

August 2015

New Products Catalog

High Performance Analog ICs



LTC4040 2.5A Battery Backup Power Manager

LTC2348-18 Octal, 18-Bit, 200ksps Differential $\pm 10.24\text{V}$ Input
SoftSpan ADC with Wide Input Common Mode Range

LTM4622 Dual Ultrathin 2.5A Step-Down DC/DC μ Module Regulator

LT8330 Low I_q Boost/SEPIC/Inverting Converter with 1A, 60V Switch

LT8616 Dual 42V Synchronous Monolithic Step-Down Regulator with
6.5 μA Quiescent Current

LTC2984 Multi-Sensor High Accuracy Digital Temperature
Measurement System with EEPROM

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Design Note

DN541 Micropower Op Amp Drives 8-Channel 18-Bit Simultaneous Sampling ADC without Compromising Accuracy or Breaking the Power Budget

LTC4015 Multichemistry Buck Battery Charger Controller with Digital Telemetry System

FEATURES

- Multichemistry Li-Ion/Polymer, LiFePO₄, or Lead-Acid Battery Charger with Termination
- High Efficiency Synchronous Buck Battery Charger
- Digital Telemetry System Monitors V_{BAT}, I_{BAT}, R_{BAT}, NTC Ratio (Battery Temperature), V_{IN}, I_{IN}, V_{SYSTEM}, Die Temperature
- Coulomb Counter and Integrated 14-Bit ADC
- Wide Charging Input Voltage Range: 4.5V to 35V
- Wide Battery Voltage Range: Up to 35V
- Input Undervoltage Charge Current Limit Loop
- Maximum Power Point Tracking
- Optional I²C Serial Port Control
- Input Current Limit Prioritizes System Load Output
- Input and Output Ideal Diodes Provide Low Loss PowerPath™ Operation
- Instant-On Operation with Discharged Battery

APPLICATIONS

- Portable Medical Instruments/Military Equipment
- Industrial Handhelds/Lighting
- Ruggedized Notebook/Tablet Computers

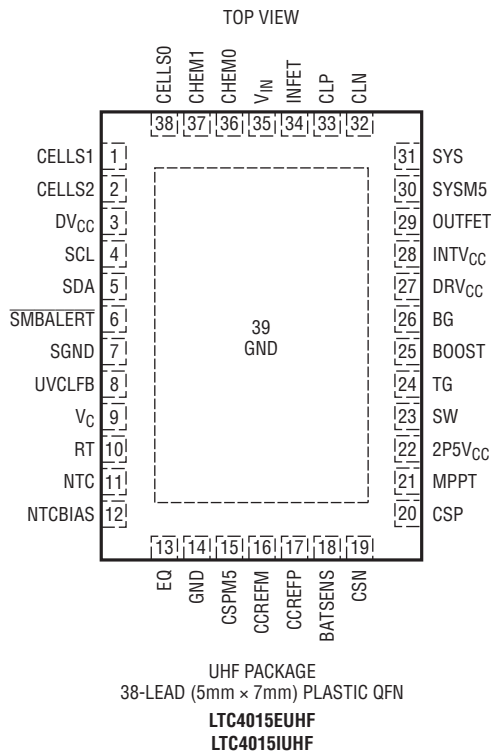
DESCRIPTION

The LTC4015 is a complete synchronous buck controller/charger with pin selectable, chemistry specific charging and termination algorithms.

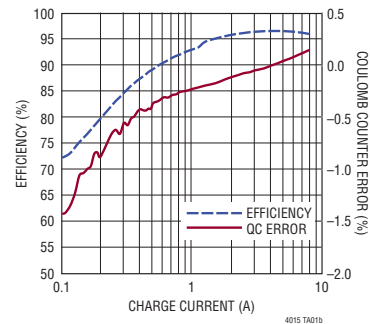
The LTC4015 can charge Li-Ion/Polymer, LiFePO₄, or lead-acid batteries. Battery charge voltage is pin selectable and I²C adjustable. Input current limit and charge current can be accurately programmed with sense resistors and can be individually adjusted via the I²C serial port. A digital telemetry system monitors all system power parameters.

Safety timer and current termination algorithms are supported for lithium chemistry batteries. The LTC4015 also includes automatic recharge, precharge (Li-Ion) and NTC thermistor protection. The LTC4015's I²C port allows user customization of charger algorithms, reading of charger status information, configuration of the maskable and programmable alerts, plus use and configuration of the Coulomb counter.

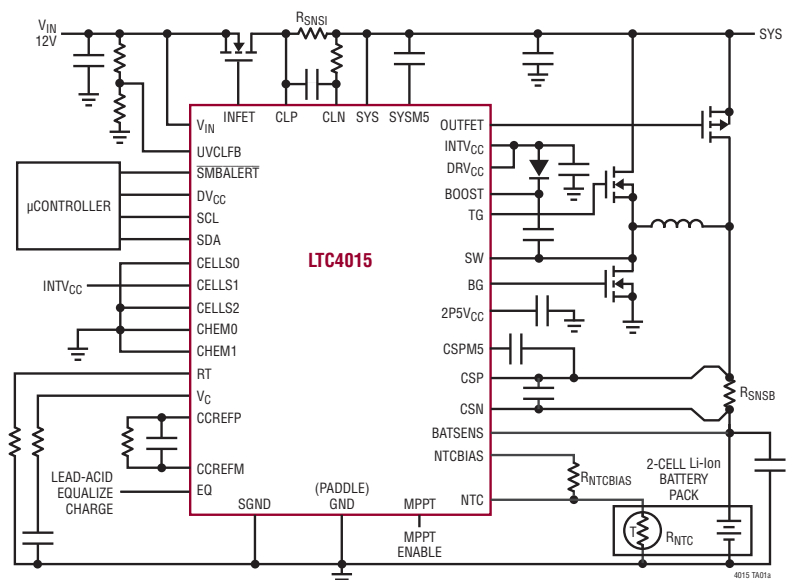
Available in a 38-lead 5mm × 7mm QFN package.



Step-Down Charger Efficiency and Coulomb Counter Error vs Battery Charge Current



12V_{IN} 2-Cell Li-Ion 8A Step-Down Battery Charger Controller



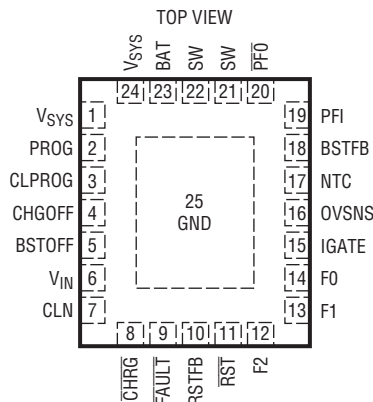
LTC4040 2.5A Battery Backup Power Manager

FEATURES

- Step-Up Backup Supply and Step-Down Battery Charger
- 6.5A Switches for 2.5A Backup from 3.2V Battery
- Input Current Limit Prioritizes Load Over Charge Current
- Input Disconnect Switch Isolates Input During Backup
- Automatic Seamless Switch-Over to Backup Mode
- Input Power Loss Indicator
- System Power Loss Indicator
- Pin Selectable Battery: Li-Ion (3.95V/4.0V/4.05V/4.1V) or LiFePO₄ (3.45V/3.5V/3.55V/3.6V)
- Optional OVP Circuitry Protects Device to >60V
- Constant Frequency Operation
- Low Profile (0.75mm) 24-Lead 4mm × 5mm QFN Package

APPLICATIONS

- Fleet and Asset Tracking
- Automotive GPS Data Loggers
- Automotive Telematics Systems
- Toll Collection Systems
- Security Systems
- USB Powered Devices



UFD PACKAGE
24-LEAD (4mm × 5mm) PLASTIC QFN
LTC4040EUFD
LTC4040IUFD

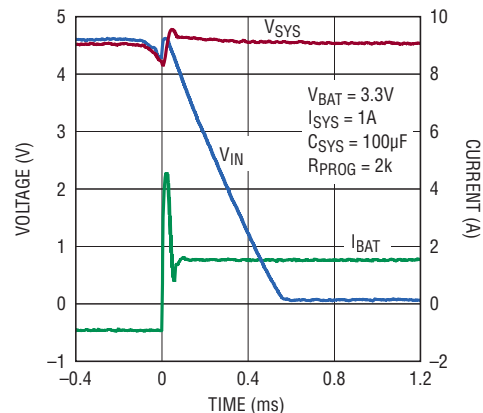
DESCRIPTION

The LTC4040 is a complete 3.5V to 5.5V supply rail battery backup system. It contains a high current step-up DC/DC regulator to back up the supply from a single-cell Li-Ion or LiFePO₄ battery. When external power is available, the step-up regulator operates in reverse as a step-down battery charger.

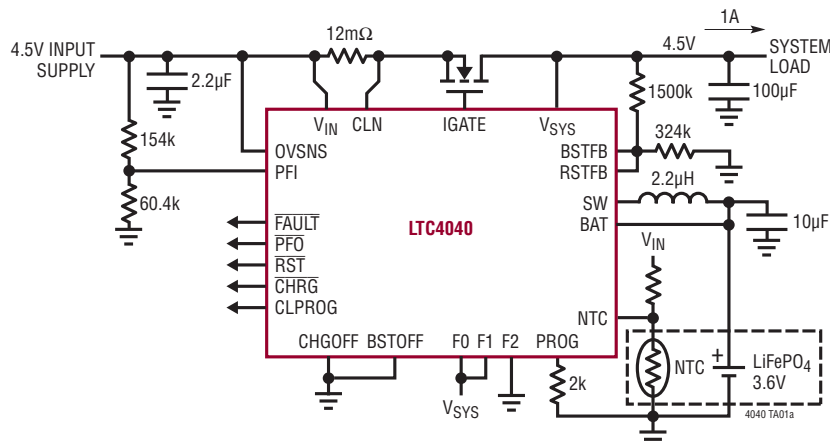
The LTC4040's adjustable input current limit function reduces charge current to protect the main supply from overload while an external disconnect switch isolates the external supply during backup. When the input supply drops below the adjustable PFI threshold, the 2.5A boost regulator delivers power from the battery to the system output.

An optional input overvoltage protection (OVP) circuit protects the LTC4040 from high voltage damage at the V_{IN} pin. One logic input selects either the Li-Ion or the LiFePO₄ battery option, and two other logic inputs program the battery charge voltage to one of four levels suitable for backup applications. The LTC4040 is available in a low profile (0.75mm) 24-lead 4mm × 5mm QFN package.

Normal to Backup Mode Transition Waveform



4.5V Backup Application with 4.22V PFI Threshold (Charge Current Setting: 1A, Input Current Limit Setting: 2A)



LTC2000A

16-/14-/11-Bit 2.7GspS DACs

FEATURES

- 80dBc SFDR at 50MHz f_{OUT}
- >68dBc SFDR from DC to 1080MHz f_{OUT}
- 40mA Nominal Full-Scale, $\pm 1V$ Output Compliant
- 10mA to 60mA Adjustable Full-Scale Current Range
- Single or Dual Port DDR LVDS and DHSTL Interface
- Low Latency (7.5 Cycles for Single Port, 11 Cycles for Dual Port)
- >78dBc 2-Tone IMD from DC to 1000MHz f_{OUT}
- 156dBc/Hz Additive Phase Noise at 1MHz Offset for 65MHz f_{OUT}
- 170-Lead (9mm \times 15mm) BGA Package

APPLICATIONS

- Broadband Communication Systems
- DOCSIS CMTS
- Direct RF Synthesis
- Radar
- Instrumentation
- Automatic Test Equipment

DESCRIPTION

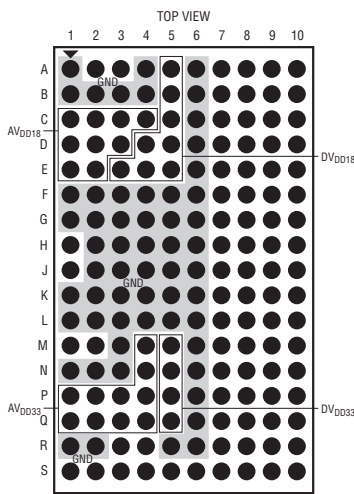
The LTC2000A is a family of 16-/14-/11-bit 2.7GspS current steering DACs with exceptional spectral purity.

The single (1.35GspS mode) or dual (2.7GspS mode) port source synchronous LVDS interface supports data rates of up to 1.35Gbps using a 675MHz DDR data clock, which can be either in quadrature or in phase with the data. An internal synchronizer automatically aligns the data with the DAC sample clock.

Additional features such as pattern generation, LVDS loopout and junction temperature sensing simplify system development and testing.

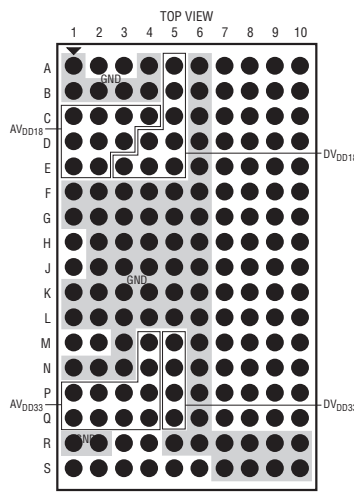
A serial peripheral interface (SPI) port allows configuration and read back of internal registers. Operating from 1.86V and 3.3V supplies, the LTC2000A consumes 2.41W at 2.7GspS and 1.43W at 1.35GspS.

LTC2000A-16



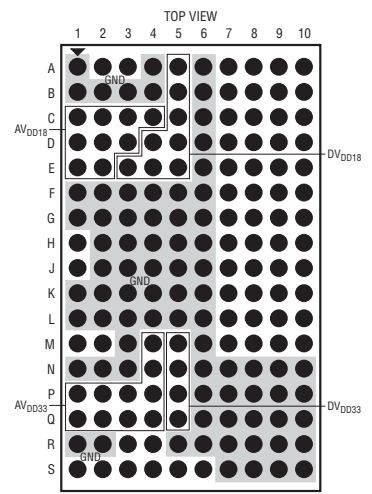
BGA PACKAGE
170-LEAD (9mm \times 15mm \times 1.54mm)
LTC2000ACY-16
LTC2000AIY-16

LTC2000A-14



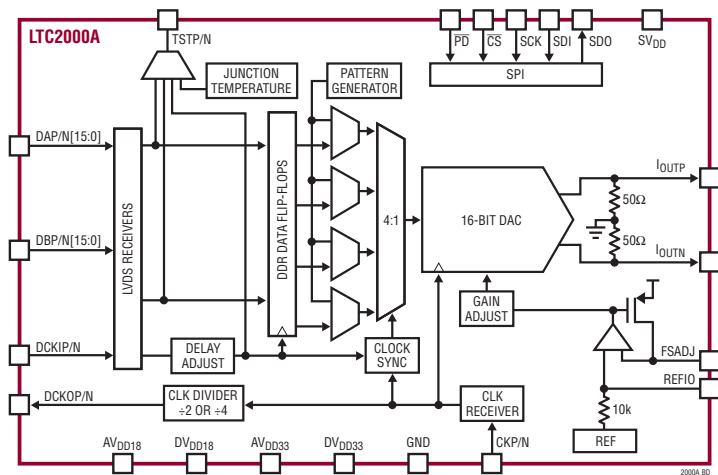
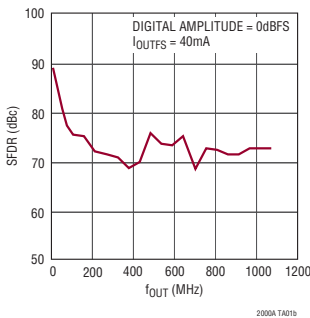
BGA PACKAGE
170-LEAD (9mm \times 15mm \times 1.54mm)
LTC2000ACY-14
LTC2000AIY-14

LTC2000A-11

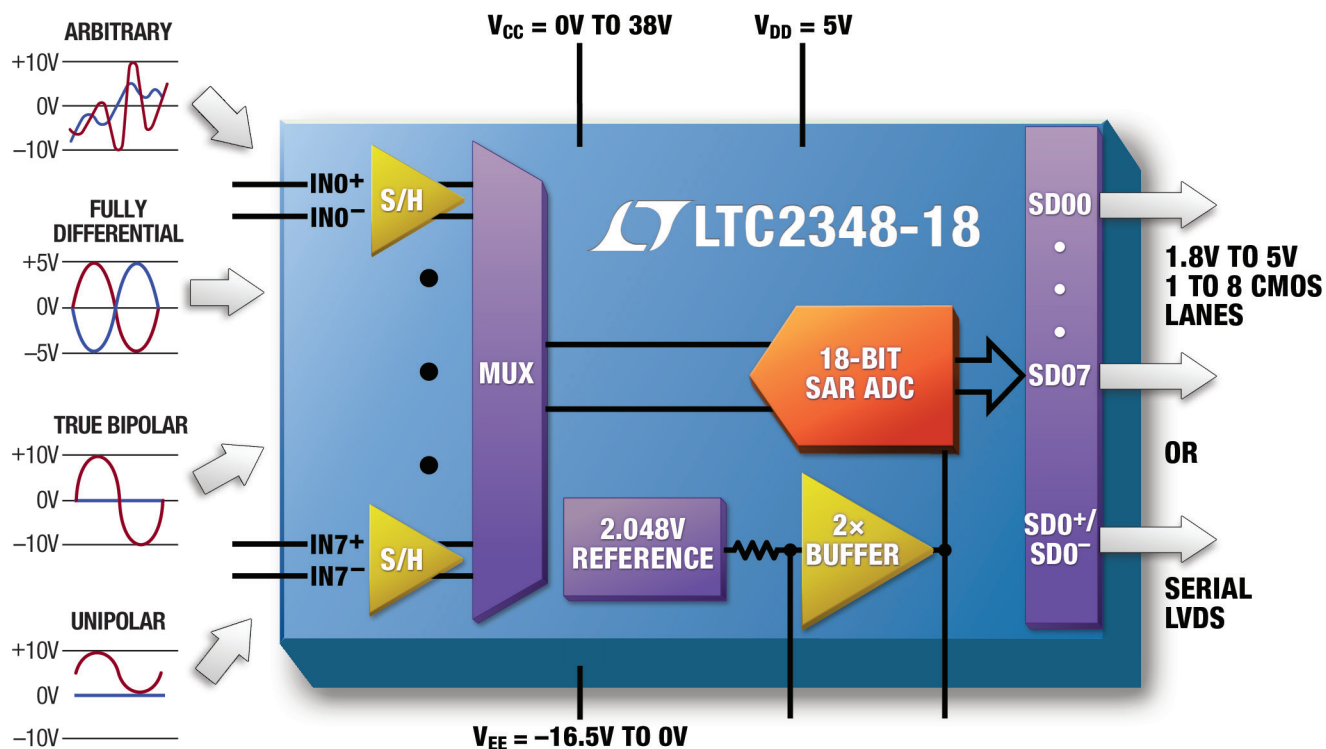


BGA PACKAGE
170-LEAD (9mm \times 15mm \times 1.54mm)
LTC2000ACY-11
LTC2000AIY-11

SFDR vs f_{OUT} , $f_{DAC} = 2.7GspS$



18-Bit Simultaneous Sampling ADC with $\pm 10.24\text{V}$ SoftSpan Inputs



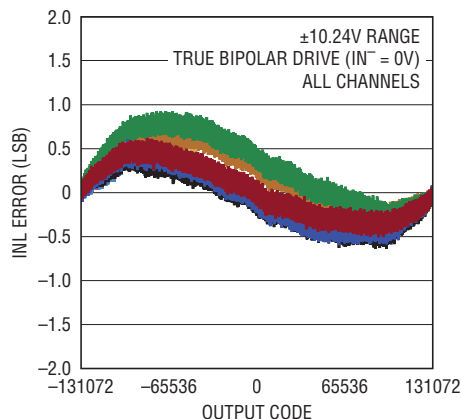
Octal ADC Offers Unprecedented Performance and Flexibility

The LTC[®]2348-18 offers the ultimate blend of high performance and flexibility. Eight differential SoftSpan[™] input channels are independently configurable on a conversion-by-conversion basis to accept different voltage ranges and input types, over a wide input common range from -16.5V to 34V . Furthermore, the high voltage supplies can be individually biased anywhere within the specified operating range to enable application-specific common mode input ranges for maximum design flexibility.

