Linear Technology Chronicle

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Product of the Month

Dual Input Battery Backup Regulator Provides Glitch-Free 300mA Output

The **LT®1579** is a dual input, single output, low dropout regulator designed to provide an uninterruptible output voltage from two independent input sources. All of the circuitry needed to switch smoothly and automatically between inputs is incorporated on chip. It can supply up to 300mA of output current from either input with a dropout voltage of only 0.5V and its output tolerance is maintained at 3% over line, load and temperature variations. The backup supply voltage can be higher or lower than the primary supply. Quiescent current under no-load conditions is 50µA and drops to 7µA in shutdown for extended battery life. The LT1579 is available with fixed 3V, 3.3V and 5V outputs or with an adjustable output voltage covering a range of 1.5V to 20V. It is ideal for powering portable instruments, where it is critical that data not be lost due to discharged batteries.

The LT1579 incorporates two comparators to monitor the voltage status of both inputs. Two additional status flags indicate which input is supplying power and provide an early warning against loss of output regulation. A secondary select ($\overline{SS}$) pin is also provided, so that the user can force the device to switch from the primary input to the secondary input, useful when changing the primary source. A single error amplifier controls both output stages so regulation remains tight regardless of which input is providing power. Threshold levels for the low-battery detectors are independently set with external resistors. Figure 1 shows a 5V output with dual battery supply.

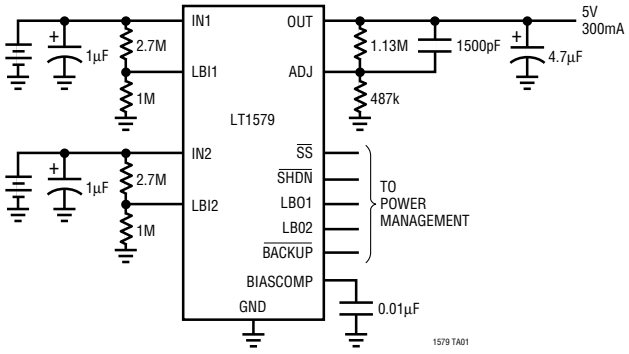

Figure 1. The LT1579 Provides a 5V Output Voltage from Two Independent Input Battery Sources. No Protection Diodes Are Required

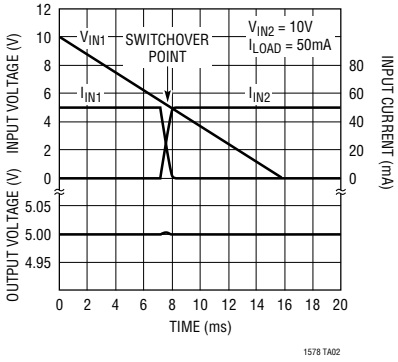

Figure 2. If the Primary Input of the LT1579 Is Supplying Load Current, Removal and Insertion of the Secondary Input Creates No Noticeable Transient at the Output

The LT1579 has built-in protection against the reverse installation of batteries by blocking reverse current flow. This eliminates the need for external diodes as required in previous solutions. Thermal limit and short circuit current limit protect the device from fault conditions on the output.

As shown in Figure 2, the LT1579 provides a smooth output voltage and maintains regulation when switching from the primary input to the secondary. Removal and insertion of the secondary input creates no noticeable transient at the output even if one of the inputs is instantaneously removed.

The LT1579 comes in 16-pin SO and SSOP packages with all the aforementioned features. A reduced feature-set version is also available in an SO-8 package for lower cost applications. For a data sheet and evaluation samples, contact your local Linear Technology sales office or visit our web site at **www.linear-tech.com** for more information.

Inside This Issue:

SMBus Dual High Side Switch Controller Simplifies Power Management in Portables

The **LTC®1623** controls two N-channel MOSFETs in high side switching applications under SMBus control. This serial bus interface standard uses just two lines, DATA and CLK, to control low power peripheral devices in portable equipment (see Figure 1). The LTC1623 operates with an input voltage from 2.7V to 5.5V and draws a standby current of only 17µA. An internal charge pump is used to boost the output gate drive to fully enhance the external N-channel MOSFETs. The LTC1623 in the 8-lead MSOP package is ideally suited for power plane switching in laptop computers and in other space restricted applications requiring power control.

