BURR - BROWN®

OPA2107

Precision Dual *Difet*® OPERATIONAL AMPLIFIER

FEATURES

- VERY LOW NOISE: 8nV/√Hz at 10kHz
- LOW V_{OS}: 500μV max
- LOW DRIFT: 5μV/°C max
- LOW I_B: 5pA max
- FAST SETTLING TIME: 2μs to 0.01%
- UNITY-GAIN STABLE

APPLICATIONS

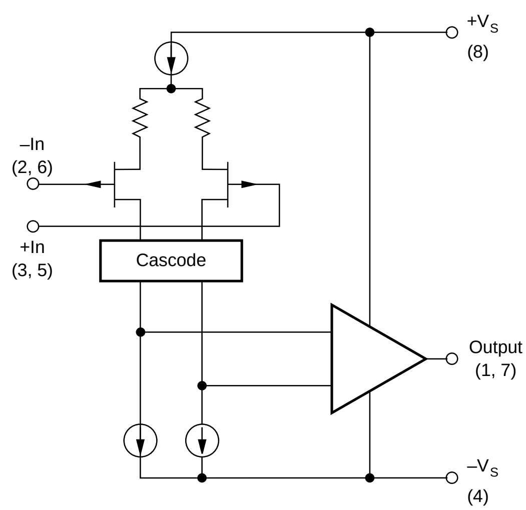
- DATA ACQUISITION
- DAC OUTPUT AMPLIFIER
- OPTOELECTRONICS
- HIGH-IMPEDANCE SENSOR AMPS
- HIGH-PERFORMANCE AUDIO CIRCUITRY
- MEDICAL EQUIPMENT, CT SCANNERS

DESCRIPTION

The OPA2107 dual operational amplifier provides precision ***Difet*** performance with the cost and space savings of a dual op amp. It is useful in a wide range of precision and low-noise analog circuitry and can be used to upgrade the performance of designs currently using BIFET® type amplifiers.

The OPA2107 is fabricated on a proprietary dielectrically isolated (***Difet***) process. This holds input bias currents to very low levels without sacrificing other important parameters, such as input offset voltage, drift and noise. Laser-trimmed input circuitry yields excellent DC performance. Superior dynamic performance is achieved, yet quiescent current is held to under 2.5mA per amplifier. The OPA2107 is unity-gain stable.

The OPA2107 is available in plastic DIP, metal TO-99, and SOIC packages. Industrial and Military temperature range versions are available.



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SPECIFICATIONS

T_A = +25°C, V_S = ±15V unless otherwise noted.

