

Product of the Month

Synchronous Switching Regulator Streamlines Design of High Current/High Voltage Power Supplies with Big MOSFET Drivers

The LT[®]1339 is a high power, current mode synchronous switching regulator controller capable of handling input voltages up to 60V. It can drive up to 30,000pF capacitance, fully enhancing FETs capable of delivering loads in excess of 50A. The LT1339 is ideal for distributed power systems as a step-down converter (48V to 12V,

for example) and other industrial control systems that require a high current DC/DC conversion, such as lead-acid battery backup systems for emergency power. Figure 1 shows the LT1339 as a 48V to 5V DC/DC converter sourcing up to 50A output current and Figure 2 shows the efficiency.

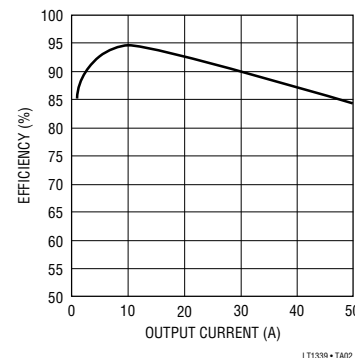


Figure 2. The LT1339 is Capable of Driving Power MOSFETs and Delivering Load Currents from 1A to 50A with an Efficiency of Over 85%

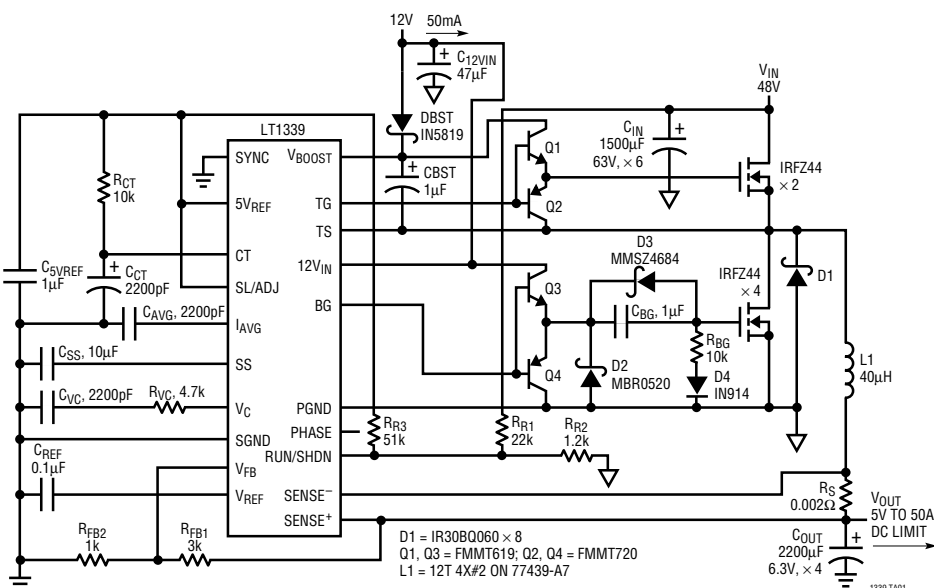


Figure 1. The LT1339 as a 48V to 5V DC/DC Converter


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The LT1339's operating frequency is programmable and can be synchronized up to 150kHz using an external system clock. This provides the low noise and spurious free operation that makes the LT1339 well suited for telecommunications, where it is essential to minimize noise and RFI in sensitive IF bands. The LT1339 also includes a phase input that will switch the roles of the upper and lower MOSFET drivers, permitting synchronous boost, SEPIC, inverter and negative buck converter operation. It also has a 5V reference with 10mA capability—useful as a local supply for 5V micropower logic and control circuits. The LT1339's drivers include an adaptive nonoverlapping gate drive to prevent FET shoot-through increasing efficiency and reducing strain on the input supply. The device also features average load current limiting that is independent of inductor ripple current. This prevents variation of output current limit with changes in input voltage. Undervoltage lock-out with hysteresis inhibits operation until sufficient input voltage is present for proper operation.

The LT1339 is available in 20-lead PDIP and SO packages and is offered in both commercial and industrial versions from stock. For a data sheet and evaluation samples, contact your local Linear Technology sales office. For more information, visit our web site at www.linear-tech.com. 

Precision Series Reference in MSOP Accurate to 0.10%, 15ppm/°C

The **LT1460** is a micropower precision 2.5V bandgap reference that is now offered in tiny 8-pin MSOP and 3-lead TO-92 packages. It combines high accuracy and low drift with low power dissipation in one of the

smallest packages available for a precision reference. The LT1460 is stable with any value of output capacitor, including none, reducing component count and board space. Drawing a maximum of only 130µA of supply current, the LT1460 will source up to 20mA of output current, making it ideal for precision regulator applications.

Table 1 lists the various package options now available for the LT1460 over the commercial temperature range (0°C to 70°C).

