Linear Technology Chronicle

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Products of the Month

Micropower Step-Down Converters in MSOP Packages Draw Only 10µA Quiescent Current

The **LTC®1474/LTC1475** are high efficiency step-down DC/DC converters that draw only 10µA of standby current at no load while maintaining the output voltage. They have on-chip P-channel MOSFET power switches (1.4Ω at V_{IN} = 10V) and require only four external components to make a complete, high efficiency (up to 92%) step-down regulator. The LTC1474/LTC1475 have an adjustable switch current limit which permits tailoring the solution to an applications need for maximum battery life. They're available in 8-lead MSOP and SO packages to provide a minimum area solution and are ideally suited for battery-powered handheld instruments requiring up to 300mA.

The LTC1474/LTC1475 operate over an input voltage range of 3V to 16V and have an adjustable output voltage (see Figure 1). Their 100% duty cycle capability ensures low dropout operation and allows maximum energy to be extracted from the batteries. Burst Mode™ operation maintains high efficiency over a wide range of load currents (see Figure 2). A low-battery comparator is included and is functional during shutdown.

The peak switch current is user-programmable to reduce the peak inductor current for low output current applications. This feature provides short-circuit protection and allows the user to minimize the size of the inductor for specific applications. Reduced inductor ripple current improves system operating time from a battery supply, particularly with Alkaline cells.

The LTC1475 is basically identical to the LTC1474, except that it has a different user interface—push-button ON/OFF operation. Two simple mechanical push-buttons are used: one at the ON pin and the other at the OFF pin. Pushing the ON button pin momentarily latches the LTC1475 ON. Pushing the button at the OFF pin momentarily turns the LTC1475 OFF (shutdown to 6µA I_Q). This user interface permits 2-button operation without the need for an external microcontroller or one-button operation with a microcontroller. The interface greatly simplifies adding push-button operation to a handheld product.

The LTC1474 is screened to the commercial and industrial temperature ranges and is available from stock in the 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.

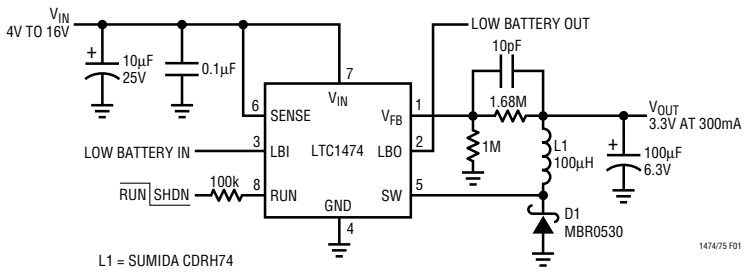

Figure 1. LTC1474 Step-Down Converter Operates over a 4V to 16V Input Voltage

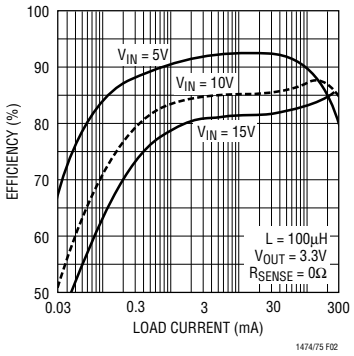

Figure 2. LTC1474 Offers High Efficiency over a Wide Range of Load Current

4Mbps IrDA Receiver Offered in Tiny MSOP and SO Packages

The **LT®1328** in an 8-lead MSOP is the smallest available IrDA® receiver that supports data rates up to 4Mbps. This receiver is compatible with IrDA standards such as SIR and FIR as well as 4ppm, Sharp ASK and TV remote control modulation methods. The LT1328 has all the necessary circuitry to convert current pulses from an external photodiode to a digital TTL output. Its highpass filtering attenuates interfering signals such

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Inside This Issue:

Dual 12-Bit Multiplying I_{OUT} DAC Needs Only 10μA Supply Current

The **LTC1590** is a dual 12-bit current output (I_{OUT}) DAC with a serial interface that draws just 10μA of supply current, the lowest available in the industry. It has excellent accuracy: INL and DNL are guaranteed better than 0.5LSB over temperature and gain error is better than ±1LSB. The LTC1590 is ideal for precision automated test equipment where the DAC must be set to a very precise value. It also excels in process control, digitally controlled filters or in remote and isolated applications, wherever small size and low power consumption are important. The narrow 16-lead SO package makes it the smallest dual 12-bit I_{OUT} DAC available.