PARAMETER	CONDITION	OPA2107AM, SM, AP, AU MIN	OPA2107AM, SM, AP, AU TYP	OPA2107AM, SM, AP, AU MAX	OPA2107BM MIN	OPA2107BM TYP	OPA2107BM MAX	UNITS
OFFSET VOLTAGE(1)								
Input Offset Voltage	V_{CM} = 0V		100	1mV		50	500	µV
Over Specified Temperature			0.5	2		0.2	1	mV
SM Grade			0.8	2.5				mV
Average Drift Over Specified Temperature			3	10		2	5	µV/°C
Power Supply Rejection	V_S = ±10 to ±18V	80	96		84	100		dB
INPUT BIAS CURRENT(1)								
Input Bias Current	V_{CM} = 0V		4	10		2	5	pA
Over Specified Temperature			0.25	1.5		0.15	1	nA
SM Grade			4	35				nA
Input Offset Current	V_{CM} = 0V		1	8		0.5	3	pA
Over Specified Temperature				1			0.5	nA
SM Grade			1	28				nA
INPUT NOISE								
Voltage: f = 10Hz	R_S = 0		30			*		$nV/\sqrt{Hz}$
f = 100Hz			12			*		$nV/\sqrt{Hz}$
f = 1kHz			9			*		$nV/\sqrt{Hz}$
f = 10kHz			8			*		$nV/\sqrt{Hz}$
BW = 0.1 to 10Hz			1.2			*		µVp-p
BW = 10 to 10kHz			0.85			*		µVrms
Current: f = 0.1Hz thru 20kHz			1.2			0.9		$fA/\sqrt{Hz}$
BW = 0.1Hz to 10Hz			23			17		fAp-p
INPUT IMPEDANCE								
Differential			10^{13} || 2			*		Ω || pF
Common-Mode			10^{14} || 4			*		Ω || pF
INPUT VOLTAGE RANGE								
Common-Mode Input Range		±10.5	±11		*	*		V
Over Specified Temperature		±10.2	±10.5		*	*		V
SM Grade		±10	±10.3					V
Common-Mode Rejection	V_{CM} = ±10V	80	94		84	100		dB
OPEN-LOOP GAIN								
Open-Loop Voltage Gain	V_O = ±10V, R_L = 2kΩ	82	96		84	100		dB
Over Specified Temperature		80	94		82	96		dB
SM Grade		80	92					dB
DYNAMIC RESPONSE								
Slew Rate	G = +1	13	18		*	*		V/µs
Settling Time: 0.1%	G = –1, 10V Step		1.5			*		µs
0.01%			2			*		µs
Gain-Bandwidth Product	G = 100		4.5			*		MHz
THD + Noise	G = +1, f = 1kHz		0.001			*		%
Channel Separation	f = 100Hz, R_L = 2kΩ		120			*		dB
POWER SUPPLY								
Specified Operating Voltage			±15			*		V
Operating Voltage Range		±4.5		±18	*		*	V
Current			±4.5	±5		*	*	mA
OUTPUT								
Voltage Output	R_L = 2kΩ	±11	±12		*	*		V
Over Specified Temperature		±10.5	±11.5		*	*		V
SM Grade		±10.2	±11.3					V
Short Circuit Current		±10	±40		*	*		mA
Output Resistance, Open-Loop	1MHz		70			*		Ω
Capacitive Load Stability	G = +1		1000			*		pF
TEMPERATURE RANGE								
Specification								
AP, AU, AM, BM		–25		+85	*		*	°C
SM		–55		+125				°C
Operating								
AP, AU		–25		+85				°C
AM, BM, SM		–55		+125	*		*	°C
Storage								
AP, AU		–40		+125				°C
AM, BM, SM		–65		+150	*		*	°C
Thermal Resistance (θ_{J-A})								
AP			90					°C/W
AU			175					°C/W
AM, BM, SM			200			*		°C/W

* Specifications same as OPA2107AM. NOTE: (1) Specified with devices fully warmed up.

ABSOLUTE MAXIMUM RATINGS

Supply Voltage .... ±18V
Input Voltage Range .... $\pm V_S \pm 2V$
Differential Input Voltage .... Total $V_S \pm 4V$
Operating Temperature
  M Package .... –55°C to +125°C
  P and U Packages .... –25°C to + 85°C
Storage Temperature
  M Package .... –65°C to +150°C
  P and U Packages .... –40°C to +125°C
Output Short Circuit to Ground (T_A = +25°C) .... Continuous
Junction Temperature .... +175°C
Lead Temperature
  M and P Packages (soldering, 10s) .... +300°C
  U Package, SOIC (3s) .... +260°C

PACKAGE INFORMATION

MODELS	PACKAGE	PACKAGE DRAWING NUMBER(1)
OPA2107AP	Plastic DIP	006
OPA2107AM	Metal TO-99	001
OPA2107BM	Metal TO-99	001
OPA2107SM	Metal TO-99	001
OPA2107AU	SO-8 SOIC	182

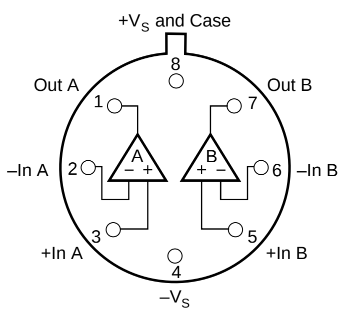
NOTE: (1) For detailed drawing and dimension table, please see end of data sheet, or Appendix D of Burr-Brown IC Data Book.

