LM6171

LM6171 High Speed Low Power Low Distortion Voltage Feedback Amplifier

Literature Number: SNOS745B

National Semiconductor

February 2003

LM6171
High Speed Low Power Low Distortion Voltage Feedback Amplifier

General Description

The LM6171 is a high speed unity-gain stable voltage feedback amplifier. It offers a high slew rate of 3600V/μs and a unity-gain bandwidth of 100 MHz while consuming only 2.5 mA of supply current. The LM6171 has very impressive AC and DC performance which is a great benefit for high speed signal processing and video applications.

The ±15V power supplies allow for large signal swings and give greater dynamic range and signal-to-noise ratio. The LM6171 has high output current drive, low SFDR and THD, ideal for ADC/DAC systems. The LM6171 is specified for ±5V operation for portable applications.

The LM6171 is built on National's advanced VIP™ III (Vertically Integrated PNP) complementary bipolar process.

Features

(Typical Unless Otherwise Noted)

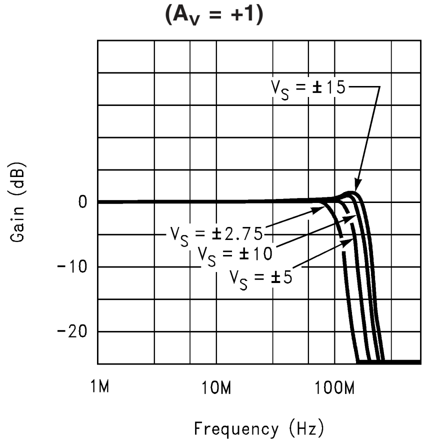
- Easy-To-Use Voltage Feedback Topology
- Very High Slew Rate: 3600V/μs
- Wide Unity-Gain-Bandwidth Product: 100 MHz
- –3dB Frequency @ A_V = +2: 62 MHz
- Low Supply Current: 2.5 mA
- High CMRR: 110 dB
- High Open Loop Gain: 90 dB
- Specified for ±15V and ±5V Operation

Applications

- Multimedia Broadcast Systems
- Line Drivers, Switchers
- Video Amplifiers
- NTSC, PAL® and SECAM Systems
- ADC/DAC Buffers
- HDTV Amplifiers
- Pulse Amplifiers and Peak Detectors
- Instrumentation Amplifier
- Active Filters

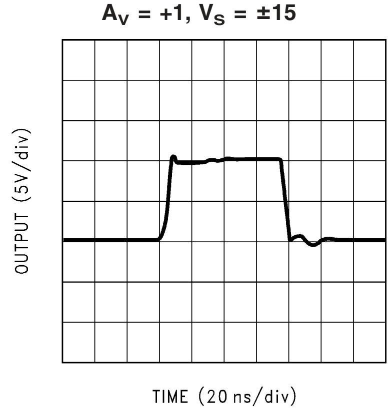
Typical Performance Characteristics

Closed Loop Frequency Responsevs. Supply Voltage (A_V = +1)



01233605

Large Signal Pulse Response A_V = +1, V_S = ±15

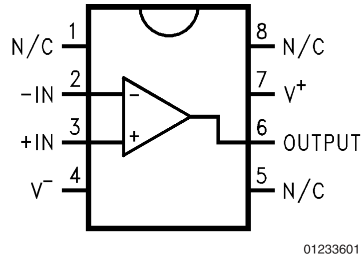


01233609

VIP™ is a trademark of National Semiconductor Corporation.
PAL® is a registered trademark of and used under licence from Advanced Micro Devices, Inc.

Connection Diagram

8-Pin DIP/SO



Top View

Ordering Information

Package	Temperature Range	Transport Media	NSC Drawing
	Industrial −40˚C to +85˚C		
8-Pin Molded DIP	LM6171AIN LM6171BIN	Rails	N08E
8-Pin Small Outline	LM6171AIM, LM6171BIM	Rails	M08A
	LM6171AIMX, LM6171BIMX	2.5k Units Tape and Reel	

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

ESD Tolerance (Note 2)	2.5 kV
Supply Voltage (V^+–V^-)	36V
Differential Input Voltage	±10V
Common-Mode Voltage Range	V^++0.3V to V^- −0.3V
Input Current	±10mA
Output Short Circuit to Ground (Note 3)	Continuous
Storage Temperature Range	−65˚C to +150˚C
Maximum Junction Temperature (Note 4)	150˚C

Soldering Information

Infrared or Convection Reflow (20 sec.)	235˚C
Wave Soldering Lead Temp (10 sec.)	260˚C

Operating Ratings (Note 1)

Supply Voltage	5.5V ≤ V_S ≤ 34V
Operating Temperature Range	
LM6171AI, LM6171BI	−40˚C to +85˚C
Thermal Resistance (θ_{JA})	
N Package, 8-Pin Molded DIP	108˚C/W
M Package, 8-Pin Surface Mount	172˚C/W

±15V DC Electrical Characteristics

Unless otherwise specified, all limits guaranteed for T_J = 25˚C, V^+ = +15V, V^- = −15V, V_{CM} = 0V, and R_L = 1 kΩ. **Boldface** limits apply at the temperature extremes

Symbol	Parameter	Conditions	Typ (Note 5)	LM6171AI Limit (Note 6)	LM6171BI Limit (Note 6)	Units
V_{OS}	Input Offset Voltage		1.5	3 **5**	6 **8**	mV max
TC V_{OS}	Input Offset Voltage Average Drift		6			μV/˚C
I_B	Input Bias Current		1	3 **4**	3 **4**	μA max
I_{OS}	Input Offset Current		0.03	2 **3**	2 **3**	μA max
R_{IN}	Input Resistance	Common Mode	40			MΩ
		Differential Mode	4.9			
R_O	Open Loop Output Resistance		14			Ω
CMRR	Common Mode Rejection Ratio	V_{CM} = ±10V	110	80 **75**	75 **70**	dB min
PSRR	Power Supply Rejection Ratio	V_S = ±15V to ±5V	95	85 **80**	80 **75**	dB min
V_{CM}	Input Common-Mode Voltage Range	CMRR ≥ 60 dB	±13.5			V
A_V	Large Signal Voltage Gain (Note 7)	R_L = 1 kΩ	90	80 **70**	80 **70**	dB min
		R_L = 100Ω	83	70 **60**	70 **60**	dB min
V_O	Output Swing	R_L = 1 kΩ	13.3	12.5 **12**	12.5 **12**	V min
			−13.3	−12.5 **−12**	−12.5 **−12**	V max
		R_L = 100Ω	11.6	9 **8.5**	9 **8.5**	V min
			−10.5	−9 **−8.5**	−9 **−8.5**	V max
	Continuous Output Current (Open Loop) (Note 8)	Sourcing, R_L = 100Ω	116	90 **85**	90 **85**	mA min

±15V DC Electrical Characteristics (Continued)

Unless otherwise specified, all limits guaranteed for $T_J = 25^{\circ}C$, $V^{+} = +15V$, $V^{-} = -15V$, $V_{CM} = 0V$, and $R_L = 1\ k\Omega$. **Boldface** limits apply at the temperature extremes

Symbol	Parameter	Conditions	Typ (Note 5)	LM6171AI Limit (Note 6)	LM6171BI Limit (Note 6)	Units
		Sinking, $R_L = 100\Omega$	105	90 **85**	90 **85**	mA max
	Continuous Output Current (in Linear Region)	Sourcing, $R_L = 10\Omega$	100			mA
		Sinking, $R_L = 10\Omega$	80			mA
I_{SC}	Output Short Circuit Current	Sourcing	135			mA
		Sinking	135			mA
I_S	Supply Current		2.5	4 **4.5**	4 **4.5**	mA max

±15V AC Electrical Characteristics

Unless otherwise specified, all limits guaranteed for $T_J = 25^{\circ}C$, $V^{+} = +15V$, $V^{-} = -15V$, $V_{CM} = 0V$, and $R_L = 1\ k\Omega$. **Boldface** limits apply at the temperature extremes

Symbol	Parameter	Conditions	Typ (Note 5)	LM6171AI Limit (Note 6)	LM6171BI Limit (Note 6)	Units
SR	Slew Rate (Note 9)	$A_V = +2$, $V_{IN} = 13\ V_{PP}$	3600			V/µs
		$A_V = +2$, $V_{IN} = 10\ V_{PP}$	3000			
GBW	Unity Gain-Bandwidth Product		100			MHz
	−3 dB Frequency	$A_V = +1$	160			MHz
		$A_V = +2$	62			MHz
ϕm	Phase Margin		40			deg
t_s	Settling Time (0.1%)	$A_V = -1$, $V_{OUT} = \pm 5V$ $R_L = 500\Omega$	48			ns
	Propagation Delay	$V_{IN} = \pm 5V$, $R_L = 500\Omega$, $A_V = -2$	6			ns
A_D	Differential Gain (Note 10)		0.03			%
ϕ_D	Differential Phase (Note 10)		0.5			deg
e_n	Input-Referred Voltage Noise	f = 1 kHz	12			$\frac{nV}{\sqrt{Hz}}$
i_n	Input-Referred Current Noise	f = 1 kHz	1			$\frac{pA}{\sqrt{Hz}}$

±5V DC Electrical Characteristics

Unless otherwise specified, all limits guaranteed for $T_J = 25^{\circ}C$, $V^{+} = +5V$, $V^{-} = -5V$, $V_{CM} = 0V$, and $R_L = 1\ k\Omega$. **Boldface** limits apply at the temperature extremes

