Intelligent power switches (IPS)

Power & Analog program

European Multi System Market Competence Center
Intelligent Power Switches (IPS)
Monolithic Fully Protected Power Stage and Control

- Designed for Harsh Environment (-40°C .. +150°C)
- Capability to drive any kind of Load
- Exhaustive Diagnostics

9V < IPS voltage range < 36V
I.P.S. Application Fields

- Programmable Logic Controller
- Peripheral I/O
- Textile Machines
- Alarm and Security Systems
- Vending Machines
- Robotic
- Industrial Automation
Intelligent power switch: features

- Under-voltage and Over-voltage Protection
- Loss of ground Protection
- Open Load detection
- Short circuit and Over current Protection
- Over-temperature Protection
- I.P.S.
- ESD Protected
- IEC 61131-2 Compliant
- Fast Demagnetization
I.P.S. versus Relays Benefits

1. Compactness: Space Saving
2. No Contacts: No Wear-out !?
3. Protections and Diagnostics: On Chip

Very High Reliability !
Competitive Prices !
• This feature is present in all VNXXX part numbers and in some L637X part numbers
This feature is present in our part numbers L6370 / L6377/TDE17XXX
Features: Short-circuit & Over temperature

These features are present in our VNXXX part numbers.
FEATURES: Fast Demagnetization

Vin

Vcc

Vout

Iout

INDUCTIVE LOAD

Logic

Undervoltage detection

Vcc-Vout Clamp

Current Lim.

Junction Temp Detection

Case Temp Detection

GND
Features: Open load detection ON state

- This feature is present in our part numbers L6370, L6375, TDE189X
Features: Short to Vcc detection

This feature is present in our part numbers L6370, L6375, TDE189X
Features: Open Load detection in OFF state

This feature is present in our part number VNI2140J
Features: Under-voltage detection

- This feature is present in our part numbers L6370, L6375, TDE189X
Features: Diagnostic

● Open Drain Diagnostic
  Wired OR is allowed.
  All VNXXX devices, except VN808 family L637X, TDE189X, TDE1707, TDE1708

● Open Source Diagnostic
  VN808 family, L6370, L6375, TDE179X, TDE1707, TDE1708
EMC compliant

**IEC 61000-4-2:** ESD Test = 2000V at Human Body Model condition;

**IEC 61000-4-4:** Burst Test (capacitive signal coupled into the control/diag wires);

**IEC 61000-4-5:** Surge Test (2KV high current signal applied to output, GND and Vcc pins, at 24V and 0.5A load);

**IEC 61000-4-6:** Current Injection Test (sweep signal applied to the output: 10VDC, 150KHz < f < 80MHz, length = 2.3s, 1kHz AM);

**IEC 61131-2:** Programmable controllers-equipments requirements and tests.
Features: EMC Compliance

- IEC 61000-4-4 Burst test  Input/Output ports & Power supply lines (with external transil diode)

- IEC 61000-4-5 Surge test  Output ports & Power supply lines (with 10nF capacitor on output pins)

- IEC 61000-4-6 Conducted disturbances  Input/Output ports & Power supply lines
Three different technologies

- **VIPower™**
- **MultiPower BCD**
- **Bipolar**
I.P.S. & Proximity Detectors Portfolio

VIPower
- VNI2140J(*)
- VN330SP
- VN340SP
- VNI4140K
- Quad HSS 200mΩ PSO10
- VN808/CM/SR
- VNI8200XP(*)
- Octal HSS 160mΩ PSO36
- NEW Octal HSS+SPI 110mΩ PSS024
- Quad HSS 270mΩ SO28/PSO36

MultiPower
- BCD
- Single HSS 0.5A SO20/DIP8/SO8
- L6377
- L6376
- L6375
- Single HSS 0.5A Full Diagnostic PSO20
- VN540
- Single HSS 60mΩ PSO10/PWATT
- VNQ860
- Proximity detectors SO-8/SO20
- Quad HSS 0.5A DIP20/P-SO20
- L6370
- Single HSS 60mΩ SO14/PSO20
- Quad HSS 200mΩ PSS024
- Single HSS 0.5A Full Diagnostic SO20/DIP8

Bipolar
- TDE1707
- TDE1717
- TDE1737
- TDE1798
- TDE1776
- TDE0160
- TDA0161
- New!
- Single HSS 0.5A Full Diag. DIP8/PS020
- Single HSS 0.5A Full Diag. DIP8/SO14
- Single HSS 0.5A SO14/DIP8
- HSS/LSS 0.3/0.5A for proximity sensors SO8/DFN8L 4X4
- Single LSS 0.5A SO14/DIP8

(*) in Development
VN751: high side driver

- Thermal shut-down
- Shorted load protection
- Undervoltage and overvoltage shut-down
- Loss of ground protection
- Compliant to IEC 61000-4-4 (up to 4kV)
- C-MOS compatible input
- Voltage clamping,