Features

- 200ksps per Channel Throughput
- Eight Simultaneous Sampling Channels
- $\pm 3\text{LSB}$ INL Maximum
- Guaranteed 18-Bit, No Missing Codes
- Differential, Wide Common Mode Range Inputs
- Per-Channel SoftSpan Input Ranges:
 - $\pm 10.24\text{V}$, 0V to 10.24V , $\pm 5.12\text{V}$, 0V to 5.12V
- 96.7dB Single-Conversion SNR
- -109dB THD and Crosstalk, 118dB CMRR
- Integrated Reference and Buffer
- SPI CMOS (1.8V to 5V) and LVDS Serial I/O
- 140mW Power Dissipation (Typical)
- 48-Lead (7mm \times 7mm) LQFP Package

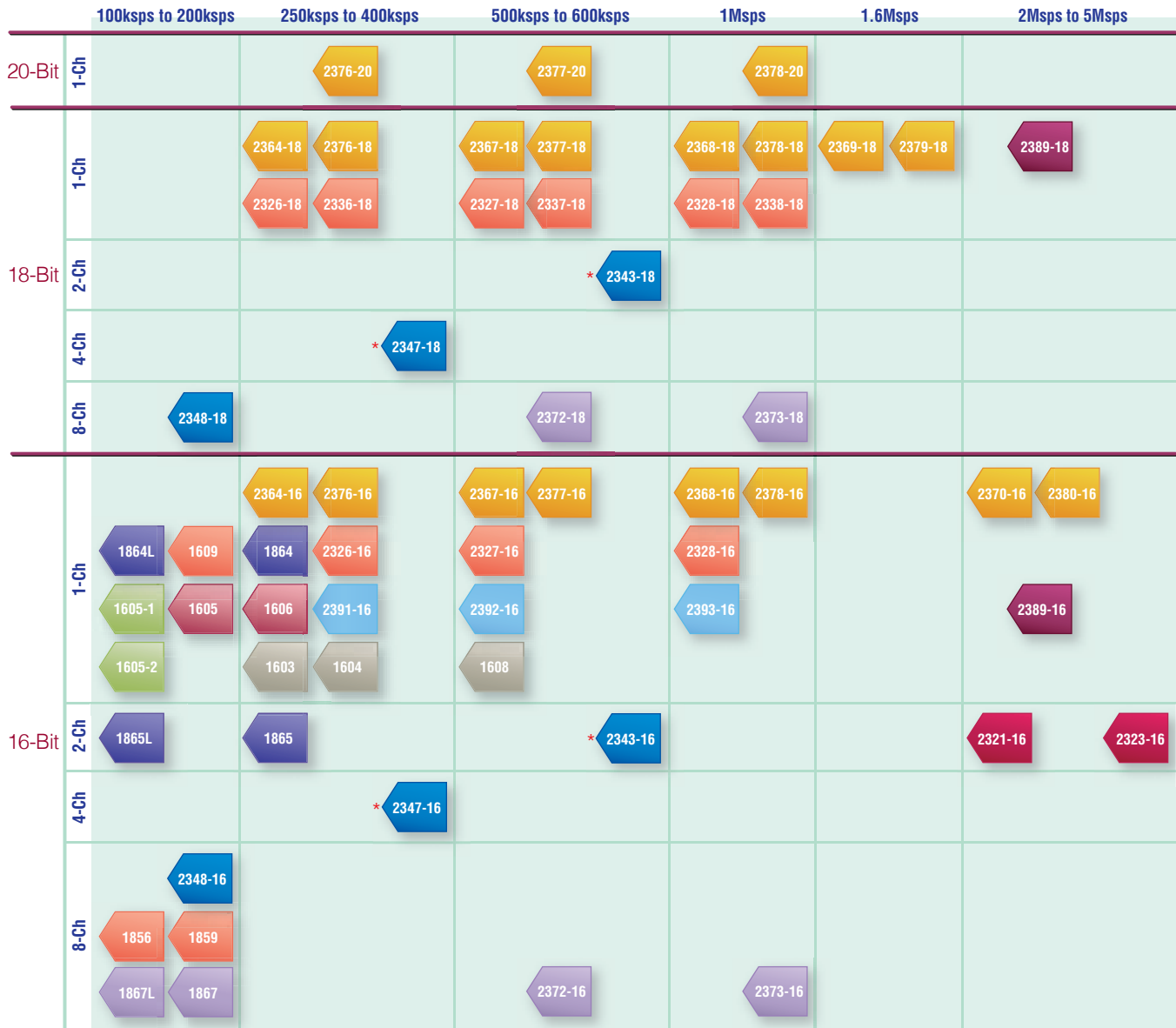
Integral Nonlinearity vs Output Code and Channel









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High Precision SAR ADCs



16-Bit to 20-Bit Resolution, 100ksps Up to 5Msps



Serial

-  Pseudo- or Fully Differential Pin-Compatible ADCs
-  ±10V True Bipolar Inputs
-  8-Channel MUX'd Input ADCs
-  3V/5V Supply µPower ADCs
-  3.3V/5V Supply Simultaneous Sampling ADCs
-  ±10V SoftSpan Simultaneous Sampling ADCs

Serial/Parallel

-  Pseudo- or Fully Differential Pin-Compatible ADCs
-  Fully Differential Pin-Compatible ADCs

Parallel

-  ±10V True Bipolar Inputs
-  0V to 4V, ±4V Unipolar/True Bipolar Inputs
-  ±2.5V True Bipolar Inputs

* Future Product

LTC2348-18

Octal, 18-Bit, 200ksps Differential $\pm 10.24V$ Input SoftSpan ADC with Wide Input Common Mode Range

FEATURES

- 200ksps per Channel Throughput
- Eight Simultaneous Sampling Channels
- $\pm 3\text{LSB}$ INL (Maximum, $\pm 10.24V$ Range)
- Guaranteed 18-Bit, No Missing Codes
- Differential, Wide Common Mode Range Inputs
- Per-Channel SoftSpan Input Ranges: $\pm 10.24V$, $0V$ to $10.24V$, $\pm 5.12V$, $0V$ to $5.12V$
- 96.7dB Single-Conversion SNR (Typical)
- -109dB THD (Typical) at $f_{IN} = 2\text{kHz}$
- 118dB CMRR (Typical) at $f_{IN} = 200\text{Hz}$
- Rail-to-Rail Input Overdrive Tolerance
- Guaranteed Operation to 125°C
- Integrated Reference and Buffer (4.096V)
- 2.5V to 5V External Reference Input Range
- SPI CMOS (1.8V to 5V) and LVDS Serial I/O
- Internal Conversion Clock, No Cycle Latency
- 140mW Power Dissipation (Typical)
- 48-Lead (7mm \times 7mm) LQFP Package

APPLICATIONS

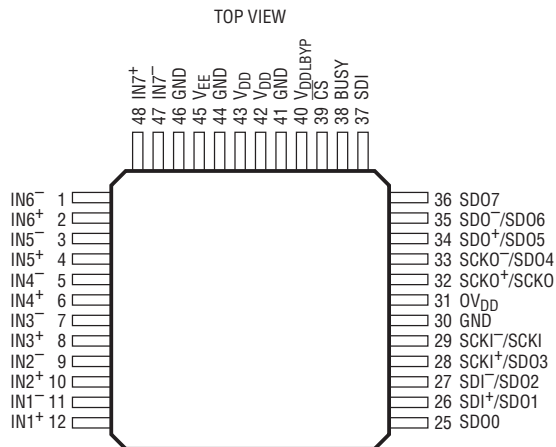
- Programmable Logic Controllers
- Industrial Process Control
- Power Line Monitoring
- Test and Measurement

DESCRIPTION

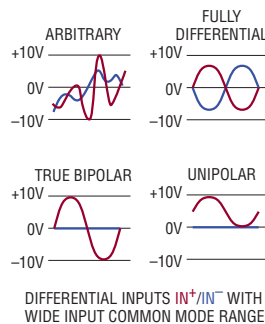
The LTC2348-18 is an 18-bit, low noise 8-channel simultaneous sampling successive approximation register (SAR) ADC with differential, wide common mode range inputs. Operating from a 5V low voltage supply, flexible high voltage supplies, and using the internal reference and buffer, each channel of this SoftSpan ADC can be independently configured on a conversion-by-conversion basis to accept $\pm 10.24V$, $0V$ to $10.24V$, $\pm 5.12V$, or $0V$ to $5.12V$ signals. Individual channels may also be disabled to increase throughput on the remaining channels.

The wide input common mode range and 118dB CMRR of the LTC2348-18 analog inputs allow the ADC to directly digitize a variety of signals, simplifying signal chain design. This input signal flexibility, combined with $\pm 3\text{LSB}$ INL, no missing codes at 18 bits, and 96.7dB SNR, makes the LTC2348-18 an ideal choice for many high voltage applications requiring wide dynamic range.

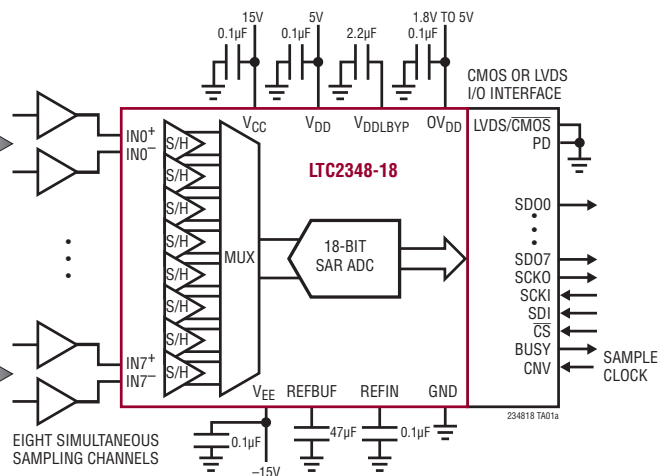
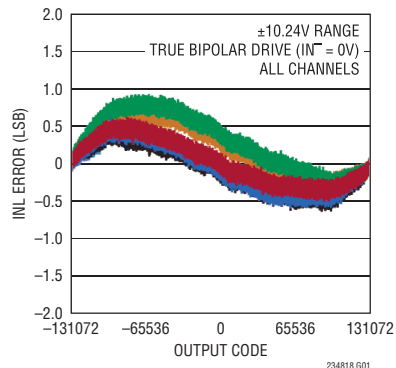
The LTC2348-18 supports pin-selectable SPI CMOS (1.8V to 5V) and LVDS serial interfaces. Between one and eight lanes of data output may be employed in CMOS mode, allowing the user to optimize bus width and throughput.



LX PACKAGE
48-LEAD (7mm \times 7mm) PLASTIC
LTC2348CLX-18
LTC2348ILX-18
LTC2348HLX-18



Integral Nonlinearity vs Output Code and Channel



LTC2372-16

16-Bit, 500ksps, 8-Channel SAR ADC with 96dB SNR

FEATURES

- 500ksps Throughput Rate
- 16-Bit Resolution with No Missing Codes
- 8-Channel Multiplexer with Selectable Input Range
 - Fully Differential ($\pm 4.096V$)
 - Pseudo-Differential Unipolar (0V to 4.096V)
 - Pseudo-Differential Bipolar ($\pm 2.048V$)
- INL: $\pm 1LSB$ (Maximum)
- SNR: 96dB (Fully Differential)/93.5dB (Pseudo-Differential) (Typical) at $f_{IN} = 1kHz$
- THD: $-110dB$ (Typical) at $f_{IN} = 1kHz$
- Programmable Sequencer
- Selectable Digital Gain Compression
- Single 5V Supply with 1.8V to 5V I/O Voltages
- SPI-Compatible Serial I/O
- Onboard 2.048V Reference and Reference Buffer
- No Pipeline Delay, No Cycle Latency
- Power Dissipation 27mW (Typical)
- Guaranteed Operation to 125°C
- 32-Lead 5mm x 5mm QFN Package

APPLICATIONS

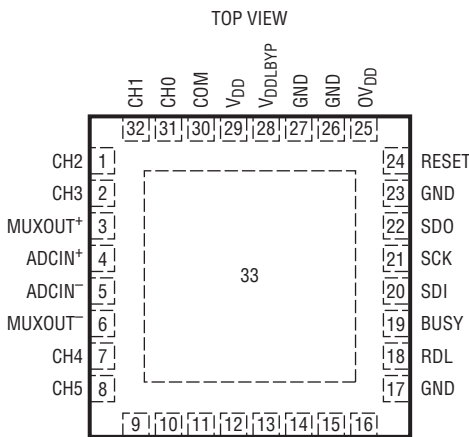
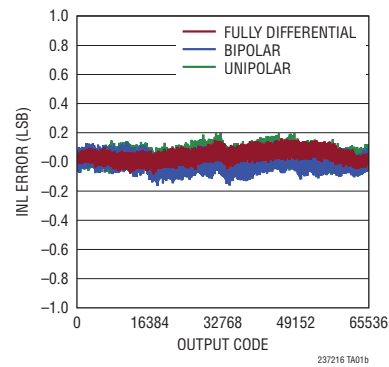
- Programmable Logic Controllers
- Industrial Process Control
- High Speed Data Acquisition
- Portable or Compact Instrumentation
- ATE

DESCRIPTION

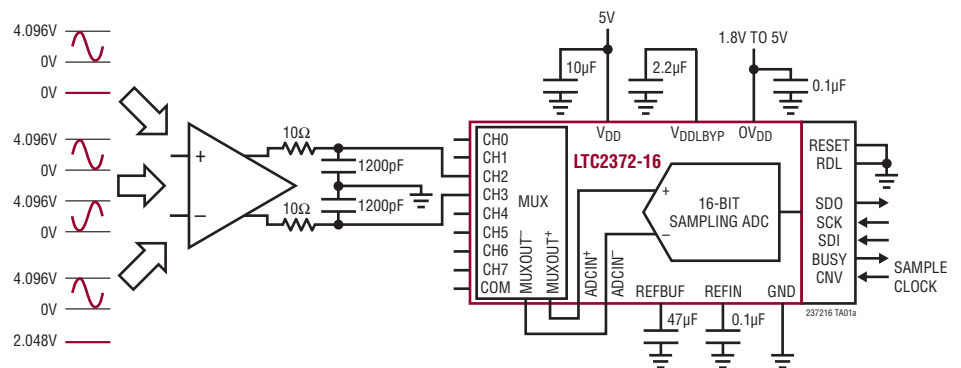
The LTC2372-16 is a low noise, high speed, 8-channel 16-bit successive approximation register (SAR) ADC. Operating from a single 5V supply, the LTC2372-16 has a highly configurable, low crosstalk 8-channel input multiplexer, supporting fully differential, pseudo-differential unipolar and pseudo-differential bipolar analog input ranges. The LTC2372-16 achieves $\pm 1LSB$ INL (maximum) in all input ranges, no missing codes at 16-bits and 96dB (fully differential)/93.5dB (pseudo-differential) SNR (typical).

The LTC2372-16 has an onboard low drift (20ppm/°C max) 2.048V temperature-compensated reference and a single-shot capable reference buffer. The LTC2372-16 also has a high speed SPI-compatible serial interface that supports 1.8V, 2.5V, 3.3V and 5V logic through which a sequencer with a depth of 16 may be programmed. An internal oscillator sets the conversion time, easing external timing considerations. The LTC2372-16 dissipates only 27mW and automatically naps between conversions, leading to reduced power dissipation that scales with the sampling rate. A sleep mode is also provided to reduce the power consumption of the LTC2372-16 to 300 μW for further power savings during inactive periods.

