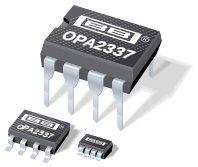
BURR-BROWN®



OPA2337

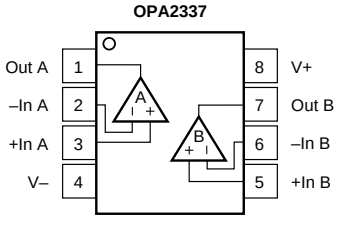
*Micro*SIZE, Single-Supply CMOS OPERATIONAL AMPLIFIER *MicroAmplifier*™ Series

FEATURES

- ***Micro*SIZE PACKAGE: SOT-23-8**
- **SINGLE SUPPLY OPERATION**
- **RAIL-TO-RAIL OUTPUT SWING**
- **FET-INPUT: I_B = 10pA max**
- **HIGH SPEED: 3MHz, 1V/μs**
- **OPERATION FROM 2.5V to 5.5V**
- **HIGH OPEN-LOOP GAIN: 120dB**
- **LOW QUIESCENT CURRENT: 525μA/amp**

APPLICATIONS

- **BATTERY POWERED INSTRUMENTS**
- **PHOTODIODE PRE-AMPS**
- **MEDICAL INSTRUMENTS**
- **TEST EQUIPMENT**
- **AUDIO SYSTEMS**
- **DRIVING ADCs**
- **CONSUMER PRODUCTS**



8-Pin DIP, SO-8, SOT-23-8

DESCRIPTION

The OPA2337 rail-to-rail output CMOS operational amplifier is designed for low cost and miniature applications. Packaged in the new SOT-23-8, the OPA2337EA is the world's *smallest* dual op amp. At only 1/4 the size of a conventional SO-8 surface mount, it is ideal for space-sensitive applications.

Performance is not sacrificed for size. Utilizing advanced CMOS technology, the OPA2337 provides low bias current, high speed operation, high open-loop gain, and rail-to-rail output swing. It operates on a single supply with operation as low as 2.5V while drawing only 525μA quiescent current. In addition, the input common-mode voltage range includes ground—ideal for single supply operations.

The OPA2337 is easy to use and free from phase inversion and overload problems found in some other op amps. It is stable in unity gain and excellent performance is maintained as the amplifier swings to its specified limits. The OPA2337 features completely independent circuitry for lowest crosstalk and freedom from interaction, even when overdriven or overloaded.

In addition to the miniature SOT-23-8 surface-mount package, the OPA2337 is available in standard 8-pin DIP and SO-8 surface-mount packages. It is fully specified from –40°C to +85°C and operates from –55°C to +125°C.

International Airport Industrial Park • Mailing Address: PO Box 11400, Tucson, AZ 85734 • Street Address: 6730 S. Tucson Blvd., Tucson, AZ 85706 • Tel: (520) 746-1111 • Twx: 910-952-1111
Internet: http://www.burr-brown.com/ • FAXLine: (800) 548-6133 (US/Canada Only) • Cable: BBRCORP • Telex: 066-6491 • FAX: (520) 889-1510 • Immediate Product Info: (800) 548-6132

PDS-1410A
Printed in U.S.A. December, 1997

SPECIFICATIONS: V_S = 2.7V to 5.5V

At T_A = +25°C, and R_L = 25kΩ connected to V_S/2, unless otherwise noted.

