

Product of the Month

Linear Phase Filter Ideal for Data Communications Applications

The LTC[®]1069-7 is the industry's first monolithic, 8th order, linear phase filter packaged in an SO-8. It requires no external components except for the power supply bypass capacitors. A maximum cutoff frequency of 200kHz can be obtained with $\pm 5V$ supplies and 140kHz with a single 5V supply. The cutoff frequency is programmed by an external clock and is equal to the clock frequency divided by 25. The LTC1069-7 is the latest version in the LTC1069 family of 8th order filters and is typically used in digital communication systems for pulse shaping and channel bandwidth limiting.

The LTC1069-7, like all members of the LTC1069-X family, requires only a power supply and a clock signal to operate, making it ideal for space limited applications. With a single 5V supply it draws just 13mA (typ) and has a dynamic range of over 60dB. As a linear phase filter, the

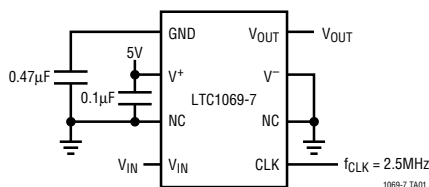


Figure 1. The LTC1069-7 Operates Up to 140kHz with a Single Supply (5V, GND) and to 200kHz with $\pm 5V$ Supplies

LTC1069-7 maintains the phase integrity of digital signals as they're processed.

Figure 2 shows the frequency response of the LTC1069-7 with single 5V supply operation. The amplitude response of the device approximates a raised cosine filter with an alpha of one. The gain at the cutoff frequency is -3dB and the attenuation at twice the cutoff frequency is -43dB. The LTC1069-7 is immediately available in volume from stock in an SO-8 surface mount package. 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.

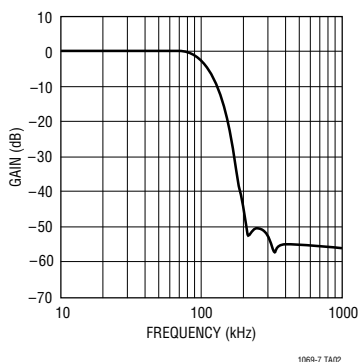


Figure 2. Frequency Response of LTC1069-7 with Single 5V Supply Provides 100kHz Cutoff Frequency and Over 60dB Dynamic Range

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Current Controller Optimizes Synchronous Switcher for Battery Charging

The LT[®]1620 is a rail-to-rail current sense amplifier with a programmable current controller that extends the output voltage range of Linear Technology's ultrahigh efficiency switching regulators. An LT1620/LTC1435 combination can implement a step-down battery charger with more than 4A charging current at battery voltages up to 36V. Over 96% efficiency is possible in these charger applications with very low dropout, as shown in Figure 1. Members of the LTC1435 and LTC1148 controller families are normally limited to 9V and 10V maximum outputs, respectively. But with the LT1620, output voltage can be extended as high as 36V.

In the 8-pin MSOP package, the LT1620 (with the LTC1435) is ideal in space limited applications for charging NiCd, NiMH, lead-acid and Li-Ion batteries. These features greatly ease the PCB layout task for a portable designer, allowing the chip set to be placed at the edge of a board or in a corner without need of a heat sink.

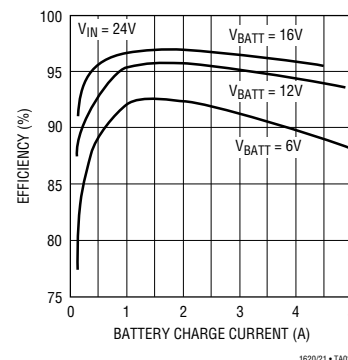



Figure 1. Efficiency of the LT1620 as a High Current/Li-Ion Battery Charger Reaches Up to 96% at 16V

Continued on page 2

The LT1620 also adds programmable output current control to a PWM switcher. It regulates average output current independent of input and output voltage variations. Output currents can be easily adjusted via a programming voltage applied to the LT1620's PROG pin (see Figure 2). The LT1621 is a dual version of the LT1620 and incorporates two fully independent current control circuits for dual loop applications.

To further support its use in battery charging applications, the LT1620 (in a 16-pin SSOP package) includes a current comparator with programmable current threshold. The comparator turns off the constant-current source some time after the charging current reaches a preset level to ensure a full charge of Li-Ion batteries.

