic coil economizer, 1 form A available with mechanical coil economizer
2 Continuous current rating is affected by conductors attached. Keep terminals below $150^{\circ} \mathrm{C}$ max continuous, 175 C for 1 hour max, and 200 C for 1 minute max.
3 Initial contact resistance may be higher than $0.3 \mathrm{~m} \Omega$, but will drop below within 30 minutes maximum

## Ordering Information

Typical Part Number
Series:
MAP201 = 350 Amp, 12-900VDC Contactor
Contact Form:
A = Normally Open
H = Normally Open with Aux. Contacts
Coil Voltage:
R = 28 Vdc , Mechanical Economizer
S = 28 Vdc , Electrical Cut-throat Economizer

## Coil Wire Length:

A = 15.3 in ( 390 mm )
D = Coil connector on relay (requires option "E" or " $X$ " in next step).

Coil Terminal Connector:
$\mathrm{N}=$ No connector
$E=9-p i n ~ s u b m i n i a t u r e ~ " D " ~ p l u g ~ m o u n t e d ~ o n ~ c o n t a c t o r ~$ housing
X = Special configuration (consult factory)

## Mounting \& Power Terminals:

A = Bottom Mount \& Male M8 $\times 1.25$ Thread Terminals
$B=$ Bottom Mount \& Female 1/4-20 Thread Terminals
$D=$ Bottom Mount \& Female M6 x 1 Thread Terminals

## KILOVAC MAP201 Series Contactor (Continued)

## Outline Dimensions*



## MAP200HR D-Sub

## Pin Out

Coil + = Pin 2
Coil - = Pin 6
Aux. $\mathrm{COM}=\operatorname{Pin} 8$
Aux. $\mathrm{NO}=\operatorname{Pin} 4$

## MAP200AR

Coil+ = Pin 2
Coil - = Pin 6

[^6]
# KILOVAC CAP202 Series Aerospace Commercial Contactor with 2 Form X (DPST-NO), Contacts Rated up to 300 Amps , 12-600 Vdc 

## Product Facts

■ Hermetically sealed
■ Up to 4X SPDT auxiliary switch outputs: $30 \mathrm{Vdc} / 2 \mathrm{~A}$ max switching or 6V/5mA min. signal

■ Integrated coil economizer with coil suppression

■ EMC compliant - no radiated coil emission
■ Bidirectional switching main contacts not polarity sensitive
■ Mount in any orientation not position sensitive


## Description

2-pole single throw hermetically sealed DC contactor; 12-900 Vdc/350A per pole
Not position sensitive
Bi-directional switching

## Applications

High Voltage DC Converter Systems (ref schematic below)

Test Equipment
Power Distribution
Power Motion Control


Electrical
Compact epoxy-sealed resin enclosure occupies only about 4 in 3 ( $65.5 \mathrm{~cm}^{3}$ )

Contact arrangement: DPST-No (2 form X)

Voltage rating: 12-900 Vdc (main contacts); 30 Vdc (auxiliary)
Mechanical life: 100,000
cycles

## Physical or Other Properties

Weight: 0.79 Kg
Hermetically sealed
Safe for harsh/corrosive environments
No contacts oxidation over periods on non-use
Number of SPDT Auxiliary Contacts per Contactor Type: CAP202AS - None
CAP202MS - Two
CAP202FS - Four

## Performance Data

Physical Data
Contact Arrangement -
Power Contacts - DPST-NO (2 Form X Auxiliary Switches - SPDT (form C)
Dimensions - See drawings on next
page
Weight — $0.79 \mathrm{Kg}(1.74 \mathrm{lb}$.

## Electrical Data

Voltage Rating -
Main Contacts - $12-900 \mathrm{Vdc}$
Auxiliary Catacts - 30VdC
Current Rating -
Main Contacts ${ }^{1}$ - 350A/pole
Auxiliary Catacts - 3A
Contact Resistance -
Main Contacts - (2)
$100 \mathrm{~m} \Omega$ max @ 1 amp
$0.3 \mathrm{~m} \Omega$ max. @ 200A after 3 mins.
Auxiliary Catacts - $200 \mathrm{~m} \Omega$ max

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

Hot Switching Performance @ $\pm 400$ Vdc (3) -
100A make/break - 10,000 cycles
250 A make/break - 2,500 cycles
700A break only - 10 cycles
Hot Switching Performance @ $\pm 270$ Vdc (4) -
100A make/break - 40,000 cycles
250A make/break - 7,500 cycles
2000 A break only @ $\pm 370 \mathrm{Vdc}$ (5) 2 cycles
Maximum Make Current - 700 A
Dielectric Withstand Voltage over
Life - Terminal to Terminal/Terminals to Coil —1mA max @ 2,200Vrms Insulation Resistance over Life - Terminal to Terminal/Terminals to Coil - $50 \mathrm{~m} \Omega \mathrm{~min} @ 500 \mathrm{Vdc}$
Mechanical Life - 100,000 cycles
Environmental Data
Shock, 11ms $1 / 2$ sine (operating) - 20G peak

Sine Vibration, 10G peak -$55-2,000 \mathrm{~Hz}$
Random Vibration, 14 Grms -

| 15 | 100 | 300 | 900 | 2000 Hz |
| :---: | :---: | :---: | :---: | :---: |
| .01 | .01 | .2 | .2 | $.01 \mathrm{G} 2 / \mathrm{Hz}$ |

Operating Temperature Range -$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$

## Notes:

${ }^{1}$ Using 4/0 conductor. Current rating is affected by attached conductor size and design. Keep terminals below $150^{\circ} \mathrm{C}$ max. continuous, $175^{\circ} \mathrm{C}$ for 2 hours max. and $200^{\circ} \mathrm{C}$ for 1 minute max. For mounting large conductors, request terminal adapter PN 3-1618396-7.
Operational contact resistance is measured by millivolt drop across contacts a>100A current. Initial contact resistance may be higher than $0.3 \mathrm{~m} \Omega$, but will drop below within 30 mins. max.
${ }^{3}$ Voltage applied to each contact set separately.
${ }^{4}$ Voltage applied across both contact sets in series.
${ }^{5}$ May not pass 2,200 Vrms dielectric testing after second interrupt cycle.

## KILOVAC CAP202 Series 12-900Vdc Contactors

## Outline Dimensions*



| Coil Data (-40 to $+85^{\circ} \mathrm{C}$ temp range unless otherwise noted) |  |
| :--- | :---: |
| Voltage/Nominal Max. | $28-32 \mathrm{VDC}$ |
| Pickup Voltage Max. | 16 VDC |
| Inrush Current @ 28 Vdc nominal/@ 32V maximum | $3.4 / 6.0 \mathrm{~A}$ |
| Inrush Time (nominal/maximum) | $75 / 150 \mathrm{mS}$ |
| Hold Current @ 28V nominal / @32V maximum | $0.27 / 0.48 \mathrm{~A}$ |
| Drop Out Voltage | 3 to 8 Vdc |
| Internal Coil Suppression (max.) | 60 Vdc |
| Main Contacts: Operate Time, nominal/maximum | $13 / 20 \mathrm{mS}$ |
| Main Contacts: Operate Bounce, nominal/maximum | $3 / 10 \mathrm{mS}$ |
| Main Contacts: Release Time, nominal/maximum | 25 mS |
| Main Contacts: Release Time, maximum including <br> Maximum arc time | $7 / 12 \mathrm{mS}$ |

## Ordering Information

## Typical Part Number <br> Series: <br> A = None <br> $M$ = Two <br> F = Four

CAP202 $=2$ form X, DPST-NO-DM Contactor
Auxiliary Contact Outputs (SPDT form C):

Coil Voltage:
S = 28V (with built-in electronically switched dual coil economizer)

## Coil and Aux. Wire Length:

A $=15.3$ inches
$B=6$ inches
X = Customer Special
Coil and Aux. Connector:
$\mathrm{N}=$ None
F = D Plug on flying leads (may affect wire length)
Mounting \& Power Terminals:
D = 2X M5 Bottom Mount with 4X, M6 x 1 Female thread terminals
Specifications are subject to change without notice.

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or
805-220-2055.

Product Facts

- Designed to be the smallest, lightest weight, lowest cost sealed contactor in the industry with its current rating
■ Built-in coil economizer only 1.7W hold power @ 12VDC and it limits back EMF to OV. (models requiring external economizer also available)
■ Optional auxiliary contact for easy monitoring of power contact position

■ Hermetically sealed intrinsically safe, operates in explosive/harsh environments with no oxidation or contamination of coil or contacts, including long periods of nonoperation

- Versatile coil and power connections

■ RoHS versions available

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055

## KILOVAC CAP200 Series Contactor with 1 Form A (SPST-NO) Contacts Rated up to 500 Amps, 12-900 Vdc




Ordering Information
Typical Part Number
CAP200 A A A N A
Series:

## Contact Form:

A = Normally Open
H = Normally Open with Aux. Contacts
250 at end of life
3 Does not meet dielectric \& IR afte Contacts

## KILOVAC CAP200 Series (Continued)

## Outline Dimensions



Estimated Make \& Break Power Switching Ratings


## NOTES:

1) For resistive loads with $300 \mu \mathrm{H}$ maximum inductance. Consult factory for inductive loads.
2) Estimates based on extrapolated data. User is encouraged to confirm performance in application.
3) End of life when dielectric strength between terminals falls below 50 megohms @ 500VDC.
4) The maximum make current is 650 A to avoid contact welding.

For factory-direct application assistance,
dial 800-253-4560, ext. 2055, or
805-220-2055.

```
Product Facts
■ Commercial aerospace
    product
■ Hermetically sealed -
    intrinsically safe.
    Operates in explosive/harsh
    environments without
    oxidation or contamination
    of contacts, during long
    periods of non-operation
■ 8kV isolation between
    open contacts permits use
    for high voltage isolation
    and carry, optional auxiliary
    contacts
■ 12, 24 and 48 Vdc coils
■ Solid copper contacts
■ Designed and built in
    accordance to AIAG QS9000
■ RoHS versions available
```


## Product Facts

```
- Commercial aerospace product
- Hermetically sealed intrinsically safe. Operates in explosive/harsh oxidation or contamination of contacts, during long periods of non-operation
- 8 kV isolation between pen contacts permits use and carry, optional auxiliary contacts
■ 12, 24 and 48 Vdc coils
■ Solid copper contacts
- Designed and built in accordance to AIAG QS9000
■ RoHS versions available
```

KILOVAC CAP100 Series 900 Vdc Contactor


## Description

Lowest cost, 900 Vdc 100 amp, hermetically sealed DC contactor in the industry with coil suppression and 1 Form C Aux. contact

Compact package available in side- or bottom-mount reinforced configurations, not position sensitive

## Applications

Power/motor control circuit isolation, circuit protection and power distribution Commercial Aerospace

## Mechanical

Compact epoxy-sealed resin enclosure occupies only about $4 \mathrm{in}^{3}$ ( $65.5 \mathrm{~cm}^{3}$ )

Robust integral mounting plate on either bottom or side of enclosure accepts two M4 screws Inert gas filled contact chamber

Flying leads for coil connections

Load terminals threaded for M5 bolts (not included)

## Performance Data

Physical Data
Contact Arrangement, Main
Contacts - SPST-NO-DM (1 Form X)
Dimensions - See drawings on next page
Weight-6.7 oz (190g)

## Contact Data

Contact Arrangement, Main
Contacts — SPST-NO-DM (1 Form X)
Voltage Rating, Main Contacts
Switching (Max) - 900VDC
Current Rating, Main Contacts
Switching -
Continuous 1 - 100A
Short Term, 3 Minutes 2 - 200A
Hot Switching Performance
(Polarity Sensitive) -
50A make/break @ +400Vdc - 50,000
cycles
100A make/break @ +400Vdc —6,000
cycles
00A make/break @ -400Vdc - 1,000
cycles
200A make/break @ +400Vdc — 500
cycles
1,000A break only @ +400Vdc —10
cycles
600A make only - 25 cycles
Maximum Short Circuit Current
(1/2 cycle, 60 Hz ) - 1,250A
(through closed contacts)
Dielectric Withstand Voltage 3 -
Between Open Contacts -
$5,600 \mathrm{Vms} / 8,000 \mathrm{Vdc}$
Contacts to Coil -
2,000Vrms/4,000Vdc

Insulation Resistance, Terminal to Terminal / Terminals to Coil -
When New - 100 megohms, min. @ 500 Vdc
At End of Life — 50 megohms, min. @ 500 Vdc
Mechanical Life - 1 million cycles
Operate \& Release Time
Operate Time Max. - 25ms
Operate Bounce Max. - 5ms
Release Time - 10ms
Environmental Data
Shock, 11ms $1 / 2$ sine
(operating) - 20G peak
Sine Vibration, 20G peak -
$55-2,000 \mathrm{~Hz}$.
Operating Temperature Range -$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Noise Emission (at 100 mm distance) - 70dB(a)

## Notes

$18.4 \mathrm{~mm}^{2}$ conductor. Current rating depends upon conductor size. Keep terminals below $175^{\circ} \mathrm{C}$ max continuous.
23 minutes at $+40^{\circ} \mathrm{C}$ ambient with $8.4 \mathrm{~mm}^{2}$ (\#8 AWG) conductor.
$32,000 \mathrm{Vrms}$ minimum under all conditions, until end of life.

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055

| Dimensions are in millimeters | USA: +18005226752 |
| :--- | :--- |
| unless otherwise specified. | Asia Pacific: +8604008206015 |
|  | UK: +44800267666 |

## KILOVAC CAP100 Series (Continued)

| Coil Operating Voltage (Valid Over Temperature Range) |  |  |  |
| :--- | :---: | :---: | :---: |
| Nominal Voltage | 12 Vdc | 24 Vdc | 48 Vdc |
| Pick Up Voltage $\left(20^{\circ} \mathrm{C}\right)$ | 8 Vdc | 16 Vdc | 33 Vdc |
| Drop Out Voltage $\left(20^{\circ} \mathrm{C}\right)$ | 1.2 Vdc | 2.4 Vdc | 4.8 Vdc |
| Coil Current (Nominal at $\left.20^{\circ} \mathrm{C}, 12 \mathrm{vdc}\right)$ | 461 mA | 250 mA | 122 mA |
| Coil Power1 <br> Nominal @ Vnom, $+20^{\circ} \mathrm{C}$ | 5.5 W | 6.0 W | 6.0 W |
| Pickup (Close) <br> Voltage Max. @ $85^{\circ} \mathrm{C}$ | 9.6 Vdc | 19.2 Vdc | 38.4 Vdc |
| Coil Resistance <br> Nominal @ $+20^{\circ} \mathrm{C} \pm 5 \%$ (ohms) | 26 | 96 | 392 |
| Do not exceed 8.0 W coil power for extended periods |  |  |  |



## Ordering Information

## Coil Termination:

$\mathrm{N}=$ None - Stripped Wires
(Consult factory for connector options)

## Mounting and Power Terminals:

G = Bottom Mount ( $2 \times$ \#8); M5 x 10
H = Side Mount ( $2 \times$ \#8); M5 x 10

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055


| Catalog 5-1773450-5 | Dimensions are shown for <br> reference purposes only. <br> Revised 3-13 |
| :--- | :--- |
| Specifications subject |  |
| www.te.com | to change. |

## KILOVAC CAP100 Series (Continued)

## Bottom Mount



Side Mount


For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

## KILOVAC EV200 Series Contactor With 1 Form X (SPST-NO) Contacts Rated 500+ Amps, 12-900 Vdc

## Product Facts

■ Designed to be the smallest, lightest weight, lowest cost sealed contactor in the industry with its current rating (500+A carry, 2000A interrupt at 320VDC)
■ Built-in coil economizer only 1.7W hold power @ 12VDC and it limits back EMF to OV. Models requiring external economizer also available

■ Optional auxiliary contact for easy monitoring of power contact position
■ Hermetically sealed intrinsically safe, operates in explosive/harsh environments with no oxidation or contamination of coil or contacts, during long periods of nonoperation

■ Versatile coil/power connections

- UL Recognized $\quad{ }_{\text {for }}$ Canada (File E208033) All contact ratings \& coil versions may not be UL Recognized
- CE marked for CE EC applications

■ AIAG QS9000 designed, built and approved

■ RoHS versions available


| Voltage (Will Operate) | 9-36VDC | 32-95VDC | 48-95VDC |
| :---: | :---: | :---: | :---: |
| Voltage (Max.) | 36VDC | 95VDC | 95VDC |
| Pickup (Close) Voltage Max. | 9VDC | 32VDC | 48VDC |
| Hold Voltage (Min.) | 7.5VDC | 22VDC | 34VDC |
| Dropout (Open) Voltage (Min.) | 6VDC | 18VDC | 27VDC |
| Inrush Current (Max.) | 3.8A | 1.3A | 0.7A |
| Holding Current (Avg.) | $\begin{aligned} & \hline 0.13 \mathrm{~A} @ 12 \mathrm{~V}, \\ & 0.07 \mathrm{~A} @ 24 \mathrm{~V} \end{aligned}$ | 0.03A@48V | 0.02A@72V |
| Inrush Time (Max.) | 130 ms | 130 ms | 130 ms |

## Ordering Information

Typical Part Number
Series:
EV200 $=500+$ Amp, 12-900VDC Contactor

## Contact Form:

$\qquad$
A = Normally Open
H = Normally Open with NO Aux. Contacts
G = Normally Open with NC Aux. Contacts

## Coil Voltage:

A = 9-36VDC ( 1 = requires external coil economizer)
D = 32-95VDC ( $2=$ requires external coil economizer)
$J=48-95 V D C \quad(3=$ requires external coil economizer)
R $=28 \mathrm{VDC}$ with Mechanical Economizer

## Coil Wire Length:

A = 15.3 in ( 390 mm )

## Coil Terminal Connector:

$\mathrm{N}=$ None
C = Molex Mini-fit Jr, 2 Skt, Female 18-24, P/N 39-01-2020 \& 39-00-0060 +red is pin 1 (A length only)

## Mounting \& Power Terminals:

A = Bottom Mount \& Male 10mm x M8 Terminals

## Performance Data

Contact Arrangement, Power
Contacts - 1 Form A (SPST-NO)
Rated Operating Voltage -
12-900 VDC
Continuous (Carry) Current,
Typical — $500 \mathrm{~A} @ 85^{\circ} \mathrm{C}, 400 \mathrm{mcm}$ conductors
Consult Factory for required conductors for higher ( $500+A$ ) currents
Make/Break Current at Various
Voltages 1 - See graph next page
Break Current at 320VDC 1 -
2,000 A, 1 cycle 3
Contact Resistance, Typ.
(@200A) — 0.2 mohms
Load Life - See graph next page
Mechanical Life - 1 million cycles
Contact Arrangement, Auxiliary
Contacts - 1 Form A (SPST-NO)
Aux. Contact Current, Max. 2A @ 30VDC / 3A @ 125VAC
Aux. Contact Current, Min. 100mA @ 8V
Aux. Contact Resistance, Max. 0.417 ohms @ 30VDC /
.150 ohms @ 125VAC
Operate Time @ $25^{\circ} \mathrm{C}$ -
Close (includes bounce), Typ. — 15 ms Bounce (after close only), Max. - 7 ms Release (includes arcing),
Max @ 2000A — 12 ms
Dielectric Withstanding Voltage 2,200 Vrms @ sea level (leakage <1mA) Insulation Resistance @ 500VDC 100 megohms 2
Shock, $11 \mathrm{~ms} 1 / 2$ Sine, Peak, Operating - 20 G
Vibration, Sine, $80-2000 \mathrm{~Hz}$.,
Peak - 20 G
Operating Ambient Temperature -
$-40^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Weight, Nominal — . 95 lb . (. 43 kg )

## Notes:

1 Main power contacts
250 at end of life
3 Does not meet dielectric \& IR after test, 1700 amp for unit with Aux.
Contacts to change.

Dimensions are in millimeters unless otherwise specified.

## KILOVAC EV200 Series (CZONKA Relay, Type III) (Continued)

## Outline Dimensions



Estimated Make \& Break Power Switching Ratings


NOTES:

1) For resistive loads with 300 HH maximum inductance. Consult factory for inductive Ioads. 2) Estimates based on extrapolated data. User is encouraged to confirm performance in application. 3) End of life when dielectric strength between terminals falls below 50 megohms @ 500 VDC . 4) The maximum make current is 650 A to avoid contact welding.

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or


805-220-2055.

## KILOVAC EV200B Series Contactor With 1 Form Y (SPST-NC) Contacts Rated $500+$ Amps, 12-900 Vdc

## Product Facts

■ Normally closed version of popular EV200 series contactors

- Designed to be the smallest, lowest cost, lightest weight sealed contactor in the industry at its current rating
■ Optional auxiliary contacts for monitoring position of power contacts
■ Hermetically sealed operates in explosive/harsh environments with no oxidation or contamination of coil or contacts during long periods of nonoperation
- Not position sensitive, can be mounted in any orientation
■ RoHS versions available

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.


Physical Data
Contact Arrangements -
Main Contacts - SPST, Normally Closed
Dimensions - See drawing
Weight, Nominal - .95 lb . $(.43 \mathrm{~kg})$
Environmental Data
Shock, 11ms $1 / 2$ Sine
(Operating) - $30 \mathrm{G}_{\text {peak }}$ (Closed)
$10 \mathrm{G}_{\text {peak }}$ (Open)
Sine Vibration, $10 \mathrm{G}_{\text {peak }}$ -
$55-2000 \mathrm{~Hz}$
Random Vibration, 7.1 Grms -
$15 \mathrm{~Hz}(.001 \mathrm{G} 2 / \mathrm{Hz}), 100 \mathrm{~Hz}(.04 \mathrm{G} 2 / \mathrm{Hz})$, $1000 \mathrm{~Hz}(.04 \mathrm{G} 2 / \mathrm{Hz}), 1500 \mathrm{~Hz}(.02 \mathrm{G} 2 / \mathrm{Hz})$
Operating Temperature Range -
$-40^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Electrical Data
Voltage Rating -
Main Contacts (Max) — 750 Vdc
Current Rating, Continuous -
Main Contacts 1 - 500 A
Contact Resistance -
Main Contacts 2 -
$0.2 \mathrm{~m} \Omega$ max above 300A
$0.3 \mathrm{~m} \Omega$ max between 50 and 300 A
Hot Switching Performance
(Positive Polarity) ${ }^{3}$ -
200A make/ break @ 270Vdc -
10,000 cycles
600A make/ break @ 360Vdc -
100 cycles
800A break only @ 360Vdc -
15 cycles
1500A break only @ 360Vdc - 1 cycle
Mechanical Life (Min) -
1 million cycles
Dielectric Withstand Voltage -
Terminal to Terminal/ Terminals to Coil 1 mA max @ 2,200 Vrms

Insulation Resistance -
Terminal to Terminal/ Terminals to Coil 100M $\Omega$ min @ 500Vdc new $50 \mathrm{M} \Omega$ min @ 500 Vdc end of life

## Coil Data 4

Nominal Coil Voltage 5 -
Low range - $9.6-14 \mathrm{Vdc}$
High range - 19-28 Vdc
Pick Up (Max) @ $25^{\circ} \mathrm{C}$ -
9.6/18.5 Vdc

Pick Up @ Max Coil Temperature 10.5/22 Vdc

Hold (Min) - 6/12 Vdc

## Ordering Information



## KILOVAC EV200B Series Contactor (Continued)

## Outline Dimensions



For factory-direct application assistance,
dial 800-253-4560, ext. 2055, or
805-220-2055.

# KILOVAC EV200P Series Latching Contactor With 1 Form X (SPST Latch) Contacts Rated 500+Amps, 12-900 Vdc 

## Product Facts

■ Latching version of popular EV200 Series
■ Designed to be the smallest, lowest cost, lightest weight sealed contactor in the industry at its current rating

- Optional auxiliary contacts for monitoring position of power contacts
- Hermetically sealed operates in explosive/harsh environments with no oxidation or contamination of coil or contacts during long periods of nonoperation
■ Not position sensitive, can be mounted in any orientation

■ RoHS versions available

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.


## Physical Data

Contact Arrangements -
Main Contacts - SPST, Latching Auxiliary Contacts 1 - Up to 2 Form A
Dimensions - See drawing
Weight, Nominal - . 95 lb . ( .43 kg )
Environmental Data
Shock, 11ms $1 / 2$ Sine
(Operating) - $30 \mathrm{G}_{\text {peak }}$
Sine Vibration, 20 Gpeak -$55-2000 \mathrm{~Hz}$

Random Vibration, 14.06 Grms -
$15 \mathrm{~Hz}(.002 \mathrm{G} 2 / \mathrm{Hz}), 100 \mathrm{~Hz}(.002 \mathrm{G} 2 / \mathrm{Hz})$, $450 \mathrm{~Hz}(.12 \mathrm{G} 2 / \mathrm{Hz}), 900 \mathrm{~Hz}(.12 \mathrm{G} / \mathrm{Hz})$, $2000 \mathrm{~Hz}(.083 \mathrm{G} 2 / \mathrm{Hz})$
Operating Temperature Range -$-40^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Electrical Data
Voltage Rating -
Main Contacts (Max) — 750 Vdc
Current Rating, Continuous -
Main Contacts 2 - 500 A
Contact Resistance -
Main Contacts 3 -
$0.2 \mathrm{~m} \Omega$ max above 300A
$0.3 \mathrm{~m} \Omega$ max between 50 and 300A
Hot Switching Performance
(Positive Polarity) ${ }^{4}$ -
200A make/ break @ 270Vdc — 10,000 cycles
600A make/ break @ 360Vdc —
100 cycles
800A break only @ 360Vdc -
15 cycles
2000A break only @ 360Vdc - 1 cycle
Mechanical Life (Min) -
1 million cycles 1 mA max @ 2,200 Vrms
Insulation Resistance 100M $\Omega$ min @ 500Vdc new

## Coil Data 5

 9 Vdc
## Coil Voltage:

4 = 12 Vdc
$5=24 \mathrm{Vdc}$
$6=48 \mathrm{Vdc}$
Coil Terminations:
$N$ = None

Dielectric Withstand Voltage -
Terminal to Terminal/ Terminals to Coil -

Terminal to Terminal/ Terminals to Coil $50 \mathrm{M} \Omega \mathrm{min} @ 500 \mathrm{Vdc}$ end of life

Nominal Coil Voltage 6 - 12 Vdc Pick Up/Latch (Max) @ $25^{\circ} \mathrm{C}$ -

## Ordering Information

= Latching
F = Latching with 1 SPDT Aux.

A = 15.3 in . $(300 \mathrm{~mm})$
Coil Termination Connector:

Mounting \& Power Terminals:
Hold (Min) — N/A
Reset (Max)/Dropout (Min) -
9 Vdc
Duty Cycle, Max 7 - $20 \%$
Coil Resistance @ $25^{\circ} \mathrm{C}-2.5 \Omega$
Operate Specs @ $25^{\circ} \mathrm{C}$ -
Operate Time (Typ) - 15 ms
Operate Bounce (Max) - 7 ms
Release Time (Max) — 15 ms
Notes:
1 Product can be configured alternately with form B or C auxiliary switches if required. This changes the product part number, depend-
ing on specific auxiliary configura-
tion. Consult TE for availability and part number
2 Ambient conditions and conductor design affect rating. Terminal temperature rise should be $75^{\circ} \mathrm{C}$ max above ambient. Keep relay terminals below $150^{\circ} \mathrm{C}$ max continuous,
$175^{\circ} \mathrm{C}$ max for two hours, and $200^{\circ} \mathrm{C}$ for 1 minute.
${ }^{3}$ Stabilized reading. Contact resistance may exceed spec in the first 10 minutes of current carry.
4 Units are polarity sensitive.
Approximately $50 \%$ de-rating for reverse polarity switching.
Consult factory for review of specific requirements.
${ }^{5}$ Over temperature range unless noted. Suggested coil pulse = $50-100 \mathrm{~ms}$.
624 V and 48 V coils available on request - consult factory.
7 Intermittent Duty Coil. Coil overheating can occur if duty cycle is exceeded. Limit average coil power to 10 W maximum.

A = Bottom Mount \& Male 10mm x
M8 Threaded Terminals

## KILOVAC EV200P Series Latching Contactor (Continued)

## Outline Dimensions



For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

## Product Facts

■ Hermetically sealed
■ Operates in explosive/ harsh environments without oxidation or contamination of contacts, during long periods of non-operation
■ 8 kV isolation between open contacts permits use for high voltage isolation and carry

- Coil economizer allows for operation between 9-36 VDC
- Designed and built in accordance with AS 9100

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

KILOVAC EV100 Series Contactor With 1 Form X Contacts Rated 100 Amps Continuous, 600 Vdc


## Description

Low cost, 600 Vdc, 100 amp, hermetically sealed DC contactor

Economized coil for low power consumption between 9-36 VDC

Bottom mount, not position sensitive

One million cycle mechanical life

## Applications

Power/motor control circuit isolation, circuit protection and safety in industrial machinery
Automotive battery switching and backup
Solar inverter switching
Automotive pre-charge
Test Equipment
Power distribution

## Electrica

Contact arrangement: SPSTNO (Form X., Double Make)
Voltage rating:
$5-600 \mathrm{Vdc}$ at 100 Amps
50K cycles Make/Break:
50 Amps at 400 Vdc
25K cycles Make/Break: 50 Amps at 600 Vdc

Holding current:
0.15 Amps at 24 Vdc

Operate time: 30 ms max.

Resistive Load Performance (polarity sensitive) -
50A make/break @ +400Vdc -
50,000 cycles
50A make/break @ +600Vdc -
25,000 cycles
100A make/break @ +400Vdc 6,000 cycles
100A make/break @ +600Vdc 5,000 cycles
100A make/break @ -400Vdc — 1,000 cycles
100A make/break @ -600Vdc 25 cycles
200A make/break @ +400Vdc 500 cycles
200A make/break @ +600Vdc — 200 cycles
1,000A break only @ +400Vdc -
5 cycles
600A break only @ +600Vdc — 5 cycles
600A make only - 10 cycles
Maximum Short Circuit Current
( $1 / 2$ cycle, 60 Hz ) - $1,250 \mathrm{~A}$
(through closed contacts)
Dielectric Withstand Voltage -
Between Open Contacts - $2,2000 \mathrm{Vrms}$ Contacts to Coil $-1,500 \mathrm{~V}$ rms/4,000Vdc
Insulation Resistance, Terminal to
Terminal / Terminals to Coil -
When New - 100 megohms, min.
@ 500Vdc
At End of Life - 50 megohms, min. @ 500Vdc
Mechanical Life - 106
Operate \& Release Time
Operate Time Max. - 30ms
Operate Bounce Max. - 5ms
Release Time - 10ms
Environmental Data
Shock, $11 \mathrm{~ms} 1 / 2$ sine (operating) - 20G peak

Sine Vibration, 20G peak -$55-2,000 \mathrm{~Hz}$.
Operating Temperature Range -$-40^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Noise Emission (at 100 mm distance) - 70dB(a)

## Notes

$18.4 \mathrm{~mm}^{2}$ conductor. Current rating is affected by conductor size. Keep terminals below $150^{\circ} \mathrm{C}$ max. continuous.
${ }^{2} 3$ minutes at $+40^{\circ} \mathrm{C}$ ambient, 1 minute at $-80^{\circ} \mathrm{C}$ ambient with $8.4 \mathrm{~mm}^{2}$ (\#8 AWG) conductor.

## KILOVAC EV100 Series (Continued)

## Outline Dimensions

Bottom Mount


| Coil Data (Internal Coil Economizer) |  |
| :--- | :---: |
| Coil Voltage Range | $9-32 \mathrm{Vdc}$ |
| Maximum Pickup Current $\left(20^{\circ} \mathrm{C}\right)$ | 1.5 A |
| Average Holding Current $\left(20^{\circ} \mathrm{C}\right)$ | $0.25 \mathrm{~A} @ 12 \mathrm{Vdc} / 0.15 \mathrm{~A} @ 24 \mathrm{Vdc}$ |
| Pickup Voltage $(20 \mathrm{C})$ | $\geq 9 \mathrm{Vdc}$ |
| Dropout Voltage | $\leq 8 \mathrm{Vdc}$ |
| Pickup Pulse (max.) | 100 ms |
| Coil Resistance $+/-5 \%\left(20^{\circ} \mathrm{C}\right)$ | $8.0 \Omega$ |
| Coil Economizer Frequency | 19.6 kHz |
| Coil Power Typ. (over temp range) | $3-4 \mathrm{~W}$ |

## Ordering Information



Specifications are subject to change without notice.

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

## KILOVAC LEV100 Series 900 Vdc Contactor With 1 Form X Contacts Rated 100A Continuous

## Product Facts <br> ■ Hermetically sealed intrinsically safe. Operates in explosive/harsh environments without oxidation or contamination of contacts, including long periods of non-operation <br> - 8 kV isolation between open contacts permits use for high voltage isolation and carry <br> ■ 12, 24 and 48 Vdc coils <br> ■ Designed and built in accordance to AIAG QS9000 <br> - Not position sensitive, can be mounted in any orientation <br> - Solid copper contacts <br> $\square$ UL Recognized Canada (File E208033) All contact ratings \& coil versions may not be UL Recognized <br> ■ RoHS versions available



## Description

Lowest cost, 900 Vdc 100 amp, hermetically sealed DC contactor in the industry
Compact package available in side- or bottom-mount configurations, not position sensitive

## Applications

Power/motor control circuit isolation, circuit protection and safety in industrial machinery

Automotive battery switching and backup

## Mechanical

Compact epoxy-sealed resin enclosure occupies only about $4 \mathrm{in}^{3}\left(65.5 \mathrm{~cm}^{3}\right)$
Robust integral mounting plate on either bottom or side of enclosure accepts two M4 screws
Inert gas filled contact chamber
Flying leads for coil connections

Load terminals threaded for M5 bolts (not included)

Performance Data
Physical Data
Contact Arrangement, Main
Contacts - SPST-NO-DM (1 Form X)
Dimensions - See drawings on next
page
Weight - 6.7 oz (190g)
Contact Data
Contact Arrangement, Main
Contacts — SPST-NO-DM (1 Form X)
Voltage Rating, Main Contacts
Switching (Max) - 900VDC
Current Rating, Main Contacts
Switching -
Continuous 1 - 100A
Short Term, 3 Minutes 2 - 200A
Hot Switching Performance
(Polarity Sensitive) -
50A make/break @ +400Vdc - 50,000
cycles
100A make/break @ +400Vdc —6,000
cycles
100A make/break @ -400Vdc — 1,000
cycles
200A make/break @ +400Vdc — 500
cycles
1,000A break only @ +400Vdc — 250
cycles
600A make only - 25 cycles
Maximum Short Circuit Current
( $1 / 2$ cycle, 60 Hz ) - 1,250A
(through closed contacts)
Dielectric Withstand Voltage 3 -
Between Open Contacts -
5,600Vrms/8,000Vdc
Contacts to Coil -
2,000Vrms/4,000Vdc

Insulation Resistance, Terminal to Terminal / Terminals to Coil -
When New - 100 megohms, min. @ 500Vdc
At End of Life - 50 megohms, min. @ 500 Vdc
Mechanical Life - 1 million cycles
Operate \& Release Time
Operate Time Max. - 25 ms
Operate Bounce Max. - 5 ms
Release Time - 10ms
Environmental Data
Shock, 11ms 1/2 sine (operating) - $20 G$ peak
Sine Vibration, 20G peak -$55-2,000 \mathrm{~Hz}$.
Operating Temperature Range -$-40^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Noise Emission (at 100 mm distance) - 70dB(a)

## Notes

$18.4 \mathrm{~mm}^{2}$ conductor. Current rating depends upon conductor size. Keep terminals below $175^{\circ} \mathrm{C}$ max continuous.
23 minutes at $+40^{\circ} \mathrm{C}$ ambient with $8.4 \mathrm{~mm}^{2}$ (\#8 AWG) conductor.
3 2,000Vrms minimum under all conditions, until end of life.

For factory-direct application assistance, dial $800-253-4560$, ext. 2055, or
805-220-2055.

## KILOVAC LEV100 Series 900 Vdc Contactor (Continued)

| Coil Operating Voltage (Valid Over Temperature Range) |  |  |  |
| :--- | :---: | :---: | :---: |
| Nominal Voltage | 12 Vdc | 24 Vdc | 48 Vdc |
| Maximum Voltage | 16 Vdc | 28 Vdc | 52 Vdc |
| Pick Up Voltage $\left(20^{\circ} \mathrm{C}\right)$ | 8 Vdc | 16 Vdc | 33 Vdc |
| Drop Out Voltage $\left(20^{\circ} \mathrm{C}\right)$ | $\leq 1.2 \mathrm{Vdc}$ | $\leq 2.4 \mathrm{Vdc}$ | $\leq 4.8 \mathrm{Vdc}$ |
| Coil Current (Nominal at $\left.20^{\circ} \mathrm{C}, 12 \mathrm{Vdc}\right)$ | 461 mA | 250 mA | 122 mA |
| Coil Power <br> Nominal @ Vnom, $+20^{\circ} \mathrm{C}$ | 5.5 W | 6.0 W | 6.0 W |
| Pickup (Close) <br> Voltage Max. @ $85^{\circ} \mathrm{C}$ | 9.6 Vdc | 19.2 Vdc | 38.4 Vdc |
| Coil Resistance <br> Nominal @ $+20^{\circ} \mathrm{C} \pm 5 \%$ (ohms) | 26 | 96 | 392 |



## Ordering Information



N = None - Stripped Wires

## Mounting and Power Terminals:

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

G = Bottom Mount ( $2 \times$ \#8); M5 x 10
H = Side Mount ( $2 \times$ \#8); M5 x 10

Dimensions are shown for reference purposes only. Specifications subject to change.

## KILOVAC LEV100 Series 900 Vdc Contactor (Continued)

## Bottom Mount



Side Mount

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or


Product Offering

| Bottom Mount Models |  |  |  |
| :--- | :--- | :--- | :--- |
| $3-1618389-7$ | LEV100A4ANG | 12Vdc coil | $15^{\prime \prime}[.4 \mathrm{~m}]$ leads |
| $9-1618389-8$ | LEV100A5ANG | 24Vdc coil | $15^{\prime \prime}[.4 \mathrm{~m}]$ leads |
| $3-1618391-7$ | LEV100A6ANG | 48Vdc coil | $15^{\prime \prime}[.4 \mathrm{~m}]$ leads |
| Side Mount Models |  |  |  |
| $4-1618391-0$ | LEV100A4ANH | 12 Vdc coil | $15^{\prime \prime}[.4 \mathrm{~m}]$ leads |
| $4-1618391-1$ | LEV100A5ANH | 24Vdc coil | $15^{\prime \prime}[.4 \mathrm{~m}]$ leads |
| $4-1618391-2$ | LEV100A6ANH | 48 Vdc coil | $15^{\prime \prime}[.4 \mathrm{~m}]$ leads |

Dimensions are shown for reference purposes only. Specifications subject to change.

## KILOVAC LEV200 Series Contactor With 1 Form X Contacts Rated $500+$ Amps, $12-900 \mathrm{Vdc}$

## Product Facts

■ Designed to be the lowest cost sealed contactor in the industry with its current rating (500+A carry, 2000A interrupt at 320 Vdc )
■ Available with bottom or side mounting - not position sensitive
■ Optional auxiliary contact for easy monitoring of power contact position

- Hermetically sealed intrinsically safe, operates in explosive/harsh environments with no oxidation or contamination of coils or contacts, including long periods of non-operation
- Typical applications include battery switching and backup, DC voltage power control, circuit protection and safety
■ Versatile coil/power connections
- Designed and built in accordance to AIAG QS9000
- RoHS compliant


| Coil Data (Valid Over Temperature Range) ${ }^{4}$ |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: |
| Nominal Voltage | 12 Vdc | 24 Vdc | 48 Vdc | 72 Vdc |
| Pickup Voltage (Will Operate) | 9.0 Vdc | 19.0 Vdc | 38.0 Vdc | 57.0 Vdc |
| Voltage (Max.) | 15 Vdc | 30 Vdc | 60 Vdc | 90 Vdc |
| Dropout Voltage | $0.75-$ | $1.0-$ | $2.0-$ | $3.0-$ |
|  | 2.0 Vdc | 5.0 Vdc | 7.0 Vdc | 12.0 Vdc |
| Coil Resistance @ 25 |  |  |  |  |

## Ordering Information

Typical Part Number
LEV200 A 4 N A A
Series:


LEV200 = 500+ Amp, 12-900Vdc Contactor

## Contact Form:

Den
$\mathrm{H}=$ Normally Open with Aux. Contacts. (Option "H" requires option "A" in Coil Wire Length and option " N " in Coil Terminal Connector.)
Note: Other auxiliary contact forms available. Consult factory.
Coil Voltage:
$4=12 \mathrm{Vdc} \quad 5=24 \mathrm{Vdc} \quad \mathrm{B}=28 \mathrm{Vdc}$
$6=48 \mathrm{Vdc} \quad \mathrm{K}=72 \mathrm{Vdc}$
$8=96 \mathrm{Vdc} \quad \mathrm{L}=110 \mathrm{Vdc} \quad \mathrm{O}=115 \mathrm{Vac} \quad 9=240 \mathrm{Vac}$
Notes: Consult factory for detailed specifications and availability of coils not listed in "Coil Data" table above. In coil voltage codes, 115 Vac is designated by the letter "O" rather than the numeral " 0 ."
Coil Wire Length:

$$
\begin{aligned}
A=15.3 \text { in }(390 \mathrm{~mm}) \quad N=\begin{array}{l}
\text { None (Requires option } \\
\text { "A" in next step.) }
\end{array}
\end{aligned}
$$

Coil Terminal Connector:
$\mathrm{N}=$ None, stripped wires
(Requires option "A" in previous step.)
A = Studs, \#10-32 Threaded (Electrical connection is made to the tab at the base of the stud.)
Note: Specify option A, stripped wires, for coil voltages > 96Vdc

## Mounting \& Power Terminals:

A = Bottom Mount \& Male 10mm x M8 Threaded Terminals $F=$ Side Mount \& Male 10mm $\times$ M8 Threaded Terminals

Consult factory regarding other available mountings and power terminals.

Performance Data
Contact Arrangement, Power
Contacts - 1 Form X (SPST-NO-DM)
Rated Operating Voltage -
12-900 VDC
Continuous (Carry) Current,
Typical - $500 \mathrm{~A} @ 65^{\circ} \mathrm{C}, 400 \mathrm{mcm}$
conductors
Consult TE for required conductors for higher ( $500+A$ ) currents
Make/Break Current at Various
Voltages ${ }^{1}$ - See graph next page
Break Current at 320VDC 1 -
2,000 A, 1 cycle 3
Contact Resistance, Typ.
(@200A) — 0.2 mohms
Load Life - See graph next page
Mechanical Life - 1 million cycles
Contact Arrangement, Auxiliary
Contacts - 1 Form A (SPST-NO)
Aux. Contact Current, Max. 2A @ 3OVDC / 3A @ 125VAC
Aux. Contact Current, Min. 100mA @ 8V
Aux. Contact Resistance, Max. -
0.417 ohms @ 30VDC /
. 150 ohms @ 125VAC
Operate Time @ $25^{\circ} \mathrm{C}$ -
Close (includes bounce), Typ. - 25 ms
Bounce (after close only), Max. -7 ms
Release (includes arcing), Max @
2000A - 12 ms
Dielectric Withstanding Voltage -
2,200 Vrms @ sea level (leakage <1mA)
Insulation Resistance @ 500VDC 100 megohms 2
Shock, 11ms 1/2 Sine, Peak,
Operating - 20 G
Vibration, Sine, 80-2000Hz.,
Peak - 20 G
Operating Ambient Temperature -
$-40^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Weight, Typical - 1.3 lb . (. 60 kg )
Notes:
1 Main power contacts
250 at end of life
3 Does not meet dielectric \& IR after test, 1700 amp for unit with Aux. Contacts
4 Contacts will operate with $0.8 \mathrm{~V}_{\text {nom }}$ $<\mathrm{V}_{\text {coil }}<1.1 \mathrm{~V}_{\text {nom }}$ over temperature range.

## Invalid

Combinations/Reason
LEV200H-NA
No auxiliary function with coil studs
LEV200_ONA_
No coil studs with rectifier circuit
LEV200_9NA_
No coil studs with rectifier circuit
LEV200_O_F
No side mont with rectifier circuit
LEV200_9_F
No side mount with rectifier circuit

## KILOVAC LEV200 Series (Continued)

## Outline Dimensions

SIde Mount Enclosure

Bottom Mount Enclosure


Note: When stud terminals are specified for coil connections the electrical connection is made at the tab located at the base of the stud.


Estimated Make \& Break Power Switching Ratings



NOTES:

1) For resistive loads with $300 \mu \mathrm{H}$ maximum inductance. Consult factory for inductive loads
2) Estimates based on extrapolated data. User is encouraged to confirm performance in application
3) End of life when dielectric strength between terminals falls below 50 megohms @ 500VDC
4) The maximum make current is 650A to avoid contact welding

For factory-direct application assistance,
dial $800-253-4560$, ext. 2055, or
805-220-2055.

| Catalog 5-1773450-5 | Dimensions are shown for <br> reference purposes only. <br> Revised 3-13 |
| :--- | :--- |
| Specifications subject |  |
| www.te.com | to change. |

Dimensions are in millimeters unless otherwise specified.

## FM200 ("Flatman III") Series Contactor

 200 Amps, 480 VAC ( $50 / 60 \mathrm{~Hz}$ ), or $48 \mathrm{Vdc}, 1-$, 2-, or 3-poles
## Product Facts <br> ■ Multi-pole configurations - Normally open, normally closed and mixed contact arrangements <br> ■ Optional quick connect tabs for sensing <br> - Small, lightweight \& costeffective - designed to be the smallest, lowest cost contactor in the industry with its current rating <br> - Standard models available with 12VDC, 24VDC and 115 VAC coils. Consult factory for 240VAC coil models. <br> - 1 Form A auxiliary contacts



For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

## Product Specifications

| Parameter | Units | Value for FM200 Series |
| :---: | :---: | :---: |
| Contact Arrangement |  | 1,2 or 3 poles |
| Contact Form (per pole) |  | Form X or Y (NO-DM or NC-DB) |
| Rated Operating Voltage | V | 480Vrms (L-L) or 48VDC |
| Max. Contact Voltage (transient) | V | 750 Vrms or 60VDC |
| Continuous (Carry) Current | Arms or ADC | 200/pole (Form X) <br> 150/pole (Form Y) |
| Power Switching Form X (0.7-1.0 PF) | Cycles | 2,000 @ 300Arms <br> 10,000@ 200Arms <br> 20,000 @ 100Arms <br> 5,000 @ 200A/48VDC <br> 2 million @ 50A/28VDC |
| Power Switching Form Y (0.7-1.0 PF) | Cycles | 2,000 @ 225Arms <br> 10,000@150Arms <br> 20,000 @ 75Arms <br> 5,000@150A/48VDC <br> 2 million @ 35A/28VDC |
| Mechanical Life | Cycles | >2 million |
| Contact Voltage Drop | mV | 75 for Form X or Form Y |
| Auxiliary Contact Arrangement |  | 1 Form A (SPST-N0) |
| Auxiliary Contact Rating | Arms or ADC | 1 @ 30VDC, 3 @ 125VAC |
| Dielectric Withstanding Voltage | Vrms | 2,200 @ sea level |
| Insulation Resistance @ 500VDC | Megohms | 100 |
| Shock, 11ms 1/2 sine, peak | G | 10 |
| Vibration, sine, 10-2000Hz. | G | 5 |
| Operating Temperature | ${ }^{\circ} \mathrm{C}$ | -20 to +60 |
| Storage Temperature | ${ }^{\circ} \mathrm{C}$ | -40 to +85 |
| Ambient Humidity | \%RH | 0 to 95 |
| Weight <br> See Outline Dimensions for model-spec | 0z. / kg <br> ific weight info | $17.6-49.4 / 0.5-1.4$ mation. |


| Coil Operating Voltage (valid over temperature range) |  |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Coil Designator | Units | A | B | C | D |
| Nominal Voltage | V | 12 (DC) | 24 (DC) | $115(\mathrm{AC)}$ | 24 (DC) |
| Voltage Range | V | $9.6-13.2$ | $19.2-26.4$ | $92-126.5$ | $19.2-26.4$ |
| Hold Voltage | V | $\geq 0.5 \mathrm{~V}_{\text {nom }}$ | $\geq 0.5 \mathrm{~V}_{\text {nom }}$ | $\geq 0.5 \mathrm{~V}_{\text {nom }}$ | $\geq 0.5 \mathrm{~V}_{\text {nom }}$ |
| Dropout Voltage | V | $\leq 0.1 \mathrm{~V}_{\text {nom }}$ | $\leq 0.1 \mathrm{~V}_{\text {nom }}$ | $\leq 0.1 \mathrm{~V}_{\text {nom }}$ | $\leq 0.2 \mathrm{~V}_{\text {nom }}$ |

Coil Resistance Data for Pole Configurations (@25 ${ }^{\circ}$ )

| Coil Designator | Units | A | $\mathrm{B}^{\star}$ | C $^{\star}$ | $\mathrm{D}^{\star}$ |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Resistance $\pm 10 \%$ | Ohms | $\mathrm{X}=36$ | $\mathrm{X}=36$ | $\mathrm{X}=36$ | $\mathrm{Y}=20.8$ |
|  |  | $X X=18$ | $\mathrm{XX}=18$ | $\mathrm{XX}=18$ | $\mathrm{YY}=10.4$ |
|  |  | $\mathrm{XXX}=12$ | $\mathrm{XXX}=12$ | $\mathrm{XXX}=12$ | $\mathrm{YYY}=6.9$ |
|  |  | $\mathrm{XY}=13.2$ | $\mathrm{XY}=13.2$ | $\mathrm{XY}=13.2$ | $\mathrm{YXY}=8.1$ |
|  |  | $\mathrm{XYX}=9.6$ | $\mathrm{XYX}=9.6$ | $\mathrm{XYX}=9.6$ |  |

*Coil resistance not measurable at terminals due to converter/economizer circuit.

| Coil Current/Power Data for Pole Configurations (@25 ${ }^{\circ} \mathrm{C}, \mathrm{V}_{\text {coil }}=1.1 \mathrm{~V}_{\text {nom }}$ ) |  |  |  |
| :---: | :---: | :---: | :---: |
| Coil Designator | A | B** |  |
| Current/Power | $\begin{gathered} X=0.37 \mathrm{ADC} / 4.84 \mathrm{~W} \\ X X=0.73 \mathrm{ADC} / 9.68 \mathrm{~W} \\ X X X=1.1 \mathrm{ADC} / 14.5 \mathrm{~W} \\ X Y=1.0 \mathrm{ADC} / 13.2 \mathrm{~W} \\ X Y X=1.38 \mathrm{ADC} / 18.2 \mathrm{~W} \end{gathered}$ | $\begin{aligned} \mathrm{X} & =0.33 \mathrm{ADC} / 3.9 \mathrm{~W} \\ \mathrm{XX} & =0.65 \mathrm{ADC} / 7.6 \mathrm{~W} \\ \mathrm{XXX} & =0.97 \mathrm{ADC} / 11.3 \mathrm{~W} \\ \mathrm{XY} & =0.98 \mathrm{ADC} / 12.7 \mathrm{~W} \\ \mathrm{XYX} & =1.31 \mathrm{ADC} / 16.5 \mathrm{~W} \end{aligned}$ |  |
| Coil Designator | C | $D^{* * *}$ | Pick-Up I / Duration |
| Current/Power | $\begin{aligned} \mathrm{X} & =0.067 \mathrm{Arms} / 6.8 \mathrm{VA} \\ \mathrm{XX} & =0.115 \mathrm{Arms} / 11.6 \mathrm{VA} \\ \mathrm{XXX} & =0.146 \mathrm{Arms} / 14.8 \mathrm{VA} \\ \mathrm{XY} & =0.074 \mathrm{Arms} / 7.5 \mathrm{VA} \\ \mathrm{XYX} & =0.161 \mathrm{Arms} / 16.3 \mathrm{VA} \end{aligned}$ | $\begin{aligned} Y & =0.13 A D C / 3.4 \mathrm{~W} \\ Y Y & =0.23 A D C / 6.1 \mathrm{~W} \\ \mathrm{YYY} & =0.34 \mathrm{ADC} / 9.0 \mathrm{~W} \\ \mathrm{YXY} & =0.28 \mathrm{ADC} / 7.4 \mathrm{~W} \end{aligned}$ | 1.28ADC / 75ms 2.4ADC / 75ms 3.0ADC / 75ms 3.0ADC / 75ms |


| Available Pole Configurations and Applicable Coil Codes |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| No. of NC Poles (across) | 0 | 1 | 2 | 3 |
| No. of NO Poles (down) |  |  |  |  |
| 0 |  | Y | YY | YYY |
|  |  | Coil D | Coil D | Coil D |
| 1 | X | XY | YXY |  |
|  | Coil A/B/C/E | Coil A/B/C/E | Coil D |  |
| 2 | XX | XYX |  |  |
|  | Coil A/B/C/E | Coil A/B/C/E |  |  |
| 3 | XXX |  |  |  |
|  | Coil A/B/C/E |  |  |  |


| **Average coil current. | ***Economized. |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Operate/Release Time ( $25^{\circ} \mathrm{C}, 0.8 \mathrm{~V}_{\text {nom }} \leq \mathrm{V}<\mathrm{V}_{\text {nom }}$ ) Typ. |  |  |  |  |  |
| Coil Designator | Units | A | $\mathrm{B}^{* * * *}$ | $C^{* * * *}$ | $D^{* * * *}$ |
| Operate Time | ms | 25-50 | 30-50 | 50-150 | 20-30 |
| Release Time | ms | 10-20 | 70-80 | 75-100 | 75-100 |
| Bounce Time | ms | 2-5 | 2-5 | 2-5 | 2-5 |

${ }^{* * * *}$ Includes internal coil suppression.
$X=$ Form X (NO-DM) Y F Form Y (NC-DB)

Catalog 5-1773450-5
Revised 3-13

Dimensions are shown for reference purposes only. Specifications subject to change. unless otherwise specified.

## FM200 "Flatman III" Series Contactor (Continued)

## Part Numbering System

| Typical Part Number | FM200 | A | B | XYX |
| :---: | :---: | :---: | :---: | :---: |
| Series: <br> FM200 = Multipole, 200 Amp, 480VAC/48VDC Contactor |  |  |  |  |
| Control Voltage: <br> A = 12VDC Coil, No Suppression <br> B $=24 \mathrm{VDC}$ Converter, with Suppression <br> C $=115$ VAC Converter, with Suppression <br> D $=$ 24VDC Electronic Chopper, with Suppression <br> E = 240VAC Converter, with Suppression - Consult Factory for Availability and Specifications |  |  |  |  |
| Optional Termination: <br> A = Optional Quick Connect Tabs <br> $B=$ No Optional Terminals |  |  |  |  |
| Pole Configuration (All models have a 1 Form A (SPST-NO) auxiliary switch): <br> $X=1$ Form X (SPST-NO-DM), Available with control voltage codes A, B, C and E <br> $X X=2$ Form X (2PST-NO-DM), Available with control voltage codes A, B, C and E <br> XXX $=3$ Form X (3PST-NO-DM), Available with control voltage codes $\mathrm{A}, \mathrm{B}, \mathrm{C}$ and E <br> $Y=1$ Form Y (SPST-NC-DB), Available only with control voltage code D <br> YY = 2 Form Y (DPST-NC-DB), Available only with control voltage code D <br> YYY = 3 Form Y (3PST-NC-DB), Available only with control voltage code D <br> $X Y=1$ Form $X($ SPST-NO-DM $)+1$ Form $Y$ (SPST-NC-DB), Available with control voltage codes A, B, C and E <br> XYX $=1$ Form X (SPST-NO-DM) +1 Form Y (SPST-NC-DB) +1 Form X (SPST-NO-DM), Available with contro <br> YXY $=1$ Form $Y($ SPST-NC-DB $)+1$ Form X (SPST-NO-DM $)+1$ Form Y (SPST-NC-DB), Available only with con | codes A, tage code |  |  |  |

## Outline Dimensions



| DIM. | NUMBER OF POLES |  |  |
| :---: | :---: | :---: | :---: |
|  | 1 | 2 | 3 |
| A | $\begin{gathered} 1.68 \\ (42.7) \\ \hline \end{gathered}$ | $\begin{array}{r} 2.67 \\ (67.7) \\ \hline \end{array}$ | $\begin{gathered} 3.65 \\ (92.7) \\ \hline \end{gathered}$ |
| B | $\begin{gathered} 2.14 \\ (54.3) \\ \hline \end{gathered}$ | $\begin{array}{r} 3.12 \\ (79.3) \\ \hline \end{array}$ | $\begin{gathered} 4.11 \\ (104.4) \\ \hline \end{gathered}$ |
| C | $\begin{gathered} 1.56 \\ (39.6) \\ \hline \end{gathered}$ | $\begin{array}{r} 2.55 \\ (64.6) \\ \hline \end{array}$ | $\begin{gathered} 3.53 \\ (89.7) \\ \hline \end{gathered}$ |
| WEIGHT | $\begin{aligned} & 17.6 \mathrm{oz} . \\ & (0.5 \mathrm{~kg}) \end{aligned}$ | $\begin{aligned} & 35.3 \mathrm{oz} . \\ & (1.0 \mathrm{~kg}) \end{aligned}$ | $\begin{aligned} & 49.4 \mathrm{oz} \\ & (1.4 \mathrm{~kg}) \end{aligned}$ |



For factory-direct application assistance, dial 800-253-4560, ext. 2055, or
805-220-2055.

| Catalog 5-1773450-5 | Dimensions are shown for | Dimensions are in millimeters | USA: +18005226752 | For additional support numbers |
| :--- | :--- | :--- | :--- | :--- |
| Revised 3-13 | reference purposes only. <br> Specifications subject |  | unless otherwise specified. | Asia Pacific: +8604008206015 | | please visit www.te.com |
| :--- |
| to change. |

Product Facts

- Designed to be the smallest, lowest cost contactor in the industry with its current rating
■ Built-in coil economizer only 1.7W hold power @ 12VDC and limits back EMF to zero volts
- Hermetically sealed intrinsically safe, operates in explosive \& harsh environments with no oxidation or contamination of coils or contacts, including long periods of non-operation.


Submitted for UL and CE evaluation

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

Performance Data

| Parameter | Units | Value for AC30 Series |
| :---: | :---: | :---: |
| Contact Arrangement |  | 3 poles |
| Contact Form (per pole) |  | Form A (NO) |
| Rated Operating Voltage | V | 600Vrms (L-L) |
| Max. Contact Voltage (transient) | V | 600Vrms (L-N) |
| Continuous (Carry) Current | Arms | 60/pole |
| Power Switching (0.7-1.0 PF) | Cycles | 50 @ 60Arms 500 @ 10Arms 500 @ 30Arms 10,000 @ 10Arms 50,000 @ 5Arms |
| Mechanical Life | Cycles | 1 million |
| Contact Voltage Drop (Max., Per Pole) | mV | 120 @ 60Arms |
| Dielectric Withstanding Voltage | Vrms | 2,200 @ sea level |
| Insulation Resistance @ 500VDC | Megohms | 100 |
| Shock, 11ms 1/2 sine, peak, operating | G | 20 |
| Vibration, sine, 80-2000Hz. | G | 20 |
| Operating Temperature | ${ }^{\circ} \mathrm{C}$ | -40 to +85 |
| Storage Temperature | ${ }^{\circ} \mathrm{C}$ | -55 to +125 |
| Ambient Humidity | \%RH | 0 to 95 |
| Weight | lb.(kg) | . 83 (.38) |
| Operate/Release Time ( $25^{\circ} \mathrm{C}$ ) |  |  |
| Operate Time (Includes bounce) | ms | 16 nominal / 35 maximum |
| Bounce Time (After Operate) | ms | 4 nominal / 11 maximum |
| Release Time (includes arcing) | ms | 5 nominal / 8 maximum |

Coil Operating Voltage (valid over temperature range)

| Voltage (will operate) | 9-36VDC | 32-95VDC | 48-95VDC |
| :--- | :---: | :---: | :---: |
| Voltage (Max.) | 36VDC | 95VDC | 95VDC |
| Pickup (close) Voltage Max. | 9VDC | 32VDC | 48VDC |
| Hold Voltage (Min.) | 7VDC | 21VDC | 33VDC |
| Dropout (open) Voltage (Min.) | 6VDC | 18 VDC | 27 VDC |
| Inrush Current (Max.) | 3.8 A | 1.3 A | 0.7 A |
| Holding Current (Avg.) | $0.13 \mathrm{~A} @ 12 \mathrm{~V}, 0.07 \mathrm{~A} @ 24 \mathrm{~V}$ | $0.03 \mathrm{~A} @ 48 \mathrm{~V}$ | $0.02 \mathrm{A@72V}$ |
| Inrush Time (Max.) | 130 ms | 130 ms | 130 ms |

Part Numbering System

| Typical Part Number AC30 | A | A | A | N |
| :---: | :---: | :---: | :---: | :---: |
| Series: <br> AC30 = Multipole, 60 Amp, 600VAC, 3-pole Contactor |  |  |  |  |
| Contact Form: A = Normally Open |  |  |  |  |
| Coil Voltage: $\begin{aligned} & A=9-36 \mathrm{VDC} \\ & \mathrm{~B}=32-95 \mathrm{VDC} \\ & \mathrm{~J}=48-95 \mathrm{VDC} \end{aligned}$ |  |  |  |  |
| Coil Wire Length: $A=15.3 \text { in }(390 \mathrm{~mm})$ |  |  |  |  |
| Coil Terminal Connector: $N=\text { None }$ |  |  |  |  |

Mounting \& Power Terminals:
A = Bottom Mount \& \#10-32 Pan Head Screws

## Outline Dimensions



## AP90X-05-90 Amps SPUD Contactor

## Product Facts

- 90 A carry, 350 A overload @ 270 Vdc
- Same size and weight as AP50X
■ Versatile power, voltage, and current operating range
- Ideal for circuit protection and control

■ Bi-directional switching

- Fast operate and release time

■ Low power consumption
■ Vacuum-sealed contacts; can operate in harsh environments
Space-rated version built in accordance with customers SCD
■ Meets many requirements of MIL-PRF-32085

*Based on data extrapolated from qualification at 270 Vdc with resistive load. Since each application is unique, user is encouraged to verify rating in actual application.

## Product Specifications

Contact Arrangement -
SPST-NO
Contact Form - X
Rated Resistive Load @ 270 Vdc 90 A
Continuous Current Carry, Max. 65 A
Overload @ 270 Vdc — 350 A
Contact Resistance, Max. 2 mohm

Dielectric at Sea Level -
Coil to Power Terminals - 1,800 Vrms All Other Points - 2,000 Vrms
Shock, 11ms, 1/2 Sine (Peak) 30 g
Vibration, Sinusoidal
( $55-2000 \mathrm{~Hz}$, Peak) - 20 g
Operating Ambient Temperature
Range - $-55^{\circ} \mathrm{C}$ to $+90^{\circ} \mathrm{C}$
Load Life @ 270 Vdc, Min. 25,000 cycles

Coil Data

| Volts, Nominal | $\mathbf{1 2}$ | $\mathbf{2 8}$ | $\mathbf{1 2 0}$ |
| :--- | :---: | :---: | :---: |
| Pickup, Max. | 9.9 Vdc | 23 Vdc | 99 Vdc |
| Dropout, Min. | .4 Vdc | 1.0 Vdc | 4.0 Vdc |
| Coil Resistance $( \pm 10 \%)$ | $19 \Omega$ | $103 \Omega$ | $1890 \Omega$ |
| Energy, Magnetic, Max. | .05 J | .05 J | .05 J |

Coil resistance rated at $25^{\circ} \mathrm{C}$

Operate Time,
Excluding Bounce, Max. - 35 ms
Release Time, Max. - 10 ms
Bounce Time, Max. - 8 ms
Insulation Resistance @ 500 Vdc,
Min. -
Initial - 100 mohm
End of Life - 50 mohm
Weight, Nominal -
454 gram (16 oz.)


For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

## AP90X - 90 Amps SPUD Contactor

## Product Facts

- 90 A carry, 350 A overload @ 270 Vdc
- Same size and weight as AP50X
■ Versatile power, voltage, and current operating range
- Ideal for circuit protection and control

■ Bi-directional switching

- Fast operate and release time
■ Low power consumption
■ Vacuum-sealed contacts; can operate in harsh environments
■ Space-rated version built in accordance with customers SCD
- Meets many requirements of MIL-PRF-32085


Maximum continuous current carry $=90 \mathrm{Amps}$
*Based on data extrapolated from qualification at 270 Vdc with resistive load. Since each application is unique, user is encouraged to verify rating in actual application.

## Product Specifications

Contact Arrangement -
SPST-NO
Contact Form - X
Rated Resistive Load @ 270 Vdc 90 A
Continuous Current Carry, Max. 90 A
Overload @ 270 Vdc — 350 A
Contact Resistance, Max. 2 mohm

Dielectric at Sea Level -
Coil to Power Terminals - 1,800 Vrms
All Other Points - 2,000 Vrms
Shock, 11ms, 1/2 Sine (Peak) 30 g
Vibration, Sinusoidal
( $55-2000 \mathrm{~Hz}$, Peak) - 20 g
Operating Ambient Temperature
Range - $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Load Life @ 270 Vdc, Min. 25,000 cycles

Operate Time,
Excluding Bounce, Max. - 27 ms
Release Time, Max. - 10 ms
Bounce Time, Max. - 8 ms
Insulation Resistance @ 500 Vdc,
Min. -
Initial - 100 mohm
End of Life - 50 mohm
Weight, Nominal -
454 gram (16 oz.)

Coil Data

| Volts, Nominal | $\mathbf{1 2}$ | $\mathbf{2 8}$ | $\mathbf{1 2 0}$ |
| :--- | :---: | :---: | :---: |
| Pickup, Max. | 9.9 Vdc | 23 Vdc | 99 Vdc |
| Dropout, Min. | .4 Vdc | 1.0 Vdc | 4.0 Vdc |
| Coil Resistance $( \pm 10 \%)$ | $19 \Omega$ | $103 \Omega$ | $1890 \Omega$ |
| Energy, Magnetic, Max. | .05 J | .05 J | .05 J |

Coil resistance rated at $25^{\circ} \mathrm{C}$

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or
805-220-2055.

## Ordering Information



## Power Terminals:

5 = Stud Terminals
Mounting:
7 = Panel Mount

## AP150X (Form X, Electrically Held)

## CZONKA Contactor

## Product Facts

- 150 A carry, 500 A overload @ 270 Vdc
- Suitable for circuit protection, control, and battery switching
■ Versatile power, voltage, and current operating range
■ Bi-directional switching
■ Electrically held and latching coil versions

■ Fast operate and release time

- Low power consumption

■ Vacuum-sealed contacts; can operate in harsh environments
■ Space-rated version built in accordance with customers SCD

- Meets many requirements of MIL-PRF-32085



## Product Specifications

Contact Arrangement -
AP150X - SPST-NO
Contact Form -
AP150X - X
Rated Resistive Load @ 270 Vdc150 A
Continuous Current Carry, Max. 150 A
Overload Make \& Break @
270 Vdc - 400/500 A*
Contact Resistance, Max. -
1 mohm
Dielectric at Sea Level -
Power Terminals to Terminal -
2,000 Vrms
Power Terminals to All Other Points 1,800 Vrms
Shock, 11ms, 1/2 Sine (Peak) 35 g
Vibration, Sinusoidal
( $55-2000 \mathrm{~Hz}$, Peak) - 20 g
Operating Ambient Temperature
Range - $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Load Life @ 270 Vdc, Min. -
10,000 cycles
Operate Time ( $28 \mathrm{Vdc}, 25^{\circ} \mathrm{C}$ ) -
Close (Includes Bounce), Typ. -
AP150X - 35 ms
Bounce (After Close Only), Max. -
AP150X - 8 ms
Open (Includes Arcing), Max. AP150X — 10 ms
Insulation Resistance @ 500 Vdc,
Min. - Initial/End of Life - 100
mohm/50 mohm
Weight, Nominal -
$1.66 \mathrm{lb}(0.753 \mathrm{~kg})$
Note:
*500 = at beginning of life which is 0 to 5,000 cycles, $400=$ at end of life which is 5,000 to 10,000 cycles.

Contact Ratings*


Maximum continuous current carry $=150$ Amps
*Based on data extrapolated from qualification at 270 Vdc with resistive load. Since each application is unique, user is encouraged to verify rating in actual application.

## Coil Data

|  | AP150X | AP150P |
| :--- | :---: | :---: |
| Voltage, Nominal $^{\star}$ | 28 Vdc | 28 Vdc |
| Pickup (Close), Max. | 23 Vdc | 20 Vdc |
| Dropout (Open), Max. | 1.0 Vdc | 20 Vdc |
| Coil Resistance @ $25^{\circ} \mathrm{C}(10 \%)$ | $52 \Omega$ | $13 \Omega^{\star \star}$ |
| Coil Duty, Recommended | Continuous | 100 ms to Toggle |
| Coil Energy, Max. | 0.10 J | 0.10 J |
| Coil Clamping | $2.5 \times$ nom. | $500 \mathrm{~W} / \mathrm{ms}$ TVS |

*12, 120 Vdc , or other special coil voltages available upon request.
**2 coils are used, both are high common. Switch coil power from low side. High side coil power switch is a special order.

## Ordering Information

Sample Part Number
Series:

## Contact Form:

X = SPST-NO Electrically Held

## Coil Voltage:

A = 12 Vdc, Stud Terminals, . 138-32
B $=28$ Vdc, Stud Terminals, .138-32
C = 120 Vdc, Stud Terminals, .138-32

## Power Terminals:

$\qquad$
5 = Stud Terminals, .375-24
Mounting:
7 = Panel Mount

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or
805-220-2055

CZONKA II Contactor
Product Facts
■ 265 A carry, 1000 A overload @ 270 Vdc

- Bi-directional power switching

■ Auxiliary Contacts
■ Electrically held and latching coil versions
■ Built-in coil drivers for electrically held (5W hold) and latching (coil pulser)
■ Coil divers EMC qualified to most of the requirements of MIL-STD-461D

■ Versatile power, voltage, and current operating range

- Excellent for safety disconnect and transfer switch applications
- Designed for main generator loads
■ Suitable for circuit protection and control
■ Remote Power Controller version with overload protection available contact factory for more information
■ Hermetically-sealed contacts; can operate in harsh environments
$■$ Space-rated version built in accordance with customers SCD
- Meets many requirements of MIL-PRF-32085

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

AP265 (Form X, Electrically Held) \& AP265P (Form P, Latching) 265 Amps


## Electrical Life Cycles vs Power Switching

Product Specifications
Contact Arrangement Mains -
AP265X - Form X - SPST-NO Form A $-2 \times$ SPST-NO
AP265P - Form X - SPST Form A $-2 \times$ SPST
Polarity (Carry and Switching) -Bi-directional
Rated Resistive Load @ 270 Vdc -
265 A
Continuous Current Carry, Max. -
265 A
Overload Current @ 270 Vdc,
Max. -
Make and Break - 600 A
Break Only - 1000 A
Contact Resistance, Max. -
0.3 mohm

Dielectric at Sea Level
(<1 mA leakage) -
Power Terminals to Terminal -
1,000 Vrms
Power Terminals to All Other Points 1,000 Vrms
Shock, 11ms, $1 / 2$ Sine (Peak) 25 g
Vibration, Sinusoidal
( $55-2000 \mathrm{~Hz}$, Peak) - 10 g
Operating Ambient Temperature
Range - $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Load Life @ 270 Vdc, Min. -
See graph above
Operate Time ( $28 \mathrm{Vdc}, 5^{\circ} \mathrm{C}$ ) -
Close (Includes Bounce), Typ. -
AP265X - 20 ms
AP265P - 10 ms
Bounce (After Close Only), Max. -
5 ms
Open (Includes Arcing), Max. 15 ms
Insulation Resistance @ 500 Vdc,
Min. -
Initial/End of Life - 100 mohm/50 mohm
Weight, Nominal -
1.7 lb ( 0.77 kg )
(Data from 270 Vdc testing @ 265A, 95\% Weibull Reliability)


Coil Data

|  | AP265X | AP265P |
| :--- | :---: | :---: |
| Type Driver | "PWM" Econ. | Pulser |
| Voltage, Nominal | 28 Vdc | 28 Vdc |
| Pickup (Close), Max. | 20 Vdc | 12 Vdc |
| Dropout (Open), Max. | 11 Vdc | 12 Vdc |
| Current @ $28 \mathrm{~V}, 25^{\circ} \mathrm{C}$ |  |  |
| Inrush | 1.8 A | 2.6 A |
| Holding (Standby) | 0.20 A | $<0.05 \mathrm{~A}$ |
| Inrush Time, Max. | 100 ms | 100 ms |

## Ordering Information



## AP350X "BUBBA" Contactor 500 Amps

## Product Facts

■ 500 A carry, 1200 A make, 3000 A break @ 270 Vdc

- Bi-directional power switching
- Auxiliary Contacts

■ Built-in coil power economizing - 6 W holding
■ Versatile power, voltage, and current operating range

- Excellent for safety disconnect and transfer switch applications
- Suited for circuit protection control
■ Hermetically-sealed contacts; can operate in harsh environments
- Designed for main generator loads
■ Space-rated version built in accordance with customers SCD
- Meets many requirements of MIL-PRF-32085

Coil Data

|  | AP350X |
| :--- | :---: |
| Type Driver | "PWM" Econ. |
| Voltage, Nominal | 28 Vdc |
| Pickup (Close), Max. | 20 Vdc |
| Dropout (Open), Max. | 11 Vdc |
| Current @ $28 \mathrm{~V}, 25^{\circ} \mathrm{C}$ |  |
| Inrush | 2.1 A |
| Holding (Standby) |  |
| Inrush Time, Max. | 0.21 A |

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.


Product Specifications
Contact Arrangement with Auxiliary Contact ( $28 \mathrm{Vdc}, 0.1 \mathrm{~A}$ ) Form X - SPST-NO
Form A - SPST-NO
Rated Resistive Load @ 270 Vdc, $85^{\circ} \mathrm{C}$ - 350 A
Continuous Current Carry, Max.,
$25^{\circ} \mathrm{C}-500 \mathrm{~A}$
Overload Current @ 270 Vdc,
Max. -
Make (Closed Into) - 1200 A
Break (Open) - 3000 A
Contact Resistance, Max. 0.2 mohm

Dielectric at Sea Level
(<1mA leakage) -
Open Power Terminal to Terminal 2,000 Vrms
Closed Power Terminals to All Other Points - 2,000 Vrms
Shock, 11ms, 1/2 Sine (Peak) 25 g
Vibration, Sinusoidal
( $55-2000 \mathrm{~Hz}$, Peak) - 10 g
Operating Ambient Temperature
Range $--55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Load Life @ 270 Vdc, Min. -
See graph above
Operate Time @ $25^{\circ} \mathrm{C}$ -
Close (Includes Bounce), Typ. 35 ms
Bounce (Occurs When Closing),
Max. - 5 ms
Open (Includes Arcing), Max. 20 ms
Insulation Resistance @ $\mathbf{5 0 0}$ Vdc, Min. -
Initial/End of Life — 100 mohm/50 mohm
Weight, Nominal -
$3.35 \mathrm{lb}(1.52 \mathrm{~kg})$


Electrical Life Cycles vs Power Switching

*Failure mode: Dielectric withstand voltage test @ 2000 Vdc, power terminal to terminal, leakage exceeds 1.0 A. Current Carry: $500 \mathrm{~A} @ 25^{\circ} \mathrm{C}$. Derate 2.5 $\mathrm{A} /{ }^{\circ} \mathrm{C}$ to $350 \mathrm{~A} @ 85^{\circ} \mathrm{C}$ for still air, no heat sink, AWG\# 00 conductor.

Ordering Information
Sample Part Number
Series:
Contact Form:
X = SPST-NO Double Make
Coil Voltage:
B = 28 Vdc, Stud Terminals
Power Terminals:
5 = Screw Terminals
Mounting:

Refer to EV500 Sales Drawing for complete specifications.

| Catalog 5-1773450-5 | Dimensions are shown for <br> reference purposes only. |
| :--- | :--- |
| www.te.com | Specifications subject |
| to change. |  |

Dimensions are in millimeters unless otherwise specified.

USA: +1 $8005226752 \quad$ For additional support numbers Asia Pacific: +86 04008206015 please visit www.te.com UK: +44 800267666

## EV250-1A \& 1B 400 Amps CZONKA-II EVX Make \& Break Load Switching

Product Facts
■ Hydrogen dielectric for power switching high current loads

■ 400 A carry, 2,500 A interrupt @ 320 Vdc

- Suited for circuit protection, control, battery switching, and main power safety disconnect

■ Versatile power, voltage, and current operating range: 28-1800 Vdc tested

- Low-cost compact version for volume production applications. Requires external coil economizer (PWM or lower hold voltage)
■ "Hammer effect" mechanism breaks light contact welds
■ "Super-sealed" environment chamber uniquely protects ALL moving parts
- Can operate in harsh environments
■ Moving contact rotates to provide fresh contact surface for low contact resistance and low power consumption
■ Sealed control connector. Mating connector with flying leads Part Number 2005 available, see page 7-95
■ Logic control enabled by external economizer Part Number 9913
■ High temperature $\left(135^{\circ} \mathrm{C}\right)$ model with 10 inch flying leads available (-4A - Call TE for sales drawing)
■ Bi-directional power switching
- Fast operate and release time


Note: Dimensions in inches. Multiply values by 25.4 for dimensions in mm .

Contact Ratings*

*For circuit conditions and actual data refer to the EV250 hot switch study. Since each application is unique, user is encouraged to verify rating in actual application.

Coil Data***

|  | EV250-1A | EV250-1B |
| :--- | :---: | :---: |
| Voltage, Nominal $^{*}$ | 12 Vdc | 24 Vdc |
| Pickup (Close), Max. | 8.3 Vdc | 16.6 Vdc |
| Continuous Hold, Max./Min.** | $5.1 / 3.8 \mathrm{Vdc}$ | $10.2 / 7.6 \mathrm{Vdc}$ |
| Dropout (Open), Min. | $0.88-3.3 \mathrm{Vdc}$ | $2.4-6.6 \mathrm{Vdc}$ |
| Coil Resistance @ $25^{\circ} \mathrm{C}, \pm 10 \%$ | $3 \Omega$ | $12 \Omega$ |
| Coil Energy, Max. | 0.2 J | 0.2 J |
| Coil Clamping | $3 \times$ nom. | $3 \times$ nom. |

*Do not apply continuously. Requires external coil economizer. Other special coil voltages available upon request.
**At maximum continuous current and maximum ambient temperature. Hold voltage must be maintained within the limits specified to keep contacts closed and to prevent coil overheating.
***Do not use a free wheeling diode or capacitor across the coil.
Ordering Information


Coil Voltage:
A $=12 \mathrm{Vdc}$, Nominal
B $=24 \mathrm{Vdc}$, Nominal

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or
805-220-2055.

For detailed specifications and recommendations, refer to the EV250-1A \& B sales drawings.

## EV250-1A \& 1B 400 Amps CZONKA-II EVX Make \& Break Load Switching (Continued)

Current vs Time

## CONTACTS CLOSED INTO 70\% AND 90\% CAPACITOR PRE CHARGE



Life Ratings and Qualification Test Plan

|  | Normal Operations |  | Abnormal Operations |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Test \# | $\mathbf{1}$ | $\mathbf{2}$ | $\mathbf{3}$ | $\mathbf{3}$ |  |
| Current | Reference Graph and | -250 A | 2500 A |  |  |
| Voltage | Test Circuit Diagram (Sht. 8) | Capacitive | Resistive | Resistive |  |
| Load Type | Capacitive | $70 \%$ | NA | N/A |  |
| \% Pre Charge | $90 \%$ | Make Only | Make/Break | Break Only |  |
| Switch Mode | Make Only |  |  |  |  |
| Sequence |  | 10 cycles | 2 | 2 |  |
| $\mathbf{1}$ | 10 K cycles | 10 | 2 | - |  |
| $\mathbf{2}$ | 10 K | 10 | 2 | - |  |
| $\mathbf{3}$ | 10 K | 10 | 2 | - |  |
| $\mathbf{4}$ | 10 K | 10 | 2 | 2 |  |
| $\mathbf{5}$ | 10 K |  | Continue Cycling to Relay Failure |  |  |
| Etc. |  |  |  |  |  |

The testing objective is to verify proper relay function for a given number of consecutive and cumulative cycles under both normal and abnormal conditions in a variety of load switching applications. The life rating of 40 K cycles minimum was calculated with $95 \%$ Weibull reliability.

## Electrical Data

(Over Temperature Range -
Max. Terminal Temp. $=200^{\circ} \mathrm{C}$ )
Make/Break Life for Capacitive \&
Resistive Loads at 320 Vdc 1,2
@ 90\% Capacitive Pre-Charge -
50,000 cycles
@ 70\% Capacitive Pre-Charge -
50 cycles
@ -250 A (2 Consecutive, Reverse
Polarity) ${ }^{1}$ - 10 cycles
@ 3300 A (Break only,
2 Consecutive) ${ }^{1}$ - 4 cycles
Mechanical Life - 100,000 cycles

## Notes:

1 Resistive load includes inductance
$\mathrm{L}=25 \mu \mathrm{H}$. Load @ 2500 A tested @ $200 \mu \mathrm{H}$.
2 Conductor: 2 each of copper
$54 \mathrm{~mm}^{2}$ (AWG 0) required for
> 250 A carry. 1 Copper (AWG 0)
conductor recommended for
$\leq 250 \mathrm{~A}$

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055

## EV250-2A \& 2B 400 Amps CZONKA II EVX Make \& Break Load Switching

## Product Facts

- Hydrogen dielectric for power switching high current loads

■ 400 A carry, 2,500 A interrupt @ 320 Vdc

- Suited for circuit protection, control, battery switching, and main power safety disconnect

■ Versatile power, voltage, and current operating range: 28-1800 Vdc tested
■ Internal coil economizer provides:

- 4W typical hold power independent of temperature \& voltage range
- EMI spectrum tested and approved
- Built-in coil suppression

■ "Hammer effect" mechanism breaks light contact welds

- Hermetically "Supersealed" environment chamber uniquely protects ALL moving parts
■ Can operate in harsh environments
■ Moving contact rotates to provide fresh contact surface for low contact resistance and low power consumption
■ Sealed control connector. Mating connector with flying leads Part Number 2005 available
■ Special versions available:
- Economical (-8A/B) for light duty power switching (without arc blowout magnets)
- 10 inch flying leads model (-7A)

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.


## Product Specifications

Contact Arrangement - SPST-NO
Contact Form - X
Continuous Current Carry, Max. -
$400 \mathrm{~A} ; 6.5$ Minutes - 500 A
Break Current @ 320 Vdc 2,500 A
Contact Resistance, Max. 0.0003 ohm

Contact Resistance, Typ. -$0.0001-0.0002$ ohm
Dielectric at Sea Level
(Leakage < 1mA) - $2,200 \mathrm{Vrms}$
Shock, 11 ms , $1 / 2$ Sine (Peak),
Operating - 30 g
Vibration, Sinusoidal
( $80-2000 \mathrm{~Hz}$, Peak) - 20 g
Operating Ambient Temperature
Range - $-40^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Load Life - See chart on next page
Operate Time, @ $25^{\circ} \mathrm{C}$ -
Close (Includes Bounce), Typ. 18 ms
Bounce (After Close Only), Max. 5 ms
Release Time (Includes Arcing),
Max. - 15 ms
Insulation Resistance @ 500 Vdc,
Min. - 100 mohm
Weight, Nominal -
$1.76 \mathrm{lb}(0.8 \mathrm{~kg})$


Note: Dimensions in inches. Multiply values by 25.4 for dimensions in mm .

Contact Ratings*

*For circuit conditions and actual data refer to the EV250 hot switch study. Since each application is unique, user is encouraged to verify rating in actual application.

Coil Data**

|  | EV250-2A | EV250-2B |
| :--- | :---: | :---: |
| Voltage, Nominal $^{*}$ | 12 Vdc | 24 Vdc |
| Pickup (Close), Max. | 9 Vdc | 18 Vdc |
| Hold, Min. | 7 Vdc | 14 Vdc |
| Dropout (Open), Min. | 5 Vdc | 10 Vdc |
| Current (@ VsNom / 25 |  |  |
| Inrush |  |  |
| Holding, Standby | 2.8 A | 1.8 A |
| Inrush Time, Max. | 0.34 A | 0.11 A |

*Other special coil voltages available upon request.
**Do not use a free wheeling diode or capacitor across the coil. Built in suppression limits back EMF to zero volts.

Ordering Information


Coil Voltage:
A $=12 \mathrm{Vdc}$, Nominal
B $=24 \mathrm{Vdc}$, Nominal
For detailed specifications and recommendations, refer to the EV250-2A \& B or 7A sales drawings.

## CONTACTS CLOSED INTO 70\% AND 90\% CAPACITOR PRE CHARGE



Life Ratings and Qualification Test Plan

| Test \# | $\frac{\text { Normal Operations }}{1}$ | Abnormal Operations |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  | 2 | 3 | 4 |
| Current | Reference Graph and Test Circuit Diagram (Sht. 8) |  | -250 A | 2500 A |
| Voltage |  |  | 320 V | 320 V |
| Load Type | Capacitive | Capacitive | Resistive | Resistive |
| \% Pre Charge | 90\% | 70\% | NA | N/A |
| Switch Mode | Make Only | Make Only | Make/Break | Break Only |
| Sequence |  |  |  |  |
| 1 | 10K cycles | 10 cycles | 2 | 2 |
| 2 | 10K | 10 | 2 | - |
| 3 | 10K | 10 | 2 | - |
| 4 | 10K | 10 | 2 | 2 |
| 5 | 10K | 10 | 2 | - |
| Etc. | Continue Cycling to Relay Failure |  |  |  |

The testing objective is to verify proper relay function for a given number of consecutive and cumulative cycles under both normal and abnormal conditions in a variety of load switching applications. The life rating of 40 K cycles minimum was calculated with $95 \%$ Weibull reliability.

## Electrical Data

(Over Temperature Range -
Max. Terminal Temp. $=200^{\circ} \mathrm{C}$ )
Make/Break Life for Capacitive \&
Resistive Loads at 320 Vdc 1,2
@ 90\% Capacitive Pre-Charge -
50,000 cycles
@ 70\% Capacitive Pre-Charge -
50 cycles
@ -250 A (2 Consecutive, Reverse
Polarity) ${ }^{1}$ - 10 cycles
@ 3300 A (Break only,
2 Consecutive) ${ }^{1}$ - 4 cycles
Mechanical Life - 100,000 cycles

## Notes:

1 Resistive load includes inductance
$\mathrm{L}=25 \mu \mathrm{H}$. Load @ 2500 A tested @ $200 \mu \mathrm{H}$.
2 Conductor: 2 each of copper
$54 \mathrm{~mm}^{2}$ (AWG 0) required for
> 250 A carry. 1 Copper (AWG 0)
conductor recommended for
$\leq 250 \mathrm{~A}$

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

## EV500 "BUBBA" Contactor 600 Amps, Make \& Break Load Switching

## Product Facts

■ Very high power sealed contactor

- Hydrogen dielectric for power switching high current loads
- Excellent for safety disconnect and transfer switch applications
■ Suited for circuit protection control
■ Hermetically "Super-sealed" environment uniquely protects contacts and all moving parts; can operate in harsh environments

■ 600-1000 A continuous carry, dependent on temperature and conductors used
■ 3,300 A interrupt, 1,000 A make, @ 320 Vdc
■ 12 and 24 volt coil control options. Call TE for custom options

- 360 kW power switch capable
- $200^{\circ} \mathrm{C}$ hot power terminals capable
■ Bi-directional power switching
■ Auxiliary contacts optional
■ Built-in dual power coil economizer, 8 W holding typical
■ Versatile power, voltage, and current operating range: 28-1800 Vdc*

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

Product Specifications
Contact Arrangement with Auxiliary Contacts -
Form X - SPST-NO
Form A - SPST-N0
Rated Resistive Load @ 270 Vdc, $85^{\circ} \mathrm{C}$ (Continuous/ 10 sec ) 600 A/1,600 A
Continuous Current Carry, Max.,
$25^{\circ} \mathrm{C} 1$ - 750 A
Overload Current @ 320 Vdc, Max. -
Make (Closed Into) - 1,000 A
Break (Open) - 3,300 A
Contact Resistance, Max. 0.0002 hm

Dielectric at Sea Level
(Leakage < 1mA) -
Open Power Terminal to Terminal $2,000 \mathrm{Vrms}$
Closed Power Terminals to All Other Points - 2,000 Vrms
Shock, 11ms, 1/2 Sine (Peak), Operating - 30 g
Vibration, Sinusoidal ( $80-2000 \mathrm{~Hz}$, Peak) - EV500-5 - 5 g

EV500-4-10 g
Operating Ambient Temperature
Range - $-40^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Load Life (Mechanical/
Electrical) ${ }^{2}$ - See next page
Operate Time @ $25^{\circ} \mathrm{C}$ -
Close (Includes Bounce), Typ. 40 ms
Bounce (After Close Only), Max. 5 ms
Release Time (Includes Arcing),
Max. at 2500 A - 20 ms
Insulation Resistance @ 500 Vdc,
Min. - 100 mohm
Weight, Nominal -
$3.38 \mathrm{lb}(1.53 \mathrm{~kg})$

## Notes:

1. Current Carry: $750 \mathrm{~A} @ 25^{\circ} \mathrm{C}$.

Derate $2.5 \mathrm{~A} /{ }^{\circ} \mathrm{C}$ to $600 \mathrm{~A} @ 85^{\circ} \mathrm{C}$ for still air, no heat sink. Reference National Electric Code for specific conductor size recommendation versus current. For > 600 A carry, call TE and request the "EV500
Current Carry study" for additiona data.
2. See EV500 sales drawing for complete specifications, including normal capacitive pre-charge make, plus abnormal make and break ratings.

Coil Data

|  | $\mathbf{1 2 ~ V}$ | $\mathbf{2 4 ~ V}$ |
| :--- | :---: | :---: |
| Type Driver | 2 Coil Electronic |  |
| Volts, Nominal $^{*}$ | 12 Vdc | 24 Vdc |
| Pickup (Close), Max. | 9.9 Vdc | 19.7 Vdc |
| Hold, Min. | 9 Vdc | 18 Vdc |
| Dropout (Open), Min. | 2 Vdc | 4 Vdc |
| Current (@ VsNom / 25 |  |  |
| Inrush |  |  |
| Holding, Standby | 3.3 A | 1.7 A |
| Inrush Time, Max. | 0.74 A | 0.37 A |



Electrical Life Cycles vs Power Switching

*Failure mode: Dielectric withstand voltage test @ 2000 Vdc, power terminal to terminal, leakage exceeds 1.0 A.


Ordering Information


A $=12 \mathrm{Vdc}$
$B=24 \mathrm{Vdc}$

Refer to EV500 Sales Drawing for complete specifications.

Catalog 5-1773450-5
Revised 3-13

Dimensions are shown for reference purposes only. Specifications subject to change.

Dimensions are in millimeters unless otherwise specified.

For additional support numbers please visit www.te.com

## EV500 "BUBBA" Contactor 600 Amps, Make \& Break Load Switching (Continued)



Life Ratings and Qualification Test Plan

| Test \# | $\frac{\text { Normal Operations }}{1}$ | Abnormal Operations |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  | 2 | 3 | 4 |
| Current | Reference Graph and Test Circuit Diagram (Sht. 8) |  | -250 A | 3300 A |
| Voltage |  |  | 320 V | 320 V |
| Load Type | Capacitive | Capacitive | Resistive | Resistive |
| \% Pre Charge | 90\% | 70\% | NA | N/A |
| Switch Mode | Make Only | Make Only | Make/Break | Break Only |
| Sequence |  |  |  |  |
| 1 | 10K cycles | 10 cycles | 2 | 2 |
| 2 | 10K | 10 | 2 | - |
| 3 | 10K | 10 | 2 | - |
| 4 | 10K | 10 | 2 | 2 |
| 5 | 10K | 10 | 2 | - |
| Etc. | Continue Cycling to Relay Failure |  |  |  |

The testing objective is to verify proper relay function for a given number of consecutive and cumulative cycles under both normal and abnormal conditions in a variety of load switching applications. The life rating of 40 K cycles minimum was calculated with $95 \%$ Weibull reliability.

## Notes:

1 Resistive load includes inductance
$\mathrm{L}=25 \mu \mathrm{H}$.
2 Testing is limited at this time.
Consult TE for official ratings.

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or
805-220-2055.

## Current vs Time

## Electrical Data

(Over Temperature Range -
Max. Terminal Temp. $=200^{\circ} \mathrm{C}$ )
Make/Break Life for Capacitive \&
Resistive Loads at 320 Vdc 1,2
@ 90\% Capacitive Pre-Charge -
50,000 cycles
@ 70\% Capacitive Pre-Charge -
50 cycles
@ -250 A (2 Consecutive, Reverse
Polarity) ${ }^{1}$ - 10 cycles
@ 3300 A (Break only,
2 Consecutive) ${ }^{1}$ - 4 cycles
Mechanical Life - 100,000 cycles

## Product Facts

■ 500 A carry, 1300 A make overload, 3000 A break overload, @ 320 Vdc

- Hydrogen dielectric for power switching high current loads
■ Auxiliary contacts
■ Coil power economizing 8 W holding
■ Versatile power, voltage, and current operating range
- Excellent for safety disconnect and transfer switch applications

■ Suited for circuit protection and control

■ Bi-directional power switching

- Hermetically-sealed contacts; can operate in harsh environments
- Fast operate and release time

■ Low power consumption

## PD350X - 500 Amps "BUBBA" Contactor, Make \& Break Load Switching

Product Specifications
Contact Arrangement -
Form X - SPST-NO
Auxiliary Contact ( $28 \mathrm{Vdc}, 0.1 \mathrm{~A}$ ) -SPST-NO
Rated Resistive Load @ 320 Vdc 300 Amps @ $85^{\circ} \mathrm{C}$
Continuous Current Carry, Max. @
$50^{\circ} \mathrm{C}$ - 500 A
Overload Current @ 320 Vdc -
Make - $1,300 \mathrm{~A}$
Break - $3,300 \mathrm{~A}$
Load Life, @ 320 Vdc, Min. -
See chart at right
Contact Resistance, Max. -
End of Life - 0.0002 ohm
Dielectric at Sea Level -
Power Terminals to Coil and All Other
Points - 1,800 Vrms
Shock, 11ms, 1/2 Sine (Peak) 30 g
Vibration, Sinusoidal
( $55-2000 \mathrm{~Hz}$, Peak) - 5 g
Operating Ambient Temperature
Range - $-40^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Operate Time, Including Bounce,
Max., $25^{\circ} \mathrm{C}$ - 40 ms
Release Time, Max. - 20 ms
Bounce Time, Max. - 5 ms
Insulation Resistance @ 500 Vdc,
Min. -
Initial - 100 mohm
End of Life - 50 mohm
Weight, Nominal -
$3.4 \mathrm{lb}(1.52 \mathrm{~kg})$


Electrical Life Cycles vs Power Switching

*Failure Mode: Dielectric withstand voltage test @ 2000 Vdc, power terminal to terminal, leakage exceeds 1.0 mA . Current carry: $500 \mathrm{~A} @ 25^{\circ} \mathrm{C}$. Derate $2.5 \mathrm{~A} /{ }^{\circ} \mathrm{C}$ to $350 \mathrm{~A} @ 85^{\circ} \mathrm{C}$ for still air, no heat sink, AWG\# 00 conductor.


Ordering Information


Catalog 5-1773450-5
Revised 3-13
www.te.com
Dimensions are shown for reference purposes only. Specifications subject to change.

Dimensions are in millimeters unless otherwise specified.

KILOVAC High Voltage Relays
High Voltage Relays Quick Reference Guide
$\left.\begin{array}{cccccc}\hline \begin{array}{c}\text { Contact } \\ \text { Voltage Vdc }\end{array} & \begin{array}{c}\text { Isolation } \\ \text { Voltage Vdc }\end{array} & \begin{array}{c}\text { Carry Current } \\ \text { (Amps DC) }\end{array} & \begin{array}{c}\text { Power } \\ \text { Switching }\end{array} & \begin{array}{c}\text { RF } \\ \text { Ratings }\end{array} & \text { Contact Form }\end{array} \begin{array}{c}\text { Part Number } \\ \text { Series }\end{array}\right]$
*Consult factory for load switching level.

For factory-direct application assistance,
dial 800-253-4560, ext. 2055, or
805-220-2055.

KILOVAC High Voltage Relays
KILOVAC High Voltage Relays Quick Reference Guide (Continued)

| Contact Voltage Vdc | Isolation Voltage Vdc | Carry Current (Amps DC) | Power Switching | $\begin{gathered} \text { RF } \\ \text { Ratings } \end{gathered}$ | Contact Form | Part Number Series |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 10 kV | 10000 | 5 | Yes | No | SPST-NO | S05LTA |
|  | 10000 | 5 | Yes | No | SPST-NC | S05LTB |
|  | 10000 | 5-30 | Special | No | SPST-NO | K81A |
|  | 10000 | 5-30 | Special | No | SPST-NC | K81B |
|  | 10000 | 5-30 | Special | No | SPDT | K81C |
|  | 10000 | 25 | Special | Yes | SPST-NO | K43A |
|  | 10000 | 25 | Special | Yes | SPST-NC | K43B |
|  | 10000 | 25 | Special | Yes | SPDT | K43C |
|  | 10000 | 24 | Special | Yes | SPDT-Latch | K43R |
|  | 10000 | 24 | Special | Yes | SPST-Latch | K43P |
| 12 kV | 12000 | 30 | Yes | Yes | DPDT | H-14 |
|  | 12000 | 30 | Yes | Yes | DPDT | H-16 |
| 15 kV | 15000 | 5 | Yes | No | SPST-NO | S05MTA |
|  | 15000 | 12 | Make Only | No | SPDT | KC-15 |
|  | 15000 | 12 | Make Only | No | SPDT | KC-16 |
|  | 15000 | 15 | Yes | Yes | SPDT | H-8 |
|  | 15000 | 15 | Yes | No | SPDT | KC-14 |
|  | 15000 | 15 | Yes | No | SPDT | KC-18 |
|  | 15000 | 30 | Yes | No | SPDT | KC-12 |
|  | 15000 | 30 | Carry Only | Yes | 4PDT | H-26 |
|  | 15000 | 30 | Yes | No | SPDT | KC-8 |
|  | 15000 | 50 | Carry Only | Yes | SPDT | KC-2 |
|  | 15000 | 50 | Carry Only | Yes | SPDT | KC-11 |
| 20 kV | 20000 | 30 | Special | Yes | DPDT | H-19 |
| 25 kV | 25000 | 15 | Make Only | No | SPST-NC | KC-38 |
|  | 25000 | 18 | Special | No | SPST-NO | K62A |
|  | 25000 | 18 | Special | No | SPST-NC | K62B |
|  | 25000 | 18 | Special | No | SPDT | K62C |
|  | 25000 | 30 | Special | Yes | SPDT | H-17 |
|  | 25000 | 30 | Make Only | No | SPST-NO | KC-28 |
|  | 25000 | 45 | Special | No | SPST-NC | KC-32 |
|  | 25000 | 55 | Carry Only | Yes | SPST-NC | KC-30 |
|  | 25000 | 65 | Special | No | SPST-NO | KC-22 |
|  | 25000 | 110 | Carry Only | Yes | SPST-NO | KC-20 |
| 30 kV | 30000 | 30 | Special | Yes | SPST-NC | H-23 |
|  | 30000 | 30 | Special | Yes | SPST-NO | H-24 |
| 35 kV | 35000 | 10 | Make Only | No | SPDT | K60C |
|  | 35000 | 10 | Make Only | No | SPST-NO | K61A |
|  | 35000 | 10 | Make Only | No | SPST-NC | K61B |
|  | 35000 | 10 | Make Only | No | SPDT | K61C |
| 50 kV | 50000 | 10 | Make Only | No | SPDT | K64C |
|  | 50000 | 30 | Special | No | SPDT | H-25 |
| 70 kV | 70000 | 10 | Make Only | No | SPST-NO | K70A |
|  | 70000 | 10 | Make Only | No | SPST-NC | K70B |
|  | 70000 | 10 | Make Only | No | SPDT | K70C |

*Consult factory for load switching level.

For factory-direct application assistance,
dial 800-253-4560, ext. 2055, or
805-220-2055.
7-50

## Product Facts

- AP5 make and break 5 A; AP10 make and break 10 A @ 270 Vdc

■ 20 A overload rating
■ Latching actuator available for low power consumption

- Ideal for applications from 28 to 1000 Vdc

■ Small size and weight
■ Wide variety of mounting styles (see pages 54 and 55)
■ No heat sinks required

- 2000 V isolation across open contacts
■ Vacuum-sealed contacts; can operate in harsh environments
■ Qualified to SAE ARD 50031
- Space-rated version built in accordance with customers SCD

Notes:
*The load terminals should always be connected as follows: Common Contact +; Other Contact -.
**10 amps for PC board connection.

## AP5/AP10 Relays

## AP5A, AP5B, \& AP5C Relays - 5 Amps

Product Specifications
Contact Arrangement -
AP5A - SPST-N0
AP5B — SPST-NC
AP5C - SPDT
Contact Form -
AP5A - A
AP5B - B
AP5C - C
Rated Resistive Load @ 270 Vdc 5 A
Continuous Current Carry, Max. AP5A, AP5B, AP5C - 25 A**

Overload @ 270 Vdc -
AP5A, AP5B - 20 A
AP5C-10 A
Contact Resistance, Max. -
10 mohm
Dielectric at Sea Level -
Coil to Case - 500 Vrms
All Other Points - 2,000 Vrms
Shock, 11ms, $1 / 2$ Sine (Peak) -
AP5A, AP5B, AP5C-50 g
Vibration, Sinusoidal
( $55-2000 \mathrm{~Hz}$, Peak) - 10 g
Operating Ambient Temperature
Range - $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Load Life @ 270 Vdc, Min. -
AP5A, AP5B - 50,000 cycles
AP5C - 10,000 cycles

## AP10A, AP10B, AP10P \& AP11A Relays - 10 Amps

Product Specifications
Contact Arrangement -
AP10A - SPST-N0
AP10B - SPST-NC
AP10P - SPST Latching
Contact Form -
AP10A - A
AP10B-B
AP10P - P
Rated Resistive Load @ 270 Vdc 10 A*
Continuous Current Carry, Max. -
AP10A, AP10B - 25 A**
AP10P - 30 A**
Overload @ 270 Vdc — 20 A
Contact Resistance, Max. -
10 mohm
Dielectric at Sea Level -
Coil to Case - 500 Vrms
All Other Points - 2,000 Vrms
Shock, 11ms, 1/2 Sine (Peak) 50 g

Coil Data

| Volts, Nominal | $\mathbf{1 2}$ | $\mathbf{2 8}$ | $\mathbf{2 8 ~ 2 ~}^{\mathbf{2}}$ | $\mathbf{1 2 0}$ |
| :--- | :---: | :---: | :---: | :---: |
| Pickup, Max. ${ }^{1}$ | 10 Vdc | 20 Vdc | 16 Vdc | 85 Vdc |
| Dropout, Min. | $.3-6 \mathrm{Vdc}$ | $.7-12 \mathrm{Vdc}$ | $\mathrm{N} / \mathrm{A}$ | $5-55 \mathrm{Vdc}$ |
| Coil Resistance ( $\pm 10 \%)$ | $53 \Omega$ | $290 \Omega$ | $80 \Omega$ | $4700 \Omega$ |

Coil resistance rated at $25^{\circ} \mathrm{C}$
Notes:

1. Value for AP5C is 24 for 28 Vdc coil \& 100 for 120 Vdc coil
2. Latching

For factory-direct application assistance,
dial $800-253-4560$, ext. 2055, or
805-220-2055.

Vibration, Sinusoidal ( $55-2000 \mathrm{~Hz}$, Peak) - 10 g
Operating Ambient Temperature
Range - $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Load Life @ 270 Vdc, Min. -
AP10A - 10,000 cycles
AP10B, AP10P - 7,000 cycles
Operate Time,
Excluding Bounce, Max. -
AP10A, AP10B - 7 ms
AP10P -4 ms

Ordering Information
Sample Part Number
Series:
Contact Form:
$A=$ SPST-NO $\quad B=$ SPST-NC $\quad C=$ SPDT
P = SPST Latching
Coil Voltage:
$2=12 \mathrm{Vdc}$, Bus Wire/PC Board
3 = 28 Vdc , Bus Wire/PC Board
$5=120$ Vdc, Bus Wire/PC Board
$7=12 \mathrm{Vdc}$, Turret Terminals
$8=28 \mathrm{Vdc}$, Turret Terminals
$9=120 \mathrm{Vdc}$, Turret Terminals
A $=12$ Vdc, Stud Terminals, Panel Mount
B $=28$ Vdc, Stud Terminals, Panel Mount
C $=120$ Vdc, Stud Terminals, Panel Mount
Release Time, Max. -
AP10A, AP10B - 10 ms
AP10P - N/A
Bounce Time, Max. -
AP10A, AP10B - 3 ms
AP10P - 2 ms
Insulation Resistance @ 500 Vdc,
Min. -
Initial - 100 mohm
End of Life - 50 mohm
Weight, Nominal -
28 gram (1 0z.)

## Power Terminals:

3 = Solder Connection/PC Board 4 = Flying Leads
5 = Stud Terminals, Panel Mount
Mounting:
$2=$ Flanged Mount $4=$ Through Chassis Mount
5 = PCB Mount 7 = Panel Mount

| Catalog 5-1773450-5 | Dimensions are shown for <br> reference purposes only. | Dimensions are in millimeters <br> Revised 3-13 |
| :--- | :--- | :--- |
| Specificatioss otherwise specified. <br> to change. |  |  |
| www.te.com |  |  |

## AP5/AP10 Relays (Continued)

Through chassis style
mounting with solder type
power terminals and turret
terminals (Available in form
A, B, \& C)

AP5A834 Shown as
Part Number Sample

Through chassis style mounting with solder type merminals and turret coil terminals (Available in forms A, B, \& C)

Part Number Sample

Through chassis style mounting with solder type power terminals and bus wire coil leads (Available in forms A, B, C, P)

AP10A334 Shown as Part Number Sample

Flanged style mounting with solder type power terminals and turret coil terminals (Available in forms A, B, \& C)

## AP5C832 Shown as

 Part Number SampleFlanged style mounting with solder type power terminals and bus wire coil leads (Available in forms A, B, C, P)

## AP5C332 Shown as

 Part Number SampleFor factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.


## AP5/AP10 Relays (Continued)

PC board style mounting with PC board terminals (Available in forms A, B, \& C)

AP10A335 Shown as Part Number Sample


4×. 15 (3.8)


Panel style mounting with flying power leads and stud terminals


Panel style mounting with stud terminals (Available in forms A \& B)


AP10AB57 Shown as Part Number Sample


For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

| Catalog 5-1773450-5 | Dimensions are shown for <br> reference purposes only. |
| :--- | :--- |
| Revised 3-13 | Specifications subject |
| www.te.com | to change. |

## AP44P - 15 Amps

## Product Facts

- 15 A make and break @ 270 Vdc
- 45 A carry

■ 60 A overload rating

- Ideal for high voltage applications from 28 to 270 Vdc
■ Latching actuator for low power consumption
- 2000 V isolation across open contacts
- Small size and weight
- Space-rated version built in accordance with customers SCD
- Meets many requirements of MIL-PRF-32085

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.