PARAMETER		CONDITION	OPA2337EA, UA, PA MIN	TYP[1]	MAX	UNITS
OFFSET VOLTAGE						
Input Offset Voltage	V_{OS}			±0.5	±3	mV
vs Temperature	dV_{OS}/dT			±2		µV/°C
vs Power Supply	PSRR	V_S = 2.7V to 5.5V		25	125	µV/V
Channel Separation		dc		0.3		µV/V
INPUT BIAS CURRENT						
Input Bias Current	I_B			±0.2	±10	pA
Input Offset Current	I_{OS}			±0.2	±10	pA
NOISE						
Input Voltage Noise, f = 0.1 to 10Hz				6		µVp-p
Input Voltage Noise Density, f = 1kHz	e_n			26		$nV/\sqrt{Hz}$
Current Noise Density, f = 1kHz	i_n			0.6		$fA/\sqrt{Hz}$
INPUT VOLTAGE RANGE						
Common-Mode Voltage Range	V_{CM}		–0.2		(V+) –1.2	V
Common-Mode Rejection Ratio	CMRR	–0.2V < V_{CM} < (V+) –1.2V	74	90		dB
INPUT IMPEDANCE						
Differential				10^{13} || 2		Ω || pF
Common-Mode				10^{13} || 4		Ω || pF
OPEN-LOOP GAIN						
Open-Loop Voltage Gain	A_{OL}	R_L = 25kΩ, 125mV < V_O < (V+) –125mV	100	120		dB
		R_L = 5kΩ, 500mV < V_O < (V+) –500mV	100	114		dB
FREQUENCY RESPONSE						
Gain-Bandwidth Product	GBW	V_S = 5V, G = 1		3		MHz
Slew Rate	SR	V_S = 5V, G = 1		1.2		V/µs
Settling Time 0.1%		V_S = 5V, 2V Step, C_L = 100pF, G = 1		2		µs
0.01%		V_S = 5V, 2V Step, C_L = 100pF, G = 1		2.5		µs
Overload Recovery Time		V_{IN} • G = V_S		2		µs
Total Harmonic Distortion + Noise	THD+N	V_S = 5V, V_O = 3Vp-p, G = 1, f = 1kHz		0.001		%
OUTPUT						
Voltage Output Swing from Rail[2]		R_L = 25kΩ		40	125	mV
		R_L = 5kΩ		150	500	mV
Short-Circuit Current	I_{SC}			±9		mA
Capacitive Load Drive	C_{LOAD}			See Typical Curve		
POWER SUPPLY						
Specified Voltage Range	V_S		2.7		5.5	V
Minimum Operating Voltage				2.5		V
Quiescent Current (per amplifier)	I_Q	I_O = 0		525	750	µA
TEMPERATURE RANGE						
Specified Range			–40		+85	°C
Operating Range			–55		+125	°C
Storage Range			–55		+125	°C
Thermal Resistance	θ_{JA}					
SOT-23-8 Surface-Mount				200		°C/W
SO-8 Surface-Mount				150		°C/W
8-Pin DIP				100		°C/W

NOTES: (1) V_S = 5V.

(2) Output voltage swings are measured between the output and negative and positive power supply rails.

ABSOLUTE MAXIMUM RATINGS[1]

Supply Voltage	5.5V
Input Voltage[2]	(V–) –0.3V to (V+) +0.3V
Input Current[2]	10mA
Output Short-Circuit[3]	Continuous
Operating Temperature	–55°C to +125°C
Storage Temperature	–55°C to +125°C
Junction Temperature	150°C
Lead Temperature (soldering, 10s)	300°C

NOTES: (1) Stresses above these ratings may cause permanent damage. (2) Input signal voltage is limited by internal diodes connected to power supplies. See text. (3) Short-circuit to ground, one amplifier per package.

ELECTROSTATIC DISCHARGE SENSITIVITY

This integrated circuit can be damaged by ESD. Burr-Brown recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

PACKAGE/ORDERING INFORMATION

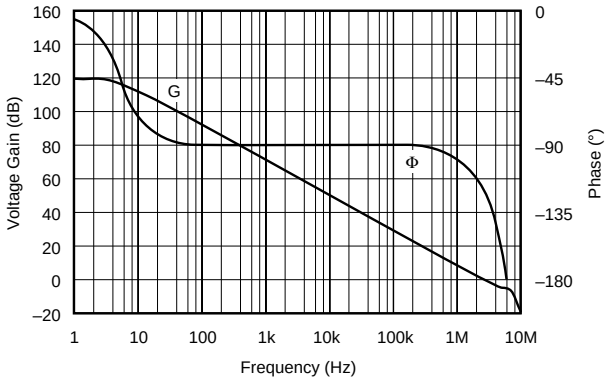
PRODUCT	PACKAGE	PACKAGE DRAWING NUMBER[1]	SPECIFIED TEMPERATURE RANGE	PACKAGE MARKING	ORDERING NUMBER[2]	TRANSPORT MEDIA
OPA2337EA	SOT-23-8 Surface-Mount	348	–40°C to +85°C	A7	OPA2337EA-250	Tape and Reel
"	"	"	"	"	OPA2337EA-3K	Tape and Reel
OPA2337PA	8-Pin DIP	006	–40°C to +85°C	OPA2337PA	OPA2337PA	Rails
OPA2337UA	SO-8 Surface-Mount	182	–40°C to +85°C	OPA2337UA	OPA2337UA	Rails[3]