Integral Nonlinearity vs Output Code



UH PACKAGE
32-LEAD (5mm x 5mm) PLASTIC QFN
LTC2372CUH-16
LTC2372IUH-16
LTC2372HUH-16



LTC2373-16

16-Bit, 1Msps, 8-Channel SAR ADC with 96dB SNR

FEATURES

- **1Msps Throughput Rate**
- **16-Bit Resolution with No Missing Codes**
- **8-Channel Multiplexer with Selectable Input Range**
 - Fully Differential ($\pm 4.096V$)
 - Pseudo-Differential Unipolar (0V to 4.096V)
 - Pseudo-Differential Bipolar ($\pm 2.048V$)
- **INL: $\pm 1LSB$ (Maximum)**
- **SNR: 96dB (Fully Differential)/93.4dB (Pseudo-Differential) (Typical) at $f_{IN} = 1kHz$**
- **THD: $-110dB$ (Typical) at $f_{IN} = 1kHz$**
- Programmable Sequencer
- Selectable Digital Gain Compression
- Single 5V Supply with 1.8V to 5V I/O Voltages
- SPI-Compatible Serial I/O
- Onboard 2.048V Reference and Reference Buffer
- No Pipeline Delay, No Cycle Latency
- Power Dissipation 40mW (Typical)
- Guaranteed Operation to 125°C
- 32-Lead 5mm \times 5mm QFN Package

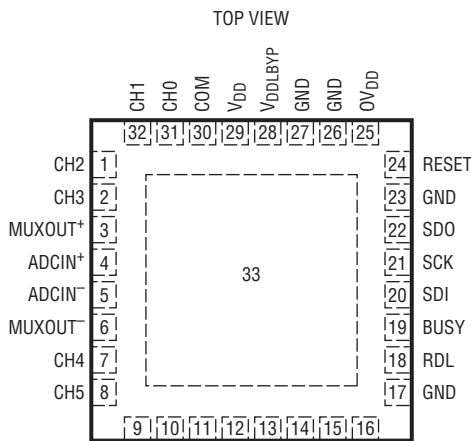
APPLICATIONS

- Programmable Logic Controllers
- Industrial Process Control
- High Speed Data Acquisition
- Portable or Compact Instrumentation
- ATE

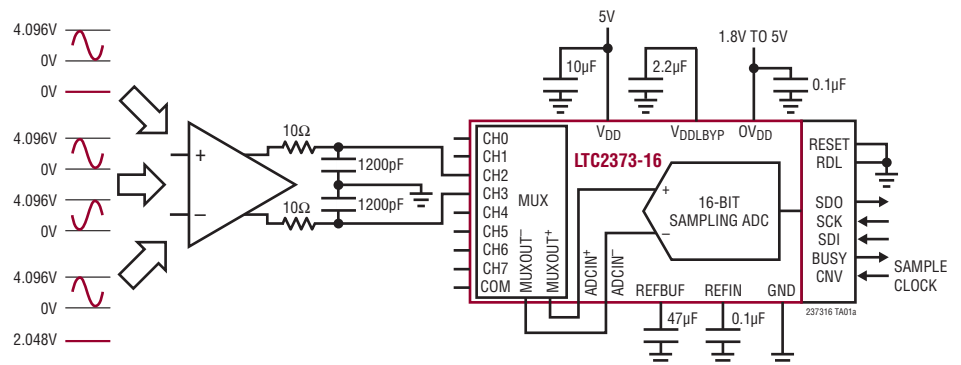
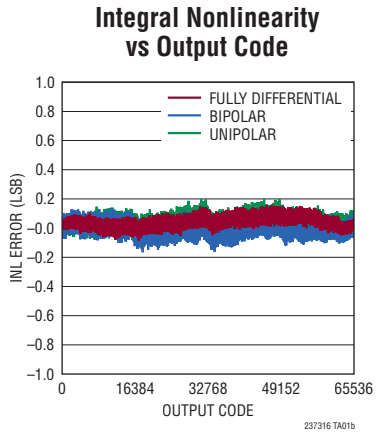
DESCRIPTION

The LTC2373-16 is a low noise, high speed, 8-channel 16-bit successive approximation register (SAR) ADC. Operating from a single 5V supply, the LTC2373-16 has a highly configurable, low crosstalk 8-channel input multiplexer, supporting fully differential, pseudo-differential unipolar and pseudo-differential bipolar analog input ranges. The LTC2373-16 achieves $\pm 1LSB$ INL (maximum) in all input ranges, no missing codes at 16-bits and 96dB (fully differential)/ 93.4dB (pseudo-differential) SNR (typical).

The LTC2373-16 has an onboard low drift (20ppm/°C max) 2.048V temperature-compensated reference and a single-shot capable reference buffer. The LTC2373-16 also has a high speed SPI-compatible serial interface that supports 1.8V, 2.5V, 3.3V and 5V logic through which a sequencer with a depth of 16 may be programmed. An internal oscillator sets the conversion time, easing external timing considerations. The LTC2373-16 dissipates only 40mW and automatically naps between conversions, leading to reduced power dissipation that scales with the sampling rate. A sleep mode is also provided to reduce the power consumption of the LTC2373-16 to 300 μ W for further power savings during inactive periods.



UH PACKAGE
32-LEAD (5mm \times 5mm) PLASTIC QFN
LTC2373CUH-16
LTC2373IUH-16
LTC2373HUH-16



LTC4316

Single I²C/SMBus Address Translator

FEATURES

- **Allows Multiple Slaves with the Same Address to Coexist on the Same Bus**
- **Resistor Configurable Address Translation**
- **No Software Programming Required**
- Compatible with SMBus, I²C and I²C Fast Mode
- Pass-Through Mode Allows General Call Addressing
- ±4kV HBM ESD Ruggedness
- Level Translation for 2.5V, 3.3V and 5V Buses
- Stuck Bus Timeout
- Prevents SDA and SCL Corruption During Live Board Insertion and Removal
- Support Bus Hot Swap™
- 10-Lead MSOP and DFN 3mm × 3mm Packages

APPLICATIONS

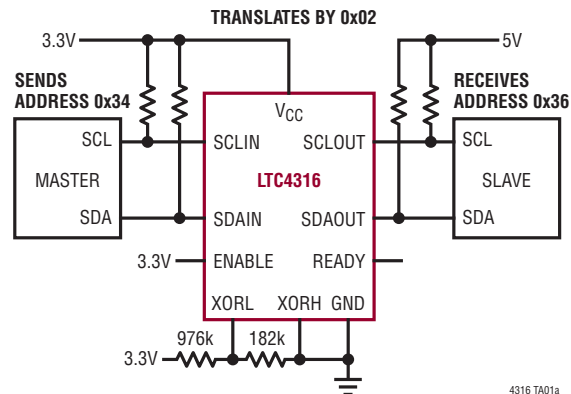
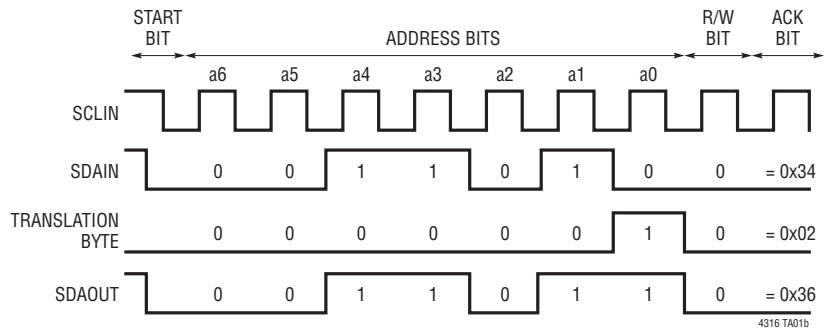
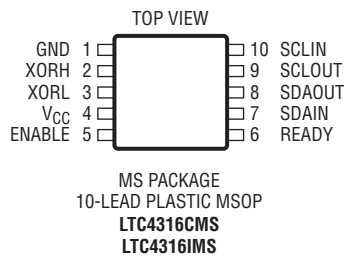
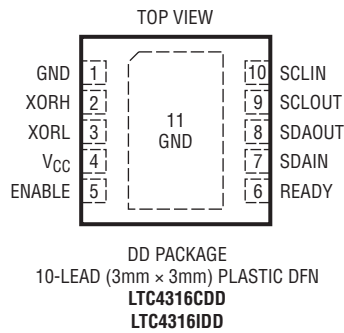
- I²C, SMBus Address Expansion
- Address Translation
- Servers
- Telecom

DESCRIPTION

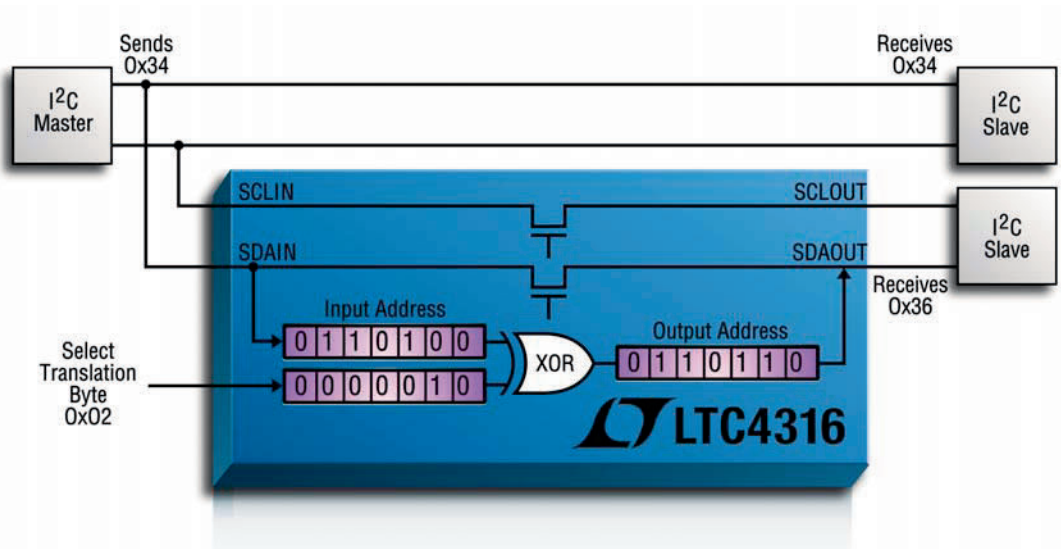
The LTC4316 enables the hardwired address of one or more I²C or SMBus slave devices to be translated to a different address. This allows slaves with the same hardwired address to coexist on the same bus. Only discrete resistors are needed to select the new address and no software programming is required. Up to 127 different address translations are available.

The LTC4316 incorporates a pass-through mode which disables the address translation and allows general call addressing by the master. The LTC4316 is designed to automatically recover from abnormal bus conditions like bus stuck low or premature STOP bits.

PART NUMBER	NUMBER OF INPUT CHANNELS	NUMBER OF OUTPUT CHANNELS
LTC4316	1	1
LTC4317	1	2
LTC4318	2	2



I²C/SMBus Address Translators



The LTC4316/LTC4317/LTC4318 are I²C/SMBus address translators that bridge two or more segments of an I²C bus, reading incoming addresses on the master side and transmitting a different 7-bit I²C address to the slave side to avoid address conflicts. Only discrete resistors are needed to select the new address and no software programming is required. Up to 127 different address translations are available.

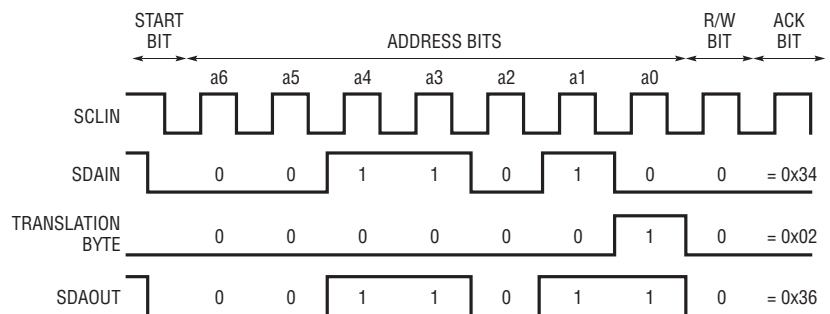
Features

- **Allows Multiple Slaves with the Same Address to Coexist on the Same Bus**
- **Resistor Configurable Address Translation**
- **No Software Programming Required**
- SMBus, I²C and I²C Fast Mode Compatible
- Pass-Through Mode Allows General Call Addressing
- ±4kV HBM ESD
- Level Translation for 2.5V, 3.3V and 5V Buses
- Stuck Bus Timeout
- Prevents SDA and SCL Corruption During Live Board Insertion and Removal

Part Selection

Part Number	Number of Input Channels	Number of Output Channels	Packages
LTC4316	1	1	3mm × 3mm DFN-10, MSOP-10
LTC4317	1	2	5mm × 3mm DFN-16
LTC4318	2	2	4mm × 4mm QFN-20

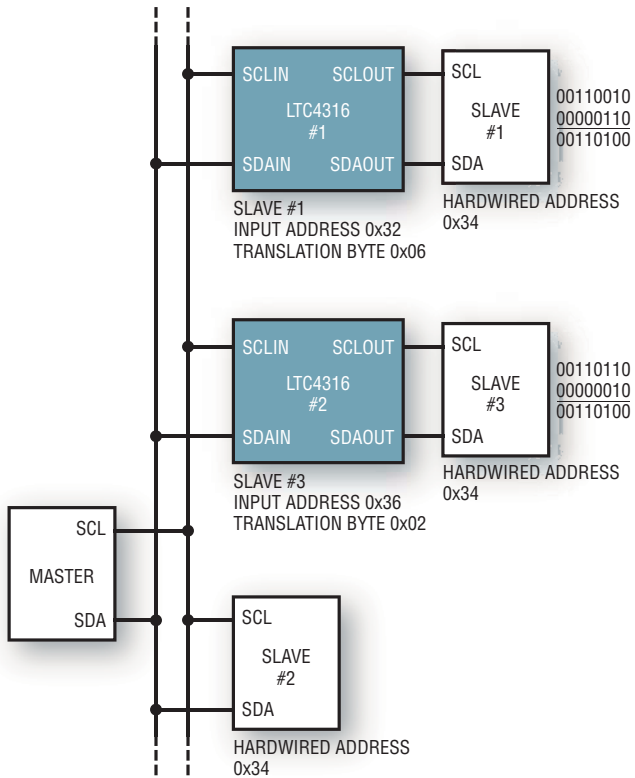
Timing Diagram Example



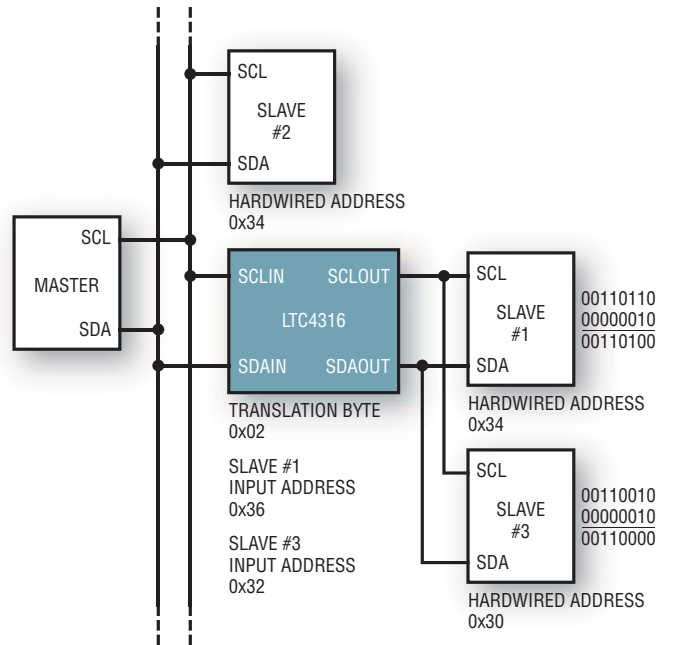
LT, LT, LTC, LTM, Linear Technology and the Linear logo are registered trademarks of Linear Technology Corporation. All other trademarks are the property of their respective owners.

