

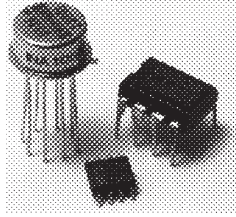
Distributed by:

JAMECO[®]
ELECTRONICS

www.Jameco.com ♦ 1-800-831-4242

The content and copyrights of the attached
material are the property of its owner.

Jameco Part Number 1340621



INA105

Precision Unity Gain DIFFERENTIAL AMPLIFIER

FEATURES

- CMR 86dB min OVER TEMPERATURE
- GAIN ERROR: 0.01% max
- NONLINEARITY: 0.001% max
- NO EXTERNAL ADJUSTMENTS REQUIRED
- EASY TO USE
- COMPLETE SOLUTION
- HIGHLY VERSATILE
- LOW COST
- PLASTIC DIP, TO-99 HERMETIC METAL, AND SO-8 SOIC PACKAGES

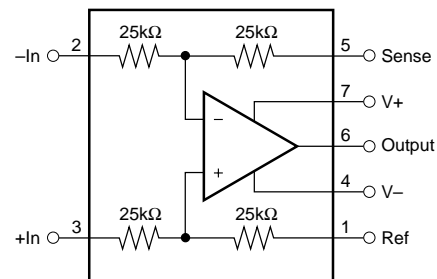
APPLICATIONS

- DIFFERENTIAL AMPLIFIER
- INSTRUMENTATION AMPLIFIER BUILDING BLOCK
- UNITY-GAIN INVERTING AMPLIFIER
- GAIN-OF-1/2 AMPLIFIER
- NONINVERTING GAIN-OF-2 AMPLIFIER
- AVERAGE VALUE AMPLIFIER
- ABSOLUTE VALUE AMPLIFIER
- SUMMING AMPLIFIER
- SYNCHRONOUS DEMODULATOR
- CURRENT RECEIVER WITH COMPLIANCE TO RAILS
- 4mA TO 20mA TRANSMITTER
- VOLTAGE-CONTROLLED CURRENT SOURCE
- ALL-PASS FILTERS

DESCRIPTION

The INA105 is a monolithic Gain = 1 differential amplifier consisting of a precision op amp and on-chip metal film resistors. The resistors are laser trimmed for accurate gain and high common-mode rejection. Excellent TCR tracking of the resistors maintains gain accuracy and common-mode rejection over temperature.

The differential amplifier is the foundation of many commonly used circuits. The INA105 provides this precision circuit function without using an expensive precision resistor network. The INA105 is available in 8-pin plastic DIP, SO-8 surface-mount and TO-99 metal packages.



SPECIFICATIONS

ELECTRICAL

At +25°C, $V_{CC} = \pm 15V$, unless otherwise noted.

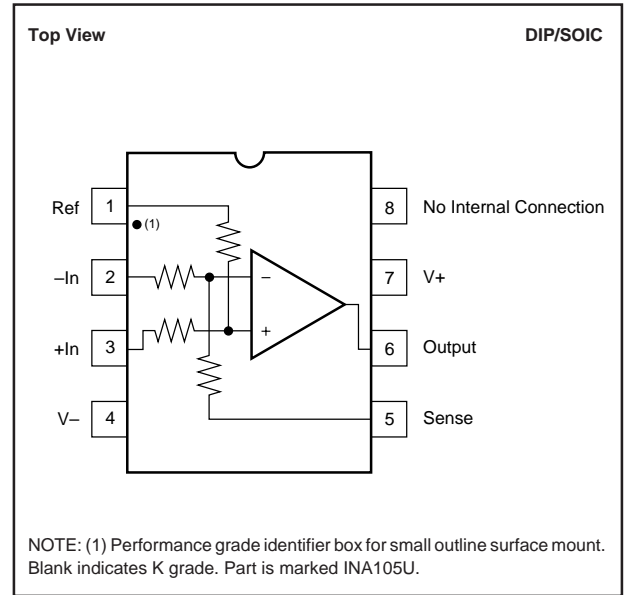
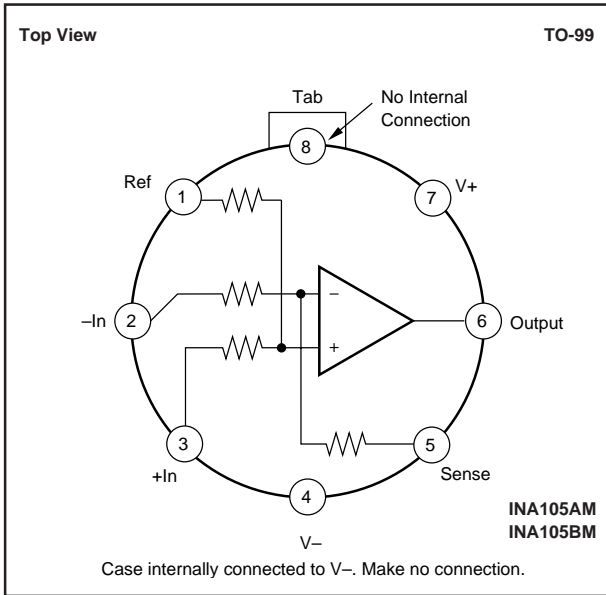
PARAMETER	CONDITIONS	INA105AM			INA105BM			INA105KP, KU			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
GAIN											
Initial ⁽¹⁾			1			*			*		V/V
Error			0.005	0.01		*	*		0.01	0.025	%
vs Temperature			1	5		*	*		*	*	ppm/°C
Nonlinearity ⁽²⁾			0.0002	0.001		*	*		*	*	%
OUTPUT											
Rated Voltage	$I_O = +20mA, -5mA$	10	12		*	*		*	*		V
Rated Current	$V_O = 10V$	+20, -5			*			*			mA
Impedance			0.01			*			*		Ω
Current Limit	To Common		+40/-10			*			*		mA
Capacitive Load	Stable Operation		1000			*			*		pF
INPUT											
Impedance ⁽³⁾	Differential		50			*			*		k Ω
	Common-Mode		50			*			*		k Ω
Voltage Range ⁽⁴⁾	Differential	± 10			*			*			V
	Common-Mode	± 20			*			*			V
Common-Mode Rejection ⁽⁵⁾	$T_A = T_{MIN}$ to T_{MAX}	80	90		86	100		72	*		dB
OFFSET VOLTAGE											
Initial	RTO ^{(6), (7)}		50	250		*	*		*	500	μV
vs Temperature			5	20		5	10		*	*	$\mu V/°C$
vs Supply	$\pm V_S = 6V$ to $18V$		1	25		*	15		*	*	$\mu V/V$
vs Time			20			*			*	*	$\mu V/mo$
OUTPUT NOISE VOLTAGE											
$f_B = 0.01Hz$ to $10Hz$	RTO ^{(6), (8)}		2.4			*			*		$\mu Vp-p$
$f_O = 10kHz$			60			*			*		nV/\sqrt{Hz}
DYNAMIC RESPONSE											
Small Signal Bandwidth	-3dB		1			*			*		MHz
Full Power Bandwidth	$V_O = 20Vp-p$	30	50		*	*		*	*		kHz
Slew Rate		2	3		*	*		*	*		V/ μs
Settling Time: 0.1%	$V_O = 10V$ Step		4			*			*		μs
0.01%	$V_O = 10V$ Step		5			*			*		μs
0.01%	$V_{CM} = 10V$ Step, $V_{DIFF} = 0V$		1.5			*			*		μs
POWER SUPPLY											
Rated			± 15			*			*		V
Voltage Range	Derated Performance	± 5		± 18	*	*	*	*	*	*	V
Quiescent Current	$V_O = 0V$		± 1.5	± 2		*	*		*	*	mA
TEMPERATURE RANGE											
Specification		-40		+85	*		*	*		*	°C
Operation		-55		+125	*		*	-40		+85	°C
Storage		-65		+150	*		*	-40		+125	°C

* Specification same as for INA105AM.

NOTES: (1) Connected as difference amplifier (see Figure 4). (2) Nonlinearity is the maximum peak deviation from the best-fit straight line as a percent of full-scale peak-to-peak output. (3) 25k Ω resistors are ratio matched but have $\pm 20\%$ absolute value. (4) Maximum input voltage without protection is 10V more than either $\pm 15V$ supply ($\pm 25V$). Limit I_{IN} to 1mA. (5) With zero source impedance (see "Maintaining CMR" section). (6) Referred to output in unity-gain difference configuration. Note that this circuit has a gain of 2 for the operational amplifier's offset voltage and noise voltage. (7) Includes effects of amplifier's input bias and offset currents. (8) Includes effects of amplifier's input current noise and thermal noise contribution of resistor network.