The LTC1590 is capable of 4-quadrant multiplying which means that both the analog reference and the digital input code can be bipolar signals. Its 3-wire serial interface eliminates many pins when compared to parallel interface parts, thus saving precious board space and reducing the number of optocouplers in isolated applications. Additional DACs may be daisy-chained together by connecting the D_{OUT} pin to the D_{IN} pin of the next chip. An asynchronous clear ($\overline{CLR}$) pin (see Figure 1) and power-on reset gives the designer flexibility in servicing interrupts and writing start-up routines.

The LTC1590 is screened to the commercial and industrial temperature ranges and is available from stock in 16-lead DIP and narrow SO packages. Contact your local Linear Technology sales office for a data sheet and evaluation samples. Visit our web site at **www.linear-tech.com** for additional information.

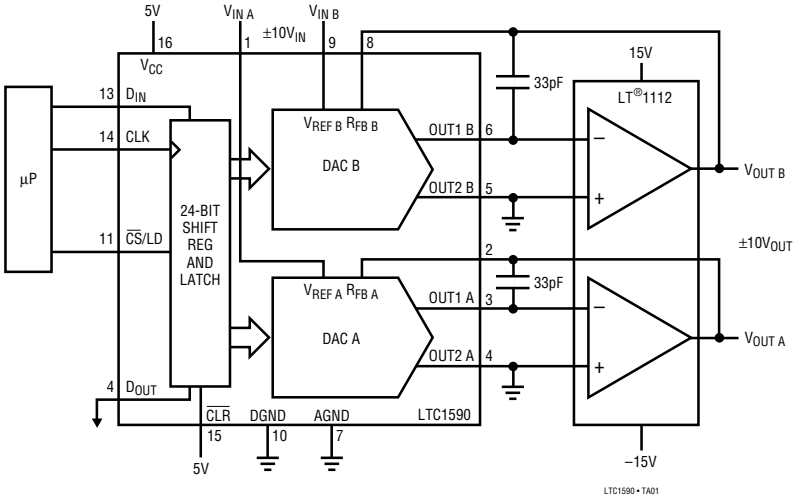

Figure 1. The LTC1590 Dual 12-Bit Quadrant Multiplying DAC Offers ±1LSB INL and DNL

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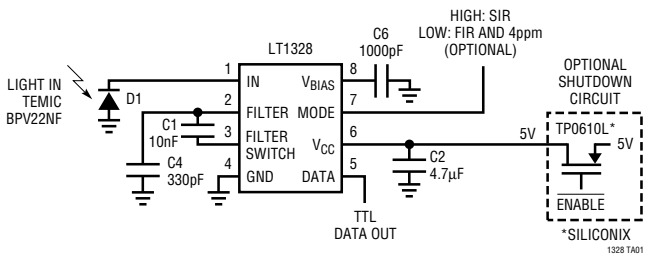
as sunlight, incandescent and fluorescent lamps. Low or high data rates are pin selectable. Power requirements are minimal—a single 5V supply and 2mA of quiescent current.

The LT1328 offers a flexible design and a lower cost IrDA solution when compared to modules and transmitters. Figure 1 shows an IrDA receiver using the LT1328 and an IrDA transmitter. The combination of speed and small size makes the LT1328 ideal for applications in PCs, notebooks, PDAs and numerous other photodiode receiver applications.

The LT1328 is available in 8-lead SO as well as 8-lead MSOP for size critical 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.

