

INA103

Low Noise, Low Distortion INSTRUMENTATION AMPLIFIER

FEATURES

- **LOW NOISE:** $1\text{nV}/\sqrt{\text{Hz}}$
- **LOW THD+N:** 0.0009% at 1kHz, $G = 100$
- **HIGH GBW:** 100MHz at $G = 1000$
- **WIDE SUPPLY RANGE:** $\pm 9\text{V}$ to $\pm 25\text{V}$
- **HIGH CMRR:** $>100\text{dB}$
- **BUILT-IN GAIN SETTING RESISTORS:**
 $G = 1, 100$
- **UPGRADES AD625**

APPLICATIONS

- **HIGH QUALITY MICROPHONE PREAMPS**
(REPLACES TRANSFORMERS)
- **MOVING-COIL PREAMPLIFIERS**
- **DIFFERENTIAL RECEIVERS**
- **AMPLIFICATION OF SIGNALS FROM:**
Strain Gages (Weigh Scale Applications)
Thermocouples
Bridge Transducers

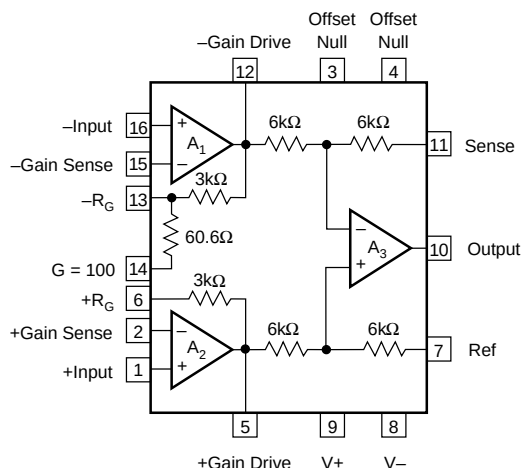
DESCRIPTION

The INA103 is a very low noise, low distortion monolithic instrumentation amplifier. Its current-feedback circuitry achieves very wide bandwidth and excellent dynamic response. It is ideal for low-level audio signals such as balanced low-impedance microphones. The INA103 provides near-theoretical limit noise performance for 200Ω source impedances. Many industrial applications also benefit from its low noise and wide bandwidth.

Unique distortion cancellation circuitry reduces distortion to extremely low levels, even in high gain. Its balanced input, low noise and low distortion provide superior performance compared to transformer-coupled microphone amplifiers used in professional audio equipment.

The INA103's wide supply voltage (± 9 to $\pm 25\text{V}$) and high output current drive allow its use in high-level audio stages as well. A copper lead frame in the plastic DIP assures excellent thermal performance.

The INA103 is available in 16-pin plastic DIP and SOL-16 surface-mount packages. Commercial and Industrial temperature range models are available.



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

SPECIFICATIONS

All specifications at $T_A = +25^\circ\text{C}$, $V_S = \pm 15\text{V}$ and $R_L = 2\text{k}\Omega$, unless otherwise noted.

PARAMETER	CONDITIONS	INA103KP, KU			UNITS
		MIN	TYP	MAX	
GAIN Range of Gain Gain Equation ⁽¹⁾ Gain Error, DC $G = 1$ $G = 100$ Equation Gain Temp. Co. $G = 1$ $G = 100$ Equation Nonlinearity, DC $G = 1$ $G = 100$	$\pm 10\text{V}$ Output $\pm 10\text{V}$ Output $\pm 10\text{V}$ Output	1	$G = 1 + 6\text{k}\Omega/R_G$ 0.005 0.07 0.05 10 25 25 0.0003 0.0006	1000 0.05 0.25 0.01 0.01	V/V V/V % % % ppm/ $^\circ\text{C}$ ppm/ $^\circ\text{C}$ ppm/ $^\circ\text{C}$ % of FS ⁽²⁾ % of FS
OUTPUT Voltage, $R_L = 600\Omega$ $R_L = 600\Omega$ Current Short Circuit Current Capacitive Load Stability	$T_A = T_{\text{MIN}}$ to T_{MAX} $V_S = \pm 25$, $T_A = 25^\circ\text{C}$ $T_A = T_{\text{MIN}}$ to T_{MAX}	± 11.5 ± 20 ± 40	± 12 ± 21 ± 70 10	 	V V mA mA nF
INPUT OFFSET VOLTAGE Initial Offset RTI ⁽³⁾ (KU Grade) vs Temp $G = 1$ to 1000 $G = 1000$ vs Supply	$T_A = T_{\text{MIN}}$ to T_{MAX} $T_A = T_{\text{MIN}}$ to T_{MAX} $\pm 9\text{V}$ to $\pm 25\text{V}$		(30 + 1200/G) 1 + 20/G 0.2 + 8/G	(250 + 5000/G) 4 + 60/G	μV μV $\mu\text{V}/^\circ\text{C}$ $\mu\text{V}/^\circ\text{C}$ $\mu\text{V/V}$
INPUT BIAS CURRENT Initial Bias Current vs Temp Initial Offset Current vs Temp	$T_A = T_{\text{MIN}}$ to T_{MAX} $T_A = T_{\text{MIN}}$ to T_{MAX}		2.5 15 0.04 0.5	12 1	μA nA/ $^\circ\text{C}$ μA nA/ $^\circ\text{C}$
INPUT IMPEDANCE Differential Mode Common-Mode			60 $\parallel$ 2 60 $\parallel$ 5		M Ω $\parallel$ pF M Ω $\parallel$ pF
INPUT VOLTAGE RANGE Common-Mode Range ⁽⁴⁾ CMR $G = 1$ $G = 100$	 DC to 60Hz DC to 60Hz	± 11 72 100	± 12 86 125		V dB dB
INPUT NOISE Voltage ⁽⁵⁾ 10Hz 100Hz 1kHz Current, 1kHz	$R_S = 0\Omega$		 2 1.2 1 2		 nV/ $\sqrt{\text{Hz}}$ nV/ $\sqrt{\text{Hz}}$ nV/ $\sqrt{\text{Hz}}$ pA/ $\sqrt{\text{Hz}}$
OUTPUT NOISE Voltage A Weighted, 20Hz-20kHz	1kHz 20Hz-20kHz		65 -100		nV/ $\sqrt{\text{Hz}}$ dBu
DYNAMIC RESPONSE -3dB Bandwidth: $G = 1$ $G = 100$ Full Power Bandwidth $V_{\text{OUT}} = \pm 10\text{V}$, $R_L = 600\Omega$ Slew Rate THD + Noise Settling Time 0.1% $G = 1$ $G = 100$ Settling Time 0.01% $G = 1$ $G = 100$ Overload Recovery ⁽⁶⁾	Small Signal Small Signal $G = 1$ $G = 1$ to 500 $G = 100$, $f = 1\text{kHz}$ $V_O = 20\text{V}$ Step $V_O = 20\text{V}$ Step 50% Overdrive		6 800 240 15 0.0009 1.7 1.5 2 3.5 1		MHz kHz kHz V/ μs % μs μs μs μs μs

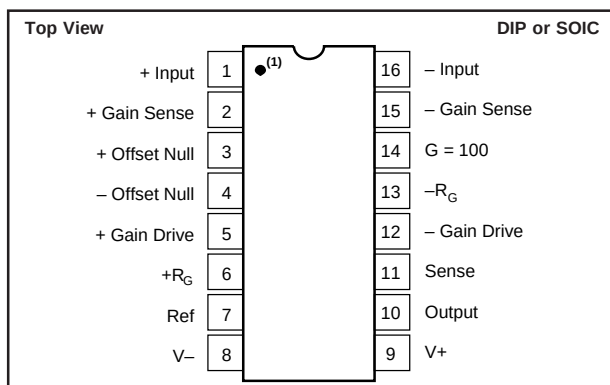
NOTES: (1) Gains other than 1 and 100 can be set by adding an external resistor, R_G between pins 2 and 15. Gain accuracy is a function of R_G . (2) FS = Full Scale. (3) Adjustable to zero. (4) $V_O = 0\text{V}$, see Typical Curves for V_{CM} vs V_O . (5) $V_{\text{NOISE RTI}} = \sqrt{V_{\text{N INPUT}}^2 + (V_{\text{N OUTPUT}}/\text{Gain})^2 + 4\text{KTR}_G}$. See Typical Curves. (6) Time required for output to return from saturation to linear operation following the removal of an input overdrive voltage.

