LT6600-15

Very Low Noise, Differential Amplifier and 15MHz Lowpass Filter

FEATURES

- Programmable Differential Gain via Two External Resistors
- Adjustable Output Common Mode Voltage
- Operates and Specified with 3V, 5V, ±5V Supplies
- 0.5dB Ripple 4th Order Lowpass Filter with 15MHz Cutoff
- 76dB S/N with 3V Supply and $2V_{P-P}$ Output
- Low Distortion, $2V_{P-P}$, 800Ω Load, $V_S = 3V$
  - 1MHz: 86dBc 2nd, 90dBc 3rd
  - 10MHz: 63dBc 2nd, 69dBc 3rd
- Fully Differential Inputs and Outputs
- Compatible with Popular Differential Amplifier Pinouts
- SO-8 Package

APPLICATIONS

- High Speed ADC Antialiasing and DAC Smoothing in Networking or Cellular Base Station Applications
- High Speed Test and Measurement Equipment
- Medical Imaging
- Drop-In Replacement for Differential Amplifiers

DESCRIPTION

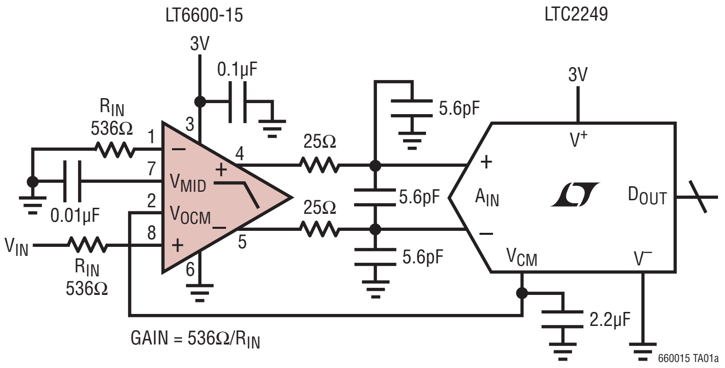
The LT®6600-15 combines a fully differential amplifier with a 4th order 15MHz lowpass filter approximating a Chebyshev frequency response. Most differential amplifiers require many precision external components to tailor gain and bandwidth. In contrast, with the LT6600-15, two external resistors program differential gain, and the filter's 15MHz cutoff frequency and passband ripple are internally set. The LT6600-15 also provides the necessary level shifting to set its output common mode voltage to accommodate the reference voltage requirements of A/Ds.

Using a proprietary internal architecture, the LT6600-15 integrates an antialiasing filter and a differential amplifier/driver without compromising distortion or low noise performance. At unity gain the measured in band signal-to-noise ratio is an impressive 76dB. At higher gains the input referred noise decreases so the part can process smaller input differential signals without significantly degrading the output signal-to-noise ratio.

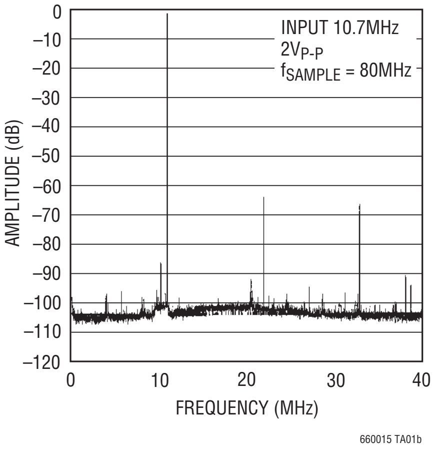
The LT6600-15 also features low voltage operation. The differential design provides outstanding performance for a $2V_{P-P}$ signal level while the part operates with a single 3V supply.

The LT6600-15 is packaged in an SO-8 and is pin compatible with standalone differential amplifiers.

TYPICAL APPLICATION



An 8192 Point FFT Spectrum

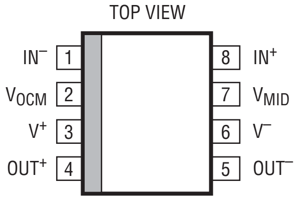


ABSOLUTE MAXIMUM RATINGS

(Note 1)

Total Supply Voltage 11V
Input Current (Note 8)...±10mA
Operating Temperature Range (Note 6)....–40°C to 85°C
Specified Temperature Range (Note 7) .... –40°C to 85°C
Junction Temperature .... 150°C
Storage Temperature Range...................–65°C to 150°C
Lead Temperature (Soldering, 10 sec) .... 300°C

PIN CONFIGURATION



S8 PACKAGE
8-LEAD PLASTIC SO
T_{JMAX} = 150°C, θ_{JA} = 100°C/W

ORDER INFORMATION

LEAD FREE FINISH	TAPE AND REEL	PART MARKING	PACKAGE DESCRIPTION	TEMPERATURE RANGE
LT6600CS8-15#PBF	LT6600CS8-15#TRPBF	660015	8-Lead Plastic SO	–40°C to 85°C
LT6600IS8-15#PBF	LT6600IS8-15#TRPBF	600I15	8-Lead Plastic SO	–40°C to 85°C
LEAD BASED FINISH	**TAPE AND REEL**	**PART MARKING**	**PACKAGE DESCRIPTION**	**TEMPERATURE RANGE**
LT6600CS8-15	LT6600CS8-15#TR	660015	8-Lead Plastic SO	–40°C to 85°C
LT6600IS8-15	LT6600IS8-15#TR	600I15	8-Lead Plastic SO	–40°C to 85°C

Consult LTC Marketing for parts specified with wider operating temperature ranges.

For more information on lead free part marking, go to: http://www.linear.com/leadfree/
For more information on tape and reel specifications, go to: http://www.linear.com/tapeandreel/

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25°C. Unless otherwise specified V_S = 5V (V^+ = 5V, V^- = 0V), R_{IN} = 536Ω, and R_{LOAD} = 1k.