The master of the SMBus always initiates communications to its slave devices by varying the status of the DATA and CLK lines. Using the 2-wire interface, the LTC1623 monitors the bus for a start condition. Once this condition is detected, the LTC1623 compares its address with the first address byte sent over the bus from the master. If matched, the LTC1623 will execute the second command byte from the master and either turn on or off the external N-channel switches. A digital "1" turns on the charge pump to drive up the output gate voltage while a digital "0" shuts down the charge pump and discharges the output gate voltage to zero.

As shown in Figure 1, the LTC1623 has two 3-level programmable address pins (AD1 and AD0), thus allowing 8 different addresses and a total of 16 available switches on the same bus. To conserve standby current, the address pins are tied to either V_{CC} or GND. If more than four addresses are needed, then either one of the address pins can be tied to a third state of half the supply voltage or V_{CC} /2.

To fully enhance the external N-channel MOSFETs, an internal charge pump is used to boost the output gate drive to a minimum of 2.7V and a maximum of 6V above V_{CC} (see Figure 2). The LTC1623 has an internal power-on reset and internal undervoltage lockout. It is offered in both commercial and industrial temperature ranges and available in 8-lead MSOP and SO packages. Contact your local Linear Technology sales office for a data sheet and evaluation samples, or visit our web site at **www.linear-tech.com** for more information.

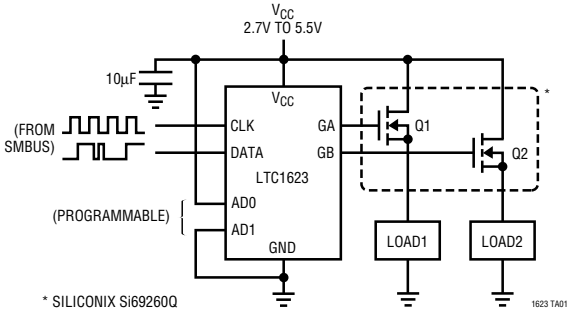

Figure 1. The LTC1623 Uses the 2-Wire Interface, CLK and DATA, to Monitor the SMBus for Start Conditions and Has Two Three-State Programmable Address Pins (AD0 and AD1)

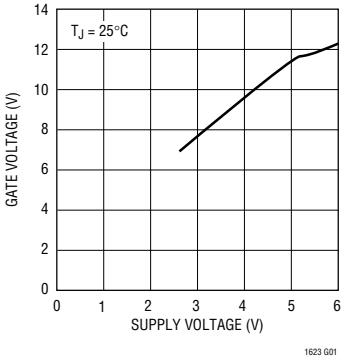

Figure 2. Gate Drive Voltage. To Fully Enhance the External N-Channel MOSFETs, an Internal Charge Pump Is Used to Boost the Output Gate Drive to a Minimum of 2.7V and a Maximum of 6V Above V_{CC}

World's Smallest Micropower 600kHz PWM DC/DC Converters Operate from 2-Cell Input

The **LT1317/LT1317B** are micropower 600kHz PWM DC/DC converters that operate over an input voltage range as low as 1.5V from two cells. With light loads, the LT1317 automatically shifts into high efficiency Burst Mode™ operation, resulting in less power consumption and extended battery life. High efficiency is maintained over a 300µA to 100mA load range, as shown in Figure 1. The LT1317B maintains constant frequency PWM operation under light loads and, while less efficient, eliminates some of the output voltage ripple that is a natural consequence of Burst Mode operation. Their 600kHz operation allows low profile, small magnetics to be used. The LT1317/LT1317B are available in 8-pin MSOP and SO packages which also save board space. Fixed frequency operation also keeps switching noise from sensitive 455kHz IF bands, important for cellular phone, pager and other wireless applications.