Symbol	Parameter	Conditions	Typ (Note 5)	LM6171AI Limit (Note 6)	LM6171BI Limit (Note 6)	Units
V_{OS}	Input Offset Voltage		1.2	3 **5**	6 **8**	mV max
TC V_{OS}	Input Offset Voltage Average Drift		4			µV/˚C
I_B	Input Bias Current		1	2.5 **3.5**	2.5 **3.5**	µA max
I_{OS}	Input Offset Current		0.03	1.5	1.5	µA

±5V DC Electrical Characteristics (Continued)

Unless otherwise specified, all limits guaranteed for T_J = 25˚C, V^+ = +5V, V^- = −5V, V_{CM} = 0V, and R_L = 1 kΩ. **Boldface** limits apply at the temperature extremes

Symbol	Parameter	Conditions	Typ (Note 5)	LM6171AI Limit (Note 6)	LM6171BI Limit (Note 6)	Units
				2.2	**2.2**	max
R_{IN}	Input Resistance	Common Mode	40			MΩ
		Differential Mode	4.9			
R_O	Open Loop Output Resistance		14			Ω
CMRR	Common Mode Rejection Ratio	V_{CM} = ±2.5V	105	80 **75**	75 **70**	dB min
PSRR	Power Supply Rejection Ratio	V_S = ±15V to ±5V	95	85 **80**	80 **75**	dB min
V_{CM}	Input Common-Mode Voltage Range	CMRR ≥ 60 dB	±3.7			V
A_V	Large Signal Voltage Gain (Note 7)	R_L = 1 kΩ	84	75 **65**	75 **65**	dB min
		R_L = 100Ω	80	70 **60**	70 **60**	dB min
V_O	Output Swing	R_L = 1 kΩ	3.5	3.2 **3**	3.2 **3**	V min
			−3.4	−3.2 **−3**	−3.2 **−3**	V max
		R_L = 100Ω	3.2	2.8 **2.5**	2.8 **2.5**	V min
			−3.0	−2.8 **−2.5**	−2.8 **−2.5**	V max
	Continuous Output Current (Open Loop) (Note 8)	Sourcing, R_L = 100Ω	32	28 **25**	28 **25**	mA min
		Sinking, R_L = 100Ω	30	28 **25**	28 **25**	mA max
I_{SC}	Output Short Circuit Current	Sourcing	130			mA
		Sinking	100			mA
I_S	Supply Current		2.3	3 **3.5**	3 **3.5**	mA max

±5V AC Electrical Characteristics

Unless otherwise specified, all limits guaranteed for T_J = 25˚C, V^+ = +5V, V^- = −5V, V_{CM} = 0V, and R_L = 1 kΩ. **Boldface** limits apply at the temperature extremes

Symbol	Parameter	Conditions	Typ (Note 5)	LM6171AI Limit (Note 6)	LM6171BI Limit (Note 6)	Units
SR	Slew Rate (Note 9)	A_V = +2, V_{IN} = 3.5 V_{PP}	750			V/μs
GBW	Unity Gain-Bandwidth Product		70			MHz
	−3 dB Frequency	A_V = +1	130			MHz
		A_V = +2	45			
φm	Phase Margin		57			deg
t_s	Settling Time (0.1%)	A_V = −1, V_{OUT} = +1V, R_L = 500Ω	60			ns

±5V AC Electrical Characteristics (Continued)

Unless otherwise specified, all limits guaranteed for T_J = 25˚C, V^+ = +5V, V^- = –5V, V_{CM} = 0V, and R_L = 1 kΩ. **Boldface** limits apply at the temperature extremes

Symbol	Parameter	Conditions	Typ (Note 5)	LM6171AI Limit (Note 6)	LM6171BI Limit (Note 6)	Units
	Propagation Delay	V_{IN} = ±1V, R_L = 500Ω, A_V = –2	8			ns
A_D	Differential Gain (Note 10)		0.04			%
ϕ_D	Differential Phase (Note 10)		0.7			deg
e_n	Input-Referred Voltage Noise	f = 1 kHz	11			$\frac{nV}{\sqrt{Hz}}$
i_n	Input-Referred Current Noise	f = 1 kHz	1			$\frac{pA}{\sqrt{Hz}}$

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not guaranteed. For guaranteed specifications and the test conditions, see the Electrical Characteristics.

Note 2: Human body model, 1.5 kΩ in series with 100 pF.

Note 3: Continuous short circuit operation at elevated ambient temperature can result in exceeding the maximum allowed junction temperature of 150˚C.

Note 4: The maximum power dissipation is a function of $T_{J(max)}$, θ_{JA}, and T_A. The maximum allowable power dissipation at any ambient temperature is P_D = ($T_{J(max)}$ – T_A)/θ_{JA}. All numbers apply for packages soldered directly into a PC board.

Note 5: Typical Values represent the most likely parametric norm.

Note 6: All limits are guaranteed by testing or statistical analysis.

Note 7: Large signal voltage gain is the total output swing divided by the input signal required to produce that swing. For V_S = ±15V, V_{OUT} = ±5V. For V_S = +5V, V_{OUT} = ±1V.

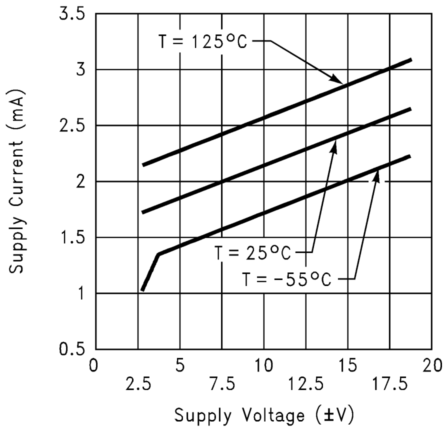
Note 8: The open loop output current is the output swing with the 100Ω load resistor divided by that resistor.

Note 9: Slew rate is the average of the rising and falling slew rates.

Note 10: Differential gain and phase are measured with A_V = +2, V_{IN} = 1 V_{PP} at 3.58 MHz and both input and output 75Ω terminated.

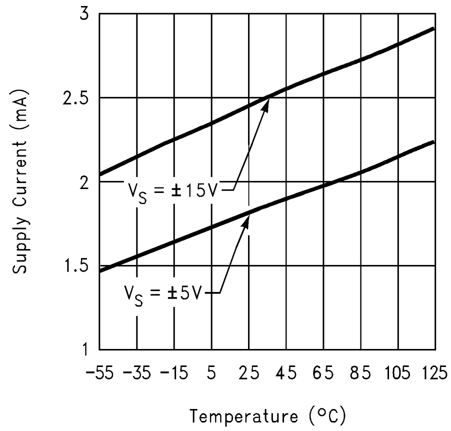
Typical Performance Characteristics Unless otherwise noted, T_A = 25˚C

Supply Current vs. Supply Voltage



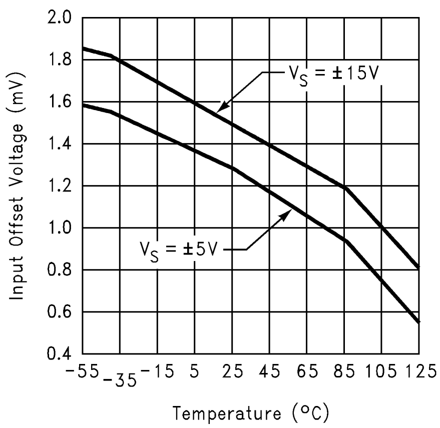
01233620

Supply Current vs. Temperature



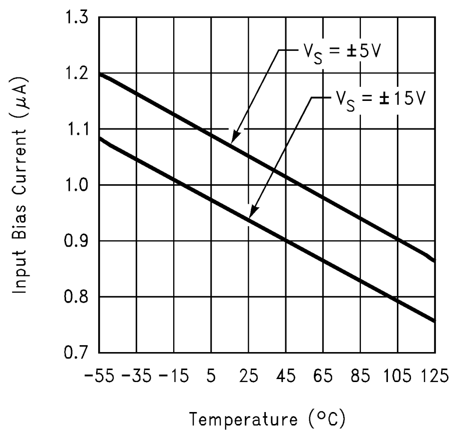
01233621

Input Offset Voltage vs. Temperature



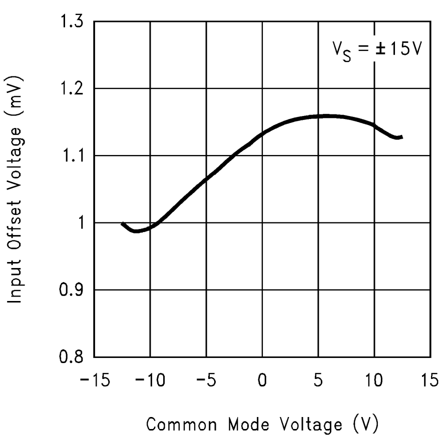
01233622

Input Bias Current vs. Temperature



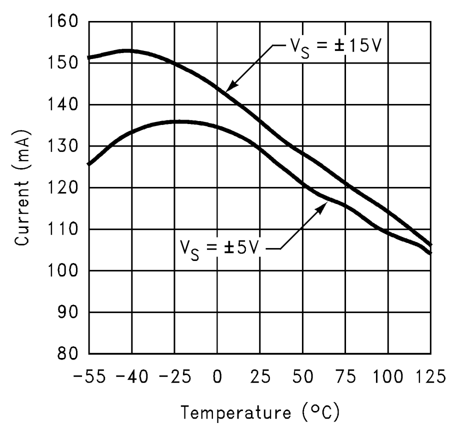
01233623

Input Offset Voltage vs. Common Mode Voltage



01233624

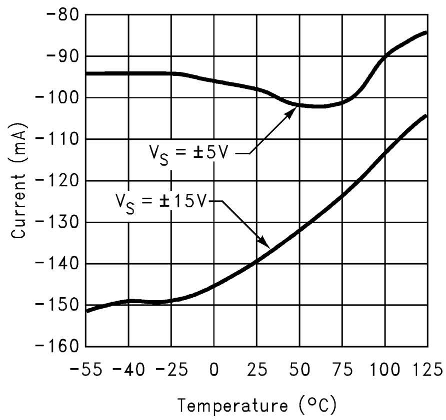
Short Circuit Current vs. Temperature (Sourcing)



