BURR-BROWN®

INA258/883B SERIES

MODEL NUMBERS:

INA258WG/883B	INA258VG/883B	INA258UG/883B
INA258WL/883B	INA258VL/883B	INA258UL/883B
INA258WG	INA258VG	INA258UG
INA258WL	INA258VL	INA258UL

REVISION B
JANUARY, 1989

Very-High Accuracy Military INSTRUMENTATION AMPLIFIER

FEATURES

- VERSATILE FOUR-OP AMP DESIGN
- ULTRA-LOW VOLTAGE DRIFT, 0.5μV/°C
- LOW OFFSET VOLTAGE, 50μV
- LOW NONLINEARITY, 0.005%
- LOW NOISE, 13nV/$\sqrt{Hz}$ at f_o = 1kHz
- HIGH CMR, 106dB at 60Hz
- HIGH INPUT IMPEDANCE, $10^{10}\Omega$

APPLICATIONS

- AMPLIFICATION OF SIGNALS FROM SOURCES SUCH AS:
  - Strain Gauges
  - Thermocouples
  - RTDs
- REMOTE TRANSDUCERS
- LOW LEVEL SIGNALS

DESCRIPTION

The INA258 is a high accuracy, multistage, integrated-circuit instrumentation amplifier designed for signal conditioning requirements where very high performance is desired.

A multiamplifier, monolithic design, which uses Burr-Brown's ultra-low drift, low noise technology, provides the highest performance with maximum versatility at the lowest cost. This makes the INA258 ideal for even high volume applications.

Burr-Brown's compatible thin film resistors and state-of-the-art wafer level laser trimming techniques are used for minimizing offset voltage and temperature drift. This advanced technique also maximizes common mode rejection and gain accuracy.

The INA258 also contains a fourth operational amplifier, specified separately, which can conveniently be used for some important applications, such as single-capacitor active low-pass filtering and easy output level shifting.

International Airport Industrial Park • Mailing Address: PO Box 11400 • Tucson, AZ 85734 • Street Address: 6730 S. Tucson Blvd. • Tucson, AZ 85706
Tel: (602) 746-111 • Twx: 910-952-1111 • Cable: BBRCORP • Telex: 066-6491 • FAX: (602) 889-1510 • Immediate Product Info: (800) 548-6132

PDS-501B

DETAILED SPECIFICATION
MICROCIRCUITS, LINEAR
INSTRUMENTATION AMPLIFIER
MONOLITHIC, SILICON

1. SCOPE

1.1 Scope. This specification covers the detail requirements for a very high accuracy instrumentation amplifier. For description of operation see paragraph 8.

1.2 Part number. The complete part number is as shown below.

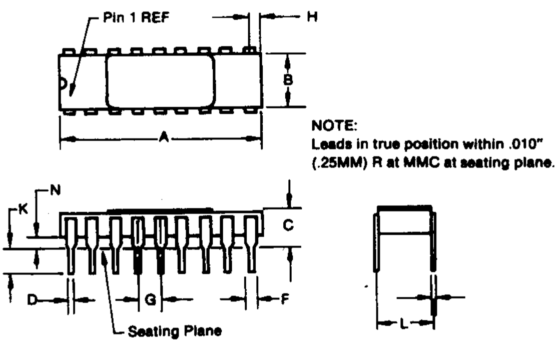
INA258	W	G	/883B
Basic model number	Grade (see 1.2.1)	Package (see 1.2.3)	Hi-Rel product designator (see 1.2.2)

1.2.1 Device type. The device is a single instrumentation amplifier. Three electrical performance grades (W, V, and U) are provided. The electrical performance characteristics are shown in Table I.

1.2.2 Device class. The device class is similar to the class B product assurance level as defined in MIL-M-38510. The Hi-Rel product designator portion of the part number distinguishes the product assurance levels available as follows:

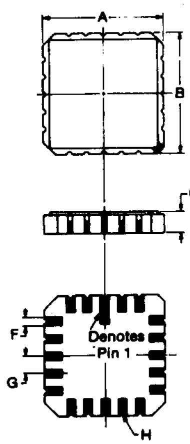
Hi-Rel Product Designator	Requirements
/883B	Standard model plus 100% MIL-STD-883 class B screening, with 5% PDA, plus quality conformance inspection (QCI) consisting of Groups A and B performed on each inspection lot, plus Groups C and D performed as required by MIL-STD-883.
(none)	Standard model including 100% electrical testing.

1.2.3 Case outline. Two case outlines are available. The case outline for the "G" package is D-6, configuration 3 (18-lead ceramic side braze), and the outline for the "L" package is C-2 (20-terminal square leadless chip carrier) as defined in MIL-M-38510 Appendix C. Figure 1 depicts the case outlines for both package types.



DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	—	.960	—	24.38
B	.220	.310	5.59	7.87
C	—	.200	—	5.08
D	.014	.023	.36	.58
F	.030	.070	.76	1.78
G	.100 BASIC		2.54 BASIC	
H	—	.098	—	2.49
J	.008	.015	.20	.38
K	.125	.200	3.18	5.08
L	.290	.320	7.37	8.13
N	.015	.060	.38	1.52

(a) 18-pin side braze; package ID: "G"



DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	.342	.358	8.69	9.09
B	.342	.358	8.69	9.09
C	.064	.100	1.63	2.54
F	.022	.028	0.56	0.71
G	.050 BASIC		1.27 BASIC	
A	.008R TYP.		0.20 TYP.	

(b) 20-terminal leadless chip carrier ID: "L"

FIGURE 1. Case Outlines.

1.2.4 Absolute maximum ratings.

Supply voltage range	±20VDC
Input voltage range	$\pm V_{CC}$
Internal power dissipation	600mW
Storage temperature range	−65°C to +165°C
Output short circuit duration	Continuous to ground
Lead temperature (soldering, 10 sec.)	+300°C

1.2.5 Recommended operating conditions.

Supply voltage range	±5VDC to ±20VDC
Ambient temperature range	−55°C to +125°C

1.2.6 Power and thermal characteristics.

Package	Case Outline	Maximum allowable power dissipation	Maximum θ_{JC}
18-lead DIP	Figure 1	600mW	41°C/W
20-terminal LCC	Figure 1	600mW	40°C/W

2. APPLICABLE DOCUMENTS

2.1 The following documents form a part of this specification to the extent specified herein.

SPECIFICATION
MILITARY
MIL-M-38510—Microcircuits, General Specification for.

