

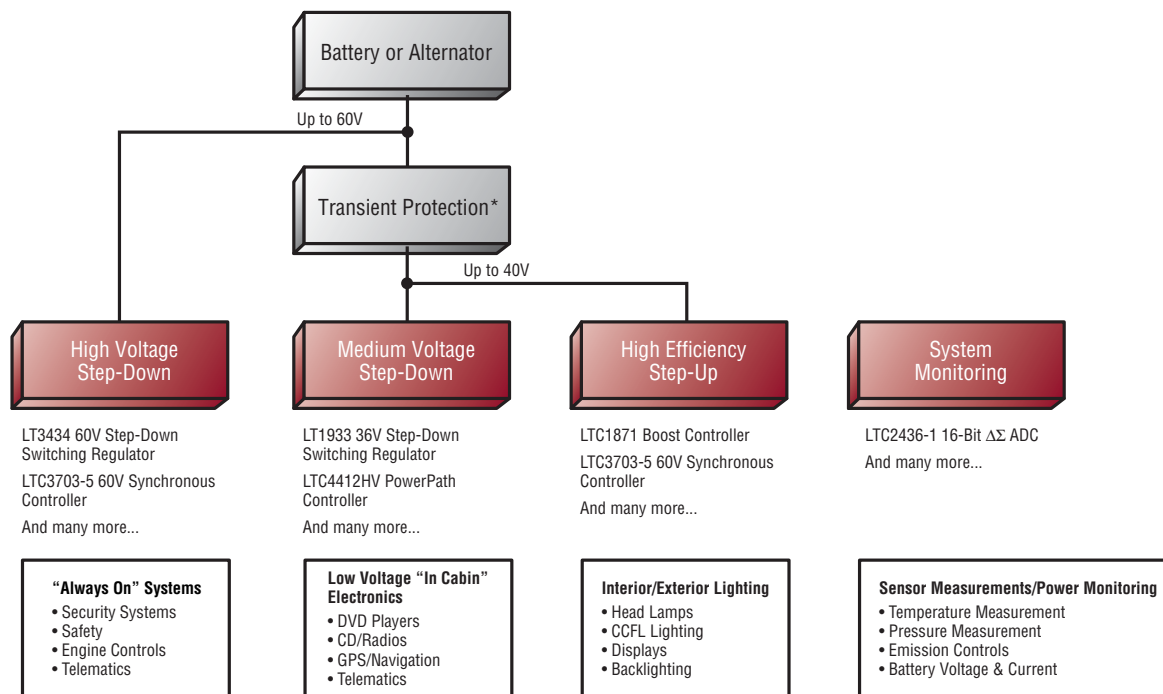
# Linear Technology Chronicle

High Performance Analog Solutions from Linear Technology

Vol. 14 No. 1

Focus...

## Automotive Solutions



\* Transient protection voltage levels depend on system requirements.

### Inside This Issue:

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Designers of automotive systems pack an impressive amount of electronics under the hood, inside the passenger compartment and even within the body of automobiles. Yet the demand for more infotainment and comfort features continues to grow unabated. To meet this demand, designers continue to use more and more high precision analog circuitry. Systems that continue to expand in complexity and performance include safety systems (collision avoidance, air bag deployment), government-driven environmental systems (emission controls, alternative energy sources), infotainment (satellite radio, rear-seat entertainment), theft-deterrent systems and the driver's instrument cluster.

Linear Technology has products that meet the needs of these systems. From high voltage power supplies and high temperature signal conditioning to white LED backlighting, Linear Technology offers devices that provide smaller packages, higher efficiency and better performance. Look inside for our latest products targeting the automotive market.

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# High Voltage Automotive Power Supplies

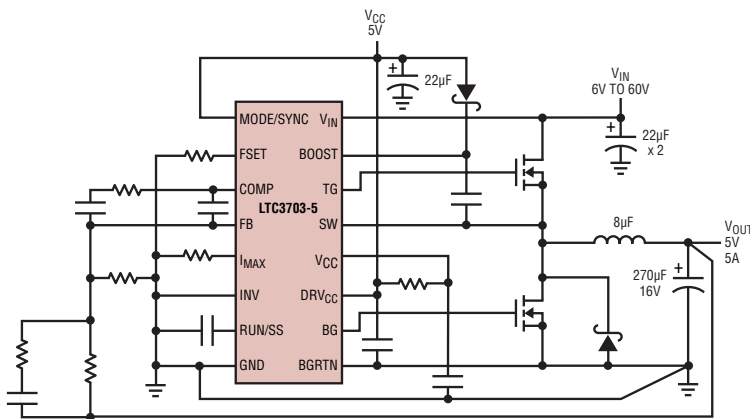
The new LTC3703-5 is a synchronous buck controller that operates with an input voltage up to 60V, making it inherently robust in the presence of large load dump transient voltages in 12V and 42V automotive systems. The device operates with a supply voltage down to 4.1V

allowing the use of logic level N-channel FETs. Up to 10A of output current is possible and patented feedforward compensation ensures excellent transient response. For even higher voltage requirements, see the LTC3703 100V controller.

