Linear Technology Chronicle

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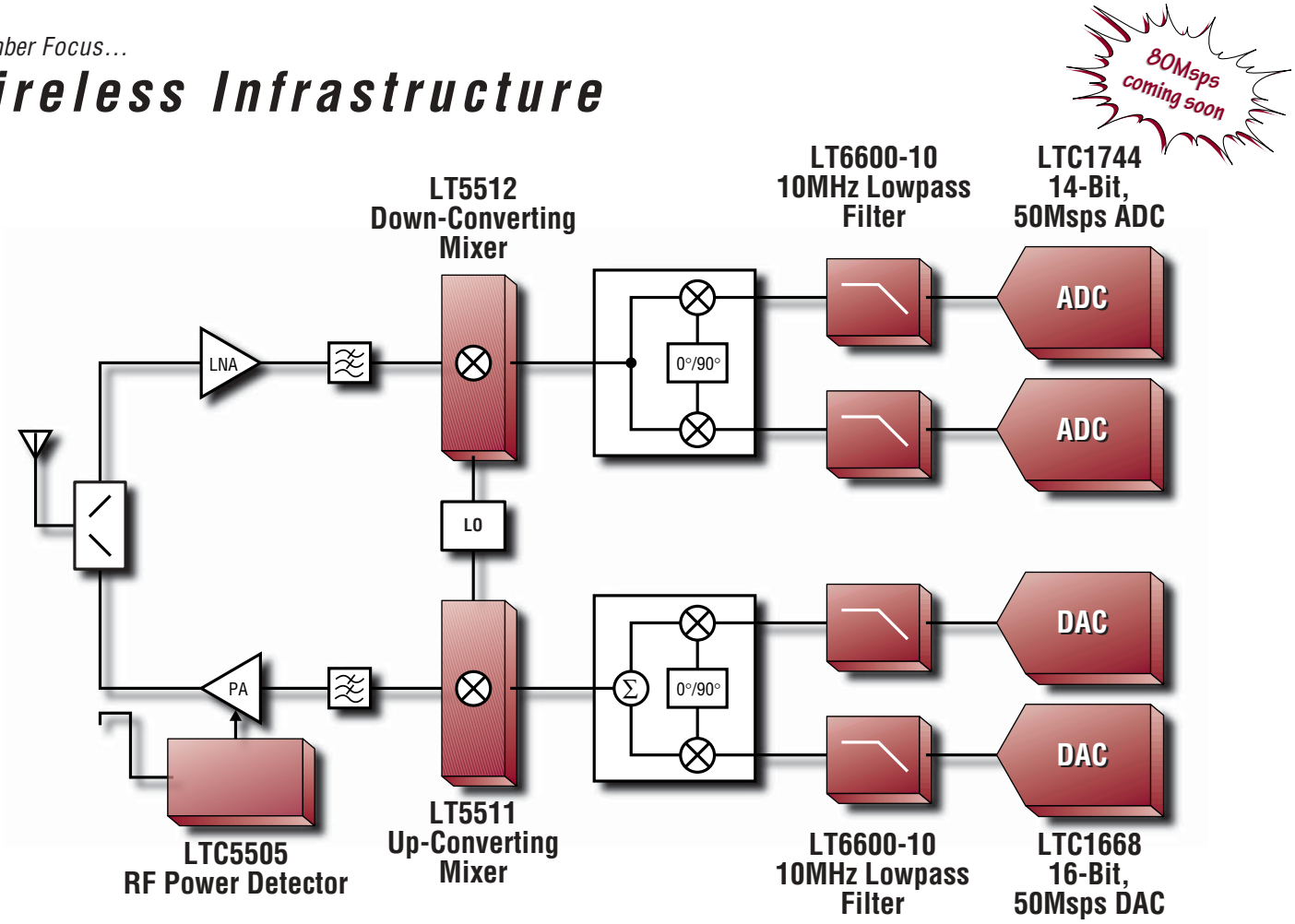
November Focus…

Wireless Infrastructure



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The design of the next generation of wireless infrastructure presents multiple challenges. Cellular networks will provide both higher capacity and faster data transmission rates. Next generation systems will also be required to accommodate complex modulation schemes and multiple air standards to maintain compatibility with systems from the previous generation. These complex systems would not be possible without high performance analog building blocks such as data converters, mixers, filters, and RF power detectors.

