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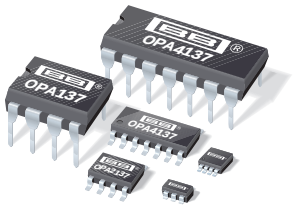


OPA137
OPA2137
OPA4137

LOW COST
FET-INPUT OPERATIONAL AMPLIFIERS
*Micro*Amplifier™ Series

FEATURES

- FET INPUT: I_B = 5pA
- LOW OFFSET VOLTAGE: 1.5mV
- WIDE SUPPLY RANGE: ±2.25V to ±18V
- LOW QUIESCENT CURRENT: 220µA/channel
- EXCELLENT SPEED/POWER: 1MHz
- INPUT TO POSITIVE SUPPLY
- *Micro*SIZE PACKAGES: SOT-23-5, MSOP-8
- SINGLE, DUAL, AND QUAD

APPLICATIONS

- STRAIN GAGE AMPLIFIER
- PHOTODETECTOR AMPLIFIER
- PRECISION INTEGRATOR
- BATTERY-POWERED INSTRUMENTS
- TEST EQUIPMENT
- ACTIVE FILTERS

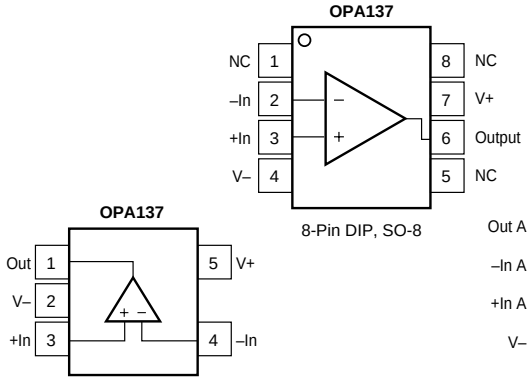
DESCRIPTION

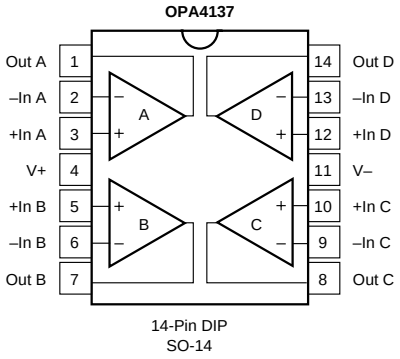
OPA137 series FET-input operational amplifiers are designed for low cost and miniature applications. In addition to small size (SOT-23-5 and MSOP-8 packages), they provide low input bias current (5pA), low quiescent currrent (220µA/channel), and high open-loop gain (94dB).

Either single (+4.5V to +36V) or dual (±2.25 to ±18V) supplies can be used. The input common-mode voltage range includes the positive supply—suitable for many single-supply applications. Single, dual, and quad versions have identical specifications for maximum design flexibility.

OPA137 op amps are easy to use and free from phase inversion and overload problems found in some FET-input amplifiers. High performance, including linearity, is maintained as the amplifiers swing to their specified limits. In addition, the combination of high slew rate (3.5V/µs) and wide bandwidth (1MHz) provide fast settling time assuring good dynamic response. Dual and quad designs feature completely independent circuitry for lowest crosstalk and freedom from interaction.

The single (OPA137) packages are the tiny 5-lead SOT-23-5 surface mount, SO-8 surface mount, and 8-pin DIP. The dual (OPA2137) comes in the miniature MSOP-8 surface mount, SO-8 surface mount, and 8-pin DIP packages. The quad (OPA4137) packages are the SO-14 surface mount and the 14-pin DIP. All are specified from –40°C to +85°C and operate from –55°C to +125°C. A SPICE macromodel is available for design analysis.





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SPECIFICATIONS: V_S = ±15V

At T_A = +25°C, R_L = 10kΩ connected to ground, unless otherwise noted.
Boldface limits apply over the specified temperature range, T_A = –40°C to +85°C.