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Filter Gain, V_S = 3V	V_{IN} = $2V_{P-P}$, f_{IN} = DC to 260kHz		–0.5	0.1	0.5	dB
	V_{IN} = $2V_{P-P}$, f_{IN} = 1.5MHz (Gain Relative to 260kHz)	●	–0.1	0	0.1	dB
	V_{IN} = $2V_{P-P}$, f_{IN} = 7.5MHz (Gain Relative to 260kHz)	●	–0.3	0	0.4	dB
	V_{IN} = $2V_{P-P}$, f_{IN} = 12MHz (Gain Relative to 260kHz)	●	–0.3	0.2	1.0	dB
	V_{IN} = $2V_{P-P}$, f_{IN} = 15MHz (Gain Relative to 260kHz)	●	–0.7	0	1.0	dB
	V_{IN} = $2V_{P-P}$, f_{IN} = 45MHz (Gain Relative to 260kHz)	●		–29	–25	dB
	V_{IN} = $2V_{P-P}$, f_{IN} = 75MHz (Gain Relative to 260kHz)	●		–46		dB
Filter Gain, V_S = 5V	V_{IN} = $2V_{P-P}$, f_{IN} = DC to 260kHz		–0.5	0	0.5	dB
	V_{IN} = $2V_{P-P}$, f_{IN} = 1.5MHz (Gain Relative to 260kHz)	●	–0.1	0	0.1	dB
	V_{IN} = $2V_{P-P}$, f_{IN} = 7.5MHz (Gain Relative to 260kHz)	●	–0.4	0	0.3	dB
	V_{IN} = $2V_{P-P}$, f_{IN} = 12MHz (Gain Relative to 260kHz)	●	–0.4	0.1	0.9	dB
	V_{IN} = $2V_{P-P}$, f_{IN} = 15MHz (Gain Relative to 260kHz)	●	–0.8	0	0.9	dB
	V_{IN} = $2V_{P-P}$, f_{IN} = 45MHz (Gain Relative to 260kHz)	●		–29	–25	dB
	V_{IN} = $2V_{P-P}$, f_{IN} = 75MHz (Gain Relative to 260kHz)	●		–46		dB
Filter Gain, V_S = ±5V	V_{IN} = $2V_{P-P}$, f_{IN} = DC to 260kHz		–0.6	–0.1	0.4	dB
Filter Gain, R_{IN} = 133Ω	V_{OUT} = $0.5V_{P-P}$, f_{IN} = DC to 260kHz, V_S = 3V		11.5	12.0	12.5	dB
	V_{OUT} = $0.5V_{P-P}$, f_{IN} = DC to 260kHz, V_S = 5V		11.5	12.0	12.5	dB
	V_{OUT} = $0.5V_{P-P}$, f_{IN} = DC to 260kHz, V_S = ±5V		11.4	11.9	12.4	dB

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at T_A = 25°C. Unless otherwise specified V_S = 5V (V^+ = 5V, V^- = 0V), R_{IN} = 536Ω, and R_{LOAD} = 1k.

PARAMETER	CONDITIONS			MIN	TYP	MAX	UNITS
Filter Gain Temperature Coefficient (Note 2)	f_{IN} = 250kHz, V_{IN} = $2V_{P-P}$				780		ppm/C
Noise	Noise BW = 10kHz to 15MHz				109		μV_{RMS}
Distortion (Note 4)	1MHz, $2V_{P-P}$, R_L = 800Ω, V_S = 3V	2nd Harmonic			86		dBc
		3rd Harmonic			90		dBc
	10MHz, $2V_{P-P}$, R_L = 800Ω, V_S = 3V	2nd Harmonic			63		dBc
		3rd Harmonic			69		dBc
Differential Output Swing	Measured Between Pins 4 and 5	V_S = 5V	●	3.80	4.75		$V_{P-P\ DIFF}$
		V_S = 3V	●	3.75	4.50		$V_{P-P\ DIFF}$
Input Bias Current	Average of Pin 1 and Pin 8		●	–90	–35		µA
Input Referred Differential Offset	R_{IN} = 536Ω	V_S = 3V	●		±5	±25	mV
		V_S = 5V	●		±10	±30	mV
		V_S = ±5V	●		±10	±35	mV
	R_{IN} = 133Ω	V_S = 3V	●		±5	±15	mV
		V_S = 5V	●		±5	±17	mV
		V_S = ±5V	●		±5	±20	mV
Differential Offset Drift					10		µV/°C
Input Common Mode Voltage (Note 3)	Differential Input = $500mV_{P-P}$,	V_S = 3V	●	0.0		1.5	V
	R_{IN} = 133Ω	V_S = 5V	●	0.0		3.0	V
		V_S = ±5V	●	–2.5		1.0	V
Output Common Mode Voltage (Note 5)	Differential Input = $2V_{P-P}$,	V_S = 3V	●	1.0		1.5	V
	Pin 7 = OPEN	V_S = 5V	●	1.5		3.0	V
	Common Mode Voltage at Pin 2	V_S = ±5V	●	–1.0		2.0	V
Output Common Mode Offset (with Respect to Pin 2)		V_S = 3V	●	–35	5	40	mV
		V_S = 5V	●	–40	0	40	mV
		V_S = ±5V	●	–55	–10	35	mV
Common Mode Rejection Ratio					64		dB
Voltage at V_{MID} (Pin 7)		V_S = 5V	●	2.45	2.50	2.55	V
		V_S = 3V			1.50		V
V_{MID} Input Resistance			●	4.3	5.7	7.7	kΩ
V_{OCM} Bias Current	V_{OCM} = V_{MID} = $V_S/2$	V_S = 5V	●	–10	–2		µA
		V_S = 3V	●	–10	–2		µA
Power Supply Current		V_S = 3V, V_S = 5V			35	39	mA
		V_S = 3V	●			44	mA
		V_S = 5V	●			45	mA
		V_S = ±5V	●		38	48	mA
Power Supply Voltage			●	3		11	V

Note 1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

Note 2: This is the temperature coefficient of the internal feedback resistors assuming a temperature independent external resistor (R_{IN}).

Note 3: The input common mode voltage is the average of the voltages applied to the external resistors (R_{IN}). Specification guaranteed for $R_{IN} \geq 100\Omega$.

Note 4: Distortion is measured differentially using a differential stimulus, The input common mode voltage, the voltage at Pin 2, and the voltage at Pin 7 are equal to one half of the total power supply voltage.