01233625

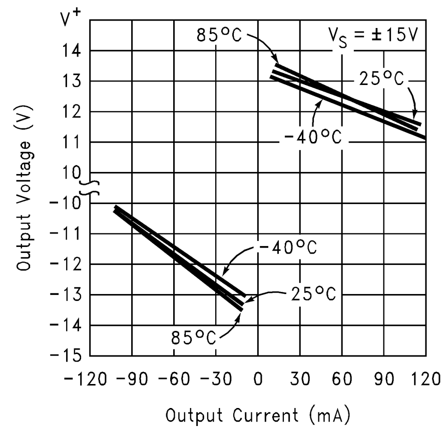
Typical Performance Characteristics Unless otherwise noted, T_A = 25˚C (Continued)

Short Circuit Current vs. Temperature (Sinking)



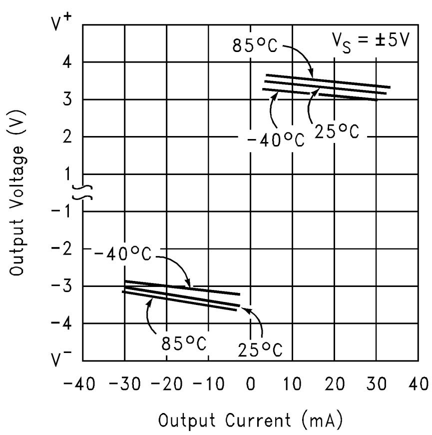
01233626

Output Voltage vs. Output Current



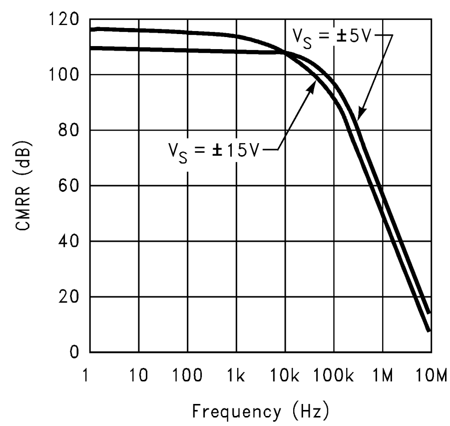
01233627

Output Voltage vs. Output Current



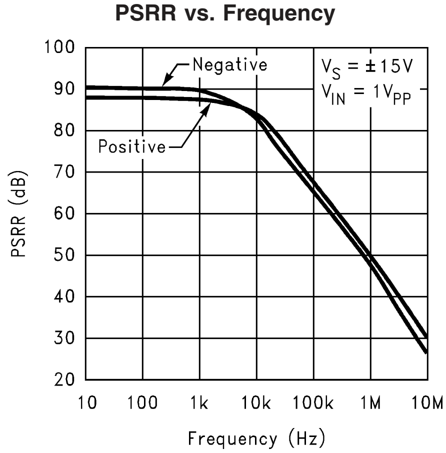
01233628

CMRR vs. Frequency



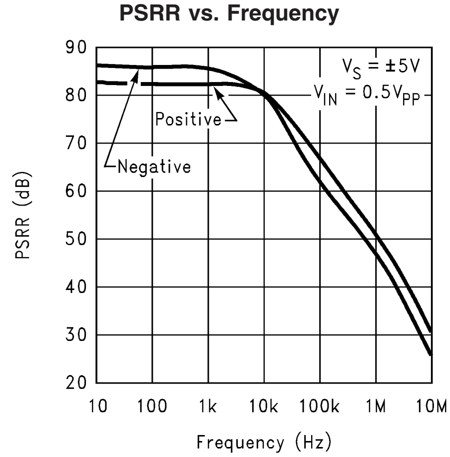
01233629

PSRR vs. Frequency



01233630

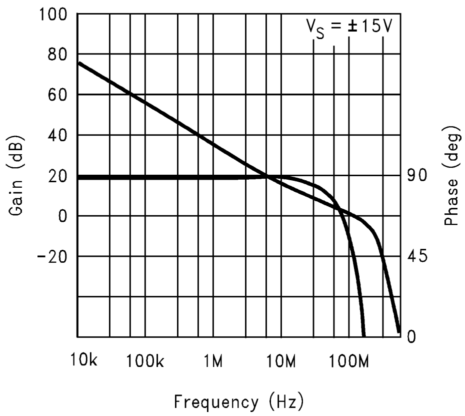
PSRR vs. Frequency



01233631

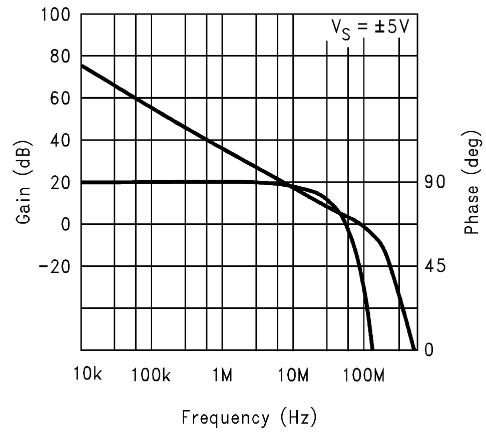
Typical Performance Characteristics Unless otherwise noted, T_A = 25˚C (Continued)

Open Loop Frequency Response



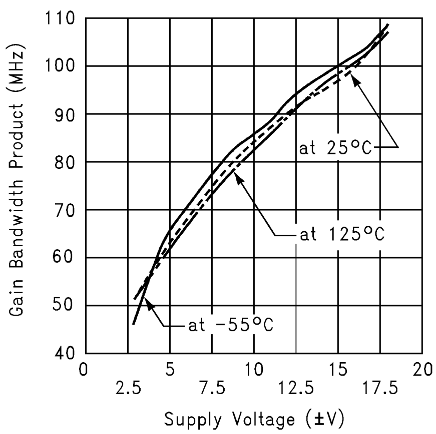
01233632

Open Loop Frequency Response



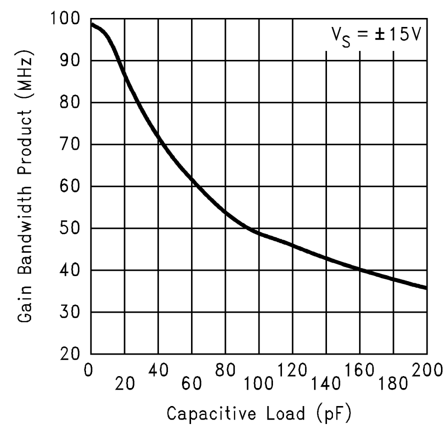
01233633

Gain Bandwidth Product vs. Supply Voltage



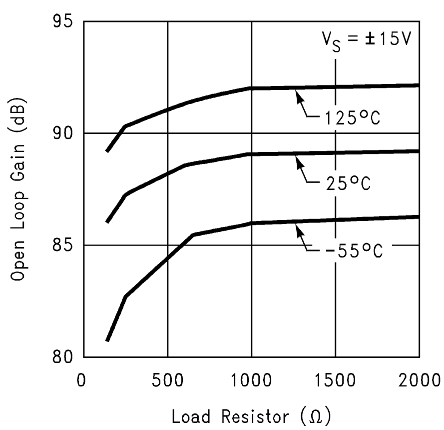
01233634

Gain Bandwidth Product vs. Load Capacitance



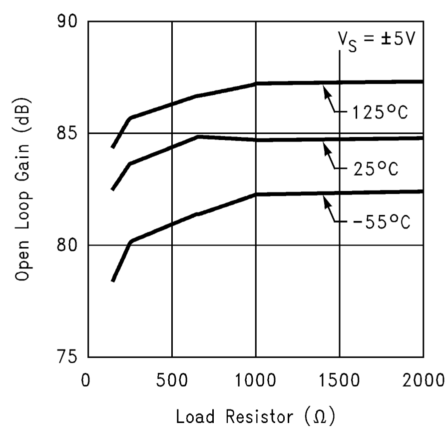
01233635

Large Signal Voltage Gain vs. Load



01233636

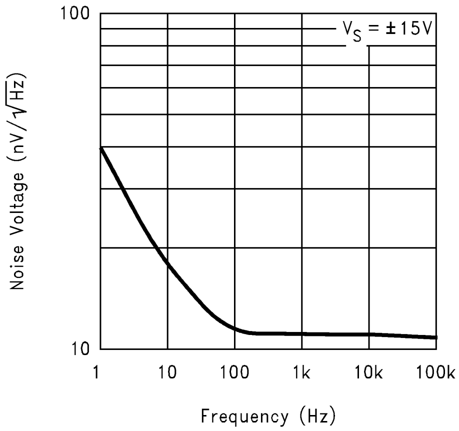
Large Signal Voltage Gain vs. Load



01233637

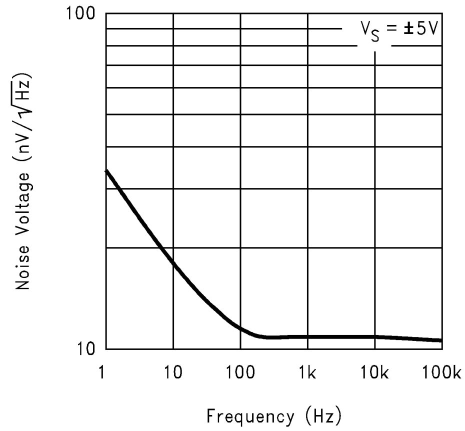
Typical Performance Characteristics Unless otherwise noted, T_A = 25˚C (Continued)