NOTES: (1) For detailed drawing and dimension table, please see end of data sheet, or Appendix C of Burr-Brown IC Data Book. (2) Models with -250 and -3K are available only in Tape and Reel in the quantities indicated (e.g., -250 indicates 250 devices per reel). Ordering 3000 pieces of "OPA2337-3K" will get a single 3000 piece Tape and Reel. For detailed Tape and Reel mechanical information, refer to Appendix B of Burr-Brown IC Data Book. (3) SO-8 models also available in Tape and Reel.

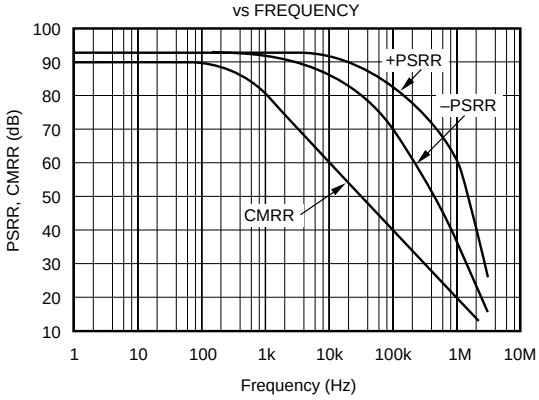
TYPICAL PERFORMANCE CURVES

At T_A = +25°C, V_S = +5V, and R_L = 25kΩ connected to V_S/2, unless otherwise noted.

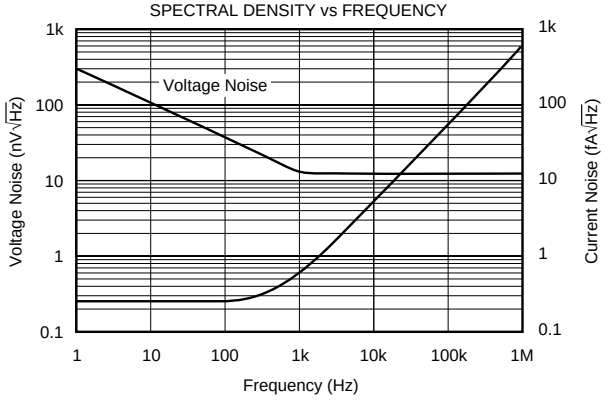
OPEN-LOOP GAIN/PHASE vs FREQUENCY



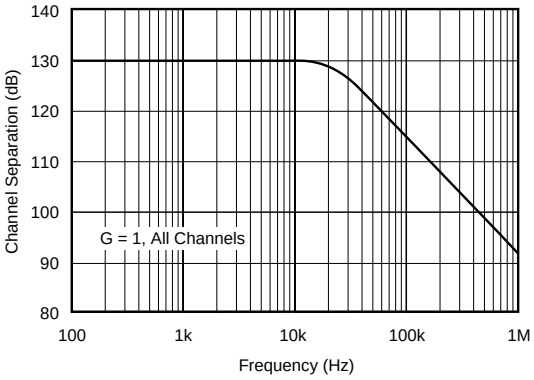
POWER SUPPLY and COMMON-MODE REJECTION vs FREQUENCY