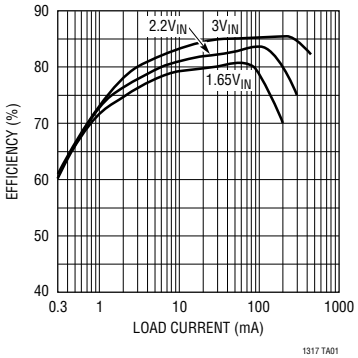

Figure 1. The LT1317 as a 2-Cell to 3.3V Boost Converter Provides High Efficiency Operation as Shown for Input Voltages of 1.65V, 2.2V and 3V. Automatic Burst Mode Operation Occurs with the LT1317 Under Light Loads to Maintain Efficiency

Figure 2 shows the LT1317 as a 2-cell to 3.3V step-up converter. No-load quiescent current is 100µA and 30µA in shutdown.

Burst Mode is a trademark of Linear Technology Corporation.

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Application of the Month

Switcher Generates Two Bias Voltages without Transformer

LCD displays and CCD imaging circuits in today's portable products require several bias voltages from a 10V to 20V input at a few milliamps. When symmetric bipolar bias supplies are needed, the negative supply can be generated with a discrete charge pump operating from the power switch of the boost regulator that generates the positive supply. However, an asymmetric bipolar supply is typically required: for example, 20V and –10V for LCD displays or 15V and –7.5V for CCDs. One possible solution is to add a linear regulator to the negative output; this adds cost and greatly reduces the efficiency of the switcher. Another possibility is a 2-output flyback circuit, but the added cost and bulk of a transformer make this solution unappealing. The circuit in Figure 1 avoids these penalties, producing 20V at 5mA and –10V at 5mA from 3.3V with 73% efficiency. The circuit uses standard surface mount parts.

The LT1316, a micropower Burst Mode switching regulator with an integrated 0.6A power switch, operates in an ordinary boost circuit to generate the 20V (V_{OUT1}) set by resistor divider R1 and R2. An internal comparator at the FB pin regulates the output by gating the LT1316's oscillator. A charge pump (C2 and associated diodes) coupled to the LT1316's switch pin generates the negative output voltage. This negative output (V_{OUT2}) is monitored by the LT1316's low-battery detector through the resistor divider R3 and R4, using the positive 20V output as a reference. When the negative output falls below 10V, the low-battery detector output (LBO pin and lowest trace in Figure 2) turns Q1 on, enabling the charge pump and charging output capacitor C4. Note that the switch pin jumps between ground and ~10V during this period. Once the negative output has been charged enough to overcome the low-battery detector's hysteresis, Q1 turns off and the switch pin is free to fly to 20V, charging the positive output.

This circuit can also operate directly from two alkaline or NiCd cells. Slightly higher peak currents are necessary; change R5, which determines the peak switch current of the LT1316, to 6.8kΩ and change L1 to 15µH.

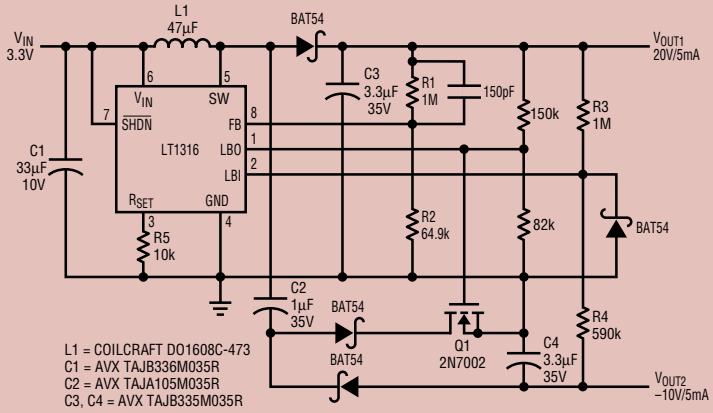

Figure 1. By Gating the Charge Pump, This Circuit Generates a Regulated Negative Output with a Magnitude Different from That of the Positive Output

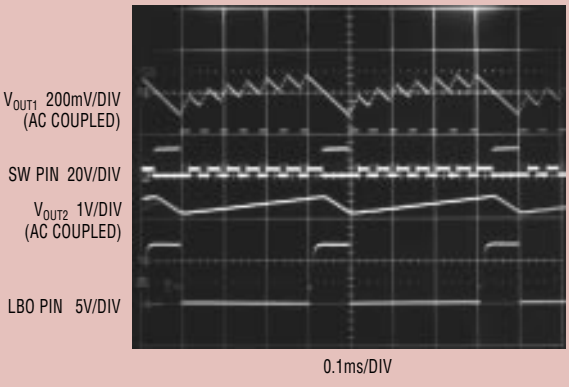

Figure 2. Voltage Waveforms of Figure 1's Circuit

Isolated Flyback Regulator for PCMCIA Ethernet Applications Regulates Tightly Without Optoisolators