STANDARD
MILITARY
MIL-STD-883—Test Methods and Procedures for Microcircuits.

3. REQUIREMENTS

3.1 General. Burr-Brown uses production and test facilities and a quality and reliability assurance program adequate to assure successful compliance with this specification.

3.1.1 Detail specifications. The individual item requirements are specified herein. In the event of conflicting requirements the order of precedence will be the purchase order, this specification, and then the reference documents.

3.2 Design, construction, and physical dimensions.

3.2.1 Package, metals, and other materials. The packages, metal surfaces, and other materials are in accordance with MIL-M-38510.

3.2.2 Design documentation. The design documentation is in accordance with MIL-M-38510.

3.2.3 Internal conductors and internal lead wires. The internal conductors and internal lead wires are in accordance with MIL-M-38510.

3.2.4 Lead material and finish. The lead material and finish is in accordance with MIL-M-38510 and is solderable per MIL-STD-883, method 2003.

3.2.5 Die thickness. The die thickness is in accordance with MIL-M-38510.

3.2.6 Physical dimensions. The physical dimensions are in accordance with paragraph 1.2.3 herein.

3.2.7 Circuit diagram and terminal connections. The circuit diagram and terminal connections for the "G" package are shown in Figure 2 and the circuit diagram and terminal connections for the "L" package are shown in Figure 3.

3.2.8 Glassivation. The microcircuit die is glassivated.

3.2.9 Schematic circuits. Simplified schematic circuits for "G" and "L" packages are shown in Figures 2 and 3 respectively.

3.3 Electrical performance characteristics. The electrical performance characteristics are specified in Table I and apply over the full operating ambient temperature range of −55°C to +125°C unless otherwise specified.

3.3.1 Additional electrical performance characteristics. Additional electrical performance curves are shown in paragraph 7.

3.3.2 Offset null. The amplifier is capable of being nulled to zero offset voltage using the circuit in Figure 4. If nulling is unnecessary, delete the potentiometer and make no connections.

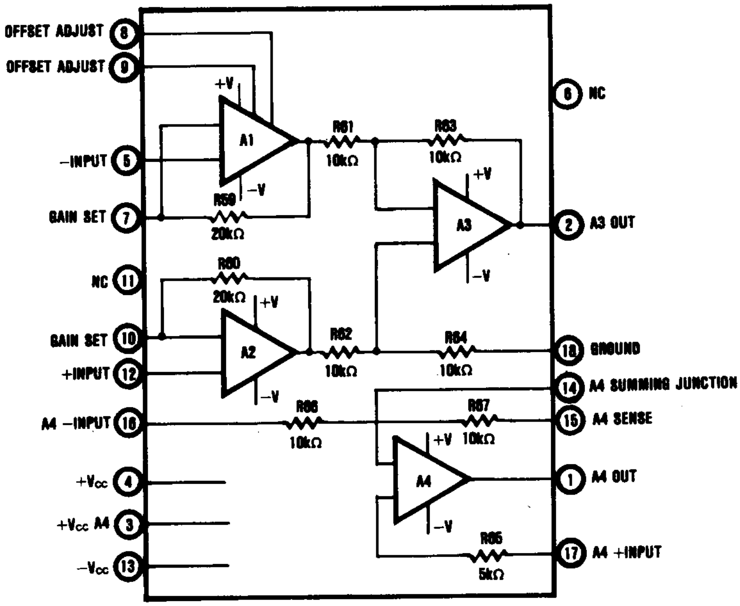


FIGURE 2. INA258 "G" Circuit Diagram and Terminal Connections.

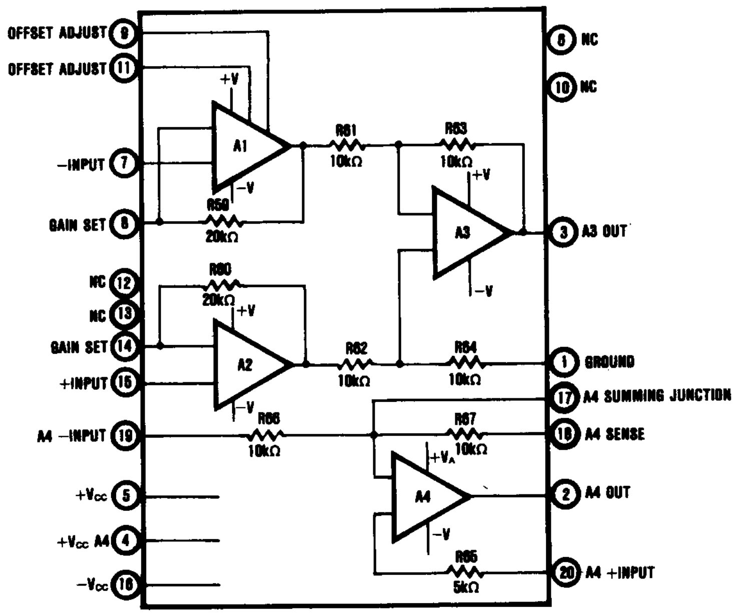


FIGURE 3. INA258 "L" Package Circuit Diagram and Terminal Connections.

TABLE I. Electrical Performance Characteristics.

All characteristics at $-55°C \leq T_A \leq +125°C$, $\pm V_{CC} = 15VDC$, unless otherwise specified.