<table>
<thead>
<tr>
<th>Part number</th>
<th>I_{out} [A]</th>
<th>V_{cl} [V]</th>
<th>R_{DS(on)} [mΩ]</th>
<th>Package</th>
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<tbody>
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<td>VN751PT</td>
<td>2.5</td>
<td>41</td>
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<td>PPAK</td>
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<tr>
<td>VN751S</td>
<td>2.5</td>
<td>41</td>
<td>60</td>
<td>SO-8</td>
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</table>
VN330 / 340 Key Features

- Vcc up to 36 V
- Output current up to 0.7 A
- Common open drain diagnostic output
- Over temperature protection
- Protection against loss of ground
- Shorted load protection
- Under voltage protection
- VN340SP single channel diag.
Product Features

• $R_{\text{dson}} = 80\text{mOhm} @ 25^\circ\text{C}, 140\text{mOhm} @ 125^\circ\text{C}$
• $I_q = 4.8\text{mA}$
• NEW !!! OUTPUT CURRENT : 1,0A PER CHANNEL WHY?
• (IEC1132 upgrade requires)
  • twice Inominal for 10msec and
  • 120% Inominal continuously
• CURRENT LIMITATION @ TYPICAL 1.35A
• OPEN LOAD DIAGNOSTIC
• VCC 45V
• TWO INDEPENDENT DIAG OUT
• SHORTED LOAD PROTECTIONS
• JUNCTION OVER-TEMPERATURE PROTECTION
• CASE OVERTEMPERATURE PROTECTION
• THERMAL INDEPENDENCE OF THE CHANNELS
• PROTECTION AGAINST LOSS OF GROUND
• UNDervoltage SHUT-DOWN
• OPEN DRAIN DIAGNOSTIC OUTPUTS
• 3.3V CMOS/TTL COMPATIBLE INPUTS
• FAST DEMAGNETIZATION OF INDUCTIVE LOADS
• Exposed slug design for optimized thermal performances
• CONFORM TO IEC 61131-2

Extended Vcc range: 9 to 45V
- **DIAG pin**
  - Provides only the over temperature indication
  - The short circuit is not indicated
Features: No simultaneous restart in Over temperature

- Undervoltage detection
- Current Limit
- Vcc-Vout Clamp
- Junction Temp Detection
- Open Load Detection

Vdiag

Iout over time (100µS)

Iout

t

Vcc

IN 1
IN 2
Diag 1
Diag 2
Logic

Case Temp Detection

Output

GND
Ordercode: STEVAL-IFP010V1

**STEVAL-IFP010V1 has proven its functionality under the EMC test criteria**

- IEC61000-4-5 voltage surge class 3 ±2KV @ 42Ohm generator impedance
- IEC61000-4-4 transient burst immunity ± 3kV peak voltage, 5kHz
- IEC61000-4-6 Conducted disturbances Input/Output ports & Power supply lines
VNI4140 Key Features

- **Rdson**
  - 80mohm @ 25°C,
  - 140mohm @ 125°C

- **I_{out} = 0.7A PER CHANNEL**

- **I_{LIM} 1.1A**

- **PROTECTIONS**
  - SHORTED LOAD
  - JUNCTION OVER-TEMPERATURE
  - CASE OVERTEMPERATURE PROTECTION
  - LOSS OF GROUND
  - UNDEVROLTAGE SHUT-DOWN

- **CONFORMS TO IEC 61131-2**
- **FOUR INDIPENDENT DIAG OUT PROTECTION**
- **THERMAL INDEPENDENCE OF THE CHANNELS**
- **OPEN DRAIN DIAGNOSTIC OUTPUTS**
- **3.3V CMOS/TTL COMPATIBLE INPUTS**
- **FAST DEMAGNETIZATION OF INDUCTIVE LOADS**
### Power dissipation decrease -42.5%

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<th>Parameter</th>
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<th>VNI4140K</th>
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<tr>
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<td>#Ch/on</td>
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<tr>
<td>Total</td>
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</table>
VNI4140K – Normal operation

**Inputs:**
- Vin
- Vdiag

**Outputs:**
- Vout
- Iout

**Key Components:**
- Logic
- Undervoltage detection
- Vcc-Vout Clamp
- Current Lim.
- Junction Temp Detection
- Case Temp Detection
- Output

**Specifications:**
- 0.7A Ilim min

**Legend:**
- LOAD
- GND
Features: Paralleling the Outputs

- Paralleling the Outputs
- Vcc
- +
- LOAD
- 0.7A I_{lim\_min}
- 1.4A I_{lim\_min}
- 2.1A I_{lim\_min}
- 2.8A I_{lim\_min}

- 2 Channels in Parallel
- 3 Channels in Parallel
- 4 Channels in Parallel

4 Channels in Parallel
2.8A I_{lim\_min}
Features: No simultaneous restart in Over temperature
**VNI4140 - Short Circuit Operation**

**DIAG pin**
- Provides only the overtemperature indication
- The short circuit itself is not indicated
Filter for bus inductance effect, make supply voltage stable and avoid undervoltage shut down

EMC Filter

Protection for IEC 61000-4-5
Surge test suggested SM15Txxx

Optional protection for Vcc disconnection.

\[ Vcc = 24V \]

Protection against IEC 61000-4-6
Current injection Test

PROTECTIONS INCLUDED IN THE DEVICE:
IEC 61000-4-2  ESD Test better than 2000V Human body model
IEC 61000-4-4 Burst Test

Order code:
STEVAL-IFP006V1
VN808 150mΩ Octal HSD

**Features**
- High-power capability PowerSO-36;
- \( V_{cc}/2 \) compatible inputs;
- Junction over-temperature protection;
- Case over-temperature protection for thermal independence of the channel;
- Current limitation;
- Shorted load protection;
- Under-voltage shutdown;
- Protection against loss of ground;
- Very low stand-by current;
- Compliance with 6100-4-4 IEC test up to 4.4kV.