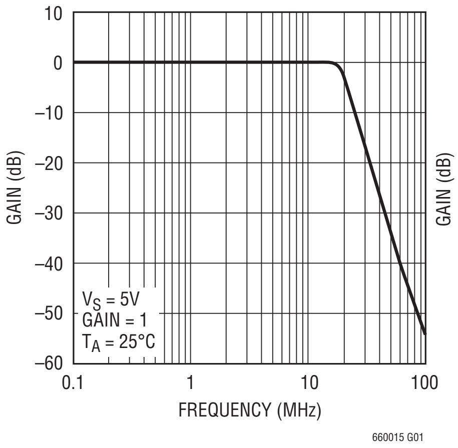
Note 5: Output common mode voltage is the average of the voltages at Pins 4 and 5. The output common mode voltage is equal to the voltage applied to Pin 2.

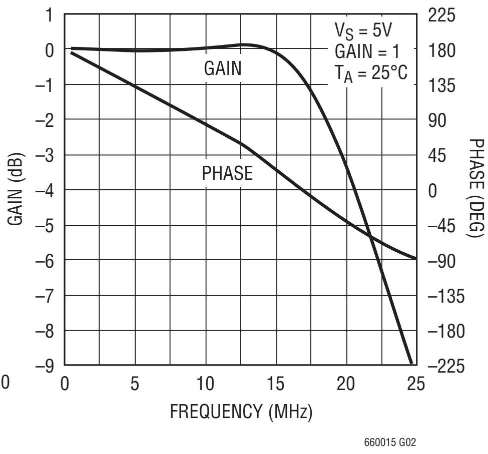
Note 6: The LT6600C-15 is guaranteed functional over the operating temperature range –40°C to 85°C.

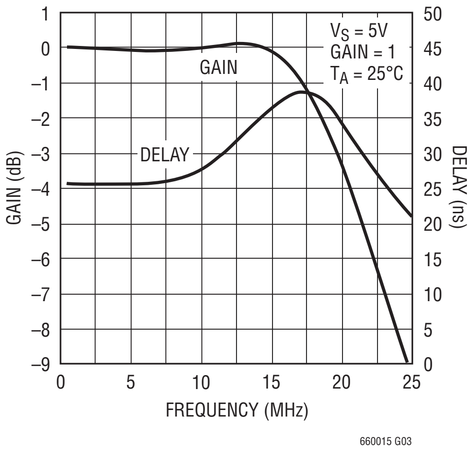
Note 7: The LT6600C-15 is guaranteed to meet 0°C to 70°C specifications and is designed, characterized and expected to meet the extended temperature limits, but is not tested at –40°C and 85°C. The LT6600I-15 is guaranteed to meet specified performance from –40°C to 85°C.

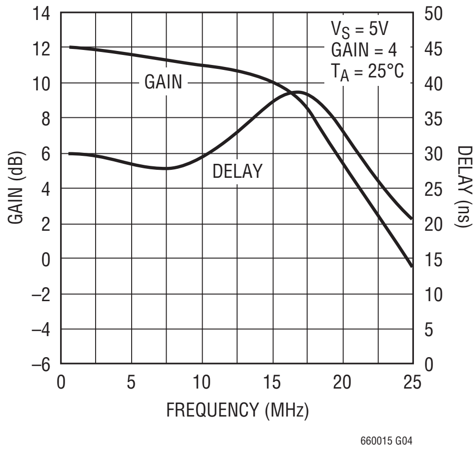
Note 8: The inputs are protected by back-to-back diodes. If the differential input voltage exceeds 1.4V, the input current should be limited to less than 10mA.