CHARACTERISTICS	SYMBOL	CONDITIONS	INA258WG/883B INA258WL/883B INA258WG INA258WL			INA258VG/883B INA258VL/883B INA258VG INA258VL			INA258UG/883B INA258UL/883B INA258UG INA258UL			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
GAIN												
Range of Gain	A_V	$A_V = 1 + (40k/R_G)$ 1/	1		1000	•		•	•		•	V/V
Gain Equation Error	E_{AV}	$A_V = 1$, $T_A = +25°C$			.05							% FS
		$A_V = 10$, $T_A = +25°C$			.10							% FS
		$A_V = 100$, $T_A = +25°C$			.10							% FS
		$A_V = 1000$, $T_A = +25°C$			.40							% FS
Gain Tempco 2/	$\Delta A_V/\Delta T$	$A_V = 1$		2			•			•		ppm/°C
		$A_V = 10$		20			•			•		ppm/°C
		$A_V = 100$		22			•			•		ppm/°C
		$A_V = 1000$		22			•			•		ppm/°C
DC Nonlinearity	NL	$A_V = 1$, $T_A = +25°C$			0.005							%
		$A_V = 10$, $T_A = +25°C$			0.005							%
		$A_V = 100$, $T_A = +25°C$			0.007							%
		$A_V = 1000$, $T_A = +25°C$			0.025							%
RATED OUTPUT												
Voltage	V_{OP}	$R_L = 2k\Omega$, $T_A = +25°C$	±10			•			•			V
Current	I_O		±5			•			•			mA
Impedance	Z_O			2			•			•		Ω
INPUT OFFSET VOLTAGE												
Initial 3/	V_{IO}	$A_V = 1$, $T_A = +25°C$			±250			•			•	μV
	V_{IO}	$A_V = 1000$, $T_A = +25°C$			±50			•			•	μV
vs Temperature	$\Delta V_{IO}/\Delta T$	$A_V = 1$, $-55°C \leq T_A \leq +125°C$			10			15			45	μV/°C
		$A_V = 1000$, $-55°C \leq T_A \leq +125°C$			0.5			1.0			3.0	μV/°C
		$A_V = 1$, $-25°C \leq T_A \leq +85°C$									20	μV/°C
		$A_V = 1000$, $-25°C \leq T_A \leq +85°C$									1.8	μV/°C
vs Supply	PSRR	$A_V = 1$, $\Delta V_{CC} = \pm 5VDC$, $T_A = +25°C$			20			•			•	μV/V
		$A_V = 1000$, $\Delta V_{CC} = \pm 5VDC$, $T_A = +25°C$			1			•			•	μV/V
INPUT BIAS CURRENT												
Initial	I_{IB}	$T_A = +25°C$			±20			•			•	nA
Tempco	$\Delta I_{IB}/\Delta T$			±.2			•			•		nA/°C
INPUT OFFSET CURRENT												
Initial	I_{IO}	$T_A = +25°C$			±20			•			•	nA
Tempco	$\Delta I_{IO}/\Delta T$			±.5			•			•		nA/°C
INPUT IMPEDANCE												
Differential	Z_{ID}	$T_A = +25°C$		$10^{10}\|\|3$			•			•		Ω||pF
Common Mode	Z_{ICM}	$T_A = +25°C$		$10^{10}\|\|3$			•			•		Ω||pF
INPUT VOLTAGE												
Linear Response Range	V_{IN}		±10			•			•			V
Common Mode Rejection	CMR	DC-60Hz, $A_V = 1k\Omega$ Source Imbalance, $T_A = +25°C$	80			•			•			dB
		DC-60Hz, $A_V = 10$, $1k\Omega$ Source Imbalance $T_A = +25°C$	96			•			•			dB
		DC-60Hz, $A_V = 100\text{-}1000$, $1k\Omega$ Source Imbalance, $T_A = +25°C$	106			•			•			dB
INPUT NOISE												
Input Voltage Noise	E_{NPP}	$f_B = 0.01$ to 10Hz, $T_A = +25°C$		.8			•			•		μV, p-p
	E_N	$A_V = 1000$, $f_O = 10Hz$, $T_A = +25°C$		18			•			•		nV/√Hz
		$A_V = 1000$, $f_O = 100Hz$, $T_A = +25°C$		15			•			•		nV/√Hz
		$A_V = 1000$, $f_O = 1kHz$, $T_A = +25°C$		13			•			•		nV/√Hz
Input Current Noise	I_{NPP}	$f_B = 0.01Hz$ to 10Hz, $T_A = +25°C$		50			•			•		pA, p-p
	I_N	$f_O = 10Hz$, $T_A = +25°C$		.8			•			•		pA/√Hz
		$f_O = 100Hz$, $T_A = +25°C$		.46			•			•		pA/√Hz
		$f_O = 1kHz$, $T_A = +25°C$		.35			•			•		pA/√Hz
DYNAMIC RESPONSE												
Slew Rate	SR	$A_V = 1$ to 100, $R_L = 2k\Omega$, $T_A = +25°C$	0.2									V/μsec
Bandwidth	BW	3dB small signal, $A_V = 1$, $T_A = +25°C$		300			•			•		kHz
		$A_V = 10$, $T_A = +25°C$		140			•			•		kHz
		$A_V = 100$, $T_A = +25°C$		25			•			•		kHz
		$A_V = 1000$, $T_A = +25°C$		2.5			•			•		kHz
	BW	Full power $A_V = 1$ to 1000, $T_A = +25°C$		6.4								kHz
Settling Time	T_S	.01%, $A_V = 1$, $T_A = +25°C$		30			•			•		μsec
		$A_V = 100$, $T_A = +25°C$		50			•			•		μsec
		$A_V = 1000$, $T_A = +25°C$		500			•			•		μsec

TABLE I. Electrical Performance Characteristics (cont).

CHARACTERISTICS	SYMBOL	CONDITIONS	INA258WG/883B INA258WL/883B INA258WG INA258WL			INA258VG/883B INA258VL/883B INA258VG INA258VL			INA258UG/883B INA258UL/883B INA258UG INA258UL			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
POWER SUPPLY												
Rated Voltage	$\pm V_{CC}$		±5	±15	±20	*	*	*	*	*	*	V
Quiescent Current	I_Q	$T_A = +25°C$			±8			*			*	mA
FOURTH OP AMP												
Input Offset Drift	V_{IO}	$T_A = +25°C$			5000			*			*	µV
Tempco	$\Delta V_{IO}/\Delta T$	$-55 \leq T_A \leq +125°C$		±5			*			*		µV/°C
Input Bias Current	I_{IB}	$T_A = +25°C$			50			*			*	nA
Input Offset Current	I_{IO}	$T_A = +25°C$			50			*			*	nA
Quiescent Current	I_Q	$T_A = +25°C$		2	4			*			*	mA

*Same as INA258W grade.