PARAMETER		CONDITION	OPA137N, U, P OPA2137E, U, P OPA4137U, P			OPA137NA, UA, PA OPA2137EA, UA, PA OPA4137UA, PA			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
OFFSET VOLTAGE									
Input Offset Voltage	V_{OS}			±1.5	±3		±2.5	±10	mV
T_A = –40°C to +85°C				±2.5	**±7**		±3.5	**±15**	mV
vs Temperature	dV_{OS}/dT	T_A = –40°C to +85°C		±15			*		µV/°C
vs Power Supply	PSRR	V_S = ±3V to ±18V		±90	±250		*	*	µV/V
T_A = –40°C to +85°C					**±250**			*	µV/V
Channel Separation (dual, quad)		dc		0.6			*		µV/V
INPUT BIAS CURRENT		V_{CM} = 0V							
Input Bias Current	I_B			±5	±100		*	*	pA
vs Temperature				See Typical Curve			*		
Input Offset Current	I_{OS}			±2	±50		*	*	pA
NOISE									
Input Voltage Noise, f = 0.1 to 10Hz				2			*		µVp-p
Input Voltage Noise Density, f = 1kHz	e_n			45			*		nV/√Hz
Current Noise Density, f = 1kHz	i_n			1.2			*		fA/√Hz
INPUT VOLTAGE RANGE									
Common-Mode Voltage Range	V_{CM}		(V–) + 3		(V+)	*		*	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = –12V to 15V							
OPA137, OPA2137			76	84		70	*		dB
OPA4137			74	84		70	*		dB
T_A = –40°C to +85°C		V_{CM} = –12V to 15V							
OPA137, OPA2137			**72**			**70**			dB
OPA4137			**70**			**70**			dB
INPUT IMPEDANCE									
Differential				10^{10} || 1			*		Ω || pF
Common-Mode				10^{12} || 2			*		Ω || pF
OPEN-LOOP GAIN									
Open-Loop Voltage Gain	A_{OL}	V_O = –13.8V to 13.9V	86	94		*	*		dB
T_A = –40°C to +85°C		V_O = –13.8V to 13.9V	**86**			*			dB
FREQUENCY RESPONSE									
Gain-Bandwidth Product	GBW			1			*		MHz
Slew Rate	SR	G = 1		3.5			*		V/µs
Settling Time, 0.1%		G = 1, 10V Step, C_L = 100pF		8			*		µs
0.01%		G = 1, 10V Step, C_L = 100pF		10			*		µs
Overload Recovery Time		V_{IN} • G = V_S		1			*		µs
Total Harmonic Distortion + Noise	THD+N	G = 1, f = 1kHz, 3.5Vrms		0.05			*		%
OUTPUT									
Voltage Output	V_{OUT}		(V–) + 1.2		(V+) – 1.1	*		*	V
T_A = –40°C to +85°C			**(V–) + 1.2**		**(V+) – 1.1**	*		*	V
Short-Circuit Current	I_{SC}			–25/+60			*		mA
Capacitive Load Drive	C_{LOAD}			1000			*		pF
POWER SUPPLY									
Specified Operating Range	V_S			±15			*		V
Operating Voltage Range									
Dual Supplies			±2.25[1]		±18	*		*	V
Single Supply			+4.5		+36	*		*	V
Quiescent Current	I_Q	I_O = 0		±220	±270		*	*	µA
T_A = –40°C to +85°C		I_O = 0			**±375**			*	µA
TEMPERATURE RANGE									
Specified Range			–40		+85	*		*	°C
Operating Range			–55		+125	*		*	°C
Storage Range			–55		+125	*		*	°C
Thermal Resistance	θ_{JA}								
SOT-23-5 Surface Mount				200			*		°C/W
MSOP-8 Surface Mount				150			*		°C/W
SO-8 Surface Mount				150			*		°C/W
8-Pin DIP				100			*		°C/W
SO-14 Surface Mount				100			*		°C/W
14-Pin DIP				80			*		°C/W

* Specifications the same as OPA137N, U, P.

NOTE: (1) At minimum power supply voltage inputs must be biased above ground in accordance with common-mode voltage range restrictions—see "Operating Voltage" discussion.

ABSOLUTE MAXIMUM RATINGS[1]

Supply Voltage, V+ to V–	36V
Input Voltage	(V–) –0.7V to (V+) +0.7V
Input Current	2mA
Output Short-Circuit[2]	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

NOTE: (1) Stresses above these ratings may cause permanent damage. Exposure to absolute maximum ratings for extended periods may affact device reliability. (2) 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