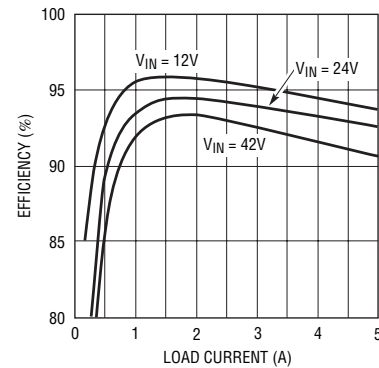
Features of the LTC3703-5 include:

- **100kHz to 600kHz synchronizable switching frequency**
- **No current sense resistor required**
- **Small 16-pin narrow or 28-pin SSOP package**
- **Large 1Ω gate drivers**

LTC3703-5 High Voltage Step-Down Controller



Efficiency vs Load Current



## High Voltage Step-Down DC/DC Converters

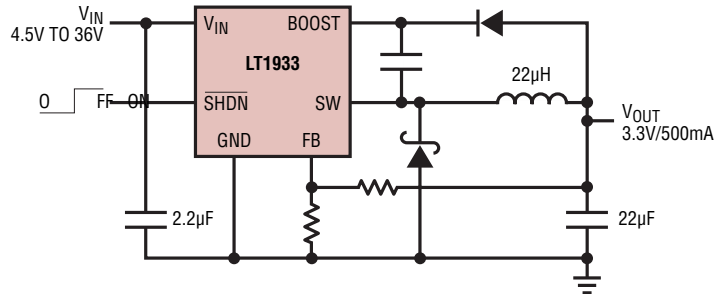
Part Number	V <sub>IN</sub> Min	V <sub>IN</sub> Max	MAX I <sub>O</sub> UT (A)	Architecture	Package	Comments
LT <sup>®</sup> 3437	3	80	0.5	Monolithic	DFN-10	Smallest Size
LT3433	4	60	0.5	Monolithic	TSSOP-16/E	Buck-Boost
LT1956-5	5.5	60	1.2	Monolithic	TSSOP-16/E and Fused Leads	Fixed 5V Output
LT1956	5.5	60	1.2	Monolithic	TSSOP-16/E and Fused Leads	Adjustable Output
LT1976	3.3	60	1.5	Monolithic	TSSOP-16/E	100µA I <sub>Q</sub>
LT1977	3.3	60	1.5	Monolithic	TSSOP-16/E	100µA I <sub>Q</sub>
LT3430	5.5	60	2.75	Monolithic	TSSOP-16/E	200kHz f <sub>SWITCH</sub>
LT3431	5.5	60	2.75	Monolithic	TSSOP-16/E	500kHz f <sub>SWITCH</sub>
LT3434	3.3	60	3	Monolithic	TSSOP-16/E	100µA I <sub>Q</sub>
LT3435	3.3	60	3	Monolithic	TSSOP-16/E	100µA I <sub>Q</sub>
LTC <sup>®</sup> 3703-5	4.1	60	10	Controller	NSSOP-16, SSOP-28	Logic Level FETs
LTC3703	9.3	100	10	Controller	NSSOP-16, SSOP-28	100V Operation

# Medium Voltage Buck Regulators

In applications where battery transient protection is provided, medium voltage regulators are often used. The LT1933 monolithic buck regulator is used in several blocks of an automotive design because of its versatility. It accepts input voltages from 3.6V to 36V (well-suited for 24V truck battery applications) and provides in excess of 500mA of output current. The device has an internal 0.75A switch and is offered in a tiny ThinSOT package. Other features include:

- Fixed 500kHz switching frequency
- PWM current mode architecture
- 2 $\mu$ A shutdown mode
- Output adjustable down to 1.25V