The LT1620 is offered in three different package options. For space constrained applications, it's available in an 8-lead

MSOP package as well as in the SO-8 package. The LT1620 is also offered in a 16-lead SSOP to accommodate a current comparator with end-of-cycle output to indicate when a Li-Ion battery charging cycle is nearing completion. The dual LT1621 is offered in the 16-lead SSOP package. 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. 

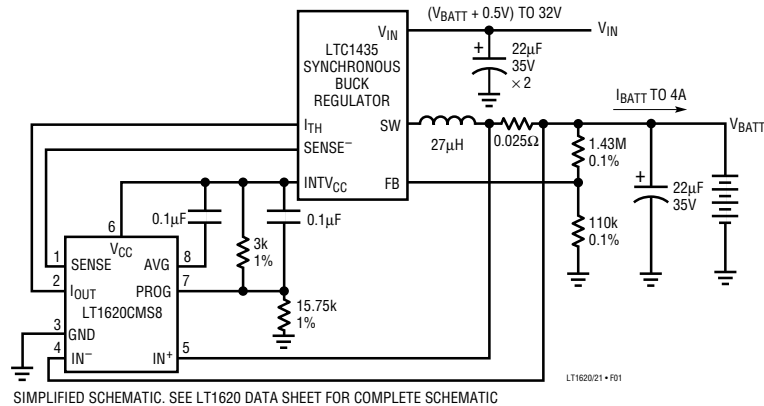


Figure 2. The LT1620 Extends the Output Voltage Range of the LTC1435 and LTC1148 Family of Synchronous Switching Regulators. It also Implements Programmable Output Current Control

Precision Micropower Dual Op Amps Offer Low Offset, Noise and Drift

The **LT2078** and **LT2178** are dual precision micropower op amps, in SO-8 packages, that combine extremely low supply current with true precision specifications.

Offset voltage is 70 μ V max and offset current is 250pA max. Their 1.5pA peak-to-peak current noise and picoampere offset currents permit the use of megohm level source resistors without introducing serious errors. The LT2178 is the lower power version of the LT2078, consuming 17 μ A of supply current/amplifier versus 50 μ A/amplifier, respectively. The quad versions of these

op amps—the LT2079 and LT2179—are offered in 14-pin narrow SO packages.

All op amps are optimized for single supply operation at 5V, but can operate from a supply voltage as low as 2.3V(1 lithium cell or 2 NiCd batteries) and are also specified at $\pm 15\text{V}$. Their output stage can swing to ground while sinking current unlike other op amps that require power consuming

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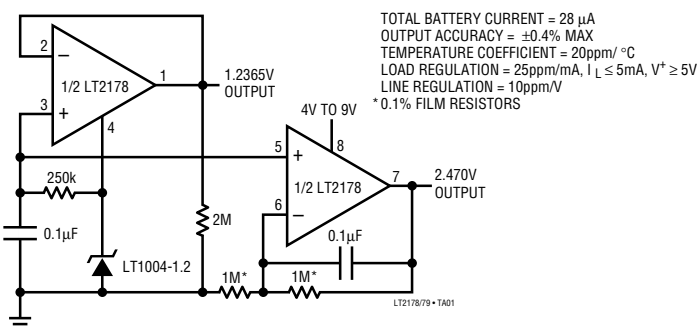


Figure 1. The LT2178 Dual Op Amp as a Micropower Reference

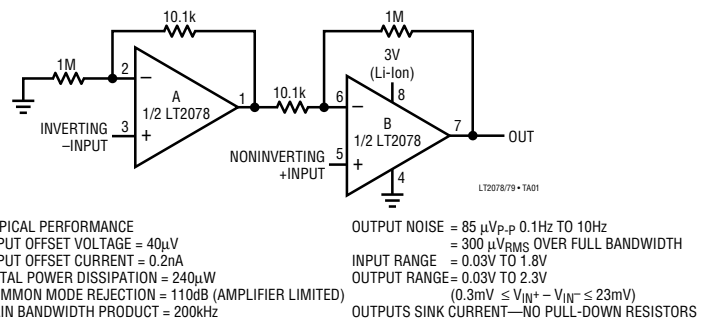


Figure 2. The LT2078 as a Single Battery, Micropower, Gain = 100, Instrumentation Amplifier

Application of the Month


A Low Power Direct Access Arrangement for Modems

An important building block in modems is the telephone line interface. The circuit shown in Figure 1 illustrates a $\pm 5V$ transmit/receive telephone line interface for 600Ω transmission systems. It allows full duplex transmission of signals on a transformer coupled 600Ω line in a differential manner.