Input Voltage Noise vs. Frequency



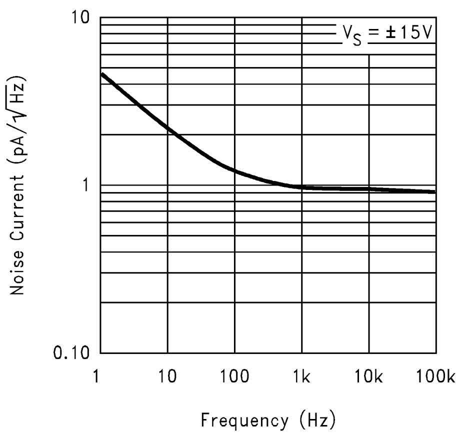
01233638

Input Voltage Noise vs. Frequency



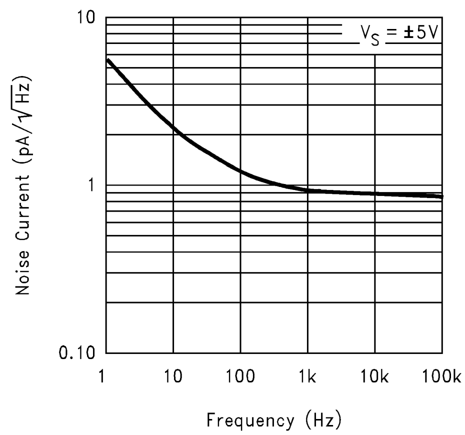
01233639

Input Current Noise vs. Frequency



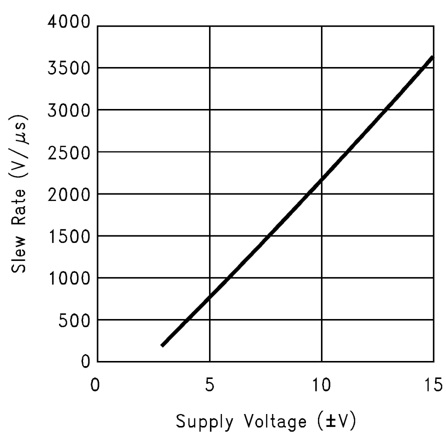
01233640

Input Current Noise vs. Frequency



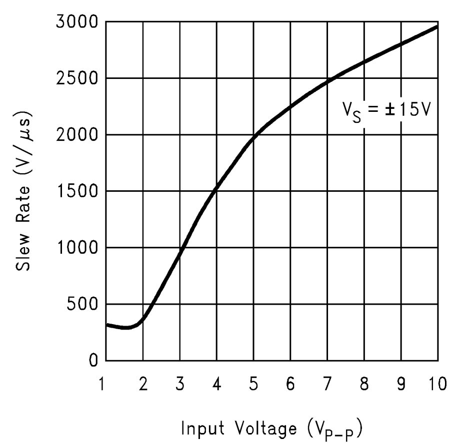
01233641

Slew Rate vs. Supply Voltage



01233642

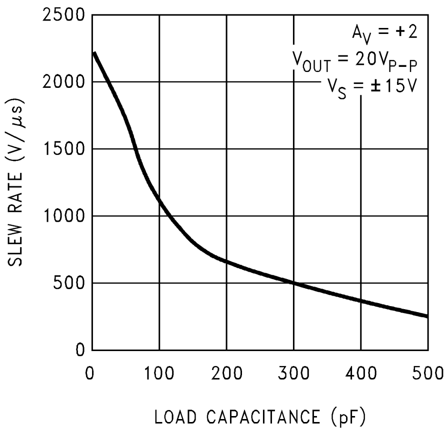
Slew Rate vs. Input Voltage



01233643

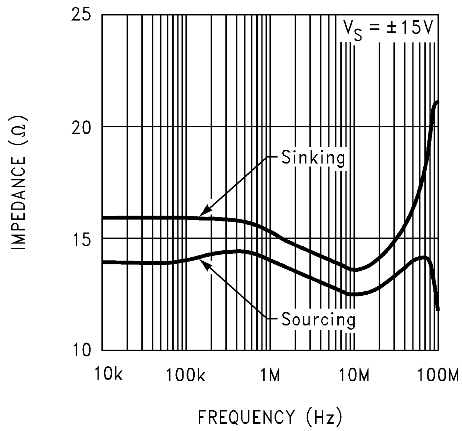
Typical Performance Characteristics Unless otherwise noted, T_A = 25˚C (Continued)

Slew Rate vs. Load Capacitance



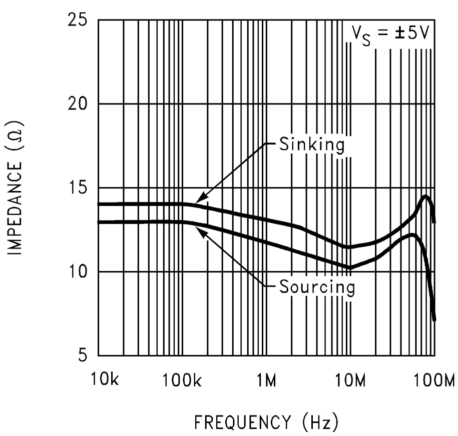
01233644

Open Loop Output Impedance vs. Frequency



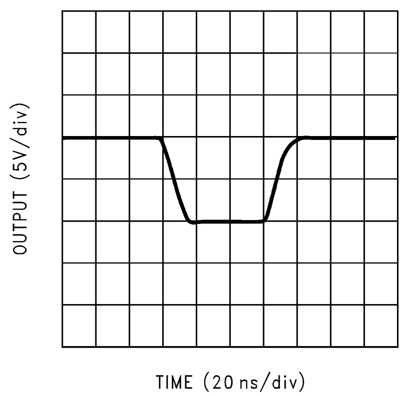
01233645

Open Loop Output Impedance vs. Frequency



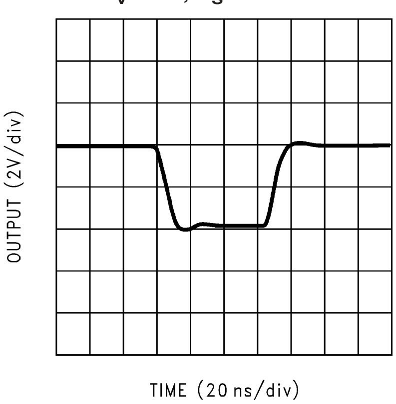
01233646

Large Signal Pulse Response
A_V = −1, V_S = ±15V



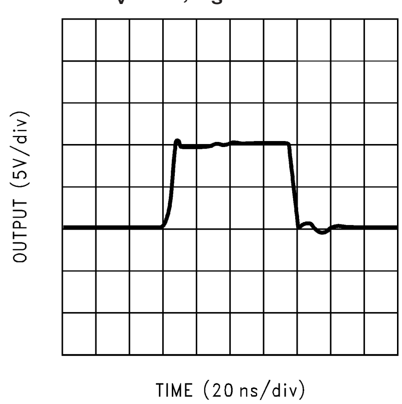
01233647

Large Signal Pulse Response
A_V = −1, V_S = ±5V



01233648

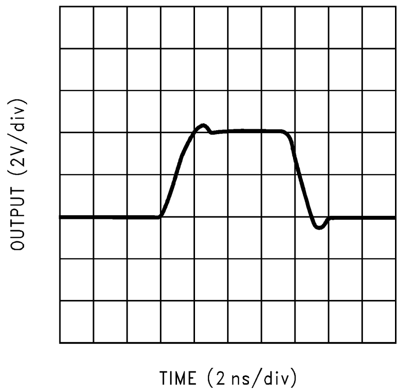
Large Signal Pulse Response
A_V = +1, V_S = ±15V



01233649

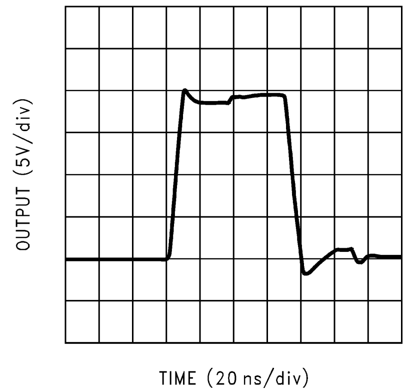
Typical Performance Characteristics Unless otherwise noted, T_A = 25˚C (Continued)