**LT1933: Allows Up to 36V Inputs**



## Medium Voltage Monolithic Buck Regulators

Part Number	V <sub>IN</sub> Min (V)	V <sub>IN</sub> Max (V)	V <sub>OUT</sub> Min (V)	Output Current (A)	Switching Frequency (MHz)	Quiescent Current, I <sub>Q</sub> (mA)	Package
LT1934-1	3.2	34	1.25	0.07	Constant On-Time	0.012	ThinSOT™
LT1934	3.2	34	1.25	0.3	Constant On-Time	0.012	ThinSOT
LT1616	3.6	25	1.25	0.5	1.4	1.9	ThinSOT
LT1933	3.6	36	1.25	0.55	0.5	1.6	ThinSOT
LT1776	7.4	40	1.24	0.56	0.2	3.2	SO-8
LT1767	3	25	1.2	1.2	1.25	1	MS8/E
LT1940	3.6	25	1.25	1.4	1.1	3.8	TSSOP-16/E
LT1765	3	25	1.2	2.5	1.25	1	TSSOP-16/E
LT1374HV	5	32	2.42	3.6	0.5	2.5	TSSOP-16/E, TO-220, DD-7
LT1074	7.3	45	2.21	4.4	0.1	8.5	DD-7, TO-220

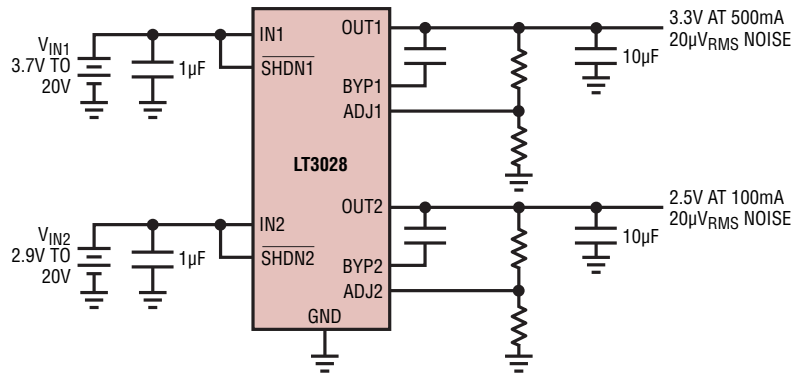
# Linear Regulators

For smallest size and lowest noise, Linear Technology's new family of low dropout linear regulators meets the most stringent needs with dropout voltages as low as 45mV and tiny DFN packages.

The LT3028 is a dual 100mA and 500mA linear regulator with only 300mV dropout at the respective maximum rated loads. Available in a 12-pin, 4mm x 3mm DFN package, it is ideal for creating a low noise low voltage supply such as 1.8V from 2.5V or 1.5V from 1.8V. With only 20 $\mu$ V<sub>RMS</sub> output noise, the device works well in noise-sensitive automotive applications. Other features of the device are:

- **Low quiescent current: 30 $\mu$ A per output**
- **1.8V to 20V input voltage range**
- **Independent shutdown control of each regulator**
- **Stable with 1 $\mu$ F output capacitors (ceramic, tantalum or aluminum electrolytic)**
- **On-chip overcurrent and thermal protection**