The information provided herein is believed to be reliable; however, BURR-BROWN assumes no responsibility for inaccuracies or omissions. BURR-BROWN assumes no responsibility for the use of this information, and all use of such information shall be entirely at the user's own risk. Prices and specifications are subject to change without notice. No patent rights or licenses to any of the circuits described herein are implied or granted to any third party. BURR-BROWN does not authorize or warrant any BURR-BROWN product for use in life support devices and/or systems.

PIN CONFIGURATIONS



ABSOLUTE MAXIMUM RATINGS

Supply	±18V
Input Voltage Range	±V _S
Operating Temperature Range: M	-55°C to +125°C
P, U	-40°C to +85°C
Storage Temperature Range: M	-65°C to +150°C
P, U	-40°C to +125°C
Lead Temperature (soldering, 10s) M, P	+300°C
Wave Soldering (3s, max) U	+260°C
Output Short Circuit to Common	Continuous

PACKAGE/ORDERING INFORMATION

PRODUCT	PACKAGE	PACKAGE DRAWING NUMBER ⁽¹⁾	TEMPERATURE RANGE
INA105AM	TO-99 Metal	001	-40°C to +85°C
INA105BM	TO-99 Metal	001	-40°C to +85°C
INA105KP	8-Pin Plastic DIP	006	-40°C to +85°C
INA105KU	8-Pin SOIC	182	-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

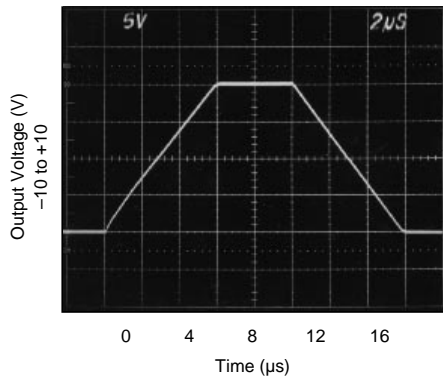
This integrated circuit can be damaged by ESD. Burr-Brown recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

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.

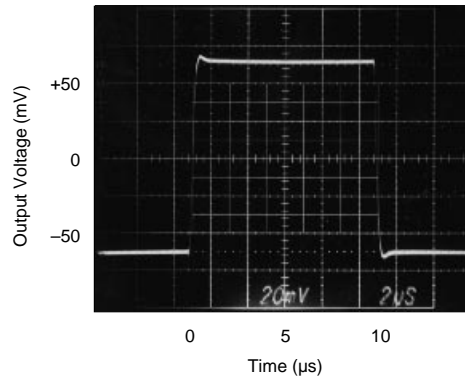
TYPICAL PERFORMANCE CURVES

At $T_A = 25^\circ\text{C}$, $V_S = \pm 15\text{V}$, unless otherwise noted.

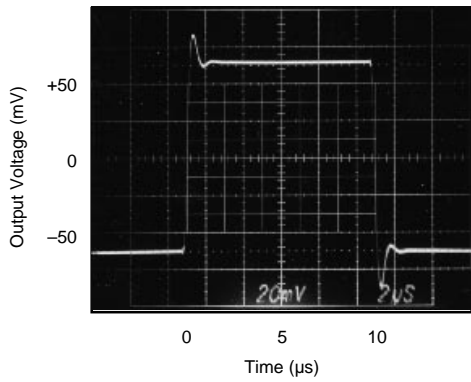
STEP RESPONSE



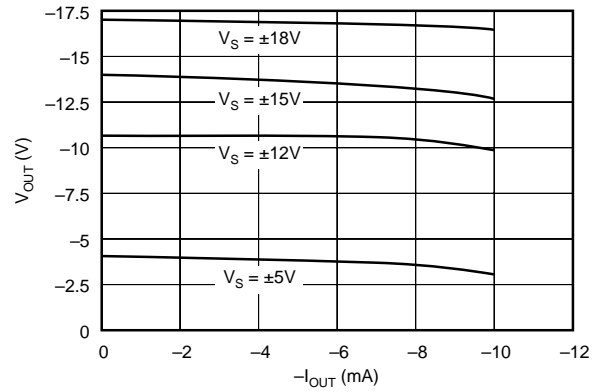
SMALL SIGNAL RESPONSE
(No Load)



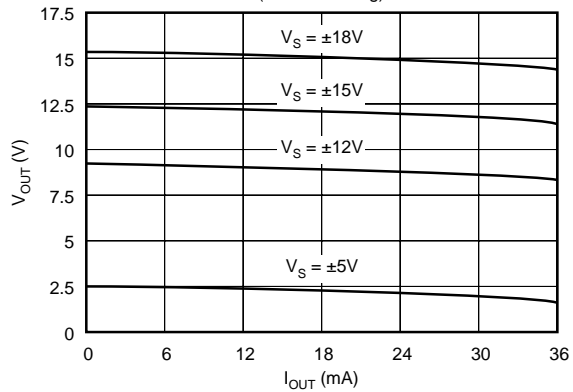
SMALL SIGNAL RESPONSE
($R_{\text{LOAD}} = \infty\Omega$, $C_{\text{LOAD}} = 1000\text{pF}$)



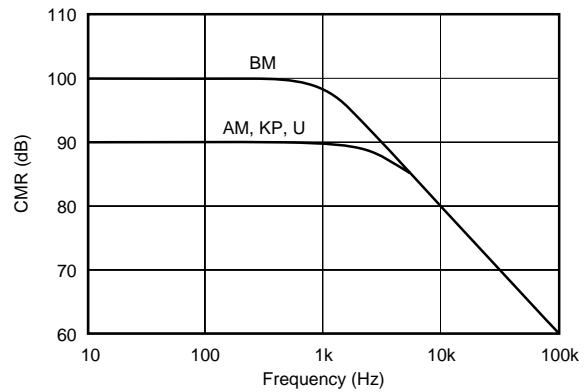
MAXIMUM V_{OUT} vs I_{OUT}
(Negative Swing)



MAXIMUM V_{OUT} vs I_{OUT}
(Positive Swing)

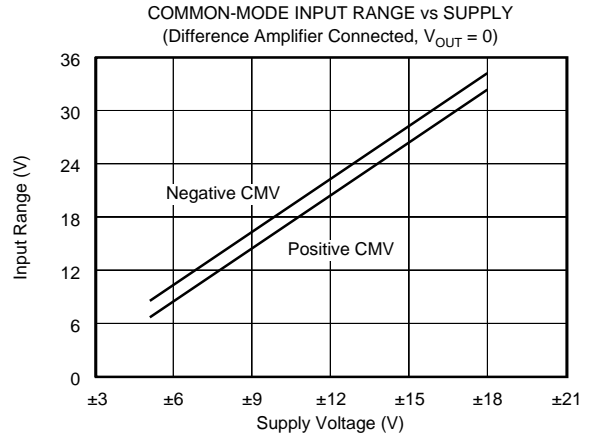
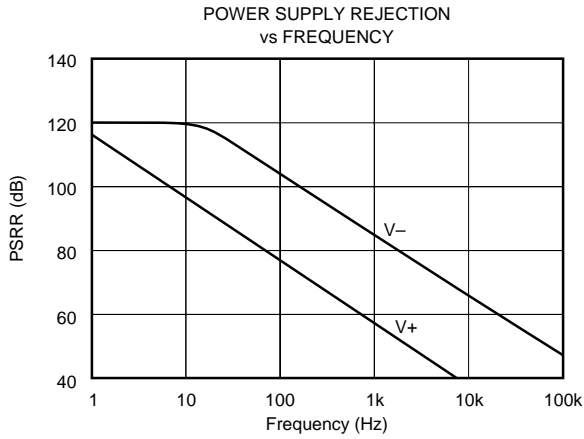


CMR vs FREQUENCY



TYPICAL PERFORMANCE CURVES (CONT)

At $T_A = 25^\circ\text{C}$, $V_S = \pm 15\text{V}$, unless otherwise noted.



APPLICATION INFORMATION

Figure 1 shows the basic connections required for operation of the INA105. Power supply bypass capacitors should be connected close to the device pins.