NOTES: 1/ Typically the tolerance of R_G will be the major source of gain error.
2/ Not including TCR of R_G.
3/ Adjustable to zero at any one gain.

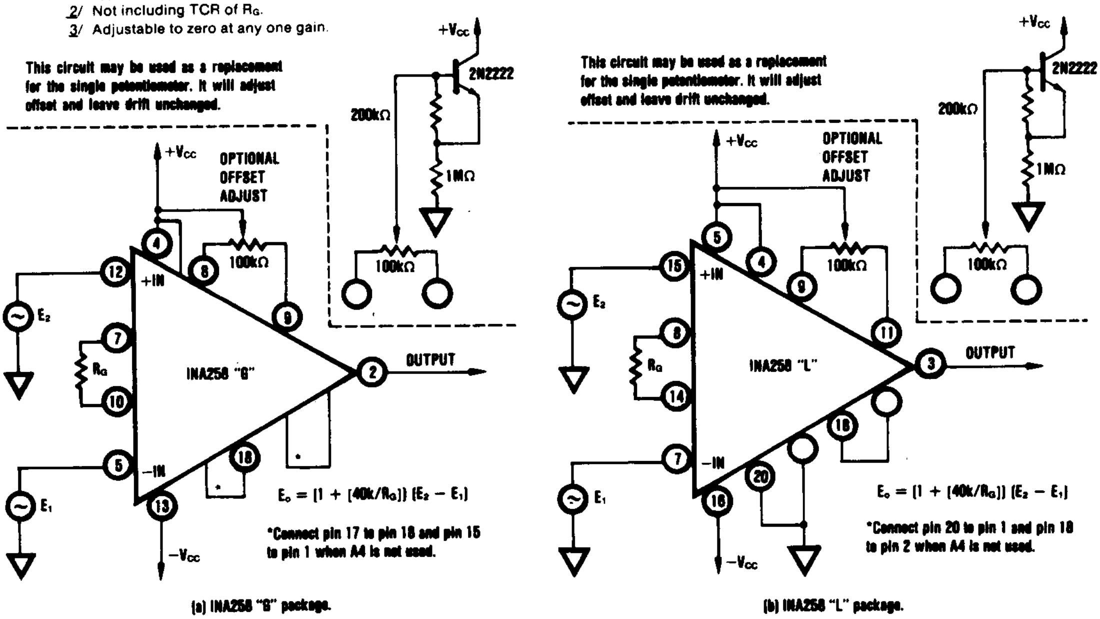


FIGURE 4. Basic Circuit Connection for the INA258 Including Optional Input Offset Null Potentiometer.

3.4 Electrical tests. Electrical tests are shown in Table II. The subgroups of Table III which constitute the minimum electrical tests for screening, qualification, and quality conformance, are shown in Table II.

3.5 Marking. Marking is in accordance with MIL-M-38510. The following marking is placed on each microcircuit as a minimum.

a. Part number (see paragraph 1.2)
b. Inspection lot identification code 1/
c. Manufacturer's identification (BURR-BROWN®)
d. Manufacturer's designating symbol (CEBS)
e. Country of origin
f. Electrostatic sensitivity identifier (Δ)
g. Compliance identifier "C"

3.6 Workmanship. These microcircuits are manufactured, processed, and tested in a workmanlike manner. Workmanship is in accordance with good engineering practices, workmanlike instructions, inspection and test procedures, and training, prepared in fulfillment of Burr-Brown's product assurance program.

1/ A 4-digit code, indicating year and week of seal, and a 4- or 5-digit lot identifier are marked on each unit.

3.6.1 Rework provisions. Rework provisions for the /883B Hi-Rel product designation, including rebonding, are in accordance with MIL-M-38510.

3.7 Traceability. Traceability for the /883B product designation is in accordance with MIL-M-38510. Each microcircuit is traceable to the production lot and to the component vendor's component lot.

3.8 Product and process change. Burr-Brown will not implement any major change to the design, materials, construction, or manufacturing process which may affect the performance, quality or interchangeability of the microcircuit without full or partial requalification.

3.9 Screening. Screening for the /883B Hi-Rel product designation is in accordance with MIL-STD-883, method 5004, class B, except as modified in paragraph 4.3 herein.

Screening for the standard model includes QC4118 internal visual inspection, stabilization bake, fine leak, gross leak, burn-in (72 hours performed preseal), constant acceleration (condition E), temperature cycle (condition C), and external visual per MIL-STD-883, method 2009.

For the /883B Hi-Rel product designator, all microcircuits will have passed the screening requirements prior to qualification or quality conformance inspection.

3.10 Qualification. Qualification is not required. See paragraph 4.2 herein.

TABLE II. Electrical Test Requirements.

(The individual tests within the subgroups appear in Table III).

MIL-STD-883 REQUIREMENTS (Class B)	INA258WG/883B INA258WG INA258WL/883B INA258WL	INA258VG/883B INA258VG INA258VL/883B INA258VL	INA258UG/883B INA258UG INA258UL/883B INA258UL
Interim electrical parameters (preburn-in) (method 5004)	1	1	1
Final electrical test parameters (method 5004)	1*, 2, 3, 4	1*, 2, 3, 4	1*, 2, 2U, 3, 3U, 4
Group A test requirements (method 5005) 1/	1, 2, 3, 4	1, 2, 3, 4	1, 2, 2U, 3, 3U, 4
Group C end point electrical parameters (method 5005) 1/	1	1	—

*PDA applies to subgroup 1 (see 4.3.c)

1/ Applies to /883B models only.

TABLE III. Group A Inspection.