Large Signal Pulse Response
A_V = +1, V_S = ±5V



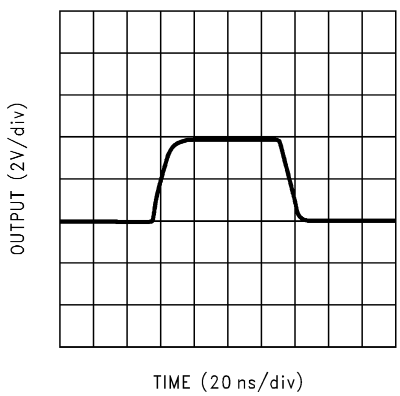
01233650

Large Signal Pulse Response
A_V = +2, V_S = ±15V



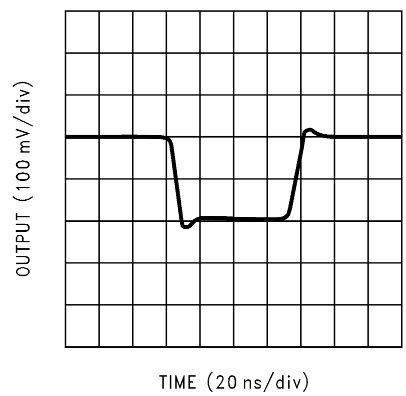
01233651

Large Signal Pulse Response
A_V = +2, V_S = ±5V



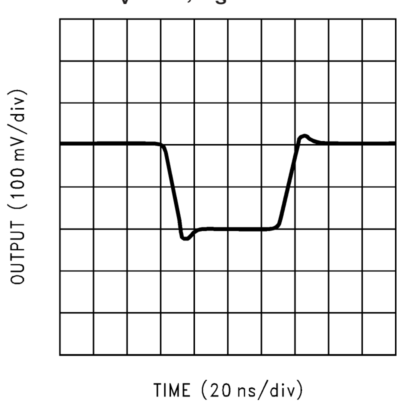
01233652

Small Signal Pulse Response
A_V = −1, V_S = ±15V



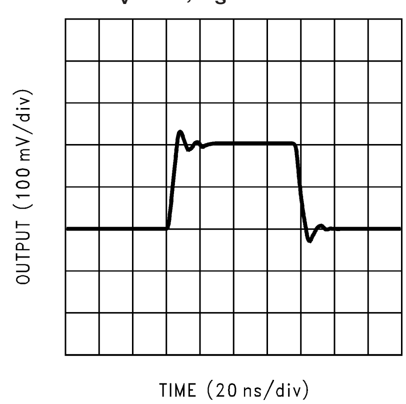
01233653

Small Signal Pulse Response
A_V = −1, V_S = ±5V



01233654

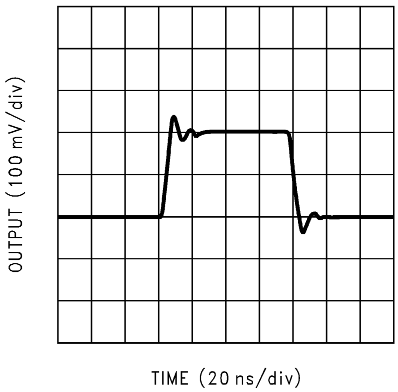
Small Signal Pulse Response
A_V = +1, V_S = ±15V



01233655

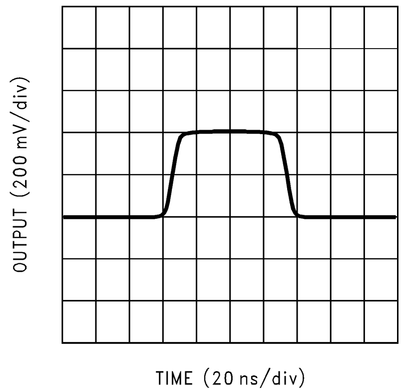
Typical Performance Characteristics Unless otherwise noted, T_A = 25˚C (Continued)

Small Signal Pulse Response
A_V = +1, V_S = ±5V



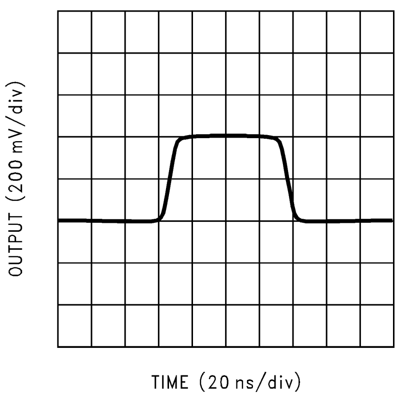
01233656

Small Signal Pulse Response
A_V = +2, V_S = ±15V



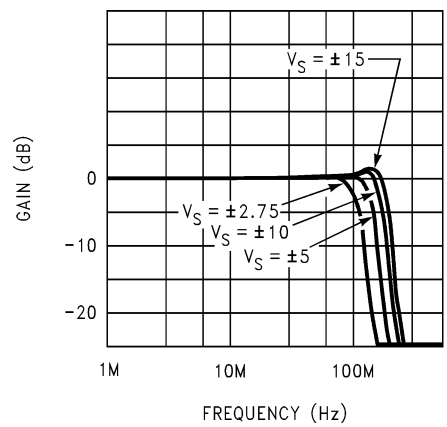
01233657

Small Signal Pulse Response
A_V = +2, V_S = ±5V



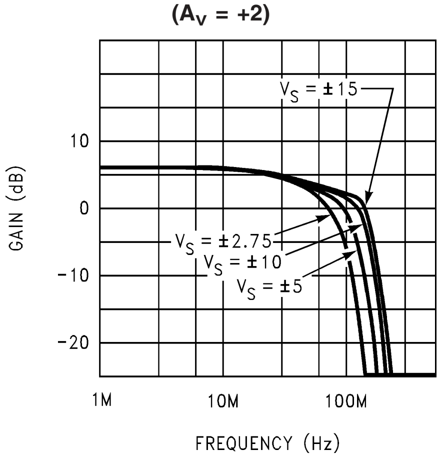
01233658

Closed Loop Frequency Response vs. SupplyVoltage
(A_V = +1)



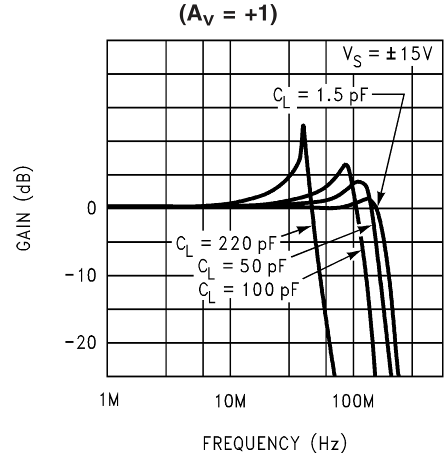
01233659

Closed Loop Frequency Response vs. Supply Voltage
(A_V = +2)



01233660

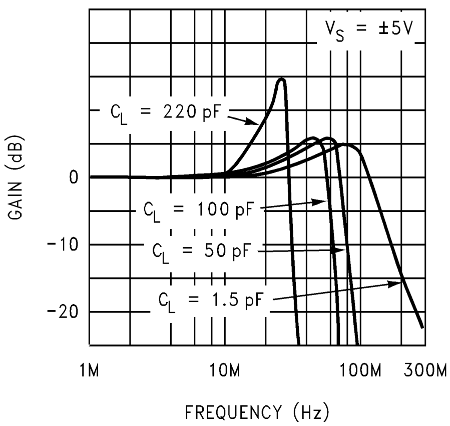
Closed Loop Frequency Response vs. Capacitive Load
(A_V = +1)



01233661

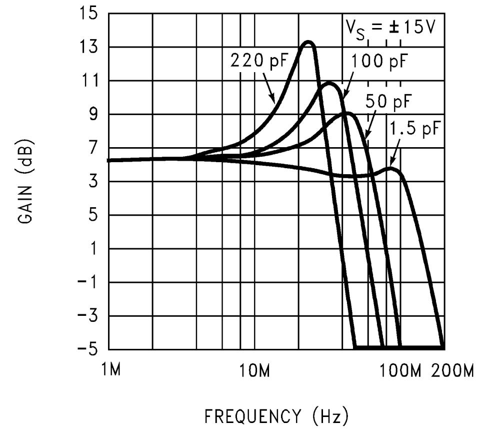
Typical Performance Characteristics Unless otherwise noted, T_A = 25˚C (Continued)

Closed Loop Frequency Response vs. Capacitive Load (A_V = +1)



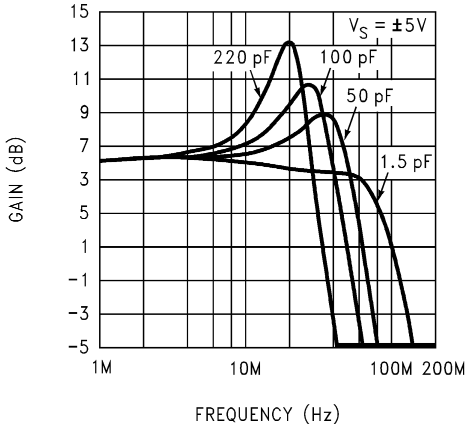
01233662

Closed Loop Frequency Response vs. Capacitive Load (A_V = +2)



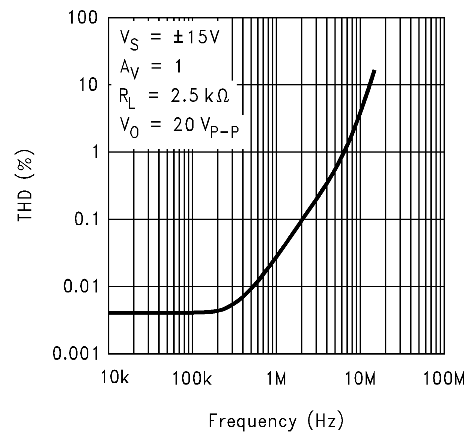
01233663

Closed Loop Frequency Response vs. Capacitive Load (A_V = +2)