The differential input signal is connected to pins 2 and 3 as shown. 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 80dB. If the source has a known mismatch in source impedance, an additional resistor in series with one input can be used to preserve good common-mode rejection.

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 2. The source impedance of a signal applied to the Ref terminal should be less than 10Ω to maintain good common-mode rejection.

Do not interchange pins 1 and 3 or pins 2 and 5, even though nominal resistor values are equal. These resistors are laser trimmed for precise resistor ratios to achieve accurate gain and highest CMR. Interchanging these pins would not provide specified performance.

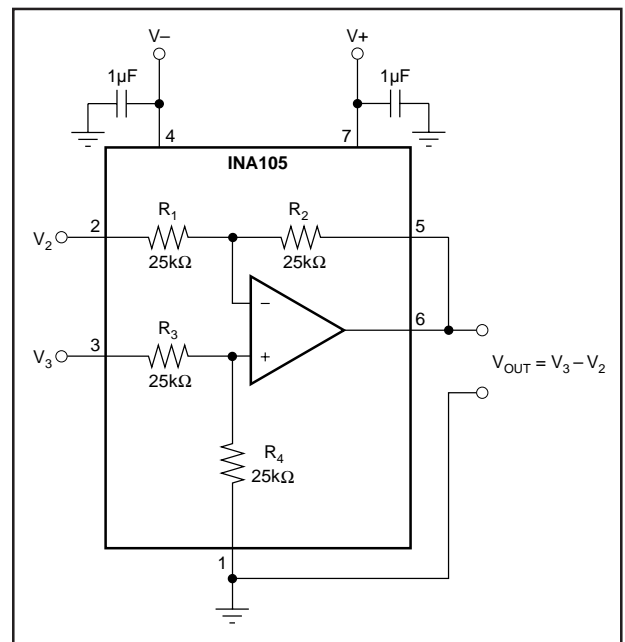


FIGURE 1. Basic Power Supply and Signal Connections.

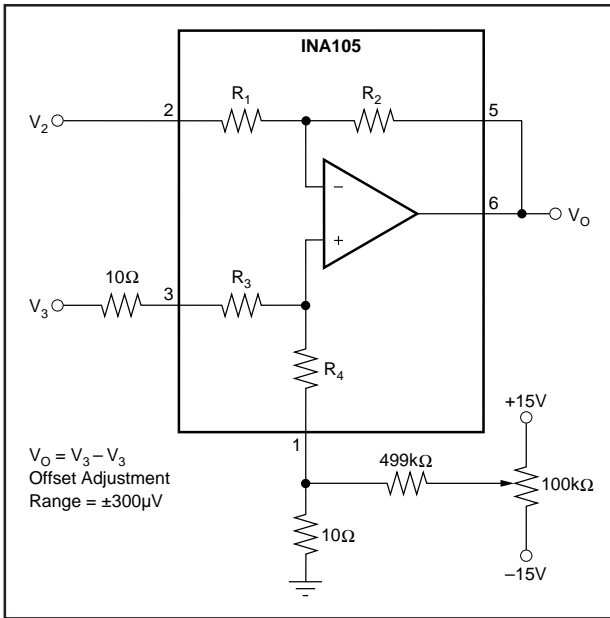


FIGURE 2. Offset Adjustment.

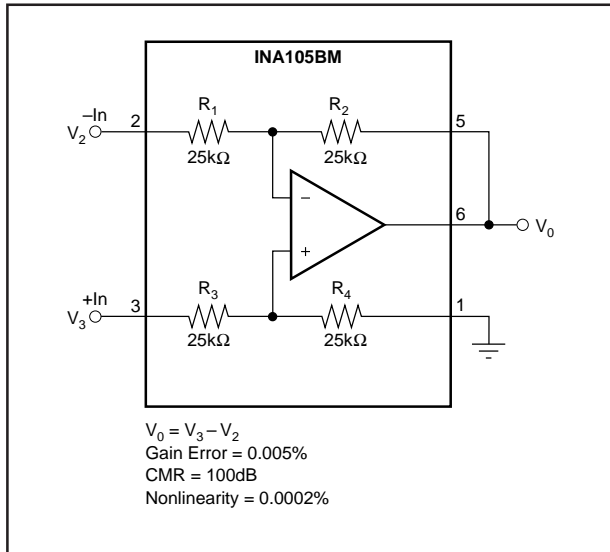


FIGURE 3. Precision Difference Amplifier.

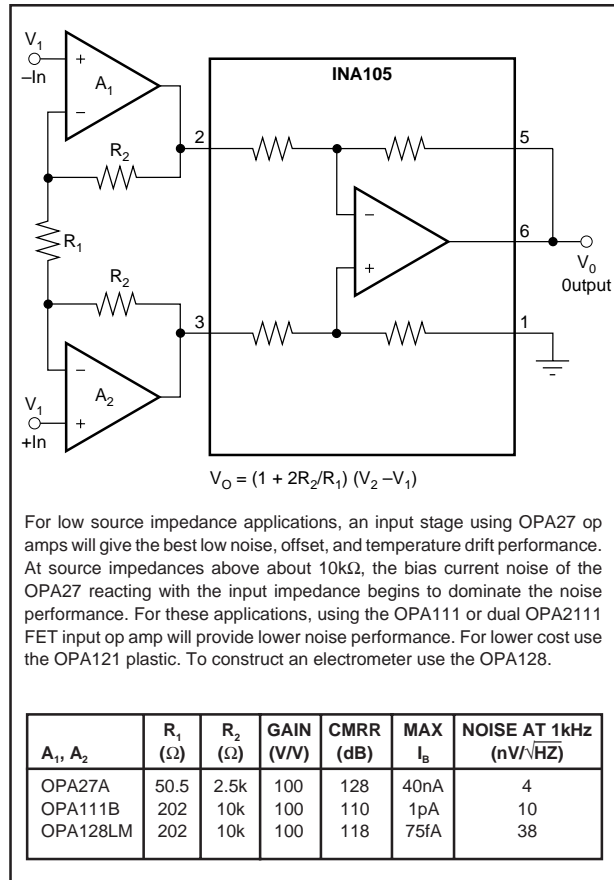


FIGURE 4. Precision Instrumentation Amplifier.

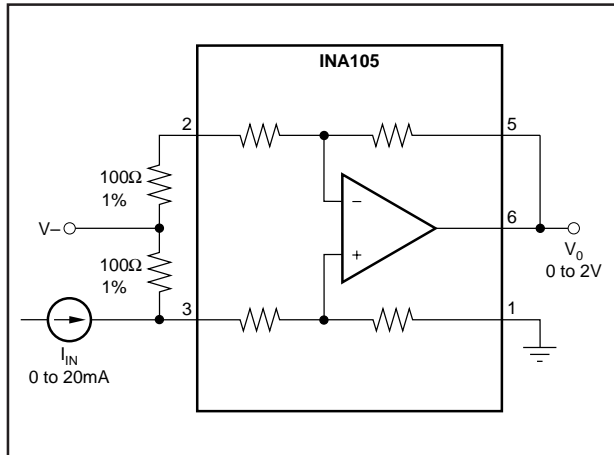


FIGURE 5. Current Receiver with Compliance to Rails.

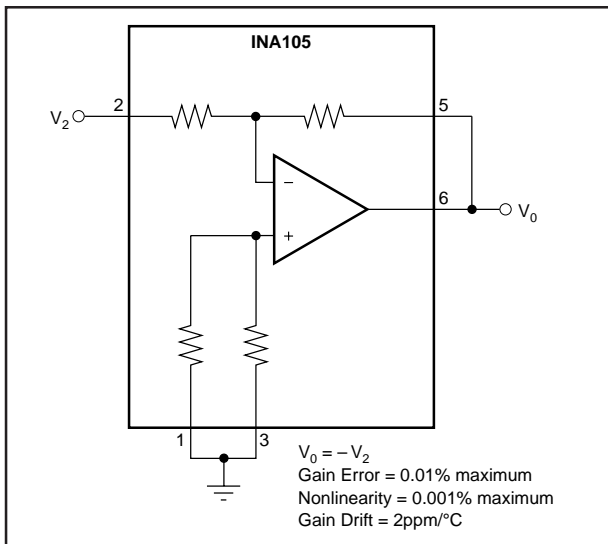


FIGURE 6. Precision Unity-Gain Inverting Amplifier.

