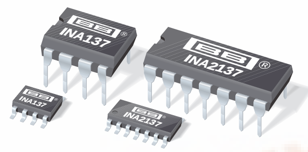
BURR - BROWN®



INA137
INA2137

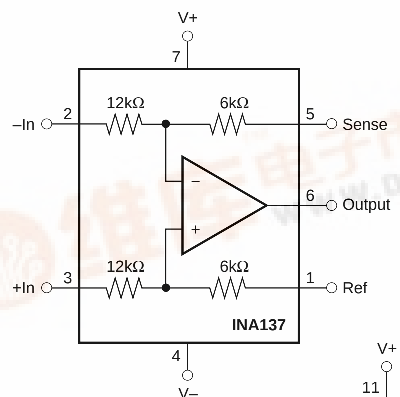
AUDIO DIFFERENTIAL LINE RECEIVERS
±6dB (G = 1/2 or 2)

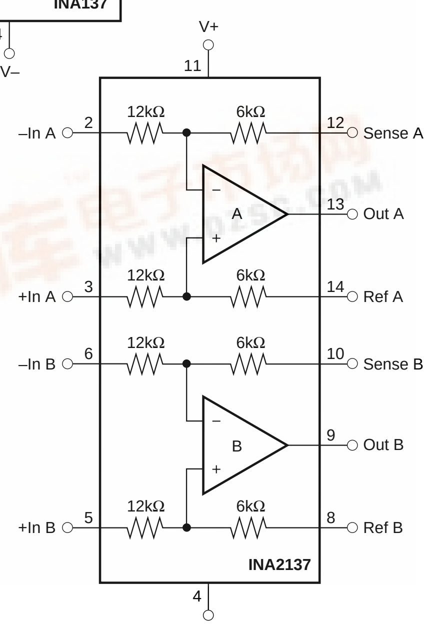
FEATURES

- SINGLE AND DUAL VERSIONS
- LOW DISTORTION: 0.0005% at f = 1kHz
- HIGH SLEW RATE: 14V/µs
- FAST SETTLING TIME: 3µs to 0.01%
- WIDE SUPPLY RANGE: ±4V to ±18V
- LOW QUIESCENT CURRENT: 2.9mA max
- HIGH CMRR: 90dB
- FIXED GAIN = ±6dB
- PACKAGES—SINGLE: 8-PIN DIP, SO-8
  DUAL: 14-PIN DIP, SO-14

APPLICATIONS

- AUDIO DIFFERENTIAL LINE RECEIVER
- G = 1/2 OR G = 2 AMPLIFIER
- INSTRUMENTATION BUILDING BLOCK
- CURRENT SHUNT MONITOR
- VOLTAGE-CONTROLLED CURRENT SOURCE
- GROUND LOOP ELIMINATOR





DESCRIPTION

The INA137 and INA2137 are differential line receivers consisting of high performance op amps with on-chip precision resistors. They are fully specified for high performance audio applications and have excellent ac specifications, including low distortion (0.0005% at 1kHz) and high slew rate (14V/µs), assuring good dynamic response. In addition, wide output voltage swing and high output drive capability allow use in a wide variety of demanding applications. The dual version features completely independent circuitry for lowest crosstalk and freedom from interaction, even when overdriven or overloaded.

The INA137 and INA2137 on-chip resistors are laser trimmed for accurate gain and optimum common-mode rejection. Furthermore, excellent TCR tracking of the resistors maintains gain accuracy and common-mode rejection over temperature. Operation is guaranteed from ±4V to ±18V (8V to 36V total supply).

The INA137 is available in 8-pin DIP and SO-8 surface-mount packages. The INA2137 comes in 14-pin DIP and SO-14 surface-mount packages. Both are specified for operation over the extended industrial temperature range, –40°C to +85°C.

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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

SPECIFICATIONS: $V_S = \pm18V$

At $T_A = +25°C$, $V_S = \pm18V$, $R_L = 2k\Omega$, G = 1/2, and Ref Pin connected to Ground, unless otherwise noted.

