



## OPA105/883B SERIES

### MODEL NUMBERS:

OPA105VM/883B    OPA105WM/883B  
 OPA105VM        OPA105WM  
 OPA105UM/883B  
 OPA105UM

REVISION C  
 JANUARY, 1989

OPA105/883B

## FET Input Military OPERATIONAL AMPLIFIER

### FEATURES

- LOW BIAS CURRENT, 1pA, max
- HIGH INPUT IMPEDANCE,  $10^{13}\Omega$
- ULTRA-LOW DRIFT,  $2\mu\text{V}/^\circ\text{C}$ , max
- LOW OFFSET VOLTAGE  $250\mu\text{V}$ , max
- LOW QUIESCENT CURRENT, 1.5mA, max
- HERMETICALLY SEALED TO-99 PACKAGE

### APPLICATIONS

- CURRENT-TO-VOLTAGE CONVERSION
- LONG TERM PRECISION INTEGRATION
- PRECISION VOLTAGE AMPLIFICATION FOR HIGH INPUT IMPEDANCE APPLICATIONS

### DESCRIPTION

The OPA105/883B Series is a low bias current operational amplifier. Guaranteed low initial offset voltage ( $250\mu\text{V}$ , max) and associated drift versus temperature ( $2\mu\text{V}/^\circ\text{C}$ , max) is achieved by laser-adjusting the amplifier during manufacturing. This feature, and guaranteed low bias current (1pA, max), allow greater system accuracy with no external components.

Quiescent current (1.5mA, max) is unaffected by changes in ambient temperature or power supply voltage. Other characteristics of the OPA105/883B Series include internal compensation for unity-gain

stability and rapid thermal response for quick stabilization after turn-on or temperature changes.

The amplifier is free from latch-up and is protected for continuous output shorts to common. As an added protection feature, either of the trim pins can be accidentally shorted to a potential greater than the negative supply voltage without damage.

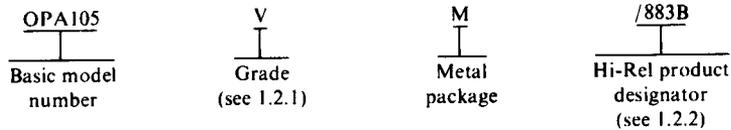
The standard pin configuration (741 type) of the OPA105/883B Series allows the user drop-in replacement capability. A pin 8 case connection permits the reduction of noise and leakage by employing guarding techniques.

**DETAILED SPECIFICATION  
MICROCIRCUITS, LINEAR  
OPERATIONAL AMPLIFIER  
MONOLITHIC, SILICON**

1. SCOPE

1.1 Scope. This specification covers the detail requirements for a FET input, low bias current, low drift, integrated circuit operational amplifier.

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



1.2.1 Device type. The device is a single operational amplifier. Three electrical performance grades are provided. The W grade features  $\pm 2\mu V/^{\circ}C$  drift (-55°C to +125°C). The V grade features  $\pm 5\mu V/^{\circ}C$  drift (-55°C to +125°C). The U grade features excellent performance ( $\pm 15\mu V/^{\circ}C$ ) from -25°C to +85°C and guarantees performance from -55°C to +125°C. Electrical specifications are shown in Table I. Electrical tests are shown in Tables II and III.

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 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 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. The case outline is A-1 (8-lead can, TO-99) as defined in MIL-M-38510, Appendix C. The case is metal and is conductive.

1.2.4 Absolute maximum ratings.

Supply voltage range	±20VDC
Input voltage range	±20VDC <sup>1</sup>
Differential input voltage range	±40VDC <sup>1</sup>
Storage temperature range	-65°C to +150°C
Output short-circuit duration	Unlimited <sup>2</sup>
Lead temperature (soldering, 60sec)	300°C
Junction temperature	T <sub>J</sub> = 175°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 J-A
8-lead can	Figure 1	225mW at T <sub>A</sub> = 125°C	70°C/W

<sup>1</sup> The absolute maximum input voltage is equal to the supply voltage.