SUBGROUP	SYMBOL	MIL-STD-883 METHOD or equivalent	CONDITIONS ($\pm V_{CC}$ = 15VDC unless otherwise specified)	LIMITS: INA258WG/883B INA258WL/883B INA258WG INA258WL MIN	MAX	INA258VG/883B INA258VL/883B INA258VG INA258VL MIN	MAX	INA258UG/883B INA258UL/883B INA258UG INA258UL MIN	MAX	UNITS
1 T_A = 25°C	V_{io}	4001	A_V = 10		±75		±75		±75	µV
			A_V = 1000		±50		±50		±50	µV
	I_{ib}	4001			±20		±20		±20	nA
	I_{io}	4001			±20		±20		±20	nA
	I_Q	4005	Each Supply		±8		±8		±8	mA
	PSRR	4003	A_V = 1, ΔV_{CC} = ±5VDC		20		20		20	µV/V
			A_V = 1000, ΔV_{CC} = ±5VDC		1		1		1	µV/V
	CMR	4003	DC, A_V = 1, 1kΩ Source Imbalance	80		80		80		dB
			DC, A_V = 10, 1kΩ Source Imbalance	96		96		96		dB
			DC, A_V = 100-1000, 1kΩ Source Imbal.	106		106		106		dB
	V_{io} 1/	4001			5000		5000		5000	µV
	I_{ib} 1/	4001			50		50		50	nA
	I_{io} 1/	4001			50		50		50	nA
	I_Q 1/	4005			4		4		4	mA
2 T_A = 125°C	V_{io}	4001	A_V = 10		±325		±450		±1200	µV
			A_V = 1000		100		150		450	µV
	$\Delta V_{io}/\Delta T$	4001	A_V = 10 [V_{io} (125°C) − V_{io} (25°C)] ÷ 100		±2.5		±3.75		±11.25	µV/°C
			A_V = 1000 [V_{io} (125°C) − V_{io} (25°C)] ÷ 100		0.5		1.0		3.0	µV/°C
2U T_A = 85°C	V_{io}	4001	A_V = 10						±225	µV
			A_V = 1000						150	µV
	$\Delta V_{io}/\Delta T$	4001	A_V = 10 [V_{io} (85°C) − V_{io} (25°C)] ÷ 60						±2.5	µV/°C
			A_V = 1000 [V_{io} (85°C) − V_{io} (25°C)] ÷ 60						1.8	µV/°C

TABLE III. Group A Inspection (cont).

SUBGROUP	SYMBOL	MIL-STD-883 METHOD or equivalent	CONDITIONS ($\pm V_{CC}$ = 15VDC unless otherwise specified)	LIMITS						UNITS
				INA258WG/883B INA258WL/883B INA258WG INA258WL		INA258VG/883B INA258VL/883B INA258VG INA258VL		INA258UG/883B INA258UL/883B INA258UG INA258UL		
				MIN	MAX	MIN	MAX	MIN	MAX	
3 $T_A = -55°C$	V_{io}	4001	$A_V = 10$		±325		±450		±1200	μV
			$A_V = 1000$		90		150		450	μV
	$\Delta V_{io}/\Delta T$	4001	$A_V = 10$ $[V_{io}(25°C) - V_{io}(-55°C)] \div 80$		±2.5		±3.75		±11.25	μV/°C
			$A_V = 1000$ $[V_{io}(25°C) - V_{io}(-55°C)] \div 80$		1.5		1.0		3.0	μV/°C
3U $T_A = -25°C$	V_{io}	4001	$A_V = 10$						±300	μV
			$A_V = 1000$						135	μV
	$\Delta V_{io}/\Delta T$	4001	$A_V = 10$ $[V_{io}(25°C) - V_{io}(-25°C)] \div 50$						±2.5	μV/°C
			$A_V = 1000$ $[V_{io}(25°C) - V_{io}(-25°C)] \div 50$						1.8	μV/°C
4 $T_A = 25°C$	E_{AV}		Gain Equation Error $A_V = 1$		0.05		0.05		0.05	% FS
			$A_V = 10$		0.10		0.10		0.10	% FS
			$A_V = 100$		0.10		0.10		0.10	% FS
			$A_V = 1000$		0.40		0.40		0.40	% FS
	V_{OP}	4004	$R_L = 2k\Omega$	±10		±10		±10		V
	SR		$R_L = 2k\Omega$	0.2		0.2		0.2		V/μsec
	NL 2/	Figure 4	$A_V = 1$		0.005		0.005		0.005	%
			$A_V = 10$		0.005		0.005		0.005	%
			$A_V = 100$		0.007		0.007		0.007	%
			$A_V = 1000$		0.025		0.025		0.025	%

NOTES: 1/ Fourth op amp.
2/ E_1 = 0V and E_2 is varied to enable nonlinearity error to be measured by sampling 21 points between $-10V \leq E_{OUT} \leq +10V$ and determining worst case deviation from straight line connecting these end points at each gain setting.

3.11 Quality conformance inspection. Quality conformance inspection, for the /883B Hi-Rel product designation, is in accordance with MIL-M-38510, except as modified in paragraph 4.4 herein. The microcircuit inspection lot will have passed quality conformance inspection prior to microcircuit delivery.

4. PRODUCT ASSURANCE PROVISIONS

4.1 Sampling and inspection. Sampling and inspection procedures are in accordance with MIL-M-38510 and MIL-STD-883, method 5005, except as modified herein.

4.2 Qualification. Qualification is not required unless specifically required by contract or purchase order. When so required, qualification will be in accordance with the inspection routine of MIL-M-38510, 4.4.2.1. The inspections to be performed are those specified herein for groups A, B, C, and D inspections (see paragraphs 4.4.1, 4.4.2, 4.4.3, and 4.4.4).

Burr-Brown has performed and successfully completed qualification inspection as described above. The most recent report is available from Burr-Brown.

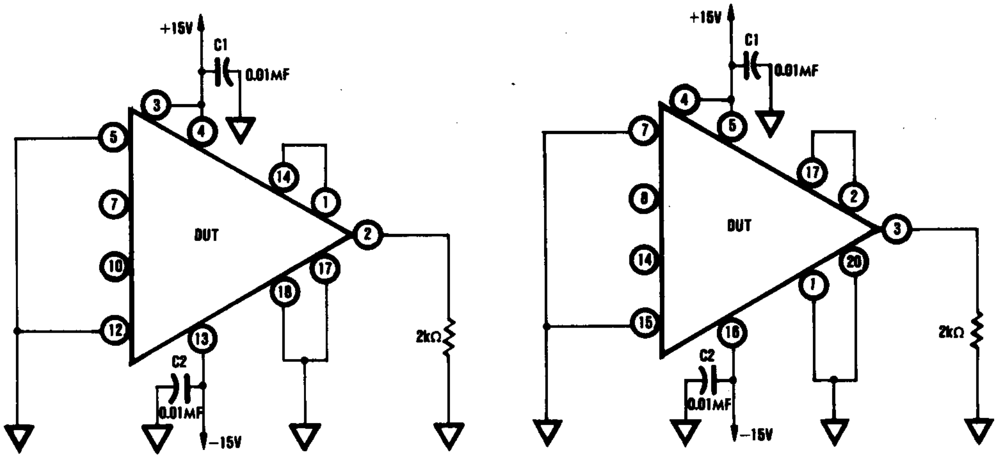
4.3 Screening. Screening for the /883 Hi-Rel product designation is in accordance with MIL-STD-883, method 5004, class B, and is conducted on all devices. The following criteria apply:

a. Interim and final test parameters are specified in Table II.