Product Specifications
Contact Arrangement -
SPST Latching
Contact Form — P
Rated Resistive Load @ 270 Vdc 15 A*
Continuous Current Carry, Max. 45 A

Overload @ 270 Vdc —60 A
Contact Resistance, Max. -
10 mohm
Dielectric at Sea Level -
Coil to Case - 500 Vrms
All Other Points - 2,000 Vrms

Shock, 11ms, 1/2 Sine (Peak) 50 g
Vibration, Sinusoidal
(55-2000 Hz, Peak) - $15 \mathrm{~g}^{\star \star}$
Operating Ambient Temperature
Range $--55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Load Life @ 270 Vdc, Min. 5,000 cycles
Operate Time,
Excluding Bounce, Max. -2 ms
Release Time, Max. - N/A
Bounce Time, Max. - 3 ms

Latch/Reset Time, Including Bounce, Max. - 5 ms

Insulation Resistance @ 500 Vdc,
Min. -
Initial - 100 mohm
End of Life - 50 mohm
Weight, Nominal 43 gram (1.5 oz.)

Notes:
*The load terminals should always be connected as follows: Common Contact +; Other Contact -

Coil Data

| AP44P | $\mathbf{2 8}$ Latching |
| :--- | :---: |
| Latch, Max. | 22 Vdc |
| Reset, Max. | 22 Vdc |
| Coil Resistance ( $\pm 10 \%)$ | $80 \Omega$ |

Coil resistance rated at $25^{\circ} \mathrm{C}$

## Ordering Information



Coil Voltage:
3 = 28 Vdc, Bus Wire
Power Terminals: $\qquad$
3 = Solder Connection
Mounting:
4 = Standard

Dimensions are shown for reference purposes only. Specifications subject to change.

## PD5 Make \& Break Load Switching

## Product Facts

■ Vacuum dielectric for power switching

- Excellent for control applications
■ PCB and panel mountings
■ Rugged design for the most demanding applications, including seismic shock
■ Small size and weight
■ Low power consumption
■ No heat sinks required
■ Vacuum-sealed; can operate in explosive and harsh environments
- 2000 V isolation across open contacts

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.


## Contact Ratings*



Switching Current (A)
*Based on extrapolated data. Since each application is unique, user is encouraged to verify rating in actual application. The load terminals should always be connected as follows: Common Contact (A2) positive; Other Contact negative.

## Coil Data

| Nominal Volts DC | $\mathbf{1 2 ~ V d c}$ | $\mathbf{2 4 ~ V d c}$ | $\mathbf{1 2 5}$ Vdc |
| :--- | :---: | :---: | :---: |
| Max. Coil Voltage | 14 Vdc | 28 Vdc | 130 Vdc |
| Pickup, Max. @ $85^{\circ} \mathrm{C}$ | 8 Vdc | 16 Vdc | 80 Vdc |
| Hold, Min. @ $85^{\circ} \mathrm{C}$ | 3.3 Vdc | 10 Vdc | 33 Vdc |
| Dropout, Min. @ $-40^{\circ} \mathrm{C}$ | .5 Vdc | 1 Vdc | 5 Vdc |
| Coil Resistance $( \pm 10 \%)$ | $70 \Omega$ | $290 \Omega$ | $4700 \Omega$ |

Ratings listed are for $25^{\circ} \mathrm{C}$, sea level conditions

## Ordering Information

Sample Part Number
PD5 A 235


A = SPST-NO
B = SPST-NC
C = SPDT (PCB Only)

## Coil Voltage:

$2=12 \mathrm{Vdc}$, PCB Version $3=24 \mathrm{Vdc}$, PCB Version
$5=125$ Vdc, PCB Version
A $=12 \mathrm{Vdc}$, Panel Mount Version
B $=24$ Vdc, Panel Mount Version
C $=125 \mathrm{Vdc}$, Panel Mount Version

## Power Terminals:

3 = PCB Solder Connection
5 = Stud Terminal, Panel Mount
Mounting:


## PD10 Make \& Break Load Switching

Product Facts

- Excellent for control applications
■ PCB and panel mountings
- Rugged design for the most demanding applications, including seismic shock
■ Small size and weight
■ Low power consumption
■ No heat sinks required
■ Vacuum-sealed; can operate in explosive and harsh environments
- 2000 V isolation across open contacts
■ Vacuum dielectric for power switching

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.


Panel mount version shown above is applicable to both PD5 and PD10. For PD10, the two power terminals are $.064^{\prime \prime}$ (1.63) diameter. Refer to PD5 for PCB mount dimensions.

Product Specifications Contact Arrangement -
PD10A - SPST-NO
PD10B - SPST-NC
PD10P*** - SPST-Latching
Contact Form -
PD10A - A**
PD10B — B**
PD10P*** - $P^{* *}$
Rated Resistive Load @ 320 Vdc 10 A
Continuous Current Carry, Max. @ $85^{\circ} \mathrm{C}$ -
PD10A and PD10B - 25 A
PD10P*** — 30 A
Overload @ 320 Vdc,
(Make/Break) — 20 A

## Contact Ratings*


*Based on extrapolated data. Since each application is unique, user is encouraged to verify rating in actual application. The load terminals should always be connected as follows: Common Contact (A2) positive; Other Contact negative.

## Coil Data

| Nominal Volts DC | $\mathbf{1 2 ~ V d c}$ | $\mathbf{2 4 ~ V d c}$ | $\mathbf{1 2 5}$ Vdc |
| :--- | :---: | :---: | :---: |
| Max. Coil Voltage | 14 Vdc | 28 Vdc | 130 Vdc |
| Pickup, Max. @ $85^{\circ} \mathrm{C}$ | 8 Vdc | 16 Vdc | 80 Vdc |
| Hold, Min. @ $85^{\circ} \mathrm{C}$ | 3.3 Vdc | 10 Vdc | 33 Vdc |
| Dropout, Min. @ $-40^{\circ} \mathrm{C}$ | .5 Vdc | 1 Vdc | 5 Vdc |
| Coil Resistance $( \pm 10 \%)$ | $70 \Omega$ | $290 \Omega$ | $4700 \Omega$ |

Ratings listed are for $25^{\circ} \mathrm{C}$, sea level conditions


Life, (Mechanical/Rated Load) -
PD10A and PD10B -
500 k cycles/ 10 k cycles
PD10P*** - 7,000 cycles
Contact Resistance, Max.,
End of Life -
PD10A and PD10B - 0.030 ohm
PD10P*** - 0.030 ohm
Dielectric at Sea Level -
Power Terminals to Coil and
All Other Points -
PD10A and PD10B - 1,800 Vrms
PD10P*** - 2,000 Vrms
Shock, 11ms, 1/2 Sine (Peak) -
25 g
Vibration, Sinusoidal
( $55-2000 \mathrm{~Hz}$, Peak) -5 g
Operating Ambient Temperature
Range -
PD10A and PD10B - $-40^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
PD10P*** - $-35^{\circ} \mathrm{C}$ to $+65^{\circ} \mathrm{C}$
Operate Time, Max., Including
Bounce @ $25^{\circ} \mathrm{C}$ -
PD10A and PD10B — 10 ms
PD10P*** -6 ms
Ordering Information
Sample Part Number
Series:
Contact Form:
A = SPST-NO
B = SPST-NC
$P=$ SPST-Latching
Coil Voltage:
$2=12 \mathrm{Vdc}$, PCB Version $3=24 \mathrm{Vdc}, \mathrm{PCB}$ Version
$5=125$ Vdc, PCB Version
A $=12 \mathrm{Vdc}$, Panel Mount Version
B $=24 \mathrm{Vdc}$, Panel Mount Version
C $=125 \mathrm{Vdc}$, Panel Mount Version

## Power Terminals:

3 = PCB Solder Connection
5 = Stud Terminal, Panel Mount

## Mounting:

5 = PCB Mount
7 = Panel Mount

Release Time, Max., Including
Bounce @ $25^{\circ} \mathrm{C}$ -
PD10A and PD10B — 10 ms
PD10P*** -6 ms
Insulation Resistance @ 500 Vdc,
Min. -
Initial/End of Life - 100 mohm/50 mohm
Weight, Nominal -
71 g (. 156 lb )

## Notes:

**Contact TE for availability of other contact forms
***Not available in package shown, package is the same as the K41P

| Catalog 5-1773450-5 | Dimensions are shown for |
| :---: | :---: |
| Revised 3-13 | reference purposes only. |
| w.te.com | Specifications subject to change. |

www.te.com

Dimensions are in millimeters unless otherwise specified.

## K45 Series Make \& Break Load Switching - 1.5-2 kV Relays

## K45C

## Product Facts

■ Small, low profile 2 kV relay
■ Vacuum dielectric for power switching low current loads
■ Single pole, double throw contacts

■ Widely used in H.F. communication equipment

■ Meets requirements of MIL-R-83725

■ Low power consumption


Product Specifications
Contact Arrangement -
SPDT
Contact Form - C
Test Voltage, DC or 60 Hz (Peak) 4 kV
Rated Operating Voltage (Peak) -
DC or $60 \mathrm{~Hz}-2 \mathrm{kV}$
$2.5 \mathrm{MHz}-1.8 \mathrm{kV}$
$16 \mathrm{MHz}-1.4 \mathrm{kV}$
$32 \mathrm{MHz}-1.1 \mathrm{kV}$

Coil Data

| Volts, Nominal DC | $\mathbf{1 2 ~ V}$ | $\mathbf{2 6 . 5}$ V |
| :--- | :---: | :---: |
| Pickup, Max. | 8 Vdc | 16 Vdc |
| Hold, Max. @ $65^{\circ} \mathrm{C}$ | 8.5 Vdc | 17 Vdc |
| Dropout | $.5-5 \mathrm{Vdc}$ | $1-10 \mathrm{Vdc}$ |
| Coil Resistance $( \pm 10 \%)$ | $230 \Omega$ | $920 \Omega$ |

Ratings listed are for $25^{\circ} \mathrm{C}$, sea level conditions.

For factory-direct application assistance,
dial 800-253-4560, ext. 2055, or
805-220-2055.


| Continuous Carry Current, Max. - | Vibration - |
| :---: | :---: |
| DC or $60 \mathrm{~Hz}-20 \mathrm{~A}$ | Peak - 10 g ( 10 to 2000 Hz ) |
| $2.5 \mathrm{MHz}-16 \mathrm{~A}$ | Operating Ambient Temperature |
| $16 \mathrm{MHz}-10 \mathrm{~A}$ | Range - $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ |
| $32 \mathrm{MHz}-6 \mathrm{~A}$ | Mechanical Life |
| Coil Hi-Pot (Vrms, 60 Hz ) - 500 A | 2 million cycles |
| Contact Capacitance - | Weight, Nominal |
| Between Open Contacts - 1.6 pF | $21.26 \mathrm{~g}(0.75 \mathrm{oz} .)$ |
| Open Contacts to Ground - 2 pF |  |
| Contact Resistance, Max. 0.05 ohm |  |
| Operate Time, Max. - 10 ms |  |
| Release Time, Max. - 10 ms |  |
| Shock, 11ms, 1/2 Sine (Peak) 30 g |  |

## Ordering Information



2 = Flanged

See page 7-87 for mounting methods.

| Catalog 5-1773450-5 | Dimensions are shown for | Dimensions are in millimeters | USA: +1 800 522 6752 | For additional support numbers |
| :--- | :--- | :--- | :--- | :--- |
| Revised 3-13 | reference purposes only. <br> Specifications subject <br> to change. |  | unless otherwise specified. | Asia Pacific: +8604008206015 | | please visit www.te.com |
| :--- |
| www.te.com |

## HC Series - 3.5 kV Relays

HC-1
No Load Switching
HC-3
Make \& Break Load Switching
Product Facts for $\mathrm{HC}-1$
■ Widely used for RF applications

- Vacuum dielectric for low leakage current applications
■ Copper contacts for high current capability
■ Not designed for power switching
■ Meets requirements of MIL-R-83725

■ QPL version available, M83725/5-001

## HC-5

Make Only Load Switching
Product Facts for HC-5
■ Gas-filled for "make only" power switching

■ SF-6 gas-filled for capacitive discharge applications

- Tungsten contacts for long life when power switching

Product Specifications for
HC-1, HC-3 and HC-5
Contact Arrangement - SPDT
Contact Form - C
Test Voltage, DC or 60 Hz (Peak) -
5 kV
Rated Operating Voltage (Peak) -
DC or $60 \mathrm{~Hz}-3.5 \mathrm{kV}$
$2.5 \mathrm{MHz}-2.5 \mathrm{kV}$
16 MHz - 2 kV
32 MHz - 1.5 kV
Continuous Carry Current, Max. -
DC or $60 \mathrm{~Hz}-\mathrm{HC}-1-25 \mathrm{~A}$
HC-3-18 A
HC-5 - 8 A
2.5 MHz-HC-1 - 14 A

16 MHz - $\mathrm{HC}-1-9 \mathrm{~A}$
32 MHz - HC-1 - 7 A
Coil Hi-Pot (Vrms, 60 Hz ) — 500 A
Contact Capacitance -
Between Open Contacts -
HC-1 - 2 pF

$2 x .25$ (6.4) max


Product Facts for HC-3
■ Tungsten contacts for
For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055

- Vacuum dielectric for power switching low current loads


Open Contacts to Ground -
HC-1 - 2.5 pF
Contact Resistance, Max. -
C-1 - 0.01 ohm
HC-3 -0.02 ohm
HC-5 - 0.50 ohm*
Operate Time, Max. - 6 ms
Release Time, Max. - 6 ms
Shock, 11ms, 1/2 Sine (Peak) 50 g
Vibration -
Peak — 10 g ( 55 to 2000 Hz )
Operating Ambient Temperature
Range - $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Mechanical Life -
HC-1, HC-3 - 2 million cycles
HC-5 - 1 million cycles
Weight, Nominal -
28.35 g (1.0 oz.)

Note:
*Contact resistance for gas-filled relays is measured at $28 \mathrm{Vdc}, 1$ Amp


Coil Data

| Nominal Volts DC | $\mathbf{1 2 ~ V d c}$ | $\mathbf{2 6 . 5}$ Vdc | $\mathbf{1 1 5 ~ V d c}$ |
| :--- | :---: | :---: | :---: |
| Pickup, Max. | 8 Vdc | 16 Vdc | 80 Vdc |
| Dropout | $.5-5 \mathrm{Vdc}$ | $1-10 \mathrm{Vdc}$ | $5-50 \mathrm{Vdc}$ |
| Coil Resistance $( \pm 10 \%)$ | $80 \Omega$ | $335 \Omega$ | $6000 \Omega$ |

Ratings listed are for $25^{\circ} \mathrm{C}$, sea level conditions

Ordering Information


## K41 Series Make \& Break Load Switching - 5.0 kV Relays

K41A, K41B

## Product Facts

■ High current carry rating
■ Vacuum dielectric for power switching low current loads
■ Glazed ceramics for low current leakage
■ Compact, space-saving design
■ Meets requirements of MIL-R-83725
■ QPL versions available, M83725/21 \& M83725/22

## K41C

## Product Facts

■ Single pole, double throw version
■ Vacuum dielectric for power switching low current loads
■ RF ratings to 32 MHz
■ Long life: 2 million cycles
■ Meets requirements of MIL-R-83725
■ QPL version available, M83725/23

Product Specifications for K41A, K41B and K41C

## Contact Arrangement -

K41A - SPST-N0
K41B - SPST-NC
K41C - SPDT
Contact Form -
K41A-A
K41B - B
K41C - C
Test Voltage, DC or 60 Hz (Peak) 6 kV
Rated Operating Voltage (Peak) -
DC or $60 \mathrm{~Hz}-5 \mathrm{kV}$
$2.5 \mathrm{MHz}-4.5 \mathrm{kV}$
16 MHz - 3.5 kV
32 MHz - 2.8 kV
Continuous Carry Current, Max. -
DC or $60 \mathrm{~Hz}-30 \mathrm{~A}$
$2.5 \mathrm{MHz}-24 \mathrm{~A}$
$16 \mathrm{MHz}-16 \mathrm{~A}$
32 MHz - 12 A
Coil Hi-Pot (Vrms, 60 Hz ) — 500 A

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.


Contact Capacitance -
Between Open Contacts - 1.2 pF Open Contacts to Ground - 1.2 pF
Contact Resistance, Max. 0.02 ohm

Operate Time, Max. - 10 ms
Release Time, Max. - 10 ms
Shock, 11ms, $1 / 2$ Sine (Peak) 50 g
Vibration -
Peak - 10 g ( 55 to 2000 Hz )
Operating Ambient Temperature
Range $--55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Mechanical Life -2 million cycles
Weight, Nominal -
28.35 g ( 1.0 oz.)
*See page 7-87 for turret terminal dimensions and mounting methods.

Coil Data

| Nominal Volts DC | $\mathbf{1 2 ~ V d c}$ | $\mathbf{2 6 . 5}$ Vdc | $\mathbf{1 1 5}$ Vdc |
| :--- | :---: | :---: | :---: |
| Pickup, Max. | 8 Vdc | 16 Vdc | 80 Vdc |
| Dropout | $.5-5 \mathrm{Vdc}$ | $1-10 \mathrm{Vdc}$ | $5-50 \mathrm{Vdc}$ |
| Coil Resistance $( \pm 10 \%)$ | $70 \Omega$ | $290 \Omega$ | $4700 \Omega$ |

Ratings listed are for $25^{\circ} \mathrm{C}$, sea level conditions

## Ordering Information



## K41 Series Make \& Break Load Switching - 5.0 kV Relays

K41P

## Product Facts

■ Fast, 6 millisecond operate time
■ Vacuum dielectric for power switching low current loads
■ Latching actuator for low power consumption
■ Ideal for frequency agile communication systems
■ Meets requirements of MIL-R-83725
■ QPL version available, M83725/24

## K41R

## Product Facts

■ Latching actuator for low power consumption
■ Vacuum dielectric for power switching low current loads

- Meets requirements of MIL-R-83725
■ Latching version of K41C

Product Specifications for
K41P and K41R
Contact Arrangement -
K41P - SPST-Latching
K41R — SPDT-Latching
Contact Form -
K41P - P
K41R — R
Test Voltage, DC or 60 Hz (Peak) 6 kV
Rated Operating Voltage (Peak) -
DC or $60 \mathrm{~Hz}-5 \mathrm{kV}$
2.5 MHz - K41P - 4.5 kV

K41R - 4.0 kV
16 MHz - $\mathrm{K} 41 \mathrm{P}-3.5 \mathrm{kV}$
$\mathrm{K} 41 \mathrm{R}-3.2 \mathrm{kV}$
32 MHz - K41P - 2.8 kV
K41R-2.5 kV
Continuous Carry Current, Max. -
DC or $60 \mathrm{~Hz}-30 \mathrm{~A}$
2.5 MHz-K41P - 20 A

K41R-16A
16 MHz - K41P - 13 A
K41R-10 A
32 MHz - K41P — 10 A
K41R-6A
Coil Hi-Pot (Vrms, 60 Hz ) — 500 A


Contact Capacitance -
Between Open Contacts -
K41P - 1.2 pF
K41R - 1.6 pF
Open Contacts to Ground -
K41P-1.2 pF
K41R - 1.6 pF
Contact Resistance, Max. -
0.02 ohm

Operate Time, Max. - 6 ms
Release Time, Max. - N/A
Shock, 11ms, $1 / 2$ Sine (Peak) -
$\mathrm{K} 41 \mathrm{P}-50 \mathrm{~g}$
K41R-30 g
Vibration -
Peak - 10 g ( 55 to 2000 Hz )
Operating Ambient Temperature
Range $-{ }^{-55^{\circ}} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Insulation Resistance -
Initial - 10 gigaohms
Mechanical Life - 1 million cycles
Weight, Nominal -
28.35 g ( 1.0 oz.)

Coil Data

| Volts, Nominal | $\mathbf{2 6 . 5 ~ V d c}$ |
| :--- | :---: |
| Reset \& Latch, Max. | $\mathbf{1 6 ~ V d c}$ |
| Dropout | $\mathrm{N} / \mathrm{A}$ |
| Coil Resistance $( \pm 10 \%)$ | $80 \Omega$ |

Ratings listed are for $25^{\circ} \mathrm{C}$, sea level conditions.

Ordering Information

*See page 7-87 for mounting methods.

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055

## K40P Make \& Break Load Switching - 5.0 kV Relays

## Product Facts for K40P

- Vacuum dielectric for power switching low current loads
- Fast, 1 millisecond operate time

■ Long life: 10 million cycles
■ 35 Amps continuous current rating at DC; 8 Amps at 32 MHz
■ Ideal for high power antenna couplers

- Meets requirements of MIL-R-83725

Product Facts for K40P364

- Double sided terminals for ease of connection to bus bar
■ Vacuum dielectric for power switching low current loads
■ Fast switching, high current capabilities
■ Small and lightweight


Contact Capacitance -
Between Open Contacts - 1.2 pF
Open Contacts to Ground - 1.2 pF
Contact Resistance, Max. 0.02 hm

Operate Time, Max. - 1 ms
Release Time, Max. - N/A
Shock, 11ms, $1 / 2$ Sine (Peak) -
50 g
Vibration -
Peak - 30 g ( 55 to 2000 Hz )
Operating Ambient Temperature
Range $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Mechanical Life - 10 million cycles
Weight, Nominal -
28.35 g ( 1.0 oz.)

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or
805-220-2055.

| $l$ |  |
| :--- | :---: |
| Coil Data |  |
| Volts, Nominal | $\mathbf{2 6 . 5 ~ V d c}$ |
| Reset \& Latch, Max. | 16 Vdc |
| Dropout | $\mathrm{N} / \mathrm{A}$ |
| Coil Resistance $( \pm 10 \%)$ | $80 \Omega$ |

Ratings listed are for $25^{\circ} \mathrm{C}$, sea level conditions.

## Ordering Information


*See page 7-87 for mounting methods.

| Catalog 5-1773450-5 | Dimensions are shown for <br> reference purposes only. |
| :--- | :--- |
| Revised 3-13 | Specifications subject <br> to change. |
| www.te.com | tol |

## KM-17 Series Make Only Load Switching — 7.5 kV Relays

## Product Facts

■ Double pole, double throw contacts

- SF-6 gas-filled for ideal discharge waveform
■ High voltage flying leads
■ Tabs for easy mount
■ Widely used in defibrillator applications


## Product Specifications for

KM-17
Contact Arrangement — DPDT
Contact Form - 2 C
Test Voltage, DC or 60 Hz (Peak) 14 kV
Rated Operating Voltage (Peak) -
DC or $60 \mathrm{~Hz}-7.5 \mathrm{kV}$
Continuous Carry Current, Max. -
DC or $60 \mathrm{~Hz}-10 \mathrm{~A}$
Coil Hi-Pot (Vrms, 60 Hz ) — 500 A
Contact Capacitance -
Between Open Contacts - N/A
Open Contacts to Ground - N/A
Contact Resistance, Max. -
$0.5 \mathrm{ohm}^{*}$
Operate Time, Max. - 20 ms
Release Time, Max. - 20 ms
Shock, 11ms, $1 / 2$ Sine (Peak) 10 g


Vibration -
Peak - $10 \mathrm{~g}(55$ to 500 Hz$)$
Operating Ambient Temperature
Range - $-20^{\circ} \mathrm{C}$ to $+65^{\circ} \mathrm{C}$
Insulation Resistance -
Initial - 10 gigaohms
Mechanical Life

- 1000,000 cycle

Weight, Nominal -
KM-17 - 311.8 g (11 oz.)

Coil Data

| Nominal Volts DC | $\mathbf{1 2 ~ V d c}$ | $\mathbf{2 6 ~ V d c}$ |
| :--- | :---: | :---: |
| Pickup, Max. | 8 Vdc | 16 Vdc |
| Dropout | $.5-5 \mathrm{Vdc}$ | $1-10 \mathrm{Vdc}$ |
| Coil Resistance $( \pm 10 \%)$ | $12 \Omega$ | $48 \Omega$ |

Ratings listed are for $25^{\circ} \mathrm{C}$, sea level conditions
Coils are not for continuous duty.


## Ordering Information



[^7]805-220-2055.

## K47 Series Make \& Break Load Switching - 8 kV Relays

K47A
Product Facts for K47A
■ Widely used in antenna coupler applications
■ Short actuator, low profile, 8 kV relay
■ Vacuum dielectric for power switching low current loads
■ Normally open contacts
■ Meets requirements of MIL-R-83725

## K47B

## Product Facts for K47B

■ Normally closed version of K47
■ Vacuum dielectric for power switching low current loads
■ 707 Ohm coil for low power consumption

- Meets requirements of MIL-R-83725
■ QPL version available, M83725/18-003

Product Specifications for
K47A and K47B
Contact Arrangement -
K47A - SPST-NO
K47B — SPST-NC
Contact Form -
K47A - A
K47B - B
Test Voltage, DC or 60 Hz (Peak) 9 kV
Rated Operating Voltage (Peak) -
DC or $60 \mathrm{~Hz}-8 \mathrm{kV}$
$2.5 \mathrm{MHz}-7.5 \mathrm{kV}$
$16 \mathrm{MHz}-7 \mathrm{kV}$
32 MHz - 5 kV
Continuous Carry Current, Max. -
DC or $60 \mathrm{~Hz}-12 \mathrm{~A}$
$2.5 \mathrm{MHz}-10 \mathrm{~A}$
$16 \mathrm{MHz}-5 \mathrm{~A}$
$32 \mathrm{MHz}-3 \mathrm{~A}$
Coil Hi-Pot (Vrms, 60 Hz ) — 500 A
Contact Capacitance -
Between Open Contacts - 1.2 pF
Open Contacts to Ground - 1.2 pF
For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.


Contact Resistance, Max. 0.03 ohm

Operate Time, Max. - 10 ms
Release Time, Max. - 10 ms
Shock, $11 \mathrm{~ms}, 1 / 2$ Sine (Peak) 30 g Vibration -
Peak — 10 g ( 55 to 1000 Hz )
Operating Ambient Temperature
Range - $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Mechanical Life - 2 million cycles
Weight, Nominal -
25.5 g (0.9 oz.)

## Ordering Information



## HC Series $\mathbf{- 8}$ kV Relays

HC-2
No Load Switching
HC-4
Make \& Break Load
Switching
Product Facts for HC-2
■ Vacuum dielectric and copper contacts for high current carry rating of 25 Amps

■ Not designed for power switching
■ Stable, low contact resistance
■ Meets requirements of MIL-R-83725


Product Facts for HC-4


Shock, 11ms, 1/2 Sine (Peak) 50 g
Vibration -
Peak — $10 \mathrm{~g}(55$ to 2000 Hz$)$
Operating Ambient Temperature
Range $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Mechanical Life -
HC-2 and HC-4 - 2 million cycles
HC-6 - 1 million cycle
Weight, Nominal -
39.69 g (1.4 oz.)
*Contact resistance for gas-filled relays is measured at $28 \mathrm{Vdc}, 1 \mathrm{Amp}$
Contact Capacitance -
Between Open Contacts - N/A
Open Contacts to Ground - N/A
Contact Resistance, Max. -
HC-2 - 0.01 ohm
HC-4 - 0.02 ohm
HC-6 - $0.50 \mathrm{hm}^{*}$
Operate Time, Max. - 6 ms
Release Time, Max. - 6 ms

- Tungsten contacts for long life in power switching applications
- Vacuum dielectric for arc suppression when making or breaking a load


Meets requirements of MIL-R-83725

## HC-6

Make Only Load Switching
Product Facts for HC-6

- Tungsten contacts for switching high in-rush loads
■ SF-6 gas-filled for capacitive discharge applications
■ Suitable for ESD testing applications
- Tungsten contacts for long life in power switching applications

Product Specifications for
HC-2, HC-4 and HC-6
Contact Arrangement - SPDT
Contact Form - C
Test Voltage, DC or 60 Hz (Peak) 10 kV
Rated Operating Voltage (Peak) -
DC or $60 \mathrm{~Hz}-8 \mathrm{kV}$
Continuous Carry Current, Max. -
DC or $60 \mathrm{~Hz}-\mathrm{HC}-2-25$ ARMS
HC-4 - 15 A RMS
HC-6 - 8 A RMS
Coil Hi-Pot (Vrms, 60 Hz ) - 500 A RMS
Ordering Information


## Product Facts

■ Smallest DPDT high voltage relay
■ Vacuum dielectric for power switching low current loads
■ 8 kV rating; carries 2 Amps at 32 MHz
■ Tungsten contacts for power switching low current loads

- Meets requirements of MIL-R-83725



## Product Specifications

Contact Arrangement DPDT
Contact Form - 2 C
Test Voltage, DC or 60 Hz (Peak) 10 kV
Rated Operating Voltage (Peak) DC or $60 \mathrm{~Hz}-8 \mathrm{kV}$
$2.5 \mathrm{MHz}-5 \mathrm{kV}$
16 MHz — 3 kV
32 MHz - 2 kV

Continuous Carry Current, Max. -
DC or $60 \mathrm{~Hz}-10 \mathrm{~A}$
2.5 MHz-7A
$16 \mathrm{MHz}-3 \mathrm{~A}$
32 MHz - 2 A
Coil Hi-Pot (Vrms, 60 Hz ) — 500 A
Contact Capacitance -
Between Open Contacts - 0.8 pF
Open Contacts to Ground - 1.5 pF
Contact Resistance, Max. -
0.02 ohm

Operate Time, Max. - 15 ms
Release Time, Max. -15 ms


Shock, 11ms, $1 / 2$ Sine (Peak) 30 g Vibration -
Peak — 10 g ( 55 to 500 Hz )
Operating Ambient Temperature Range $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Mechanical Life - 1 million cycles
Weight, Nominal -
70.87 g (2.5 oz.)

Coil Data

| Volts, Nominal DC | $\mathbf{1 2 ~ V}$ | $\mathbf{2 6 . 5} \mathrm{V}$ | $\mathbf{1 1 5} \mathrm{V}$ |
| :--- | :---: | :---: | :---: |
| Pickup, Max. | 8 Vdc | 16 Vdc | 80 Vdc |
| Dropout | $.5-5 \mathrm{Vdc}$ | $1-10 \mathrm{Vdc}$ | $5-50 \mathrm{Vdc}$ |
| Coil Resistance $( \pm 10 \%)$ | $60 \Omega$ | $250 \Omega$ | $3500 \Omega$ |

Ordering Information


For factory-direct application assistance, dial 800-253-4560, ext. 2055, or
805-220-2055.

|  |  |  | 7-65 |  |
| :--- | :--- | :--- | :--- | :--- | :--- |
| Catalog 5-1773450-5 | Dimensions are shown for | Dimensions are in millimeters | USA: +18005226752 | For additional support numbers |
| Revised 3-13 | reference purposes only. | unless otherwise specified. | Asia Pacific: +8604008206015 | please visit www.te.com |
| Specifications subject |  | UK: +44800267666 |  |  |

## K44P Make \& Break Load Switching - 8 kV Relays

## Product Facts

■ Single pole, single throw contacts with latching actuator
■ Vacuum dielectric for power switching low current loads

- 20 G vibration rating

■ Carries 50 Amps at DC

- Space rated versions available
■ Meets requirements of MIL-R-83725



## Product Specifications

Contact Arrangement -
SPST-Latching
Contact Form — P
Test Voltage, DC or 60 Hz (Peak) 10 kV
Rated Operating Voltage (Peak) DC or $60 \mathrm{~Hz}-8 \mathrm{kV}$
2.5 MHz — 7 kV
$16 \mathrm{MHz}-6 \mathrm{kV}$
32 MHz - 4 kV
Continuous Carry Current, Max. -
DC or $60 \mathrm{~Hz}-50 \mathrm{~A}$
2.5 MHz-40 A

16 MHz — 25 A
$32 \mathrm{MHz}-20 \mathrm{~A}$
Coil Hi-Pot (Vrms, 60 Hz ) — 500 A
Contact Capacitance -
Between Open Contacts - 2.5 pF
Open Contacts to Ground - 2.8 pF
Contact Resistance, Max. -
0.01 ohm

Operate Time, Max. - 5 ms
Release Time, Max. - N/A
Shock, 11ms, $1 / 2$ Sine (Peak) 50 g
Vibration -
Peak - 20 g (55 to 2000 Hz )
Operating Ambient Temperature
Range - $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Mechanical Life - 1 million cycles
Weight, Nominal -
59.53 g (2.1 oz.)

Coil Data

| Volts, Nominal | $\mathbf{2 6 . 5}$ Vdc |
| :--- | :---: |
| Latch \& Reset, Max. | 23 Vdc |
| Dropout | $\mathrm{N} / \mathrm{A}$ |
| Coil Resistance ( $\pm 10 \%)$ | $155 \Omega$ |

Ratings listed are for $25^{\circ} \mathrm{C}$, sea level conditions

Ordering Information

| Sample Part Number | K44 P 33 |
| :---: | :---: |
| Series: |  |
| Contact Form: P = SPST-Latching |  |
| Coil Voltage: 3 = 26.5 Vdc, Bus Wire |  |
| High Voltage Connections: <br> 3 = Solder Connection |  |
| Mounting: <br> 2 = Flanged |  |

*See page 7-87 for mounting methods.

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

## K81 A/B Series Make \& Break Load Switching - 10 kV Relays




Operating Ambient Temperature
Range - $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Mechanical Life
-2 million cycles
Weight, Nominal -
56.7 g (2 oz.)

## Notes:

1. PC pin versions carry 5 or 20 Amps, see part number at right. Flying lead and panel versions carry 30 Amp.
*Power terminal on 20 Amp version is a larger diameter than on the 5 Amp version ( $.025=5$ Amp, .064 = 20 Amp)

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

Coil Data

| Volts, Nominal DC | $\mathbf{1 2 ~ V}$ | $\mathbf{2 6 . 5}$ V | $\mathbf{1 1 5}$ V |
| :--- | :---: | :---: | :---: |
| Pickup, Max. | 8 Vdc | 16 Vdc | 80 Vdc |
| Dropout | $.5-5 \mathrm{Vdc}$ | $1-10 \mathrm{Vdc}$ | $5-50 \mathrm{Vdc}$ |
| Coil Resistance $( \pm 10 \%)$ | $70 \Omega$ | $290 \Omega$ | $4700 \Omega$ |

Ratings listed are for $25^{\circ} \mathrm{C}$, sea level conditions
Ordering Information
Sample Part Number
Series:
Contact Form:
A = SPST-NO
B = SPST-NC
Coil Voltage:
2 = 12 Vdc, PC Board 3 = 26.5 Vdc, PC Board
$5=115 \mathrm{Vdc}$, PC Board
A $=12$ Vdc, Stud Terminals, Panel Mount
B $=26.5 \mathrm{Vdc}$, Stud Terminals, Panel Mount
C $=115$ Vdc, Stud Terminals, Panel Mount
High Voltage Connections:
A $^{*}=$ PCB Solder Connection - 20 Amp
3 = PCB Solder Connection - 5 Amp
4 = Flying Leads $\quad 5=$ Stud Terminals
Mounting:
5 = PC Board 7 = Panel Mount

## KILOVAC High Voltage Relays

## K81C Series Make \& Break Load Switching - 10 kV Relays

## Product Facts

■ SPDT version of K81
■ Vacuum dielectric for power switching low current loads

- Flying lead version will carry 10 Amps continuous current


■ PCB mount version will carry 5 Amps continuous current


Product Specifications Contact Arrangement SPDT
Contact Form — C
Test Voltage, DC or 60 Hz (Peak) -
11 kV
Rated Operating Voltage (Peak) DC or 60 Hz - 10 kV

Continuous Carry Current, Max. DC or 60 Hz - See Note 1 Coil Hi-Pot (Vrms, 60 Hz) —N/A
Contact Resistance, Max. 0.05 hm

Operate Time, Max. - 10 ms
Release Time, Max. - 10 ms

Shock, 11ms, 1/2 Sine (Peak) 30 g
Vibration -
Peak — 10 g ( 55 to 500 Hz )
Operating Ambient Temperature
Range - $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Mechanical Life - 2 million cycles
Weight, Nominal -
70.87 g (2.5 oz.)

Note:

1. 5 Amp carry for PC pin versions. 30 Amp carry for flying lead versions.

Coil Data

| Volts, Nominal DC | $\mathbf{1 2}$ V | $\mathbf{2 6 . 5} \mathbf{V}$ | $\mathbf{1 1 5}$ V |
| :--- | :---: | :---: | :---: |
| Pickup, Max. | $\mathbf{8 V d c}$ | 16 Vdc | 80 Vdc |
| Dropout | $.5-5 \mathrm{Vdc}$ | $1-10 \mathrm{Vdc}$ | $5-50 \mathrm{Vdc}$ |
| Coil Resistance $( \pm 10 \%)$ | $70 \Omega$ | $290 \Omega$ | $4700 \Omega$ |

Ratings listed are for $25^{\circ} \mathrm{C}$, sea level conditions

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or
805-220-2055

Ordering Information
 5 = PC Board

## K43 Series Make \& Break Load Switching - 10 kV Relays

K43A and K43B
Product Facts for
K43A and K43B
■ 10 kV, 25 Amps continuous current relay

- RF ratings to 32 MHz

■ Vacuum dielectric for power switching low current loads

- 2 million cycle mechanical life
■ QPL versions available, M83725/17 \& M83725/10


## K43C

Product Facts for K43C
■ SPDT version of K43
■ Vacuum dielectric for power switching low current loads
■ Flange mounting available
■ Carries 10 Amps at 32 MHz
■ Meets requirements of MIL-R-83725
■ QPL version available, M83725/16

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

Product Specifications for
K43A, K43B and K43C
Contact Arrangement -
K43A - SPST-N0
K43B — SPST-NC
K43C - SPDT
Contact Form -
K43A - A
K43B - B
K43C - C
Test Voltage, DC or 60 Hz (Peak) -
11 kV
Rated Operating Voltage (Peak) -
DC or 60 Hz - 10 kV
$2.5 \mathrm{MHz}-7 \mathrm{kV}$
$16 \mathrm{MHz}-6 \mathrm{kV}$
32 MHz - 4 kV
Continuous Carry Current, Max. -
DC or $60 \mathrm{~Hz}-25 \mathrm{~A}$
$2.5 \mathrm{MHz}-20 \mathrm{~A}$
$16 \mathrm{MHz}-13 \mathrm{~A}$
32 MHz - 10 A
Coil Hi-Pot (Vrms, 60 Hz ) — 500 A
Contact Capacitance -
Between Open Contacts - 1.2 pF
Open Contacts to Ground - 1.2 pF


Contact Resistance, Max. 0.02 ohm

Operate Time, Max. — 10 ms
Release Time, Max. - 10 ms
Shock, 11ms, $1 / 2$ Sine (Peak) 50 g
Vibration -
Peak — 10 g ( 55 to 2000 Hz )
Operating Ambient Temperature Range $-{ }^{-55^{\circ}} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Mechanical Life - 2 million cycles
Weight, Nominal -
28.35 g ( 102 .)
*See page 7-87 for turret terminal dimensions and mounting methods.


Coil Data

| Volts, Nominal DC | $\mathbf{1 2 ~ V}$ | $\mathbf{2 6 . 5} \mathrm{V}$ | $\mathbf{1 1 5}$ V |
| :--- | :---: | :---: | :---: |
| Pickup, Max. | 8 Vdc | 16 Vdc | 80 Vdc |
| Dropout | $.5-5 \mathrm{Vdc}$ | $1-10 \mathrm{Vdc}$ | $5-50 \mathrm{Vdc}$ |
| Coil Resistance $( \pm 10 \%)$ | $70 \Omega$ | $290 \Omega$ | $4700 \Omega$ |

Ratings listed are for $25^{\circ} \mathrm{C}$, sea level conditions

Ordering Information


Coil Voltage:
$2=12 \mathrm{Vdc}$, Bus Wire $\quad 3=26.5 \mathrm{Vdc}$, Bus Wire
$5=115 \mathrm{Vdc}$, Bus Wire $\quad 7=12 \mathrm{Vdc}$, Turret Terminal*
$8=26.5 \mathrm{Vdc}$, Turret Terminal*
$9=115 \mathrm{Vdc}$, Turret Terminal*
High Voltage Connections:


3 = Solder Connection
Mounting*:


KILOVAC K43P
Make \& Break Load Switching
Product Facts for K43P
■ High power rating; 24 Amps DC continuous current carry

- Vacuum dielectric for power switching low current loads
- Low power consumption
- Fast operating: 5 millisecond operate time
- Meets requirements of MIL-R-83725

KILOVAC K43R

## Make \& Break Load

 SwitchingProduct Facts for K43R
■ Single pole, double throw contacts with latching actuator
■ Vacuum dielectric for power switching low current loads
■ Carries 6 Amps at 32 MHz

- Meets requirements of MIL-R-83725


## Product Specifications for

K43P and K43R
Contact Arrangement -
K43P — SPST-Latching
K43R — SPDT-Latching
Contact Form -
K43P - P
K43R — R
Test Voltage, DC or 60 Hz (Peak) 11 kV
Rated Operating Voltage (Peak) -
DC or 60 Hz - 10 kV
$2.5 \mathrm{MHz}-7 \mathrm{kV}$
$16 \mathrm{MHz}-6 \mathrm{kV}$
$32 \mathrm{MHz}-4 \mathrm{kV}$
Continuous Carry Current, Max. -
DC or $60 \mathrm{~Hz}-24 \mathrm{~A}$
2.5 MHz-16 A
$16 \mathrm{MHz}-9 \mathrm{~A}$
$32 \mathrm{MHz}-6 \mathrm{~A}$
Coil Hi-Pot (Vrms, 60 Hz ) — 500 A
Contact Capacitance -
Between Open Contacts - 1.2 pF
Open Contacts to Ground - 1.2 pF
For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

## K43 Series Make \& Break Load Switching - 10 kV Relays (Continued)



Contact Resistance, Max. -
0.02 ohm

Operate Time, Max. -
K43P - 5 ms
K43R-6 ms
Release Time, Max. — N/A
Shock, $11 \mathrm{~ms}, 1 / 2$ Sine (Peak) 30 g
Vibration -
Peak — 7 g ( 55 to 2000 Hz )
Operating Ambient Temperature
Range - $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Mechanical Life - 1 million cycles
Weight, Nominal -
28.35 g (1 oz.)
*See page 7-87 for mounting methods.

Coil Data

| Volts, Nominal | $\mathbf{2 6 . 5 ~ V d c}$ |
| :--- | :---: |
| Latch \& Reset, Max. | 16 Vdc |
| Dropout | $\mathrm{N} / \mathrm{A}$ |
| Coil Resistance $( \pm 10 \%)$ | $80 \Omega$ |

Ratings listed are for $25^{\circ} \mathrm{C}$, sea level conditions

## H-14/16 Series Make \& Break Load Switching - 12 kV Relays

H-14
Product Facts for H-14

- Double pole, double throw contacts

■ Vacuum dielectric for power switching low current loads
■ 30 Amps DC continuous current rating

■ Corona shield high voltage terminals available

■ Meets requirements of MIL-R-83725

H-16
Product Facts for H-16
■ 12 kV rating; isolates 5 kV at 32 MHz

- Vacuum dielectric for power switching low current loads
- Double pole, double throw contacts
■ Widely used as a transmit/receive switch
- Meets requirements of MIL-R-83725


Product Specifications for
$\mathrm{H}-14$ and $\mathrm{H}-16$
Contact Arrangement - DPDT
Contact Form - 2 C
Test Voltage, DC or 60 Hz (Peak) -
15 kV
Rated Operating Voltage (Peak) -
DC or 60 Hz - 12 kV
2.5 MHz - 10 kV

16 MHz - 8 kV
32 MHz - 5 kV
Continuous Carry Current, Max. -
DC or 60 Hz - 30 A
$2.5 \mathrm{MHz}-\mathrm{H}-14-15 \mathrm{~A}$
H-16 - 10 A
16 MHz - $\mathrm{H}-14$ - 10 A
H-16 - 6 A
32 MHz - $\mathrm{H}-14-8 \mathrm{~A}$
H-16-4A
Coil Hi-Pot (Vrms, 60 Hz ) — 500 A

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or
805-220-2055.

$L_{2 \times .25(6.4) \text { max }}$



Contact Capacitance -
Between Open Contacts - 1 pF Open Contacts to Ground — 2.5 pF Contact Resistance, Max. -
H-14 - 0.015 ohm
H-16 - 0.03 ohm
Operate Time, Max. - 20 ms
Release Time, Max. - 20 ms
Shock, 11ms, $1 / 2$ Sine (Peak) -
20 g
Vibration -
Peak - 10 g ( 55 to 500 Hz )
Operating Ambient Temperature
Range $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Mechanical Life
(Operations x $\mathbf{1 0}^{6}$ ) -
H-14 - 1 million cycles
H-16 - 500,000 cycles
Weight, Nominal -
$\mathrm{H}-14$ - 226.8 g ( 8 oz.)
$\mathrm{H}-16$ - 170.1 g ( 6 oz.)

Coil Data

| Nominal Volts DC | $\mathbf{1 2 ~ V d c}$ | $\mathbf{2 6 . 5}$ Vdc | $\mathbf{1 1 5}$ Vdc |
| :--- | :---: | :---: | :---: |
| Pickup, Max. | 8 Vdc | 16 Vdc | 80 Vdc |
| Dropout | $.5-5 \mathrm{Vdc}$ | $1-10 \mathrm{Vdc}$ | $5-50 \mathrm{Vdc}$ |
| Coil Resistance $( \pm 10 \%)$ | $24 \Omega$ | $120 \Omega$ | $2000 \Omega$ |

Ratings listed are for $25^{\circ} \mathrm{C}$, sea level conditions

Ordering Information


Blank = 26.5 Vdc
$/ 12 \mathrm{Vdc}=12 \mathrm{Vdc}$
$/ 115 \mathrm{Vdc}=115 \mathrm{Vdc}$

| Catalog 5-1773450-5 | Dimensions are shown for <br> reference purposes only. |
| :--- | :--- |
| Revised 3-13 | Specifications subject <br> to change. |
| www.te.com | lol |

## H-8 Make \& Break Load Switching - 15 kV Relays

Product Facts
■ Single pole, double throw contacts
■ Vacuum dielectric for power switching low current loads

- 30 Amps DC continuous current rating
■ Corona shield high voltage terminals available
- Meets requirements of MIL-R-83725


| Product Specifications | Continuous Carry Current, Max. | Shock, 11ms, 1/2 Sine (Peak) - |
| :---: | :---: | :---: |
| Contact Arrangement - | DC or 60 Hz - 15 A RMS | 30 g |
| SPDT | 2.5 MHz - 10 A RM | Vibration - |
| Contact Form - C | $16 \mathrm{MHz}-6 \mathrm{ARMS}$ | Peak - 10 g ( 55 to 500 Hz ) |
| Test Voltage, DC or 60 Hz (Peak) 20 kV | Coil Hi-Pot (Vrms, 60 Hz ) — 500 A RMS | Operating Temperature Range - $-55^{\circ} \mathrm{C} \text { to }+125^{\circ} \mathrm{C}$ |
| Rated Operating Voltage (Peak) DC or 60 Hz - 15 kV | Between Open Contacts - 1 pF <br> Open Contacts to Ground - 1.5 pF | Mechanical Life -1 million cycles Weight, Nominal - |
| $\begin{aligned} & 2.5 \mathrm{MHz}-12 \mathrm{kV} \\ & 16 \mathrm{MHz}-10 \mathrm{kV} \end{aligned}$ | Contact Resistance, Max. 0.015 ohm |  |
|  | Operate Time, Max. - 15 ms |  |
|  | Release Time, Max. - 15 ms |  |

Coil Data

| Volts, Nominal DC | $\mathbf{1 2 ~ V}$ | $\mathbf{2 6 . 5}$ V | $\mathbf{1 1 5 ~ V}$ |
| :--- | :---: | :---: | :---: |
| Pickup, Max. | 8 Vdc | 16 Vdc | 80 Vdc |
| Dropout | $.5-5 \mathrm{Vdc}$ | $1-10 \mathrm{Vdc}$ | $5-50 \mathrm{Vdc}$ |
| Coil Resistance $( \pm 10 \%)$ | $60 \Omega$ | $265 \Omega$ | $3500 \Omega$ |

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

## KC Series Make \& Break Load Switching - 15 kV Relays

## KC-14



KC-18
Product Facts for
KC-14 and KC-18

- Specifically designed for load switching applications
- Can power switch and isolate loads
■ Replaces KILOVAC KC-8 and KC-12
■ Meets requirements of MIL-R-83725


## Product Specifications for

KC-14 and KC-18
Contact Arrangement - SPDT
Contact Form - C
Test Voltage, DC or 60 Hz (Peak) 17 kV
Rated Operating Voltage (Peak) -
DC or $60 \mathrm{~Hz}-15 \mathrm{kV}$
Continuous Carry Current, Max. -
DC or $60 \mathrm{~Hz}-30 \mathrm{~A}$
Coil Hi-Pot (Vrms, 60 Hz ) — 500 A
Contact Capacitance -
Between Open Contacts - 0.5 pF
Open Contacts to Ground - 1 pF
Contact Resistance, Max. -
0.025 ohm

Operate Time, Max. - 15 ms
Release Time, Max. - 9 ms
For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

*Hot Switching, Resistive Load Life

| Voltage | Current | Load Life <br> Operations |
| :---: | :---: | :---: |
| 330 Vdc | 17 Amps | 10,000 |
| 330 Vdc | 5 Amps | 100,000 |
| $5,000 \mathrm{Vdc}$ | 2 Amps | 100,000 |
| $10,000 \mathrm{Vdc}$ | 1 Amps | 50,000 |

*Ratings are for normally open contacts only. No testing has been performed on normally closed contacts.

## Coil Data

| Volts, Nominal DC | $\mathbf{1 2 ~ V}$ | $\mathbf{2 6 . 5} \mathrm{V}$ | $\mathbf{1 1 5}$ V |
| :--- | :---: | :---: | :---: |
| Pickup, Max. | 8 Vdc | 16 Vdc | 80 Vdc |
| Dropout | $.5-5 \mathrm{Vdc}$ | $1-10 \mathrm{Vdc}$ | $5-50 \mathrm{Vdc}$ |
| Coil Resistance $( \pm 10 \%)$ | $48 \Omega$ | $180 \Omega$ | $2900 \Omega$ |

Ratings listed are for $25^{\circ} \mathrm{C}$, sea level conditions
Ordering Information


## KC-2

No Load Switching
Product Facts
■ Vacuum dielectric for low and stable contact resistance
■ Carries 50 Amps at DC; 10 Amps at 32 MHz

- Not designed for power switching


## KC-8

## Product Facts for KC-8

- Not recommended for new design. See KC-14 on page 7-82 for replacement.


## KC-11

No Load Switching

## Product Facts

■ Threaded base version of KC-2

■ Vacuum dielectric for low leakage current applications

## KC-12

Product Facts
■ Not recommended for new design. See KC-18 on page 7-67 for replacement.
■ Vacuum dielectric for power switching low current loads

## KC Series Make \& Break Load Switching - 15 kV Relays (Continued)



Contact Capacitance -
Between Open Contacts - 0.5 pF
Open Contacts to Ground — 1 pF Contact Resistance, Max. -KC-2 and KC-11 - 0.012 ohm KC-8 and KC-12 - 0.025 ohm
Operate Time, Max. - 15 ms
Release Time, Max. - 9 ms
Shock, $11 \mathrm{~ms}, 1 / 2$ Sine (Peak) 50 g
Vibration -
Peak — $10 \mathrm{~g}(55$ to 500 Hz )
Operating Ambient Temperature Range $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Mechanical Life - 1 million cycles
Weight, Nominal -
85 g (3 oz.)

Coil Data

| Nominal Volts DC | $\mathbf{1 2 ~ V d c}$ | $\mathbf{2 6 . 5}$ Vdc | $\mathbf{1 1 5}$ Vdc |
| :--- | :---: | :---: | :---: |
| Pickup, Max. | 8 Vdc | 16 Vdc | 80 Vdc |
| Dropout | $.5-5 \mathrm{Vdc}$ | $1-10 \mathrm{Vdc}$ | $5-50 \mathrm{Vdc}$ |
| Coil Resistance ( $\pm 10 \%)$ |  |  |  |
| KC-2 and KC-11 | $60 \Omega$ | $250 \Omega$ | $3500 \Omega$ |
| KC-8 and KC-12 | $48 \Omega$ | $180 \Omega$ | $2900 \Omega$ |

Ratings listed are for $25^{\circ} \mathrm{C}$, sea level conditions

Ordering Information


## KC Series Make Only Load Switching - 15 kV Relays (Continued)

KC-15
Product Facts
■ SF-6 gas-filled for power switching on the "make"
■ Long load life in capacitive discharge

- Recommended for ESD testing and safety interlock applications
- Meets requirements of MIL-R-83725

KC-16
Product Facts
■ Threaded base version of KC-15
■ SF-6 gas-filled for power switching on the "make"
■ 15 kV rating

- Meets requirements of MIL-R-83725

Product Specifications for
KC-15 and KC-16
Contact Arrangement - SPDT
Contact Form - C
Test Voltage, DC or 60 Hz (Peak) 17 kV
Rated Operating Voltage (Peak) -
DC or $60 \mathrm{~Hz}-15 \mathrm{kV}$
Continuous Carry Current, Max. -
DC or $60 \mathrm{~Hz}-12 \mathrm{~A}$
Coil Hi-Pot (Vrms, 60 Hz ) — 500 A
Contact Capacitance -
Between Open Contacts - N/A
Open Contacts to Ground - N/A
Contact Resistance, Max. -
$1.0 \mathrm{hm}^{*}$
Operate Time, Max. - 15 ms
Release Time, Max. - 9 ms
Shock, 11ms, $1 / 2$ Sine (Peak) 50 g
Vibration -
Peak — 10 g ( 55 to 500 Hz )

Coil Data

| Volts, Nominal DC | $\mathbf{1 2 ~ V}$ | $\mathbf{2 6 . 5} \mathrm{V}$ | $\mathbf{1 1 5} \mathrm{V}$ |
| :--- | :---: | :---: | :---: |
| Pickup, Max. | 8 Vdc | 16 Vdc | 80 Vdc |
| Dropout | $.5-5 \mathrm{Vdc}$ | $1-10 \mathrm{Vdc}$ | $5-50 \mathrm{Vdc}$ |
| Coil Resistance ( $\pm 10 \%)$ | $48 \Omega$ | $180 \Omega$ | $2900 \Omega$ |

Ratings listed are for $25^{\circ} \mathrm{C}$, sea level conditions

## Ordering Information



For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.



Operating Ambient Temperature
Range $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Mechanical Life - 1 million cycles Weight, Nominal - 85 g ( 3 oz.$)$

Note:
*Contact resistance for gas-filled relays measured $28 \mathrm{Vdc}, 1 \mathrm{Amp}$

## Product Facts

- Highly reliable four pole double throw relay
- Used to switch multiple loads and for polarity reversal
■ Vacuum dielectric for power switching low current loads
■ Meets requirements of MIL-R-83725


## H-19/17 Series Make \& Break Load Switching — 20/25 kV Relays

H-19

## Product Facts

■ 20 kV operating voltage
■ Vacuum dielectric and tungsten contacts for power switching low current loads
■ Double pole, double throw contacts

■ Available with corona shield connectors

■ Meets requirements of MIL-R-83725

## H-17

Product Facts
■ Will isolate 12 kV at 32 MHz

- Tungsten contacts suitable for power switching low current loads
■ Available with corona shield connectors
- Meets requirements of MIL-R-83725

■ QPL version available, M83725/2

## Product Specifications for

$\mathrm{H}-19$ and $\mathrm{H}-17$
Contact Arrangement -
H-19 - DPDT
H-17 - SPDT
Contact Form -
H-19 - 2 C
H-17 - C
Test Voltage, DC or 60 Hz (Peak) -
$\mathrm{H}-19-25 \mathrm{kV}$
H-17 - 30 kV
Rated Operating Voltage (Peak) -
DC or 60 Hz - $\mathrm{H}-19-20 \mathrm{kV}$
H-17-25 kV
2.5 MHz - H-19-15 kV

H-17-20 kV
16 MHz - $\mathrm{H}-19-10 \mathrm{kV}$
H-17 - 15 kV
$32 \mathrm{MHz}-\mathrm{H}-19-7 \mathrm{kV}$
H-17-12 kV
Continuous Carry Current, Max. -
DC or $60 \mathrm{~Hz}-30 \mathrm{~A}$
2.5 MHz-H-19—18A

H-17 - 16 A

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or
805-220-2055.


16 MHz - $\mathrm{H}-19-9 \mathrm{~A}$
$\mathrm{H}-17-10 \mathrm{~A}$
$32 \mathrm{MHz}-\mathrm{H}-19-6 \mathrm{~A}$
H-17-8 A
Coil Hi-Pot (Vrms, 60 Hz ) — 500 A
Contact Capacitance -
Between Open Contacts - 1 pF
Open Contacts to Ground - 2.5 pF
Contact Resistance, Max. -
0.015 ohm

Operate Time, Max. -
H-19 - 30 ms
H-17-25ms
Release Time, Max. -
H-19 - 20 ms
H-17 - 25 ms
Shock, 11ms, $1 / 2$ Sine (Peak) -
H-19—30 g
$\mathrm{H}-17-20 \mathrm{~g}$
Vibration -
Peak — 10 g ( 55 to 500 Hz )
Operating Ambient Temperature
Range $--55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Mechanical Life - 1 million cycles
Weight, Nominal -
$\mathrm{H}-19-241 \mathrm{~g}$ (8.5 02.) H-17 - 198.4 g ( 7 0z.)


Coil Data

| Nominal Volts DC | $\mathbf{1 2 ~ V d c}$ | $\mathbf{2 6 . 5}$ Vdc | $\mathbf{1 1 5 ~ V d c}$ |
| :--- | :---: | :---: | :---: |
| Pickup, Max. | 8 Vdc | 16 Vdc | 80 Vdc |
| Dropout | $.5-5 \mathrm{Vdc}$ | $1-10 \mathrm{Vdc}$ | $5-50 \mathrm{Vdc}$ |
| Coil Resistance ( $\pm 10 \%)$ |  |  |  |
| H-19 | $48 \Omega$ | $225 \Omega$ | $2100 \Omega$ |
| $\mathrm{H}-17$ | $24 \Omega$ | $120 \Omega$ | $2900 \Omega$ |

Ratings listed are for $25^{\circ} \mathrm{C}$, sea level conditions

## Ordering Information

| Sample Part Number | H- $17 / 12 \mathrm{Vdc}$ |
| :---: | :---: |
| Series: |  |
| Model: $\qquad$ <br> H-19 <br> H-17 |  |
| Coil Voltage: <br> Blank $=26.5 \mathrm{Vdc}$ $/ 12 \mathrm{Vdc}=12 \mathrm{Vdc}$ $/ 115 \mathrm{Vdc}=115 \mathrm{Vdc}$ |  |

## K62 Series Make \& Break Load Switching - $\mathbf{2 5}$ kV Relays

K62A and K62B
Product Facts

- 25 kV relay with flying leads for ease of installation

■ Vacuum dielectric and tungsten contacts for power switching low current loads

- Meets requirements of MIL-R-83725



## K62C

Product Facts
■ SPDT version of K62
■ Vacuum dielectric for power switching low current loads
■ Carries 18 Amps continuous current
■ Meets requirements of MIL-R-83725

Product Specifications for K62A, K62B and K62C
Contact Arrangement -
K62A - SPST-N0
K62B - STST-NC
K62C - SPDT
Contact Form -
K62A - A
K62B - B
K62C - C
Test Voltage, DC or 60 Hz (Peak) -
30 kV
Rated Operating Voltage (Peak) DC or $60 \mathrm{~Hz}-25 \mathrm{kV}$

Continuous Carry Current, Max. -
DC or 60 Hz - 18 A
Coil Hi-Pot (Vrms, 60 Hz ) — 500 A
Contact Resistance, Max. -
0.50 ohm

Operate Time, Max. - 15 ms
Release Time, Max. - 15 ms

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or
805-220-2055.

Shock, 11ms, $1 / 2$ Sine (Peak) 20 g
Vibration -
Peak — 10 g ( 55 to 500 Hz )
Operating Ambient Temperature
Range - $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Mechanical Life - 1 million cycles
Weight, Nominal - 340 g (12 02.)


Coil Data

| Volts, Nominal DC | $\mathbf{1 2 ~ V}$ | $\mathbf{2 6 . 5}$ V | $\mathbf{1 1 5}$ V |
| :--- | :---: | :---: | :---: |
| Pickup, Max. | 9 Vdc | 18 Vdc | 90 Vdc |
| Dropout | $.5-5 \mathrm{Vdc}$ | $1-10 \mathrm{Vdc}$ | $5-55 \mathrm{Vdc}$ |
| Coil Resistance $( \pm 10 \%)$ | $30 \Omega$ | $125 \Omega$ | $2400 \Omega$ |

Ratings listed are for $25^{\circ} \mathrm{C}$, sea level conditions

## Ordering Information



1 = Threaded

## KC-Series No Load Switching - 25 kV Relays

KC-20
Product Facts

- Rugged, high current carry ceramic relay
■ Carries 30 Amps at 32 MHz
- Copper contacts; not designed for power switching
- Meets requirements of MIL-R-83725


## KC-30

## Product Facts

■ Normally closed version of KC-20
■ Carries 55 Amps DC
■ Vacuum dielectric for low leakage current applications

Product Specifications for
KC-20 and KC-30
Contact Arrangement -
KC-20 - SPST-NO
KC-30 - SPST-NC
Contact Form -
KC-20 - X
KC-30 - Y
Test Voltage, DC or 60 Hz (Peak) -
KC-20-30 kV
KC-30-28 kV
Rated Operating Voltage (Peak) -
DC or 60 Hz - KC-20 - 28 kV
KC-30-25 kV
$2.5 \mathrm{MHz}-22 \mathrm{kV}$
16 MHz - KC-20 - 12 kV
KC-30 - 10 kV
32 MHz - $\mathrm{KC}-20-10 \mathrm{kV}$
Continuous Carry Current, Max. -
DC or 60 Hz - KC-20 - 110 A
KC-30-55A
2.5 MHz - KC-20 - 60 A

KC-30-30 A

$16 \mathrm{MHz}-\mathrm{KC}-20-40 \mathrm{~A}$
$\mathrm{KC}-30-20 \mathrm{~A}$
$32 \mathrm{MHz}-\mathrm{KC}-20-30 \mathrm{~A}$
$\mathrm{KC}-30-15 \mathrm{~A}$
Coil Hi-Pot (Vrms, 60 Hz) — 500 A
Contact Capacitance -
Between Open Contacts - 2.5 pF
Open Contacts to Ground - 2.5 pF
Contact Resistance, Max. -
KC-20 - 0.005 ohm
KC-30 — 0.01 ohm
Operate Time, Max. — 18 ms
Release Time, Max. -
KC-20 - 10 ms
KC-30-20 ms
Shock, 11ms, 1/2 Sine (Peak) 30 g
Vibration -
Peak — 10 g ( 55 to 500 Hz )
Operating Ambient Temperature
Range $--55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Mechanical Life - 2 million cycles
Weight, Nominal -
340 g (12 0z.)


Coil Data

| Volts, Nominal DC | $\mathbf{1 2}$ V | $\mathbf{2 6 . 5}$ V | $\mathbf{1 1 5}$ V |
| :--- | :---: | :---: | :---: |
| Pickup, Max. | 8 Vdc | 16 Vdc | 80 Vdc |
| Dropout | $.5-5 \mathrm{Vdc}$ | $1-10 \mathrm{Vdc}$ | $5-50 \mathrm{Vdc}$ |
| Coil Resistance $( \pm 10 \%)$ | $24 \Omega$ | $120 \Omega$ | $2000 \Omega$ |

Ratings listed are for $25^{\circ} \mathrm{C}$, sea level conditions

For factory-direct application assistance, dial $800-253-4560$, ext. 2055, or 805-220-2055.

## KC-Series - 25 kV Relays

KC-22, KC-32
Make \& Break Load Switching
Product Facts for KC-22

- Tungsten contacts for power switching
Product Facts for KC-32
- Normally closed version of KC-22
- Vacuum dielectric for power switching low current loads


## KC-28, KC-38

Make Only Load Switching
Product Facts for KC-28

- SF-6 gas-filled for capacitive discharge and "make only" applications
- Capable of switching 2000 Amps peak capacitive discharge for 400 nanoseconds
Product Facts for KC-38
- Normally closed version of KC-28
- SF-6 gas-filled for capacitive discharge and "make only" applications



Product Specifications for KC-22, KC-32, KC-28 \& KC-38
Contact Arrangement -
KC-22 and KC-28 - SPST-NO
KC-32 and KC-38 - SPST-NC
Contact Form -
KC-22 and KC-28 - X
KC-32 and KC-38 - Y
Test Voltage, DC or 60 Hz (Peak) 28 kV
Rated Operating Voltage (Peak) DC or $60 \mathrm{~Hz}-25 \mathrm{kV}$


Continuous Carry Current, Max. -
DC or $60 \mathrm{~Hz}-\mathrm{KC}-22-65 \mathrm{~A}$
KC-22 - 0.005 ohm
KC-33 - 0.01 ohm
KC-28 - 1.0 ohm*
KC-38-1.0 ohm*
Operate Time, Max. - 18 ms
Release Time, Max. -
$\mathrm{KC}-22$ and $\mathrm{KC}-28-10 \mathrm{~ms}$
KC32 and KC-38 - 20 ms
Shock, 11ms, 1/2 Sine (Peak) 30 g
Vibration -
Peak — 10 g ( 55 to 500 Hz )
Operating Ambient Temperature
Range $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Mechanical Life - 2 million cycles
Weight, Nominal - 340 g (12 0z.)

Coil Data

| Volts, Nominal DC | $\mathbf{1 2 ~ V}$ | $\mathbf{2 6 . 5}$ V | $\mathbf{1 1 5}$ V |
| :--- | :---: | :---: | :---: |
| Pickup, Max. | 8 Vdc | 16 Vdc | 80 Vdc |
| Dropout | $.5-5 \mathrm{Vdc}$ | $1-10 \mathrm{Vdc}$ | $5-50 \mathrm{Vdc}$ |
| Coil Resistance $( \pm 10 \%)$ | $24 \Omega$ | $120 \Omega$ | $2000 \Omega$ |

Ratings listed are for $25^{\circ} \mathrm{C}$, sea level conditions

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or
805-220-2055.

Ordering Information


## H-23/24 Series Make \& Break Load Switching - 30 kV Relay

(Not recommended for new designs)
Product Facts

- See K61 or K62 series for latest generation products
■ Vacuum dielectric for power switching low current loads



## Product Specifications

Contact Arrangement -
H-23 — SPST-NC
H-24 — SPST-N0
Contact Form -
H-23-B
H-24 - A
Test Voltage, DC or 60 Hz (Peak) 35 kV
Rated Operating Voltage (Peak) -
DC or 60 Hz - 30 kV
2.5 MHz - 24 kV

16 MHz - 18 kV
32 MHz - 7 kV
Continuous Carry Current, Max. -
DC or $60 \mathrm{~Hz}-30 \mathrm{~A}$
$2.5 \mathrm{MHz}-20 \mathrm{~A}$
$16 \mathrm{MHz}-12 \mathrm{~A}$
32 MHz - 7 A
Coil Hi-Pot (Vrms, 60 Hz ) — 500 A

Coil Data

| Volts, Nominal DC | $\mathbf{1 2}$ V | $\mathbf{2 6 . 5}$ V | $\mathbf{1 1 5}$ V |
| :--- | :---: | :---: | :---: |
| Pickup, Max. | $\mathbf{8}$ Vdc | 16 Vdc | 80 Vdc |
| Dropout | $.5-5 \mathrm{Vdc}$ | $1-10 \mathrm{Vdc}$ | $5-50 \mathrm{Vdc}$ |
| Coil Resistance $( \pm 10 \%)$ | 24 | $120 \Omega$ | $2000 \Omega$ |

Ratings listed are for $25^{\circ} \mathrm{C}$, sea level conditions

## Ordering Information

| Sample Part Number | H- 23 /12Vdc |
| :---: | :---: |
| Series: |  |
| Model: $\qquad$ <br> H-23 <br> H-24 |  |
| Coil Voltage: <br> Blank $=26.5 \mathrm{Vdc}$ <br> $/ 12 \mathrm{Vdc}=12 \mathrm{Vdc}$ <br> $/ 115 \mathrm{Vdc}=115 \mathrm{Vdc}$ |  |

## Contact Capacitance -

Between Open Contacts - N/A
Open Contacts to Ground - N/A
Contact Resistance, Max. 0.015 ohm

Operate Time, Max. - 30 ms
Release Time, Max. - 20 ms
Shock, 11ms, 1/2 Sine (Peak) -
20 g
Vibration -
Peak — 10 g ( 55 to 500 Hz )
Operating Ambient Temperature
Range - $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Mechanical Life - 1 million cycles
Weight, Nominal — 198.4 g (7 0z.)

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

## Product Facts

- SF-6 gas-filled relay is excellent for capacitive discharge applications

■ Widely used in test equipment and medical instruments
■ Fully operable in air and suitable for adverse environments

- Contact forms A, B \& C

■ 35 kV rating in compact, durable package
■ Lower cost version of K61 series

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055

## KP61 Series - 35 kV Relays



## Product Specifications

Contact Arrangement/Form -
SPST-NO / A
SPST-NC / B
SPDT / C
Test Voltage, DC or 60 Hz (Peak) 40 kV
Rated Operating Voltage (Peak) -
DC or $60 \mathrm{~Hz}-35 \mathrm{~V}$
Continuous Carry Current, Max. -
DC or $60 \mathrm{~Hz}-10 \mathrm{~A}$
Contact Resistance, Max. -
$1.0 \Omega$
Shock, 11ms, 1/2 Sine (Peak) 20 g


> Vibration —

Peak — 10 g ( 55 to 500 Hz )
Operating Ambient Temperature
Range - $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Mechanical Life - 1 million cycles
Weight, Nominal - 297.7g (10.5
oz.)

Coil Data

| Volts, Nominal DC | $\mathbf{1 2}$ V | $\mathbf{2 6 . 5}$ V | $\mathbf{1 1 5}$ V |
| :--- | :---: | :---: | :---: |
| Pickup, Max. | 30 Vdc | 125 Vdc | 2000 Vdc |
| Dropout | $.5-5 \mathrm{Vdc}$ | $1-10 \mathrm{Vdc}$ | $5-50 \mathrm{Vdc}$ |
| Coil Resistance $( \pm 10 \%)$ | 24 | $120 \Omega$ | $2000 \Omega$ |

Ratings listed are for $25^{\circ} \mathrm{C}$, sea level conditions

## Ordering Information

$$
=115 \text { Vdc, Turret Terminal }
$$

erorer

## High Voltage Connections:

4 = Flying Leads, 12"
5 = Flying Leads, 72"
6 = Flying Leads, 36"

## Mounting:

1 = Threaded

## K60 Series Make Only Load Switching - 35 kV Relays

K60C (35 kV)*

## Product Facts

■ 35 kV rating when operated in oil or potting
■ Smallest 35 kV rated relay available
*Customer must isolate high voltage terminals using suitable dielectric such as oil or potting


## Product Specifications

Contact Arrangement - SPDT
Contact Form - C
Test Voltage, DC or 60 Hz (Peak) 37 kV**

Rated Operating Voltage (Peak) -
DC or $60 \mathrm{~Hz}-35 \mathrm{kV}$ **
Continuous Carry Current, Max. -
DC or 60 Hz - 10 A RMS
Coil Hi-Pot (Vrms, 60 Hz) — 500 A RMS
Contact Resistance, Max. — N/A
Operate Time, Max. - 15 ms
Release Time, Max. - 15 ms

Shock, 11ms, $1 / 2$ Sine (Peak) 20 g
Vibration -
Peak — 10 g ( 55 to 500 Hz )
Operating Ambient Temperature
Range - $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Mechanical Life - 1 million cycles
Weight, Nominal - $93.6 \mathrm{~g}(3.3 \mathrm{oz}$.

Note:
**37 kV test voltage, 35 kV operate voltage when operated in oil.

Coil Data

| Volts, Nominal DC | $\mathbf{1 2}$ V | $\mathbf{2 6 . 5}$ V | $\mathbf{1 1 5}$ V |
| :--- | :---: | :---: | :---: |
| Pickup, Max. | 9 Vdc | 18 Vdc | 90 Vdc |
| Coil Resistance ( $\pm 10 \%)$ | $30 \Omega$ | $125 \Omega$ | $2400 \Omega$ |

Ratings listed are for $20^{\circ} \mathrm{C}$, sea level conditions

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

## K61 Series Make Only Load Switching - 35 kV Relays

K61A and K61B Product Facts for K61A and K61B

■ SF-6 gas-filled relay excellent for capacitive discharge applications
■ Widely used in test equipment and medical instruments

- Fully operable in air and suitable for adverse environments


## K61C

Product Facts for K61C

- 35 kV rating in compact, durable package
■ SF-6 gas-filled relay excellent for capacitive discharge applications
■ SPDT version of K61

Product Specifications for K61A, K61B and K61C
Contact Arrangement -
K61A - SPST-N0
K61B - STST-NC
K61C - SPDT
Contact Form -
K61A - A
K61B - B
K61C - C
Test Voltage, DC or 60 Hz (Peak) 40 kV
Rated Operating Voltage (Peak) -
DC or $60 \mathrm{~Hz}-35 \mathrm{kV}$
Continuous Carry Current, Max. -
DC or $60 \mathrm{~Hz}-10 \mathrm{~A}$
Coil Hi-Pot (Vrms, 60 Hz) — 500 A
Contact Resistance, Max. 1.0 ohm*

Operate Time, Max. - 15 ms
Release Time, Max. - 15 ms
Shock, 11ms, $1 / 2$ Sine (Peak) -
20 g

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or
805-220-2055.


## Vibration -

Peak - 10 g ( 55 to 500 Hz )
Operating Ambient Temperature Range - $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Mechanical Life -1 million cycles
Weight, Nominal - 340 g (12 oz.)

Note:
*Contact resistance for gas-filled relays measured at $28 \mathrm{Vdc}, 1 \mathrm{Amp}$

Coil Data

| Volts, Nominal DC | $\mathbf{1 2 ~ V}$ | $\mathbf{2 6 . 5}$ V | $\mathbf{1 1 5}$ V |
| :--- | :---: | :---: | :---: |
| Pickup, Max. | 9 Vdc | 18 Vdc | 90 Vdc |
| Dropout | $.5-5 \mathrm{Vdc}$ | $1-10 \mathrm{Vdc}$ | $5-50 \mathrm{Vdc}$ |
| Coil Resistance $( \pm 10 \%)$ | $30 \Omega$ | $125 \Omega$ | $2000 \Omega$ |

Ratings listed are for $25^{\circ} \mathrm{C}$, sea level conditions

## Ordering Information



## K64 \& H-25 Series - 50 kV Relays

## K64C <br> Make Only Load Switching <br> Product Facts for K64C <br> ■ SF-6 gas-filled relay ideal for high voltage isolation or "make only" power switching <br> ■ 50 kV rating in compact package <br> ■ High voltage leads and encapsulation allow full operation in air

## H-25

Make \& Break Load
Switching
Product Facts for $\mathrm{H}-25$
■ Vacuum relay provides low contact resistance
■ Vacuum dielectric for power switching low current loads


Shock, 11ms, $1 / 2$ Sine (Peak) K64C - 10 g
$\mathrm{H}-25-15 \mathrm{~g}$
Vibration -
Peak — 10 g ( 55 to 500 Hz )
Operating Ambient Temperature
Range - $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Mechanical Life -
K64C - 1 million cycles
H-25 - 500,000 cycles
Weight, Nominal -
K64C - 340 g ( 12 oz.)
H-25 -850.5 g (30 oz.)

Note:
*Contact resistance for gas-filled relays measured at $28 \mathrm{Vdc}, 1 \mathrm{Amp}$
K64C - 15 ms
H-25-60 ms
Release Time, Max. -
K64C - 15 ms
$\mathrm{H}-25-60 \mathrm{~ms}$

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or
805-220-2055.


Coil Data

|  | K64C | H-25 |
| :--- | :---: | :---: |
| Nominal Volts DC | $\mathbf{2 6 . 5}$ Vdc | $\mathbf{2 6 . 5}$ Vdc |
| Pickup, Max. | 18 Vdc | 16 Vdc |
| Dropout | $1-10 \mathrm{Vdc}$ | $1-10 \mathrm{Vdc}$ |
| Coil Resistance $( \pm 10 \%)$ | $80 \Omega$ | $120 \Omega$ |

Ratings listed are for $25^{\circ} \mathrm{C}$, sea level conditions

Ordering Information


K70A and K70B

## Product Facts

■ New, small, compact 70 kV relay package
■ SF-6 gas-filled for capacitive discharge and high voltage isolation applications
■ Suitable for charging and discharging of high voltage capacitors
■ Safe for use in adverse environments

## K70C

## Product Facts

■ SPDT version of K70A
■ SF-6 gas-filled for capacitive discharge and high voltage isolation applications
■ Suitable for charging and discharging of high voltage capacitors

Product Specifications for
K70A, K70B and K70C
Contact Arrangement -
K70A - SPST-NO
K70B - SPST-NC
K70C - SPDT
Contact Form -
K70A - A
K70B - B
K70C - C
Test Voltage, DC or 60 Hz (Peak) 75 kV
Rated Operating Voltage (Peak) DC - 70 kV
60 Hz RMS - 30 kV
Continuous Carry Current, Max. -
DC or $60 \mathrm{~Hz}-10 \mathrm{~A}$
Coil Hi-Pot (Vrms, 60 Hz ) — 500 A
Contact Capacitance -
Between Open Contacts - N/A
Open Contacts to Ground - N/A
Contact Resistance, Max. -
2.0 ohm*

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

## K70 Series Make Only Load Switching — 70 kV Relays



Operate Time, Max. - 20 ms
Release Time, Max. - 15 ms
Shock, 11ms, $1 / 2$ Sine (Peak) 20 g
Vibration -
Peak — 10 g ( 55 to 500 Hz )
Operating Ambient Temperature
Range $-0^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$
Mechanical Life - 500,000 cycles
Weight, Nominal -
510.3 g (18 oz.)

## Note:

*Contact resistance for gas-filled relays measured at $28 \mathrm{Vdc}, 1 \mathrm{Amp}$

Coil Data

| Volts, Nominal | $\mathbf{2 6 . 5 ~ V d c}$ |
| :--- | :---: |
| Pickup, Max. | 22 Vdc |
| Dropout | $1-10 \mathrm{Vdc}$ |
| Coil Resistance $( \pm 10 \%)$ | $75 \Omega$ |

Ratings listed are for $25^{\circ} \mathrm{C}$, sea level conditions

## Ordering Information



1 = Threaded

## Mounting Methods

KILOVAC "stacked ceramic" series relays can be easily mounted in any of the several ways shown below. The relay base should be mounted to a ground
potential for high voltage applications. KILOVAC relays are not position sensitive and can be mounted in any orientation.

Optional Coil Turret Terminals for PD5, PD10; K41, K43 Types


Figure 1.

Standard Flange Mounting


Figure 2.

Optional Flange Mounting for PD5, PD10; K40, K41, K43 and K45 types


Figure 4

Optional Flange Mounting for K44


Figure 3.

Spring Clip Mounting


Figure 5. Seastrom Manufacturing (800/447-3927 or 208/737-4300) Part Number 4502-53-50-2N or similar.

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

Strap Mounting


Figure 6. Adel Fasteners

| Catalog 5-1773450-5 | Dimensions are shown for <br> reference purposes only. |
| :--- | :--- |
| Revised 3-13 | Specifications subject <br> to change. |
| www.te.com | ( | 9320002 (carbon steel \& neoprene)

## Special Connectors

A number of KILOVAC relays are available with special, anti-corona high voltage connectors. Refer to the chart to determine if high voltage connectors are available for your model relay. These connectors can be ordered separately, by part number, or at the same time you order your relays (for "H: relays only) by simply adding the letter "C" to the part number. For instance, if you wish to purchase an H-8 relay with special connectors, you should order an "H-8C". If you already have an $\mathrm{H}-8$, you can order three Part Number 0510 connectors and install them yourself by removing the standard solder lugs and carefully installing the connectors so as not to damage the glass-to-metal seals.

Optional High Voltage Connectors

| Relay Model | Connector Part Number |
| :--- | :--- |
| $\mathrm{H}-14$ |  |
| $\mathrm{H}-16$ |  |

## Connectors for EV250-1A, 1B, 2A \& 2B

TE supplies a connector with 7 leads attached. Order Part Number 2005, Part Number 1618004-1.

For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

Special Connectors (Continued)


## AC Coil Operation

All TE KILOVAC relays are supplied with a DC coil. If you wish to operate the relay with AC, you may order a bridge rectifier as Part Number 0260.

## Bus Bar Connector Option for EV, LEV, CAP and MAP Products



For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

Dimensions are shown for reference purposes only. Specifications subject to change.

## Application Notes for EV/LEV Contactors

## Introduction - Product Capabilities and Typical Applications

TE KILOVAC EV and LEV contactors are designed to be the highest performance, smallest and lightest weight, sealed High Voltage contactors in the industry. With current carrying capability of up to 500A and power switching up to 200kW, they are used in a variety of industrial, marine, automotive, and commercial applications. Primarily designed to switch resistive loads, they can be used in a variety of circuit applications bearing in mind a few important considerations. This application note focuses on a few of the more common circuit configurations, and what to consider when selecting, installing and using the contactors.

## 1. Installation

EV/LEV contactors can be mounted in any orientation, and due to the nature of their hermetic seal and isolated enclosure, can be mounted in close proximity to other equipment. However, care must be taken with regard to the termination of the power cables to the main terminals. It is important that the main power connection lugs are mated directly to the terminal seats. Be sure that the hardware stackup is in the proper order, and that washers and other spacers are not placed between the lug and terminal seat. Extraneous connection resistance can cause considerable power dissipation and terminal heating at high current carry.
Refer to Figure 1 and Table I for the recommended hardware stackup and torque.


Figure 1
Main Terminal Hardware Installation

| THREAD <br> ENGAGEMENT(turns) | TORQUE |
| :---: | :---: |
| Less than 5 | Use longer fastener |
| 5 TO 7 | 7.9 Nm ( $70 \mathrm{in}-\mathrm{lb}$ ) MAX |
| 7 TO 8 | 9.0 Nm (80 in-lb) MAX |
| 8 TO 11 | $\begin{aligned} & \text { 9.0 Nm (80 in-lb) } \\ & 11 \mathrm{Nm}(100 \mathrm{in}-\mathrm{lb}) \mathrm{MAX} \end{aligned}$ |
| Mounting Feet (all) | 1.7-3.3 Nm (30-35 in-lb) |

## 2. Coils, Drive Circuits and Coil Economizing

Since the power required to close the contacts is generally much greater than the required holding power, many KILOVAC contactors can be packaged with low-profile coils that utilize either an electronic economizer (switchmode PWM), or mechanical cut-throat economizer. The economizer lets-through the higher power required for contact closure, then reduces the power for holding, greatly reducing the coil power consumption and heating. These circuits are packaged with the contactor, and in most cases include coil suppression components as well. For customers who wish to provide their own circuitry, TE can provide suggestions for driving the coils of all versions of contactors. Single coil, uneconomized products are also available in the LEV product line. These coils are designed to operate at nominal power over all specified voltage and temperature ranges withouteconomizing circuitry. DC Coils up to 400 Vdc and AC coils with integrated converters are available up to 240 Vac .

## 3. Load Types and Power Switching Recommendations

In general, all EV/LEV contactors are designed primarily for connection and interruption of resistive loads and slightly inductive loads (L/R<1ms). High currents (up to 2000A) can be interrupted in case of circuit faults, and high continuous currents upwards of 500A can be maintained through closed contacts. Some important points to consider are:
a. Closing into current spikes due to uncharged filter capacitors. Capacitors should be pre-charged whenever possible to avoid excessive contact erosion and nuisance welds. Keep inrush current spikes below 650A at all times. Care should also be taken when considering other high-inrush loads such as lamps or motors.
b. Large current spikes through closed contacts. Large current spikes through closed contacts in excess of 3000A can sometimes cause spot welding or contact levitation.
c. Circuit inductance. Contactor break-arcs generally last as long as it takes to dissipate the stored inductive energy of the load ( $\left.\mathrm{t}(\operatorname{arc})=1.1^{*} \mathrm{~L} / \mathrm{R}\right)$.
Longer arcs due to circuit inductance can accelerate contact wear, and in extreme cases, can cause contactor failure. TE recommends that the time constant of the load be less than 1 ms for safe operation and maximum life.
Contactor life is a function of the power level switched. Higher make/break currents erode contact materials faster and accelerate loss of dielectric withstanding between the open contacts. Figure 2 can be used as a guideline for estimating product life at a given load.

Table I
Use the same guidelines and torque maximum values for stud terminal contactors as well.

| Catalog 5-1773450-5 | Dimensions are shown for | Dimensions are in millimeters | USA: +18005226752 | For additional support numbers |
| :--- | :--- | :--- | :--- | :--- |
| Revised 3-13 | reference purposes only. | unless otherwise specified. | Asia Pacific: +8604008206015 | please visit www.te.com |
| www.te.com | Specifications subject |  | UK: +44800267666 |  |

## Application Notes for EV/LEV Contactors (Continued)



Figure 2
Life Cycles vs. Power Switched

## 4. Recommended Conductor Sizes for

 Continuous Current CarryMany sources exist for recommending the proper conductor size for a given current carry. Many of these sources are concerned primarily with wire insulation safety issues. Cable bundling, conduit types, length of runs, etc., are all important considerations. With regard to a contactor placed in line with the conductors, it is important to make sure that the wire size is sufficient such that the contactor terminals themselves do not overheat, leading to a failure of the device. In most cases, the primary path for removal of heat from the contactor terminals is the conductors themselves. Convection to atmosphere and conduction via the base mountings play a lesser role in this type of contactor due to the nature of the construction. TE has performed basic characterization of many of the styles of contactors discussed herein, and the data is presented in Figure 3. The recommended maximum power terminal temperature for all EV/LEV contactors is $150^{\circ} \mathrm{C}$ continuous and $175^{\circ} \mathrm{C}$ for 1 hour.


For applications requiring larger conductors than can practically be installed with single 4/0 AWG cable and lugs, adapter buss extensions can be obtained from TE.

## 5. Auxiliary Circuits

Auxiliary contacts are available on most models. Configurations available are: SPST-NO, SPST-NC and SPDT. Auxiliary contacts are rated at $125 \mathrm{Vac} / 1 \mathrm{~A}$ or $30 \mathrm{Vdc} / 3 \mathrm{~A}$. Contacts with gold plating for low level loads are also available. For circuit voltage below 10V/0.1A, gold contacts are recommended.

The auxiliary contact actuating method will indicate the true position of the main contacts. The auxiliary contact actuation is directly coupled to the main contact moving bridge, and will not indicate "open" unless both contact gaps of the double-make, Form X contact are fully disconnected. Keep in mind that the auxiliary contact is mainly a status indication, and should not be used to directly power other loads such as a relay coil or high power lamp load.

## 6. Environmental Considerations

All KILOVAC contactors are characterized for operation in thermal, vibration, moisture and fluid environments. Consult the appropriate data sheet for limits concerning shock, vibration, temperature range and altitude limits. In some cases, there may be variations in limits with regard to "specified operation" or "survival only".

## 7. Custom Configurations

Most parts can be ordered with a variety of combinations of main terminal and coil configurations, auxiliary contacts, interface connectors, coil voltages, etc. If you have a requirement for a particular configuration not shown on the data sheet, consult the factory for information regarding custom configurations.

## 8. Summary

This Application Note is meant to address some of the more common questions regarding the use of EV/LEV contactors. In all cases, please refer to the applicable product data sheet for specific information. Also, Product Application Engineers are available to answer questions regarding these products by calling 800-253-4560 x2055, or 805-220-2055.

| Catalog 5-1773450-5 | Dimensions are shown for <br> reference purposes only. | Dimensions are in millimeters <br> Revised 3-13 |
| :--- | :--- | :--- |
| Specifications otherwise specified. |  |  |
| www.te.com | to change. |  |

## Application Notes for MAP/CAP Contactors

## Introduction - Product Capabilities <br> And Typical Applications

TE KILOVAC MAP/CAP contactors are designed to be the highest performance, smallest and lightest weight, sealed High Voltage contactors in the industry. With current carrying capability of up to 500 A and power switching up to 200 kW , they are used in a variety of commercial aerospace and military applications. Primarily designed to switch resistive loads, they can be used in a variety of circuit applications bearing in mind a few important considerations. This application note focuses on a few of the more common circuit configurations, and what to consider when selecting, installing and using the contactors.

## 1. Installation

TE KILOVAC MAP/CAP contactors can be mounted in any orientation, and due to the nature of their hermetic seal and isolated enclosure, can be mounted in close proximity to other equipment. However, care must be taken with regard to the termination of the power cables to the main terminals. It is important that the main power connection lugs are mated directly to the terminal seats. Be sure that the hardware stackup is in the proper order, and that washers and other spacers are not placed between the lug and terminal seat. Extraneous connection resistance can cause considerable power dissipation and terminal heating at high current carry. Refer to Figure 1 and Table I for the recommended hardware stackup and torque.


Figure 1 Main Terminal Hardware Installation

| THREAD <br> ENGAGEMENT(turns) | TORQUE |
| :--- | :--- |
| Less than 5 | Use longer fastener |
| 5 TO 7 | $7.9 \mathrm{Nm}(70 \mathrm{in}-\mathrm{lb}) \mathrm{MAX}$ |
| 7 TO 8 | $9.0 \mathrm{Nm}(80 \mathrm{in}-\mathrm{lb}) \mathrm{MAX}$ |
| 8 TO 11 | $9.0 \mathrm{Nm}(80 \mathrm{in}-\mathrm{lb})$ <br> $11 \mathrm{Nm}(100 \mathrm{in}-\mathrm{lb}) \mathrm{MAX}$ |
| Mounting Feet (all) | $1.7-3.3 \mathrm{Nm}(30-35 \mathrm{in}-\mathrm{lb})$ |

Table I
Use the same guidelines and torque maximum values for stud terminal contactors as well.

## 2. Coils, Drive Circuits and Coil Economizing

Since the power required to close the contacts is generally much greater than the required holding power, many contactors can be packaged with low-profile coils that utilize either an electronic economizer (switchmode PWM, electronic cut-throat), or mechanical cutthroat economizer. The economizer lets-through the higher power required for contact closure, then reduces the power for holding, greatly reducing the coil power consumption and heating. These circuits are packaged with the contactor, and in most cases include coil suppression components as well. For customers who wish to provide their own circuitry, TE can provide suggestions for driving the coils of all versions of contactors. Four types of actuators are typically used:
a. Single Coil requiring customer economizer circuit
b. Single Coil with supplied electronic economizer
c. Dual Coil with supplied mechanical "cut-throat" economizer
d. Dual Coil with supplied electrical "cut-throat" economizer

The advantages of each type of coil circuit are shown in Table II.

| Type | Advantage |
| :--- | :--- |
| Electronic PWM | Operates over widest <br> voltage range |
| Electronic CT | Simple, Robust, EMC <br> Compliant |
| Mechanical CT | Simple, robust, fastest <br> operate time |
| Single Coil - <br> (customer economized) | Flexibility, lower initial cost |

Table II Coil Configurations

## 3. Load Types and Power Switching Recommendations

In general, all MAP/CAP contactors are designed primarily for connection and interruption of resistive loads and slightly inductive loads ( $\mathrm{L} / \mathrm{R}<1 \mathrm{~ms}$ ). High currents (up to 2000A) can be interrupted in case of circuit faults, and high continuous currents upwards of 500A can be maintained through closed contacts. Some important pints to consider are:
a. Closing into current spikes due to uncharged filter capacitors. Capacitors should be pre-charged whenever possible to avoid excessive contact erosion and nuisance welds. Keep inrush current spikes below 650A at all times. Care should also be taken when considering other high-inrush loads such as lamps or motors.

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| :--- | :--- | :--- | :--- | :--- |
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## Application Notes for MAP/CAP Contactors (Continued)

b. Large current spikes through closed contacts. Large current spikes through closed contacts in excess of 3000A can sometimes cause spot welding or contact levitation. Consult with the factory if your application requires passing large current pulses. Many contactors can be ordered with "Dual Contact" arrangements (Arcing contacts of harder material in parallel with high current carry material).
c. Circuit inductance. Contactor break-arcs generally last as long as it takes to dissipate the stored inductive energy of the load ( $\left.\mathrm{t}(\mathrm{arc})=1.1^{*} \mathrm{~L} / \mathrm{R}\right)$.

Longer arcs due to circuit inductance can accelerate contact wear, and in extreme cases, can cause contactor failure. TE recommends that the time constant of the load be less than 1 ms for safe operation and maximum life.

Contactor life is a function of the power level switched. Higher make/break currents erode contact materials faster and accelerate loss of dielectric withstanding between the open contacts. Figure 2 can be used as a guideline for estimating product life at a given load.

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Figure 2
Life Cycle vs. Power Switched

## 4. Recommended Conductor Sizes for Continuous Current Carry

Many sources exist for recommending the proper conductor size for a given current carry. Many of these sources are concerned primarily with wire insulation safety issues. Cable bundling, conduit types, length of runs, etc., are all important considerations. With regard to a contactor placed in line with the conductors, it is important to make sure that the wire size is sufficient such that the contactor terminals themselves do not overheat, leading to a failure of the device. In most cases, the primary path for removal of heat from the contactor terminals is the conductors themselves. Convection to atmosphere and conduction via the base mountings play a lesser role in this type of contactor due to the nature of the construction. TE has performed basic characterization of many of the styles of contactors discussed herein, and the data is presented in Figure 3.

The recommended maximum power terminal temperature for all MAP/CAP contactors is $150^{\circ} \mathrm{C}$ continuous and $175^{\circ} \mathrm{C}$ for 1 hour.


Figure 3
Recommended Conductor Sizes

For applications requiring larger conductors than can practically be installed with single 4/0 AWG cable and lugs, adapter buss extensions can be obtained from TE.

## 5. Auxiliary Circuits

Auxiliary contacts are available on most models. Configurations available are: SPST-NO, SPST-NC and SPDT. Auxiliary contacts are rated at $125 \mathrm{Vac} / 1 \mathrm{~A}$ or 30Vdc/3A. Contacts with gold plating for low level loads are also available. For circuit voltage below 10V/0.1A, gold contacts are recommended. The auxiliary contact actuating method will indicate the true position of the main contacts. The auxiliary contact actuation is directly coupled to the main contact moving bridge, and will not indicate
"open" unless both contact gaps of the double-make, Form X contact are fully disconnected. Keep in mind that the auxiliary contact is mainly a status indication, and should not be used to directly power other loads such as a relay coil or high power lamp load.

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| to change. |  |

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UK: +44 800267666

# Application Notes for MAP/CAP Contactors (Continued) 

## 6. Environmental Considerations

All TE KILOVAC contactors are characterized for operation in thermal, vibration, moisture and fluid environments. Consult the appropriate data sheet for limits concerning shock, vibration, temperature range and altitude limits. In some cases, there may be variations in limits with regard to "specified operation" or "survival only".

## 7. Custom Configurations

Most parts can be ordered with a variety of combinations of main terminal and coil configurations, auxiliary contacts, interface connectors, coil voltages, etc. If you have a requirement for a particular configuration not shown on the data sheet, consult the factory for information regarding custom configurations.

## 8. Summary

This Application Note is meant to address some of the more common questions regarding the use of MAP/CAP contactors. In all cases, please refer to the applicable product data sheet for specific information.

Also, Product Application Engineers are available to answer questions regarding these products by calling 800-253-4560 x2055, or 805-220-2055.

## Application Notes on Coil Power Economizing using PWM Circuits

## Introduction - Reducing Coil Power Dissipation through the use of PWM Circuits

The coil power of most TE KILOVAC Relays and Contactors can be reduced after Pickup by using several economizing schemes. One of the most popular methods used in many of our standard products, and one that is suitable for implementation by customers, is the Pulse Width Modulated (PWM) coil driver.

## 1. Typical PWM Coil Drive Circuit

Figure 1 shows a typical PWM coil drive/economizer circuit.

In the circuit shown, the "Fast Dropout" (FDO) and PWM driver are energized simultaneously for a sufficient time to allow the contacts to fully close. The PWM driver is then modulated such that the stored coil energy is utilized during the PWM driver "OFF" time to circulate holding current through the FDO driver and freewheeling diode. Since the holding current is much lower than the current required for pickup, the holding power for the contacts is greatly reduced.

The Fast Dropout circuit allows for the switching in/out of the "free-wheeling" diode. When power is removed, the FDO and PWM drivers will turn off, causing the stored energy of the coil to be rapidly dissipated in the body diodes. This minimizes the decay time of the coil current and facilitates a fast opening of the relay contacts.


Fast Drop-out FET stays on during operation. FDO and
Power can be applied simultaneously
Filtering/Protection should be applied to FET gates as required.
For higher energy coils, additional TVS protection may be required across FET drain-to-source.

Figure 1
Coil Drive Circuit

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## Application Notes on Coil Power Economizing using PWM Circuits (Continued)

This fast opening is useful for circuit interruption, and it allows the over travel mechanism of the contact actuator to work effectively in breaking minor contact welds that may occur when closing the contacts.

Allowing the free-wheeling diode to remain across the coil would significantly increase the contact opening time and opening speed, and possibly result in nuisance contact welds and/or reduced capability to interrupt circuit currents.

If additional diodes are required to protect the FET body diodes, select a Transient Voltage Suppressor (TVS) diode with a breakdown rating lower than that of the driver FET body diode. In general, a higher voltage TVS diode will result in faster contact opening and higher clamping voltage, while a lower voltage TVS diode will result in slower contact opening and lower clamping voltage. For more detailed information regarding TVS diode selection, contact TE and request the report titled DC Relay Magnetic Energy Determination and Transient Voltage suppressor Diode Selection.

### 1.1 Recommended Operating Frequency and Duty Cycle

The frequency at which the PWM circuit is operated should be high enough such that the oscillation of the coil current does not lead to audible noise being generated by the magnetic components and coil winding. For most KILOVAC contactors, a coil drive frequency $>15 \mathrm{kHz}$ is usually sufficient to ensure that nuisance audible noise is not generated. The PWM duty cycle required for economizing power while maintaining sufficient holding force can be calculated from the required holding current as follows:

$$
\begin{aligned}
& \text { Duty Cycle }(\%)=(\text { Ihold*R(T)Coil/Vsource })^{*} 100 \text { (1) } \\
& \text { Where: } \\
& \mathrm{R}(\mathrm{~T})=\text { Coil Resistance at Temperature } \\
& \text { Ihold }^{*}=\text { Required Holding Current } \\
& V_{\text {source }}=\text { Source Voltage }
\end{aligned}
$$

Contact TE regarding the minimum required hold current needed for a particular Part Number. In general, divide the specified dropout voltage by the coil resistance at $20^{\circ} \mathrm{C}$, and add $25 \%$ above that to get an estimate of the value to use in equation (1) for $I_{\text {hold }}$.

### 2.0 Summary

This Application Note is meant to address some of the more common questions regarding the use of PWM circuits for coil power economization. In all cases, please refer to the applicable product data sheet for specific information.

TE can also recommend alternative solutions for mechanical dual-coil economizers, as well as "Electronic Cut-Throat" economizers. Product Application Engineers are available to answer questions regarding this subject by calling 800-253-4560 x2055, or 805-220-2055.

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## 7-95

## Engineering Notes

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## 1600/1700 Series Delay On Operate Timers

## Product Facts

■ AC/DC input delay on operate timer offered in fixed (1600) and adjustable (1700) types
■ Up to 10A loads

- CMOS digital design
- Hermetic package
- Built to MIL-R-83726 environmentals
- Many customizing options - Extended timing ranges
- Tighter timing tolerances
- Header and mounting
- 115Vac, 60 Hz . input types


## Electrical Specifications

Timing Range -
1600 series (fixed) - 50 ms to 600 s
1700 series (adjustable) - 50 ms
to 240 s
Tolerance $- \pm 10 \%$ or 10 ms ,
whichever is greater
Recycle Time - 10 ms (DC input),
50ms (AC input)
Recovery Time - 10 ms (DC input),
50 ms (AC input)
Input Voltage - 18 to 31 Vdc ,
105 to $125 \mathrm{Vac}, 400 \mathrm{~Hz}$
Current Drain (at $25^{\circ} \mathrm{C}, 28 \mathrm{Vdc}$ ) DC Coil, 10A contacts -
1- and 2-pole - 135 mA maximum
AC or DC Coil, 4A contacts -
1-pole - 100 mA maximum
2-pole - 150 mA maximum
3 - and 4-pole - 200 mA maximum
Contact Ratings -
DC Coil, 10A contacts -
10A resistive @ 30Vdc
5 A inductive @ 30 Vdc
5A resistive @ 115 Vrms, 400 Hz
3A inductive @ $115 \mathrm{Vrms}, 400 \mathrm{~Hz}$
AC or DC Coil, 4A contacts -
4A resistive @ 30Vdc
1A inductive @ 30Vdc
2A resistive @ 115 Vrms, 400 Hz
1 A inductive @ $115 \mathrm{Vrms}, 400 \mathrm{~Hz}$
Environmental Specifications
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$ or $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Vibration-20 G's, $10-2,000 \mathrm{~Hz}$
Shock - 50 G's, $11 \pm 1 \mathrm{~ms}$ duration
Insulation Resistance - 1,000
megohms, min., at 500 Vdc , all terminals to case
Dielectric Strength - $1,000 \mathrm{Vrms}, 60$
Hz., at sea level, all terminals to case
Sealing - Hermetic, 1.3 in. ( 33.0 mm )
of mercury
Life - 100,000 operations, min.
Weight -
4A units - 4.5 oz (127.6g) max.
10A units - 8.5 oz ( 240 g ) max.

Kilovac 1600/1700 series delay on operate timers combine solid state timing circuits with electromechanical output relays in robust hermetically sealed

enclosures. The 1600 types are fixed timers, while the 1700 models are adjustable via an external resistor. Numerous output options include 4A rated contacts in

1-4 form C (SPDT - 4PDT) arrangements and 10A rated contacts in 1-2 form C (SPDT-DPDT) arrangements.

## Specifications by Model Number - 4 Amp Contact Versions

| Fixed Timer Model Number | Adjustable Timer Model Number | $\begin{gathered} \text { Input } \\ \text { Voltage } \end{gathered}$ | Temperature Range | Housing Length (Dim. "A") | Contact Arrangement |
| :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & 1601 \\ & 1602 \\ & 1603 \\ & 1604 \end{aligned}$ | $\begin{aligned} & 1701 \\ & 1702 \\ & 1703 \\ & 1704 \end{aligned}$ | $\begin{aligned} & \text { DC } \\ & \text { DC } \\ & D C \\ & D C \end{aligned}$ | $\begin{aligned} & -55^{\circ} \mathrm{C} \text { to }+85^{\circ} \mathrm{C} \\ & -55^{\circ} \mathrm{C} \text { to }+85^{\circ} \mathrm{C} \\ & -55^{\circ} \mathrm{C}+85^{\circ} \mathrm{C} \\ & -55^{\circ} \mathrm{C} \text { to }+85^{\circ} \mathrm{C} \end{aligned}$ | $1.656[42.06]$ $1.656[42.06]$ $2.0[50.8]$ $2.0[50.8]$ | $\begin{aligned} & 1 \text { Form C (SPDT) } \\ & 2 \text { Form C (DPDT) } \\ & 3 \text { Form C (3PDT) } \\ & 4 \text { Form C (4PDT) } \end{aligned}$ |
| $\begin{aligned} & \hline 1621 \\ & 1622 \\ & 1623 \\ & 1624 \end{aligned}$ | $\begin{aligned} & \hline 1721 \\ & 1722 \\ & 1723 \\ & 1724 \\ & \hline \end{aligned}$ | $\begin{aligned} & \text { DC } \\ & \text { DC } \\ & D C \\ & D C \end{aligned}$ | $\begin{aligned} & -55^{\circ} \mathrm{C} \text { to }+125^{\circ} \mathrm{C} \\ & -55^{\circ} \mathrm{C} \text { to }+125^{\circ} \mathrm{C} \\ & -55^{\circ} \mathrm{Co}+125^{\circ} \mathrm{C} \\ & -55^{\circ} \mathrm{C} \text { to }+125^{\circ} \mathrm{C} \\ & \hline \end{aligned}$ | $1.656[42.06]$ $1.656[42.06]$ $2.0[50.8]$ $2.0[50.8]$ | $\begin{aligned} & 1 \text { Form C (SPDT) } \\ & 2 \text { Form C (DPDT) } \\ & 3 \text { Form C ( } 3 P D T) \\ & 4 \text { Form C (4PDT) } \end{aligned}$ |
| $\begin{aligned} & 1651 \\ & 1652 \\ & 1653 \\ & 1654 \\ & \hline \end{aligned}$ | $\begin{aligned} & 1751 \\ & 1752 \\ & 1753 \\ & 1754 \\ & \hline \end{aligned}$ | $\begin{aligned} & \text { AC } \\ & A C \\ & A C \\ & A C \\ & \hline \end{aligned}$ | $\begin{aligned} & -55^{\circ} \mathrm{C} \text { to }+85^{\circ} \mathrm{C} \\ & -55^{\circ} \mathrm{C} \text { to }+85^{\circ} \mathrm{C} \\ & -55^{\circ} \mathrm{Co}+85^{\circ} \mathrm{C} \\ & -55^{\circ} \mathrm{C} \text { to } 85^{\circ} \mathrm{C} \\ & \hline \end{aligned}$ | $2.0[50.8]$ $2.0[50.8]$ $2.375[60.33]$ $2.375[60.33]$ | $\begin{aligned} & 1 \text { Form C (SPDT) } \\ & 2 \text { Form C (DPDT) } \\ & 3 \text { Form C (3PDT) } \\ & 4 \text { Form C (4PDT) } \end{aligned}$ |
| $\begin{aligned} & \hline 1671 \\ & 1672 \\ & 1673 \\ & 1674 \end{aligned}$ | $\begin{aligned} & 1771 \\ & 1772 \\ & 1773 \\ & 1774 \end{aligned}$ | $\begin{aligned} & \text { AC } \\ & A C \\ & A C \\ & A C \end{aligned}$ | $\begin{aligned} & -55^{\circ} \mathrm{C} \text { to }+125^{\circ} \mathrm{C} \\ & -55^{\circ} \mathrm{C} \text { to }+125^{\circ} \mathrm{C} \\ & -55^{\circ} \mathrm{C}++125^{\circ} \mathrm{C} \\ & -55^{\circ} \mathrm{C} \text { to }+125^{\circ} \mathrm{C} \\ & \hline \end{aligned}$ | $2.0[50.8]$ $2.0[50.8]$ $2.375[60.33]$ $2.375[60.33]$ | $\begin{aligned} & 1 \text { Form C (SPDT) } \\ & 2 \text { Form C (DPDT) } \\ & 3 \text { Form C (3PDT) } \\ & 4 \text { Form C (4PDT) } \end{aligned}$ |

Specifications by Model Number - 10 Amp Contact Versions

| Fixed Timer <br> Model Number | Adjustable Timer <br> Model Number | Input <br> Voltage | Temperature <br> Range | Housing Length <br> (Dim. "A") | Contact <br> Arrangement |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1610 | 1710 | DC | $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$ | $2.419[61.44]$ | 1 Form C (SPDT) |
| 1620 | 1720 | DC | $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$ | $2.419[61.44]$ | 2 Form C (DPDT) |

## Adjustable Timing Formula (1700 types)

The resistance required to obtain timing within this range is determined by using the formula:
$R x=400 \mathrm{~K}(\mathrm{~T} / \mathrm{Tmax})-.40 \mathrm{~K}$, where
$\mathrm{Rx}=$ External Resistance in Ohms,
$\mathrm{T}=$ Desired Time in Seconds, and Tmax. = Maximum Time (Code).
A high quality deposited carbon $\pm 1 \%$, 0.1 W (min.) resistor is recommended for external resistance.