IrDA Receiver



IrDA Transmitter

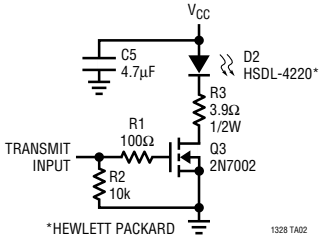


Figure 1. The LT1328 and Five External Components is All That's Required to Make an IrDA Compatible Receiver

Application of the Month

Wireless Micropower Digital Thermometer

In the circuit shown, the 8-bit LTC1096 converts the temperature-dependent voltage across the 13.5k resistor into eight bits that modulate a wireless RF transmitter. This is useful when a physical barrier exists between the temperature sensor and monitoring electronics. The LT1004 provides a reference source current for the temperature-dependent voltage applied to the LTC1096's positive input (+IN). An RC oscillator and 74HC161 counter provide the ADC conversion clock. The ADC performs a conversion and turns the RF oscillator on and off, corresponding to the serial data stream. After the conversion, the counter disables the oscillator for one second. Then the cycle repeats. The entire system draws only a few microamps from a 3V battery, making it ideal for remote location.

When the chip select ($\overline{CS}$) signal falls, the data is converted and transmitted as shown. For each *zero* valued bit, an RF burst occurs. For each *one* value, the burst is inhibited. Three leading zeros allow the receiving system to calibrate to the bit spacing and prepare for the incoming data. Four bits of data are repeated in reverse order at the end of the conversion.

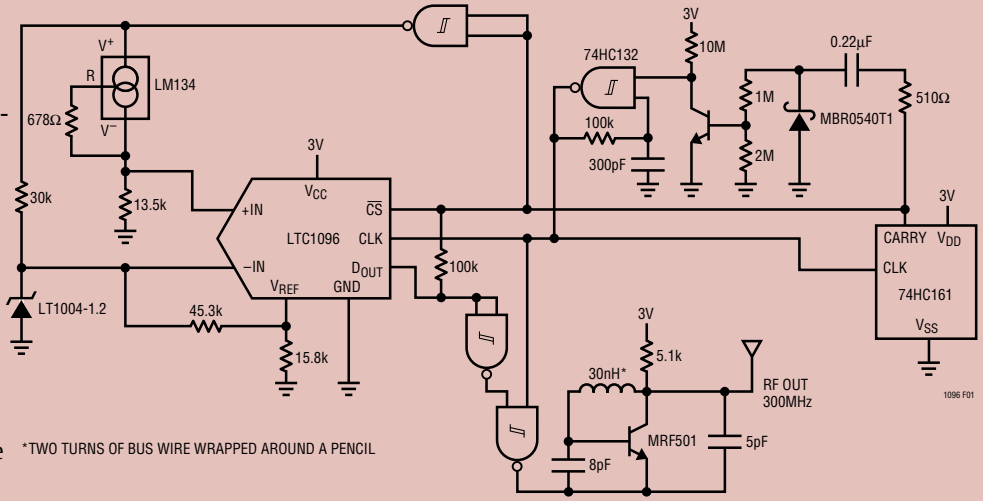


Figure 1. Battery-Powered Digital Thermometer Transmits over RF Link

Figure 2. Wireless Micropower 8-Bit Temperature Sensor

Rail-to-Rail Output Op Amp in SO-8 Has Built-in Reference

The **LT1635** is the only rail-to-rail output op amp with a precision reference in an SO-8 package. It has an offset voltage of only 1.3mV and guarantees a maximum value for reference voltage drift of 100ppm/°C max. The LT1635 can operate from a single 1.2V supply to ±5V, yet consumes only 130µA of supply current. This makes it ideal for portable applications, such as in precision current sensing or as a battery level indicator. Low voltage operation is important for detecting and monitoring batteries, especially when they are approaching full discharge.

The input common mode range of the op amp includes ground and incorporates phase reversal protection to prevent false outputs from occurring when the input is below the negative supply. The rail-to-rail output stage can swing to within 15mV of each rail with no load and can swing to within 250mV of each rail while delivering 10mA of output current. The gain bandwidth of the op amp is 175kHz and it is unity-gain stable with up to 1000pF load capacitance.

The 0.2V reference is referred to V^- and includes a buffer amplifier to enhance flexibility. The reference and buffer combine to achieve a drift of 30ppm/°C, a line regulation of 20ppm/V and a load regulation of 150ppm/mA.