**VN808 Electrical Characteristics**

<table>
<thead>
<tr>
<th>( V_{CC} ) [V]</th>
<th>( V_{DSS} ) [V]</th>
<th>( R_{DS(on)} ) [mΩ]</th>
<th>( I_{OUT} ) [A]</th>
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<tr>
<td>10.5 to 36</td>
<td>41</td>
<td>8 x 150</td>
<td>0.7</td>
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</table>

APPNOTE 2208

*Designing Industrial Applications with VN808/VN340SP High-side Drivers*
Features
- CMOS compatible inputs
- Junction over-temperature protection
- Case over-temperature protection for thermal independence of the channels
- Current limitation
- Shorted load protection
- Under-voltage shutdown
- Protection against loss of ground
- Very low stand-by current
- PowerSO-36 package, high power capability
- Compliance with 6100-4-4 IEC test up to 4.4kV

VN808CM Electrical Characteristics

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<tr>
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<td>$V_{IL}$</td>
<td>1.25 V</td>
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<td>$V_{IH}$</td>
<td>2.25 V</td>
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<tr>
<td>$R_{DS(on)}$</td>
<td>8 x 0.150 Ω</td>
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<tr>
<td>$I_{OUT}$</td>
<td>0.7 A</td>
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</table>

VN808CM in a typical application
VNI8200XP – EIGHT CHANNELS
Serial/Parallel Selectable Interface

- Serial/Parallel Selectable Interface
- PowerSSO-36
- SPI
- Logic
- DC/DC Converter
- Undervoltage detection
- Vcc-Vout Clamp
- Current Limit.
- Junction Temp Detection
- Case Temp Detection
- Vcc Clamp
- Junction Temp Detection
- LED Driving
- SPI/PAR
- Output
- Vcc
- PHASE
- BOOT
- Vreg
- SDI/IN8
- SS/IN7
- SCK/IN6
- SDO/IN5
- WD/IN4
- OUT_EN/IN3
- WD_EN/IN2
- SEL1/IN1
- PowerSSO-36
Advantages of BCD Technology

- Possibility to design precise analogue circuits like current mirrors, references etc.
- Precise current programmability.
- Full logic capability, ability to use CMOS components in the driver area to achieve low quiescent current.
- The Power DMOS stage can be designed in high, low side and in bridge configuration on the same chip.
- 2-bit high end diagnostic features
L6370/L6375: Single HSS 2.5A/0.5 A

- 2.5A/0.5A OUTPUT CURRENT
- 50V MAX. $V_S$ VOLTAGE
- THERMAL SHUTDOWN
- OPEN GROUND PROTECTION
- INTERNAL NEGATIVE VOLTAGE CLAMPING TO $V_S$ - 50V FOR FAST DEMAGNETIZATION
L6376D: Quad HSS 0.5A

- 9.5 TO 35 V SUPPLY VOLTAGE RANGE
- INTERNAL CURRENT LIMIT
- THERMAL SHUTDOWN
- UNDER VOLTAGE LOCKOUT WITH HYSTERESIS
- DIAGNOSTIC OUTPUT FOR UNDER VOLTAGE, OVER TEMPERATURE AND OVER CURRENT
- EXTERNAL ASYNCHRONOUS RESET INPUT
- PRESETTABLE DELAY FOR OVERCURRENT DIAGNOSTIC
- OPEN GROUND PROTECTION
L6374D: Quad Line Driver 100mA

- Four independent line drivers with 100 mA up to 35V outputs
- Input signals between -7V and +35V
- Current limiting
- Voltage clamping
- Overtemperature and undervoltage protections
- Diagnostic for overtemperature, undervoltage and overcurrent
- Presettable delay for overcurrent diagnostic
- High speed operation up to 300kHz
VIPower technology
### VIPOWER technology IPS spectrum

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<th>Type</th>
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<th>Rds(on)</th>
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TOOLS: Reference Boards

VN340SP
Order code: STEVAL-IFP003V1

VN808
Order code: STEVAL-IFP002V1

VN808CM
Order code: STEVAL-IFP001V1

VN751PT
Order code: STEVAL-IFP005V1

VNI4140K
Order code: STEVAL-IFP006V1

VNI2140J
Order code: STEVAL-IFP010V1
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Complete list: www.st.com -> Support -> Evaluation Boards