Configurations

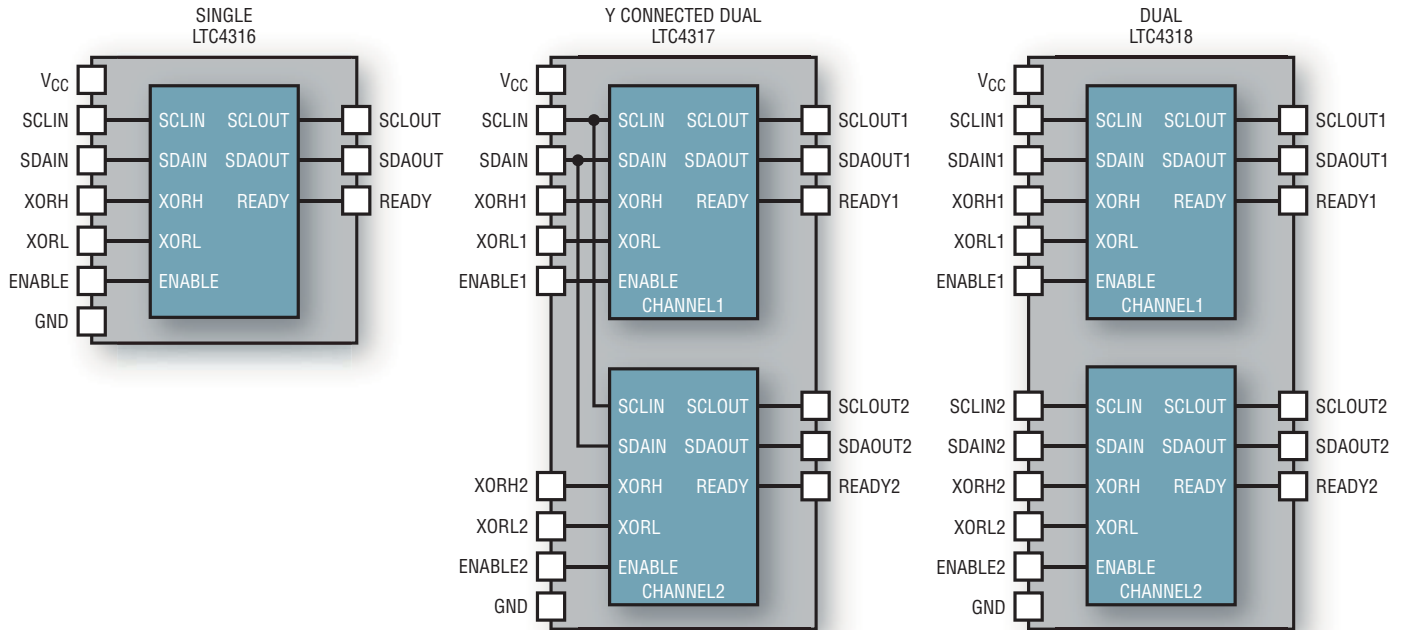
Two Independent Address Translations



Two Slaves Sharing One LTC4316



Part Comparison



LTC4317

Dual I²C/SMBus Address Translator

FEATURES

- Allows Multiple Slaves with the Same Address to Coexist on the Same Bus
- Resistor Configurable Address Translation
- No Software Programming Required
- Compatible with SMBus, I²C and I²C Fast Mode
- Pass-Through Mode Allows General Call Addressing
- ±4kV HBM ESD Ruggedness
- Level Translation for 2.5V, 3.3V and 5V Buses
- Stuck Bus Timeout
- Prevents SDA and SCL Corruption During Live Board Insertion and Removal
- Support Bus Hot Swap
- 16-Lead DFN 5mm × 3mm Package

APPLICATIONS

- I²C, SMBus Address Expansion
- Address Translation
- Servers
- Telecom

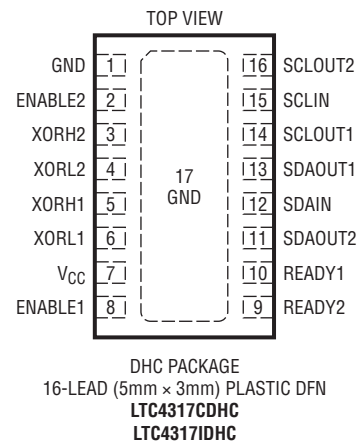
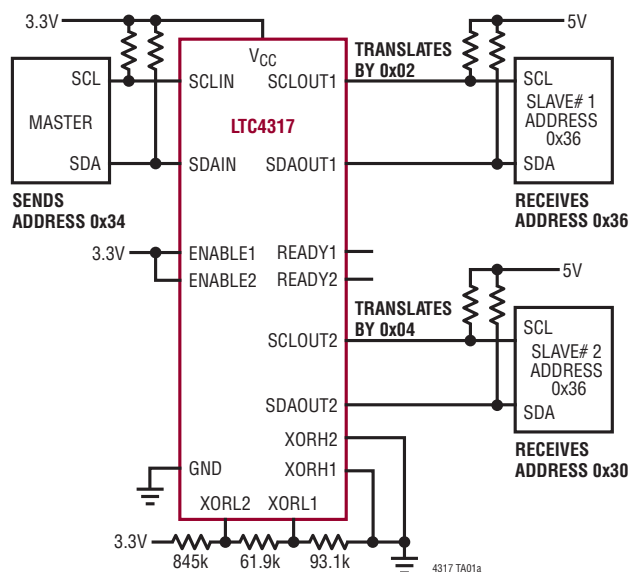
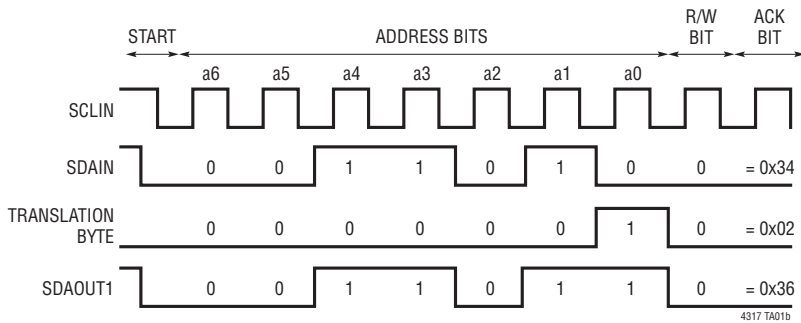
DESCRIPTION

The LTC4317 enables the hardwired address of one or more I²C or SMBus slave device to be translated to a different address. This allows slaves with the same hardwired address to coexist on the same bus. Only discrete resistors are needed to select the new address and no software programming is required. Up to 127 different address translations are available.

The LTC4317 incorporates a pass-through mode which disables the address translation and allows general call addressing by the master. The LTC4317 is designed to automatically recover from abnormal bus conditions like bus stuck low or premature STOP bits.

The LTC4317 has two output channels for two different sets of slaves. The input channels are tied together to a common set of pins to reduce the pin count and package size.

PART NUMBER	NUMBER OF INPUT CHANNELS	NUMBER OF OUTPUT CHANNELS
LTC4316	1	1
LTC4317	1	2
LTC4318	2	2



LTC4318

Dual I²C/SMBus Address Translator

FEATURES

- Allows Multiple Slaves with the Same Address to Coexist on the Same Bus
- Resistor Configurable Address Translation
- No Software Programming Required
- Compatible with SMBus, I²C and I²C Fast Mode
- Pass-Through Mode Allows General Call Addressing
- ±4kV HBM ESD Ruggedness
- Level Translation for 2.5V, 3.3V and 5V Buses
- Stuck Bus Timeout
- Prevents SDA and SCL Corruption During Live Board Insertion and Removal
- Support Bus Hot Swap
- 20-Lead QFN 4mm × 4mm Package

APPLICATIONS

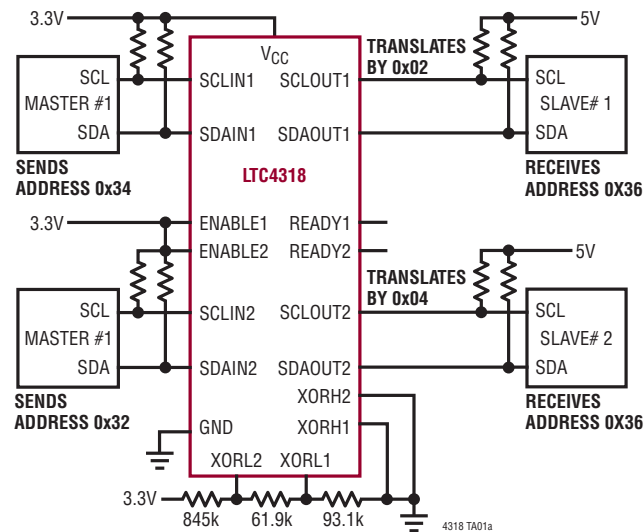
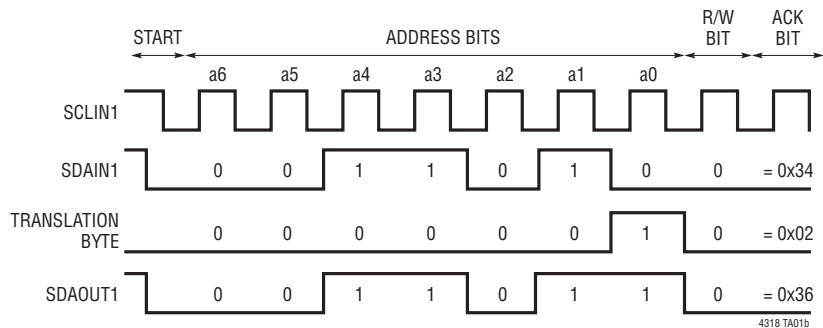
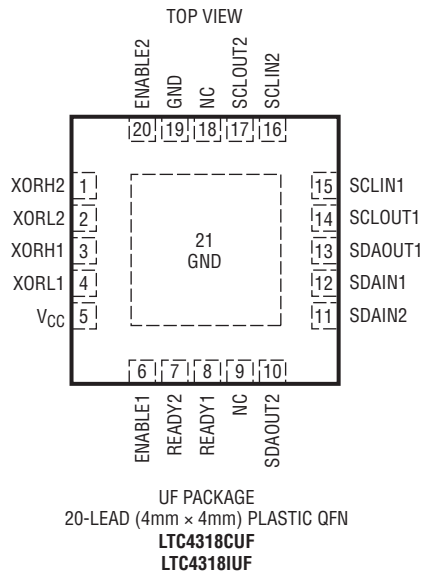
- I²C, SMBus Address Expansion
- Address Translation
- Servers
- Telecom

DESCRIPTION

The LTC4318 enables the hardwired address of one or more I²C or SMBus slave devices to be translated to a different address. This allows slaves with the same hardwired address to coexist on the same bus. Only discrete resistors are needed to select the new address and no software programming is required. Up to 127 different address translations are available.

The LTC4318 incorporates a pass-through mode which disables the address translations and allows general call addressing by the master. The LTC4318 is designed to automatically recover from abnormal bus conditions like bus stuck low or premature STOP bits.

PART NUMBER	NUMBER OF INPUT CHANNELS	NUMBER OF OUTPUT CHANNELS
LTC4316	1	1
LTC4317	1	2
LTC4318	2	2



LT4276

LTPoE++/PoE+/PoE PD Forward/Flyback Controller

FEATURES

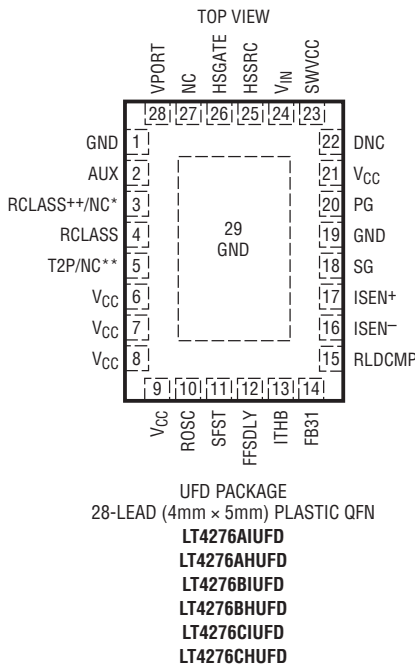
- IEEE802.3af/at and LTPoE++ 90W Powered Device (PD) with Forward/Flyback Controller
- LT4276A Supports All of the Following Standards:
 - LTPoE++ 38.7W, 52.7W, 70W and 90W
 - IEEE 802.3at 25.5W Compliant
 - IEEE 802.3af up to 13W Compliant
- LT4276B is IEEE 802.3at/af Compliant
- LT4276C is IEEE 802.3af Compliant
- Superior Surge Protection (100V Absolute Maximum)
- Wide Junction Temperature Range (-40°C to 125°C)
- Auxiliary Power Support as Low as 9V
- No Opto-Isolator Required for Flyback Operation
- External Hot Swap N-Channel MOSFET for Lowest Power Dissipation and Highest System Efficiency
- >94% End-to-End Efficiency with LT4321 Ideal Bridge
- Available in a 28-Lead 4mm x 5mm QFN Package

APPLICATIONS

- High Power Wireless Data Systems
- Outdoor Security Camera Equipment
- Commercial and Public Information Displays
- High Temperature Applications

DESCRIPTION

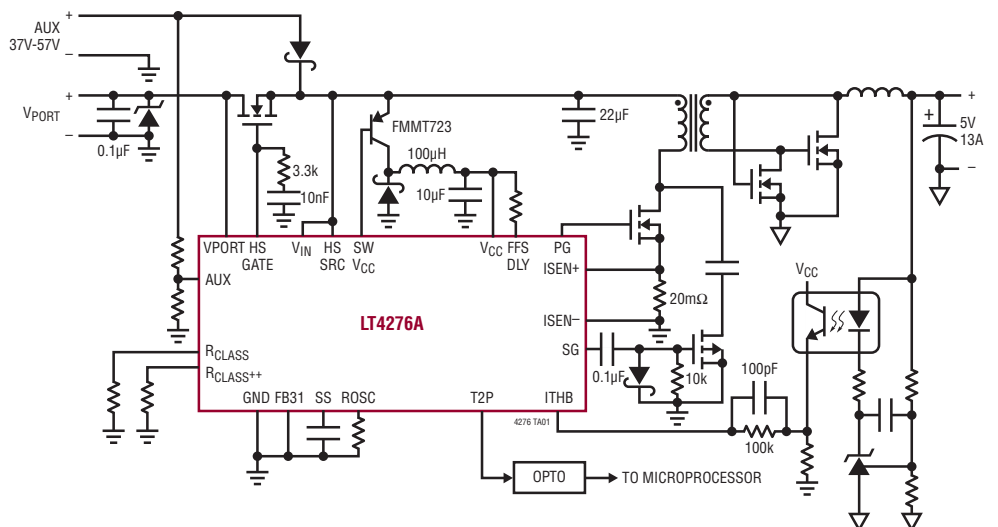
The LT4276 is a pin-for-pin compatible family of IEEE 802.3 and LTPoE++ Powered Device (PD) controllers. It includes an isolated switching regulator controller capable of synchronous operation in both forward and flyback topologies with auxiliary power support. The LT4276A employs the LTPoE++ classification scheme, receiving 38.7W, 52.7W, 70W or 90W of power at the PD RJ45 connector, and is backwards compatible with IEEE 802.3. The LT4276B is a fully 802.3at compliant, 25.5W Type 2 (PoE+) PD. The LT4276C is a fully 802.3af compliant, 13W Type 1 (PoE) PD. The LT4276 supports both forward and flyback power supply topologies, configurable for a wide range of PoE applications. The flyback topology supports No-Opto feedback. Auxiliary input voltage can be accurately sensed with just a resistor divider connected to the AUX pin. The LT4276 utilizes an external, low $R_{DS(ON)}$ N-channel MOSFET for the Hot Swap function, maximizing power delivery and efficiency, reducing heat dissipation, and easing the thermal design.



LT4276 Family

MAX DELIVERED POWER	LT4276 GRADE		
	A	B	C
LTPoE++ 90W	●		
LTPoE++ 70W	●		
LTPoE++ 52.7W	●		
LTPoE++ 38.7W	●		
25.5W	●	●	
13W	●	●	●

LTPoE++ 70W Power Supply in a Forward Mode



LTM4622

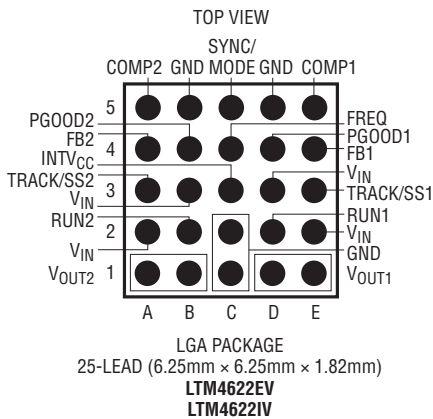
Dual Ultrathin 2.5A Step-Down DC/DC µModule Regulator

FEATURES

- Complete Solution in <math><1\text{cm}^2</math>
- Wide Input Voltage Range: 3.6V to 20V
- 3.3V Input Compatible with V_{IN} Tied to $INTV_{CC}$
- 0.6V to 5.5V Output Voltage
- Dual 2.5A DC, 3A Peak Output Current
- $\pm 1.5\%$ Maximum Total Output Voltage Regulation Error Over Load, Line and Temperature
- Current Mode Control, Fast Transient Response
- External Frequency Synchronization
- Multiphase Parallelable with Current Sharing
- Output Voltage Tracking and Soft-Start Capability
- Selectable Burst Mode[®] Operation
- Overvoltage Input and Overtemperature Protection
- Power Good Indicators
- 6.25mm × 6.25mm × 1.82mm LGA Package

APPLICATIONS

- General Purpose Point of Load Conversion
- Telecom, Networking and Industrial Equipment
- Medical Diagnostic Equipment
- Test and Debug Systems



DESCRIPTION

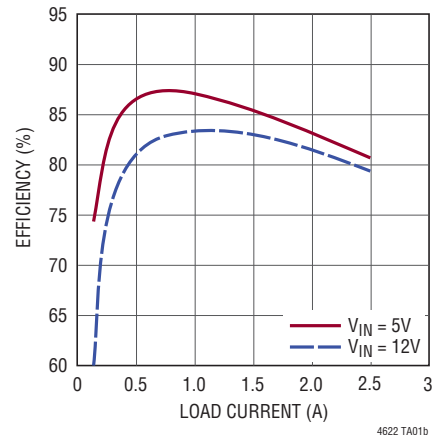
The LTM4622 is a complete dual 2.5A step-down switching mode µModule (micromodule) regulator in a tiny ultrathin 6.25mm × 6.25mm × 1.82mm LGA package. Included in the package are the switching controller, power FETs, inductor and support components. Operating over an input voltage range of 3.6V to 20V, the LTM4622 supports an output voltage range of 0.6V to 5.5V, set by a single external resistor. Its high efficiency design delivers dual 2.5A continuous, 3A peak, output current. Only a few ceramic input and output capacitors are needed.

The LTM4622 supports selectable Burst Mode operation and output voltage tracking for supply rail sequencing. Its high switching frequency and current mode control enable a very fast transient response to line and load changes without sacrificing stability.