Analog building blocks also provide the flexibility and performance to meet the needs of a wide variety of wireless applications. Unlike highly specialized chip set solutions, these basic building blocks can be configured to fit applications using a wide range of frequencies and modulation schemes.

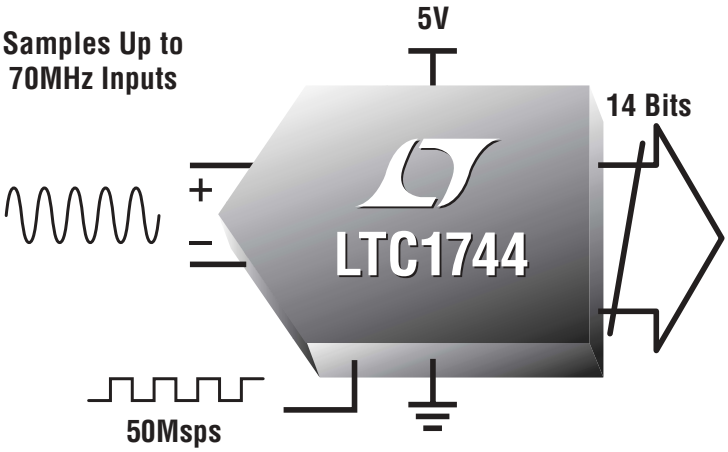
Applications include:

- Cellular Basestations
- CATV Infrastructure
- Wireless Local Loop
- Remote Monitoring
- Security Systems

High Speed ADCs

The next generation of wireless infrastructure must not only provide high capacity and high data rates, it must also be compatible with a variety of complex modulation schemes. High dynamic range and high speed ADCs enable wireless basestations that can meet the demanding requirements of 3rd generation cellular networks. These converters must provide:

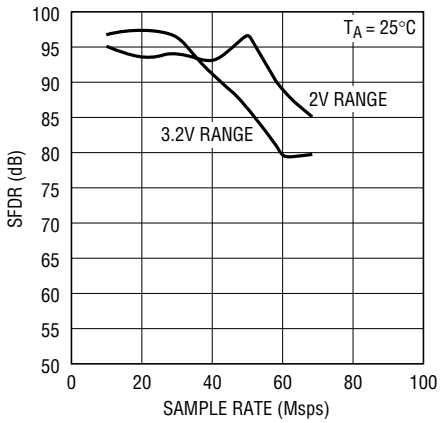
- **High conversion rates to allow the intermediate frequency to be sampled directly, eliminating the cost and complexity of a down-conversion stage**
- **High SNR and SFDR to give these ADCs the dynamic range to detect small signals in the presence of large interferers**
- **Flexible input ranges which can be adjusted to achieve maximum SNR for Nyquist applications or SFDR for undersampling applications**



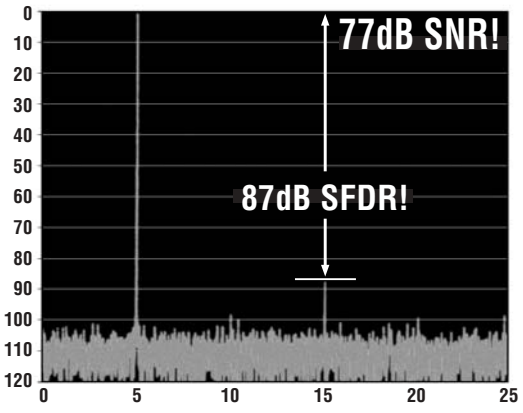
High Speed ADCs

Part Number	Bits	Speed (Msps)	SINAD (dB)	SFDR (dB)	V_{SUPPLY}	Power	Package
LTC®1744	14	50	77	87	5V	1.5W	TSSOP-48
LTC1411	14	2.5	80	82	5V	195mW	SSOP-36
LTC1414	14	2.2	78	84	±5V	150mW	SSOP-28
LTC1420	12	10	71	83	5V, ±5V	200mW	SSOP-28
LTC1405	12	5	71.3	85	5V, ±5V	115mW	SSOP-28