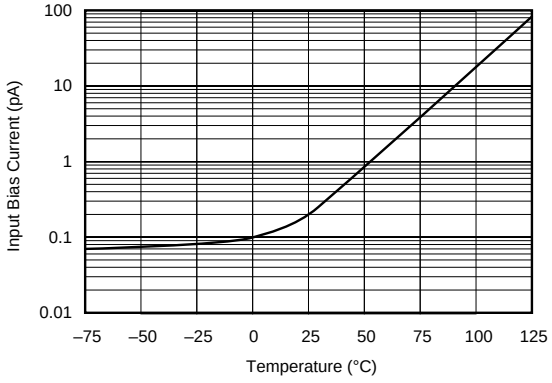
INPUT VOLTAGE and CURRENT NOISE SPECTRAL DENSITY vs FREQUENCY



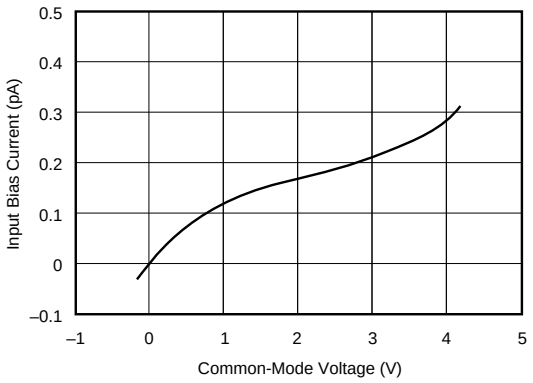
CHANNEL SEPARATION vs FREQUENCY



INPUT BIAS CURRENT vs TEMPERATURE



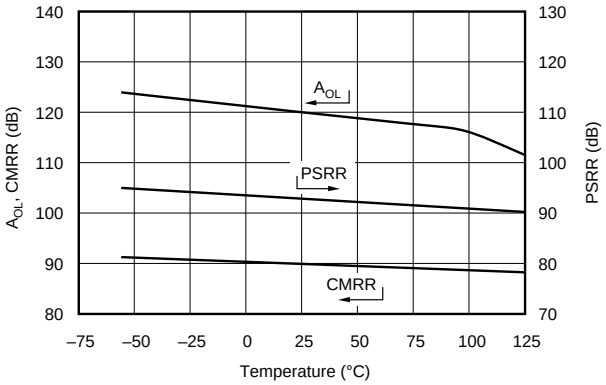
INPUT BIAS CURRENT vs INPUT COMMON-MODE VOLTAGE



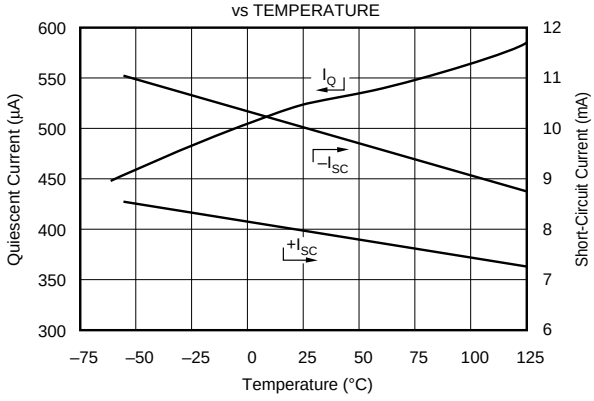
TYPICAL PERFORMANCE CURVES (CONT)

At T_A = +25°C, V_S = +5V, and R_L = 25kΩ connected to V_S/2, unless otherwise noted.