b. Burn-in test (MIL-STD-883, method 1015) conditions:
   (1) Test condition B
   (2) Test circuit is Figure 5 herein
   (3) $T_A = +125°C$ minimum
   (4) Test duration is 160 hours minimum

c. Percent defective allowable (PDA). The PDA, for /883B product designation only, is 5 percent and includes both both parametric and catastrophic failures. It is based on failures from group A, subgroup 1 test, after cool-down as final electrical test in accordance with MIL-STD-883, method 5004, and with no intervening electrical measurements. If interim electrical parameter tests are performed prior to burn-in, failures resulting from preburn-in screening failures may be excluded from the PDA. If interim electrical parameter tests are omitted, all screening failures shall be included in the PDA. The verified failures of group A, subgroup 1, after burn-in are used to determine the percent defective for each manufacturing lot, and the lot is accepted or rejected based on the PDA.

d. External visual inspection need not include measurement of case and lead dimensions.



(a) INA258 "G".   (b) INA258 "L".

FIGURE 5. Test Circuit, Burn-In and Operating Life Test.

4.4 Quality conformance inspection. Groups A and B inspections of MIL-STD-883, method 5005, are performed on each inspection lot. Groups C and D inspections of MIL-STD-883, method 5005, are performed as required by MIL-STD-883.

A report of the most recent groups C and D inspections is available from Burr-Brown.

4.4.1 Group A inspection. Group A inspection consists of the test subgroups and LTPD values shown in MIL-STD-883, method 5005, and as specified in Table II herein.

4.4.2 Group B inspection. Group B inspection consists of the test subgroups and LTPD values shown in MIL-STD-883, method 5005, class B.

4.4.3 Group C inspection. Group C inspection consists of the test subgroups and LTPD values shown in MIL-STD-883, method 5005, class B, and as follows:

a. Operating life test (MIL-STD-883, method 1005) conditions:
   (1) Test condition B
   (2) Test circuit is Figure 5 herein
   (3) $T_A = +125°C$ minimum
   (4) Test duration is 1000 hours minimum

b. End point electrical parameters are specified in Table II herein.

4.4.4 Group D inspection. Group D inspection consists of the test subgroups and LTPD values shown in MIL-STD-883, method 5005 and as follows:

a. End point electrical parameters are specified in Table II herein.

4.4.5 Inspection of packaging. Inspection of packaging shall be in accordance with MIL-M-38510.

4.5 Methods of examination and test. Methods of examination and test are specified in the appropriate tables. Electrical test circuits are as prescribed herein or in the referenced test methods of MIL-STD-883.

4.5.1 Voltage and current. All voltage values given, except the input offset voltage (or differential voltage) are referenced to the external zero reference level of the supply voltage. Currents given are conventional current and positive when flowing into the referenced terminal.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-M-38510.

6. NOTES

6.1 Notes. The notes specified in MIL-M-38510 are applicable to this specification.

6.2 Intended use. Microcircuits conforming are intended for use in applications where the use of screened parts is required or desirable.

6.3 Order data. The contract or purchase order should specify the following:

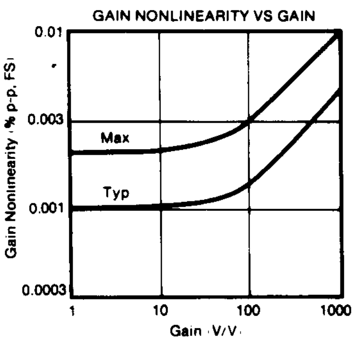
a. Complete part number (see paragraph 1.2).
b. Requirement for certificate of compliance, if desired.

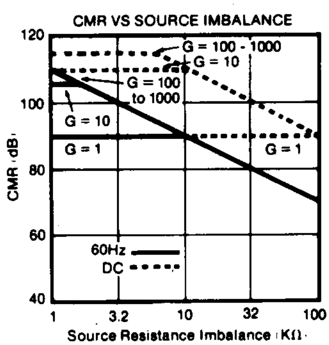
6.4 Microcircuit group assignment. These microcircuits are assigned to Technology Group D as defined in MIL-M-38510, Appendix E.

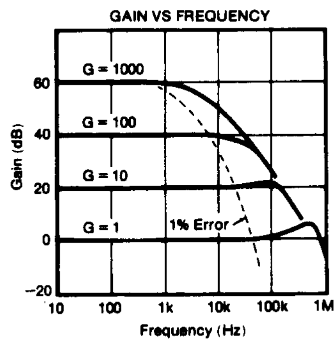
6.5 Electrostatic sensitivity. CAUTION—These microcircuits may be damaged by electrostatic discharge. Precautions should be observed at all times.

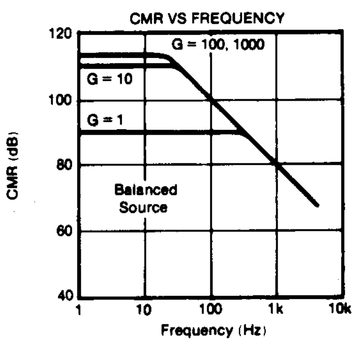
7. ELECTRICAL PERFORMANCE GRADES

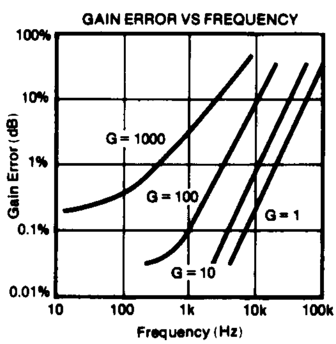
(Typical at +25°C and $\pm V_{CC}$ = 15VDC unless otherwise specified.)