LTC1744 SFDR vs Sample Rate, Input Frequency = 5MHz



LTC1744 50Msps, 4096-Point FFT



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High Speed DACs

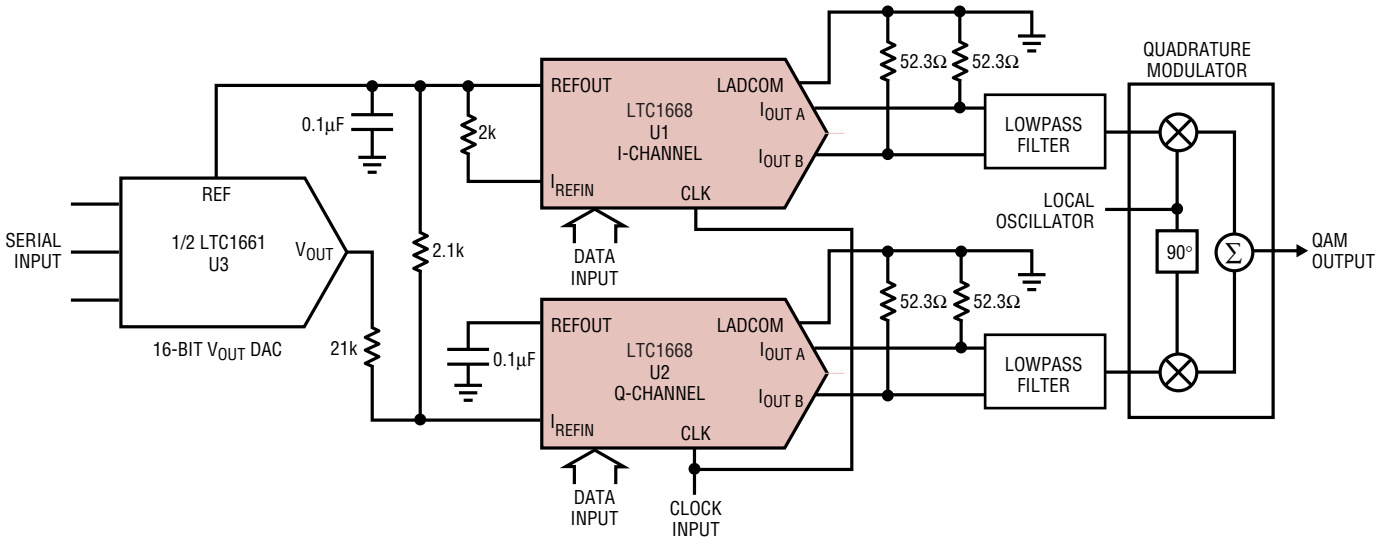
Digital to analog converters with both high speed and high dynamic range are the building blocks of the basestation's transmit channel. In addition to basestation designs, these high speed DACs are perfect for power amp linearization applications as well as wireless instrumentation and communications test equipment.

