

Product of the Month

Low Noise, Micropower, Low Dropout Regulators Withstand Reverse Voltage—LT1762 and LT1763

The LT[®]1762 and LT1763 are very low noise, low dropout linear regulators. The LT1762 is rated for 150mA of output current, whereas the LT1763 is rated for 500mA. For supply flexibility and good efficiency, the input voltage of these regulators can be as low as 350mV (maximum dropout voltage) above the output at maximum rated current. The regulators are designed for use in battery-powered systems with 25 μ A operating current for the LT1762 and 30 μ A for the LT1763. Both regulators feature a 0.1 μ A shutdown state. Quiescent current is well controlled for these devices; it does not rise in dropout—when the input to output voltage differential is below the dropout rating—as is the case with many other regulators.

The LT1762 and LT1763 regulators feature low noise operation. With the addition of an external 0.01 μ F bypass capacitor, output voltage noise over the 10Hz to 100kHz bandwidth is reduced to <30 μ V_{RMS} (Figures 1 and 2). Both regulators can operate with output capacitors as low in value as 2.2 μ F for the LT1762 and 4.7 μ F for the LT1763. Small ceramic capacitors can be used with either device without the need for additional series resistance as is common

with other regulators. Internal protection circuitry on both regulators includes reverse-battery protection, current limiting, thermal limiting and reverse-current protection. No protection diodes are required.

Both regulators are available in fixed output voltages of 2.5V, 3V, 3.3V and 5V or as an adjustable device with an output range of 1.22V to 20V. The LT1762 is packaged in an 8-lead MSOP and the LT1763 is available in an 8-lead SO package. These regulators can be paralleled for more output current if required. 

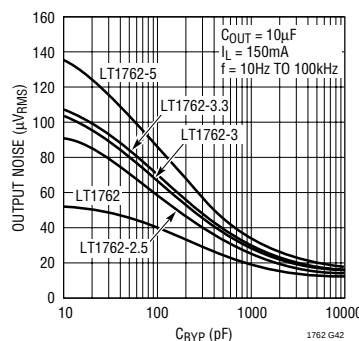


Figure 2. LT1762 RMS Output Noise vs Bypass Capacitor

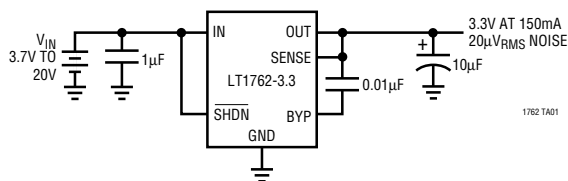


Figure 1. 3.3V Low Noise Regulator

Positive High Voltage Hot Swap Controller—LT1641

When a circuit board is inserted into a live backplane, the supply bypass capacitors on the board draw high peak currents from the backplane power bus as they charge. The transient currents can permanently damage the connector pins and cause glitches on the system supply, causing other boards in the system to reset.

The LT1641 is designed to turn on a board's supply voltage in a controlled manner (Figure 1), allowing the board to be safely inserted into or removed from a live backplane. A high side switch driver controls an N-channel pass transistor in the power path (Q1 in Figure 2) for supply voltages ranging from 9V to 80V. The LT1641 is tested and guaranteed to be safe from damage with supply voltages up to 100V and may be connected directly to 24V and 48V supplies without floating grounds or level shifting of logic signals. The device provides undervoltage and overcurrent protection and a power good signal that indicates when the output supply voltage is ready. It comes in an 8-lead SO package.

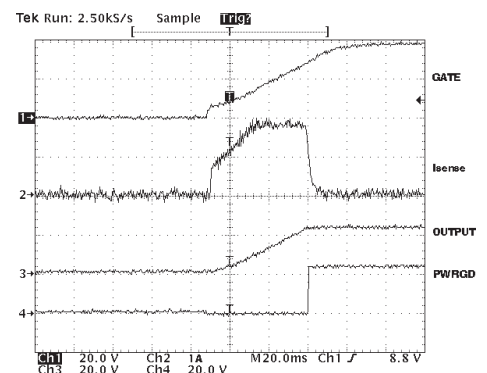


Figure 1. LT1641 Power-Up Waveforms

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Application of the Month

High Efficiency Linear and Switching Solutions for Splitting a Digital Supply—LT1118 and LTC1504

This note presents two methods of creating a split supply with good transient response and minimal supply current in a 5V-only system.