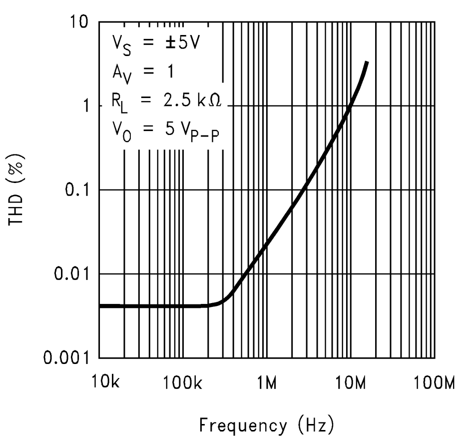
01233664

Total Harmonic Distortion vs. Frequency



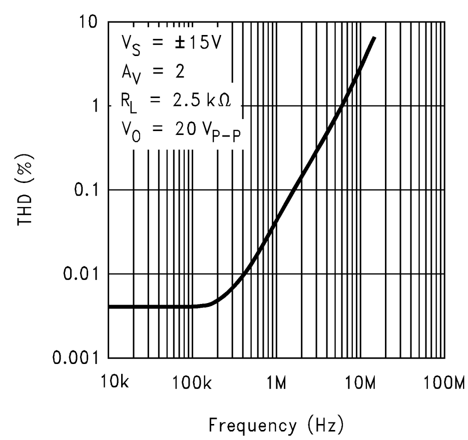
01233665

Total Harmonic Distortion vs. Frequency



01233666

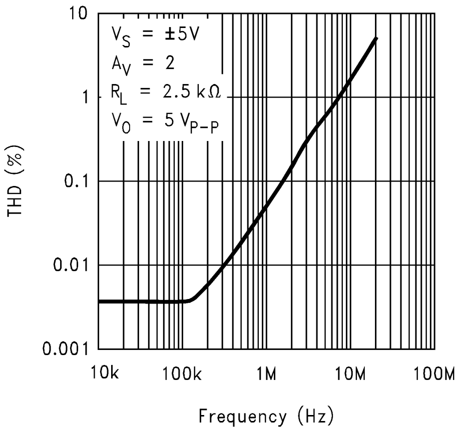
Total Harmonic Distortion vs. Frequency



01233667

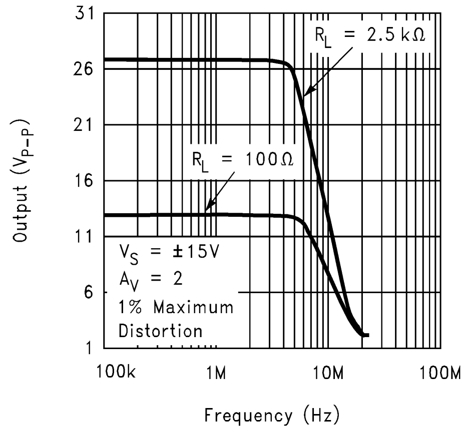
Typical Performance Characteristics Unless otherwise noted, T_A = 25˚C (Continued)

Total Harmonic Distortion vs. Frequency



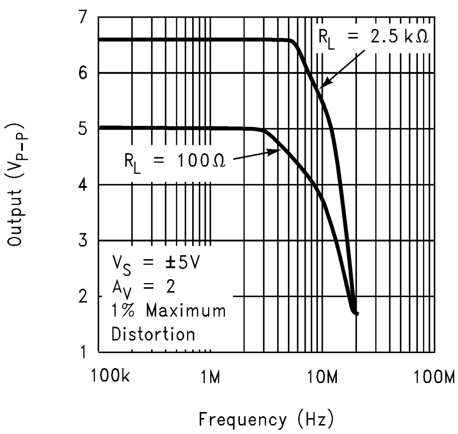
01233668

Undistorted Output Swing vs. Frequency



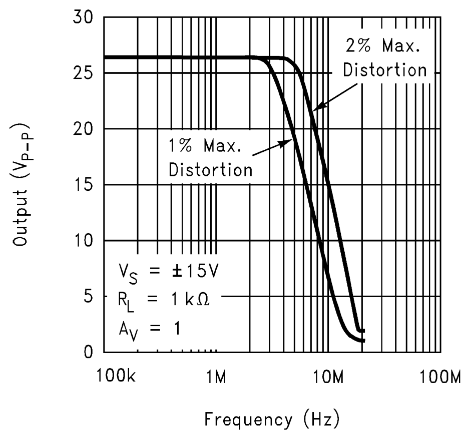
01233669

Undistorted Output Swing vs. Frequency



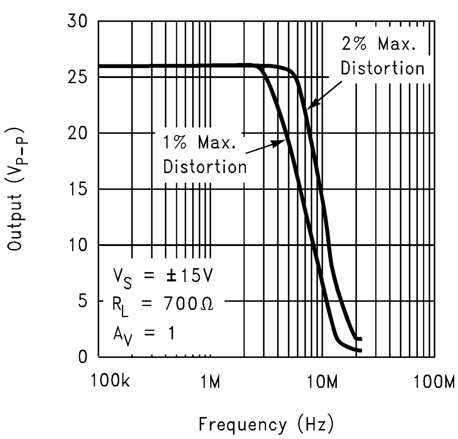
01233670

Undistorted Output Swing vs. Frequency



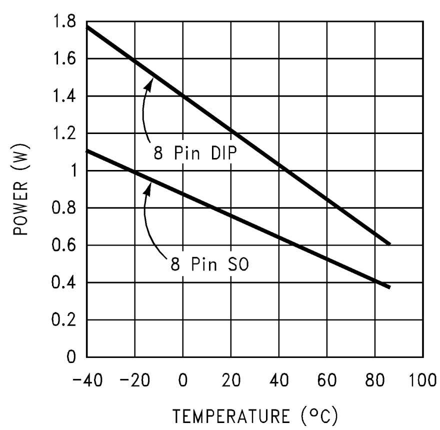
01233671

Undistorted Output Swing vs. Frequency



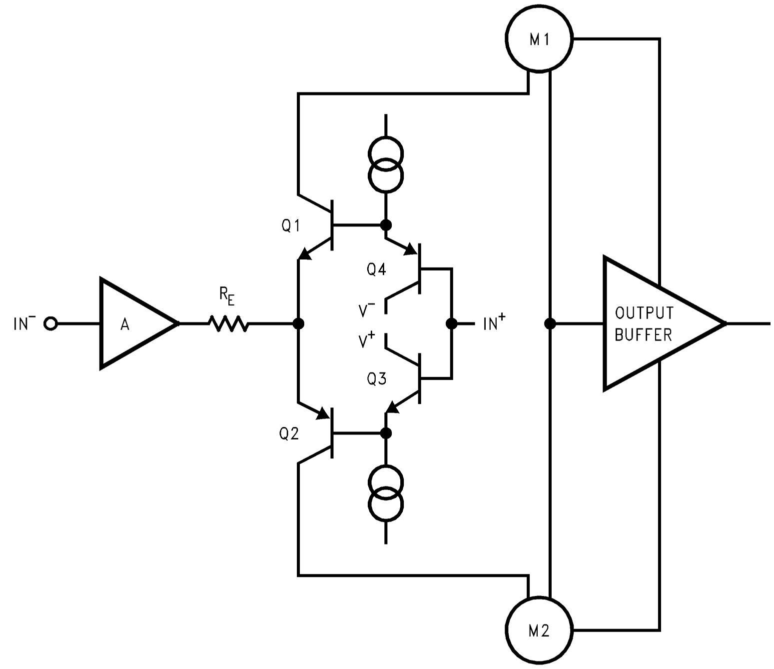
01233672

Total Power Dissipation vs. Ambient Temperature



01233673

LM6171 Simplified Schematic



01233610

Application Information

LM6171 PERFORMANCE DISCUSSION

The LM6171 is a high speed, unity-gain stable voltage feedback amplifier. It consumes only 2.5 mA supply current while providing a gain-bandwidth product of 100 MHz and a slew rate of 3600V/µs. It also has other great features such as low differential gain and phase and high output current. The LM6171 is a good choice in high speed circuits.

The LM6171 is a true voltage feedback amplifier. Unlike current feedback amplifiers (CFAs) with a low inverting input impedance and a high non-inverting input impedance, both inputs of voltage feedback amplifiers (VFAs) have high impedance nodes. The low impedance inverting input in CFAs will couple with feedback capacitor and cause oscillation. As a result, CFAs cannot be used in traditional op amp circuits such as photodiode amplifiers, I-to-V converters and integrators.

LM6171 CIRCUIT OPERATION

The class AB input stage in LM6171 is fully symmetrical and has a similar slewing characteristic to the current feedback amplifiers. In the LM6171 Simplfied Schematic, Q1 through Q4 form the equivalent of the current feedback input buffer, R_E the equivalent of the feedback resistor, and stage A buffers the inverting input. The triple-buffered output stage isolates the gain stage from the load to provide low output impedance.

LM6171 SLEW RATE CHARACTERISTIC

The slew rate of LM6171 is determined by the current available to charge and discharge an internal high impedance node capacitor. The current is the differential input voltage divided by the total degeneration resistor R_E. Therefore, the slew rate is proportional to the input voltage level, and the higher slew rates are achievable in the lower gain configurations.