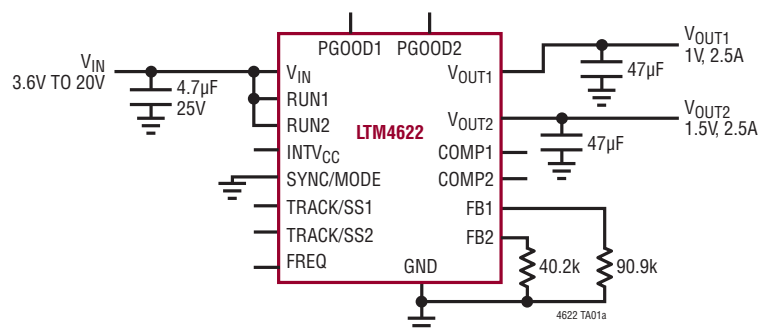
Fault protection features include input overvoltage, output overcurrent and overtemperature protection.

The LTM4622 is RoHS compliant with Pb-free finish.

1.5V Output Efficiency vs Load Current



1.5V and 1V Dual Output DC/DC Step-Down µModule Regulator



LTM4630-1

Dual 18A or Single 36A μModule Regulator with 0.8% DC and 3% Transient Accuracy

FEATURES

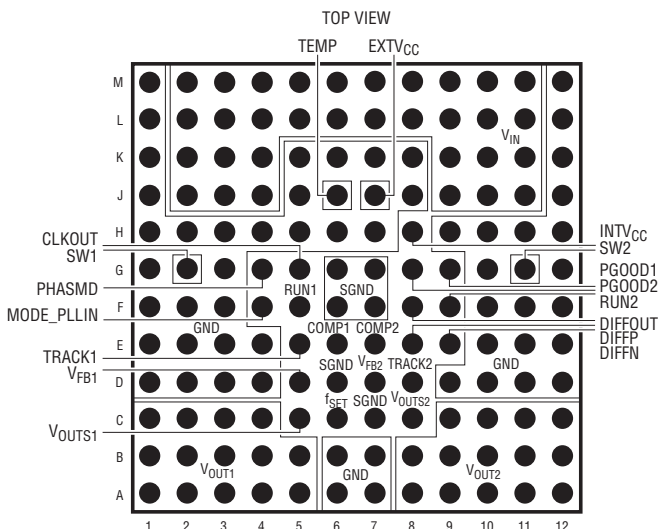
- ±0.8% Maximum Total DC Output Error Over Line, Load and Temperature (LTM4630-1A)
- ±3% Transient Output Error with Minimum Output Capacitance
- Dual 18A or Single 36A Output
- 4.5V to 15V Input, 0.6V to 1.8V Output Voltage Range
- Differential Remote Sense Amplifier
- Current Mode Control/Fast Transient Response
- Current Sharing Up to 144A
- 16mm × 16mm × 5.01mm BGA Package

APPLICATIONS

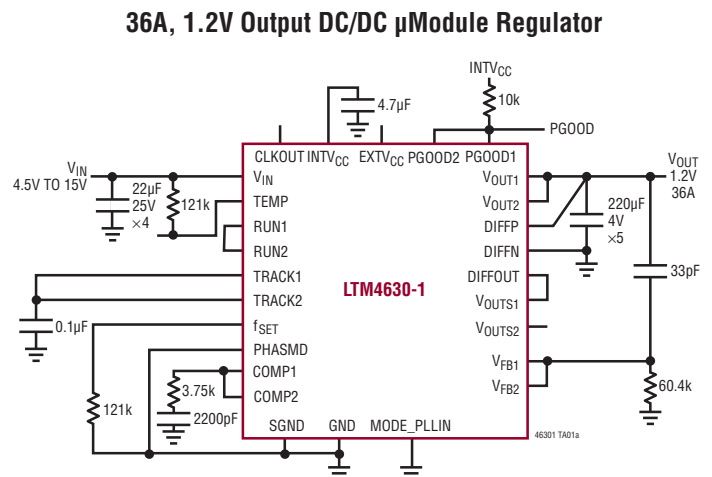
- FPGA, ASIC, μProcessor Core Voltage Regulation
- Information, Communication Systems

DESCRIPTION

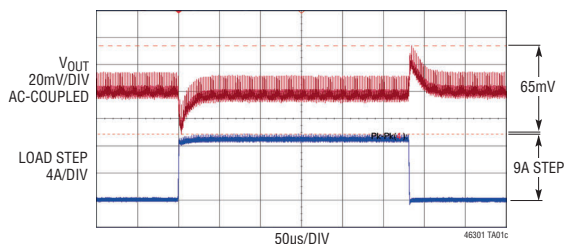
The LTM4630-1A/LTM4630-1B are dual 18A or single 36A output step-down μModule (micromodule) regulators with ±0.8% (LTM4630-1A) and ±1.5% (LTM4630-1B) total DC output error, respectively, with ±3% transient output error. Included in the package are the switching controller, power FETs, inductors, and all supporting components. External compensation allows for fast transient response to minimize output capacitance when powering FPGAs, ASICs and processors. With synchronized multiphase parallel current sharing, four LTM4630-1 devices can deliver up to 144A. The LTM4630-1 is offered in a 16mm × 16mm × 5.01mm BGA package.



BGA PACKAGE
144-LEAD (16mm × 16mm × 5.01mm)
LTM4630EY-1A
LTM4630IY-1A
LTM4630EY-1B
LTM4630IY-1B

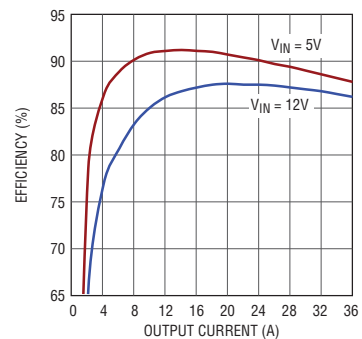


25% Load Step Transient Response, ±3% Output Regulation Window. 12V_{IN}, 1.2V_{OUT}, 36A with 5x 220μF Ceramic Cap



*SEE DEMO CIRCUIT DC2081A-B

1.2V Output Efficiency, f_{sw} = 500kHz



LTM4675

Dual 9A or Single 18A µModule Regulator with Digital Power System Management

FEATURES

- Dual, Fast, Analog Loops with Digital Interface for Control and Monitoring
- Wide Input Voltage Range: 4.5V to 17V
- Output Voltage Range: 0.5V to 5.5V
- ±0.5% Maximum DC Output Error Over Temperature
- ±2.5% Current Readback Accuracy at 9A Load
- 400kHz PMBus-Compliant I²C Serial Interface
- Integrated 16-Bit ΔΣ ADC
- Supports Telemetry Polling Rates Up to 125Hz
- Constant Frequency Current Mode Control
- Parallel and Current Share Multiple Modules
- All 7-Bit Slave Addresses Supported
- Drop-In Pin-Compatible to Dual 13A LTM4676A
- 16mm × 11.9mm × 3.51mm BGA Package

Readable Data:

- Input and Output Voltages, Currents and Temperatures
- Running Peak Values, Uptime, Faults and Warnings
- Onboard EEPROM Fault Log Record

Writable Data and Configurable Parameters:

- Output Voltage, Voltage Sequencing and Margining
- Digital Soft-Start/Stop Ramp
- OV/UV/OT, UVLO, Frequency and Phasing

APPLICATIONS

- System Optimization, Characterization and Data Mining in Prototype, Production and Field Environments

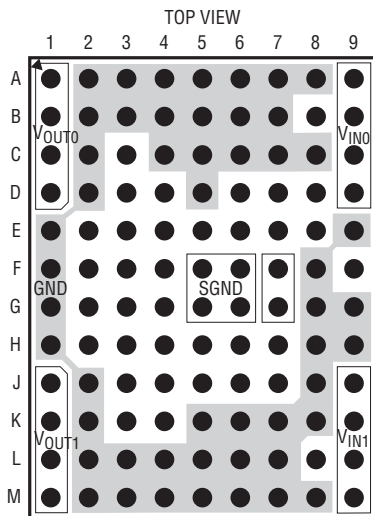
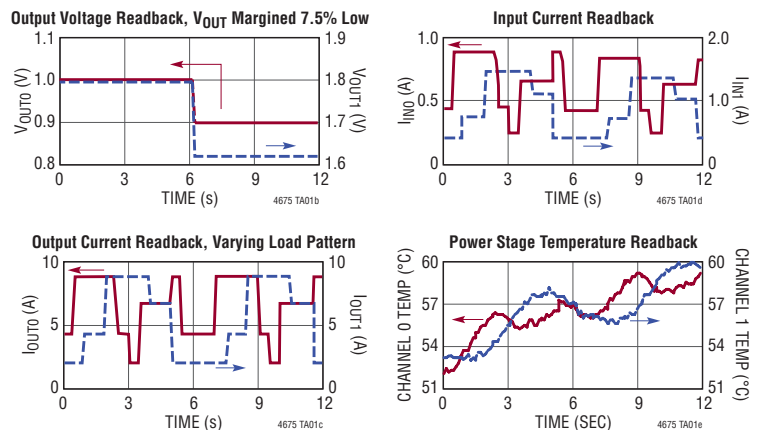
DESCRIPTION

The LTM4675 is a dual 9A or single 18A step-down µModule (micromodule) DC/DC regulator with 70ms turn-on time. It features remote configurability and telemetry-monitoring of power management parameters over PMBus— an open standard I²C-based digital interface protocol. The LTM4675 is comprised of fast analog control loops, precision mixed-signal circuitry, EEPROM, power MOSFETs, inductors and supporting components.

The LTM4675's 2-wire serial interface allows outputs to be margined, tuned and ramped up and down at programmable slew rates with sequencing delay times. Input and output currents and voltages, output power, temperatures, uptime and peak values are readable. Custom configuration of the EEPROM contents is not required. At start-up, output voltages, switching frequency, and channel phase angle assignments can be set by pin-strapping resistors. The LTpowerPlay GUI and DC1613 USB-to-PMBus converter and demo kits are available.

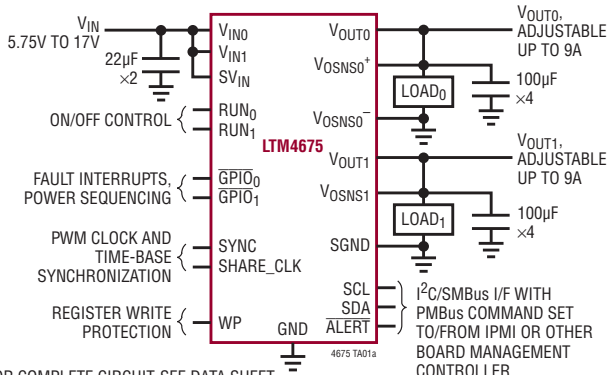
The LTM4675 is offered in a 16mm × 11.9mm × 3.51mm BGA package available with SnPb or RoHS compliant terminal finish.

Using PMBus and LTpowerPlay™ to Monitor Telemetry and Margin V_{OUT0}/V_{OUT1} During Load Pattern Tests. 10Hz Polling Rate. 12V_{IN}



BGA PACKAGE
108-LEAD (16mm × 11.9mm × 3.51mm)
LTM4675EY
LTM4675IY

Dual 9A µModule Regulator with Digital Interface for Control and Monitoring*



*FOR COMPLETE CIRCUIT, SEE DATA SHEET

LTM4676A

Dual 13A or Single 26A µModule Regulator with Digital Power System Management

FEATURES

- Dual, Fast, Analog Loops with Digital Interface for Control and Monitoring
- Wide Input Voltage Range: 4.5V to 17V
- Output Voltage Range: 0.5V to 5.5V
- ±0.5% Maximum DC Output Error Over Temperature
- ±2.5% Current Readback Accuracy at 10A Load
- 400kHz PMBus-Compliant I²C Serial Interface
- Integrated 16-Bit ΔΣ ADC
- Supports Telemetry Polling Rates Up to 125Hz
- Constant Frequency Current Mode Control
- Parallel and Current Share Multiple Modules
- All 7-Bit Slave Addresses Supported
- Rail and Global Addressing Supported
- 16mm × 16mm × 5.01mm BGA Package

Readable Data:

- Input and Output Voltages, Currents, and Temperatures
- Running Peak Values, Uptime, Faults and Warnings
- Onboard EEPROM Fault Log Record

Writable Data and Configurable Parameters:

- Output Voltage, Voltage Sequencing and Margining
- Digital Soft-Start/Stop Ramp
- OV/UV/OT, UVLO, Frequency and Phasing

APPLICATIONS

- System Optimization, Characterization and Data Mining in Prototype, Production and Field Environments

DESCRIPTION

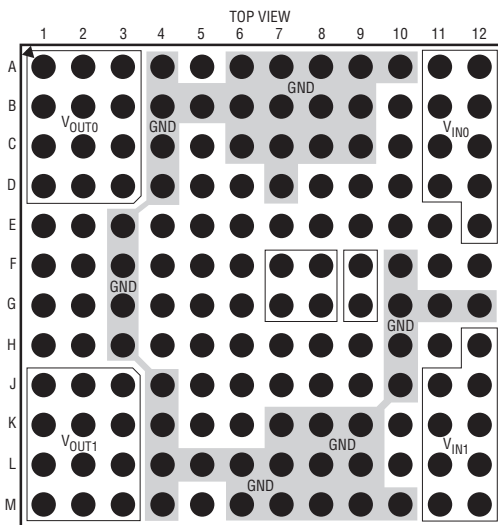
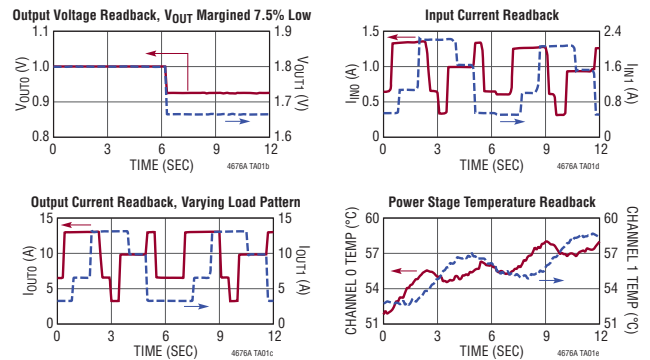
The LTM4676A is a dual 13A or single 26A step-down µModule (micromodule) DC/DC regulator with 70ms turn-on time. It features remote configurability and telemetry-monitoring of power management parameters over PMBus— an open standard I²C-based digital interface protocol. The LTM4676A is comprised of fast analog control loops, precision mixed-signal circuitry, EEPROM, power MOSFETs, inductors and supporting components.

The LTM4676A's 2-wire serial interface allows outputs to be margined, tuned and ramped up and down at programmable slew rates with sequencing delay times. Input and output currents and voltages, output power, temperatures, uptime and peak values are readable. At start-up, output voltages, switching frequency, and channel phase angle assignments can be set by pin-strapping resistors. The LTpowerPlay GUI and DC1613 USB-to-PMBus converter and demo kits are available.

PART NUMBER	TURN-ON START-UP TIME (MAX) (ms)	V _{IN} RANGE (V)	V _{OUT} RANGE (V)	PIN-COMPATIBLE
LTM4676	170	4.5 to 26.5	0.5V to 4 (CH0) 0.5 to 5.4 (CH1)	Yes
LTM4676A	70	4.5 to 17	0.5 to 5.5 (Both CH)	

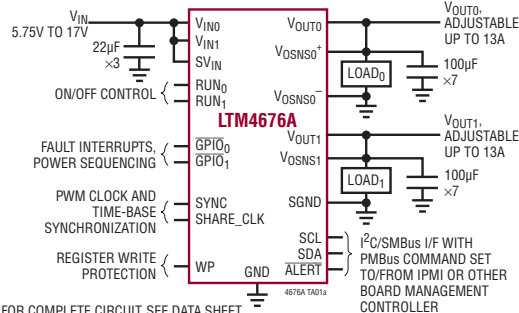
See Table 1 and page 18 on data sheet for more on LTM4676A's enhancements over LTM4676's feature set.