SPECIFICATIONS (CONT)

All specifications at $T_A = +25^\circ\text{C}$, $V_S = \pm 15\text{V}$ and $R_L = 2\text{k}\Omega$, unless otherwise noted.

PARAMETER	CONDITIONS	INA103KP, KU			UNITS
		MIN	TYP	MAX	
POWER SUPPLY					
Rated Voltage			± 15		V
Voltage Range		± 9		± 25	V
Quiescent Current			9	12.5	mA
TEMPERATURE RANGE					
Specification		0		+70	$^\circ\text{C}$
Operation		-40		+85	$^\circ\text{C}$
Storage		-40		+100	$^\circ\text{C}$
Thermal Resistance, θ_{JA}			100		$^\circ\text{C/W}$

PIN CONFIGURATION



NOTE: (1) Pin 1 Marking—SOL-16 Package

PACKAGE/ORDERING INFORMATION

PRODUCT	PACKAGE	PACKAGE DRAWING NUMBER ⁽¹⁾	TEMPERATURE RANGE
INA103KP	Plastic DIP	180	0°C to +70°C
INA103KU	SOL-16	211	0°C to +70°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

Any 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 published specifications.

ABSOLUTE MAXIMUM RATINGS⁽¹⁾

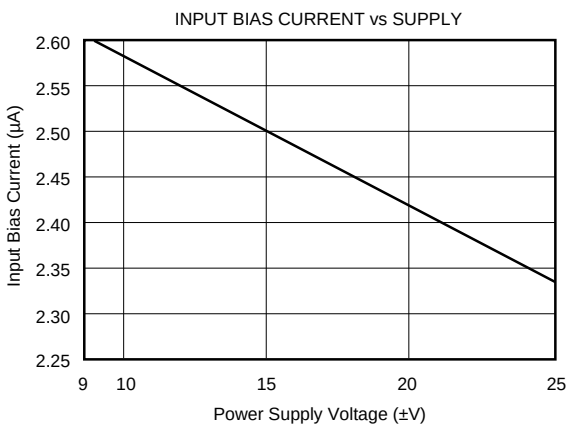
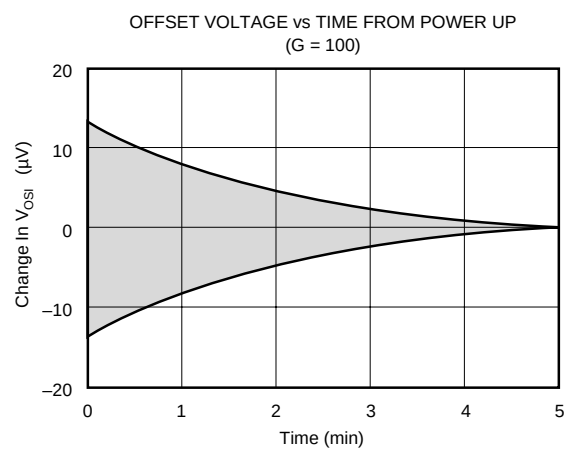
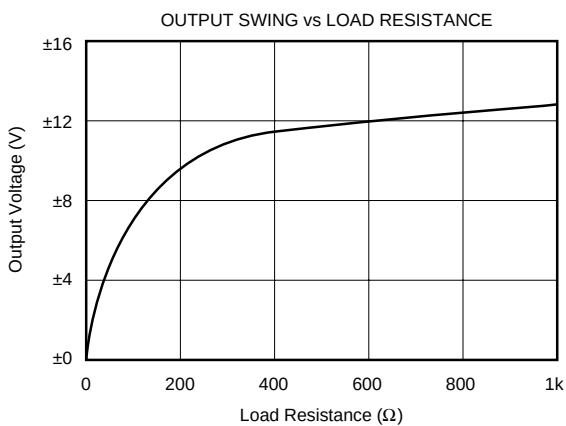
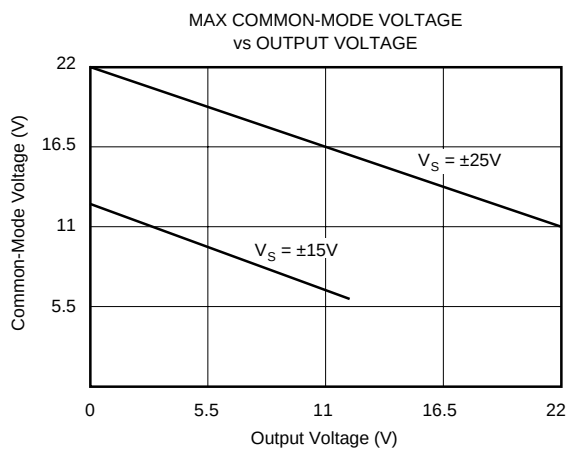
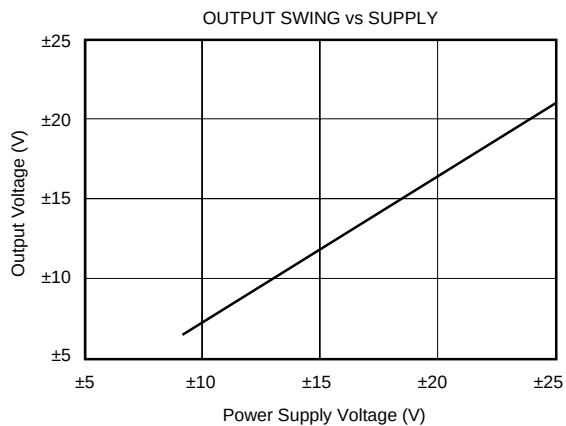
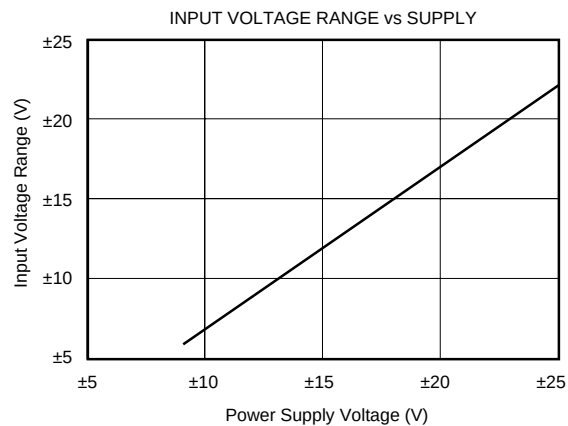
Power Supply Voltage	$\pm 25\text{V}$
Input Voltage Range, Continuous	$\pm V_S$
Operating Temperature Range:	-40°C to +85°C
Storage Temperature Range:	-40°C to +85°C
Junction Temperature:	
P, U Package	+125°C
Lead Temperature (soldering, 10s)	+300°C
Output Short Circuit to Common	Continuous

NOTE: (1) Stresses above these ratings may cause permanent damage.

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.