Amplifier A1 provides gain which can be adjusted via potentiometer P1 to meet the modem output drive requirements. Both

A1 and A2 are configured so as to apply the largest possible signal from the LT1353 to the transformer. Because of the LT1353's high output current drive, the peak output voltage swing across the transformer's primary winding is $7V_{P-P}$.

Amplifier A3 is configured as a difference amplifier for two reasons: (1) it prevents the transmit signal from interfering with the received signal and (2) it extracts the receive signal from the transmission line

for amplification by A4. A4's gain can be adjusted in the same manner as A1's to meet the modem's input signal requirement. Standard resistor values permit the use of SIP (Single In-Line Package) format resistor arrays. Couple this with the LT1353's 14-pin SO footprint and this circuit offers a compact, cost sensitive solution. 

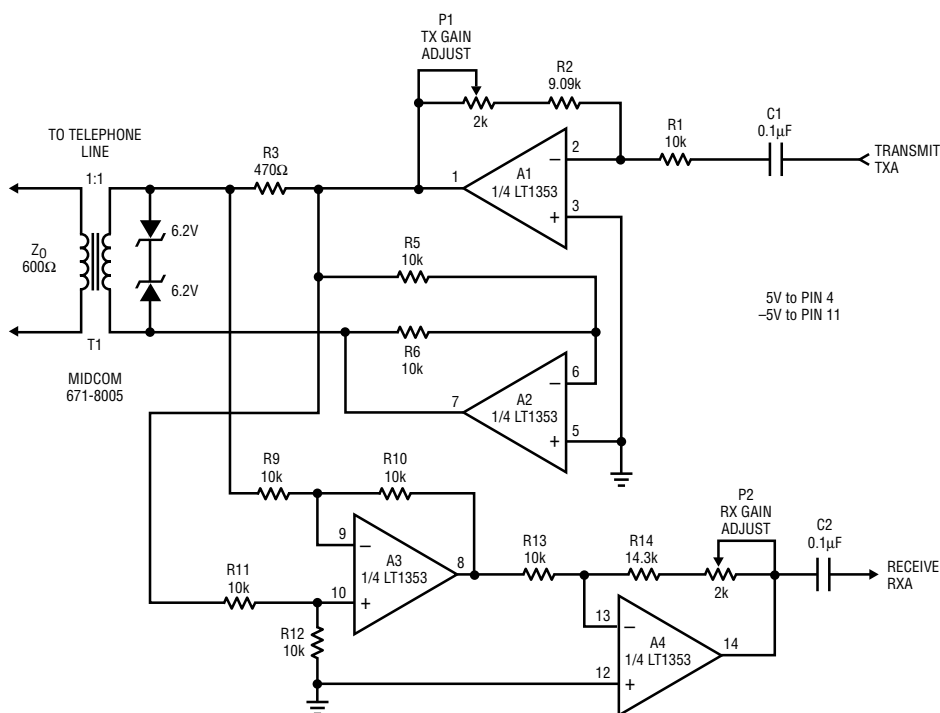


Figure 1. Compact Transmit/Receive Telephone Line Interface for 600Ω Transmission System

LT2078 and LT2178 from page 2

pull-down resistors. They are shown in typical applications in Figures 1 and 2. The LT2078 and LT2178 share the same pinout as the 8-pin PDIP versions of the LT1078 and LT1178 op amps.

The A-grade versions of the LT2078 and LT2178 have input noise voltages of only $0.6\mu V$ and $0.9\mu V_{P-P}$, respectively and current noise of only $2.3pA$ and $1.5pA$ peak-to-peak, respectively. These A-grade amps meet demanding applications where extra precision and low power consumption are

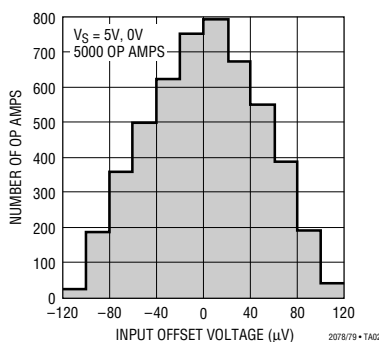



Figure 3. Distribution of Input Offset Voltage for the LT2078

critical, such as in battery-operated precision instruments.