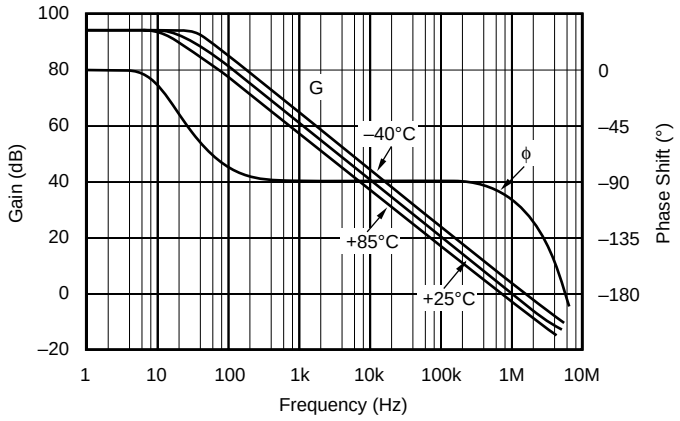
PRODUCT	PACKAGE	PACKAGE DRAWING NUMBER[1]	SPECIFIED TEMPERATURE RANGE	PACKAGE MARKING	ORDERING NUMBER[2]	TRANSPORT MEDIA
Single						
OPA137N	5-Lead SOT-23-5 Surface Mount	331	–40°C to +85°C	E37[3]	OPA137N/250	Tape and Reel
"	"	"	"	"	OPA137N/3K	Tape and Reel
OPA137NA	5-Lead SOT-23-5 Surface Mount	331	–40°C to +85°C	E37[3]	OPA137NA/250	Tape and Reel
"	"	"	"	"	OPA137NA/3K	Tape and Reel
OPA137U	SO-8 Surface Mount	182	–40°C to +85°C	OPA137U	OPA137U	Rails
"	"	"	"	"	OPA137U/2K5	Tape and Reel
OPA137UA	SO-8 Surface Mount	182	–40°C to +85°C	OPA137UA	OPA137UA	Rails
"	"	"	"	"	OPA137UA/2K5	Tape and Reel
OPA137P	8-Pin DIP	006	–40°C to +85°C	OPA137P	OPA137P	Rails
OPA137PA	8-Pin DIP	006	–40°C to +85°C	OPA137PA	OPA137PA	Rails
Dual						
OPA2137E	MSOP-8 Surface Mount	337	–40°C to +85°C	E37[3]	OPA2137E/250	Tape and Reel
"	"	"	"	"	OPA2137E/2K5	Tape and Reel
OPA2137EA	MSOP-8 Surface Mount	337	–40°C to +85°C	E37[3]	OPA2137EA/250	Tape and Reel
"	"	"	"	"	OPA2137EA/2K5	Tape and Reel
OPA2137U	SO-8 Surface Mount	182	–40°C to +85°C	OPA2137U	OPA2137U	Rails
"	"	"	"	"	OPA2137U/2K5	Tape and Reel
OPA2137UA	SO-8 Surface Mount	182	–40°C to +85°C	OPA2137UA	OPA2137UA	Rails
"	"	"	"	"	OPA2137UA/2K5	Tape and Reel
OPA2137P	8-Pin DIP	006	–40°C to +85°C	OPA2137P	OPA2137P	Rails
OPA2137PA	8-Pin DIP	006	–40°C to +85°C	OPA2137PA	OPA2137PA	Rails
Quad						
OPA4137U	SO-14 Surface Mount	235	–40°C to +85°C	OPA4137U	OPA4137U	Rails
"	"	"	"	"	OPA4137U/2K5	Tape and Reel
OPA4137UA	SO-14 Surface Mount	235	–40°C to +85°C	OPA4137UA	OPA4137UA	Rails
"	"	"	"	"	OPA4137UA/2K5	Tape and Reel
OPA4137P	14-Pin DIP	010	–40°C to +85°C	OPA4137P	OPA4137P	Rails
OPA4137PA	14-Pin DIP	010	–40°C to +85°C	OPA4137PA	OPA4137PA	Rails

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 a slash (/) are available only in Tape and Reel in the quantities indicated (e.g., /2K5 indicates 2500 devices per reel). Ordering 3000 pieces of "OPA137NA/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) Grade information is marked on the reel.

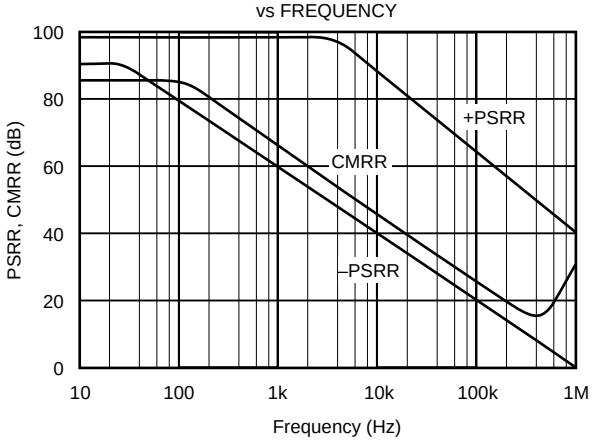
TYPICAL PERFORMANCE CURVES

At T_A = +25°C, V_S = ±15V, R_L = 10kΩ, connected to ground, unless otherwise noted.