ORDERING INFORMATION

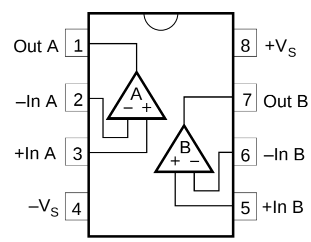
MODELS	PACKAGE	SPECIFICATION TEMPERATURE RANGE
OPA2107AP	Plastic DIP	–25 to +85°C
OPA2107AM	Metal TO-99	–25 to +85°C
OPA2107BM	Metal TO-99	–25 to +85°C
OPA2107SM	Metal TO-99	–55 to +125°C
OPA2107AU	SO-8 SOIC	–25 to +85°C

PIN CONFIGURATIONS

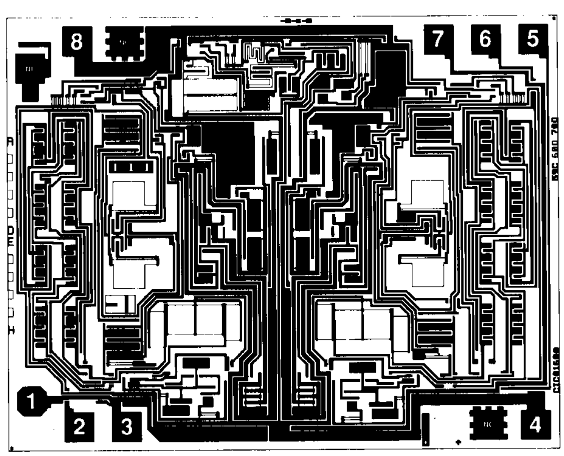
Top View – M Package



Top View – P & U Packages



DICE INFORMATION



OPA2107 DIE TOPOGRAPHY

PAD	FUNCTION
1	Out A
2	–In A
3	+In A
4	$-V_S$
5	+In B
6	–In B
7	Out B
8	$+V_S$

Substrate Bias: $-V_S$

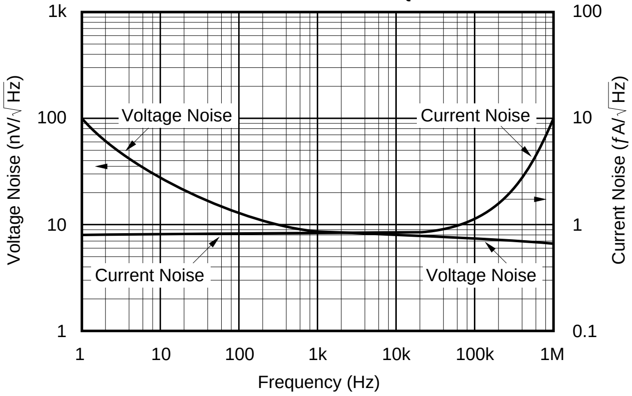
MECHANICAL INFORMATION

	MILS (0.001")	MILLIMETERS
Die Size	97 x 77 ±3	2.46 x 1.96 ±0.13
Die Thickness	20 ±3	0.51 ±0.08
Min. Pad Size	4 x 4	0.10 x 0.10
Transistor Count		53
Backing		None

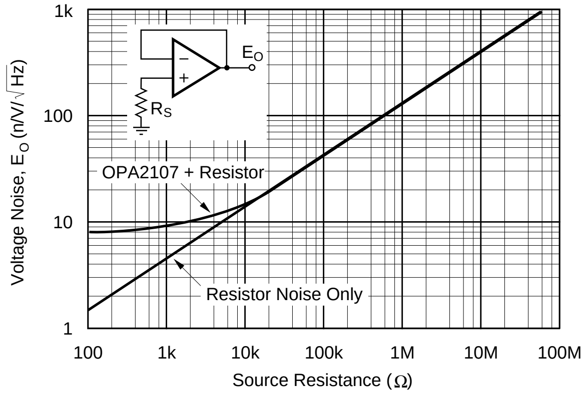
TYPICAL PERFORMANCE CURVES

T_A = +25°C, V_S = ±15V unless otherwise noted.