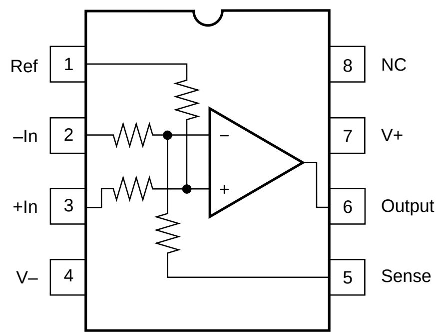
PARAMETER	CONDITIONS	INA137PA, UA INA2137PA, UA MIN	TYP	MAX	UNITS
AUDIO PERFORMANCE					
Total Harmonic Distortion + Noise, f = 1kHz	V_{IN} = 10Vrms		0.0005		%
Noise Floor, RTO(1)	20kHz BW		–106		dBu
Headroom, RTO(1)	THD+N < 1%		+23		dBu
FREQUENCY RESPONSE					
Small-Signal Bandwidth			4.0		MHz
Slew Rate			14		V/µs
Settling Time: 0.1%	10V Step, C_L = 100pF		2		µs
0.01%	10V Step, C_L = 100pF		3		µs
Overload Recovery Time	50% Overdrive		3		µs
Channel Separation (dual), f = 1kHz			123		dB
OUTPUT NOISE VOLTAGE(2)					
f = 20Hz to 20kHz			3.5		µVrms
f = 1kHz			26		nV/√HZ
OFFSET VOLTAGE(3)	RTO				
Input Offset Voltage	V_{CM} = 0V		±100	±1000	µV
vs Temperature	Specified Temperature Range		±2		µV/°C
vs Power Supply	V_S = ±4V to ±18V		±5	±60	µV/V
INPUT					
Common-Mode Voltage Range: Positive	V_O = 0V	3(V+)–7.5	3(V+)–6		V
Negative	V_O = 0V	3(V–)+7.5	3(V–)+3		V
Differential Voltage Range			See Typical Curve		
Common-Mode Rejection	V_{CM} = ±46.5V, R_S = 0Ω	74	90		dB
Impedance(4)					
Differential			24		kΩ
Common-Mode			18		kΩ
GAIN					
Initial			0.5		V/V
Error	V_O = –10V to 10V		±0.01	±0.1	%
vs Temperature			±1	±10	ppm/°C
Nonlinearity	V_O = –10V to 10V		0.0001		%
OUTPUT					
Voltage Output, Positive		(V+)–2	(V+)–1.8		V
Negative		(V–)+2	(V–)+1.6		V
Current Limit, Continuous to Common			±60		mA
Capacitive Load (Stable Operation)			500		pF
POWER SUPPLY					
Rated Voltage			±18		V
Voltage Range		±4		±18	V
Quiescent Current (per Amplifier)	I_O = 0		±2.4	±2.9	mA
TEMPERATURE RANGE					
Specification Range		–40		85	°C
Operation Range		–55		125	°C
Storage Range		–55		125	°C
Thermal Resistance, θ_{JA}					
8-Pin DIP			100		°C/W
SO-8 Surface-Mount			150		°C/W
14-Pin DIP			80		°C/W
SO-14 Surface-Mount			100		°C/W

RTO = Referred to Output.

NOTES: (1) dBu = 20log (Vrms/0.7746). (2) Includes effects of amplifier's input current noise and thermal noise contribution of resistor network. (3) Includes effects of amplifier's input bias and offset currents. (4) Internal resistors are ratio matched but have ±25% absolute value.

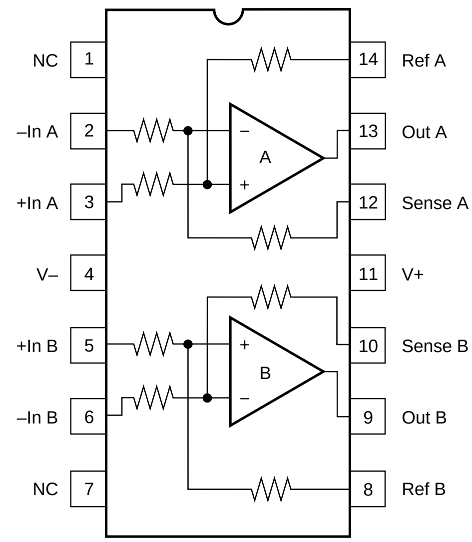
PIN CONFIGURATIONS

Top View — 8-Pin DIP/SO-8



NC = No Connection

Top View — 14-Pin DIP/SO-14



NC = No Connection

ABSOLUTE MAXIMUM RATINGS[1]

Supply Voltage, V+ to V–	40V
Input Voltage Range	±80V
Output Short-Circuit (to ground)[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. (2) One channel per package.

PACKAGE/ORDERING INFORMATION

PRODUCT	PACKAGE	PACKAGE DRAWING NUMBER[1]	SPECIFICATION TEMPERATURE RANGE
Single			
INA137PA	8-Pin DIP	006	–40°C to +85°C
INA137UA	SO-8 Surface-Mount	182	–40°C to +85°C
Dual			
INA2137PA	14-Pin DIP	010	–40°C to +85°C
INA2137UA	SO-14 Surface-Mount	235	–40°C to +85°C

NOTE: (1) For detailed drawing and dimension table, please see end of data sheet, or Appendix C of Burr-Brown IC Data Book.