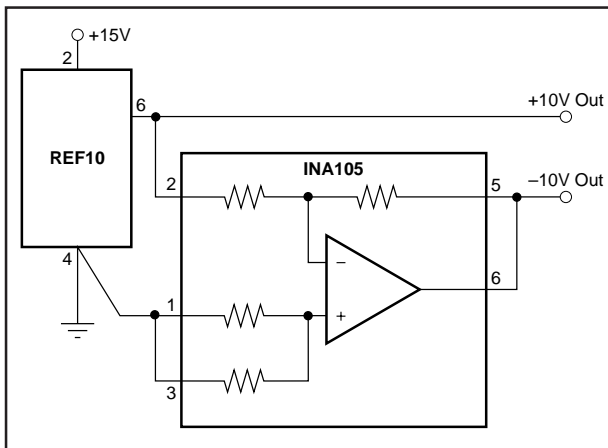


FIGURE 7. ±10V Precision Voltage Reference.

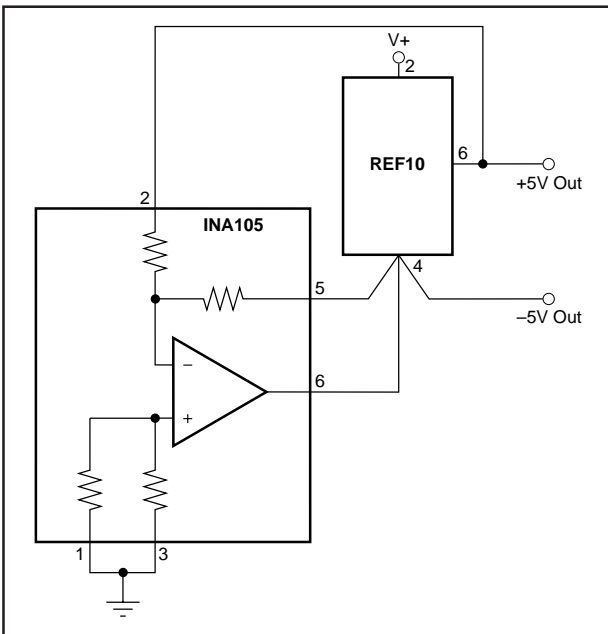


FIGURE 8. ±5V Precision Voltage Reference.

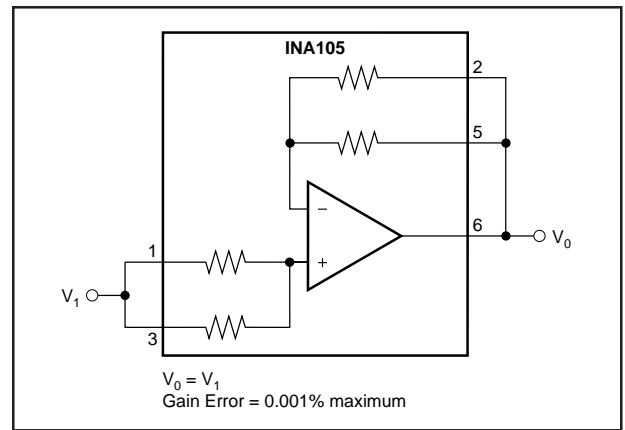


FIGURE 9. Precision Unity-Gain Buffer.

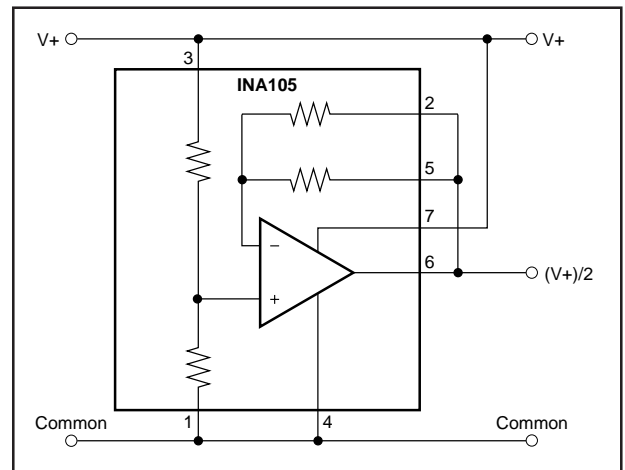


FIGURE 10. Pseudoground Generator.

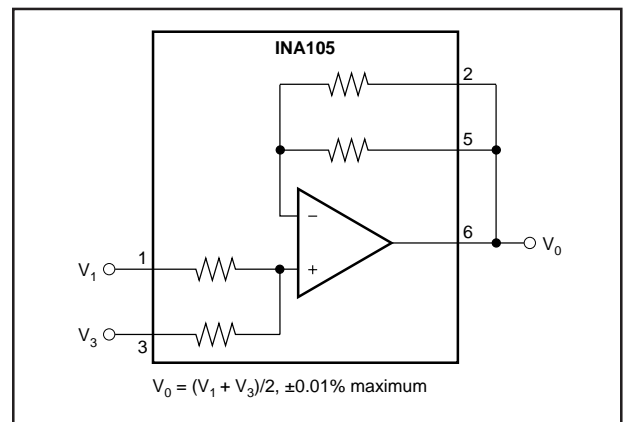


FIGURE 11. Precision Average Value Amplifier.

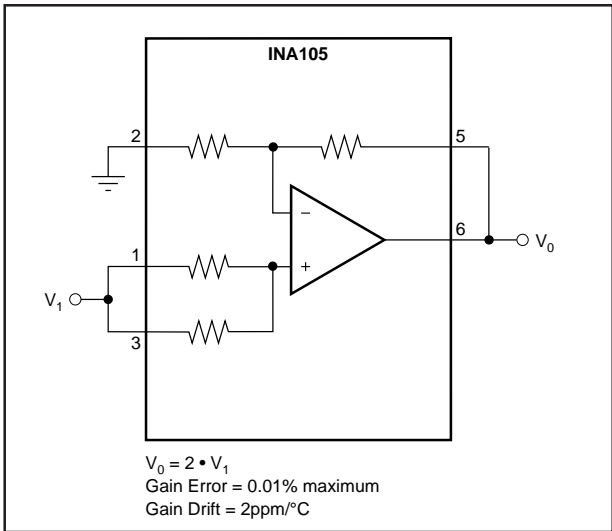


FIGURE 12. Precision (G = 2) Amplifier.

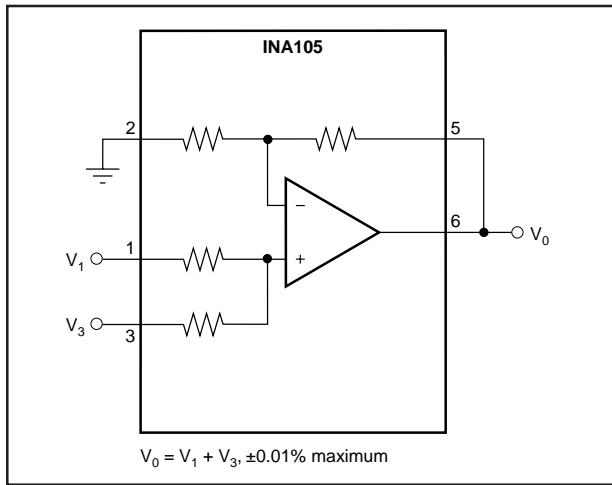


FIGURE 13. Precision Summing Amplifier.

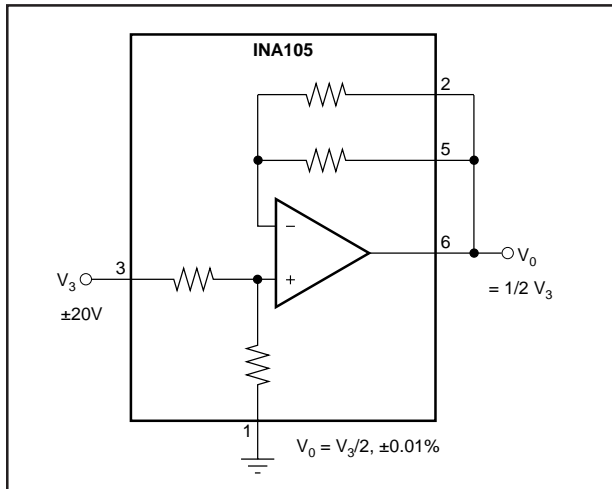


FIGURE 14. Precision Gain = 1/2 Amplifier.