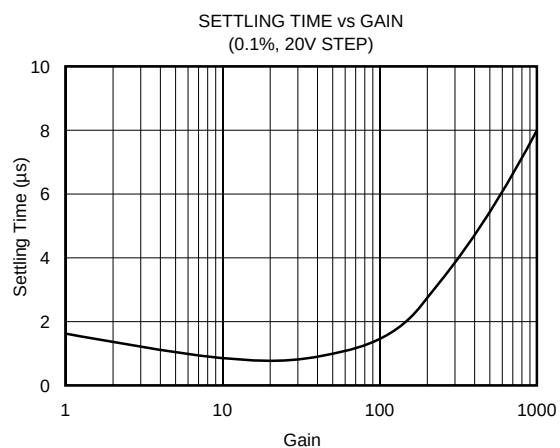
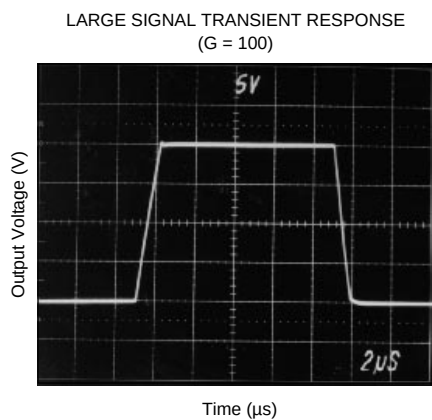
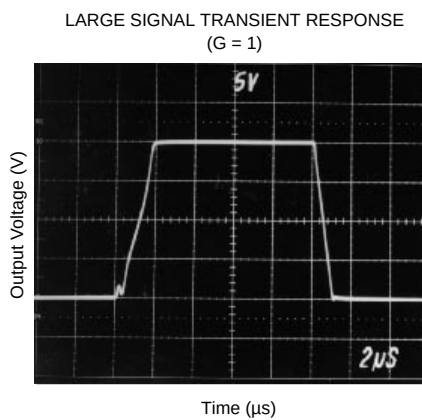
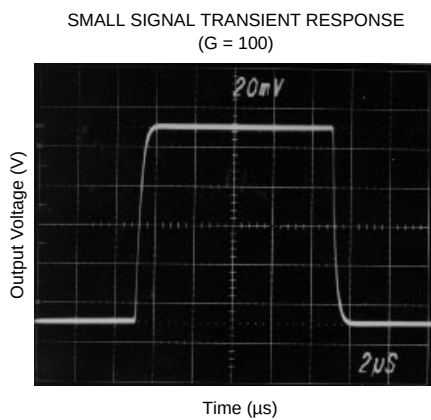
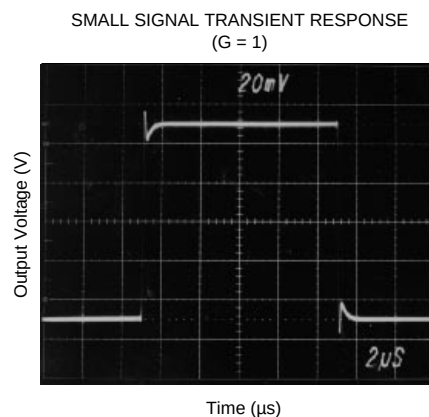
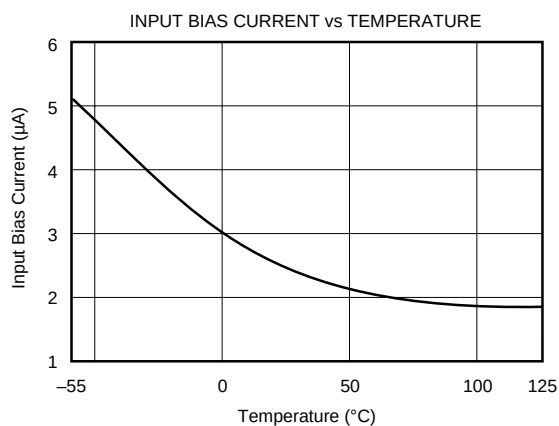
TYPICAL PERFORMANCE CURVES

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



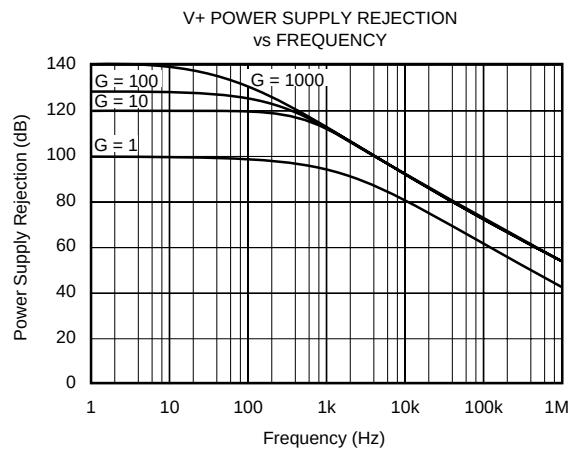
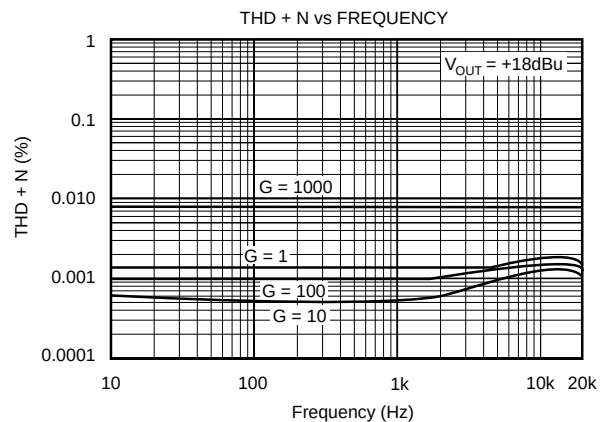
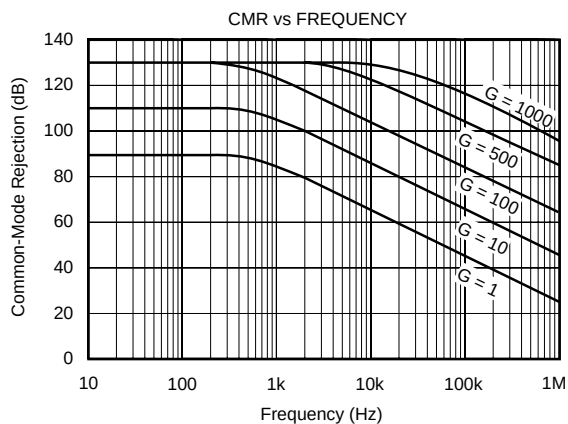
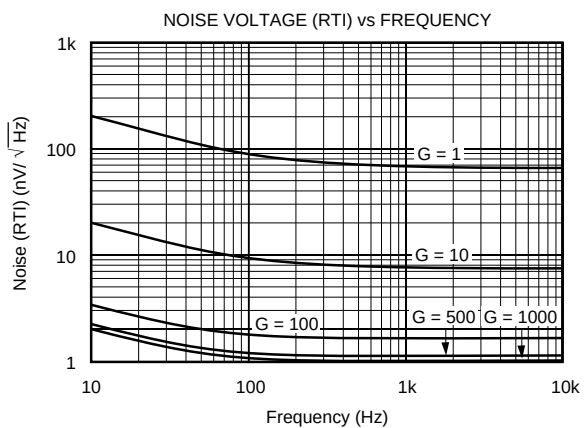
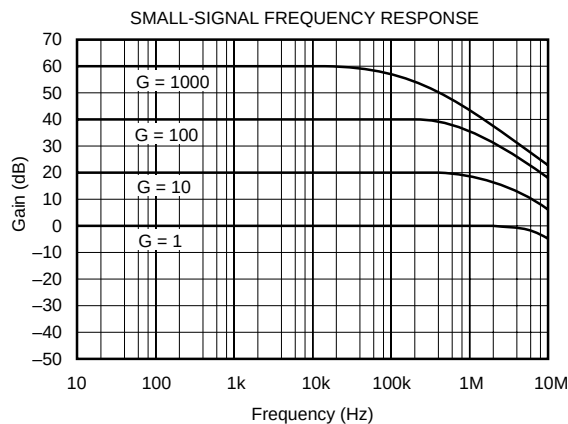
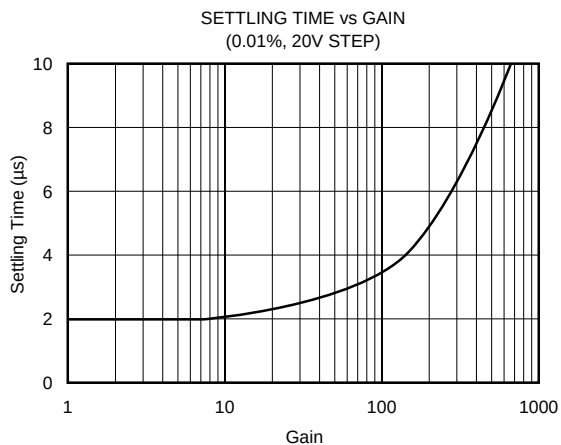
TYPICAL PERFORMANCE CURVES (CONT)