ELECTROSTATIC DISCHARGE SENSITIVITY

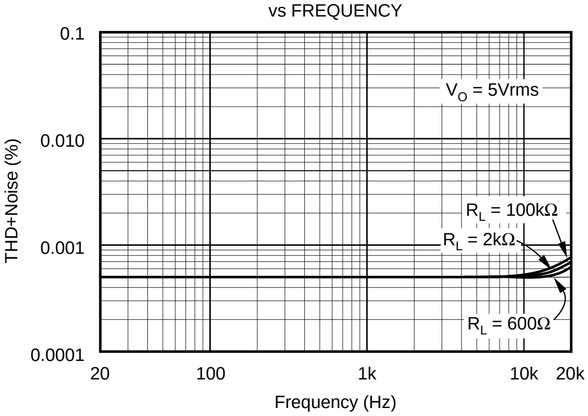
This integrated circuit can be damaged by ESD. Burr-Brown recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

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.

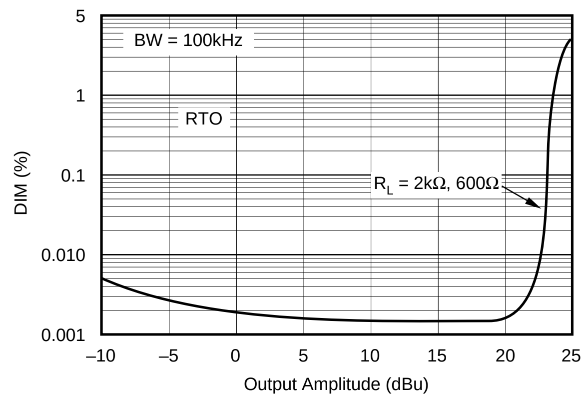
TYPICAL PERFORMANCE CURVES

At T_A = +25°C, V_S = ±18V, and G = 1/2, unless otherwise noted.

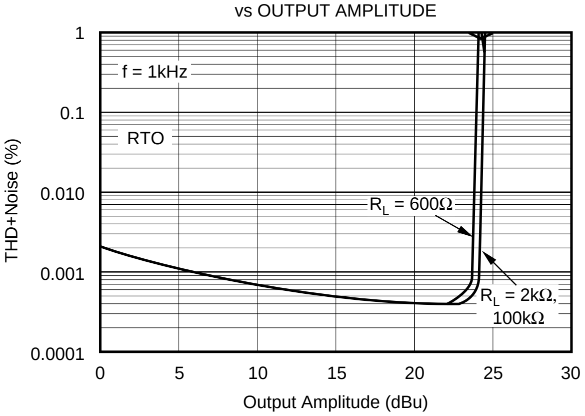
TOTAL HARMONIC DISTORTION+NOISE
vs FREQUENCY



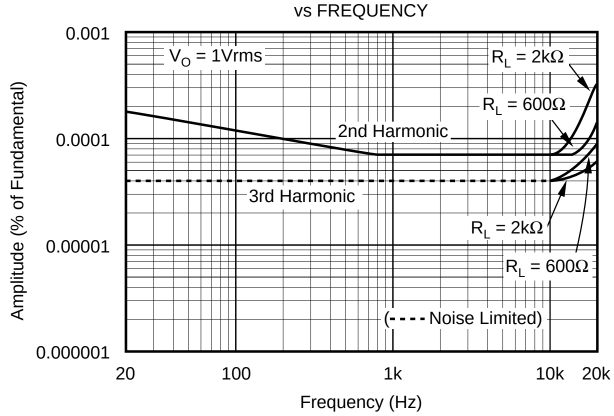
DIM INTERMODULATION DISTORTION
vs OUTPUT AMPLITUDE



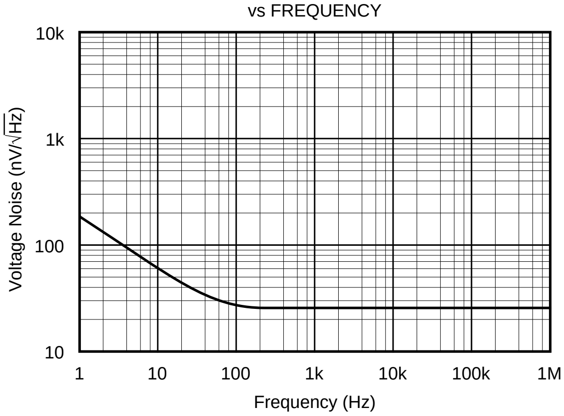
HEADROOM - TOTAL HARMONIC DISTORTION+NOISE
vs OUTPUT AMPLITUDE



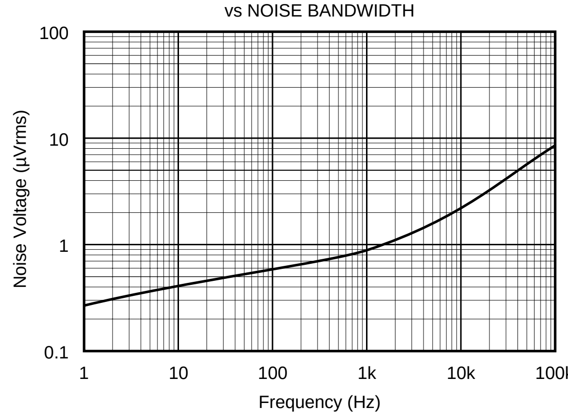
HARMONIC DISTORTION PRODUCTS
vs FREQUENCY