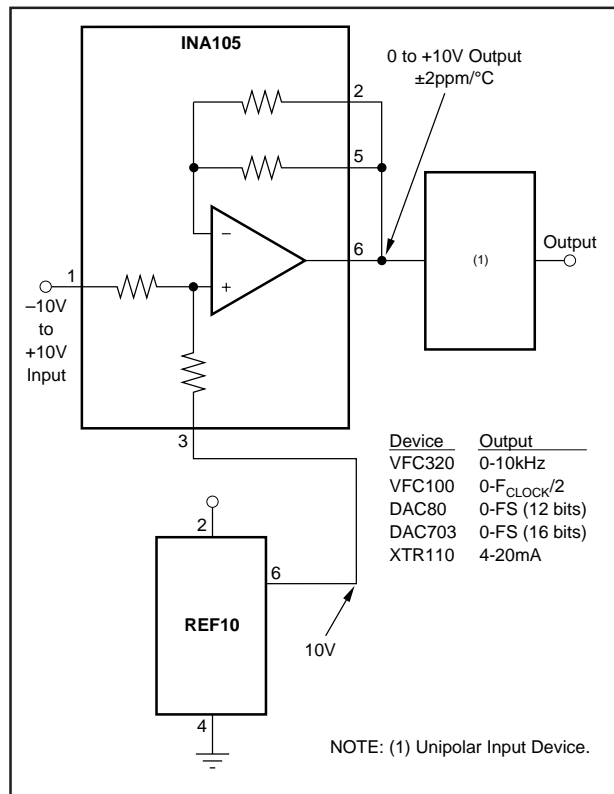


FIGURE 15. Precision Bipolar Offsetting.

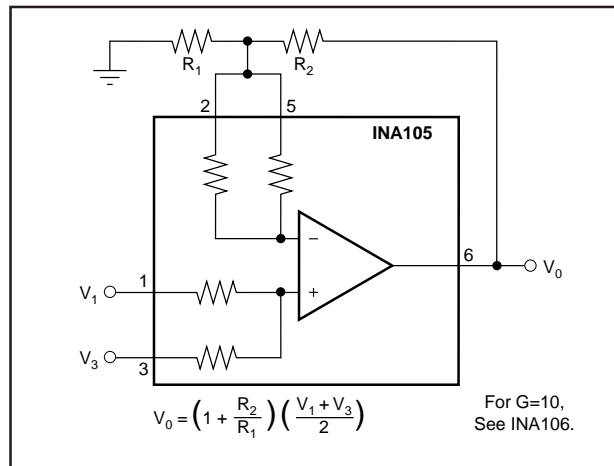


FIGURE 16. Precision Summing Amplifier with Gain.

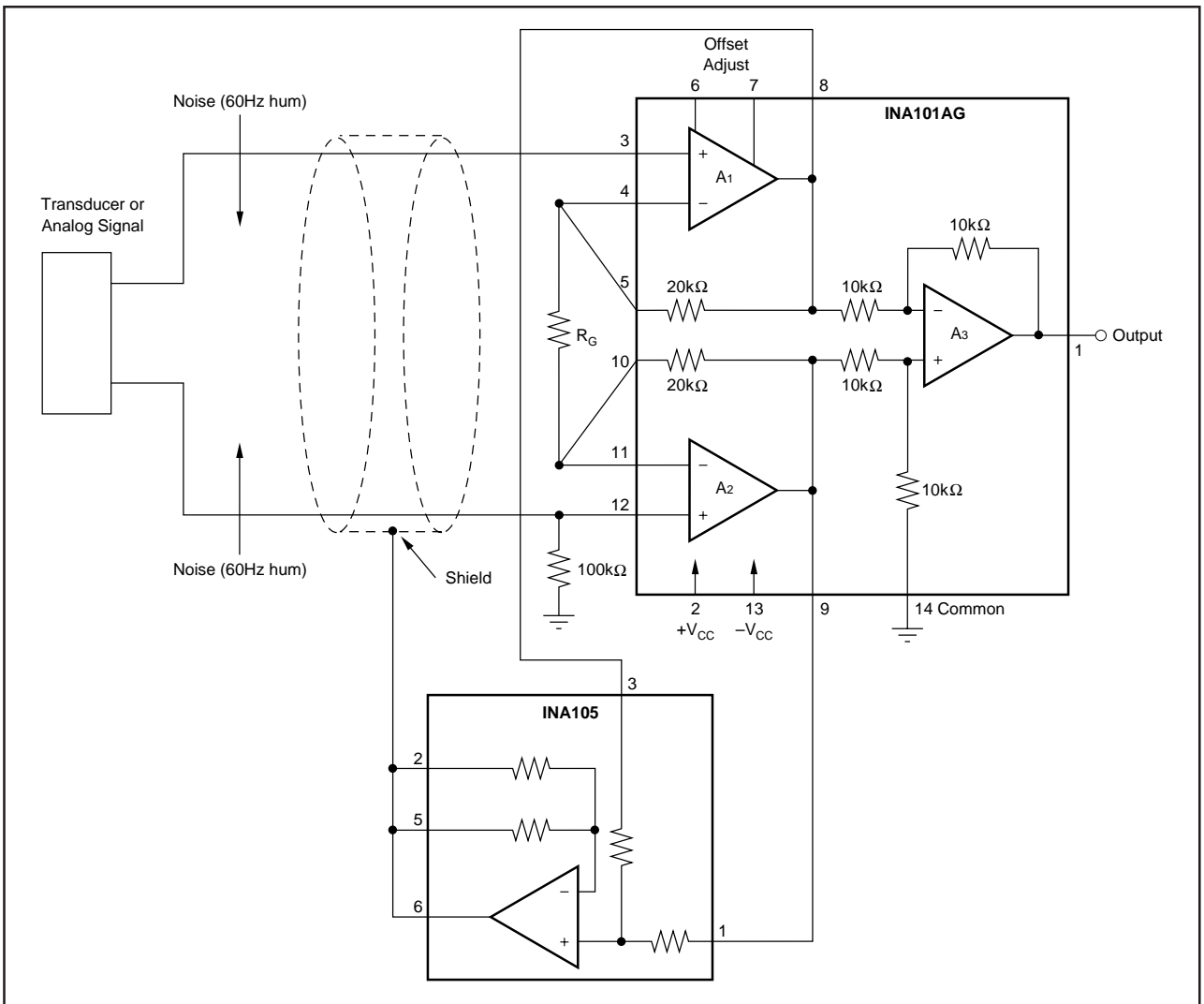


FIGURE 17. Instrumentation Amplifier Guard Drive Generator.

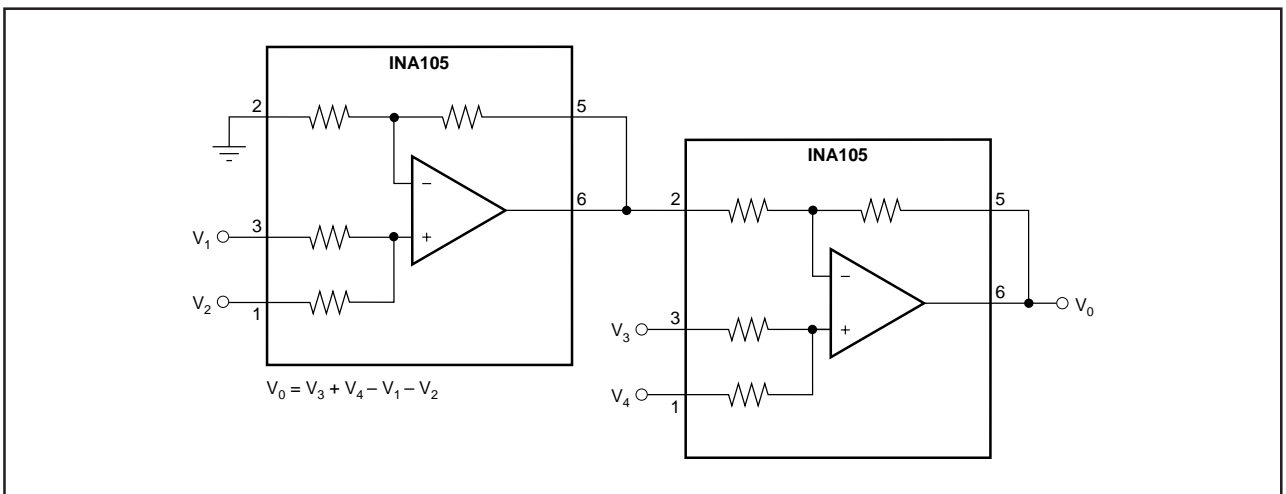


FIGURE 18. Precision Summing Instrumentation Amplifier.