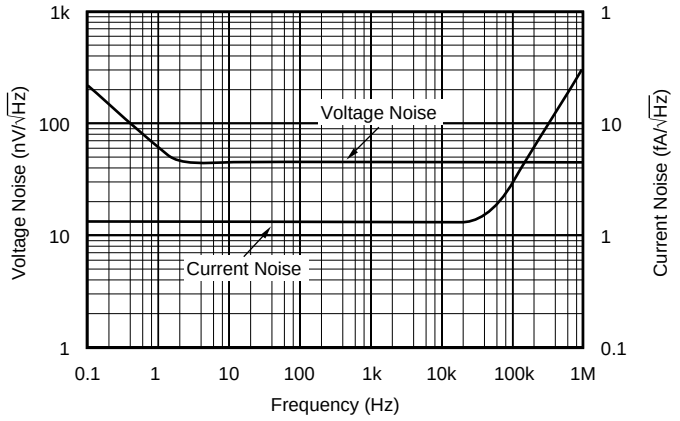
OPEN-LOOP GAIN/PHASE vs FREQUENCY



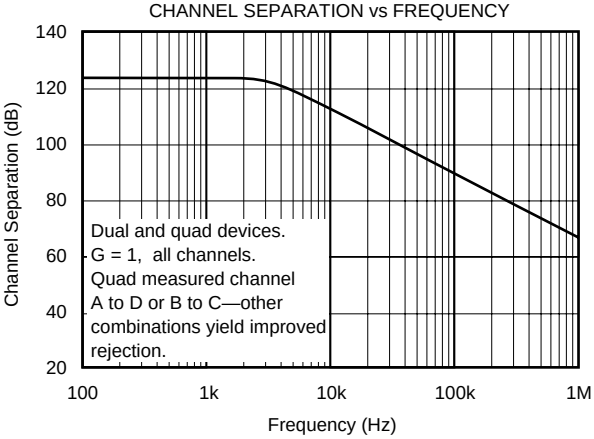
POWER SUPPLY AND COMMON-MODE REJECTION vs FREQUENCY



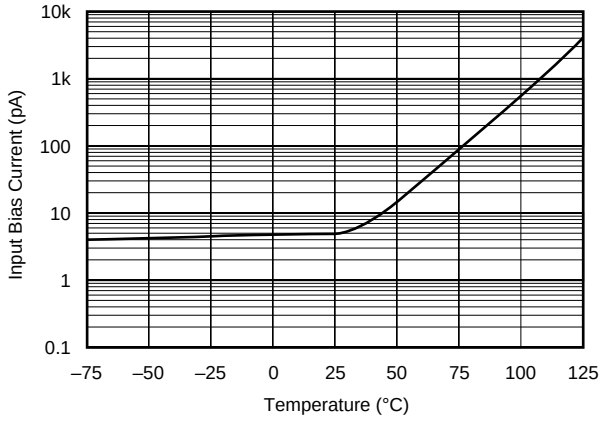
INPUT VOLTAGE AND CURRENT NOISE SPECTRAL DENSITY vs FREQUENCY



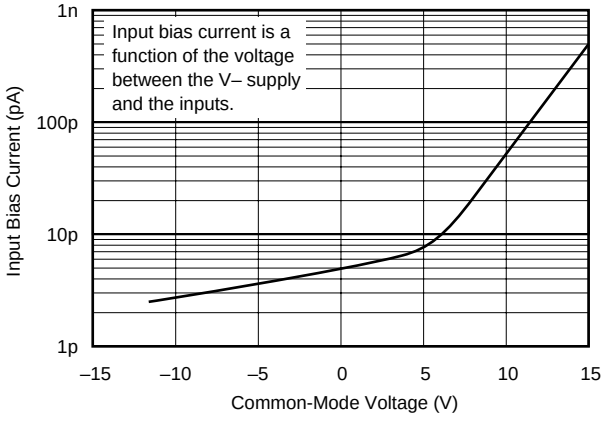
CHANNEL SEPARATION vs FREQUENCY



INPUT BIAS CURRENT vs TEMPERATURE



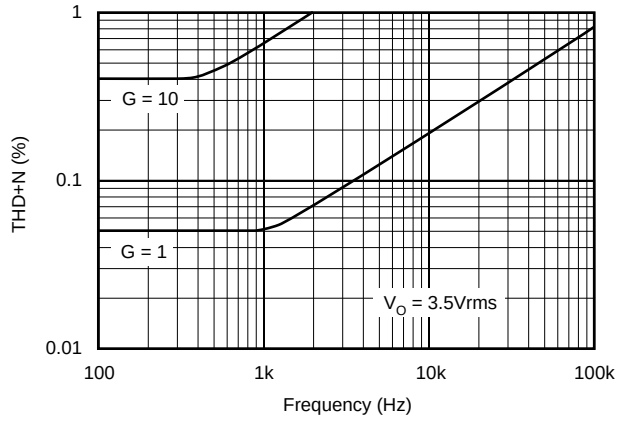
INPUT BIAS CURRENT vs INPUT COMMON-MODE VOLTAGE