- **High speed up to 50Msps**
- **High resolution of 12, 14 or 16 bits**
- **High dynamic range 78dB (min) SFDR**

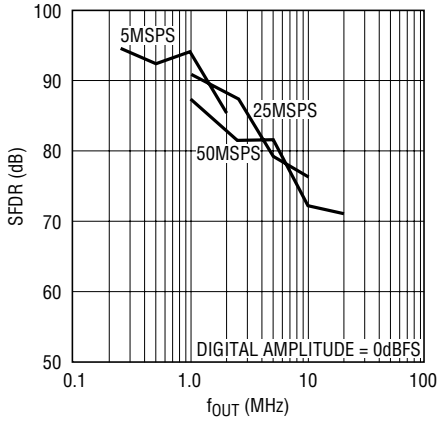
High Speed DACs

Part Number	Bits	Speed	SFDR (at 1MHz)	Power	Package
LTC1668	16	50Msps	87dB	180mW	SSOP-28
LTC1667	14	50Msps	87dB	180mW	SSOP-28
LTC1666	12	50Msps	87dB	180mW	SSOP-28

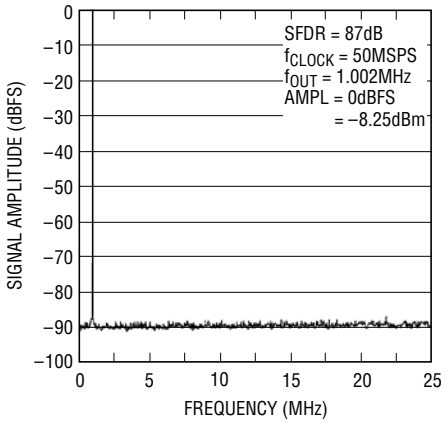
QAM Modulation Using LTC1668 with Digitally Controlled I vs Q Channel Gain Adjustment



LTC1668 SFDR vs f_{OUT} and f_{CLOCK}



LTC1668 Single Tone SFDR at 50Msps



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High Linearity Up and Down Converting Mixers

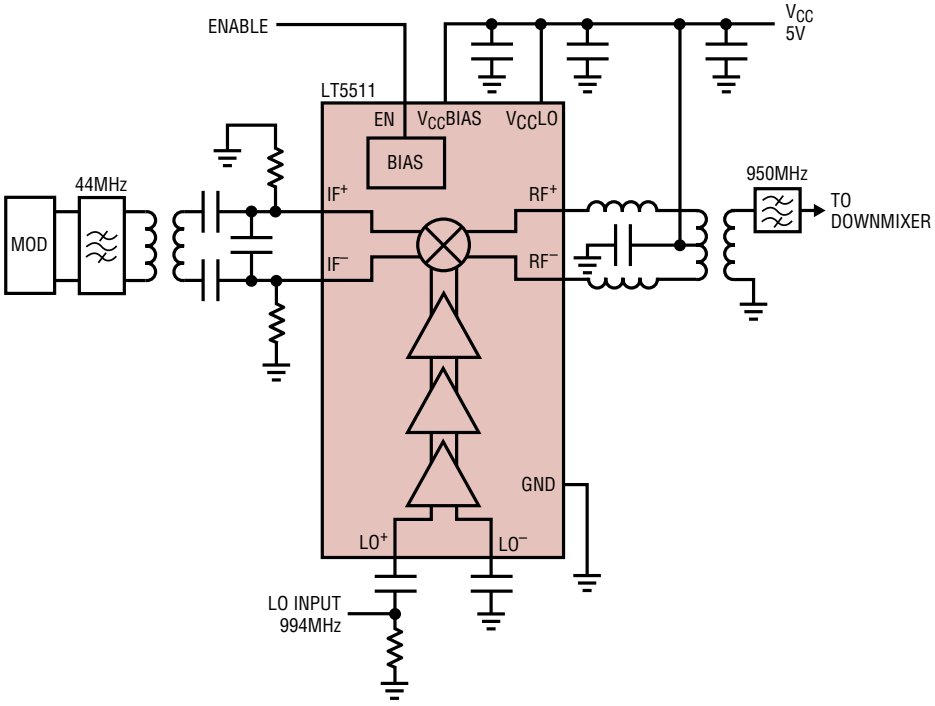
Linear Technology's precision up and down converting mixers feature best in class linearity and excellent port to port isolation. Low distortion operation makes these mixers ideal for use in wireless and cable infrastructure as well as RF instrumentation and radio links.