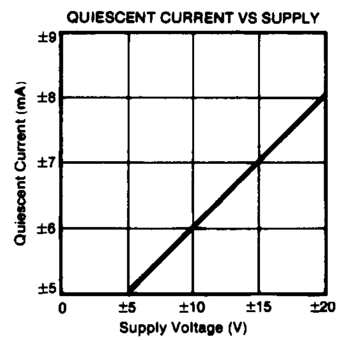


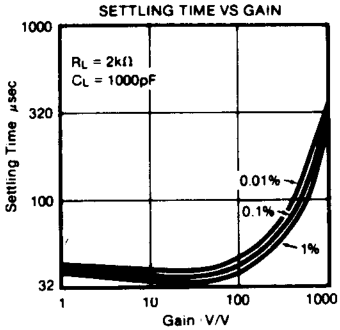


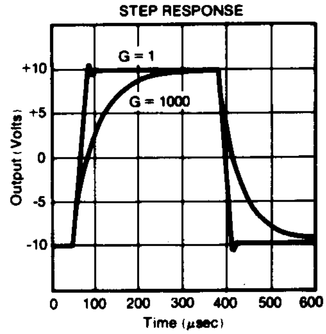


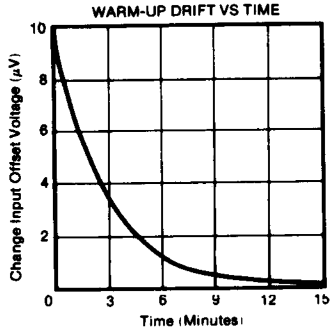


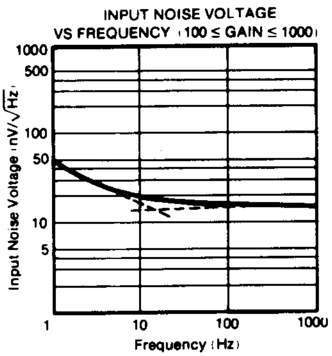


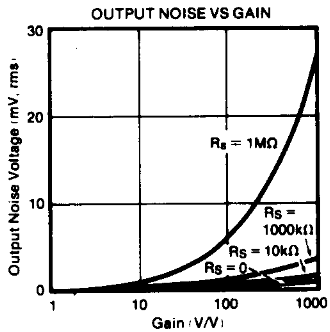












8. APPLICATION INFORMATION

8.1 Description. The INA258 is a three-amplifier device which provides all the desirable characteristics of a premium performance instrumentation amplifier. In addition, it has features not normally found in integrated circuit instrumentation amplifiers. See simplified schematics in Figures 2 and 3.

The input section (A1 and A2) incorporates high performance, low drift amplifier circuitry. The amplifiers are connected in the noninverting configuration to provide the high input impedance ($10^{10}\Omega$) desirable in the instrumentation amplifier function. The offset voltage and offset voltage versus temperature are low due to the monolithic design, and are improved even further by state-of-the-art laser-trimming techniques.

The output section (A3) is connected in a unity-gain difference amplifier configuration. A critical part of this stage is the matching of the four 10kΩ resistors which provide the difference function. These resistors must be initially well matched and the matching must be maintained over temperature and time in order to retain excellent common-mode rejection. (The 106dB minimum at 60Hz for gains greater than 100V/V is a significant improvement compared to most other integrated circuit instrumentation amplifiers.)

All of the internal resistors are compatible thin-film nichrome formed with the integrated circuit. The critical resistors are laser-trimmed to provide the desired high gain accuracy and common-mode rejection. Nichrome ensures long-term stability of trimmed resistors and simultaneous achievement of excellent TCR and TCR tracking. This provides gain accuracy and common-mode rejection when the INA258 is operated over wide temperature ranges.

The fourth op-amp (A4) of the INA258 adds a great deal of versatility and convenience to the amplifier. Its use allows easy implementation of active low-pass filtering, output offsetting, and additional gain generation. The pin connections make the use of this stage optional and the specifications appear separately in the table of Electrical Specifications.

8.2 Using the INA258. Figure 4 shows the simplest configuration of the INA258. The gain is set by the external resistor, R_G, with a gain equation of $G = 1 + (40K/R_G)$. The reference and TCR of R_G contribute directly to the gain accuracy and drift.

For gains greater than unity, resistor R_G is connected externally. At high gains, where the value of R_G becomes small, additional resistance (i.e., relays, sockets) in the R_G circuit will contribute to a gain error. Care should be taken to minimize this effect.

8.3 Basic circuit connection. The basic circuit connection for the INA258 is shown in Figure 4. The output voltage is a function of the differential input voltage times the gain.

Figure 4 does not include additional internal op amp A4. Power supply bypassing with a 1μF tantalum capacitor or equivalent is always recommended.

In applications which do not use the fourth internal amplifier, insure the A4 +V_{CC} is not connected to V_{CC}, the A4 + input is connected to common and A4 sense is connected to A4 output.

8.4 Typical applications. Many applications of instrumentation amplifiers involve the amplification of low-level differential signals from bridges and transducers such as strain gauges, thermocouples, and RTD's. Some of the important parameters include common-mode rejection (differential cancellation of common-mode offset and noise), input impedance, offset voltage and drift, gain accuracy, linearity, and noise. The INA258 accomplishes all of these with high precision.

Figures 6, 7, and 8 show some typical applications circuits.

Figure 6 shows how the output stage may be used to provide additional gain. If gains greater than 1000V/V (10,000 up to 100,000 and greater) are desired, it is better to place some gain in the output amplifier rather than the input stage, due to the low values of R_G required ($R_G < 40\Omega$ for $[1 + 40k/R_G] > 1000$). Note, however, that accuracy can degrade due to very high amplification of offset, drift, and noise errors.

Output offsetting ("zero suppression" or "zero elevation") may be more easily accomplished with the INA258 than with most other IC instrumentation amplifiers, as shown in Figure 7. The use of the extra internal op amp, A4, means that CMR of the instrument amp is not disturbed, and that a convenient value of variable resistor can be used.

Amplifier A4 also allows active low-pass filtering to be implemented conveniently with a single capacitor. Filtering can be used for noise reduction or band-limiting of the output signal as shown in Figure 8.