## Part Numbering System



A typical part number for an adjustable timer would be 1722-C-1102. This is a DC unit in the $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ temperature range with a 2 form C (DPDT) contact arrangement in a style " $C$ " mounting, with a maximum time delay of 11 s.
$\begin{array}{ll}\text { Catalog 5-1773450-5 } & \begin{array}{l}\text { Dimensions are shown for } \\ \text { reference purposes only. }\end{array} \\ \text { Revised 3-13 } & \text { Specifications subject }\end{array}$
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Dimensions are in millimeters unless otherwise specified.

1600/1700 Series Delay On Operate Timers (Continued)

## Outline Dimensions

10 Amp Units


Mounting Option A

4 Amp Units


Mounting Option A


Mounting Option B


Mounting Option B

## Wiring Diagrams

1600 Series (Fixed)


1 Form C


1 Form C


2 Form C



3 Form C



Mounting Option C


Mounting Option C

# 2400 Series Delay On Operate Timer, Fixed Timing, Relay Output 

## Product Facts

- DC input fixed delay on operate timer
■ 2 Form C (DPDT), 2A output
■ CMOS digital design
- Reverse polarity protection
- Hermetic package

■ Built to MIL-R-83726 environmentals
■ Customizing options include - Tighter timing tolerances

- Header and mounting
- Different input voltages


## Electrical Specifications

Timing Range - 50 ms to 600 s
Tolerance - $\pm 10 \%$ or 10 ms ,
whichever is greater
Recycle Time - 10 ms
Recovery Time - 20 ms
Input Data -
Input Voltage - 18 to 31 Vdc
Current Drain - 85 mA @ 31 Vdc ,
$25^{\circ} \mathrm{C}$
Output Data -
Output Form — 2 Form C (DPDT).
Output Rating -
2 A resistive at 30 Vdc ;
125 mA resistive at $115 \mathrm{Vac}, 400 \mathrm{~Hz}$
Transient Protection - 80Vdc for 50ms

## Environmental Specifications

## Temperature Range -

$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$ or $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Vibration-20 G's, $10-2,000 \mathrm{~Hz}$
Shock - 50 G's, $11 \pm 1 \mathrm{~ms}$ duration
Insulation Resistance - 1,000
megohms, min., at 500 Vdc , all terminals to case
Dielectric Strength - 500Vrms, 60 Hz., at sea level, all terminals to case
Sealing - Hermetic, 1.3 in. ( 33.0 mm ) of mercury
Life - 100,000 operations, min.
Weight - $1.202(30 \mathrm{~g})$ max

Plug-in sockets are available for header option 2

Kilovac 2400 series delay on operate timers combine solid state timing circuits with relay outputs in robust hermetically sealed enclosures. They are fixed timers. The 2 Form C (DPDT) output relay is rated 2 A .

## Timing Diagram




Part Numbering System


A typical part number would be 2401-1A-1102. This fixed timer operates at $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$, has hook terminals, style " A " mounting, and a time delay of 11 s .

Outline Dimensions


Mounting Option A

## Wiring Diagram

|  |  |
| :---: | :---: |
|  |  |



Mounting Option B


Mounting Option D


Mounting Option E

Header Options

. 03


TERMINAL SPACING IS 0.2 [ 5.08 ] FOR ALL HEADERS
Header Option 1
Header Option 2
Header Option 3

## 5600/5700 Series Delay On Release Timers

## Product Facts

■ DC input delay on release timer offered in fixed (5600) and adjustable (5700) types
■ Up to 10A loads

- Reverse polarity protection

■ CMOS digital design

- Built to MIL-R-83726 environmentals
■ Many customizing options - Extended timing ranges
- Tighter timing tolerances
- Header and mounting
- Different Aux. voltages
- Different control line voltages
- Input either 115Vac, 60 Hz or 400 Hz .


## Electrical Specifications

## Timing Range -

5600 series (fixed) - 50 ms to 600 s
5700 series (adjustable) - 50 ms to 240 s
Tolerance $- \pm 10 \%$ or $\pm 15 \mathrm{~ms}$, whichever is less
Recycle Time - 10 ms
Reset Time - 20 ms
Operate Time (Max.) - 10 ms (2A and 5 A models), 20 ms ( 10 A models)
Input Voltage - 18 to 31 Vdc
Control Voltage - 10 to 31 Vdc .
Ground common to aux. power line. 10 Vdc minimum must be applied for a minimum duration of 20 ms to energize output and initiate the timing circuit.
Current Drain (at $25^{\circ} \mathrm{C}, 28 \mathrm{Vdc}$ ) -
Control Line - 15 mA typ., 25 mA max. Input Line De-energized (after completion of delay period) 125 mA
Input Line Energized -
1-pole, 2 \& 5A models - 100 mA
1 -pole, 10A models - 150 mA
2 -pole, 2 \& 5A models - 150 mA
2-pole,10A models - 240 mA

## Contact Ratings -

## 10A contacts -

10A resistive @ 30Vdc
5 A inductive @ 30Vdc
5A resistive @ 115 Vrms, 400 Hz
3A inductive @ $115 \mathrm{Vrms}, 400 \mathrm{~Hz}$

## 5A contacts -

5A resistive @ 30Vdc
1.5A inductive @ 30 Vdc

3A resistive @ 115 Vrms, 400 Hz
1 A inductive @ $115 \mathrm{Vrms}, 400 \mathrm{~Hz}$

## 2A contacts -

2A resistive @ 30Vdc
1A inductive @ 30Vdc
1A resistive @ 115 Vrms, 400 Hz
0.3A inductive @ $115 \mathrm{Vrms}, 400 \mathrm{~Hz}$

Kilovac 5600/6700 series delay on release timers combine solid state timing circuits with electromechanical output relays in robust

hermetically sealed enclosures. The 5600 types are fixed timers, while the 5700 models are adjustable via an external resistor.

Numerous output options include 2A, 5A and 10A rated contacts in 1, and 2 form C (SPDT and DPDT) arrangements.

Specifications by Model Number

| Fixed Timer Model Number | Adjustable Timer Model Number | Input Voltage | Temperature Range | Contact Rating | $\begin{gathered} \text { Contact } \\ \text { Arrangement } \end{gathered}$ | Available Enclosures |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 5601 | 5701 | DC | $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$ | 2 Amp | 1 Form C (SPDT) | A-C-D-E |
| 5602 | 5702 | DC | $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$ | 2 Amp | 2 Form C (DPDT) | A-C-D-E |
| 5605 | 5705 | DC | $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$ | 5 Amp | 1 Form C (SPDT) | D-E |
| 5606 | 5706 | DC | $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$ | 5 Amp | 2 Form C (DPDT) | D-E |
| 5610 | 5710 | DC | $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$ | 10 Amp | 1 Form C (SPDT) | D-E |
| 5611 | 5711 | DC | $-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$ | 10 Amp | 2 Form C (DPDT) | D-E |
| 5621 | 5721 | DC | $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ | 2 Amp | 1 Form C (SPDT) | A-C-D-E |
| 5622 | 5722 | DC | $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ | 2 Amp | 2 Form C (DPDT) | A-C-D-E |
| 5625 | 5725 | DC | $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ | 5 Amp | 1 Form C (SPDT) | D-E |
| 5626 | 5726 | DC | $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ | 5 Amp | 2 Form C (DPDT) | D-E |

See next page for complete ordering information and outline dimensions for the available enclosures.

## Environmental Specifications

Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$ or $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Vibration-20 G's, $10-2,000 \mathrm{~Hz}$
Shock - 50 G's, $11 \pm 1 \mathrm{~ms}$ duration
Insulation Resistance -
1,000 megohms, min., at 500Vdc
Dielectric Strength - $1,000 \mathrm{Vrms}$,
60 Hz ., at sea level, all terminals to case
Sealing - Hermetic, 1.3 in. ( 33.0 mm ) of mercury
Life - 100,000 operations, min. (2A
and 5A models); 50,000 operations,
min. (10A models)
Weight - 8.5 oz ( 240 g ) max.

## Adjustable Timing Formula (4700 types)

The resistance required to obtain timing within this range is determined by using the formula:
$R x=400 \mathrm{~K}$ (T/Tmax.) -40 K , where
Rx = External Resistance in Ohms, T - Desired Time in Seconds, and Tmax. = Maximum Time (Code).
A high quality deposited carbon $\pm 1 \%$, 0.1 W (min.) resistor is recommended for external resistance.

## Timing Diagram

inPuT
CONTROL
OUTPUT


Apply input power. Upon application of control power, the output will energize. Remove control power and initiate delay period.

## Special Notes

10 Vdc minimum must be applied for a minimum duration of 20 ms to energize output and initiate timing.
Units rated 10A have a minimum time delay of 100 ms . to change.

For additional support numbers please visit www.te.com

## Part Numbering System

| Typical Part Number | 5722 | -C |
| :---: | :---: | :---: |
| Model Number: |  |  |
| Four digit code from table on the previous page. |  |  |
| Mounting (see outline dimension drawings): |  |  |
| A = Studs on bottom of 2.5 in tall case | $\mathrm{C}=$ Studs on side of 2.5 in . tall case |  |
| D = Studs on bottom of 1.812 in. tall case | $\mathrm{E}=$ Bracket on side of 1.812 in. tall case |  |

Model Number:

Mounting (see outline dimension drawings):

Timing Code:
Four-digit code for any value between 50 ms .
Note: Units with 10A contacts have a minimum time delay of 100 ms .
A typical part number for an adjustable timer would be 5722-C-1102. This DC unit is in the $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ temperature range with a 2 amp contacts in a 2 form C (DPDT) arrangement, enclosed in case with a style " $C$ " mounting, with a maximum time delay of 11 s .

Outline Dimensions


## Wiring Diagrams

```
5600 Series (Fixed)
```



1 Form C


2 Form C

## 5700 Series (Adjustable)



1 Form C


2 Form C

## 1800/1900 Series Delay On Operate Digital Timing Modules

## Product Facts

■ DC input delay on operate timer offered in fixed (1800) and adjustable (1900) types

- 300 mA output
- CMOS digital design
- Reverse polarity protection
- Hermetic package

■ Built to MIL-R-83726 environmentals
■ Customizing options include

- Tighter timing tolerances
- Header and mounting


## Electrical Specifications

Timing Range -
1800 series (fixed) - 50 ms to 600 s
1900 series (adjustable) - 50 ms
to 240 s
Tolerance - $\pm 10 \%$ or 10 ms ,
whichever is greater
Repeatability — $\pm 0.1 \%$
Recycle Time - 10 ms
Recovery Time - 20 ms
Input Data -
Input Voltage - 18 to 31 Vdc
Current Drain (at $25^{\circ} \mathrm{C}, 28 \mathrm{Vdc}$ ) -
10mA, plus load current
Output Data -
Output Form — 1 Form A (SPST-NO)
solid state switch closure to ground
Output Rating — $300 \mathrm{~mA} @ 25^{\circ} \mathrm{C}$,
$100 \mathrm{~mA} @ 125^{\circ} \mathrm{C}$
Minimum Load — 10mA
Saturation Voltage - 2.5Vdc, max.
Leakage - $1 \mu \mathrm{~A} @ 25^{\circ} \mathrm{C}, 10 \mu \mathrm{~A} @$
$125^{\circ} \mathrm{C}$
Environmental Specifications
Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+85^{\circ} \mathrm{C}$ or $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Vibration-20 G's, $10-2,000 \mathrm{~Hz}$
Shock - 50 G's, $11 \pm 1 \mathrm{~ms}$ duration
Insulation Resistance - 1,000
megohms, min., at 500 Vdc , all terminals to case
Dielectric Strength — 500Vrms, 60
Hz ., at sea level, all terminals to case
Sealing — Hermetic, 1.3 in. ( 33.0 mm ) of mercury
Life - 100,000 operations, min.
Weight - 1 oz (28.3g) max

## Timing Diagram




Kilovac 1800/1900 series delay on operate timer modules combine solid state timing circuits with solid state switch outputs in robust hermetically sealed enclosures. The 1800 types are fixed timers, while the 1900 models are adjustable via an external resistor. The 1 Form A (SPST-NO) switch is rated 300 mA .

## Adjustable Timing Formula (1900 types)

The resistance required to obtain timing within this range is determined by using the formula:
$R x=400 \mathrm{~K}$ (T/Tmax.) - 40K, where
$R x=$ External Resistance in Ohms,
T- Desired Time in Seconds, and Tmax. = Maximum Time (Code).
A high quality deposited carbon $\pm 1 \%$, 0.1 W (min.) resistor is recommended for external resistance.

## Outline Dimensions


. 187 MAX .


Mounting Option A

## Wiring Diagrams



1800 Series (Fixed)
Note: The blank pin on 1800 series types is active and must not be connected.


Mounting Option D


Mounting Option E

## Header Options



TERMINAL SPACING IS 0.2 in [5.081
Header Option 1 Header Option 2 to change.

# 6001 Series Delay On Operate Digital Timing Module 

## Product Facts

■ Fixed delay on operate timer

- 300 mA output

■ CMOS digital design

- Voltage surge protection

■ Qualified to MIL-R-83726/13

## Electrical Specifications

Timing Range - 50 ms to 600 s .
Timing Accuracy - $\pm 10 \%$ of nominal timing under all conditions of input voltage and environmental extremes

## Recycle Characteristics -

Before Time Out - A power interruption occurring after the start but before completion of the timing cycle shall be for a duration of $0.5 \%$ of the nominal time delay or 10 ms , whichever is greater, to ensure a loss in timing of no greater than 10\%
After Time Out - A power interruption of $0.5 \%$ of the nominal time delay or 10 ms , whichever is greater, will initiate a new timing cycle with a loss in timing of no greater than 5\%
Input Data -
Input Voltage - 28Vdc, nominal; range 18 to 31 Vdc
Current Drain (at $25^{\circ} \mathrm{C}, 28 \mathrm{Vdc}$ ) 10mA (max.), plus load current

## Reverse Polarity Protection -

The timer will not be damaged or operate when input voltage polarity is reversed

## Output Data -

Configuration — 1 Form A (SPST-NO) solid state switch closure to ground
Load Ratings -
Resistive - $300 \mathrm{~mA} @+25^{\circ} \mathrm{C}$, derated to $100 \mathrm{~mA} @+125^{\circ} \mathrm{C}$
Inductive - Three MIL-R-5757/9
relays (any relay with 26.5 V dc coil)
Lamp Load - Two MS25237-327 lamps per MIL-L-6363
Load Suppression - Suppression for inductive loads for output protection is provided within the unit
Voltage Drop - 2.5 Vdc , max. @ - $55^{\circ} \mathrm{C}$ and $+25^{\circ} \mathrm{C} ; 2.0 \mathrm{Vdc}$, max., @ $+125^{\circ} \mathrm{C}$
Leakage Current - $1 \mu \mathrm{~A}$, max. @ $+25^{\circ} \mathrm{C}, 10 \mu \mathrm{~A}$, max. $@+125^{\circ} \mathrm{C}$
Insulation Resistance - 1,000 megohms, min., @ 500 Vdc , measured between all terminals tied together to the case
Dielectric Strength - 500Vrms, 60
Hz ., at sea level, measured between all terminals tied together to the case
Transients -
Voltage Surge - Per MIL-STD-704A, figure 9 , limit 1 , for category B equipment Self-generated Spikes - $\pm 10 \mathrm{~V}$

Kilovac 6001 series delay on operate timer modules are miniature devices combining solid state timing circuits with solid state switch outputs in robust hermetically sealed DIP enclosures. The 1 Form A (SPST-NO) switch is rated 300 mA .

## Timing Diagram



## Environmental Specifications

Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Altitude - $80,000 \mathrm{ft}$.
Shock - 150 G's, $11 \pm 1 \mathrm{~ms}$ half-sine wave
Vibration (sinusoidal) - $10-80 \mathrm{~Hz}$.
at 0.06 inch DA; $80-3,000 \mathrm{~Hz}$. at 20 G 's
Sealing - MIL-STD-202, method
112, condition C
Materials:
Cover - Nickel
Header - Kovar® Alloy
Pins - Kovar® Alloy, gold plated
Marking — Per MIL-R-83726
Weight - 0.42 oz (12g) max.

KOVAR is a trademark of Carpenter
Technology Corporation.


Part Numbering System

| Typical Part Number | 6001 | -6002 | C |
| :--- | :--- | :--- | :--- |

Model Number:
$6001=$ Fixed timer, $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Timing Code:
Four-digit code for any value between 50 ms and 600 s .
The timing code consists of four digits and gives the time in ms. The first three digits are the significant figures and the last digit is the number of zeros following the significant figures; thus 50 ms would be coded 0500, 1.1 s would read 1101, and 1 m ( 60 s ) would be 6002 .
Optional Suffix:
$\mathrm{C}=$ Commercial version equivalent to $\mathrm{M} 83726 / 13$.

A typical part number would be 6001-6002C. This solid state output timing module has a time delay of 60 s at 28 Vdc and is the commercial equivalent to $\mathrm{M} 83726 / 13$.

## Outline Dimensions



## Wiring Diagram



PIN 10 IS ACTIVE. DO NOT CONNECT.

## Special Notes:

- Load is connected between B+ and terminal designated. Delay begins upon application of power to terminals ( $\mathrm{B}+$ and $\mathrm{B}-$ ).
- Always consult latest military specification for changes and additional information.

| Catalog 5-1773450-5 Revised 3-13 | Dimensions are shown for reference purposes only. Specifications subject | Dimensions are in millimeters unless otherwise specified. | USA: +1 8005226752 <br> Asia Pacific: +86 04008206015 UK: +44 800267666 | For additional support numbers please visit www.te.com |
| :---: | :---: | :---: | :---: | :---: |

# 2600 Series Flasher/Repeat-Cycle, Timer-Fixed, Solid State Output 

## Product Facts <br> - All solid-state <br> ■ Digital timing <br> - Reverse polarity protection <br> - Transient/surge protection

## Electrical Specifications

## Timing Range -

"On" Time (. 05 to 600 SEC)
"Off" Time (. 05 to 600 SEC)
Duty Cycle -D.C. $=\frac{\text { T on }}{\text { T on \& T off }}$
$\underset{\text { (Flash rate) }}{\text { Frequency }}-\mathrm{f}=\frac{1}{\text { T on \& T off }}$
Tolarance - $\pm 10 \%$
Repeatability — $\pm 0.1 \%$
Input Data -
Input Voltage - 18 to 31 V dc
Current Drain — 30 ma @ 28 V dc
Output Data -
Output - 28 V dc
Vin (dc) - 1.5 V dc @ 100 ma
Load - 30 ma max.

## Environmental Specifications

Operature Temperature -
$-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Vibration-20 G's, $10-2,000 \mathrm{~Hz}$
Shock - 50 G's, $11 \pm 1$ milliseconds duration
Insulation Resistance - 1,000
megohms at 500 Vdc
Dielectric Strength - 1,000 Vrms,
60 Hz ., at sea level. All terminals tied
together to case
Sealing — Hermetic, 1.3 in. (33.0mm) mercury
Life - over 1,000,000 operations
Weight - $80 z(200 \mathrm{~g})$ max.

## Applications

The Hi-G Series 2600 Flasher can be used wherever warning or indicating light, navigation or position lights, panel or control lights must be operated with a maximum of reliability in severe environments. The Series 2600 can also be used to interrupt Tone Generators or other Signaling Devices at a predetermined frequency.


The part number consists of four elements. The series number, a letter signifying mounting style and the timing code numbers. The first timing is the "ON" time and the second is "OFF" time. The timing code number consists of four digits and gives the time in milliseconds. The first three digits are the significant figures and the last digit is the number of zeros following the significant figures, thus, 50 milliseconds would be coded 0500. 1.1 seconds would read 1101, and 1 minute ( 60 seconds) would be 6002.

Example: HI-G Part Number


| Catalog 5-1773450-5 | Dimensions are shown for <br> reference purposes only. |
| :--- | :--- |
| Revised 3-13 | Specifications subject <br> to change. |
| www.te.com | then |

## 4600/4700 Series Interval Timers

## Product Facts

- AC/DC input interval timer offered in fixed (4600) and adjustable (4700) types
■ Up to 10A loads
- Reverse polarity protection
- Hermetic package

■ Built to MIL-R-83726 environmentals
■ Many customizing options - Extended timing ranges

- Tighter timing tolerances
- Header and mounting
- 115Vac, 60 Hz . input types


## Electrical Specifications

## Timing Range -

4600 series (fixed) - 100 ms to 600 s
4700 series (adjustable) - 100 ms to 240 s
Tolerance - $\pm 10 \%$
Recycle Time - 10 ms (DC input),
50 ms (AC input)
Operate Time (Max.) — 10 ms ( 4 A
models), 20 ms ( 10 A models)
Input Voltage - 18 to 31 Vdc ,
105 to $125 \mathrm{Vac}, 400 \mathrm{~Hz}$
Current Drain (at $25^{\circ} \mathrm{C}, 28 \mathrm{Vdc}$ ) -
DC Coil, 10A contacts -
1- and 2-pole - 135 mA maximum
AC or DC Coil, 4A contacts -
1-pole - 100 mA maximum
2-pole - 150 mA maximum
3- and 4-pole - 200 mA maximum
Contact Ratings -
DC Coil, 10A contacts -
10A resistive @ 30Vdc
5 A inductive @ 30Vdc
5A resistive @ 115 Vrms, 400 Hz
3 A inductive @ $115 \mathrm{Vrms}, 400 \mathrm{~Hz}$

## AC or DC Coil, 4A contacts -

4A resistive @ 30Vdc
1A inductive @ 30Vdc
2A resistive @ 115 Vrms, 400 Hz
1 A inductive @ $115 \mathrm{Vrms}, 400 \mathrm{~Hz}$

## Environmental Specifications

Temperature Range -
$-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$
Vibration-20 G's, $10-2,000 \mathrm{~Hz}$
Shock - 50 G's, $11 \pm 1 \mathrm{~ms}$ duration
Insulation Resistance - 1,000
megohms, min., at 500Vdc
Dielectric Strength $-1,000 \mathrm{Vrms}$, 60 Hz ., at sea level, all terminals to case
Sealing - Hermetic, 1.3 in. ( 33.0 mm ) of mercury
Life - 100,000 operations, min. (4A
models); 50,000 operations, min. (10A models);

## Weight -

4A units - 4.5 oz (127.6g) max.
10A units - 8.5 oz ( 240 g ) max.


The 4600 types are fixed timers, while the 4700 models are adjustable via an external resistor. Numerous output options include 4A rated contacts in 1, 2 and 4
form C (SPDT, DPDT and 4PDT) arrangements and 10A rated contacts in 1-2 form C (SPDT-DPDT) arrangements.

| Fixed Timer Model Number | Adjustable Timer Model Number | $\begin{gathered} \text { Input } \\ \text { Voltage } \end{gathered}$ | Temperature Range | Contact Rating | Contact Arrangement |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 4610 | 4710 | DC | $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ | 10 Amp | 1 Form C (SPDT) |
| 4611 | 4711 | DC | $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ | 10 Amp | 2 Form C (DPDT) |
| 4621 | 4721 | DC | $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ | 4 Amp | 1 Form C (1PDT) |
| 4622 | 4722 | DC | $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ | 4 Amp | 2 Form C (DPDT) |
| 4624 | 4724 | DC | $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ | 4 Amp | 4 Form C (4PDT) |
| 4671 | 4771 | AC | $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ | 4 Amp | 1 Form C (SPDT) |
| 4672 | 4772 | AC | $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ | 4 Amp | 2 Form C (DPDT) |
| 4674 | 4774 | AC | $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ | 4 Amp | 4 Form C (4PDT) |

## Timing Diagram



Apply power and the output will energize. After time-out, the output will revert to de-energized state. Remove and reapply input to cycle.

## Adjustable Timing Formula

 (4700 types)The resistance required to obtain timing within this range is determined by using the formula:
$R x=400 \mathrm{~K}$ (T/Tmax.) - 40K, where
$\mathrm{Rx}=$ External Resistance in Ohms,
T - Desired Time in Seconds, and Tmax. = Maximum Time (Code).
A high quality deposited carbon $\pm 1 \%$, 0.1 W (min.) resistor is recommended for external resistance.

Part Numbering System
 100 ms and 240 s for adjustable (4700) timers.
The timing code consists of four digits and gives the time in ms. The first three digits are the significant figures and the last digit is the number of zeros following the significant figures; thus 50 ms would be coded $0500,1.1 \mathrm{~s}$ would read 1101, and $1 \mathrm{~m}(60 \mathrm{~s})$ would be 6002.
Adjustable timers cover one decade, e.g., 62 ms to 620 ms . The upper decade limit is Tmax. in the timing formula and is the the value defined by the timing code in the part number.
A typical part number for an adjustable timer would be 4722-C-1102. This is a DC unit in the $-55^{\circ} \mathrm{C}$ to $+125^{\circ} \mathrm{C}$ temperature range with a 2 form C (DPDT) contact arrangement in a style " $C$ " mounting, with a maximum time delay of 11 s .