- **Wide frequency range up to 3GHz**
- **Very low distortion**
- **Very low local oscillator leakage minimizes filtering requirements**
- **Compared with passive mixers, active mixers do not require a high local oscillator drive level. This eliminates the need for an external local oscillator amplifier**

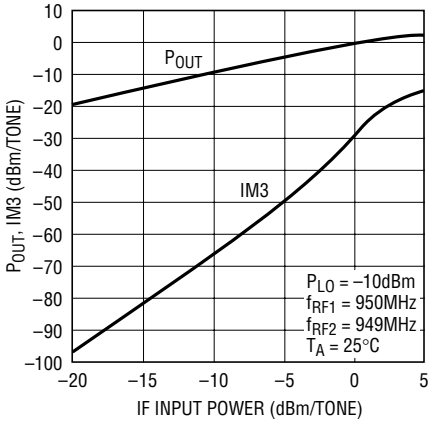
Up and Down Converting Mixers

Part Number	LT®5511 Up-Converter	LT5512 Down-Converter
Frequency Range	10MHz to 3GHz	DC to 3GHz
IIP3 950MHz 1900MHz	17dBm 15.5dBm	21dBm 17dBm
SSB Noise Figure	15dB	13.3dB
LO Output Leakage	–46dBm	–46dBm
LO Drive Level	–15 to –5dBm	–15 to –5dBm
Supply Current	56mA	57mA
Supply Voltage	4V to 5.25V	4.5V to 5.25V
Package	TSSOP-16	4mm X 4mm QFN

LT5511 High Signal Level Upmixer for CATV Downlink Infrastructure



LT5511 RF Output Power and IM3 vs Input Power



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RF Power Detectors

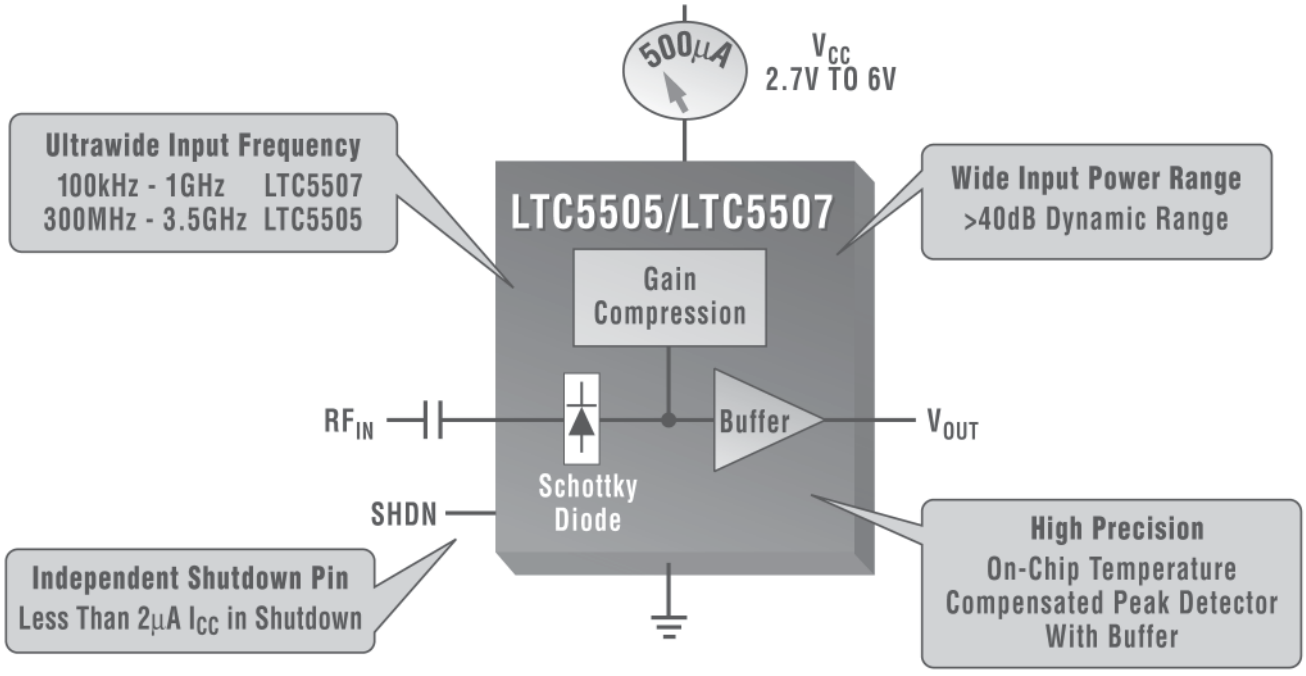
3G cellular networks make use of complex RF power control algorithms to enhance the density and performance of the network. For these algorithms to maintain maximum network performance, RF power must be detected with wide dynamic range at both the basestation and handset.