OUTPUT VOLTAGE NOISE SPECTRAL DENSITY
vs FREQUENCY



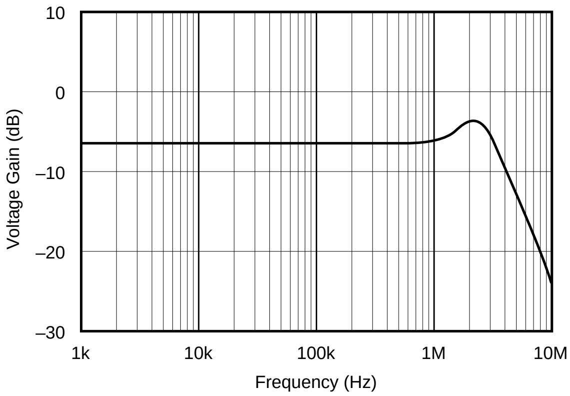
OUTPUT NOISE VOLTAGE
vs NOISE BANDWIDTH



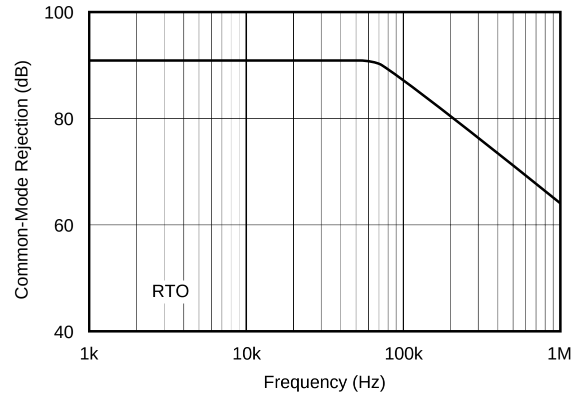
TYPICAL PERFORMANCE CURVES (CONT)

At $T_A = +25°C$, $V_S = ±18V$, and G = 1/2, unless otherwise noted.