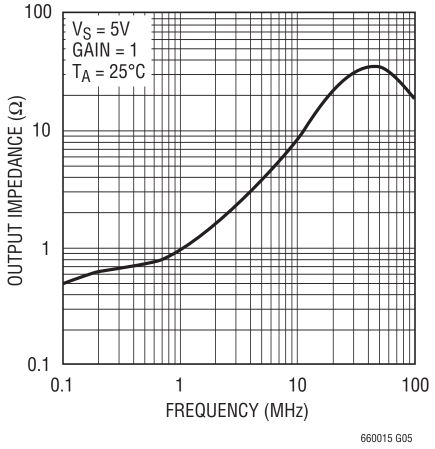
TYPICAL PERFORMANCE CHARACTERISTICS

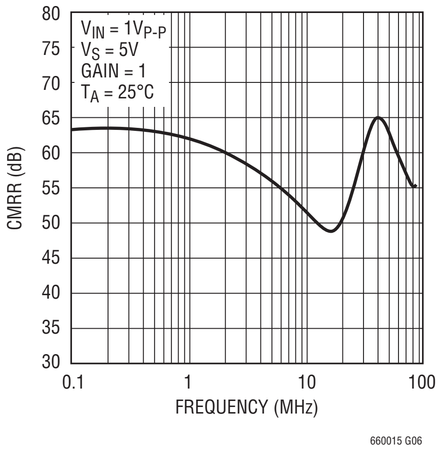

Amplitude Response

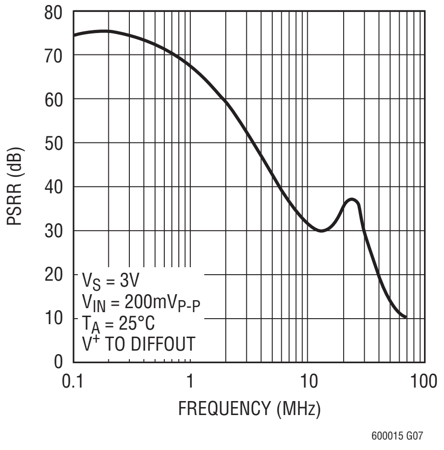

Passband Gain and Phase

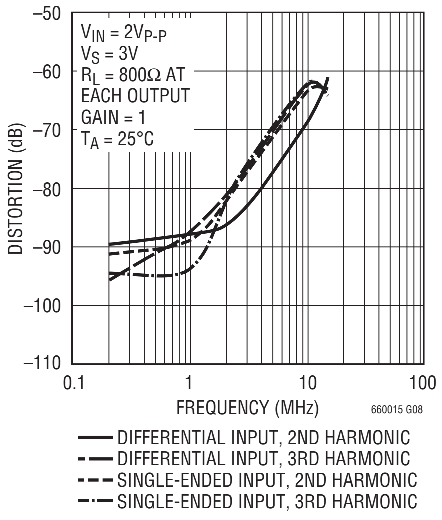

Passband Gain and Delay


Passband Gain and Delay


Output Impedance

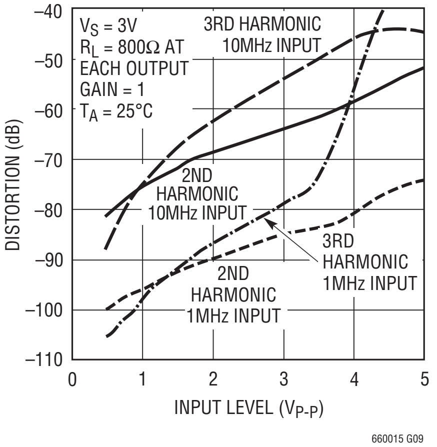

Common Mode Rejection Ratio


Power Supply Rejection Ratio

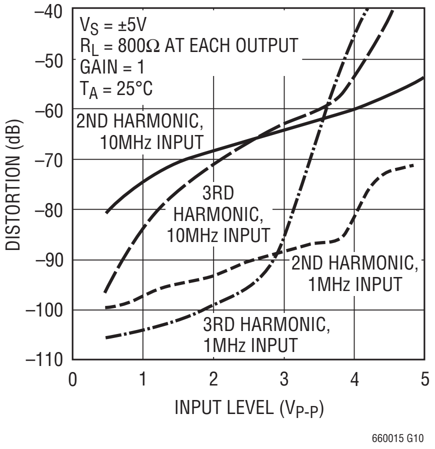

Distortion vs Frequency

TYPICAL PERFORMANCE CHARACTERISTICS

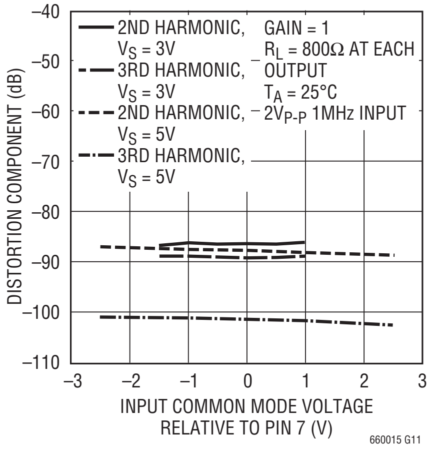
Distortion vs Signal Level



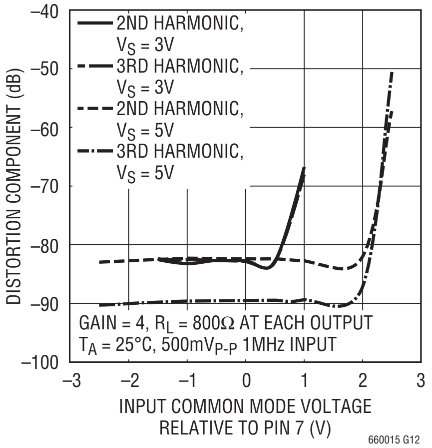
Distortion vs Signal Level



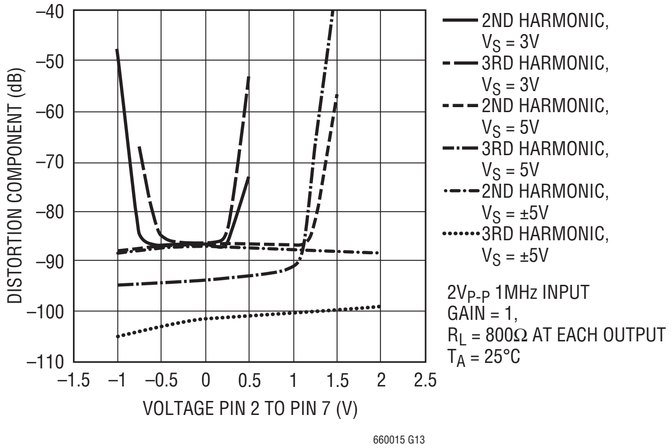
Distortion
vs Input Common Mode Level



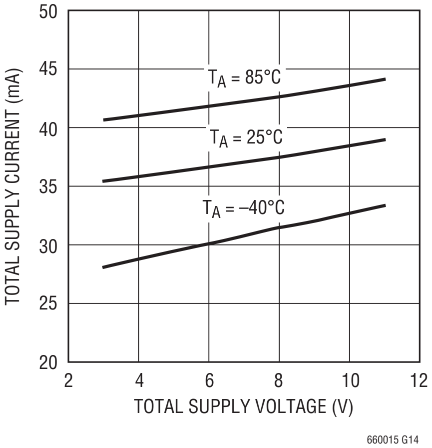
Distortion
vs Input Common Mode Level



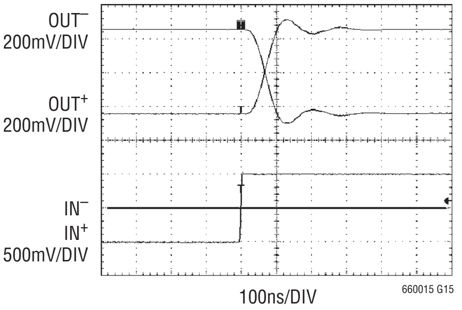
Distortion
vs Output Common Mode



Total Supply Current
vs Total Supply Voltage



Transient Response



DIFFERENTIAL GAIN = 1
SINGLE-ENDED INPUT
DIFFERENTIAL OUTPUT

PIN FUNCTIONS

IN^- and IN^+ (Pins 1, 8): Input Pins. Signals can be applied to either or both input pins through identical external resistors, R_{IN}. The DC gain from differential inputs to the differential outputs is 536Ω/R_{IN}.