**Dual Input, Dual Output Low Noise Linear Regulator**



## Family of Low Dropout Linear Regulators

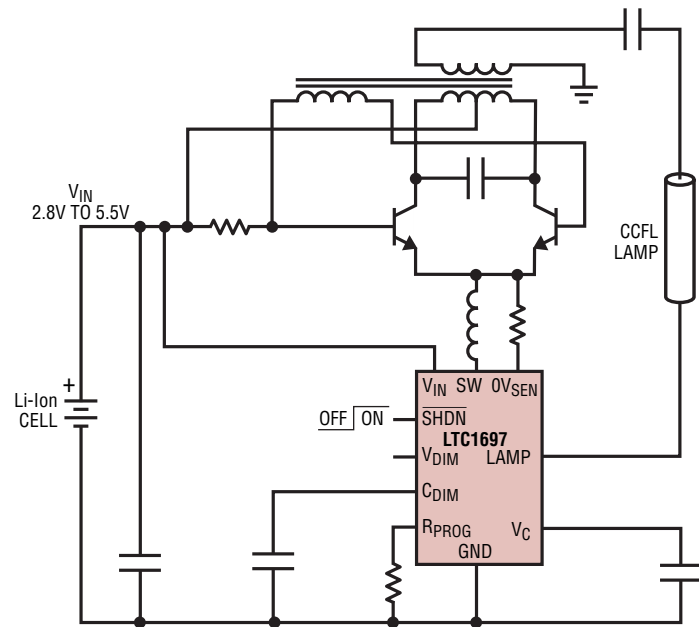
Part Number	Number of Regulators	Dropout Voltage at Max Load	V <sub>IN</sub> Range	Output Current	Output Noise ( $\mu$ V <sub>RMS</sub> )	Comments	Package
LT3010	1	300mV	3V to 80V	50mA	100 $\mu$ V	Operation Up to 80V	MSOP-8/E
LT3020	1	150mV	0.9V to 10V	100mA	245 $\mu$ V	Operates at V <sub>IN</sub> = 0.9V	DFN-8, MSOP-8
LTC3025	1	45mV	0.9V to 5.5V	300mA	80 $\mu$ V	Lowest dropout	DFN-6
LT3023	2	300mV	1.8V to 20V	100mA/ 100mA	20 $\mu$ V	Separate V <sub>IN</sub> pins	DFN-10, MSOP-10/E
LT3024	2	300mV	1.8V to 20V	100mA/ 500mA	20 $\mu$ V	One V <sub>IN</sub> pin	DFN-12, TSSOP-16/E
LT3027	2	300mV	1.8V to 20V	100mA/ 100mA	20 $\mu$ V	One V <sub>IN</sub> pin	DFN-10, MSOP-10/E
LT3028	2	300mV	1.8V to 20V	100mA/ 500mA	20 $\mu$ V	Separate V <sub>IN</sub> pins	DFN-12, TSSOP-16/E

## CCFL Backlighting

The LTC1697 targets TFT-LCD backlighting applications such as GPS map displays, in-dash computers and small monitors that operate with cold cathode fluorescent lamp (CCFL) lighting for improved light conversion efficiency. It includes 1A MOSFET on-chip and has a 300kHz switching frequency, resulting in the most integrated and smallest footprint solution. Designed for 1W CCFLs, the LTC1697 operates from 2.8V to 5.5V and has a well-controlled 2% accurate lamp current which prolongs the lamp's lifetime. Other features include:

- **Small MSOP-10 package**
- **Internal or external dimming feature**
- **Synchronous buck architecture for highest efficiency**

High Efficiency 1 Watt CCFL Driver

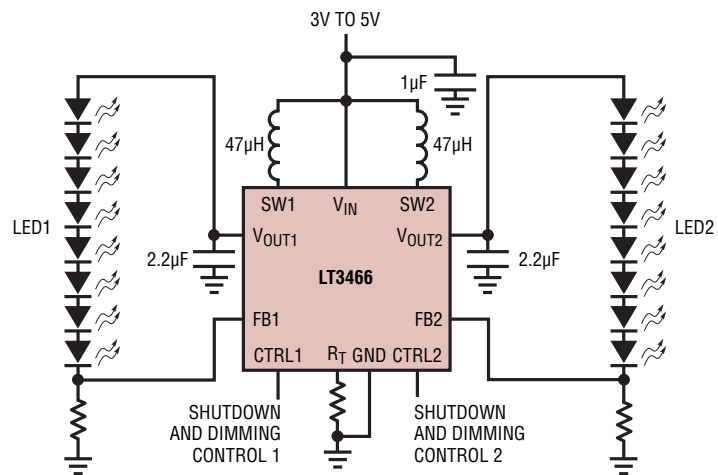


## White LED Backlighting

For white LED backlit automotive displays, the LT3466 is an excellent choice for applications that require good efficiency, small size and ease of design. The device drives two independent strings of up to 10 LEDs using two step-up converters. Each string has independent control of intensity and shutdown. The supply voltage range is 2.7V to 24V and the switching frequency can be set as high as 2MHz which keeps the external components small. Other features are:

- **Small DFN-10 package**
- **Internal Schottky diodes save space and reduce external component count**
- **Constant current architecture - LEDs are matched in intensity**

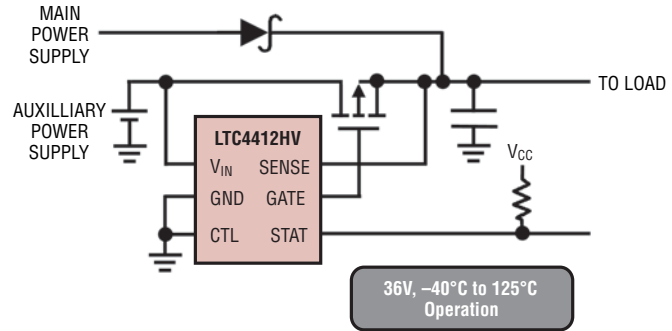
Dual Step-Up Converter Drives Two White LED Strings