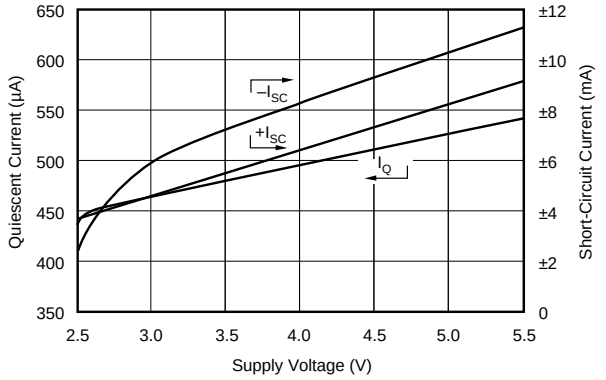
A_{OL}, CMRR, PSRR vs TEMPERATURE



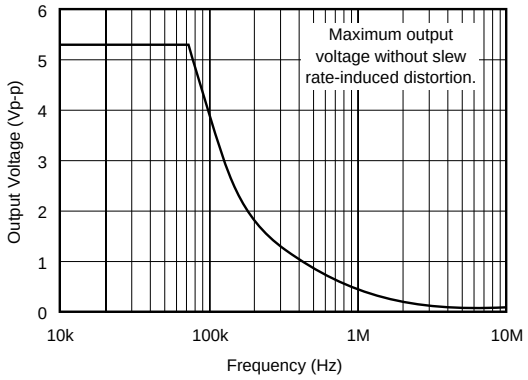
QUIESCENT CURRENT and SHORT-CIRCUIT CURRENT vs TEMPERATURE



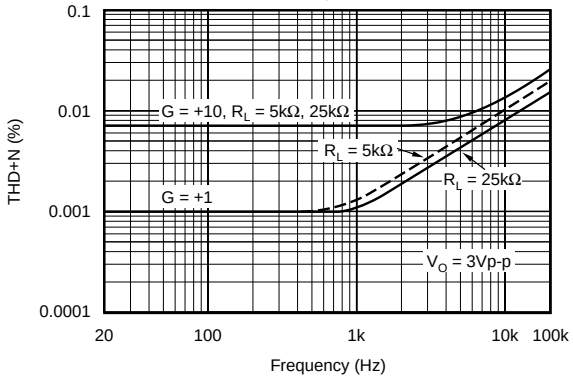
QUIESCENT and SHORT-CIRCUIT CURRENT vs SUPPLY VOLTAGE



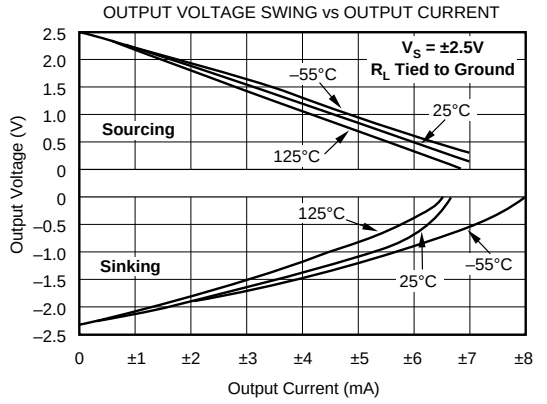
MAXIMUM OUTPUT VOLTAGE vs FREQUENCY



TOTAL HARMONIC DISTORTION + NOISE vs FREQUENCY



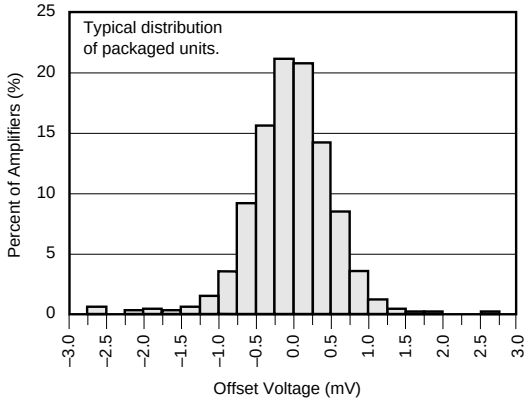
OUTPUT VOLTAGE SWING vs OUTPUT CURRENT



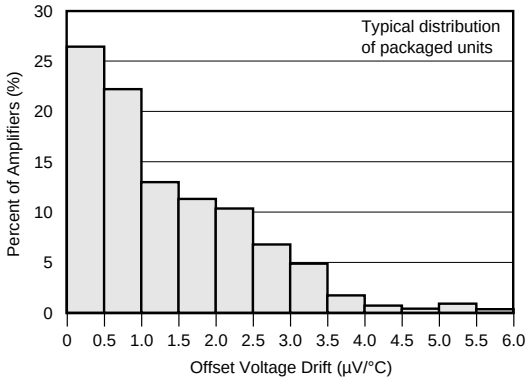
TYPICAL PERFORMANCE CURVES (CONT)

At T_A = +25°C, V_S = +5V, and R_L = 25kΩ connected to V_S/2, unless otherwise noted.