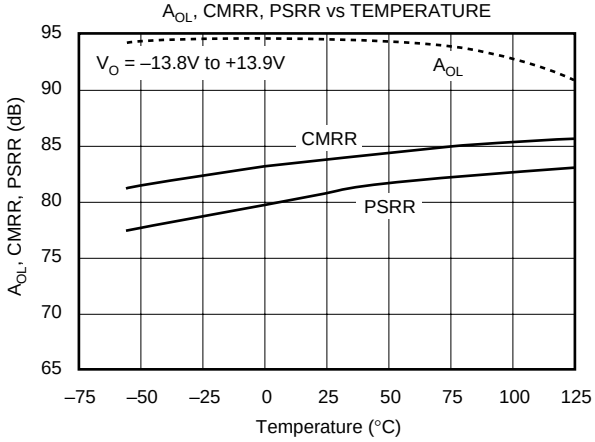
TYPICAL PERFORMANCE CURVES (CONT)

At T_A = +25°C, V_S = ±15V, R_L = 10kΩ, connected to ground, unless otherwise noted.

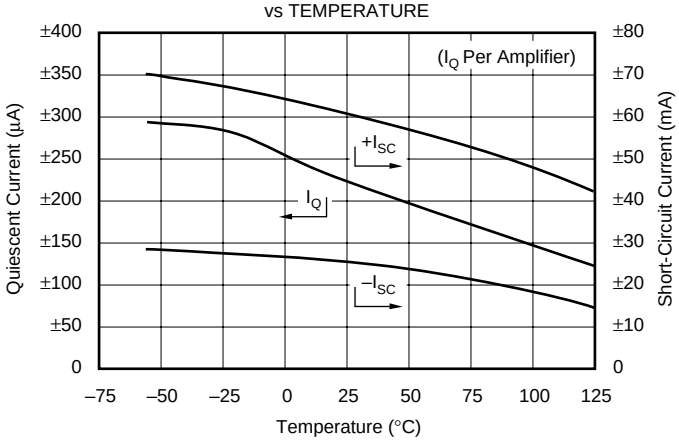
TOTAL HARMONIC DISTORTION + NOISE vs FREQUENCY



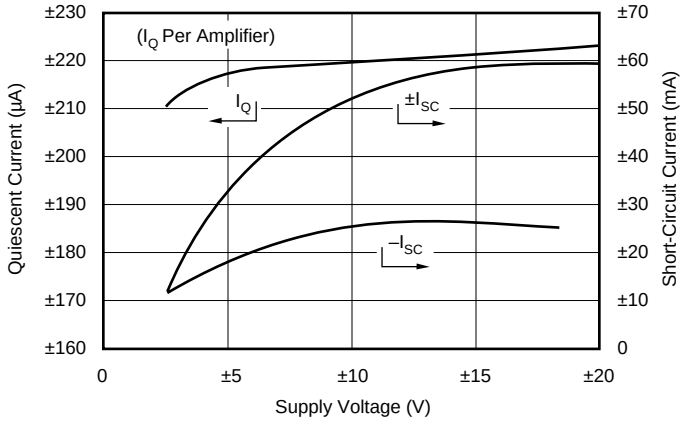
A_{OL}, CMRR, PSRR vs TEMPERATURE



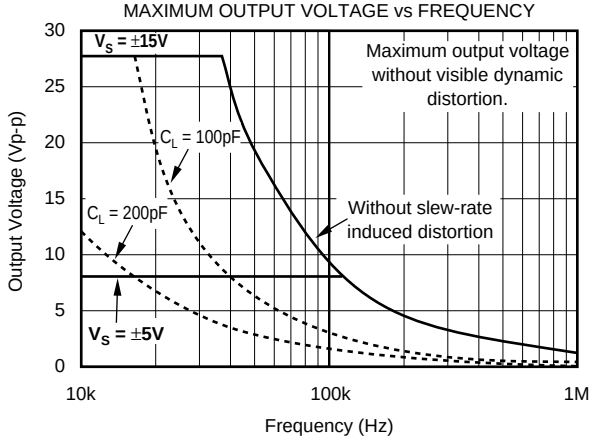
QUIESCENT CURRENT and SHORT-CIRCUIT CURRENT vs TEMPERATURE