Dimensions are in millimeters unless otherwise specified.

```
USA: +1 }800522675
Asia Pacific: +86 0400 820 6015
UK: +44800 267666

4600/4700 Series Interval Timers (Continued)

\section*{Outline Dimensions}

10 Amp Units


Mounting Option A

4 Amp Units


Mounting Option A


Mounting Option B


Mounting Option B


Mounting Option C


Mounting Option C

\section*{Wiring Diagrams}

4600 Series (Fixed)


1 Form C


1 Form C


2 Form C



3 Form C


Dimensions are shown for reference purposes only. Specifications subject to change.

\title{
4800 Series Interval Timer, Fixed Timing, Solid State Output
}

Product Facts
■ DC input fixed delay interval timer
■ 1 Form A (SPST-NO), 500 mA output
■ CMOS digital design
- Reverse polarity protection
- Hermetic package

■ Built to MIL-R-83726 environmentals
- Customizing options include
- Adjustable timing
- Tighter timing tolerances
- Header and mounting
- Relay output
- AC input

\section*{Electrical Specifications}

Timing Range: 100 s . to 600 s .
Tolerance: \(\pm 10 \%\).
Repeatability: \(\pm 2 \%\).
Recycle Time: 0.5\% of Max. Delay. Input Data:
Input Voltage: 18 to 31 Vdc .
Current Drain: 40mA. max.
Output Data:
Output Form: 1 Form A (SPST-NO).
Output Rating:
500 mA @ \(+25^{\circ} \mathrm{C}\);
\(200 \mathrm{~mA} @+125^{\circ} \mathrm{C}\).
Saturation Voltage:
\(1.0 \mathrm{~V}, 500 \mathrm{~mA}\left(25^{\circ} \mathrm{C}\right)\).

\section*{Leakage:}
\(10 \mu \mathrm{~A}\left(125^{\circ} \mathrm{C}\right)\).

\section*{Environmental Specifications}

Temperature Range:
\(-55^{\circ} \mathrm{C}\) to \(+85^{\circ} \mathrm{C}\) or \(-55^{\circ} \mathrm{C}\) to \(+125^{\circ} \mathrm{C}\).
Vibration: 20 G's, \(10-2,000 \mathrm{~Hz}\).
Shock: 50 G's, \(11 \pm 1 \mathrm{~ms}\) duration.
Insulation Resistance: 1,000
megohms, min., at 500Vdc.
Dielectric Strength: \(500 \mathrm{Vrms}, 60 \mathrm{~Hz}\)., at sea level, all terminals to case.
Sealing: Hermetic, 1.3 in. ( 33.0 mm ) of mercury.
Life: Over 1 million operations.
Weight: 2 oz ( 50 g ) max.

Plug-in sockets are available


Kilovac 4800 series interval timers combine solid state timing circuits with solid state outputs in robust hermetically sealed enclosures. They are fixed timers. The 1 Form A (SPST-NO) output switch is rated 500 mA .

Timing Diagram


Apply power and the output will energize After time-out, the output will revert to de-energized state. Remove and reapply power to recycle.

Part Numbering System
\begin{tabular}{|c|c|c|}
\hline Typical Part Number 48801 & \multirow[t]{2}{*}{-1} & \multirow[t]{2}{*}{-1102} \\
\hline \begin{tabular}{l}
Model Number: \\
\(4801=\) Fixed timer, \(-55^{\circ} \mathrm{C}\) to \(+85^{\circ} \mathrm{C}\) \\
\(4851=\) Fixed timer, \(-55^{\circ} \mathrm{C}\) to \(+125^{\circ} \mathrm{C}\)
\end{tabular} & & \\
\hline \begin{tabular}{l}
Header Style (see Header Options drawings): \\
1 = Hook terminals \(\quad 2=\) Straight terminals, short \\
\(3=\) Straight terminals, long
\end{tabular} & & \\
\hline \begin{tabular}{l}
Mounting (see outline dimension drawings): \\
\(A=\) Plain case \(\quad B=\) Bracket \(B \quad C=\) Studs on side
\end{tabular} & \(\mathrm{E}=\) Bracket E & \\
\hline \multicolumn{3}{|l|}{\begin{tabular}{l}
Timing Code: \\
Four-digit code for any value between 50 ms and 600 s.
\end{tabular}} \\
\hline \multicolumn{3}{|l|}{The timing code consists of four digits and gives the time in ms. The first three digits are the significant figures and the last digit is the number of zeros following the significant figures; thus 50 ms would be coded 0500, 1.1 s would read 1101, and 1 m ( 60 s) would be 6002 .} \\
\hline
\end{tabular}

A typical part number would be \(4801-1 \mathrm{~A}-1102\). This fixed timer operates at \(-55^{\circ} \mathrm{C}\) to \(+85^{\circ} \mathrm{C}\), has hook terminals, style "A" mounting, and a time delay of 11 s .

\section*{Outline Dimensions}


Mounting Option A
Wiring Diagram


Mounting Option B
Header Options



Mounting Option D


Mounting Option E

Header Option 1
TERMINAL SPACING IS 0.2 [5.08] FOR ALL HEADERS


Header Option 3
Kilovac Sensing Relays
Table of Contents
1310 Series DC Voltage Sensors ..... 9-2
1350 Series AC Voltage Sensors ..... 9-3
1400 Series Phase Sensors ..... 9-4, 9-5
7000 Series Frequency Sensors ..... 9-6
Kilovac Sensing Relays

\title{
1310 Series DC Voltage Level Sensor, Relay Output
}

\section*{Product Facts}
- Standard models combine DC voltage-sensing circuit with 2A DPDT output relay
■ Various applications
- Battery protection
- Computer protection
- Low or high voltage alarms
- Many customizing options
- Solid state output
- Two-stage sensing (voltage band)
- Up to 10A relay output
- Controlled dropout differential
- Operate with auxiliary control voltage
- Time delay on trip point
- Tighter accuracy
- Different package, mounting, header

\section*{Electrical Specifications}

Pull-In Voltage - Any voltage level between 10 to 150 Vdc
Drop-Out Voltage - 0 to 0.5 V below pull-in voltage
Current Drain — \(15 \mathrm{~mA} \max @ 25^{\circ} \mathrm{C}\)
Accuracy - \(\pm 2.5 \%\) of set point over temperature range
Max. Allowable Applied Voltage \(150 \%\) of specified pull-in voltage
Auxiliary Voltage - None required
Operate and Release Times -
50 ms max. over the temperature range
Contact Arrangement - 2 Form C
(DPDT)
Contact Rating -
2 amps resistive @ 30Vdc
300mA resistive @ 115 Vrms, 400 Hz

\section*{Environmental Specifications}

\section*{Temperature Range -}
\(-55^{\circ} \mathrm{C}\) to \(+125^{\circ} \mathrm{C}\)
Vibration-20 G's, \(10-2,000 \mathrm{~Hz}\)
Shock - 50 G's, \(11 \pm 1 \mathrm{~ms}\) duration Insulation Resistance - 1,000 megohms, min., at 500 Vdc , all terminals to case
Dielectric Strength \(-1,000 \mathrm{Vrms}\), 60 Hz ., at sea level, all terminals to case Sealing - Hermetic, 1.3 in. ( 33.0 mm ) of mercury
Life - 100,000 operations, min.
Weight - 3.5 oz ( 99.2 g ) max.


The Kilovac 1310 series DC voltage sensor is essentially a voltage monitoring device operating a snap-action transistor circuit with low drift and inherent temperature compensation. This device will either open or close a

\section*{Outline Dimensions}


Mounting Option C

Part Numbering System
Wiring Diagram


\section*{Product Facts}

■ Standard models combine AC ( 400 Hz .) voltagesensing circuit with 2A DPDT output relay
■ Various applications - Motor protection - Ground support equipment
- Low or high line alarms
- Computer protection
- Many customizing options
- Solid state output
- Two-stage sensing (voltage band)
- Up to 10A relay output
- 3 phase version
- Controlled dropout differential
- Operate with auxiliary control voltage
- Under and over voltage trip
- Time delay on trip point
- Tighter accuracy
- Lower trip points
- Different package, mounting, header
- 60 Hz . versions

\section*{Electrical Specifications}

Pull-In Voltage - Any voltage level between 50 to \(150 \mathrm{Vac}, 400 \mathrm{~Hz}\)., in 1.0 volt increments
Drop-Out Voltage - 0 to 3.0 V max, (1.5V nom.) below pull-in voltage Current Drain — 100 mA max @ \(25^{\circ} \mathrm{C}\)
Accuracy - \(\pm 2.5 \%\) of set point over temperature range
Max. Allowable Applied Voltage -
\(150 \%\) of specified pull-in voltage
Auxiliary Voltage - None required
Operate and Release Times -
50ms max. over the temperature range
Contact Arrangement -
2 Form C (DPDT)
Contact Rating -
2 amps resistive @30Vdc
300mA resistive @ 115 Vrms, 400 Hz

\section*{Environmental Specifications}

Temperature Range -
\(-55^{\circ} \mathrm{C}\) to \(+125^{\circ} \mathrm{C}\)
Vibration-20'G,s, \(10-2,000 \mathrm{~Hz}\)
Shock - 50 G's, \(11 \pm 1 \mathrm{~ms}\) duration
Insulation Resistance - 1,000
megohms, min., at 500 Vdc , all terminals to case
Dielectric Strength - \(1,000 \mathrm{Vrms}\), 60 Hz ., at sea level, all terminals to case Sealing — Hermetic, 1.3 in. ( 33.0 mm ) of mercury
Life - 100,000 operations, min.
Weight: \(3.5 \mathrm{oz}(99.2 \mathrm{~g}\) ) max.

\section*{1350 Series AC Voltage Level Sensor, Relay Output}


The Kilovac 1350 series AC voltage sensor energizes a relay when the monitored power line voltage reaches a predetermined level. This rugged unit with reliable solid-state design provides precise, repeatable operation over a wide temperature

\section*{Outline Dimensions}


Mounting Option A

Wiring Diagram

range. The input voltage is fed into a temperature compensated comparator circuit. When the input reaches the preset level, transistor amplifiers switch the output relay. This output may control any external devices, process or warning


Mounting Option B
system to protect expensive equipment. The unit is potted and hermetically sealed and is designed to meet the environmental requirements of MIL-R-83726.

\section*{Part Numbering System}


Dimensions are shown for reference purposes only. Specifications subject to change.

\section*{Product Facts}
- Phase sensor for 115 or 208Vac, 60 or 400 Hz
- Up to 2A loads
- Static and motor load types

■ Hermetic package
■ Built to MIL-R-83726 environmentals
- Various applications
- Motor protection
- Brown-out protection
- Power supply sequencing
- Air conditioner protection
- Ground support equipment protection
- Many customizing options
- 50 Hz . input types
- Contact ratings to 10 A
- Higher voltages
- Different packages, headers and mounting

\section*{Electrical Specifications}

Input Data -
\[
\text { Voltage - } 115 \text { or } 208 \mathrm{Vac}
\]

Frequency - 60 or 400 Hz
Operate Time (Max.) - 75 ms
Release Time (Max.) - 100 ms
Contact Arrangement - 1 Form C
(SPDT)
Contact Ratings -
2 A resistive @ 30Vdc
0.5A inductive @ 30Vdc
0.25 A resistive or inductive @ 115 Vrms ,

60 or 400 Hz

\section*{Environmental Specifications}

\section*{Temperature Range -}
\(-55^{\circ} \mathrm{C}\) to \(+85^{\circ} \mathrm{C}\)
Vibration - 20 G's, \(10-2,000 \mathrm{~Hz}\)
Shock - 50 G's, \(11 \pm 1 \mathrm{~ms}\) duration
Insulation Resistance - 1,000
megohms, min., at 500Vdc
Dielectric Strength \(-1,000 \mathrm{Vrms}, 60\)
Hz ., at sea level, all terminals to case
Sealing - Hermetic, 1.3 in. ( 33.0 mm ) of mercury
Life - 100,000 operations, min.
Weight - 12 oz (340g) max.


Kilovac 1400 series phase sensors combine solid state sensing circuits with electromechanical output relays in robust hermetically sealed enclosures.
P-Type models are for static loads. With the line voltage and frequency are within operating limits, P-Type units will energize only when input phases are in sequence A-B-C. They will de-energize only when
power is removed. The P-Type unit is best suited to applications where static loads are used and where regenerated voltage will not be present if a phase opens.
Q-Type units perform the same function as the P-Type since they will energize only when input phases are in sequence A-B-C. In addition, the Q-Type unit will deenergize when any phase is disconnected or grounded,
provided the voltage input to the unit is below \(50 \%\) of the nominal phase-to-phase voltage input. Q-Type units are suitable for motor loads where regenerated voltage is produced.
Neither P-Type nor Q-Type units require connection to the neutral leg.
For high-current applications, phase sensors are used with slave relays having heavy duty contact ratings.

\section*{Specifications by Model Number}
\begin{tabular}{cccccc}
\hline \begin{tabular}{c} 
Fixed Timer \\
Model Number
\end{tabular} & \begin{tabular}{c} 
Load \\
Type
\end{tabular} & \begin{tabular}{c} 
Line to Line \\
Voltage \(\mathbf{1 0 \%}\)
\end{tabular} & \begin{tabular}{c} 
Frequency \\
\(\mathbf{\pm 1 0 \%} \%\)
\end{tabular} & \begin{tabular}{c} 
Max. Power \\
Required
\end{tabular} & \begin{tabular}{c} 
Mounting Style \\
Figure
\end{tabular} \\
\hline 1407 & \(P\) & 115 V & 60 Hz & 4 Watts & 3 \\
1408 & \(P\) & 115 V & 400 Hz. & 4 Watts & 1 or 3 \\
1409 & \(P\) & 208 V & 60 Hz. & 6 Watts & 3 \\
1410 & \(P\) & 208 V & 400 Hz. & 6 Watts & 3 \\
\hline 1437 & \(Q\) & 115 V & 60 Hz. & 6 Watts & 2 \\
1438 & \(Q\) & 115 V & 400 Hz. & 6 Watts & 3 \\
1439 & \(Q\) & 208 V & 90 Hz. & 9 Wats & 4 \\
1440 & \(Q\) & 400 Hz. & 9 Watts & 4 \\
\hline
\end{tabular}

Typical Applications Connections


Wiring Diagram


Part Numbering System


A typical part number would be 1408-1A. This is a 115Vac, 400 Hz ., "P" type phase sensor with a 1 form C (SPDT) contact arrangement in a style " \(A\) " mounting to change.

\section*{Outline Dimensions}

Figure 1
Applicable to 1408


Mounting Option A


Mounting Option C

Figure 2
Applicable to 1437

Mounting Option A

Figure 4
Applicable to 1439 and 1440


Kilovac Sensing Relays

\section*{7000 Series Frequency Sensor}

\section*{Product Facts}

■ 320 to 480 Hz . frequency sensor
- 1 or 2 Form C (SPDT or DPDT) contacts
■ Hermetic package
■ Many customizing options
- 50 or 60 Hz . Sensing
- Dual trip points
- Tighter accuracy
- Enclosures
- Higher temperature range
- Up to 4 Form C (4PDT) - 10A contacts

\section*{Electrical Specifications}

Input Voltage - 95 to \(135 \mathrm{Vac}, 400 \mathrm{~Hz}\) Frequency Range - 320 to 480 Hz Accuracy - \(\pm 2 \%\)
Contact Arrangement -
1 Form C (SPDT) or 2 Form C (DPDT)
Contact Ratings -
4A resistive @ 30Vdc
2A resistive @ 115 Vrms, 400 Hz
Current Drain - 150 mA maximum
Hysteresis - \(0.5 \%\) from trip point

Environmental Specifications
Temperature Range -
\(-55^{\circ} \mathrm{C}\) to \(+85^{\circ} \mathrm{C}\)
Vibration-20 G's, \(10-2,000 \mathrm{~Hz}\)
Shock - 50 G's, \(11 \pm 1 \mathrm{~ms}\) duration
Insulation Resistance - 1,000 megohms, min., at 500Vdc, all terminals to case
Dielectric Strength \(-1,000 \mathrm{Vms}\),
60 Hz ., at sea level, all terminals to case
Sealing - Hermetic, 1.3 in. (33.0mm) of mercury
Life - 100,000 operations, min.
Weight - 8.5 oz ( 240 g ) max.

Kilovac 7000 series frequency sensor utilizes an integrated circuit digital logic design to determine, cycle by cycle, whether a given input signal is within a predetermined frequency pass band. Typical application is in monitoring MIL-STD-704 power systems.

\section*{Function Diagram}



Part Numbering System


A typical part number would be 7000-2B-380. This would be a sensor with a 2 form C (DPDT) contact arrangement in a style "C" mounting, with a 380 Hz . trip point for \(-55^{\circ} \mathrm{C}\) to \(+85^{\circ} \mathrm{C}\) temperature range .

\section*{Outline Dimensions}


Mounting Option A


Mounting Option B

Mounting Option C


\section*{Wiring Diagrams}

1 Form C


2 Form C


\section*{Table of Contents}

DS11 Series DC Relays, 2 Amp Output Rating, Qualified to DSCC Drawing 88062 \(10-2\) - 10-5
DS13 Series DC Relays, 2 Amp Output Rating,
Qualified to DSCC Drawing 90091 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .10-6 - 10-9
MS14 Series Solid State Relay . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .10-10, 10-11
JTS5, 6, \& 7 Series, DC \& Bi-Directional Output, Up to 250mA \& 250V Output Rating,
TO-5 Package, Qualified to MIL-PRF-28750/5, /6, \& /7 . . . . . . . . . . . . . . . . . . . . . . 10-12
MS18 Series, DC \& Bi-Directional Output, Up to 2A \& 350V Output Rating,
Qualified to DSCC Drawing 89116 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 10-13, 10-14
JDS9 Series, AC Relays, 2A/250Vrms Rating, Qualified to MIL-PRF-28750/9 . . .10-15, 10-16
PS12 Series, AC Relays, 10A/250Vrms Rating,
Qualified to DSCC Drawing 86031 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .10-17, 10-18
JPS10 Series, AC Relays, 25A/250Vrms Rating, Qualified to MIL-PRF-28750/10 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . .10-19, 10-20

\title{
DS11 Series SSR For DC Loads up to 2A @ 60Vdc
}

\section*{Product Facts}

■ Standard options: short circuit/overload protection, switch status and trip status
■ Optically coupled all solid state relay
- TTL \& CMOS compatible input
■ Low on-resistance power MOSFET output
■ Tested per MIL-PRF-28750D and approved to DSCC drawing 88062 with " \(Y\) " level screening


DS11 series SSRs feature state of the art photo-voltaic optical isolation and power MOSFET output chips for ultra-reliable high speed switching of DC loads up to 2 amps, with extremely low on-resistance. Standard options include integral current overload/short circuit protection to provide protection of the relay, load
and wiring; and isolated switch status or trip status. The overload feature provides protection if a short or overload develops while the relay is in the on state or if the relay is turned on into a dead short. Switch status, optically isolated from the load, signals the status of the output and provides a logic " 0 " when the output is
off and a logic " 1 " when the output is on. Trip status, also optically isolated from the load, provides a logic "1" if the output trips off and a logic " 0 " when the output is in a normal condition, on or off, and is available only in conjunction with short circuit protection.
\begin{tabular}{|ccc|}
\hline Kilovac Part No. & DSCC Dwg. No. & Relay Version \\
\hline DS11-1Y & \(88062-008\) & Basic relay \\
DS11-1000 & \(88062-004\) & Relay w/ short circuit protection \\
DS11-1001 & \(88062-006\) & Relay w/ switch status \\
DS11-1002 & \(88062-002\) & Relay w/ short circuit protection and switch status \\
DS11-1003 & N/A & Relay w/ short circuit protection and trip status \\
\hline
\end{tabular}

\section*{2 Terminal Input Configuration}


\section*{3 Terminal Input Configuration}


Without Output Status


\section*{DS11 Series SSR For DC Loads up to 2A @ 60Vdc (Continued)}

Environmental Characteristics Ambient Temperature Range -
Operating \(--55^{\circ} \mathrm{C}\) to \(+105^{\circ} \mathrm{C}\)
Storage \(--55^{\circ} \mathrm{C}\) to \(+105^{\circ} \mathrm{C}\)
Vibration Resistance -
100 G's, \(10-3,000 \mathrm{~Hz}\)
Shock Resistance -
50 G's, 11 ms pulse
Constant Acceleration Resistance
(Y1 axis) -
5,000 G's

\section*{Mechanical Characteristics}

Weight (approx.) -
. 176 oz. ( 5 grams)

\section*{Materials -}

Header - KOVAR
Cover - Nickel
Pins — KOVAR, gold plated
\begin{tabular}{|c|c|}
\hline Input (2 terminal configuration) & \\
\hline Input supply voltage range (Vcc) & 3.8-32 Vdc (Notes 1 \& 2, Figures 1 \& 2) \\
\hline Input current (max.) @ 5Vdc & 15 mAdc (Notes \(1 \& 2\), Figures 1 \& 2) \\
\hline Must turn-on voltage & 3.8 Vdc \\
\hline Must turn-off voltage & 1.5 Vdc \\
\hline Reverse voltage protection & -32Vdc \\
\hline \multicolumn{2}{|l|}{Input (3 terminal configuration)} \\
\hline Control voltage range & 0-18 Vd \\
\hline Control current (max.) & 250uAdc @ 5V, 1mA @ 18V \\
\hline Input supply voltage range (Vcc) & 3.8-32 Vdc (Notes \(1 \& 2\), Figures 1 \& 2) \\
\hline Input current (max.) @ 5Vdc & 15 mADC (Notes \(1 \& 2\), Figures 1 \& 2) \\
\hline Must turn-on voltage & 0.3 Vdc \\
\hline Must turn-off voltage & 3.2 Vdc \\
\hline \multicolumn{2}{|l|}{1/0} \\
\hline Dielectric strength (min.) & 1,000V rms \\
\hline Insulation resistance (min.) @ 500Vdc & \(10^{9} \mathrm{ohms}\) \\
\hline Capacitance (max.) & 10pF \\
\hline \multicolumn{2}{|l|}{Output} \\
\hline Continuous load current (max.) @ \(25^{\circ} \mathrm{C}\) & 2.1Adc (Figure 7) \\
\hline Continuous load voltage (max.) & 60Vdc \\
\hline Transient blocking voltage (max.) & 80Vdc (Note 5) \\
\hline On resistance (max.) @ \(\mathrm{T}_{\mathrm{j}}=25^{\circ} \mathrm{C}, \mathrm{L}_{\mathrm{L}}=100 \mathrm{~mA}\) & 0.15 ohm (Note 6, Figure 6) \\
\hline Output voltage drop (max.) & 0.5 Vdc \\
\hline Leakage current (max.) @ V = 60Vdc & 100 \(\mu\) Adc \\
\hline Leakage current (max.) @ V = 60Vdc, with switch status & 2 mAdc \\
\hline Turn-on time (max.) & 3 ms (Figure 3) \\
\hline Turn-off time (max.) & 1 ms (Figure 3) \\
\hline dv/dt (min.) & \(100 \mathrm{~V} / \mathrm{\mu s}\) \\
\hline Electrical system spike & 600 Vdc (Note 5) \\
\hline Output chip junction temperature (max.) & \(125^{\circ} \mathrm{C}\) \\
\hline Thermal resistance (max.), junction to ambient & \(90^{\circ} \mathrm{C} / \mathrm{W}\) \\
\hline Thermal resistance (max.), junction to case & \(25^{\circ} \mathrm{C} / \mathrm{W}\) \\
\hline \multicolumn{2}{|l|}{Status} \\
\hline Status supply voltage range & 1-18Vdc \\
\hline Status current (max.) @ Vstatus \(\leq 0.4 \mathrm{Vdc}\) & 600^ADC (Figure 5, Note 8) \\
\hline Status leakage current (max.) @ 16Vdc & \(10 \mu \mathrm{Adc}\) \\
\hline Status turn-on time (max.) & 3.5 ms (Figure 4) \\
\hline Status turn-off time (max.) & 8 ms (Figure 4) \\
\hline \multicolumn{2}{|l|}{Short Circuit Protection} \\
\hline Current surge without tripping (max.), 100 ms pulse & 4.25Adc \\
\hline Overload trip current (max.), 0.5 ms pulse, \(\mathrm{V}=60 \mathrm{Vdc}\) & 10Adc \\
\hline Trip time (typical), turning on into short & 400 \(\mu \mathrm{s}\) \\
\hline Trip time (typical), shorting while relay is on & 280us \\
\hline
\end{tabular}

KOVAR is a trademark of Carpenter Technology Corporation.

\section*{DS11 Series SSR For DC Loads up to 2A @ 60Vdc (Continued)}

Figure 1 - Maximum Input Current vs. Input Voltage


Figure 3 - Turn-on and Turn-off Timing
Pin 14


Figure 5 - Status Resistor vs. Status Supply Voltage


Figure 2 - Series Resistance vs. Vcc Supply Voltage (Note 1)


Figure 4-Output Status Timing


Figure 6-On-Resistance vs. Temperature (Note 6)


\section*{DS11 Series SSR For DC Loads up to 2A @ 60Vdc (Continued)}

Figure 7 - Temperature Derating Curve


Figure 8 - Maximum Surge Current Without Tripping


Figure 9-Outline Dimensions

\(\pm 0.010\) ( 0.25 mm ) FOR 2 PLACE DECIMALS,
\(\pm 0.005(0.13 \mathrm{~mm})\) FOR 3 PLACE DECIMALS.
UNLESS OTHERWISE SPECIFIED

\section*{Notes}
1.2 terminal input configuration is compatible with CMOS or open collector TTL (with pull-up resistor). For Vcc levels above 6Vdc, a series limiting resistor is required. See Fig. 2 for resistor value. Use standard resistor value equal to or less than value from the curve.
2. Input transitions to be \(\leq 1 \mathrm{~ms}\) duration, and input direct drive should be "bounceless contact" type.
3. \(\mathrm{Vcc}=5 \mathrm{Vdc}\) for all tests unless otherwise specified.
4. All DS11 Series relays may drive loads connected to either positive or negative referenced power supply lines. Reversing polarity of output may cause permanent damage. Inductive loads must be diode suppressed.
5. Transient blocking voltage and electrical system spike tests are performed per MIL-STD-704 (28VDC systems).
6. To determine the maximum on-resistance at any given junction temperature, multiply on-resistance at \(25^{\circ} \mathrm{C}(0.15\) ohm \()\) by normalized on-resistance factor from curve (Fig. 6).
7. Overload testing per MIL-R-28750 is constrained to the limits imposed by the short circuit protection requirements of this specification and DSCC drawing 88062 . Load circuit series inductance for "load shorted" mode of operation to be limited to 50 mH max. Maximum repetition rate into a shorted load should not exceed 10 Hz .
8. Proper operation of the status feedback requires a status pull-up resistor. See Fig. 5 for status resistor value.
\begin{tabular}{ll} 
Catalog 5-1773450-5 & \begin{tabular}{l} 
Dimensions are shown for \\
reference purposes only. \\
Revised 3-13
\end{tabular} \\
\begin{tabular}{ll} 
Specifications subject \\
to change.
\end{tabular}
\end{tabular}
\begin{tabular}{ll} 
Dimensions are in millimeters & USA: +1 8005226752 \\
unless otherwise specified. & Asia Pacific: +86 04008206015 \\
& UK: +44 800 267666
\end{tabular}

For additional support numbers
Revised 3-13 reference purposes only. to change.

\section*{DS13 SSR for loads up to 2A @ 60Vdc}

\section*{Product Facts}

■ Standard options: short circuit/overload protection and control status.
■ Optically coupled all solid state relay.
■ TTL \& CMOS compatible input.
■ Low on-resistance power MOSFET output.
■ Tested per MIL-PRF-28750D and approved to DSCC drawing 90091.
- All versions available with Tyco Electronics "W" level screening for Kilovac relays.

\section*{2 Terminal Input Configuration}


DS13 series SSRs employ state of the art photovoltaic optical isolation and power MOSFET output chips for ultra-reliable high speed switching of DC loads up to 2 amps, with low onresistance. Standard options include integral current overload/short
circuit protection and a separate input control status line. The overload feature provides protection of the relay, load and load circuit wiring in the event of a sustained current overload or short circuit while the relay is on or when it is turned on into a short. The
control status provides a built-in test function which provides a logic " 0 " when the input circuit is energized and functional. The relay is packaged into a custom hermetically sealed lowprofile 8-pin ceramic DIP package, with through hole or surface mount pins.
\begin{tabular}{|ccc|}
\hline Kilovac Part No. & DSCC Dwg. No. & Relay Version \\
\hline DS13-1Y & \(90091-008\) & Basic relay \\
DS13-1000 & \(90091-004\) & Relay w/ short circuit protection \\
DS13-1001 & \(90091-006\) & Relay w/ control status \\
DS13-1002 & \(90091-002\) & Relay w/ short circuit protection and control status \\
\hline
\end{tabular}

Notes: Add suffix "S" to part number for surface mount versions.
Add suffix " \(T\) " to part number for tinned leads.
Add suffix "W" to part number for lower screening level.

\section*{Direct Drive}


TTL Drive


\section*{3 Terminal Input Configuration}


Without Status


Environmental Characteristics

Ambient Temperature Range:
Operating: \(-55^{\circ} \mathrm{C}\) to \(+105^{\circ} \mathrm{C}\)
Storage: \(-55^{\circ} \mathrm{C}\) to \(+125^{\circ} \mathrm{C}\).
Vibration Resistance:
100 G's, \(10-3,000 \mathrm{~Hz}\).
Shock Resistance:
1,500 G's, 0.5 ms pulse.
Constant Acceleration Resistance: 5,000 G's.

\section*{Mechanical Characteristics}

Weight (max.):
. 07 0z. (2 grams)

\section*{Materials:}

Case: DIP, hermetically sealed, ceramic
Pins: Copper, gold plated
\begin{tabular}{|c|c|}
\hline Input (2 terminal configuration) & \\
\hline Input supply voltage range (Vcc) & 3.8-32 Vdc (Notes 1 \& 2, Figures 1 \& 2) \\
\hline Input current (max.) @ 5Vdc & 15 mAdc (Notes \(1 \& 2\), Figures \(1 \& 2\) ) \\
\hline Must turn-on voltage & 3.8 Vdc \\
\hline Must turn-off voltage & 1.5 Vdc \\
\hline Reverse voltage protection & -32Vdc \\
\hline \multicolumn{2}{|l|}{Input (3 terminal configuration)} \\
\hline Control voltage range & 0-18 Vdc \\
\hline Control current (max.) & 240HAdc @ 5V, 1mA @ 18V \\
\hline Input supply voltage range (Vcc) & 3.8-32 Vdc (Notes \(1 \& 2\), Figures 1 \& 2) \\
\hline Input current (max.) @ 5Vdc & 15 mAdc (Notes \(1 \& 2\), Figures \(1 \& 2\) ) \\
\hline Must turn-on voltage & 0.3 Vdc \\
\hline Must turn-off voltage & 3.2 Vdc \\
\hline \multicolumn{2}{|l|}{1/0} \\
\hline Dielectric Strength (min.) & 1,000V rms \\
\hline Insulation Resistance (min.) @ 500Vdc & \(10^{9}\) ohms \\
\hline Capacitance (max.) & 10pF \\
\hline \multicolumn{2}{|l|}{Output} \\
\hline Continuous load current (max.) @ \(25^{\circ} \mathrm{C}\), without short circuit protection & 2.0Adc (Figure 5, Note 3) \\
\hline Continuous load current (max.) @ \(25^{\circ} \mathrm{C}\), with short circuit protection & 1.0Adc (Figure 5, Note 3) \\
\hline Continuous load voltage (max.) & 60Vdc \\
\hline Transient blocking voltage (max.) & 80Vdc (Note 4) \\
\hline On resistance (max.) @ \(\mathrm{T}_{\mathrm{j}}=25^{\circ} \mathrm{C}, \mathrm{I}_{\mathrm{L}}=100 \mathrm{ma}\), with short circuit protection & 0.45 ohm (Note 5, Figure 4) \\
\hline On resistance (max.) @ \(\mathrm{T}_{\mathrm{j}}=25^{\circ} \mathrm{C}, \mathrm{I}_{\mathrm{L}}=100 \mathrm{ma}\), without short circuit protection & 0.22 ohm (Note 5, Figure 4) \\
\hline Output voltage drop (max.), with short circuit protection & 0.6 Vdc \\
\hline Output voltage drop (max.), without short circuit protection & 0.75 Vdc \\
\hline Off-state leakage current (max.) @ 60Vdc & \(100 \mu \mathrm{Adc}\) \\
\hline Turn-on time (max.) & 1.5 ms (Figure 3) \\
\hline Turn-off time (max.) & . 25 ms (Figure 3) \\
\hline dv/dt (min.) & \(100 \mathrm{~V} / \mathrm{\mu s}\) \\
\hline Electrical system spike & \(\pm 600 \mathrm{Vdc}\) (Note 4) \\
\hline Junction temperature (max.) & \(150^{\circ} \mathrm{C}\) \\
\hline Thermal resistance (max.), junction to ambient & \(80^{\circ} \mathrm{C} / \mathrm{W}\) \\
\hline Thermal resistance (max.), junction to case & \(20^{\circ} \mathrm{C} / \mathrm{W}\) \\
\hline \multicolumn{2}{|l|}{Status} \\
\hline Status supply voltage & 30Vdc \\
\hline Status sink current (max.) @ Vstatus \(\leq 0.3 \mathrm{Vdc}\) & 2mAdc (Note 7) \\
\hline Status leakage current (max.) @ 15Vdc & \(4 \mu \mathrm{Adc}\) \\
\hline Short Circuit Protection & See Figure 6, Note 7 \\
\hline
\end{tabular}

Figure 1 - Maximum Input Current vs. Input Voltage


Figure 3-Output Turn-on and Turn-off Timing


Figure 5 - Temperature Derating Curve


Figure 2 - Series Resistance vs. Vcc Supply Voltage (Note 1)


Figure 4 - On-Resistance vs. Temperature (Note 6)


Figure 6 - Typical Current Trip Levels


\section*{DS13 SSR for loads up to 2A @ 60Vdc (Continued)}

Figure 7-Outline Dimensions
Through-Hole Mount Version
Surface Mount Version


\section*{Notes}
1.2 terminal input configuration is compatible with CMOS or open collector TTL (with pull-up resistor). For Vcc levels above 6Vdc, a series limiting resistor is required. See Fig. 2 for resistor value. Use standard resistor value equal to or less than value form the curve.
2. \(\mathrm{Vcc}=5 \mathrm{Vdc}\) for all tests unless otherwise specified.
3. All DS13 Series relays may drive loads connected to either positive or negative referenced power supply lines. Reversing polarity of output may cause permanent damage. Inductive loads must be diode suppressed.
4. Transient blocking voltage \& electrical system spike tests are performed per MIL-STD-704 (28Vdc systems).
5. To determine the maximum on-resistance at any given junction temperature, multiply on-resistance at \(25^{\circ} \mathrm{C}\) by normalized on-resistance factor from curve (Fig. 4 ).
6. Overload testing per MIL-R-28750 is constrained to the limits imposed by the short circuit protection requirements of this specification and DSCC drawing 90091. Load circuit series inductance for "load shorted" mode of operation to be limited to 50 mH max. Maximum repetition rate into a shorted load should not exceed 10 Hz . To calculate maximum on-resistance at any temperature, use the following equation: \(\mathrm{R}(\mathrm{on})=\mathrm{R}(\mathrm{on}) @ 25^{\circ} \mathrm{C} \times \mathrm{NF}\) (without short circuit protection) and \(R(o n)=0.2 \times N F+.21\) (with short circuit protection) where NF = normalized on-resistance factor from Fig. 4.
7. Proper operation of the status feedback requires a status pull-up resistor. Select the status resistor such that it limits status output current to 2 mA : R status \(=\) V status \(-0.3 \mathrm{~V} / 2 \mathrm{~mA}\).
\begin{tabular}{ll}
\hline Catalog 5-1773450-5 & \begin{tabular}{l} 
Dimensions are shown for \\
reference purposes only.
\end{tabular} \\
Revised 3-13 & Specifications subject \\
www.te.com & to change.
\end{tabular}

\title{
MS14 Series Solid State Relay, \\ With DC or Bi-Directional Output to 350mA @ 400V
}

\section*{Product Facts}
- 1000V optical isolation protects control and driver circuitry from load transients.
- Buffered/current limited input for direct drive from CMOS or TTL logic.
- Power MOSFET output chips for low voltage drop.
- \(90 \& 240 \mathrm{~mA}\) output current.
- \(85,100 \& 400 \mathrm{~V}\) output voltage.
- Subminiature hermetically sealed .100 grid package.
- Screened per " \(\gamma\) " level of MIL-PRF-28750D.
- Direct replacement for TELEDYNE M92F \& M93F series

Environmental Characteristics
Ambient Temperature Range:
Operating: \(-55^{\circ} \mathrm{C}\) to \(+105^{\circ} \mathrm{C}\)
Storage: \(-55^{\circ} \mathrm{C}\) to \(+125^{\circ} \mathrm{C}\).
Vibration Resistance:
30 G's, 10-3,000 Hz.
Shock Resistance:
1,500 G's 0.5 ms pulse.
Constant Acceleration Resistance:
5,000 G's.

\section*{Mechanical Characteristics}

Weight (max.):
. 07 oz. (2 grams)
Materials:
Case: Nickel, hermetically sealed.
Pins: Kovar, gold plated

\section*{TTL Configuration}


CMOS Configuration



MS14 series subminiature SSRs employ state of the art photo-voltaic optical isolation providing 1000 Vrms input/output isolation and power mosfet output chips for ultra-reliable

\section*{Ordering Information}
\begin{tabular}{|ccc|}
\hline Kilovac Part No. & DSCC Drawing/Pin No. & Output Rating \\
\hline MS14-1Y & \(85092-001\) & \(350 \mathrm{~mA} / 400 \mathrm{~V}\) \\
MS14-2Y & \(85092-002\) & \(135 \mathrm{~mA} / 400 \mathrm{~V}\) \\
MS14-3Y & \(87034-003\) & \(\pm 240 \mathrm{~mA} / 85 \mathrm{~V}\) \\
\hline
\end{tabular}

Electrical Specifications \(\left(-55^{\circ} \mathrm{C}\right.\) to \(+105^{\circ} \mathrm{C}\) unless otherwise specified)
\begin{tabular}{|c|c|}
\hline Input (TTL Drive) & \\
\hline Input supply voltage range (Vcc) & 3.8-32 Vdc (Notes 1 \& 2, Figures 1 \& 2) \\
\hline Input current (max.) @ 5Vdc & 16 mAdc (Notes \(1 \& 2\), Figures 1 \& 2) \\
\hline Must turn-on voltage & 3.8 Vdc \\
\hline Must turn-off voltage & 1.5 Vdc \\
\hline Input (CMOS Drive) & \\
\hline Control voltage range & 0-18 Vdc \\
\hline Control current (max.) & 250uAdc @ 5V, 1mA @ 18V \\
\hline Input supply voltage range (Vcc) & 3.8-32 Vdc (Notes 1 \& 2, Figures 1 \& 2) \\
\hline Input current (max.) @ 5Vdc & 16 mAdc (Notes \(1 \& 2\), Figures 1 \& 2) \\
\hline Must turn-on voltage & 0.3 Vdc \\
\hline Must turn-off voltage & 2.8 Vdc \\
\hline 1/0 & \\
\hline Dielectric Strength (min.) & 1,000V rms \\
\hline Insulation Resistance (min.) @ 500Vdc & \(10^{9}\) ohms \\
\hline Output & \\
\hline Continuous load current (max.) @ \(25^{\circ} \mathrm{C}\) : MS14-1Y & 350 mAdc \\
\hline Continuous load current (max.) @ \(25^{\circ} \mathrm{C}\) : MS14-2Y & 135 mAdc \\
\hline Continuous load current (max.) @ \(25^{\circ} \mathrm{C}\) : MS14-3Y & +/-240mA \\
\hline Continuous load voltage (max.) @ \(25^{\circ} \mathrm{C}\) : MS14-1Y & 100 Vdc \\
\hline Continuous load voltage (max.) @ \(25^{\circ} \mathrm{C}\) : MS14-2Y & 400 Vdc \\
\hline Continuous load voltage (max.) @ \(25^{\circ} \mathrm{C}\) : MS14-3Y & +/-85V \\
\hline On resistance (max.) @ \(\mathrm{T}_{\mathrm{j}}=25^{\circ} \mathrm{C}, \mathrm{L}_{\mathrm{L}}=100 \mathrm{~mA}\) : MS14-1Y & 4 ohms \\
\hline On resistance (max.) @ \(\mathrm{T}_{\mathrm{j}}=25^{\circ} \mathrm{C}, \mathrm{L}_{\mathrm{L}}=100 \mathrm{~mA}\) : \(\mathrm{MS14-2Y}\) & 25 ohms \\
\hline On resistance (max.) @ \(\mathrm{T}_{\mathrm{j}}=25^{\circ} \mathrm{C}, \mathrm{L}_{\mathrm{L}}=100 \mathrm{~mA}\) : MS14-3Y & 8 ohms \\
\hline Off-state leakage I (max.) @ 80\% max. V @ -55 to +25* & \(1 \mu \mathrm{~A}\) \\
\hline Off-state leakage I (max.) @ 80\% max. V @ \(=25\) to \(+85^{\circ} \mathrm{C}\) & \(50 \mu \mathrm{~A}\) \\
\hline Junction temperature (max.) & \(150^{\circ} \mathrm{C}\) \\
\hline Turn-on time (max.) MS14-1Y \& -2Y & 7 mS \\
\hline Turn-on time (max.) MS14-3Y & 2 mS \\
\hline Turn-off time (max.) (all versions) & 1 mS \\
\hline
\end{tabular}
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\title{
MS14 Series Solid State Relay, \\ With DC or Bi-Directional Output to 350mA @ 400V (Continued)
}

Figure 1 -
Max. Input Current vs. Input Voltage


Figure 4 Temperature Derating Curve


Figure 2 -
Series Res. vs. Vcc Supply Voltage (Note 1)


Figure 5 -
On-Resistance vs. Temperature (Note 6)


Figure 3 -
Output Turn-on and Turn-off Timing


Figure 6 -
Simplified Circuit


Note: MS14-1Y and -2 Y have a single output chip.

Figure 7-Outline Dimensions


Unless otherwise specified, tolerances are: \(\pm 0.010\) [0.25] for 2 place decimals \(\pm 0.005\) [0.13] for 3 place decimals

Terminal numbers are for reference only and do not appear on the header.

Notes
1.2 terminal input configuration is compatible with CMOS or open collector TTL (with pull-up resistor).
2. For Vcc levels above 6 Vdc , a series limiting resistor is required. See Fig. 2 for resistor value. Use standard resistor value equal to or less than value form the curve.
3. Vcc \(=5 \mathrm{Vdc}\) for all tests unless otherwise specified.
4. All MS14 Series relays may drive loads connected to either positive or negative referenced power supply lines. Inductive loads must be diode suppressed.
5. If an input series current limiting resistor is used, derating of output current vs. Vcc is not necessary. Curve for 4V applies.
6. On-resistance at any ambient temperature other than \(25^{\circ} \mathrm{C}\) can be computed as follows:
\(R(@\) any T\()=\mathrm{R}\left(@+25^{\circ} \mathrm{C}\right) \times \mathrm{e}^{0.006}\), where \(\mathrm{T}=\) new temperature \(-25^{\circ} \mathrm{C}, \mathrm{e}=2.7182818\).

9-1773439-2-PDF-KRG-9-07 Specifications subject to change.

\section*{JTS5, 6, \& 7 Series, DC \& Bi-Directional Output, Up to 250mA \& 250V Output Rating, T0-5 Package}

Input Characteristics
Input Voltage Range -
\(4.0-7.0 \mathrm{Vdc}\)
Maximum Turn-on Voltage -
5.0 Vdc
Minimum Turn-off Voltage -
1.0 Vdc
I/O Dielectric -1000 Vac pk-pk

Output Characteristics
Max. Output Current
(Continuous, \(25^{\circ} \mathrm{C}\) ) -
50 mAac or mAdc (JTS5-1Y)
250 mAdc (JTS6-1Y)
100 mAdc (JTS7-1Y)

\section*{Max. Output Voltage -}

40 Vac or Vdc (JTS5-1Y)
40 Vdc (JTS6-1Y)
250 Vdc (JTS7-1Y)
Max. On-resistance -
5 ohms (JTS5-1Y)
Turn-on Time - 10 usec.
Turn-off Time - \(15 \mu \mathrm{sec}\).

Environmental Characteristics
Shock - 1500 G's, 0.5 ms.
Vibration - 100 G's, 10 to 2000 Hz
Operating Ambient Temperature --55 to \(+125^{\circ} \mathrm{C}\)

\section*{Product Facts}
- Hermetically sealed TO-5 package
- Transformer coupled
- High speed switching
- JTS5-1Y switches AC or DC
- Qualified to M28750/5, 6 ,
\& 7



Notes: 1) Reversing polarity of input (or output except for JTS5-1) may cause permanent damage.
2) Input must be a step function. Rise or fall time, as applicable, not to exceed \(100 \mu \mathrm{sec}\).
3) Inductive loads must be diode suppressed.
4) For any control voltage, the maximum load current shown on graphs must not be exceeded. Attempting to draw currents in excess of those specified on graphs can cause permanent damage.


\title{
MS18-1006 High Performance DC and Bi-directional Solid State Relay For Loads up to 2A @ 80Vdc
}

\section*{Product Facts}

■ Bi-directional power FET output
■ Optically coupled
■ Low on-resistance
■ Extremely low leakage current
- Subminiature hermetically sealed package
■ Tested per MIL-PRF-28750D and approved to DSCC drawing 89116-006

The MS18-1006 is an optically coupled SSR employing power MOSFET output chips in an inverse series configuration for switching DC or bi-directional loads. A common source connection is provided for the user

to configure the output switching circuit for DC operation up to 2A with very low on-resistance. The relay features fast switching speeds, low off-state leakage, virtually zero offset voltage and the capability to with-
stand high inrush currents up to \(350 \%\) of rated. The low profile subminiature package is hermetically sealed with pinouts on a \(0.1^{\prime \prime} \times 0.3^{\prime \prime}\) grid pattern.
\begin{tabular}{|ccc|}
\hline Kilovac Part No. & DSCC Dwg. No. & Relay Version \\
\hline MS18-1006 & \(89116-006\) & Basic relay \\
\hline
\end{tabular}

\section*{Environmental Characteristics}

\section*{Ambient Temperature Range -}

Operating - \(-55^{\circ} \mathrm{C}\) to \(+120^{\circ} \mathrm{C}\)
Storage - \(-55^{\circ} \mathrm{C}\) to \(+125^{\circ} \mathrm{C}\)
Vibration Resistance -
100 G's, 10-2,000 Hz
Shock Resistance -
1,500 G's, 0.5 ms pulse

\section*{Constant Acceleration Resistance}
( Y -1 axis) -
5,000 G's

Mechanical Characteristics
Weight (approx.) -
. 07 oz. (5 grams)
Materials -
Header - Kovar® Alloy
Cover - Grade A Nickel
Pins — Kovar® Alloy, gold plated

KOVAR is a trademark of Carpenter Technology Corporation.

\section*{Electrical Specifications ( \(-55^{\circ} \mathrm{C}\) to \(+120^{\circ} \mathrm{C}\) unless otherwise specified)}
\begin{tabular}{|c|c|}
\hline Input & \\
\hline Input current (max.) & 25 mAdc \\
\hline Input voltage drop (max. @ 25mA)) & 1.5 Vdc \\
\hline Must turn-on current & 10 mA \\
\hline Must turn-off current & \(10 \mu \mathrm{~A}\) \\
\hline Reverse voltage protection & \(-5.0 \mathrm{Vdc}\) \\
\hline I/O & \\
\hline Dielectric strength (60Hz., 1mA leakage) & 500 V rms \\
\hline Insulation resistance (min.) @ 500Vdc & \(10^{9} \mathrm{ohms}\) \\
\hline Capacitance (max. @ 25Vdc, 1 Mhz) & 5 pF \\
\hline Output & \\
\hline Continuous load current, parallel (DC) configuration (max.) & 2A (Figure 2) \\
\hline Continuous load current, series (bi-directional) configuration (max.) & 1A (Figure 2) \\
\hline Continuous operating load voltage (max.) & +/-80V \\
\hline Transient blocking voltage (5 sec max.) & +/-90V \\
\hline Overload (100ms, 10\% duty cycle, 10 cycles max.) & \(350 \%\) of rated \\
\hline dv/dt (min.) & \(100 \mathrm{~V} / \mu \mathrm{s}\) \\
\hline On resistance (max.), parallel (DC) configuration & 0.4 ohm \\
\hline On resistance (max.), series (bi-directional) configuration & 0.6 ohm \\
\hline Turn-on time (max, @ +/-80V) & \(800 \mu \mathrm{~s}\) (Figure 3) \\
\hline Turn-off time (max, @ +/-80V) & \(500 \mu \mathrm{~s}\) (Figure 3) \\
\hline Thermal resistance, junction to ambient & \(110^{\circ} \mathrm{C} / \mathrm{W}\) \\
\hline Thermal resistance, junction to case & \(20^{\circ} \mathrm{C} / \mathrm{W}\) \\
\hline
\end{tabular}

Figure 1 - Wiring Diagrams


Dimensions are shown for reference purposes only. Specifications subject to change.

Dimensions are in millimeters unless otherwise specified.

\section*{MS18-1006 High Performance DC and Bi-directional Solid State Relay For Loads up to 2A @ 80Vdc (Continued)}

Figure 2 - Temperature Derating Curves

Series Configuration


Figure 3 - Turn-on and Turn-off Timing


Parallel Configuration


Figure 4 - Functional Block Diagram


Figure 5-Outline Dimensions


\section*{Notes}
1. An external resistor must be in series with the input at all times.
2. Do not ramp input current. Input transition should be \(<1.0 \mathrm{~ms}\).
3. Input current/series resistor calculation (Approx.): \(I_{\text {(input) }}=V_{I N}-V_{\text {DROP }} / R_{\text {SERIES }}\).
4. Unless otherwise specified parametric testing is accomplished at 25 ma input current.
5. To calculate \(R_{D S(O N)}\) for temperatures other than \(25^{\circ} \mathrm{C}\), use the following equation: \(T_{(T E M P)}=\left(R_{D S(O N)}\right.\) at \(\left.+25^{\circ} \mathrm{C}\right) \bullet e^{(x \cdot \Delta T)}\) where \(x=0.0065\).
6. Inductive loads must be diode suppressed.
7. Continuous load current is rated under conditions of still air.
8. Load may be connected to either side of relay, sink or source modes.
9. Reverse polarity \(>5 \mathrm{Vdc}\) may cause permanent damage
10. Acceptance testing is accomplished in the series (bi-directional) mode.
11. DSCC part numbers 89116-002 \& 89116-004 are also available.

\section*{JDS9 Series, AC Relays, 2A/250Vrms Rating}


Input Characteristics Input Voltage Range -\(3.8-32 \mathrm{Vdc}\)
Pick-up Voltage -
3.8 Vdc

Dropout Voltage - 1.5 Vdc I/O Dielectric - 1500 Vrms

Output Characteristics
Max. Output Current (Continuous, \(25^{\circ} \mathrm{C}\) ) -2 Arms
Max. Output Voltage - 250 Vrms
Peak Over Voltage Rating 500 Vpk
Frequency Range - \(40-440 \mathrm{~Hz}\)
Zero Switch Window - 15 Vpk
Thermal Resistance -
Junction to Ambient - \(65^{\circ} \mathrm{C} /\) Watt Junction to Case - \(15^{\circ} \mathrm{C} /\) Watt

Environmental Characteristics
Shock - 1500 G's, 0.5 ms .
Vibration - 30 G's, 10 to 3000 Hz
Operating Ambient Temperature --55 to \(+110^{\circ} \mathrm{C}\)


Terminal View

Product Facts
■ Hermetically sealed
■ Thick film hybrid construction
■ Optically isolated
- Zero voltage turn-on

■ Qualified to MIL-R-28750/9




JDS9 Max. Output Current vs. Temperature


JDS9 Typical Input Current vs. Input Voltage

Electrical Specifications ( \(-55^{\circ} \mathrm{C}\) to \(+105^{\circ} \mathrm{C}\) unless otherwise specified)
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|l|}{Input} \\
\hline Input supply voltage range (Vcc) & 3.8-32 Vdc \\
\hline Input current (max.) @ 5Vdc & 15 mAdc \\
\hline Must turn-on voltage & 3.8 Vdc \\
\hline Must turn-off voltage & 1.5 Vdc \\
\hline Reverse voltage protection & -32Vdc \\
\hline \multicolumn{2}{|l|}{I/0} \\
\hline Dielectric strength (min.) & 1,500V rms/60 Hz. \\
\hline Insulation resistance (min.) @ 500Vdc & \(10^{9} \mathrm{ohms}\) \\
\hline Capacitance (max.) & 10pF \\
\hline \multicolumn{2}{|l|}{Output} \\
\hline Output current rating (max.) & 2A rms (Fig. 2, Note 1) \\
\hline Surge current (max.), 16ms @ 25 \({ }^{\circ} \mathrm{C}\) (max.) & 8A pk (Fig. 1, Note 3) \\
\hline Continuous load voltage (max.) & 250 V rms \\
\hline Transient blocking voltage (max.) & 500 V pk \\
\hline Frequency range & \(40-440 \mathrm{~Hz}\). \\
\hline Output voltage drop (max.) @ 1A load current & 1.5 V rms \\
\hline Off-state leakage current (max.) @ 250V rms/400 Hz. & 1 mA rms \\
\hline Turn-on time (max.) & 1/2 cycle \\
\hline Turn-off time (max.) & 1 cycle \\
\hline Off-state dv/dt (min.), with snubber & 200V / \(\mu \mathrm{s}\) (Note 2) \\
\hline Zero voltage turn-on window (max.) & 10 V \\
\hline Wave distortion (max.) & 4 V rms \\
\hline Output chip junction temperature (max.) & \(130^{\circ} \mathrm{C}\) \\
\hline Thermal resistance (max.), junction to ambient & \(65^{\circ} \mathrm{C} / \mathrm{W}\) \\
\hline Thermal resistance (max.), junction to case & \(15^{\circ} \mathrm{C} / \mathrm{W}\) \\
\hline
\end{tabular}

\section*{Notes}
1. Operation at elevated load currents up to 2 amps is dependent on the use of suitable heatsink to maintain case temperature.
2. Recommended output snubber: \(R=100\) ohms ( \(1 / 2 \mathrm{~W}\) ), \(\mathrm{C}=.01 \mu \mathrm{~F}\) ( 600 V ).
3. Heating of output chip during and after a surge may cause loss of output blocking capability until junction temperature falls below maximum rating.

\title{
PS12 Series High Performance Solid State Relays For AC Loads up to 10A @ 250Vrms
}

\section*{Product Facts}
- Approved to DSCC drawing 86031

■ Optically coupled all solid state relay
- TTL compatible input

■ Zero voltage turn-on for low EMI
■ Custom power package with screw terminals


The PS12 series solid state relay is designed for AC power switching up to 10 amps at 250 Vrms . The circuit employs back-to-back SCRs with zero voltage turnon for reliable switching of
resistive or reactive loads. TTL compatible input circuitry is optically isolated to \(1,500 \mathrm{Vrms}\) from the AC load circuit. The relay is offered in two versions: the PS12-1Y with "Y" level screening per

MIL-PRF-28750D, and the PS12-1W screened per Tyco Electronics specifications for Kilovac relays, equivalent to former "W" level of Mil-R-28750.
\begin{tabular}{|ccc|}
\hline Kilovac Part Number & DSCC Part Number & Screening Level \\
\hline PS12-1Y & \(86031-001\) & Y \\
PS12-1W & N/A & W \\
\hline
\end{tabular}

Outline Drawing


Kilovac Solid State Relays

Environmental Characteristics Ambient Temperature Range -
Operating - \(-55^{\circ} \mathrm{C}\) to \(+95^{\circ} \mathrm{C}\)
Storage - \(-55^{\circ} \mathrm{C}\) to \(+110^{\circ} \mathrm{C}\)

\section*{Vibration Resistance -}

30 G's, \(78-2,000 \mathrm{~Hz}\)
Shock Resistance -
100 G's, 6 ms pulse
Constant Acceleration Resistance 100 G's

\section*{Mechanical Characteristics}

Weight (max.) -
3 oz. (85 grams)
Materials -
Case - Plastic, self-extinguishing,
epoxy filled
Terminals - Brass, nickel-plated
Base Plate - Aluminum
NOTE: Do not exceed 125 in-oz when
tightening screws.

\section*{PS12 Series High Performance Solid State Relays For AC Loads up to 10A @ 250Vrms (Continued)}

Electrical Specifications \(\left(-55^{\circ} \mathrm{C}\right.\) to \(+95^{\circ} \mathrm{C}\) unless otherwise specified)
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|l|}{Input} \\
\hline Input supply voltage range (Vcc) & 3.8-32 Vdc \\
\hline Input current (max.) @ 5Vdc & 16 mAdc \\
\hline Must turn-on voltage & 3.8 Vdc \\
\hline Must turn-off voltage & 1 Vdc \\
\hline \(\underline{\text { Reverse voltage protection }}\) & \(-32 \mathrm{Vdc}\) \\
\hline \multicolumn{2}{|l|}{I/O} \\
\hline Dielectric strength (min.) & 1,500V rms/ 60 Hz . \\
\hline Insulation resistance (min.) @ 500Vdc & \(10^{8}\) ohms \\
\hline Capacitance (max.) & 15pF \\
\hline \multicolumn{2}{|l|}{Output} \\
\hline Output current rating (max.) & 10A rms (Fig. 2, Note 1) \\
\hline Surge current (max.) & 100A pk (Fig. 1, Note 2) \\
\hline Continuous load voltage (max.) & 250 V rms \\
\hline Transient blocking voltage (max.) & 460 V pk \\
\hline Frequency range & \(45-440 \mathrm{~Hz}\). \\
\hline Output voltage drop (max.) @ 25A load current & 1.5 V rms \\
\hline Off-state leakage current (max.) @ \(220 \mathrm{~V} \mathrm{rms} / 400 \mathrm{~Hz}\). & 9 mA rms \\
\hline Turn-on time (max.) & 1/2 cycle \\
\hline Turn-off time (max.) & 1 cycle \\
\hline Off-state dv/dt (min.), with snubber & 200V / \(\mu \mathrm{s}\) (Note 3) \\
\hline Zero voltage turn-on window (max.) & \(\pm 15 \mathrm{~V}\) pk \\
\hline Output chip junction temperature (max.) & \(125^{\circ} \mathrm{C}\) (Note 1) \\
\hline Thermal resistance (max.), junction to ambient & \(11.5^{\circ} \mathrm{C} / \mathrm{W}\) \\
\hline Thermal resistance (max.), junction to case & \(2.0^{\circ} \mathrm{C} / \mathrm{W}\) \\
\hline Fusing 12T, 1 ms (max.) & \(150 A^{2} \mathrm{~s}\) \\
\hline Load power factor (min.) & 0.2 \\
\hline Power dissipation (max.) & 1.5W/A \\
\hline
\end{tabular}

\section*{Notes}
1. Operation at elevated load currents up to 10 amps is dependent on the use of suitable heatsink to limit junction temperature.
2. Heating of output chips during and after a surge may cause loss of output blocking capability until junction temperature falls below maximum rating.
3. Internal snubber network is provided across output chips.

Figure 1-Peak Surge Current vs. Surge Current Duration


Figure 2 - Load Current vs. Temperature


Dimensions are shown for reference purposes only. Specifications subject to change.

Kilovac Solid State Relays

\section*{JPS10 Series High Performance Solid State Relays \\ For AC Loads up to 25A @ 250Vrms}

\section*{Product Facts}
- Qualified to

MIL-PRF-28750D (Mil Part Numbers M28750/10-001Y and M28750/10-002Y)
- Optically coupled all solid state relay
- TTL compatible input
- Zero voltage turn-on for low EMI
- Custom power package


The JPS10 series solid state relay is designed for AC power switching up to 25 amps at 250 V rms. The circuit employs back-toback photo SCRs with zero voltage turn-on for reliable
switching of resistive or reactive loads. TTL compatible input circuitry is optically isolated to \(1,500 \mathrm{Vrms}\) from the AC load circuit. The relay is offered in two versions: the JPS10-1Y with a maximum
zero voltage turn-on window of 15 volts (preferred version for resistive loads), and the JPS10-2Y with a maximum window of 40 volts (preferred version for reactive loads).
\begin{tabular}{|ccc|}
\hline Kilovac Part Number & Military Part Number & Zero Crossing Window \\
\hline JPS10-1Y & M28750/10-001Y & 15 V pk max. \\
JPS10-2Y & M28750/10-002Y & \(40 \mathrm{Vpk} \max\). \\
\hline
\end{tabular}

Circuit Diagram
Terminal View


Outine Drawing


Environmental Characteristics Ambient Temperature Range Operating - \(-55^{\circ} \mathrm{C}\) to \(+110^{\circ} \mathrm{C}\)
Storage \(-55^{\circ} \mathrm{C}\) to \(+125^{\circ} \mathrm{C}\)
Vibration Resistance -
30 G's, \(10-3,000 \mathrm{~Hz}\)
Shock Resistance -
1,500 G's, 0.5 ms pulse
Constant Acceleration Resistance
(Y1 axis) -
5,000 G's

Mechanical Characteristics
Weight (max.) -
6 oz. (170 grams)

\section*{Materials -}

Case - Aluminum, hot tin dipped
Terminals - Copper cored wire, gold plated

\section*{JPS10 Series High Performance Solid State Relays \\ For AC Loads up to 25A @ 250Vrms (Continued)}

Electrical Specifications \(\left(-55^{\circ} \mathrm{C}\right.\) to \(+105^{\circ} \mathrm{C}\) unless otherwise specified)
\begin{tabular}{lc}
\hline Input & \\
\hline Input supply voltage range (Vcc) & \(4-32 \mathrm{Vdc}\) \\
\hline Input current (max.) & 16 mAdc \\
\hline Must turn-on voltage & 4 Vdc \\
\hline Must turn-off voltage & 1 Vdc \\
\hline Reverse voltage protection & -32 Vdc \\
\hline \(\mathbf{I / O}\) & \\
\hline Dielectric strength (min.) & \(1,500 \mathrm{Vrms} / 60 \mathrm{~Hz}\). \\
\hline Insulation resistance (min.) @ 500Vdc & \(10^{9} \mathrm{ohms}\) \\
\hline Capacitance (max.) & 20 pF \\
\hline Output & \\
\hline Output current rating (max.) & \(25 \mathrm{Arms} \mathrm{(Fig}. \mathrm{2} ,\mathrm{Note} \mathrm{1)}\) \\
\hline Surge current (max.) & \(80 \mathrm{~A} \mathrm{pk} \mathrm{(Fig}. \mathrm{1} ,\mathrm{Note} \mathrm{2)}\) \\
\hline Continuous load voltage (max.) & 250 Vrms \\
\hline Transient blocking voltage (max.) & 500 V pk \\
\hline Frequency range & \(45-440 \mathrm{~Hz}\). \\
\hline Output voltage drop (max.) @ 25A load current & 1.5 Vrms \\
\hline Off-state leakage current (max.) @ 220Vrms/400 Hz. & 10 mArms \\
\hline Turn-on time (max.) & \(1 / 2 \mathrm{cycle}\) \\
\hline Turn-off time (max.) & 1 cycle \\
\hline Off-state dv/dt (min.), with snubber & \(100 \mathrm{~V} / \mu \mathrm{s} \mathrm{(Note} \mathrm{3)}\) \\
\hline Zero voltage turn-on window (max.), JPS10-1Y & 15 V pk \\
\hline Zero voltage turn-on window (max.), JPS10-2Y & 40 V pk \\
\hline Waveform distortion (max.) & 4 Vrms \\
\hline Output chip junction temperature (max.) & \(125^{\circ} \mathrm{C} \mathrm{(Note} \mathrm{4)}\) \\
\hline Thermal resistance (max.), junction to ambient & \(6.8^{\circ} \mathrm{C} / \mathrm{W}\) \\
\hline Thermal resistance (max.), junction to case & \(1.2^{\circ} \mathrm{C} / \mathrm{W}\) \\
\hline
\end{tabular}

\section*{Notes}
1. Operation at elevated load currents up to 25 amps is dependent on the use of suitable heatsink to maintain case temperature per Fig. 2.
2. Heating of output chips during and after a surge may cause loss of output blocking capability until junction temperature falls below maximum rating.
3. Internal snubber network is provided across output chips.
4. Case temperature measurement point is center of mounting surface.

Figure 1 - Peak Surge Current vs. Surge Current Duration
Figure 2 - Load Current vs. Temperature



Dimensions are shown for reference purposes only. Specifications subject to change.

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\begin{tabular}{llll}
\hline Catalog 5-1773450-5 & Dimensions are shown for & Dimensions are in millimeters & USA: +1 800 5226752 \\
Revised 3-13 & reference purposes only. & unless otherwise specified. & Asia Pacific: +8604008206015 \\
& Specifications subject & & UK: +44800267666 \\
www.te.com & to change. & &
\end{tabular}

\section*{KILOVAC WD Series, DIN Rail or Screw Mounted Protective Relays}

\section*{Product Facts}

■ WD25 Paralleling (Synch Check) Relays
■ WD2759 Over/undervoltage Relays
■ WD32 Reverse Power Relays
■ WD47 Phase Sequence Relays
■ WD5051 Single- or ThreePhase Overcurrent Relays

■ WD810U Over/Underfrequency Relays
■ File E58048, DIN EN50022-35

Users should thoroughly review the technical data before selecting a product part number. It is recommended that user also seek out the pertinent approvals files of the agencies/laboratories and review them to ensure the product meets the requirements for a given application.


The WD series offers several different models of protective relays in a common package that is suitable for either DIN rail or screw mounting. These flexible, multifunction devices offer user selectable voltages, sense currents and frequencies. Adjustable time delays are standard. This allows a single part number to be suitable for multiple applications, thereby reducing inventory costs.

\section*{Specifications Common to} All Models
Power Consumption -
2.5VA, maximum.

\section*{Contact Ratings -}

5 amps, resistive, at 120VAC.
5 amps, resistive, at 30VDC.
Isolation from Control to Sense Inputs - \(2,500 \mathrm{VAC}\).
Mechanical Life -
10 million operations.
Shock - 10g.
Vibration - 0.062 (1.57) double amplitude at \(10-55 \mathrm{~Hz}\).
Terminals - M 3.5 screws.
Maximum Wire Size - \(2 \times 24\) AWG
(2.5mm²) solid to DIN 46288 or \(2 \times 16\) AWG ( \(1.5 \mathrm{~mm}^{2}\) ) stranded w/end sleeves. Operating Temperature Range -\(-40^{\circ} \mathrm{C}\) to \(+60^{\circ} \mathrm{C}\)
Enclosure - Plastic case (not sealed).
Mounting Options - Snap mounts on standard DIN rail (DIN-EN 50022-35) or panel mounts with M4, M5, \#8 or \#10 screws.
Weight — 14.4 oz. (400g) approximately.

\section*{Installation and Maintenance} Information
Installation - To mount the WD series protective relay on a DIN rail, hook the top edge of the cutout on the base of the case over one edge of the DIN rail, then press the opposite side of the cutout containing the release clip over the opposite side of the DIN rail. To remove or reposition the relay, lever the release clip and move the relay as required. WD series relays should be installed in a dry location where the ambient temperature will be within the operating temperature range.

\section*{Outline Dimensions}


\title{
KILOVAC WD25 Paralleling Relays
}

\section*{Product Facts \\ - Function 25 \\ ■ ANSI/IEEE C37.90-1978}

\section*{WD25 Operation}

WD25 paralleling relays are used to ensure that two circuits are synchronized. When voltage, phase relationship and frequency are within the selected synchronizing limits, the output relay will energize. The WD25 paralleling relay allows for a generator to be brought online without damage or system disturbance. WD25 series with a "dead bus" feature will energize for a synchronized condition or an "on line" generator, "dead bus" condition. This "dead bus" feature allows the generator to energize a dead bus. The "double dead bus" feature permits paralleling of two buses when: (a) both the line voltages are equal and in phase, or (b) when either bus is "hot" and the other bus is "dead."

\section*{WD25 Specifications} Nominal Operating Range -
\(120,208,277\) or 480 VAC, selectable. Maximum Sensing Range 575VAC.
Nominal Frequency Range -\(40-400 \mathrm{~Hz}\).

\section*{Contact Form - 2 form C (DPDT).}

\section*{WD25 Calibration}

The calibration marks on the faceplate are provided only as guides. Proper calibration requires using an accurate voltmeter. Use the following procedure to calibrate the WD25:
1. Remove the cover.
2. Adjust the SYNC VOLTAGE control fully counterclockwise (CCW). Apply nominal voltage to the LINE B (bus) sensing terminals.
3. Apply the maximum desired synchronization voltage to the LINE A (generator) terminals. This voltage should be in phase with LINE B (bus) voltage and have the same frequency.
4. Slowly adjust the SYNC VOLTAGE control clockwise (CW) until the relay energizes.

\section*{Sense Voltage}
\begin{tabular}{lcccc}
\hline Voltage (nominal) & 120 & 208 & 277 & 480 \\
\hline Synch Voltage (\% of nom.) & \(6-30 \%\left(\approx 4^{\circ}-20^{\circ}\right.\) electrical degree) \\
\hline Dead Bus Voltage (\% of nom.) & \multicolumn{2}{c}{\(10-70 \%\) (Dead Bus) } \\
\hline
\end{tabular}

Control Voltage
\begin{tabular}{lccc}
\hline Model WD25 & \(-0 \times 1\) & \(-0 \times 2\) & \(-0 \times 3\) \\
\hline Input Voltage (VDC) & 18 to 54 & 13.5 to 32 & 100 to 200 \\
\hline Input Voltage (VAC) & - & - & 100 to 140 \\
\hline
\end{tabular}

\section*{WD25 Controls}


WD25 Connections


\section*{WD25 Typical Hookup}


NOTE: For single dead bus option, connect the generator to \(1 \& 3\) and the bus to 5 \& 7 .

\section*{KILOVAC WD2759 Over/Undervoltage Relays}

\author{
Product Facts \\ - Function 27/59 \\ ■ ANSI/IEEE C37.90-1978
}

\section*{WD2759 Operation}

WD2759 AC voltage sensing relays provide voltage monitoring and protection in AC systems from 50 to 400 Hz . Sensing voltages, number of phases, over and undervoltage setpoint, and time delays are user configured. WD2759 voltage relays operate when the externally adjustable trip point is reached. An external time delay control is provided with an adjustment of .5 to 10 seconds. This time delay may be used to prevent false tripping when there are slight variations in the voltage supply. On overvoltage (OV) the output relay energizes when the input signal exceeds the trip point. On undervoltage (UV) the output relay energizes when the input signal goes below the trip point. A green LED indicates power to the relay. Red LED lights indicate the state of the undervoltage and overvoltage trips.

\section*{Sense Voltage}
\begin{tabular}{lcccc}
\hline Voltage (nominal) & 120 & 208 & 277 & 480 \\
\hline UV Adjustment Range & \(72-120\) & \(125-208\) & \(166-277\) & \(288-480\) \\
\hline OV Adjustment Range & \(120-168\) & \(208-291\) & \(277-388\) & \(480-672\) \\
\hline
\end{tabular}

Control Voltage
\begin{tabular}{lccc}
\hline Model WD2759 & -001 & -002 & -003 \\
\hline Input Voltage (VDC) & 18 to 54 & 13.5 to 32 & 100 to 200 \\
\hline Input Voltage (VAC) & - & - & 100 to 140 \\
\hline
\end{tabular}

\section*{WD2759 Specifications}

Nominal Operating Range -
120, 208, 277 or 480 VAC, selectable.

\section*{Maximum Sensing Range -} 700VAC.

\section*{Nominal Frequency Range -} \(50-400 \mathrm{~Hz}\)
Contact Form - 1 form C (SPDT) for undervoltage and 1 form C (SPDT) for overvoltage.
Time Delay Adjustment 0.5 to 10 sec

\section*{WD2759 Calibration}

The calibration marks on the faceplate have a maximum error of \(10 \%\) and are provided only as guides. Proper calibration requires using an accurate voltmeter in parallel with the input signal. Use the following procedure to calibrate your relay.
OVER VOLTAGE
1. Remove cover.
2. Adjust the TRIP SET control fully clockwise (CW) and the TIME DELAY control fully counterclockwise (CCW).
3. Apply the desired trip voltage to the relay.
4. Slowly adjust the TRIP SET control CCW until the relay trips.
5. Remove the applied voltage (do not change the voltage level) and set the TIME DELAY control to the desired time delay.
6. Apply the trip voltage to the relay and measure the time to trip.
7. Adjust the TIME DELAY and repeat steps 4 and 5 until you have the desired time delay.

\section*{UNDER VOLTAGE}
1. Remove cover.
2. Adjust the TRIP SET control fully CCW and the TIME DELAY control fully CCW.
3. Decrease the applied sensing voltage from the nominal value until the desired tripping voltage is reached
4. Slowly adjust the TRIP SET control CW until the relay trips.
5. Set the TIME DELAY control to the desired time delay and apply nominal voltage to the relay.
6. Step down the applied voltage from nominal to a level jest below the trip level set in Step 3 and measure the time delay.
7. Adjust the TIME DELAY and repeat steps 4 and 5 until the desired time delay is achieved.

\section*{Ordering Information}
Typical Part Number \(\quad\) WD 2759 -002
1. Basic Series:

WD = DIN mount Protective Relay.

\section*{2. Type:}

2759 = Over/Undervoltage Relay.
3. Control Voltage:
\(001=18\) to 54 VDC
\(002=13.5\) to 32 VDC
\(003=100-200 \mathrm{VDC}\) or \(100-140 \mathrm{VAC}\).
Our authorized distributors are more likely to stock these items.
WD2759-003

KILOVAC WD2759 Over/Undervoltage Relays (Continued)
WD2759 Controls


WD2759 Connections


WD2759 Typical Hookup


\section*{KILOVAC WD32 Reverse Power Relays}

\section*{Product Facts}

■ Function 32

\section*{WD32 Operation}

WD32 reverse power relays are used to monitor the direction of power from AC generators. This is accomplished by measuring I cos q. If current from the generator is reversed and exceeds the adjustable setting, the relay will trip. A 0.5 to 20 second time delay is provided. A correct setting of the trip point and time delay will prevent motorizing the generator and prevent tripping during transients that occur while synchronizing. A POWER LED indicates the condition of the power supply and a REVERSE POWER TRIP LED indicates the output status of the relay.

\section*{WD32 Specifications}

Nominal Operating Range 120 to 480 VAC, 1 or 3 phase.
Maximum Sensing Range 575VAC.
Nominal Sensing Current - 5A. Nominal Frequency Range -WD32-00X - 40-400 Hz.; WD32-01X - 60 Hz .
Contact Form - 2 form C (DPDT).
Time Delay Adjustment 0.5 to 20 sec .

Sense Current - Reverse Power Trip: 0.2 to 1.0 A (4-20\% of nominal sense current).

Control Voltage
\begin{tabular}{lccc}
\hline Model WD32 & -001 & -002 & -003 \\
\hline Input Voltage (VDC) & 18 to 54 & 13.5 to 32 & 100 to 200 \\
\hline Input Voltage (VAC) & - & \(\sim\) & 100 to 140 \\
\hline
\end{tabular}

\section*{WD32 Calibration}

The calibration marks on the faceplate have a maximum error of \(10 \%\) and are provided only as guides. Proper calibration requires using an accurate Current Meter in series with the input current. Use the following procedure to calibrate your relay.
REVERSE POWER
1. Remove cover.
2. Adjust the TRIP SET control fully clockwise (CW) and the TIME DELAY control fully counterclockwise (CCW)
3. Apply the desired trip current to the relay. NOTE: for the Reverse Power (WD32-00X) a resistive load must be used and for the Reverse kVAR (WD32-01X) an inductive load must be used.
4. Slowly adjust the TRIP SET control CCW until the relay trips.
5. Remove the applied Current and set the TIME DELAY control to the desired time delay.
6. Re-apply the Current ( \(10 \%\) more than the trip current) to the relay and measure the time to trip.
7. Adjust the TIME DELAY and repeat steps 4 and 5 until you have the desired time delay.

\section*{Ordering Information}


\section*{4. Control Voltage:}
\(1=18\) to 54 VDC
\(2=13.5\) to 32 VDC
\(3=100-200 \mathrm{VDC}\) or 100-140VAC.

\section*{Our authorized distributors are more likely to stock these items.}

WD32-003
WD32-011

\section*{KILOVAC WD32 Reverse Power Relays (Continued)}

\section*{WD32 Controls}


\section*{WD32 Connections}


WD32 Typical Hookup


BI-DIRECTIONAL AC OR DC INPUT


BI-DIRECTIONAL AC OR DC INPUT


BI-DIRECTIONAL AC OR DC INPUT

\section*{KILOVAC WD47 Phase Sequence Relays}

\section*{Product Facts}
- Function 47

■ ANSI/IEEE C37.90-1978

\section*{WD47 Operation}

WD47 phase sequence relays are designed to monitor the correct phase rotation and loss of phase of three phase ac systems from 50 to 400 Hz . An incorrect phase sequence or loss of any phase will cause the WD47 to pickup. When the phase sequence is corrected or the lost phase is restored the contacts dropout. Red LED's light to indicate a fault condition. A green LED indicates power to the relay. The WD47 is often used to detect reverse phase rotation or loss of phase to generators, busses, motors, and transformers.

WD47 Specifications Nominal Operating Range 120 to 480 VAC
Maximum Sensing Range 575VAC.
Nominal Frequency Range -\(40-400 \mathrm{~Hz}\).
Contact Form - 2 form C (DPDT).
WD47 Calibration
The WD47 has no adjustments and no calibration is necessary. Proper operation may be verified as follows:
1. Apply a nominal, three-phase input with the correct phase sequence. The output relay should dropout and the green LED should light.
2. Apply a nominal, three-phase input with an incorrect phase sequence. The output relay should pickup and the red LED should light.
3. Apply only one or two phases with the correct phase sequence. The output relay should pickup and the red LED should light.

\section*{Ordering Information}


Our authorized distributors are more likely to stock these items.
WD47-001

\section*{Control Voltage}
\begin{tabular}{cccc}
\hline Model WD47 & -001 & -002 & -003 \\
\hline Input Voltage (VDC) & 18 to 54 & 13.5 to 32 & 100 to 200 \\
\hline Input Voltage (VAC) & - & - & 100 to 140 \\
\hline
\end{tabular}

WD47 Controls


\section*{WD47 Connections}


WD47 Typical Hookup


BI-DIRECTIONAL AC OR DC INPUT

\section*{KILOVAC WD5051 10 and 30 Overcurrent Relays}

\section*{Product Facts}

■ Function 5051

\section*{WD5051 Operation}

WD5051 AC current sensing relays provide current monitoring and protection in AC systems from 50 to 400 Hz. Nominal Sensing Current, Instantaneous Over Current setpoint, Time Over Current setpoint, and Time Over Current time delay are user configured. WD5051 current relays operate when the externally adjustable trip point is reached. An external time over current time delay control is provided with an adjustment of .5 to 20 seconds. This time delay may be used to prevent false tripping when there are slight variations in the sensed current. With control power applied, the Instantaneous Over Current (IOC) contacts pick-up when the input signal exceeds the IOC trip setpoint. Similarly, with control power applied, the Time Over Current (TOC) contacts pick-up after the preset time delay when the Sense Current rises above the TOC trip setpoint. The IOC contacts may also be configured to function as an under current relay. A green LED indicates power to the relay. Red LED lights indicate the state of the IOC and TOC trips.

Sense Current
\begin{tabular}{lcccc}
\hline Current (nominal) & 1 & 3 & 6 & 8 \\
\hline IOC & 0.2 to 1.2 & 0.6 to 3.6 & 1.2 to 7.2 & 1.6 to 9.6 \\
\hline TOC & 0.2 to 1.2 & 0.6 to 3.6 & 1.2 to 7.2 & 1.6 to 9.6 \\
\hline
\end{tabular}

Control Voltage
\begin{tabular}{lccc}
\hline Model WD5051 & -001 & -002 & -003 \\
\hline Input Voltage (VDC) & 18 to 54 & 13.5 to 32 & 100 to 200 \\
\hline Input Voltage (VAC) & - & - & 100 to 140 \\
\hline
\end{tabular}

\section*{WD5051 Specifications}

Sense Current Full Scale - 1, 3, 6
or 8 A , selectable.
Maximum Sensing Current -
10A continuous; 30A for 10 sec.; 60 A for 2.5 sec .; 100 A for 0.9 sec. .
Nominal Frequency Range -\(50-400 \mathrm{~Hz}\).
Contact Form - 1 form C (SPDT) for IOC and 1 form C (SPDT) for TOC. TOC Time Delay Adjustment 0.5 to 20 sec .

IOC Operate Time (max.) 0.2 sec .

\section*{WD5051 Calibration}

The calibration marks on the faceplate are provided only as guides. Proper calibration requires using an accurate ammeter in series with the current source. Use the following procedure to calibrate your relay:
OVERCURRENT
1. Remover the cover.
2. Adjust the TRIP SET control fully clockwise (CW) and the TIME DELAY control (TOC only) fully counterclockwise (CCW).
3. Apply the desired trip current to the relay.
4. Slowly adjust the TRIP SET control CCW until the relay trips.
5. Remove the applied current (do not change the current level). Set the TIME DELAY (TOC only) control to the desired time delay.

\section*{Ordering Information}


Our authorized distributors are more likely to stock these items.
WD5051-001
WD5051-003
WD5051-3-001

Dimensions are shown for reference purposes only. Specifications subject to change.

KILOVAC WD5051 10 and 30 Overcurrent Relays (Continued)
WD5051 Controls


WD5051 Connections

WD5051
Single Phase Model

D5051-3
Three Phase Model


WD5051 Typical Hookup
WD5051
Single Phase Model


CONTROL
BI-DIRECTIONAL AC OR DC INPUT

WD5051-3
Three Phase Model


BI-DIRECTIONAL AC OR DC INPUT

\title{
KILOVAC WD810U Over/Underfrequency Relays
}

\section*{Product Facts}
- Function 8100

■ ANSI/IEEE C37.90-1978

\section*{WD810U Operation}

WD81OU frequency relays are used to provide frequency monitoring and protection to generators, buses, power supplies, and other equipment. The relay operates at voltages from 120 to 480 Vac and at nominal frequencies of 50, 60, and 400 Hz . External controls include nominal frequency selection, under frequency (UF) trip set, over frequency (OF) trip set, UF time delay, and OF time delay. A green LED indicates power to the relay. Red LED's indicate the status of the UF and OF trips
WD810U Specifications Nominal Operating Frequency 50,60 or 400 Hz ., selectable.

\section*{Maximum Frequency @ 400 Hz .}

Nominal - 1000 Hz .
Nominal Sensing Voltage -20-480VAC.
Maximum Sensing Voltage 575VAC.
Contact Form - 1 form C (SPDT) for underfrequency and 1 form C (SPDT) for overfrequency.
Time Delay Adjustment - 0.5 to 10 sec.

\section*{WD810U Calibration}

The calibration marks on the faceplate are provided only as guides. Proper calibration requires using an accurate frequency meter in parallel with the input signal.
UNDER FREQUENCY
1. Remove the cover.
2. Set the SENSE FREQUENCY to the nominal system frequency. Adjust the Under Frequency TRIP SET fully clockwise (CW) and the TIME DELAY control fully counterclockwise (CCW)
3. Apply the desired trip frequency to the relay.
4. Slowly adjust the TRIP SET control CCW until the relay trips.
5. Set the TIME DELAY control to the desired time delay and apply nominal frequency to the relay.
6. Step down the applied frequency from nominal to just below the trip level set in Step 4 and measure the time delay.
7. Adjust the TIME DELAY and repeat steps 5 and 6 until the desired time delay is set.
OVER FREQUENCY
1. Remove the cover.
2. Set the SENSE FREQUENCY to the nominal system frequency. Adjust the OF TRIP SET and TIME DELAY controls fully counterclockwise (CCW).
3. Apply the desired trip frequency to the relay.
4. Slowly adjust the TRIP SET control clockwise (CW) until the relay trips.
5. Set the TIME DELAY control to the desired time delay and apply nominal frequency to the relay.
6. Step down the applied frequency from nominal to just below the trip level set in Step 4 and measure the time delay.
7. Adjust the TIME DELAY and repeat steps 5 and 6 until the desired time delay is set.

\section*{Ordering Information}

\section*{Sense Frequency}
\begin{tabular}{lccc}
\hline Frequency (nominal) & 50 & 60 & 400 \\
\hline UF Adjustment Range & \(40-50\) & \(48-60\) & \(360-400\) \\
\hline OF Adjustment Range & \(50-60\) & \(60-72\) & \(400-480\) \\
\hline
\end{tabular}

\section*{Control Voltage}
\begin{tabular}{lccc}
\hline Model WD81OU & -001 & -002 & -003 \\
\hline Input Voltage (VDC) & 18 to 54 & 13.5 to 32 & 100 to 200 \\
\hline Input Voltage (VAC) & - & - & 100 to 140 \\
\hline
\end{tabular}

\section*{WD810U Controls}


\section*{WD810U Connections}


\section*{WD810U Typical Hookup}


CONTROL
BI-DIRECTIONAL AC OR DC INPUT

None at present.

Dimensions are shown for reference purposes only. Specifications subject to change.

\section*{WUV/WOV DC Series}

\section*{Product Facts \\ ■ ANSI/IEEE C37.90-1978}

\section*{Undervoltage Models}

The relay is energized at normal voltage, N.C. contacts will open and N.O. contacts will close. The relay will de-energize when the voltage drops below the U/V set point.

\section*{Overvoltage Models}

The relay is de-energized at normal voltage, N.C. contacts are closed and N.O. contacts are open. The relay will energize, when the voltage rises above the O/V set point.


\section*{Product Specifications}

Nominal Voltage - 12 VDC to 560 VDC
Drop-out Point (u/v models) -
70-100\% of nominal voltage, screwdriver adjustable
Pick-Up Point (o/v models) -
100-125\% of nominal voltage, screwdriver adjustable
Output Contacts - One set N.O. One set N.C.

\section*{Contact Ratings -}

5 amp resistive at 120 VAC or 28 VDC
Operating Temperature Range -\(-40^{\circ} \mathrm{C}\) to \(+75^{\circ} \mathrm{C}\)
Temperature Effects - Less than \(1 \%\) voltage drift over the temperature range

\section*{Power Consumption -}

12 to 60 VDC models - 1 W max. 120 to 305 VDC models - 2 W max 405 to 470 VDC models - 3 W max. 560 VDC model - 4 W max.
Time Delay - A short duration delay is provided to prevent nuisance tripping due to momentary dips or surges in voltage. The drop-out delay, following a voltage fault is 75 to 100 milliseconds.

Notes:
1. Remove black screws for access to the O/V and U/V trip adjustment.
2. Clockwise rotation of the adjustment potentiometer will raise the voltage trip point.
3. The adjustments are by means of a single turn potentiometer. Use a small screwdriver and do not force beyond the limit stops.

\section*{Ordering Information}
\begin{tabular}{|c|c|}
\hline Sample Part Number & WOV-12DC -A \\
\hline Type: & \\
\hline WOV - Overvoltage & \\
\hline WUV - Undervoltage & \\
\hline Line Voltage VDC & , \\
\hline 12DC 125DC & \\
\hline 18DC 240DC & \\
\hline 24DC 250DC & \\
\hline 28DC 305DC & \\
\hline 32DC 405DC & \\
\hline 48DC 430DC & \\
\hline 60DC 470DC & \\
\hline 120DC 560DC & \\
\hline Options: & \\
\hline
\end{tabular}

Blank - Standard
A \(=2\) Form A Contacts
B \(=2\) Form B Contacts
H = 125 VDC Contacts
\(P=\) Transient Protection

Time Curves DC Overvoltage Relays


Transient Protection - All voltage relays will withstand momentary voltage surges of twice the nominal rated input voltage (standard).
Option "P" provides additional transient protection which complies with the requirements of ANSI//EEE C37.90-1978
Consult factory for additional models.
\begin{tabular}{|c|c|c|c|c|}
\hline \begin{tabular}{l}
Catalog 5-1773450-5 Revised 3-13 \\
www.te.com
\end{tabular} & Dimensions are shown for reference purposes only. Specifications subject & Dimensions are in millimeters unless otherwise specified. & \begin{tabular}{l}
USA: +1 8005226752 \\
Asia Pacific: +86 04008206015 UK: +44 800267666
\end{tabular} & For additional support numbers please visit www.te.com \\
\hline
\end{tabular}

\section*{WUV/WOV Series}

\section*{Product Facts \\ - Function 27/59 \\ ■ ANSI/IEEE C37.90-1978 \\ ■ UL File No. E58048 \\ ■ CSA File No. LR61158}

Voltage sensitive relays are available for both \(A C\) and DC applications for over/undervoltage protection. Combination over/undervoltage relays provide bandpass capabilities. AC relays are either single or three-phase type. Three phase models are designed to sense the average of the three phases or the highest single phase. Voltage trip points are screwdriver adjustable, and operation is time-delayed so that momentary voltage transients will not cause nuisance tripping.


Note: Dimensions in inches. Multiply values by 25.4 for dimensions in mm .


\section*{Product Specifications}

Nominal Voltage - 120 VAC to 575
VAC
Phase - Single or Three
Line Frequency - \(50-400 \mathrm{~Hz}\)
Pick-up to Drop-out Differential 2.5\% maximum

Drop-out Point (u/v models) -70-100\% of nominal voltage, screwdriver adjustable
Pick-Up Point (o/v models) -100-125\% of nominal voltage, screwdriver adjustable
Output Contacts - One set N.O., One set N.C.

\section*{Contact Ratings -}

5 amp resistive at 120 VAC or 28 VDC Operating Temperature Range -\(-20^{\circ} \mathrm{C}\) to \(+65^{\circ} \mathrm{C}\)
Power Consumption -
2 VA maximum
Time Delay - \(150-300 \mathrm{~ms}\) (UV Model)
Minimum Life - 500,000 operations

\section*{Notes:}
1. Remove black screw for access to the voltage trip adjustment.
2. Clockwise rotation of the adjustment potentiometer will raise the voltage trip point.

Three Phase

\section*{Ordering Information}
\begin{tabular}{|c|c|}
\hline Sample Part Number & WUV -1 \\
\hline Type: & \\
\hline WUV - Undervoltage & \\
\hline WOV - Overvoltage & \\
\hline
\end{tabular}

No. Phases
1 = Single
3 = Three
Line Voltage VAC
120416
208440
220460
230480
\(240 \quad 525\)
380575
Options
P - Transient Protection
A - Two Normally Open Contacts
B - Two Normally Closed Contacts
H-125VDC, 3A Contacts


Transient Protection - All voltage
relays will withstand momentary voltage surges of twice the nominal rated input voltage (standard).
Option "P" provides additional transient protection which complies with the requirements of ANSI//EEE C37.90-1978
Consult factory for additional models.

\section*{WUVT/WOVT Series}

\section*{Product Facts \\ - Function 27/59 \\ ■ ANSI/IEEE C37.90-1978 \\ ■ UL File No. E58048 \\ ■ CSA File No. LR61158}

\section*{Undervoltage Models}

The relay is energized at normal voltage, N.C. contacts will open and N.O. contacts will close. The relay will de-energize when the voltage drops and remains below the U/V set point for the duration of the set time delay.

\section*{Overvoltage Models}

The relay is de-energized at normal voltages, N.C. contacts are closed and N.O. contacts are open. The relay will energize, when the voltage rises and remains above the \(O / V\) set point for the duration of the set time delay.


Note: Dimensions in inches. Multiply values by 25.4 for dimensions in mm .


Single Phase

\section*{Ordering Information}
\[
\begin{aligned}
& \text { Type: } \\
& \text { WUVT - Undervoltage } \\
& \text { WOVT - Overvoltage } \\
& \text { No. Phases } \\
& 1=\text { Single } \\
& 3=\text { Three (line to line) }
\end{aligned}
\]

\section*{Line Voltage VAC}
100240
115380

120416
150440
200460
208480
220525
230575
Options:
Blank - Standard
A \(=2\) Form A Contacts
B \(=2\) Form B Contacts
\(\mathrm{H}=125 \mathrm{VDC} 3 \mathrm{~A}\) Contacts
P = Transient Protection

\section*{Product Specifications}

Nominal Voltage - 100 VAC to 575
VAC
Phase - Single or Three
Line Frequency - \(50-400 \mathrm{~Hz}\)
Pick-up to Drop-out Differential 1\% typical
Drop-out Point (u/v models) -
70-100\% of nominal voltage,
screwdriver adjustable
Pick-Up Point (o/v models) -100-125\% of nominal voltage, screwdriver adjustable
Output Contacts - One set N.O., One set N.C.

\section*{Contact Ratings -}

5 amp resistive at 120 VAC or 28 VDC
Operating Temperature Range -
\(-40^{\circ} \mathrm{C}\) to \(+70^{\circ} \mathrm{C}\)
Power Consumption -
3 VA maximum
Time Delay - 0.5 to 20 seconds, screwdriver adjustable
Voltage Reset - The reset is automatic when voltage returns to normal.

\section*{Notes:}
1. Remove black screws for access to the voltage and time delay adjustment potentiometer
2. Clockwise rotation of the voltage adjust potentiometer will raise the voltage trip point.
3. Clockwise rotation of the time adjust potentiometer will increase the time delay (Pick-up time for O/V models, drop-out time for U/V models).
4. The adjustments are single turn potentiometers, use a small screwdriver and do not force beyond the limit stops.
5. On U/V models, when the voltage falls to approximately \(33 \%\) of nominal or below, the relay will drop out in 0.150 to 0.300 seconds, regardless of the time delay setting.

Transient Protection - All voltage relays will withstand momentary voltage surges of twice the nominal rated input voltage (standard).
Option "P" provides additional transient protection which complies with the requirements of ANSI/IEEE C37.90-1978
Consult factory for additional models.

\section*{WOUV DC Series, Over/Undervoltage}

\section*{Product Facts \\ ANSI/IEEE C37.90-1978}

The relay will energize at normal voltage conditions. The normally open contacts will close, and the normally closed contacts will open. The relay will de-energize during over or undervoltage conditions. Reset is automatic when the voltage returns to normal.


Note: Dimensions in inches. Multiply values by 25.4 for dimensions in mm .


\section*{Product Specifications}

Nominal Voltage ( \(\pm 10 \%\) ) 12 VDC to 560 VDC
Drop-out Point (u/v models) -
70-100\% of nominal voltage, screwdriver adjustable
Pick-Up Point (o/v models) -100-125\% of nominal voltage, screwdriver adjustable
Output Contacts - One set N.O. One set N.C.

\section*{Contact Ratings -}

5 amp resistive at 120 VAC or 28 VDC
Operating Temperature Range -\(-40^{\circ} \mathrm{C}\) to \(+75^{\circ} \mathrm{C}\)

\section*{Temperature Effects -}

Less than \(1 \%\) voltage drift over the temperature range.

\section*{Power Consumption -}

12 to 60 VDC models - 1 W max. 120 to 305 VDC models - 2 W max. 405 to 470 VDC models - 3 W max. 560 VDC Model - 4 W max.
Time Delay - A short duration delay is provided to prevent nuisance tripping due to momentary dips or surges in volt age. The drop-out delay, following a voltage fault is 75 to 100 milliseconds

Notes:
1. Remove black screws for access to the O/V and U/V trip adjustment.
2. Clockwise rotation of the adjustment potentiometer will raise the voltage trip point.
3. The adjustments are by means of a single turn potentiometer. Use a small screwdriver and do not force beyond the limit stops.

\section*{Ordering Information}


Blank - Standard
A = 2 Form A Contacts
B \(=2\) Form B Contacts
H = 125 VDC Contacts
P = Transient Protection


Transient Protection - All voltage
relays will withstand momentary voltage surges of twice the nominal rated input voltage (standard).
Option "P" provides additional transient protection which complies with the requirements of ANSI/IEEE C37.90-1978
Consult factory for additional models.

\section*{WOUVT Series, Over/Undervoltage}

\section*{Product Facts \\ - Function 27/59 \\ ■ ANSI/IEEE C37.90-1978}

Voltage sensitive relays are available for both AC and DC applications for overvoltage and undervoltage protection. Combination over/undervoltage relays provide band-pass capabilities. AC relays are either single or three-phase type. Three phase relays are designed to sense the average of the three phases. Voltage trip points are screwdriver adjustable, and operation is time-delayed so that momentary voltage transients will not cause nuisance tripping.

\section*{Operation}

The relay will energize at normal voltage condition. The normally closed contact (Form B) will open and the normally open (Form A) will close. The relay will deenergize after time delay when over or undervoltage condition is reached.


Note: Dimensions in inches. Multiply values by 25.4 for dimensions in mm .


Single Phase Models


Three Phase Models

\section*{Product Specifications}

Nominal Voltage - 120 VAC to 575 VAC
Phase - Single or Three
Line Frequency - \(50-400 \mathrm{~Hz}\)
Type of Sensing - Average of all three phases
Undervoltage Trip - \(70-100 \%\) of nominal voltage, screwdriver adjustable
Overvoltage Trip - 100-125\% of nominal voltage, screwdriver adjustable
Drop-out Time Delay - 0.5 to 20 seconds, screwdriver adjustable
Pick-up to Drop-out Differential 2\% maximum
Output Contacts - One set N.O., One set N.C.
Contact Ratings - 5 amp resistive at 120 VAC or 28 VDC
Operating Temperature Range -\(-40^{\circ} \mathrm{C}\) to \(+70^{\circ} \mathrm{C}\)
Power Consumption -
4 VA maximum

\section*{Notes:}
1. Remove black screw for access to the voltage trip and time delay adjustment potentiometer
2. Clockwise rotation of the voltage adjustment potentiometer will raise the voltage trip point.
3. Clockwise rotation of the time adjustment potentiometer will increase the drop-out time delay.

\section*{Ordering Information}


Options:
Blank - Standard
A \(=2\) Form A Contacts
B \(=2\) Form B Contacts
H = 125 VDC Contacts
P = Transient Protection

Option "H" provides for contacts rating of 3 amps @ 125VDC.
Option "P" provides additional transient protection which complies with the requirements of ANSI/IEEE C37.90-1978 Consult factory for additional models.

\section*{250 Series, Over/Undervoltage}

Product Facts
■ Function 27/59
■ ANSI/IEEE C37.90-1978

The 250 series relays provide combined Overvoltage and Undervoltage protection in a single compact unit.
Models are available for single phase or three phase applications, and are suitable for either 50 Hz , 60 Hz , or 400 Hz operation. The trip point is adjustable.
A transistorized circuit provides a sharp and accurate response at the preset tripping voltage; unaffected by temperature or frequency variations.


Note: Dimensions in inches. Multiply values by 25.4 for dimensions in mm .


\section*{Ordering Information}


\section*{Product Specifications}

Nominal Voltage - See Ordering
Information
Undervoltage Trip - \(70-100 \%\) of nominal voltage, screwdriver adjustable
Overvoltage Trip - \(100-125 \%\) of nominal voltage, screwdriver adjustable
Pick-up to Drop-out Differential 3\% maximum
Contact Ratings - 5 amp resistive at 120 VAC or 28 VDC
Contact Form - One set N.O., one set N.C.
Operating Temperature Range -\(-20^{\circ} \mathrm{C}\) to \(+85^{\circ} \mathrm{C}\)

\section*{Notes:}
1. Remove screws for access the overvoltage or undervoltage trip adjustments. Clockwise rotation of the adjustment potentiometer will raise the trip point.

\section*{Contact Arrangements}

NC - Open at nominal voltage. Closed at Overvoltage and Undervoltage
NO - Closed at nominal voltage. Open at Overvoltage and Undervoltage

Consult factory for additional models.

\section*{Product Facts}

■ ANSI/IEEE C37.90-1978
■ UL File No. E58048
■ CSA File No. LR61158

Close Differential Relays are voltage sensitive. The pickup and drop-out voltage settings are independently adjustable, which allows precise setting of the differential voltage. This relay is available in a wide range of AC and DC voltages. Their primary application is the sensing and control of transfer switches.

\section*{Operation}

Monitors a single phase AC signal, and is used for undervoltage detection. Has separate pick-up and drop-out voltage settings, providing an adjustable hysteresis.

\section*{D100X Series, Close Differential}


\section*{Product Specifications}

Nominal Voltage - AC, Single
Phase, see Ordering Information
Nominal Frequency - 50 to 400 Hz .
Pick-Up Adjustment Range -\(67-100 \%\) of nominal voltage
Drop-Out Adjustment Range -
\(67-100 \%\) of nominal voltage
Maximum Differential Setting -
\(33 \%\) of nominal voltage
Minimum Differential Setting -
\(2 \%\) of nominal voltage
Output Contacts - Form C (SPDT)
Contact Ratings - 5 Amp resistive at
120 VAC or 28 VDC
Operating Temperature Range -\(-20^{\circ} \mathrm{C}\) to \(+85^{\circ} \mathrm{C}\)
Expected Life - 10 million opera-
tions
Inverse Time Drop-Out -
The differential relay contains a time delay before operation so that momentary voltage transients do not affect the operation of the relay. The time delay has an inverse time characteristic so that excessive voltage conditions will cause a more rapid drop-out. This time delay is approximately 200 mSec . ( 12 cycles) at the trip settings and decreases to 30 mSec. at approximately \(15 \%\) beyond the trip settings.

\section*{Notes:}
1. Remove black nylon protective screws to gain access to the two internal adjustment potentiometers.
2. Clockwise rotation of the pick-up and drop-out adjustment will raise the voltage trip point.
3. The relay contacts are shown in the de-energized state.

\section*{Ordering Information}
\begin{tabular}{|c|c|}
\hline Sample Part Number \(>\) D100X & \\
\hline Model: L-L Volts & Height \\
\hline D100X = 120 VAC & 2 " \\
\hline D100-6X = 120 VAC, Spike Suppression & \(2 "\) \\
\hline D100-3X \(=208\) VAC & \(3.125{ }^{\prime \prime}\) \\
\hline D100-4X \(=240\) VAC & \(3.125{ }^{\prime \prime}\) \\
\hline D100-8X \(=277\) VAC & \(3.125{ }^{\prime \prime}\) \\
\hline D100-5X \(=480\) VAC & \(3.125{ }^{\prime \prime}\) \\
\hline D100-7X \(=510\) VAC & \(3.125{ }^{\prime \prime}\) \\
\hline
\end{tabular}

Surge Withstand Capability is in
compliance with the requirements of
ANSI/IEEE C37.90B
Consult factory for additional models.

\section*{Height}

3.125"
\(3.125{ }^{\prime \prime}\)
\(3.125^{\prime \prime}\)
\(3.125{ }^{\prime \prime}\)

\section*{D101X Series, 3 Phase Adjustable, Close Differential}

\section*{Product Facts}

■ ANSI/IEEE C37.90-1978
■ UL File No. E58048
- CSA File No. LR61158 (UL)


Close Differential Relays are voltage sensitive. The pickup and drop-out voltage settings are independently adjustable, which allows precise setting of the differential voltage. This relay is available in a wide range of AC voltages. Their primary application is the sensing and control of transfer switches.

\section*{Operation}

The output contacts will close when the voltage of all three phases is above the pre-set pick-up point, and will open when any one phase drops below its drop-out setting.


Note: Dimensions in inches. Multiply values by 25.4 for dimensions in mm .


\section*{Ordering Information}

\begin{tabular}{cccc}
\hline Model & \begin{tabular}{c} 
Power Consumption \\
Each Phase
\end{tabular} & \begin{tabular}{c} 
H1 \\
(inches)
\end{tabular} & \begin{tabular}{c} 
H2 \\
(inches)
\end{tabular} \\
\hline D101X & 2 VA max. & 2 & \(211 / 16\) \\
\hline D101-4X & 3 VA max. & \(31 / 2\) & \(43 / 16\) \\
\hline D101-6X & 3 VA max. & \(31 / 2\) & \(43 / 16\) \\
\hline D101-7X & 4 VA max. & \(31 / 2\) & \(43 / 16\) \\
\hline D101-10X & 4 VA max. & \(31 / 2\) & \(43 / 16\) \\
\hline
\end{tabular}

\section*{Product Specifications}

Nominal Voltage - AC, Three Phase, see Ordering Information
Nominal Frequency - 50 to 500 Hz . Pick-Up Adjustment Range -66-100\% of nominal voltage, screwdriver adjustable
Drop-Out Adjustment Range -66-100\% of nominal voltage, screwdriver adjustable
Output Contacts - SPNO
Contact Ratings - 5 amp resistive at 120 VAC or 28 VDC
Operating Temperature Range -\(-20^{\circ} \mathrm{C}\) to \(+85^{\circ} \mathrm{C}\)

\section*{Notes:}
1. Remove screws for access to pick-up and drop-out trip adjustments.
2. Clockwise rotation of the pick-up and drop-out adjustment will raise the voltage trip point.

Consult factory for additional models.

\section*{Product Facts \\ ■ Function 32 \\ ■ ANSI/IEEE C37.90-1978 \\ ■ UL File No. E58048 \\ ■ CSA File No. LR61158}

Several types of Reverse Power Relays are available including relays sensitive to reverse reactive power (kVAR). KILOVAC is the leading brand of reverse power relays. Our rugged sealed construction provides continuous and reliable operation unaffected by shock, vibration or other severe environments. Reverse Power Relays are used for the protection of generator sets operating in parallel.

\section*{700 Series w/ Adjustable Time Delay}


Note: Dimensions in inches. Multiply values by 25.4 for dimensions in mm .


Designed for 120, 220 or 266 volt line to neutral connection

Model 720TD (X) thru 724TD (X)


For operation on three phase, three wire

\section*{Ordering Information}
Sample Part Number
Type: \begin{tabular}{l} 
710TD \(=120 \mathrm{~V}, 220 \mathrm{~V}, 266 \mathrm{~V}\) line to neutral \\
720TD \(=120 \mathrm{~V}, \mathrm{~L}-\mathrm{L}, 3\) Phase \\
721TD \(=230 \mathrm{~V}, \mathrm{~L}-\mathrm{L}, 3\) Phase \\
722TD \(=380 \mathrm{~V}, \mathrm{~L}-\mathrm{L}, 3\) Phase \\
723TD \(=460 \mathrm{~V}, \mathrm{~L}-\mathrm{L}, 3\) Phase \\
724TD \(=575 \mathrm{~V}, \mathrm{~L}-\mathrm{L}, 3\) Phase \\
725TD \(=416 \mathrm{~V}, \mathrm{~L}-\mathrm{L}, 3\) Phase \\
730TD \(=\) \\
\\
\\
\\
\(120 \mathrm{~V}, 230 \mathrm{~V}\), Single Phase, L-N
\end{tabular} l

\section*{Mounting:}

X = Flange
Blank - Stud
Options:
7 = Reverse Inductive, 60 Hz

\section*{Product Specifications}

\section*{Line Voltage -}

Model 710TD - \(120 \mathrm{~V}, 220 \mathrm{~V}\) or 266 V
line to neutral
Model 730 TD - \(120 \mathrm{~V}, 230 \mathrm{~V}, 380 \mathrm{~V}\),
460 V, L-L, 3 Phase or 120 V, Single
Phase, L-N
All models for three phase, three wire sensing are available, see Ordering Information
Line Frequency - \(50-500 \mathrm{~Hz}\).
Current Requirements -
0 to 5 amp max direct or from CT with 5 amp secondary
Trip Adjustment -
Screwdriver adjustable 4\% to 20\% (of the 5 amp rating)
Time Delay Adjustment - 0.5 to 20 seconds, screwdriver adjustable
Output Contacts - One set N.O., one set N.C.
Contact Ratings - 5 amp resistive at
120 AC or 28 Vdc

\section*{Power Consumption -}

Voltage circuit - 2 VA max.
Current circuit - 4 VA max.
Weight -2.75 lbs . max.

\section*{Notes:}
1. Remove screw for access to the pick-up and time delay adjustments.
2. Clockwise rotation of the pick-up adjustment will raise the reverse trip point.
3. Clockwise rotation of the time adjustment will increase the time delay.
4. Polarity of the voltage and the current connections must be observed for true power sensing.
5. Interchanging connections on terminals 5 and 6 , will cause the output contacts to pick-up on forward power and dropout on no power or reverse power.

\section*{Consult factory for additional} models.

\section*{1000 Series}

\section*{Product Facts}
- Function 47

■ ANSI/IEEE C37.90-1978
■ UL File No. E58048
■ CSA File No. LR61158

Phase failure relays protect motors, equipment and personnel from damage or injury caused by open phase, reversed phase sequence, or low voltage in a three phase system. Models are available for 50 and 60 Hz with voltages up to 575 volts. Motor control switchboards are a common application.

\section*{Operation}

The contacts of the relay will close only when it senses normal conditions of three phase power at the proper phase sequence.
The relay contacts will remain in their normally open position (de-energized) when voltage with incorrect phase sequence is applied, one or more phases are open, or at undervoltage condition.


Note: Dimensions in inches. Multiply values by 25.4 for dimensions in mm .


\section*{Ordering Information}


\section*{X = Flange}

Blank - Stud

\section*{Product Specifications}

Nominal Voltage - See Ordering Information
Voltage Drop-Out - \(75 \%\) to \(100 \%\) of nominal, screwdriver adjustable
Pick-Up to Drop-Out Differential 3\% approx.
Ambient Operating Temperature -\(-40^{\circ} \mathrm{C}\) to \(+70^{\circ} \mathrm{C}\)
Temperature Drift — \(\pm 1 \%\)
Time Delay - See Curve
Output Contacts - One set, normally open
Contact Ratings -
10 amp at 28 VDC resistive
10 amp at 230 VAC resistive

\section*{Notes:}
1. Remove screw for access to the undervoltage adjustment
2. Clockwise rotation of the adjustment potentiometer will raise the drop-out voltage.
\begin{tabular}{llll} 
Catalog 5-1773450-5 & \begin{tabular}{l} 
Dimensions are shown for \\
reference purposes only.
\end{tabular} & \begin{tabular}{l} 
Dimensions are in millimeters \\
unless otherwise specified.
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USA: +18005226752 \\
Asia Pacific: +8604008206015 \\
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\end{tabular} \\
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Specifications subject \\
to change.
\end{tabular} & & UK: +44800267666
\end{tabular}
Consult factory for additional models. to change

\section*{900 Series}

\section*{Product Facts \\ ■ Function 47}

Phase sequence relays are designed to monitor the correct phase rotation of a three phase system. Several models are available from \(50 \mathrm{~Hz}, 60 \mathrm{~Hz}\), and 400 Hz with voltages up to 575 volts. High shock relay output and reverse contacts are also available.

\section*{Operation}

The relay remains de-energized when voltage in the proper phase sequence (A, \(B, C)\) is applied, the relay is energized when voltage with incorrect sequence (A, \(C, B\) ) is applied.


Product Specifications
Input Voltage - See Ordering
Information
Output Contacts - SPDT
Contact Ratings -
5 amp resistive at 120 Vac or 28 Vdc

Note: Dimensions in inches. Multiply values by 25.4 for dimensions in mm .


\section*{Ordering Information}


X = Flange
Blank - Stud

Consult factory for additional models.

\section*{WCB Series}

\section*{Product Facts}

■ Function 60 or 87
■ ANSI/IEEE C37.90-1978
■ UL File No. E58048
■ CSA File No. LR61158

Current Balance Relays are designed to sense unbalanced current flow in a three phase system. The primary application of Current Balance Relays is to protect three phase motors against phase unbalance or phase failure.

\section*{Operation}

With control voltage applied to the relay, the output contacts will energize when the three phase currents are balanced (including zero currents), and will be de-energize by unbalance currents.


Note: Dimensions in inches. Multiply values by 25.4 for dimensions in mm .


Notes:
1. Remove black screw for access to the trip adjustment.
2. Clockwise rotation of the adjustment potentiometer will raise the unbalance trip point.
3. The output contacts are shown de-energized.

\section*{Product Specifications}

Line Current - Three Phase, AC current, \(50-400 \mathrm{~Hz}\) Direct or from CT. 5 amp continuously
\(20 \mathrm{amp}, 30 \mathrm{sec}\).
\(200 \mathrm{amp}, 0.10 \mathrm{sec}\).
Control Voltage - See Ordering Information
Unbalanced Trip Point -
Screwdriver adjustable. Adjustment range in accordance with ordering information. (The unbalanced value is defined as the difference between the highest and the lowest phase current).
Drop-Out Time Delay -
0.9 to 1.3 seconds

Surge Withstand Capability -
In compliance with C37.90B ANSI//EEE
Operating Temperature -
\(-40^{\circ} \mathrm{C}\) to \(+70^{\circ} \mathrm{C}\)

\section*{Burden -}

Current input - 5.0 VA ,
Phase Control voltage - 3.0 VA
Contact Ratings -
One set, N.O., One set N.C
5 amp resistive at 120 VAC or 28 VDC

\section*{Ordering Information}


Trip Adjustment Range
\(.5=0.1 \mathrm{amp}\) to 0.5 amps
\(1=0.2 \mathrm{amp}\) to 1 amp
\(2=0.4 \mathrm{amp}\) to 2 amp
Options:
A = two normally open contacts
B = two normally closed contacts

For additional support numbers please visit www.te.com

\section*{WC1 \& WCT1 Series, Overcurrent}

\section*{Product Facts \\ ■ Function 50/51 \\ ■ ANSI/IEEE C37.90-1978 \\ ■ UL File No. E58048 \\ ■ CSA File No. LR61158}

Current sensitive relays are available for single and three phase applications. Voltage controlled overcurrent relays protect generators against fault currents below the full rated value, when the fault produces a voltage drop as in the case of short circuits or grounds. Phase balance relays are available to sense and control unbalanced current flow in three phase systems. Current differential relays operate when the differential between two currents exceeds preset values. Over/under current phase-band relays are also available.


Note: Dimensions in inches. Multiply values by 25.4 for dimensions in mm .


\section*{Time Delay}

Standard Time Delay
(WC1 Series) - A fixed inverse time delay is incorporated in all overcurrent relays and is represented by the typical curves shown.
Adjustable Time Delay
(WCT1 Series) - The time delay is field adjustable. The standard time delay can be increased by any value between 0.5 and 20 seconds.

\section*{Product Specifications}

Line Current - Single Phase, AC current, \(50-400 \mathrm{~Hz}\) Direct or from CT
Control Voltage - See Ordering Information
Trip Point - Screwdriver adjustable. Adjustment range in accordance with ordering information.
Pick-Up to Drop-Out Differential Approximately 0.1 amp.
Overcurrent Allowance -
Maximum of \(500 \%\) for 0.25 seconds
Surge Withstand Capability In compliance with C37.90B ANSI/IEEE
Operating Temperature -
\(-40^{\circ} \mathrm{C}\) to \(+70^{\circ} \mathrm{C}\)
Temperature Drift - \(\pm .05 \%\)
Burden -
Current input - 1.2 VA ,
Control voltage - 2.5 VA
Contact Ratings -
One set, N.O., One set N.C
5 amp resistive at 120 VAC or 28 VDC

\section*{Notes:}
1. Remove black screws for access to the current pick-up and the time delay adjustment.
2. Clockwise rotation of the pick-up adjustment will raise the current trip point.
3. Clockwise rotation of the time
delay adjustment, (Type WCT1 only) will increase the time delay.

\section*{Ordering Information}


Typical Curves (WC1 Series)


Trip Adjustment Range
\(1=.2 \mathrm{amp}-1 \mathrm{amp}\)
\(5=1 \mathrm{amp}\) to 5 amp
\(10=2 \mathrm{amp}\) to 10 amp

\section*{Other Options}
\(A=\) Two normally open contacts
\(B=\) Two normally closed contacts
See next page for 3-phase types and consult factory for additional models.
\begin{tabular}{ll} 
Dimensions are in millimeters & USA: +1 8005226752 \\
unless otherwise specified. & Asia Pacific: +8604008206015 \\
& UK: +44 800 267666
\end{tabular}

For additional support numbers please visit www.te.com

\section*{WC3 \& WCT3 Series, Overcurrent}

\section*{Product Facts}

■ Function 50/51
■ ANSI/IEEE C37.90-1978
■ UL File No. E58048
■ CSA File No. LR61158

Current sensitive relays are available for single and three phase applications. Voltage controlled overcurrent relays protect generators against fault currents below the full rated value, when the fault produces a voltage drop as in the case of short circuits or grounds. Phase balance relays are available to sense and control unbalanced current flow in three phase systems. Current differential relays operate when the differential between two currents exceeds preset values. Over/under current phase-band relays are also available.


Note: Dimensions in inches. Multiply values by 25.4 for dimensions in mm .


Time Delay
Standard Time Delay
(WC3 Series) - A fixed inverse time delay is incorporated in all overcurrent relays and is represented by the typical curves shown.

Adjustable Time Delay
(WCT3 Series) - The time delay is field adjustable. The standard time delay can be increased by any value between 0.5 and 20 seconds.

\section*{Ordering Information}



Trip Adjustment Range
\(1=.2 \mathrm{amp}-1 \mathrm{amp}\)
\(5=1 \mathrm{amp}\) to 5 amp
\(10=2 \mathrm{amp}\) to 10 amp
Other Options
A = Two normally open contacts
See previous page for 1-phase models and consult factory for
\(B=\) Two normally closed contacts additional models.

\section*{Product Specifications}

Line Current - Three Phase,
AC current, \(50-400 \mathrm{~Hz}\) Direct or from CT
Control Voltage - See Ordering Information
Trip Point - Screwdriver adjustable. Adjustment range in accordance with ordering information.
Pick-Up to Drop-Out Differential Approximately 0.1 amp
Overcurrent Allowance - Maximum of \(500 \%\) for 0.25 seconds
Surge Withstand Capability -
In compliance with the requirements of ANSI/IEEE
Operating Temperature -
\(-40^{\circ} \mathrm{C}\) to \(+70^{\circ} \mathrm{C}\)
Temperature Drift \(- \pm 0.05 \% /{ }^{\circ} \mathrm{C}\)

\section*{Burden -}

Current input - 1.2 VA ,
Control voltage - 2.5 VA

\section*{Contact Ratings -}

One set, N.O., One set N.C.
5 amp resistive at 120 VAC or 28 VDC

\section*{Notes:}
1. Remove black screws for access to the current pick-up and the time delay adjustment.
2. Clockwise rotation of the pick-up adjustment will raise the current trip point.
3. Clockwise rotation of the time delay adjustment, (Type WCT3 only) will increase the time delay.
\begin{tabular}{|c|c|c|c|}
\hline \begin{tabular}{l}
Catalog 5-1773450-5 Revised 3-13 \\
www.te.com
\end{tabular} & Dimensions are shown for reference purposes only. Specifications subject to change. & Dimensions are in millimeters unless otherwise specified. & \begin{tabular}{l}
USA: +1 8005226752 \\
Asia Pacific: +8604008206015 \\
UK: +44 800267666
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For additional support numbers please visit www.te.com to change.

\section*{WCD Series}

\author{
Product Facts \\ ■ Function 87 \\ ■ ANSI/IEEE C37.90-1978
}

Current Differential Relays are used for the protection of transformers, motors and generators, by comparing the magnitude of the current entering and leaving the protected circuit. On a given phase winding, any difference between the two currents will indicate an internal fault; the relay will sense the vectorial difference between the two currents of the protected section and will initiate a quick disconnection of the unit, to prevent disastrous consequences.

The relay may also be used to protect internal faults on transformers, such as: ground faults, shorted winding, leakage between primary and secondary, etc. It will sense and compare primary vs. secondary currents, once the turns ratio has been taken into consideration.

\section*{Operation}

With control voltage applied, the output contacts (shown in the de-energized position) will remain deenergized as long as the difference between the two input currents remains below the preset trip value. The contact will transfer to the energized position when the current difference exceeds the trip value.


172 DIA. 4 MTG. HOLES

Note: Dimensions in inches. Multiply values by 25.4 for dimensions in mm .


\section*{Ordering Information}

\(.5=0.1 \mathrm{amp}\) to 0.5 amp
\(1=0.2 \mathrm{amp}\) to 1 amp
2 = 0.4 amp to 2 amp
Options:
A = Two normally open contacts
B = Two normally closed contacts
\(\mathrm{H}=\) Contacts rated 3 amp at 125 VDC
\(P=\) Transient protection is provided in compliance with ANSI/IEEE C37.90-1978

\section*{Product Specifications}

Line Current -
Single Phase, AC current, 50-400 Hz
Direct or from CT
5 amp continuously
20 amp 30 seconds
200 amp, 0.10 seconds
Control Voltage - See Ordering
Information
Differential Trip Point -
Screwdriver adjustable. See Ordering
Information
Operating Temperature -
\(-40^{\circ} \mathrm{C}\) to \(+75^{\circ} \mathrm{C}\)
Burden -
Current input - 2.5 VA max.
Control voltage DC -2 W max. AC -2 VA max.

\section*{Output Contacts -}

One set, N.O., One set N.C.
Contact Ratings -
5 amp resistive at 120 VAC or 28 VDC

\section*{Notes:}
1. Remove black screws for access to the trip adjustments.
2. Clockwise rotation of the adjustment potentiometer will raise the current differential trip point.
3. The output contacts are shown de-energized.
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Catalog 5-1773450-5 & Dimensions are shown for & Dimensions are in millimeters & USA: +1 800 5226752 \\
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Asia Pacific: +8604008206015 \\
Specifications subject
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ww.te.com & to change. & &
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imensions are shown for Specifications subject to change.

\section*{Consult factory for additional models.}

Protective Relays

\section*{1800 Series}

\section*{Product Facts}
- Function 25

■ ANSI/IEEE C37.90-1978
■ UL File No. E58048
■ CSA File No. LR61158

\section*{Application}