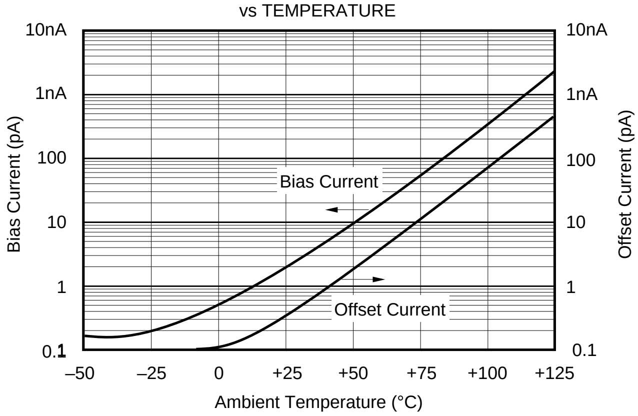
INPUT VOLTAGE AND CURRENT NOISE SPECTRAL DENSITY vs FREQUENCY



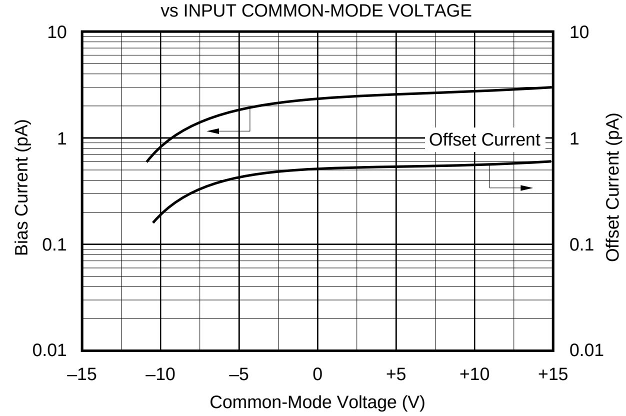
TOTAL INPUT VOLTAGE NOISE SPECTRAL DENSITY at 1kHz vs SOURCE RESISTANCE



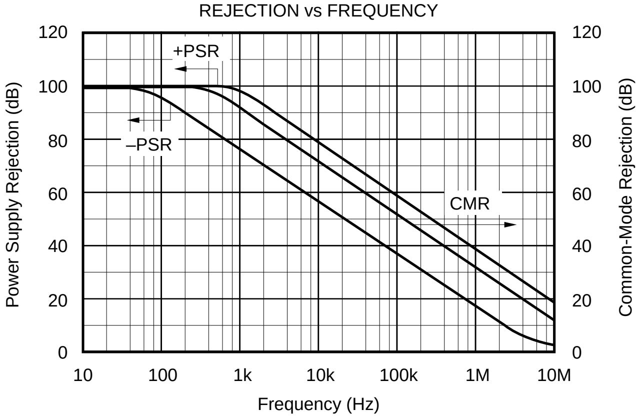
BIAS AND OFFSET CURRENT vs TEMPERATURE



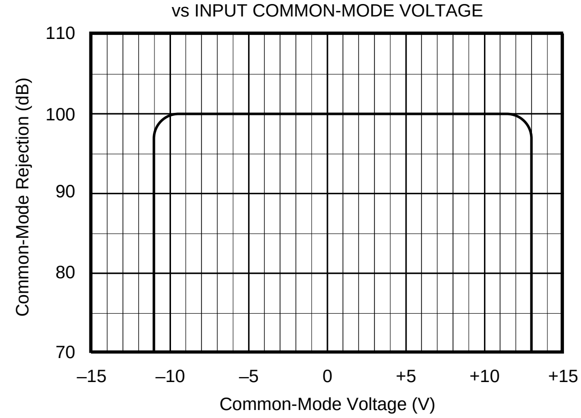
BIAS AND OFFSET CURRENT vs INPUT COMMON-MODE VOLTAGE