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



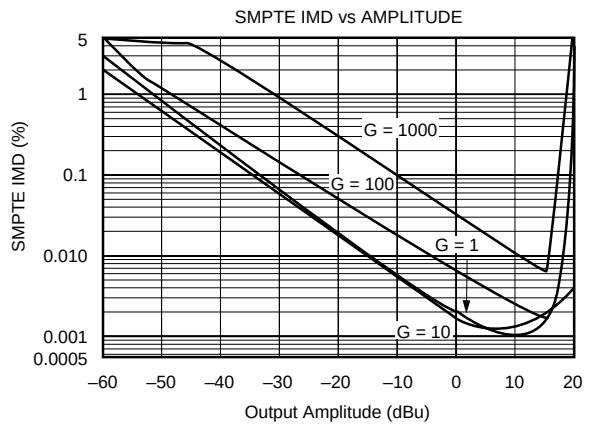
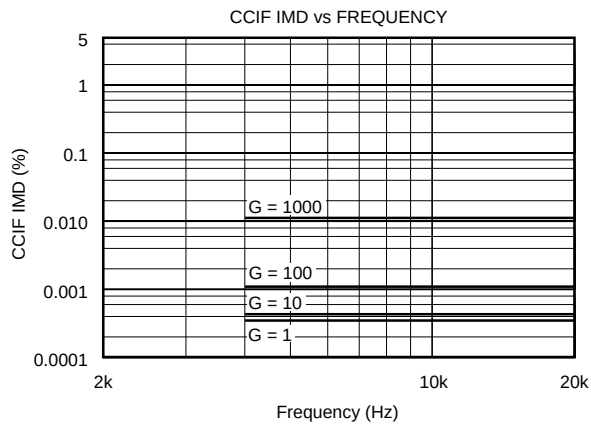
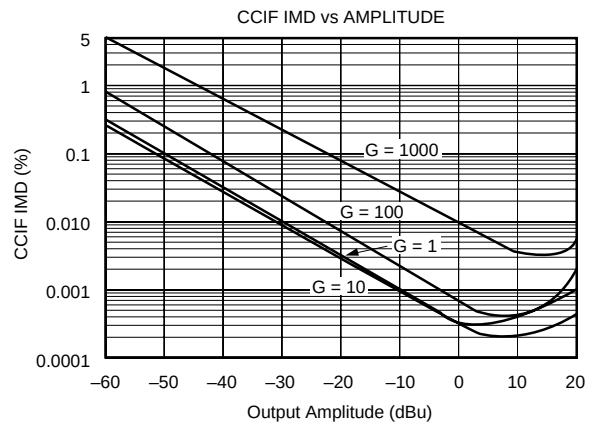
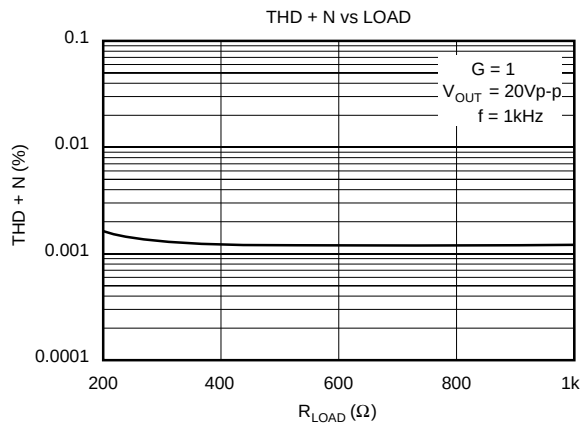
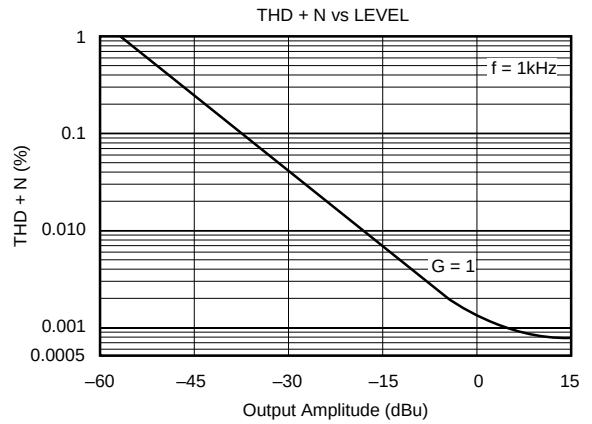
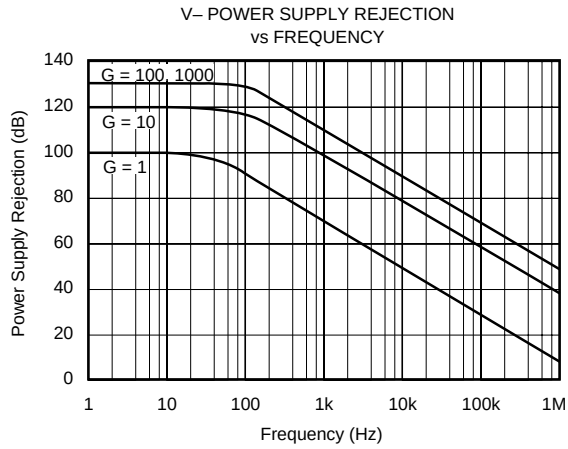
TYPICAL PERFORMANCE CURVES (CONT)

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



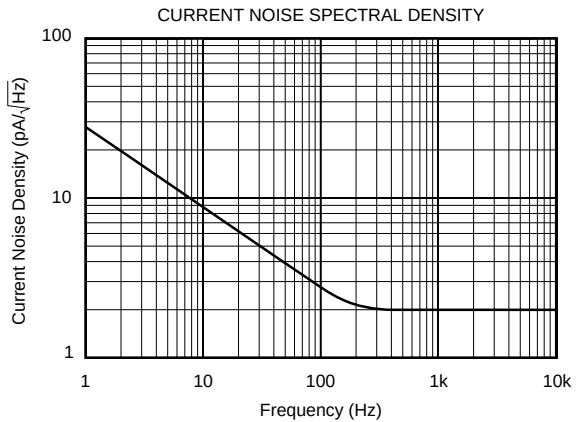
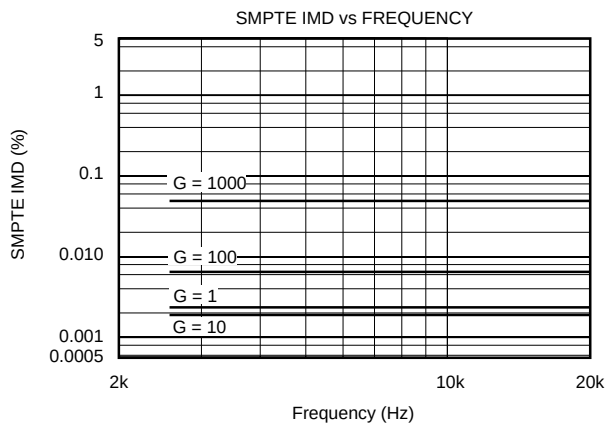
TYPICAL PERFORMANCE CURVES (CONT)

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



TYPICAL PERFORMANCE CURVES (CONT)

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



APPLICATIONS INFORMATION

Figure 1 shows the basic connections required for operation. Power supplies should be bypassed with $1\mu\text{F}$ tantalum capacitors near the device pins. The output Sense (pin 11) and output Reference (pin 7) should be low impedance connections. Resistance of a few ohms in series with these connections will degrade the common-mode rejection of the amplifier.