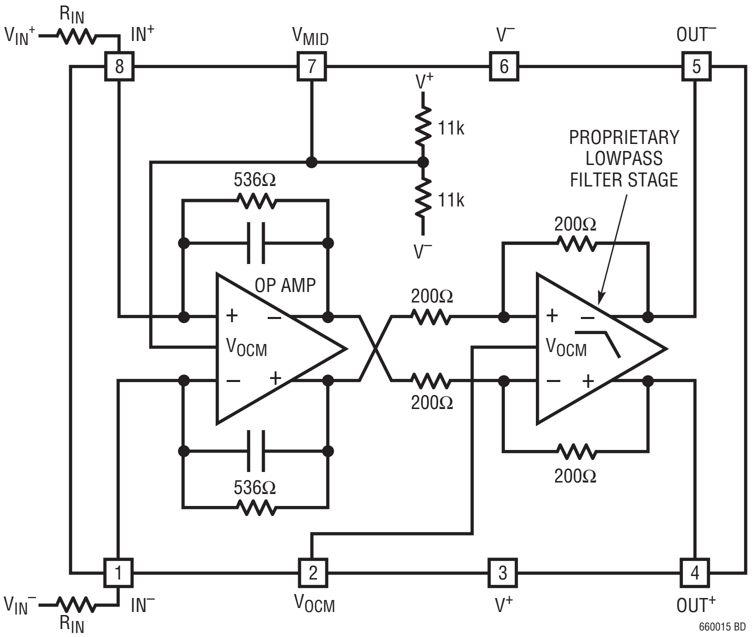
V_{OCM} (Pin 2): Is the DC Common Mode Reference Voltage for the 2nd Filter Stage. Its value programs the common mode voltage of the differential output of the filter. Pin 2 is a high impedance input, which can be driven from an external voltage reference, or Pin 2 can be tied to Pin 7 on the PC board. Pin 2 should be bypassed with a 0.01μF ceramic capacitor unless it is connected to a ground plane.

V^+ and V^- (Pins 3, 6): Power Supply Pins. For a single 3.3V or 5V supply (Pin 6 grounded) a quality 0.1μF ceramic bypass capacitor is required from the positive supply pin (Pin 3) to the negative supply pin (Pin 6). The bypass should be as close as possible to the IC. For dual supply applications, bypass Pin 3 to ground and Pin 6 to ground with a quality 0.1μF ceramic capacitor.

OUT^+ and OUT^- (Pins 4, 5): Output Pins. Pins 4 and 5 are the filter differential outputs. Each pin can drive a 100Ω and/or 50pF load.

V_{MID} (Pin 7): The V_{MID} pin is internally biased at mid-supply, see the Block Diagram section. For single supply operation, the V_{MID} pin should be bypassed with a quality 0.01μF ceramic capacitor to Pin 6. For dual supply operation, Pin 7 can be bypassed or connected to a high quality DC ground. A ground plane should be used. A poor ground will increase noise and distortion. Pin 7 sets the output common mode voltage of the 1st stage of the filter. It has a 5.5kΩ impedance, and it can be overridden with an external low impedance voltage source.

BLOCK DIAGRAM



APPLICATIONS INFORMATION

Interfacing to the LT6600-15

The LT6600-15 requires two equal external resistors, R_{IN}, to set the differential gain to 536Ω/R_{IN}. The inputs to the filter are the voltages V_{IN}^+ and V_{IN}^- presented to these external components, Figure 1. The difference between V_{IN}^+ and V_{IN}^- is the differential input voltage. The average of V_{IN}^+ and V_{IN}^- is the common mode input voltage. Similarly, the voltages V_{OUT}^+ and V_{OUT}^- appearing at Pins 4 and 5 of the LT6600-15 are the filter outputs. The difference between V_{OUT}^+ and V_{OUT}^- is the differential output voltage. The average of V_{OUT}^+ and V_{OUT}^- is the common mode output voltage.

Figure 1 illustrates the LT6600-15 operating with a single 3.3V supply and unity passband gain; the input signal is DC coupled. The common mode input voltage is 0.5V, and the differential input voltage is $2V_{P-P}$. The common mode output voltage is 1.65V, and the differential output voltage is $2V_{P-P}$ for frequencies below 15MHz. The common mode output voltage is determined by the voltage at Pin 2. Since Pin 2 is shorted to Pin 7, the output common mode is the mid-supply voltage. In addition, the common mode input voltage can be equal to the mid-supply voltage of Pin 7 (see the Distortion vs Input Common Mode Level graphs in the Typical Performance Characteristics section).

Figure 2 shows how to AC couple signals into the LT6600-15. In this instance, the input is a single-ended signal. AC coupling allows the processing of single-ended or differential signals with arbitrary common mode levels. The 0.1µF coupling capacitor and the 536Ω gain setting resistor form a high pass filter, attenuating signals below 3kHz. Larger values of coupling capacitors will proportionally reduce this highpass 3dB frequency.