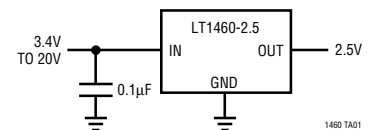
As a series reference, the LT1460 has a significant advantage over older shunt-style references that require a resistor from the power supply to operate. A series reference does not waste current drawn through this pull-up resistor. The LT1460 operates with as little as 0.9V from input to output or as much as 20V input.

Contact your local Linear Technology sales office for a data sheet and evaluation samples. For more information, visit our web site at www.linear-tech.com.

Table 1. Commercial Grade 2.5V Versions of the LT1460 Reference

Part Number	Package	Electrical Grade	Maximum Initial Accuracy	Maximum Temperature Drift
LT1460ACN8-2.5	8-Lead PDIP	A	0.075%	10ppm/°C
LT1460ACS8-2.5	8-Lead SO	A	0.075%	10ppm/°C
LT1460CCMS8-2.5	8-Lead MSOP	C	0.10%	15ppm/°C
LT1460DCN8-2.5	8-Lead PDIP	D	0.10%	20ppm/°C
LT1460DCS8-2.5	8-Lead SO	D	0.10%	20ppm/°C
LT1460FCMS8-2.5	8-Lead MSOP	F	0.15%	25ppm/°C
LT1460GCZ-2.5	TO-92	G	0.25%	25ppm/°C

LT1460 2.5V Series Reference is Now Available in 8-Pin MSOP



Actual Size

Precision Micropower C-Load Dual JFET Op Amps Have Only 2pA Max Input Bias Current

The **LT1462A** and **LT1464A** are precision dual JFET input amplifiers with ultralow input bias currents of 2pA max. They are also micropower op amps with supply currents of only 45µA and 200µA per amplifier, respectively. Offset voltage is a maximum 800µV and offset current is only 1pA max at ±5V supply. The combination of ultralow input bias current and very low supply currents make these op amps ideal for battery-powered systems, photo current amplifiers, low frequency micropower filters or in low droop track-and-hold circuits.

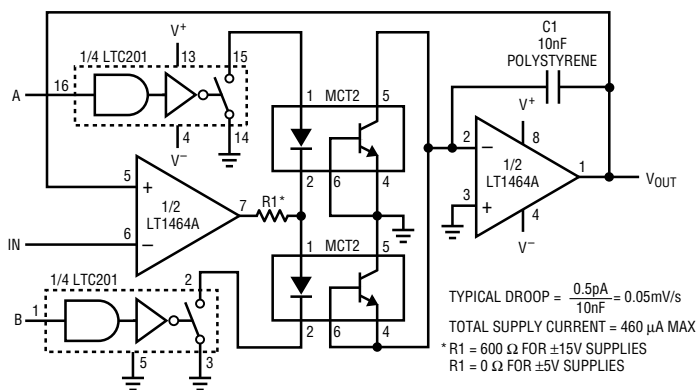
These C-Load op amps drive capacitive loads as high as 10,000pF without oscillation. The LT1462A and LT1464A do not phase-

reverse when the common mode input is anywhere within the supplies.

The LT1462A and the LT1464A are offered in standard 8-pin PDIP and SO pack-

ages. For a data sheet and evaluation samples, contact your local Linear Technology sales office. For more information, visit our web site at www.linear-tech.com.

The LT1464A is Used in a Low Droop Track-and-Hold/Peak Detector



FUNCTION	MODE	IN A	IN B	MODE	IN A	IN B
Track-and-Hold	Track	0	0	Hold	1	1
Positive Peak Detector	Reset	0	0	Store	0	1
Negative Peak Detector	Reset	0	0	Store	1	0

LTC201 switch is open for logic "1".

LT1464A • TA01

Application of the Month


12-Bit ADC Directly Demodulates AM Signals

The LTC[®]1275's wide bandwidth sample-and-hold can cleanly capture signals beyond the ADC's Nyquist limit of 150kHz. As illustrated below, the LTC1275 is used to undersample a 455kHz signal that has been amplitude modulated by a 5kHz tone. By sampling the 455kHz AM signal at a 212.5ksps rate, the signal will be aliased to 30kHz. The digitized sideband information will be intact around the new 30kHz carrier for further processing.