When a very fast large signal pulse is applied to the input of an amplifier, some overshoot or undershoot occurs. By placing an external series resistor such as 1 kΩ to the input of LM6171, the bandwidth is reduced to help lower the overshoot.

LAYOUT CONSIDERATION

Printed Circuit Boards and High Speed Op Amps

There are many things to consider when designing PC boards for high speed op amps. Without proper caution, it is very easy and frustrating to have excessive ringing, oscillation and other degraded AC performance in high speed circuits. As a rule, the signal traces should be short and wide to provide low inductance and low impedance paths. Any unused board space needs to be grounded to reduce stray signal pickup. Critical components should also be grounded at a common point to eliminate voltage drop. Sockets add capacitance to the board and can affect frequency performance. It is better to solder the amplifier directly into the PC board without using any socket.

Using Probes

Active (FET) probes are ideal for taking high frequency measurements because they have wide bandwidth, high input impedance and low input capacitance. However, the probe ground leads provide a long ground loop that will produce errors in measurement. Instead, the probes can be grounded directly by removing the ground leads and probe jackets and using scope probe jacks.

Components Selection And Feedback Resistor

It is important in high speed applications to keep all component leads short because wires are inductive at high frequency. For discrete components, choose carbon

Application Information (Continued)

composition-type resistors and mica-type capacitors. Surface mount components are preferred over discrete components for minimum inductive effect.

Large values of feedback resistors can couple with parasitic capacitance and cause undesirable effects such as ringing or oscillation in high speed amplifiers. For LM6171, a feedback resistor of 510Ω gives optimal performance.

COMPENSATION FOR INPUT CAPACITANCE

The combination of an amplifier's input capacitance with the gain setting resistors adds a pole that can cause peaking or oscillation. To solve this problem, a feedback capacitor with a value

$$C_F > (R_G \times C_{IN})/R_F$$

can be used to cancel that pole. For LM6171, a feedback capacitor of 2 pF is recommended. *Figure 1* illustrates the compensation circuit.

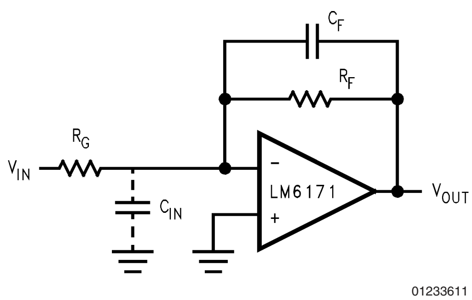


FIGURE 1. Compensating for Input Capacitance

POWER SUPPLY BYPASSING

Bypassing the power supply is necessary to maintain low power supply impedance across frequency. Both positive and negative power supplies should be bypassed individually by placing 0.01 µF ceramic capacitors directly to power supply pins and 2.2 µF tantalum capacitors close to the power supply pins.

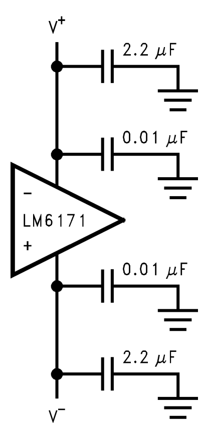


FIGURE 2. Power Supply Bypassing

TERMINATION

In high frequency applications, reflections occur if signals are not properly terminated. *Figure 3* shows a properly terminated signal while *Figure 4* shows an improperly terminated signal.

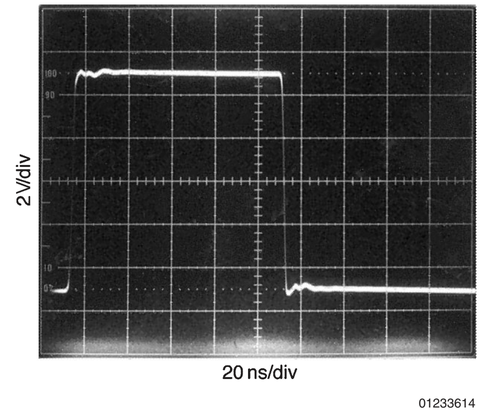


FIGURE 3. Properly Terminated Signal

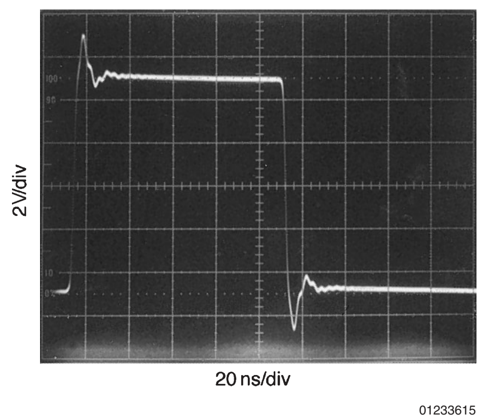


FIGURE 4. Improperly Terminated Signal

Application Information (Continued)

To minimize reflection, coaxial cable with matching characteristic impedance to the signal source should be used. The other end of the cable should be terminated with the same value terminator or resistor. For the commonly used cables, RG59 has 75Ω characteristic impedance, and RG58 has 50Ω characteristic impedance.

DRIVING CAPACITIVE LOADS

Amplifiers driving capacitive loads can oscillate or have ringing at the output. To eliminate oscillation or reduce ringing, an isolation resistor can be placed as shown below in *Figure 5*. The combination of the isolation resistor and the load capacitor forms a pole to increase stablility by adding more phase margin to the overall system. The desired performance depends on the value of the isolation resistor; the bigger the isolation resistor, the more damped the pulse response becomes. For LM6171, a 50Ω isolation resistor is recommended for initial evaluation. *Figure 6* shows the LM6171 driving a 200 pF load with the 50Ω isolation resistor.

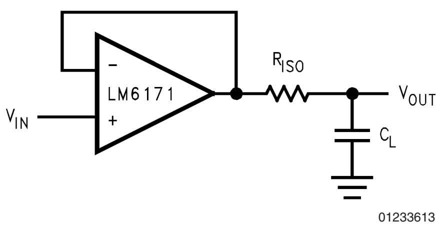


FIGURE 5. Isolation Resistor Used to Drive Capacitive Load

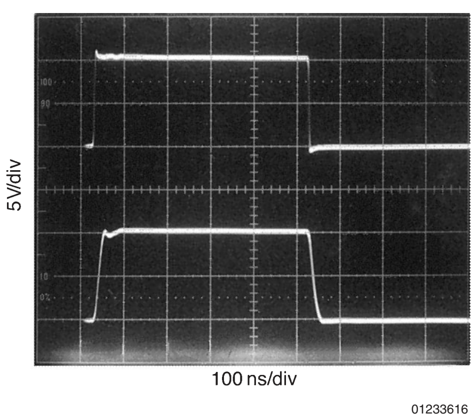


FIGURE 6. The LM6171 Driving a 200 pF Load with a 50Ω Isolation Resistor

POWER DISSIPATION

The maximum power allowed to dissipate in a device is defined as:

$$P_D = (T_{J(max)} - T_A)/\theta_{JA}$$

Where P_D is the power dissipation in a device

$T_{J(max)}$ is the maximum junction temperature

T_A is the ambient temperature

θ_{JA} is the thermal resistance of a particular package

For example, for the LM6171 in a SO-8 package, the maximum power dissipation at 25˚C ambient temperature is 730 mW.

Thermal resistance, θ_{JA}, depends on parameters such as die size, package size and package material. The smaller the die size and package, the higher θ_{JA} becomes. The 8-pin DIP package has a lower thermal resistance (108˚C/W) than that of 8-pin SO (172˚C/W). Therefore, for higher dissipation capability, use an 8-pin DIP package.

The total power dissipated in a device can be calculated as:

$$P_D = P_Q + P_L$$

P_Q is the quiescent power dissipated in a device with no load connected at the output. P_L is the power dissipated in the device with a load connected at the output; it is not the power dissipated by the load.

Furthermore,

P_Q = supply current x total supply voltage with no load

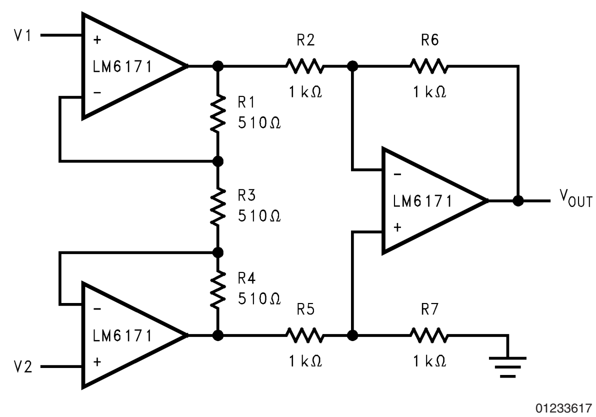
P_L = output current x (voltage difference between supply voltage and output voltage of the same supply)

For example, the total power dissipated by the LM6171 with V_S = ±15V and output voltage of 10V into 1 kΩ load resistor (one end tied to ground) is

$$\begin{aligned} P_D &= P_Q + P_L \\ &= (2.5\ mA) \times (30V) + (10\ mA) \times (15V - 10V) \\ &= 75\ mW + 50\ mW \\ &= 125\ mW \end{aligned}$$