To avoid oscillations, make short, direct connection to the gain set resistor and gain sense connections. Avoid running output signals near these sensitive input nodes.

INPUT CONSIDERATIONS

Certain source impedances can cause the INA103 to oscillate. This depends on circuit layout and source or cable characteristics connected to the input. An input network consisting of a small inductor and resistor (Figure 2) can greatly reduce the tendency to oscillate. This is especially

useful if various input sources are connected to the INA103. Although not shown in other figures, this network can be used, if needed, with all applications shown.

GAIN SELECTION

Gains of 1 or 100V/V can be set without external resistors. For $G = 1\text{V/V}$ (unity gain) leave pin 14 open (no connection)—see Figure 4. For $G = 100\text{V/V}$, connect pin 14 to pin 6—see Figure 5.

Gain can also be accurately set with a single external resistor as shown in Figure 1. The two internal feedback resistors are laser-trimmed to $3\text{k}\Omega$ within approximately $\pm 0.1\%$. The temperature coefficient of these resistors is approximately $50\text{ppm}/^\circ\text{C}$. Gain using an external R_G resistor is—

$$G = 1 + \frac{6\text{k}\Omega}{R_G}$$

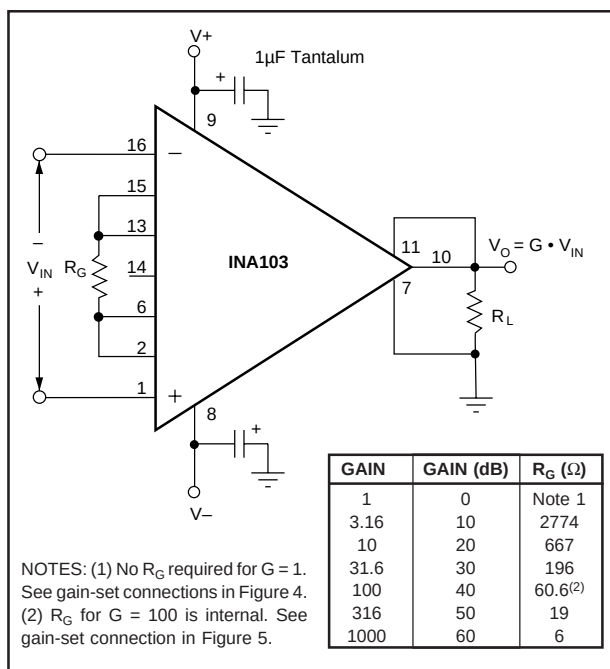


FIGURE 1. Basic Circuit Configuration.

Accuracy and TCR of the external R_G will also contribute to gain error and temperature drift. These effects can be directly inferred from the gain equation.

Connections available on A₁ and A₂ allow external resistors to be substituted for the internal 3kΩ feedback resistors. A precision resistor network can be used for very accurate and stable gains. To preserve the low noise of the INA103, the value of external feedback resistors should be kept low. Increasing the feedback resistors to 20kΩ would increase noise of the INA103 to approximately 1.5nV/√Hz. Due to the current-feedback input circuitry, bandwidth would also be reduced.

NOISE PERFORMANCE

The INA103 provides very low noise with low source impedance. Its 1nV/√Hz voltage noise delivers near theoretical noise performance with a source impedance of 200Ω. Relatively high input stage current is used to achieve this low noise. This results in relatively high input bias current and input current noise. As a result, the INA103 may not provide best noise performance with source impedances greater than 10kΩ. For source impedance greater than 10kΩ, consider the INA114 (excellent for precise DC applications), or the INA111 FET-input IA for high speed applications.

OFFSET ADJUSTMENT

Offset voltage of the INA103 has two components: input stage offset voltage is produced by A₁ and A₂; and, output stage offset is produced by A₃. Both input and output stage offset are laser trimmed and may not need adjustment in many applications.

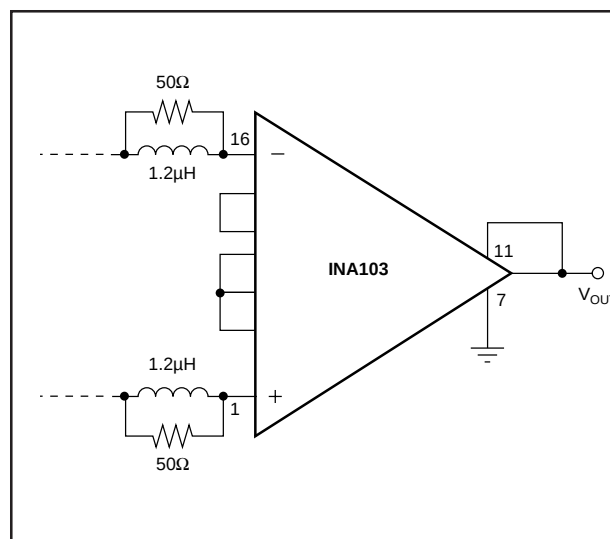


FIGURE 2. Input Stabilization Network.

Offset voltage can be trimmed with the optional circuit shown in Figure 3. This offset trim circuit primarily adjusts the output stage offset, but also has a small effect on input stage offset. For a 1mV adjustment of the output voltage, the input stage offset is adjusted approximately 1μV. Use this adjustment to null the INA103's offset voltage with zero differential input voltage. Do not use this adjustment to null offset produced by a sensor, or offset produced by subsequent stages, since this will increase temperature drift.

To offset the output voltage without affecting drift, use the circuit shown in Figure 4. The voltage applied to pin 7 is summed at the output. The op amp connected as a buffer provides a low impedance at pin 7 to assure good common-mode rejection.

Figure 5 shows a method to trim offset voltage in AC-coupled applications. A nearly constant and equal input bias current of approximately 2.5μA flows into both input terminals. A variable input trim voltage is created by adjusting the balance of the two input bias return resistances through which the input bias currents must flow.

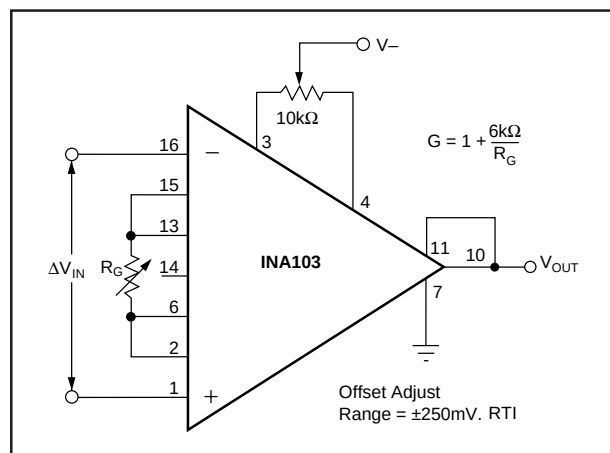


FIGURE 3. Offset Adjustment Circuit.

Figure 6 shows an active control loop that adjusts the output offset voltage to zero. A_2 , R , and C form an integrator that produces an offsetting voltage applied to one input of the INA103. This produces a -6dB/octave low frequency roll-off like the capacitor input coupling in Figure 5.

COMMON-MODE INPUT RANGE

For proper operation, the combined differential input signal and common-mode input voltage must not cause the input amplifiers to exceed their output swing limits. The linear input range is shown in the typical performance curve “Maximum Common-Mode Voltage vs Output Voltage.” For a given total gain, the input common-mode range can be increased by reducing the input stage gain and increasing the output stage gain with the circuit shown in Figure 7.

OUTPUT SENSE

An output sense terminal allows greater gain accuracy in driving the load. By connecting the sense connection at the load, $I \cdot R$ voltage loss to the load is included inside the feedback loop. Current drive can be increased by connecting a current booster inside the feedback loop as shown in Figure 11.