- **Low power**
- **Wide frequency range**
- **Small package size**
- **LTC5505 offers a wide frequency range for IF detection**
- **LTC5507 offers a lower frequency range for base band detection or general purpose envelope detection**
- **LTC5508 operates up to 7GHz for 802.11a, 802.11b and 802.11g applications**
- **LTC5504 offers 80dB dynamic range for the most demanding infrastructure applications**

RF Power Detectors for Wireless Infrastructure

Part Number	Freq Range	Dynamic Range	I_Q/I_{SHDN}	Package
LTC5505	300MHz to 3.5GHz	>40dB	500µA/2µA	ThinSOT™
LTC5507	100kHz to 1GHz	>40dB	500µA/2µA	ThinSOT
LTC5508	300MHz to 7GHz	>40dB	500µA/2µA	SC70
LTC5504	800MHz to 2.7GHz	80dB	14.7mA/0.2µA	MSOP-8

RF In → Baseband Out with Only One or Two External Components



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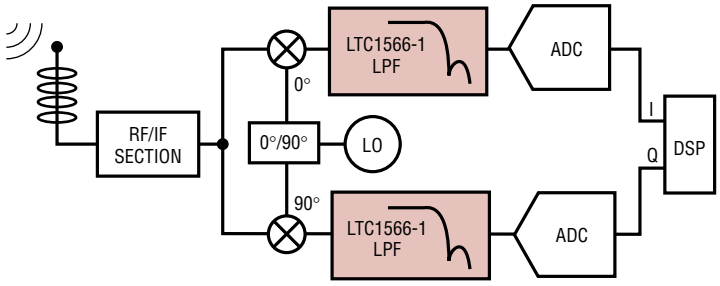
Filters

Filters, both analog and digital, provide a critical building block for wireless systems. Linear Technology offers a range of high performance integrated filters offering ease of design and maximum performance.

- **Exceptionally low noise**
- **Integrated high order lowpass filters eliminate design complexity and parts count**
- **Filtering in the analog domain can reduce the speed, complexity and cost of the digital design**
- **With 5% cutoff frequency accuracy, the LTC1566 and LTC1565 can be used in applications requiring pairs of matched filters, such as transceiver I and Q channels**

Wideband CDMA Basestation Receiver Block Diagram



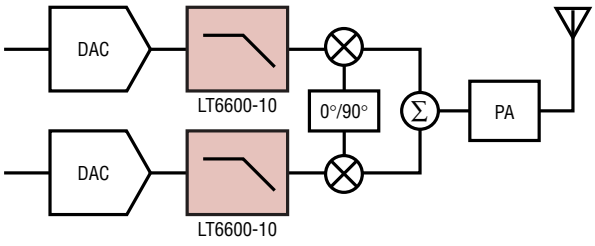
ADC Antialiasing Filters

Part Number	Cutoff Freq	Filter Response	Package	Comments
LTC1565-31	650kHz	7th order linear phase lowpass	SO-8	Differential in/out filter for CDMA
LTC1566-1	2.3MHz	7th order lowpass	SO-8	Differential in/out filter for WCDMA

Other filter responses and cutoff frequencies can be provided upon request. Please contact Linear Technology marketing.