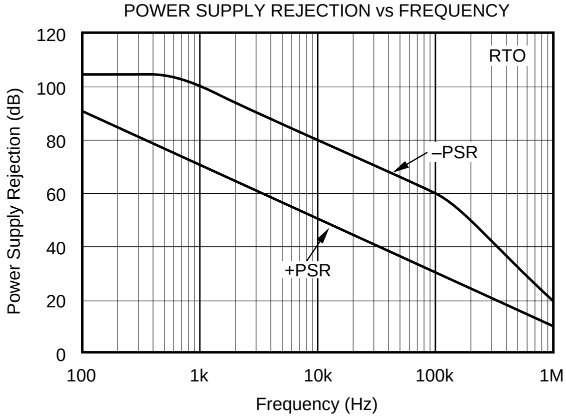
GAIN vs FREQUENCY



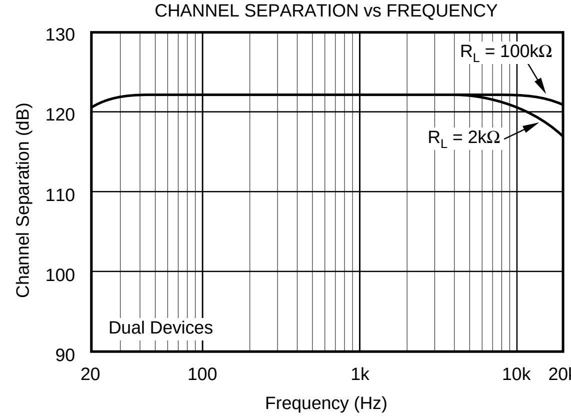
COMMON-MODE REJECTION vs FREQUENCY



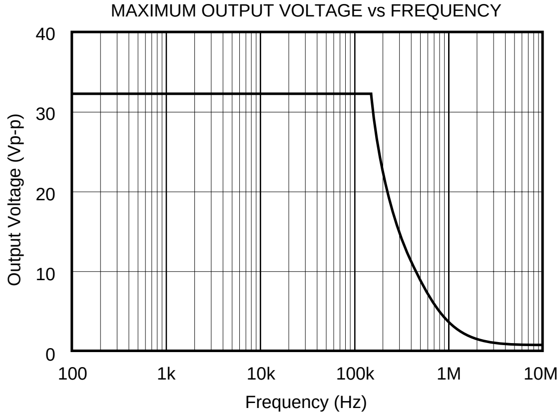
POWER SUPPLY REJECTION vs FREQUENCY



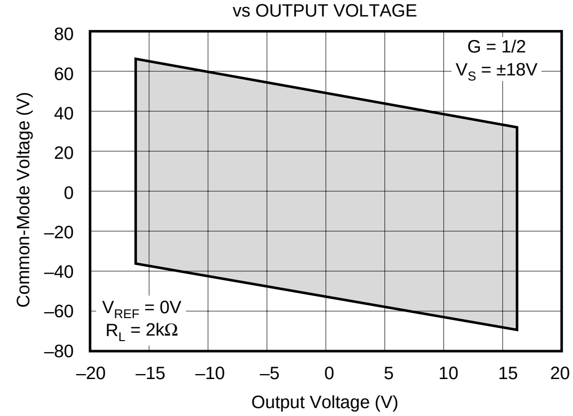
CHANNEL SEPARATION vs FREQUENCY



MAXIMUM OUTPUT VOLTAGE vs FREQUENCY



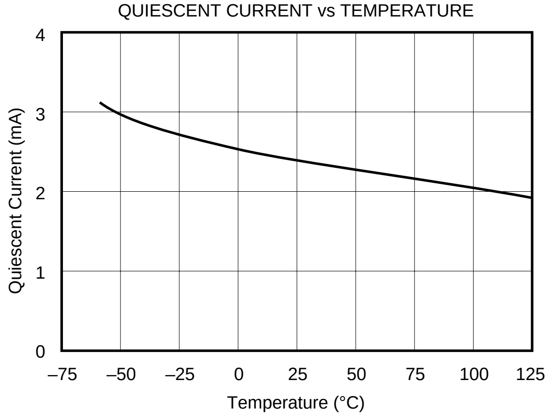
INPUT COMMON-MODE VOLTAGE
vs OUTPUT VOLTAGE



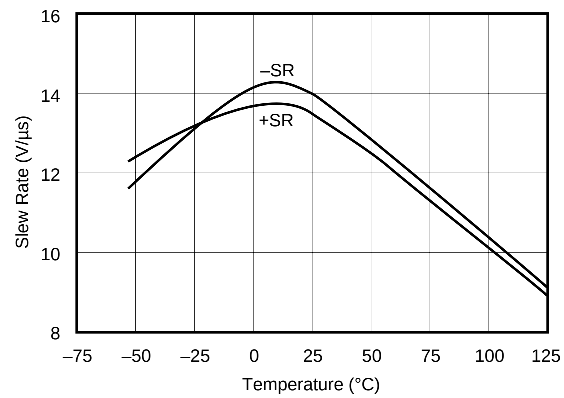
TYPICAL PERFORMANCE CURVES (CONT)

At T_A = +25°C, V_S = ±18V, and G = 1/2, unless otherwise noted.