System designers benefit from knowing a guaranteed maximum reference drift (TCV_{REF}) of 100ppm/°C since they can expect the maximum change in reference voltage with temperature and calibrate their initial design accordingly. On the other hand,

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52Mbps High Speed Quad RS485 Receivers Have Low 500ps Skew

The **LTC1518/LTC1519** are high speed, precision delay, RS485 quad line receivers that can operate at data rates as high as 52Mbps. They are pin compatible with the LTC488/SN75173 and LTC489/SN75175 line receivers respectively, but *five* times faster with a skew as low as 500ps.

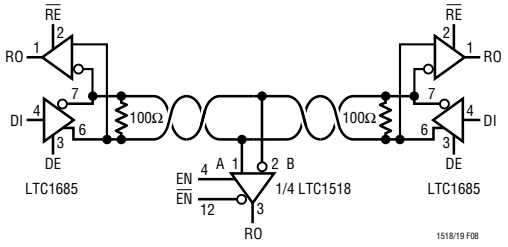
The limiting factor when sending data in parallel is the difference in propagation delays (skew) between the fastest and slowest channels. The LTC1518/LTC1519 have tightly controlled propagation delays, guaranteed to be 18.5ns ±3.5ns. Typical t_{PLH}/t_{PHL} and channel-to-channel skew is just 500ps. At the same temperature, the typical chip-to-chip skew is only 1.5ns. These features make the LTC1518/LTC1519 perfect for high speed, parallel applications up to 52Mbps, such as in backplanes or short cable runs (about 100 feet max) within a box.

The LTC1518/LTC1519 are RS485 compatible and their speed range allows them to support Optical Carrier (OC) and equivalent Synchronous Transport Signals (STS) standards, as defined for the Synchronous Optical Network (SONET). (OC-1 and STS-1 define a line rate of 51.84Mbps.) They operate over the entire –7V to 12V input common mode range. Optical network switching equipment receives optical data, but processes it inside the box using backplanes or copper cabling. Other applications would be collision detection for network routers or applications that currently use RS485 but need to run faster.

The LTC1518/LTC1519 outputs are guaranteed to be in a *high* state when the inputs are left open or shorted with a controlled maximum short-circuit current of 50mA. Input resistance remains ≥ 22k, even when unpowered, thus allowing hot swapping without loading the data lines. They operate from a single 5V supply and draw 12mA of supply current.

The LTC1518 and LTC1519 differ only in their pinouts. (The LTC1519 has separate enable pins for the receiver pairs.) They are available from stock in 16-lead SO packages. Contact your local Linear Technology sales office for a data sheet and evaluation samples or for more information, visit our web site at **www.linear-tech.com**.

The LTC1518 in a 52Mbps Data Communications Application over Twisted Pair



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knowing only the typical value means that every system built may need calibration depending on the parametric variations of the parts they receive.

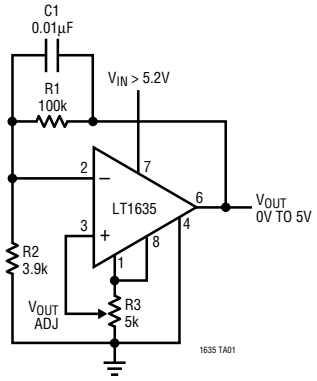

Figure 1. The LT1635 is an Analog Building Block That Includes a Rail-to-Rail Output Op Amp, a Precision Reference and Reference Buffer. Here it is a 0V to 5V Regulator

The LT1635 is immediately available in volume from stock in 8-lead SO and PDIP 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.

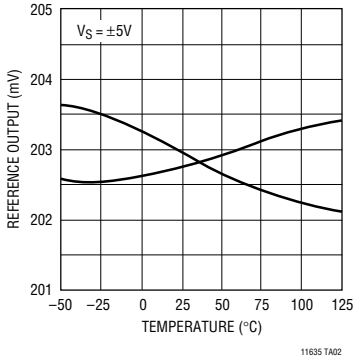

Figure 2. Reference Output vs Temperature of Two Typical Units