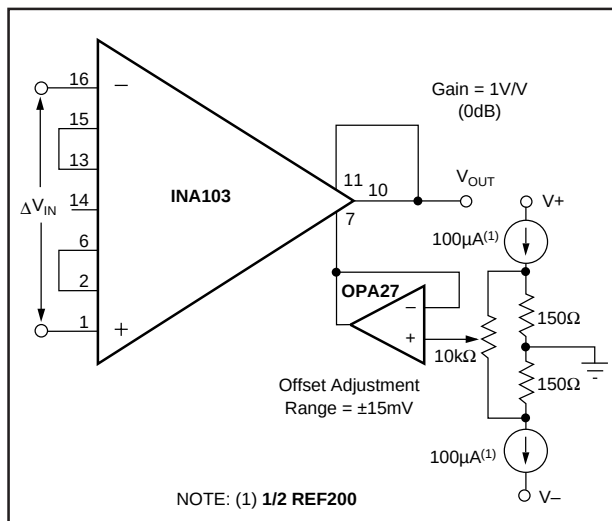


FIGURE 4. Output Offsetting.

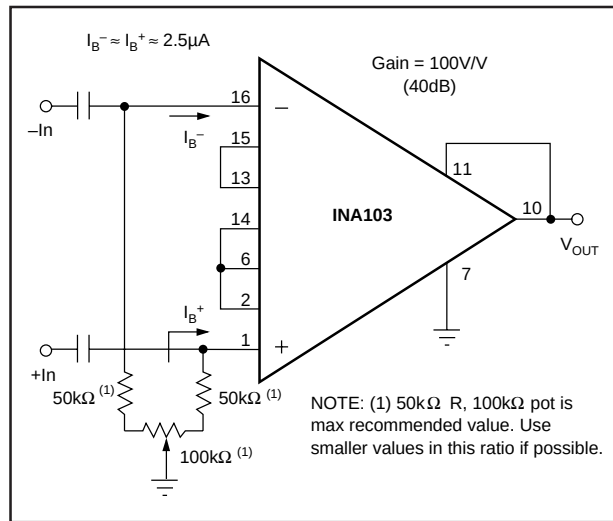


FIGURE 5. Input Offset Adjustment for AC-Coupled Inputs.

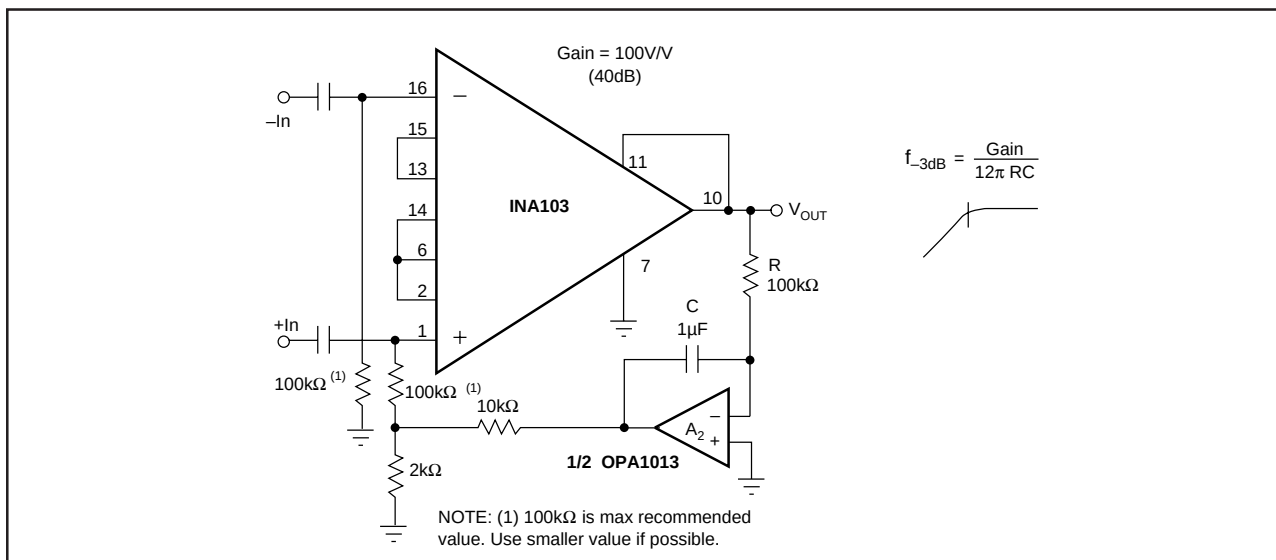


FIGURE 6. Automatic DC Restoration.

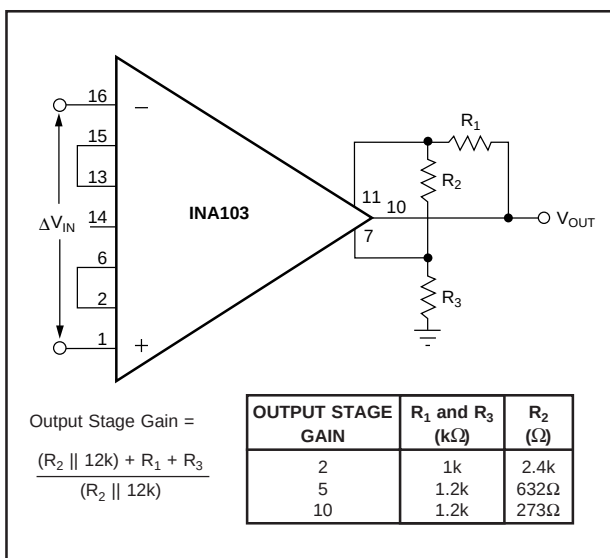


FIGURE 7. Gain Adjustment of Output Stage.

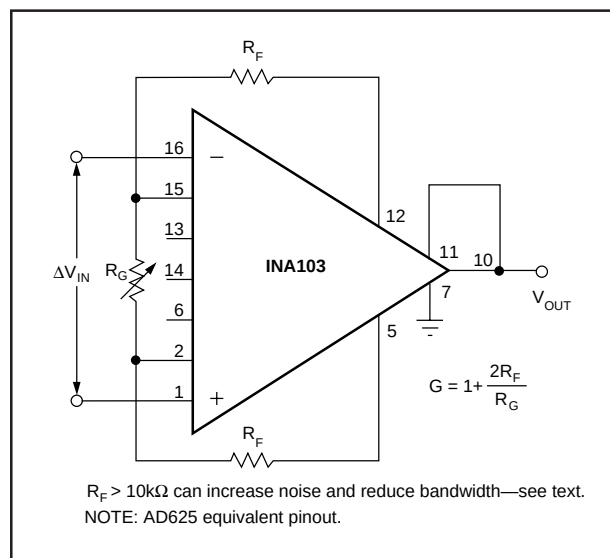


FIGURE 8. Use of External Resistors for Gain Set.

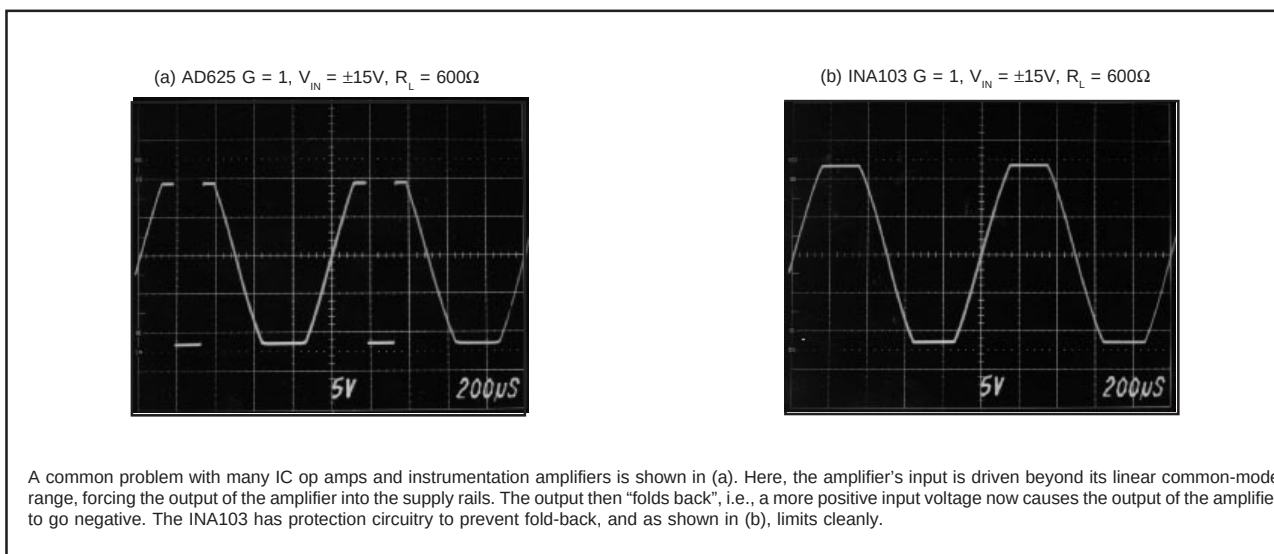


FIGURE 9. INA103 Overload Condition Performance.