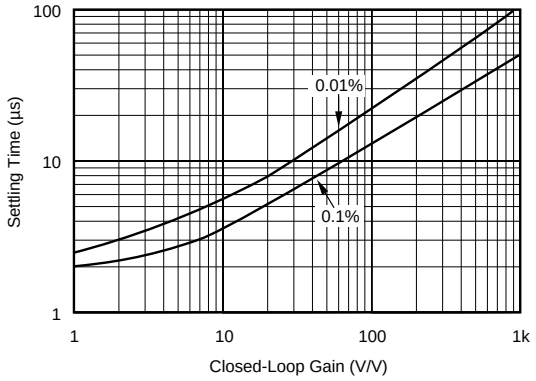
OFFSET VOLTAGE
PRODUCTION DISTRIBUTION



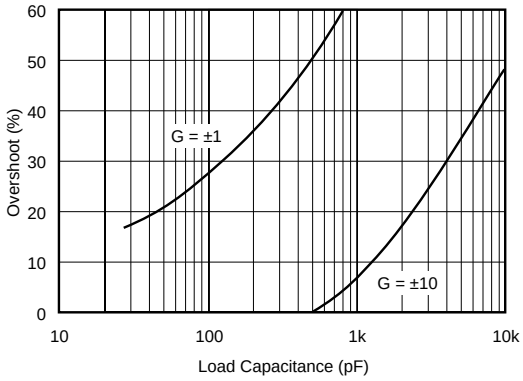
OFFSET VOLTAGE DRIFT
PRODUCTION DISTRIBUTION



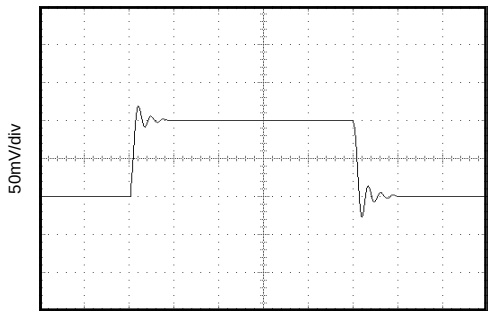
SETTLING TIME vs CLOSED-LOOP GAIN



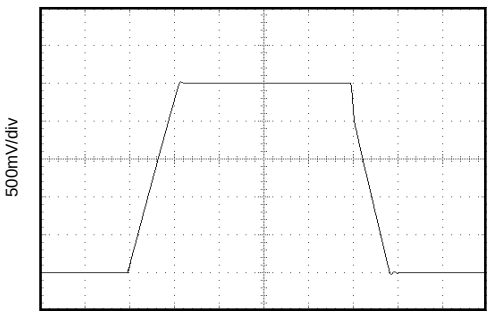
SMALL-SIGNAL OVERSHOOT vs LOAD CAPACITANCE



SMALL-SIGNAL STEP RESPONSE
G = 1, C_L = 100pF, V_S = +5V



LARGE-SIGNAL STEP RESPONSE
G = 1, C_L = 100pF, V_S = +5V



APPLICATIONS INFORMATION

The OPA2337 is fabricated on a state-of-the-art 0.6 micron CMOS process. It is unity-gain stable and suitable for a wide range of general purpose applications. Power supply pins should be bypassed with 0.01µF ceramic capacitors.

OPERATING VOLTAGE

The OPA2337 can operate from a +2.5V to +5.5V single supply with excellent performance. Unlike most op amps which are specified at only one supply voltage, the OPA2337 is specified for real-world applications; a single limit applies throughout the +2.7V to +5.5V supply range. This allows a designer to have the same assured performance at any supply voltage within the specified voltage range. Most behavior remains unchanged throughout the full operating voltage range. Parameters which vary significantly with operating voltage are shown in typical performance curves.