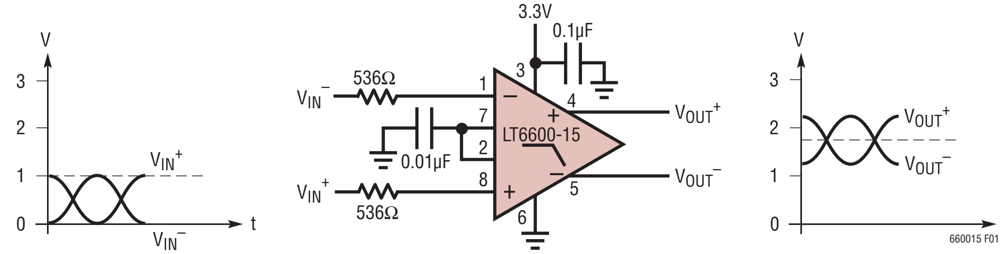


Figure 1

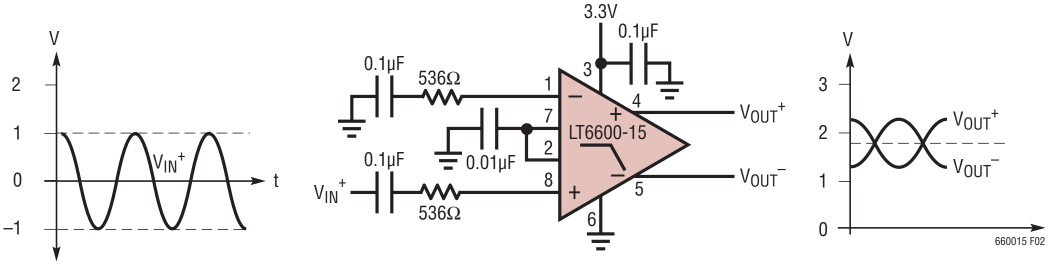


Figure 2

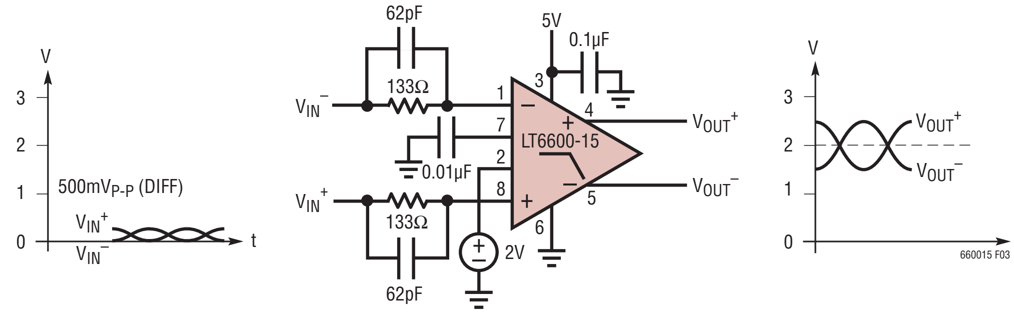


Figure 3

APPLICATIONS INFORMATION

In Figure 3 the LT6600-15 is providing 12dB of gain. The gain resistor has an optional 62pF in parallel to improve the passband flatness near 15MHz. The common mode output voltage is set to 2V.

Use Figure 4 to determine the interface between the LT6600-15 and a current output DAC. The gain, or "transimpedance," is defined as $A = V_{OUT}/I_{IN}$. To compute the transimpedance, use the following equation:

$$A = \frac{536 \cdot R1}{(R1+R2)}(\Omega)$$

By setting R1 + R2 = 536Ω, the gain equation reduces to A = R1(Ω).

The voltage at the pins of the DAC is determined by R1, R2, the voltage on Pin 7 and the DAC output current. Consider Figure 4 with R1 = 49.9Ω and R2 = 487Ω. The voltage at Pin 7 is 1.65V. The voltage at the DAC pins is given by:

$$V_{DAC} = V_{PIN7} \cdot \frac{R1}{R1+R2+536} + I_{IN} \cdot \frac{R1 \cdot R2}{R1+R2}$$
$$= 77mV + I_{IN} \cdot 45.3\Omega$$

I_{IN} is I_{IN}^{+} or I_{IN}^{-}. The transimpedance in this example is 49.8Ω.

Evaluating the LT6600-15

The low impedance levels and high frequency operation of the LT6600-15 require some attention to the matching networks between the LT6600-15 and other devices. The previous examples assume an ideal (0Ω) source impedance and a large (1kΩ) load resistance. Among practical examples where impedance must be considered is the evaluation of the LT6600-15 with a network analyzer. Figure 5 is a laboratory setup that can be used to characterize the LT6600-15 using single-ended instruments with 50Ω source impedance and 50Ω input impedance. For a unity gain configuration the LT6600-15 requires a 536Ω source resistance yet the network analyzer output is calibrated for a 50Ω load resistance. The 1:1 transformer, 52.3Ω and 523Ω resistors satisfy the two constraints above. The transformer converts the single-ended source into a differential stimulus. Similarly, the output of the LT6600-15 will have lower distortion with larger load resistance yet the analyzer input is typically 50Ω. The 4:1 turns (16:1 impedance) transformer and the two 402Ω resistors of Figure 5, present the output of the LT6600-15 with a 1600Ω differential load, or the equivalent of 800Ω to ground at each output. The impedance seen by the network analyzer input is still 50Ω, reducing reflections in the cabling between the transformer and analyzer input.

Differential and Common Mode Voltage Ranges

The differential amplifiers inside the LT6600-15 contain circuitry to limit the maximum peak-to-peak differential voltage through the filter. This limiting function prevents excessive power dissipation in the internal circuitry and provides output short-circuit protection. The limiting function begins to take effect at output signal levels above $2V_{P-P}$ and it becomes noticeable above $3.5V_{P-P}$. This is illustrated in Figure 6; the LT6600-15 was configured with unity passband gain and the input of the filter was driven with a 1MHz signal. Because this voltage limiting takes place well before the output stage of the filter reaches the