Lowpass filters are also commonly required in the transmit path of the system as post-DAC smoothing filters. The LT6600-10 incorporates a very low noise differential amplifier and a 10MHz lowpass filter in a single package.

LT6600-10 10MHz Lowpass Filter Used as a Post-DAC Filter for Wireless Infrastructure



DAC Post Filter

Part Number	Cutoff Freq	Filter Response	Package	Comments
LT6600-10	10MHz	4th order lowpass Chebyshev	SO-8	Differential in/out

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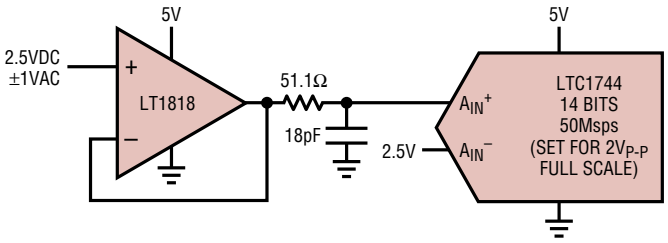
High Speed Amplifiers

High speed, low noise, low distortion op amps provide the building blocks for high performance filters, drivers and amplifiers. These parts offer the speed and flexibility required for next generation wireless systems.

- **High gain bandwidth**
- **High slew rate**
- **Low distortion**
- **Low noise**
- **Optimize filter performance by designing custom filters of any order or frequency response**