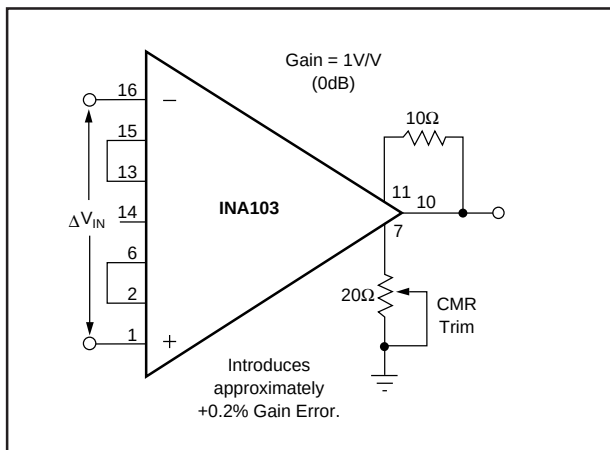


FIGURE 10. Optional Circuit for Externally Trimming CMR.

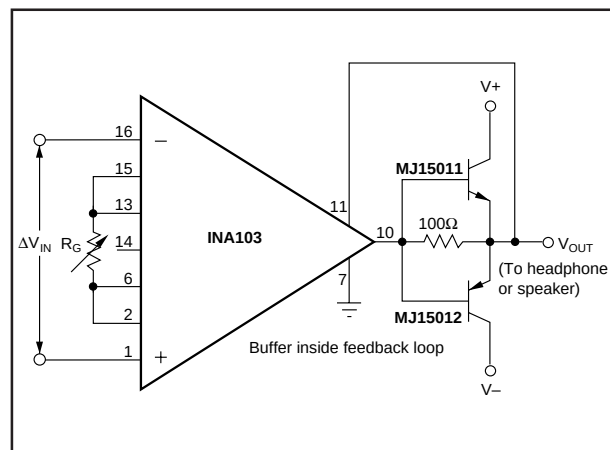


FIGURE 11. Increasing Output Circuit Drive.

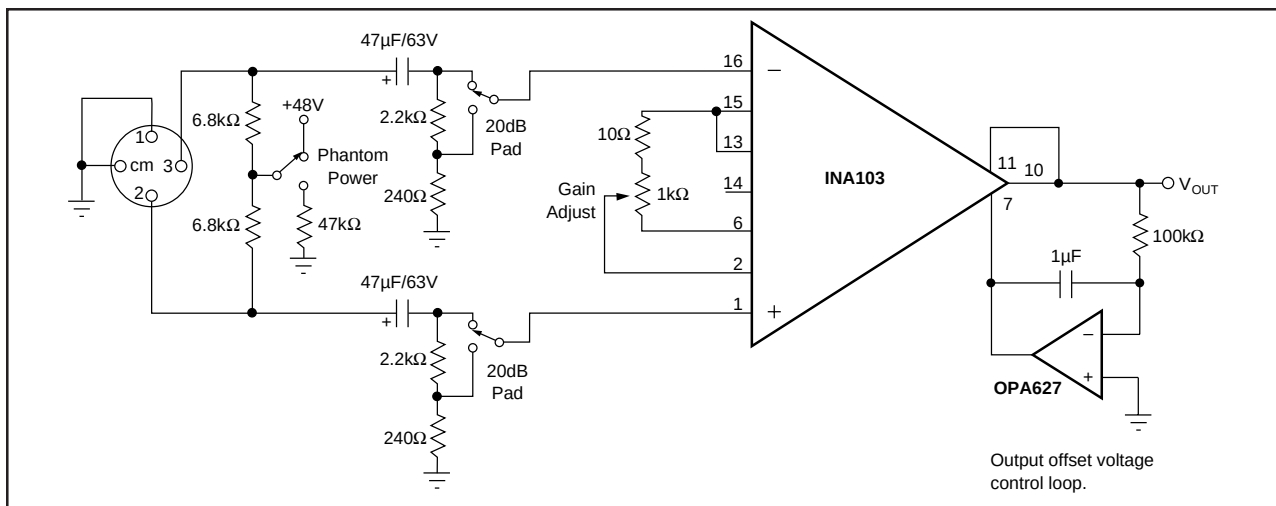


FIGURE 12. Microphone Preamplifier with Provision for Phantom Power Microphones.

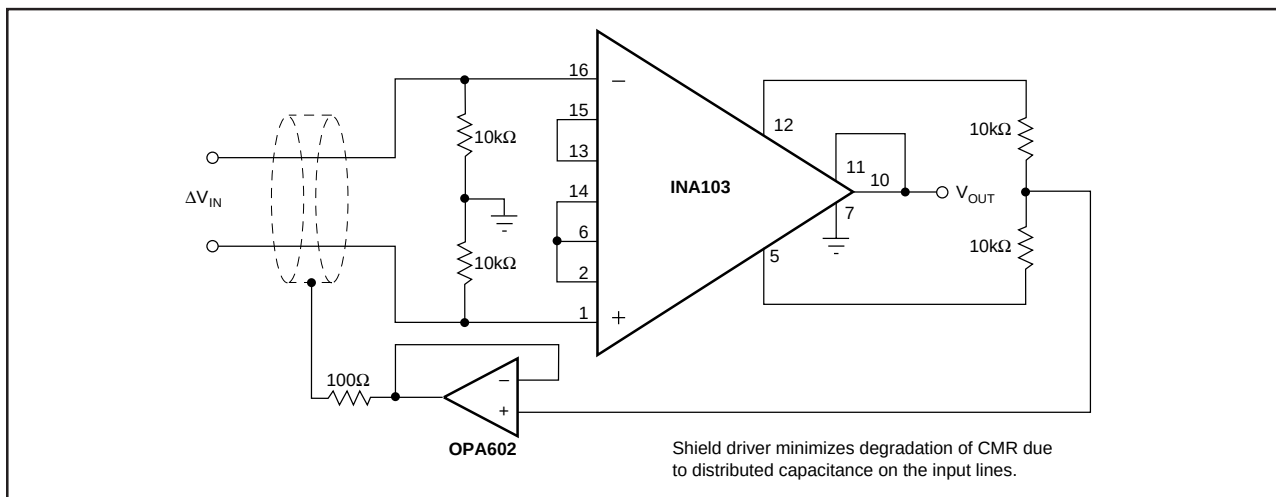


FIGURE 13. Instrumentation Amplifier with Shield Driver.