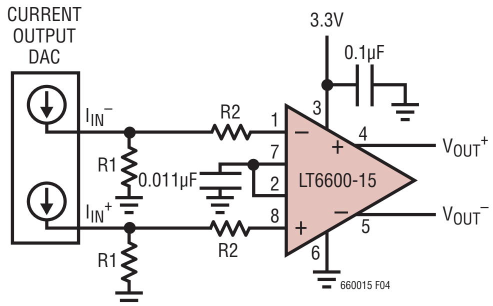


Figure 4

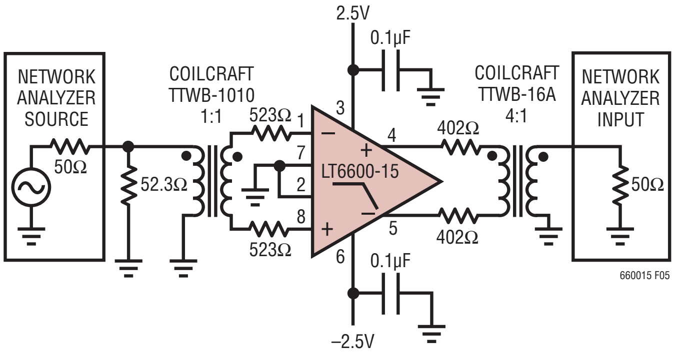


Figure 5

APPLICATIONS INFORMATION

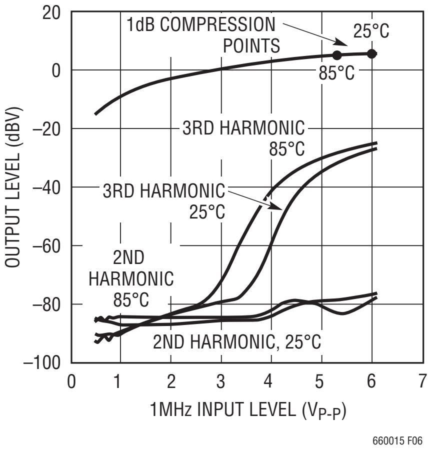


Figure 6. Output Level vs Input Level, Differential 1MHz Input, Gain = 1

supply rails, the input/output behavior of the IC shown in Figure 6 is relatively independent of the power supply voltage.

The two amplifiers inside the LT6600-15 have independent control of their output common mode voltage (see the Block Diagram section). The following guidelines will optimize the performance of the filter.

Pin 7 must be bypassed to an AC ground with a 0.01µF or larger capacitor. Pin 7 can be driven from a low impedance source, provided it remains at least 1.5V above V^- and at least 1.5V below V^+. An internal resistor divider sets the voltage of Pin 7. While the internal 11k resistors are well matched, their absolute value can vary by ±20%. This should be taken into consideration when connecting an external resistor network to alter the voltage of Pin 7.

Pin 2 can be shorted to Pin 7 for simplicity. If a different common mode output voltage is required, connect Pin 2 to a voltage source or resistor network. For 3V and 3.3V supplies the voltage at Pin 2 must be less than or equal to the mid supply level. For example, voltage (Pin 2) ≤ 1.65V on a single 3.3V supply. For power supply voltages higher than 3.3V the voltage at Pin 2 should be within the voltage of Pin 7 – 1V to the voltage of Pin 7 + 2V. Pin 2 is a high impedance input.

The LT6600-15 was designed to process a variety of input signals including signals centered around the mid-supply voltage and signals that swing between ground and a positive voltage in a single supply system (Figure 1). The range of allowable input common mode voltage (the average of V_{IN}^+ and V_{IN}^- in Figure 1) is determined by the power supply level and gain setting (see Distortion vs Input Common Mode Level in the Typical Performance Characteristics section).

Common Mode DC Currents

In applications like Figure 1 and Figure 3 where the LT6600-15 not only provides lowpass filtering but also level shifts the common mode voltage of the input signal, DC currents will be generated through the DC path between input and output terminals. Minimize these currents to decrease power dissipation and distortion.

Consider the application in Figure 3. Pin 7 sets the output common mode voltage of the 1st differential amplifier inside the LT6600-15 (see the Block Diagram section) at 2.5V. Since the input common mode voltage is near 0V, there will be approximately a total of 2.5V drop across the series combination of the internal 536Ω feedback resistor and the external 133Ω input resistor. The resulting 3.7mA common mode DC current in each input path, must be absorbed by the sources V_{IN}^+ and V_{IN}^-. Pin 2 sets the common mode output voltage of the 2nd differential amplifier inside the LT6600-15, and therefore sets the common mode output voltage of the filter. Since, in the example of Figure 3, Pin 2 differs from Pin 7 by 0.5V, an additional 2.5mA (1.25mA per side) of DC current will flow in the resistors coupling the 1st differential amplifier output stage to filter output. Thus, a total of 9.9mA is used to translate the common mode voltages.

A simple modification to Figure 3 will reduce the DC common mode currents by 40%. If Pin 7 is shorted to Pin 2 the common mode output voltage of both op amp stages will be 2V and the resulting DC current will be 6mA. Of course, by AC coupling the inputs of Figure 3, the common mode DC current can be reduced to 2.5mA.

APPLICATIONS INFORMATION

Noise

The noise performance of the LT6600-15 can be evaluated with the circuit of Figure 7.

Given the low noise output of the LT6600-15 and the 6dB attenuation of the transformer coupling network, it is necessary to measure the noise floor of the spectrum analyzer and subtract the instrument noise from the filter noise measurement.

Example: With the IC removed and the 25Ω resistors grounded, Figure 7, measure the total integrated noise (e_S) of the spectrum analyzer from 10kHz to 15MHz. With the IC inserted, the signal source (V_{IN}) disconnected, and the input resistors grounded, measure the total integrated noise out of the filter (e_O). With the signal source connected, set the frequency to 1MHz and adjust the amplitude until V_{IN} measures $100mV_{P-P}$. Measure the output amplitude, V_{OUT}, and compute the passband gain $A = V_{OUT}/V_{IN}$. Now compute the input referred integrated noise (e_{IN}) as:

$$e_{IN} = \frac{\sqrt{(e_O)^2 - (e_S)^2}}{A}$$

Table 1 lists the typical input referred integrated noise for various values of R_{IN}.

Figure 8 is plot of the noise spectral density as a function of frequency for an LT6600-15 using the fixture of Figure 7 (the instrument noise has been subtracted from the results).

Table 1. Noise Performance

PASSBAND GAIN (V/V)	R_{IN}	INPUT REFERRED INTEGRATED NOISE 10kHz TO 15MHz	INPUT REFERRED INTEGRATED NOISE 10kHz TO 30MHz
4	133Ω	$36\mu V_{RMS}$	$51\mu V_{RMS}$
2	267Ω	$62\mu V_{RMS}$	$92\mu V_{RMS}$
1	536Ω	$109\mu V_{RMS}$	$169\mu V_{RMS}$

The noise at each output is comprised of a differential component and a common mode component. Using a transformer or combiner to convert the differential outputs to single-ended signal rejects the common mode noise and gives a true measure of the S/N achievable in the system. Conversely, if each output is measured individually and the noise power added together, the resulting calculated noise level will be higher than the true differential noise.