POWER SUPPLY AND COMMON-MODE REJECTION vs FREQUENCY

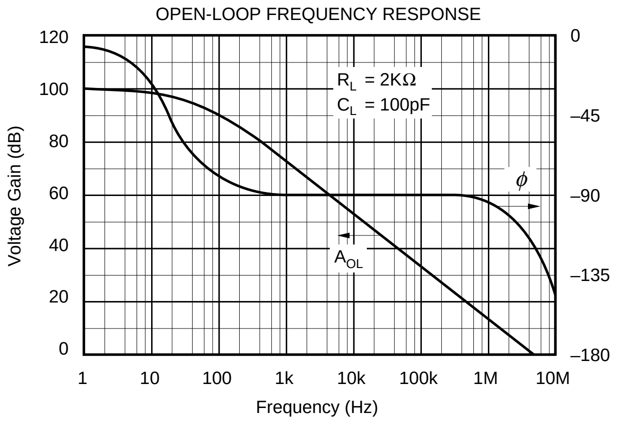


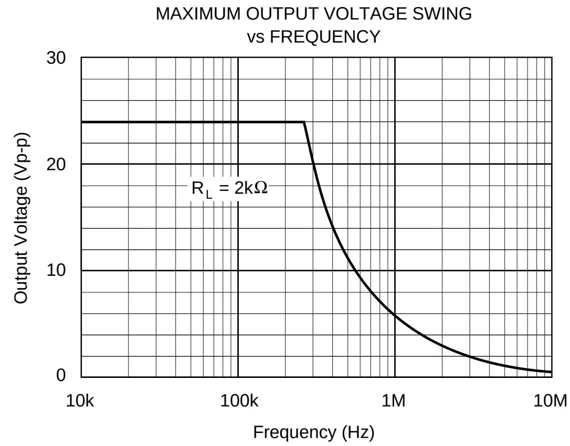
COMMON-MODE REJECTION vs INPUT COMMON-MODE VOLTAGE

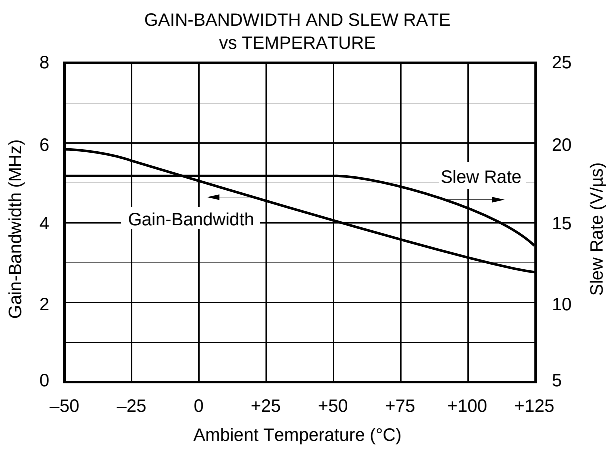


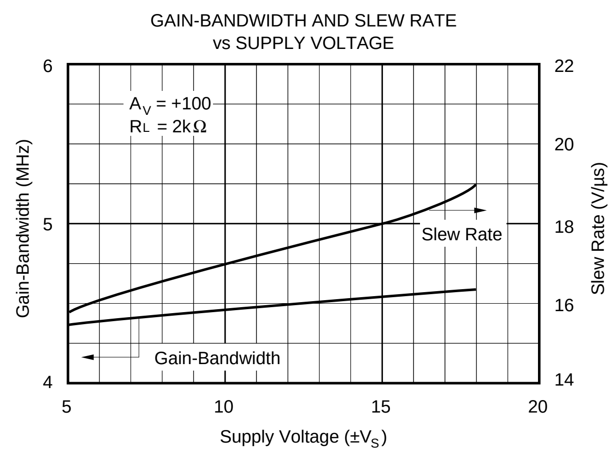
TYPICAL PERFORMANCE CURVES (CONT)