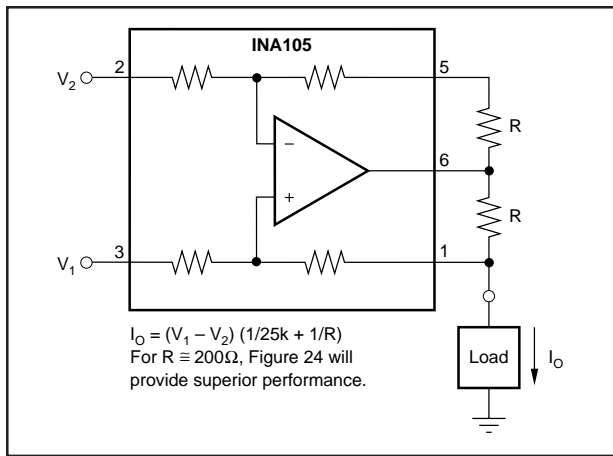


FIGURE 19. Precision Voltage-to-Current Converter with Differential Inputs.

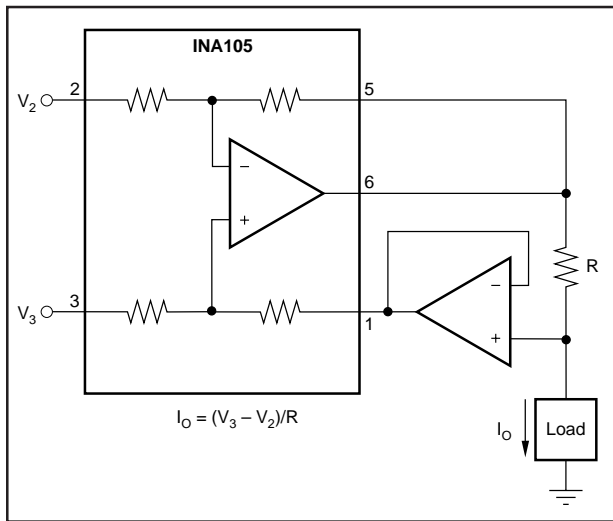


FIGURE 20. Differential Input Voltage-to-Current Converter for Low I_{OUT} .

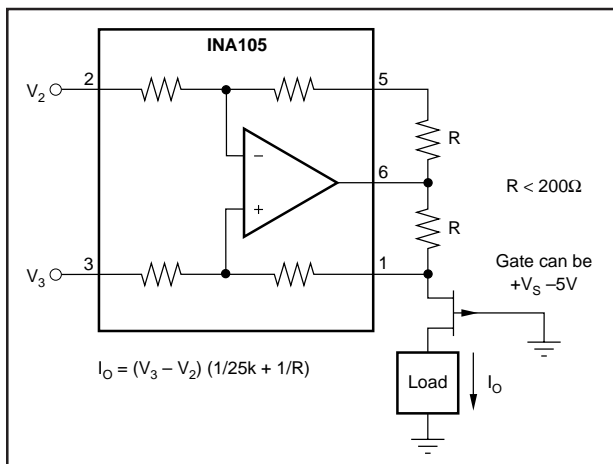


FIGURE 21. Isolating Current Source.

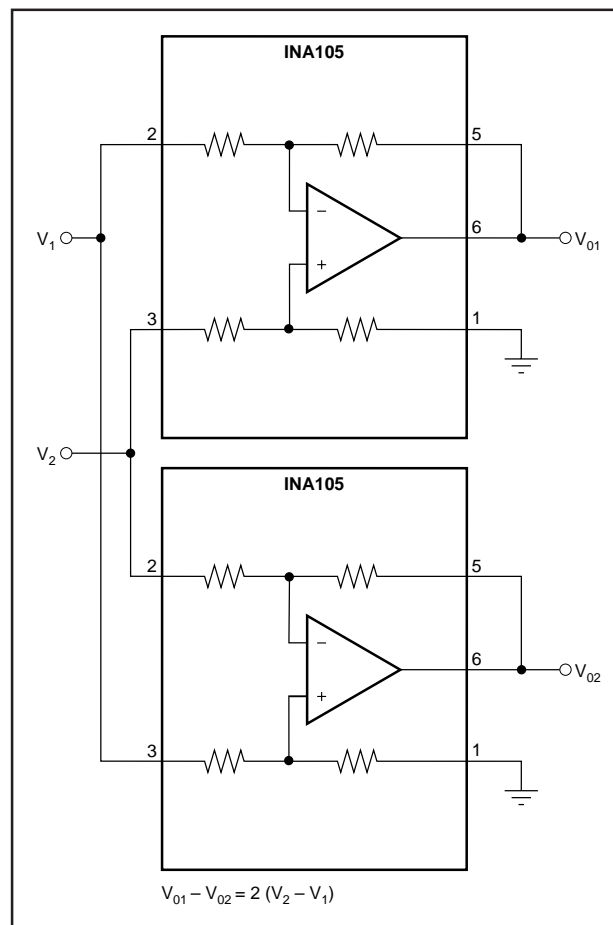


FIGURE 22. Differential Output Difference Amplifier.

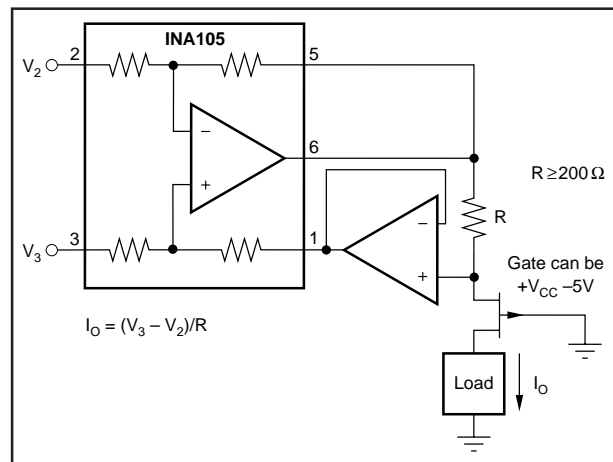


FIGURE 23. Isolating Current Source with Buffering Amplifier for Greater Accuracy.

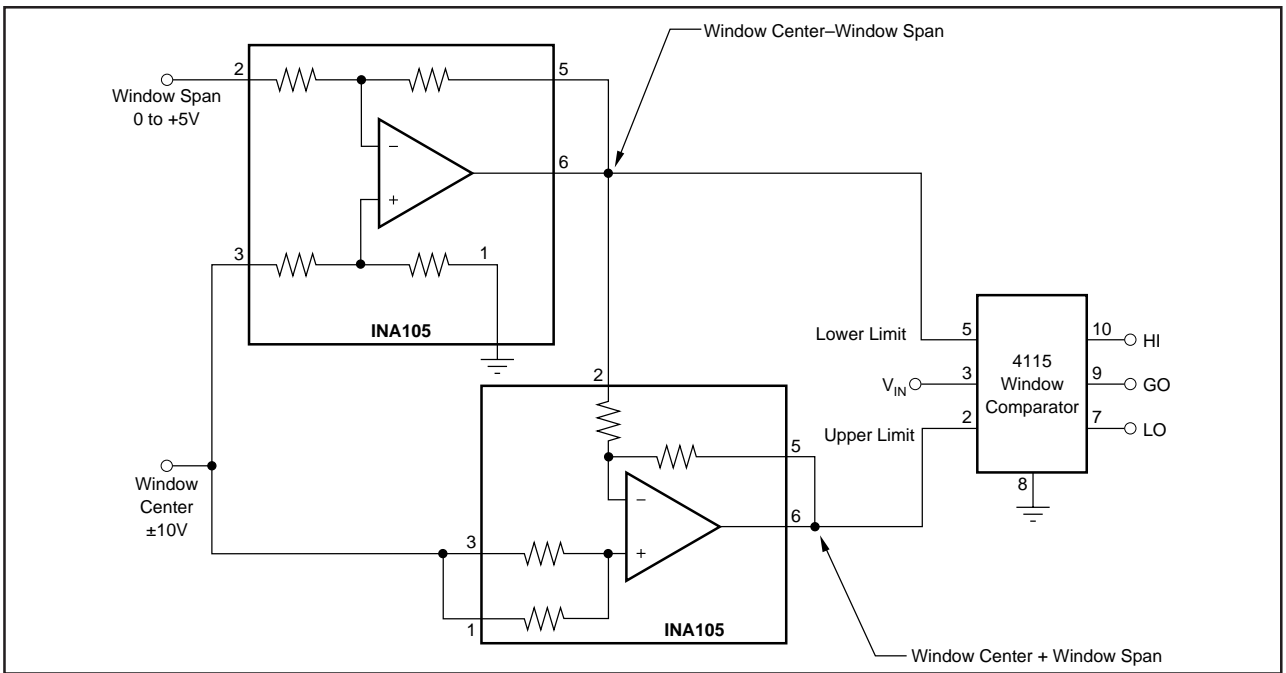


FIGURE 24. Window Comparator with Window Span and Window Center Inputs.