Using PMBus and LTpowerPlay to Monitor Telemetry and Margin V_{OUT0}/V_{OUT1} During Load Pattern Tests. 10Hz Polling Rate. 12V_{IN}



BGA PACKAGE
144-LEAD (16mm × 16mm × 5.01mm)
LTM4676AEY
LTM4676AIY

Dual 13A µModule Regulator with Digital Interface for Control and Monitoring*



*FOR COMPLETE CIRCUIT, SEE DATA SHEET

LTC3110 2A Bidirectional Buck-Boost DC/DC Regulator and Charger/Balancer

FEATURES

- V_{CAP} Operating Range: 0.1V to 5.5V
- V_{SYS} Operating Range: 1.71V to 5.25V
- Automatic Switchover from Charge to Backup Mode
- Programmable $\pm 2\%$ Accurate Charge Input Current Limit from 125mA to 2A
- $\pm 1\%$ Backup Voltage Accuracy
- Automatic Backup Capacitor Balancing
- Fixed 1.2MHz Switching Frequency
- Burst Mode Operation: 40 μ A Quiescent Current
- Built-In Programmable Multipurpose Comparator with Open-Collector Output
- Open-Collector Outputs to Indicate Direction of Operation and End of Charge
- Thermally Enhanced TSSOP-24 and 4mm \times 4mm QFN-24 Packages

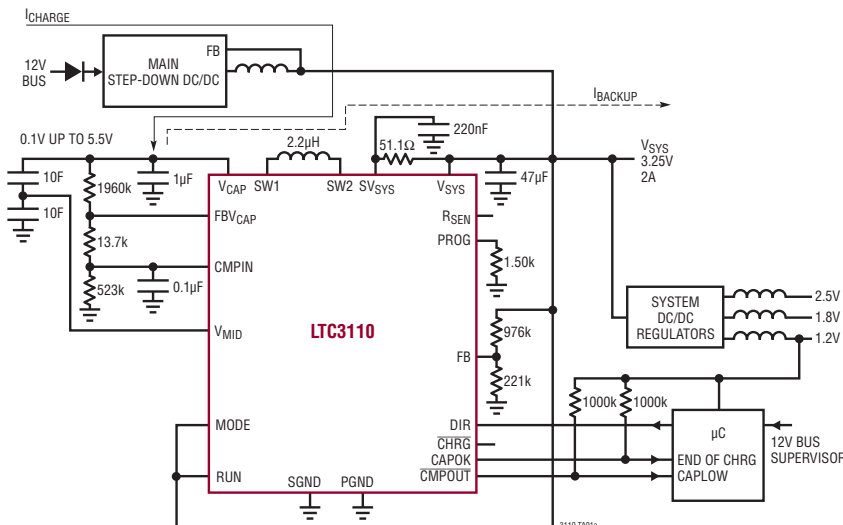
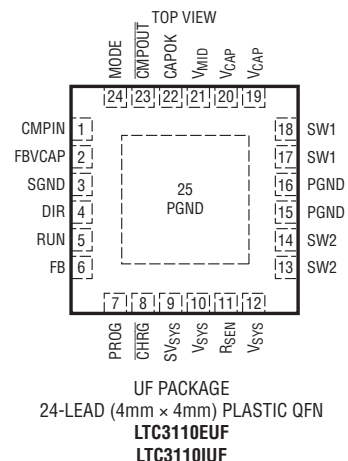
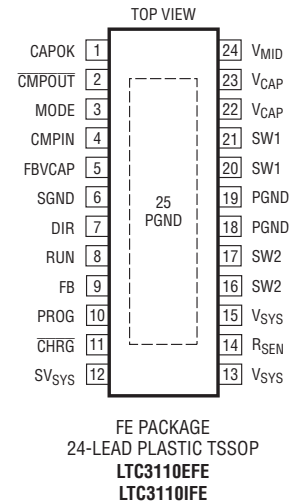
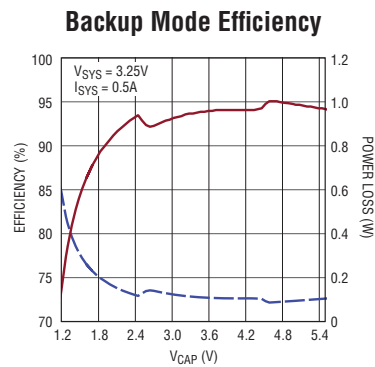
APPLICATIONS

- Supercapacitor Backup Converter and Charger
- Battery Backup Converter and Charger
- Servers, RAID Systems
- RF Systems with Battery/Capacitor Backup

DESCRIPTION

The LTC3110 is a 2A bidirectional buck-boost DC/DC regulator with capacitor charger and balancer. Its wide 0.1V to 5.5V capacitor/battery voltage and 1.8V to 5.25V system backup voltage ranges make it well suited to a wide variety of backup applications using supercapacitors or batteries. A proprietary low noise switching algorithm optimizes efficiency with capacitor/battery voltages that are above, below or equal to the system output voltage.

The LTC3110 can autonomously transition from charge to backup mode or switch modes based on an external command. Pin-selectable Burst Mode operation reduces standby current and improves light-load efficiency, which combined with a 1 μ A shutdown current make the LTC3110 ideally suited for backup applications. Additional features include voltage supervisors for direction control and end of charge, and a general purpose comparator with open-collector output for interfacing with a μ C. The LTC3110 is available in thermally enhanced, low profile 24-lead TSSOP and 4mm \times 4mm QFN packages.



LTC3335

Nanopower Buck-Boost DC/DC with Integrated Coulomb Counter

FEATURES

- 680nA Input Quiescent Current (Output in Regulation at No Load)
- 1.8V to 5.5V Input Operating Range
- Selectable Output Voltages of 1.8V, 2.5V, 2.8V, 3V, 3.3V, 3.6V, 4.5V, 5V
- Integrated Coulomb Counter Measures Accumulated Battery Discharge
- ±5% Battery Discharge Measurement Accuracy
- Programmable Peak Input Current of 5mA, 10mA, 15mA, 25mA, 50mA, 100mA, 150mA, 250mA
- Up to 50mA of Output Current
- Up to 90% Efficiency
- Programmable Coulomb Counter Prescaler for Wide Range of Battery Sizes
- Programmable Discharge Alarm Threshold
- I²C Interface
- Low Profile (0.75mm) 20-Lead (3mm × 4mm) QFN Package

APPLICATIONS

- Long Lifetime Primary Cell Battery Applications
- Wireless Sensors
- Remote Monitors
- Dust Networks[®] SmartMesh[®] Applications

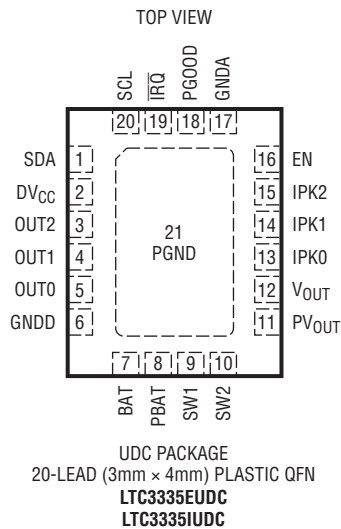
DESCRIPTION

The LTC3335 is a high efficiency, low quiescent current (680nA) buck-boost DC/DC converter with an integrated precision coulomb counter which monitors accumulated battery discharge in long life battery powered applications. The buck-boost can operate down to 1.8V on its input and provides eight pin-selectable output voltages with up to 50mA of output current.

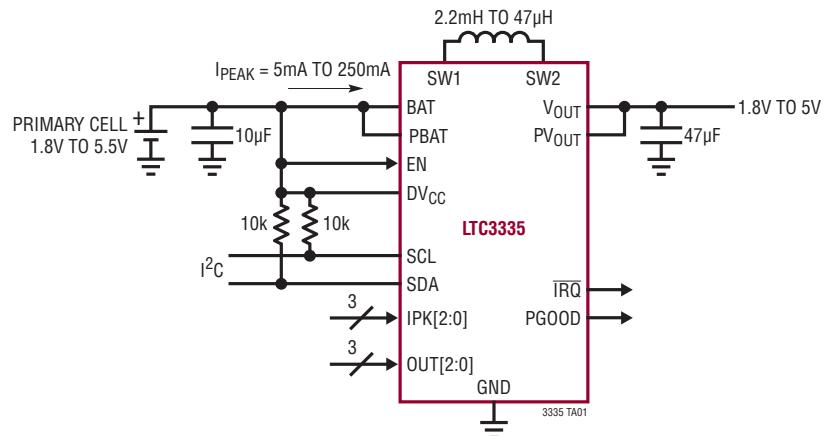
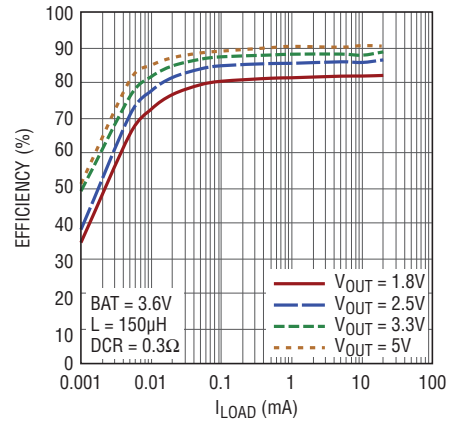
The coulomb counter stores the accumulated battery discharge in an internal register accessible via an I²C interface. The LTC3335 features a programmable discharge alarm threshold. When the threshold is reached, an interrupt is generated at the $\overline{\text{IRQ}}$ pin.

To accommodate a wide range of battery types and sizes, the peak input current can be selected from as low as 5mA to as high as 250mA and the full-scale coulomb counter has a programmable range of 32,768:1.

The LTC3335 is available in a 3mm × 4mm QFN-20 package.



Efficiency vs Load for 100mA
I_{PEAK} Setting



LTC3815

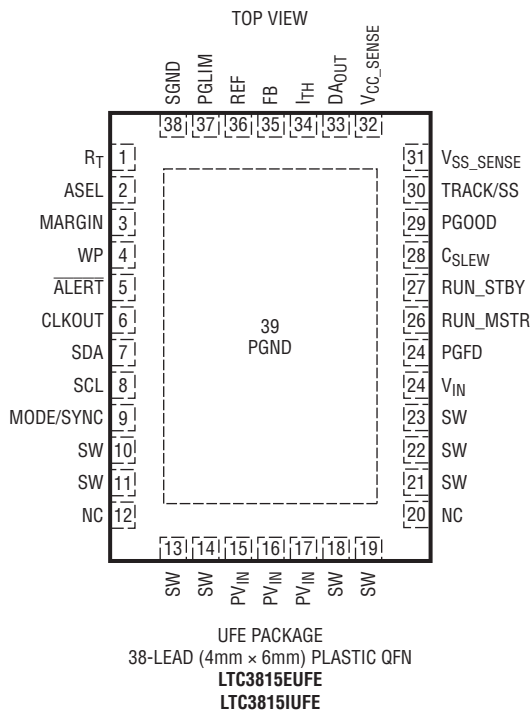
6A Monolithic Synchronous DC/DC Step-Down Converter with Digital Power System Management

FEATURES

- 2.25V to 5.5V Input Voltage Range
- $\pm 1\%$ Total Output Voltage Accuracy Over Temperature at $V_{IN} = 3.3V$ or 5V
- Single Resistor-Programmable Output Voltage
- PMBus Compliant Serial Interface:
 - Programmable Output Voltage Margining: Up to $\pm 25\%$ V_{OUT} Range with 0.1% Resolution
 - Read back of Average and Peak Temperature, Current, and Voltage (25Hz Refresh Rate)
 - Fault Status
- Phase-Lockable Fixed Frequency Up to 3MHz
- Less Than 1ms Power-Up Time
- Integrated 13-Bit ADC
- Optional External Reference Input
- Pin Selectable Fast-Margining of the Output Voltage
- Power Good Flag with Pin Programmable Thresholds and Filter Delay
- Differential Remote Output Voltage Sensing
- Master Shutdown Mode: $< 1\mu A$ Supply Current
- Clock Out for 2-Phase Operation (12A Output Current)
- Available in a Thermally Enhanced 38-Lead 4mm \times 6mm QFN Package

APPLICATIONS

- Intelligent Energy Efficient Power Conversion
- ASIC/FPGA/Processor Power
- Distributed Power Systems
- Point of Load Power Conversion

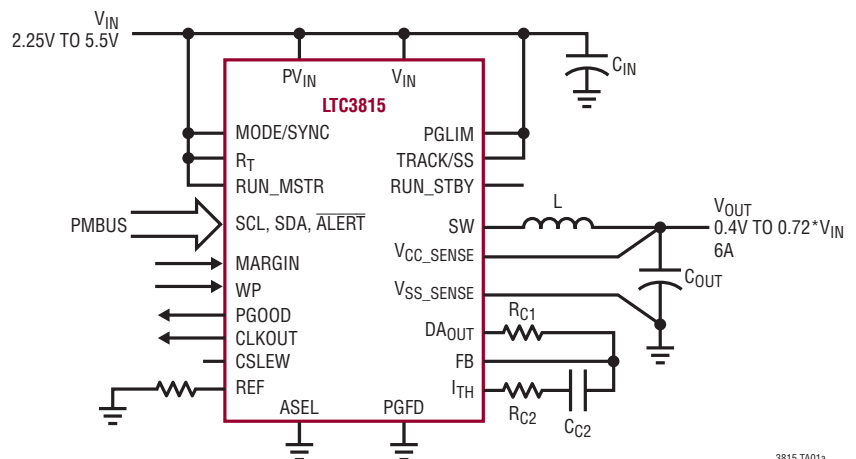
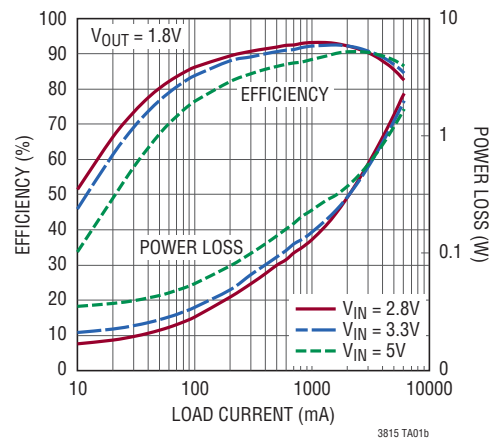


DESCRIPTION

The LTC3815 is a high efficiency, 6A monolithic synchronous buck regulator using a phase lockable controlled on-time, current mode architecture. The output voltage is programmable from 0.4V to 72% of V_{IN} with a single external resistor or an external voltage reference through the reference input (REF) pin. The output voltage can be margined up or down up to 25% with 0.1% resolution via a PMBus-compliant serial interface. The serial interface can also be used to read back fault status and both time-averaged ($\sim 4ms$) and peak input/output current, input/output voltage, and temperature. System configuration and monitoring is supported by the LTpowerPlay development system.

The architecture provides extremely fast transient response and allows operation at the very low on-times required to regulate low output voltages at high switching frequencies. The operating frequency is programmable from 400kHz to 3MHz with an external resistor or for noise sensitive applications, it can be synchronized to an external clock over the same range. The operating supply voltage range is from 2.25V to 5.5V making it suitable for operation from 2.5V, 3.3V or 5V rails or lithium-ion batteries.

Efficiency and Power Loss vs Load Current



LT8330

Low I_Q Boost/SEPIC/Inverting Converter with 1A, 60V Switch

FEATURES

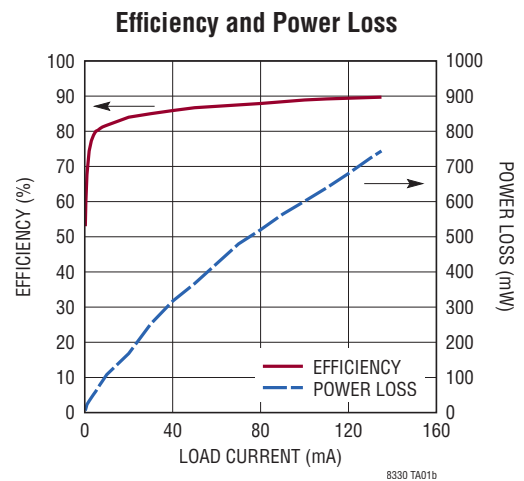
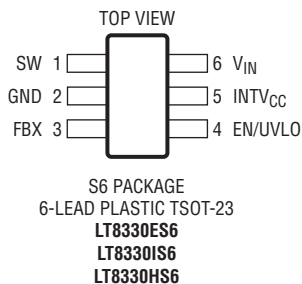
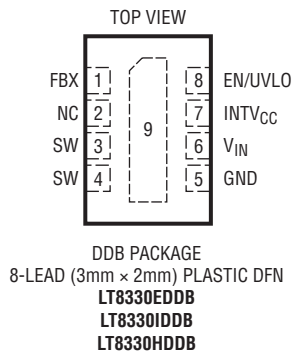
- 3V to 40V Input Voltage Range
- Ultralow Quiescent Current and Low Ripple Burst Mode Operation: $I_Q = 6\mu\text{A}$
- 1A, 60V Power Switch
- Positive or Negative Output Voltage Programming with a Single Feedback Pin
- Fixed 2MHz Switching Frequency
- Accurate 1.6V EN/UVLO Pin Threshold
- Internal Compensation and Soft-Start
- Low Profile (1mm) ThinSOT™ Package
- Low Profile (0.75mm) 8-Lead (3mm × 2mm) DFN Package

APPLICATIONS

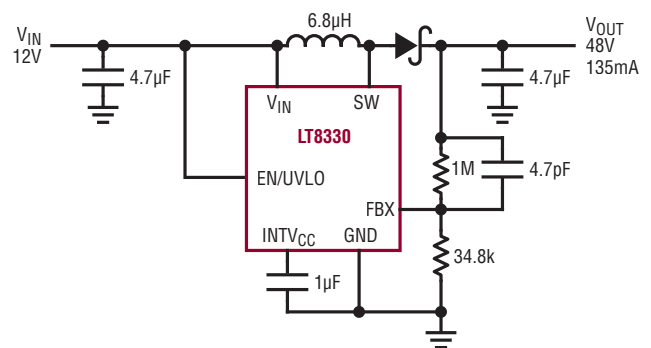
- Industrial and Automotive
- Telecom
- Medical Diagnostic Equipment
- Portable Electronics

DESCRIPTION

The LT8330 is a current mode DC/DC converter capable of generating either positive or negative output voltages using a single feedback pin. It can be configured as a boost, SEPIC or inverting converter consuming as low as $6\mu\text{A}$ of quiescent current. Low ripple Burst Mode operation maintains high efficiency down to very low output currents while keeping the output ripple below 15mV in a typical application. The internally compensated current mode architecture results in stable operation over a wide range of input and output voltages. Integrated soft-start and frequency foldback functions are included to control inductor current during start-up. The 2MHz operation combined with small package options, enables low cost, area efficient solutions.



48V Boost Converter



LT8494 SEPIC/Boost DC/DC Converter with 2A, 70V Switch, and 7 μ A Quiescent Current

FEATURES

- Low Ripple Burst Mode Operation:
 - 7 μ A I_Q at 12V_{IN} to 5V_{OUT}
 - Output Ripple (<10mV Typ.)
- Dual Supply Pins:
 - Improves Efficiency
 - Reduces Minimum Supply Voltage to ~1V after Start-Up to Extend Battery Life
- Wide Input Voltage Range of ~1V to 60V (2.5V to 32V for Start-Up)
- PG Functional for Input Supply Down to 1.3V
- FMEA Fault Tolerant in TSSOP Package
- Fixed Frequency PWM, SEPIC/BOOST/FLYBACK Topologies
- NPN Power Switch: 2A/70V
- Programmable Switching Frequency: 250kHz to 1.5MHz
- UVLO Programmable on SWEN Pin
- Soft-Start Programmable with One Capacitor
- Small 20-Lead QFN or 20-Lead TSSOP Packages

APPLICATIONS

- Automotive ECU Power
- Power for Portable Products
- Industrial Supplies

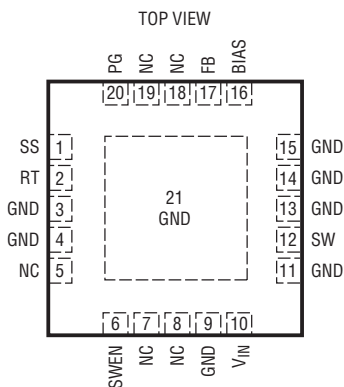
DESCRIPTION

The LT8494 is an adjustable frequency (250kHz to 1.5MHz) monolithic switching regulator. Quiescent current can be less than 7 μ A when operating and is ~0.3 μ A when SWEN is low. The LT8494 can be configured as either a SEPIC, boost or flyback converter.