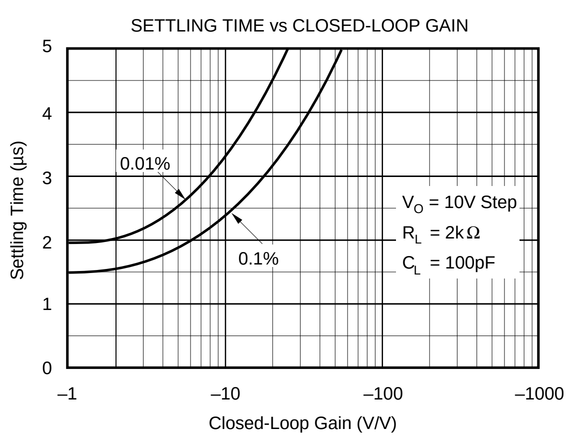
T_A = +25°C, V_S = ±15V unless otherwise noted.

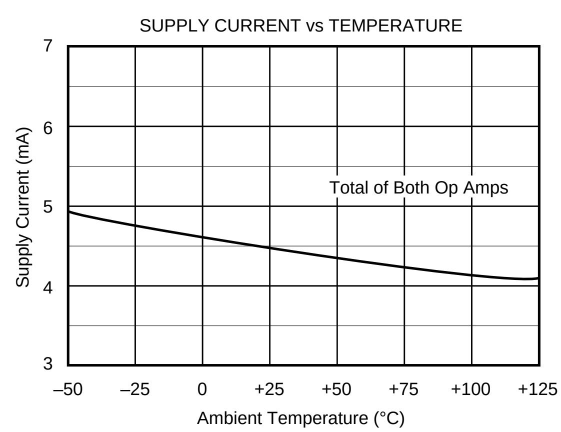








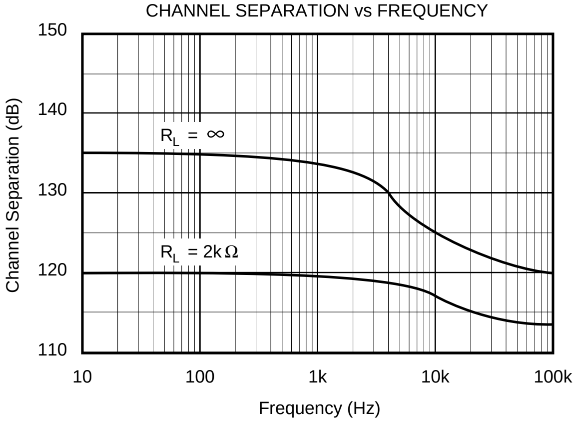




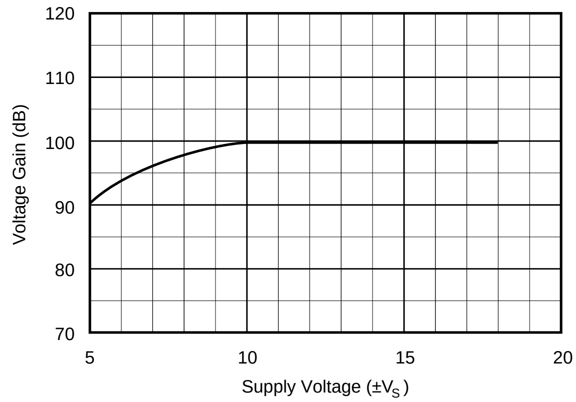
TYPICAL PERFORMANCE CURVES (CONT)

T_A = +25°C, V_S = ±15V unless otherwise noted.