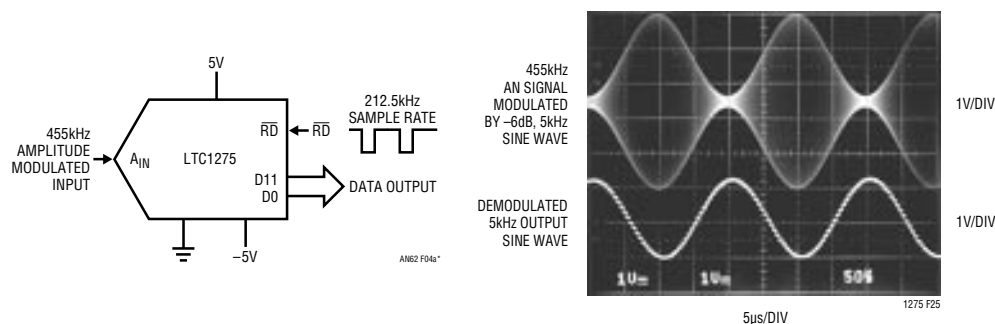
The converter provides a 100dB noise floor and 68dB distortion when digitizing

455kHz. The FFT shows the 0dB fundamental at 30kHz [= 455kHz input - (2) (212.5kHz sample rate)] with the two -17dB sidebands spaced at ± 5 kHz. Two unwanted images of the AM signal appear also, one centered at 60kHz and one at 90kHz. These images are the 2nd and 3rd harmonics of the AM signal. They are reduced in amplitude by 68dB and 77dB, respectively. This means that 68dB (11 bits) of dynamic range are available for processing the information contained in the AM

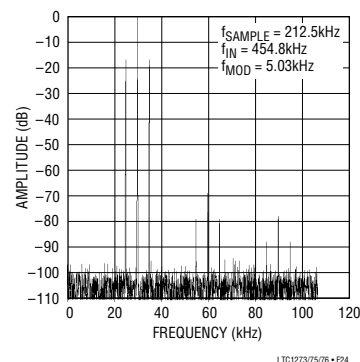
sidebands. If the unwanted images are identified and removed digitally, the dynamic range can be enhanced. The limit to this type of enhancement is the noise floor of 100dB at any single frequency.

The top trace shows the 455kHz waveform modulated by a -6dB, 5kHz signal. The bottom trace shows the demodulated signal produced by the LTC1275 reconstructed through a 12-bit DAC. The resultant frequency is 5kHz with a sample rate of 227.5kHz. 

Demodulating a Signal Using Undersampling



455kHz AM Signal Cleanly Shifted to 30kHz



Precision Low Voltage Rail-to-Rail Op Amps Have Excellent CMRR

The LT1218 and LT1218L are high precision rail-to-rail input and output op amps with a common mode rejection ratio (CMRR) of over 97dB. The input offset voltage (V_{OS}) is a max of 90μV for both the LT1218 and LT1218L across their entire rail-to-rail input ranges. The LT1218 operates over a 2V to ± 15 V supply range and the LT1218L operates over a 2V to ± 5 V supply range. Linear Technology uses a patented trimming scheme that minimizes V_{OS} over the full input range, including both supplies. These op amps are ideal for high side supply current sensing, driving A/D converters and in precision instrumentation applications.

The LT1218 and LT1218L require only 420μA max supply current and just 30μA max in shutdown. Gain bandwidth is

300kHz and slew rate is 0.1V/μs. Figure 1 shows a pair of LT1218s used as a MUX amplifier with very low out error (110μV) due to their excellent CMRR. Figure 2 illustrates the LT1218 as a voltage follower and its in-to-out error.

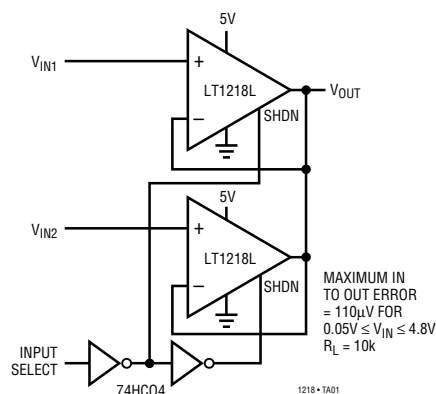



Figure 1. Pair of LT1218s Serve Well as a MUX Amplifier. Their Minimum Open-Loop Gain of 500V/mV Virtually Eliminates All Gain Error

The LT1218 and LT1218L are available in 8-lead PDIP and SO packages from stock in commercial and industrial temperature versions. For a data sheet and evaluation samples, contact your local Linear Technology sales office. For more information, visit our web site at www.linear-tech.com. 

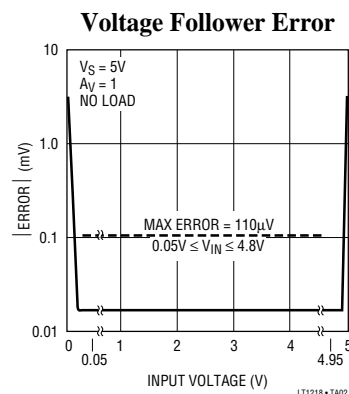


Figure 2. The LT1218 and LT1218L Have a Maximum Input Offset Voltage of Only 90μV for $V_{CM} = V^-$ to V^+

Linear Regulator Delivers 10A with Only 430mV Dropout

The **LT1581** is a low dropout regulator (LDO) designed to power the new generation of high speed Pentium®, PowerPC™ and dual processor architectures, operating on 3V or lower supply voltages. The LT1581 delivers up to 10A of load current and has a fast transient response to supply high load currents on demand without large amounts of bulk output capacitance.