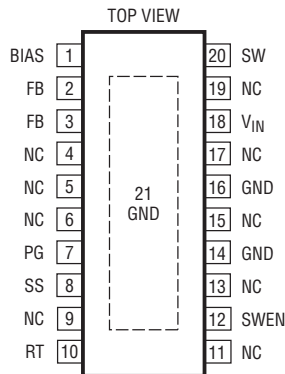
The low ripple Burst Mode operation maintains high efficiency at low output current while keeping output ripple below 10mV. Dual supply pins (V_{IN} and BIAS) allow the part to automatically operate from the most efficient supply. Input supply voltage can be up to 60V for SEPIC topologies and up to 32V (with ride-through up to 60V) for boost and flyback topologies. After start-up, battery life is extended since the part can draw current from its output (BIAS) even when V_{IN} voltage drops below 2.5V.

Using a resistor divider on the SWEN pin provides a programmable undervoltage lockout (UVLO) for the converter. A power good flag signals when V_{OUT} reaches 92% of the programmed output voltage.

Additional features such as frequency foldback and soft-start are integrated. The LT8494 is available in 20-lead QFN and 20-lead TSSOP packages with exposed pads for low thermal resistance. Fault tolerance in the TSSOP allows for adjacent pin shorts or an open without raising the output voltage above its programmed value.

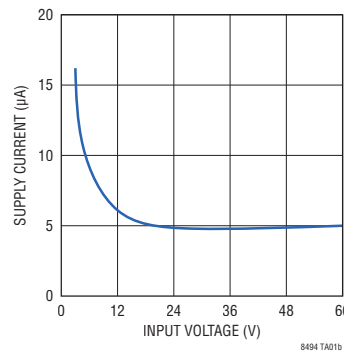


UF PACKAGE
20-LEAD (4mm × 4mm) PLASTIC QFN
LT8494EUF
LT8494IUF

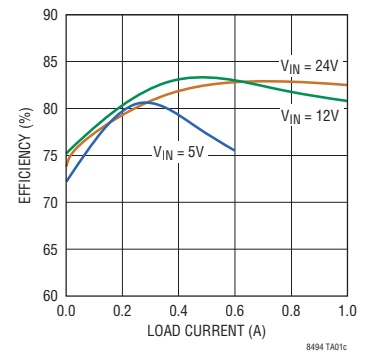


FE PACKAGE
20-LEAD PLASTIC TSSOP
LT8494EFE
LT8494IFE
LT8494HFE

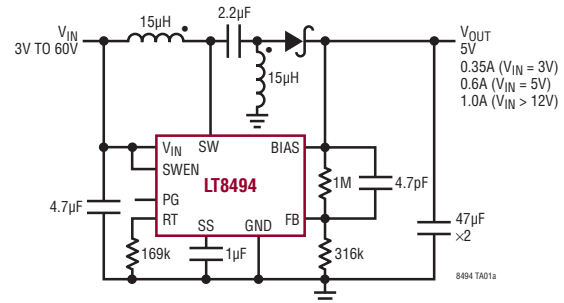
No-Load Supply Current



Efficiency



450kHz, 5V Output SEPIC Converter



LT8602 42V Quad Monolithic Synchronous Step-Down Regulator

FEATURES

- Flexible Power Supply System Providing Four Outputs with a Wide Input Range
- Two High Voltage Synchronous Buck Regulators:
 - 3V to 42V Input Voltage Range
 - Output Currents Up to 2.5A and 1.5A
 - High Efficiency Up to 93%
- Two Low Voltage Synchronous Buck Regulators:
 - 2.6V to 5.5V Input Voltage Range
 - Output Currents Up to 1.8A and 94% Efficiency
- Resistor Programmable and Synchronizable 250kHz to 2.2MHz Switching Frequency
- Low Ripple Burst Mode Operation:
 - 30μA I_Q at 12V_{IN}
 - Output Ripple < 15mV
- Programmable Power-On Reset
- Power Good Indicators
- 2-Phase Clock Reduces Input Current Ripple
- Available in Thermally Enhanced 40-Lead QFN (6mm × 6mm) Package

APPLICATIONS

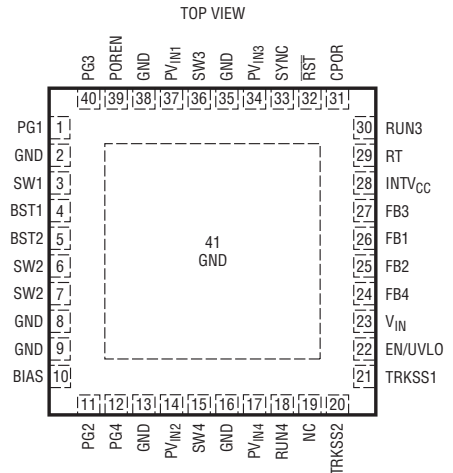
- Automotive Systems
- Distributed Supply Regulation
- Industrial Controls and Power Supplies

DESCRIPTION

The LT8602 is a quad channel, current mode, monolithic buck switching regulator with a programmable power-on reset. All regulators are synchronized to a single oscillator with an adjustable frequency from 250kHz to 2.2MHz. The LT8602 can be configured for micropower Burst Mode operation or pulse-skipping operation at light load. Micropower operation results in quiescent current of 30μA with all four regulators operating in the application below.

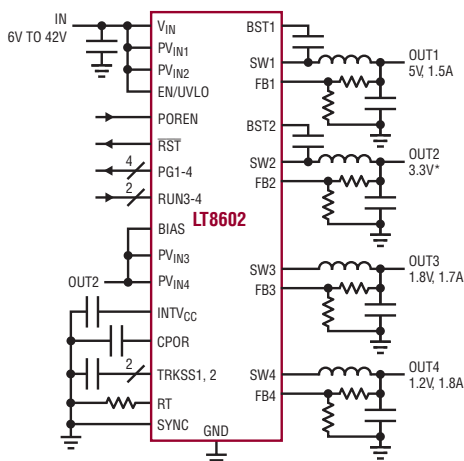
The high voltage channels are synchronous buck regulators that operate from an input of 3V to 42V. The output currents are up to 1.5A (OUT1) and 2.5A (OUT2). The low voltage channels operate from an input of 2.6V to 5.5V. Internal synchronous power switches provide high efficiency with output currents up to 1.8A. The LT8602 uses a 2-phase clock with channels 1 and 3 operating 180° from channels 2 and 4 to reduce input ripple current on both HV and LV inputs. All channels have cycle-by-cycle current limit, providing protection against shorted outputs. Thermal shutdown provides additional protection.

The LT8602 is available in a 40-lead 6mm × 6mm QFN package.



UJ PACKAGE
40-LEAD (6mm × 6mm) PLASTIC QFN
LT8602EUJ
LT8602IUJ

5V, 3.3V, 1.8V and 1.2V Step-Down Regulators



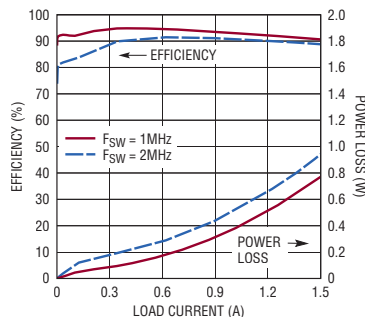
$$I_{OUT2} = 2.5A - I_{PVIN3} - I_{PVIN4}$$

8602 TA01a

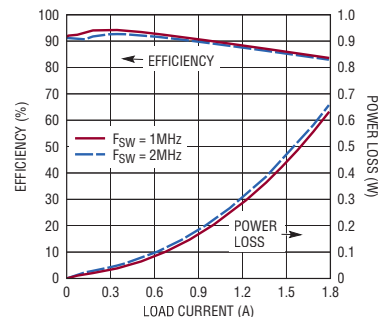
8602 TA01b

8602 TA01c

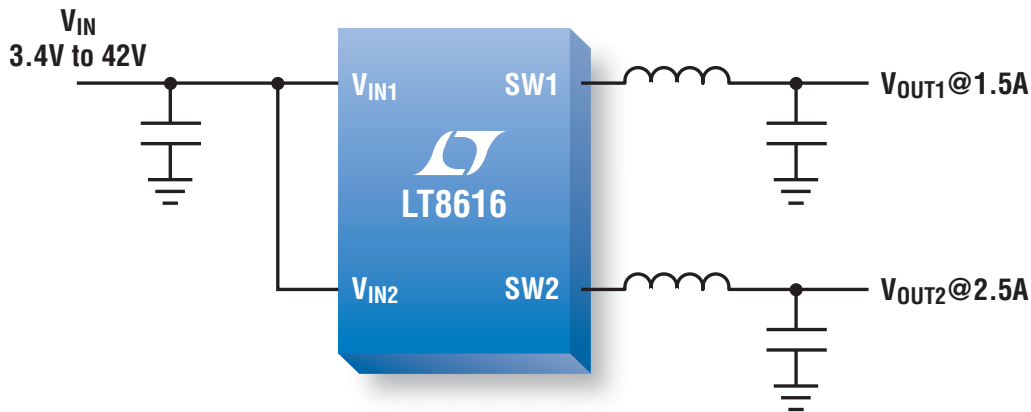
HV Channel Efficiency,
V_{IN} = 12V, V_{OUT1} = 5V



LV Channel Efficiency,
V_{OUT3} = 1.8V



DUAL 42V, 2MHz Sync Buck



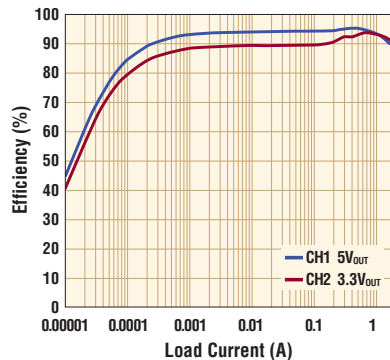
96% Efficient, 2.5A and 1.5A Outputs, 6.5 μ A I_Q

The LT[®]8616 brings a new level of performance for 42V input monolithic synchronous buck converters by incorporating dual outputs in a FMEA compliant 28-pin package. Channel 1 is capable of delivering 1.5A of continuous output current, while channel 2 can deliver 2.5A, both with outputs as low as 0.8V. Each channel operates 180° out of phase to further reduce input ripple. Burst Mode[®] operation requires only 6.5 μ A of quiescent current (both channels on), thereby extending battery life in battery-powered systems. For high step-down ratio applications, the LT8616 bucks from 16V down to 1.5V at a switching frequency of 2MHz, enabling a compact solution footprint.

Features

- Input Voltage Range: 3.4V to 42V
- Dual Outputs: 2.5A and 1.5A
- Ultralow Quiescent Current: 6.5 μ A (Both Channels On)
- Low Output Ripple: < 10mV_{P-P}
- Adjustable/Synchronizable Frequency: 200kHz to 3MHz
- High Step-Down Ratios: 16V to 1.5V@2MHz
- 28-Lead 3mm x 6mm QFN and FMEA Compliant TSSOP-28E Packages

Efficiency with
12V_{IN} to 5V_{OUT} and 3.3V_{OUT}



Info & Free Samples

www.linear.com/product/LT8616

www.linear.com/LT86XX

1-800-4-LINEAR

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LT8616 Dual 42V Synchronous Monolithic Step-Down Regulator with 6.5µA Quiescent Current

FEATURES

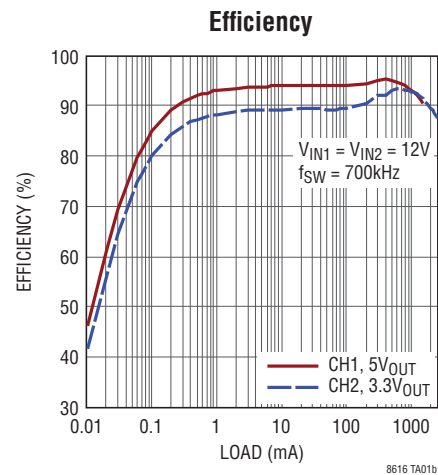
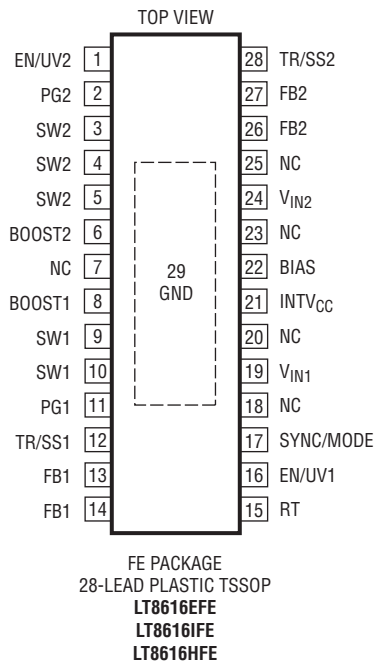
- **Wide Input Voltage Range: 3.4V to 42V**
- **2.5A and 1.5A Buck Regulators with Separate Inputs**
- **Fast Minimum Switch On-Time: 35ns**
- **Ultralow Quiescent Current Burst Mode Operation:**
 - **6.5µA I_Q Regulating 12V_{IN} to 5V_{OUT} and 3.3V_{OUT}**
 - **Output Ripple < 15mV**
- 180° Out-of-Phase Switching
- Adjustable and Synchronizable: 200kHz to 3MHz
- Accurate 1V Enable Pin Thresholds
- Internal Compensation
- Output Soft-Start and Tracking
- TSSOP Package: Output Stays at or Below Regulation Voltage During Adjacent Pin Short or When a Pin Is Left Floating
- Thermally Enhanced 28-Lead TSSOP Package

APPLICATIONS

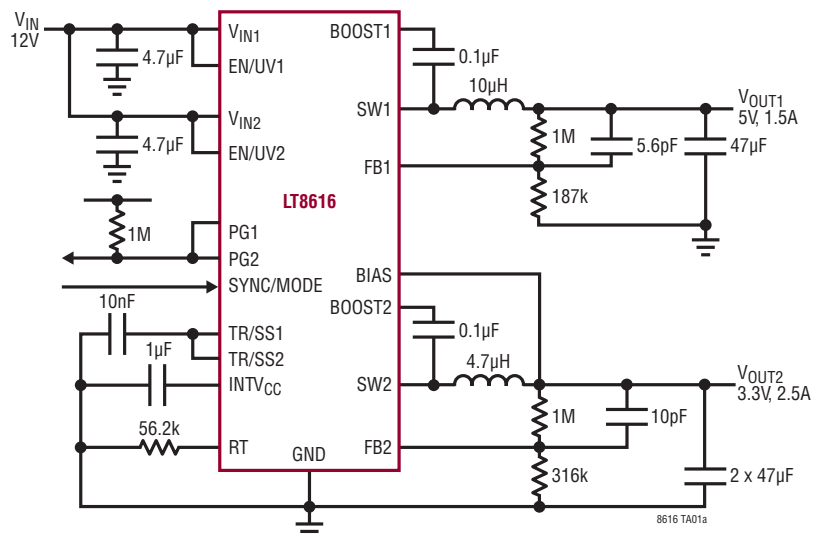
- Automotive and Industrial Supplies
- General Purpose Step-Down

DESCRIPTION

The LT8616 is a high efficiency, high speed, dual synchronous monolithic step-down switching regulator that consumes only 6.5µA of quiescent current with both channels enabled. Both channels contain all switches and necessary circuitry to minimize the need for external components. Low ripple Burst Mode operation enables high efficiency down to very low output currents while minimizing output ripple. A SYNC pin allows synchronization to an external clock. Internal compensation with peak current mode topology allows the use of small inductors and results in fast transient response and good loop stability. The enable pins have accurate 1V thresholds and can be used to program undervoltage lockout. Capacitors on the TR/SS pins programs the output voltage ramp rate during start-up while the PG pins signal when each output is within 10% of the programmed output voltage. The LT8616 is available in a TSSOP package for high reliability.