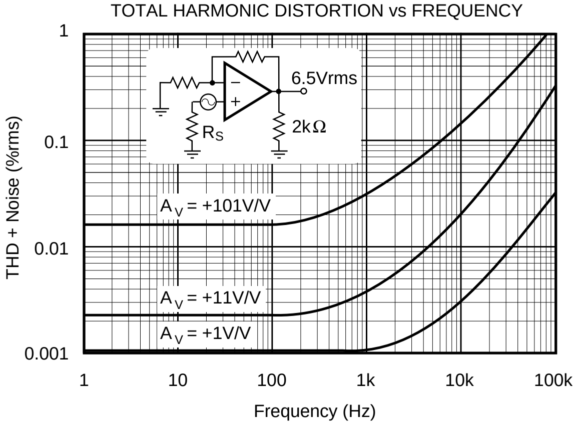
CHANNEL SEPARATION vs FREQUENCY



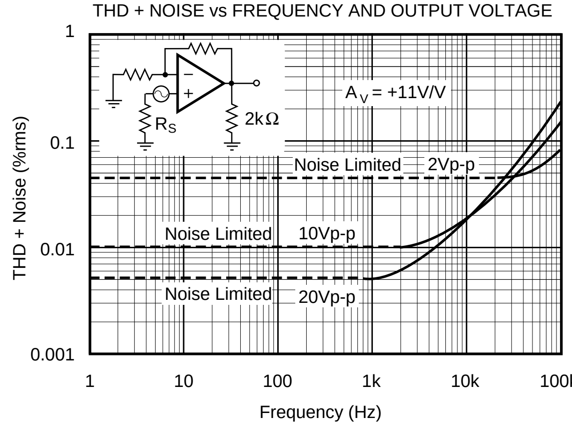
OPEN-LOOP GAIN vs SUPPLY VOLTAGE



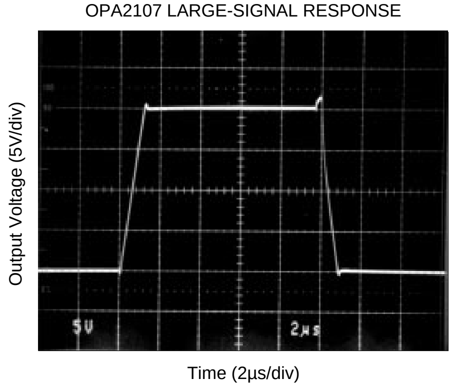
TOTAL HARMONIC DISTORTION vs FREQUENCY



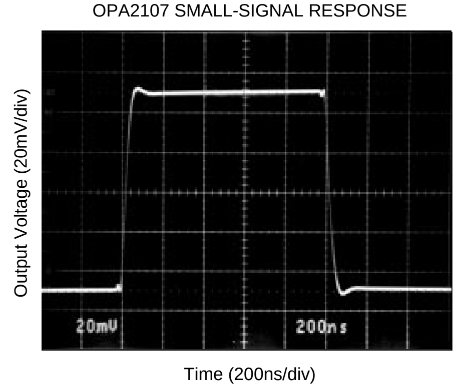
THD + NOISE vs FREQUENCY AND OUTPUT VOLTAGE



OPA2107 LARGE-SIGNAL RESPONSE



OPA2107 SMALL-SIGNAL RESPONSE



APPLICATIONS INFORMATION AND CIRCUITS

The OPA2107 is unity-gain stable and has excellent phase margin. This makes it easy to use in a wide variety of applications.

Power supply connections should be bypassed with capacitors positioned close to the amplifier pins. In most cases, 0.1µF ceramic capacitors are adequate. Applications with larger load currents and fast transient signals may need up to 1µF tantalum bypass capacitors.

INPUT BIAS CURRENT

The OPA2107's ***Difet*** input stages have very low input bias current—an order of magnitude lower than BIFET op amps. Circuit board leakage paths can significantly degrade performance. This is especially evident with the SO-8 surface-mount package where pin-to-pin dimensions are particularly small. Residual soldering flux, dirt, and oils, which conduct leakage current, can be removed by proper cleaning. In most instances a two-step cleaning process is adequate using a clean organic solvent rinse followed by de-ionized water. Each rinse should be followed by a 30-minute bake at 85°C.

A circuit board guard pattern effectively reduces errors due to circuit board leakage (Figure 1). By encircling critical high impedance nodes with a low impedance connection at the same circuit potential, any leakage currents will flow harmlessly to the low impedance node. Guard traces should be placed on all levels of a multiple-layer circuit board.