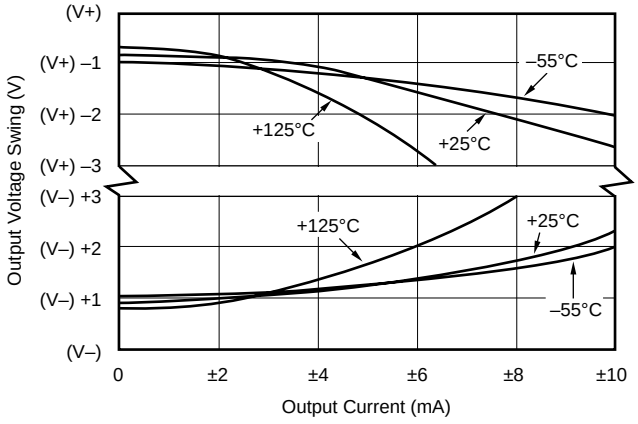
QUIESCENT CURRENT and SHORT-CIRCUIT CURRENT vs SUPPLY VOLTAGE



MAXIMUM OUTPUT VOLTAGE vs FREQUENCY



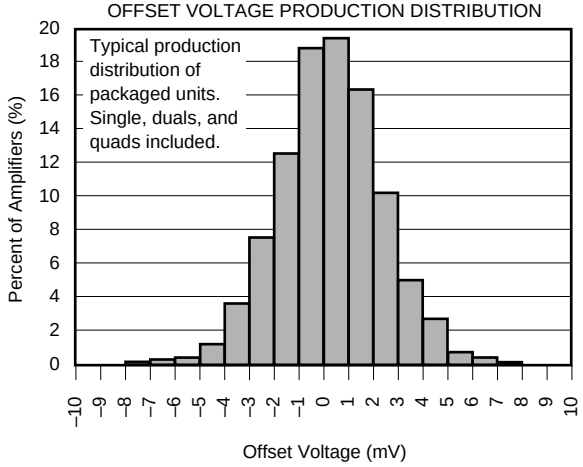
OUTPUT VOLTAGE SWING vs OUTPUT CURRENT



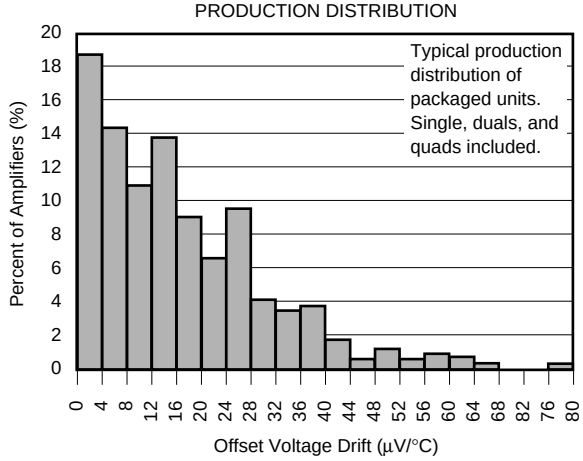
TYPICAL PERFORMANCE CURVES (CONT)

At T_A = +25°C, V_S = ±15V, R_L = 10kΩ, connected to ground, unless otherwise noted.