INPUT VOLTAGE

The input common-mode range of the OPA2337 extends from (V–) –0.2V to (V+) –1.2V. For normal operation, inputs should be limited to this range. The absolute maximum input voltage is 300mV beyond the supplies. Thus, inputs greater than the input common-mode range but less than maximum input voltage, while not valid, will not cause any damage to the op amp. Furthermore, the inputs may go beyond the power supplies without phase inversion (Figure 1) unlike some other op amps.

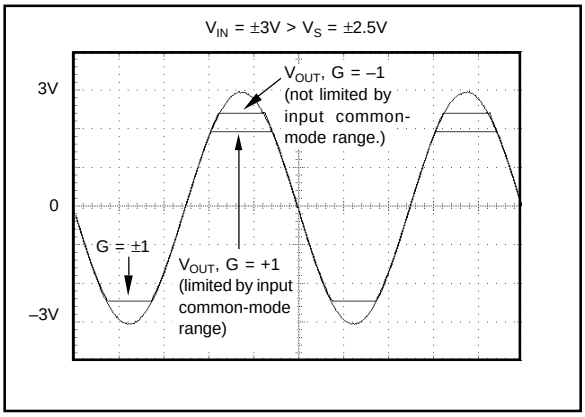


FIGURE 1. No Phase Inversion with Inputs Greater than the Power Supply Voltage.

Normally, input currents are 1pA. However, large inputs can cause excessive current to flow in or out of the input pins. Therefore, as well as keeping the input voltage below the maximum rating, it is also important to limit the input current to less than 10mA. This is easily accomplished with an input resistor as shown in Figure 2.

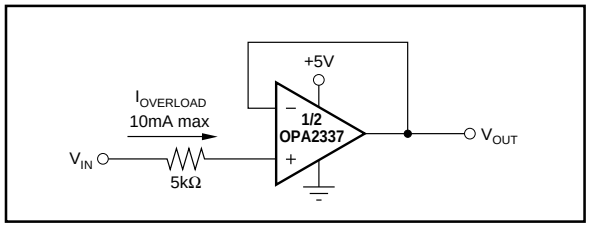


FIGURE 2. Input Current Protection for Voltages Exceeding the Supply Voltage.

OUTPUT SWING

The OPA2337 has “rail-to-rail” output voltage swing. With a 25kΩ load, the output can typically swing to within 40mV of both the positive and negative supplies (or ground). However, there is a small region near the positive rail in which there is a possibility for instability. As shown in Figure 3, this region is dependent on the combination of output swing and output current. A signal on either side of this narrow region (±20mV at any point) is stable and a signal that has passed through the region is unchanged. In most applications, this region is not encountered. For example, with V_S = +5V and R_L = 25kΩ, the OPA2337 is required to source 200µA. For this case, the region of possible instability occurs approximately 70mV to 110mV from the positive rail (beyond the guaranteed swing of 125mV to the rail). This behavior is common with CMOS rail-to-rail output op amps. Note that this condition does not occur with output voltage swing near the negative rail.

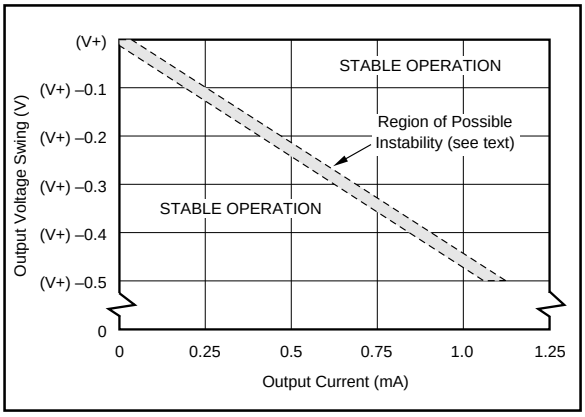


FIGURE 3. Output Voltage Swing to Positive Rail.