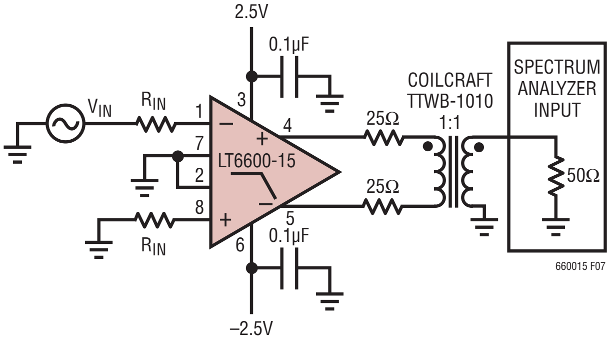


Figure 7

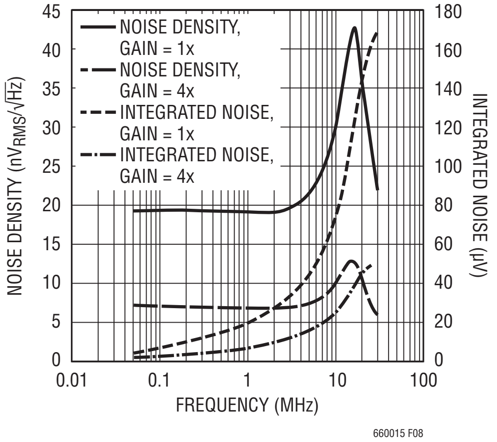


Figure 8. Input Referred Noise, Gain = 1

Power Dissipation

The LT6600-15 amplifiers combine high speed with large-signal currents in a small package. There is a need to ensure that the die junction temperature does not exceed 150°C. The LT6600-15 package has Pin 6 fused to the lead frame to enhance thermal conduction when connecting to a ground plane or a large metal trace. Metal trace and plated through-holes can be used to spread the heat generated by the device to the backside of the PC board. For example, on a 3/32" FR-4 board with 2oz copper, a total of 660 square millimeters connected to Pin 6 of the LT6600-15 (330 square millimeters on each side of the PC board) will result in a thermal resistance, θ_{JA}, of about 85°C/W. Without the extra metal trace connected to the V^- pin to provide a heat sink, the thermal resistance will be around 105°C/W. Table 2 can be used as a guide when considering thermal resistance.

APPLICATIONS INFORMATION

Table 2. LT6600-15 SO-8 Package Thermal Resistance

COPPER AREA			
TOPSIDE (mm^2)	BACKSIDE (mm^2)	BOARD AREA (mm^2)	THERMAL RESISTANCE (JUNCTION-TO-AMBIENT)
1100	1100	2500	65°C/W
330	330	2500	85°C/W
35	35	2500	95°C/W
35	0	2500	100°C/W
0	0	2500	105°C/W

Junction temperature, T_J, is calculated from the ambient temperature, T_A, and power dissipation, P_D. The power dissipation is the product of supply voltage, V_S, and supply current, I_S. Therefore, the junction temperature is given by:

$$T_J = T_A + (P_D \bullet \theta_{JA}) = T_A + (V_S \bullet I_S \bullet \theta_{JA})$$

where the supply current, I_S, is a function of signal level, load impedance, temperature and common mode voltages.

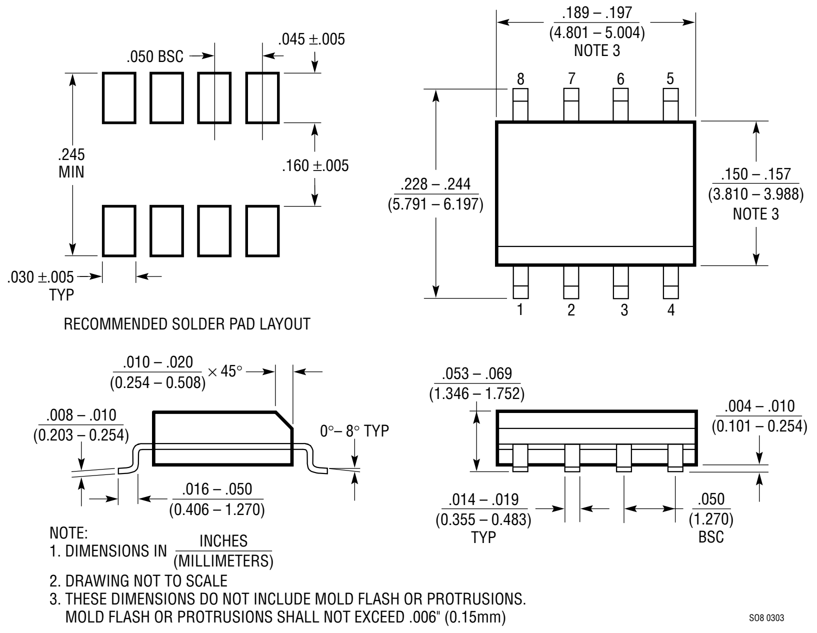
For a given supply voltage, the worst-case power dissipation occurs when the differential input signal is maximum, the common mode currents are maximum (see the Applications Information section regarding common mode DC currents), the load impedance is small and the ambient temperature is maximum. To compute the junction temperature, measure the supply current under these worst-case conditions, estimate the thermal resistance from Table 2, then apply the equation for T_J. For example, using the circuit in Figure 3 with a DC differential input voltage of 250mV, a differential output voltage of 1V, no load resistance and an ambient temperature of 85°C, the supply current (current into Pin 3) measures 50mA. Assuming a PC board layout with a 35mm^2 copper trace, the θ_{JA} is 100°C/W. The resulting junction temperature is:

$$T_J = T_A + (P_D \bullet \theta_{JA}) = 85 + (5 \bullet 0.05 \bullet 100) = 110°C$$

When using higher supply voltages or when driving small impedances, more copper may be necessary to keep T_J below 150°C.

PACKAGE DESCRIPTION

S8 Package
8-Lead Plastic Small Outline (Narrow .150 Inch)
(Reference LTC DWG # 05-08-1610)



NOTE:
1. DIMENSIONS IN $\frac{\text{INCHES}}{\text{(MILLIMETERS)}}$
2. DRAWING NOT TO SCALE
3. THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .006" (0.15mm)