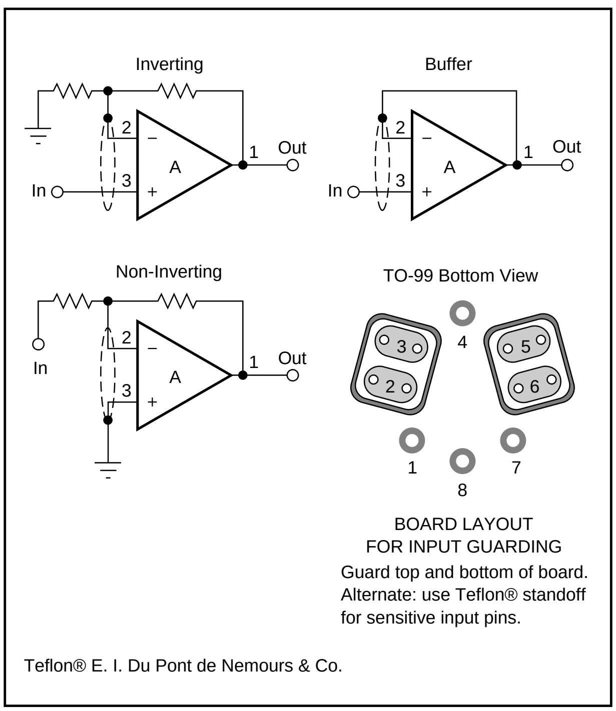


FIGURE 1. Connection of Input Guard.

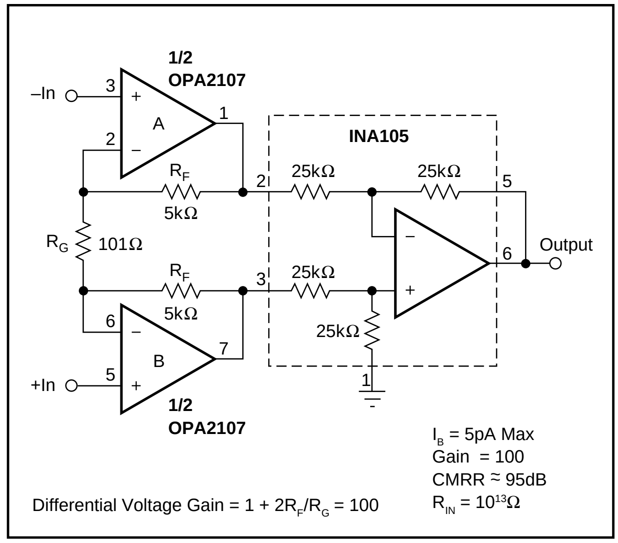
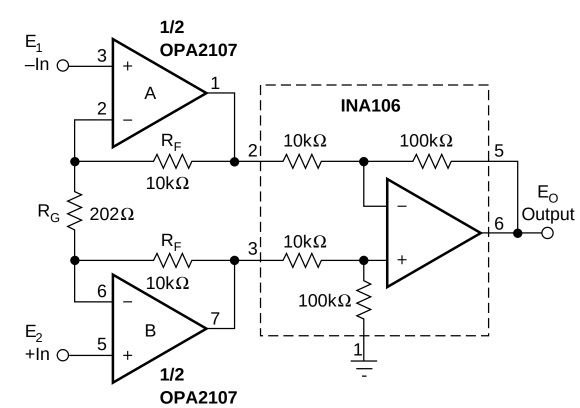


FIGURE 2. FET Input Instrumentation Amplifier.



$$E_O = [10\,(1 + 2R_F/R_G)\,(E_2 - E_1)] = 1000\,(E_2 - E_1)$$

Using the INA106 for an output difference amplifier extends the input common-mode range of an instrumentation amplifier to ±10V. A conventional IA with a unity-gain difference amplifier has an input common-mode range limited to ±5V for an output swing of ±10V. This is because a unity-gain difference amp needs ±5V at the input for 10V at the output, allowing only 5V additional for common-mode range.

FIGURE 3. Precision Instrumentation Amplifier.