These relays are designed for automatic paralleling (synchronizing) of generators. The relays sense the phase angle displacement and the amplitude difference between two voltages and permit paralleling only when both voltages are equal and in phase. A short time delay is provided to assure that the frequencies are essentially the same at the moment of paralleling. The basic series is designed to parallel two or more energized AC generators. The "Dead Bus" type provides paralleling of AC generators to the main bus. They permit electrical connection of an energized generator to an un-energized line (Dead Bus). If the bus is energized, connection of the generator to the bus is permitted only when both are synchronized.

\section*{Notes}
*Permits paralleling of two generators only when they are "on-line" and their voltages are equal and in phase (synchronized)
**Normally used to permit paralleling of a generator to a bus when: (a) both line voltages are equal and in phase, or: (b) when the generator is "on-line" and the bus is "dead"
***Permits paralleling of two power lines (buses) when: (a) both line voltages are equal and in phase, or: (b) when either bus is "hot" and the other bus is "dead"

\section*{Output Contact Options -}
1. Two Form A. (Add -A to Model Number)
2. Two Form B. (Add -B to Model Number)

Consult factory for additional models.


Note: Dimensions in inches. Multiply values by 25.4 for dimensions in mm .


\section*{A. 3 Phase, 4 Wire System}

Connect phase "A" of LINE 1 to terminal 1 Connect phase "A" of LINE 2 to terminal 3 Connect the neutrals to terminals 2 \& 4
B. 3 Phase, 3 Wire or 1 Phase, 2 Wire System

Connect phase "A" of LINE 1 to terminal 1
Connect phase "B" of LINE 1 to terminal 2
Connect phase "A" of LINE 2 to terminal 3
Connect phase "B" of LINE 2 to terminal 4

\section*{Selection Guide (Typical Applications)}
\begin{tabular}{cccc}
\hline \begin{tabular}{c} 
Sensing \\
Voltage
\end{tabular} & \begin{tabular}{c} 
Series 1800* \\
Generator to Generator
\end{tabular} & \begin{tabular}{c} 
Series 1800DB** \\
Generator to Bus
\end{tabular} & \begin{tabular}{c} 
Series 1800DDB*** \\
Bus to Bus
\end{tabular} \\
\hline 120 Volts & \(1810 X\) & 1810 DBX & 1810 DDBX \\
\hline 230 Volts & 1820 X & 1820 DBX & 1820 DDBX \\
\hline 380 Volts & \(1830 X\) & 1830 DBX & 1830 DDBX \\
\hline 460 Volts & \(1840 X\) & 1840 DBX & 1840 DDBX \\
\hline 575 Volts & \(1850 X\) & 1850 DBX & 1850 DDBX \\
\hline 415 Volts & \(1860 X\) & 1860 DBX & 1860 DDBX \\
\hline 277 Volts & \(1870 X\) & 1870 DBX & 1870 DDBX \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|c|c|}
\hline \multicolumn{2}{|l|}{\multirow[t]{2}{*}{}} & \multicolumn{3}{|c|}{Condition} & \multicolumn{2}{|l|}{Series 1800 Contacts} & \multicolumn{2}{|l|}{Series 1800DB Contacts} & \multicolumn{2}{|l|}{Series 1800DDB Contacts} \\
\hline & & Energized & Not Energized & Synch. & N.C. & N.O. & N.C. & N.O. & N.C. & N.O. \\
\hline \multirow[b]{2}{*}{1} & Line 1 & X & & & \multirow[b]{2}{*}{Open} & \multirow[b]{2}{*}{Close} & \multirow[b]{2}{*}{Open} & \multirow[b]{2}{*}{Close} & \multirow[b]{2}{*}{Open} & \multirow[b]{2}{*}{Close} \\
\hline & Line 2 & X & & Yes & & & & & & \\
\hline \multirow[b]{2}{*}{2} & Line 1 & X & & No & \multirow[b]{2}{*}{Close} & \multirow[b]{2}{*}{Open} & \multirow[b]{2}{*}{Close} & \multirow[b]{2}{*}{Open} & \multirow[b]{2}{*}{Close} & \multirow[b]{2}{*}{Open} \\
\hline & Line 2 & X & & No & & & & & & \\
\hline \multirow[t]{2}{*}{3} & Line 1 & X & & & \multirow[t]{2}{*}{Close} & \multirow[b]{2}{*}{Open} & \multirow[t]{2}{*}{Open} & \multirow[t]{2}{*}{Close} & \multirow[b]{2}{*}{Open} & \multirow[t]{2}{*}{Close} \\
\hline & Line 2 & & X & & & & & & & \\
\hline \multirow[t]{2}{*}{4} & Line 1 & & X & & \multirow[t]{2}{*}{Close} & \multirow[t]{2}{*}{Open} & \multirow[t]{2}{*}{Close} & \multirow[t]{2}{*}{Open} & \multirow[t]{2}{*}{Close} & \multirow[t]{2}{*}{Open} \\
\hline & Line 2 & & X & & & & & & & \\
\hline \multirow[b]{2}{*}{5} & Line 1 & & X & & \multirow[b]{2}{*}{Close} & \multirow[b]{2}{*}{Open} & \multirow[b]{2}{*}{Close} & \multirow[b]{2}{*}{Open} & \multirow[b]{2}{*}{Open} & \multirow[b]{2}{*}{Close} \\
\hline & Line 2 & X & & & & & & & & \\
\hline
\end{tabular}

\section*{Product Specifications}

Sensing Voltage - \(120 \mathrm{~V}, 230 \mathrm{~V}\), \(277 \mathrm{~V}, 380 \mathrm{~V}, 460 \mathrm{~V}, 575 \mathrm{~V}, \& 415 \mathrm{~V}\)
Line Frequency - \(50-500 \mathrm{~Hz}\)
Pick-Up Adjustment -
External adjustment for field sensing of 10-30\% of nominal input voltage. (Vertical voltage differential of 6 to 18 electrical degrees).
Time Delay —Fixed @ 60 milliseconds is provided to assure that the frequencies of both input lines are sufficiently close to permit paralleling within the preset window.

\section*{Output Contacts -}

One set N.O., one set N.C.
5 amp resistive at 120 VAC or 28 VDC

Dimensions are shown for reference purposes only. Specifications subject to change.

\section*{Product Facts}
- Function \(810 / \mathrm{U}\)

■ ANSI/IEEE C37.90-1978
■ UL File No. E58048
■ CSA File No. LR61158

\section*{Application}

The output contacts of frequency relays are energized when the frequency exceeds the adjustable set point. Overfrequency and underfrequency relays are available in 50, 60 and 400 Hz . Combination over/underfrequency "band pass" relays are also available. These are energized at rated frequency and deenergized during overfrequency or underfrequency conditions. Frequency Differential relays are energized above the preset frequency. The pick-up and drop-out frequency settings are independently adjustable.


Consult factory for additional models.

\section*{WOF \& WUF Series}


Product Specifications
Nominal Voltage ( \(\pm 20 \%\) ) -
120, 230, 380 and 460 volts
Nominal Frequencies -
50,60 and 400 Hz .
Trip Point - Screwdriver adjustable Adjustment range in accordance with ordering information.
Operating Temperature -
\(-20^{\circ} \mathrm{C}\) to \(+65^{\circ} \mathrm{C}\)
Differential - The frequency pitch-up to drop-out differential is .5\% max
Voltage Drift - \(\pm .05 \%\) maximum
frequency error for input voltage variation of \(\pm 10 \%\)
Time Delay - See Time versus Frequency curves
Surge Withstand Capability In compliance with C37.90B ANSI/IEEE
Output Contacts - One set N.O., one set N.C.

Contact Ratings -
5 amp resistive at 120 VAC or 28 VDC


\section*{Ordering Information}

blank = Per Time Curve
T = Adjustable

\section*{Time Delay}

Standard Time Delay - A minimum,
fixed inverse time delay is incorporated in all frequency relays to prevent nuisance tripping and is represented by the typical curves shown above.

\section*{Adjustable Time Delay -}

It additional time delay is required, a suffix "T" must be added to the part number. This allows the minimum fixed time delay to be field-adjustable up to 20 seconds.

\section*{Notes:}
1. Remove black screws for access to the frequency and the time adjustments.
2. Clockwise rotation of the frequency potentiometer will raise the frequency trip point.
3. Clockwise rotation of the time adjustment, option " T " will increase the time for overfrequency relays and dropout time for underfrequency relays.

Dimensions are shown for reference purposes only. Specifications subject to change

Dimensions are in millimeters unless otherwise specified.

Protective Relays

\section*{WOUF Series, Over/Underfrequency}

\section*{Product Facts}
- Function 81 0/U

■ ANSI/IEEE C37.90-1978
■ UL File No. E58048
■ CSA File No. LR61158

The output contacts of frequency relays are energized when the frequency exceeds the adjustable set point. Overfrequency and underfrequency relays are available in 50, 60 and 400 Hz . Combination over/underfrequency "band pass" relays are also available. These are energized at rated frequency and de-energized during overfrequency or underfrequency conditions. Frequency Differential relays are energized above the preset frequency. The pick-up and drop-out frequency settings are independently adjustable.

\section*{Operation}

The relay will energize at normal frequency; The normally closed contacts will open and the normally open contacts will close. The relay will drop-out after time delay at overfrequency or underfrequency.

Consult factory for additional models.


Note: Dimensions in inches. Multiply values by 25.4 for dimensions in mm .


Product Specifications
Nominal Voltage ( \(\pm 20 \%\) ) -
120, 230, 380 and 460 volts

\section*{Nominal Frequencies -}

50,60 and 400 Hz .
Trip Point - Screwdriver adjustable. Adjustment range in accordance with ordering information.

\section*{Operating Temperature -}
\(-40^{\circ} \mathrm{C}\) to \(+65^{\circ} \mathrm{C}\)
Differential - The frequency pick-up to drop-out differential is \(5 \%\) max
Voltage Drift \(- \pm 0.05 \%\) maximum frequency error for input voltage variation of \(\pm 10 \%\)
Time Delay - See Time versus
Frequency curves
Surge Withstand Capability In compliance with C37-90B ANSI//EEE Output Contacts - One set N.O., one set N.C.
Contact Ratings -
5 amp resistive at 120 VAC or 28 VDC

Notes:
1. Remove black screws for access to the frequency and the time adjustments.
2. Clockwise rotation of the frequency potentiometer will raise the frequency trip point.
3. Clockwise rotation of the time adjustment, option "T" will increase the drop-out time delay.

\section*{Time Delay}

Standard Time Delay - A minimum, fixed inverse time delay is incorporated in all frequency relays to prevent nuisance tripping and is represented by the typical curves shown below.

\section*{Adjustable Time Delay -}

If additional time delay is required, a suffix "T" must be added to the part number. This allows the minimum fixed time delay to be field-adjustable up to 20 seconds.


\section*{20-000 Series}

\section*{Product Facts}

■ Function 810

The output contacts of frequency relays are energized when the frequency exceeds the adjustable set point. Overfrequency and underfrequency relays are available in 50, 60 and 400 Hz . Combination over/underfrequency "band pass" relays are also available. These are energized at rated frequency and de-energized during overfrequency or underfrequency conditions. Frequency Differential relays are energized between the preset frequencies. The pick-up and drop-out frequency settings are independently adjustable.

\section*{Operation}

The normally open contacts close, and the normally closed contacts open, at all frequencies above the set point. The contacts in the connection diagram, are shown in the de-energized position (below the trip set point).


11/64" DIA.
4 MTG. HOLES
Note: Dimensions in inches. Multiply values by 25.4 for dimensions in mm .


\section*{Ordering Information}


X = Flange
blank = Stud

\section*{Product Specifications}

Input Voltage ( \(\pm 10 \%\) ) -
120 VAC, Single Phase
Frequencies Range (adjustable) -
See Ordering Information
Differential - Frequency pick-up to drop-out differential is \(1 \%\) max
Temperature Range -
\(-40^{\circ} \mathrm{C}\) to \(+85^{\circ} \mathrm{C}\)
Temperature Drift \(- \pm 1 \%\) frequency error over temperature range
Voltage Error \(- \pm 1 \%\) for input
voltage of \(120 \mathrm{VAC} \pm 10 \%\)
Contact Ratings - 5 amp resistive at 120 VAC or 28 VDC
Output Contacts -
One set N.O., one set N.C.

\section*{Notes:}
1. Remove screw for access to trip adjustment.

Consult factory for additional models.

\section*{25-000 Series}

\section*{Product Facts \\ - Function \(810 / \mathrm{U}\) \\ ■ ANSI/IEEE C37.90-1978}

The output contacts of frequency relays are energized when the frequency exceeds the adjustable set point. Overfrequency and underfrequency relays are available in 50, 60 and 400 Hz . Combination over/underfrequency "band pass" relays are also available. These are energized at rated frequency and de-energized during overfrequency or underfrequency conditions. Frequency Differential relays are energized above the preset frequency. The pick-up and drop-out frequency settings are independently adjustable.

\section*{Operation}

The normally open contacts close, and the normally closed contacts open, at nominal frequency. The contacts are de-energize at underfrequency, overfrequency or no input voltage.


Note: Dimensions in inches. Multiply values by 25.4 for dimensions in mm .


\section*{Ordering Information}


X = Flange
blank = Stud

\section*{Product Specifications}

Input Voltage ( \(\mathbf{\pm 1 0 \%}\) ) — 120 VAC Frequency Range (adjustable) See Ordering Information
Trip Points - Screwdriver adjustable
Temperature Range -
\(-20^{\circ} \mathrm{C}\) to \(+85^{\circ} \mathrm{C}\)
Temperature Drift — \(\pm 1 \%\) frequency error over temperature range
Voltage Drift \(- \pm 1 \%\) frequency error input voltage variation of \(\pm 10 \%\)
Contact Ratings - 5 Amp resistive at 120 VAC or 28VDC
Output Contacts -
One set N.O., One set N.C.

\section*{Notes:}
1. The contacts are shown in the de-energized position.
. Remove screws for access to the underfrequency and overfrequency trip adjustments.
3. Clockwise rotation of the adjustment potentiometer will raise the frequency trip points.

Consult factory for additional models. to change.

\section*{Product Facts}

■ Function 27/81
■ ANSI/IEEE C37.90-1978
■ UL file No. E58048
■ CSA file No. LR61158

The output contacts of frequency relays are energized when the frequency exceeds the adjustable set point. Overfrequency and underfrequency relays are available in 50, 60, and 400 Hz . Combination over/underfrequency "band pass" relays are also available. These are energized at rated frequency and de-energized during overfrequency or underfrequency conditions. Frequency Differential relays are energized above the preset frequency. The pick-up and drop-out frequency settings are independently adjustable.

\section*{20-050-19 Series (Voltage/Frequency)}


Note: Dimensions in inches. Multiply values by 25.4 for dimensions in mm.


\section*{Ordering Information}


\section*{Mounting Options}

Blank = stud
X = Flange
Options:
P = Surge Suppression

Consult factory for additional models.

\section*{WGD Series — Floating Ground}

\section*{Product Facts}

■ ANSI/IEEE C37.90-1978
■ UL file No. E58048
■ CSA file No. LR61158

Ground Fault Detectors are used to sense leakage current to ground in power transformers and generators. They are available for both \(A C\) and DC systems. Some generator systems provide auxiliary power outlets for small equipment. TE Connectivity GFD's eliminate personnel risk of accessing these outlets if a ground fault exists. Diesel locomotives and railroad line signal boxes also use GFD's for operational control purposes. The GFD monitors both positive and negative grounds for fault currents and can trigger either notification or system shutdown if these are detected. GFD's are available for both grounded and ungrounded systems.

\section*{Operation}

When the resistance between any phase to ground falls below the set point the relay will energize; The normally closed contacts will open, the normally open contacts will close.


Product Specifications
Sensing Voltage ( \(\pm 10 \%\) ) -
3 phase, 3 -wire. See Ordering Information.
Control Voltage - 120 Volts AC
Contacts Trip Points (sensitivity) -
Screwdriver adjustable. See Ordering Information.
Pick-up Time Delay - 1.5 seconds approximately
Contact Ratings - 5 amp resistive at 120 VAC or 28 VDC

\section*{Operating Temperature -} \(-40^{\circ} \mathrm{C}\) to \(+65^{\circ} \mathrm{C}\)

Temperature Effects -
\(\pm 1 \%\) over temperature range
Power Consumption -
Sensing: \(-2 \mathrm{~mA} /\) Phase Approx., Control - 2 VA at 120VAC
Surge Withstand Capability In accordance with the requirements of ANSI//EEE

\section*{Notes:}
1. Remove screw for access to the pick-up adjustment potentiometer 2. Clockwise rotation of the adjustment potentiometer will raise the relay sensitivity.

\section*{WGD-}

Trip Point Adj. Phase to Ground
\begin{tabular}{llc} 
115-120AC & 115 & \(11-55 \mathrm{~K} \Omega\) \\
120-120AC & 120 & \(12-60 \mathrm{~K} \Omega\) \\
200-120AC & 200 & \(20-100 \mathrm{~K} \Omega\) \\
\(208-120 A C\) & 208 & \(21-105 \mathrm{~K} \Omega\) \\
220-120AC & 220 & \(22-110 \mathrm{~K} \Omega\) \\
230-120AC & 230 & \(23-115 \mathrm{~K} \Omega\) \\
\(240-120 A C\) & 240 & \(23-115 \mathrm{~K} \Omega\) \\
380-120AC & 380 & \(38-190 \mathrm{~K} \Omega\) \\
400-120AC & 400 & \(40-200 \mathrm{~K} \Omega\) \\
416-120AC & 416 & \(42-210 \mathrm{~K} \Omega\) \\
440-120AC & 440 & \(44-220 \mathrm{~K} \Omega\) \\
460-120AC & 460 & \(46-230 \mathrm{~K} \Omega\) \\
480-120AC & 480 & \(48-240 \mathrm{~K} \Omega\) \\
525-120AC & 525 & \(52-260 \mathrm{~K} \Omega\) \\
575-120AC & 575 & \(57-285 \mathrm{~K} \Omega\) \\
600-120AC & 600 & \(60-300 \mathrm{~K} \Omega\)
\end{tabular}

\section*{WC1G Series — Grounded}

Ground Fault Detectors are designed to provide very sensitive Ground-Current protection for motor, equipment and personnel from damage or electrical shock. In a ground system, the leakage current is monitored through a toroidal or doughnut current transformer placed around the supply conductors to a motor, transformer, equipment or outlets. Since the sums of the current in a system add to zero, the relay is responsive only to groundfault current.

\section*{Operation}

The output contacts are shown in de-energized position. They will change state when these conditions are met:
1. Control voltage is applied.
2. Leakage current exceed the trip setting.


Note: Dimensions in inches. Multiply values by 25.4 for dimensions in mm .


Current Transformer

Ordering Information


\section*{Product Specifications}

CT Window Diameter - 1.7 inches
(std) or can be specified by customer
Leakage Current Range -
10 to 60 mA
Control Voltage - See Ordering
Information
Output Contacts - One set N.C.,
one set N.O.
Operating Temperature -
\(40^{\circ} \mathrm{C}\) to \(+65^{\circ} \mathrm{C}\)
Contact Ratings - 10 amp resistive at \(250 \mathrm{Vac}, 8\) amp. resistive @ 30 Vdc

\section*{Notes:}
1. Remove screw for access to the pick-up adjustment potentiometer.
2. Clockwise rotation of the adjustment potentiometer will raise the relay sensitivity.

\section*{Additional Relays}

\section*{OVERVOLTAGE RELAYS}

AC, SINGLE PHASE, 50-400 HZ, SPECIALS

300X
300HX
300S-1X
300-2X
300S-2X
300-3X
300-4X
300-5X
\(300-5 \mathrm{KX}\)
300-6X
300-7X
300-8X
300-9X
300-10X
300-10HX
300-11X
300-12X
300-13X
300-14X
300-17X
300-18X
300-20X
300-21X
300-24X
300-25X
300-26X
300-27X
300-28X
300-29x
300-30X
300-32X
300-33X
300-34X
300-35X
300-36X
300-37X
300-38X
300-39X
300-40X
300-41X
\(300-42 X\)
300-43X
300-44X
300-45X
\(300-46 \mathrm{X}\)
300-47X
300-48X
300-49X
300-50X

120VAC
120VAC, Similar to 300X, with 125VDC 3A Contacts
440VAC, \(370-480\) V Range, Navy High Shock 120 VAC , Set at 132V, .010 Sec . Time Delay
120VAC, Navy High Shock
190VAC, 180-280V Range
190VAC, P.U. 264V, D.O. 261V
240VAC, 230-360V Range
240VAC, Similar to \(300-5 \mathrm{X}\), except \(1-10 \mathrm{KHz}\)
230VAC, \(230-300 \mathrm{~V}\) Range
450VAC, 375-475V Range
120VAC, P.U. 130 V , D.O. 125 V
120VAC, P.U. 132 V, D.O. 126 V
120VAC, 99-132V Range
120VAC, Sim. to \(300-10 \mathrm{X}\), 125VDC 3A
Contacts
120VAC, 0.5 Sec. Time Delay
480VAC, \(480-600 \mathrm{~V}\) Range
120VAC, 2 N.O. Contacts
95 VAC, \(95-120 \mathrm{~V}\) Range
120VAC, Similar to 300X with Spike Suppression
120VAC, Differential, 2V Max.
10VAC, 8-12V Range, 120 V Transient, 120VAC Ctrl.
120VAC, 1.5-2.0 Sec. Time Delay
277VAC, 140-320VAC Range
24VAC, 24-30VAC Range
120VAC, \(90-150 \mathrm{~V}\) Range
120VAC, 105-135VAC Range
10VAC, 8-12VAC , 220VAC Transient, 120VAC Ctrl.
120VAC, 150-180V Range
120VAC, 375V Max., 24VDC Control
120VAC, \(135-180 \mathrm{~V}\) Range, 1.5 Sec . Time Delay
115/230VAC, DPDT Contacts 230VAC 1A
100VAC, \(1.5-2.0 \mathrm{Sec}\). T.D., \(100-120 \mathrm{~V}\) Range 480VAC, 1.5-2.0 Sec. T.D., 480-600V Range 138VAC, 138-172V Range
\(350 \mathrm{VAC}, 350-450 \mathrm{~V}\) Range, 2.0 Sec . T.D., Supp.
120VAC, 99-132V Range, 125VDC 1A Contacts
120VAC, 120-150V Range, 0.3-3.0 Adj. T.D. 230VAC, 220-300V Range, 2.0 Sec . T.D.
120VAC, 120-165V Range, 1.5 Sec. T.D., Supp.
120VAC, Similar to 300-39X, but 2 N.O.
Contacts
120/240VAC, 140-180V Range, Phase Protection
277VAC, 277-350V Range
30/60VAC, 277V Continuous, 115VAC Control 67VAC, \(67-120 \mathrm{~V}\) Range
\(360 \mathrm{VAC}, 10-64 \mathrm{~V}\) Range, \(0.75-7.5 \mathrm{Sec}\). T.D.
10VAC, \(8-21 \mathrm{~V}, 220 \mathrm{VAC}\) Transient, 125VDC Ctrl.
120VAC, Similar to WOV-1-120,

\section*{but 0.2 Sec . T.D.}

120/240VAC, Highest of \(2,0.5-10 \mathrm{Sec}\). T.D.

300-51X
300-52X
300-53X
300DC-1X

302X
302-SX
302-1X
302-2X
302-3X
302-4X

301X
301-SX
301-HX
301-1X
301-2X
301-3X
301-3HX
301-4X
301-4HX
301-5X
301-6X
301-7X
301-8X
301-9X
301-11X
301-12X
301-13SX
301-15X
301-16X
301-17SX
301-18X
301-195x
301-20SX
301-21X
301-22X
301-23X
301-25X
301-26X
301-27X
301-28X
301-29X
301-30SX
301-31X
301-32X
301-34X
301-35X
301-37X
301-39x
301-40X
301-41SX

\section*{301-42X}

301-45X
301-46X
\(30 / 60 \mathrm{VAC}, 400 \mathrm{~V}\) Max. Contin., 120 V 60 Hz Ctrl. 208VAC, 208-291V, 24VDC Ctrl., 1 N.O.
Contact
200-480VAC, 200-240V Range
28VDC, Set at 30V, Curve 1 MIL-STD-704

\section*{AC, SINGLE PHASE, 400 HZ}

120VAC
120VAC, A.E.I. . Special
\(120 \mathrm{VAC}, 0.3 \mathrm{Sec}\). T.D.
120VAC, 125-175V Range
120VAC, 125-150V Range with T.D.
120VAC, \(125-150 \mathrm{~V}\) Range, 0.3 Sec . T.D.

\section*{AC, THREE PHASE, \(50-400 \mathrm{HZ}\), SPECIALS}

120/208VAC4W
120/208VAC, 4W, Similar to WOV-3-208 with hi-shock
120/208VAC, 4W, 125VDC 3A Contacts
240VAC, 4W, 240-330V Range
220/380VAC, 4W
254/440VAC, 4W, 440-605V Range
277/480VAC, 4W, 125VDC 3A Contacts
127/220VAC, 4W, 220-275V Range
120/208VAC, 4W, 125VDC 3A Contacts
\(380 \mathrm{VAC}, 4 \mathrm{~W}, 370-460 \mathrm{~V}\) Range
380VAC, 4W, 375-528V Range
120/208VAC, 4W, 0.022 Sec. T.D.
120VAC. 3W, 120-150VAC
240VAC, 3W, 240-300V Range
120/208VAC, Similar to 301-7X
440VAC, 3W
120/208VAC, 4W, Hi-Shock, T.D., Solar
120/208VAC, 4W, 140-180V Range 254/440VAC, 4W, Sim to 301-3, but 3 XFMS 120VAC, 3W, Sim to 301-13SX except 120V 277/480VAC,4W,3 independent adjustments
94VAC, 3W, Similar to 301-17SX
86/150VAC, 4W, 90-120V Range, T.D., Solar
460VAC, 3W, 125VDC Contacts
277/480VAC, 4W, 323-425V Range (L-N)
\(380 \mathrm{VAC}, 3\) or 4W, 0.022 Sec. T.D.
120/208V, 4W, 2-3 Sec. T.D.
416VAC, 3 or 4W, 415-520V Range
277/480VAC, 4W, 2-3 Sec. T.D.
20.8VAC, 3W, 20-25V Range

480VAC, 3 or 4W, Sim. to 301-3X with spike supp.
100VAC, 3W, 100-125V Range, hi-shock
208-240, 3W, 200-280V Range, \(45-65 \mathrm{~Hz}\).
400VAC, 3W, 400-500V Range
208VAC, 3W, Set 240V, Withstand 600V contin.
\(120 \mathrm{VAC}, 3 \mathrm{~W}, 3-5 \mathrm{Sec}\). T.D.
120VAC, 3W, Sim. to 301-8X with spike suppression
138/240VAC, 3 or 4 W , 2 Sec. T.D.
120/208VAC, 4W, Highest of 3, Solar
450VAC, 3W, Navy Hi-Shock,
75VDC 3A Contacts
120VAC, 3W, Highest of \(3,120-150 \mathrm{~V}\) Range
120/208VAC, 4W, Highest of 3, Adj. T.D.
104VAC, 3W, Similar to WOV-3-104
\begin{tabular}{lllll}
\hline Catalog 5-1773450-5 & Dimensions are shown for & Dimensions are in millimeters & USA: +1 800 5226752 & \begin{tabular}{l} 
For additional support numbers \\
Revised \(3-13\)
\end{tabular} \\
\begin{tabular}{ll} 
reference purposes only.
\end{tabular} & \begin{tabular}{l} 
unless otherwise specified. \\
Asia Pacific: +8604008206015
\end{tabular} & \begin{tabular}{l} 
please visit www.te.com \\
Specifications subject
\end{tabular} & & UK: +44800267666
\end{tabular}

\section*{Additional Relays (Continued)}

301-47X
301-48X 301-49X
301-50X
301-51X
301-52X
301-53X

303X
\(303-1 X\)
303-1SX
303-2X
303-3X
303-4X
303-8X
303-9X
303-10X
303-12X
303-13X
303-15X
303-16X

310DCX
310DC-HX
310DC-SX

310DC-2X
310DC-3X
310DC-4X
311DCX
311DC-1X
320DCX
320DC-HX
320DC-1X
320DC-2X
320DC-4X
320DC-5X
330DCX
330DC-HX

330DC-1X 330DC-2X 340DCX 340DC-HX

340DC-1SX

350DCX 350DC-HX

350DC-1SX

360DCX 360DC-HX

69/120VAC, 4W, 69-90V Range, 120V (L-N) Contin.
380VAC, 3 or 4W, 380-500V Range 250VAC, Withstand 520VAC Continuous
180VAC, 3W, Similar to WOV-3-180
120VAC, 3W, Supp, 10CFR Class1E (Nuclear) 95VAC, 3W, 95-120V (L-L) Range 115/200VAC, Similar to WOV-3-200, 1.0 Sec T.D.

AC, THREE PHASE, 400 HZ
120/208VAC, 4W
115/200VAC, 4W, Highest of 3, T.D.,
MIL-E-7894
115/200VAC, 3W, High Shock
120/208VAC, 4W, High of 3, T.D., MIL-E-7894
120/208VAC, Highest of 3, T.D.
120VAC, 3W, 120-160V Range
254/440VAC, 4W
240/416VAC, 4W
120/208VAC, 4W, 168V P.U., Kato
120/208VAC, 4W, Fast Operating
120/208VAC, 4W, 0 deg. C to 90 deg. C
120/208VAC, Sim. to 303-13X with
Latching Circuit
120/208VAC, 303X with conformal coating
DC
28VDC, 28-36V Range
28VDC, 28-36V Range, 125VDC 2A Contacts
28VDC, 28-36V Range, 2A Contacts, High Shock
28VDC, 28-36V Range, T.D., MIL-E-7894 Fig. 2
28VDC, 35-46V Range, T.D., MIL-E-7894
28VDC, Set 31V, 2 Sec; 40V, 0.2 Sec.
12VDC, 12-16V Range
12VDC, 12-16V Range, 1V Differential
60VDC, 60-85V Range
60VDC, 60-85V Range, 125VDC 2A Contacts
35-60VDC, Spike Suppression
55-80VDC, Spike Suppression
48VDC, 48-70V Range
20-70VDC, 120VAC Control
120VDC, 120-160V Range
120VDC, 120-160V Range,
125VDC 2A Contacts
120VDC, 110-150V Range
120VDC, 150-190V Range
240VDC, 240-300V Range
240VDC, 240-300V Range,
125VDC 2A Contacts
200VDC, 240-300V Range, Non-Mag., High Shock
305VDC, 280-400V Range
305VDC, 280-400V Range,
125VDC 2A Contacts
250VDC, 280-400V Range, Hi-Shock,
120VAC Control
405VDC, 400-470V Range
405VDC, 400-470V Range,
125VDC 2A Contacts

360DC-1X
360DC-2X
360DC-3X
360DC-4X
360DC-4HX
370DCX
370DC-2X
370DC-1X
370DC-3X
370DC-5X

\section*{AC, SINGLE PHASE, 50/60 HZ, SPECIALS}

120VAC
120VAC, Sim. to 400X with
125VDC 3A Contacts
120VAC, Hi-Shock, 10A Contacts
120VAC, \(55-72 \mathrm{~V}\) Range
120VAC, Sim. to 400-1X,
125VDC 3A Contacts
450VAC, 240-350V Range, Hi-Shock, T.D.
120VAC, 0.017 Sec. T.D.
440VAC, 280-420V Range, Hi-Shock, T.D.
120VAC, 4.8 Sec. T.D., 80-115V Range
440VAC, 280-420V Range, Hi-Shock, T.D.
240VAC, 170-240V Range
440VAC, Sim. to 400-2SX, 2-3 Sec. T.D.,
D.O. 160 V

450VAC, 320-450V Range
450VAC, 70-100\% Range, Hi-Shock, 10A Contacts
120VAC, 90-123V Range
277VAC, 190-290V Range
120VAC, 55-80V Range
120VAC, 50-70\% Range, Hi-Shock
480VAC, 320-480V Range
120VAC, 1.0 Sec. T.D. with power loss 480VAC, 1.0 Sec. T.D., 320-480V Range
120VAC, Similar to 400-10X except 1 N.O. \& 1 N.C.
120VAC, 14-30V Range
67VAC, 30-67V Range, Suppression
120VAC, 0.6 Sec. T.D., \(50-420 \mathrm{~Hz}\)
120VAC, Similar to 400-2 with seismic 120VAC, 125VDC 2A Contacts, Suppression 208VAC, 24-48V Range
120VAC, 94.8-102V Range, 6 +/-2 Sec. T.D. 480VAC, 320-480V Range, 2.0 Sec . T.D.
120VAC, 2.0 Sec. T.D.
240/480VAC, 3-30Sec. T.D., Latching
480VAC, 160-200V Range
460VAC, 250-350V Range, 0.3 Sec. T.D., Set to 76V
0.5VAC, 0.5-1.0V Range, 115VAC Control

120VAC, 0.15 Sec. T.D., 10A Contacts
24VAC, 18-24VAC Adjustable
120VAC, 105-135V Range
120VAC, 1 Ph. T.D. 0-10 Sec.
480VAC, 1 Ph. T.D., 0-10Sec.
120VAC, \(55-72\) V Range, 2 N.O. Contacts 120VAC, Similar to 400X, but 2 N.C. Contacts
\begin{tabular}{lllll}
\hline Catalog 5-1773450-5 & Dimensions are shown for & Dimensions are in millimeters & USA: +1 800 5226752 & For additional support numbers \\
Revised 3-13 & \begin{tabular}{l} 
reference purposes only. \\
unless otherwise specified.
\end{tabular} & \begin{tabular}{l} 
Asia Pacific: +8604008206015 \\
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please visit www.te.com
\end{tabular} \\
www.te.com & \begin{tabular}{lll} 
Specifications subject \\
to change.
\end{tabular} & & &
\end{tabular}

\section*{Additional Relays (Continued)}
\begin{tabular}{|c|c|c|c|}
\hline 400-36X & \begin{tabular}{l}
120VAC, Similar to 400-24X, 1 N.O., \\
1 N.C. Contact
\end{tabular} & D100DC-35X & 30-40VDC Range, Plug-in, NSN 5945-00-650-8613 \\
\hline 400-37X & 120VAC, Similar to 400X, with Suppression & D100DC-36X & 48VDC, Adjustable 38-48VDC \\
\hline 400-38X & 120VAC, 85-120V, 1-20 Sec. T.D., Instant. at 50 V & D100DC-37X & 75VDC, 50-80VDC Range, 0.5A, 74VDC Contacts \\
\hline 400-38PX & 120VAC, Similar to 400-38X with Spike Protection & D100DC-38X & 270VDC, 190-270VDC Range, Similar to D100DC-23 \\
\hline 400-39X & 120VAC, 1.0 Sec. T.D., Transient Protection & D100DC-39X & 28VDC, Adjustable 15-30VDC \\
\hline 400-40X & \(120 \mathrm{VAC}, 0.083 \mathrm{Sec}\). T.D. & D100DC-40X & 28VDC, Approx. 2.0 Sec T.D. \\
\hline 400-41X & 120VAC, Similar to 400X with 2 N.O. Contacts & & \\
\hline 400-43X & \(240 \mathrm{VAC}, 120-240 \mathrm{~V}\) Range & \multicolumn{2}{|r|}{AC, THREE PHASE, 50/60 HZ, SPECIALS} \\
\hline 400-44X & 208VAC, 150-210V Range & 401X & 120/208VAC, 4W, 85-120V Range \\
\hline 400-47X & 380VAC, Fast Operating, 220VAC 5A Contacts & 401-HX & 120/208VAC, 4W, 125VDC 3A Contacts \\
\hline 400-49x & \(120 \mathrm{VAC}, 55-80 \mathrm{~V}\) Range, 125VDC Contacts & 401-1X & \(240 \mathrm{VAC}, 4 \mathrm{~W}, 182-244 \mathrm{~V}\) Range (L-L) \\
\hline \multirow[t]{2}{*}{400-50X} & \(480 \mathrm{VAC}, 320-480 \mathrm{~V}\) Range, & 401-2X & 480VAC, 4W, 360-485V Range (L-L) \\
\hline & 125VDC 1A Contacts & 401-2HX & 480VAC, 3 or 4W, 125VDC 3A Contacts \\
\hline 400-51X & 120VAC, Sim. to 400-38X with 1-30 Sec. T.D. & 401-3X & 220VAC, 3W, 160-200V Range (L-L) \\
\hline 400-52X & 120VAC, \(55-80 \mathrm{~V}\) Range, 125VDC 2A Contacts & 401-4X & 380VAC, 4W, 150-220V Range (L-N) \\
\hline 400-53SX & \(450 \mathrm{VAC}, 110-300 \mathrm{~V}\) Range, 120 V Control & 401-5X & 120VAC, 4W, 90-120V Range (L-L) \\
\hline 400-54X & 120 VAC , Sim. to \(400-13 \mathrm{X}\) with 1.0 Sec . T.D. & 401-6X & 120VAC, 3W, \(85-120 \mathrm{~V}\) Range (L-L) \\
\hline \multirow[t]{2}{*}{400-55X} & 208VAC, 125-208V, 24VDC Ctrl., & 401-7X & 480VAC, 4W, 332-407V Range (L-L) \\
\hline & 1 N.O. Contact & 401-8X & 100VAC, 3W, 70-100V Range (L-L) \\
\hline 400-56X & 208VAC, 24-48V Range, 2 N.O. Contacts & 401-9X & 120/208VAC, 4W, Fast Operating \\
\hline 400-57X & \(120 \mathrm{VAC}, 25 \mathrm{~Hz}, 84-120 \mathrm{~V}\), 125VDC 3A Contacts & 401-9HX & 120/208VAC, 4W, 0.02S T.D., 125VDC 3A Cont. \\
\hline 400-58X & \(277 \mathrm{VAC}, 194-277 \mathrm{~V}\) Range, 0.020 Sec . T.D. & 401-10X & 480VAC, 3W, 360-485V Range \\
\hline 400-59X & 139VAC, 97-159V Range & 401-10HX & 480VAC, 3W, 125VDC 3A Contacts \\
\hline 400-60X & 240VAC, \(84-120 \mathrm{~V}\) Range & 401-11X & 240VAC, 3W, 180-240V Range \\
\hline 400-6IPX & 120VAC, Similar to WUV-1-120P & 401-11HX & 240VAC, 3W, 125VDC 3A Contacts \\
\hline 400-62X & 120VAC, \(30-42 \mathrm{~V}\) Range, 125VDC Contacts & 401-12X & 120/208VAC, 4W, 1.0 Sec. T.D. \\
\hline \multirow[t]{2}{*}{400-63X} & 120VAC, \(30-42 \mathrm{~V}\) Range, 120VAC Contacts & 401-12HX & 120/208VAC, 4W, 1.0 Sec. T.D., 125VDC 3A Contacts \\
\hline & AC, SINGLE PHASE, 400 HZ & 401-13X & 380VAC, 3W, 1.0 Sec. T.D. \\
\hline 402X & 120VAC & 401-14X & \(480 \mathrm{VAC}, 4 \mathrm{~W}, 0.5 \mathrm{Sec} . \mathrm{T} . \mathrm{D}\). \\
\hline 402-SX & 120VAC, Hi-Shock, NSN 5945-00-258-6662 & 401-15X & 120/208VAC, Sim. to 401X with 6" leads \\
\hline 402-1X & 240VAC, 170-240V Range & & and socket \\
\hline 402-1SX & 240VAC, High Shock & \multirow[t]{2}{*}{401-16X} & \multirow[t]{2}{*}{\begin{tabular}{l}
380VAC, Sim. to 401-4X with 6 " leads and socket \\
120/208VAC, 4W, 10 Sec. T.D., Solar
\end{tabular}} \\
\hline 402-2X & 120VAC, \(90-120 \mathrm{~V}\) Range, 0.3 Sec . T.D., Set to 96V & & \\
\hline 402-3X & 120VAC, Similar to 402-2X with 10A Contact & 401-18X & 480VAC, 3W, 2.0 Sec. T.D., 90\% P.U., 70\% D.O. \\
\hline 402-4X & 120VAC, Similar to 402-2X with 0.15 Sec . T.D. & 401-19X & 120/208VAC, Sim. to 401X with 2KV Diodes, Supp. \\
\hline \multicolumn{2}{|l|}{AC \& DC, SINGLE PHASE, CLOSE DIFFERENTIAL} & \multirow[t]{2}{*}{401-20X} & 69/120VAC, 4W, 25-35V Range, 4KV Diodes, \\
\hline D100-10X & \(120 \mathrm{VAC}, 50-500 \mathrm{~Hz},-40\) to +75 deg. C & & Supp. \\
\hline D100-13X & 450VAC, D.O. \(60-100 \%\), P.U. 66-100\% & 401-21X & 120/208VAC, 4W, 85-120V Range, \\
\hline D100-15X & \(120 \mathrm{VAC}, 50-500 \mathrm{~Hz}, 125 \mathrm{VDC}, 1\) Amp Contacts & & 0.05 Sec . T.D. \\
\hline D100-16X & \(208 \mathrm{VAC}, 50-500 \mathrm{~Hz}, 125 \mathrm{VDC}, 1 \mathrm{Amp}\) Contacts & 401-22X & \(480 \mathrm{VAC}, 3\) or 4W, 5.0 Sec. T.D. \\
\hline \multirow[t]{2}{*}{D100-17X} & \(120 \mathrm{VAC}, 50-500 \mathrm{~Hz}, 450 \mathrm{VAC}\) Input Capacitor, & 401-23x & \(120 \mathrm{VAC}, 3 \mathrm{~W}, 0.05 \mathrm{Sec} . \mathrm{T} . \mathrm{D}\). \\
\hline & GE & 401-24X & \(120 \mathrm{VAC}, 3 \mathrm{~W}, 2\) N.C. Contacts \\
\hline \multirow[t]{2}{*}{D100-18X} & 120VAC, Hi-Shock, D. O. 72-84, & 401-25SX & 120VAC, 3W, 10Sec. T.D., Solar \\
\hline & P.U. 102-114 Range & 401-26X & 67/115VAC, 4W, Suppression \\
\hline \multirow[t]{2}{*}{D100-19X} & 120VAC, Hi-Shock, D.O. 80-120, & 401-28X & 120/208VAC, 4W, 60-100V Range, Set at 90V \\
\hline & P.U. 80-120 Range & 401-29X & \(120 \mathrm{VAC}, 4 \mathrm{~W}, 90-120 \mathrm{~V}\) Range, 1.0 Sec . T.D. \\
\hline D100-20X & \(150 \mathrm{VAC}, 105-150 \mathrm{~V}\) Range & 401-29HX & 69/120VAC, 4W, 1.0 Sec. T.D., \\
\hline D100DCX & 60 VDC, 48-55VDC Range, 1.5 Sec. T.D. & & 125VDC 3A Contacts \\
\hline D100DC-15X & 120VDC, 80-120VDC Adjust, 0.4V Differential & 401-30X & 480VAC, 3W, 360-480V Range, 2.0 Sec . T.D. \\
\hline D100DC-16X & 60VDC, 40-60VDC Adjust, 0.2V Differential & & 125VDC 3A Contacts \\
\hline D100DC-18X & 40VDC, 20-40VDC Adjust, 120VAC Control & 401-31SX & 94VAC, 3W, 10 Sec. T.D., Solar \\
\hline D100DC-19X & 140VDC, 100-140VDC, 0.4V Differential & 401-33X & 480VAC, 4W, 139-231V Range (L-N) \\
\hline D100DC-22HX & \(120 \mathrm{VDC}, 80-120 \mathrm{VDC}\) Range, & 401-34X & 120/208VAC, 4W, 2-3 Sec. T.D. \\
\hline & 120VDC Contacts & 401-35X & 208VAC, 3W, 0.008 Sec. T.D., 28VDC Control \\
\hline D100DC-23X & 260VDC, 195-260VDC Range & 401-36X & \(480 \mathrm{VAC}, 3 \mathrm{~W}, 0.008 \mathrm{Sec}\). T.D., 28VDC Control \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|}
\hline \begin{tabular}{l}
Catalog 5-1773450-5 Revised 3-13 \\
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\end{tabular} & Dimensions are shown for reference purposes only. Specifications subject to change. & Dimensions are in millimeters unless otherwise specified. & \begin{tabular}{l}
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UK: +44 800267666
\end{tabular} & For additional support numbers please visit www.te.com \\
\hline
\end{tabular}

\section*{Additional Relays (Continued)}

401-37X
401-38X
401-39X
401-41X
401-41HX
401-42X
401-43SX
401-44X
401-45X
401-46X
401-47X
401-48X
401-49X
401-50X
401-51SX
401-52X
401-53X
401-54X
401-55X
401-58X
401-59X
401-60X
401-61X
401-62X
401-63X
401-67X
401-68X
401-69X
401-70X
401-71X
401-72X
401-74X

401-75X
401-76SX
401-77X
401-79X
401-80X
401-81X
401-82X
401-83SX
401-84X
401-85Sx
401-86SX
401-87SX
401-90X
401-93X
401-97X
401-98X

403X
403-1X
403-1SX
403-2X
403-3X
403-4X
403-5X
\(120 \mathrm{VAC}, 3 \mathrm{~W}, 5.0 \mathrm{Sec}\). T.D.
\(380 \mathrm{VAC}, 3 \mathrm{~W}, 0.05 \mathrm{Sec} . \mathrm{T} . \mathrm{D}\).
480VAC, 4W, 250-550V Range (L-L) 240/416VAC, 4W, 312-416V Range (L-L)
230/400VAC, 4W, 125VDC 3A Contacts
120/208VAC, 4W, 5.0 Sec. T.D.
480VAC, Sim. to 403-7SX except 60 Hz .
139/240VAC, 4W, 2.0 Sec. T.D.
120VAC, 3W, 85-120V Range (L-L), 125VDC Contacts
480VAC, Similar to 401-2X with Suppression
380VAC, 3W, 2.0 Sec. T.D.
208VAC, 3W, 145-208V Range
20.8VAC, 3W, 15.5-20.8V Range

120VAC, 3W, 0-10 Sec. T.D.
90/156 VAC, 4W, Similar to 401-17SX
480VAC, 3W, Sim. to 401-10X
120/208VAC, 4W, 1 N.O., 1 N.C.
400VAC, 3W, 300-400V Range
600VAC, 3W, 480-600V Range
120/208VAC, Sim. to 401X except 2 N.C. Contacts
\(220-380 \mathrm{VAC}\), Dual Voltage 220 V or 380 V 480VAC, 1 N.O., 1 N.C. Contact, 2-3 Sec. T.D.
120VAC, 3W, 85-120V Range (L-L),
1.0 Sec . T.D.

380VAC, 3W, 220VAC 5A Contacts
120VAC, 3W, Sim. to 401-6X with Suppression
120/208VAC, 4W, 1.0 Sec. T.D., -55F to +150F
120VAC, \(3 \mathrm{~W}, 85-120 \mathrm{~V}\) Range, 2-3 Sec. T.D.
120/208VAC, 4W, 85-120V Range, Lowest of 3 133/230VAC, 4W, 99-133V Range, Lowest of 3 \(220 / 380 \mathrm{VAC}, 4 \mathrm{~W}, 154-220 \mathrm{~V}\) Range, Lowest of 3 266/460VAC, 4W, 186-266V Range, Lowest of 3 66/115VAC, 4W, 65-75\% Adj., Supp., 125VDC Cont.
115/200VAC, 3W, 65-75\% Adj., Suppression 450VAC, 3W, 382-450V, 0.3-0.5S T.D., Hi-Shock
120/208VAC, 4W, 0.5-10 Sec. T.D., Lowest of 3 \(480 \mathrm{VAC}, 3 \mathrm{~W}, 0.2-0.3 \mathrm{Sec}\). T.D., Suppression
76VAC, 3W, 53-76V Range
120/208VAC, Sim. to 401-12X with
48VDC Contacts
104VAC, 3W, Similar to WUV-3-104
120/208VAC, MIL-R-2033A
180VAC, 3W, Similar to WUV-3-180
480VAC, Similar to 401-25SX except 480V
380VAC, Similar to 401-25SX except 380V
240VAC, Similar to 401-25SX except 240V
120/208VAC, 4W, 0.5 Sec. T.D.
480VAC, 3W Fast Oper. 50mS., Suppression
69/120VAC, Lowest of 3
480VAC, Sim. to 401TD-9HX with 2.0 Sec . T.D.

\section*{AC, THREE PHASE, 400 HZ}

120/208VAC, 4W
\(115 / 200 \mathrm{VAC}, 4 \mathrm{~W}, 35-400 \mathrm{mS}\) T.D.
115VAC, 3W, Hi-Shock
120VAC, 3W
120/208VAC, 4W, 1.0 Sec. T.D.
254/440VAC, 4W
120/208VAC, 4W, 2 N.C. Contacts

403-7SX
403-10X
403-11X
403-13X
403-14X
403-15X
403-16X

D101-3X
D101-5X
D101-9X
D101-11X
D101-12X
D101-13X
D101-14X
D101-15X
D101-16X
D101-17X
D101-18X
D101-19X

D101-20X
D101-21X
D101-24X
D101-25X
D101-26X
D101-27X
D101-29X
D101-30X
D101-31X
D101-32X

400DCX
400DC-HX
400DC-IX
400DC-2X
400DC-3X
400DC-4X
400DC-5X
410DCX
410DC-SX
410DC-1X
410DC-5X
410DCTDX
411DCX
411DC-1X
411DCTDX
420DCX

\section*{AC THREE PHASE, CLOSE DIFFERENTIAL}

480VAC, 3W, T.D., Hi-Shock 120/208VAC, 4W, 10A Contacts 480VAC, \(4 \mathrm{~W}, 60 \%\) to \(80 \%\) Range 120/208VAC, 4W, OC to +90C \(575 \mathrm{VAC}, 3 \mathrm{~W}, 400-500 \mathrm{~V}\) Range 120/208VAC, Sim. to 403-13X with Latching Circuit 120/208VAC, Sim. to 403X with Conformal Coating

Similar to D101X, -55C to +85C
120VAC, \(50-500 \mathrm{~Hz}\), Military
120VAC, \(50-500 \mathrm{~Hz}, 0.5 \mathrm{Sec}\) T.D.
\(120 \mathrm{VAC}, 50-500 \mathrm{~Hz}, 120-150 \mathrm{VAC}\) Adjust,
N.C. Cont.

120VAC, Similar to D101X but 60-120VAC Range
120VAC, Similar to D101X but

\section*{3 N.C. Contacts}

208VAC, Similar to D101-6X but 3 N.C. Contacts
480VAC, \(50-500 \mathrm{~Hz}\), Spike Suppressors
480VAC, Similar to D101-7X but 3 N.C. Contacts
120VAC, 0.4A 120VDC Contact, -20 to +85 deg C
120VAC, Similar to D101X but Spike Suppression
208VAC, Similar to D101-6X but Spike Suppression
240VAC, Similar to D101-4X but Spike Suppression
380VAC, Similar to D101-10X but Spike Suppression
240VAC, 3 N.C. Contacts
208VAC, 3 N.C. Contacts, Spike Suppression
277VAC, \(50-500 \mathrm{~Hz}, 66-100 \%\) Adjustable
120VAC, Sim. to D101X, withstand
208 V continuous
\(415 \mathrm{VAC}, 50-500 \mathrm{~Hz}\)
380VAC, \(50-500 \mathrm{~Hz}, 3\) N.C. Contacts
525VAC, Spike Suppression
\(120 \mathrm{VAC}, 50-500 \mathrm{~Hz}, 5 \mathrm{Sec}\) T.D.
DC
120VDC, 85-120V Range 120VDC, 85-120V Range, 125VDC 2A Contacts 28VDC, 15-29V Range
240VDC, 180-220V Range
62.5VDC, 40-65V Range

305VDC, 200-300V Range
5.6VDC, 4-6V Range, 120VAC Cont

28VDC, 16-29V Range
28VDC, 16-29V Range, Hi-Shock, MIL-R-57
28VDC, 15-32V Range, 1.5V Differential
24VDC, 16-29V Range, Suppression
28VDC, 0.5-20 Sec. T.D.
12VDC, 9-12 V Range
15VDC, 11-15V Range
12VDC, \(0.5-20 \mathrm{Sec}\). T.D.
60VDC, 40-65V Range
\begin{tabular}{|c|c|c|c|c|}
\hline Catalog 5-1773450-5 & Dimensions are shown for & Dimensions are in millimeters & USA: +1 8005226752 & \multirow[t]{4}{*}{For additional support numbers please visit www.te.com} \\
\hline Revised 3-13 & reference purposes only. & unless otherwise specified. & Asia Pacific: +86 04008206015 & \\
\hline & Specifications subject & & UK: +44 800267666 & \\
\hline www.te.com & to change. & & & \\
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\end{tabular}

\section*{Additional Relays (Continued)}
\begin{tabular}{|c|c|c|c|}
\hline 420DC-4X & 48VDC, 32-48V Range & 250-12X & 120VAC, Sim. to 250X, MIL-R-5757 2A \\
\hline 420DC-5X & 48VDC, \(20-48 \mathrm{~V}\) Range & 250-14XAC & 67VAC, Sim. to 250-3X with removable cover \\
\hline 420DC-6X & 70VDC, 50-70V Range & 250-17X & 120VAC, Sim. to 250X plus suppression \\
\hline 420DC-8X & 32VDC, 33-40V Range (Pick-Up) & 250-19x & 120VAC, Sim. to 250X with 2 N.O. Contacts \\
\hline \multirow[t]{2}{*}{420DC-9X} & 48VDC, Similar to 420DC-4X with 2 N.O. & 250-22X & 240VAC, 1-2 Sec. TD on Drop Out \\
\hline & Contacts & 250-23X & 120VAC, Sim. to 250X but -40C to +52C \\
\hline \multirow[t]{2}{*}{420-470 SUFFIX} & SUFFIX: "A" 2 N.O. Contacts & 250-27X & 139VAC, Same as 250-12X except voltage \\
\hline & "B" 2 N.C. Contacts & 250-28X & 138VAC, Same as 250-10X except voltage \\
\hline 430DCX & 120VDC, 85-120V Range & 250-29HX & 120VAC, \(50-400 \mathrm{~Hz}\)., 125VDC 3A Contacts \\
\hline \multirow[t]{2}{*}{430DC-HX} & 120VDC, 85-120V Range, & 250-30X & 480VAC \\
\hline & 125VDC 3A Contacts & 250-31X & 240VAC, Fast Trip 25mS \\
\hline 430DC-1X & 140VDC, 105-140V Range & 250-32HX & 480VAC, 100 Hz , 1Sec TD \\
\hline \multirow[t]{2}{*}{430DC-2X} & 140VDC, 105-140V Range, 0.5 Sec. T.D., & & 120V 3ADC Contacts \\
\hline & Suppression & 250-33HX & 480VAC, 25Hz, 1 Sex TD, \\
\hline 430DC-3X & 120VDC, 50-80V Range & & 120V 3ADC Contacts \\
\hline \multirow[t]{2}{*}{430DC-4X} & 120VDC, 85-120V Range, 0.5 Sec. T.D., & 250-34X & 120VAC, 72-120-160V Range, Hi Shock \\
\hline & Set at 90V & 250-35X & 230VAC, Sim. to 250-22X, 3.0 Sec. TD \\
\hline 430DC-5X & 125VDC, 90-125V Range, Spike Suppression & 250-36X & 120VAC, 84-120-150V Range, Hi Shock, \\
\hline 430DC-6X & 125VDC, 105-140V Range, 3.0-5.0 Sec. T.D. & & -40C to 70C \\
\hline 430DC-7X & 170VDC, 120-170V Range & 250-37HX & 120VAC, 25 Hz , 1 Sec. TD, \\
\hline 430DC-8X & 120VDC, \(85-120 \mathrm{~V}\) Range, 2 N.C. Contacts & & 120V 3ADC Contacts \\
\hline 430DC-9X & 100VDC, 35-50V Range & 250-38X & 240VAC, Two N.O. Contacts \\
\hline 430DC-10X & 120VDC, 85-120V Range, 2 N.O. Contacts & 250-39X & 120VAC, Similar to 250X, Range +/- 35\% \\
\hline 440DCX & 240VDC, 168-240V Range & & \\
\hline \multirow[t]{2}{*}{440DC-HX} & 240VDC, 168-240V Range, & & AC, SINGLE PHASE, 50-400HZ \\
\hline & 125VDC 3A Contacts & 251SX & 120/208VAC, Sim. to 251X with Hi Shock \\
\hline 440DC-1X & 280VDC, 190-260V Range & 251-1X & 120/208VAC, 4W, 0.50 Sec. TD \\
\hline 450DCX & 305VDC, 230-305V Range & & NSN 5895-00-139-0337 \\
\hline \multirow[t]{2}{*}{450DC-HX} & 305VDC, 230-305V Range, & 251-4X & 139/240VAC, 4W \\
\hline & 125VDC 3A Contacts & 251-5X & 120/208VAC, 4W, Two N.C. Contacts \\
\hline \multirow[t]{2}{*}{450DC-1X} & 305VDC, 230-305V Range, & 251-8X & 120/208VAC, 4W, 1.2 Sec. TD \\
\hline & 2 N.C. Contacts & 251-10X & 110/190VAC, 4W \\
\hline 460DCX & 405VDC, 315-415V Range & 251-13X & 120/208VAC, Sim. to 251X except -40C to 52C \\
\hline \multirow[t]{2}{*}{460DC-HX} & 405VDC, 315-415V Range, & 251-14X & 120/208VAC, 4W, Withstand 220/380V \\
\hline & 125VDC 3A Contacts & & Continuous \\
\hline 460DC-1X & 405VDC, 300-330V Range & 251-15X & 120/208VAC, Sim. to 251X with Transient \\
\hline 460DC-3X & 405VDC, 300-425V Range & & Protection \\
\hline 460DC-4X & 432VDC, 275-325V Range & 251-16X & 120/208VAC, 1.2 Sec. TD, Transient Protection \\
\hline 460DC-5X & 470VDC, 300-425V Range & 251-17X & 120/208VAC, Similar to 251X, \\
\hline 470DC & 560VDC, 400-500V Range & & 208V 7.5A Contacts \\
\hline \multirow[t]{2}{*}{470DC-1X} & 585VDC, 400-500V Range & 251-18X & 120/208VAC, Highest/Lowest of three, TD Adjust 12VDC control \\
\hline & DC TIME DELAY & 251-19X & 120/208VAC, Highest/Lowest of three, \\
\hline 420DCTDX & 48VDC, 32-48V Range, 0.5-20 Sec. T.D. & & TD Adjust 120VAC control \\
\hline 430DCTDX & 125VDC, \(83-125 \mathrm{~V}\) Range, \(0.5-20 \mathrm{Sec}\). T.D. 250VDC, 166-250V Range, \(0.5-20 \mathrm{Sec}\). T.D. & 251-20X & \begin{tabular}{l}
120/208VAC, Highest/Lowest of three, \\
TD Adjust, 24VDC Control
\end{tabular} \\
\hline 440DCTDX & 250VDC, 166-250V Range, 0.5-20 Sec. T.D. & 251-21X & 120/208VAC, Sim. to 251X, 0.5Sec. TD \\
\hline \multicolumn{2}{|l|}{OVER/UNDERVOLTAGE RELAYS} & 251-22X & 115/200VAC, Sim. to 251X, 0.75 Sec . TD \\
\hline & AC, SINGLE PHASE & 253-HX & 230VAC, 3W, 48VDC 3A Contacts \\
\hline 250SX & 120VAC, Hi-Shock & 253-1X & 230VAC, 3W, Spike Suppression \\
\hline \multirow[t]{2}{*}{250-1X} & 120VAC, 72-120V, Mil, & 253-1HX & \begin{tabular}{l}
230VAC, 3W, Spike Suppression, \\
125VDC Contacts
\end{tabular} \\
\hline & NSN 6125-00-091-0969 & 253-3X & 230VAC, 3W, 1.0 Sec. TD \\
\hline 250-2X & 120VAC, 1.2 Sec. Time Delay & \[
253-5 X
\] & 230VAC \(3 / 4\) W 2 N . C. Contacts, -51 C to +71 C \\
\hline 250-3X & 67VAC, UV 30-67V, OV 67-91V & 253-6X & 230VAC 3W 3.0 Sec. TD \\
\hline 250-4X & 26VAC, 28VDC Control, Connector & 253-6X & 415VAC 3W, 290-415-519V \\
\hline 250-5X & 240VAC, Two N.C. Contacts & 254-1X & 415VAC, 3W, 290-415-519V \\
\hline 250-6X & 240VAC, One N.O., One N.C. Contact & 254-2X & 416VAC, \(3 / 4 \mathrm{~W}, 2\) N.C. Contacts, -51 C to 71C \\
\hline 250-6HX & 240VAC, 120VDC, 3A Contact & 254-3X & 416VAC, 3/4W, 2 N.C. Contacts, -51C to 71C 460VAC, 3W, 125VDC 3A Contacts \\
\hline 250-7X & \(120 \mathrm{VAC}, 3 \mathrm{Sec}\). Time Delay & 255-HX & 460VAC, 3/4W, Spike Suppression \\
\hline 250-8X & 100VAC & \[
\begin{gathered}
\text { 255-1X }
\end{gathered}
\] & 460VAC, 3/4W, Spike Suppression 480VAC 3W, High Shock \\
\hline 250-10X & 120VAC, Fast Trip, 25mS &  & 480VAC, 3W, High Shock \\
\hline 250-11X & 120VAC, Set at 97V and 156V & 255-3X & 495VAC, 3W, 3.0 Sec. TD \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|}
\hline Catalog 5-1773450-5 & Dimensions are shown for & Dimensions are in millimeters & USA: +1 8005226752 & For additional support numbers \\
\hline Revised 3-13 & reference purposes only. Specifications subject & unless otherwise specified. & Asia Pacific: +86 04008206015 UK: +44 800267666 & please visit www.te.com \\
\hline www.te.com & to change. & & & \\
\hline
\end{tabular}

\section*{Additional Relays (Continued)}
\begin{tabular}{|c|c|}
\hline 255-4X & 460VAC, 3W, 2 N.O. Contacts,
\[
\text { EMD \# } 9333490
\] \\
\hline 255-5X & 460VAC, 3W, Sim. to 255-4X, MIL-R-5757, 10A Relay \\
\hline 255-6X & 460VAC, 3W, EMD\# 9337151 \\
\hline 255-7X & 460VAC, 3W, Sim. to 255X, Fast operating, 40 mSec . \\
\hline 255-8X & 480VAC, 3W, 5.0 Sec. fixed TD, 120VAC Control \\
\hline 255-9X & 480VAC, 3W, Sim. to 255-8X except +/- 10\% Setting \\
\hline & AC, SINGLE PHASE, \(50-400 \mathrm{HZ}\) \\
\hline 256-1X & 600VAC, 3W, 60Hz, 2 N.O. Contacts, EMD Canada \\
\hline 256-2X & 575VAC, 3W, GM\# 6964912 Rev. A \\
\hline & DC \\
\hline 250DC-HX & 24VDC, 16-24-30V Range, 48VDC 3A Contacts \\
\hline 250DC-1X & 28VDC, MIL Shock and Vibration \\
\hline 250DC-2X & 26VDC, UV 20-30V, OV 26-36V \\
\hline 250DC-3X & 28VDC, 20-28-35V Range, Hi Shock, -40 C to 70 C \\
\hline 250DC-4X & 14VDC, Commonwealth Edison \\
\hline 250DC-5X & 28VDC, Commonwealth Edison \\
\hline 251DC-1X & 48VDC, Removable Cover \\
\hline 251DC-2X & 35VDC, UV 23-30V, OV 40-52V \\
\hline 251DC-3X & 30VDC, UV 21-27V, OV 30-40V \\
\hline 251DC-HX & 48VDC, \(32-48-60 \mathrm{~V}, 48 \mathrm{VDC} 3 \mathrm{~A}\) Contacts \\
\hline 251DC-4X & 60VDC, 45-60-75VDC, 2N.O. 120VAC Contacts \\
\hline 252DCX & 120VDC, 85-120-150V Range \\
\hline 252DC-1X & 130VDC, 80-130/120-150V Range \\
\hline 252DC-1HX & 125VDC, 85-125/125-160V, 48VDC 3A Contacts \\
\hline 252DC-2X & 130VDC, 80-130/120-150V, Removable Cover \\
\hline 253DCX & 250VDC, 175-250-315VDC Range \\
\hline 253DC-HX & 250VDC, 175-250-315VDC, 48VDC 3A Contacts \\
\hline
\end{tabular}

\section*{REVERSE POWER RELAYS}

\section*{AC, SINGLE PHASE}

710-HX
710-PX
710-1X
710-3X
120/220/266VAC, 125VDC 3A Control
120/220/266VAC, 0.2-1.0A, Spike Suppression 120/220/266VAC, 125VDC 1/4A Control 120VAC (L-N), 1 Phase, 3-5A

\section*{120/220/266VAC. SINGLE PHASE TIME DELAY}

710TD-1X
710TD-5X
710TD-7X
710TD-7PX
710TD-8X
710TD-9X
710TD-12X
710TD-14X
720TD-14X
721TD-14X
722TD-14X
723TD-14X
724TD-14X
\(0.05-0.25 \mathrm{~A}, 0.5-10 \mathrm{Sec}\). T.D. with Knobs 2 N.O. Contacts
60 Hz , Reverse Inductive
Similar to 710TD-7X with Suppression
Similar to 710TDX with -55 F to +150 F Similar to 710TDX with Suppression Similar to 710TDX, 125VDC 2A Contacts 50 Hz , Reverse Inductive
120 V, L-L, 50 Hz , Reverse Inductive 230 V, L-L, 50Hz, Reverse Inductive \(380 \mathrm{~V}, \mathrm{~L}-\mathrm{L}, 50 \mathrm{~Hz}\), Reverse Inductive \(460 \mathrm{~V}, \mathrm{~L}-\mathrm{L}, 50 \mathrm{~Hz}\), Reverse Inductive 575 V, L-L, 50Hz, Reverse Inductive

725TD-14X
726TD-14X
727TD-14X
415 V, L-L, 50Hz, Reverse Inductive 100 V, L-L, 50Hz, Reverse Inductive 185 V, L-L, 50Hz, Reverse Inductive

\section*{PHASE SEQUENCE RELAYS}

\section*{AC, THREE PHASE}

900-2PX
900-4X
900-5X
900-8X
900-10X
901-1X
901-5X
901-6X
901-SX
910-1X
910-2X
910-3X
920X
920-1X
920-2X
920-3X
920-5X
920-6X
930X
930-1X
930-3X
930-4X
931X
932-5X
932-7X
208-230VAC, Spike Suppression
208VAC, \(50 / 60 \mathrm{~Hz}\)
120VAC, \(50 / 60 \mathrm{~Hz}\)
120VAC, 60 Hz , 125VDC 2A Contacts
120VAC, 60 Hz, Spike Suppression
440VAC, \(60 \mathrm{~Hz}, 5 \mathrm{~A}\) Contacts
575VAC, Porcelain Term., AZ Relay
460VAC, 60 Hz , Spike Suppression 440VAC, \(55-65 \mathrm{HZ}\), HI-Shock
220/440VAC, 60 Hz , N.O. Contacts 220/440VAC, 60 Hz , Reversed Contact Operation
220/440VAC, 60 Hz, Porcelain Term.,

\section*{Sigma Relay}

380VAC, 50 Hz
\(380 \mathrm{VAC}, 50 \mathrm{~Hz}\), Mounting per 21-037
380VAC, 50 Hz , Porcelain Terminals, Sigma Relay
416VAC, \(50 \mathrm{~Hz}, 5 \mathrm{~A}\) Contacts
220/380VAC, 50 Hz
440VAC, 50 Hz
208VAC, 400 Hz
208VAC, \(400 \mathrm{~Hz}, 2 \mathrm{~A}\) at 28VDC Contacts, Energized A-B-C, 5A
400VAC, 400 Hz
\(400 \mathrm{VAC}, 2\) N.C. Contacts, -51 C to +71 C 120VAC, 400 Hz .
115/200VAC, 400 Hz , 2A Contact,Hi-Shock
230/400VAC, 400 Hz

\section*{PHASE FAILURE RELAYS}
\begin{tabular}{|c|c|}
\hline 980X & 120VAC, 60 Hz , no T.D. on Starting \\
\hline 981X & \(230 \mathrm{VAC}, 60 \mathrm{~Hz}\), no T.D. on Starting \\
\hline 982X & \(460 \mathrm{VAC}, 60 \mathrm{~Hz}\), no T.D. on Starting \\
\hline 983X & \(380 \mathrm{VAC}, 60 \mathrm{~Hz}\), no T.D. on Starting \\
\hline 984X & \(575 \mathrm{VAC}, 60 \mathrm{~Hz}\), no T.D. on Starting \\
\hline 985X & \(525 \mathrm{VAC}, 60 \mathrm{~Hz}\), no T.D. on Starting \\
\hline 1980X & 120VAC, 60 Hz \\
\hline 1981X & \(230 \mathrm{VAC}, 60 \mathrm{~Hz}\) \\
\hline 1982X & \(460 \mathrm{VAC}, 60 \mathrm{~Hz}\) \\
\hline 1983X & \(380 \mathrm{VAC}, 50 \mathrm{~Hz}\) \\
\hline 1984X & \(575 \mathrm{VAC}, 60 \mathrm{~Hz}\) \\
\hline 1985X & \(525 \mathrm{VAC}, 60 \mathrm{~Hz}\) \\
\hline 1986X & \(415 \mathrm{VAC}, 50 \mathrm{~Hz}\) \\
\hline 1987X & \(380 \mathrm{VAC}, 60 \mathrm{~Hz}\) \\
\hline SUFFIX: & \begin{tabular}{l}
"-S": Time Delay (0.5-30 Sec.) \\
"-3S": Factory Set Time Delay ( \(0-60 \mathrm{Sec}\).)
\end{tabular} \\
\hline 1981-1SX & 230VAC, Similar to 1981X except 50 Hz \\
\hline 1980-2SX & 120VAC, Similar to 1980X except N.C. Contacts \\
\hline
\end{tabular}

\section*{AC, THREE PHASE, VOLTAGE SENSITIVE}
\begin{tabular}{ll} 
1003X-60HZ & 380VAC, Similar to 1003X except 60HZ \\
1009 X & 415VAC, 50 Hz \\
1010 X & 208VAC, 50 Hz.
\end{tabular}
\begin{tabular}{|c|c|c|c|c|}
\hline \begin{tabular}{l}
Catalog 5-1773450-5 Revised 3-13 \\
www.te.com
\end{tabular} & Dimensions are shown for reference purposes only. Specifications subject to change. & Dimensions are in millimeters unless otherwise specified. & \begin{tabular}{l}
USA: +1 8005226752 \\
Asia Pacific: +86 04008206015 UK: +44 800267666
\end{tabular} & For additional support numbers please visit www.te.com \\
\hline
\end{tabular}

\section*{Additional Relays (Continued)}

1001X-1010X SUFFIX "-1": N.C. Contact (example: 1004-1X) 1001X-1010X SUFFIX "-2": -53C to +70C, 2\% Drift below -20C
1001X-1010X SUFFIX "-3": 400Hz, N.O. Contacts
1001X-1010X SUFFIX "-T": Spike Suppression
1001X-1010X SUFFIX "-H': 125VDC 3A Contacts
1001X-1010X SUFFIX"-9" 1 N.O. \& 1 N.C. Contacts
1001X-1010X SUFFIX "-12": Spike Supp., 125VDC 3A Contacts
1001X-1010X SUFFIX "-13": 1 N.O + 1 N.C. 125VDC 3A Contacts

\section*{OVERCURRENT RELAYS}

\section*{1100X}

1100-1X
1100-2X
1100-2SX
1100-9X
1100-11X
1100-13X
1100-14X
1100-15X
1100-17X
1100-18X
1100-19x
1100-20X
1100-21X
1100-22X
1100-23X
\(1100-24 \mathrm{X}\)
1100-25X
1100-26X
1100-27X
1100-32X

1100-35X
1100-36X
1100-37X
1100-38X
AC, SINGLE PHASE, ADJ. DIFFERENTIAL

D1100X
D1100-2X
D1100-3X
D1100-4X D1100-5X
D1100-6X
D1100-7X
D1100-8X

1100TDX
1100TD-HX

1100TD-SX

1100TD-1X
1100TD-2X
1100TD-3X
1100TD-5X
1100TD-6X
1100TD-8X

120VAC, 1-5A Range
120VAC, 0.5-5A Range, Remote Adjust 120VAC, 0.5-5A Range
120VAC, 0.5-5 A Range, Hi-Shock, 2A Contact
120VAC, 1-5A, Fast Operating
120VAC, 1-5A, 3\% Diff., Suppression 2.5KV
\(120 \mathrm{VAC}, 1-5 \mathrm{~A}, 2\) N.C. Contacts
120VAC, \(7-30 \mathrm{~A}, 2\) N.C. Contacts
120VAC, 2-10A, 2 Sec. T.D.
120VAC, 1-5A, 2 Sec. T.D.
120VAC, 0.05-0.15A, 5A Max, 400 Hz
24VDC, 1-5A Range
120VAC, 1-5A, Suppression (15 times in-rush)
74VDC, 7-30A, 50mS T.D., Shock \& Vibration
120VAC, 1-5A Remote Adjust
125VDC, 0.25-1.8A, 1 N.O.
125VDC 2A Contact
32VDC, 1-5AAC Range
120VAC, \(0.25-1.25 \mathrm{~A}\)
120VAC, 0.3-1.5A, Withstand 5A 220VAC, 1-5A Range, 220VAC Contacts
120VAC, Undercurrent 1-10A Adj,
\(0.2-5 \mathrm{Sec}\). T.D.
120VAC, 0.1-0.4A Range
74VDC, 4-20A, 50 mS T.D., Shock \& Vibration
24VDC, 0.1-0.3A Range
74VDC, Similar to WC1-74DC-5

120VAC, 1-5A Range
220VAC, 1-5A Range
120VAC, 4-12A Range
230VAC, 4-12A Range
460VAC, 4-12A Range
120VAC, 1-5A Range, 1-2 Sec. T.D.
120VAC, 0.7-5A Range,
125VDC 0.5A Contacts
120VAC, 5-15A Range
AC, SINGLE PHASE, TIME DELAY
120VAC, 1-5A Range, 0.5-30 Sec. T.D. 120VAC, 1-5A, \(0.5-30 \mathrm{Sec}\). T.D., 125VDC 3A Cont.
120VAC, 1-5A Range, \(0.5-20 \mathrm{Sec}\). T.D., Hi-Shock
240VAC, 1-5A Range, 0.5-30 Sec. T.D.
24VDC, 1-5AAC Range, \(0.5-30 \mathrm{Sec}\). T.D.
120VAC, \(0.5-5 \mathrm{~A}\) Range, \(0.5-30 \mathrm{Sec}\). T.D. 120VAC, 0.5-2.5A Range, 0.5-30 Sec. T.D. 120VAC, 1-5A , 0.2-20 Sec. T.D., Manual Reset

1100TD-9X 1100TD-10X

1100TD-11X
1100TD-12X
OPTION

1130TDX 1130TD-1X 1130TD-2X 1130TD-3X

1150X 1150-1X 1150-2X
1150-4X
1150-6X
1150-8X
1150-10X
1150-10SX
1150-11X
1150-12X
1150-14X
1150-15X
1150-16X

1200X
1200-1X
1200-4X
1200-5X
1200-6X
1200-7X
1200-8HX
1100DCX
1100DC-1X 1100DC-2X

1100DC-3X
1100DC-4X
1100DC-6X
1100DC-7X
1100DC-8X
1100DC-9X

1100DC-10X
1100DC-11X
1100DC-13X
1100DC-15X
1100DC-17X
1100DC-20X

24VDC, 0.5-5AAC Range, \(0.5-20 \mathrm{Sec}\). T.D. 120VAC, Sim. to WCT1-120AC-5 w/ removable cover
120VAC, Sim. to WCT1-120AC-5, 1-5 Min. T.D.
120VAC, Sim. to WCT1-120AC-5,
\(0.5-5 \mathrm{Sec} . \mathrm{T} . \mathrm{D}\).

> 1: 0.2 A to 1.0 A Range
> 2.5: 0.5 A to 2.5 A Range
> 5: 1.0 A to 5.0 A Range

10: 2.0 A to 10.0A Range
AC, THREE PHASE, TIME DELAY
\(120 \mathrm{VAC}, 1-5 \mathrm{~A}, 0.5-20 \mathrm{Sec}\). T.D.
24VDC, 1-5A, 0.5-20 Sec. T.D.
120VAC, 1-5A, 0.5-20 Sec. T.D., Suppression
120VAC, 1-5A, 0.5-60 Sec. T.D.,
2 N.C. Contacts
120VAC, \(4.35 \mathrm{~A}, 0.5-5 \mathrm{Sec}\). T.D.
120VAC, 4.26A, 0.5-5 Sec. T.D.
120VAC, \(3.72 \mathrm{~A}, 0.5-5 \mathrm{Sec}\). T.D.
120VAC, 1-5A, (P.G.E.)
120VAC, 1-5A, 2-3 Sec. T.D. on D.O.
120VAC,Same as \(1150-2 \mathrm{X}\) with 2 N.O. Contacts
120VAC, 1-5A, 2 Sec. T.D.
120VAC, 1-5A, 2 Sec. T.D., Hi-Shock
120VAC, \(2.5-5\) A, 400 Hz , Special T.D. Curve
120VAC, \(2.5-5 \mathrm{~A}, 60 \mathrm{~Hz}\), Special T.D. Curve
120VAC, \(2.5-5 \mathrm{~A}, 400 \mathrm{~Hz}\), T.D. Curve, Aux. N.O.
24VDC, \(1.2-2.2 \mathrm{~A}, 60 \mathrm{~Hz}\), T.D. Curve, (Solar)
\(24 \mathrm{VDC}, ~ 2.5-4.3 \mathrm{~A}, 60 \mathrm{~Hz}\), T.D. Curve, (Solar)
VOLTAGE RESTRAINT
120VAC, 1-5A, 24VDC Control
120VAC, 1-5A, 12VDC Control
120/208VAC, 1-5A, 3 Phase, 24VDC Control
120VAC, 1-5A, 3 Phase, 24VDC Control
120VAC, 1-5A, 3 Phase, 24VDC Control,
Suppression
120VAC, 1-5A, 1 Phase, 120VAC Control
120VAC, 1-5A, 3 Phase, 125VDC Control DC
120VAC, \(10-50 \mathrm{mV}\) ext. Shunt, 5A Contacts
230VAC, 0-10VDC ext. Shunt, 5A Contacts
120VAC, \(10-50 \mathrm{mV}\) ext. Shunt,
Transistor Output
120VAC, 0.2-0.6ADC with 0.125 ohm Shunt
\(28 \mathrm{VDC}, 10-50 \mathrm{mV}\), Inverter, ext. Shunt,
2 Sec. T.D.
125VDC, 10-50mV, Inverter,
125VDC 3A Contacts
120VAC, 10-50mV, Inverter,
125VDC 3A Contacts
120 VAC , isolated outputs
250VDC, 150mV Shunt, Hi-Shock,
+/- 20\% Adj.
120VAC, \(50-150 \mathrm{mV}\)
220VDC, \(5-25 \mathrm{mV}\), 1-25 Sec. T.D.,
Inverse Current
120VAC, \(20-35 \mathrm{mV}\), Hi-Shock
12VDC, \(10-50 \mathrm{mV}\), Inverter
74VDC, 10-50mV, Inverter
120VAC, Similar to 1100DCX except \(4-25 \mathrm{mV}\)

Catalog 5-1773450-5
Revised 3-13

Dimensions are shown for
reference purposes only.
Specifications subject to change.

\section*{Additional Relays (Continued)}

UNDERCURRENT RELAYS
\(\begin{array}{ll}\text { 21-693-1 } & \text { Self Contained CT, 120VAC Control } \\ 21-693-2 & \text { Self Contained CT, 230VAC Control }\end{array}\)

CURRENT DIFFERENTIAL
1350X 24VDC, 0.1-0.5A Range
1350PX 24VDC, 0.1-0.5A Range, Suppression, 1 N.O. Contact
1350SX 24VDC, 0.1-0.5A Range, High Shock
1350-1X 24VDC, 0.1-0.5A Range, 1 N.C. Contact
1350-3X
1351X
1351PX
1351SX
1351-1X
1351-2X
1351-4X
48VDC, 0.1-0.5A Range
120VAC, 0.1-0.5A Range
120VAC, 0.1-0.5A Range, Suppression
120VAC, 0.1-0.5A Range, High Shock
120VAC, 0.1-0.5A Range, 1 N.C. Contact
120VAC, 2 Sec. T.D. on application of voltage
120VAC, 0.1-0.5A Range, Fast,
125VDC Contacts
PARALLELING (SYNCHRO-CHECK) RELAYS

\section*{1880X}

1890X
SUFFIX
1880DBX
1890DBX
SUFFIX
200VAC, 1 N.O. \& 1 N.C. Contact
90VAC, 1 N.O. \& N.C. Contact
"-A": Two Normally Open Contacts
"-B": Two Normally Closed Contacts
"-P": Spike Suppression
"-7": 0.025 Second Time Delay
"-9": 125VDC 2A Contacts
"-13": 0.250 Second Time Delay

\section*{DEAD BUS TYPE}

200VAC, 1 N.O. \& 1 N.C. Contact
90VAC, 1 N.O. \& 1 N.C. Contact
"-A": 2 Normally Open Contacts
"-B": 2 Normally Closed Contacts
"-S": High Shock
"-2": 2 N.O. Contacts, Cond. 5 same as 3
"-3": Condition 1 reversed
" -5 ": 12 deg. to 36 deg. adjustment
"-8" 3 Phase, Phase Sequence
"-9": 125VDC 2A Contacts
"-12": \(25 \mathrm{~Hz}, 125 \mathrm{VDC} 3 \mathrm{~A}\) Contacts
\begin{tabular}{ll}
\multicolumn{2}{c}{ DOUBLE DEAD BUS (EITHER BUS DEAD) } \\
1880DDBX & 200VAC, 1 N.O. \& 1 N.C. Contact \\
1890DDBX & 90VAC, 1 N.O. \& 1 N.C. Contact \\
SUFFIX & "-A": 2 Normally Open Contacts \\
& "-B": 2 Normally Closed Contacts \\
& "-9": 125VDC Contacts; 2A res. , 1A ind.
\end{tabular}

DOUBLE DEAD BUS, UNDERVOLTAGE
2800-120
2800-208
2800-240
2800-380
2800-416
2800-440

120VAC, Ph. Ang. 5-25 deg.,
UV: 70\% D.O. 80\% P.U.
208VAC, Ph. Ang. 5-25 deg.,
UV: 70\% D.O. 80\% P.U.
240VAC, Ph. Ang. 5-25 deg.,
UV: 70\% D.O. 80\% P.U.
380VAC, Ph. Ang. 5-25 deg.,
UV: 70\% D.O. 80\% P.U.
416VAC, Ph. Ang. 5-25 deg., UV: 70\% D.O. 80\% P.U.
440VAC, Ph. Ang. 5-25 deg.,
UV: 70\% D.O. 80\% P.U.

2800-480
2800-600

2850X
2850-1X

480VAC, Ph. Ang. 5-25 deg., UV: 70\% D.O. 80\% P.U.
600VAC, Ph. Ang. 5-25 deg.,
UV: 70\% D.O. 80\% P.U.

\section*{PHASE BAND MONITOR}

208/230/460 V, 5-60 deg. Range, 60 Hz 208/240/380/480 V, 5-45 deg. Range, 50/60 Hz

\section*{OVERFREQUENCY RELAYS}

WOF-12-100110 120VAC, 100-110 Hz. Range SUFFIX "-1": 0.2\% Max. Differential
"-T": 0.5-20 Sec. Time Delay "-2T": 60 Second Time Delay "-S": High Shock
\(120 \mathrm{VAC}, 50-60 \mathrm{~Hz}\)
120VAC, \(60-70 \mathrm{~Hz}\)
\(120 \mathrm{VAC}, 400-450 \mathrm{~Hz}\)

\section*{UNDERFREQUENCY RELAYS}
\begin{tabular}{ll} 
22-050X & 120VAC, \(50-60 \mathrm{~Hz}\) \\
\(22-060 X\) & 120VAC, \(60-70 \mathrm{~Hz}\) \\
\(22-400 \mathrm{X}\) & 120VAC, \(400-450 \mathrm{~Hz}\)
\end{tabular}

\section*{FREQUENCY RELAYS (Over or Under)}
\begin{tabular}{|c|c|}
\hline 25-050HX & 120VAC, 40-50-60 Hz, 125VDC 3A Contacts \\
\hline 25-050SX & \(120 \mathrm{VAC}, 40-50-60 \mathrm{~Hz}\), High Shock \\
\hline 25-050-1X & \(120 \mathrm{VAC}, 40-50-60 \mathrm{~Hz}, 2\) N.C. Contacts \\
\hline 25-050-2X & \(120 \mathrm{VAC}, 40-50-60 \mathrm{~Hz}, 1.2 \mathrm{Sec}\). Time Delay \\
\hline 25-060HX & \(120 \mathrm{VAC}, 50-60-70 \mathrm{~Hz}\), 125VDC 3A Contacts \\
\hline 25-060SX & 120VAC, \(50-60-70 \mathrm{~Hz}\), High Shock \\
\hline 25-060-1X & 120VAC, \(50 / 60 \mathrm{~Hz}+/-10 \%\) on each Frequency \\
\hline 25-060-2X & \(120 \mathrm{VAC}, 50-60-70 \mathrm{~Hz}, 0.4 \mathrm{~Hz}\) Differential \\
\hline 25-060-3X & \(120 \mathrm{VAC}, 50-60-70 \mathrm{~Hz}, 2\) N.C. Contacts \\
\hline 25-060-4X & \(120 \mathrm{VAC}, 50-60-70 \mathrm{~Hz}, 2\) N.O. Contacts \\
\hline 25-060-5X & 120VAC, \(50-60-70 \mathrm{~Hz}, 2\) N.O, 10A MIL-R-5757 \\
\hline 25-060-7X & 120VAC, EMD \#9337150, Set 57.4 \& \(62.6+/-0.6 \mathrm{~Hz}\) \\
\hline 25-060-8X & \(120 \mathrm{VAC}, 50-60-70 \mathrm{~Hz}\), 1 Sec . T.D. \\
\hline 25-060-10X & 120VAC, Spike Suppression \\
\hline 25-060-12X & \(104 \mathrm{VAC}, 50-60-70 \mathrm{~Hz}\) \\
\hline 25-060-14X & \(240 \mathrm{VAC}, 50-60-70 \mathrm{~Hz}\) \\
\hline 25-060-18X & \(120 \mathrm{VAC}, 50-60-70 \mathrm{~Hz}, 1 \mathrm{Sec}\). T.D., Suppression \\
\hline 25-060-19X & 120VAC, \(50-60-70 \mathrm{~Hz}, 0.5-10 \mathrm{Sec} . \mathrm{T} . \mathrm{D}\). , 12VDC Ctrl. \\
\hline 25-060-20X & 120VAC, \(50-60-70 \mathrm{~Hz}, 0.5-10 \mathrm{Sec}\). T.D., 24VDC Ctrl. \\
\hline 25-100X & \(120 \mathrm{VAC}, 90-100-110 \mathrm{~Hz}\) \\
\hline 25-400X & \(120 \mathrm{VAC}, 350-400-450 \mathrm{~Hz}\) \\
\hline 25-400-2X & \(120 \mathrm{VAC}, 350-400-450 \mathrm{~Hz}\), 220VAC 5A Contacts \\
\hline 25-400-5X & \(120 \mathrm{VAC}, 350-400-450 \mathrm{~Hz}\), Suppression \\
\hline 25-025T-1HX & 480VAC, \(20-25-30 \mathrm{~Hz}, 0.5-20 \mathrm{Sec}\) T.D., 125VDC 3A Contacts \\
\hline 25-025T-2HX & \begin{tabular}{l}
120VAC, \(20-25-30 \mathrm{~Hz}, 0.5-20 \mathrm{Sec}\). T.D., \\
125VDC 3A Contacts
\end{tabular} \\
\hline 25-100T-1HX & 480VAC, \(90-100-110 \mathrm{~Hz}, 0.5-20 \mathrm{Sec}\). T.D., 125VDC 3A Contacts \\
\hline 20-040-1X & 100VAC, \(40-50 \mathrm{~Hz}\) \\
\hline 20-040-2X & \(120 \mathrm{VAC}, 40-50 \mathrm{~Hz}, 1.5-2.0 \mathrm{Sec}\). T.D. \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|}
\hline \begin{tabular}{l}
Catalog 5-1773450-5 Revised 3-13 \\
www.te.com
\end{tabular} & Dimensions are shown for reference purposes only. Specifications subject to change. & Dimensions are in millimeters unless otherwise specified. & \begin{tabular}{l}
USA: +1 8005226752 \\
Asia Pacific: +86 04008206015 UK: +44 800267666
\end{tabular} & For additional support numbers please visit www.te.com \\
\hline
\end{tabular}

\section*{Additional Relays (Continued)}
\begin{tabular}{|c|c|}
\hline 20-040-3X & \(120 \mathrm{VAC}, 40-50 \mathrm{~Hz}\), 2 N.C. Contacts \\
\hline 20-040-4X & \(220 \mathrm{VAC}, 40-50 \mathrm{~Hz}\). \\
\hline 20-050-HX & 120VAC, \(50-60 \mathrm{~Hz}\), 125VDC 3A Contacts \\
\hline 20-050SX & 120VAC, \(50-60 \mathrm{~Hz}\), High Shock, MIL-S-901C \\
\hline 20-050-1X & \(120 \mathrm{VAC}, 50-60 \mathrm{~Hz}, 0.2 \mathrm{Sec}\). T.D. \\
\hline 20-050-2X & \(120 \mathrm{VAC}, 45-66 \mathrm{~Hz}\), U.L. \\
\hline 20-050-3X & \(120 \mathrm{VAC}, 50-60 \mathrm{~Hz}, 2000 \mathrm{~V}\) PIV Diode \\
\hline 20-050-4X & 120VAC, \(50-60 \mathrm{~Hz}\), 1 Sec. T.D., 0.5\% Drift \\
\hline 20-050-8X & 120VAC, \(57-60 \mathrm{~Hz}, 0.2 \mathrm{~Hz}\) Diff., 240 V Contacts, FAA \\
\hline 20-050-8PX & 120VAC, Similar to 20-050-8X w/ Spike Suppression \\
\hline 20-050-9x & \(120 \mathrm{VAC}, 45-55 \mathrm{~Hz}\) \\
\hline 20-050-10X & \(120 \mathrm{VAC}, 50-60 \mathrm{~Hz}\), Suppression \\
\hline 20-050-12X & \(120 \mathrm{VAC}, 50-60 \mathrm{~Hz}, 125 \mathrm{VDC}\) Contacts \\
\hline 20-050-13X & \(120 \mathrm{VAC}, 50-60 \mathrm{~Hz}, 2 \mathrm{Sec}\). T.D. \\
\hline 20-050-16X & 150VAC, Similar to 20-050-10X except Voltage \\
\hline 20-050-19X & 120VAC, Volt./Freq., \(45-60 \mathrm{~Hz}, 85-120 \mathrm{~V}\) \\
\hline 20-050-19PX & 120VAC, Similar to 20-050-19X w/ Suppression \\
\hline 20-050-20X & \(120 \mathrm{VAC}, 50-60 \mathrm{~Hz}, 2\) N.C. Contacts \\
\hline 20-050-21X & 220VAC, \(50-60 \mathrm{~Hz}\) \\
\hline 20-050-22X & \(120 \mathrm{VAC}, 50-60 \mathrm{~Hz}, 125 \mathrm{VDC}\) Contacts, Seismic \\
\hline 20-050-23X & 240VAC, Similar to 20-050-19X except Voltage \\
\hline 20-050-23PX & 240VAC, Similar to 20-050-23X w/Suppression \\
\hline 20-050-25X & \(104 \mathrm{VAC}, 50-60 \mathrm{~Hz}\) \\
\hline 20-050-26X & \(120 \mathrm{VAC}, 57-60 \mathrm{~Hz}\), Supp., 0.2 Sec. T.D. on D.O. \\
\hline 20-050-27X & 120VAC, Sim. to 20-050-26X, Operation Reversed \\
\hline 20-050-28X & 120VAC, Sim. to 20-050-2X with Suppression \\
\hline 20-050-29X & 120VAC, Sim. to 20-050-19X w/125VDC 2A Contacts \\
\hline 20-050-30X & 120VAC, Sim. to 20-050-1X w/125VDC 2A Contacts \\
\hline 20-050-31X & 200-480VAC, \(50-60 \mathrm{~Hz}\) Range, 26VDC Control \\
\hline 20-050-32X & 120VAC, Sim. to WUF-12-5060T, Operation Rev. \\
\hline 20-060-1X & 120VAC, \(60-70 \mathrm{~Hz}\), 2000V Diode \\
\hline 20-060-2X & 120VAC, \(60-63 \mathrm{~Hz}, 0.2 \mathrm{~Hz}\) Diff., 240VAC Contacts \\
\hline
\end{tabular}
\begin{tabular}{|c|c|}
\hline 20-060-2PX & 120VAC, Sim. to 20-060-2X w/Suppression \\
\hline 20-060-4X & \(120 \mathrm{VAC}, 65-77 \mathrm{~Hz}\) \\
\hline 20-060-5X & 120VAC, Jumper, Set at \(60 \mathrm{~Hz}+3 \%\) or \(50 \mathrm{~Hz}+3 \%\) \\
\hline 20-060-6X & \begin{tabular}{l}
120VAC, \(103-156 \mathrm{~V}\) Range, \(60-70 \mathrm{~Hz}\), \\
Set at 70 Hz
\end{tabular} \\
\hline 20-060-7X & \(120 \mathrm{VAC}, 60-63 \mathrm{~Hz}, 0.2 \mathrm{Sec}\) T.D. on P.U., Suppression \\
\hline 20-060-8X & \(120 \mathrm{VAC}, 60-70 \mathrm{~Hz}\), Spike Suppression \\
\hline 20-060-9X & 120VAC, \(60-70 \mathrm{~Hz}, 0.25 \mathrm{Sec}\). Inverse T.D. on P.U. \\
\hline 20-350X & \(120 \mathrm{VAC}, 350-500 \mathrm{~Hz}\) \\
\hline 20-350SX & 120VAC, \(350-400 \mathrm{~Hz}\), 2 N.C. 2 A Contacts, Hi-Shock \\
\hline 20-350-2SX & 115VAC, \(350-400 \mathrm{~Hz}\), Hi-Shock \\
\hline 20-350-4X & \(120 \mathrm{VAC}, 300-400 \mathrm{~Hz}\) \\
\hline 20-400X & \(120 \mathrm{VAC}, 400-450 \mathrm{~Hz}\) \\
\hline 20-400SX & 120VAC, \(400-450 \mathrm{~Hz}\), High Shock \\
\hline 20-400-2SX & 115VAC, Hi-Shock \\
\hline 20-400-3X & 120VAC, \(400-450 \mathrm{~Hz}, 2\) N.C. Contacts \\
\hline 20-400-4X & 120VAC, \(400-500 \mathrm{~Hz}\) \\
\hline & ADJUSTABLE DIFFERENTIAL \\
\hline D20-040X & \(120 \mathrm{VAC}, 40-50 \mathrm{~Hz}\) \\
\hline D20-050X & \(120 \mathrm{VAC}, 50-60 \mathrm{~Hz}\) \\
\hline D20-050-2X & 120VAC, P.U. \(50-60 \mathrm{~Hz}\), D.O. \(40-50 \mathrm{~Hz}\) \\
\hline D20-060X & \(120 \mathrm{VAC}, 60-70 \mathrm{~Hz}\) \\
\hline \multicolumn{2}{|l|}{VOLTAGE UNBALANCE RELAYS} \\
\hline 1500X & 120VAC, 3 Phase, 15\%-25\% Adjustment \\
\hline 1510X & 230VAC, 3 Phase, 15\%-25\% Adjustment \\
\hline 1520X & 380VAC, 3 Phase, 15\%-25\% Adjustment \\
\hline 1530X & 460VAC, 3 Phase, 15\%-25\% Adjustment \\
\hline 1540X & 575VAC, 3 Phase, 15\%-25\% Adjustment \\
\hline 1550X & \begin{tabular}{l}
208VAC, 3 Phase, 15\% - 25\% Adjustment \\
SUFFIX "-2": N.C. Contacts (Example: 1500-2X) \\
"-3": 10\%-20\% Adjustment \\
"-4": Transient Suppression \\
"-H": 125VDC 3A Contacts
\end{tabular} \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|}
\hline \begin{tabular}{l}
Catalog 5-1773450-5 Revised 3-13 \\
www.te.com
\end{tabular} & Dimensions are shown for reference purposes only. Specifications subject to change. & Dimensions are in millimeters unless otherwise specified. & USA: +1 8005226752 Asia Pacific: +8604008206015 UK: +44 800267666 \\
\hline
\end{tabular}

\section*{Engineering Notes}

\section*{Table of Contents}


\section*{MDR Series, 10 Amp Rotary Relay For Demanding Shock \& Vibration Applications}

\section*{Product Facts}

■ AC and DC coils, latching and non-latching
■ 4PDT through 24PDT contact arrangements
- Designed to withstand high impact shock per MIL-S-901


Small 8PDT

\section*{Specifications}

Contact Data
Arrangements - 4 Form C (4PDT)
through 24 Form C ( 24 PDT).
\begin{tabular}{cc}
\multicolumn{3}{l}{ Contact Ratings } \\
\hline \begin{tabular}{c} 
Single \\
Contacts
\end{tabular} & \begin{tabular}{c} 
Two Contacts \\
in Series
\end{tabular} \\
\hline 10 A, & 3 A, \\
115 VAC & 440 VAC \\
\hline 3 A, \\
28 VDC & 15 A, \\
\hline \(0.8 \mathrm{~A}, \mathrm{C}\) & 115 VAC \\
125 VDC & 125 VDC \\
\hline
\end{tabular}

The above AC contact ratings are based on contact loads having a \(50 \%\) power factor. The DC contact ratings are based on resistive loads.


Medium 24PDT
Operate Data @ \(77^{\circ} \mathrm{F}\left[25^{\circ} \mathrm{C}\right]\)
\begin{tabular}{ccc}
\hline \multicolumn{1}{c}{ Type } & \begin{tabular}{c} 
Typ. Operate \\
Time (ms)
\end{tabular} & \begin{tabular}{c} 
Typ. Release \\
Time (ms)
\end{tabular} \\
\hline Small AC Non-Latching & 5 to 12 & 5 to 18 \\
\hline Small DC Non-Latching & 15 to 30 & 5 to 15 \\
\hline Small AC Latching & 6 to 12 & N/A \\
\hline Small DC Latching & 10 to 16 & \(\mathrm{~N} / \mathrm{A}\) \\
\hline Medium AC Non-Latching & 6 to 12 & 6 to 20 \\
\hline Medium DC Non-Latching & 65 to 90 & 10 to 30 \\
\hline Medium AC Latching & 50 (max.) & \(\mathrm{N} / \mathrm{A}\) \\
\hline Medium DC Latching & 30 to 80 & \(\mathrm{~N} / \mathrm{A}\) \\
\hline
\end{tabular}

Latching Two-Position Types -
Except for the latching feature, MDR
latching relays utilize the same general construction as non-latching types. They
have two sets of coils and provide a
latching two-position operation.

\section*{Contact Section}



Coils Must be Energized Alternately, Not Simultaneously.

\section*{Environmental Data}

\section*{Temperature Range -}

Standard models - \(0^{\circ} \mathrm{F}\) to \(+149^{\circ} \mathrm{F}\)
[ \(0^{\circ} \mathrm{C}\) to \(+65^{\circ} \mathrm{C}\) ]
Special order models - \(0^{\circ} \mathrm{F}\) to \(+194^{\circ} \mathrm{F}\)
[ \(0^{\circ} \mathrm{C}\) to \(+90^{\circ} \mathrm{C}\) ]

\section*{Mechanical Data}

Termination - \#5-40 screw terminals
supplied
Weight (Approx.) -
Small -
4 \& 8PDT — 32 oz. [0.914 kg];
12PDT - 33 oz. [0.943 kg]
Medium -
16PDT - 72 oz. [2.04 kg];
24PDT - 74 oz. [2.10 kg]

\section*{MDR Series, 10 Amp Rotary Relay For Demanding Shock \& Vibration Applications (Continued)}

Note: All values are for reference, specific values may be different and subject to environmental factors such as temperature, humidity, pressure or variations in voltage.

Ordering Information and Coil Characteristics - No models in this series are maintained in stock.
\begin{tabular}{|c|c|c|c|c|c|}
\hline Type & Part Number & Contacts & \[
\begin{aligned}
& \text { Coil Voltage } \\
& \text { ( } 60 \mathrm{~Hz} \text {. } \\
& \text { for AC) }
\end{aligned}
\] & Coil Power* (Watts) & Breakdown (Volts RMS) \\
\hline \multirow{10}{*}{\begin{tabular}{l}
Small \\
Non-Latching
\end{tabular}} & MDR-131-1 & 4PDT & 115 VAC & 6.5 & 1,230 \\
\hline & MDR-131-2 & 4PDT & 440 VAC & 5.1 & 1,880 \\
\hline & MDR-135-1 & 4PDT & 28 VDC & 10.0 & 1,308 \\
\hline & MDR-137-8 & 4PDT & 125 VDC & 10.3 & 2,375 \\
\hline & MDR-134-1 & 8PDT & 115 VAC & 6.5 & 1,230 \\
\hline & MDR-134-2 & 8PDT & 440 VAC & 5.1 & 1,880 \\
\hline & MDR-136-1 & 8PDT & 28 VDC & 10.0 & 1,308 \\
\hline & MDR-138-8 & 8PDT & 125 VDC & 10.3 & 2,375 \\
\hline & MDR-163-1 & 12PDT & 115 VAC & 6.9 & 1,230 \\
\hline & MDR-163-2 & 12PDT & 440 VAC & 6.3 & 1,880 \\
\hline \multirow{8}{*}{Medium Non-Latching} & MDR-170-1 & 16PDT & 115 VAC & 17.0 & 1,230 \\
\hline & MDR-170-2 & 16PDT & 440 VAC & 17.0 & 1,880 \\
\hline & MDR-172-1 & 16PDT & 28 VDC & 18.7 & 1,308 \\
\hline & MDR-173-1 & 16PDT & 125 VDC & 16.0 & 2,375 \\
\hline & MDR-141-1 & 24PDT & 115 VAC & 17.0 & 1,230 \\
\hline & MDR-141-2 & 24PDT & 440 VAC & 17.0 & 1,880 \\
\hline & MDR-167-1 & 24PDT & 28 VDC & 18.7 & 1,308 \\
\hline & MDR-142-1 & 24PDT & 125 VDC & 16.0 & 2,375 \\
\hline \multirow{8}{*}{Small Latching} & MDR-67-2 & 4PDT & 115 VAC & 5.5 & 1,230 \\
\hline & MDR-4091 & 4PDT & 440 VAC & 3.0 & 1,880 \\
\hline & MDR-67-3 & 4PDT & 28 VDC & 21.8 & 1,308 \\
\hline & MDR-5060 & 4PDT & 125 VDC & 20.6 & 2,375 \\
\hline & MDR-4076 & 8PDT & 115 VAC & 5.5 & 1,230 \\
\hline & MDR-4092 & 8PDT & 440 VAC & 3.0 & 1,880 \\
\hline & MDR-5035 & 8PDT & 28 VDC & 21.8 & 1,308 \\
\hline & MDR-5061 & 8PDT & 125 VDC & 20.6 & 2,375 \\
\hline \multirow{8}{*}{Medium Latching} & MDR-6064 & 12PDT & 115 VAC & 12.0 & 1,230 \\
\hline & MDR-6065 & 12PDT & 440 VAC & 5.7 & 1,880 \\
\hline & MDR-7020 & 12PDT & 28 VDC & 8.8 & 1,308 \\
\hline & MDR-7035 & 12PDT & 125 VDC & 10.4 & 2,375 \\
\hline & MDR-66-4 & 16PDT & 115 VAC & 12.0 & 1,230 \\
\hline & MDR-6066 & 16PDT & 440 VAC & 5.7 & 1,880 \\
\hline & MDR-7025 & 16PDT & 28 VDC & 8.8 & 1,308 \\
\hline & MDR-7036 & 16PDT & 125 VDC & 10.4 & 2,375 \\
\hline
\end{tabular}
*Actual Wattmeter readings.

\section*{Outline Dimensions}

Tolerances: Decimals \(\pm .010\) [ \(\pm .25]\) Unless Otherwise Specified.

Small Models


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Dimensions are shown for reference purposes only. Specifications subject to change.

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Product Facts
■ High Repeat Accuracy over voltage and temperature extremes

■ Hermetically sealed units are designed for high shock and vibration applications
■ Instant recycling easy linear adjustment
■ Exclusive Dial Head adjustment - no needle valves
- Delay ranges from milliseconds to 3 minutes
■ DPDT contacts

\section*{Design \& Construction}

Sealed patented timing head circulates air under controlled pressure through a variable orifice to provide adjustable timing. Circular-path Dial Head principle replaces traditional needle valve.

\section*{Snap-action switch assembly -}
provides sustained contact pressure during timing cycles. Specially designed over center mechanism assures flutter-free load transfer after extended delay periods.

\section*{Precision-wound solenoid}
assembly - supplies the basic motive force when the control circuit is closed.
These assemblies are mounted in a rigid self-supporting framework within a steel enclosure. This rugged construction assures permanent alignment of all operating members, the key to this unit's long trouble-free operation.

Users should thoroughly review the technical data before selecting a product part number. It is recommended that users also seek out the pertinent approvals files of the agencies/aboratories and review them to ensure the product meets the requirements for a given application.

\section*{12-4}

\section*{AGASTAT 2100 Series, Miniature Electropneumatic Timing Relay}

\section*{Operation}

Series 2112
(On-Delay) Applying rated voltage to the solenoid coil starts the preset time delay. At the
 riod the NC contacts break and the NO contacts make. Contacts remain in this position until the coil is de-energized, when the switch instantaneously returns to its original position. De-energizing the coil, either during or after the delay period, will immediately (within 25 msec .) recycle the unit. It will then provide another full delay period on re-energization.

\section*{Series 2122}
(Off-Delay) Applying rated voltage to the coil for at least 75 msec . (for accurate timing) will instantaneously
 transfer the switch, breaking the NC contacts and making the NO contacts. Contacts remain in this position as long as the coil is energized. The preset time delay period begins as soon as the coil is de-energized, at the end of which the switch returns to its original position. No power is required during the timing period. Re-energizing the coil, either during or after the delay period, will immediately start a new cycle with full delay period.
Operation (Listed values at nom. voltage, \(25^{\circ} \mathrm{C}\) unless noted)

\section*{Operating Mode -}

2112 - On-delay (delay on pull-in); 2122 - Off-delay (delay on drop-out) Timing Adjustment - All standard models offer easy linear adjustment over one of nine timing ranges listed below. For applications requiring frequent readjustment, the external knob model is recommended. For tamper-proof installation or where readjustment is infrequent, the internal key model may be preferred. This model requires removal of the cover plate for timing adjustment. Hermetically sealed models provide a slotted adjusting screw under the cap nut on the top cover.
Timing Ranges -
\begin{tabular}{cc}
\hline \multicolumn{2}{c}{ Code } \\
\hline A & Range \\
\hline B & .03 to .1 sec. \\
\hline C & .15 to .3 sec. 1.0 sec. \\
\hline D & .375 to 3.0 sec. \\
\hline E & .75 to 10.0 sec. \\
\hline F & 1.0 to 30.0 sec. \\
\hline G & 2.0 to 60.0 sec. \\
\hline H & 5.0 to 120.0 sec. \\
\hline J & 5.0 to 180.0 sec. \\
\hline K & 1.5 to 30.0 cycles \\
\hline L & 3.0 to 120.0 cycles \\
\hline
\end{tabular}

Repeat Accuracy - NORMAL VERTICAL POSITION
\(\pm 5 \%\) at \(25^{\circ} \mathrm{C} ; \pm 7 \%\) at \(85^{\circ} \mathrm{C} ; \pm 8 \%\) at \(-55^{\circ} \mathrm{C}\).
The average time between \(-55^{\circ} \mathrm{C}\) and \(85^{\circ} \mathrm{C}\) will be within \(\pm 20 \%\) of the average @ \(25^{\circ} \mathrm{C}\) with a proportionally reduced effect at lesser extremes.
In extremely short delay settings an additional 8 msec. variation may result on AC models due to "half cycle" alternating current effect.
Setting Tolerance - Factory time setting, when specified, subject to additional \(+5 \%\) tolerance.

\section*{Position Sensitivity -}

HORIZONTAL POSITION - Approximately 5\% increase from the initial time in the vertical position.
INVERTED POSITION - Approximately \(10 \%\) increase from the initial time in the vertical position.
Reset Time - 2112 Series: \(25 \mathrm{msec} . ; 2122\) Series: 75 msec .
Relay Release Time - 25 msec . (2112 Series)
Relay Operate Time - 75 msec . (2122 Series)
Operating Voltage - Coil Data
\begin{tabular}{ccc}
\hline Code & \begin{tabular}{c} 
Nominal \\
Operating \\
Voltage
\end{tabular} & \begin{tabular}{c} 
Resistance \\
Ohms \\
\(\pm 10 \%\)
\end{tabular} \\
\hline M & 12VDC & 30 \\
\hline N & 28 VDC & 131 \\
\hline P & 48 VDC & 500 \\
\hline R & 110 VDC & 3200 \\
\hline S & 120 V 60 Hz & \(190(2112\) Series \()\) \\
\hline S & 120 V 60 Hz & \(285(2122\) Series \()\) \\
\hline T & 240 V 60 Hz & 765 \\
\hline U & 115 V 400 Hz & 2600 \\
\hline Y & 125 VDC & 3380 \\
\hline
\end{tabular}

Transients - Insensitive to transients of \(\pm 1500\) VAC for 10 milliseconds
Dielectric - 1000V RMS @ 60Hz between non-connected terminals.
Contact Rating (DPDT Contacts) -
\begin{tabular}{cccccc}
\hline & \begin{tabular}{c}
30 V \\
DC
\end{tabular} & \begin{tabular}{c}
110 V \\
DC
\end{tabular} & \begin{tabular}{c}
\(\mathbf{1 2 0 V}\) \\
\(\mathbf{6 0 H z}\)
\end{tabular} & \begin{tabular}{c}
\(\mathbf{1 2 0 V}\) \\
\(\mathbf{4 0 0 H z}\)
\end{tabular} & \begin{tabular}{c}
\(\mathbf{2 4 0 V}\) \\
\(\mathbf{6 0 H z}\)
\end{tabular} \\
\hline Inductive (Amps) & 2 & .75 & 3 & 2 & 1.5 \\
\hline Resistive (Amps) & 10 & 1 & 10 & 10 & 5 \\
\hline
\end{tabular}

Based on 100,000 operations electrical, 1,000,000 mechanical. Inductive and capaci-
tive load should not have inrush currents that exceed five times normal operating load.
Ambient Temperature Range - \(-55^{\circ} \mathrm{C}\) to \(+85^{\circ} \mathrm{C}\)
Weight - Maximum, any unit - 17 ozs.
Mounting/Terminals - Chassis mounting tabs, octal plugs and external (-4) or internal (-5) adjustment. Panel mounting back plate, internal adjustment, and solder hook terminals ( -9 ).


These are minimum standards; where more severe environmental conditions must be met, please consult the factory.

Dimensions are shown for reference purposes only. Specifications subject to change.

Dimensions are in millimeters unless otherwise specified.

For additional support numbers please visit www.te.com

\title{
AGASTAT 2100 Series, Miniature Electropneumatic Timing Relay (Continued)
}

Outline Dimensions for Industrial Models (Dimensions in inches. Multiply by 25.4 to obtain millimeters.)


\section*{Ordering Information for Industrial Models}


Our authorized distributors are more likely to maintain the following items in stock for immediate delivery.
None at present.
\begin{tabular}{llll}
\hline Catalog 5-1773450-5 & Dimensions are shown for & Dimensions are in millimeters & USA: +1 8005226752 \\
Revised 3-13 & \begin{tabular}{l} 
reference purposes only. \\
unless otherwise specified.
\end{tabular} & \begin{tabular}{l} 
Asia Pacific: +8604008206015 \\
Specifications subject
\end{tabular} & \\
www.te.com & \begin{tabular}{ll} 
Uo change.
\end{tabular} & &
\end{tabular} to change.

\section*{Specifications for Hermetically} Sealed Models


Dielectric - Withstands 1,000 Volts RMS at 60 Hz between non-connected terminals.

Other - AGASTAT Miniature Timing Relays also
conform to applicable requirements covering
Moisture Ozone
Humidity Sunshine
Sand/Dust Acoustic Noise
Salt Spray Prolonged Storage


Outline Dimensions for Hermetically Sealed Models (In inches. Multiply by 25.4 for millimeters.)


\section*{Ordering Information for Hermetically Sealed \& Unsealed Models}


Our authorized distributors are more likely to maintain the following items in stock for immediate delivery.
None at present.


\section*{Product Facts}

■ Available in on-delay, true off-delay, and on/off-delay
■ Timing from 0.1 seconds to 60 minutes, in linear increments
■ Oversize adjustment knobs, serrated with high-resolution markings visible from all angles makes the timer easy to set timers
■ Inherent transient immunity
- Standard voltages from 6-550VAC and 12-550VDC (special voltages available)
■ Available in 2-pole or 4-pole models
■ Numerous enclosure options - explosion proof, dust tight, watertight, hermetically-sealed, NEMA 1
- Auxiliary timed and instantaneous switches can be added for greater switching flexibility
- Many mounting options Surface mount, Panel mount, Octal plug-in mounting
■ Options: quick-connect terminals, dial stops, and transient protection module
■ Easy-to-reach screw terminals, all on the face of the unit, clearly identified
- Modular assembly timing head, coil assembly and switchblock are all individual modules, with switches field-replaceable
■ File E15631, File LR29186


\section*{AGASTAT 7000 Series, Industrial Electropneumatic Timing Relay}

\section*{Design \& Construction}

There are three main components of Series 7000 Timing Relays:
Timing Head circulates air through a variable length to provide linearly adjustable timing. Patented design provides easy adjustment and long service life under severe operating conditions.

\section*{Precision-Wound Potted Coil}

Total sealing without external leads eliminates moisture problems, gives maximum insulation value.

\section*{Snap-Action Switch Assembly -} custom-designed over-center mechanism provides snap action. Standard switches are DPDT arrangement.
Each of these subassemblies forms self-contained modules assembled at the factory with the other two to afford a wide choice of operating types, coil voltages, and timing ranges.
The squared design with front terminals and rear mounting permits the grouping of Series 7000 units side-by-side in minimum panel space. Auxiliary switches may be added in the base of the unit, without affecting the overall width or depth.

\section*{Operation}

Two basic operating types are available. "On-Delay" models provide a delay period on energization, at the end of which the switch transfers the load from one set of contacts to another. De-energizing the unit during the delay period immediately recycles the unit, readying it for another full delay period on re-energization. In "Off-Delay" models the switch transfers the load immediately upon energization and the delay period does not begin until the unit is de-energized. At the end of the delay period the switch returns to its original position. Re-energizing the unit during the delay period immediately resets the timing, readying it for another full delay period on de-energization. No power is required during the timing period, providing a true off delay. In addition to these basic operating types, "Double-Head" models offer sequential delays on pull-in and drop-out in one unit. With the addition of auxiliary switches the basic models provide twostep timing.
Note: Seismic \& radiation tested E7000 models are available. Consult factory for detailed information.

On-delay model 7012 (delay on pickup)


Applying voltage to the coil (L1-L2) for at least 50 msec starts a time delay lasting for the preset time. During this period the normally closed contacts ( \(3-5\) and 4-6) remain closed. At the end of the delay period the normally closed contacts break and the normally open contacts (1-5 and 2-6) make. The contacts remain in this transferred position until the coil is deenergized, at which time the switch returns to its original position.
De-energizing the coil, either during or after the delay period, will recycle the unit within 50 msec .
It will then provide a full delay period upon re-energization, regardless of how often the coil voltage is interrupted before the unit has been permitted to "time-out" to its full delay setting.

Off-delay model 7022 (delay on dropout)


Applying voltage to the coil (for at least 50 msec ) will transfer the switch, breaking the normally closed contacts ( \(1-5\) and \(2-6\) ), and making the normally open contacts (3-5 and 4-6). Contacts remain in this transferred position as long as the coil is energized. The time delay begins immediately upon de-energization. At the end of the delay period the switch returns to its normal position.
Re-energizing the coil during the delay period will immediately return the timing mechanism to a point where it will provide a full delay period upon subsequent de-energization. The switch remains in the transferred position.

Note: 7032 types and certain models with accessories are not agency approved.
Users should thoroughly review the technical data before selecting a product part number. It is recommended that users also seek out the pertinent approvals files of the agencies/laboratories and review them to ensure the product meets the requirements for a given application.
Consult factory for ordering information
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Dimensions are shown for reference purposes only. Specifications subject to change.

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please visit www.te.com

\section*{Auxiliary Switch Options}

To increase the versatility of the basic timer models, auxiliary switches may be added to either on-delay or off-delay types. They switch additional circuits, provide two-step timing action, or furnish electrical interlock for sustained coil energization from a momentary impulse, depending on the type selected and its adjustment. They are installed at the factory. All auxiliary switches are SPDT with UL listings of 10A @ 125, 250 , or 480 VAC. A maximum of one Code T or two Code L auxiliary switches may be added to each relay. The L or LL switch is available with on-delay relays only. The T switch is available with both the on-delay and off-delay relays.

\section*{AGASTAT 7000 Series, Industrial Electropneumatic Timing Relay (Continued)}

\section*{Auxiliary Switch Options for} On-Delay
Instant Transfer (Auxiliary Switch
Code L, maximum of 2 per relay.)
1. Energizing coil begins time delay and transfers auxiliary switch.
2. Main switch transfers after total preset delay.
3. De-energizing coil resets both switches instantly.
Auxiliary switch is nonadjustable.
Two-Step Timing (Auxiliary Switch Code T , maximum of 1 per relay.)
1. Energizing coil begins time delay.
2. After first delay auxiliary switch transers.
3. Main switch transfers after total preset delay.
4. De-energizing coil resets both switches instantly. First delay is independently adjustable, up to \(30 \%\) of overall delay. (Recommended maximum 100 seconds.)

\section*{Auxiliary Switch Options for Off-Delay}

In these models the same auxiliary switch provides either two-step timing or instant transfer action, depending on the adjustment of the actuator.
Two-Step Timing (Auxiliary Switch Code T, maximum of 1 per relay.)
1. Energizing coil transfers main and auxiliary switches instantly.
2. De-energizing coil begins time delay.
3. After first delay auxiliary switch transfers.
4. Main switch transfers after total preset delay. First delay is independently adjustable, up to \(30 \%\) of overall delay. (Recommended maximum 100 seconds.)
Instant Transfer (Auxiliary Switch
Code L, maximum of 1 per relay.)
1. Energizing coil transfers main and auxiliary switches instantly.
2. De-energizing coil resets auxiliary switch and begins time delay.
3. Main switch transfers after total preset delay.
Auxiliary switch is factory adjusted to give instant transfer operation. Two-step timing may be set at the factory to customer specification up to a 3:2 ratio.

On-delay, Off-delay Model 7032 (Double Head)


The Double Head model provides delayed switch transfer on energization of its coil, and delayed resetting upon coil deenergization. Each delay period is independently adjustable. In new circuit designs or the improvement of existing controls now using two or more conventional timers, the Double Head unit offers distinct advantages.
Its compact design saves panel space, while the simplified wiring reduces costly interconnection.

On-delay Model 7014, Off-delay Model 7024


With the addition of an extra switch block at the bottom of the basic unit, this version of the Series 7000 offers four pole switch capacity with simultaneous timing or two-step timing. The two-step operation is achieved by factory adjustment to your specifications.
For two-step operation, a maximum timing ratio between upper and lower switches of \(3: 2\) is recommended. Once adjusted at the factory, this ratio remains constant regardless of changes in dial settings. (Ex: If upper switch transfer is set on dial at 60 sec., minimum time on lower switch should be 40 sec .)
This Series 7000 unit offers many of the performance features found in basic models - voltage ranges, timing and switch capacities.
Four pole models add approximately \(1-1 / 4\) " to the maximum height of the basic model, approximately \(1 / 8^{\prime \prime}\) to the depth. They are designed for vertical operation only.

\section*{Surge/Transient Protection Option}

The Surge/Transient Protection Option protects electronic control circuits from transients and surges which are generated when the timer coil is activated. The device is not polarity sensitive and permits the user to initiate, delay, sequence and program equipment actions over a wide range of applications under the most severe operating conditions.
The varistor will not affect the operating characteristics of the 7000 Timer. The varistor has bilateral and symmetrical voltage and current characteristics.

Timing Specifications (All values shown are at nominal voltage and \(25^{\circ} \mathrm{C}\) unless otherwise specified)

\section*{Operating Modes -}

Model 7012/7014 — On-delay (delay on pick-up).
Model 7022/7024 - Off-delay (delay on drop-out).
Model 7032 - On-delay, off-delay (double head).
Timing Adjustment - Timing is set by simply turning the dial to the desired time value. In the zone of approximately \(25^{\circ}\) separating the high and low end of timing ranges \(A, D, E\), and \(K\), instantaneous operation (no time delay) will occur. All other ranges produce an infinite time delay when the dial is set in this zone.
Models 7014 and 7032 are available with letter dials only. The upper end of the time ranges in these models may be twice the values shown.
Linear Timing Ranges -
\begin{tabular}{ccc}
\hline Code & \begin{tabular}{c} 
Models 7012, \\
\(\mathbf{7 0 2 2 , 7 0 2 4}\)
\end{tabular} & \begin{tabular}{c} 
Models 7014, \\
7032
\end{tabular} \\
\hline A & .1 to 1 Sec. & .2 to 2 Sec. \\
\hline B & .5 to 5 Sec. & .7 to 7 Sec. \\
\hline C & 1.5 to 15 Sec & 2 to 20 Sec. \\
\hline D & 5 to 50 Sec. & 10 to 100 Sec. \\
\hline E & 20 to 200 Sec. & 30 to 300 Sec. \\
\hline F & 1 to 10 Min. & 1.5 to 15 Min. \\
\hline H & 3 to 30 Min. & 3 to 30 Min. \\
\hline I & 6 to 60 Min. & Not Avail. \\
\hline J & 3 to 120 Cyc. & Not Avail. \\
\hline K & 1 to 300 Sec. & Not Avail. \\
\hline
\end{tabular}

Repeat Accuracy -
\begin{tabular}{lcc}
\hline For delays of 200 seconds or less: & \(7012^{\star}, 7022,7024:\) & \(\pm 5 \%\) \\
\cline { 2 - 3 } & \(7014^{\star}:\) & \(\pm 10 \%\) \\
\hline For delays greater than 200 seconds: & \(7012^{\star}, 7022,7014^{\star}, 7024:\) & \(\pm 15 \%\) \\
\cline { 2 - 3 } & \(7032:\) & \(\pm 15 \%\) \\
\hline
\end{tabular}
* The first time delay afforded by Model 7012 with H (3 to 30 min.) and I (6 to 60 min.) time ranges or Model 7014 with H time range will be approx. 15\% Ionger than subsequent delays due to coil temperature rise.
Reset Time - 50 msec . (except model 7032)
Relay Release Time - 50 msec . for on-delay models (7012/7014)
Relay Operate Time - 50 msec . for off-delay models (7022/7024)

Operating Voltage Coil Data (for DPDT)
\begin{tabular}{|c|c|c|c|c|c|}
\hline Coil Part \# & Code Letter & Rated Voltage & Operating* Voltage Range @ 60Hz & Rated Voltage & Operating Voltage Range @ 50 Hz \\
\hline \multirow[t]{5}{*}{7000} & A & 120 & 102-132 & 110 & 93.5-121 \\
\hline & B & 240 & 204-264 & 220 & 187-242 \\
\hline & C & 480 & 408-528 & & \\
\hline & D & 550 & 468-605 & & \\
\hline & E & 24 & 20.5-26.5 & & \\
\hline \multirow[t]{7}{*}{AC} & F & & & 127 & 108-140 \\
\hline & G & & & 240 & 204-264 \\
\hline & H & 12 & 10.2-13.2 & & \\
\hline & I & 6 & 5.1-6.6 & & \\
\hline & J & 208 & 178-229 & & \\
\hline & K & & Dual Voltage Coil (Combines A\&B) & & \\
\hline & L & & Special AC Coils (L1, L2, etc.) & & \\
\hline \multirow[t]{6}{*}{7010} & M & 28 & 22.4-30.8 & & \\
\hline & N & 48 & 38.4-52.8 & & \\
\hline & 0 & 24 & 19.2-26.4 & & \\
\hline & P & 125 & 100-137.5 & & \\
\hline & Q & 12 & 9.6-13.2 & & \\
\hline & R & 60 & 48-66 & & \\
\hline \multirow[t]{8}{*}{DC} & S & 250 & 200-275 & & \\
\hline & T & 550 & 440-605 & & \\
\hline & U & 16 & 12.8-17.6 & & \\
\hline & V & 32 & 25.8-35.2 & & \\
\hline & W & 96 & 76.8-105.6 & & \\
\hline & Y & 6 & 4.8-6.6 & & \\
\hline & Z & 220 & 176-242 & & \\
\hline & X & & Special DC Coils (X1, X2, etc.) & & \\
\hline
\end{tabular}
*Four pole Models: Operational voltage range \(90 \%\) to \(110 \%\) for AC units; \(85 \%\) to 110\% for DC units.

See next page for more coil data.

\section*{AGASTAT 7000 Series, Industrial Electropneumatic Timing Relay (Continued)}

Timing Specifications (All values shown are at nominal voltage and \(25^{\circ} \mathrm{C}\) unless otherwise specified)

Minimum operating voltages are based on vertically mounted 7012 units. 7012 horizontally mounted or 7022 vertically or horizontally mounted units will operate satisfactorily at minimum voltages approximately \(5 \%\) lower than those listed.
AC units drop out at approximately \(50 \%\) of rated voltage. DC units drop out at approximately \(10 \%\) of rated voltage.
All units may be operated on intermittent duty cycles at voltages \(10 \%\) above the listed maximums (intermittent duty - maximum 50\% duty cycle and 30 minutes "on" time.)

\section*{Surge/Transient Protection Option Characteristics (DC Timers Only)}
\begin{tabular}{ccc}
\hline \begin{tabular}{c} 
Coil Voltage \\
Nominal (DC)
\end{tabular} & \begin{tabular}{c} 
Max Excess \\
Energy Capacity (Joule)
\end{tabular} & \begin{tabular}{c} 
Max De-energization \\
Transient Voltage
\end{tabular} \\
\hline 12 V & 0.4 J & 48 V \\
\hline 24 V & 1.8 J & 93 V \\
\hline 28 V & 1.8 J & 93 V \\
\hline 32 V & 2.5 J & 135 V \\
\hline 48 V & 3.57 J & 145 V \\
\hline 60 V & 6 J & 250 V \\
\hline 96 V & 10 J & 340 V \\
\hline 110 V & 10 J & 340 V \\
\hline 125 V & 10 J & 340 V \\
\hline 220 V & 17 J & 366 V \\
\hline 250 V & 17 J & 366 V \\
\hline
\end{tabular}

\section*{Surge Life -}

Applied 100,000 times continuously with the interval of 10 seconds at room temperature. Below 68 VAC: 12A; Above 68 VAC: 35A

\section*{Temperature Range -}

Operating - \(-22^{\circ} \mathrm{F}\) to \(+167^{\circ} \mathrm{F}\left(-30^{\circ} \mathrm{C}\right.\) to \(\left.+75^{\circ} \mathrm{C}\right)\)
Storage - \(-40^{\circ} \mathrm{F}\) to \(+167^{\circ} \mathrm{F}\left(-40^{\circ} \mathrm{C}\right.\) to \(\left.+75^{\circ} \mathrm{C}\right)\)
Output/Life Contact Ratings — Contact Capacity in Amps (Resistive Load)
\begin{tabular}{ccc}
\hline \begin{tabular}{c} 
Contact \\
Voltage
\end{tabular} & \begin{tabular}{c} 
Min. 100,000 \\
Operations
\end{tabular} & \begin{tabular}{c} 
Min. 1,000,000 \\
Operations
\end{tabular} \\
\hline 30 VDC & 15.0 & 7.0 \\
\hline 110 VDC & 1.0 & 0.5 \\
\hline \(120 \mathrm{~V} \mathrm{60Hz}\) & 20.0 & 15.0 \\
\hline \(240 \mathrm{~V} \mathrm{60Hz}\) & 20.0 & 15.0 \\
\hline \(480 \mathrm{~V} \mathrm{60Hz}\) & 12.0 & 10.0 \\
\hline
\end{tabular}

10 Amps Resistive, 240 VAC
1/4 Horsepower, 120 VAC/240VAC (per pole)
15 Amps 30 VDC (per pole)
5 Amps, General Purpose, 600VAC (per pole)

Dielectric - Withstands 1500 volts RMS 60 Hz between terminals and ground. 1,000 volts RMS 60 Hz between non-connected terminals. For dielectric specification on hermetically sealed models consult factory.
Insulation Resistance - 500 Megohms with 500VDC applied.

\section*{Temperature Range -}

Operating - \(-20^{\circ} \mathrm{F}\) to \(+165^{\circ} \mathrm{F}\left(-29^{\circ} \mathrm{C}\right.\) to \(\left.74^{\circ} \mathrm{C}\right)\)
Storage - \(-67^{\circ} \mathrm{F}\) to \(+165^{\circ} \mathrm{F}\left(-55^{\circ} \mathrm{C}\right.\) to \(\left.74^{\circ} \mathrm{C}\right)\)
Temperature Variation - Using a fixed time delay which was set and measured when the ambient temperature was \(77^{\circ} \mathrm{F}\left(25^{\circ} \mathrm{C}\right)\), the maximum observed shift in the average of three consecutive time delays was \(-20 \%\) at \(-20^{\circ} \mathrm{F}\left(-29^{\circ} \mathrm{C}\right)\) and \(+20 \%\) at \(165^{\circ} \mathrm{F}\left(74^{\circ} \mathrm{C}\right)\).
Mounting/Terminals - Normal mounting of the basic unit is in a vertical position, from the back of the panel. All units are tested for vertical operation. Basic models \((7012,7022)\) may also be horizontally mounted, and will be adjusted accordingly when Accessory Y1 is specified in your order.
Standard screw terminals (8-32 truss head screws supplied) are located on the front of the unit, with permanent schematic markings. Barrier isolation is designed to accommodate spade or ring tongue terminals, with spacing to meet all industrial control specifications.
The basic Series 7000 may also be panel mounted with the addition of a panel mount kit, \(X\) option, that includes all necessary hardware and faceplate. This offers the convenience of "out-front" adjustment, with large dial skirt knob. The faceplate and knob blend with advanced equipment and console designs, while the body of the unit and its wiring are protected behind the panel.
Other mounting options include plug-in styles and special configurations to meet unusual installation requirements. Contact factory for details.
Power Consumption — Approximately 8 watts power at rated voltage .

\section*{Approximate Weights -}

Models 7012,7022 . . . . . . . . . . . . . . . . . . . . . . . 2 lbs. 4 ozs.
7014, 7024 . . . . . . . . . . . . . . . . . . . . . . 2 Ibs. 10 ozs.
7032 . . . . . . . . . . . . . . . . . . . . . . . . . . . . 3 Ibs. 5 ozs.
Weight may vary slightly with coil voltage.

\section*{AGASTAT 7000 Series, Industrial Electropneumatic Timing Relay (Continued)}

Outline Dimensions (Dimensions in inches)
Models 7012, 7022


Panel Mount Option "X"


12-12

\section*{Ordering Information}


Notes:
1. Cannot be combined with B, P or X Options
2. Cannot be combined with B, P or Y2 Options
3. Cannot be combined with GZ, H, I1, I2, K, W or Y1 Options
4. Not Avail. on 4-Pole Models
5. Not Available with L, T or LL options.
6. Not Available on hermetically sealed units.
* Sized to accommodate one L or T Auxiliary Switch
** Not available on 7032 model.
\(\dagger\) Available with letter graduated dials only. Upper end of time range may be twice the value shown
\(\dagger \dagger 120\) cycles \(=2 \mathrm{sec}\).

Our authorized distributors are more likely to maintain the following items in stock for immediate delivery.
\begin{tabular}{lllllllll} 
7012AA & 7012AE & 7012ACL & 7012PB & 7012PJ & 7022AA & 7022AE & 7022AJ & 7022PA \\
7012AB & 7012AF & 7012BC & 7012PC & 7012PK & 7022AB & 7022AF & 7022AKT & 7022PB \\
7012AC & 7012AH & 7012NC & 7012PD & 7012PKX & 7022AC & 7022AH & 7022BC & 7022PC \\
7012AD & 7012AK & 7012PA & 7012PF & 7012PJX & 7022AD & 7022AI & 7022BK & 7022PK
\end{tabular} to change.

Ordering Options - Can only be ordered as factory installed options (Dimensions, where shown, are in inches)
A1 - Single Quick-Connect
Terminals

A2 - Double Quick-Connect
Terminals


I- Tamper-Proof Cover


P-Octal Plug Adapter


X - Panelmount Kit Mounting hardware included.


V - Transient/Surge Protection

B - Plug-In Connectors
Use with Accessory "C" or "D" below.


L - Auxiliary Switch


S - Dial Stops


GZ - Metal Enclosure
With knockouts for bottom connection. 3.16" W x 3.84 " D x \(7.63^{\prime \prime} \mathrm{H}\)


LL - Auxiliary Switch


T-Auxiliary Switch


Accessories (Not available for 7032 models)

Plug-In Receptacle (Accessory C)


Screw Terminals Catalog No. 700137.
For use with "B" Option.

Plug-In Receptacle (Accessory D)


Ordering options can only be ordered as factory installed options.
12-14

Specialty Relays

\section*{AGASTAT E7000 Series, Nuclear Qualified Time Delay Relays}


\section*{Test Procedure}

\section*{Test Procedure}

AGASTAT timing relay Models E7012, E7022, E7014 and E7024 were tested in accordance with the requirements of IEEE STD. 323-1974 (Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations), IEEE STD. 344-1975 (Seismic Qualification for Nuclear Power Generating Stations) and referenced to ANSI/EEE C37.98 (formerly IEEE Standard 501-1978, Standard for Seismic Testing of Relays). The relays were tested according to parameters which in practice, should encompass the majority of applications. Documented data applies to timing relays which were mounted on rigid test fixtures. The following descriptions of the tests performed are presented in their actual sequence.

\section*{Baseline Performance}

In addition to aging tests, a series of baseline tests were conducted before, and immediately after each aging sequence:

\section*{Pull-in Voltage}

Drop-out Voltage
Dielectric Strength at 1650 V 60 Hz
Insulation Resistance

Operate Time (milliseconds)
Recycle Time (milliseconds)
Time Delay (seconds)
Repeatability (percent)
Contact Bounce
(milliseconds at 28VDC, 1 amp)
Contact Resistance
(milliohms at 28VDC, 1 amp)
Data was measured and recorded and used for comparison throughout the qualification test program in order to detect any degradation of performance.

\section*{Radiation Aging}

Relays were subjected to a radiation dosage of \(2.0 \times 10^{5}\) Rads, which is considered to exceed adverse plant operating requirements for such areas as auxiliary and control buildings.

\section*{Cycling with Load Aging}

The radiated units were then subjected to 27,500 operations at accelerated rate, with one set of contacts loaded to \(120 \mathrm{VAC}, 60 \mathrm{~Hz}\) at 10 amps ; or 125 VDC at 1 amp, and the number of mechanical operations exceeding those experienced in actual service.

The SRS shape (at 5 percent damping), is defined by four points: point \(\mathrm{A}=1.0 \mathrm{~Hz}\) and an acceleration equal to 25 percent of the Zero Period Acceleration
point \(\mathrm{D}=4.0 \mathrm{~Hz}\) and 250 percent of the ZPA
point \(\mathrm{E}=16.0 \mathrm{~Hz}\) and 250 percent of the ZPA
point \(\mathrm{G}=33.0 \mathrm{~Hz}\) and a level equal to the ZPA
SPECIMEN 1 \& 3 (E7012 SERIES)
RELAY STATE: TRANSITIONAL MODE (TD X 2)
AXIS ( \(\mathrm{H}+\mathrm{V}\) ):
TEST RUN NO. 41, 45, 60, 63
COMPOSITE OF FB \(N-\)-, SS/N-, SS/N+, FB/N+X . 707
DUE TO \(45^{\circ}\) INCLINATION OF TEST MACHINE.

Qualifying Class 1E Equipment for Nuclear Power Generating Stations) and IEEE Standard 344-1975 (Seismic Qualifications for Nuclear Power Generating Stations). Testing was also referenced to ANSI/IEEE C37.98 (formerly IEEE Standard 501-1978, Standard for Seismic Testing of Relays).

\section*{Temperature Aging}

This test subjected the relays to a temperature of \(100^{\circ} \mathrm{C}\) for 42 days, with performance measured before and after thermal stress.

\section*{Seismic Aging}

Sufficient interactions were performed at levels less than the fragility levels of the devices in order to satisfy the seismic aging requirements of IEEE STD 3231974 and IEEE STD 344-1975.

\section*{Seismic Qualification}

Artificially aged relays were subjected to simulated seismic vibration, which verified the ability of the individual device to perform its required function before, during and/or following design basis earthquakes. Relays were tested in the non-operating, operating and transitional modes.

The present E7000 Series design has evolved over 40 years of continual field use in a wider range of industrial applications. On-Delay, Off-Delay and Four-Pole versions are available for use with a choice of 23 coil voltages, as well as time delay adjustment to as long as 60 minutes.

\section*{Hostile Environment}

Since the timing relays are intended for use in auxiliary and control buildings, and not in the reactor containment areas, a hostile environment test was performed in place of the Loss of Coolant Accident (LOCA) test. Relays were subjected to combination extreme temperature/humidity plus under/over voltage testing to prove their ability to function under adverse conditions even atter having undergone all the previous aging simulation and seismic testing. The devices were operated at minimum and maximum voltage extremes: 85 and 120 percent of rated voltage for AC units, and 80 and 120 percent of rated voltage for DC units, with temperatures ranging from \(40^{\circ} \mathrm{F}\) to \(172^{\circ} \mathrm{F}\) at 95 percent relative humidity.
\begin{tabular}{lll}
\hline Catalog 5-1773450-5 & \begin{tabular}{l} 
Dimensions are shown for \\
reference purposes only.
\end{tabular} & \begin{tabular}{l} 
Dimensions are in millimeters \\
unless otherwise specified.
\end{tabular} \\
Revised 3-13 & \begin{tabular}{l} 
Specifications subject \\
to change.
\end{tabular} & \\
www.te.com & &
\end{tabular}

Figure 1. Response Spectrum, Transitional Mode

Dimensions are shown for reference purposes only to change.

Dimensions are in millimeters unless otherwise specified.


AGASTAT E7000 Series, Nuclear Qualified Time Delay Relays (Continued)

\section*{Operation}

Two basic operating types are available: On-delay models provide a delay period on energization, at the end of which the switch transfers the load from one set of contacts to another. Deenergizing the unit during the delay period immediately recycles the unit, readying it for another full delay period on reenergization.

In off-delay models the switch transfers the load immediately upon energization, and the delay period does not begin until the unit is deenergized. At the end of the delay period the switch returns to its original position. Reenergizing the unit during the delay period immediately resets the timing, readying it for another full delay period on deenergization. No power is required during the timing period.

On-Delay Models, E7012
(Delay on pick-up)


Off-Delay Models, E7022
(Delay on drop-out)


Applying for at least 50 msec voltage to the coil (L1-L2) starts a time delay lasting for the preset time. During this period the normally closed contacts ( \(3-5\) and \(4-6\) ) remain closed. At the end of the delay period the normally closed contacts break and the normally open contacts (1-5 and 2-6) make. The contacts remain in this transferred position until the coil is deenergized, at which time the switch instantaneously returns to its original position.
Deenergizing the coil, either during or after the delay period, will recycle the unit within . 050 second. It will then provide a full delay period upon reenergization, regardless of how often the coil voltage is interrupted before the unit has been permitted to "time-out" to its full delay setting.

Applying voltage to the coil (for at least .050 second) will instantaneously transfer the switch, breaking the normally closed contacts (1-5 and 2-6), and making the normally open contacts (3-5 and 4-6). Contacts remain in this transferred position as long as the coil is energized. The time delay begins immediately upon deenergization. At the end of the delay period the switch returns to its normal position.
Reenergizing the coil during the delay period will immediately return the timing mechanism to a point where it will provide a full delay period upon subsequent deenergization. The switch remains in the transferred position.
Four Pole Models, E7014, E7024
With the addition of an extra switch block at the bottom of the basic units, this version of the E7000 Series offers four pole switch capacity with simultaneous timing or two-step timing. The two-step operation is achieved by factory adjustment to your specifications.

Specialty Relays


\title{
AGASTAT E7000 Series, Nuclear Qualified Time Delay Relays (Continued)