I-grade versions ($-40^{\circ}C$ to $85^{\circ}C$ temperature range) are also available in both regular and A-grades. 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. 

Single 5V RS232/RS485 Serial Transceiver

The **LTC1387** is a RS232/RS485 transceiver that operates off a single 5V supply and switches between RS232 and RS485 under software control. It draws only 7mA of supply current, 5 μ A in shutdown mode. The LTC1387 can be software configured as either two RS232 drivers and receivers or as a single RS485 driver and receiver, as shown in Figure 1. It can quickly switch

between protocols, such as an RS232 serial ports for normal operation but RS485 for high speed data transfer or network updates. The LTC1387 incorporates a charge pump that uses four 0.1 μ F capacitors to generate the boosted (\pm) voltage supplies required for RS232/RS485 operation. Single 5V, low power operation and shutdown mode make this 20-lead device ideal for space constrained, portable applications, such as handheld data loggers.

Separate driver and receiver enable controls provide the flexibility to operate in

full-duplex, half-duplex or receive-only modes. The LTC1387 also features logic selectable fast/slow RS485 driver slew rates allowing data delivery at 5Mbps (fast mode) or at 150kbps (slow mode) with reduced EMI. The LTC1387 is offered in 20-lead narrow SSOP and SW packages. The LTC1334 is a dual version of the LTC1387 with similar features. 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. 

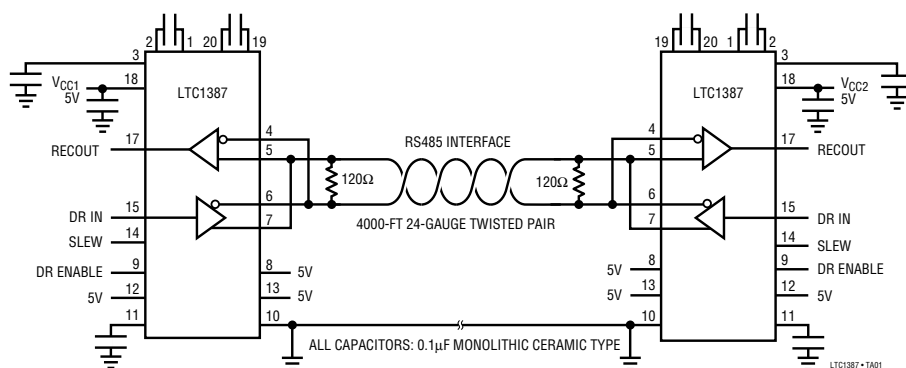



Figure 1. The LTC1387 Multiprotocol Transceiver Can Operate in Full-Duplex, Half-Duplex or Receiver-Only Modes. It is the First Single 5V Single Port, RS232/RS485 Transceiver

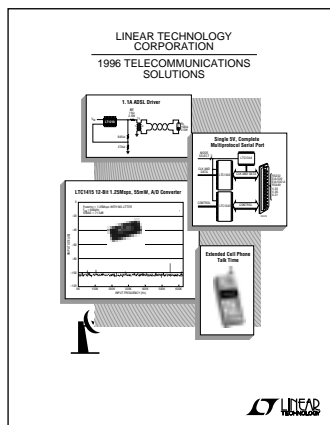
Telecommunications Solutions Brochure Now Available

Linear Technology's 1996 *Telecommunications Solutions* brochure contains a wealth of product and applications information to help you better understand the plethora of data and information relating to competing telecom designs and existing and emerging standards. This 66 page booklet describes 16 new analog ICs introduced by LTC that are appropriate for telecom use, including transceivers, power switches, DC/DC converters, line drive amplifiers and 12/14-bit A/D converters. This is followed by 29 illustrated Application Notes that describe how these and other LTC products can be effectively used in cellular phones, central office switching, cellular base stations and in other general telecom applications.

Reference information at the back of the booklet include a glossary of terms and electrical specifications for key telecommunication standards. Pin assignments for popular functional cable interfaces are also presented in several well illustrated pages for such standards as RS232, RS530, RS449, V.35, RS561, EIA/TIA-574 and

X.21. The booklet concludes with a listing of 47 Application Notes and 90 Design Notes, all of which are appropriate for telecom designs and accessible for review on LTC's web site—www.linear-tech.com.

For a free copy of the 1996 *Telecommunications Solutions* brochure, please call your local Linear Technology sales office or 1-800-4-LINEAR. 



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