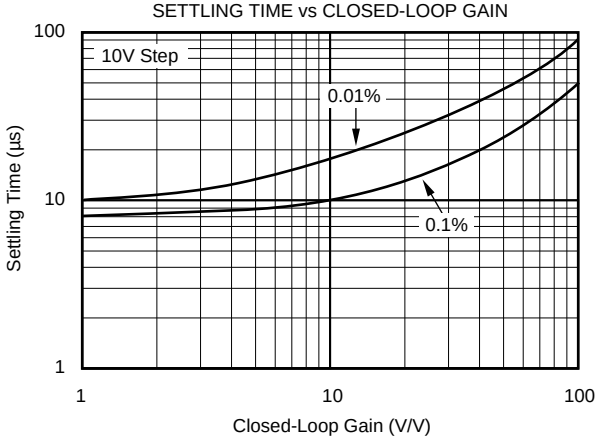
OFFSET VOLTAGE PRODUCTION DISTRIBUTION



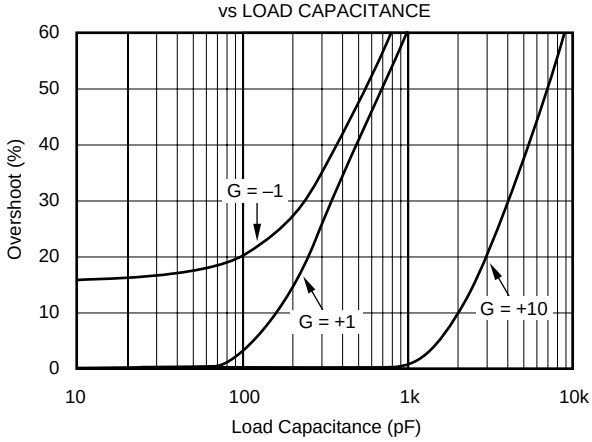
OFFSET VOLTAGE DRIFT PRODUCTION DISTRIBUTION



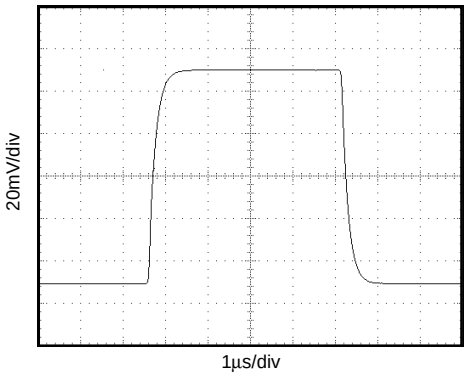
SETTLING TIME vs CLOSED-LOOP GAIN



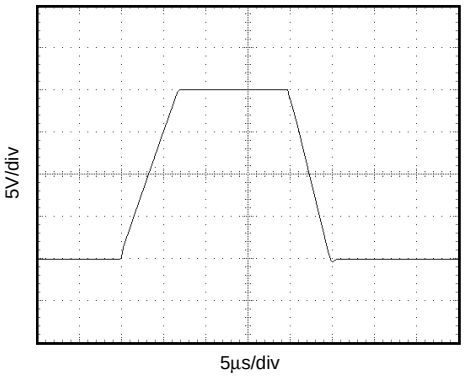
SMALL-SIGNAL OVERSHOOT vs LOAD CAPACITANCE



SMALL-SIGNAL STEP RESPONSE
G = 1, C_L = 50pF



LARGE-SIGNAL STEP RESPONSE
G = 1, C_L = 50pF



APPLICATIONS INFORMATION

OPA137 series op amps are unity-gain stable and suitable for a wide range of general-purpose applications. Power supply pins should be bypassed with 10nF ceramic capacitors or larger. All circuitry is completely independent in dual and quad versions, assuring normal performance when one amplifier in a package is overdriven or short circuited. Many key parameters are guaranteed over the specified temperature range, –40°C to +85°C.

OPERATING VOLTAGE

OPA137 op amps can be operated on power supplies as low as ±2.25V. Performance remains excellent with power supplies ranging from ±2.25V to ±18V (+4.5V to +36V single supply). Most parameters vary only slightly throughout this supply voltage range. Quiescent current and short-circuit current vs supply voltage are shown in Typical Performance Curves.

Operation at very low supply voltage ($V_S \leq \pm 3V$) requires careful attention to ensure that the common-mode voltage remains within the linear range, V_{CM} = (V–)+3V to (V+). Inputs may need to be biased above ground in accordance with the common-mode voltage range restrictions for linear operation.

INPUT VOLTAGE

The input common-mode voltage range of OPA137 series op amps extends from (V–)+3V to the positive rail, V+. For normal operation, inputs should be limited to this range. The inputs may go beyond the power supplies without output phase-reversal. Many FET-input op amps (such as TL061 types) exhibit phase-reversal of the output when the input common-mode range is exceeded. This can occur in voltage-follower circuits, causing serious problems in control loop applications.

Input terminals are diode-clamped to the power supply rails for ESD protection. If the input voltage can exceed the negative supply by 500mV, input current should be limited to 2mA (or less). If the input current is not adequately limited, you may see unpredicatable behavior in the other amplifiers in the package. This is easily accomplished with an input resistor as shown in Figure 1. Many input signals are inherently current-limited, therefore, a limiting resistor may not be required.

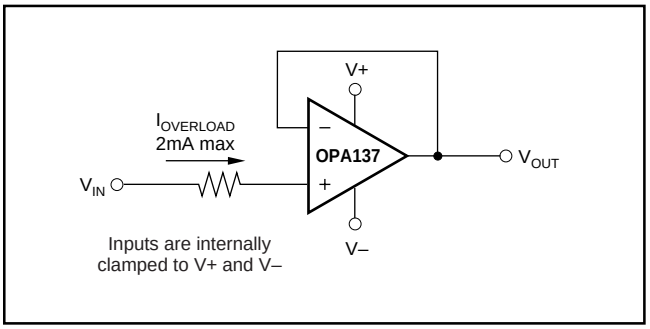


FIGURE 1. Input Current Protection for Voltages Exceeding the Supply Voltage.