}

\section*{Time Delay Information}

All units are furnished with dials in linear increments covering the range selected. (See "Catalog Number Code"). In addition, ranges B through K provide non-linear adjustment from .2 second to the beginning of the linear zone.

\section*{Repeat Accuracy}

Repeat accuracy at any fixed temperature is defined as:
*The repeat accuracy deviation \(\left(A_{R}\right)\) of a time-delay relay is a measure of the maximum deviation in the time-delay that will be experienced in successive operations at any particular time setting of the relay and for any particular operating voltage or current.
Repeat accuracy is obtained from the following formula:
\(A_{R}= \pm 100 \frac{\left(T_{1}-T_{2}\right)}{\left(T_{1}+T_{2}\right)}\)
Where -
\(\mathrm{T}_{1}=\) Maximum time delay. \(\mathrm{T}_{2}=\) Minimum time delay. *NEMA part ICS 2-218.02
Repeat accuracy at any fixed temperature is \(\pm 10 \%\) of setting.
The first time delay afforded by units with H ( 3 to 30 minutes) and I ( 6 to 60 minutes) time ranges may be up to \(15 \%\) longer than subsequent delays, due to coil temperature rise.
Dial position error is not included in the repeat accuracy specification above.

\section*{Delay Setting}

Dial graduations are provided to minimize the time required to set the unit to a specific delay. Rotate the dial clockwise to increase the delay; counter-clockwise to decrease it.
The following procedure is recommended if the unit must be set to a very precise delay value:
1. Set dial to desired time delay. (On letter-graduated units, this requires an approximation of a percentage value between the arrowhead " \(\boldsymbol{\nabla}\) " on the dial, which provides minimum time, and the letter "E," which provides maximum time.)
2. Record as many time delays as required to establish a stable average.
3. If the recorded average delay is shorter than the desired time, turn dial slightly clockwise; if it is longer, turn dial counter-clockwise.
4. Repeat step 2 after each adjustment, until required delay is recorded.
Because of the variety of environments in which time delay relays are applied, we recommend a re-check of the time delay atter approximately three hours of operation. If any change from the initial time setting is apparent, the relay should be reset to the desired delay. The time delay accuracy should then be monitored on a monthly basis for severa months, and if no substantial change in time delay has taken place, the frequency of checking may be reduced. It is recommended that this procedure be incorporated in the Operating Instructions for your equipment.

Contact Ratings — Nuclear
Resistive at 125 VDC ........ 1.0 Amp Resistive at 120 VAC 60 Hz . . 10.0 Amp
Contact Ratings — Non-Nuclear
Contact Capacity in Amps
(Resistive Loads)
\begin{tabular}{cc}
\hline \begin{tabular}{c} 
Contact \\
Voltage
\end{tabular} & \begin{tabular}{c} 
Min. 100,000 \\
Operations
\end{tabular} \\
\hline 30 VDC & 15.0 \\
\hline 110 VDC & 1.0 \\
\hline 120 V 60 Hz & 20.0 \\
\hline 240 V 60 Hz & 20.0 \\
\hline 480 V 60 Hz & 12.0 \\
\hline
\end{tabular}

Four pole models add approximately \(1-1 / 4^{"}\) to the maximum height of the basic model, approximately \(1 / 8\) " to the depth. They are designed for vertical operation only.

\section*{Timing Adjustment}

The AGASTAT E7000 Series is the first electropneumatic timer to offer the ease of adjustment and resetting of a graduated dial head. Discrete ranges covering a total span from . 1 second to 60 minutes are available. (See table on page 12-20.) Each has its own graduated, clearly identified dial. Timing is set by simply turning the dial to the desired time value. In the zone of approximately \(25^{\circ}\) separating the high and low ends of timing ranges \(\mathrm{A}, \mathrm{D}, \mathrm{E}\), and K , instantaneous operation (no time delay) will occur. All other ranges produce an infinite time delay when the dial is set in this zone.

For additional support numbers please visit www.te.com

Specialty Relays


AGASTAT E7000 Series, Nuclear Qualified Time Delay Relays (Continued)
Environmental Characteristics
(Qualified Life) Parameter
Temperature-
Minimum - \(40^{\circ} \mathrm{F}\)
Normal - \(70^{\circ} \mathrm{F}-104^{\circ} \mathrm{F}\)
Maximum - \(156^{\circ} \mathrm{F}\)
Humidity (R.H. \%) -
Minimum - \(10 \%\)
Normal - \(40-60 \%\)
Maximum - \(95 \%\)
Pressure - Atmospheric
Radiation (rads) -
\(2.0 \times 105\) Gamma max.

Operating Conditions
(Normal Environment)
Coil Operating Voltage, Nominal
(Rated) -
Pull-in (\% of rated value) -
\(80 \%\) min. with DC; \(85 \%\) min. with
AC coils
Drop-out (\% of rated value) -
10\% approx. with DC coils;
50\% approx. with AC coils
Power (Watts at rated value) -
8 approx. with DC or AC coils
Relay Operate Time -
Model E7012 - N/A
Model E7022 - 50 ms. max. with DC or AC coils

Relay Release (Recycle) Time -
Model E7012 - 50 ms max. with DC or AC coils
Model E7022 — N/A
Contact Ratings, Continuous -
(Resistive at 125 Vdc ) -
1.0 amp with DC or AC coils
(Resistive at \(120 \mathrm{Vac}, 60 \mathrm{~Hz}\) ) -
10.0 amp with DC or AC coils

Insulation Resistance
(In megohms at 500 Vdc ) -
500 min. with DC or AC coils
Dielectric (Vrms, 60 Hz ) -
Between Terminals and Ground 1,500 with DC or AC coils Between Non-connected Terminals - 1,000 with DC or AC coils
Repeat Accuracy - \(\pm 10 \%\) with DC or AC coils

\section*{Operating Conditions (Abnormal Environment)}
\begin{tabular}{|c|c|c|c|c|c|}
\hline Adverse Operating Specifications & Normal & DBE "A" & DBE "B" & DBE "C" & DBE "D" \\
\hline Temperature ( \({ }^{\circ} \mathrm{F}\) ) & 70-104 & 40 & 120 & 145 & 156 \\
\hline Humidity (R.H. \%) & 40-60 & 10-95 & 10-95 & 10-95 & 10-95 \\
\hline Coil Operating Voltage * (\% of Rated) & & & & & \\
\hline Model E7012 (AC) & 85-110 & 85-110 & 85-110 & 85-110 & 85-110 \\
\hline (DC) & 80-110 & 80-110 & 80-110 & 90-110 & 90-110 \\
\hline Model E7022 (AC) & 85-110 & 85-110 & 85-110 & 85-110 & 85-110 \\
\hline (DC) & 80-110 & 80-110 & 80-110 & 80-110 & 80-110 \\
\hline
\end{tabular}
*All coils may be operated on intermittent duty cycles at voltages \(10 \%\) above listed maximums (Intermittent Duty = Maximum \(50 \%\) duty cycle and 30 minutes "ON" time.)

\section*{REPLACEMENT SCHEDULE}

The qualified life of this unit is 25,000 operations or 10 years from the date of manufacture, whichever occurs first.

\section*{Contact ratings as listed under} the UL Component Recognition Program for 100,000 operations (Per pole) -
10 Amps, resistive, 240 VAC;
\(1 / 4\) horsepower, \(120 \mathrm{VAC} / 240 \mathrm{VAC}\); 15 Amps, 30 VDC;
5 Amps, General Purpose, 600 VAC
Coil Data -
All units draw approximately 8 watts power at rated voltage.
The operating voltage range for AC relays is 85 to 110 percent of nominal rated value.
AC units drop-out at approximately \(50 \%\) of rated voltage.
The operating range of DC relays is 80 to 110 percent of nominal rated value.
DC units drop-out at approximately \(10 \%\) of rated voltage.
All units may be operated on intermittent duty cycles ( \(50 \%\) on/off, maximum 30 minutes on) at voltages \(10 \%\) above the listed maximums.

\section*{Approximate Weight -}

Model E7012 and E7022 with AC Coils - 2.13 lbs .
Model E7012 and E7022 with DC Coils - 2.25 lbs .
Model E7014 and E7024 with AC Coils - 2.43 lbs .
Model E7014 and E7024 with DC Coils - 2.57 lbs .
(Weight may vary slightly with particular coil voltage.)
Terminals -
Standard screw terminals (\#8-32 truss head screws supplied) are located on the front of the unit, with permanent schematic markings. Barrier isolation is designed to accommodate spade or ring-tongue terminals with spacing to meet industrial control specifications.
Note: TE Connectivity Corporation cannot recommend the use of its products in the containment areas of Nuclear Power Generating Stations.

The date of manufacture can be found in the first four (4) digits of the serial number on the nameplate:
 the week
Example: Date code 8014: 80 indicates 1980; 14 indicates the week of April 2 through 8.
\begin{tabular}{|lll|}
\hline MODEL & E7012PC003 \\
\hline COIL & 125VDC & Serial 8014 - \\
\hline TIME & 1.5 TO 15 SEC. \\
\hline \multicolumn{3}{|c|}{ L1 } \\
\hline
\end{tabular}

\section*{Dimensions and Mounting}

MODEL E7012, E7022


QUALIFICATION TESTED FOR VERTICAL OPERATION ONLY

MODEL E7014, E7024


QUALIFICATION TESTED FOR VERTICAL OPERATION ONLY


The E7000 Series relay must be mounted in the vertical position. All performance specifications of these units are valid only when they are mounted in this manner.

A bracket for mounting the device and the screws and lockwashers required to attach it to the relay are supplied with each unit. Four \#8-32 tapped holes
are provided in the rear of the device for attaching the mounting bracket, or for mounting the relay directly to a panel, from the rear.

\title{
AGASTAT E7000 Series, Nuclear Qualified Time Delay Relays (Continued)
}

\section*{Ordering Information \\ Catalog Number Code}


\section*{Relay Classifications Control Code Summary}

Configuration Control
\begin{tabular}{|c|c|c|c|c|}
\hline Product & Code - 001 & Code - 002 & Code - 003 & Code - 004 \\
\hline E7000 & Contains all materials present in original qualification testing. & Sept. 1981 - Elastomer gasket material change to improve thermal aging properties. Material changed for Buna-N or Neoprene to Neoprene only. & March 1989 - Paint change to timing head portion of relay. New paint: Sherwin-Williams E61YC37 primer and PPG W48392 silver polyester top coat. & Dec. 1991 - Paint change to timing head portion of relay. New paint: Prime coatings No. 28032 Enamel. No primer is used with this finish. \\
\hline
\end{tabular}

Configuration Code: The Configuration code is a suffix to the Model Number which provides a means of identification. When a significant product change is introduced, the Configuration code and specification sheets will be revised. (001, 002, 003, 004, etc.)

PPG is a trademark of PPG Industries.
Sherwin-Williams is a trademark of
The Sherwin-Williams Company.
\begin{tabular}{lllll}
\hline Catalog 5-1773450-5 & Dimensions are shown for & Dimensions are in millimeters & USA: +1 800 522 6752 & For additional support numbers \\
Revised 3-13 & \begin{tabular}{ll} 
reference purposes only. & unless otherwise specified.
\end{tabular} & \begin{tabular}{l} 
Asia Pacific: +8604008206015
\end{tabular} & please visit www.te.com \\
www.te.com & Specifications subject & & UK: +44800267666 &
\end{tabular}

Specialty Relays

\section*{AGASTAT EGP/EML/ETR Series, Nuclear Qualified Control Relays}


\section*{Test Procedure}

\section*{Test Procedure}

AGASTAT control relay Series EGP, EML and ETR were tested in accordance with the requirements of IEEE STD. 323-1974 (Standard for Qualifying Class 1 E Equipment for Nuclear Power Generating Stations), IEEE STD. 344-1975 (Seismic Qualification for Nuclear Power Generating Stations) and referenced to ANSI/IEEE C37.98 (formerly IEEE Standard 501-1978, Standard for Seismic Testing of Relays). The relays were tested according to parameters which in practice, should encompass the majority of applications. Documented data applies to relays which were mounted on rigid test fixtures. The following descriptions of the tests performed are presented in their actual sequence.

\section*{Baseline Performance}

In addition to aging tests, a series of baseline tests were conducted before, and immediately after each aging sequence:

\section*{Pull-in Voltage}

Drop-out Voltage
Dielectric Strength at 1650 V 60 Hz
Insulation Resistance
Operate Time (milliseconds)

Recycle Time (milliseconds)
Time Delay (seconds) | Series ETR
Repeatability (percent) only
Contact Bounce
(milliseconds at 28VDC, 1 amp)
Contact Resistance
(milliohms at 28VDC, 1 amp)
Data was measured and recorded and used for comparison throughout the qualification test program in order to detect any degradation of performance.

\section*{Radiation Aging}

Relays were subjected to a radiation dosage of \(2.0 \times 105\) Rads, which is considered to exceed adverse plant operating requirements for such areas as auxiliary and control buildings.

\section*{Cycling with Load Aging}

The radiated units were then subjected to 27,500 operations at accelerated rate, with one set of contacts loaded to 120VAC, 60 Hz at 10 amps ; or 125VDC at 1 amp, and the number of mechanical operations exceeding those experienced in actual service.

The SRS shape (at 5 percent damping), is defined by four points:
point \(\mathrm{A}=1.0 \mathrm{~Hz}\) and an acceleration equal to 25 percent of the Zero Period Acceleration (ZPA)
point \(\mathrm{D}=4.0 \mathrm{~Hz}\) and 250 percent of the ZPA
point \(\mathrm{E}=16.0 \mathrm{~Hz}\) and 250 percent of the ZPA
point \(\mathrm{G}=33.0 \mathrm{~Hz}\) and a level equal to the ZPA
Specimen 13,15 \& 16 (EGP Series)
Relay State: Non-Operate Mode (De-ener.)
Test Run No. 318, 319, (205-206), (198-199)
Axis ( \(\mathrm{H}+\mathrm{V}\) ):
Composite of \(F B / N-, S S / N, F B N+X .707\)
Due to \(45^{\circ}\) inclination of test machine.
Additional Seismic Response Curves are available on request.
Relay State: Non-Operate Mode (De-ener.)
Test Run No. 318, 319, (205-206), (198-199)

\section*{Temperature Aging}

This test subjected the relays to a temperature of \(100^{\circ} \mathrm{C}\) for 42 days, with performance measured before and after thermal stress.

\section*{Seismic Aging}

Sufficient interactions were performed at levels less than the fragility levels of the devices in order to satisfy the seismic aging requirements of IEEE STD 3231974 and IEEE STD 344-1975.

\section*{Seismic Qualification}

Artificially aged relays were subjected to simulated seismic vibration, which verified the ability of the individual device to perform its required function before, during and/or following design basis earthquakes. Relays were tested in the non-operating, operating and transitional modes.

\section*{Hostile Environment}

Since the timing relays are intended for use in auxiliary and control buildings, and not in the reactor containment areas, a hostile environment test was performed in place of the Loss of Coolant Accident (LOCA) test. Relays were subjected to combination extreme temperature/humidity plus under/over voltage testing to prove their ability to function under adverse conditions even atter having undergone all the previous aging simulation and seismic testing. The devices were operated at minimum and maximum voltage extremes: 85 and 120 percent of rated voltage for AC units, and 80 and 120 percent of rated voltage for DC units, with temperatures ranging from \(40^{\circ} \mathrm{F}\) to \(172^{\circ} \mathrm{F}\) at 95 percent relative humidity.


Figure 1. Model EGP, Response Spectrum, Non-Operate Mode
\begin{tabular}{lll}
\hline Catalog 5-1773450-5 & Dimensions are shown for & Dimensions are in millimeters \\
Revised 3-13 & \begin{tabular}{l} 
reference purposes only. \\
Specifications subject
\end{tabular} & \\
unless otherwise specified. \\
www.te.com & to change.
\end{tabular}

Specialty Relays

\section*{AGASTAT EGP/EML/ETR Series, Nuclear Qualified Control Relays (Continued)}

\section*{Operation}

\section*{Series EGP \\ Power Relay}

Applying a voltage to the coil (B1-B4) for more than 50 msec energizes the coil and instantaneously transfers the switch, breaking the normally closed contacts (M1-R1, M2-R2, M3-R3, M4R4) and making the normally open contacts (M1-T1, M2-T2, M3-T3, M4T4). The contacts remain in this transferred position until the coil is deenergized, at which time the switch instantaneously returns the contacts to their original position.


Series EML

\section*{Magnetic Latch}

Application of a voltage to the latching input (B1-B4) will cause the relay to latch in (Make the N.O. Contacts, break the N.C. Contacts). When this voltage is removed, the relay will remain in this "Latched" condition. Application of a voltage to the unlatching input (B3-B4) will cause the relay to dropout (Break the N.O. Contacts, make the N.C. Contacts). When this voltage is removed, the relay will remain in this "Unlatched" condition.


Wiring Diagram (Wiring and Connections)
The ML relay has three terminals for the windings: latching winding between terminals B1 and B4, un-latching winding between terminals B3 and B4.

The ML Relay is not symmetrical due to its three coil connections.

The relays are normally delivered polarized so that terminal B4 carries the negative voltage. To reverse the polarity, a deenergize/energize cycle should be carried out using a voltage \(50 \%\) greater than the normal rating.


\section*{Continuous Duty Wiring}

Since the double wound coil does not have a continuous duty rating, voltage pulses to the coils should not exceed a ratio of \(40 \%\) on, to \(60 \%\) off, with maximum power-on periods not to exceed 10 minutes.
If continuous energizing only is available, a resistor/capacitor network should be connected as shown below. In this case the shortest time between two operations must not be less than 5 seconds.

The relay will always assume the energized position in the event of both windings being energized simultaneously.

It is advisable not to put another load in parallel with the windings of the ML relay.


R-C Values
\begin{tabular}{cccccc}
\hline \begin{tabular}{c} 
Nominal \\
\begin{tabular}{l} 
Voltage \\
VDC
\end{tabular}
\end{tabular} & \multicolumn{2}{c}{ R } & & \multicolumn{2}{c}{\(\mathbf{C}\)} \\
\cline { 5 - 6 } & \begin{tabular}{c} 
Ohms \\
\(\pm 5 \%\)
\end{tabular} & Watts & & UF & VDC \\
\hline 12 & 62 & 2 & 5000 & 15 \\
\hline 24 & 240 & 2 & & 2000 & 50 \\
\hline 48 & 1000 & 2 & 500 & 100 \\
\hline 125 & 6200 & 2 & 150 & 150 \\
\hline
\end{tabular}

Series ETR
Time Delay Relay
(Delay on Energization)
Applying a voltage to the input terminals (B1-B4) for more than 50 msec starts a time delay lasting for the preset time period. During this period the normally closed contacts (Four M-R sets) remain closed. At the end of the delay period, the normally closed contacts break and the normally open contacts (Four M-T sets) make. The contacts remain in this position until the relay is deenergized, at which time the contacts instantaneously return to their normal position. Deenergizing the relay, either during or after the delay period will recycle the unit within .075 second. It will then provide a full delay period upon reenergization, regardless of how often the voltage is interrupted before the unit has been permitted to "time-out" to its full delay setting


Catalog 5-1773450-5
Revised 3-13

Dimensions are shown for reference purposes only. Specifications subject to change.

Dimensions are in millimeters unless otherwise specified.

For additional support numbers please visit www.te.com

Specialty Relays
AGASTAT EGP/EML/ETR Series, Nuclear Qualified Control Relays (Continued)

\section*{REPLACEMENT SCHEDULE Series EGP/EML/ETR}

The qualified life of these relays is 25,000 electrical operations or 10 years from the date of manufacture, whichever occurs first.
\begin{tabular}{l}
\(l\) \\
\(\begin{array}{l}\text { Specifications } \\
\text { Contact Ratings - } \\
\text { Series EGP/EML/ETR - } \\
\text { Contact Capacity in Amperes } \\
\text { (Resistive) }\end{array}\) \\
\hline \multicolumn{1}{c}{ Contact } \\
Voltage
\end{tabular} \(\left.\begin{array}{c}\text { Min. 1,000,000 } \\
\text { Operations }\end{array}\right]\)\begin{tabular}{cc}
\hline 24 Vdc & 10.0 Amps \\
\hline 125 Vdc & 1.0 Amp \\
\hline \(120 \mathrm{Vac}, 60 \mathrm{~Hz}\) & 10.0 Amps \\
\hline \(240 \mathrm{Vac}, 60 \mathrm{~Hz}\) & 7.5 Amps \\
\hline
\end{tabular}

\section*{Contact Ratings, UL -} Series EGP/EML Only -
Contact ratings as Listed under the Underwriters Laboratory Component Recognition Program.
(Two poles per load):
1/3 Horsepower, 120 Vac
10 Amps, General Purpose, 240 Vac
\(120 \mathrm{Vdc}, 1.0 \mathrm{Amp}\)

\section*{Mechanical Life -}

Series EGP/EML/ETR -
25,000 mechanical operations
Approximate Weight -
Series EGP/EML/ETR -
1 lb .
Transient Protection -
Series ETR Only - A 1500 volt
transient of less than 100 microseconds, or 1000 volts of less than 1 millisecond will not affect timing accuracy
Timing Adjustment -
Series ETR Only -
Internal Fixed
Internal Potentiometer
Time Ranges - Series ETR Only -
A - 15 to 3 sec .
B - .55 to 15 sec .
C - 1 to 30 sec .
D 2 to 60 sec .
E-4 to 120 sec
G - 10 to 300 sec .
I-2 to 60 min .
N - 1 to 30 min .
Repeat Accuracy -
Series ETR Only -
The repeat accuracy deviation \(\left(A_{R}\right)\) of a time-delay relay is a measure of the maximum deviation in the time-delay that will be experienced in five successive operations at any particular time setting of the relay and over the operating voltage and temperature range specified. Repeat accuracy is obtained from the following formula:
\(A_{R}= \pm 100 \frac{\left(T_{1}-T_{2}\right)}{\left(T_{1}+T_{2}\right)}\)
Where -
\(\mathrm{T}_{1}=\) Maximum Time Delay
\(\mathrm{T}_{2}=\) Minimum Time Delay

The date of manufacture can be found in the first four (4) digits of the serial number on the nameplate:


Second two digits indicate the week.
Example: In the date code 7814 below:
" 78 " indicates the year 1978;
" 14 " indicates the 14th week (or April 3 through April 7).
\begin{tabular}{|ll|}
\hline Model & \\
\hline Coil & 125 VDC \\
\hline Serial & 78140028 \\
\hline
\end{tabular}

Note: TE Corporation does not recommend the use of its products in the containment areas of Nuclear Power Generating Stations.
\begin{tabular}{ll}
\hline Catalog 5-1773450-5 & \begin{tabular}{l} 
Dimensions are shown for \\
reference purposes only. \\
Revised 3-13
\end{tabular} \\
Specifications subject \\
www.te.com & to change.
\end{tabular}

AGASTAT EGP/EML/ETR Series, Nuclear Qualified Control Relays (Continued)
Operating Characteristics
Environmental Conditions (Qualified Life) — Series EGP/EML/ETR
\begin{tabular}{lccc}
\hline Parameter & Min. & Normal & Max. \\
\hline Temperature \(\left({ }^{\circ} \mathrm{F}\right)\) & 40 & \(70-104\) & 156 \\
Humidity (R.H. \%) & 10 & \(40-60\) & 95 \\
Pressure & - & Atmospheric & - \\
Radiation (rads) & - & - & \(2.0 \times 105(\mathrm{Gamma})\) \\
\hline
\end{tabular}

Operating Conditions, Normal Environment - Series EGP/EML/ETR
\begin{tabular}{|c|c|c|c|c|c|}
\hline Normal Operating Specifications & \multicolumn{3}{|c|}{With DC Coils} & \multicolumn{2}{|c|}{With AC Coils} \\
\hline & EGP & EML & ETR & EGP & ETR \\
\hline Coil Operating Voltage, Nominal (rated)* & As Spec. & As Spec. & As Spec. & As Spec. & As Spec. \\
\hline Pull-in (\% of rated value) & 80\% Min. & 85\% Min. & 80\% Min. & 85\% Min. & 85\% Min. \\
\hline Drop-out (\% of rated value) & 5-45\% & 85\% Min. & 5-45\% & 5-45\% & 5-50\% \\
\hline Continuous (\% of rated value) & 110\% Max. & N/A & 110\% Max. & 110\% Max. & 110\% Max. \\
\hline \multicolumn{6}{|l|}{Power (Watts at rated value)} \\
\hline Pull-in & 6 Apprx. & 15 Apprx. & 6 Apprx. & 6 Apprx. & 6 Apprx. \\
\hline Drop-out & N/A & 13 Apprx. & N/A & N/A & N/A \\
\hline Relay Operate Time & \(30 \mathrm{~ms} \mathrm{Max}\). & \begin{tabular}{l}
25 ms Max. \\
With min. \\
latch pulse \\
of 30 ms .
\end{tabular} & N/A & \(35 \mathrm{~ms} \mathrm{Max}\). & N/A \\
\hline Relay Release (Recycle) Time & 25 ms Max. & 20 ms Max. With min. latch pulse of 30 ms . & \(75 \mathrm{~ms} \mathrm{Max}\). & 85 ms Max. & \(75 \mathrm{~ms} \mathrm{Max}\). \\
\hline \multicolumn{6}{|l|}{Contact Ratings, Continuous} \\
\hline Resistive at 125 vdc & 1.0 amp . & 1.0 amp . & 1.0 amp . & 1.0 amp . & 1.0 amp . \\
\hline Resistive at \(120 \mathrm{vac}, 60 \mathrm{~Hz}\) & 10.0 amp . & 10.0 amp . & 10.0 amp . & 10.0 amp . & 10.0 amp . \\
\hline Insulation Resistance (In megohms at 500 vdc ) & 500 Min . & 500 Min . & 500 Min . & 500 Min . & 500 Min . \\
\hline \multicolumn{6}{|l|}{Dielectric (vrms, 60 Hz )} \\
\hline Between Terminals and Ground & 1,500 & 1,500 & 1,500 & 1,500 & 1,500 \\
\hline Between Non-connected Terminals & 1,500 & 1,500 & 1,500 & 1,500 & 1,500 \\
\hline Repeat Accuracy & N/A & N/A & \(\pm 5 \%\) & N/A & \(\pm 5 \%\) \\
\hline
\end{tabular}

Operating Conditions, Abnormal Environment - Series EGP/EML
\begin{tabular}{|c|c|c|c|c|c|}
\hline Adverse Operating Specifications & Normal & DB "A" & DB "B" & DB "C" & DB "D" \\
\hline Temperature ( \({ }^{\circ} \mathrm{F}\) ) & 70-104 & 40 & 120 & 145 & 156 \\
\hline Humidity (R.H. \%) & 40-60 & 10-95 & 10-95 & 10-95 & 10-95 \\
\hline \multicolumn{6}{|l|}{Coil Operating Voltage (\% of rated)*} \\
\hline AC (Series EGP only) & 85-110 & 85-110 & 85-110 & 85-110 & 85-110 \\
\hline DC (Series EGP only) & 80-110 & 80-110 & 80-110 & 80-110 & 80-110 \\
\hline DC (Series EML only) & 85-110 & 85-110 & 85-110 & 85-110 & 85-110 \\
\hline \multicolumn{6}{|l|}{Relay Operate Time (ms)} \\
\hline AC (Series EGP only) & 35 Max. & 35 Max . & 35 Max. & 35 Max. & 35 Max . \\
\hline DC (Series EGP, Series EML) & 30 Max . & 25 Max. & 37 Max. & 40 Max . & 40 Max . \\
\hline
\end{tabular}

Operating Conditions, Abnormal Environment - Series ETR
\begin{tabular}{lll}
\hline Adverse Operating Specifications & With DC Coils & With AC Coils \\
\hline Coil Operating Voltage (rated) & As Spec. & As Spec. \\
Pull-in (\% of rated value) & \(80 \%\) Min. & \(85 \%\) Min. \\
Continuous (\% of rated value) & \(110 \%\) Max. & \(110 \%\) Max. \\
Drop-out (\% of rated value) & \(5-45 \%\) & \(5-50 \%\) \\
Power (Watts at rated value) & 6 Apprx. & 6 Apprx. \\
Relay Release (Recycle) Time & 75 ms Max. & \(75 \mathrm{~ms} \mathrm{Max}\). \\
Contact Ratings, Continuous & & \\
Resistive at 125 vdc & 1.0 amp. & 1.0 amp. \\
Resistive at 120 vac, 60 Hz & 10.0 amp. & 10.0 amp. \\
Repeat Accuracy & \(\pm 10 \%\) & \(\pm 10 \%\) \\
\hline
\end{tabular}
*All coils may be operated on intermittent duty cycles at voltages 10\% above listed maximums
(Intermittent Duty = Maximum 50\% duty cycle and 30 minutes "ON" time.)

12-24

Catalog 5-1773450-5
Revised 3-13

Dimensions are shown for reference purposes only. Specifications subject to change.

\section*{Dimensions and Mounting}


Qualification tested in the horizontal position, mounted in socket ECR0001-001
(captive clamp terminals) or in socket ECR0002-001 (screw terminals) with locking straps ECR0133.


Qualification tested in the horizontal position, mounted in socket ECR0095-001
(screw terminals) with locking strap ECR0155.

Series EGP, EML and ETR AGASTAT control relays must be mounted in the horizontal position; performance specifications of these units are valid only when they are mounted as indicated in either of the above drawings. All dimensions in inches.

\section*{Ordering Information}

Catalog Number Code Series EGP and EML


\section*{* Configuration Code}

The Configuration Code is a suffix to the Model Number which provides a means of identification. When a significant product change is introduced, the Configuration code and specification sheets will be revised.
\begin{tabular}{|c|c|c|c|c|c|}
\hline E & TR14 & B & 1 & A & **004 \\
\hline & & & & & \\
\hline Nuclear & AGASTAT & Operating & Timing & Time & Configuration \\
\hline Safety & Control & Voltage & Adjustment & Range & Code \\
\hline Related & Relay Model & & & & \\
\hline & & Code & Code & Code & Code \\
\hline Code & Code & - B-24VDC & 1 - Internal & A - . 15 to 3 sec . & 004 \\
\hline E & TR14 - Time & DC D-125VDC & Fixed & B -.55 to 15 sec . & \\
\hline & Delay & Г & 3 - Internal & C - 1 to 30 sec . & \\
\hline & Relay & AC I-120 VAC 60Hz & Potentiometer & D-2 to 60 sec . & \\
\hline & (Delay & ட & & E-4 to 120 sec . & \\
\hline & on & & & \(\mathrm{G}-10\) to 300 sec . & \\
\hline & Pull-in) & & & I - 2 to 60 min . & \\
\hline & & & & \(\mathrm{N}-1\) to 30 min . & \\
\hline
\end{tabular}

\section*{* Configuration Code}

The Configuration Code is a suffix to the Model Number which provides a means of identification. When a significant product change is introduced, the Configuration code and specification sheets will be revised.

\section*{Relay Classifications Control Code Summary}

Configuration Control
\begin{tabular}{|c|c|c|c|c|}
\hline Product & Code - 001 & Code - 002 & Code - 003 & Code - 004 \\
\hline EGP & Contains all materials present in original qualification testing. & Nov. 1981 - Material change to coil wrapping tape and lead wire insulation to improve thermal life. & Dec. 1987 - Material change on leaf spring from nickel copper to beryllium copper. & \begin{tabular}{l}
Dec. 1995 - Material change on bobbin from Nylon \\
ZYTEL 101 to RYNITE FR530. \\
Material change on base from Melamine Phenolic to GRILON PMV-5HV0.
\end{tabular} \\
\hline EML & Contains all materials present in original qualification testing. & Nov. 1981 - Material change to coil wrapping tape and lead wire insulation to improve thermal life. & Dec. 1987 - Material change on leaf spring from nickel copper to beryllium copper. & \begin{tabular}{l}
Dec. 1995 - Material change on bobbin from Nylon \\
ZYTEL 101 to RYNITE FR530. \\
Material change on base from Melamine Phenolic to GRILON PMV-5HV0.
\end{tabular} \\
\hline ETR & Contains all materials present in original qualification testing. & Nov. 1981 - Material change to coil wrapping tape and lead wire insulation to improve thermal life. & Dec. 1987 - Material change on leaf spring from nickel copper to beryllium copper. & \begin{tabular}{l}
Dec. 1995 - Material change on bobbin from Nylon \\
ZYTEL 101 to RYNITE FR530. \\
Material change on base from Melamine Phenolic to GRILON PMV-5HV0.
\end{tabular} \\
\hline ECR0001 & Contains all materials present in original qualification testing. & June 1989 - Material change from NORYL N-225 std. black to NORYL SE-I-701AA black. & & \\
\hline ECR0002 & Contains all materials present in original qualification testing. & June 1989 - Material change
from NORYL N-225 std. black to NORYL SE-I-701AA black. & & \\
\hline ECR0095 & Contains all materials present in original qualification testing. & June 1989 - Material change from NORYL N-225 std. black to NORYL SE-I-701AA black. & & \\
\hline ECR0133 & Contains all materials present in original qualification testing. & & & \\
\hline ECR0155 & Contains all materials present in original qualification testing. & & & \\
\hline
\end{tabular}

Configuration Code: The Configuration code is a suffix to the Model Number which provides a means of identification. When a significant product change is introduced, the Configuration code and specification sheets will be revised. (001, 002, 003, 004, etc.)

GRILON is a trademark of EMS-Chemie AG. NORYL is a trademark of SABIC Innovative Plastics.
RYNITE and ZYTEL are trademarks of
E.I. du Pont de Nemours and Company.
\begin{tabular}{ll}
\hline Catalog 5-1773450-5 & \begin{tabular}{l} 
Dimensions are shown for \\
reference purposes only.
\end{tabular} \\
www.te.com 3-13 & \begin{tabular}{l} 
Specifications subject \\
to change.
\end{tabular} \\
wo
\end{tabular}

Dimensions are in millimeters unless otherwise specified.

Specialty Relays

\section*{AGASTAT GP/ML/TR Series, 10 Amp Control Relay, Non-latching, Latching \& Timing Versions}


Product Facts
■ Occupies very small panel space
- May be mounted singly, in continuous rows or in groups
■ Available with screw terminal molded socket.

■ 4 SPDT contacts
■ Magnetic blowout device option increases DC current carrying ability approximately ten times for both N.O. and N.C. contacts. In both AC and DC operation, the addition of the device will normally double the contact life, due to reduced arcing.
■ File E15631, File LR29186 - S

\section*{GP/ML/TR Design Features}

Among the advances AGASTAT control relays offer over existing designs is a unique contact operating mechanism. An articulated arm assembly amplifies the movement of the solenoid core, allowing the use of a short stroke coil to produce an extremely wide contact gap. The long support arms used in conventional relays are eliminated. Both current capacity and shock/ vibration tolerance are greatly increased, as well as life expectancy.

\section*{Design/Construction}

AGASTAT control relays are operated by a moving core electromagnet whose main gap is at the center of the coil.
The coil provides a low mean turn length and also assists heat dissipation. Since the maximum travel of the electromagnet does not provide optimum contacts movement, an ingenious amplifying device has been designed.

Users should thoroughly review the technical data before selecting a product part number. It is recommended that users also seek out the pertinent approvals files of the agencies/laboratories and review them to ensure the product meets the requirements for a given application.

Figure 1 -

Note: Seismic \& radiation tested EGP, EML and ETR models are available. Consult factory for detailed information.


This consists of a W-shaped mechanism, shown in Figure 1. When the center of the W is moved vertically the lower extremities move closer to each other as can be seen in the illustration. The center of the W mechanism is connected to the moving core of the electromagnet and the two lower points are connected to the moving contacts.
Two of these mechanisms are placed side-by-side to actuate the four contacts sets of the relay. These arms act as return springs for their corresponding contacts.

The mechanical amplification of the motion of the electromagnet permits a greater distance between the contacts, while the high efficiency of the electromagnet provides a nominal contact force in excess of 100 grams on the normally open contacts.

All the contacts are positioned well away from the cover and are well ventilated and separated from each other by insulating walls.

The absence of metal-tometal friction, the symmetrical design of the contact arrangement and the lack of heavy impacts provides a mechanical life of 100,000,000 operations.
For use in AC circuits, the relay is supplied with a built-in rectification circuit, thus retaining the high DC efficiency of the electromagnet. The current peak on energizing is also eliminated and consequently the relay can operate with a resistance in series (e.g. for high voltages or for drop-out by shorting the coil). The use of the rectification circuit offers still other advantages. The same model can operated at frequencies ranging from 40 to 400 cycles. Operation of the relay is possible even with a low AC voltage.
The plastic dust cover has two windows to facilitate cooling and also to allow direct mounting of the relay.

\section*{AGASTAT GP/ML/TR Series, 10 Amp Control Relay, Non-latching, Latching \& Timing Versions (Continued)}

GP/ML Contact Data @ \(25^{\circ} \mathrm{C}\)
Arrangements - 4 Form C (4PDT)
Material - Silver plated

\section*{Expected Life -}

Mechanical - 100 million operations
Electrical - See chart and graph

\section*{Contact Ratings and Expected Life}
\begin{tabular}{cccrc}
\hline Voltage & \begin{tabular}{c} 
Current \\
\((\) Amps \()\)
\end{tabular} & \begin{tabular}{c} 
Power Factor \\
or \\
Time Constant
\end{tabular} & \begin{tabular}{c} 
Number of \\
Electrical \\
Operations
\end{tabular} & Remarks \\
\hline 540 VAC & 3 & COS \(\varnothing=0.5\) & 15,000 & 2 contacts in series \\
\hline 380 VAC & 15 & Resistive & 10,000 & 2 contacts in parallel \\
\hline 380 VAC & 10 & Resistive & 200,000 & \\
\hline 380 VAC & \(3 \times 3.3\) & COS \(\varnothing=0.8\) & 200,000 & 3hp motor \\
\hline 220 VAC & 20 & Resistive & 20,000 & 2 contacts in parallel \\
\hline 220 VAC & 15 & COS \(\varnothing=0.5\) & 20,000 & 2 contacts in parallel \\
\hline 220 VAC & 10 & Resistive & 400,000 & \\
\hline 220 VAC & \(3 \times 6\) & COS \(\varnothing=0.8\) & 200,000 & 3 hp motor \\
\hline 220 VAC & 5 & & \(1,500,000\) & Filament lamps \\
\hline 220 VAC & 5 & Resistive & \(3,000,000\) & \\
\hline 220 VAC & 2.5 & COS \(\varnothing=0.25\) & \(2,000,000\) & \\
\hline 220 VAC & 2 & Resistive & \(15,000,000\) & \\
\hline 220 VAC & 1.25 & Resistive & \(30,000,000\) & \\
\hline 120 VDC & 1.5 & Resistive & \(20,000,000\) & with blow-out device \\
\hline 48 VDC & 10 & Resistive & \(1,000,000\) & \\
\hline 48 VDC & 1.5 & 5 ms & \(18,000,000\) & \\
\hline
\end{tabular}


Initial Dielectric Strength -
Between non-connected terminals \(2,000 \mathrm{~V}\) rms, 60 Hz
Between non-connected terminals \& relay yoke \(-2,000 \mathrm{~V} \mathrm{rms}, 60 \mathrm{~Hz}\)
Initial Insulation Resistance Between non-connected terminals 109 ohms at 500VDC
Between non-connected terminals \& relay yoke - 109 ohms at 500VDC

\section*{Coil Data}

Voltage - 24,120 \& 220VAC, 60 Hz ;
Add series resistor for 380-440VDC;
\(12,24,48,125\) \& 250 VDC
Duty Cycle - Continuous
Nominal Coil Power -
6VA for AC coils; 6W for DC coils. There is no surge current during operation.

\section*{Coil Operating Voltage}
\begin{tabular}{lcccccccc}
\hline & DC & & & & \multicolumn{4}{c}{ AC, 50/60Hz } \\
\hline Nominal Coil Voltage & 12 & 24 & 48 & 125 & 250 & 24 & 120 & 220 \\
\hline Minimum Pick-up & & & & & & & & \\
\hline Voltage at \(20^{\circ} \mathrm{C}\) & 9 & 18 & 36 & 94 & 187 & 19 & 92 & 175 \\
\hline Minimum Pick-up & & & & & & & & \\
\hline Voltage at \(40^{\circ} \mathrm{C}\) & 9.5 & 19 & 38 & 100 & 200 & 20 & 102 & 188 \\
\hline \begin{tabular}{l} 
Maximum voltage \\
for continuous use
\end{tabular} & 13.5 & 27 & 53 & 143 & 275 & 27 & 137 & 245 \\
\hline
\end{tabular}

For 380 VAC - Use 6800 ohms 4 watt resistor in series with 220VAC relay.
For 440 VAC - Use 8200 ohms 6 watt resistor in series with 220VAC relay.
Drop-out voltage is between \(10 \%\) and \(40 \%\) of the nominal voltages for both DC and
AC (For example: in a 120 VAC unit, drop-out will occur between 12 and 48 volts.)
\(D C\) relays will function with unfiltered DC from a full-wave bridge rectifier.

\section*{Operate Data @ \(20^{\circ} \mathrm{C}\)}

Operate Time at Rated Voltage -
Between energizing and opening of
normally closed contacts - less than
18 milliseconds on AC and less than 15
milliseconds on DC.

\section*{Release Time -}

Between energizing and closing of
normally open contacts - less than
35 milliseconds on AC and less than
30 milliseconds on DC.
Between de-energizing and opening of
normally open contacts - less than
70 milliseconds on \(A C\) and less than
8 milliseconds on DC.
Between de-energizing and closing of normally closed contacts - less than 85 milliseconds on \(A C\) and less than
25 milliseconds on DC.

\section*{Environmental Data}

Operating Temperature Range: \(0^{\circ} \mathrm{C}\) to \(+60^{\circ} \mathrm{C}\).
Vibration: Single axis fragility curve data are available on request at frequencies from 5 Hz . to 33 Hz .
Shock: The relay, when kept energized by means of one of its own contact sets, will withstand 40 g shock load when operating on DC, and 150 g shock load on AC.

\section*{Mechanical Data}

Mounting Terminals -
16 flat base pins. Screw terminal sockets are available.
Wire Connection - The 16 flat pins are arranged in four symmetrical rows of four pins; the pitch in both directions being 394 ". Connection may be made to the relay by soldering. Sockets are available with screw terminals.
The internal wiring of the relay is also symmetrical as shown in the adjacent figure, allowing the relay to be inserted into the socket in either of two positions. Terminals B2 and B3 are provided as extra connections for special applications.

\section*{Weight -}
10.9 oz. (308g) approximately to change.

For additional support numbers please visit www.te.com

\section*{AGASTAT GP/ML/TR Series, 10 Amp Control Relay,}

Non-latching, Latching \& Timing Versions (Continued)

\section*{Ordering Information}


Our authorized distributors are more likely to maintain the following items in stock for immediate delivery.
GPD
GPDN


12-30

\title{
AGASTAT GP/ML/TR Series, 10 Amp Control Relay, Non-latching, Latching \& Timing Versions (Continued)
}

\section*{TR Series}

\section*{Product Facts}
- 8 timing ranges

■ 4 SPDT contacts
■ Magnetic blowout device option increases DC current carrying ability approximately ten times for both N.O. and N.C. contacts. In both AC and DC operation, the addition of the device will normally double the contact life, due to reduced arcing.

\section*{TR Design/Construction}

Couples an advanced electromechanical design with a field-proven solidstate timing network, an adaptation of the circuit used in the AGASTAT premium grade SSC Timer. This unique circuit also eliminates the need for supplementary temperaturecompensation components, affording unusual stability over a realistically broad operating temperature range. It also provides transient protection and protection against premature switching of the output contacts due to power interruption during timing.

Timing Specifications
Operating Mode -
On-Delay (Delay on energization)
Timing Adjustment -
internal fixed or internal potentiometer

\section*{Timing Ranges -}
.15 to 3 sec.
55 to 15 sec.
1 to 30 sec .
2 to 60 sec .
4 to 120 sec .
10 to 300 sec .
1 to 30 min .
2 to 60 min .

\section*{Accuracy -}

Repeat - \(\pm 2 \%\) as fixed temperature and voltage
Overall — \(\pm 5 \%\) over combined rated extremes of temperature and voltage
Reset Time - 75 ms .
Contact Data @ \(25^{\circ} \mathrm{C}\)
Arrangements - 4 Form C (4PDT)
Nominal Rating - 10A @ 120VAC
Contact Pressure -
Between movable and normally closed contacts - 30 g , typical.
Between movable and normally open contacts - 100 g , typical.

Expected Life -
Mechanical - 100 million operations
Electrical - See load/life graph
Initial Dielectric Strength -
Between terminals and case and between mutually-isolated contacts - \(2,000 \mathrm{VAC}\)
Initial Insulation Resistance -
Between non-connected terminals -
109 ohms at 500VDC
Between non-connected terminals \& relay yoke - 109 ohms at 500VDC

\section*{Coil Data}

Voltage - 120VAC, 50-60 Hz.; 24 \& 125VDC

\section*{Transient Protection -}

1,500 volt transient of less than 100 microseconds, or 1,000 volts or less

\section*{Environmental Data}

Operating Temperature Range \(0^{\circ} \mathrm{C}\) to \(+50^{\circ} \mathrm{C}\)

\section*{Mechanical Data}

Mounting Terminals -
16 flat base pins. Screw terminal sockets are available.
Weight - 11 oz. (311g) approximately

\section*{Ordering Information}

\(\begin{array}{lll}\text { Timing Range: } & \mathrm{C}=1 \text { to } 30 \mathrm{sec} . & \mathrm{E}=4 \text { to } 120 \mathrm{sec} . \\ \mathrm{A}=.15 \text { to } 3 \mathrm{sec} . & \mathrm{I}=2 \text { to } 60 \mathrm{~min} .\end{array}\)
\(B=.55\) to 15 sec .
Options:
\(\mathrm{N}=\) Magnetic blow-out device.

Our authorized distributors are more likely to maintain the following items in stock for immediate delivery.

None at present.




Wiring Diagram (Bottom View)

For Outline Dimensions see page 12-30
\begin{tabular}{ll} 
& \\
Catalog 5-1773450-5 & \begin{tabular}{l} 
Dimensions are shown for \\
reference purposes only. \\
Revised 3-13
\end{tabular} \\
\begin{tabular}{l} 
Specifications subject \\
to change.
\end{tabular} \\
www.te.com &
\end{tabular}

Specifications subject to change.
\begin{tabular}{ll} 
Dimensions are in millimeters & USA: +18005226752 \\
unless otherwise specified. & Asia Pacific: +8604008206015 \\
& UK: +44800267666
\end{tabular}

Asia Pacific: +86 04008206015 UK: +44 800267666

For additional support numbers please visit www.te.com

\section*{Accessories for GP/ML/TR Series Control Relays}

\section*{Front Connected Sockets}


Hold Down (Locking) Springs


Cat. No. CROO69
For socket: CR0067



Cat. No. CROO70
For socket: CR0095



Cat. No. CR0111
For sockets: CRO001\& CR0002


\section*{Heavy-duty Hold Down (Locking) Straps}

* Catalog number includes strap, strap plate and necessary brackets.
*Cat. No. CR0133
For socket: CRO001 \& CR0002

Magnetic Blowout Device

*Cat. No. CR0155
For socket: CR0095


Extracting Handle


Cat. No. CR0179
Used to remove GP, ML and TR units from mounting bases.

Cat. No. CR0190
Reduces arcing on the relay contacts when they make or break contact, either upon energizing or de-energizing, resulting in less contact degradation. Extends the life of the contact.

Specialty Relays

Users should thoroughly review the technical data before selecting a product part number. It is recommended that user also seek out the pertinent approvals files of the agencies/laboratories and review them to ensure the product meets the requirements for a given application.


VCA Series, Single Phase, Undervoltage Relay

\section*{Function}

Single phase undervoltage relay
Sensing Specifications
Voltage Set-Point Adjustment Internal potentiometer (screwdriver adjustable) with linear calibrated dial
Response Time - Depending on severity of undervoltage: \(0.1-1 \mathrm{sec}\).

\section*{Accuracy -}

Repeat Accuracy 一 \(\pm 0.2 \%\)
Overall Accuracy — \(\pm 1 \%\)
Output Data
Arrangement - 1 Form C (SPDT)
Rating - 7A @ 250VAC; 1/6 HP @ 250VAC; 300VA @ 120/240VAC; 3A@30VDC
Expected Mechanical Life -
10,000,000 operations
Expected Electrical Life - 100,000
operations at rated resistive load
Initial Dielectric Strength -
Between Terminals and Case - \(1,480 \mathrm{~V}\)
Between Relay Contacts and Active
Circuitry - \(1,480 \mathrm{~V}\)

Ordering Information
\begin{tabular}{cc}
\hline Part Number & Operating Voltage \\
\hline VCAA & 120 VAC \\
\hline VCAB & 240 VAC \\
\hline
\end{tabular}

Authorized distributors are likely to stock the following:
None at present.

Input Data
Voltage - 120VAC, 240VAC
Power Requirement - 4W max.
Transient Protection -
120VAC ........ 30 joules
240VDC \(\ldots \ldots \ldots .30\) joules
120VAC \(\ldots \ldots \ldots 10\) joules
120VDC ........ 10 joules

\section*{Environmental Data}

Temperature Range -
Storage - \(-40^{\circ} \mathrm{C}\) to \(+85^{\circ} \mathrm{C}\)
Operating - \(-23^{\circ} \mathrm{C}\) to \(+55^{\circ} \mathrm{C}\)
Mechanical Data
Mounting - Panel mount with one \#8 screw
Termination - 0.250 in (6.35) quick
connect terminals
Status Indication - LED indicates
normal voltage condition
Weight - 3.2 oz. (90.7g) approximately


Outline Dimensions and Wiring Diagram
\begin{tabular}{ll} 
Catalog 5-1773450-5 & \begin{tabular}{l} 
Dimensions are shown for \\
reference purposes only.
\end{tabular} \\
Revised 3-13 & Specifications subject \\
www.te.com & to change.
\end{tabular}

Specialty Relays


Product Facts
■ Automatic reset minimizes equipment downtime
- Fixed pickup point prevents Iow voltage start-up
- Adjustable dropout point protects against undervoltage operation
■ Locking potentiometer maintains selected set point
■ Delayed dropout prevents nuisance tripping
- Plug-in mounting for easier installation
- Built-in protection against polarity reversal
- LED indicates normal voltage condition
■ File E60363 피

\section*{VMA series, Single Phase, Plug-in, Undervoltage Relay}

Function
Single phase undervoltage relay
Sensing Specifications
Voltage Set-Point Adjustment -
Locking potentiometer with calibrated dial
Response Time - Standard 0.5 sec . delay on dropout
Accuracy -
Repeat Accuracy - \(\pm 0.5 \%\) under fixed conditions
Overall Accuracy — \(\pm 1 \%\)
Temperature Coefficient \(\pm 0.02 \% /{ }^{\circ} \mathrm{C}\) (Max.)
Output Data
Arrangement-2 Form C (DPDT)
Rating — 7A @ 250VAC; 1/6 HP @
250VAC; 300VA @ 120/240VAC; 3A @ 3OVDC
Expected Mechanical Life -
10,000,000 operations
Expected Electrical Life - 100,000
operations at rated resistive load

Initial Dielectric Strength -
Between Terminals and Case - \(1,480 \mathrm{~V}\)
Between Relay Contacts and Active
Circuitry - \(1,480 \mathrm{~V}\)
Input Data
Voltage - See ordering information.
Power Requirement - 4W max.
Transient Protection -
24VAC . .......... 1.5 joules
24VDC . . . . . . . . . 1.5 joules
48VDC .......... 10 joules
120VAC ......... 10 joules
125VDC ......... 10 joules
240VDC .......... 20 joules
Reverse Polarity Protection -
On DC models
Duty Cycle - Continuous
Environmental Data
Temperature Range -
Storage - \(-30^{\circ} \mathrm{C}\) to \(+60^{\circ} \mathrm{C}\)
Operating - \(-10^{\circ} \mathrm{C}\) to \(+55^{\circ} \mathrm{C}\)

Ordering Information
\begin{tabular}{cccc}
\hline Part Number & Nominal Voltage & Pick-Up (V) & Drop-Out Range (V) \\
\hline VMAXEA & 24 VAC & 21 & 15 to 20 \\
\hline VMAXAA & 120 VAC & 104 & 78 to 99 \\
\hline VMAXBA & 240 VAC & 209 & 156 to 199 \\
\hline VMAXOA & 24 VDC & 21 & 15 to 20 \\
\hline VMAXNA & 48VDC & 42 & 31 to 40 \\
\hline VMAXPA & 125 VDC & 109 & 81 to 103 \\
\hline
\end{tabular}

Authorized distributors are likely to stock the following:

None at present.


Mechanical Data
Mounting - Octal plug. Fits 27E122 or 27E891 (snap-on) screw terminal socket. Order socket separately.
Enclosure - Nylon cover protects against particles.
Status Indication - LED indicates normal voltage condition.
Weight - 6 oz. ( 168 g ) approximately.

Users should thoroughly review the technical data before selecting a product part number. It is recommended that user also seek out the pertinent approvals files of the agencies/laboratories and review them to ensure the product meets the requirements for a given application.
\begin{tabular}{ll} 
Dimensions are in millimeters & USA: +18005226752 \\
unless otherwise specified. & Asia Pacific: +8604008206015 \\
& UK: +44800267666
\end{tabular}

Asia Pacific: +86 04008206015 UK: +44 800267666

Specialty Relays


Product Facts
■ On-Delay, Off-Delay and Interval timing modes
■ 13 timing ranges from 0.1 sec. to 60 min .
■ 10A DPDT output contacts
■ Knob, fixed or external timing adjustment
- Rated for pilot duty
- Premium components

■ File 3520, File E60363, File LR51332, File E60363 (SCC only)

\section*{샜․ (1)}

SCB/SCC Series, Specification Grade Discrete Plug-in, Time Delay Relay
Timing Specifications
Timing Modes -
On-Delay, Off-Delay and Interval
Timing Ranges -6 to 180 cycles;
0.1 to \(3 / 0.1\) to \(10 / 0.33\) to \(10 / 1\) to 30
/ 4 to 120 sec.; 0.33 to 10 / 1 to 30 / 2 to
60 min.; 0.33 to 10 hr . (All are \(+5 \%\), -
\(0 \%\) of maximum values).
Timing Adjustment -
Knob or fixed time (internal fixed resis-
tor) - all models; customer supplied external potentiometer or resistor -On-Delay and Interval models only.

\section*{Accuracy -}

Repeat Accuracy - \(\pm 0.5 \% \pm 0.004\) sec.
Overall Accuracy - \(\pm 2 \%\) max.
Reset Time - 25 ms .
Relay Operate Time -
Off-Delay mode - 30 ms ;
Interval mode - 20 ms .
Relay Release Time -
On-Delay mode only - 15 ms .

Users should thoroughly review the technical data before selecting a product part number. It is recommended that user also seek out the pertinent approvals files of the agencies/laboratories and review them to ensure the product meets the requirements for a given application.


Outline Dimensions


BELDEN is a trademark of Belden
Technologies, Inc.

\section*{Contact Data @ \(25^{\circ} \mathrm{C}\)}

Arrangements - 2 Form C (DPDT)
Rating - 10A @ 28VDC or 120VAC, resistive; \(1 / 3 \mathrm{HP}\) @ 120/240VAC; 345VA. Same polarity.
Expected Mechanical Life -
10 million operations
Expected Electrical Life - 500,000
operations, min., at rated resistive load
Initial Dielectric Strength -
Between Terminals and Case -
1,000VAC plus twice the nominal voltage for one minute.
Input Data @ \(\mathbf{2 5}^{\circ} \mathrm{C}\)
Voltage - See Ordering Information section for details.
Power Requirement - 3W, max.

Environmental Data
Temperature Range -
Storage -
SCB and SCC \(-40^{\circ} \mathrm{C}\) to \(+85^{\circ} \mathrm{C}\)
Operating -
SCB: \(-30^{\circ} \mathrm{C}\) to \(+65^{\circ} \mathrm{C}\)
SCC: \(-30^{\circ} \mathrm{C}\) to \(+50^{\circ} \mathrm{C}\)
Mechanical Data
Mounting/Termination -
SCB - UL recognized. Optional 8- or 11-pin octal-type sockets may be ordered separately.
SCC - 8- or 11-pin octal type sockets supplied with timer. (Must be used to qualify as "UL Listed" device.)
Weight - SCB: 5.3 oz. (149g) approx.; SCC: 7.5 oz. (210g) approx.

Transient Protection: Non-repetitive transients of the following magnitudes will not cause spurious operation of affect function and accuracy.
\begin{tabular}{ccc}
\hline \begin{tabular}{c} 
Operating \\
Voltage
\end{tabular} & \(<0.1 \mathrm{~ms}\) & \(<1 \mathrm{~ms}\) \\
\hline \begin{tabular}{c} 
All except \\
\(12 \& 24\)
\end{tabular} & \(3,000 \mathrm{~V}\) & 2,500 \\
\hline \(12 \& 24\) & \multicolumn{2}{c}{ Consult Factory } \\
\hline
\end{tabular}

\section*{Ordering Information (All "X's" must be included to complete part number)}


Authorized distributors are likely to stock the following:
None at present.
\begin{tabular}{ll} 
Catalog 5-1773450-5 & \begin{tabular}{l} 
Dimensions are shown for \\
reference purposes only.
\end{tabular} \\
Revised 3-13 & \begin{tabular}{l} 
Specifications subject \\
to change.
\end{tabular} \\
www.te.com &
\end{tabular}
\begin{tabular}{ll} 
Dimensions are in millimeters & USA: +18005226752 \\
unless otherwise specified. & Asia Pacific: +8604008206015 \\
& UK: +44800267666
\end{tabular}

For additional support numbers
Asia Pacific: +86 0400

\section*{SCE Series, Specification Grade Discrete Plug-in, True Off-Delay Time Delay Relay}


\section*{Product Facts}

■ True Off-Delay timing modes
■ Six time delays from 0.1 sec. to 10 min .
- 10A SPDT or 5A DPDT output contacts
- Excellent repeat accuracy - typically better than \(\pm 1 \%\)
- 8-pin octal plug.

■ File E15631, File LR51332


CAUTION: If unit has not been energized for several months, apply operating voltage for 20 minutes prior to initial time delay.
Timing Specifications
Timing Modes -
True Off-Delay - Upon application of operating voltage (min. 100 ms ), output relay contacts transfer. When operating voltage is removed, the time delay period is initiated. At the end of the delay period, output relay contacts release. If operating voltage is reapplied prior to expiration of the delay period, the delay will be cancelled and output relay contacts will remain transferred.

\section*{Timing Ranges -}
0.1 to \(3 / 0.5\) to \(15 / 1\) to \(30 / 4\) to 120 / 10 to 300 sec.; 0.33 to 10 min.
Timing Adjustment -
Knob adjustment - Internal potentiometer with external knob adjustment. Maximum time calibrated with + \(10 \%\), \(0 \%\) of values shown below at rated voltage, at \(68^{\circ} \mathrm{F}\).
Fixed time - internal fixed resistor.
Users should thoroughly review the technical data before selecting a product part number. It is recommended that user also seek out the pertinent approvals files of the agencies/laboratories and review them to ensure the product meets the requirements for a given application.


Outline Dimensions

Wiring Diagrams (Bottom Views)


Accuracy -
Repeat Accuracy \(- \pm 1\)
Overall Accuracy - \(\pm 5 \%\)
Reset Time - \(30 \mathrm{~ms} . \mathrm{min}\).
Relay Operate Time - 30 ms .
Contact Data @ \(25^{\circ} \mathrm{C}\)
Arrangements - 1 Form C (SPDT)
and 2 Form C (DPDT)
Rating -
1 Form C—10A@120/240VAC, resistive; 1/3 HP @ 120VAC; 345VA @ 120VAC; 1/4 HP @ 240VAC; 275VA @ 240VAC. Same polarity.
2 Form C — 5 A @ 28VDC or
120/240VAC, resistive; 1/6 HP @ 120/240VAC; 200VA @ 120/240VAC. Same polarity.

\section*{Expected Mechanical Life -}

10 million operations
Expected Electrical Life - 200,000 operations, min., at rated resistive load Initial Dielectric Strength Between Terminals and Case and relay contacts and active circuitry 1,480VAC for one minute

Input Data @ \(25^{\circ} \mathrm{C}\)
Voltage - See Ordering Information section for details
Power Requirement - 750 mW
Transient Protection - \(1,000 \mathrm{~V}\) plus
twice rated voltage for 0.1 ms
Environmental Data
Temperature Range -
Storage - \(-40^{\circ} \mathrm{C}\) to \(+85^{\circ} \mathrm{C}\)
Operating - \(-30^{\circ} \mathrm{C}\) to \(+65^{\circ} \mathrm{C}\)
Mechanical Data
Mounting/Termination - 8 -pin octal plug fits either 27 E 122 or 27 E891 (snap-on) socket (order separately) Weight - 4 oz. (112g) approximately

Ordering Information (All "X's" must be included to complete part number)


Authorized distributors are likely to stock the following:
None at present.

\section*{SCF Series, Programmable, Time Delay Relay}


\section*{Product Facts}
- 4 user-programmable timing modes
■ 0.1 sec. to 10 hr . programmable timing range

■ Parameters set with recessed dials

■ Narrow width saves panel space
■ 10A DPDT output relay
■ Socket can be DIN-rail or back panel mounted

■ File E15631(relay) and E140494 (socket)
■ File LR29186 (relay) and LR29513M7 (socket)

Users should thoroughly review the technical data before selecting a product part number. It is recommended that user also seek out the pertinent approvals files of the agencies/laboratories and review them to ensure the product meets the requirements for a given application.


\section*{Timing Modes}

Modes are user selectable via screwdriver adjustment of recessed 4-position selector dial.
Modes offered are: On-Delay, Off-Delay, Interval and Latching Interval.
Timing Specifications
Timing Ranges - 0.1 to \(3 / 0.33\) to 10 / 1 to 30 / 4 to 120 sec.; 0.33 to 10 / 1 to \(30 / 2\) to 60 min.; 0.33 to 10 hr .
Timing Range Selection -
Screwdriver select via recessed 8-position selector dial.
Timing Adjustment - External knob potentiometer adjustment with reference calibrations.
Accuracy -
Repeat Accuracy \(- \pm 1 \% \pm 0.01 \mathrm{sec}\).
Overall Accuracy - \(\pm 3 \% \pm 0.01 \mathrm{sec}\).
Reset Time - 30 ms .
Relay Operate Time - On-Delay and Interval mode: 55 ms .
Relay Release Time - Off-Delay,
Interval and Latching Interval: 40 ms .

Contact Data @ \(25^{\circ} \mathrm{C}\)
Arrangements - 2 Form C (DPDT)
Rating — 10A @ 28VDC or 120VAC, resistive; 1/3 HP @ 120/240VAC 345VA.
Expected Mechanical Life 10 million operations.
Expected Electrical Life - 500,000
operations, min., at rated resistive load. Initial Dielectric Strength -
Between Terminals and Case -
1,000VAC plus twice the nominal voltage for one minute.
Input Data @ \(25^{\circ} \mathrm{C}\)
Voltage — See Ordering Information section for details.
Power Requirement - 2W, max
Transient Protection -
Non-repetitive transients of the following magnitudes will not cause spurious operation of affect function and accuracy.
\begin{tabular}{ccc}
\hline \begin{tabular}{c} 
Operating \\
Voltage
\end{tabular} & \(<0.1 \mathrm{~ms}\) & \(<1 \mathrm{~ms}\) \\
\hline 12VDC & \(1,000 \mathrm{~V}\) & \(240 \mathrm{~V}^{*}\) \\
\hline \(24 \mathrm{VAC} / \mathrm{VDC}\) & \(1,000 \mathrm{~V}\) & \(240 \mathrm{~V}^{*}\) \\
\hline 48 VAC/VDC & \(1,000 \mathrm{~V}\) & \(480 \mathrm{~V}^{*}\) \\
\hline \begin{tabular}{c}
120 VAC \\
125 VDC
\end{tabular} & \(3,000 \mathrm{~V}\) & \(2,500 \mathrm{~V}^{*}\) \\
\hline 240VAC/VDC & \(3,000 \mathrm{~V}\) & \(2,500 \mathrm{~V}^{*}\) \\
\hline *Minimum source impedance of 100 hm
\end{tabular}

\section*{Environmental Data \\ Temperature Range - \\ Storage - \(-40^{\circ} \mathrm{C}\) to \(+85^{\circ} \mathrm{C}\).}

Operating \(-30^{\circ} \mathrm{C}\) to \(+65^{\circ} \mathrm{C}\).

\section*{Mechanical Data}

Mounting/Termination - 11-pin
octal-type plug for use with mating socket. Mount relay in horizontal position (pins horizontal, knob down, LEDs up).
Status Indication - Power On LED and Output Contacts LED.
Weight — Relay: 3.5 oz. (156g)
approx.; Socket: 1.7 oz. (48.3g) approx.

\section*{Outline Dimensions}


SCF Timer

Ordering Information (All "X's" must be included to complete part number)


\section*{Authorized distributors are likely to stock the following:}

None at present.


Product Facts
■ Repeat Cycle timing mode
■ Dual knobs for user adjustment of on and off times
■ 13 timing ranges from 0.1 sec. to 60 min .
■ 10A DPDT output contacts
■ Exceptional immunity to line transients and noise
- Premium components enhance reliability
■ Superior reset time of 24 msec.

C

Users should thoroughly review the technical data before selecting a product part number. It is recommended that user also seek out the pertinent approvals files of the agencies/laboratories and review them to ensure the product meets the requirements for a given application.

\section*{SRC Series, Specification Grade Repeat Cycle, Plug-in Time Delay Relay}

Timing Specifications Timing Modes -
Repeat Cycle: Application of line voltage starts the pre-set OFF-time period Upon expiration of the period, the output relay is energized, its contacts transfer, and the pre-set ON-time period begins. At the end of this period the output relay is deenergized, and a new cycle begins. The OFF and ON cycles continue until power is removed. To reset the timer, input voltage must be removed for at least 25 ms .
Timing Ranges - OFF time and ON time ranges need not be the same. 6 to 180 cycles; 0.1 to \(3 / 1\) to 10 / 0.5 to 15 / 1 to 30 / 2 to \(60 / 4\) to 120 / 6 to 180 / 10 to 300 sec.; 0.33 to 10 / 0.5 to 15 / 1 to 30 / 2 to 60 min . (All are \(+10 \%,-1 \%\) of maximum values).
Timing Adjustment - Two internal potentiometers with external knobs.

\section*{Accuracy -}

Repeat Accuracy - \(\pm 1 \% \pm 0.004\) sec.
Overall Accuracy - \(\pm 2.25 \%\) max.
Reset Time - 25 ms . max. (between deenergization and reenergization without affecting accuracy.)
Relay Operate Time - 20 ms .
Relay Release Time - 15 ms .

Contact Data @ \(25^{\circ} \mathrm{C}\)
Arrangements - 2 Form C (DPDT)
Rating - 10A @ 28VDC or 120VAC resistive; \(1 / 3\) HP @ 120/240VAC.
Expected Mechanical Life -
10 million operations
Expected Electrical Life - 500,000 operations, min., at rated resistive load. Initial Dielectric Strength -
Between Terminals \& Case and Mutually Isolated Contacts - \(1,480 \mathrm{VAC}\)
Input Data @ \(25^{\circ} \mathrm{C}\)
Voltage - See Ordering Information section for details.
Power Requirement - 3 W max.
Transient Protection - Non-repetitive transients of the following magnitudes will not cause spurious operation of affect function and accuracy.
\begin{tabular}{ccc}
\hline \begin{tabular}{c} 
Operating \\
Voltage
\end{tabular} & \(<0.1 \mathrm{~ms}\) & \(<1 \mathrm{~ms}\) \\
\hline 12 VDC & \(1,000 \mathrm{~V}\) & \(240 \mathrm{~V}^{*}\) \\
\hline 12 VDC & \(1,000 \mathrm{~V}\) & \(24 \mathrm{~V}^{*}\) \\
\hline \(24 \mathrm{VAC} / \mathrm{VDC}\) & \(1,000 \mathrm{~V}\) & \(24 \mathrm{~V}^{*}\) \\
\hline \(48 \mathrm{VAC} / \mathrm{VDC}\) & \(1,000 \mathrm{~V}\) & \(48 \mathrm{~V}^{*}\) \\
\hline \(120 \mathrm{VAC} / \mathrm{VDC}\) & \(3,000 \mathrm{~V}\) & \(2,50 \mathrm{~V}^{*}\) \\
\hline 240 VAC & \(3,000 \mathrm{~V}\) & \(2,500 \mathrm{~V}^{*}\) \\
\hline *Minimum source impedance of 100 ohm
\end{tabular}

Environmental Data
Temperature Range -
Storage \(-40^{\circ} \mathrm{C}\) to \(+85^{\circ} \mathrm{C}\) Operating - \(-30^{\circ} \mathrm{C}\) to \(+65^{\circ} \mathrm{C}\)

\section*{Mechanical Data}

Mounting/Termination -
Quick connect terminals fit either 27E121 or 27E893 (snap-on) socket (order separately)
Weight - 5.3 oz. (149g) approximately


Outline Dimensions


Wiring Diagram (Bottom View)

\section*{Ordering Information}


Authorized distributors are likely to stock the following:
None at present.


\section*{Product Facts}

■ On-Delay, Off-Delay and Interval timing modes
■ 13 timing ranges from 0.1 sec. to 60 min .

■ 10A DPDT output contacts
■ Excellent repeatability of \(\pm 1 \%\) or better.
- Exceptional immunity to transients and noise.

■ Wide operating temperature range.
- File 3520, File LR29186 ․․ © \(\mathrm{Cb}^{\circ} \mathrm{C}\)

Users should thoroughly review the technical data before selecting a product part number. It is recommended that user also seek out the pertinent approvals files of the agencies/laboratories and review them to ensure the product meets the requirements for a given application.

Contact Data @ \(25^{\circ} \mathrm{C}\)
Arrangements - 2 Form C (DPDT)
Rating — 10A @ 28VDC or 120VAC resistive; 1/3 HP @ 120/240VAC.
Expected Mechanical Life 10 million operations
Expected Electrical Life - 500,000 operations, min., at rated resistive load. Initial Dielectric Strength Between Terminals and Case 1,000 VAC plus twice the nominal voltage for one minute.

Input Data @ \(\mathbf{2 5}^{\circ} \mathrm{C}\)
Voltage - See Ordering Information section for details.
Power Requirement - 3W max
Transient Protection -Non-repetitive transients of the following magnitudes will not cause spurious operation of affect function and accuracy.
\begin{tabular}{|c|c|c|}
\hline Operating Voltage & \(<0.1\) ms & <1 \\
\hline VDC & ,000 & \(240 \mathrm{~V} *\) \\
\hline DC & 1,000 & \(240 \mathrm{~V} *\) \\
\hline VAC/VDC & ,000 & \(240 \mathrm{~V}^{*}\) \\
\hline VAC/VDC & 1,000 & \(480 \mathrm{~V}^{*}\) \\
\hline 20 VAC/VDC & 3,000 & 2,500 \\
\hline 240VAC & 3,000 & 2,50 \\
\hline \multicolumn{3}{|l|}{\({ }^{*}\) Minimum source impedance of 100 ohm} \\
\hline \multicolumn{3}{|l|}{\begin{tabular}{l}
Environmental Data \\
Temperature Range - \\
Storage \(-40^{\circ} \mathrm{C}\) to \(+85^{\circ} \mathrm{C}\) \\
Operating - \(-30^{\circ} \mathrm{C}\) to \(+65^{\circ} \mathrm{C}\)
\end{tabular}} \\
\hline \multicolumn{3}{|l|}{\multirow[t]{2}{*}{\begin{tabular}{l}
Mechanical Data \\
Mounting/Termination - \\
8- or 11 -pin octal type plug. 8-pin types fit either 27 E 122 or 27 E 891 , while 11-pin types fit 27 E 123 or 27 E 892.
\end{tabular}}} \\
\hline & & \\
\hline \multicolumn{3}{|l|}{Weight - 4 oz. (112g) a} \\
\hline
\end{tabular}

Weight - 4 oz. (112g) approximately

\section*{Ordering Information}


Authorized distributors are likely to stock the following:
\begin{tabular}{lll} 
SSC12AAA & SSC12ACA & SSC12AGA \\
SSC12ABA & SSC12ADA & SSC12ALA
\end{tabular}

Timing Specifications
Timing Modes -
On-Delay, Off-Delay and Interval
Timing Ranges - 6 to 180 cycles;
0.1 to 3 / 0.1 to 10 / 0.33 to 10 / 1 to 30 / 4 to 120 sec.; 0.33 to 10 / 1 to 30 / 2 to 60 min.; 0.33 to 10 hr. (All are +10\%, 1\% of maximum values)
Timing Adjustment - Knob or fixed time (internal fixed resistor) - all models; customer supplied external potentiometer or resistor - On-Delay and interval models only.

\section*{Accuracy -}

Repeat Accuracy - \(\pm 1 \% \pm 0.004 \mathrm{sec}\). at any combination of operating temperature and voltage.
Overall Accuracy - \(\pm 5.25 \%\) throughout
operating temperature and voltage ranges.

Reset Time - 25 ms . (minimum deenergized interval for on-delay or offdelay models, or minimum required closure interval for interval models without affecting accuracy.)
Relay Operate Time - Off-Delay mode only: 35 ms
Relay Release Time - On-Delay mode only: 20 ms

Outline Dimensions


Off-Delay
Fixed or Knob Adjust



Wiring Diagrams (Bottom Views)

\title{
SSC Series, Specification Grade Discrete Plug-in, Time Delay Relay
}

\footnotetext{
Dimensions are shown for reference purposes only. Specifications subject
} to change

\section*{Dimensions are in millimeters} unless otherwise specified.


Product Facts
- 4 user-programmable timing modes
■ 0.1 sec. to 10 hr . programmable timing range
■ Parameters set with recessed screwdriver dials

■ Universal voltage (plug-in relay dependent)

■ 10A DPDT replaceable output relay minimizes downtime
- Front screw terminals
- DIN-rail, panel or machine tool track mount
■ File E15631, File LR29186 . \({ }^{\circ}\) (1)

Users should thoroughly review the technical data before selecting a product part number. It is recommended that user also seek out the pertinent approvals files of the agencies/laboratories and review them to ensure the product meets the requirements for a given application.

\section*{SSF Series, Programmable Time Delay Relay}

Timing Specifications
Timing Modes -
Modes are user selectable via screwdriver adjustment of recessed 4 -position selector dial.
Modes offered are: On-Delay, Off-Delay, Interval and Latching Interval.
Timing Ranges - 0.1 to 3 / 0.33 to
10 / 1 to 30 / 4 to 120 sec.; 0.33 to 10 / 1 to \(30 / 2\) to 60 min.; 0.33 to 10 hr .

\section*{Timing Range Selection -}

Screwdriver select via recessed
8 -position selector dial.
Timing Adjustment - Recessed potentiometer adjustment with reference calibrations.

\section*{Accuracy -}

Repeat Accuracy \(- \pm 1 \% \pm 0.01 \mathrm{sec}\). Overall Accuracy - \(\pm 3 \% \pm 0.01 \mathrm{sec}\). Reset Time - 30 ms .
Relay Operate Time - On-Delay and Interval mode: 30 ms . Relay Release Time - Off-Delay, Interval and Latching Interval: 30 ms . (with factory-installed relay).

Contact Data @ \(25^{\circ} \mathrm{C}\)
Arrangements - 2 Form C (DPDT).
Rating - 10A @ 28VDC or 120VAC, resistive; \(1 / 3 \mathrm{HP}\) @ 120/240VAC 345VA.
Expected Mechanical Life -
10 million operations (with factoryinstalled relay).
Expected Electrical Life - 500,000
operations, min., at rated resistive load
(with factory-installed relay).
Initial Dielectric Strength -
Between Coil/Control Switch and Contacts - \(1,500 \mathrm{VAC}\) for one minute.
Input Data @ \(\mathbf{2 5}{ }^{\circ} \mathrm{C}\)
Voltage - See Ordering Information section for details.
Power Requirement - 2 W max.

Transient Protection -
Non-repetitive transients of the following magnitudes will not cause spurious operation of affect function and accuracy.
\begin{tabular}{|c|c|c|}
\hline Operating Voltage & \(<0.1\) ms & \(<1 \mathrm{~ms}\) \\
\hline & ,000 & 480 V \\
\hline 120, VAC/V & 3,000V & 250 \\
\hline \multicolumn{3}{|l|}{* Min. source impedance of 100 ohm@120/240VAC, 3000V <0.1 sec.Environmental Data} \\
\hline \multicolumn{3}{|l|}{\begin{tabular}{l}
Environmental Data \\
Temperature Range - \\
Storage \(-40^{\circ} \mathrm{C}\) to \(+85^{\circ} \mathrm{C}\) \\
Operating - \(-30^{\circ} \mathrm{C}\) to \(+65^{\circ} \mathrm{C}\)
\end{tabular}} \\
\hline \multicolumn{3}{|l|}{\multirow[t]{2}{*}{\begin{tabular}{l}
Mechanical Data \\
Mounting/Termination - Panel, DIN-rail, Machine Tool mounting track mounting case with screw terminals. Weight - 5.5 oz. (156g) approximately
\end{tabular}}} \\
\hline & & \\
\hline
\end{tabular}

\(\dagger\) Voltage determined by customer-supplied relay. Only relays that operate on the above-listed voltages should be used. Timer operation using other relay voltages is not recommended.

Authorized distributors are likely to stock the following:
SSFR90A
SSFR90X
\begin{tabular}{|c|c|c|c|c|}
\hline Catalog 5-1773450-5 Revised 3-13 & Dimensions are shown for reference purposes only. Specifications subject & Dimensions are in millimeters unless otherwise specified. & \begin{tabular}{l}
USA: +1 8005226752 \\
Asia Pacific: +86 04008206015 UK: +44 800267666
\end{tabular} & For additional support numbers please visit www.te.com \\
\hline www.te.com & to change. & & & \\
\hline
\end{tabular}


Product Facts
■ On-Delay, Off-Delay, Interval, One Shot \& Repeat modes
■ Time delays to 120 min .
- Fast setting with time calibrated knobs
- Superior transient protection
■ Rugged construction with 8- or 11-pin plug
■ Flame retardant housing
■ File E15631, File LR33434 -

Ordering Information
SST2 - Off Delay Types
\begin{tabular}{ccc}
\hline Input & Time Range & Part No. \\
\hline & \(0.1-10\) sec. & SST22AAA \\
\cline { 2 - 3 } 120 & \(1.8-180\) sec. & SST22ADA \\
\cline { 2 - 3 } VAC & \(3-300\) sec. & SST22AEA \\
\cline { 2 - 3 } & 18 sec. -30 min. & SST22AGA \\
\cline { 2 - 3 } & 36 sec. -60 min & SST22AHA \\
\hline 24 & \(0.1-10\) sec. & SST22EAA \\
\cline { 2 - 3 } VAC & \(1.8-180\) sec. & SST22EDA \\
\hline 24 & \(0.1-10\) sec. & SST22OAA \\
\cline { 2 - 3 } VDC & \(1.8-180\) sec. & SST22ODA \\
\hline 12 & \(0.1-10\) sec. & SST22QAA \\
\cline { 2 - 3 } & \(1.8-180\) sec. & SST22QDA \\
\hline
\end{tabular}

SST3 - Interval Types
\begin{tabular}{ccc}
\hline Input & Time Range & Part No. \\
\hline & \(0.1-10\) sec. & SST32AAA \\
\cline { 2 - 3 } 120 & \(1.8-180\) sec. & SST32ADA \\
\cline { 2 - 3 } VAC & \(3-300\) sec. & SST32AEA \\
\cline { 2 - 3 } & 36 sec. -60 min. & SST32AHA \\
\hline 24 & \(0.1-10\) sec. & SST32EAA \\
\cline { 2 - 3 } VAC & \(1.8-180\) sec. & SST32EDA \\
\hline 24 & \(0.1-10\) sec. & SST22OAA \\
\cline { 2 - 3 } VDC & \(1.8-180\) sec. & SST32ODA \\
\hline 12 & \(0.1-10\) sec. & SST32QAA \\
\cline { 2 - 3 } VDC & \(1.8-180\) sec. & SST32QDA \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|}
\hline Input & Time Range & Part No. \\
\hline \multirow{6}{*}{\[
\begin{aligned}
& 120 \\
& \text { VAC }
\end{aligned}
\]} & 0.1-10 sec. & SST12AAA \\
\hline & 0.6-60 sec. & SST12ACA \\
\hline & 1.8-180 sec. & SST12ADA \\
\hline & 3-300 sec. & SST12AEA \\
\hline & \(18 \mathrm{sec} .-30 \mathrm{~min}\). & SST12AGA \\
\hline & \(36 \mathrm{sec} .-60 \mathrm{~min}\). & SST12AHA \\
\hline \multirow{3}{*}{\[
\begin{gathered}
24 \\
\text { VAC }
\end{gathered}
\]} & \(0.1-10 \mathrm{sec}\). & SST12EAA \\
\hline & 1.8-180 sec. & SST12EDA \\
\hline & 3-300 sec. & SST12EEA \\
\hline \multirow{3}{*}{\[
\begin{gathered}
24 \\
\text { VDC }
\end{gathered}
\]} & \(0.1-10 \mathrm{sec}\). & SST120AA \\
\hline & 1.8-180 sec. & SST120DA \\
\hline & 3-300 sec. & SST120EA \\
\hline \multirow{3}{*}{\[
\begin{gathered}
12 \\
\text { VDC }
\end{gathered}
\]} & \(0.1-10 \mathrm{sec}\). & SST12QAA \\
\hline & 1.8-180 sec. & SST12QDA \\
\hline & 3-300 sec. & SST12QEA \\
\hline
\end{tabular}

SST1 - On Delay Types

Users should thoroughly review the technical data before selecting a product part number. It is recommended that user also seek out the pertinent approvals files of the agencies/laboratories and review them to ensure the product meets the requirements for a given application.

\section*{SST Series, Industrial Grade Discrete Plug-in, Time Delay Relay}

Expected Mechanical Life -
10 million operations
Expected Electrical Life - 500,000 operations, min., at rated resistive load. Initial Dielectric Strength -
Between Contacts, Line Inputs and Control Circuits - 1,500 V RMS, minimum, at 60 Hz .

\section*{Input Data @ \(25^{\circ} \mathrm{C}\)}

Voltage - See Ordering Information section for details.
Power Requirement - 3 W max. Transient Protection -
Non-repetitive transients of the following magnitudes will not cause spurious operation of affect function and accuracy.
\begin{tabular}{ccc}
\hline \begin{tabular}{c} 
Operating \\
Voltage
\end{tabular} & \(<0.1 \mathrm{~ms}\) & \(<1 \mathrm{~ms}\) \\
\hline 12 VDC & \(1,000 \mathrm{~V}\) & \(240 \mathrm{~V}^{*}\) \\
\hline \begin{tabular}{c}
12 \& \\
\(24 \mathrm{VAC} / \mathrm{VDC}\)
\end{tabular} & 860 V & \(208 \mathrm{~V}^{\star}\) \\
\hline 120 VAC & \(2,580 \mathrm{~V}\) & \(2,150 \mathrm{~V}^{*}\) \\
\hline
\end{tabular}
*Minimum source impedance of 100 ohm.
Environmental Data
Temperature Range -
Storage \(-23^{\circ} \mathrm{C}\) to \(+71^{\circ} \mathrm{C}\)
Operating - \(-23^{\circ} \mathrm{C}\) to \(+54^{\circ} \mathrm{C}\)
Mechanical Data
Mounting/Termination - On-Delay, Interval and Repeat types have 8- pin octal plug that fits either 27E122 or 27 E891 socket. Off-Delay and One Shot types have 11-pin octal-type plug that fits \(27 E 123\) or \(27 E 892\). Sockets must be ordered separately.
Weight - 4 oz. (112g) approximately

Rating - 10A @ 120/240VAC, resistive; 1/3 HP @ 120/240VAC, 50/60 Hz.

Timing Specifications
Timing Modes -
On-Delay, Off-Delay, Interval, One Shot (Latching Interval) or Repeat Cycle.
Timing Ranges - Nine ranges spanning 0.1 sec. to 120 min .
Timing Adjustment — Knob adjust.

\section*{Accuracy -}

Repeat Accuracy - \(\pm 1 \%\)
Overall Accuracy — \(\pm 5 \%\)
Reset Time - 50 ms ., max., ( 25 ms typ.) for on-delay and interval; 300 ms , max., for off-delay and one shot; 500 ms, max., for repeat type.
Relay Operate Time - 50 ms .
Relay Release Time - 30 ms .
Contact Data @ \(25^{\circ} \mathrm{C}\)
Arrangements - 2 Form C (DPDT)


Outline Dimensions

\section*{STA Series, Specification Grade Discrete Plug-in, Time Delay Relay With QC Terminals}


Product Facts
■ On-Delay, Off-Delay, Interval and Accumulating On-Delay timing modes
- 13 timing ranges from 0.1 sec. to 48 hr .

■ 10A DPDT output contacts
- Knob, fixed or external timing adjustment
- QC plug-in terminals save space, two LEDs show status
■ File 3520, File E60363, File LR51332


\section*{Timing Specifications}

Timing Modes -
On-Delay, Off-Delay, Interval and Accumulating On-Delay.
Timing Ranges - 6 to 180 cycles; 0.1 to \(3 / 0.5\) to 15 / 1 to \(30 / 2\) to 60 / 4 to \(120 / 6\) to 180 / 10 to 300 sec.; 0.33 to 10 / 0.5 to 15 / 1 to 30 min.; 1 to 6 / 2 to 48 hr. (All are \(+5 \%,-0 \%\) of maximum values).
Timing Adjustment - Knob or fixed time (internal fixed resistor) - all models; customer supplied external potentiometer or resistor - On-Delay and Interval models only.

\section*{Accuracy -}

Repeat Accuracy - \(\pm .5 \% \pm 0.004 \mathrm{sec}\).
Overall Accuracy - \(\pm 2 \%\) throughout operating temperature and voltage ranges.
Reset Time - 30 ms . min. (between deenergization and reenergization without affecting accuracy.)
Relay Operate Time - Off-Delay mode: 35 ms .; Interval mode - 20 ms .
Relay Release Time - On-Delay and Accumulating On-Delay modes 20 ms

Users should thoroughly review the technical data before selecting a product part number. It is recommended that user also seek out the pertinent approvals files of the agencies/aboratories and review them to ensure the product meets the requirements for a given application.



Off-Delay \& Accumulating On-Delay Fixed or Knob Adjust

EXT. RES.



Wiring Diagrams (Bottom Views)

Contact Data @ \(25^{\circ} \mathrm{C}\)
Arrangements-2 Form C (DPDT).
Rating - 10A @ 28VDC or 120VAC, resistive; \(1 / 3 \mathrm{HP}\) @ 120/240VAC; 345VA. Same polarity.
Expected Mechanical Life 10 million operations
Expected Electrical Life - 500,000
operations, min., at rated resistive load.
Initial Dielectric Strength -
\(1,000 \mathrm{VAC}\) plus twice the nominal voltage for one minute.

Input Data @ \(\mathbf{2 5}^{\circ} \mathrm{C}\)
Voltage - See Ordering Information section for details.
Power Requirement - 3W max.
Transient Protection -
Non-repetitive transients of the following magnitudes will not cause spurious operation of affect function and accuracy.
\begin{tabular}{ccc}
\hline \begin{tabular}{c} 
Operating \\
Voltage
\end{tabular} & \(<0.1 \mathrm{~ms}\) & \(<1 \mathrm{~ms}\) \\
\hline \begin{tabular}{c} 
All except \\
\(12 ~ \& ~ 24 ~\)
\end{tabular} & \(3,000 \mathrm{~V}\) & 2,500 \\
\hline \(12 \& 24\) & \multicolumn{2}{c}{\begin{tabular}{c} 
Consult \\
Factory
\end{tabular}} \\
\hline
\end{tabular}

Environmental Data
Temperature Range -
Storage - \(-40^{\circ} \mathrm{C}\) to \(+85^{\circ} \mathrm{C}\)
Operating - \(-30^{\circ} \mathrm{C}\) to \(+65^{\circ} \mathrm{C}\)

\section*{Mechanical Data}

Mounting/Termination -
Quick connect terminals fit either
27E121 or 27E893 (snap-on) socket (order separately).
Status Indication — Power On LED and Output Contacts LED (optional).
Weight - 4.2 oz. (119g) approximately.

Ordering Information (All "X's" must be included to complete part number)

\begin{tabular}{|c|c|}
\hline Operating Voltage
\[
(+10 \%,-15 \%)
\] & Timing Adjustment \(X A=\) Knob Adjust \\
\hline \(\mathrm{A}=120 \mathrm{VAC}, 50 / 60\) & XB \(=\) External \\
\hline Hz. / 120VDC & Potentiometer or \\
\hline \(\mathrm{E}=24 \mathrm{VAC}, 50 / 60 \mathrm{~Hz}\). & resistor (Operating \\
\hline / 24VDC & modes 1 and 3 only). \\
\hline \(\mathrm{F}=48 \mathrm{VAC}, 50 / 60 \mathrm{~Hz}\). & XF =Fixed Times -Specify \\
\hline / 48VDC & time delay in seconds \\
\hline \(Q=12 V D C\) & per the following \\
\hline & examples: \\
\hline & XF9.000 \(=9 \mathrm{sec}\). \\
\hline & XF99.00 \(=99 \mathrm{sec}\). \\
\hline & XF999.0 \(=9999 \mathrm{sec}\) \\
\hline & \(X F 1000=1000\) sec . \\
\hline
\end{tabular}

Authorized distributors are likely to stock the following:
None at present.

Dimensions are in millimeters unless otherwise specified.

For additional support numbers please visit www.te.com

Specialty Relays

\section*{VTM1 Series, On-Delay, Timing Module}


Product Facts
■ On-delay timing mode
- Reliable solid state timing circuitry

■ Excellent transient protection
- Compact design

■ Flame retardant, solvent resistant housing

■ File E60363, File LR33434

(1)

Users should thoroughly review the technical data before selecting a product part number. It is recommended that user also seek out the pertinent approvals files of the agencies/laboratories and review them to ensure the product meets the requirements for a given application.

Timing Specifications
Timing Mode - On-Delay
Timing Ranges - 0.5 to \(10 / 3\) to 60
sec.; 0.5 to \(10 / 3\) to 60 min .
Timing Range Selection -
Screwdriver select via recessed 8 -position selector dial.
Timing Adjustment - External resistor or potentiometer. An external resistance of 1 megohm is required to obtain the maximum time for all ranges. To determine the actual resistance needed to obtain the required time delay, use the following formula:
\(R_{T}=\frac{\left(T_{\text {REQ }}-T_{\text {MII }}\right)}{T_{\text {MAX }}-T_{\text {MIN }}} \times 1,000,000\) ohms

\section*{Accuracy -}

Repeat Accuracy — \(\pm 1 \%\)
Overall Accuracy - \(\pm 2 \%\) at
\(\mathrm{R}=1\) megohm
Reset Time - 100 ms , max., before

Output Switch
Arrangement - Solid state 1 Form A (SPST-NO)
Rating - 1A, inductive, at nominal operating voltage.
Expected Electrical Life 10,000,000 operations at rated load.
Initial Dielectric Strength Between Terminals and Mounting \(3,000 \mathrm{VAC}\) rms.
Between Input and Output 1,500VAC rms.
time-out; 10 ms , max., after time-out.


Outline Dimensions


Ordering Information
\begin{tabular}{|c|c|c|}
\hline VTM1 & A & CD \\
\hline & - & \\
\hline Series VTM1 & Input Voltage & Time Range \\
\hline On-Delay & \(\mathrm{A}=12 \mathrm{OVAC} / \mathrm{NDC}\) & \(C D=0.5-10 \mathrm{sec}\). \\
\hline Timing Module & \(\mathrm{E}=24 \mathrm{VAC} / \mathrm{NDC}\) & DD \(=3-60 \mathrm{sec}\). \\
\hline & \(Q=12 \mathrm{VAC} / \mathrm{NDC}\) & \(\mathrm{FD}=0.5-10 \mathrm{~min}\). \\
\hline
\end{tabular}

Authorized distributors are likely to stock the following:
VTM1ECD
VTM1EDD

Dimensions are in millimeters unless otherwise specified.

Input Data @ \(\mathbf{2 5}^{\circ} \mathrm{C}\)
Voltage - 12 VAC/VDC, 24VAC/VDC, 120 VACNDC.
Power Requirement - 3W max.
Transient Protection -
Non-repetitive transients of the following magnitudes will not cause spurious operation of affect function and accuracy.
\begin{tabular}{ccc}
\hline \begin{tabular}{c} 
Operating \\
Voltage
\end{tabular} & \(<0.1 \mathrm{~ms}\) & \(<1 \mathrm{~ms}\) \\
\hline 12, \\
\(24 \mathrm{VAC} / \mathrm{VDC}\) & \(860 \mathrm{~V}^{\star}\) & \(208 \mathrm{~V}^{\star}\) \\
\hline \(120 \mathrm{VAC} / \mathrm{VDC}\) & \(2,580 \mathrm{~V}\) & \(2,150 \mathrm{~V}^{*}\) \\
\hline\({ }^{*}\) Min. Source impedance of 100 ohm.
\end{tabular}

\section*{Environmental Data}

Temperature Range -
Storage - \(-40^{\circ} \mathrm{C}\) to \(+85^{\circ} \mathrm{C}\)
Operating - \(-40^{\circ} \mathrm{C}\) to \(+65^{\circ} \mathrm{C}\)

\section*{Mechanical Data}

Mounting - Panel mount with one \#8 screw.
Termination - 0.250 in (6.35) quick
connect terminals.
Weight - 3 oz. (84g) approximately

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Dimensions are shown for reference purposes only. Specifications subject to change.

For additional support numbers please visit www.te.com

\section*{VTM-1 Series, Specification Grade, On-Delay, Timing Module}


Product Facts
■ On-delay timing mode
- Timing from 1 to 1000 sec.
- 1A solid state SPST-NO output
■ 0.25" (6.35) quick connect terminals

■ Universal voltage: 24 to 240VAC/VDC
- Rated to 10 million operations

■ File E60363, File LR51332


Users should thoroughly review the technical data before selecting a product part number. It is recommended that user also seek out the pertinent approvals files of the agencies/laboratories and review them to ensure the product meets the requirements for a given application.

\section*{Timing Specifications}

Timing Mode - On-Delay - VTM-1 in-line timing module is wired in series with the Ioad circuit. Time delay is initiated when power is applied to the series network. Connecting a resistor across the center terminals provides tamper-proof setting of time delay from 1-1000 sec.
Timing Ranges - 1 to \(1,000 \mathrm{sec}\).
Timing Adjustment - Time delay is set by connecting an appropriately rated resistor or potentiometer between the center two terminals. As supplied, the unit provides a nominal 1 second delay. Add 10k ohm of resistance for every additional second of delay required. For example: 5 seconds \(=40 \mathrm{k}\) ohms; 10 seconds \(=90 \mathrm{k}\) ohms.

\section*{Accuracy -}

Repeat Accuracy - \(\pm 2 \%\)
Reset Time - 100 ms , max., in the timing or time-out condition.
\begin{tabular}{|c|c|}
\hline Output Switch Data & Input Data @ \(25^{\circ} \mathrm{C}\) \\
\hline Arrangement - 1 Form A (SPST-NO) & Operating Voltage - Universal - \\
\hline Rating - 5 A , inductive, at nominal & 24-240VAC/VDC (19-288VAC/VDC). \\
\hline operating voltage. & Current - 2 mA (max.) required to \\
\hline Inrush - Not to exceed 10A for one & operate timer regardless of output state. \\
\hline cycle. & Power Requirement - 3W max. \\
\hline Max. Leakage Current - 4mA rms & Transient Protection - \\
\hline \begin{tabular}{l}
Expected Electrical Life - \\
10,000,000 operations at rated load.
\end{tabular} & MOV across input 2,000V for 11 s on line side of load. \\
\hline \multirow[t]{8}{*}{Initial Dielectric Strength Between Active Terminals and Outside of Case - \(1,480 \mathrm{VAC}\) for one min.} & Environmental Data \\
\hline & Temperature Range - \\
\hline & Storage - \(-40^{\circ} \mathrm{C}\) to \(+85^{\circ} \mathrm{C}\) \\
\hline & Operating - \(-30^{\circ} \mathrm{C}\) to \(+65^{\circ} \mathrm{C}\) \\
\hline & Mechanical Data \\
\hline & Mounting - Screw mount in horizontal or vertical position through built-in mounting ears. \\
\hline & Termination - 0.250 in (6.35) quick connect terminals for input line, load output and timing resistor connection. \\
\hline & Weight - 3 oz. (84g) approximately \\
\hline
\end{tabular}


Outline Dimensions

Ordering Information




Notes:
1. Do not operate timer without connecting load in series with line voltage.
2. For a time delay of 1 second, connect a jumper across the center two terminals.

\section*{Authorized distributors are likely to stock the following:}

VTM-1


Product Facts
- Off-delay timing mode
- Reliable solid state timing circuitry
- Excellent transient protection
- Compact design
- Flame retardant, solvent resistant housing
■ File E60363, File LR33434


Users should thoroughly review the technical data before selecting a product part number. It is recommended that user also seek out the pertinent approvals files of the agencies/laboratories and review them to ensure the product meets the requirements for a given application.

\section*{VTM2 Series, Off-Delay, Timing Module}
\begin{tabular}{|c|c|c|}
\hline Timing Specifications & Output Switch Data & Input Data @ \(\mathbf{2 5}^{\circ} \mathrm{C}\) \\
\hline Timing Mode - Off-Delay & Arrangement - Solid state 1 Form A (SPST-NO) & Voltage ( \(\mathbf{\pm 1 0 \%}\) ) — 12 VAC/VDC, 24VAC/VDC, 120 VACNDC. \\
\hline Timing Ranges - 0.5 to \(10 / 3\) to 60 \(\mathrm{sec} \cdot 3\) to 60 min & (SPST-NO) \({ }_{\text {Rating - } 1 \text {, inductive, at nominal }}\) & Power Requirement - 4 W with \\
\hline Timing Adjustment - External & operating voltage. & rated load \\
\hline resistor or potentiometer. An external & Expected Electrical Life - & Transient Protection - \\
\hline resistance of 1 megohm is required to & 10,000,000 operations at rated load. & Non-repetitive transients of the following \\
\hline obtain the maximum time for all ranges. & Initial Dielectric Strength - & magnitudes will not cause spurious \\
\hline To determine the actual resistance & Between Terminals and Mounting - & operation of affect function and accuracy. \\
\hline needed to obtain the required time delay, use the following formula: & \(3,000 \mathrm{VAC}\) rms.
Between Input and Output- & \begin{tabular}{c} 
Operating \\
Voltage
\end{tabular}\(<0.1 \mathrm{~ms}<1 \mathrm{~ms}\) \\
\hline \[
R_{T}=\frac{\left(T_{\text {REQ }}-T_{\text {MII }}\right)}{T_{\text {MAX }}-T_{\text {MIN }}} \times 1,000,000 \text { ohms }
\] & 1,500VAC rms. & \[
\begin{array}{ccc}
\hline 12, & 860 V^{*} & 208 V^{*} \\
\hline 24 \text { VAC/VDC }
\end{array}
\] \\
\hline Accuracy & & \(120 \mathrm{VAC} / \mathrm{VDC}\) c \(2,580 \mathrm{~V} \quad 2,150 \mathrm{~V}^{*}\) \\
\hline Repeat Accuracy - \(\pm 1 \%\) & & \({ }^{*}\) Min. source impedance of 100 ohm. \\
\hline Overall Accuracy - \(\pm 2 \%\) at & & Environmental Data \\
\hline \(\mathrm{R}=1\) megohm & & Temperature Range - \\
\hline Reset Time - 50 ms , max. & & \[
\begin{aligned}
& \text { Storage - }-40^{\circ} \mathrm{C} \text { to }+85^{\circ} \mathrm{C} \\
& \text { Operating - }-40^{\circ} \mathrm{C} \text { to }+65^{\circ} \mathrm{C}
\end{aligned}
\] \\
\hline & & \begin{tabular}{l}
Mechanical Data \\
Mounting - Panel mount with one \#8 screw.
\end{tabular} \\
\hline \[
\longleftarrow_{(50.8)}^{2.00} \longrightarrow \mid
\] & \[
|\underbrace{1.25}_{(131.8)}|_{\leftarrow}
\] & \begin{tabular}{l}
Termination - 0.250 in (6.35) quick connect terminals. \\
Weight - 4 oz. (112g) approximately
\end{tabular} \\
\hline
\end{tabular}


\section*{Outline Dimensions} to change.

For additional support numbers please visit www.te.com


\section*{Product Facts}
- Interval timing mode
- Reliable solid state timing circuitry
- Excellent transient protection
- Compact design
- Flame retardant, solvent resistant housing
■ File E60363, File LR33434


Users should thoroughly review the technical data before selecting a product part number. It is recommended that user also seek out the pertinent approvals files of the agencies/laboratories and review them to ensure the product meets the requirements for a given application.

\section*{VTM3 Series, Interval, Timing Module}
Timing Specifications
Timing Mode - Interval
Timing Ranges -0.5 to \(10 / 3\) to 60
sec.; 3 to 60 min.
Timing Adjustment - External
resistor or potentiometer. An external
resistance of 1 megohm is required to
obtain the maximum time for all ranges.
To determine the actual resistance
needed to obtain the required time delay,
use the following formula:
\(R_{T}=\frac{\left.\text { TReQ }-T_{\text {MIIN }}\right)}{T_{\text {MAX }}-T_{\text {MIN }}} \times 1,000,000\) ohms
Accuracy
Repeat Accuracy \(- \pm 1 \%\)
Overall Accuracy \(- \pm 2 \%\) at
R \(=1\) megohm
Reset Time -50 ms, max.

\section*{Output Switch Data}

Arrangement - Solid state 1 Form A (SPST-NO)
Rating - 1A, inductive, at nominal operating voltage.
Expected Electrical Life 10,000,000 operations at rated load.
Initial Dielectric Strength Between Terminals and Mounting \(3,000 \mathrm{VAC}\) rms.
Between Input and Output 1,500VAC rms.
Input Data @ \(25^{\circ} \mathrm{C}\)
Voltage ( \(\mathbf{\pm 1 0 \%}\) ) - \(12 \mathrm{VAC} / \mathrm{NDC}\), 24VAC/VDC, 120 VAC/NDC.
Power Requirement - 4W with rated load
Reset Time - 50 ms , max.


Outline Dimensions


Ordering Information
\begin{tabular}{|c|c|c|}
\hline VTM3 & A & CD \\
\hline & | & \\
\hline Series VTM3 & Input Voltage & Time Range \\
\hline Interval & \(\mathrm{A}=120 \mathrm{VAC} / \mathrm{NDC}\) & \(C D=0.5-10 \mathrm{sec}\). \\
\hline Timing Module & \(\mathrm{E}=24 \mathrm{VAC} / \mathrm{VDC}\) & \(\mathrm{DD}=3-60 \mathrm{sec}\). \\
\hline & \(Q=12 V A C N D C\) & \(\mathrm{GD}=3-60 \mathrm{~min}\). \\
\hline
\end{tabular}

Authorized distributors are likely to stock the following:
None at present.


Product Facts
■ One shot (latching interval) timing mode
■ Reliable solid state timing circuitry
■ Excellent transient protection

■ Compact design
■ Flame retardant, solvent resistant housing
■ File E60363, File LR33434
-

Users should thoroughly review the technical data before selecting a product part number. It is recommended that user also seek out the pertinent approvals files of the agencies/aboratories and review them to ensure the product meets the requirements for a given application.

\section*{VTM4 Series, One Shot (Latching Interval), Timing Module}
\begin{tabular}{|c|c|c|}
\hline Timing Specifications & Output Switch Data & Input Data @ \(\mathbf{2 5}^{\circ} \mathrm{C}\) \\
\hline Timing Mode - One Shot (Latching Interval) & Arrangement - Solid state 1 Form A (SPST-NO) & Voltage ( \(\mathbf{\pm 1 0 \%}\) ) — 12 VAC/VDC, 24VAC/VDC, 120 VAC/VDC. \\
\hline Timing Ranges - 0.5 to \(10 / 3\) to 60 sec.; 0.5 to \(10 / 3\) to 60 min . & Rating - 1 A , inductive, at nominal operating voltage. & Power Requirement - 4 W with rated load \\
\hline \multirow[t]{4}{*}{Timing Adjustment - External resistor or potentiometer. An external resistance of 1 megohm is required to obtain the maximum time for all ranges. To determine the actual resistance needed to obtain the required time delay, use the following formula:
\[
R_{T}=\frac{\left(T_{\text {REQ }}-T_{\text {MII }}\right)}{T_{\text {MAX }}-T_{\text {MIN }}} \times 1,000,000 \mathrm{ohms}
\]} & \multirow[t]{4}{*}{\begin{tabular}{l}
Expected Electrical Life \(10,000,000\) operations at rated load. Initial Dielectric Strength Between Terminals and Mounting \(3,000 \mathrm{VAC}\) rms. \\
Between Input and Output \(1,500 \mathrm{VAC}\) rms.
\end{tabular}} & \begin{tabular}{l}
Transient Protection - \\
Non-repetitive transients of the following magnitudes will not cause spurious operation of affect function and accuracy.
\end{tabular} \\
\hline & & \begin{tabular}{c}
\begin{tabular}{c} 
Operating \\
Voltage
\end{tabular}
\end{tabular}\(<0.1 \mathrm{~ms} \quad<1 \mathrm{~ms}\) \\
\hline & & 12,
\(24 \mathrm{VAC} / \mathrm{VDC}\)
\(860 \mathrm{~V}^{*}\)
\(208 V^{*}\) \\
\hline & & \begin{tabular}{lll}
\hline \(120 \mathrm{VAC/VDC}\) & \(2,580 \mathrm{~V}\) & \(2,150 \mathrm{~V}^{*}\)
\end{tabular} \\
\hline \multirow[t]{5}{*}{\begin{tabular}{l}
Accuracy - \\
Repeat Accuracy \(- \pm 1 \%\) \\
Overall Accuracy - \(\pm 2 \%\) at \\
\(R=1\) megohm \\
Reset Time - 50 ms , max
\end{tabular}} & \multirow[t]{5}{*}{} & *Min. source impedance of 100 ohms. \\
\hline & & Current Drain - Less than 5mA. \\
\hline & & Environmental Data \\
\hline & & \begin{tabular}{l}
Temperature Range - \\
Storage - \(-40^{\circ} \mathrm{C}\) to \(+85^{\circ} \mathrm{C}\) \\
Operating - \(-40^{\circ} \mathrm{C}\) to \(+65^{\circ} \mathrm{C}\)
\end{tabular} \\
\hline & & \begin{tabular}{l}
Mechanical Data \\
Mounting - Panel mount with one \#8 screw.
\end{tabular} \\
\hline \[
\longleftarrow \underset{(50.8)}{2.00} \longrightarrow \mid
\] & \[
\underset{\rightarrow 1}{\underbrace{1.25}_{(31.8)}} \mid
\] & Termination - 0.250 in (6.35) quick connect terminals. \\
\hline  & (22.5) & Weight - 4 oz. (112g) approximately \\
\hline . 170 DIA (4.32) & 2.250 (6.35) X . 032 (.813) & \\
\hline ACCEPTS \#8 SCREW & QUICK CONNECTS & \\
\hline
\end{tabular}
 to change.

For additional support numbers please visit www.te.com

Specialty Relays


Product Facts
- Repeat cycle timing mode

■ Independently adjustable On and Off times
- Reliable solid state timing circuitry
■ Excellent transient protection
- Compact design

■ Flame retardant, solvent resistant housing
- File E60363, File LR33434

\section*{제 땅}

\section*{VTM7 Series, Repeat Cycle, Timing Module}
Timing Specifications
Timing Mode - Repeat Cycle
Timing Ranges - 0.5 to \(10 / 3\) to 60
sec.; 3 to 60 min.
Timing Adjustment - External
resistor or potentiometer. An external
resistance of 1 megohm is required to
obtain the maximum time for all ranges.
To determine the actual resistance
needed to obtain the required time delay
use the following formula:
\(R_{T}=\frac{\left(T_{\text {REQ }}-T_{\text {MIN }}\right)}{T_{\text {MAX }}-T_{\text {MIN }}} \times 1,000,000\) ohms

Output Switch Data
Arrangement - Solid state 1 Form A (SPST-NO)
Rating - 1A, inductive, at nominal operating voltage.
Expected Electrical Life 10,000,000 operations at rated load.
Initial Dielectric Strength -
Between Terminals and Mounting \(3,000 \mathrm{VAC}\) rms.
Between Input and Output 1,500VAC rms.

\section*{Accuracy -}

Repeat Accuracy - \(\pm 1 \%\)
Overall Accuracy - \(\pm 2 \%\) at
\(R=1\) megohm
Reset Time - 500 ms


Outline Dimensions

Ordering Information
\begin{tabular}{lll}
\multicolumn{1}{c}{ VTM7 } & \multicolumn{1}{c}{ A } & \multicolumn{1}{c}{ CD } \\
| & \multicolumn{1}{c}{\(\mid\)} \\
Series VTM7 & Input Voltage & Time Range \\
Repeat Cycle & \(A=120 V A C N D C C\) & \(C D=0.5-10\) sec. \\
Timing Module & \(\mathrm{E}=24\) VACNDC & \(\mathrm{DD}=3-60\) sec. \\
& \(\mathrm{Q}=12\) VACNDC & \(\mathrm{GD}=3-60\) min.
\end{tabular}

Authorized distributors are likely to stock the following:
None at present.

Users should thoroughly review the technical data before selecting a product part number. It is recommended that user also seek out the pertinent approvals files of the agencies/laboratories and review them to ensure the product meets the requirements for a given application.



\section*{Product Facts}

■ On-delay timing mode
- Discrete voltage or universal type
■ Internal potentiometer for timing adjustment
- Reliable solid state timing circuitry

■ Excellent transient protection
■ Flame retardant, solvent resistant housing
■ File E60363, File LR33434
. \({ }^{\circ}\).

\section*{VTMA1 Series, On-Delay Timing Module, With Internal Potentiometer}

Timing Specifications
Timing Mode - On-Delay
Timing Ranges -
VTMA1ULA only - 24 to 480 sec.
All others -0.5 to \(10 / 3\) to \(60 / 15\) to
300 sec.; 3 to 60 min .
Timing Adjustment -
Internal potentiometer
Accuracy -
Repeat Accuracy - \(\pm 5 \%\)
Overall Accuracy -
Max. Time: \(-0 \%,+10 \%\).
Min. Time: \(-30 \%,+10 \%\).
Reset Time - 250 ms , max., before
time-out; 10 ms , max., after time-out.
Output Switch Data
Arrangement - Solid state 1 Form A (SPST-NO)
Rating - 1A, inductive, at nominal operating voltage.
Expected Electrical Life 10,000,000 operations at rated load. Initial Dielectric Strength Between Terminals and Mounting \(3,000 \mathrm{VAC}\) rms.
Between Input and Output 1,500VAC rms.


Outline Dimensions and Wiring Diagram

Input Data @ \(\mathbf{2 5}^{\circ} \mathrm{C}\)
Voltage ( \(\mathbf{\pm} \mathbf{1 0 \%}\) ) - 120VAC/VDC
(unfiltered DC must be full-wave rectified) or 24 to 240 VAC/VDC.
Power Requirement - 250 mW
during timing; 3 W , max. after time out.
Transient Protection -
Non-repetitive transients of the following magnitudes will not cause spurious operation of affect function and accuracy.
\begin{tabular}{|c|c|c|}
\hline ating & 0.1 & \(<1 \mathrm{~ms}\) \\
\hline VAC/VDC & 860 & \\
\hline \[
\begin{aligned}
& 120 \\
& \text { VAC }
\end{aligned}
\] & ,580 & \\
\hline \multicolumn{3}{|l|}{\({ }^{*}\) Min. source impedance of 100 ohms. Current Drain - 2mA, Max.} \\
\hline \multicolumn{3}{|l|}{\begin{tabular}{l}
Environmental Data \\
Temperature Range - \\
Storage - \(-40^{\circ} \mathrm{C}\) to \(+85^{\circ} \mathrm{C}\) \\
Operating - \(-40^{\circ} \mathrm{C}\) to \(+65^{\circ} \mathrm{C}\)
\end{tabular}} \\
\hline \multicolumn{3}{|l|}{\begin{tabular}{l}
Mechanical Data \\
Mounting - Panel mount with one \#8 screw.
\end{tabular}} \\
\hline \multicolumn{3}{|l|}{Termination - 0.250 in (6.35) quick connect terminals.} \\
\hline
\end{tabular}

\section*{Ordering Information}
\begin{tabular}{ccc}
\hline Part Number & Time Range & Input Voltage \\
\hline VTMA1ACA & 0.5 to 10 sec. & \\
\hline VTMA1ADA & 3 to 60 sec. & \\
\hline VTMA1ULA & 24 to 480 sec. & \\
\hline
\end{tabular}

\section*{Authorized distributors are likely to stock the following:}

None at present.

Users should thoroughly review the technical data before selecting a product part number. It is recommended that user also seek out the pertinent approvals files of the agencies/laboratories and review them to ensure the product meets the requirements for a given application.

\begin{tabular}{|c|c|c|c|}
\hline \begin{tabular}{l}
Catalog 5-1773450-5 Revised 3-13 \\
www.te.com
\end{tabular} & Dimensions are shown for reference purposes only. Specifications subject to change. & Dimensions are in millimeters unless otherwise specified. & \begin{tabular}{l}
USA: +1 8005226752 \\
Asia Pacific: +86 04008206015 UK: +44 800267666
\end{tabular} \\
\hline
\end{tabular}

Specialty Relays

\section*{VTMR1 Series, On-Delay Timing Module, With Internal Potentiometer, Relay Output}


\section*{Product Facts}

■ On-delay timing mode
■ 8A SPDT relay output
■ Internal potentiometer for timing adjustment
- Reliable solid state timing circuitry
■ Excellent transient protection
■ Flame retardant, solvent resistant housing
■ File E60363, File LR33434

\begin{tabular}{|c|c|c|}
\hline Timing Specifications & Output Switch Data & Input Data @ \(25^{\circ} \mathrm{C}\) \\
\hline Timing Mode - On-Delay & Arrangement - 1 Form C (SPDT) & Voltage ( \(\pm 10 \%\) - 120VAC/VDC \\
\hline Timing Ranges - 15 to 300 sec . Timing Adjustment - & Rating - 8 A , resistive, at nominal operating voltage. & Power Requirement - 3.5VA max. during timing; 3W, max. after time out. \\
\hline Internal potentiometer & Expected Mechanical Life - & Transient Protection - \\
\hline Accuracy - & 10,000,000 operations & Non-repetitive transients of the following \\
\hline Repeat Accuracy \(\pm 5 \%\) max. ( \(0.25 \%\) typ.) & Expected Electrical Life 100,000 operations & magnitudes will not cause spurious operation of affect function and accuracy. \\
\hline \begin{tabular}{l}
Overall Accuracy - \\
Max. Time: \(-0 \%,+10 \%\).
\end{tabular} & \begin{tabular}{l}
Initial Dielectric Strength - \\
Between Terminals and Mounting -
\end{tabular} & \begin{tabular}{c}
\begin{tabular}{c} 
Operating \\
Voltage
\end{tabular}
\end{tabular}\(<0.1 \mathrm{~ms} \quad<1 \mathrm{~ms}\) \\
\hline Min. Time: -30\%, +10\%. & 3,000VAC rms. & 120 VAC/VDC \(2,580 \mathrm{~V}\) 2,150V* \\
\hline Reset Time - 250 ms , max. & Between Input and Output \(1,500 \mathrm{VAC}\) rms. & * Min. source impedance of 100 ohms. Current Drain — 30mA, Max. \\
\hline & & \begin{tabular}{l}
Environmental Data \\
Temperature Range - \\
Storage - \(-40^{\circ} \mathrm{C}\) to \(+70^{\circ} \mathrm{C}\) \\
Operating - \(-40^{\circ} \mathrm{C}\) to \(+70^{\circ} \mathrm{C}\)
\end{tabular} \\
\hline & & \begin{tabular}{l}
Mechanical Data \\
Mounting - Panel mount with one \#8 screw.
\end{tabular} \\
\hline & & Termination - 0.250 in (6.35) quick connect terminals. \\
\hline & & Weight - 40 oz. (112g) approximately \\
\hline
\end{tabular}

Input Data @ \(25^{\circ} \mathrm{C}\)
Voltage ( \(\mathbf{\pm 1 0 \%}\) ) — 120VAC/VDC
Power Requirement - 3.5VA max

Transient Protection -
Non-repetitive transients of the following magnitudes will not cause spurious

Current Drain - 30mA, Max.
Environmental Data
Storage \(40^{\circ} \mathrm{C}\) to \(70^{\circ} \mathrm{C}\)
Operating - \(-40^{\circ} \mathrm{C}\) to \(+70^{\circ} \mathrm{C}\)

Mounting - Panel mount with one \#8 screw. connect terminals.

Weight - 4 oz. (112g) approximately

Users should thoroughly review the technical data before selecting a product part number. It is recommended that user also seek out the pertinent approvals files of the agencies/laboratories and review them to ensure the product meets the requirements for a given application.

Outline Dimensions and Wiring Diagram

\section*{Ordering Information}
\begin{tabular}{ccc}
\hline Part Number & Time Range & Input Voltage \\
\hline VTMR1AEA & 15 to 300 sec. & 120 VAC \\
\hline
\end{tabular}

Authorized distributors are likely to stock the following:
None at present.


CII Solenoids
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\begin{tabular}{lllll}
\hline Catalog 5-1773450-5 & Dimensions are shown for & Dimensions are in millimeters & USA: +18005226752 & For additional support numbers \\
Revised 3-13 & \begin{tabular}{ll} 
reference purposes only. \\
Specifications subject
\end{tabular} & & Unless otherwise specified. & Asia Pacific: +8604008206015
\end{tabular} \begin{tabular}{l} 
please visit www.te.com \\
to change.
\end{tabular}

\section*{Product Facts}
- Designed and built to customer requirements
■ Push, pull or combination motion
- Broad operating temperature range
■ Multiple termination and mounting options
- \(200^{\circ} \mathrm{C}\) magnet wire insulation is standard

\section*{CII Custom High Performance Solenoids}


\section*{Description}

Custom-designed linear solenoids for demanding applications
Top-end devices are engineered for applications where extreme temperatures and other severe environmental conditions may exist

High altitude, shock, acceleration and vibration reliable

\section*{Product Options}

Linear motion, tubular solenoid line ranges from models only one-half inch \((12.7 \mathrm{~mm})\) in diameter producing only a few ounces ( \(<1 \mathrm{~N}\) ) of force at very short strokes, to threeinch ( 76.2 mm ) diameter models capable of 100 pounds (445N) force at one-inch ( 25.4 mm ) strokes
Push, pull or combination motion available

Continuous or intermittent duty coils available

AC voltages can be handled through the use of internal rectifiers

Dual coil models with low holding power requirement may be appropriate in power sensitive equipment
Solenoids with plunger seals can be built for harsh environments

Solenoids can be made water-resistant, fuelresistant and with encapsulated coils (ferrous parts are plated for protection against corrosion)

Leads are normally provided with fluoropolymer insulation, PTFE or ETFE; however, any type wire may be used as specified by the customer. MIL type connectors may also be used when specified. Can be provided with flat or conical face depending on stroke
Solenoid plungers can be internally or externally threaded or have clevis attachment
Prototype solenoids can be custom built to a customer's requirements

\section*{Electrical Characteristics}

Voltage Rating -
6 to 270 VDC
28 to 115 VAC ( 60 or 400 Hz )
Mechanical Characteristics
Ambient Temperature Range -\(-65^{\circ} \mathrm{C}\) to \(+125^{\circ} \mathrm{C}\)
Force - 1 0z. to 100 lbs. push, pull, hold
Rated at 100,000 operations Built IAW MIL-S-4040 as applicable

\section*{Typical Applications}

\section*{Fin Locking Solenoid}

Three of these husky Solenoids are used to lock steering fins in place until the guided weapon is released.


Voltage - \(22-28\) VDC
Max. Allowable Current - Not specified
Actuating Force - 12 to 15.4 lb . (depends on input V)
Stroke - . 095 "
Time On — Bomb drop time
Time Off - Continuous
Cycling Rate - Not applicable
Type Operation - Pull
Temperature Range - Ambient \(-65^{\circ} \mathrm{F}\) to \(+125^{\circ} \mathrm{F}\)
Coil Connections — Fluoropolymer Insulation \(8^{\prime \prime}\) to \(83 / 4^{\prime \prime}\)
Approximate Dimensions - 2.20 " diameter \(\times 2.05\) " long Type Mounting - Integral tapped holes
Special Environmental Consideration - Exposure to sand, dust, aircraft oils and fuels, will require an "0" ring seal on plunger.

\section*{Primer Firing Solenoid}

This extremely powerful Solenoid together with its companion pulse control module is designed to fire a standard Military \#41 arsenal primer, as part of an advanced mine detection system.


\section*{Voltage - 26 VDC}

Max. Allowable Current - 10.4 Amps @ 26 VDC
Actuating Force - 90 oz. force inches (. 64 joules)
Stroke - . 38 "
Time On - W/pulse control module, 25 ms
Time Off — 3 seconds
Cycling Rate - 20 operations/minute
Type Operation - Push
Temperature Range - Ambient \(-65^{\circ} \mathrm{F}\) to \(+85^{\circ} \mathrm{F}\)
Coil Connections - Fluoropolymer Insulation \#20 stranded 6' long
Approximate Dimensions - \(3 / 4\) " diameter \(\times 31 / 2^{\text {" long }}\)
Type Mounting - Integral 1/2" - 20 threaded base
Special Environmental Consideration - Sand and dust

\section*{Aero Medical Valve Solenoid}

A scant \(3 / 8^{\prime \prime}\) in diameter, this tiny precision Solenoid is capable of 100,000 reliable operations, controlling various airborne gas systems.


Voltage - 28 VDC
Max. Allowable Current - . 18 Amps @ 28 VDC
Actuating Force - 190 grams @ . 030 Amps
Stroke - .030" minimum
Time \(\mathbf{0 n}\) - Continuous duty
Time Off — Not specified
Cycling Rate - Not applicable
Type Operation - Pull
Temperature Range - Ambient \(-65^{\circ} \mathrm{F}\) to \(+125^{\circ} \mathrm{F}\)
Coil Connections - \#32 AWG Fluoropolymer Insulation, 24" minimum
Approximate Dimensions - \(3 / 8^{\prime \prime}\) diameter x \(3 / 4\) " long
Type Mounting - None

\section*{CII Custom High Performance Solenoids (Continued)}

\section*{Typical Applications (Continued)}

\section*{Fuel Valve Solenoid}

This is a unique application in which the Solenoid is mounted inside an aircraft fuel tank submerged in JP-8 jet fuel. The coil is potted, completely fuel proof.


Voltage - 115 VAC 400 Hz
Actuating Force - 1 lb . minimum @ \(160^{\circ} \mathrm{F}\)
Stroke - . 030 "
Time \(\mathbf{O n}\) - Continuous duty rating
Time Off — Not specified
Type Operation - Push
Temperature Range - Ambient \(-65^{\circ} \mathrm{F}\) to \(+160^{\circ} \mathrm{F}\)
Coil Connections - IAW customer drawing,
Fluoropolymer Insulation Leads
Approximate Dimensions - Tubular, 3/4" diameter X
3" long
Type Mounting - Flange IAW customer drawing
Special Environmental Consideration - Coil must be air tight, plunger operates while submerged in JP-8 jet fuel

\section*{Directional Valve Solenoid}

A major valve company selected this rugged type Solenoid to control a directional hydraulic valve in heavy industrial machinery. The valve assembly has a 20 year expected life.