# New ICs Rated for Automotive Temperature (-40°C to 125°C)

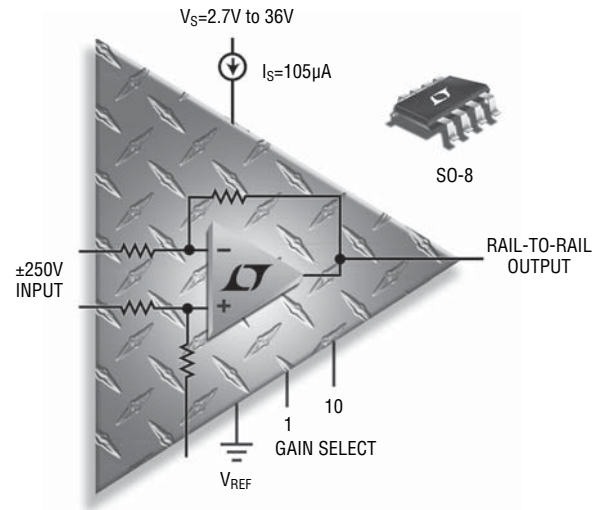
## LTC4412HV – Low Loss PowerPath™ Controller

The LTC4412HV controls an external P-FET to provide a low loss ideal diode function when OR'ing power supplies. Featuring a 2.5V to 36V input voltage range, it is available in a small ThinSOT package.



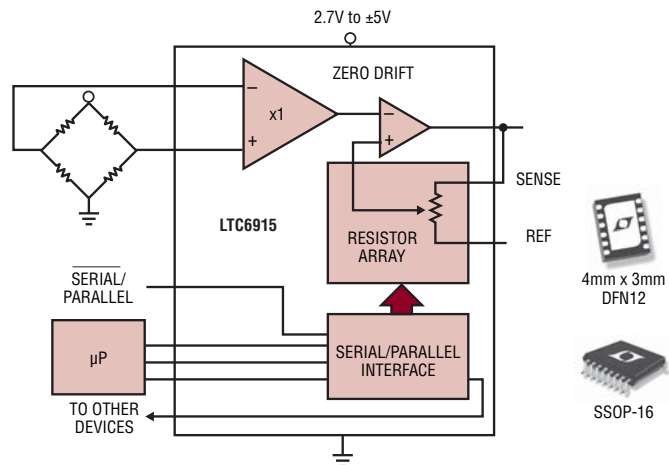
## LT1990 ±250V Input Range Difference Amplifier

The LT1990 difference amplifier, which offers a very high input common mode range and good common mode rejection, is ideal for high side current sensing, fault-protected front end amplification and signal conditioning in noisy automotive environments. It operates from 2.7V to 36V.



## LTC6915 – Precision Instrumentation Amplifier with Digital Gain Control

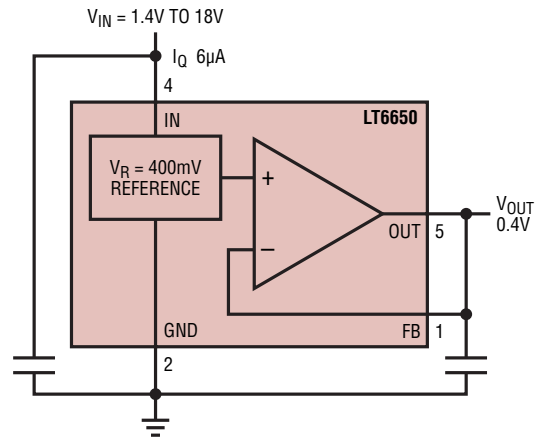
The LTC6915 is a zero drift digitally programmable gain amplifier with less than 10µV offset error, rail-to-rail inputs and outputs, and 119dB common mode rejection. The gain range is 0 to 4096 and the device operates from 2.7V to ±5.5V.