HIGH-SIDE CURRENT SENSING

Many applications require the sensing of signals near the positive supply. The common-mode input range of OPA137 op amps includes the positive rail, enabling them to be used to sense power supply currents as shown in Figure 2.

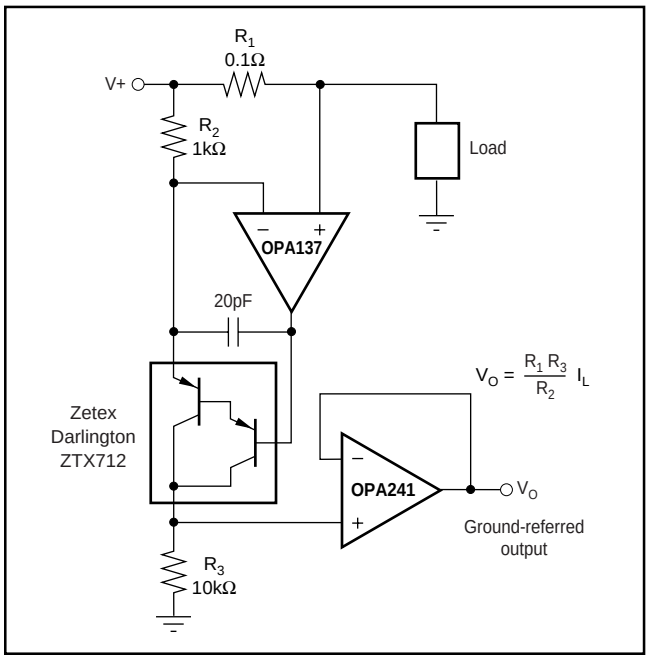


FIGURE 2. High-Side Current Monitor.

INPUT BIAS CURRENT

The input bias current is approximately 5pA at room temperature and increases with temperature as shown in the typical performance curve “Input Bias Current vs Temperature.”

Input Bias current also varies with common-mode voltage and power supply voltage. This variation is dependent on the voltage between the negative power supply and the common-mode input voltage. The effect is shown in the typical performance curve “Input Bias Current vs Common-Mode Voltage.”

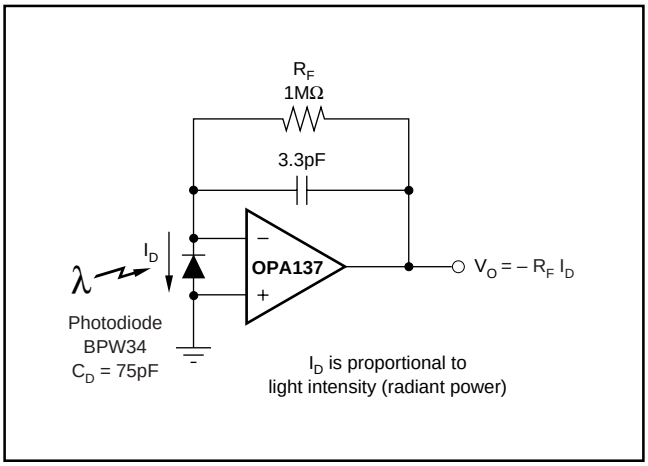
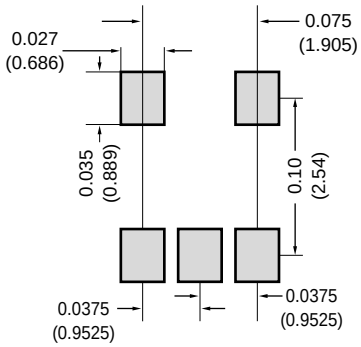
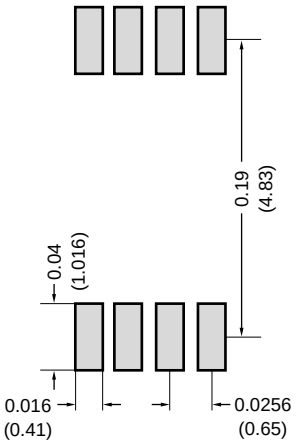


FIGURE 3. Photodetector Amplifier.

SOT-23-5
(Package Drawing #331)



MSOP-8
(Package Drawing #337)



Refer to end of data sheet or Appendix C of Burr-Brown Data Book for tolerances and detailed package drawing. For further information on solder pads for surface-mount devices consult Application Bulletin AB-132.

FIGURE 4. Recommended SOT-23-5 and MSOP-8 Solder Footprints.

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