```

Voltage - 92 VDC
Max. Allowable Current - 7.2 Amps inrush,
. 08 Amps hold
Actuating Force - 30 lbs . minimum
Holding Force - 40 lbs . minimum
Stroke - . 500 "
Time $\mathbf{O n}$ - Continuous duty
Time Off - Not applicable
Cycling Rate - Not applicable
Type Operation - Push and hold
Temperature Range - Ambient $-55^{\circ} \mathrm{F}$ to $+85^{\circ} \mathrm{F}$
Coil Connections - Fluoropolymer Insulation \#18
AWG, 72" L
Approximate Dimensions — $23 / 16$ " dia. $\times 4$ 3/16"
Type Mounting - Plate
Special Environmental Consideration - Sand, dust, rain

```

\section*{Refueling Release Solenoid}

This complex Solenoid with internal current limiting switch is part of an "Air to Air" refueling system.


Voltage - 18 to 30 VDC
Max. Allowable Current - 10 Amps/50 ms - 1 Amp continuous holding
Actuating Force - 20 lbs . min. for .10 l of initial stroke
Holding Force - Plunger must hold at bottom
Stroke - . 17 to \(.20^{\prime \prime}\)
Time On - Continuous duty
Time Off - Not applicable
Cycling Rate - Not applicable
Type Operation - Pull
Temperature Range - Ambient \(-65^{\circ} \mathrm{F}\) to \(+160^{\circ} \mathrm{F}\)
Coil Connections - Connector MS 30ZE-10SL-4P per MIL-C-5015
Approximate Dimensions — \(21 / 4^{\prime \prime}\) dia. \(\times 2\) 13/16"
Type Mounting - Integral with refueling receptacle
Special Environmental Consideration -
High performance aircraft exposure

\title{
CII Custom High Performance Solenoids (Continued)
}

\section*{Application Information Form}

Customer Firm Name: \(\qquad\)
Customer Name: \(\qquad\)
Customer Address: \(\qquad\)

Telephone number: \(\qquad\)
Email address: \(\qquad\)
Voltage: \(\qquad\) \(\pm\) \(\qquad\) \% AC or DC (circle one)

Maximum allowable current: \(\qquad\) Amps

Actuating force: \(\qquad\) (Energy produced when coil is energized at start of stroke)

Holding force: \(\qquad\) (Energy required at zero stroke, plunger seated on butt flange with coil energized).

Stroke: \(\qquad\) inches or millimeters (circle one)

Duty cycle: Time On: \(\qquad\) Time Off: \(\qquad\)
Cycle rate: \(\qquad\) cycles per hour

Type of operation: Push or Pull (circle one)
Temperature range if other than \(-65^{\circ} \mathrm{C}\) to \(+125^{\circ} \mathrm{C}\) : \(\qquad\)
Coil connections: \(\qquad\) Leads or Mil-type connector (circle one)

Approximate dimensions: \(\qquad\)
Type of mounting: \(\qquad\)
Applicable Mil-specs: \(\qquad\)
Special environmental considerations (i.e., exposure to salt spray, jet fuel, water, sand and dust): \(\qquad\)
\(\qquad\)
\(\qquad\)
End application of solenoid: \(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
Special tests: \(\qquad\)

Application Type: \(\quad\) New Design \(\quad\) Replacement
Approximate quantity (annual requirement): \(\qquad\)
Please return completed form to John Gilbart, Product Manager for custom solenoids.
Fax: 828-338-1103 E-mail: gilbartj@te.com
\begin{tabular}{lllll}
\hline Catalog 5-1773450-5 & \begin{tabular}{l} 
Dimensions are shown for \\
reference purposes only.
\end{tabular} & \begin{tabular}{l} 
Dimensions are in millimeters \\
unless otherwise specified.
\end{tabular} & \begin{tabular}{l} 
USA: +1 8005226752 \\
Asia Pacific: +8604008206015
\end{tabular} & \begin{tabular}{l} 
For additional support numbers \\
please visit www.te.com
\end{tabular} \\
www.te.com & \begin{tabular}{l} 
Specifications subject \\
to change.
\end{tabular} & & UK: +44800267666
\end{tabular}

\section*{Engineering Notes}

\section*{Table of Contents}

Custom-designed and built AC or DC products for aerospace applications
Key platforms for which we have designed and built PDUs:

■ Beech 1900 Commuter
- Bell Textron Landing Craft Air Cushion

■ Boeing 767, 777
■ British Aerospace Jetstream 41
■ Dassault Falcon 7X
- Grumman Aerospace S-2 Tracker
- Gulfstream New Commander
- Lockheed Martin F-35 Lightning II
■ McDonnell Douglas AH-64 Apache
■ McDonnell Douglas F-4 Phantom
- Northrup Grumman E2C Hawkeye
■ Piper Cheyenne IV
■ Rockwell Sabreliner 65A
■ Saab SF-340A/B
■ Sikorsky S-92, S76D

\section*{Power Distribution Units}



HARTMAN AC and DC power distribution units (PDUs) and KILOVAC DC PDUs from TE Connectivity are designed, built and qualified to meet your specific requirements

We have a half-century of experience providing PDUs for the aerospace industry, serving both commercial and military customers.
Allow us to apply our significant expertise in integrating bus-bar and plug-in contactors, relays, sensors, monitors, circuit breakers, shunts, generator control units and other components into compact, lightweight PDUs.

Through our value-added service we can save you time and money in your design and manufacturing processes, as well as the end customers' maintenance programs.

Whether you require innovative modular units or backplane-type panels for fixed wing aircraft or rotorcraft, we can help.


PDU utilizing bus bar mount AC contactors.


PDU utilizing both bus bar mount and plug-in AC contactors.

For additional support numbers
please visit www.te.com

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\section*{Introduction}

This index covers all High Performance Group military qualified (QPL) products under the following specifications:
- CII Hybrid Relays

MIL-PRF-28776: Relays, Hybrid, Established Reliability, Low level to 1 Amp
- CII Electromechanical Relays

MIL-PRF-39016: Relays, Electromagnetic, Established Reliability, Low level to 5 Amps MIL-R-5757: Relays, Electromagnetic, Low level to 10 Amps
MS27245: Relays, Electromagnetic, 10 Amps
MS27247: Relays, Electromagnetic, 10 Amps
MIL-PRF-83536: Relays, Electromagnetic, Established Reliability, Low level to 25 Amps
- Hartman Contactors

MS27750: Relays, Electromagnetic, 50 Amps
- Kilovac Vacuum Relays

MIL-DLT-83725: Relays, Vacuum, High or Low Voltage Circuits
- Kilovac Time Delay Relays

MIL-PRF-83726: Relays, Hybrid and Solid State, Time Delay
(NOTE: QPL STATUS PENDING AT TIME OF CATALOG PRINTING)
- Kilovac Solid State Relays

MIL-PRF-28750: Relay, Solid State, Hermetically Sealed or Encapsulated
DSCC 85092: Relay, Solid State, Optically Isolated, Analog Signal Switching
DSCC 86031: Relay, Solid State, Optically Isolated, 10 Amps
DSCC 88062: Relay, Solid State, Optically Isolated, 2.1 Amps
DSCC 89116: Relay, Solid State, Optically Isolated, 0.25 to 1 Amp
DSCC 90091: Relay, Solid State, Optically Isolated, 1 or 2 Amps

Military Part Number Example
\begin{tabular}{|cccc|}
\hline \(\mathbf{M}\) & \(\mathbf{3 9 0 1 6 / 1 0}\) & \(\mathbf{- 0 0 1}\) & \(\mathbf{L}\) \\
\hline Military & Specification & Dash & Failure Rate \\
Designator & Sheet Number & Number & Level (see below) \\
& & & \\
\hline
\end{tabular}

\section*{Failure Rate Designation}
\begin{tabular}{|cc|}
\hline \begin{tabular}{c} 
Failure Rate Level \\
Designation
\end{tabular} & \begin{tabular}{c} 
Failure Rate Level \\
(Percent per 10,000 \\
cycles)
\end{tabular} \\
\hline L & 3.0 \\
\hline M & 1.0 \\
\hline P & 0.1 \\
\hline
\end{tabular}

\section*{CII Hybrid Relays}

MIL-PRF-28776/1
\begin{tabular}{lr} 
Military Part Number & CIIPart Number \\
\hline M28776/1-013L,M,P & JMAWT-5XL,XM,XP \\
\hline M28776/1-014L,M,P & JMAWT-6XL,XM,XP \\
\hline M28776/1-015L,M,P & JMAWT-9XL,XM,XP \\
\hline M28776/1-016L,M,P & JMAWT-12XL,XM,XP \\
\hline M28776/1-017L,M,P & JMAWT-18XL,XM,XP \\
\hline M28776/1-018L,M,P & JMAWT-26XL,XM,XP \\
\hline M28776/1-019L,M,P & JMAPT-5XL,XM,XP \\
\hline M28776/1-020L,M,P & JMAPT-6XL,XM,XP \\
\hline M28776/1-021L,M,P & JMAPT-9XL,XM,XP \\
\hline M28776/1-022L,M,P & JMAPT-12XL,XM,XP \\
\hline M28776/1-023L,M,P & JMAPT-18XL,XM,XP \\
\hline M28776/1-024L,M,P & JMAPT-26XL,XM,XP \\
\hline M28776/1-025L,M,P & JMACT-5XL,XM,XP \\
\hline M28776/1-026L,M,P & JMACT-6XL,XM,XP \\
\hline M28776/1-027L,M,P & JMACT-9XL,XM,XP \\
\hline M28776/1-028L,M,P & JMACT-12XL,XM,XP \\
\hline M28776/1-029L,M,P & JMACT-18XL,XM,XP \\
\hline M28776/1-030L,M,P & JMACT-26XL,XM,XP \\
\hline M28776/1-031L,M,P & JMACT-5XLS,XMS,XPS \\
\hline M28776/1-032L,M,P & JMACT-6XLS,XMS,XPS \\
\hline M28776/1-033L,M,P & JMACT-9XLS,XMS,XPS \\
\hline M28776/-034L,M,P & JMACT-12XLS,XMS,XPS \\
\hline M28776/-035L,M,P & JMACT-18XL,XMS,XPS \\
\hline M28776/1-036L,M,P & JMACT-26XLS,XMS,XPS \\
\hline
\end{tabular}

MIL-PRF-28776/3
\begin{tabular}{|c|c|}
\hline Military Part Number & CIIPart Number \\
\hline M28776/3-017L,M, P & JIMSWT-5XL, XM, XP \\
\hline M28776/3-018L,M, P & JMSWT-6XL, XM, XP \\
\hline M28776/3-019L,M, P & JMSWT-9XL, XM, XP \\
\hline M28776/3-020L,M, P & JMSWT-12XL, XM, XP \\
\hline M28776/3-021L,M, P & JMSWT-18XL, XM, XP \\
\hline M28776/3-022L,M, P & JMSWT-26XL,XM, XP \\
\hline M28776/3-023L,M, P & JMSWT-36XL,XM, ХP \\
\hline M28776/3-024L,M, P & JMSWT-48XL, XM, XP \\
\hline M28776/3-025L,M, P & JMSPT-5XL,XM, XP \\
\hline M28776/3-026L,M, P & JMSPT-6XL,XM, XP \\
\hline M28776/3-027L,M, P & JMSPT-9XL, XM, XP \\
\hline M28776/3-028L,M, P & JMSPT-12XL,XM, XP \\
\hline M28776/3-029L,M, P & JMSPT-18XL, XM, XP \\
\hline M28776/3-030L,M, P & JMSPT-26XL, XM, XP \\
\hline M28776/3-031L,M, P & JMSPT-36XL, XM, XP \\
\hline M28776/3-032L,M, P & JMSPT-48XL, XM, XP \\
\hline M28776/3-033L,M, P & JMSCT-5XL, XM, XP \\
\hline M28776/3-034L,M, P & JMSCT-6XL,XM, XP \\
\hline M28776/3-035L,M,P & JMSCT-9XL,XM, XP \\
\hline M28776/3-036L,M, P & JMSCT-12XL, XM, XP \\
\hline M28776/3-037L,M,P & JMSCT-18XL, XM, XP \\
\hline M28776/3-038L,M,P & JMSCT-26XL,XM, XP \\
\hline M28776/3-039L,M, P & JMSCT-36XL, XM, XP \\
\hline M28776/3-040L,M, P & JMSCT-48XL, XM, XP \\
\hline M28776/3-041L,M, P & JMSCT-5XLS,XMS,XPS \\
\hline M28776/3-042L,M, P & JMSCT-6XLS,XMS,XPS \\
\hline M28776/3-043L,M, P & JMSCT-9XLS,XMS,XPS \\
\hline M28776/3-044L,M,P & JMSCT-12XLS,XMS, XPS \\
\hline M28776/3-045L,M, P & JMSCT-18XLS,XMS, XPS \\
\hline M28776/3-046L,M, P & JMSCT-26XLS,XMS,XPS \\
\hline M28776/3-047L,M,P & JMSCT-36XLS,XMS,XPS \\
\hline M28776/3-048L,M,P & JMSCT-48XLS,XMS, XPS \\
\hline
\end{tabular}

MIL-PRF-28776/4
\begin{tabular}{|c|c|}
\hline Military Part Number & CIIPart Number \\
\hline M28776/4-017L,M, P & J1MSWT-5XL,XM, XP \\
\hline M28776/4-018L,M, P & J1MSWT-6XL,XM, XP \\
\hline M28776/4-019L,M, P & J1MSWT-9XL, XM, XP \\
\hline M28776/4-020L,M, P & J1MSWT-12XL, XM, XP \\
\hline M28776/4-021L,M, P & J1MSWT-18XL, XM, XP \\
\hline M28776/4-022L,M, P & J1MSWT-26XL,XM, XP \\
\hline M28776/4-023L,M, P & J1MSWT-32XL, XM, XP \\
\hline M28776/4-024L,M, P & J1MSWT-40XL, XM, XP \\
\hline M28776/4-025L,M, P & J1MSPT-5XL,XM, XP \\
\hline M28776/4-026L,M, P & J1MSPT-6XL,XM, XP \\
\hline M28776/4-027L,M,P & J1MSPT-9XL, XM, XP \\
\hline M28776/4-028L,M, P & J1MSPT-12XL,XM, XP \\
\hline M28776/4-029L,M,P & J1MSPT-18XL,XM, XP \\
\hline M28776/4-030L,M, P & J1MSPT-26XL, XM, XP \\
\hline M28776/4-031L,M,P & J1MSPT-32XL,XM, XP \\
\hline M28776/4-032L,M,P & J1MSPT-40XL, XM, XP \\
\hline M28776/4-033L,M, P & J1MSCT-5XL, XM, XP \\
\hline M28776/4-034L,M, P & J1MSCT-6XL,XM,XP \\
\hline M28766/4-035L,M, P & J1MSCT-9XL,XM, XP \\
\hline M28776/4-036L,M, P & J1MSCT-12XL,XM, XP \\
\hline M28776/4-037L,M, P & J1MSCT-18XL,XM, XP \\
\hline M28776/4-038L,M, P & J1MSCT-26XL,XM, XP \\
\hline M28776/4-039L,M, P & J1MSCT-32XL, XM, XP \\
\hline M28776/4-040L,M, P & J1MSCT-40XL,XM, XP \\
\hline M28776/4-041L,M,P & J1MSCT-5XLS,XMS,XPS \\
\hline M28776/4-042L,M, P & J1MSCT-6XLS,XMS,XPS \\
\hline M28776/4-043L,M, P & J1MSCT-9XLS, XMS,XPS \\
\hline M28776/4-044L,M,P & J1MSCT-12XLS,XMS,XPS \\
\hline M28776/4-045L,M, P & J1MSCT-18XLS,XMS,XPS \\
\hline M28776/4-046L,M, P & J1MSCT-26XLS,XMS,XPS \\
\hline M28776/4-047L,M, P & J1MSCT-32XLS,XMS,XPS \\
\hline M28776/4-048L,M, P & J1MSCT-40XLS,XMS,XPS \\
\hline
\end{tabular}

MIL-PRF-28776/5
\begin{tabular}{|c|c|}
\hline Militiary Part Number & CIIPart Number \\
\hline M28776/5-013L,M, P & J1MAWT-5XL, XM, XP \\
\hline M28776/5-014L,M, P & J1MAWT-6XL, XM, XP \\
\hline M28776/5-015L,M, P & J1MAWT-9XL,XM, XP \\
\hline M28776/5-016L,M, P & J1MAWT-12XL, XM, XP \\
\hline M28776/5-017L,M, P & J1MAWT-18XL, XM, XP \\
\hline M28776/5-018L,M, P & J1MAWT-26XL,XM, XP \\
\hline M28776/5-019L,M, P & J1MAPT-5XL,XM, XP \\
\hline M28776/5-020L,M, P & J1MAPT-6XL,XM, XP \\
\hline M28776/5-021L,M, P & J1MAPT-9XL,XM, XP \\
\hline M28776/5-022L,M,P & J1MAPT-12XL,XM, XP \\
\hline M28776/5-023L,M, P & J1MAPT-18XL, XM, XP \\
\hline M28776/5-024L,M, P & J1MAPT-26XL,XM, XP \\
\hline M28776/5-025L,M, P & J1MACT-5XL,XM, XP \\
\hline M28776/5-026L,M, P & J1MACT-6XL, XM, XP \\
\hline M28776/5-027L,M, P & J1MACT-9XL, XM, XP \\
\hline M28776/5-028L,M, P & J1MACT-12XL, XM, XP \\
\hline M28776/5-029L,M,P & J1MACT-18XL, XM, XP \\
\hline M28776/5-030L,M, P & J1MACT-26XL, XM, XP \\
\hline M28776/5-031L,M, P & J1MACT-5XLS,XMS,XPS \\
\hline M28776/5-032L,M,P & J1MACT-6XLS,XMS,XPS \\
\hline M28776/5-033L,M, P & J1MACT-9XLS,XMS,XPS \\
\hline M28776/5-034L,M, P & J1MACT-12XLS,XMS,XPS \\
\hline M28776/5-035L,M, P & J1MACT-18XLS,XMS,XPS \\
\hline M28776/5-036L,M,P & J1MACT-26XLS,XMS,XPS \\
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\end{tabular}

Dimensions are in millimeters unless otherwise specified.

USA: +1 8005226752
Asia Pacific: +8604008206015
UK: +44 800267666

Military Qualified Products List (QPL)
\begin{tabular}{|c|c|c|c|}
\hline \multicolumn{4}{|c|}{CII Hybrid Relays (Continued)} \\
\hline \multicolumn{2}{|c|}{MIL-PRF-28776/6} & \multicolumn{2}{|c|}{MIL-PRF-28776/7} \\
\hline Military Part Number & CIIPart Number & Military Part Number & CII Part Number \\
\hline M28776/6-001L,M & JMGAT-5L,M & M28776/7-001L,M & JMGST-5L,M \\
\hline M28776/6-002L,M & JMGAT-6L,M & M28776/7-002L,M & JMGST-6L,M \\
\hline M28776/6-003L,M & JMGAT-9L,M & M28776/7-003L,M & JMGST-9L,M \\
\hline M28776/6-004L,M & JMGAT-12L,M & M28776/7-004L,M & JMGST-12L,M \\
\hline M28776/6-005L,M & JMGAT-18L,M & M28776/7-005L, M & JMGST-18L,M \\
\hline M28776/6-006L,M & JMGAT-26L,M & M28776/7-006L,M & JMGST-26L,M \\
\hline M28776/6-007L,M & JMGAT-5LW,MW & M28776/7-007L,M & JMGST-5LW,MW \\
\hline M28776/6-008L,M & JMGAT-6LW,MW & M28776/7-008L,M & JMGST-6LW,MW \\
\hline M28776/6-009L,M & JMGAT-9LW,MW & M28776/7-009L,M & JMGST-9LW,MW \\
\hline M28776/6-010L,M & JMGAT-12LW,MW & M28776/7-010L,M & JMGST-12LW,MW \\
\hline M28776/6-011L,M & JMGAT-18LW,MW & M28776/7-011L,M & JMGST-18LW,MW \\
\hline M28776/6-012L,M & JMGAT-26LW,MW & M28776/7-012L,M & JMGST-26LW,MW \\
\hline
\end{tabular}

\section*{CII Electromechanical Relays}
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|c|}{MIL-PRF-39016/6} \\
\hline Military Part Number & CII Part Number \\
\hline M39016/6-104L,M,P & HFW1130K06L,M,P \\
\hline M39016/6-105L,M,P & HFW1230K06,M,P \\
\hline M39016/6-107L,M,P & HFW1131K04,M, P \\
\hline M39016/6-109L,M,P & HFW1201K45,M,P \\
\hline M39016/6-111L,M, P & HFW1130G01,M,P \\
\hline M39016/6-112L,M,P & HFW1230G01,M,P \\
\hline M39016/6-114L,M, P & HFW1131G01,M,P \\
\hline M39016/6-116L,M,P & HFW1201G01,M,P \\
\hline M39016/6-118L,M, P & HFW1130F01,M, P \\
\hline M39016/6-119L,M, P & HFW1230F01,M, P \\
\hline M39016/6-121L,M,P & HFW1131F01,M, P \\
\hline M39016/6-123L,M,P & HFW1201F01,M, P \\
\hline M39016/6-125L,M,P & HFW1231K05,M,P \\
\hline M39016/6-126L,M,P & HFW1231G01,M, P \\
\hline M39016/6-127L,M,P & HFW1231F01,M,P \\
\hline M39016/6-128L,M,P & HFW1106K12,M,P \\
\hline M39016/6-129L,M,P & HFW1101K06,M,P \\
\hline M39016/6-130L,M,P & HFW1101G01,M,P \\
\hline M39016/6-131L,M,P & HFW1101F01,M, P \\
\hline M39016/6-132L,M,P & HFW1130L01,M, P \\
\hline M39016/6-133L,M, P & HFW1230L01,M, P \\
\hline M39016/6-135L,M,P & HFW1131L01,M,P \\
\hline M39016/6-136L,M,P & HFW1231L01,M,P \\
\hline M39016/6-138L,M, P & HFW1101L01,M, P \\
\hline M39016/6-139L,M,P & HFW1201L01,M,P \\
\hline M39016/6-141L,M,P & HFW1230K11,M,P \\
\hline M39016/6-142L,M, P & HFW1201K103,M, P \\
\hline M39016/6-143L,M, P & HFW1230G03,M,P \\
\hline M39016/6-144L,M, P & HFW1201G14,M,P \\
\hline M39016/6-145L,M,P & HFW1230F03,M, P \\
\hline M39016/6-146L,M, P & HFW1201F15,M, P \\
\hline M39016/6-147L,M,P & HFW1230L03,M,P \\
\hline M39016/6-148L,M,P & HFW1201L06,M,P \\
\hline M39016/6-204L,M,P & HFW1130K07,M,P \\
\hline M39016/6-205L,M,P & HFW1230K07,M, P \\
\hline M39016/6-207L,M,P & HFW1131K05,M, P \\
\hline M39016/6-209L,M,P & HFW1201K46,M,P \\
\hline M39016/6-211L,M, P & HFW1130G02,M,P \\
\hline M39016/6-212L,M,P & HFW1230G02,M,P \\
\hline M39016/6-214L,M, P & HFW1130G02,M,P \\
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\end{tabular}

MIL-PRF-39016/6 (continued)
\begin{tabular}{|c|c|}
\hline Military Part Number & CII Part Number \\
\hline M39016/6-216L,M, P & HFW1201G02,M,P \\
\hline M39016/6-218L,M, P & HFW1130F02,M, P \\
\hline M39016/6-219L,M, P & HFW1230F02,M, P \\
\hline M39016/6-221L,M, P & HFW1131F02,M, P \\
\hline M39016/6-223L,M, P & HFW1201F02,M, P \\
\hline M39016/6-225L,M, P & HFW1231K06,M, P \\
\hline M39016/6-226L,M, P & HFW1231G02,M,P \\
\hline M39016/6-227L,M, P & HFW1231F02,M, P \\
\hline M39016/6-228L,M, P & HFW1106K13,M, P \\
\hline M39016/6-229L,M, P & HFW1101K07,M,P \\
\hline M39016/6-230L,M, P & HFW1101G02,M, P \\
\hline M39016/6-231L,M, P & HFW1101F02,M, P \\
\hline M39016/6-232L,M, P & HFW1130L02,M, P \\
\hline M39016/6-233L,M, P & HFW1230L02,M, P \\
\hline M39016/6-235L,M, P & HFW1131L02,M, P \\
\hline M39016/6-236L,M, P & HFW1231L02,M, P \\
\hline M39016/6-238L,M, P & HFW1101L02,M, P \\
\hline M39016/6-239L,M, P & HFW1201L02,M, P \\
\hline M39016/6-241L,M, P & HFW1230K12,M,P \\
\hline M39016/6-242L,M, P & HFW1201K104,M, P \\
\hline M39016/6-243L,M, P & HFW1230G04,M,P \\
\hline M39016/6-244L,M, P & HFW1201G15,M, P \\
\hline M39016/6-245L,M, P & HFW1230F04,M, P \\
\hline M39016/6-246L,M, P & HFW1201F16,M, P \\
\hline M39016/6-247L,M, P & HFW1230L04,M, P \\
\hline M39016/6-248L,M, P & HFW1201L07,M, P \\
\hline \multicolumn{2}{|c|}{MIL-PRF-39016/7} \\
\hline Military Part Number & CIIPart Number \\
\hline M39016/7-013L,M, P & J1MAW-5XL, XM, XP \\
\hline M39016/7-014L,M, P & J1MAP-5XL, XM, XP \\
\hline M39016/7-015L,M, P & J1MAW-6XL, XM, XP \\
\hline M39016/7-016L,M, P & J1MAP-6XL, XM, XP \\
\hline M39016/7-017L,M, P & J1MAW-9XL, XM, XP \\
\hline M39016/7-018L,M, P & J1MAP-9XL, XM, XP \\
\hline M39016/7-019L,M, P & J1MAW-12XL, XM, XP \\
\hline M39016/7-020L,M, P & J1MAP-12XL, XM, XP \\
\hline M39016/7-021L,M, P & J1MAW-18XL, XM, XP \\
\hline M39016/7-022L,M, P & J1MAP-18XL, XM, XP \\
\hline M39016/7-023L,M, P & J1MAW-26XL, XM, XP \\
\hline M39016/7-024L,M, P & J1MAP-26XL,XM, XP \\
\hline
\end{tabular}

\section*{CII Electromechanical Relays (Continued)}
\begin{tabular}{lr}
\multicolumn{2}{c}{ MIL-PRF-39016/7 (continued) } \\
\hline Military Part Number & CIIPart Number \\
\hline M39016/7-025L,M,P & J1MAC-5XL,XM,XP \\
\hline M39016/7-026L,M,P & J1MAC-6XL,XM,XP \\
\hline M39016/7-027L,M,P & J1MAC-9XL,XM,XP \\
\hline M39016/7-028,M,M,P & J1MAC-12XL,XM,XP \\
\hline M39016/7-029L,M,P & J1MAC-18XL,XM,XP \\
\hline M39016/7-030L,M,P & J1MAC-26XL,XM,XP \\
\hline M39016/7-031L,M,P & J1MAC-5XLS,XMS,XPS \\
\hline M39016/7-032L,M,P & J1MAC-6XLS,XMS,XPS \\
\hline M39016/7-033L,M,P & J1MAC-9XLS,XMS,XPS \\
\hline M39016/7-034L,M,P & J1MAC-12XLS,XMS,XPS \\
\hline M39016/7-035L,M,P & J1MAC-18XLS,XMS,XPS \\
\hline M39016/7-036L,M,P & J1MAC-26XLS,XMS,XPS \\
\hline
\end{tabular}
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|c|}{MIL-PRF-39016/9} \\
\hline Military Part Number & CII Part Number \\
\hline M39016/9-013L,M,P & JMAW-5XL, XM, XP \\
\hline M39016/9-014L,M,P & JMAW-6XL, XM, XP \\
\hline M39016/9-015L,M,P & JMAW-9XL, XM, XP \\
\hline M39016/9-016L,M,P & JMAW-12XL,XM, XP \\
\hline M39016/9-017L,M,P & JMAW-18XL, XM, XP \\
\hline M39016/9-018L,M,P & JMAW-26XL,XM, XP \\
\hline M39016/9-019L,M,P & JMAP-5XL, XM, XP \\
\hline M39016/9-020L,M, P & JMAP-6XL, XM, XP \\
\hline M39016/9-021L,M,P & JMAP-9XL,XM, XP \\
\hline M39016/9-022L,M,P & JMAP-12XL, XM, XP \\
\hline M39016/9-023L,M,P & JMAP-18XL, XM, XP \\
\hline M39016/9-024L,M,P & JMAP-26XL, XM, XP \\
\hline M39016/9-051L,M,P & JMAW-30XL, XM, XP \\
\hline M39016/9-052L,M,P & JMAP-30XL, XM, XP \\
\hline M39016/9-057L,M,P & JMAC-5XL, XM, XP \\
\hline M39016/9-058L,M,P & JMAC-6XL, XM, XP \\
\hline M39016/9-059L,M,P & JMAC-9XL, XM, XP \\
\hline M39016/9-060L,M,P & JMAC-12XL, XM, XP \\
\hline M39016/9-061L,M,P & JMAC-18XL, XM, XP \\
\hline M39016/9-062L,M,P & JMAC-26XL, XM, XP \\
\hline M39016/9-063L,M,P & JMAC-30XL,XM, XP \\
\hline M39016/9-071L,M, P & JMAC-5XLS,XMS,XPS \\
\hline M39016/9-072L,M,P & JMAC-6XLS, XMS, XPS \\
\hline M39016/9-073L,M,P & JMAC-9XLS, XMS, XPS \\
\hline M39016/9-074L,M,P & JMAC-12XLS, XMS,XPS \\
\hline M39016/9-075L,M,P & JMAC-18XLS, XMS,XPS \\
\hline M39016/9-076L,M,P & JMAC-26XLS, XMS,XPS \\
\hline M39016/9-077L,M,P & JMAC-30XLS, XMS,XPS \\
\hline M39016/9-106L,M, P & JMAC-5XLS, XMS, XPS \\
\hline M39016/9-107L,M,P & JMAC-6XLS,XMS, XPS \\
\hline M39016/9-108L,M,P & JMAC-9XLS, XMS, XPS \\
\hline M39016/9-109L,M,P & JMAC-12XLS, XMS, XPS \\
\hline M39016/9-110L,M,P & JMAC-18XLS, XMS,XPS \\
\hline M39016/9-111L,M,P & JMAC-26XLS,XMS,XPS \\
\hline M39016/9-112L,M,P & JMAC-30XLS,XMS,XPS \\
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\end{tabular}

\section*{MIL-PRF-39016/10}
\begin{tabular}{lr} 
Military Part Number & CIIPart Number \\
\hline M39016/10-017L,M,P & J1MSW-5XL,XM,XP \\
\hline M39016/10-018L,M,P & J1MSP-5XL,XM,XP \\
\hline M39016/10-019L,M,P & J1MSW-6XL,XM,XP \\
\hline M39016/10-020L,M,P & J1MSP-6XL,XM,XP \\
\hline M39016/10-021L,M,P & J1MSW-12XL,XM,XP \\
\hline M39016/10-022L,M,P & J1MSP-12XL,XM,XP \\
\hline M39016/10-023L,M,P & J1MSW-26XL,XM,XP \\
\hline M39016/10-024L,M,P & J1MSP-26XL,XM,XP \\
\hline
\end{tabular}
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|c|}{MIL-PRF-39016/10 (continued)} \\
\hline Military Part Number & CIIPart Number \\
\hline M39016/10-025L,M,P & J1MSW-32XL,XM,XP \\
\hline M39016/10-026L,M,P & J1MSP-32XL, XM, XP \\
\hline M39016/10-027L,M,P & J1MSW-40XL,XM, XP \\
\hline M39016/10-028L,M,P & J1MSP-40XL, XM, XP \\
\hline M39016/10-029L,M,P & J1MSW-9XL,XM, XP \\
\hline M39016/10-030L,M,P & J1MSP-9XL, XM, XP \\
\hline M39016/10-031L,M, P & J1MSW-18XL, XM, XP \\
\hline M39016/10-032L,M,P & J1MSP-18XL, XM, XP \\
\hline M39016/10-033L,M,P & J1MSC-5XL, XM, XP \\
\hline M39016/10-034L,M,P & J1MSC-6XL, XM, XP \\
\hline M39016/10-035L,M,P & J1MSC-12XL, XM, XP \\
\hline M39016/10-036L,M,P & J1MSC-26XL, XM, XP \\
\hline M39016/10-037L,M,P & J1MSC-32XL, XM, XP \\
\hline M39016/10-038L,M,P & J1MSC-40XL, XM, XP \\
\hline M39016/10-039L,M,P & J1MSC-9XL, XM, XP \\
\hline M39016/10-040L,M,P & J1MSC-18XL, XM, XP \\
\hline M39016/10-041L,M,P & J1MSC-5XLS,XMS,XPS \\
\hline M39016/10-042L,M,P & J1MSC-6XLS, XMS, XPS \\
\hline M39016/10-043L,M,P & J1MSC-12XLS, XMS,XPS \\
\hline M39016/10-044L,M,P & J1MSC-26XLS, XMS,XPS \\
\hline M39016/10-045L,M,P & J1MSC-32XLS, XMS, XPS \\
\hline M39016/10-046L,M, P & J1MSC-40XLS, XMS,XPS \\
\hline M39016/10-047L,M, P & J1MSC-9XLS, XMS,XPS \\
\hline M39016/10-048L,M, P & J1MSC-18XLS,XMS,XPS \\
\hline
\end{tabular}

\footnotetext{
Dimensions are in millimeters unless otherwise specified.
}

MIL-PRF-39016/13
\begin{tabular}{|c|c|}
\hline Military Part Number & CII Part Number \\
\hline M39016/13-055L & 3SBC1501A2 \\
\hline M39016/13-055M & 3SBC1516A2 \\
\hline M39016/13-055P & 3SBC2000A2 \\
\hline M39016/13-056L & 3SBC1502A2 \\
\hline M39016/13-056M & 3SBC1517A2 \\
\hline M39016/13-056P & 3SBC2001A2 \\
\hline M39016/13-057L & 3SBC1503A2 \\
\hline M39016/13-057M & 3SBC1518A2 \\
\hline M39016/13-057P & 3SBC2002A2 \\
\hline M39016/13-058L & 3SBC1504A2 \\
\hline M39016/13-058M & 3SBC1519A2 \\
\hline M39016/13-058P & 3SBC2003A2 \\
\hline M39016/13-059L & 3SBC1505A2 \\
\hline M39016/13-059M & 3SBC1520A2 \\
\hline M39016/13-059P & 3SBC2004A2 \\
\hline M39016/13-060L & 3SBC1506A2 \\
\hline M39016/13-060M & 3SBC1521A2 \\
\hline M39016/13-060P & 3SBC2005A2 \\
\hline M39016/13-061L & 3SBC1507A2 \\
\hline M39016/13-061M & 3SBC1522A2 \\
\hline M39016/13-061P & 3SBC2006A2 \\
\hline M39016/13-062L & 3SBC1508A2 \\
\hline M39016/13-062M & 3SBC1523A2 \\
\hline M39016/13-062P & 3SBC2007A2 \\
\hline M39016/13-063L & 3SBC1509A2 \\
\hline M39016/13-063M & 3SBC1524A2 \\
\hline M39016/13-063P & 3SBC2008A2 \\
\hline M39016/13-064L & 3SBC1510A2 \\
\hline M39016/13-064M & 3SBC1525A2 \\
\hline M39016/13-064P & 3SBC2009A2 \\
\hline M39016/13-065L & 3SBC1511A2 \\
\hline M39016/13-065M & 3SBC1526A2 \\
\hline M39016/13-065P & 3SBC2010A2 \\
\hline M39016/13-066L & 3SBC1512A2 \\
\hline M39016/13-066M & 3SBC1527A2 \\
\hline M39016/13-066P & 3SBC2011A2 \\
\hline M39016/13-067L & 3SBC1513A2 \\
\hline M39016/13-067M & 3SBC1528A2 \\
\hline M39016/13-067P & 3SBC2012A2 \\
\hline M39016/13-068L & 3SBC1514A2 \\
\hline M39016/13-068M & 3SBC1529A2 \\
\hline M39016/13-068P & 3SBC2013A2 \\
\hline M39016/13-069L & 3SBC1515A2 \\
\hline M39016/13-069M & 3SBC1530A2 \\
\hline M39016/13-069P & 3SBC2014A2 \\
\hline M39016/13-070L & 3SBC1532A2 \\
\hline M39016/13-070M & 3SBC1535A2 \\
\hline M39016/13-070P & 3SBC2015A2 \\
\hline M39016/13-071L & 3SBC1533A2 \\
\hline M39016/13-071M & 3SBC1536A2 \\
\hline M39016/13-071P & 3SBC2016A2 \\
\hline M39016/13-072L & 3SBC1534A2 \\
\hline M39016/13-072M & 3SBC1537A2 \\
\hline M39016/13-072P & 3SBC2017A2 \\
\hline M39016/13-073L & 3SBC1538A2 \\
\hline M39016/13-073M & 3SBC1547A2 \\
\hline M39016/13-073P & 3SBC2018A2 \\
\hline M39016/13-074L & 3SBC1539A2 \\
\hline M39016/13-074M & 3SBC1548A2 \\
\hline M39016/13-074P & 3SBC2019A2 \\
\hline M39016/13-075L & 3SBC1540A2 \\
\hline
\end{tabular}

MIL-PRF-39016/13 (continued)
\begin{tabular}{|c|c|}
\hline Military Part Number & Part Number \\
\hline M39016/13-075M & 3SBC1549A2 \\
\hline M39016/13-075P & 3SBC2020A2 \\
\hline M39016/13-076L & 3SBC1541A2 \\
\hline M39016/13-076M & 3SBC1550A2 \\
\hline M39016/13-076P & 3SBC2021A2 \\
\hline M39016/13-077L & 3SBC1542A2 \\
\hline M39016/13-077M & 3SBC1551A2 \\
\hline M39016/13-077P & 3SBC2022A2 \\
\hline M39016/13-078L & 3SBC1543A2 \\
\hline M39016/13-078M & 3SBC1552A2 \\
\hline M39016/13-078P & 3SBC2023A2 \\
\hline M39016/13-079L & 3SBC1544A2 \\
\hline M39016/13-079M & 3SBC1553A2 \\
\hline M39016/13-079P & 3SBC2024A2 \\
\hline M39016/13-080L & 3SBC1545A2 \\
\hline M39016/13-080M & 3SBC1554A2 \\
\hline M39016/13-080P & 3SBC2025A2 \\
\hline M39016/13-081L & 3SBC1546A2 \\
\hline M39016/13-081M & 3SBC1555A2 \\
\hline M39016/13-081P & 3SBC2026A2 \\
\hline M39016/13-082L & 3SBC1582A2 \\
\hline M39016/13-082M & 3SBC1589A2 \\
\hline M39016/13-082P & 3SBC2027A2 \\
\hline M39016/13-083L & 3SBC1583A21 \\
\hline M39016/13-083M & 3SBC1590A2 \\
\hline M39016/13-083P & 3SBC2028A2 \\
\hline M39016/13-084L & 3SBC1584A2 \\
\hline M39016/13-084M & 3SBC1591A2 \\
\hline M39016/13-084P & 3SBC2029A2 \\
\hline M39016/13-085L & 3SBC1585A2 \\
\hline M39016/13-085M & 3SBC1592A2 \\
\hline M39016/13-085P & 3SBC2030A2 \\
\hline M39016/13-086L & 3SBC1586A2 \\
\hline M39016/13-086M & 3SBC1593A2 \\
\hline M39016/13-086P & 3SBC2031A2 \\
\hline M39016/13-087L & 3SBC1587A2 \\
\hline M39016/13-087M & 3SBC1594A2 \\
\hline M39016/13-087P & 3SBC2032A2 \\
\hline M39016/13-088L & 3SBC1588A2 \\
\hline M39016/13-088M & 3SBC1595A2 \\
\hline M39016/13-088P & 3SBC2033A2 \\
\hline M39016/13-089L & 3SBC1655A2 \\
\hline M39016/13-089M & 3SBC1658A2 \\
\hline M39016/13-089P & 3SBC2034A2 \\
\hline M39016/13-090L & 3SBC1656A2 \\
\hline M39016/13-090M & 3SBC1659A2 \\
\hline M39016/13-090P & 3SBC2035A2 \\
\hline M39016/13-091L & 3SBC1657A2 \\
\hline M39016/13-091M & 3SBC1660A2 \\
\hline M39016/13-091P & 3SBC2036A2 \\
\hline M39016/13-092L & 3SBC1758A2 \\
\hline M39016/13-092M & 3SBC1784A2 \\
\hline M39016/13-092P & 3SBC2037A2 \\
\hline M39016/13-093L & 3SBC1759A2 \\
\hline M39016/13-093M & 3SBC1785A2 \\
\hline M39016/13-093P & 3SBC2038A2 \\
\hline M39016/13-094L & 3SBC1760A2 \\
\hline M39016/13-094M & 3SBC1786A2 \\
\hline M39016/13-094P & 3SBC2039A2 \\
\hline M39016/13-095L & 3SBC1761A2 \\
\hline M39016/13-095M & 3SBC1787A2 \\
\hline
\end{tabular}

Military Qualified Products List (QPL)
CII Electromechanical Relays (Continued)
\begin{tabular}{|c|c|c|c|}
\hline \multicolumn{2}{|c|}{MIL-PRF-39016/13 (continued)} & \multicolumn{2}{|c|}{MIL-PRF-39016/13 (continued)} \\
\hline Military Part Number & CIIP Part Number & Military Part Number & CIIPart Number \\
\hline M39016/13-095P & 3SBC2040A2 & M39016/13-116L & 3SBC1782A2 \\
\hline M39016/13-096L & 3SBC1762A2 & M39016/13-116M & 3SBC1808A2 \\
\hline M39016/13-096M & 3SBC1788A2 & M39016/13-116P & 3SBC2061A2 \\
\hline M39016/13-096P & 3SBC2041A2 & M39016/13-117L & 3SBC1783A2 \\
\hline M39016/13-097L & 3SBC1763A2 & M39016/13-117M & 3SBC1809A2 \\
\hline M39016/13-097M & 3SBC1789A2 & M39016/13-117P & 3SBC2062A2 \\
\hline M39016/13-097P & 3SBC2042A2 & M39016/13-118L & 3SBC2141A2 \\
\hline M39016/13-098L & 3SBC1764A2 & M39016/13-118M & 3SBC2148A2 \\
\hline M39016/13-098M & 3SBC1790A2 & M39016/13-118P & 3SBC2155A2 \\
\hline M39016/13-098P & 3SBC2043A2 & M39016/13-119L & 3SBC2142A2 \\
\hline M39016/13-099L & 3SBC1765A2 & M39016/13-119M & 3SBC2149A2 \\
\hline M39016/13-099M & 3SBC1791A2 & M39016/13-119P & 3SBC2156A2 \\
\hline M39016/13-099P & 3SBC2044A2 & M39016/13-120L & 3SBC2143A2 \\
\hline M39016/13-100L & 3SBC1766A2 & M39016/13-120M & 3SBC2150A2 \\
\hline M39016/13-100M & 3SBC1792A2 & M39016/13-120P & 3SBC2157A2 \\
\hline M39016/13-100P & 3SBC2045A2 & M39016/13-121L & 3SBC2144A2 \\
\hline M39016/13-101L & 3SBC1767A2 & M39016/13-121M & 3SBC2151A2 \\
\hline M39016/13-101M & 3SBC1793A2 & M39016/13-121P & 3SBC2158A2 \\
\hline M39016/13-101P & 3SBC2046A2 & M39016/13-122L & 3SBC2145A2 \\
\hline M39016/13-102L & 3SBC1768A2 & M39016/13-122M & 3SBC2152A2 \\
\hline M39016/13-102M & 3SBC1794A2 & M39016/13-122P & 3SBC2159A2 \\
\hline M39016/13-102P & 3SBC2047A2 & M39016/13-123L & 3SBC2146A2 \\
\hline M39016/13-103L & 3SBC1769A2 & M39016/13-123M & 3SBC2153A2 \\
\hline M39016/13-103M & 3SBC1795A2 & M39016/13-123P & 3SBC2160A2 \\
\hline M39016/13-103P & 3SBC2048A2 & M39016/13-124L & 3SBC2147A2 \\
\hline M39016/13-104L & 3SBC1770A2 & M39016/13-124M & 3SBC2154A2 \\
\hline M39016/13-104M & 3SBC1796A2 & M39016/13-124P & 3SBC2161A2 \\
\hline M39016/13-104P & 3SBC2049A2 & & \\
\hline M39016/13-105L & 3SBC1771A2 & \multicolumn{2}{|c|}{MIL-PRF-39016/14} \\
\hline M39016/13-105M & 3SBC1797A2 & Military Part Number & CII Part Number \\
\hline M39016/13-105P & 3SBC2050A2 & M39016/14-001L & 3SBH1141A2 \\
\hline M39016/13-106L & 3SBC1772A2 & M39016/14-001M & 3SBH1138A2 \\
\hline M39016/13-106M & 3SBC1798A2 & M39016/14-002L & 3SBH1142A2 \\
\hline M39016/13-106P & 3SBC2051A2 & M39016/14-002M & 3SBH1139A2 \\
\hline M39016/13-107L & 3SBC1773A2 & M39016/14-003L & 3SBH1143A2 \\
\hline M39016/13-107M & 3SBC1799A2 & M39016/14-003M & 3SBH1140A2 \\
\hline M39016/13-107P & 3SBC2052A2 & M39016/14-004L & 3SBH1144A2 \\
\hline M39016/13-108L & 3SBC1774A2 & M39016/14-004M & 3SBH1129A2 \\
\hline M39016/13-108M & 3SBC1800A2 & M39016/14-005L & 3SBH1145A2 \\
\hline M39016/13-108P & 3SBC2053A2 & M39016/14-005M & 3SBH1130A2 \\
\hline M39016/13-109L & 3SBC1775A2 & M39016/14-006L & 3SBH1146A2 \\
\hline M39016/13-109M & 3SBC1801A2 & M39016/14-006M & 3SBH1148A2 \\
\hline M39016/13-109P & 3SBC2054A2 & M39016/14-007L & 3SBH1147A2 \\
\hline M39016/13-110L & 3SBC1776A2 & M39016/14-007M & 3SBH1149A2 \\
\hline M39016/13-110M & 3SBC1802A2 & M39016/14-008L & 3SBH1151A2 \\
\hline M39016/13-110P & 3SBC2055A2 & M39016/14-008M & 3SBH1165A2 \\
\hline M39016/13-111L & 3SBC1777A2 & M39016/14-009L & 3SBH1179A2 \\
\hline M39016/13-111M & 3SBC1803A2 & M39016/14-009M & 3SBH1209A2 \\
\hline M39016/13-111P & 3SBC2056A2 & M39016/14-010L & 3SBH1180A2 \\
\hline M39016/13-112L & 3SBC1778A2 & M39016/14-010M & 3SBH1210A2 \\
\hline M39016/13-112M & 3SBC1804A2 & M39016/14-011L & 3SBH1181A2 \\
\hline M39016/13-112P & 3SBC2057A2 & M39016/14-011M & 3SBH1211A2 \\
\hline M39016/13-113L & 3SBC1779A2 & M39016/14-012L & 3SBH1182A2 \\
\hline M39016/13-113M & 3SBC1805A2 & M39016/14-012M & 3SBH1212A2 \\
\hline M39016/13-113P & 3SBC2058A2 & M39016/14-013L & 3SBH1183A2 \\
\hline M39016/13-114L & 3SBC1780A2 & M39016/14-013M & 3SBH1213A2 \\
\hline M39016/13-114M & 3SBC1806A2 & M39016/14-014L & 3SBH1184A2 \\
\hline M39016/13-114P & 3SBC2059A2 & M39016/14-014M & 3SBH1214A2 \\
\hline M39016/13-115L & 3SBC1781A2 & M39016/14-015L & 3SBH1185A2 \\
\hline M39016/13-115M & 3SBC1807A2 & M39016/14-015M & 3SBH1215A2 \\
\hline M39016/13-115P & 3SBC2060 & & \\
\hline
\end{tabular}

MIL-PRF-39016/15
\begin{tabular}{|c|c|}
\hline Military Part Number & CII Part Number \\
\hline M39016/15-029L,M,P & JMAWD-6XL, XM, XP \\
\hline M39016/15-030L,M,P & JMAWD-9XL, XM, XP \\
\hline M39016/15-031L,M,P & JMAWD-12XL,XM, XP \\
\hline M39016/15-032L,M,P & JMAWD-18XL, XM, XP \\
\hline M39016/15-033L,M,P & JMAWD-26XL,XM, XP \\
\hline M39016/15-034L,M,P & JMAWD-5XL, XM, XP \\
\hline M39016/15-035L,M,P & JMAPD-6XL,XM, XP \\
\hline M39016/15-036L,M,P & JMAPD-9XL, XM, XP \\
\hline M39016/15-037L,M, P & JMAPD-12XL, XM, XP \\
\hline M39016/15-038L,M,P & JMAPD-18XL, XM, XP \\
\hline M39016/15-039L,M, P & JMAPD-26XL,XM, XP \\
\hline M39016/15-040L,M, P & JMAPD-5XL, XM, XP \\
\hline M39016/15-065L,M,P & JMAWDG-6XL,XM, XP \\
\hline M39016/15-066L,M, P & JMAWDG-9XL,XM, XP \\
\hline M39016/15-067L,M,P & JMAWDG-12XL,XM, XP \\
\hline M39016/15-068L,M,P & JMAWDG-18XL, XM, XP \\
\hline M39016/15-069L,M, P & JMAWDG-26XL,XM, XP \\
\hline M39016/15-070L,M,P & JMAWDG-5XL,XM, XP \\
\hline M39016/15-077L,M,P & JMACD-6XL, XM, XP \\
\hline M39016/15-078L,M,P & JMACD-9XL, XM, XP \\
\hline M39016/15-079L,M, P & JMACD-12XL,XM, XP \\
\hline M39016/15-080L,M,P & JMACD-18XL, XM, XP \\
\hline M39016/15-081L,M, P & JMACD-26XL, XM, XP \\
\hline M39016/15-082L,M,P & JMACD-5XL, XM, XP \\
\hline M39016/15-089L,M,P & JMACDG-6XL,XM, XP \\
\hline M39016/15-090L,M, P & JMACDG-9XL,XM, XP \\
\hline M39016/15-091L,M,P & JMACDG-12XL,XM, XP \\
\hline M39016/15-092L,M,P & JMACDG-18XL,XM, XP \\
\hline M39016/15-093L,M,P & JMACDG-26XL,XM, XP \\
\hline M39016/15-094L,M, P & JMACDG-5XL,XM, XP \\
\hline M39016/15-101L,M, P & JMACD-6XLS,XMS,XPS \\
\hline M39016/15-102L,M,P & JMACD-9XLS,XMS,XPS \\
\hline M39016/15-103L,M, P & JMACD-12XLS, XMS,XPS \\
\hline M39016/15-104L,M, P & JMACD-18XLS,XMS,XPS \\
\hline M39016/15-105L,M,P & JMACD-26XLS,XMS,XPS \\
\hline M39016/15-106L,M, P & JMACD-5XLS,XMS,XPS \\
\hline M39016/15-113L,M, P & JMACDG-6XLS,XMS,XPS \\
\hline M39016/15-114L,M, P & JMACDG-9XLS,XMS,XPS \\
\hline M39016/15-115L,M,P & JMACDG-12XLS,XMS,XPS \\
\hline M39016/15-116L,M, P & JMACDG-18XLS,XMS,XPS \\
\hline M39016/15-117L,M,P & JMACDG-26XLS,XMS,XPS \\
\hline M39016/15-118L,M,P & JMACDG-5XLS,XMS,XPS \\
\hline M39016/15-125L,M, P & JMACD-6XLS, XMS,XPS \\
\hline M39016/15-126L,M, P & JMACD-9XLS,XMS,XPS \\
\hline M39016/15-127L,M, P & JMACD-12XLS,XMS,XPS \\
\hline M39016/15-128L,M, P & JMACD-18XLS,XMS,XPS \\
\hline M39016/15-129L,M,P & JMACD-26XLS,XMS,XPS \\
\hline M39016/15-130L,M,P & JMACD-5XLS,XMS,XPS \\
\hline
\end{tabular}
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|c|}{MIL-PRF-39016/16} \\
\hline Military Part Number & CII Part Number \\
\hline M39016/16-017L,M,P & JMSWD-5XL, XM, XP \\
\hline M39016/16-018L,M,P & JMSWD-6XL, XM, XP \\
\hline M39016/16-019L,M, P & JMSWD-12XL, XM, XP \\
\hline M39016/16-020L,M,P & JMSWD-26XL, XM, XP \\
\hline M39016/16-021L,M,P & JMSWD-36XL, XM, XP \\
\hline M39016/16-022L,M, P & JMSWD-48XL,XM, XP \\
\hline M39016/16-023L,M, P & JMSWD-9XL, XM, XP \\
\hline M39016/16-024L,M,P & JMSWD-18XL, XM, XP \\
\hline M39016/16-025L,M,P & JMSPD-5XL, XM, XP \\
\hline M39016/16-026L,M,P & JMSPD-6XL,XM, XP \\
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\end{tabular}

MIL-PRF-39016/16 (continued)
\begin{tabular}{|c|c|}
\hline Mililiary Part Number & CIIPart Number \\
\hline M39016/16-027L,M, P & JMSPD-12XL,XM,XP \\
\hline M39016/16-028L,M,P & JMSPD-26XL,XM,XP \\
\hline M39016/16-029L,M,P & JMSPD-36XL,XM,XP \\
\hline M39016/16-030L,M, P & JMSPD-48XL,XM, XP \\
\hline M39016/16-031L,M,P & JMSPD-9XL, XM, XP \\
\hline M39016/16-032L,M, P & JMSPD-18XL,XM,XP \\
\hline M39016/16-033L,M, P & JMSCD-5XL, XM, XP \\
\hline M39016/16-034L,M, P & JMSCD-6XL, XM, XP \\
\hline M39016/16-035L,M,P & JMSCD-12XL,XM, XP \\
\hline M39016/16-036L,M, P & JMSCD-26XL,XM, XP \\
\hline M39016/16-037L,M, P & JMSCD-36XL,XM, XP \\
\hline M39016/16-038L,M,P & JMSCD-48XL,XM, XP \\
\hline M39016/16-039L,M,P & JMSCD-9XL, XM, XP \\
\hline M39016/16-040L,M, P & JMSCD-18XL, XM, XP \\
\hline M39016/16-041L,M, P & JMSCD-5XLS,XMS,XPS \\
\hline M39016/16-042L,M,P & JMSCD-6XLS,XMS,XPS \\
\hline M39016/16-043L,M, P & JMSCD-12XLS, XMS, XPS \\
\hline M39016/16-044L,M, P & JMSCD-26XLS,XMS,XPS \\
\hline M39016/16-045L,M,P & JMSCD-36XLS,XMS,XPS \\
\hline M39016/16-046L,M, P & JMSCD-48XLS, XMS, XPS \\
\hline M39016/16-047L,M, P & JMSCD-9XLS,XMS,XPS \\
\hline M39016/16-048L,M, P & JMSCD-18XLS,XMS,XPS \\
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\end{tabular}

MIL-PRF-39016/17
\begin{tabular}{|c|c|}
\hline Military Part Number & CII Part Number \\
\hline M39016/17-025L,M,P & JMGAP-5L,M,P \\
\hline M39016/17-026L,M, P & JMGAP-6L,M,P \\
\hline M39016/17-027L,M, P & JMGAP-9L,M,P \\
\hline M39016/17-028L,M,P & JMGAP-12L,M,P \\
\hline M39016/17-029L,M, P & JMGAP-18L,M,P \\
\hline M39016/17-030L,M, P & JMGAP-26L,M, P \\
\hline M39016/17-031L,M,P & JMGAC-5L,M,P \\
\hline M39016/17-032L,M,P & JMGAC-6L,M,P \\
\hline M39016/17-033L,M, P & JMGAC-9L,M, P \\
\hline M39016/17-034L,M, P & JMGAC-12L,M, P \\
\hline M39016/17-035L,M,P & JMGAC-18L,M, P \\
\hline M39016/17-036L,M,P & JMGAC-26L,M, P \\
\hline M39016/17-037L,M, P & JMGAC-5LW,MW, PW \\
\hline M39016/17-038L,M,P & JMGAC-6LW,MW, PW \\
\hline M39016/17-039L,M,P & JMGAC-9LW,MW,PW \\
\hline M39016/17-040L,M, P & JMGAC-12LW,MW,PW \\
\hline M39016/17-041L,M, P & JMGAC-18LW,MW,PW \\
\hline M39016/17-042L,M,P & JMGAC-26LW,MW,PW \\
\hline M39016/17-043L,M, P & JMGACG-5L,M,P \\
\hline M39016/17-044L,M, P & JMGACG-6L,M,P \\
\hline M39016/17-045L,M, P & JMGACG-9L,M,P \\
\hline M39016/17-046L,M,P & JMGACG-12L,M,P \\
\hline M39016/17-047L,M, P & JMGACG-18L,M,P \\
\hline M39016/17-048L,M,P & JMGACG-26L,M, P \\
\hline M39016/17-049L,M,P & JMGACG-5LW,MW,PW \\
\hline M39016/17-050L,M,P & JMGACG-6LW,MW,PW \\
\hline M39016/17-051L,M, P & JMGACG-9LW,MW,PW \\
\hline M39016/17-052L,M,P & JMGACG-12LW,MW,PW \\
\hline M39016/17-053L,M,P & JMGACG-18LW,MW,PW \\
\hline M39016/17-054L,M,P & JMGACG-26LW,MW,PW \\
\hline
\end{tabular}

\section*{MIL-PRF-39016/18}
\begin{tabular}{ll} 
Military Part Number & CII Part Number \\
\hline M39016/18-025L,M, P & JMGAPD-5L,M,P \\
\hline M39016/18-026L,M, P & JMGAPD-6L,M, P \\
\hline M39016/18-027L,M,P & JMGAPD-9L,M,P, \\
\hline
\end{tabular}

Military Qualified Products List (QPL)
\begin{tabular}{|c|c|}
\hline & CII Electromechanical Re \\
\hline \multicolumn{2}{|r|}{MIL-PRF-39016/18 (continued)} \\
\hline Military Part Number & CIIPart Number \\
\hline M39016/18-028L,M, P & JMGAPD-12L,M, P \\
\hline M39016/18-029L,M, P & JMGAPD-18L,M,P \\
\hline M39016/18-030L,M,P & JMGAPD-26L,M,P \\
\hline M39016/18-031L,M, P & JMGACD-5L,M, P \\
\hline M39016/18-032L,M,P & JMGACD-6L,M,P \\
\hline M39016/18-033L,M, P & JMGACD-9L,M,P \\
\hline M39016/18-034L,M,P & JMGACD-12L,M,P \\
\hline M39016/18-035L,M,P & JMGACD-18L,M, P \\
\hline M39016/18-036L,M,P & JMGACD-26L,M, P \\
\hline M39016/18-037L,M,P & JMGACD-5LW,MW,PW \\
\hline M39016/18-038L,M,P & JMGACD-6LW,MW,PW \\
\hline M39016/18-039L,M,P & JMGACD-9LW,MW,PW \\
\hline M39016/18-040L,M, P & JMGACD-12LW,MW,PW \\
\hline M39016/18-041L,M,P & JMGACD-18LW,MW,PW \\
\hline M39016/18-042L,M,P & JMGACD-26LW,MW,PW \\
\hline M39016/18-043L,M, P & JMGACDG-5L,M,P \\
\hline M39016/18-044L,M, P & JMGACDG-6L,M,P \\
\hline M39016/18-045L,M,P & JMGACDG-9L,M,P \\
\hline M39016/18-046L,M,P & JMGACDG-12L,M, P \\
\hline M39016/18-047L,M, P & JMGACDG-18L,M, P \\
\hline M39016/18-048L,M,P & JMGACDG-26L,M,P \\
\hline M39016/18-049L,M,P & JMGACDG-5LW,MW,PW \\
\hline M39016/18-050L,M,P & JMGACDG-6LW,MW,PW \\
\hline M39016/18-051L,M, P & JMGACDG-9LW,MW,PW \\
\hline M39016/18-052L,M,P & JMGACDG-12MW,MW,PW \\
\hline M39016/18-053L,M,P & JMGACDG-18LW,MW,PW \\
\hline M39016/18-054L,M,P & JMGACDG-26LW,MW,PW \\
\hline
\end{tabular}

\section*{MIL-PRF-39016/19}
\begin{tabular}{|c|c|}
\hline Military Part Number & CII Part Number \\
\hline M39016/19-025L,M,P & JMGAPDD-5L,M,P \\
\hline M39016/19-026L,M,P & JMGAPDD-6L,M, P \\
\hline M39016/19-027L,M,P & JMGAPDD-9L,M,P \\
\hline M39016/19-028L,M,P & JMGAPDD-12L,M, P \\
\hline M39016/19-029L,M,P & JMGAPDD-18L,M, P \\
\hline M39016/19-030L,M,P & JMGAPDD-26L,M,P \\
\hline M39016/19-031L,M,P & JMGACDD-5L,M,P \\
\hline M39016/19-032L,M,P & JMGACDD-6L,M, P \\
\hline M39016/19-033L,M,P & JMGACDD-9L,M, P \\
\hline M39016/19-034L,M,P & JMGACDD-12L,M, P \\
\hline M39016/19-035L,M,P & JMGACDD-18L,M, P \\
\hline M39016/19-036L,M,P & JMGACDD-26L,M, P \\
\hline M39016/19-037L,M,P & JMGACDD-5LW,MW,PW \\
\hline M39016/19-038L,M,P & JMGACDD-6LW,MW,PW \\
\hline M39016/19-039L,M,P & JMGACDD-9LW,MW,PW \\
\hline M39016/19-040L,M,P & JMGACDD-12LW,MW,PW \\
\hline M39016/19-041L,M,P & JMGACDD-18LW,MW,PW \\
\hline M39016/19-042L,M,P & JMGACDD-26LW,MW,PW \\
\hline M39016/19-043L,M,P & JMGACDDG-5L,M,P \\
\hline M39016/19-044L,M,P & JMGACDDG-6L,M,P \\
\hline M39016/19-045L,M,P & JMGACDDG-9L,M, P \\
\hline M39016/19-046L,M,P & JMGACDDG-12L,M,P \\
\hline M39016/19-047L,M,P & JMGACDDG-18L,M,P \\
\hline M39016/19-048L,M, P & JMGACDDG-26L,M,P \\
\hline M39016/19-049L,M,P & JMGACDDG-5LW,MW,PW \\
\hline M39016/19-050L,M,P & JMGACDDG-6LW,MW,PW \\
\hline M39016/19-051L,M, P & JMGACDDG-9LW,MW,PW \\
\hline M39016/19-052L,M, P & JMGACDDG-12LW,MW,PW \\
\hline M39016/19-053L,M,P & JMGACDDG-18LW,MW,PW \\
\hline M39016/19-054L,M, P & JMGACDDG-26LW,MW,PW \\
\hline
\end{tabular}
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|c|}{MIL-PRF-39016/20} \\
\hline Military Part Number & CIIPart Num \\
\hline M39016/20-007L,M, P & JMAWDD-5XL,XM,XP \\
\hline M39016/20-008L,M,P & JMAWDD-6XL, XM, XP \\
\hline M39016/20-009L,M,P & JMAWDD-9XL, XM, XP \\
\hline M39016/20-010L,M, P & JMAWDD-12XL,XM, XP \\
\hline M39016/20-011L,M, P & JMAWDD-18XL, XM, XP \\
\hline M39016/20-012L,M,P & JMAWDD-26XL,XM, XP \\
\hline M39016/20-019L,M, P & JMAWDD-5XL,XM, XP \\
\hline M39016/20-020L,M,P & JMAWDD-6XL, XM, XP \\
\hline M39016/20-021L,M,P & JMAWDD-9XL, XM, XP \\
\hline M39016/20-022L,M,P & JMAWDD-12XL, XM, XP \\
\hline M39016/20-023L,M, P & JMAWDD-18XL, XM, XP \\
\hline M39016/20-024L,M,P & JMAWDD-26XL, XM, XP \\
\hline M39016/20-037L,M,P & JMAPDD-5XL,XM, XP \\
\hline M39016/20-038L,M, P & JMAPDD-6XL,XM, XP \\
\hline M39016/20-039L,M,P & JMAPDD-9XL,XM, XP \\
\hline M39016/20-040L,M,P & JMAPDD-12XL, XM, XP \\
\hline M39016/20-041L,M,P & JMAPDD-18XL, XM, XP \\
\hline M39016/20-042L,M, P & JMAPDD-26XL,XM, XP \\
\hline M39016/20-043L,M,P & JMAPDD-5XL, XM, XP \\
\hline M39016/20-044L,M,P & JMAPDD-6XL,XM, XP \\
\hline M39016/20-045L,M, P & JMAPDD-9XL,XM, XP \\
\hline M39016/20-046L,M, P & JMAPDD-12XL, XM, XP \\
\hline M39016/20-047L,M, P & JMAPDD-18XL,XM, XP \\
\hline M39016/20-048L,M,P & JMAPDD-26XL, XM, XP \\
\hline M39016/20-049L,M, P & JMACDD-5XL,XM, XP \\
\hline M39016/20-050L,M, P & JMACDD-6XL,XM, XP \\
\hline M39016/20-051L,M,P & JMACDD-9XL, XM, XP \\
\hline M39016/20-052L,M, P & JMACDD-12XL, XM, XP \\
\hline M39016/20-053L,M, P & JMACDD-18XL, XM, XP \\
\hline M39016/20-054L,M, P & JMACDD-26XL,XM, XP \\
\hline M39016/20-055L,M,P & JMACDD-5XL,XM, XP \\
\hline M39016/20-056L,M, P & JMACDD-6XL,XM, XP \\
\hline M39016/20-057L,M, P & JMACDD-9XL,XM,XP \\
\hline M39016/20-058L,M,P & JMACDD-12XL, XM, XP \\
\hline M39016/20-059L,M, P & JMACDD-18XL, XM, XP \\
\hline M39016/20-060L,M, P & JMACDD-26XL,XM, XP \\
\hline M39016/20-061L,M, P & JMACDD-5XLS,XMS,XPS \\
\hline M39016/20-062L,M,P & JMACDD-6XLS,XMS,XPS \\
\hline M39016/20-063L,M, P & JMACDD-9XLS, XMS,XPS \\
\hline M39016/20-064L,M,P & JMACDD-12XLS,XMS,XPS \\
\hline M39016/20-065L,M,P & JMACDD-18XLS,XMS,XPS \\
\hline M39016/20-066L,M, P & JMACDD-26XLS,XMS,XPS \\
\hline M39016/20-073L,M, P & JMACDD-5XLS,XMS,XPS \\
\hline M39016/20-074L,M,P & JMACDD-6XLS,XMS,XPS \\
\hline M39016/20-075L,M, P & JMACDD-9XLS,XMS,XPS \\
\hline M39016/20-076L,M,P & JMACDD-12XLS,XMS,XPS \\
\hline M39016/20-077L,M, P & JMACDD-18XLS,XMS,XPS \\
\hline M39016/20-078L,M, P & JMACDD-26XLS,XMS,XPS \\
\hline M39016/20-079L,M, P & JMACDDG-5XLS,XMS,XPS \\
\hline M39016/20-080L,M, P & JMACDDG-6XL,XM, XP \\
\hline M39016/20-081L,M, P & JMACDDG-9XL,XM, XP \\
\hline M39016/20-082L,M,P & JMACDDG-12XL,XM, XP \\
\hline M39016/20-083L,M, P & JMACDDG-18XL, XM, XP \\
\hline M39016/20-084L,M, P & JMACDDG-26XL,XM, XP \\
\hline M39016/20-085L,M, P & JMACDDG-5XL,XM,XP \\
\hline M39016/20-086L,M, P & JMACDDG-6XL,XM,XP \\
\hline M39016/20-087L,M, P & JMACDDG-9XL,XM, XP \\
\hline M39016/20-088L,M, P & JMACDDG-12XL, XM, XP \\
\hline M39016/20-089L,M,P & JMACDDG-18XL, XM, XP \\
\hline M39016/20-090L,M, P & JMACDDG-26XL,XM, XP \\
\hline M39016/20-091L,M, P & JMACDDG-5XLS,XMS,XPS \\
\hline
\end{tabular}

\title{
CII Electromechanical Relays（Continued）
}
\begin{tabular}{lr}
\multicolumn{2}{c}{ MIL－PRF－39016／20（continued）} \\
\begin{tabular}{lr} 
Military Part Number & CIIPart Number \\
\hline M39016／20－092L，M，P & JMACDDG－6XLS，XMS，XPS \\
\hline M39016／20－093L，M，P & JMACDDG－9XLS，XMS，XPS \\
\hline M39016／20－094L，M，P & JMACDDG－12XLS，XMS，XPS \\
\hline M39016／20－095L，M，P & JMACDDG－18XLS，XMS，XPS \\
\hline M39016／20－096L，M，P & JMACDDG－26XLS，XMS，XPS \\
\hline
\end{tabular}\(⿳ ⺈ ⿴ 囗 十 一 ⿱ 一 一 厶 女\)
\end{tabular}
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|c|}{MIL－PRF－39016／21} \\
\hline Military Part Number & CIIPart Number \\
\hline M39016／21－007L，M，P & JMSWDD－5XL，XM，XP \\
\hline M39016／21－008L，M，P & JMSWDD－6XL，XM，XP \\
\hline M39016／21－009L，M，P & JMSWDD－9XL，XM，XP \\
\hline M39016／21－010L，M，P & JMSWDD－12XL，XM，XP \\
\hline M39016／21－011L，M，P & JMSWDD－18XL，XM，XP \\
\hline M39016／21－012L，M，P & JMSWDD－26XL，XM，XP \\
\hline M39016／21－019L，M，P & JMSPDD－5XL，XM，XP \\
\hline M39016／21－020L，M，P & JMSPDD－6XL，XM，ХP \\
\hline M39016／21－021L，M，P & JMSPDD－9XL，XM，XP \\
\hline M39016／21－022L，M，P & JMSPDD－12XL，XM，XP \\
\hline M39016／21－023L，M，P & JMSPDD－18XL，XM，XP \\
\hline M39016／21－024L，M，P & JMSPDD－26XL，XM，XP \\
\hline M39016／21－029L，M，P & JMSWDD－36XL，XM，XP \\
\hline M39016／21－030L，M，P & JMSWDD－48XL，XM，XP \\
\hline M39016／21－031L，M，P & JMSPDD－36XL，XM，XP \\
\hline M39016／21－032L，M，P & JMSPDD－48XL，XM，XP \\
\hline M39016／21－033L，M，P & JMSCDD－5XL，XM，XP \\
\hline M39016／21－034L，M，P & JMSCDD－6XL，XM，XP \\
\hline M39016／21－035L，M，P & JMSCDD－9XL，XM，XP \\
\hline M39016／21－036L，M，P & JMSCDD－12XL，XM，XP \\
\hline M39016／21－037L，M，P & JMSCDD－18XL，XM，XP \\
\hline M39016／21－038L，M，P & JMSCDD－26XL，XM，XP \\
\hline M39016／21－039L，M，P & JMSCDD－36XL，XM，XP \\
\hline M39016／21－040L，M，P & JMSCDD－48XL，XM，XP \\
\hline M39016／21－041L，M，P & JMSCDD－5XLS，XMS，XPS \\
\hline M39016／21－042L，M，P & JMSCDD－6XLS，XMS，XPS \\
\hline M39016／21－043L，M，P & JMSCDD－9XLS，XMS，XPS \\
\hline M39016／21－044L，M，P & JMSCDD－12XLS，XMS，XPS \\
\hline M39016／21－045L，M，P & JMSCDD－18XLS，XMS，XPS \\
\hline M39016／21－046L，M，P & JMSCDD－26XLS，XMS，XPS \\
\hline M39016／21－047L，M，P & JMSCDD－36XLS，XMS，XPS \\
\hline M39016／21－048L，M，P & JMSCDD－48XLS，XMS，XPS \\
\hline
\end{tabular}

MIL－PRF－39016／22
\begin{tabular}{|c|c|}
\hline Minitiary Part Number & CIIPart Number \\
\hline M39016／22－004L，M，P & HMB1130K01L，M，P \\
\hline M39016／22－005L，M，P & HMB1230K01L，M，P \\
\hline M39016／22－007L，M，P & HMB1131K01L，M，P \\
\hline M39016／22－009L，M，P & HMB1201K01L，M，P \\
\hline M39016／22－011L，M，P & HMB1130G01L，M，P \\
\hline M39016／22－012L，M，P & HMB1230G01L，M，P \\
\hline M39016／22－014L，M，P & HMB1131G01L，M，P \\
\hline M39016／22－016L，M，P & HMB1201G01L，M，P \\
\hline M39016／22－018L，M，P & HMB1130F01L，M，P \\
\hline M39016／22－019L，M，P & HMB1230F01L，M，P \\
\hline M39016／22－020L，M，P & HMB1330F01L，M， P \\
\hline M39016／22－021L，M，P & HMB1131F01L，M，P \\
\hline M39016／22－023L，M，P & HMB1201F01L，M，P \\
\hline
\end{tabular}
\begin{tabular}{lr}
\multicolumn{2}{c}{ MIL－PRF－39016／23（continued）} \\
Military Part Number & CIIPart Number \\
\hline M39016／23－015L，M，P & J1MAWD－9XL，XM，XP \\
\hline M39016／23－016L，M，P & J1MAWD－12XL，XM，XP \\
\hline M39016／23－017L，M，P & J1MAWD－18XL，XM，XP \\
\hline M39016／23－018L，M，P & J1MAWD－26XL，XM，XP \\
\hline M39016／23－019L，M，P & J1MAPD－5XL，XM，XP \\
\hline M39016／23－020L，M，P & J1MAPD－6XL，XM，XP \\
\hline M39016／23－021L，M，P & J1MAPD－9XL，XM，XP \\
\hline M39016／23－022L，M，P & J1MAPD－12XL，XM，XP \\
\hline M39016／23－023L，M，P & J1MAPD－18XL，XM，XP \\
\hline M39016／23－024L，M，P & J1MAPD－26XL，XM，XP \\
\hline M39016／23－025L，M，P & J1MACD－5XL，XM，XP \\
\hline M39016／23－026L，M，P & J1MACD－6XL，XM，XP \\
\hline M39016／23－027L，M，P & J1MACD－9XL，XM，XP \\
\hline M39016／23－028L，M，P & J1MACD－12XL，XM，XP \\
\hline M39016／23－029L，M，P & J1MACD－18XL，XM，XP \\
\hline M39016／23－030L，M，P & J1MACD－26XL，XM，XP \\
\hline M39016／23－031L，M，P & J1MACD－5XLS，XMS，XPS \\
\hline M39016／23－032L，M，P & J1MACD－6XLS，XMS，XPS \\
\hline M39016／23－033L，M，P & J1MACD－9XLS，XMS，XPS \\
\hline M39016／23－034L，M，P & J1MACD－12XLS，XMS，XPS \\
\hline M39016／23－035L，M，P & J1MACD－18XLS，XMS，XPS \\
\hline M39016／23－036L，M，P & J1MACD－26XLS，XMS，XPS \\
\hline
\end{tabular}

\section*{MIL－PRF－39016／24}
\begin{tabular}{lr} 
Military Part Number & CIIPart Number \\
\hline M39016／24－013L，M，P & J1MAWDD－5XL，XM，XP \\
\hline M39016／24－014L，M，P & J1MAWDD－6XL，XM，XP \\
\hline M39016／24－015L，M，P & J1MAWDD－9XL，XM，XP \\
\hline M39016／24－016L，M，P & J1MAWDD－12XL，XM，XP \\
\hline M39016／24－017L，M，P & J1MAWDD－18XL，XM，XP \\
\hline M39016／24－018L，M，P & J1MAWDD－26XL，XM，XP \\
\hline M39016／24－019L，M，P & J1MAPDD－5XL，XM，XP \\
\hline M39016／24－020L，M，P & J1MAPDD－6XL，XM，XP \\
\hline M39016／24－021L，M，P & J1MAPDD－9XL，XM，XP \\
\hline M39016／24－022L，M，P & J1MAPDD－12XL，XM，XP \\
\hline M39016／24－023L，M，P & J1MAPDD－18XL，XM，XP \\
\hline M39016／24－024L，M，P & J1MAPDD－26XL，XM，XP \\
\hline M39016／24－025L，M，P & J1MACDD－5XL，XM，XP \\
\hline M39016／24－026L，M，P & J1MACDD－6XL，XM，XP \\
\hline M39016／24－027L，M，P & J1MACDD－9XL，XM，XP \\
\hline M39016／24－028L，M，P & J1MACDD－12XL，XM，XP \\
\hline M39016／24－029L，M，P & J1MACDD－18XL，XM，XP \\
\hline M39016／24－030L，M，P & J1MACDD－26XL，XM，XP \\
\hline M39016／24－031L，M，P & J1MACDD－5XLS，XMS，XPS \\
\hline M39016／24－032L，M，P & J1MACDD－6XLS，XMS，XPS \\
\hline M39016／24－033L，M，P & J1MACDD－9XLS，XMS，XPS \\
\hline M39016／24－034L，M，P & J1MACDD－12XLS，XMS，XPS \\
\hline M39016／24－035L，M，P & J1MACDD－18XLS，XMS，XPS \\
\hline M39016／24－036L，M，P & J1MACDD－26XLS，XMS，XPS \\
\hline
\end{tabular}

MIL－PRF－39016／25
\begin{tabular}{lr} 
Military Part Number & CII Part Number \\
\hline M39016／25－017L，M，P & J1MSWD－5XL，XM，XP \\
\hline M39016／25－018L，M，P & J1MSWD－6XL，XM，XP \\
\hline M39016／25－019L，M，P & J1MSWD－12XL，XM，XP \\
\hline M39016／25－020L，M，P & J1MSWD－26XL，XM，XP \\
\hline M39016／25－021L，M，P & J1MSWD－32XL，XM，XP \\
\hline M39016／25－022L，M，P & J1MSWD－40XL，XM，XP \\
\hline M39016／25－023L，M，P & J1MSWD－9XL，XM，XP \\
\hline M39016／25－024L，M，P & J1MSWD－18XL，XM，XP \\
\hline M39016／25－025L，M，P & J1MSPD－5XL，XM，XP \\
\hline
\end{tabular}
\begin{tabular}{lr} 
Military Part Number & CII Part Number \\
\hline M39016／23－013L，M，P & J1MAWD－5XL，XM，XP \\
\hline M39016／23－014L，M，P & J1MAWD－6XL，XM，XP \\
\hline
\end{tabular}

Military Qualified Products List (QPL)
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|r|}{CII Electromechanical Re} \\
\hline \multicolumn{2}{|c|}{MIL-PRF-39016/25 (continued)} \\
\hline Military Part Number & CII Part Number \\
\hline M39016/25-026L,M,P & J1MSPD-6XL,XM,XP \\
\hline M39016/25-027L,M,P & J1MSPD-12XL,XM, XP \\
\hline M39016/25-028L,M, P & J1MSPD-26XL,XM, XP \\
\hline M39016/25-029L,M,P & J1MSPD-32XL,XM, XP \\
\hline M39016/25-030L,M, P & J1MSPD-40XL,XM, XP \\
\hline M39016/25-031L,M, P & J1MSPD-9XL,XM, XP \\
\hline M39016/25-032L,M,P & J1MSPD-18XL, XM, XP \\
\hline M39016/25-033L,M,P & J1MSCD-5XL,XM, XP \\
\hline M39016/25-034L,M, P & J1MSCD-6XL,XM, XP \\
\hline M39016/25-035L,M, P & J1MSCD-12XL, XM, XP \\
\hline M39016/25-036L,M, P & J1MSCD-26XL, XM, XP \\
\hline M39016/25-037L,M,P & J1MSCD-32XL, XM, XP \\
\hline M39016/25-038L,M, P & J1MSCD-40XL, XM, XP \\
\hline M39016/25-039L,M, P & J1MSCD-9XL, XM, XP \\
\hline M39016/25-040L,M, P & J1MSCD-18XL, XM, XP \\
\hline M39016/25-041L,M,P & J1MSCD-5XLS,XMS,XPS \\
\hline M39016/25-042L,M, P & J1MSCD-6XLS,XMS,XPS \\
\hline M39016/25-043L,M, P & J1MSCD-12XLS,XMS,XPS \\
\hline M39016/25-044L,M, P & J1MSCD-26XLS,XMS,XPS \\
\hline M39016/25-045L,M, P & J1MSCD-32XLS,XMS,XPS \\
\hline M39016/25-046L,M, P & J1MSCD-40XLS,XMS,XPS \\
\hline M39016/25-047L,M,P & J1MSCD-9XLS,XMS,XPS \\
\hline M39016/25-048L,M,P & J1MSCD-18XLS,XMS,XPS \\
\hline
\end{tabular}
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|c|}{MIL-PRF-39016/26} \\
\hline Military Part Number & CII Part Number \\
\hline M39016/26-017L,M, P & J1MSWDD-5XL, XM, XP \\
\hline M39016/26-018L,M,P & J1MSWDD-6XL, XM, XP \\
\hline M39016/26-019L,M,P & J1MSWDD-12XL, XM, XP \\
\hline M39016/26-020L,M,P & J1MSWDD-26XL, XM, XP \\
\hline M39016/26-021L,M,P & J1MSWDD-32XL, XM, XP \\
\hline M39016/26-022L,M,P & J1MSWDD-40XL, XM, XP \\
\hline M39016/26-023L,M,P & J1MSWDD-9XL, XM, XP \\
\hline M39016/26-024L,M,P & J1MSWDD-18XL,XM,XP \\
\hline M39016/26-025L,M,P & J1MSPDD-5XL,XM, XP \\
\hline M39016/26-026L,M,P & J1MSPDD-6XL,XM, XP \\
\hline M39016/26-027L,M,P & J1MSPDD-12XL,XM, XP \\
\hline M39016/26-028L,M,P & J1MSPDD-26XL,XM,XP \\
\hline M39016/26-029L,M,P & J1MSPDD-32XL,XM, XP \\
\hline M39016/26-030L,M,P & J1MSPDD-40XL,XM,XP \\
\hline M39016/26-031L,M,P & J1MSPDD-9XL,XM, XP \\
\hline M39016/26-032L,M,P & J1MSPDD-18XL, XM, XP \\
\hline M39016/26-033L,M,P & J1MSCDD-5XL,XM, XP \\
\hline M39016/26-034L,M,P & J1MSCDD-6XL,XM, XP \\
\hline M39016/26-035L,M,P & J1MSCDD-12XL, XM, XP \\
\hline M39016/26-036L,M,P & J1MSCDD-26XL,XM, XP \\
\hline M39016/26-037L,M, P & J1MSCDD-32XL, XM, XP \\
\hline M39016/26-038L,M,P & J1MSCDD-40XL, XM, XP \\
\hline M39016/26-039L,M,P & J1MSCDD-9XL,XM, XP \\
\hline M39016/26-040L,M,P & J1MSCDD-18XL,XM, XP \\
\hline M39016/26-041L,M,P & J1MSCDD-5XLS,XMS,XPS \\
\hline M39016/26-042L,M,P & J1MSCDD-6XLS,XMS,XPS \\
\hline M39016/26-043L,M, P & J1MSCDD-12XLS,XMS,XPS \\
\hline M39016/26-044L,M,P & J1MSCDD-26XLS,XMS,XPS \\
\hline M39016/26-045L,M,P & J1MSCDD-32XLS,XMS,XPS \\
\hline M39016/26-046L,M,P & J1MSCDD-40XLS,XMS,XPS \\
\hline M39016/26-047L,M,P & J1MSCDD-9XLS,XMS,XPS \\
\hline M39016/26-048L,M,P & J1MSCDD-18XLS,XMS,XPS \\
\hline
\end{tabular}
\begin{tabular}{|c|c|}
\hline Military Part Number & CIIPart Number \\
\hline M39016/31-001L & 3SBM1063A2 \\
\hline M39016/31-001M & 3SBM1069A2 \\
\hline M39016/31-002L & 3SBM1064A2 \\
\hline M39016/31-002M & 3SBM1070A2 \\
\hline M39016/31-003L & 3SBM1065A2 \\
\hline M39016/31-003M & 3SBM1071A2 \\
\hline M39016/31-004L & 3SBM1066A2 \\
\hline M39016/31-004M & 3SBM1072A2 \\
\hline M39016/31-005L & 3SBM1067A2 \\
\hline M39016/31-005M & 3SBM1073A2 \\
\hline M39016/31-006L & 3SBM1068A2 \\
\hline M39016/31-006M & 3SBM1074A2 \\
\hline
\end{tabular}

MIL-PRF-39016/35 (continued)
\begin{tabular}{lr} 
Military Part Number & CIIPart Number \\
\hline M39016/35-004L & 3SBM1104A2 \\
\hline M39016/35-004M & 3SBM1110A2 \\
\hline M39016/35-005L & 3SBM1105A2 \\
\hline M39016/35-005M & 3SBM1111A2 \\
\hline M39016/35-006L & 3SBM1106A2 \\
\hline M39016/35-006M & 3SBM1112A2 \\
\hline & \\
& MIL-PRF-39016/36 \\
Military Part Number & CIIPart Number \\
\hline M39016/36-001L & 3SBM1078A2 \\
\hline M39016/36-001M & 3SBM1084A2 \\
\hline M39016/36-002L & 3SBM1079A2 \\
\hline M39016/36-002M & 3SMB1085A2 \\
\hline M39016/36-003L & 3SBM1080A2 \\
\hline M39016/36-003M & 3SBM1086A2 \\
\hline M39016/36-004L & 3SBM1081A2 \\
\hline M39016/36-004M & 3SBM1087A2 \\
\hline M39016/36-005L & 3SBM1082A2 \\
\hline M39016/36-005M & 3SBM1088A2 \\
\hline M39016/36-006L & 3SBM1083A2 \\
\hline M39016/36-006M & 3SBM1089A2 \\
\hline
\end{tabular}

MIL-PRF-39016/37
\begin{tabular}{lr} 
Military Part Number & CIIPart Number \\
\hline M39016/37-001L & 3SBC1601A2 \\
\hline M39016/37-001M & 3SBC1628A2 \\
\hline M39016/37-001P & 3SBC2071A2 \\
\hline M39016/37-002L & 3SBC1602A2 \\
\hline M39016/37-002M & 3SBC1629A2 \\
\hline M39016/37-002P & 3SBC2072A2 \\
\hline M39016/37-003L & 3SBC1603A2 \\
\hline M39016/37-003M & 3SBC2073A2 \\
\hline M39016/37-003P & 3SBC1604A2 \\
\hline M39016/37-004L & 3SBC1631A2 \\
\hline M39016/37-004M & 3SBC2074A2 \\
\hline M39016/37-004P & 3SBC1605A2 \\
\hline M39016/37-005L & 3SBC1632A2 \\
\hline M39016/37-005M & 3SBC2075A2 \\
\hline M39016/37-005P & 3SBC1606A2 \\
\hline M39016/37-006L & 3SBC1633A2 \\
\hline M39016/37-006M & 3SBC16076A2 \\
\hline M39016/37-006P & 3SBC1634A2 \\
\hline M39016/37-007L & 3SBC2077A2 \\
\hline M39016/37-007M & 3SBC1608A2 \\
\hline M39016/37-007P & 3SBC1635A2 \\
\hline M39016/37-008L & 3SBC2078A2 \\
\hline M39016/37-008M & 3SBC1609A2 \\
\hline M39016/37-008P & 3SBC1636A2 \\
\hline M39016/37-009L & 3SBC2079A2 \\
\hline M39016/37-009M & 3SBC1610A2 \\
\hline M39016/37-009P & 3SBC1637A2 \\
\hline M39016/37-010L & 3SBC2080A2 \\
\hline M39016/37-010M & 3SBC1611A2 \\
\hline M39016/37-010P & 3SBC1638A2 \\
\hline M39016/37-011L & 3SBC1612A2 \\
\hline M39016/37-011M & 3SBC1639A2 \\
\hline M39016/37-011P & 3SBC2082A2 \\
\hline M39016/37-012L & \\
\hline M39016/3-012M & \\
\hline M39016/3-012P & \\
\hline
\end{tabular}

MIL-PRF-39016/37 (continued)

Military Part Number CIIPart Number
\begin{tabular}{lr}
\hline M39016/37-013M & 3SBC1640A2 \\
\hline M39016/37-013P & 3SBC2083A2 \\
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\end{tabular}
\begin{tabular}{ll}
\hline M39016/37-014L & 3SBC1614A2 \\
\hline M39016/37-014M & 3SBC1641A2 \\
\hline
\end{tabular}
M39016/37-014P 3SBC2084A2
\begin{tabular}{ll}
\hline M39016/37-015L & 3SBC1615A2 \\
\hline M39016/37-015M & 3SBC1642A2
\end{tabular}
\begin{tabular}{ll}
\hline M39016/37-015P & 3SBC2085A2 \\
\hline M39016/37-016L & 3SBC1616A2 \\
\hline
\end{tabular}
\begin{tabular}{ll}
\hline M39016/37-016M & 3SBC1643A2 \\
\hline M39016/37-016P & 3SBC2086A2 \\
\hline M39016/37-017L & 3SBC1617A2
\end{tabular}
M39016/37-017M 3SBC1644A2
\begin{tabular}{ll}
\hline M39016/37-017P & 3SBC2087A2 \\
\hline M39016/37-018L & 3SBC1618A2 \\
\hline M39016/37-018M & 3SBC1645A2
\end{tabular}
\begin{tabular}{ll} 
M39016/37-018P & 3SBC2088A2
\end{tabular}
\begin{tabular}{ll}
\hline M39016/37-019L & 3SBC1619A2 \\
\hline M39016/37-019M & 3SBC1646A2 \\
\hline
\end{tabular}
\begin{tabular}{ll}
\hline M39016/37-019P & 3SBC2089A2 \\
\hline M39016/37-020L & 3SBC1620A2 \\
\hline M39016/37-020M & 3SBC1647A2
\end{tabular}
M39016/37-020P 3SBC2090A2
\begin{tabular}{ll} 
M39016/37-021L & 3SBC1621A2 \\
\hline M39016/37-021M & 3SBC1648A2 \\
\hline
\end{tabular}
\begin{tabular}{ll}
\hline M39016/37-021P & 3SBC2091A2 \\
\hline M39016/37-022L & 3SBC1622A2
\end{tabular}
M39016/37-022M 3SBC1649A2
\begin{tabular}{ll}
\hline M39016/37-022P & 3SBC2092A2 \\
\hline M39016/37-023L & 3SBC1623A2 \\
\hline
\end{tabular}
\begin{tabular}{ll}
\hline M39016/37-023M & 3SBC1650A2 \\
\hline M39016/37-023P & 3SBC2093A2 \\
\hline
\end{tabular}
M39016/37-024L 3SBC1624A2
M39016/37-024M 3SBC1651A2
\begin{tabular}{ll}
\hline M39016/37-024P & 3SBC2094A2 \\
\hline M39016/37-025L & 3SBC1625A2 \\
\hline M39016/37-025M & 3SBC1652A2
\end{tabular}
M39016/37-025P 3SBC2095A2
M39016/37-026L \(\quad\) 3SBC1626A2
\begin{tabular}{ll}
\hline M39016/37-026M & 3SBC1653A2 \\
\hline 3SBC20962
\end{tabular}
\begin{tabular}{ll} 
M39016/37-026P & 3SBC2096A2 \\
M39016/37-027L & 3SBC1627A2
\end{tabular}
M39016/37-027M 3SBC1654A2
M39016/37-027P \(\quad\) 3SBC2097A2
\begin{tabular}{lr}
\multicolumn{2}{c}{ MIL-PRF-39016/38 } \\
Military Part Number & CIIPart Number \\
\hline M39016/38-001L & 3SBC1661A2 \\
\hline M39016/38-001M & 3SBC1701A2 \\
\hline M39016/38-001P & 3SBC2101A2 \\
\hline M39016/38-002L & 3SBC1662A2 \\
\hline M39016/38-002M & 3SBC1702A2 \\
\hline M39016/38-002P & 3SBC2102A2 \\
\hline M39016/38-003L & 3SBC1663A2 \\
\hline M39016/38-003M & 3SBC1703A2 \\
\hline M39016/38-003P & 3SBC2103A2 \\
\hline M39016/38-004L & 3SBC1664A2 \\
\hline M39016/38-004M & 3SBC1704A2 \\
\hline M39016/38-004P & 3SBC2104A2 \\
\hline M39016/38-005L & 3SBC1665A2 \\
\hline
\end{tabular}

Military Qualified Products List (QPL)
CII Electromechanical Relays (Continued)
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|c|}{MIL-PRF-39016/38 (continued)} \\
\hline Military Part Number & CIIPart Number \\
\hline M39016/38-005P & 3SBC2105A2 \\
\hline M39016/38-006L & 3SBC1666A2 \\
\hline M39016/38-006M & 3SBC1706A2 \\
\hline M39016/38-006P & 3SBC2106A2 \\
\hline M39016/38-007L & 3SBC1667A2 \\
\hline M39016/38-007M & 3SBC1707A2 \\
\hline M39016/38-007P & 3SBC2107A2 \\
\hline M39016/38-008L & 3SBC1668A2 \\
\hline M39016/38-008M & 3SBC1708A2 \\
\hline M39016/38-008P & 3SBC2108A2 \\
\hline M39016/38-009L & 3SBC1669A2 \\
\hline M39016/38-009M & 3SBC1709A2 \\
\hline M39016/38-009P & 3SBC2109A2 \\
\hline M39016/38-010L & 3SBC1670A2 \\
\hline M39016/38-010M & 3SBC1710A2 \\
\hline M39016/38-010P & 3SBC2110A2 \\
\hline M39016/38-011L & 3SBC1671A2 \\
\hline M39016/38-011M & 3SBC1711A2 \\
\hline M39016/38-011P & 3SBC2111A2 \\
\hline M39016/38-012L & 3SBC1672A2 \\
\hline M39016/38-012M & 3SBC1712A2 \\
\hline M39016/38-012P & 3SBC2112A2 \\
\hline M39016/38-013L & 3SBC1673A2 \\
\hline M39016/38-013M & 3SBC1713A2 \\
\hline M39016/38-013P & 3SBC2113A2 \\
\hline M39016/38-014L & 3SBC1674A2 \\
\hline M39016/38-014M & 3SBC1714A2 \\
\hline M39016/38-014P & 3SBC2114A2 \\
\hline M39016/38-015L & 3SBC1675A2 \\
\hline M39016/38-015M & 3SBC1715A2 \\
\hline M39016/38-015P & 3SBC2115A2 \\
\hline M39016/38-016L & 3SBC1676A2 \\
\hline M39016/38-016M & 3SBC1716A2 \\
\hline M39016/38-016P & 3SBC2116A2 \\
\hline M39016/38-017L & 3SBC1677A2 \\
\hline M39016/38-017M & 3SBC1717A2 \\
\hline M39016/38-017P & 3SBC2117A2 \\
\hline M39016/38-018L & 3SBC1678A2 \\
\hline M39016/38-018M & 3SBC1718A2 \\
\hline M39016/38-018P & 3SBC2118A2 \\
\hline M39016/38-019L & 3SBC1679A2 \\
\hline M39016/38-019M & 3SBC1719A2 \\
\hline M39016/38-019P & 3SBC2119A2 \\
\hline M39016/38-020L & 3SBC1680A2 \\
\hline M39016/38-020M & 3SBC1720A2 \\
\hline M39016/38-020P & 3SBC2120A2 \\
\hline M39016/38-021L & 3SBC1681A2 \\
\hline M39016/38-021M & 3SBC1721A2 \\
\hline M39016/38-021P & 3SBC2121A2 \\
\hline M39016/38-022L & 3SBC1682A2 \\
\hline M39016/38-022M & 3SBC1722A2 \\
\hline M39016/38-022P & 3SBC2122A2 \\
\hline M39016/38-023L & 3SBC1683A2 \\
\hline M39016/38-023M & 3SBC1723A2 \\
\hline M39016/38-023P & 3SBC2123A2 \\
\hline M39016/38-024L & 3SBC1684A2 \\
\hline M39016/38-024M & 3SBC1724A2 \\
\hline M39016/38-024P & 3SBC2124A2 \\
\hline M39016/38-025L & 3SBC1685A2 \\
\hline M39016/38-025M & 3SBC1725A2 \\
\hline M39016/38-025P & 3SBC2125A2 \\
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\end{tabular}

MIL-PRF-39016/38 (continued)
\begin{tabular}{lr} 
Military Part Number & CIIPart Number \\
\hline M39016/38-026L & 3SBC1686A2 \\
\hline M39016/38-026M & 3SBC1726A2 \\
\hline M39016/38-026P & 3SBC2126A2 \\
\hline M39016/38-027L & 3SBC1687A2 \\
\hline M39016/38-027M & 3SBC1727A2 \\
\hline M39016/38-027P & 3SBC2127A2 \\
\hline
\end{tabular}

MIL-PRF-39016/40
\begin{tabular}{lr} 
Military Part Number & CII Part Number \\
\hline M39016/40-001 & SR-7601
\end{tabular}
\begin{tabular}{lr} 
M39016/40-002 & SR-7602 \\
\hline M39016/40-003 & SR-7603 \\
\hline
\end{tabular}
M39016/40-004 SR-7604
M39016/40-005 SR-7605
\begin{tabular}{ll}
\hline M39016/40-006 & SR-7606 \\
\hline M39016/40-007 & SR-7607 \\
\hline
\end{tabular}
M39016/40-008 SR-7608
\begin{tabular}{lr}
\hline M39016/40-009 & SR-7609 \\
\hline M39016/40-010 & SR-7610 \\
\hline
\end{tabular}
\begin{tabular}{lr}
\hline M39016/40-011 & SR-7611 \\
\hline M39016/40-012 & SR-7612 \\
\hline M39016/40-013 & SR-7613
\end{tabular}
M39016/40-014 SR-7614
M39016/40-015 SR-7615
M39016/40-016 SR-7616
\begin{tabular}{lr}
\hline M39016/40-017 & SR-7617 \\
\hline M39016/40-018 & SR-7618
\end{tabular}
M39016/40-019 SR-7619
M39016/40-020 SR-7620
M39016/40-021 SR-7621
\begin{tabular}{ll}
\hline M39016/40-022 & SR-7622 \\
\hline M39016/40-023 & SR-7623 \\
\hline
\end{tabular}
M39016/40-024 SR-7624
M39016/40-025 SR-7625
M39016/40-026 SR-7626
\begin{tabular}{lr}
\hline M39016/40-027 & SR-7627 \\
\hline M39016/40-028 & SR-7628 \\
\hline
\end{tabular}
M39016/40-029 SR-7629
M39016/40-030 SR-7630

\section*{MIL-PRF-39016/41}
\begin{tabular}{lr} 
Military Part Number & CIIPart Number \\
\hline M39016/41-033L,M,P & JMGSC-5L,M,P \\
\hline M39016/41-034L,M,P & JMGSC-6L,M,P \\
\hline M39016/41-035L,M,P & JMGSC-12L,M,P \\
\hline M39016/41-036L,M,P & JMGSC-26L,M,P \\
\hline M39016/41-037L,M,P & JMGSC-36L,M,P \\
\hline M39016/41-038L,M,P & JMGSC-48L,M,P \\
\hline M39016/41-039L,M,P & JMGSC-9L,M,P \\
\hline M39016/41-040L,M,P & JMGSC-18L,M,P \\
\hline M39016/41-041L,M,P & JMGSP-5L,M,P \\
\hline M39016/41-042L,M,P & JMGSP-6L,M,P \\
\hline M39016/41-043L,M,P & JMGSP-12L,M,P \\
\hline M39016/41-044L,M,P & JMGSP-26L,M,P \\
\hline M39016/41-045L,M,P & JMGSP-36L,M,P \\
\hline M39016/41-046L,M,P & JMGSP-48L,M,P \\
\hline M39016/41-047L,M,P & JMGSP-9L,M,P \\
\hline M39016/41-048L,M,P & JMGSP-18L,M,P \\
\hline M39016/41-049L,M,P & JMGSC-5LW,MW,PW \\
\hline M39016/41-050L,M,P & JMGSC-6LW,MW,PW \\
\hline M39016/41-051L,M,P & JMGSC-12LW,MW,PW \\
\hline
\end{tabular}

Military Qualified Products List (QPL)
CII Electromechanical Relays (Continued)
\begin{tabular}{lr}
\multicolumn{2}{c}{ MIL-PRF-39016/41(continued) } \\
\hline Military Part Number & CII Part Number \\
\hline M39016/41-052L,M,P & JMGSC-26LW,MW,PW \\
\hline M39016/41-053L,M,P & JMGSC-36LW,MW,PW \\
\hline M39016/41-054L,M,P & JMGSC-48LW,MW,PW \\
\hline M39016/41-055L,M,P & JMGSC-9LW,MW,PW \\
\hline M39016/41-056L,M,P & JMGSC-18LW,MW,PW \\
\hline M39016/41-057L,M,P & JMGSCG-5L,M,P \\
\hline M39016/41-058L,M,P & JMGSCG-6L,M,P \\
\hline M39016/41-059L,M,P & JMGSCG-12L,M,P \\
\hline M39016/41-060L,M,P & JMGSCG-26L,M,P \\
\hline M39016/41-061L,M,P & JMGSCG-36L,M,P \\
\hline M39016/41-062L,M,P & JMGSCG-48L,M,P \\
\hline M39016/41-063L,M,P & JMGSCG-9L,M,P \\
\hline M39016/41-064L,M,P & JMGSCG-18L,M,P \\
\hline M39016/41-065L,M,P & JMGSCG-5LW,MW,PW \\
\hline M39016/41-066L,M,P & JMGSCG-6LW,MW,PW \\
\hline M39016/41-067L,M,P & JMGSCG-12LW,MW,PW \\
\hline M39016/41-068L,M,P & JMGSCG-26LW,MW,PW \\
\hline M39016/41-069L,M,P & JMGSCG-36LW,MW,PW \\
\hline M39016/41-070L,M,P & JMGSCG-48LW,MW,PW \\
\hline M39016/41-071L,M,P & JMGSCG-9LW,MW,PW \\
\hline M39016/41-072L,M,P & JMGSCG-18LW,MW,PW \\
\hline
\end{tabular}
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|c|}{MIL-PRF-39016/42} \\
\hline Military Part Number & CIIPart Number \\
\hline M39016/42-033L,M,P & JMGSCD-5L,M, P \\
\hline M39016/42-034L,M, P & JMGSCD-6L,M,P \\
\hline M39016/42-035L,M,P & JMGSCD-12L,M,P \\
\hline M39016/42-036L,M,P & JMGSCD-26L,M,P \\
\hline M39016/42-037L,M, P & JMGSCD-36L,M,P \\
\hline M39016/42-038L,M,P & JMGSCD-48L,M,P \\
\hline M39016/42-039L,M,P & JMGSCD-9L,M, P \\
\hline M39016/42-040L,M,P & JMGSCD-18L,M,P \\
\hline M39016/42-041L,M,P & JMGSPD-5L,M,P \\
\hline M39016/42-042L,M,P & JMGSPD-6L,M,P \\
\hline M39016/42-043L,M, P & JMGSPD-12L,M,P \\
\hline M39016/42-044L,M,P & JMGSPD-26L,M,P \\
\hline M39016/42-045L,M,P & JMGSPD-36L,M,P \\
\hline M39016/42-046L,M,P & JMGSPD-48L,M,P \\
\hline M39016/42-047L,M, P & JMGSPD-9L,M,P \\
\hline M39016/42-048L,M,P & JMGSPD-18L,M,P \\
\hline M39016/42-049L,M,P & JMGSCD-5LW,MW, \\
\hline M39016/42-050L,M,P & JMGSCD-6LW,MW,PW \\
\hline M39016/42-051L,M, P & JMGSCD-12LW,MW,PW \\
\hline M39016/42-052L,M,P & JMGSCD-26LW,MW,PW \\
\hline M39016/42-053L,M,P & JMGSCD-36LW,MW,PW \\
\hline M39016/42-054L,M,P & JMGSCD-48LW,MW,PW \\
\hline M39016/42-055L,M,P & JMGSCD-9LW,MW,PW \\
\hline M39016/42-056L,M,P & JMGSCD-18LW,MW,PW \\
\hline M39016/42-057L,M,P & JMGSCDG-5L,M, P \\
\hline M39016/42-058L,M,P & JMGSCDG-6L,M,P \\
\hline M39016/42-059L,M,P & JMGSCDG-12L,M,P \\
\hline M39016/42-060L,M,P & JMGSCDG-26L,M,P \\
\hline M39016/42-061L,M,P & JMGSCDG-36L,M,P \\
\hline M39016/42-062L,M,P & JMGSCDG-48L,M,P \\
\hline M39016/42-063L,M,P & JMGSCDG-9L,M,P \\
\hline M39016/42-064L,M,P & JMGSCDG-18L,M,P \\
\hline M39016/42-065L,M,P & JMGSCDG-5LW,MW,PW \\
\hline M39016/42-066L,M,P & JMGSCDG-6LW,MW,PW \\
\hline M39016/42-067L,M,P & JMGSCDG-12LW,MW,PW \\
\hline M39016/42-068L,M,P & JMGSCDG-26LW,MW,PW \\
\hline M39016/42-069L,M,P & JMGSCDG-36LW,MW,PW \\
\hline
\end{tabular}
\begin{tabular}{lr}
\multicolumn{2}{c}{ MIL-PRF-39016/42 (continued) } \\
\begin{tabular}{lr} 
Military Part Number & ClIPart Number \\
\hline M39016/42-070L,M,P & JMGSCDG-48LW,MW,PW \\
\hline M39016/42-071L,M,P & JMGSCDG-9LW,MW,PW \\
\hline M39016/42-072L,M,P & JMGSCDG-18LW,MW,PW \\
\hline \multicolumn{3}{c}{ MIL-PRF-39016/43 } & \\
Military Part Number & CIIPart Number
\end{tabular} \\
\hline
\end{tabular}
\begin{tabular}{|c|c|}
\hline Military Part Number & CII Part Number \\
\hline M39016/43-033L,M,P & JMGSCDD-5L,M,P \\
\hline M39016/43-034L,M,P & JMGSCDD-6L,M,P \\
\hline M39016/43-035L,M,P & JMGSCDD-9L,M,P \\
\hline M39016/43-036L,M,P & JMGSCDD-12L,M, P \\
\hline M39016/43-037L,M,P & JMGSCDD-18L,M, P \\
\hline M39016/43-038L,M,P & JMGSCDD-26L,M,P \\
\hline M39016/43-039L,M,P & JMGSCDD-36L,M, P \\
\hline M39016/43-040L,M,P & JMGSCDD-48L,M,P \\
\hline M39016/43-041L,M,P & JMGSPDD-5L,M,P \\
\hline M39016/43-042L,M,P & JMGSPDD-6L,M,P \\
\hline M39016/43-043L,M,P & JMGSPDD-9L,M,P \\
\hline M39016/43-044L,M,P & JMGSPDD-12L,M,P \\
\hline M39016/43-045L,M,P & JMGSPDD-18L,M, P \\
\hline M39016/43-046L,M, P & JMGSPDD-26L,M, P \\
\hline M39016/43-047L,M,P & JMGSPDD-36L,M,P \\
\hline M39016/43-048L,M,P & JMGSPDD-48L,M,P \\
\hline M39016/43-049L,M,P & JMGSCDD-5LW,MW,PW \\
\hline M39016/43-050L,M,P & JMGSCDD-6LW,MW,PW \\
\hline M39016/43-051L,M, P & JMGSCDD-9LW,MW,PW \\
\hline M39016/43-052L,M, P & JMGSCDD-12LW,MW,PW \\
\hline M39016/43-053L,M,P & JMGSCDD-18LW,MW,PW \\
\hline M39016/43-054L,M,P & JMGSCDD-26LW,MW,PW \\
\hline M39016/43-055L,M, P & JMGSCDD-36LW,MW,PW \\
\hline M39016/43-056L,M,P & JMGSCDD-48LW,MW,PW \\
\hline M39016/43-057L,M,P & JMGSCDDG-5L,M, P \\
\hline M39016/43-058L,M,P & JMGSCDDG-6L,M, P \\
\hline M39016/43-059L,M,P & JMGSCDDG-9L,M, P \\
\hline M39016/43-060L,M,P & JMGSCDDG-12L,M,P \\
\hline M39016/43-061L,M, P & JMGSCDDG-18L,M,P \\
\hline M39016/43-062L,M,P & JMGSCDDG-26L,M, P \\
\hline M39016/43-063L,M,P & JMGSCDDG-36L,M,P \\
\hline M39016/43-064L,M,P & JMGSCDDG-48L,M,P \\
\hline M39016/43-065L,M, P & JMGSCDDG-5LW,MW,PW \\
\hline M39016/43-066L,M,P & JMGSCDDG-6LW,MW,PW \\
\hline M39016/43-067L,M,P & JMGSCDDG-9LW,MW,PW \\
\hline M39016/43-068L,M, P & JMGSCDDG-12LW,MW,PW \\
\hline M39016/43-069L,M,P & JMGSCDDG-18LW,MW,PW \\
\hline M39016/43-070L,M,P & JMGSCDDG-26LW,MW,PW \\
\hline M39016/43-071L,M, P & JMGSCDDG-36LW,MW,PW \\
\hline M39016/43-072L,M,P & JMGSCDDG-48LW,MW,PW \\
\hline
\end{tabular}
\begin{tabular}{lr}
\multicolumn{2}{c}{ MIL-PRF-39016/44 } \\
Military Part Number & CII Part Number \\
\hline M39016/44-001L,M, P & HMS1130S01L,M,P \\
\hline M39016/44-002L,M,P & HMS1230S01L,M,P \\
\hline M39016/44-004L,M,P & HMS1131S01L,M,P \\
\hline M39016/44-005L,M,P & HMS1231S01L,M,P \\
\hline M39016/44-007L,M,P & HMS1101S01L,M,P \\
\hline M39016/44-008L,M,P & HMS1201S108L,M,P \\
\hline M39016/44-010L,M,P & HMS1130S02L,M,P \\
\hline M39016/44-011L,M,P & HMS1230S02L,M,P \\
\hline M39016/44-013L,M,P & HMS1131S02L,M,P \\
\hline M39016/44-014L,M,P & HMS1231S02L,M,P \\
\hline M39016/44-016L,M,P & HMS1101S02L,M,P \\
\hline M39016/44-017L,M,P & HMS1201S109L,M,P \\
\hline
\end{tabular}

Military Qualified Products List (QPL)
CII Electromechanical Relays (Continued)
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|c|}{MIL-PRF-39016/44 (continued)} \\
\hline Military Part Number & CIIPart Number \\
\hline M39016/44-019L,M,P & HMS1130S03L,M, P \\
\hline M39016/44-020L,M,P & HMS1230S03L,M, P \\
\hline M39016/44-022L,M,P & HMS1131S03L,M, P \\
\hline M39016/44-023L,M, P & HMS1231S03L,M, P \\
\hline M39016/44-025L,M,P & HMS1101S03L,M, P \\
\hline M39016/44-026L,M,P & HMS1201S110L,M,P \\
\hline M39016/44-028L,M,P & HMS1130S04L,M, P \\
\hline M39016/44-029L,M,P & HMS1230S04L,M, P \\
\hline M39016/44-031L,M,P & HMS1131S04L,M, P \\
\hline M39016/44-032L,M,P & HMS1231S04L,M, P \\
\hline M39016/44-034L,M,P & HMS1101S04L,M, P \\
\hline M39016/44-035L,M,P & HMS1201S111L,M,P \\
\hline M39016/44-037L,M, P & HMS1130S05L,M, P \\
\hline M39016/44-038L,M,P & HMS1230S05L,M, P \\
\hline M39016/44-040L,M, P & HMS1131S05L,M, P \\
\hline M39016/44-041L,M,P & HMS1231S05L,M, P \\
\hline M39016/44-043L,M,P & HMS1101S05L,M, P \\
\hline M39016/44-044L,M,P & HMS1201S112L,M,P \\
\hline M39016/44-046L,M,P & HMS1130S07L,M, P \\
\hline M39016/44-047L,M,P & HMS1230S06L,M, P \\
\hline M39016/44-049L,M,P & HMS1131S06L,M, P \\
\hline M39016/44-050L,M,P & HMS1231S06L,M, P \\
\hline M39016/44-052L,M,P & HMS1101S07L,M, P \\
\hline M39016/44-053L,M, P & HMS1201S118L,M, P \\
\hline
\end{tabular}
\begin{tabular}{lr} 
Military Part Number & CIIPart Number \\
\hline M39016/53-018L & 3SBH1268A2 \\
M39016/53-018M & 3SBH1282A2 \\
\hline M39016/53-019L & 3SBH1269A2 \\
\hline M39016/53-019M & 3SBH1283A2 \\
\hline M39016/53-020L & 3SBH1270A2 \\
\hline M39016/53-020M & 3SBH1284A2 \\
\hline M39016/53-021L & 3SBH1271A2 \\
\hline M39016/53-021M & 3SBH1285A2 \\
\hline M39016/53-022L & 3SBH1272A2 \\
\hline M39016/53-022M & 3SBH1286A2 \\
\hline M39016/53-023L & 3SBH1287A2 \\
\hline M39016/53-023M & 3SBH1274A2 \\
\hline M39016/53-024L & 3SBH1288A2 \\
\hline M39016/53-024M & 3SBH1275A2 \\
\hline M39016/53-025L & 3SBH1289A2 \\
\hline M39016/53-025M & 3SBH1276A2 \\
\hline M39016/53-026L & 3SBH1277A2 \\
\hline M39016/53-026M & 3SBH1291A2 \\
\hline M39016/53-027L & 3SBH1278A2 \\
\hline M39016/53-027M & 3SBH1292A2 \\
\hline
\end{tabular}
\begin{tabular}{lr}
\multicolumn{2}{c}{ MIL-PRF-39016/53 } \\
Military Part Number & CIIPart Number \\
\hline M39016/53-001L & 3SBH1190A2 \\
\hline M39016/53-001M & 3SBH122OA2 \\
\hline M39016/53-002L & 3SBH1191A2 \\
\hline M39016/53-002M & 3SBH1221A2 \\
\hline M39016/53-003L & 3SBH1192A2 \\
\hline M39016/53-003M & 3SBH1222A2 \\
\hline M39016/53-004L & 3SBH1193A2 \\
\hline M39016/53-004M & 3SBH1223A2 \\
\hline M39016/53-005L & 3SBH1194A2 \\
\hline M39016/53-005M & 3SBH1224A2 \\
\hline M39016/53-006L & 3SBH1195A2 \\
\hline M39016/53-006M & 3SBH1225A2 \\
\hline M39016/53-007L & 3SBH1196A2 \\
\hline M39016/53-007M & 3SBH1226A2 \\
\hline M39016/53-008L & 3SBH1197A2 \\
\hline M39016/53-008M & 3SBH1198222 \\
\hline M39016/53-009L & 3SBH1228A2 \\
\hline M39016/53-009M & 3SBH1199A2 \\
\hline M39016/53-010L & 3SBH1229A2 \\
\hline M39016/53-010M & 3SBH1200A2 \\
\hline M39016/53-011L & 3SBH1230A2 \\
\hline M39016/53-011M & 3SBH1201A2 \\
\hline M39016/53-012M & 3SBH1231A2 \\
\hline M39016/53-013L & 3SBH1202A2 \\
\hline M39016/53-013M & 3SBH1232A2 \\
\hline M39016/53-014L & 3SBH1203A2 \\
\hline M39016/53-014M & 3SBH1233A2 \\
\hline M39016/53-015L & 3SBH1265A2 \\
\hline M39016/53-015M & 3SBH1279A2 \\
\hline M39016/53-016L & 3SBH1266A2 \\
\hline M39016/53-016M & 3SBH1280A2 \\
\hline M39016/53-017L & 3SBH1267A2 \\
\hline
\end{tabular}
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|c|}{MIL-PRF-39016/54} \\
\hline Miritary Part Number & CIIPart Number \\
\hline M39016/54-001L & 3SBH1234A2 \\
\hline M39016/54-001M & 3SBH1251A2 \\
\hline M39016/54-002L & 3SBH1235A2 \\
\hline M39016/54-002M & 3SBH1252A2 \\
\hline M39016/54-003L & 3SBH1236A2 \\
\hline M39016/54-003M & 3SBH1253A2 \\
\hline M39016/54-004L & 3SBH1237A2 \\
\hline M39016/54-004M & 3SBH1254A2 \\
\hline M39016/54-005L & 3SBH1238A2 \\
\hline M39016/54-005M & 3SBH1255A2 \\
\hline M39016/54-006L & 3SBH1239A2 \\
\hline M39016/54-006M & 3SBH1256A2 \\
\hline M39016/54-007L & 3SBH1240A2 \\
\hline M39016/54-007M & 3SBH1257A2 \\
\hline M39016/54-008L & 3SBH1241A2 \\
\hline M39016/54-008M & 3SBH1258A2 \\
\hline M39016/54-009L & 3SBH1242A2 \\
\hline M39016/54-009M & 3SBH1259A2 \\
\hline M39016/54-010L & 3SBH1243A2 \\
\hline M39016/54-010M & 3SBH1260A2 \\
\hline M39016/54-011L & 3SBH1244A2 \\
\hline M39016/54-011M & 3SBH1261A2 \\
\hline M39016/54-012L & 3SBH1245A2 \\
\hline M39016/54-012M & 3SBH1262A2 \\
\hline M39016/54-013L & 3SBH1246A2 \\
\hline M39016/54-013M & 3SBH1263A2 \\
\hline M39016/54-014L & 3SBH1247A2 \\
\hline M39016/54-014M & 3SBH1264A2 \\
\hline M39016/54-015L & 3SBH1293A2 \\
\hline M39016/54-015M & 3SBH1307A2 \\
\hline M39016/54-016L & 3SBH1294A2 \\
\hline M39016/54-016M & 3SBH1308A2 \\
\hline M39016/54-017L & 3SBH1295A2 \\
\hline M39016/54-017M & 3SBH1309A2 \\
\hline M39016/54-018L & 3SBH1296A2 \\
\hline M39016/54-018M & 3SBH1310A2 \\
\hline
\end{tabular}

CII Electromechanical Relays (Continued)
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|c|}{MIL-PRF-39016/54 (continued)} \\
\hline Nilitary Part Number & CIIPart Number \\
\hline M39016/54-019L & 3SBH1297A2 \\
\hline M39016/54-019M & 3SBH1311A2 \\
\hline M39016/54-020L & 3SBH1298A2 \\
\hline M39016/54-020M & 3SBH1312A2 \\
\hline M39016/54-021L & 3SBH1299A2 \\
\hline M39016/54-021M & 3SBH1313A2 \\
\hline M39016/54-022L & 3SBH1300A2 \\
\hline M39016/54-022M & 3SBH1314A2 \\
\hline M39016/54-023L & 3SBH1301A2 \\
\hline M39016/54-023M & 3SBH1315A2 \\
\hline M39016/54-024L & 3SBH1302A2 \\
\hline M39016/54-024M & 3SBH1316A2 \\
\hline M39016/54-025L & 3SBH1303A2 \\
\hline M39016/54-025M & 3SBH1317A2 \\
\hline M39016/54-026L & 3SBH1304A2 \\
\hline M39016/54-026M & 3SBH1318A2 \\
\hline M39016/54-027L & 3SBH1305A2 \\
\hline M39016/54-027M & 3SBH1319A2 \\
\hline M39016/54-028L & 3SBH1306A2 \\
\hline M39016/54-028M & 3SBH1320A2 \\
\hline
\end{tabular}
\begin{tabular}{lrr} 
& MIL-R-5757/1 & \\
\begin{tabular}{llr} 
Military Part Number & & CII Part Number \\
\hline M5757/1-021 & RD6CAH2600 \\
\hline M5757/1-026 & RD6CA2600 \\
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\end{tabular}
\begin{tabular}{|c|c|}
\hline Military Part Number & CIIPart Number \\
\hline M5757/13-088 & 3SAT1305A2 \\
\hline M5757/13-089 & 3SAT1306A2 \\
\hline M5757/13-090 & 3SAT1307A2 \\
\hline M5757/13-091 & 3SAT1308A2 \\
\hline M5757/13-092 & 3SAT1309A2 \\
\hline M5757/13-093 & 3SAT1310A2 \\
\hline M5757/13-094 & 3SAT1311A2 \\
\hline M5757/13-095 & 3SAT1312A2 \\
\hline M5757/13-096 & 3SAT1313A2 \\
\hline M5757/13-097 & 3SAT1314A2 \\
\hline M5757/13-098 & 3SAT1315A2 \\
\hline M5757/13-099 & 3SAT1316A2 \\
\hline M5757/13-100 & 3SAT1317A2 \\
\hline M5757/13-101 & 3SAT1318A2 \\
\hline M5757/13-102 & 3SAT1319A2 \\
\hline M5757/13-103 & 3SAT1320A2 \\
\hline M5757/13-104 & 3SAT1321A2 \\
\hline M5757/13-105 & 3SAT1322A2 \\
\hline M5757/13-106 & 3SAT1323A2 \\
\hline M5757/13-107 & 3SAT1324A2 \\
\hline M5757/13-108 & 3SAT1325A2 \\
\hline M5757/13-109 & 3SAT1326A2 \\
\hline M5757/13-110 & 3SAT1327A2 \\
\hline M5757/13-111 & 3SAT1328A2 \\
\hline M5757/13-112 & 3SAT1329A2 \\
\hline M5757/13-113 & 3SAT1330A2 \\
\hline M5757/13-114 & 3SAT1331A2 \\
\hline M5757/13-115 & 3SAT1332A2 \\
\hline M5757/13-116 & 3SAT1333A2 \\
\hline M5757/13-117 & 3SAT1334A2 \\
\hline M5757/13-118 & 3SAT1335A2 \\
\hline M5757/13-119 & 3SAT1336A2 \\
\hline M5757/13-120 & 3SAT1337A2 \\
\hline M5757/13-121 & 3SAT1338A2 \\
\hline M5757/13-122 & 3SAT1339A2 \\
\hline M5757/13-123 & 3SAT1340A2 \\
\hline M5757/13-124 & 3SAT1341A2 \\
\hline M5757/13-125 & 3SAT1342A2 \\
\hline M5757/13-126 & 3SAT1343A2 \\
\hline M5757/13-127 & 3SAT1344A2 \\
\hline M5757/13-128 & 3SAT1345A2 \\
\hline M5757/13-129 & 3SAT1346A2 \\
\hline M5757/13-130 & 3SAT1347A2 \\
\hline M5757/13-131 & 3SAT1348A2 \\
\hline M5757/13-132 & 3SAT1349A2 \\
\hline M5757/13-133 & 3SAT1350A2 \\
\hline M5757/13-134 & 3SAT1351A2 \\
\hline M5757/13-135 & 3SAT1352A2 \\
\hline M5757/13-136 & 3SAT1353A2 \\
\hline M5757/13-137 & 3SAT1354A2 \\
\hline M5757/13-138 & 3SAT1355A2 \\
\hline M5757/13-139 & 3SAT1356A2 \\
\hline M5757/13-140 & 3SAT1357A2 \\
\hline M5757/13-141 & 3SAT1358A2 \\
\hline M5757/13-142 & 3SAT1359A2 \\
\hline M5757/13-143 & 3SAT1360A2 \\
\hline
\end{tabular}
\begin{tabular}{lr} 
& MIL-R-5757/23 \\
Military Part Number & CII Part Number \\
\hline M5757/23-001 & B07D692BZ2-0011 \\
\hline M5757/23-002 & B07D992BZ2-0050 \\
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\end{tabular}

\footnotetext{
Catalog 5-1773450-5
}

Military Qualified Products List (QPL)
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|r|}{CII Electromechanical R} \\
\hline \multicolumn{2}{|c|}{MIL-R-5757/23 (continued)} \\
\hline Military Part Number & CIIPart Number \\
\hline M5757/23-003 & B07D634BC2-0051 \\
\hline M5757/23-004 & B07D934BC2-0052 \\
\hline M5757/23-005 & B07D034BC2-0053 \\
\hline M5757/23-006 & B07D692BB2-0069 \\
\hline M5757/23-007 & B07D992BB2-0117 \\
\hline M5757/23-008 & B07D634BB2-0118 \\
\hline M5757/23-009 & B07D934BB2-0119 \\
\hline M5757/23-010 & B07D034BB2-0120 \\
\hline M5757/23-011 & B07D692BA2-0121 \\
\hline M5757/23-012 & B07D992BA2-0122 \\
\hline M5757/23-013 & B07D634BA2-0123 \\
\hline M5757/23-014 & B07D934BA2-0124 \\
\hline M5757/23-015 & B07D034BA2-0125 \\
\hline M5757/23-016 & B07D692BD2-0126 \\
\hline M5757/23-017 & B07D992BD2-0127 \\
\hline M5757/23-018 & B07D634BD2-0128 \\
\hline M5757/23-019 & B07D934BD2-0129 \\
\hline M5757/23-020 & B07D034BD2-0130 \\
\hline M5757/23-026 & B07D692BE2-0131 \\
\hline M5757/23-027 & B07D992BE2-0132 \\
\hline M5757/23-028 & B07D634BE2-0133 \\
\hline M5757/23-029 & B07D934BE2-0134 \\
\hline M5757/23-030 & B07D034BE2-0135 \\
\hline M5757/23-031 & B07D932BC2-0348 \\
\hline M5757/23-032 & B07D932BB2-0349 \\
\hline M5757/23-033 & B07D932BA2-0350 \\
\hline M5757/23-034 & B07D932BD2-0351 \\
\hline M5757/23-036 & B07D932BE2-0352 \\
\hline M5757/23-037 & B07D632BZ2-0353 \\
\hline M5757/23-038 & B07D932BZ2-0354 \\
\hline M5757/23-039 & B07D634BZ2-0355 \\
\hline M5757/23-040 & B07D934BZ2-0356 \\
\hline M5757/23-041 & B07D034BZ2-0357 \\
\hline M5757/23-042 & B07D932BZ2-0358 \\
\hline
\end{tabular}
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|c|}{MS27245} \\
\hline Military Part Number & CIIPart Number \\
\hline MS27245-1 & B07D112BC4-0007 \\
\hline MS27245-2 & B07D919BC4-0054 \\
\hline MS27245-3 & B07D112BC4-0203 \\
\hline MS27245-4 & B07D919BC4-0204 \\
\hline MS27245-5 & B07E932BC4-0262 \\
\hline MS27245-6 & B07D932BC4-0263 \\
\hline & \\
\hline
\end{tabular}
\begin{tabular}{|c|c|}
\hline Miritiary Part Number & CIIPart Number \\
\hline MS27247-1 & B07D111BC4-0006 \\
\hline MS27247-2 & B07D111BC4-0202 \\
\hline MS27247-4 & B07D915BC4-0264 \\
\hline MS27247-5 & B07E915BC4-0265 \\
\hline \multicolumn{2}{|c|}{MIL-PRF-6106/19} \\
\hline Mrilitary Part Number & CIIPart Number \\
\hline M6106/19-003 & FCA-125-3 \\
\hline M6106/19-004 & FCA-125-4 \\
\hline M6106/19-005 & FCA-125-5 \\
\hline M6106/19-006 & FCA-125-6 \\
\hline M6106/19-007 & FCA-125-7 \\
\hline M6106/19-008 & FCA-125-8 \\
\hline M6106/19-009 & FCA-125-9 \\
\hline M6106/19-010 & FCA-125-10 \\
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\end{tabular}
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|c|}{MIL-PRF-6106/19 (continued)} \\
\hline Military Part Number & CIIPart Number \\
\hline M6106/19-011 & FCA-125-11 \\
\hline M6106/19-012 & FCA-125-12 \\
\hline M6106/19-013 & FCA-125-13 \\
\hline M6106/19-014 & FCA-125-14 \\
\hline M6106/19-015 & FCA-125-15 \\
\hline M6106/19-016 & FCA-125-16 \\
\hline M6106/19-017 & FCA-125-17 \\
\hline M6106/19-018 & FCA-125-18 \\
\hline M6106/19-019 & FCA-125-19 \\
\hline M6106/19-020 & FCA-125-20 \\
\hline M6106/19-021 & FCA-125-21 \\
\hline M6106/19-022 & FCA-125-22 \\
\hline M6106/19-023 & FCA-125-23 \\
\hline M6106/19-024 & FCA-125-24 \\
\hline M6106/19-025 & FCA-125-25 \\
\hline
\end{tabular}
\begin{tabular}{ll}
\multicolumn{2}{c}{ MIL-PRF-83536/1 } \\
Military Part Number & CII Part Number
\end{tabular}
\begin{tabular}{|c|c|}
\hline Mrilitary Part Number & CIIPart Number \\
\hline M83536/1-001L,M & FCB-205-0101L,M \\
\hline M83536/1-002L,M & FCB-205-0102L,M \\
\hline M83536/1-003L,M & FCB-205-0103L,M \\
\hline M83536/1-004L,M & FCB-205-0104L,M \\
\hline M83536/1-005L,M & FCB-205-0105L,M \\
\hline M83536/1-006L,M & FCB-205-0106L,M \\
\hline M83536/1-007L,M & FCB-205-0107L,M \\
\hline M83536/1-008L,M & FCB-205-0108L,M \\
\hline M83536/1-009L,M & FCB-205-0109L,M \\
\hline M83536/1-010L,M & FCB-205-0110L,M \\
\hline M83536/1-011L,M & FCB-205-0111L,M \\
\hline M83536/1-012L,M & FCB-205-0112L,M \\
\hline M83536/1-013L,M & FCB-205-0113L,M \\
\hline M83536/1-014L,M & FCB-205-0114L,M \\
\hline M83536/1-015L,M & FCB-205-0115L,M \\
\hline M83536/1-016L,M & FCB-205-0116L,M \\
\hline M83536/1-017L,M & FCB-205-0117L,M \\
\hline M83536/1-018L,M & FCB-205-0118L,M \\
\hline M83536/1-019L,M & FCB-205-0119L,M \\
\hline M83536/1-020L,M & FCB-205-0120L,M \\
\hline M83536/1-021L,M & FCB-205-0121L,M \\
\hline M83536/1-022L,M & FCB-205-0122L,M \\
\hline M83536/1-023L,M & FCB-205-0123L,M \\
\hline M83536/1-024L,M & FCB-205-0124L,M \\
\hline M83536/1-025L,M & FCB-205-0125L,M \\
\hline M83536/1-026L,M & FCB-205-0126L,M \\
\hline M83536/1-027L,M & FCB-205-0127L,M \\
\hline M83536/1-028L,M & FCB-205-0128L,M \\
\hline M83536/1-029L,M & FCB-205-0129L,M \\
\hline M83536/1-030L,M & FCB-205-0130L,M \\
\hline M83536/1-031L,M & FCB-205-0131L,M \\
\hline M83536/1-032L,M & FCB-205-0132L,M \\
\hline M83536/1-033L,M & FCB-205-0133L,M \\
\hline M83536/1-034L,M & FCB-205-0134L,M \\
\hline M83536/1-035L,M & FCB-205-0135L,M \\
\hline M83536/1-036L,M & FCB-205-0136L,M \\
\hline
\end{tabular}
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|c|}{MIL-PRF-83536/2} \\
\hline Miviliary Part Number & CIIPart Number \\
\hline M83536/2-001L,M & FCB-205-0201L,M \\
\hline M83536/2-003L,M & FCB-205-0202L,M \\
\hline M83536/2-004L,M & FCB-205-0204L,M \\
\hline M83536/2-005L,M & FCB-205-0205L,M \\
\hline
\end{tabular}
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|c|}{MIL-PRF-83536/2 (continued)} \\
\hline Military Part Number & CIIPart Number \\
\hline M83536/2-006L,M & FCB-205-0206L,M \\
\hline M83536/2-007L,M & FCB-205-0207L,M \\
\hline M83536/2-008L,M & FCB-205-0208L,M \\
\hline M83536/2-009L,M & FCB-205-0209L,M \\
\hline M83536/2-010L,M & FCB-205-0210L,M \\
\hline M83536/2-011L,M & FCB-205-0211L,M \\
\hline M83536/2-012L,M & FCB-205-0212L,M \\
\hline M83536/2-013L,M & FCB-205-0213L,M \\
\hline M83536/2-014L,M & FCB-205-0214L,M \\
\hline M83536/2-016L,M & FCB-205-0216L,M \\
\hline M83536/2-017L,M & FCB-205-0217L,M \\
\hline M83536/2-018L,M & FCB-205-0218L,M \\
\hline M83536/2-019L,M & FCB-205-0219L,M \\
\hline M83536/2-020L,M & FCB-205-0220L,M \\
\hline M83536/2-021L,M & FCB-205-0221L,M \\
\hline M83536/2-022L,M & FCB-205-0222L,M \\
\hline M83536/2-023L,M & FCB-205-0223L,M \\
\hline M83536/2-024L,M & FCB-205-0224L,M \\
\hline M83536/2-025L,M & FCB-205-0225L,M \\
\hline M83536/2-026L,M & FCB-205-0226L,M \\
\hline M83536/2-027L,M & FCB-205-0227L,M \\
\hline M83536/2-028L,M & FCB-205-0228L,M \\
\hline M83536/2-030L,M & FCB-205-0230L,M \\
\hline M83536/2-031L,M & FCB-205-0231L,M \\
\hline M83536/2-032L,M & FCB-205-0232L,M \\
\hline M83536/2-033L,M & FCB-205-0233L,M \\
\hline M83536/2-034L,M & FCB-205-0234L,M \\
\hline M83536/2-035L,M & FCB-205-0235L,M \\
\hline M83536/2-036L,M & FCB-205-0236L,M \\
\hline M83536/2-037L,M & FCB-205-0237L,M \\
\hline M83536/2-038L,M & FCB-205-0238L,M \\
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\end{tabular}
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|c|}{MILL-PRF-83536/5} \\
\hline Military Part Number & CIIPart Number \\
\hline M83536/5-001L,M & FCB-405-0501L,M \\
\hline M83536/5-002L,M & FCB-405-0502L,M \\
\hline M83536/5-003L,M & FCB-405-0503L,M \\
\hline M83536/5-004L,M & FCB-405-0504L,M \\
\hline M83536/5-005L,M & FCB-405-0505L,M \\
\hline M83536/5-006L,M & FCB-405-0506L,M \\
\hline M83536/5-007L,M & FCB-405-0507L,M \\
\hline M83536/5-008L,M & FCB-405-0508L,M \\
\hline M83536/5-009L,M & FCB-405-0509L,M \\
\hline M83536/5-010L,M & FCB-405-0510L,M \\
\hline M83536/5-011L,M & FCB-405-0511L,M \\
\hline M83536/5-012L,M & FCB-405-0512L,M \\
\hline M83536/5-013L,M & FCB-405-0513L,M \\
\hline M83536/5-014L,M & FCB-405-0514L,M \\
\hline M83536/5-015L,M & FCB-405-0515L,M \\
\hline M83536/5-016L,M & FCB-405-0516L,M \\
\hline M83536/5-017L,M & FCB-405-0517L,M \\
\hline M83536/5-018L,M & FCB-405-0518L,M \\
\hline M83536/5-019L,M & FCB-405-0519L,M \\
\hline M83536/5-020L,M & FCB-405-0520L,M \\
\hline M83536/5-021L,M & FCB-405-0521L,M \\
\hline M83536/5-022L,M & FCB-405-0522L,M \\
\hline M83536/5-023L,M & FCB-405-0523L,M \\
\hline M83536/5-024L,M & FCB-405-0524L,M \\
\hline M83536/5-025L,M & FCB-405-0525L,M \\
\hline M83536/5-026L,M & FCB-405-0526L,M \\
\hline M83536/5-027L,M & FCB-405-0527L,M \\
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\end{tabular}

MIL-PRF-83536/5 (continued)
\begin{tabular}{lr} 
Military Part Number & CIIPart Number \\
\hline M83536/5-028L,M & FCB-405-0528L,M \\
\hline M83536/5-029L,M & FCB-405-0529L,M \\
\hline M83536/5-030L,M & FCB-405-0530L,M \\
\hline M83536/5-031L,M & FCB-405-0531L,M \\
\hline M83536/5-032L,M & FCB-405-0532L,M
\end{tabular}
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|c|}{MIL-PRF-83536/6} \\
\hline Military Part Number & CII Part Number \\
\hline M83536/6-001L,M & FCB-405-0601L,M \\
\hline M83536/6-002L,M & FCB-405-0602L,M \\
\hline M83536/6-003L,M & FCB-405-0603L,M \\
\hline M83536/6-004L,M & FCB-405-0604L,M \\
\hline M83536/6-005L,M & FCB-405-0605L,M \\
\hline M83536/6-006L,M & FCB-405-0606L,M \\
\hline M83536/6-007L,M & FCB-405-0607L,M \\
\hline M83536/6-008L,M & FCB-405-0608L,M \\
\hline M83536/6-009L,M & FCB-405-0609L,M \\
\hline M83536/6-010L,M & FCB-405-0610L,M \\
\hline M83536/6-011L,M & FCB-405-0611L,M \\
\hline M83536/6-012L,M & FCB-405-0612L,M \\
\hline M83536/6-013L,M & FCB-405-0613L,M \\
\hline M83536/6-014L,M & FCB-405-0614L,M \\
\hline M83536/6-015L,M & FCB-405-0615L,M \\
\hline M83536/6-016L,M & FCB-405-0616L,M \\
\hline M83536/6-017L,M & FCB-405-0617L,M \\
\hline M83536/6-018L,M & FCB-405-0618L,M \\
\hline M83536/6-019L,M & FCB-405-0619L,M \\
\hline M83536/6-020L,M & FCB-405-0620L,M \\
\hline M83536/6-021L,M & FCB-405-0621L,M \\
\hline M83536/6-022L,M & FCB-405-0622L,M \\
\hline M83536/6-023L,M & FCB-405-0623L,M \\
\hline M83536/6-024L,M & FCB-405-0624L,M \\
\hline M83536/6-025L,M & FCB-405-0625L,M \\
\hline M83536/6-027L,M & FCB-405-0627L,M \\
\hline M83536/6-028L,M & FCB-405-0628L,M \\
\hline M83536/6-029L,M & FCB-405-0629L,M \\
\hline M83536/6-030L,M & FCB-405-0630L,M \\
\hline M83536/6-031L,M & FCB-405-0631L,M \\
\hline M83536/6-032L,M & FCB-405-0632L,M \\
\hline M83536/6-033L,M & FCB-405-0633L,M \\
\hline M83536/6-034L,M & FCB-405-0634L,M \\
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\end{tabular}

MIL-PRF-83536/9
\begin{tabular}{|c|c|}
\hline Military Part Number & CII Part Number \\
\hline M83536/9-001L,M & FCA-210-0901L,M \\
\hline M83536/9-002L,M & FCA-210-0902L,M \\
\hline M83536/9-003L,M & FCA-210-0903L,M \\
\hline M83536/9-004L,M & FCA-210-0904L,M \\
\hline M83536/9-005L,M & FCA-210-0905L,M \\
\hline M83536/9-006L,M & FCA-210-0906L,M \\
\hline M83536/9-007L,M & FCA-210-0907L,M \\
\hline M83536/9-008L,M & FCA-210-0908L,M \\
\hline M83536/9-009L,M & FCA-210-0909L,M \\
\hline M83536/9-010L,M & FCA-210-0910L,M \\
\hline M83536/9-011L,M & FCA-210-0911L,M \\
\hline M83536/9-012L,M & FCA-210-0912L,M \\
\hline M83536/9-013L,M & FCA-210-0913L,M \\
\hline M83536/9-014L,M & FCA-210-0914L,M \\
\hline M83536/9-015L,M & FCA-210-0915L,M \\
\hline M83536/9-016L,M & FCA-210-0916L,M \\
\hline M83536/9-017L,M & FCA-210-0917L,M \\
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\end{tabular}

Military Qualified Products List (QPL)
CII Electromechanical Relays (Continued)
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|c|}{MIL-PRF-83536/9 (continued)} \\
\hline Military Part Number & CIIPart Number \\
\hline M83536/9-018L,M & FCA-210-0918L,M \\
\hline M83536/9-019L,M & FCA-210-0919L,M \\
\hline M83536/9-020L, M & FCA-210-0920L,M \\
\hline M83536/9-021L,M & FCA-210-0921L,M \\
\hline M83536/9-022L,M & FCA-210-0922L,M \\
\hline M83536/9-023L,M & FCA-210-0923L,M \\
\hline M83536/9-024L,M & FCA-210-0924L,M \\
\hline M83536/9-025L,M & FCA-210-0925L,M \\
\hline M83536/9-026L,M & FCA-210-0926L,M \\
\hline M83536/9-027L,M & FCA-210-0927L,M \\
\hline M83536/9-030L,M & FCA-210-0930L,M \\
\hline M83536/9-031L,M & FCA-210-0931L,M \\
\hline M83536/9-032L,M & FCA-210-0932L,M \\
\hline M83536/9-033L,M & FCA-210-0933L,M \\
\hline M83536/9-034L,M & FCA-210-0934L,M \\
\hline M83536/9-035L,M & FCA-210-0935L,M \\
\hline M83536/9-036L,M & FCA-210-0936L,M \\
\hline M83536/9-037L,M & FCA-210-0937L,M \\
\hline M83536/9-038L,M & FCA-210-0938L,M \\
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\end{tabular}
\begin{tabular}{ll} 
& \multicolumn{1}{c}{ MIL-PRF-83536/10 } \\
Military Part Number & CIIPart Number \\
\hline M83536/10-001L,M & FCA-210-1001L,M \\
\hline M83536/10-00LL,M & FCA-210-1003L,M \\
\hline M83536/10-00LL,M & FCA-210-1004L,M \\
\hline M83536/10-005L,M & FCA-210-1005L,M \\
\hline M83536/10-006L,M & FCA-210-1006L,M \\
\hline M83536/10-007L,M & FCA-210-1007L,M \\
\hline M83536/10-008L,M & FCA-210-1008L,M \\
\hline M83536/10-009L,M & FCA-210-1009L,M \\
\hline M83536/10-010L,M & FCA-210-1010L,M \\
\hline M83536/10-011L,M & FCA-210-1011L,M \\
\hline M83536/10-012L,M & FCA-210-1012L,M \\
\hline M83536/10-013L,M & FCA-210-1013L,M \\
\hline M83536/10-014L,M & FCA-210-1014L,M \\
\hline M83536/10-016L,M & FCA-210-1016L,M \\
\hline M83536/10-017L,M & FCA-210-1017L,M \\
\hline M83536/10-018L,M & FCA-210-1018L,M \\
\hline M83536/10-019L,M & FCA-210-1019L,M \\
\hline M83536/10-020L,M & FCA-210-1020L,M \\
\hline M83536/10-021L,M & FCA-210-1021L,M \\
\hline M83536/10-022L,M & FCA-210-1022L,M \\
\hline M83536/10-023L,M & FCA-210-1023L,M \\
\hline M83536/10-024L,M & FCA-210-1024L,M \\
\hline M83536/10-025L,M & FCA-210-1025L,M \\
\hline M83536/10-026L,M & FCA-210-1026L,M \\
\hline M83536/10-027L,M & FCA-210-1027L,M \\
\hline M83536/10-029L,M & FCA-210-1029L,M \\
\hline M83536/10-030L,M & FCA-210-1030L,M \\
\hline M83536/10-031L,M & FCA-210-1031L,M \\
\hline M83536/10-032L,M & FCA-210-1032L,M \\
\hline M83536/10-033L,M & FCA-210-1033L,M \\
\hline M83536/10-034L,M & FCA-210-1034L,M \\
\hline M83536/10-035L,M & FCA-210-1035L,M \\
\hline M83536/0-036L,M & FCA-210-1036L,M \\
\hline M83536/0-037L,M & FCA-210-1037L,M \\
\hline M83536/10-038L,M &
\end{tabular}
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|c|}{MIL-PRF-83536/15} \\
\hline Military Part Number & CIIPart Number \\
\hline M83536/15-001L,M & FCA-410-1501L,M \\
\hline M83536/15-002L,M & FCA-410-1502L,M \\
\hline M83536/15-003L,M & FCA-410-1503L,M \\
\hline M83536/15-004L,M & FCA-410-1504L,M \\
\hline M83536/15-005L,M & FCA-410-1505L,M \\
\hline M83536/15-006L,M & FCA-410-1506L,M \\
\hline M83536/15-007L,M & FCA-410-1507L,M \\
\hline M83536/15-008L,M & FCA-410-1508L,M \\
\hline M83536/15-009L,M & FCA-410-1509L,M \\
\hline M83536/15-010L,M & FCA-410-1510L,M \\
\hline M83536/15-011L,M & FCA-410-1511L,M \\
\hline M83536/15-012L,M & FCA-410-1512L,M \\
\hline M83536/15-013L,M & FCA-410-1513L,M \\
\hline M83536/15-014L,M & FCA-410-1514L,M \\
\hline M83536/15-015L,M & FCA-410-1515L,M \\
\hline M83536/15-016L,M & FCA-410-1516L,M \\
\hline M83536/15-017L,M & FCA-410-1517L,M \\
\hline M83536/15-018L,M & FCA-410-1518L,M \\
\hline M83536/15-019L,M & FCA-410-1519L,M \\
\hline M83536/15-020L,M & FCA-410-1520L,M \\
\hline M83536/15-021L,M & FCA-410-1521L,M \\
\hline M83536/15-022L,M & FCA-410-1522L,M \\
\hline M83536/15-023L,M & FCA-410-1523L,M \\
\hline M83536/15-024L,M & FCA-410-1524L,M \\
\hline M83536/15-025L,M & FCA-410-1525L,M \\
\hline M83536/15-026L,M & FCA-410-1526L,M \\
\hline M83536/15-027L,M & FCA-410-1527L,M \\
\hline M83536/15-028L,M & FCA-410-1528L,M \\
\hline M83536/15-029L,M & FCA-410-1529L,M \\
\hline M83536/15-030L,M & FCA-410-1530L,M \\
\hline M83536/15-031L,M & FCA-410-1531L,M \\
\hline M83536/15-032L,M & FCA-410-1532L,M \\
\hline
\end{tabular}
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|r|}{CII Electromechanical Re} \\
\hline \multicolumn{2}{|c|}{MIL-PRF-83536/16 (continued)} \\
\hline Military Part Number & CIIP Part Number \\
\hline M83536/16-030L,M & FCA-410-1630L,M \\
\hline M83536/16-031L,M & FCA-410-1631L,M \\
\hline M83536/16-033L,M & FCA-410-1633L,M \\
\hline M83536/16-034L,M & FCA-410-1634L,M \\
\hline \multicolumn{2}{|c|}{MIL-PRF-83536/32} \\
\hline Military Part Number & CIIPart Number \\
\hline M83536/32-001L & FCA-325-3201L \\
\hline M83536/32-002L & FCA-325-3202L \\
\hline M83536/32-003L & FCA-325-3203L \\
\hline M83536/32-004L & FCA-325-3204L \\
\hline M83536/32-005L & FCA-325-3205L \\
\hline \multicolumn{2}{|c|}{MIL-PRF-83536/33} \\
\hline Military Part Number & CIIPart Number \\
\hline M83536/33-001L & FCA-325-3301L \\
\hline M83536/33-002L & FCA-325-3302L \\
\hline M83536/33-003L & FCA-325-3303L \\
\hline M83536/33-004L & FCA-325-3304L \\
\hline M83536/33-005L & FCA-325-3305L \\
\hline
\end{tabular}

MIL-PRF-83536/36
\begin{tabular}{|c|c|}
\hline Mrilitary Part Number & CIIPart Number \\
\hline M83536/36-001L & FCA-125-3601L \\
\hline M83536/36-002L & FCA-125-3602L \\
\hline M83536/36-003L & FCA-125-3603L \\
\hline M83536/36-004L & FCA-125-3604L \\
\hline M83536/36-005L & FCA-125-3605L \\
\hline M83536/36-006L & FCA-125-3606L \\
\hline M83536/36-007L & FCA-125-3607L \\
\hline M83536/36-008L & FCA-125-3608L \\
\hline
\end{tabular}

MIL-PRF-83536/37
\begin{tabular}{ll} 
Miritiary Part Number & CIIPart Number \\
\hline M835366/37-001L & FCA-1255-3701L \\
\(M 85536 / 37-002 \mathrm{~L}\) & FCA-125-3702L \\
\hline M83536/37-003L & FCA-125-3703L \\
\hline M8353636/37-04L & FCA-125-3704L \\
\hline
\end{tabular}

\section*{CII Time Delay Relays}
\begin{tabular}{|c|c|c|c|}
\hline \multicolumn{2}{|c|}{MIL-PRF-83726/28} & \multicolumn{2}{|c|}{MIL-PRF-83726/30} \\
\hline Military Part Number & Kilovac Part Number & Military Part Number & Kilovac Part Number \\
\hline M83726/28-1000P & TD228-1000P & M83726/30-1000P & TD230-1000P \\
\hline through & through & through & through \\
\hline M83726/28-5003P & TD228-5003P & M83726/30-5003P & TD230-5003P \\
\hline M83726/28-1000S & TD228-1000S & Military Part Number & Kilovac Part Number \\
\hline through & through & M83726/30-1000S & TD230-1000S \\
\hline M83726/28-5003S & TD228-5003S & through & through \\
\hline \multicolumn{2}{|c|}{MIL-PRF-83726/29} & M83726/30-5003S & TD230-5003S \\
\hline Military Part Number & Kilovac Part Number & \multicolumn{2}{|c|}{MIL-PRF-83726/31} \\
\hline M83726/29-1000P & TD229-1000P & Military Part Number & Kilovac Part Number \\
\hline through & through & M83726/31-1000P & TD231-1000P \\
\hline M83726/29-5003P & TD229-5003P & through & through \\
\hline & & M83726/31-5003P & TD231-5003P \\
\hline M83726/29-1000S & TD229-1000S & & \\
\hline through & through & M83726/31-1000S & TD231-1000S \\
\hline M83726/29-5003S & TD229-5003S & through & through \\
\hline & & M83726/31-5003S & TD231-5003S \\
\hline
\end{tabular}

\section*{Hartman Contactors — MS27750}
\begin{tabular}{lr}
\hline Military Part Number & Hartman Part Number \\
\hline MS27750-1 & M277501 \\
\hline MS27750-2 & M277502 \\
\hline
\end{tabular}

Military Qualified Products List (QPL)
\begin{tabular}{|c|c|c|c|}
\hline \multicolumn{4}{|c|}{Kilovac Vacuum Relays} \\
\hline \multicolumn{2}{|c|}{MIL-DTL-83725/1} & \multicolumn{2}{|c|}{MIL-DTL-83725/18} \\
\hline Military Part Number & Kilovac Part Number & Military Part Number & Kilovac Part Number \\
\hline M83725/1-001 & MH-8A & M83725/18-003 & MK47B334-003 \\
\hline M83725/1-002 & MH-8 & & \\
\hline M83725/1-003 & MH-8C & & \\
\hline M83725/1-004 & MH-8AF & Military Part Number & Kilovac Part Number \\
\hline M83725/1-005 & MH-8F & M83725/21-001 & MK41A234-001 \\
\hline M83725/1-006 & MH-8CF & M83725/21-002 & MK41A334-002 \\
\hline & & M83725/21-003 & MK41A534-003 \\
\hline \multicolumn{2}{|c|}{MIL-DTL-83725/2} & M83725/21-004 & MK41A232-004 \\
\hline Military Part Number & Kilovac Part Number & M83725/21-005 & MK41A332-005 \\
\hline M83725/2-001 & MH-17A & M83725/21-006 & MK41A532-006 \\
\hline M83725/2-002 & MH-17 & M83725/21-007 & MK41A734-007 \\
\hline M83725/2-003 & MH-17C & M83725/21-008 & MK41A834-008 \\
\hline M83725/2-004 & MH-17A/115VDC & M83725/21-009 & MK41A934-009 \\
\hline M83725/2-005 & MH-17/115VDC & M83725/21-010 & MK41A732-010 \\
\hline M83725/2-006 & MH-17C/115VDC & M83725/21-011 & MK41A832-011 \\
\hline & & M83725/21-012 & MK41A932-012 \\
\hline \multicolumn{2}{|c|}{MIL-DTL-83725/4} & \multicolumn{2}{|c|}{\multirow[b]{2}{*}{MIL-DTL-83725/22}} \\
\hline Military Part Number & Kilovac Part Number & & \\
\hline \multicolumn{2}{|l|}{M83725/4-001} & Military Part Number & Kilovac Part Number \\
\hline & & M83725/22-001 & MK41B234-001 \\
\hline \multicolumn{2}{|l|}{} & M83725/22-002 & MK41B334-002 \\
\hline & & M83725/22-003 & MK41B534-003 \\
\hline Military Part Number & Kilovac Part Number & M83725/22-004 & MK41B232-004 \\
\hline M83725/5-001 & MHC-1 & M83725/22-005 & MK41B332-005 \\
\hline \multicolumn{2}{|c|}{\multirow[b]{2}{*}{MIL-DTL-83725/10}} & M83725/22-006 & MK41B532-006 \\
\hline & & M83725/22-007 & MK41B734-007 \\
\hline Military Part Number & Kilovac Part Number & M83725/22-008 & MK41B834-008 \\
\hline M83725/10-001 & MK43B834-001 & M83725/22-009 & MK41B934-009 \\
\hline M83725/10-002 & MK43B832-002 & M83725/22-010 & MK41B732-010 \\
\hline M83725/10-003 & MK43B332-003 & M83725/22-011 & MK41B832-011 \\
\hline & & M83725/22-012 & MK41B932-012 \\
\hline \multicolumn{2}{|l|}{\multirow[t]{2}{*}{M83725/10-004 MK43B332-004}} & & \\
\hline & & \multicolumn{2}{|c|}{MIL-DTL-83725/23} \\
\hline M83725/10-005 & MK43B734-005 & Whilitary Part Number & Kilovac Part Number \\
\hline M83725/10-006 & MK43B732-006 & M83725/23-001 & MK41C234-001 \\
\hline M83725/10-007 & MK43B234-007 & M83725/23-002 & MK41C334-002 \\
\hline M83725/10-008 & MK43B232-008 & M83725/23-003 & MK41C534-003 \\
\hline \multicolumn{2}{|c|}{\multirow[b]{2}{*}{MIL-DTL-83725/16}} & M83725/23-004 & MK41C232-004 \\
\hline & & M83725/23-005 & MK41C332-005 \\
\hline Military Part Number & Kilovac Part Number & M83725/23-006 & MK41C532-006 \\
\hline M83725/16-001 & MK43C734-001 & M83725/23-007 & MK41C734-007 \\
\hline M83725/16-002 & MK43C834-002 & M83725/23-008 & MK41C834-008 \\
\hline M83725/16-003 & MK43C732-003 & M83725/23-009 & MK41C934-009 \\
\hline M83725/16-004 & MK43C832-004 & M83725/23-010 & MK41C732-010 \\
\hline M83725/16-005 & MK43C234-005 & M83725/23-011 & MK41C832-011 \\
\hline M83725/16-006 & MK43C334-006 & M83725/23-012 & MK41C932-012 \\
\hline M83725/16-007 & MK43C232-007 & & \\
\hline M83725/16-008 & MK43C332-008 & \multicolumn{2}{|c|}{MIL-DTL-83725/24} \\
\hline \multicolumn{2}{|c|}{\multirow[b]{2}{*}{MIL-DTL-83725/17}} & Mililiary Part Number & Kilovac Part Number \\
\hline & & M83725/24-001 & MK41P334-001 \\
\hline Militiary Part Number & Kilovac Part Number & M83725/24-002 & MK41P332-002 \\
\hline M83725/17-001 & MK43A834-001 & M83725/24-003 & MK40P334-003 \\
\hline M83725/17-002 & MK43A832-002 & M83725/24-004 & MK40P332-004 \\
\hline M83725/17-003 & MK43A334-003 & & \\
\hline M83725/17-004 & MK43A332-004 & & \\
\hline M83725/17-005 & MK43A734-005 & & \\
\hline M83725/17-006 & MK43A732-006 & & \\
\hline M83725/17-007 & MK43A234-007 & & \\
\hline M83725/17-008 & MK43A232-008 & & \\
\hline
\end{tabular}

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Revised 3-13

Dimensions are shown for reference purposes only. Specifications subject to change.

Dimensions are in millimeters unless otherwise specified.
\begin{tabular}{|c|c|}
\hline & ac Solid State Re \\
\hline \multicolumn{2}{|c|}{MIL-PRF-28750/5} \\
\hline Military Part Number & Kilovac Part Number \\
\hline M28750/5-001W & JTS5-1W \\
\hline M28750/5-001Y & JTS5-1Y \\
\hline \multicolumn{2}{|c|}{MIL-PRF-28750/6} \\
\hline Military Part Number & Kilovac Part Number \\
\hline M28750/6-001W & JTS6-1W \\
\hline M28750/6-001Y & JTS6-1Y \\
\hline \multicolumn{2}{|c|}{MIL-PRF-28750/7} \\
\hline Military Part Number & Kilovac Part Number \\
\hline M28750/7-001W & JTS7-1W \\
\hline M28750/7-001Y & JTS7-1Y \\
\hline \multicolumn{2}{|c|}{MIL-PRF-28750/9} \\
\hline Military Part Number & Kilovac Part Number \\
\hline M28750/9-001W & JDS9-1W \\
\hline M28750/9-001Y & JDS9-1Y \\
\hline \multicolumn{2}{|c|}{MIL-PRF-28750/10} \\
\hline Military Part Number & Kilovac Part Number \\
\hline M28750/10-001W & JPS10-1W \\
\hline M28750/10-001Y & JPS10-1Y \\
\hline M28750/10-002W & JPS10-2W \\
\hline M28750/10-002Y & JPS10-2Y \\
\hline \multicolumn{2}{|c|}{DSCC 85092} \\
\hline Military Part Number & Kilovac Part Number \\
\hline 85092-001 & MS14-1Y \\
\hline 85092-002 & MS14-2Y \\
\hline
\end{tabular}
\begin{tabular}{lcr} 
& DSCC 86031 & \\
Military Part Number & & Kilovac Part Number \\
\hline \(86031-001\) & & PS12-1Y \\
\hline & DSCC 87034 & \\
\hline Military Part Number & & Kilovac Part Number \\
\hline \(87034-001\) & & MS14-3Y \\
\hline & & \\
Military Part Number & & \\
\hline \(88062-002\) & & KSCC 88062
\end{tabular}

\section*{Superseded Conversion Index for MIL-PRF-6106 Part Numbers Superseded by MIL-PRF-83536}
\begin{tabular}{|c|c|c|c|}
\hline \multicolumn{2}{|c|}{MS27400} & \multirow[t]{2}{*}{Superseded MIL Spec} & \multirow[t]{2}{*}{Current MIL Spec/ CII Part Number} \\
\hline \multirow[t]{3}{*}{Superseded MIL Spec} & Current MIL Spec/ & & \\
\hline & CII Part Number & MS27400-30 & M83536/16-024M \\
\hline & & & FCA-410-1624M \\
\hline \multirow[t]{2}{*}{MS27400-5} & M83536/15-021M & MS27400-31 & M83536/16-022M \\
\hline & FCA-410-1521M & & FCA-410-1622M \\
\hline \multirow[t]{2}{*}{MS27400-6} & M83536/15-022M & MS27400-35 & M83536/15-020M \\
\hline & FCA-410-1522M & & FCA-410-1520M \\
\hline \multirow[t]{2}{*}{MS27400-9} & M83536/15-021M & MS27400-36 & M83536/15-020M \\
\hline & FCA-410-1521M & , & FCA-410-1520M \\
\hline \multirow[t]{2}{*}{MS27400-10} & M83536/15-022M & MS27400-37 & M83536/16-020M \\
\hline & FCA-410-1522M & & FCA-410-1620M \\
\hline \multirow[t]{2}{*}{MS27400-17} & M83536/16-022M & MS27400-38 & M83536/16-020M \\
\hline & FCA-410-1622M & & FCA-410-1620M \\
\hline \multirow[t]{2}{*}{MS27400-18} & M83536/16-031M & MS27400-40 & M83536/15-018M \\
\hline & FCA-410-1631M & NS2700-40 & FCA-410-1518M \\
\hline MS27400-19 & \[
\begin{array}{r}
\hline \text { M83536/15-024M } \\
\text { FCA-410-1524M }
\end{array}
\] & MS27400-41 & M83536/15-017M \\
\hline \multirow[t]{2}{*}{MS27400-21} & M83536/15-024M & & FCA-410-1517M \\
\hline & FCA-410-1524M & MS27400-42 & M83536/16-018M
FCA-410-1618M \\
\hline \multirow[t]{2}{*}{MS27400-23} & M83536/16-021M & MS27400-43 & M83536/16-017M \\
\hline & FCA-410-1621M & MS27400-43 & \[
\begin{aligned}
& \text { FCA-410-1617M } \\
& \text { FCA }
\end{aligned}
\] \\
\hline \multirow[t]{2}{*}{MS27400-24} & M83536/16-024M & MS27400-44 & M83536/15-018M \\
\hline & FCA-410-1624M & & FCA-410-1518M \\
\hline \multirow[t]{4}{*}{MS27400-29} & M83536/16-021M & MS27400-46 & 83536/16-018M \\
\hline & FCA-410-1621M & & FCA-410-1618M \\
\hline & & MS27400-47 & M83536/16-017M \\
\hline & & & FCA-410-1617M \\
\hline
\end{tabular}

\footnotetext{
Catalog 5-1773450-5
}

Military Qualified Products List (QPL)

\section*{Superseded Conversion Index for MIL-PRF-6106 Part Numbers \\ Superseded by MIL-PRF-83536 (Continued)}
\begin{tabular}{|c|c|c|c|}
\hline \multicolumn{2}{|c|}{MS27401} & \multicolumn{2}{|c|}{MS27401 (continued)} \\
\hline Superseded MIL Spec & Current MIL Spec/
CII Part Number & Superseded MIL Spec & Current MILL Spec/
CII Part Number \\
\hline MS27401-4 & M83536/9-022M & MS27401-53 & M83536/10-019M \\
\hline MS27401-5 & M83536/9-023M FCA-210-0923 & MS27401-58 & M83536/9-027M FCA-210-0927M \\
\hline MS27401-6 & \[
\begin{aligned}
& \text { M83536/9-024M } \\
& \text { FCA-210-0924M } \\
& \hline
\end{aligned}
\] & MS27401-59 & M83536/10-027M
FCA-210-1027M \\
\hline MS27401-10 & \[
\begin{aligned}
& \text { M83536/9-009M } \\
& \text { FCA-210-0929M } \\
& \hline
\end{aligned}
\] & & \\
\hline MS27401-13 & \[
\begin{aligned}
& \text { M83536/9-023M } \\
& \text { FCA-210-0923M } \\
& \hline
\end{aligned}
\] & Superseded MIL Spec & Current MIL Spec/ CII Part Number \\
\hline MS27401-14 & \[
\begin{aligned}
& \text { M83536/9-024M } \\
& \text { FCA-210-0924M }
\end{aligned}
\] & MS27743-1 & \[
\begin{aligned}
& \text { M83536/32-002L } \\
& \text { FCA-325-3202L }
\end{aligned}
\] \\
\hline MS27401-21 & M83536/9-026M FCA-210-0926M & MS27743-2 & \[
\begin{aligned}
& \text { M83536/32-003L } \\
& \text { FCA-325-3203L } \\
& \hline
\end{aligned}
\] \\
\hline MS27401-23 & M83536/9-026M FCA-210-0926M & MS27743-3 & \[
\begin{aligned}
& \text { M83536/32-005L } \\
& \text { FCA-325-3205L }
\end{aligned}
\] \\
\hline MS27401-25 & \[
\begin{array}{r}
\text { M83536/10-023M } \\
\text { FCA-210-1023M } \\
\hline
\end{array}
\] & MS27743-4 & \[
\begin{aligned}
& \text { M83536/32-002L } \\
& \text { FCA-325-3202L } \\
& \hline
\end{aligned}
\] \\
\hline MS27401-26 & \[
\begin{array}{r}
\text { M83536/10-026M } \\
\text { FCA-210-1026M } \\
\hline
\end{array}
\] & MS27743-5 & \[
\begin{aligned}
& \text { M83536/32-005L } \\
& \text { FCA-325-3205L } \\
& \hline
\end{aligned}
\] \\
\hline MS27401-27 & M83536/10-024M
FCA-210-1024M & MS27743-6 & \[
\begin{aligned}
& \text { M83536/32-003L } \\
& \text { FCA-325-3203L }
\end{aligned}
\] \\
\hline MS27401-30 & \[
\begin{array}{r}
\text { M83536/10-007M } \\
\text { FCA-210-1007M } \\
\hline
\end{array}
\] & MS27743-10 & \[
\begin{aligned}
& \text { M83536/32-002L } \\
& \text { FCA-325-3202L } \\
& \hline
\end{aligned}
\] \\
\hline MS27401-31 & \[
\begin{array}{r}
\text { M83536/10-023M } \\
\text { FCA-210-1023M } \\
\hline
\end{array}
\] & MS27743-11 & \[
\begin{aligned}
& \text { M83536/32-005L } \\
& \text { FCA-325-3205L }
\end{aligned}
\] \\
\hline MS27401-32 & \[
\begin{array}{r}
\text { M83536/10-026M } \\
\text { FCA-210-1026M }
\end{array}
\] & MS27743-12 & \[
\begin{aligned}
& \text { M83536/32-003L } \\
& \text { FCA-325-3203L } \\
& \hline
\end{aligned}
\] \\
\hline MS27401-33 & M83536/10-024M
FCA-210-1024M & MS27743-16 & M83536/33-002L FCA-325-3302L \\
\hline MS27401-37 & M83536/9-025M FCA-210-0925M & MS27743-17 & \[
\begin{aligned}
& \text { M83536/33-005L } \\
& \text { FCA-325-3305L } \\
& \hline
\end{aligned}
\] \\
\hline MS27401-38 & M83536/9-025M FCA-210-0925M & MS27743-18 & \[
\begin{aligned}
& \text { M83536/33-003L } \\
& \text { FCA-325-3303L } \\
& \hline
\end{aligned}
\] \\
\hline MS27401-39 & \[
\begin{aligned}
& \text { M83536/10-025M } \\
& \text { FCA-210-1025M }
\end{aligned}
\] & MS27743-22 & \[
\begin{aligned}
& \text { M83536/33-002L } \\
& \text { FCA-325-3302L } \\
& \hline
\end{aligned}
\] \\
\hline MS27401-40 & \[
\begin{array}{r}
\text { M83536/10-025M } \\
\text { FCA-210-1025M } \\
\hline
\end{array}
\] & MS27743-23 & \[
\begin{aligned}
& \text { M83536/33-005L } \\
& \text { FCA-325-3305L } \\
& \hline
\end{aligned}
\] \\
\hline MS27401-42 & \[
\begin{aligned}
& \text { M83536/9-022M } \\
& \text { FCA-210-0922M } \\
& \hline
\end{aligned}
\] & MS27743-24 & \[
\begin{aligned}
& \text { M83536/33-003L } \\
& \text { FCA-325-3303L } \\
& \hline
\end{aligned}
\] \\
\hline MS27401-43 & \[
\begin{gathered}
\text { M83536/10-022M } \\
\text { FCA-210-1022M } \\
\hline
\end{gathered}
\] & MS27743-28 & \[
\begin{aligned}
& \text { M83536/32-001L } \\
& \text { FCA-325-3201L } \\
& \hline
\end{aligned}
\] \\
\hline MS27401-44 & M83536/10-022M
FCA-210-1022M & MS27743-29 & \[
\begin{aligned}
& \text { M83536/32-004L } \\
& \text { FCA-325-3204L }
\end{aligned}
\] \\
\hline MS27401-46 & \[
\begin{aligned}
& \text { M83536/9-020M } \\
& \text { FCA-210-0920M }
\end{aligned}
\] & MS27743-30 & \[
\begin{aligned}
& \text { M83536/32-001L } \\
& \text { FCA-325-3201L } \\
& \hline
\end{aligned}
\] \\
\hline MS27401-47 & \[
\begin{aligned}
& \text { M83536/9-019M } \\
& \text { FCA-210-0919M } \\
& \hline
\end{aligned}
\] & MS27743-31 & \[
\begin{aligned}
& \text { M83536/32-004L } \\
& \text { FCA-325-3204L }
\end{aligned}
\] \\
\hline MS27401-48 & \[
\begin{array}{r}
\text { M83536/10-002M } \\
\text { FCA-210-1020M } \\
\hline
\end{array}
\] & MS27743-32 & M83536/33-001L FCA-325-3301L \\
\hline MS27401-49 & \[
\begin{aligned}
& \text { M83536/10-019M } \\
& \text { FCA-210-1019M }
\end{aligned}
\] & MS27743-33 & \[
\begin{aligned}
& \text { M83536/33-004L } \\
& \text { FCA-325-3304L }
\end{aligned}
\] \\
\hline MS27401-50 & M83536/9-020M FCA-210-0920M & MS27743-34 & M83536/33-001L \\
\hline MS27401-51 & M83536/9-019M FCA-210-0919M & MS27743-35 & \[
\begin{aligned}
& \text { M83536/33-004L } \\
& \text { FCA-325-3304L } \\
& \hline
\end{aligned}
\] \\
\hline
\end{tabular}

\section*{Superseded Conversion Index for MIL-PRF-6106 Part Numbers \\ Superseded by MIL-PRF-83536 (Continued)}
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|c|}{MIL-PRF-6106/21} \\
\hline Superseded MIL Spec & \begin{tabular}{l}
Current MIL Spec/ \\
CII Part Number
\end{tabular} \\
\hline M6106/21-003 & \[
\begin{aligned}
& \text { M83536/2-028M } \\
& \text { FCB-205-0228M }
\end{aligned}
\] \\
\hline \multicolumn{2}{|c|}{MIL-PRF-6106/22} \\
\hline Superseded MIL Spec & Current MIL Spec CII Part Number \\
\hline M6106/22-003 & \[
\begin{aligned}
& \hline \text { M83536/6-025M } \\
& \text { FCB-405-0625M }
\end{aligned}
\] \\
\hline \multicolumn{2}{|c|}{MIL-PRF-6106/27} \\
\hline Superseded MIL Spec & \begin{tabular}{l}
Current MIL Spec/ \\
CII Part Number
\end{tabular} \\
\hline M6106/27-001 & \[
\begin{aligned}
& \text { M83536/1-019M } \\
& \text { FCB-205-0119M }
\end{aligned}
\] \\
\hline M6106/27-002 & \[
\begin{aligned}
& \text { M83536/1-019M } \\
& \text { FCB-205-0119M }
\end{aligned}
\] \\
\hline M6106/27-003 & \[
\begin{aligned}
& \text { M83536/2-019M } \\
& \text { FCB-205-0219M }
\end{aligned}
\] \\
\hline M6106/27-004 & \[
\begin{aligned}
& \hline \text { M83536/2-019M } \\
& \text { FCB-205-0219M }
\end{aligned}
\] \\
\hline M6106/27-005 & \[
\begin{aligned}
& \text { M83536/1-020M } \\
& \text { FCB-205-0120M }
\end{aligned}
\] \\
\hline M6106/27-006 & \[
\begin{aligned}
& \text { M83536/1-020M } \\
& \text { FCB-205-0120M }
\end{aligned}
\] \\
\hline M6106/27-007 & \[
\begin{aligned}
& \text { M83536/2-020M } \\
& \text { FCB-205-0220M }
\end{aligned}
\] \\
\hline M6106/27-008 & \[
\begin{aligned}
& \text { M83536/2-020M } \\
& \text { FCB-205-0220M }
\end{aligned}
\] \\
\hline M6106/27-009 & \[
\begin{aligned}
& \text { M83536/1-021M } \\
& \text { FCB-205-0121M }
\end{aligned}
\] \\
\hline M6106/27-010 & \[
\begin{aligned}
& \text { M83536/1-021M } \\
& \text { FCB-205-0121M }
\end{aligned}
\] \\
\hline M6106/27-011 & \[
\begin{aligned}
& \text { M83536/2-021M } \\
& \text { FCB-205-0221M }
\end{aligned}
\] \\
\hline M6106/27-012 & \[
\begin{aligned}
& \text { M83536/2-021M } \\
& \text { FCB-205-0221M }
\end{aligned}
\] \\
\hline M6106/27-013 & \[
\begin{aligned}
& \text { M83536/1-022M } \\
& \text { FCB-205-0122M }
\end{aligned}
\] \\
\hline M6106/27-014 & \[
\begin{aligned}
& \text { M83536/1-022M } \\
& \text { FCB-205-0122M }
\end{aligned}
\] \\
\hline M6106/27-015 & \[
\begin{aligned}
& \text { M83536/2-022M } \\
& \text { FCB-205-0222M }
\end{aligned}
\] \\
\hline M6106/27-016 & \[
\begin{aligned}
& \text { M83536/2-022M } \\
& \text { FCB-205-0222M }
\end{aligned}
\] \\
\hline M6106/27-017 & \[
\begin{aligned}
& \text { M83536/1-023M } \\
& \text { FCB-205-0123M }
\end{aligned}
\] \\
\hline M6106/27-018 & \[
\begin{aligned}
& \text { M83536/1-023M } \\
& \text { FCB-205-0123M }
\end{aligned}
\] \\
\hline M6106/27-019 & \[
\begin{aligned}
& \text { M83536/2-023M } \\
& \text { FCB-205-0223M }
\end{aligned}
\] \\
\hline M6106/27-020 & \[
\begin{aligned}
& \text { M83536/2-023M } \\
& \text { FCB-205-0223M }
\end{aligned}
\] \\
\hline M6106/27-021 & \[
\begin{aligned}
& \text { M83536/1-024M } \\
& \text { FCB-205-0124M }
\end{aligned}
\] \\
\hline M6106/27-022 & \[
\begin{aligned}
& \text { M83536/1-024M } \\
& \text { FCB-205-0124M }
\end{aligned}
\] \\
\hline M6106/27-023 & \[
\begin{aligned}
& \text { M83536/2-024M } \\
& \text { FCB-205-0224M }
\end{aligned}
\] \\
\hline
\end{tabular}
\(\left.\begin{array}{lr}\text { Superseded MIL Spec } & \begin{array}{c}\text { Current MIL Spec/ } \\
\text { ClI Part Number }\end{array} \\
\hline \text { M6106/27-024 } & \text { M83536/2-024M } \\
& \text { FCB-205-0224M }\end{array}\right\}\)\begin{tabular}{lr} 
M83536/1-025M \\
M6106/27-025 & FCB-205-0125M \\
\hline M6106/27-026 & M83536/1-025M \\
& FCB-205-0125M \\
\hline M6106/27-027 & M83536/2-025M \\
& FCB-205-0225M \\
\hline M6106/27-028 & M83536/2-025M \\
& FCB-205-0225M \\
\hline M6106/27-029 & M83536/1-026M \\
\hline M6106/27-030 & FCB-205-0126M \\
\hline & M83536/1-026M \\
\hline M6106/27-031 & FCB-205-0126M \\
\hline M6106/27-032 & M83536/2-026M \\
\hline M6106/27-037 & FCB-205-0226M \\
\hline M6106/27-038 & M83536/2-026M \\
\hline M6106/27-039 & FCB-205-0226M \\
\hline M6106/27-040 & M83536/1-027M \\
& FCB-205-0127M \\
\hline & FCB-205-0127M \\
\hline
\end{tabular}
\(\left.\begin{array}{lr}\hline \text { Superseded MIL Spec } & \begin{array}{c}\text { Current MIL Spec/ } \\
\text { CII Part Number }\end{array} \\
\hline \text { M6106/28-001 } & \text { M83536/5-017M } \\
& \text { FCB-405-0517M }\end{array}\right\}\)\begin{tabular}{lc} 
M83536/5-017M \\
M6106/28-002 & FCB-405-0517M \\
& M83536/6-017M \\
\hline M6106/28-003 & FCB-405-0617M \\
\hline M6106/28-004 & M83536/6-017M \\
& FCB-405-0617M \\
\hline M6106/28-005 & M83536/5-018M \\
& FCB-405-0518M \\
\hline M6106/28-006 & M83536/5-018M \\
& FCB-405-0518M \\
\hline M6106/28-007 & M83536/6-018M \\
& FCB-405-0618M \\
\hline M6106/28-008 & M83536/6-018M \\
\hline M6106/28-023 & FCB-405-0618M \\
\hline M6106/28-024 & M83536/6-022M \\
\hline M6106/28-025 & FCB-405-0622M \\
\hline M6106/28-026 & M83536/6-022M \\
& FCB-405-0622M \\
\hline M6106/28-027 & M83536/5-023M \\
\hline M6106/28-028 & FCB-405-0523M \\
\hline M6106/28-029 & M83536/5-023M \\
& FCB-405-0523M \\
\hline & M83536/6-023M \\
& FCB-405-0623M \\
\hline
\end{tabular}

Military Qualified Products List (QPL)

\section*{Superseded Conversion Index for MIL-PRF-6106 Part Numbers}

Superseded by MIL-PRF-83536 (Continued)
\begin{tabular}{lr}
\multicolumn{2}{c}{ MIL-PRF-6106/28 } \\
\hline Superseded MIL Spec & Current MIL Spec/ \\
& CII Part Number \\
\hline M6106/28-030 & M83536/5-024M \\
& FCB-405-0524M \\
\hline M6106/28-031 & M83536/6-024M \\
& FCB-405-0624M \\
\hline M6106/28-032 & M83536/6-024M \\
& FCB-405-0624M \\
\hline M6106/28-037 & M83536/5-012M \\
& FCB-405-0512M \\
\hline M6106/28-038 & M83536/6-012M \\
& FCB-405-0612M \\
\hline M6106/28-039 & M83536/5-013M \\
& FCB-405-0513M \\
\hline M6106/28-040 & M83536/6-013M \\
& FCB-405-0613M \\
\hline M6106/28-041 & M83536/5-014M \\
& FCB-405-0514M \\
\hline M6106/28-042 & M83536/6-014M \\
\hline M6106/28-043 & FCB-405-0614M \\
\hline M6106/28-044 & M83536/5-015M \\
\hline M6106/28-045 & FCB-405-0515M \\
\hline M6106/28-046 & M83536/6-015M \\
& FCB-405-0615M \\
\hline
\end{tabular}

\section*{Engineering Notes}

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Reference

If your application requires only that the relay carry current, provide voltage isolation, and the power is always removed prior to actuating the relay contacts, then you have a relatively simple task selecting the proper relay based on its voltage isolation and current carry capability.
If there is any possibility that the relay could at some time switch a load, for example in a fault condition, then a load switching relay should be selected. Please review next page to determine which TE relays meet your voltage and current carry needs and then proceed directly to the indicated product page.

\section*{Non-Power Switching Applications (Isolation Only)}


\section*{Technical Considerations}

When the relay will not be required to power switch, the primary issues to consider are the maximum system voltage and the maximum current the relay must carry. Normally these can be easily determined and, by reviewing the product specifications, the
appropriate relay can be selected.

\section*{Momentary or Pulsed Loads Through Closed Contacts}

KILOVAC vacuum and gas-filled relays can handle momentary current pulses much higher than their continuous current rating. The key is to keep the
temperature rise of the relay within safe limits since the normal failure mode in high peak current applications will be either contact welding from very high, very short current pulses or loss of seal integrity of the glass-to-metal, ceramic-to-metal or epoxy-to-metal seals due to excessive heat.

Figure 1. Recommended Relays For High Voltage Isolation (Non-power Switching) Applications
\begin{tabular}{|c|c|c|c|c|c|c|}
\hline Part Number & Isolation Voltage & Continuous Current & Contact Form & \[
\begin{aligned}
& \hline \text { Load } \\
& \text { Switch* }
\end{aligned}
\] & Peak Current & \[
\begin{gathered}
\text { See } \\
\text { Page } \\
\hline
\end{gathered}
\] \\
\hline \[
\begin{gathered}
\text { MAP100 } \\
\text { CAP100 } \\
\text { EV100 } \\
\text { LEV100 } \\
\hline
\end{gathered}
\] & 1800 V & 90 Amps & A & Yes & 600*** & \[
\begin{gathered}
7-8,7-9 \\
7-18-7-20 \\
7-27,7-28 \\
7-29-7-31
\end{gathered}
\] \\
\hline MAP200
CAP200
EV200
LEV200
CAP202 & 1800 V & 150 Amps & A & Yes & 1,000*** & \[
\begin{gathered}
7-10,7-11 \\
7-16,7-17 \\
7-21-7-26 \\
7-32-7-33 \\
7-16,7-17
\end{gathered}
\] \\
\hline EV500 & 2000 V & 600 Amps & A & Yes & 3,300*** & 7-46, 7-47 \\
\hline HC-1 & 3.5 kV & 25 Amps & C & No & - & 7-58 \\
\hline HC-5 & 3.5 kV & 8 Amps & C & Yes & 200** & 7-58 \\
\hline K41 Series & 5.0 kV & 25 Amps & A,B,C,P,R & Yes & 175** & 7-59, 7-60 \\
\hline HC-2 & 8.0 kV & 25 Amps & C & No & 200** & 7-64 \\
\hline HC-6 & 8.0 kV & 8 Amps & C & Yes & 200** & 7-64 \\
\hline H-18 & 8.0 kV & 10 Amps & 2 C & Yes & - & 7-65 \\
\hline K81 Series & 10.0 kV & 10 Amps & A,B,C & Yes & 175** & 7-67 \\
\hline K43 Series & 10.0 kV & 25 Amps & A,B,C,P,R & Yes & 175** & 7-69, 7-70 \\
\hline KC-14, KC-18 & 15.0 kV & 50 Amps & C & No & - & 7-73 \\
\hline H-26 & 15.0 kV & 30 Amps & 4C & Yes & - & 7-76 \\
\hline H-19 & 20.0 kV & 30 Amps & 2 C & Yes & - & 7-77 \\
\hline KC-20, KC-30 & 25.0 kV & 110, 55 Amps & X, Y & No & - & 7-79 \\
\hline KC-22, KC-32 & 25.0 kV & 64, 45 Amps & X, Y & Yes & 500** & 7-80 \\
\hline K62 Series & 25.0 kV & 18 Amps & A,B,C & Yes & 350** & 7-79 \\
\hline K61 Series & 35.0 kV & 10 Amps & A,B,C & Yes & 450** & 7-84 \\
\hline K64C & 50.0 kV & 10 Amps & C & Yes & 400** & 7-85 \\
\hline K70 Series & 70.0 kV & 10 Amps & A,B,C & Yes & 400** & 7-86 \\
\hline
\end{tabular}

\footnotetext{
*In Fault Condition. "Yes" means relay is capable of tolerating some faults
**Pulse, 5 ms Duration, Closed Contacts: Failure=Welded Contacts
***Pulse, 1s Duration, Closed Contacts
}
```