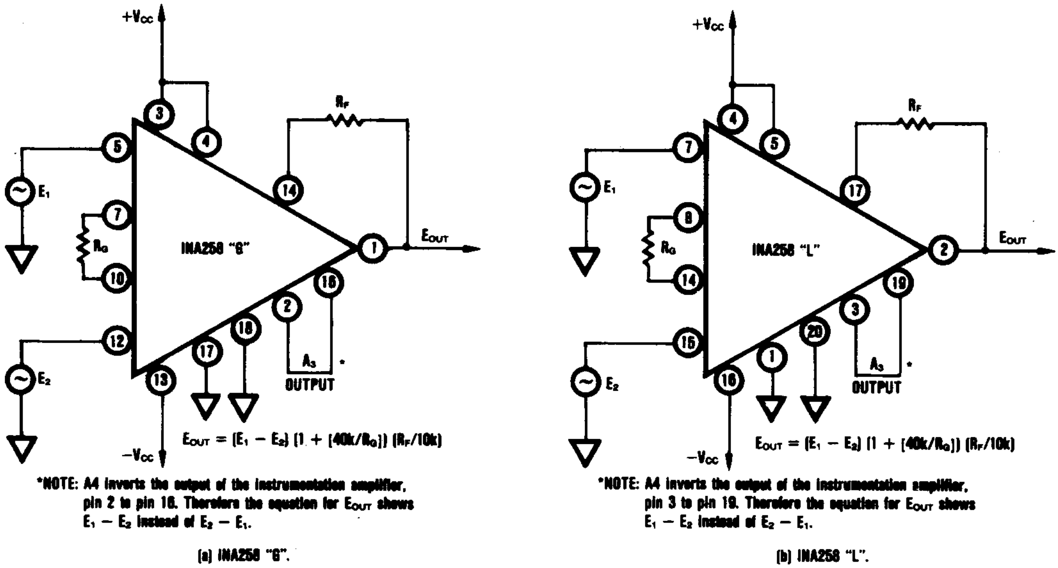
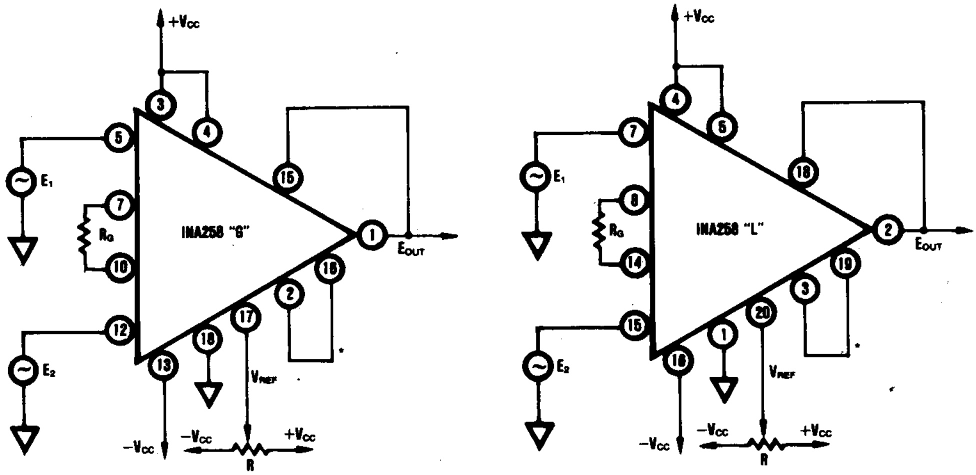


FIGURE 6. Additional Gain From Output Stage.



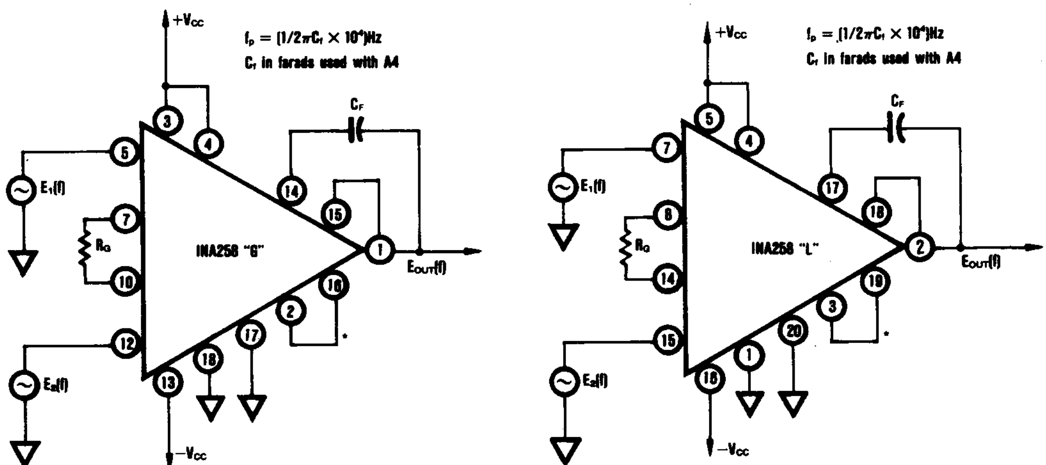
R = a convenient value (<100kΩ typically)
$E_{OUT} = (E_1 - E_2)(1 + [40k/R_G]) + 2V_{REF}$
*NOTE: A4 inverts, see Figure 6.

(a) INA258 "G".

R = a convenient value (<100kΩ typically)
$E_{OUT} = (E_1 - E_2)(1 + [40k/R_G]) + 2V_{REF}$
*NOTE: A4 inverts, see Figure 6.

(b) INA258 "L."

FIGURE 7. Output Offsetting.



$E_{OUT} = (E_1 - E_2)(1 + [40k/R_G])(1/(1 + 2\pi f \times 10^4 \times C_F))$
*NOTE: A4 inverts, see Figure 6.

(a) INA258 "G"

$E_{OUT} = (E_1 - E_2)(1 + [40k/R_G])(1/(1 + 2\pi f \times 10^4 \times C_F))$
*NOTE: A4 inverts, see Figure 6.

(b) INA258 "L".

FIGURE 8. Active Low-Pass Filtering.