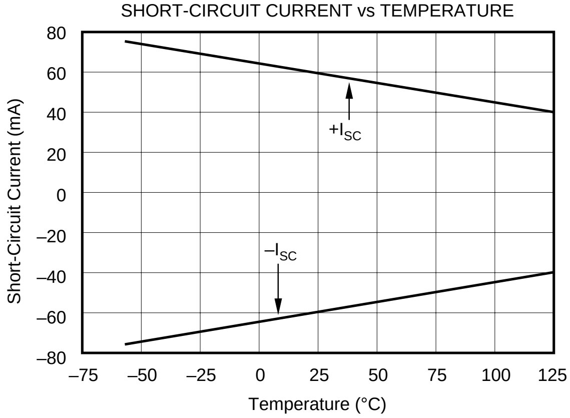
QUIESCENT CURRENT vs TEMPERATURE



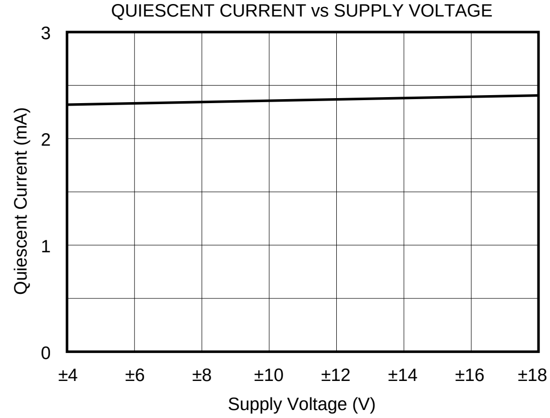
SLEW RATE vs TEMPERATURE



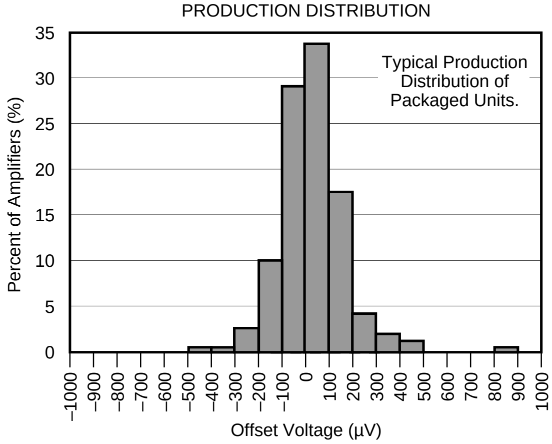
SHORT-CIRCUIT CURRENT vs TEMPERATURE



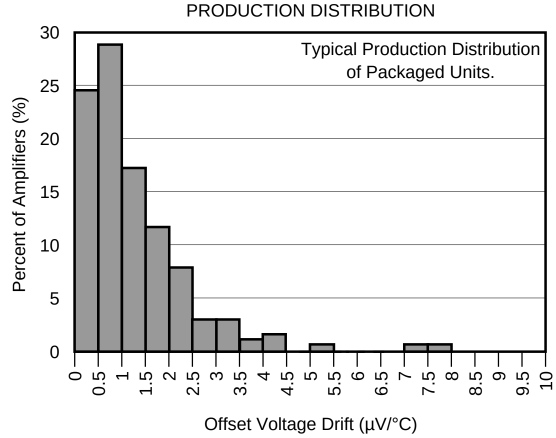
QUIESCENT CURRENT vs SUPPLY VOLTAGE



OFFSET VOLTAGE
PRODUCTION DISTRIBUTION



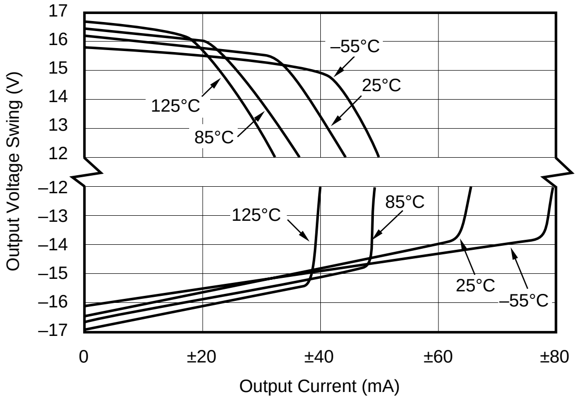
OFFSET VOLTAGE DRIFT
PRODUCTION DISTRIBUTION



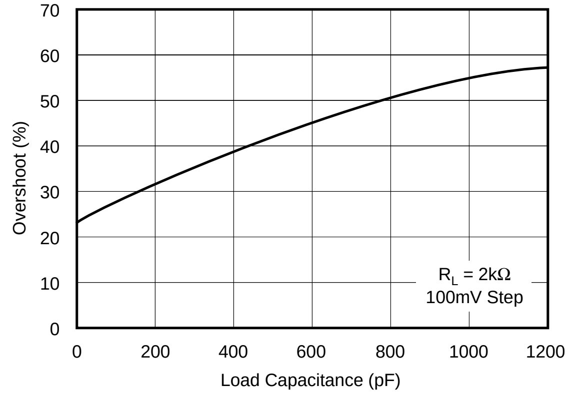
TYPICAL PERFORMANCE CURVES (CONT)

At T_A = +25°C, V_S = ±18V, and G = 1/2, unless otherwise noted.

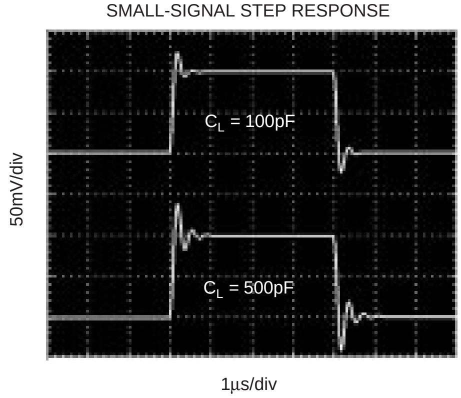
OUTPUT VOLTAGE SWING vs OUTPUT CURRENT



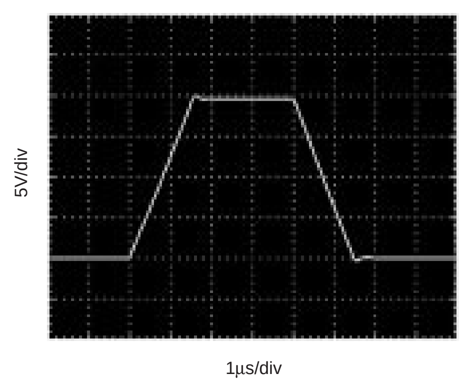
SMALL-SIGNAL OVERSHOOT vs LOAD CAPACITANCE



SMALL-SIGNAL STEP RESPONSE



LARGE-SIGNAL STEP RESPONSE
C_L = 100pF



APPLICATIONS INFORMATION

The INA137 and INA2137 are differential line receivers suitable for a wide range of audio and general-purpose applications. Figure 1 shows the basic G = 1/2 (–6dB) differential receiver configuration. The input and feedback resistors can be reversed to achieve G = 2 (+6dB), as shown in Figure 2. For applications requiring G = 1 (0dB), the INA134 and INA2134 are recommended.