The LT1118 is a linear regulator designed to source or sink current to keep its output in regulation. It draws 600 μ A of quiescent current typically and can source 800mA or sink 400mA, enough to satisfy most analog subsystems. The LT1118 requires only two external components (Figure 1) and has a DC output impedance below 0.1 Ω . The LT1118 provides nearly 50% power efficiency over a wide range of load currents (Figure 2). Load transient response is excellent with less than 5 μ s recovery time from a ± 400 mA load step.

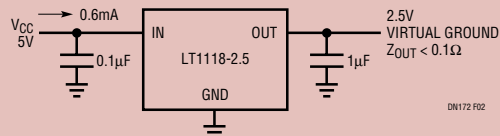


Figure 1. LT1118-2.5 Supply Splitter

At low current levels the LT1118 is the optimum solution.

The LTC1504 is a synchronous switching regulator that provides as much as 90% efficiency (Figure 2) while sourcing or sinking up to 500mA. It will draw only 56mA from the 5V supply while sourcing 100mA from its 2.5V output. The switching architecture of the LTC1504 requires more external components than the LT1118 (Figure 3) and generates a small amount of output noise

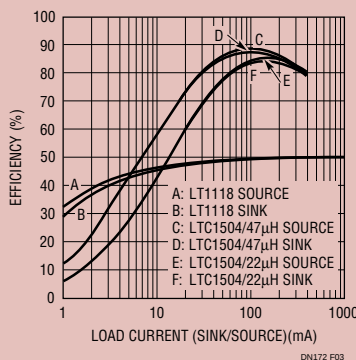


Figure 2. Efficiency Comparison

(ripple) at its 200kHz switching frequency. With a 47 μ H inductor, switching noise is minimal and the circuit recovers from a ± 400 mA output load step in 30 μ s. A shut-down function drops quiescent current below 10 μ A when the split supply is not required. The LTC1504 is the best solution where efficiency, especially at high current levels, is the overriding concern. (See Design Note 172) 

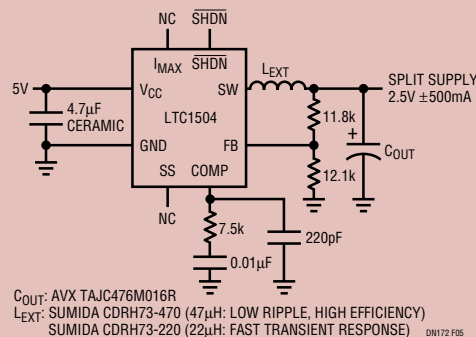


Figure 3. LTC1504 Supply Splitter

High Efficiency PolyPhase DC/DC Current Mode Controllers Provide 20A to 200A Using Surface Mount Components—LTC1629/LTC1929

The LTC1629 and LTC1929 are high power true current mode DC/DC controllers. These dramatically simplify the design of DC/DC converters for powering today's high end microprocessors, large memory arrays and other high power loads. Using a unique PolyPhase switching technique, the LTC1629 can be configured to supply load currents up to 200A with inherent current sharing using readily available surface mount components. This PolyPhase technique allows a significant reduction of input and output ripple currents, resulting in high efficiency, low EMI DC/DC converter designs that require very little PC board space.

Unlike traditional switching regulators, the LTC1629 and LTC1929 interleave the clock signals of their two paralleled power stages 180° out of phase. Ripple current

cancellation occurs in both the input and output circuits due to properly phased current pulses. Their multiple phase technique

effectively multiplies the fundamental frequency by the number of channels used,

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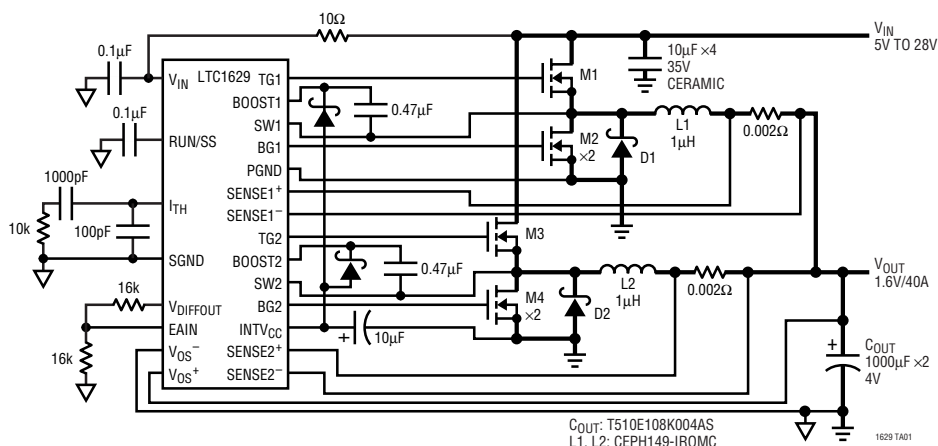


Figure 1. High Current Dual Phase Step-Down Converter

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improving transient response while operating each channel at an optimum frequency for efficiency. This allows a dramatic reduction in input and output capacitance requirements and EMI generation while improving overall efficiency.