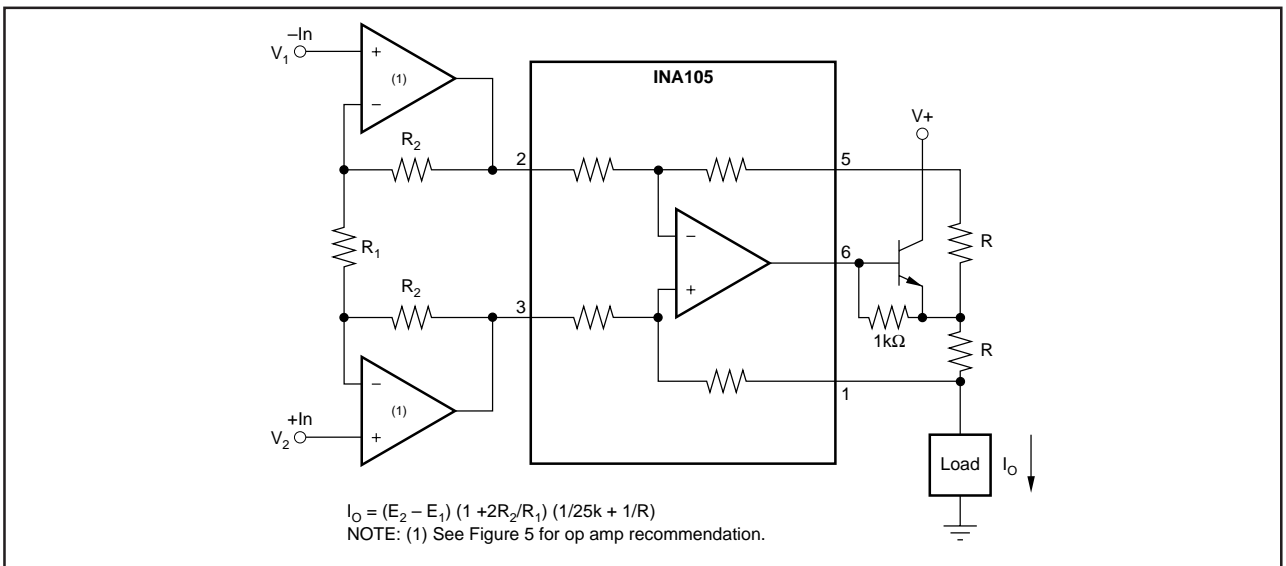


FIGURE 25. Precision Voltage-Controlled Current Source with Buffered Differential Inputs and Gain.

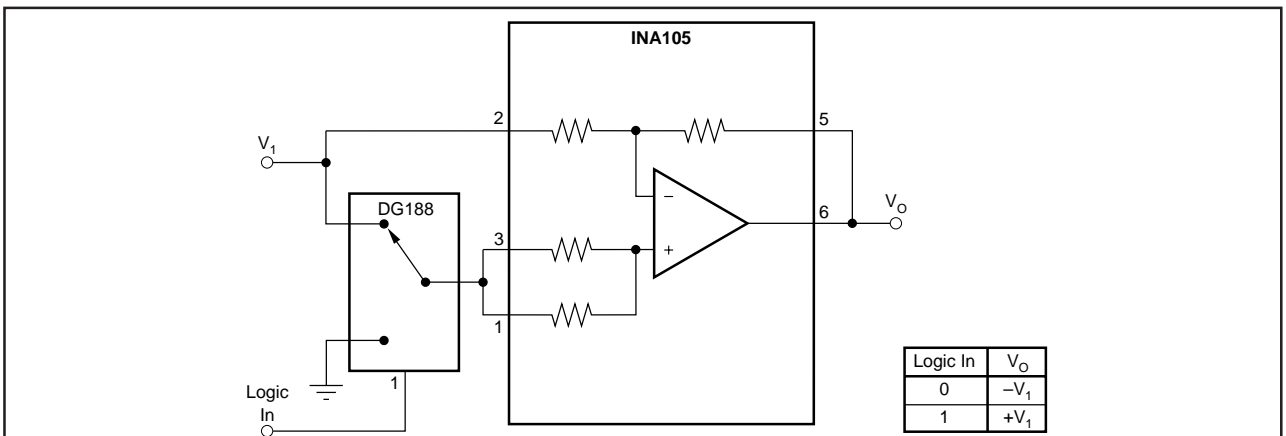


FIGURE 26. Digitally Controlled Gain of ±1 Amplifier.

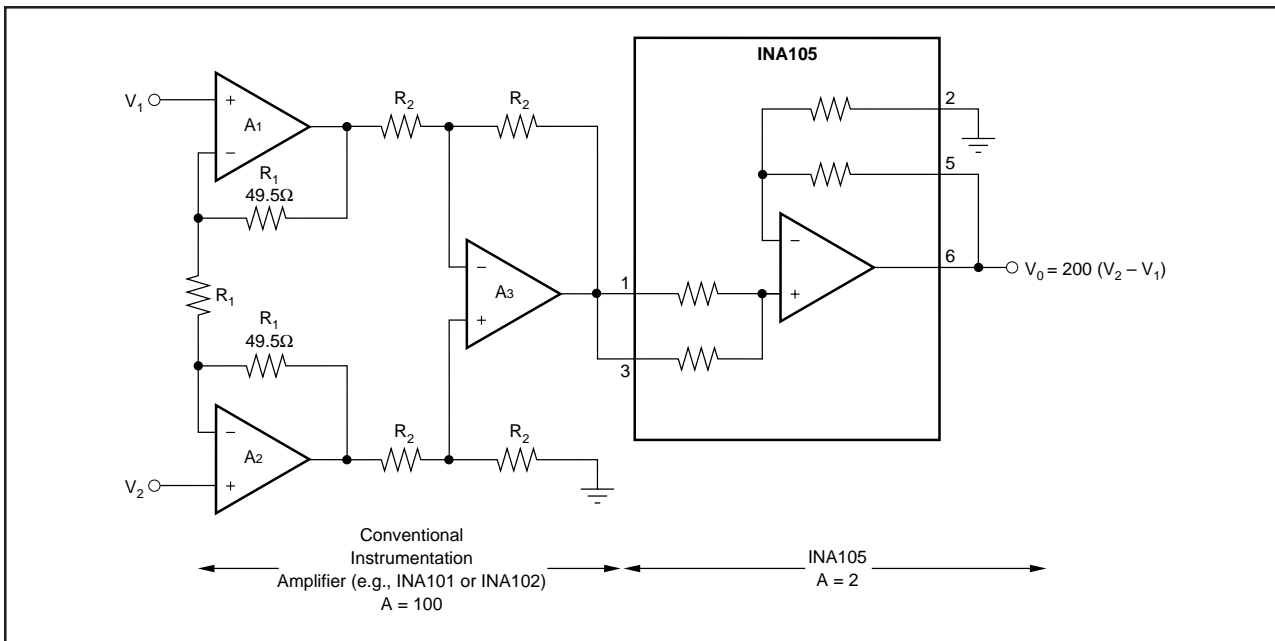


FIGURE 27. Boosting Instrumentation Amplifier Common-Mode Range From ± 5 to ± 7.5 V with 10V Full-Scale Output.