APPLICATION CIRCUITS

Fast Instrumentation Amplifier



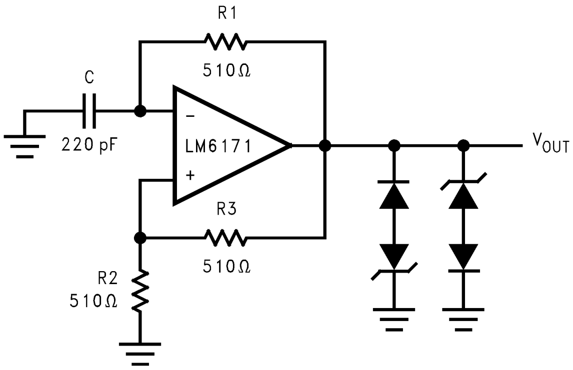
$$V_{IN} = V2 - V1$$

if R6 = R2, R7 = R5 and R1 = R4

$$\frac{V_{OUT}}{V_{IN}} = \frac{R6}{R2}\left(1 + 2\frac{R1}{R3}\right) = 3$$

Application Information (Continued)

Multivibrator

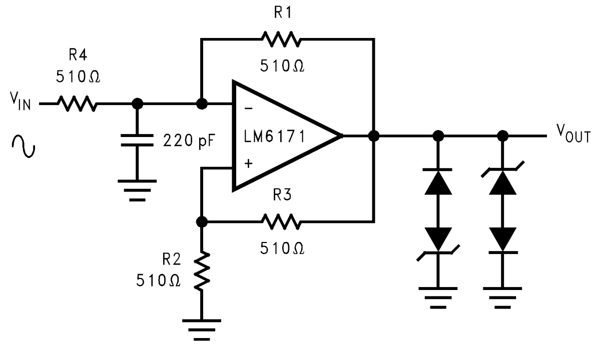


01233618

$$f = \frac{1}{2\left(R1C\ln\left(1 + 2\frac{R2}{R3}\right)\right)}$$

$f = 4$ MHz

Pulse Width Modulator



01233619

DESIGN KIT

A design kit is available for the LM6171. The design kit contains:

- High Speed Evaluation Board
- LM6171 in 8-pin DIP Package
- LM6171 Datasheet
- Pspice Macromodel Diskette With the LM6171 Macromodel
- An Amplifier Selection Guide

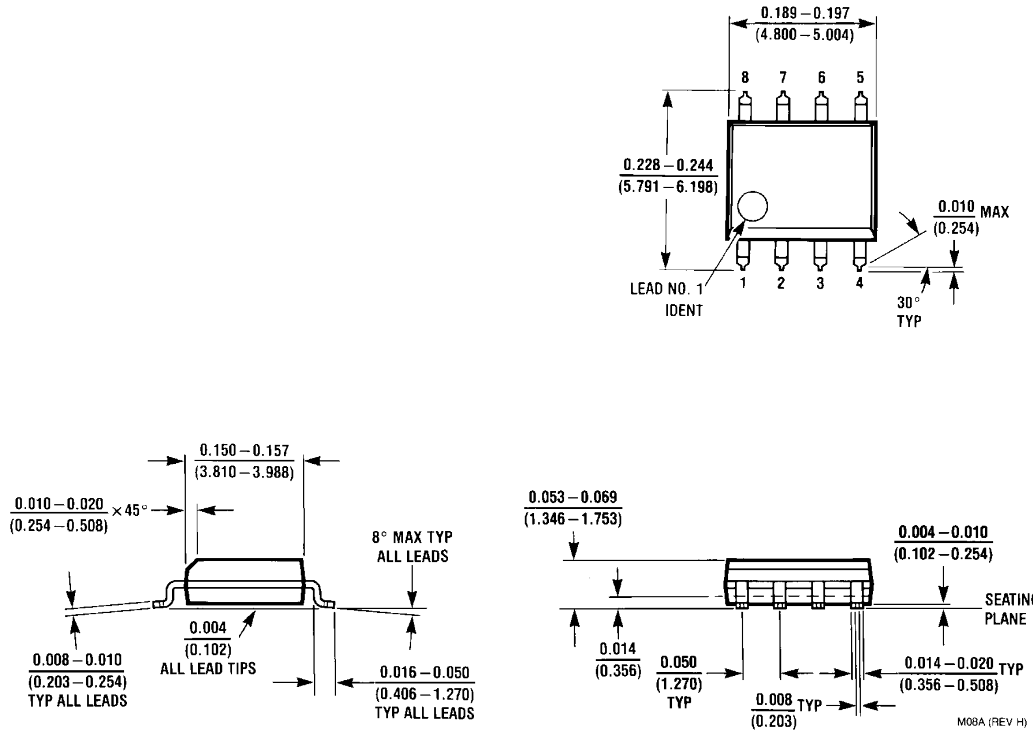
PITCH PACK

A pitch pack is available for the LM6171. The pitch pack contains:

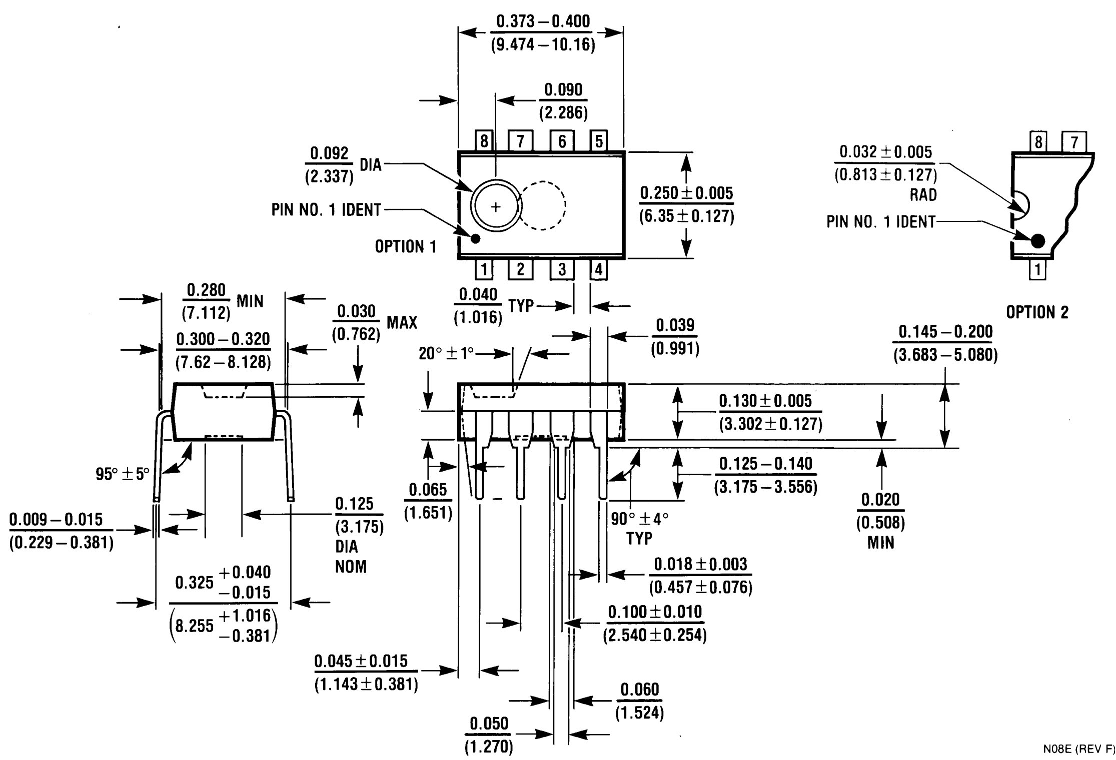
- High Speed Evaluation Board
- LM6171 in 8-pin DIP Package
- LM6171 Datasheet
- Pspice Macromodel Diskette With the LM6171 Macromodel

Contact your local National Semiconductor sales office to obtain a pitch pack.

Physical Dimensions inches (millimeters) unless otherwise noted



8-Pin Small Outline Package
NS Package Number M08A



8-Pin Molded DIP Package
NS Package Number N08E

Notes

National Semiconductor
Americas Customer
Support Center
Email: new.feedback@nsc.com
Tel: 1-800-272-9959

www.national.com

National Semiconductor
Europe Customer Support Center
Fax: +49 (0) 180-530 85 86
Email: europe.support@nsc.com
Deutsch Tel: +49 (0) 69 9508 6208
English Tel: +44 (0) 870 24 0 2171
Français Tel: +33 (0) 1 41 91 8790

National Semiconductor
Asia Pacific Customer
Support Center
Fax: +65-6250 4466
Email: ap.support@nsc.com
Tel: +65-6254 4466

National Semiconductor
Japan Customer Support Center
Fax: 81-3-5639-7507
Email: jpn.feedback@nsc.com
Tel: 81-3-5639-7560

IMPORTANT NOTICE

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		**Applications**	
Audio	www.ti.com/audio	Communications and Telecom	www.ti.com/communications
Amplifiers	amplifier.ti.com	Computers and Peripherals	www.ti.com/computers
Data Converters	dataconverter.ti.com	Consumer Electronics	www.ti.com/consumer-apps
DLP® Products	www.dlp.com	Energy and Lighting	www.ti.com/energy
DSP	dsp.ti.com	Industrial	www.ti.com/industrial
Clocks and Timers	www.ti.com/clocks	Medical	www.ti.com/medical
Interface	interface.ti.com	Security	www.ti.com/security
Logic	logic.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Power Mgmt	power.ti.com	Transportation and Automotive	www.ti.com/automotive
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Mobile Processors	www.ti.com/omap		
Wireless Connectivity	www.ti.com/wirelessconnectivity		
		TI E2E Community Home Page	e2e.ti.com

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265