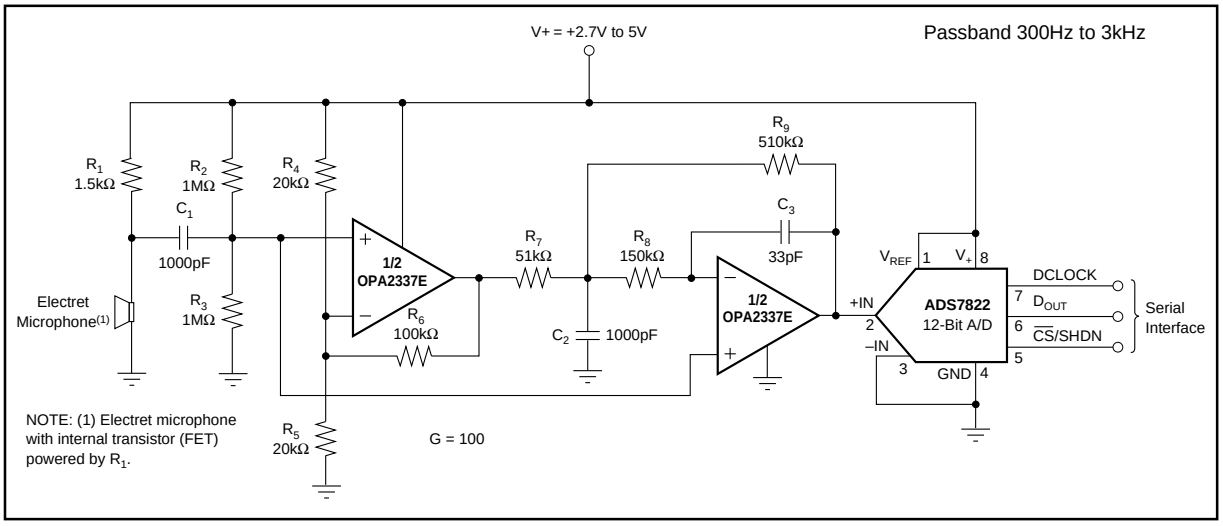


FIGURE 4. Low Power, Single Supply, Small Footprint Speech Bandpass Filtered Data Acquisition System.

TYPICAL APPLICATION

Figure 4 shows the OPA2337 in a typical application. The ADS7822 is a 12-bit, micro-power sampling analog-to-digital converter available in the tiny MSOP-8 package. As with the OPA2337, it operates with a supply voltage as low as +2.7V. When used with the miniature SOT-23-8 package of the OPA2337, the circuit is ideal for space-limited and low power applications. In addition, OPA2337's high input impedance allows large value resistors to be used which results in small physical capacitors, further reducing circuit size. For further information, consult the ADS7822 data sheet.

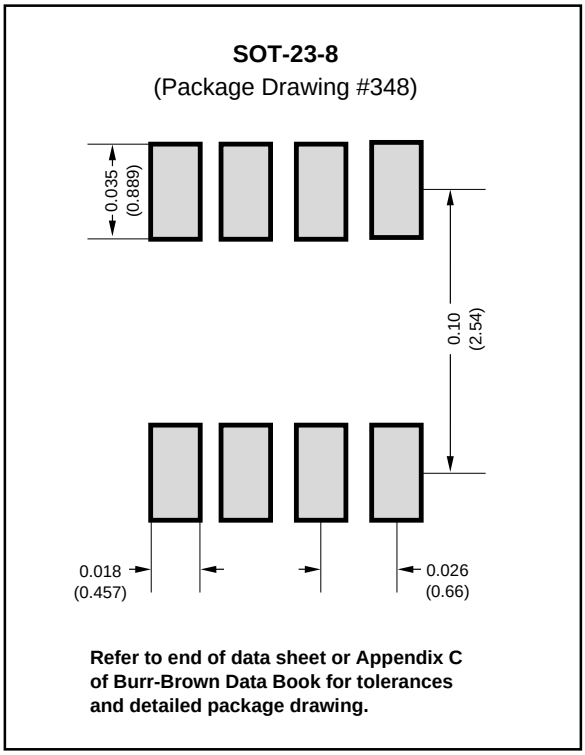


FIGURE 5. Recommended SOT-23-8 Solder Footprints.