Dimensions are shown for reference purposes only. Specifications subject to change.

```

Dimensions are in millimeters unless otherwise specified.

\section*{Non-Power Switching Applications (Isolation Only) (Continued)}

Therefore, there are two key parameters you must consider in selecting a relay for this type of application. First, refer to Figure 1 for recommended relays and their estimated peak current pulse rating. Second, you must calculate the duty cycle of the pulse to ensure that you will not exceed, on average, the relay's continuous current rating. To calculate duty cycle,

\section*{Pulse duration (in seconds) X pulse rep rate (in cycles per second) \(\times 100=\) duty cycle (in percent)}

The duty cycle times pulse peak current should not exceed the continuous current rating of the relay.
For example: A pulse of 50 amps, lasting 50 milliseconds is passed through the relay every 200 milliseconds. The duty cycle is ...

\section*{. 050 pulse duration X 1 cycle/. 200 seconds = \(\mathbf{2 5 \%}\) duty cycle}

The average current is ...

\section*{\(\mathbf{2 5 \%}\) X 50 amp peak current \(=12.5 \mathrm{amps}\) continuous}


TE Connectivity offers a wide variety of high voltage relays for RF applications to 32 MHz .

Thus, a relay with a 12.5 amp or greater continuous current rating will be suitable for this application.

\section*{Radio Frequency (RF) Applications}

Because of their good insulation qualities and low contact resistance, vacuum relays are quite commonly used in RF applications such as transmitters, antenna couplers, semiconductor processing equipment, and power supplies. However, operating any relay at RF imposes current and voltage limitations. The "skin effect" of RF current on the surface of the conductor creates the current limitation. As frequency is increased, the effective cross-section of the conductor path is decreased, resulting in heating of the conductor surface. This heating limits the maximum current the conductor can carry due to the inherent temperature limitations of the ceramic-to-metal or glass-to-metal seals.
When the relay is used as an insulator, there is RF voltage across the open contacts, or between contacts and ground. For all practical purposes, this insulator has a high voltage capacitance of from 1 to 2 picofarads. The leakage current flowing through this insulator/ capacitor results in the heating of the lossy elements of the insulator which, again due to the temperature limitations of the seals, limits the maximum RF voltage that can be handled. In addition, contact gaps simply break down at lower voltages with RF than DC.
These effects make it necessary to derate the current and voltage specifications for operating at RF. Ceramic relays can handle higher RF power than glass relays due to their reduced susceptibility to failure from localized heating; however, both types are commonly used. Many of the KILOVAC relays recommended for RF applications have pure copper contacts for better heat conduction and increased ratings. Because of this, relays in RF applications should normally not be switched under load as a catastrophic failure caused by melting of the relay contacts may occur. If you have an application which requires high frequency power switching, call TE at the numbers listed below.


\section*{Non-Power Switching Applications (Isolation Only) (Continued)}

Figure 2 shows the typical RF deratings that can be expected when specifying vacuum relays. Specific relay deratings are shown on the product pages. Figure 3 displays the relays recommended for RF applications.

Typical RF Derating For High Voltage Vacuum Relays


Figure 2.

Figure 3.
\begin{tabular}{|c|c|c|c|c|}
\hline Part Number & \[
\begin{aligned}
& \text { Rated Voltage } \\
& \text { (dc) } \\
& \hline
\end{aligned}
\] & \[
\begin{gathered}
\text { Current Carry @ } \\
32 \mathrm{MHz} \\
\hline
\end{gathered}
\] & Contact Form & See Page \\
\hline S06CBA335 & 2.0 kV & 6 Amps & A & 7-49 \\
\hline K45C & 2.0 kV & 6 Amps & C & 7-57 \\
\hline HC-1 & 3.5 kV & 7 Amps & C & 7-58 \\
\hline S06FNA218 & 5.0 kV & 8 Amps & A & 7-49 \\
\hline K41 Series & 5.0 kV & 12 Amps & A,B,C,P,R & 7-59, 7-60 \\
\hline K40P & 5.0 kV & 8 Amps & P & 7-61 \\
\hline S06HBA318 & 7.0 kV & 8 Amps & A & 7-49 \\
\hline S06JNB218 & 8.0 kV & 8 Amps & B & 7-49 \\
\hline K47 Series & 8.0 kV & 3 Amps & A, B & 7-63 \\
\hline K44P & 8.0 kV & 20 Amps & P & 7-66 \\
\hline H-18 & 8.0 kV & 2 Amps & 2 C & 7-65 \\
\hline K43 Series & 10.0 kV & 10 Amps & A,B,C,P,R & 7-69, 7-70 \\
\hline H-14 & 12.0 kV & 8 Amps & 2 C & 7-71 \\
\hline H-16 & 12.0 kV & 4 Amps & 2 C & 7-71 \\
\hline KC-2, KC-11 & 15.0 kV & 10 Amps & C & 7-74 \\
\hline H-26 & 15.0 kV & 4 Amps & 4C & 7-76 \\
\hline H-19 & 20.0 kV & 6 Amps & 2 C & 7-77 \\
\hline H-17 & 25.0 kV & 8 Amps & C & 7-77 \\
\hline KC-20, KC-30 & 25.0 kV & 30, 15 Amps & X, Y & 7-79 \\
\hline H-23, H-24 & 30.0 kV & 7 Amps & A,B & 7-81 \\
\hline
\end{tabular}

\section*{Power Switching Applications}

High voltage power switching applications are those which require the relay to make and/or break the load. In most applications, it is important to know the highest potential fault current which could be encountered and how many times the relay or contactor will be required to clear the fault since this will determine the relay or contactor which should be selected.
Load switching in AC circuits is sometimes easier on the relay due to the natural arc extinction which occurs as the current passes through zero. Because of this, relay ratings are usually much higher when switching AC circuit loads.


TE vacuum relays and contactors have been selected for a variety of high reliability space and undersea fiber applications.


Switching of direct current loads creates special problems for relays. Many traditional relays and contactors have difficulty interrupting loads above 48 Vdc. TE has a broad product line of relays, contactors, and power controllers which have been specially designed to handle the problems of DC switching. When load switching must be done at voltages above 1000 volts, refer to the power switching curve on the product data pages or the below graphs for relay families. For specific recommendations, call TE at the numbers listed below.
Higher current affects relay ratings more than higher voltage. There are no hard and fast rules which can be used to develop a relay's electrical life rating given voltage and current switching specifications. Once again, experience and thorough testing in the actual circuit are the best ways to establish relay life and reliability. Figure 4 illustrates the operating characteristic determined experimentally for one family of power switching products.

Figure 4. Typical Hot Switching Resistive load-Life Characteristics K41A, K43A, K81A Relays


Note: Life expectancy for SPDT relays is lower due to greater contact bounce

Reference

\section*{Power Switching Applications (Continued)}

\section*{Capacitive Discharge or "Make-Only" Power Switching}

One of the most common applications for high voltage relays is the charge and discharge of a high voltage capacitor. Since this normally involves "make-only" power switching, KILOVAC SF-6 gas-filled relays generally offer superior performance to vacuum relays. In order to select the proper relay, you must determine the peak current and RC time constant in addition to the normal parameters of voltage, contact configuration, etc. The RC time constant is the time it takes for the capacitor to discharge \(63 \%\) of its stored electrical charge. Virtually all electrical charge will be discharged in 5 RC time constants. The RC time constant is simply the product of the circuit resistance and capacitance. For example, a circuit discharging an 8 microFarad capacitor through 100 ohms of series resistance will have an RC time constant of 800 microseconds.

\section*{\((R \times C)=100 X .000008=.0008\) or \(\mathbf{8 0 0}\) microseconds}

It is often difficult to specify the proper relay for capacitive discharge applications because of the many potential variables. It is especially important in these applications to conduct tests to determine which relays are suitable and their reliability.

Figure 5 below is based on "rules of thumb" and actual circuit data. If your application differs significantly from those shown in the figure, contact your local Tyco Electronic sales engineer.

Figure 5. Recommended Relays for Capacitive Discharge Applications at Rated Voltage
\begin{tabular}{ccccccc}
\hline Part Number & \begin{tabular}{c} 
Rated \\
Voltage
\end{tabular} & \begin{tabular}{c} 
Contact \\
Form
\end{tabular} & \begin{tabular}{c} 
Peak Current \\
\(\mathbf{5 0 0} \mathbf{n s ~ R C ~ T i m e ~}\)
\end{tabular} & \begin{tabular}{c} 
Peak Current \\
\(\mathbf{5 0 0} \boldsymbol{\mu s}\) RC Time
\end{tabular} & \begin{tabular}{c} 
Peak Current \\
\(\mathbf{1 ~ m s ~ R C ~ T i m e ~}\)
\end{tabular} & \begin{tabular}{c} 
See \\
Page
\end{tabular} \\
\hline \(\mathrm{HC}-5\) & 3.5 kV & C & 50 A & 25 A & 5 A & \(7-58\) \\
\hline \(\mathrm{KM}-17\) & 5.5 kV & 2 C & 150 A & 75 A & 35 A & \(7-62\) \\
\hline \(\mathrm{HC}-6\) & 8.0 kV & C & 50 A & 25 A & 5 A & \(7-64\) \\
\hline \(\mathrm{KC}-15,16\) & 15.0 kV & C & 200 A & 100 A & 10 A & \(7-75\) \\
\hline KC-28, 38 & 25.0 kV & \(\mathrm{X}, \mathrm{Y}\) & 1500 A & 1000 A & 400 A & \(7-80\) \\
\hline K61 Series & 35.0 kV & \(\mathrm{A}, \mathrm{B}, \mathrm{C}\) & 500 A & 250 A & 125 A & \(7-82\) \\
\hline K64C & 50.0 kV & C & 400 A & 200 A & 100 A & \(7-85\) \\
\hline K70 Series & 70.0 kV & \(\mathrm{A}, \mathrm{B}, \mathrm{C}\) & 350 A & 175 A & 90 A & \(7-86\) \\
\hline
\end{tabular}

Note: Relay life can be expected to be in excess of 100,000 cycles at these load levels. This chart is intended to serve as a general guide only. We recommend you test the relay in your circuit to confirm its suitability.

\section*{Failure Modes in Capacitive Discharge Switching}

There are two possible failure modes in capacitive discharge switching: contact welding and shortened load life. Both are due to excessive contact heating from high peak currents and/ or long RC times. Therefore, we often recommend that customers either reduce the capacitance or increase the resistance of their circuit to improve relay performance.

\section*{Direct Current Power Switching}

Vacuum and hydrogen gas filled relays and contactors are being selected more and more often for use in direct current electrical systems. Switching a direct current load is one of the toughest tasks a relay can be asked to perform. Many times the relay or contactor will also be called upon to clear the maximum fault current, often several times higher than the normal load. Unlike AC power, where both voltage and current regularly pass through zero allowing the arc formed during switching to naturally extinguish, a DC load can only be interrupted by forcing the arc voltage higher than the source voltage. A number of schemes are commonly used to increase the arc voltage, ranging from arc chutes or multiple contacts to magnetic blowout, which lengthens the arc path.
The TE power switching relays are designed to interrupt rated power as supplied. However, reactive inductive loads can result in significant voltage overshoot in some applications. Voltage overshoot can be suppressed by a variety of measures.
Figure 6a, b, and c show three methods used to limit the voltage transient developed across the relay contacts when interrupting inductive loads. The same circuits impressed across the load will protect it from voltage overshoot:
- Figure 6a shows a Metal Oxide Varistor (MOV) across the power contacts. We recommends this circuit for most general purpose applications and suggests the user consult MOV manufacturers application notes since the proper MOV selection depends on transient energy, etc. MOV's are compact in size and low in cost.

Reference


TE offers a wide variety of relays and contactors for power switching applications.

\section*{Power Switching Applications (Continued)}
- Figure 6b indicates an MOV in series with an SVP (Surge Voltage Protector - spark gap). The MOV absorbs transient overshoot energy, the SOV provides excellent dielectric once the circuit is open. This solution is also compact in size and low cost.
- Figure 6c illustrates the traditional RC Snubber. The snubber will suffice for low power and energy situations, but suffers a size and cost penalty at high power.
KILOVAC vacuum, hydrogen and nitrogen gas-filled "super sealed" relays have some significant inherent advantages in switching high current DC loads. These include:
- Longer load life due to ability to use high temperature contact materials
- Low contact resistance due to the elimination of contact oxidation/contamination
- Lighter weight and smaller size due to smaller contacts and shorter contact gaps
- Low coil power due to optimized magnetic circuits and small size
- High integrity, durable ceramic to metal hermetic seals

Today, the TE products have been rated at 320 Vdc since this is the most common voltage being adopted by many new applications. However, the new products are versatile, encompassing a wide range of power, voltage, and current applications.
For detailed application notes on EV relays, contact TE to request a copy of the TE EVS-13 paper entitled, "Use of High Current Relays in Electric and Hybrid Electric Vehicles".

\section*{Double Throw Power Switching}

Double throw relays like the TE PD5C are used in a variety of "hot" or "power" switching applications, and they generally work fine. However, many application problems can be avoided by verifying that the relay was tested with the polarity and load conditions exactly like the application. In the aerospace industry, it is generally well known that switching un-synchronized AC loads is not recommended (see Figure 7a).
We found another application that took our experts some time to troubleshoot. This application required the charging and discharging of a capacitor. The double throw relay was used to switch a capacitor, which was in series with a resistor, between the plus and minus of the power source (see Figure 7b.).
But when the relay was used to discharge the capacitor, an arc occurred as the plus side of the load was interrupted, and an arc with full power system potential followed the moving contact to the minus side of the power source, thereby causing a short. To remedy the problem, the resistor was removed from the moving contact, and resistors were installed on both the plus and minus sides of the power source (see Figure 7c).
This reduced the current, and therefore eliminated the arc fault during contact transfer. TE tests all of our hot switching relays with the positive polarity on the common contact, unless otherwise requested. The application above, and others that may involve switching between two power sources, require special testing to confirm a workable circuit design.

\section*{270 Vdc Aerospace Relays, and Contactors}

With the need for more power, less weight and the desire to eliminate unreliable hydraulic systems, next generation military aircraft, ground, and sea vehicles have moved to 270 Vdc as the primary power. One of the reasons it has taken so long for 270 Vdc to be used in these systems is that there were no relays or circuit breakers that could handle this new higher dc voltage. We have solved this problem.
Since 1987, TE has invested substantial time and effort in developing products that can switch direct current 270 Vdc loads. Today TE has the largest selection of aerospace products available for these applications with load ratings from milliamps to 350A, continuous current carry to 800A, and overload rating to 3000A. These relays and contactors an be used at voltages ranging from 28 to 400 Vdc . These ratings have been extrapolated and plotted onto graphs which are shown on the individual product data sheets.
In addition, we have the resources necessary to work directly with you in developing a new product or modifying an existing product to meet your specific application's requirements. TE recommends that you contact your local sales engineer for specific rating informationfor higher voltage applications.

Dimensions are shown for reference purposes only. Specifications subject to change.

Dimensions are in millimeters unless otherwise specified.

\section*{Power Switching Applications \\ (Continued)}

Figure 8. Recommended Relays for D.C. Power Switching Aerospace Applications
\begin{tabular}{|c|c|c|c|c|c|}
\hline Part Number & Contact Form & Load Rating @ 270 Vdc & Continuous Current Carry & \begin{tabular}{l}
Overload Rating \\
@ 270 Vdc
\end{tabular} & See Page \\
\hline AP5 Series AP10 Series & \[
\begin{gathered}
\mathrm{A}, \mathrm{~B}, \mathrm{C}, \mathrm{P}, \mathrm{R} \\
\mathrm{~A}, \mathrm{~B}, \mathrm{P}
\end{gathered}
\] & \[
\begin{aligned}
& 5 \mathrm{~A} \\
& 10 \mathrm{~A}
\end{aligned}
\] & \[
\begin{aligned}
& 15 \mathrm{~A} \\
& 15 \mathrm{~A}
\end{aligned}
\] & \[
\begin{aligned}
& 20 \mathrm{~A} \\
& 20 \mathrm{~A}
\end{aligned}
\] & \[
\begin{aligned}
& 7-51-7-53 \\
& 7-51-7-53
\end{aligned}
\] \\
\hline AP44P & P & 15 A & 45 A & 60 A & 7-54 \\
\hline \begin{tabular}{l}
MAP 100 \\
CAP100 \\
EV100 \\
LEV100
\end{tabular} & X & 50 A & 50 A & 200 A & \[
\begin{gathered}
7-8,7-9 \\
7-18-7-20 \\
7-27,7-28 \\
7-29-7-31
\end{gathered}
\] \\
\hline \begin{tabular}{l}
MAP200
CAP200 \\
EV200 \\
LEV200
\end{tabular} & X & up to 350 A & 500 A & 1500 A & \[
\begin{gathered}
7-10,7-11 \\
7-16,7-17 \\
7-21-7-26 \\
7-32,7-33 \\
\hline
\end{gathered}
\] \\
\hline
\end{tabular}
*SPST-NO, latching version available, contact TE for more information.

\section*{270 Vdc Aerospace Relay and Contactor Reliability}

In order to allow customers to select the desired failure rate for TE's power switching devices, and determine the appropriate life rating and vice-versa, TE has created a series of curves showing the failure rate vs rated life. These curves have been generated using the results from Weibull analysis. The use of the Weibull distribution to predict product reliability from life test data has been shown to be an accurate and effective method when applied to TE' electromechanical devices. As an example, the following graph shows the hot switch life estimate for EV200 contactors:

Failure Rate vs. Rated Resistive Load Life at 90 A, 270 Vdc

*Failure rate letter designations per MIL-STD-690

\section*{Contact TE for more information on the following:}
- Reliability data for other 270 Vdc KILOVAC contactors and relays.
- Methodology using Weibull analysis; ask for TE Engineering Report No.415,
"Determination of Failure Rate Curve from Weibull Data".
- Correlation between Weibull analysis and traditional reliability methods; ask for TE Paper "Correlation Between Weibull Analysis and Traditional Reliability Methods".

\section*{270 Vdc Aerospace Remote Power Controllers (RPCs)}

The TE high voltage DC power contactors can be coupled with our custom designed CED1034 electronic control circuit to provide the remote power controller function. The controller performs the circuit protection function by monitoring the load current via a low resistance, precision temperature compensated resistor. An overload has priority over all control functions. The trip characteristic graphically illustrates the typical trip envelope with trip time as a function of overload current. The trip envelope can be tailored to meet specific customer requirements.

\section*{Test Equipment for Hartman Relays and Contactors}

\section*{VIBRATION TEST EQUIPMENT}

\section*{Vibration Control:}

Spectral Dynamics PUMA Vibration Control System; Auto/Manual operation; Sine, 1 - 5000Hz; Random, \(50-20,000 \mathrm{~Hz}\); Shock Pulse: half-sine, sawtooth, trapezoidal, rectangular; Accuracy: \(\pm 1 \mathrm{~dB}\) (with 120 Dof), calibration frequency: 6 months.

\section*{Power Amplifier:}

Unholtz-Dickie, model: TA-115, range: 16 KVA output power, calibration frequency: 6 months.

\section*{Shaker:}

Unholtz-Dickie, model: TC-205, 4,000 Ibs. pk. force sine 3,300 Ibs. force RDM 1 inch pk. stroke, frequency range \(5-3,000 \mathrm{~Hz}\).

\section*{Slip Table:}

Mitron.

\section*{Charge Amplifier:}

Unholtz-Dickie, model: D22PMJO, range: 1/10/100 mv/pk.g., 0-10 kHz., 0 to 1,000 g, accuracy: \(\pm 2 \%\), calibration frequency: 6 months, P/N- SN5103
\begin{tabular}{|c|c|}
\hline \multirow[t]{8}{*}{CHAMBERS} & Temperature Chamber: \\
\hline & Thermotron, model S-1.2, range \(-73^{\circ} \mathrm{C}\) to \(+175^{\circ} \mathrm{C}\) (3 units) \\
\hline & Temperature/Altitude Chamber: \\
\hline & Envirotronics, Model EA27-2-5-WC, temperature range: \(-68^{\circ} \mathrm{C}\) to \(+177^{\circ} \mathrm{C} \pm 1.1^{\circ} \mathrm{C}\), altitude range \(0-100,000\) feet. \\
\hline & Temperature Chamber: \\
\hline & Envirotronics, Model EVS \(37-2-30\), range \(-73^{\circ} \mathrm{C}\) to \(+177^{\circ} \mathrm{C}\) accuracy \(\pm 1.0^{\circ} \mathrm{C}\), calibration frequency 6 months; capable of \(30^{\circ} \mathrm{C} /\) minute maximum change rate. \\
\hline & Humidity/Temperature Chamber \\
\hline & Thermotron Model SM 5.5 C range \(-68^{\circ} \mathrm{C}\) to \(177^{\circ} \mathrm{C} \pm 1.1^{\circ} \mathrm{C}\), relative humidity \(20 \%\) to \(95 \%\), \(\pm 2.5 \% \mathrm{RH}\) \\
\hline \multirow[t]{4}{*}{GENERATORS} & AC Generator: \\
\hline & Ideal, \(300 \mathrm{KVA}, 3\) phase, 4 wire, 400 Hz ., 208/120 volts. \(415 / 240-450 / 260\) volts \\
\hline & AC Generator: \\
\hline & Kato Engineering, 30 KVA, 3 phase, 4 wire, 400 Hz ., 208/120 volts. \\
\hline
\end{tabular}

\section*{Other Capabilities:}

Voltage, Current and Power Sensing
Over and Reverse Current
Over and Under Voltage
Over and Under Frequency
Ground Fault and Detection
Phase Sequence, Unbalance and Failure Positive, Negative and Zero Sequence Voltage
Impedance Relays
Ripple Detection

Signal Amplification
Time Delay
Turbine Starting
Trip-Free, Electrical and Mechanical Interlocking
Electrical and Magnetic Latching
Polarization
Power Switching
\begin{tabular}{llll}
\hline Catalog 5-1773450-5 & \begin{tabular}{l} 
Dimensions are shown for \\
Revised \(3-13\)
\end{tabular} & \begin{tabular}{l} 
Dimensions are in millimeters
\end{tabular} & USA: +18005226752 \\
refence purposes only. \\
unless otherwise specified. & Asia Pacific: +8604008206015 \\
Specifications subject & & UK: +44800267666
\end{tabular}

For additional support numbers please visit www.te.com

\section*{Typical KILOVAC Relay Applications}

\section*{Predicting Reliability by Weibull Plotting}

TE uses Weibull plotting to predict product reliability. Weibull plotting is a simple and efficient way to predict reliability from a small number of life tests and it is widely used for this purpose. At least five and preferably seven or more samples are tested to failure. The cumulative percent failure is plotted against life on Weibull paper. The scales of Weibull paper are designed so the failure data of a wide variety of manufactured devices will tend to lie in a straight line. As the chart above shows, this data can then be interpreted to estimate the likelihood of failure at a given life. If you would like more information on this valuable technique, contact TE and request "Weibull Plotting," TE Engineering Report \#219.

\section*{PC Board Mount Relays}

TE' K81 series of relays offer designers the flexibility of printed circuit board mounting. High voltage relay connections are directly on the board or to high voltage flying leads. With a new rating of 10 kV and capable of carrying 10 amps , the K 81 series can serve a wide range of high voltage applications. Failsafe, latching, and SPDT versions are available and we will be happy to provide special terminations on request.
Figure 9 shows the predicted life of K81 series relays making and breaking a resistive load. Since circuit conditions vary widely, this information should be considered a general guide only. Please contact your TE sales engineer with your design requirements.

Figure 9. Typical Hot Switching Resistive Load-in Characteristics K41A, K43A, K81A Relays


Note: Life expectancy for SPDT relays is lower due to contact bounce

\section*{Typical KILOVAC Relay Applications (Continued)}

\section*{Test Equipment Applications}

Test equipment applications, by their very nature, tend to impose difficult requirements on relays. The overall criterion is for reliable, repeatable, and consistent results. Without this, no piece of test equipment can be considered usable.

TE relays have some special characteristics which contribute to their wide application in test equipment.
1. The relay contacts are in a controlled environment. Dust, humidity, or infrequent use will not affect the relay's performance.
2. KILOVAC vacuum relays have extremely low and stable contact resistance since oxides cannot form on the contacts. Even when load switching, contact resistance will vary within a very narrow range.
3. Since they are designed for high voltage isolation, KILOVAC relays offer extremely high insulation resistance and very low current leakage. This is an advantage in many switching matrices where these values must be kept as low and repeatable as possible.
TE high voltage relays are used in many in-house test equipment applications as well as OEM applications. For example:
- Hipot Testing
- Test Sets
- Motor/Generator Test Sets
- Cable Testing
- Capacitor Testing
- Electrostatic Discharge (ESD) Testing
- Relay Test Equipment
- Power Supply Test Equipment

\section*{High Insulation Resistance Applications}

Both vacuum and gas-filled relays are often used in applications, particularly test equipment, which require very high insulation resistance due to the sensitivity of the measurements being conducted. Standard KILOVAC relays often have sufficiently high insulation resistance for many applications and other KILOVAC relays can be modified to meet special insulation resistance requirements upon request. The chart below shows the typical insulation resistance of standard KILOVAC relays. If you have an application that requires a high insulation resistance relay, call TE at the numbers listed below and tell us of your requirement.

Figure 10. Recommended Relays for High Insulation Resistance Applications
\begin{tabular}{cccccccc}
\hline \multirow{2}{*}{\begin{tabular}{c} 
Part \\
Number
\end{tabular}} & \begin{tabular}{c} 
Rated \\
Voltage
\end{tabular} & \begin{tabular}{c} 
Contact \\
Form
\end{tabular} & & \multicolumn{2}{c}{\begin{tabular}{c} 
Contact to Case \\
Insulation Resistance* \\
@
\end{tabular}} & & \multicolumn{2}{c}{\begin{tabular}{c} 
Contact to Contact \\
Insulation Resistance*
\end{tabular}} \\
\hline HC-1 Series & 3.5 kV & C & \(9.5 \times 10^{13}\) & @ Rated Voltage
\end{tabular}
* Typical values; measured In ohms

Note: Measurement of insulation resistance requires strict control of the test environment. Contact TE for more information.
\begin{tabular}{llll}
\hline Catalog 5-1773450-5 & \begin{tabular}{l} 
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reference purposes only.
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www.te.com & Specifications subject & & UK: +44800267666 \\
to change. & &
\end{tabular}


PDU featuring bus bar mount 270 Vdc DC contactors.

\section*{Typical KILOVAC Relay Applications (Continued)}

\section*{Relays with Special Modifications and Power Distribution Units}

TE routinely develops KILOVAC relays with special modifications for customers. These modifications can include:
- contact arrangement
- operating voltage
- pickup or dropout voltage
- operate time
- mounting style or method
- coil voltage
- high voltage terminations
- coil terminations
- markings

\section*{Customized Lightweight Power Distribution Units}
- For primary and secondary power distribution
- Modular systems consist of various plug-in and bus bar line-replaceable modules (LRMs) installed on a panel mounting system or backplane
- LRMs may be contactors, circuit breakers, sensing units, ELCUs, etc.
- Backplanes, designed as a fault-free zone with no moving parts, are intended as a permanent installation on the mother vehicle
- Optional current/voltage sensing, fuses, circuit breakers, power monitors, etc.
- Weight-saving and space-saving designs reduce OEM labor requirements and easy maintenance
- Optional integration of generator control units and logic control units

In addition, TE can take a standard relay or several relays and package them to your specifications. By packaging components and subassemblies with the relays, as demonstrated in Figure 16, the handling and installation of the product during manufacturing and field service can be greatly simplified. In this case, four high frequency inductive filters and special quick-connect cable assemblies of the correct length have been assembled with the relay. Then the whole assembly has been encapsulated for ease of handling and mounting.
Contact the TE sales engineer in your area to review your special requirements and establish a special part number which identifies your relay's unique characteristics.

\section*{Relay Application Notes}

A number of modifications can be made to KILOVAC relays so they will operate faster than the catalog specifications, consume less power, and function reliably at elevated temperatures. In addition, high voltage relay users should be familiar with high voltage processing techniques, high voltage connectors available by special order, and when to be concerned about radiation exposure. The following chapter covers these topics, and more.

\section*{Improving Relay Operate Time}

There are a number of methods which can be used to substantially improve relay operate time over the standard specification. Operate times of one millisecond or less can sometimes be achieved.
Our definition of operate time is "the interval between the application of the nominal coil voltage and closing of all normally open contacts (or opening of all normally closed contacts)." This includes:
1. Time for the coil to build up the magnetic field.
2. Transfer time of the moveable contact.
3. Bounce time after the initial make or break.

Operate time is basically a function of the coil power and inductance. More than half of the switching time is necessary simply to build up the coil field, thus; the basic scheme for reducing operate time is to apply more voltage to the coil. This can be accomplished by overdriving the coil with a higher than nominal voltage directly from your supply. To prevent overheating, the coil voltage should be reduced to the nominal value shortly after the relay operates or a resistor equal to or greater in value than the coil resistance should be placed in series with the coil to keep total power applied at the specified level (See Figure 11). Doubling the nominal voltage and adding an external resistor equal to the coil resistance can reduce the operate time up to roughly \(40 \%\).

Figure 11. Over Voltage Method of Reducing Operate Time


Figure 12. Recommended Relays for Fast Switching Applications
\begin{tabular}{cccccc}
\hline Part Number & \begin{tabular}{c} 
Rated \\
Voltage
\end{tabular} & \begin{tabular}{c} 
Contact \\
Form
\end{tabular} & \begin{tabular}{c} 
Operate Time \\
Specifications \\
(Typical Time)
\end{tabular} & \begin{tabular}{c} 
Operate Time \\
with "Hot Shot" \\
Circuit*
\end{tabular} & \begin{tabular}{c} 
See \\
Page
\end{tabular} \\
\hline HC-1, HC-3 & 3.5 kV & C & \(6(2.5)\) & 2.0 & \(7-58\) \\
\hline K 41 P & 5.0 kV & P & \(6(2.7)\) & 2.3 & \(7-60\) \\
\hline K 40 P & 5.0 kV & P & \(1(0.75)\) & 0.6 & \(7-61\) \\
\hline K 44 P & 8.0 kV & P & \(5(2.5)\) & 2.2 & \(7-66\) \\
\hline \(\mathrm{HC}-2,4,6\) & 8.0 kV & C & \(6(2.5)\) & 2.0 & \(7-64\) \\
\hline K 43 P & 10.0 kV & P & \(5(3.0)\) & 2.9 & \(7-70\) \\
\hline
\end{tabular}
*Time is in milliseconds.
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Revised 3-13 & \begin{tabular}{l} 
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\end{tabular}

\section*{Relay Application Notes (Continued)}

\section*{Calculating Pull-in and Drop-out Voltages at High or Low Temperatures}

Most of our specifications are for a \(25^{\circ} \mathrm{C}\) ambient temperature. However, a well known phenomena of electrical circuits is the rise in resistance of a current path as temperature is increased. The temperature rise may be caused by current flow or by changes in ambient temperature, but the effect in either case is increased resistance. Therefore, you can expect coil resistance, pull-in, and drop-out values to change over the operating temperature range of the relay.

Figure 13. Change in Pull-In Voltage Over Temperature


The coil resistance \(\left(R_{t}\right)\) after a specific temperature rise \((\Delta T)\) is calculated using the formula:
\[
\mathrm{R}_{\mathrm{t}}=\mathrm{R}_{25^{\circ} \mathrm{C}}(1+.003853 \Delta \mathrm{~T})
\]
where:
\[
\begin{aligned}
& \mathbf{R}_{\mathbf{t}}=\text { New resistance at elevated temperature } \\
& \mathbf{R}_{\mathbf{2 5}}{ }^{\circ} \mathbf{C}=\text { Coil resistance at room temperature }\left(25^{\circ} \mathrm{C}\right) \\
& \Delta \mathbf{T}=\text { Rise in temperature from } 25^{\circ} \mathrm{C}
\end{aligned}
\]

Pick-up voltage varies directly with the change in coil resistance caused by a change in temperature. The basis for this is Ohms Law:
\[
E / I=R
\]

Since a relay coil is a current-driven device, as the coil resistance varies with temperature, so must the pick-up voltage ( \(I=V / R\) ). Thus, the same formula we used above to calculate the change in resistance with a change in temperature can be used to calculate pick-up voltage by substituting pick-up voltage for resistance. For example, assume that you have selected a relay that has a maximum pick-up voltage of 16 Vdc at \(25^{\circ} \mathrm{C}\), a standard value for a relay with a 26.5 Vdc coil, and you want to operate it in a \(85^{\circ} \mathrm{C}\) environment. Using the formula, we find:
\[
\mathrm{V}_{\mathrm{t}}=16 \mathrm{Vdc}\left(1+.003853 \times 60^{\circ} \mathrm{C}\right)=19.7 \mathrm{Vdc}
\]

If the ambient temperature is raised to \(100^{\circ} \mathrm{C}\), the new pick-up voltage will be:
\[
V_{t}=16 \mathrm{Vdc}(1+.003853 \times 75)=20.6 \mathrm{Vdc}
\]

If the power supply you are using is rated at 20 Vdc , the relay would operate in an \(85^{\circ} \mathrm{C}\) environment but not in a \(100^{\circ} \mathrm{C}\) environment.
This same formula works for a decrease in temperature. For instance, at \(-25^{\circ} \mathrm{C}\) the pick-up voltage will drop to 12.9 Vdc , as follows:
\[
V_{t}=16 \mathrm{Vdc}(1+.003853 \mathrm{X}-50)=12.9 \mathrm{Vdc}
\]

If you want your circuit to operate properly over its entire temperature range, it is essential that you make the necessary calculations to ensure that the available voltage exceeds the temperature-adjusted relay specification.

16-14
\begin{tabular}{ll} 
Catalog 5-1773450-5 & \begin{tabular}{l} 
Dimensions are shown for \\
reference purposes only.
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\section*{Relay Application Notes (Continued)}

\section*{Suppressing Relay Coil Transients}

When a 28 Vdc relay coil is turned off, the inductive energy stored in it can create surge voltages to 1500 volts on a DC power line. With the increased use of solid state devices which are sensitive to spikes, relay coils must be suppressed to limit voltage spikes to a maximum of 50 to 80 volts.
The measure of successful coil suppression depends on the degree to which the method affects the operation of the relay. Improper or excessive suppression can cause the relay to suffer from a long release time, slow contact transfer, and contact bounce on break. All of these conditions will increase contact arcing when load switching, which will reduce relay life dramatically.
There are a number of common ways for a relay user to suppress relay coil transients and each has advantages and disadvantages. However, the most widely used methods utilize zener-diode and/or zener-zener combinations. These combinations are compact, provide excellent suppression, and do not affect relay release-time or contact life. Figure 14 illustrates some of the more common configurations.

Figure 14. Comparison of Relay Coil Transient-Suppression Methods
\begin{tabular}{|c|c|c|c|c|c|c|c|c|c|}
\hline & Suppression Device & Increase Over Standard Cost & Space Problem & Polarization Requirement & \[
\begin{aligned}
& \text { Possible } \\
& \text { Temperature } \\
& \text { Problems }
\end{aligned}
\] & Line-Surge Sensitive & Effect on Release Transfer Time \& Bounce Before Complete Break & Effect on Relay Power & Relay Life Reduction \\
\hline  & Bifilar Coil & Great & Great & No & None & No & Considerable & Considerable Reduction & Considerable \\
\hline " & Resistor & Minor & Reasonable & No & Yes & No & Considerable & None & Considerable \\
\hline  & Varistor & Minor & Reasonable & No & None & No & Minor & None & Minor \\
\hline  & Resistor Capacitor & Reasonable & Great & No & Yes & No & Considerable & None & Considerable \\
\hline I & Diode & Minor & Minor & Yes & Yes & Yes & Excessive & None & Excessive \\
\hline 需 & Zener-Diode & Reasonable & Minor & Yes & Yes & Yes & Negligible & None & Negligible \\
\hline \(\ldots\) & Zener-Zener* & Reasonable & Minor & No & Yes & Yes & Negligible & None & Negligible \\
\hline
\end{tabular}
*Recommended Method

\section*{Radiation Exposure at High Voltage; Is it A Problem?}

High voltage vacuum relays, like any high voltage component, can potentially produce hazardous X-rays when operated above 15 kV . However, KILOVAC gas-filled high voltage relays can be operated safely at very high voltages without any concern for X-rays. Gasfilled relays cannot produce X -rays because the electrons collide with the gas molecules and are unable to accumulate sufficient energy to make significant radiation.
Many KILOVAC relays rated for use above 15 kV are gas-filled relays and, whenever possible, we recommend you use one of these. If a vacuum relay must be used, then it, or the equipment it's in, should be shielded with lead which is at least .062 inches thick. If shielding is not possible, then appropriate warnings of the potential for X-ray exposure must be posted and a radiation monitoring program implemented. Contact your local health agency for more information.

\section*{Relay Application Notes (Continued)}

\section*{Power Conservation Schemes}

Quite often in space, aircraft, or battery operated applications it is important to minimize relay power consumption either to conserve power or to minimize heating. TE offers three ways to help you reduce the power which must be dedicated to supply the relays.
1. Use a latching relay. Latching relays need only to be pulsed to switch. Power can be removed and the relay will maintain its latched position. If a normally open or normally closed relay must be used, TE has developed a custom hybrid circuit which allows a latching relay to function as a non-latching relay.
2. If a latching relay is not available for your application, TE may be able to incorporate an "energy conserving" circuit in your relay package. This circuit regulates the power provided to the coil, providing full power during relay operation and providing a reduced power level which is adequate for holding the relay contacts in position at other times. An energy conserving circuit such as this must be custom designed for each application and each model relay. Contact the your local TE sales engineer for more information.
3. For failsafe contactors, TE offers electronic economizers for reducing coil power once the contacts are closed. These schemes result in more energetic activation, smaller size contactors, and substantially reduced coil temperature rise.

\section*{High Voltage Processing of Vacuum Relays}

Although the shelf life of vacuum relays is typically many years, occasionally a relay will show signs of "gassiness" after a relatively short period of non-use. A trace of gas released from its adsorbed state on the internal surface of the relay is usually responsible. Fortunately, this trace can normally be eliminated by the use of the high voltage processing procedure de-scribed below. The need for such processing can be readily determined by a simple, high voltage test just before installing the component in a system, which is good practice for any high voltage component. It is not necessary to high voltage process gas-filled relays.

\section*{High Voltage Process Procedure}
1. Connect a variable high voltage AC or DC power supply in series with a 10 megohm resister, a micrometer, and the relay (with the relay on the ground side of the power supply).

SPST-NO relay: Process between open contacts.
SPST-NC relay: Ground the base, energize the coil, and process between open contacts.
SPDT relay: Connect the base and the NO terminal together, ground the base, and process between open contacts with the coil energized and de-energized.
DPDT relay: Process each set of contacts in the same manner suggested for a SPDT relay.
2. Immerse the relay in a dielectric fluid for processing. Transformer oil can be used but FLUORINERT FC-77 is cleaner since it evaporates quickly from the relay surface.
3. Raise the voltage slowly. If the peak voltage is made equal to the maximum specified test voltage and less than 5 microamps of current is drawn at this level (or no glow is visible in a darkened room), then the vacuum is "hard" and no further processing is necessary.
4. If a glow occurs at a lower than maximum specified test voltage, hold the voltage just above the glow initiation level until the glow disappears; raise the voltage again to the onset of glow, or until the maximum specified test voltage is reached. If a DC supply is used, reverse the polarity and repeat the process.
5. Processing at levels up to \(20 \%\) above the maximum specified test voltage may be done. Typical processing times range from one minute to several minutes for very high voltage relays.
WARNING: X-rays are produced during high voltage processing at voltages above 15 kV . See page 16-15 in this catalog for information on the precautions you should take when operating vacuum relays above 15 kV .

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\begin{tabular}{|c|c|c|c|c|}
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Catalog 5-1773450-5 Revised 3-13 \\
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\end{tabular} & Dimensions are shown for reference purposes only. Specifications subject to change. & Dimensions are in millimeters unless otherwise specified. & \begin{tabular}{l}
USA: +1 8005226752 \\
Asia Pacific: +8604008206015 UK: +44 800267666
\end{tabular} & For additional support numbers please visit www.te.com \\
\hline
\end{tabular}

\section*{Common KILOVAC High Voltage Relay Designs}

\section*{Hinged Armature Design}

This traditional design approach provides high mechanical reliability and is adaptable to a number of contact configurations. The contact is actuated by the movement of the spring-loaded armature when the coil is energized. The coil assembly is external to the vacuum package and readily replaceable.

\section*{Diaphragm Design}

This simple, low-cost design approach makes use of a thin molybdenum diaphragm which allows contact movement to be transferred into the vacuum package from the external motor assembly. This basic design is used in a large number of Kilovac products.

\section*{Solenoid Design}

When high current loads must be interrupted, the solenoid design provides the force necessary to separate large contacts quickly. It also provides high contact holding force to keep contact resistance low. These attributes make this design the choice for high current DC load switching relays and contactors.

 to change.

\section*{Definition of Specifications}

\section*{Bounce Time}

The time interval between when the contact first makes, and when the last contact make occurs.

Coil Hi Pot
The minimum voltage which the relay coil terminals will isolate when the relay is properly mounted.

\section*{Coil Resistance}

The DC resistance, in ohms, of the coil at \(25^{\circ} \mathrm{C}\).
Contact Arrangement
Contact arrangements of relays may be one or a combination of the following:
single pole single throw (SPST)
single pole double throw (SPDT)
double pole single throw (DPST)
double pole double throw (DPDT)
3 pole single throw (3PST)
3 pole double throw (3PDT)
four pole double throw (4PDT)

\section*{Contact Capacitance}

Contact capacitance is measured either between open contacts or between contacts and ground. Measurements are made per MIL-STD-202, Method 305, at 1 kHz .

\section*{Contact Form}

The contact form of relays may be one or a combination of the following (see page 16-20):

> Form A: SPST - Normally Open
> Form 3A: 3PST - Normally Open
> Form B: SPST - Normally Closed
> Form C: SPDT
> Form 2C: DPDT
> Form 3C: 3PDT
> Form 4C: 4PDT
> Form K: SPDT Center Off
> Form P: SPST - Latching
> Form R: SPDT - Latching
> Form 3R: 3PDT - Latching
> Form X: SPST-NO-Double Make
> Form Y: SPST-NC-Double Break
> Form Z: SPST NO and SPST NC Double Break/Make
> Form ZZ: DPST NO and DPST NC Double Break/Make

\section*{Contact Resistance}

In vacuum relays, the resistance of closed contacts is measured as voltage drop across contacts carrying 1 amp at 6 Vdc . Measurement is made in accordance with MIL-R-83725, SAE ARD 50031, or MIL-R-6016. In gasfilled relays, 1 amp at 28 Vdc is used to measure contact resistance. "Kelvin" connections should be used to obtain accurate readings.

\section*{Contact Voltage Drop}

Contact voltage drop is typically measured with the contacts carrying rated current. Measurements are made at the external terminals of the circuit being tested.

\section*{Continuous Current}

The maximum current that can be carried by the closed contacts of the relay for a sustained time period through the specified operating temperature range.

\section*{Dielectric Strength}

The maximum allowable Ac rms voltage ( 50 or 60 Hz ) which may be applied between two test points, such as the coil and case or current carrying and non-current carrying points, without a leakage current in excess of 1 milliamp.

\section*{Drop-out Voltage}

The voltage at which all contacts return to their "normal", unoperated positions. (Applicable only to non-latching relays.) Unless otherwise noted, maximum drop-out voltage is specified during a continuous current test with a hot coil at maximum temperature. Minimum drop-out voltage is done at minimum temperature.

\section*{Insulation Resistance}

The minimum allowable DC resistance between two test points, such as the relay contacts and the coil, or contacts and case at a specified voltage, usually 500 Vdc.

\section*{Hold Voltage}

The lowest voltage that can be applied without any change in state of the contacts from their energized position. This is just above the maximum drop-out voltage.

\section*{Leakage Current}

The rms current conducted by the output circuit of the relay at maximum rated voltage with the contacts open.

\section*{Load Life}

The minimum number of cycles the relay will make, carry, and break the specified load without contact sticking or welding, and without exceeding the electrical specifications of the device. Load life is verified through qualification testing.

\section*{Load Life, Rated Resistive}

The voltage and current encountered by the contacts when opening and/or closing. To be considered a resistive load, the inductance in the test circuit shall not exceed an L/R ratio of \(1 \times 10^{-4}\). Load ratings are established using various methods including Weibull analysis.

\section*{Mechanical Life}

This is the number of operations which a relay can be expected to perform while maintaining mechanical integrity. Mechanical life is normally tested with no load or voltage applied to the power contacts and is verified through qualification testing.
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\end{tabular}

\section*{Definition of Specifications (Continued)}

\section*{Operating Temperature Range}

The ambient temperature range over which an unmounted relay is specified to operate.

\section*{Operate Time}

The time interval between the coil energization (nominal coil voltage) and the closing of the normally open contacts. This includes time for the coil to build up its magnetic field (a significant limiting factor) and transfer time of the moveable contact between stationary contact(s), and bounce time after the initial contact make. All KILOVAC relays, except "AP" and "PD" power switching products include bounce time.

\section*{Graphic Representation of Operate Time}


\section*{Overload}

The maximum current the relay can make and break for the specified number of operations at the maximum system voltage without contact welding, sticking, or blowing of a 1 amp fuse connected between the case and load system ground.

\section*{Pick-Up Voltage}

The voltage at which normally open contacts close and/or normally closed contacts open. Pick-up voltage increases as coil temperature rises. Unless otherwise specified, pick-up voltage is specified during a continuous current test with a hot coil at maximum temperature.

\section*{Release Time}

The time interval between de-energizing of the coil and the relay returning to normal de-energized position.

\section*{Shock}

Shock tests determine what acceleration a relay can sustain without normally closed contacts opening or normally open contacts closing. The shock pulse is typically an 11 millisecond, \(1 / 2\) sine pulse. Contacts are monitored for chatter in excess of 10 microseconds and no transfer.

\section*{Vibration}

The maximum acceleration over the frequency range which the relay can withstand without impairing operation or causing contact chatter of more than 10 microseconds or contact transfer.
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Asia Pacific: +8604008206015 \\
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\end{tabular}

For additional support numbers please visit www.te.com Specifications subject to change.

\section*{Contact Configurations}
\begin{tabular}{|c|c|c|c|c|}
\hline Form A & Form 3A & Form B & Form C & Form 2C \\
\hline \[
\begin{gathered}
\text { SPST-NO } \\
\text { (make) }
\end{gathered}
\] & 3PST-NO & \[
\begin{aligned}
& \text { SPST-NC } \\
& \text { (break) }
\end{aligned}
\] & \[
\begin{gathered}
\text { SPDT } \\
\text { (break-make) }
\end{gathered}
\] & \[
\begin{gathered}
\text { DPDT } \\
\text { (break-make) }
\end{gathered}
\] \\
\hline  &  &  &  &  \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|}
\hline Form 3C & Form 4C & Form K & Form P & Form R \\
\hline 3PDT & \[
\begin{gathered}
\text { 4PDT } \\
\text { (break-make) }
\end{gathered}
\] & SPDT-CO & SPST-Latching & SPDT-Latching \\
\hline  &  &  & (LASt eneraized) & (LAST ENERGIZED) \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|}
\hline Form 3R & Form X & Form Y & Form Z & Form ZZ \\
\hline 3PDT-Latching & \begin{tabular}{c} 
SPST-NO \\
(double-make)
\end{tabular} & \begin{tabular}{c} 
SPST-NC \\
(double-break)
\end{tabular} & \begin{tabular}{c} 
SPST-NO \& SPST-NC \\
(double-break/make)
\end{tabular} & \begin{tabular}{c} 
DPST-NO \& DPST-NC \\
(double-break/make)
\end{tabular} \\
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\end{tabular}

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\hline Catalog 5-1773450-5 & Dimensions are shown for & Dimensions are in millimeters & USA: +1 8005226752 \\
\hline Revised 3-13 & reference purposes only. Specifications subject & unless otherwise specified. & Asia Pacific: +86 04008206015 UK. +44 800267666 \\
\hline ww.te.com & Specifications subject & & \\
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\section*{Engineering Notes}

\section*{Product Information Center: Relay Technical Support}
\begin{tabular}{|c|c|c|}
\hline United States & China & Germany \\
\hline 800-522-6752 & +86 400-820-6015 & +49 6151-607-1999 \\
\hline \multicolumn{3}{|l|}{Kilovac/Wilmar Products (800-253-4560)} \\
\hline \multirow[t]{2}{*}{Hartman Products (419-521-9500)} & Denmark & Italy \\
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\hline \multicolumn{3}{|l|}{Belgium} \\
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[^0]:    * The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15.

[^1]:    Dimensions are in millimeters unless otherwise specified.

[^2]:    *Values listed are factory test and inspection values. User should allow for meter variations.
    $\dagger$ Applicable over the operating temperature range in circulating air.

[^3]:    *Values listed are factory test and inspection values. User should allow for meter variations.
    $\dagger$ Applicable over the operating temperature range in circulating air.

[^4]:    * The part number example shown on this page is for catalog items. For a list of specific QPL part numbers, please see the index in Section 15.

[^5]:    Catalog 5-1773450-5
    Revised 3-13 to change.

[^6]:    For factory-direct application assistance, dial 800-253-4560, ext. 2055, or 805-220-2055.

[^7]:    For factory-direct application assistance,
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