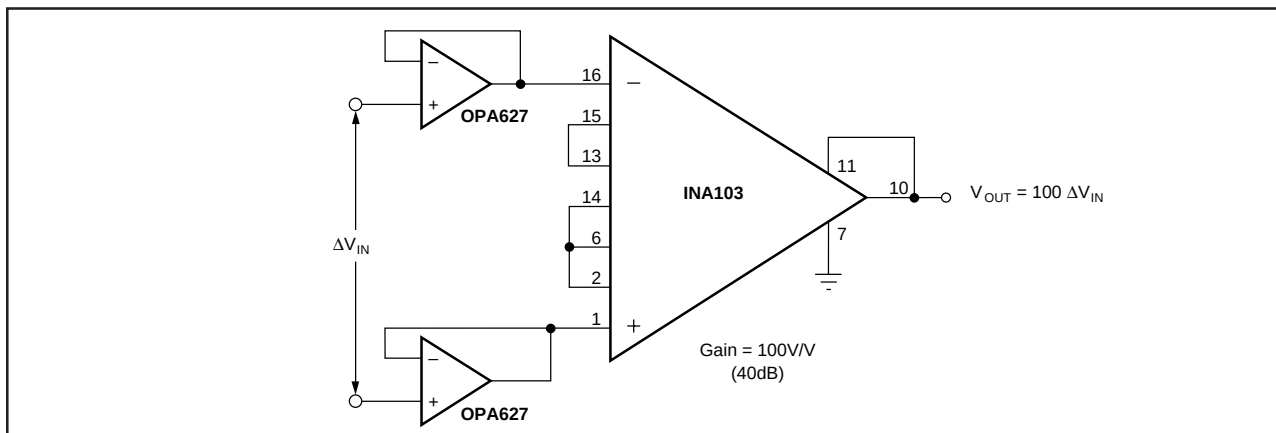


FIGURE 14. Gain-of-100 INA103 with FET Buffers.

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/ Ball Finish	MSL Peak Temp ⁽³⁾	Samples (Requires Login)
INA103KP	ACTIVE	PDIP	N	16	25	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type	Contact TI Distributor or Sales Office
INA103KPG4	ACTIVE	PDIP	N	16	25	Green (RoHS & no Sb/Br)	CU NIPDAU	N / A for Pkg Type	Contact TI Distributor or Sales Office
INA103KU	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	Contact TI Distributor or Sales Office
INA103KU/1K	ACTIVE	SOIC	DW	16	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	Purchase Samples
INA103KU/1KE4	ACTIVE	SOIC	DW	16	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	Purchase Samples
INA103KUG4	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-3-260C-168 HR	Contact TI Distributor or Sales Office

⁽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.



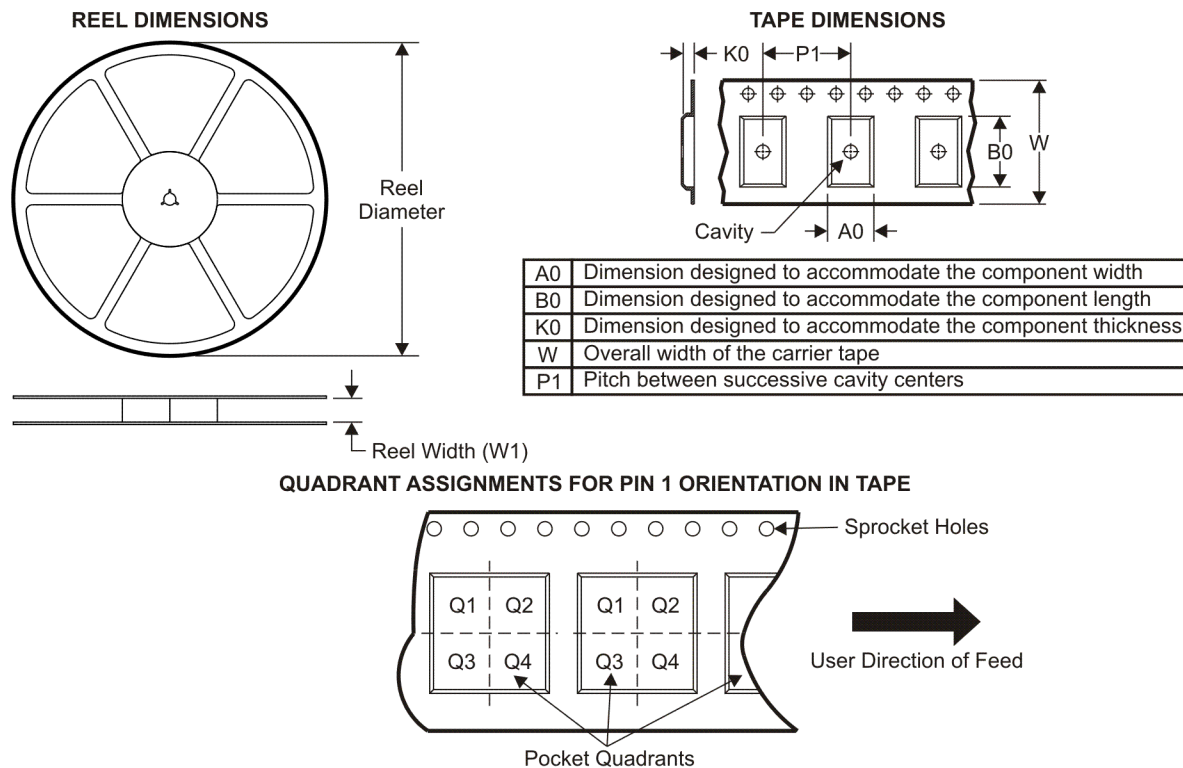
www.ti.com

PACKAGE OPTION ADDENDUM

28-Oct-2010

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.

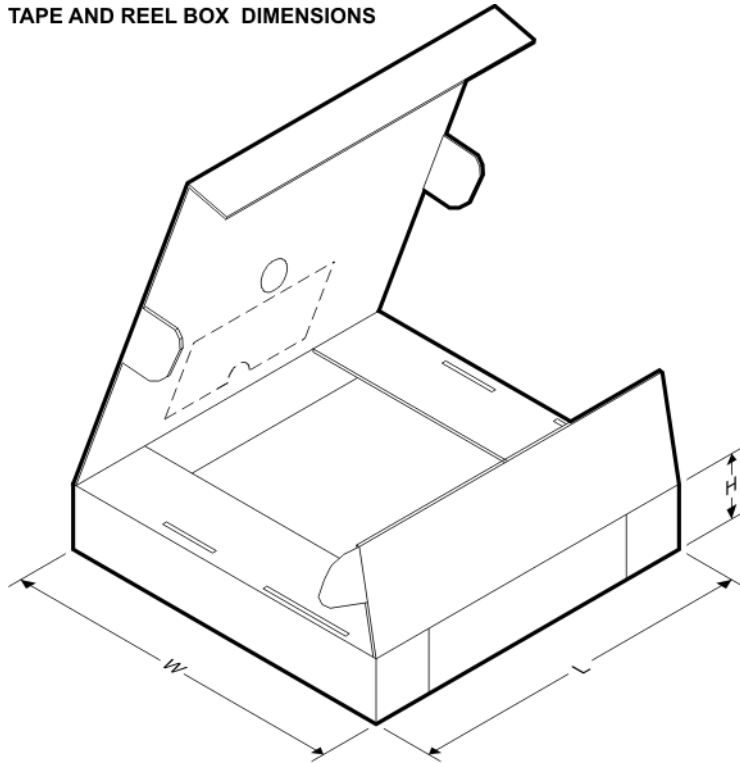
TAPE AND REEL INFORMATION



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
INA103KU/1K	SOIC	DW	16	1000	330.0	16.4	10.85	10.8	2.7	12.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
INA103KU/1K	SOIC	DW	16	1000	346.0	346.0	33.0

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
DLP® Products	www.dlp.com	Communications and Telecom	www.ti.com/communications
DSP	dsp.ti.com	Computers and Peripherals	www.ti.com/computers
Clocks and Timers	www.ti.com/clocks	Consumer Electronics	www.ti.com/consumer-apps
Interface	interface.ti.com	Energy	www.ti.com/energy
Logic	logic.ti.com	Industrial	www.ti.com/industrial
Power Mgmt	power.ti.com	Medical	www.ti.com/medical
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
RFID	www.ti-rfid.com	Space, Avionics & Defense	www.ti.com/space-avionics-defense
RF/IF and ZigBee® Solutions	www.ti.com/lprf	Video and Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless-apps