## New ICs Rated for Automotive Temperature (-40°C to 125°C)

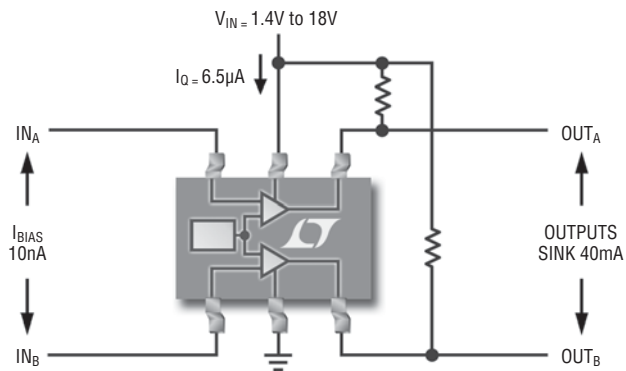
### LT6650 – Micropower 400mV Reference

The LT6650 is a precision low voltage, low power series reference with 1.5% accuracy over the automotive temperature range. Targeting low voltage subsystems (which includes “always on” systems), it provides an accurate reference voltage for sub 2V data conversion or a stable offset voltage for single supply amplifiers when measuring signals near ground. The device draws only 5.6µA and features a buffered output. It is available in a ThinSOT package.



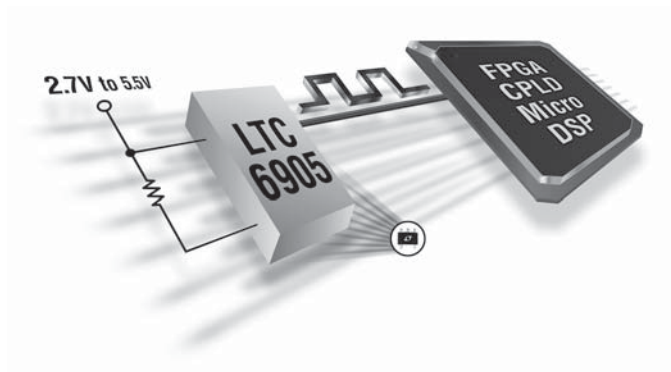
### LT6700 – Dual Comparator with 400mV Reference

The LT6700 is a robust dual comparator targeting harsh environments. It allows comparator input and output voltages up to 18V regardless of the power supply rails. Three versions are available with different comparator input polarity options. The device can sink 40mA of output current and is available in a ThinSOT package.



### LTC6905 – 17MHz to 170MHz Resistor Programmable Oscillator

Inherently more resistant to shock and vibration than crystal oscillators and ceramic resonators, the LTC6905 is a silicon oscillator in a small ThinSOT package. It has 1.4% initial accuracy at 25°C and has an impressive 50ps jitter specification. This performance at high frequencies makes the LTC6905 a good choice for FPGA, CPLD and DSP clocks in addition to high-speed data transfer clocks. The wide frequency range opens up many new applications when a small footprint, high frequency, low power low-jitter robust clock is needed.

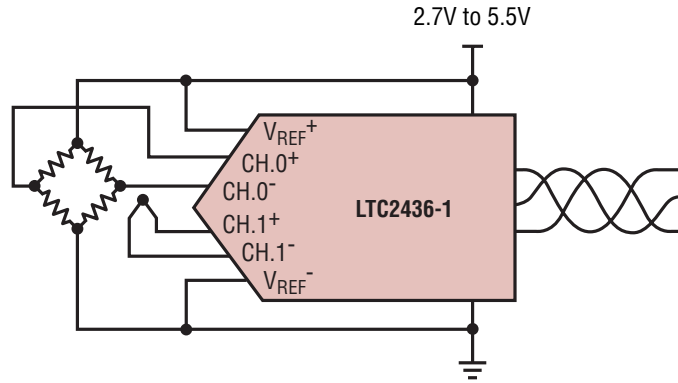


Contact your local Linear Technology sales office for a data sheet and evaluation samples. For more information, visit our web site at [www.linear.com](http://www.linear.com).

# 16-Bit Delta-Sigma ADCs

Linear Technology's 16-bit delta-sigma data converters provide precise measurement of a variety of parameters in a host of automotive applications. These vary from data acquisition in automotive test and measurement equipment, monitoring exhaust emissions for automotive diagnostic equipment and onboard

emissions control, monitoring alternative power sources (hybrid electric vehicle battery status or fuel cell capacity) and intelligent automotive sensors. The devices provide a low noise no-latency solution that allows many sensors to connect directly to the data converter.



## 16-Bit Low Noise Delta-Sigma Data Converters

Part Number	Bits	MUX Channels	Output Rate (Hz)	Noise ( $\mu\text{VRMS}$ )	Power (mW)	Package
LTC2433-1	16	1 differential	6.8	1.45	1	MSOP-10
LTC2436-1	16	2 differential	6.8	0.8	1	SSOP-16
LTC2439-1	16	8 differential/ 16 single-ended	6.8	1	1	SSOP-28

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