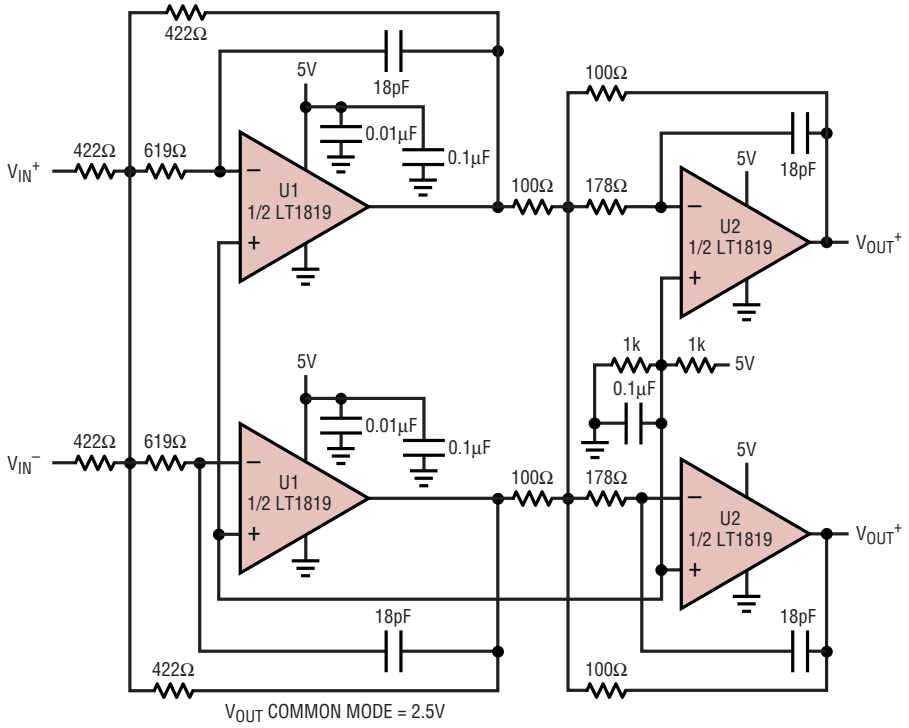
Single Supply Unity-Gain ADC Driver



High Speed Op Amps

Part Number	GBW	SR	Noise	Distortion	I_Q	V_{SUPPLY}	Rail-to-Rail In/Out	Package
LT1818/LT1819	400MHz	2500V/µs	6nV/√Hz	–85dB (5MHz)	9mA	5V, ±5	No	SO-8
LT1815/LT1816	220MHz	1500V/µs	6nV/√Hz	–70dB (5MHz)	6.5mA	5V, ±5V	No	ThinSOT
LT1806/LT1807	325MHz	140V/µs	3.5nV/√Hz	–80dBc (5MHz)	13mA	3V, 5V, ±5V	Yes	ThinSOT
LT1809/LT1810	180MHz	350V/µs	16nV/√Hz	–90dBc (5MHz)	17mA	3V, 5V	Yes	ThinSOT

LT1819 Op Amp as a Lowpass Filter with Adjustable Bandwidth Up to 20MHz



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Low Noise LDOs

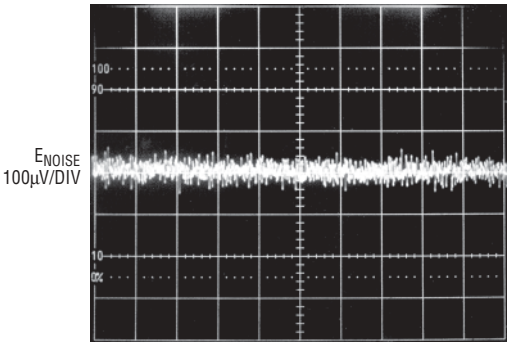
Even the most carefully designed communications systems can be sabotaged by poor power supply design. Noise in the power supply can directly compromise the performance of the complex and sensitive mixed signal or RF components. For absolute lowest noise, our family of high performance LDOs offers:

- **Low noise of 20μV_{RMS}**
- **Wide input voltage range up to 20V**
- **Low quiescent current of 20μA**
- **Stable output with ceramic capacitors**

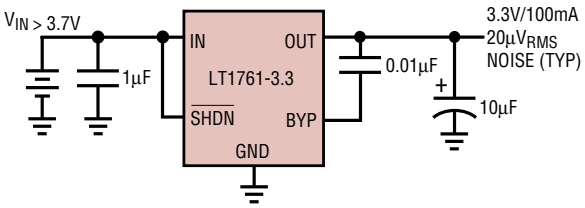
Low Noise LDOs

Part Number	Output Current	Noise	Q Current	Output Voltages	Package
LT3010	50mA	100μV_{RMS}	30μA	Adj., 5V	ThinSOT
LT1761	100mA	20μV_{RMS}	20μA	Adj., 1.5V, 1.8V, 2V, 2.5V, 2.8V, 3V, 3.3V, 5V	ThinSOT
LTC1844	150mA	30μV_{RMS}	40μA	Adj., 1.5V, 1.8V, 2.5V, 2.8V, 3.3V	ThinSOT
LT1762	150mA	20μV_{RMS}	25μA	Adj., 2.5V, 3V, 3.3V, 5V	MSOP-8
LT1962	300mA	20μV_{RMS}	30μA	1.5V, 1.8V, 2.5V, 3V, 3.3V, 5V	MSOP-8
LT1763	500mA	20μV_{RMS}	30μA	1.5V, 1.8V, 2.5V, 3V, 3.3V, 5V	SO-8
LT1963A	1.5A	40μV_{RMS}	1mA	Adj., 1.5V, 1.8V, 2.5V, 3.3V	SO-8
LT1764A	3A	40μV_{RMS}	1mA	1.8V, 2.5V, 3.3V	DD, TO-220

LT1761 Output Voltage Noise in a 10Hz to 100kHz Bandwidth. 20μV_{RMS} Noise Is the Lowest Available in an LDO



Applying the Low Noise, Low Dropout, Micropower Regulator. Bypass Pin and Associated Capacitor are Key to Low Noise Performance



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