The **LT1424-9** switching regulator delivers an isolated –9V for Ethernet applications, providing ±5% output regulation without the need for optoisolators or an extra primary-side transformer winding. Using standard magnetics, the whole solution fits within the PCMCIA II height restriction. Because of its unique feedback architecture, excellent output regulation is provided over a very wide range of load current. The LT1424-9 is ideal for low voltage circuitry, such as local area networks (LANs) and telephone interfaces that require isolated power supplies.

The LT1424-9 operates at a nominal 285kHz switching frequency and can be synchronized from 320kHz to 450kHz by an external system clock. One of the benefits of the 285kHz operation is that there are no harmonics located close to the 455kHz IF radio frequency, thus avoiding potential RFI problems in telecommunications equipment.

It has a 1.35A onboard switch and can deliver up to 200mA at –9V output from a 5V source, as required in Ethernet applications (see Figure 1). Quiescent current is 7mA and in shutdown mode the total supply current reduces to just 20µA for standby operation. It also has unique control circuitry to maintain regulation well into discontinuous mode.

The LT1424-9 is packaged in a thermally enhanced 8-lead SO package which has a low thermal resistance and is screened to the commercial and industrial temperature ranges.

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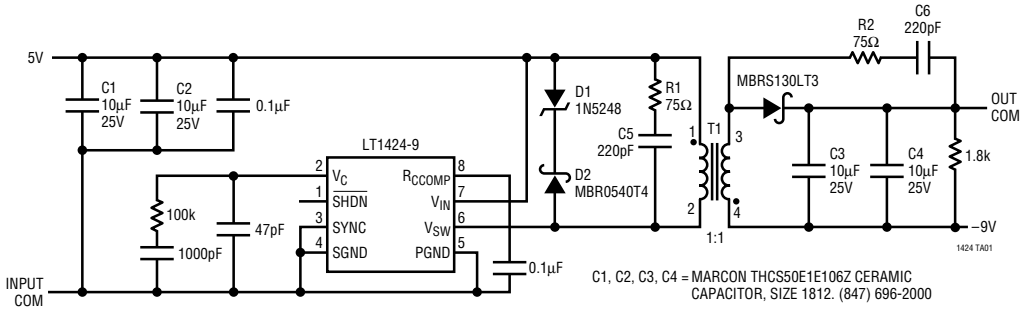

Figure 1. LT1424-9's Isolated Flyback Topology Allows Sensing of the Output Voltage Directly from the Primary-Side Flyback Waveform Without Using an Optoisolator or Extra Primary-Side Transformer Winding

LT1317/LT1317B from page 2

Its internal NPN power switch handles a 650mA current with a voltage drop of just 350mV. Peak switch current during Burst Mode operation is kept below 250mA for most operating conditions which results in an low output ripple voltage, even at high input voltages.

The LT1317/LT1317B contain an internal low-battery detector with a 1.24V reference that stays alive when the device goes into shutdown. They are available in 8-lead MSOP and SO packages and pin-for-pin compatible with the LT1307/LT1307B. Delivery is from stock. A data sheet and evaluation samples are available by contacting your local Linear Technology sales office. For more information, visit our web site at **www.linear-tech.com**.

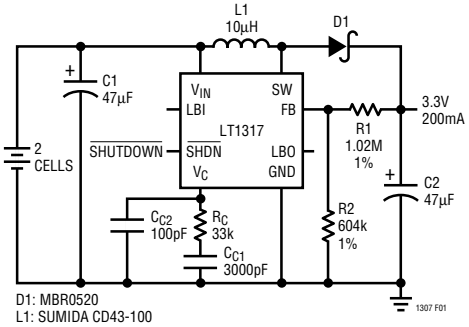

Figure 2. The LT1317/LT1317B Operate from Two Battery Cells with an Input Voltage as Low as 1.5V. They Have a Low-Battery Detector That Is Active in Shutdown