Decoupling capacitors are strongly recommended for applications with noisy or high impedance power supplies. The capacitors should be placed close to the device pins as shown in Figure 1. All circuitry is completely independent in the dual version assuring lowest crosstalk and normal behavior when one amplifier is overdriven or short-circuited.

As shown in Figure 1, the differential input signal is connected to pins 2 and 3. The source impedances connected to the inputs must be nearly equal to assure good common-mode rejection. A 5Ω mismatch in source impedance will degrade the common-mode rejection of a typical device to approximately 77dB (RTO). If the source has a known impedance mismatch, an additional resistor in series with the opposite input can be used to preserve good common-mode rejection.

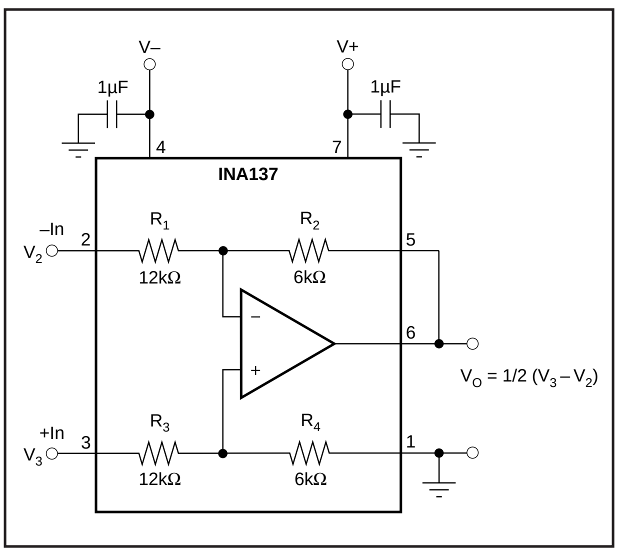


FIGURE 1. G = 1/2 Differential Receiver (Basic Power Supply and Signal Connections).

AUDIO PERFORMANCE

The INA137 and INA2137 were designed for enhanced ac performance. Very low distortion, low noise, and wide bandwidth provide superior performance in high quality audio applications. Laser-trimmed matched resistors provide optimum common-mode rejection (typically 90dB), especially when compared to circuits implemented with an op amp and discrete precision resistors. In addition, high slew rate (14V/µs) and fast settling time (3µs to 0.01%) ensure excellent dynamic performance.

The INA137 and INA2137 have excellent distortion characteristics. THD+Noise is below 0.001% throughout the audio frequency range. Up to approximately 10kHz distortion is below the measurement limit of commonly used test equipment. Furthermore, distortion remains relatively flat over its wide output voltage swing range (approximately 1.7V from either supply).

OFFSET VOLTAGE TRIM

The INA137 and INA2137 are laser trimmed for low offset voltage and drift. Most applications require no external offset adjustment. Figure 3 shows an optional circuit for trimming the output offset voltage. The output is referred to the output reference terminal (pin 1), which is normally grounded. A voltage applied to the Ref terminal will be summed with the output signal. This can be used to null offset voltage as shown in Figure 3. The source impedance of a signal applied to the Ref terminal should be less than 10Ω to maintain good common-mode rejection.

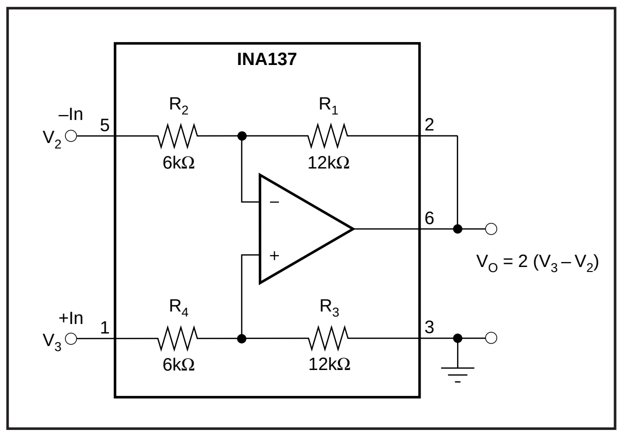


FIGURE 2. G = 2 Differential Receiver.