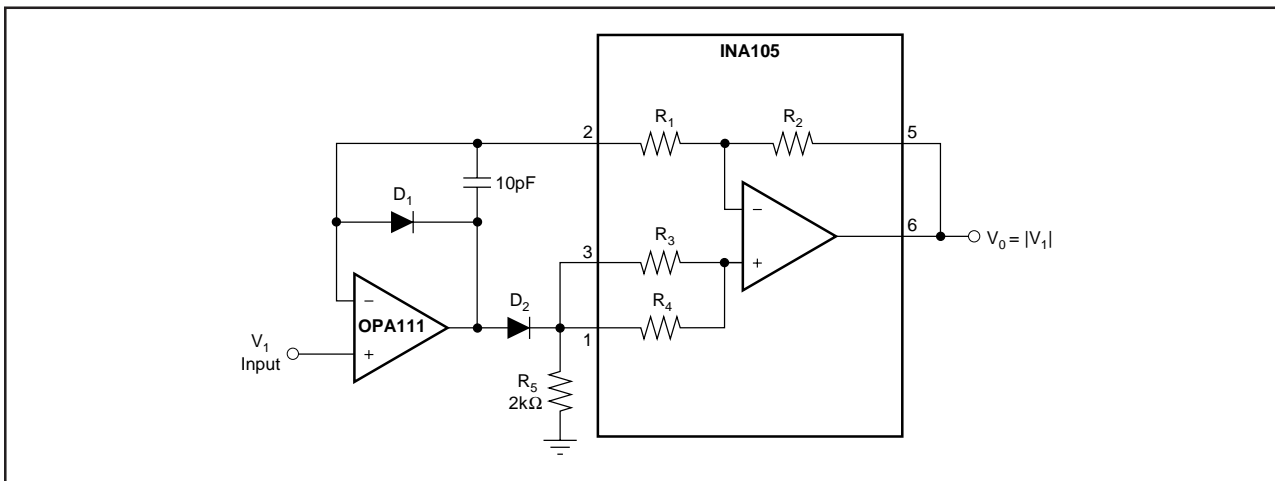


FIGURE 28. Precision Absolute Value Buffer.

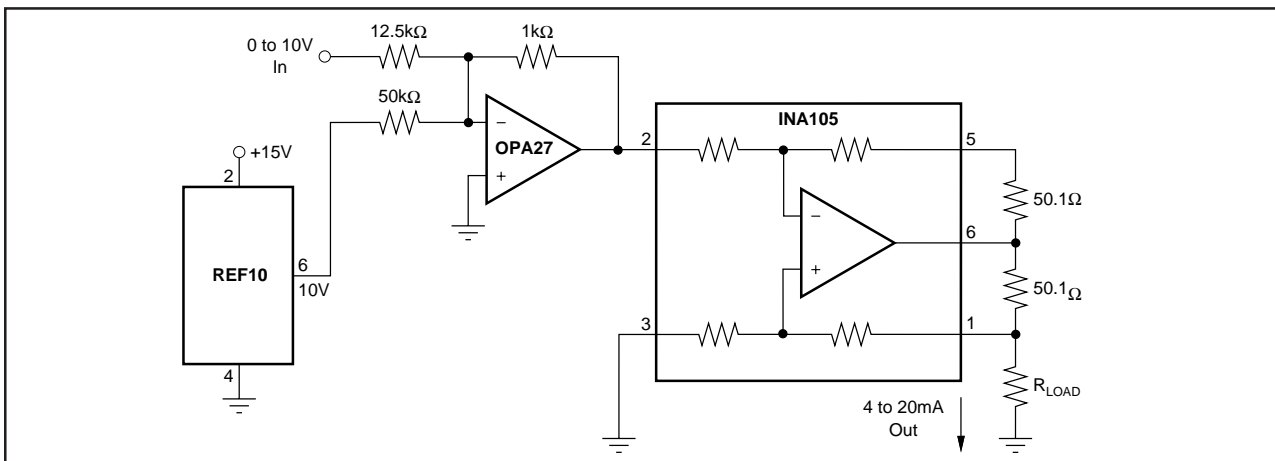


FIGURE 29. Precision 4-20mA Current Transmitter.

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
INA105AM	NRND	TO-99	LMC	8	20	Green (RoHS & no Sb/Br)	AU	N / A for Pkg Type
INA105BM	NRND	TO-99	LMC	8	20	Green (RoHS & no Sb/Br)	AU	N / A for Pkg Type
INA105KP	ACTIVE	PDIP	P	8	50	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type
INA105KPG4	ACTIVE	PDIP	P	8	50	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type
INA105KU	ACTIVE	SOIC	D	8	100	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR
INA105KU/2K5	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR
INA105KU/2K5E4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR
INA105KUE4	ACTIVE	SOIC	D	8	100	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

⁽²⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

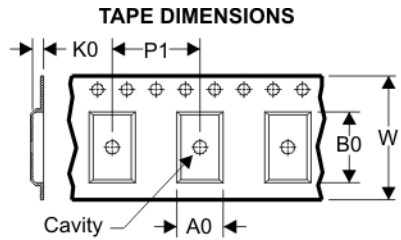
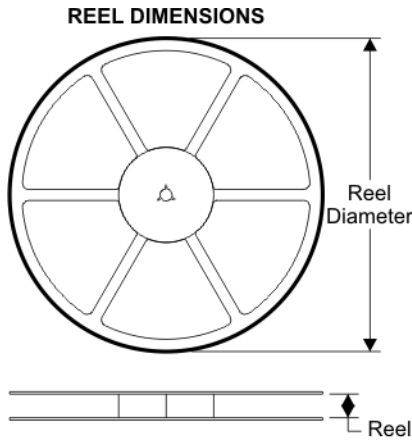
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

Important Information and Disclaimer:The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

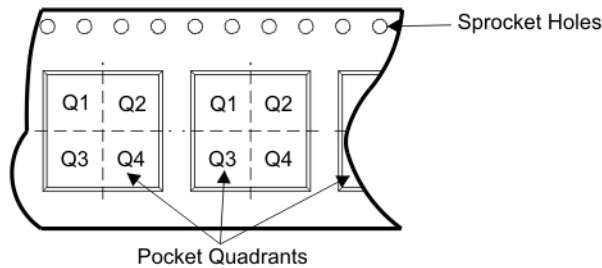
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL BOX INFORMATION



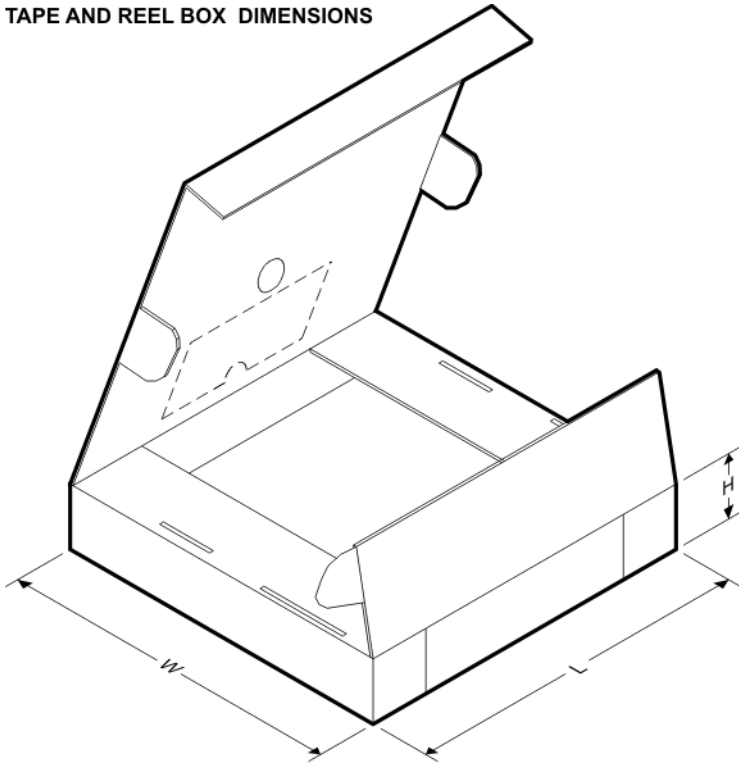
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



Device	Package	Pins	Site	Reel Diameter (mm)	Reel Width (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
INA105KU/2K5	D	8	SITE 41	330	12	6.9	5.4	2.0	8	12	Q1

TAPE AND REEL BOX DIMENSIONS



Device	Package	Pins	Site	Length (mm)	Width (mm)	Height (mm)
INA105KU/2K5	D	8	SITE 41	346.0	346.0	29.0

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

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

Products		Applications	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
RFID	www.ti-rfid.com	Telephony	www.ti.com/telephony
Low Power Wireless	www.ti.com/lpw	Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2007, Texas Instruments Incorporated