A second low current input voltage (V_{CONTROL}) is used to bias the chip and achieve the low dropout, as shown in Figure 1. This bias voltage is typically one of the multiple supply voltages available in desktop computer systems and used to improve efficiency and reduce heat generated by the local voltage regulator.

With input voltages of 3.3V to 5V, dropout voltage is just 100mV at light loads, rising to only 430mV at 10A load current, as shown in Figure 2. This integrated low dropout dual input regulator greatly simplifies PC motherboard designs.

The LT1581 has several innovative features that require additional pins over

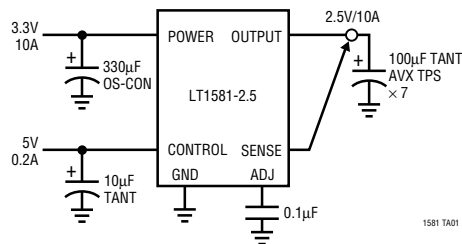


Figure 1. The LT1581 Regulator Uses a Second 5V Low Current Input Voltage to Achieve Low Dropout

traditional 3-terminal LDO regulators. It includes a precision 1% tolerance internal reference voltage, reducing the tolerance requirements of external precision feedback resistors. Both the fixed and adjustable versions have a remote SENSE pin, permitting very accurate regulation of the output voltage at the load. Typical load regulation for a load current step of 100mA to 10A, measured at the SENSE pin, is less than 1mV. On the fixed output device, an ADJUST pin is available. Transient response can be improved by adding a small bypass capacitor from the ADJUST pin to ground.

The LT1581 is also fully protected against overcurrent and overtemperature conditions. The output voltage will not turn on until both supplies are operating. If the control voltage comes up first, the output current

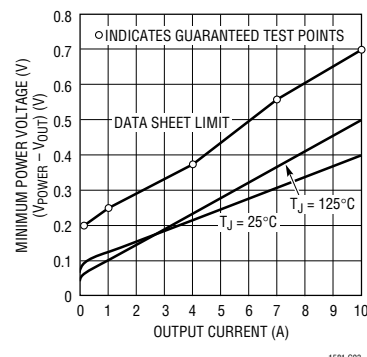


Figure 2. The LT1581 Dropout Voltage Is Only 430mV at 10A Output Current and Just 100mV at Light Loads

will be limited to a few milliamperes until the power input voltage comes up. If the power input comes up first, the output will not turn on until the control voltage comes up.

The LT1581 is offered in a 7-lead TO-220 package with either an adjustable or fixed 2.5V output. For a data sheet and evaluation samples, contact your local Linear Technology sales office. For more information, visit our web site at www.linear-tech.com.

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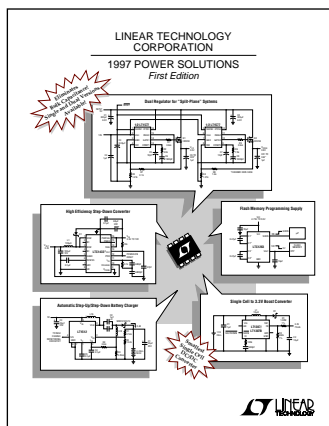
1997 Power Solutions Brochure Now Available

Linear Technology's *1997 Power Solutions* brochure, First Edition, is the latest on the subject of DC/DC power conversion and power management. This 84 page brochure contains 87 application briefs, each with a schematic and circuit description, organized in 11 chapters. Chapter topics are: Battery Chargers, Power Supplies for High Performance Desktop Microprocessors, Portable Equipment Power Supplies, PCMCIA Power, Micropower DC/DC Switching Regulators, Step-Up and Step-Down Switching Regulators, Switched Capacitor Converters, Off-Line Conversion, Linear Regulators and Power Management. The first chapter includes a Battery Charger Primer and the last chapter, on Power Management, describes applications for hot swapping and motor control. Each chapter concludes with a reference guide to help in selecting the best device for a particular application.

To assist in reviewing and understanding the variety of products and solutions offered, there are two charts on the front and rear inside covers of the brochure, one on switching regulators and the other on linear regulators. These pages provide a listing on each of the devices by family and the current and voltage limits that apply.

The brochure concludes with a list of suggested manufacturers and abstracts on 23

additional Selected Application Notes, that are available on request. New device cameos—the new power products recently introduced or planned for introduction soon are also presented. All product data sheets are available for review on LTC's web site—www.linear-tech.com. For a free copy of the *1997 Power Solutions* brochure, please call your local Linear Technology sales office.



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