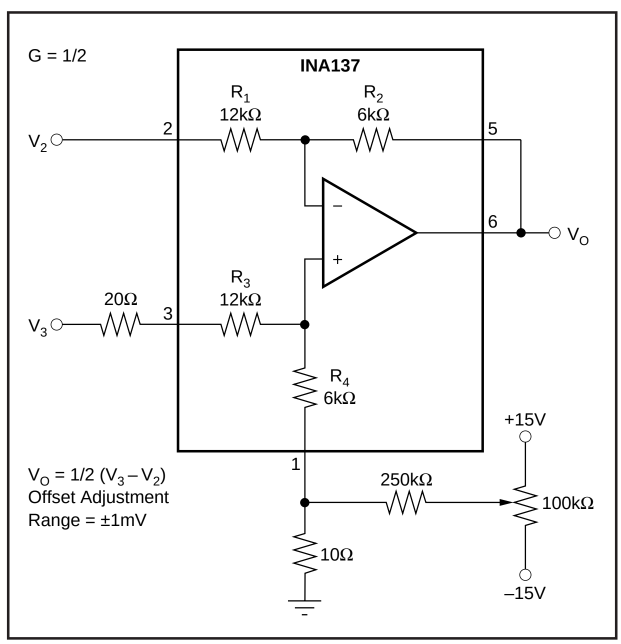


FIGURE 3. Offset Adjustment.

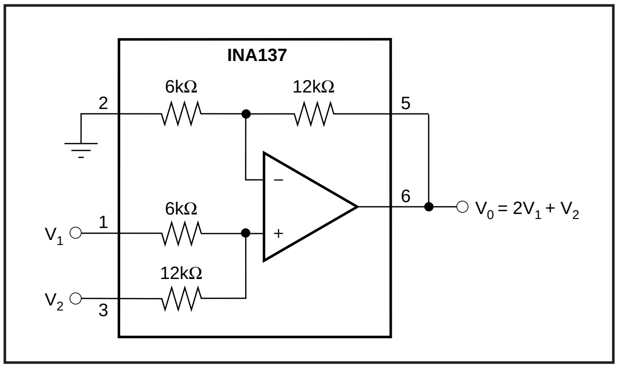


FIGURE 4. Precision Summing Amplifier.

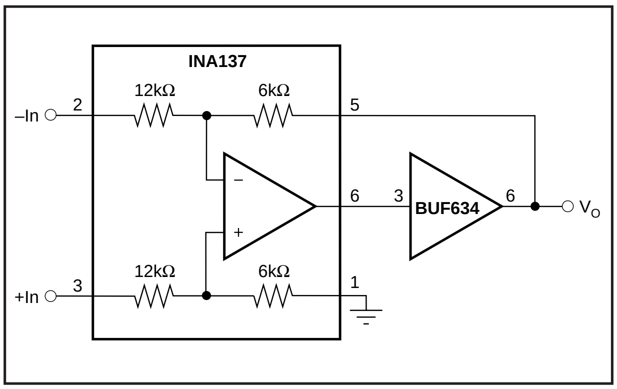


FIGURE 5. Boosting Output Current.

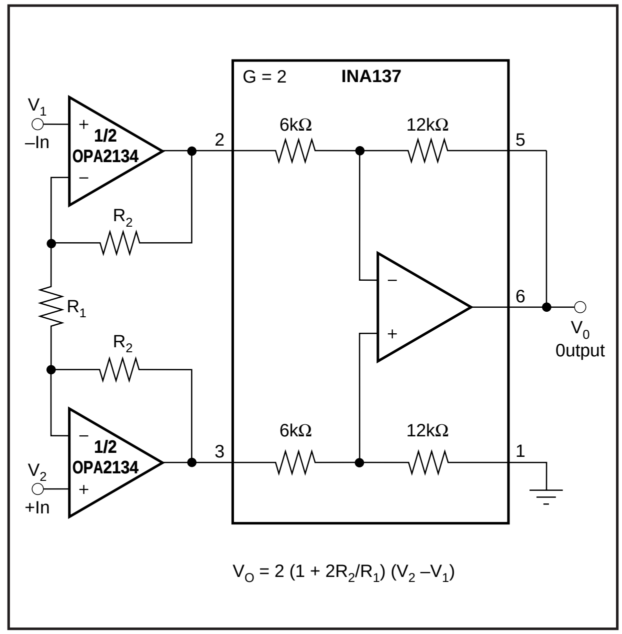


FIGURE 6. High Input Impedance Instrumentation Amplifier.

The difference amplifier is a highly versatile building block that is useful in a wide variety of applications. See the INA105 data sheet for additional applications ideas, including:

- Current Receiver with Compliance to Rails
- ±10V Precision Voltage Reference
- ±5V Precision Voltage Reference
- Precision Average Value Amplifier
- Precision Bipolar Offsetting
- Precision Summing Amplifier with Gain
- Instrumentation Amplifier Guard Drive Generator
- Precision Summing Instrumentation Amplifier
- Precision Absolute Value Buffer
- Precision Voltage-to-Current Converter with Differential Inputs
- Differential Input Voltage-to-Current Converter for Low I_{OUT}
- Isolating Current Source
- Differential Output Difference Amplifier
- Isolating Current Source with Buffering Amplifier for Greater Accuracy
- Window Comparator with Window Span and Window Center Inputs
- Precision Voltage-Controlled Current Source with Buffered Differential Inputs and Gain