The LTC1929 operates in a 2-phase configuration and can support load currents up to 40A. The LTC1629 adds additional internal clock management circuitry that allows multiple devices to be connected in parallel to support higher currents. Using this technique, the LTC1629 can be used in DC/DC converter circuits incorporating up

to twelve phases to provide load currents up to 200A.

A wide 4V to 36V input range allows the LTC1629 and LTC1929 to operate from a variety of input sources and OPTI-LOOP™ compensation allows the transient response to be optimized for the specific output capacitors used in each application. The LTC1629 and LTC1929 provide output voltages from 0.8V to 6V. An internal differential amplifier provides true remote sensing of the regulated supply's positive and negative output terminals as required in high current applications. Internal current foldback with a

shutdown timer and a soft-latch overvoltage protection feature helps protect the load against harmful voltage spikes and overcurrent conditions.

The LTC1629 and LTC1929 are both offered in a 28-lead SSOP package, in commercial and industrial temperature grades. Where previous high power applications required the use of an expensive and bulky DC/DC converter module, the LTC1629 and LTC1929 offer a smaller and more efficient alternative that can be easily integrated into even the most space-constrained system. 

A 10-Bit Voltage Output Micropower DAC in a Tiny SOT-23 Package—LTC1663

The LTC1663 is a single, 10-bit, voltage output DAC with true buffered rail-to-rail output voltage capability, all in a tiny SOT-23 package. Operating from supply voltages between 2.7V and 5.5V, the LTC1663 consumes only 60μA of supply current and a mere 10μA in shutdown mode. The part also features a simple 2-wire serial interface compatible with

SMBus and I²C™, allowing multiple devices to drive and monitor the bus without contention. In the MS8 package, eight user-selectable addresses allow up to eight LTC1663s to be placed on the same bus. Its ultralow power consumption and small size make the LTC1663 ideal for portable, battery-powered applications where supply current directly affects the operation time and board space is at a premium.

The LTC1663 allows the user to select either an internal 1.25V bandgap reference or the positive supply as the DAC's reference voltage. Selecting the internal reference will set the full-scale output voltage to 0V–2.5V. Selecting V_{CC} as the reference

extends the full-scale output to the positive supply voltage, adding extra flexibility for ratiometric applications and maximizing the output voltage range.

The LTC1663 includes a rail-to-rail output buffer, eliminating the need for external op amps. A DNL of ±0.75LSB (max) guarantees true 10-bit monotonic performance over the full temperature range, critical in control loop applications. A power-on reset function ensures that the DAC output is at 0V when power is initially applied and all internal registers are cleared.

The LTC1663 is available in MS8 and 5-lead SOT-23 packages. 

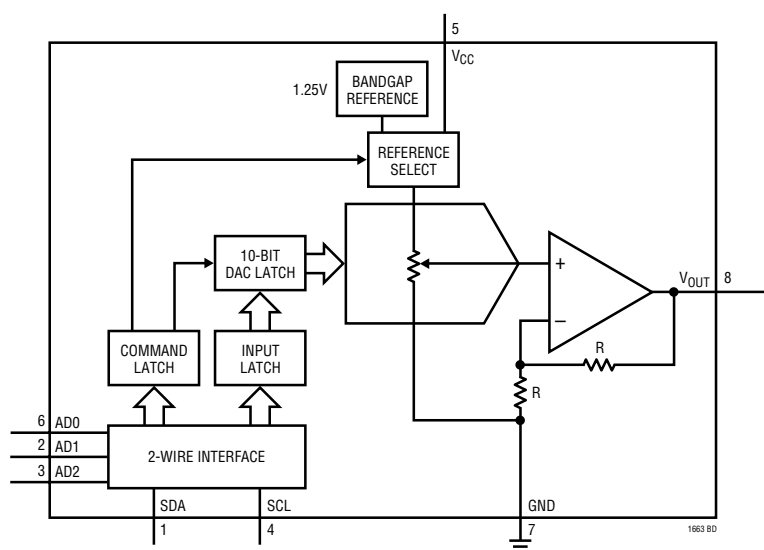


Figure 1. LTC1663 Block Diagram

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