5V, 3.3V, 700kHz Step-Down Converter



LT8631 100V, 1A Synchronous Micropower Step-Down Regulator

FEATURES

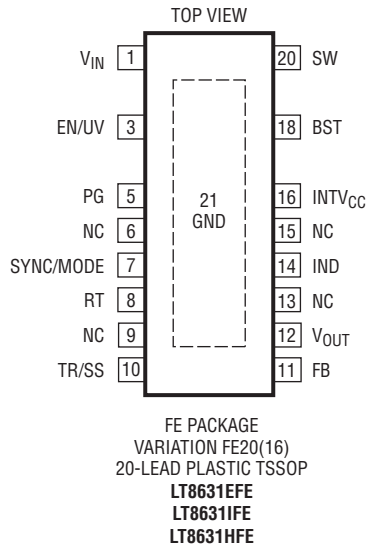
- **Ultrawide Input Voltage Range: 3V to 100V**
- **Output Voltage Range: 0.8V to 60V**
- **Internal Synchronous Switches**
- **Low Ripple Burst Mode Operation:**
 $16\mu\text{A } I_Q$ at 12V_{IN} to 5V_{OUT} Output Ripple $<10\text{mV}_{\text{p-p}}$
 $7\mu\text{A } I_Q$ at 48V_{IN} to 5V_{OUT} Output Ripple $<10\text{mV}_{\text{p-p}}$
- **Low Dropout: 99% Maximum Duty Cycle**
- **Peak Current Mode Control**
- **Fixed Frequency Operation: 100kHz to 1MHz**
- **Synchronization Input**
- **Programmable Undervoltage Lockout**
- **Power Good Flag**
- Flexible Output Voltage Tracking
- Short-Circuit Protection
- Low Shutdown Current: $5\mu\text{A}$
- Tolerates Pin Open/Short Faults
- Thermally Enhanced 20-Lead TSSOP with High Voltage Lead Spacing

APPLICATIONS

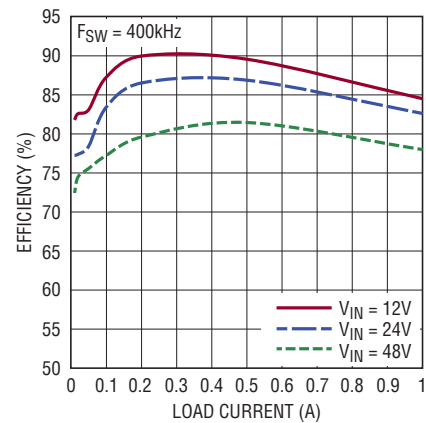
- Automotive Supplies
- Telecom Supplies
- Distributed Supply Regulation

DESCRIPTION

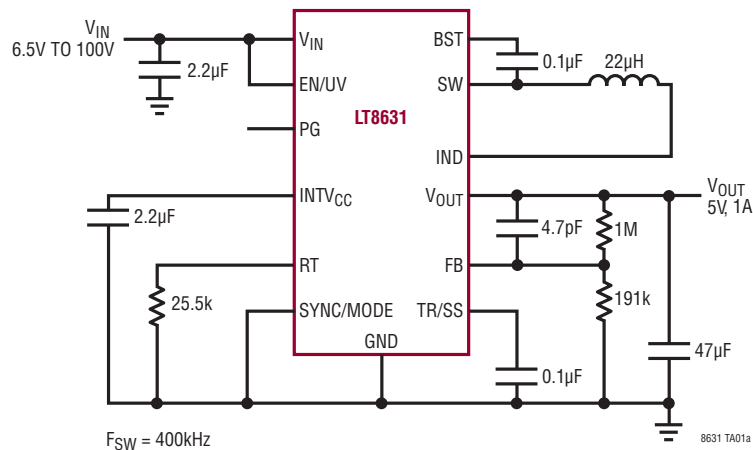
The LT8631 is a current mode PWM step-down DC/DC converter with internal synchronous switches that provide current for output loads up to 1A. The wide input range of 3V to 100V makes the LT8631 suitable for regulating power from a wide variety of sources, including automotive and industrial systems and 36V to 72V telecom supplies. Low ripple Burst Mode operation enables high efficiency operation down to very low output currents while keeping the output ripple below $10\text{mV}_{\text{p-p}}$. Resistor programmable 100kHz to 1MHz frequency range and synchronization capability enable optimization between efficiency and external component size. The soft-start feature controls the ramp rate of the output voltage, eliminating input current surge during start-up, while also providing output tracking. A power good flag signals when the output voltage is within $\pm 7.5\%$ of the regulated output. Undervoltage lockout can be programmed using the EN/UV pin. Shutdown mode reduces the total quiescent current to $<5\mu\text{A}$. The LT8631 is available in a 20-lead TSSOP package with exposed pad for low thermal resistance and high voltage lead spacing.



Efficiency vs Load Current



5V, 1A Step-Down Converter



LTC2984

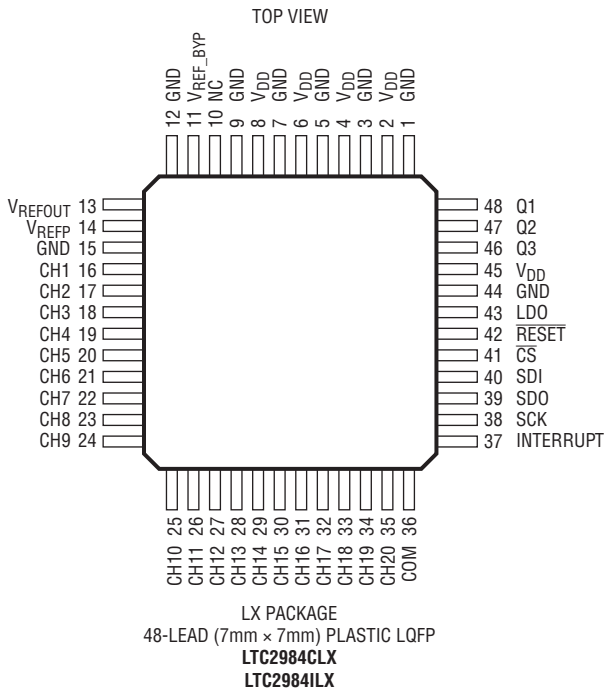
Multi-Sensor High Accuracy Digital Temperature Measurement System with EEPROM

FEATURES

- Directly Digitizes 2-, 3-, or 4-Wire RTDs, Thermocouples, Thermistors, and Diodes
- On-Chip EEPROM Stores Channel Configuration Data and Custom Coefficients
- Single 2.85V to 5.25V Supply
- 20 Flexible Inputs Allow Interchanging Sensors
- Automatic Thermocouple Cold Junction Compensation
- Built-In Standard and User-Programmable Coefficients for Thermocouples, RTDs and Thermistors
- Measures Negative Thermocouple Voltages
- Automatic Burn Out, Short-Circuit and Fault Detection
- Buffered Inputs Allow External Protection
- Simultaneous 50Hz/60Hz Rejection
- Includes 15ppm/°C (Max) Reference (I-Grade)

APPLICATIONS

- Direct Thermocouple Measurements
- Direct RTD Measurements
- Direct Thermistor Measurements
- Custom Sensor Applications

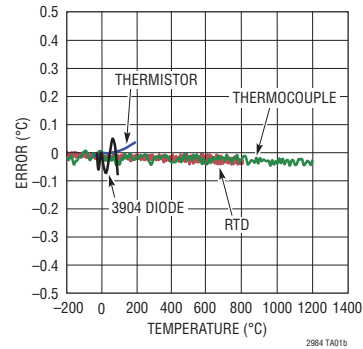


DESCRIPTION

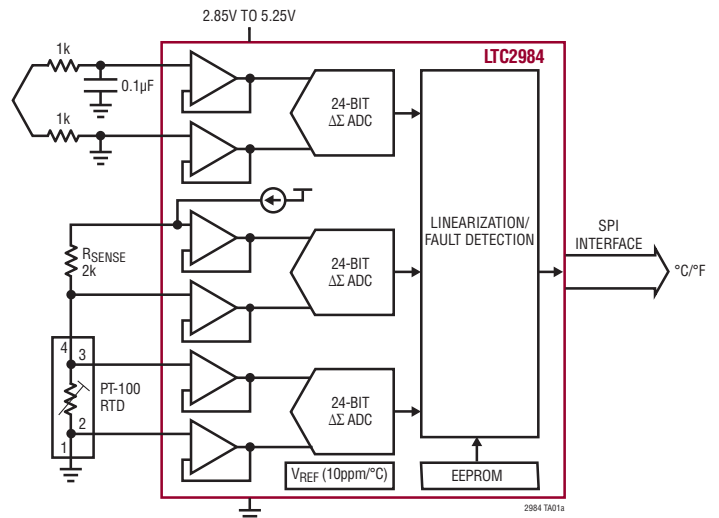
The LTC2984 measures a wide variety of temperature sensors and digitally outputs the result, in °C or °F, with 0.1°C accuracy and 0.001°C resolution. The LTC2984 can measure the temperature of virtually all standard (type B, E, J, K, N, S, R, T) or custom thermocouples, automatically compensate for cold junction temperatures and linearize the results. The device can also measure temperature with standard 2-, 3-, or 4-wire RTDs, thermistors, and diodes. It has 20 reconfigurable analog inputs enabling many sensor connections and configuration options. The LTC2984 includes excitation current sources and fault detection circuitry appropriate for each type of temperature sensor as well as an EEPROM for storing custom coefficients and channel configuration data.

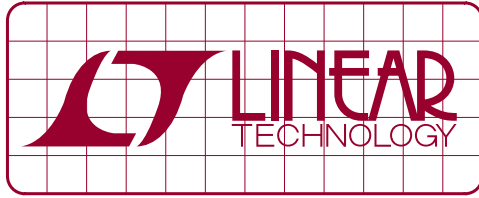
The LTC2984 allows direct interfacing to ground referenced sensors without the need for level shifters, negative supply voltages or external amplifiers. All signals are buffered and simultaneously digitized with three high accuracy, 24-bit $\Delta\Sigma$ ADCs, driven by an internal 10ppm/°C (maximum) reference.

Typical Temperature Error Contribution



Thermocouple Measurement with Automatic Cold Junction Compensation





DESIGN NOTES

Micropower Op Amp Drives 8-Channel 18-Bit Simultaneous Sampling ADC without Compromising Accuracy or Breaking the Power Budget

Design Note 541

Guy Hoover

Introduction

The op amps used to drive 18-bit analog-to-digital converters (ADCs) typically draw as much supply current as the ADC itself, often with a maximum offset spec that is well above that of the ADC. If multiple ADC channels are required, the power dissipation from these drivers quickly rises to unacceptable levels.

If 18-bit precision is required (SNR, THD, V_{OS}), but not high sampling rates, and the input signals are low frequency or DC, the simple buffer presented is capable of driving the LTC[®]2348-18 8-channel simultaneous sampling ADC. It also achieves performance equivalent to typical specs for SNR, THD and offset performance with very low power dissipation.

Circuit Description

The LTC2348-18 is a low noise, 8-channel simultaneous sampling 18-bit successive approximation register (SAR) ADC with wide input common mode range. With a $\pm 10.24V$ input range, the LTC2348-18 achieves $-109dB$ THD (typical), $96.7dB$ SNR (typical) with an offset of $\pm 550\mu V$ (maximum) while dissipating only $140mW$ (typical) at $200ksps$. When operated at the $10ksps$ rate of this application, the ADC's power consumption drops to $45mW$ (typical) by using the device's NAP mode.

The LT6020 is a dual micropower, $5V/\mu s$ precision rail-to-rail output op amp with input offset voltage of less than $30\mu V$ (maximum) that draws only $100\mu A$ per amplifier (maximum).

The circuit of Figure 1 shows the LT6020 op amp configured as a noninverting buffer driving the analog inputs of the LTC2348-18. Maximum power dissipation of each op amp is only $3mW$. For all eight channels this adds up to only $24mW$, approximately half the ADC power consumption at $10ksps$.

The RC filter at the buffer output minimizes the noise contribution of the LT6020 and reduces the effect of the sampling transient caused by the MUX and the input sampling capacitor. For a chosen RC time constant, the R value should be kept as small as possible to reduce the voltage drop across the resistor. This results in a gain error if the filter output is not allowed to settle completely. The R value must be large enough to prevent excessive ringing at the op amp output, which adds to settling time and increases distortion.

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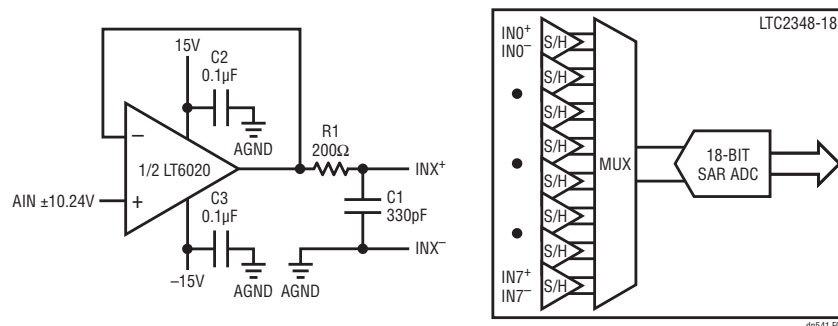


Figure 1. LT6020 Buffer Driving the LTC2348-18 8-Channel Simultaneous Sampling SAR ADC

The LTC2348-18 accepts arbitrary differential input signals swinging over a wide common mode range. Differential signals may be buffered into the positive and negative analog inputs using two unity-gain amplifiers. Pseudo-differential input signals referenced to a low impedance node such as ground require only one buffer amplifier. This second case is used by the circuit in Figure 1.

Circuit Performance

All data and curves shown were taken with the DC2094A-A. Improved performance may be possible by holding t_{ACQ} constant at $12\mu s$ while varying the sample rate. Figure 2 shows an 8192-point FFT of the LTC2348-18 driven pseudo-differentially by the buffer of Figure 1. THD is -108dB and SNR is 95.8dBFS at 10ksps , which compares well with the typical specs of the LTC2348-18.

Figure 3 shows SNR and THD vs sampling rate. SNR stays fairly flat near 96dBFS up to 10ksps . THD starts to rise above -108dB at 10ksps .

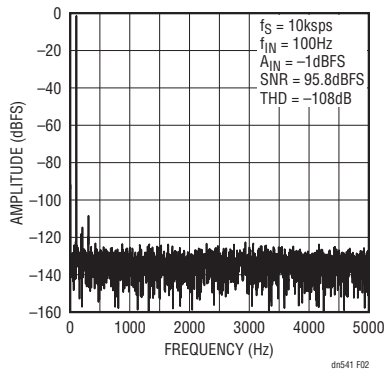


Figure 2. 8192-Point FFT for the Circuit of Figure 1

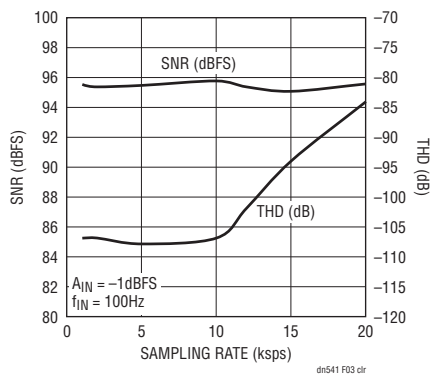


Figure 3. SNR and THD vs Sampling Rate for the Circuit of Figure 1

Figure 4 shows SNR and THD vs input frequency. Both SNR and THD slowly degrade from the typical specs of the LTC2348-18 above 100Hz until at 1kHz SNR is 94dBFS and THD is -85dB .

Figure 5 shows the combined offset error of the LT6020 driver and ADC vs sampling rate. Offset is initially less than 1LSB and starts to degrade as the sampling rate exceeds 10ksps .

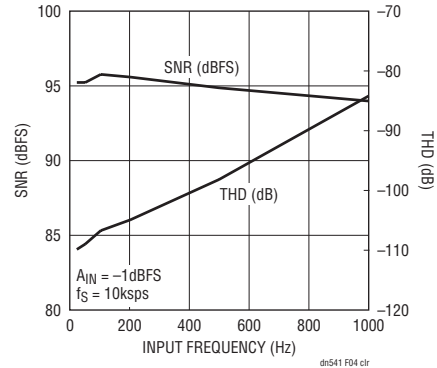


Figure 4. SNR and THD vs Input Frequency for the Circuit of Figure 1

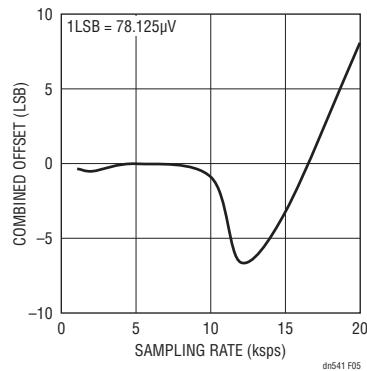


Figure 5. Combined ADC and Driver Offset vs Sampling Rate for the Circuit of Figure 1

Conclusion

A simple driver for the LTC2348-18 18-bit, 200ksps , 8-channel simultaneous sampling SAR ADC—consisting of the LT6020 low power precision dual op amp configured as noninverting buffers—dissipates only 3mW per op amp (maximum), and at 10ksps the LTC2348-18 dissipates only 45mW . At a sampling rate of 10ksps , SNR is measured at 95.8dB , THD -109dB and offset is measured at less than 1LSB .

Data Sheet Download

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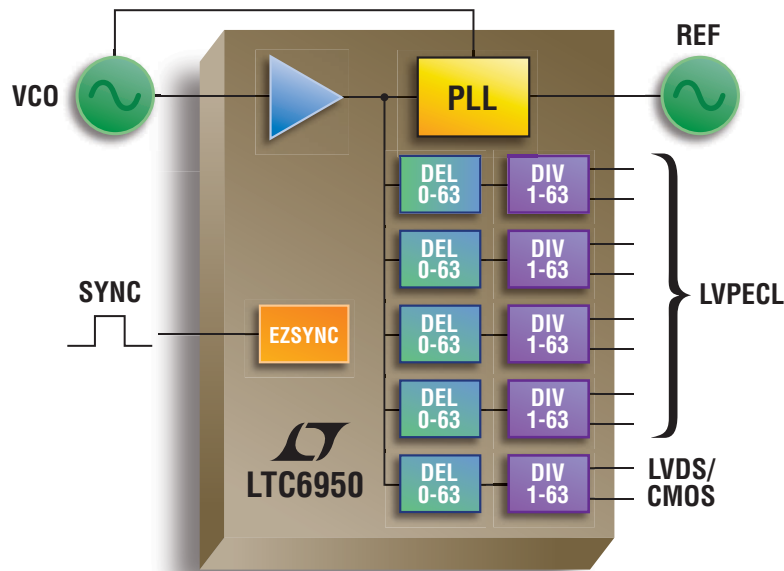
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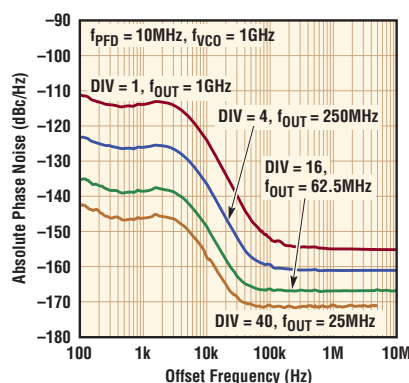
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