<sup>2</sup> Short circuit may be to ground only. Rating applies to +135°C case temperature or +50°C ambient temperature at ±15VDC supply voltage.

## 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.

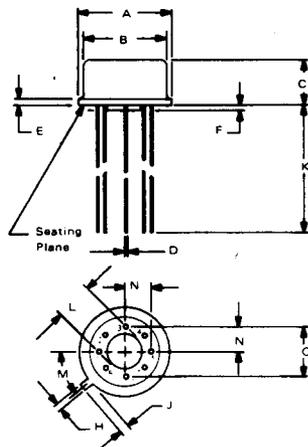
## 3. REQUIREMENTS

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 package is in accordance with paragraph 3.5.1 of MIL-M-38510. The exterior metal surfaces are corrosion resistant. The other materials are nonnutritive to fungus as specified in MIL-M-38510. See Figure 1 for the case outline.



## Note:

Leads in true position within 0.010"

0.25mm R at MMC at seating plane.

Pin numbers shown for reference only.

Numbers may not be marked on package.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.335	.370	8.51	9.40
B	.305	.335	7.75	8.51
C	.165	.185	4.19	4.70
D	.016	.021	0.41	0.53
E	.010	.040	0.25	1.02
F	.010	.040	0.25	1.02
G	200 BASIC		5.08 BASIC	
H	.028	.034	0.71	0.86
J	.029	.045	0.74	1.14
K	.500		12.7	
L	.110	.160	2.79	4.06
M	45° BASIC		45° BASIC	
N	.095	.105	2.41	2.67

FIGURE 1. Case Outline (TO-99) Package Configuration.

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 is kovar type (type A). The lead finish is gold plate with nickel underplating. 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 are shown in Figure 2.

3.2.8 Glassivation. All dice are glassivated.

3.2.9 Schematic Circuit. A simplified schematic circuit is shown in Figure 3.

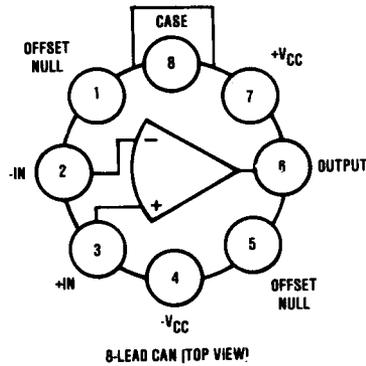
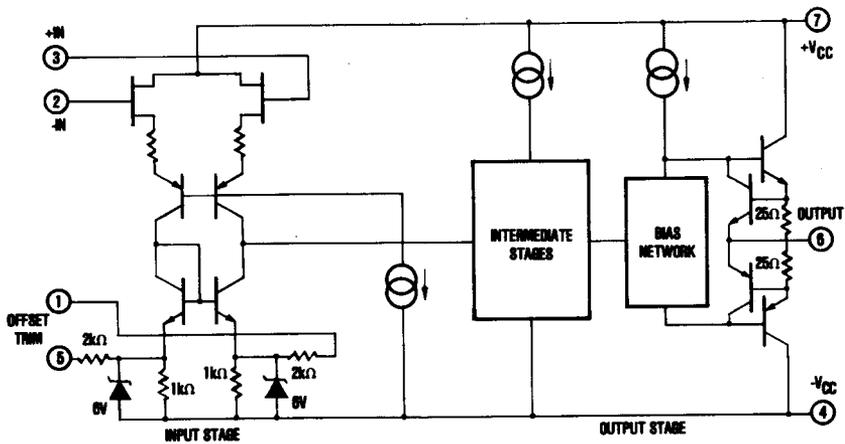


FIGURE 2. Circuit Diagram and Terminal Connections.



3.3 Electrical Performance Characteristics. The electrical performance characteristics are as specified in Table I and apply over the full operating ambient temperature range of  $-55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  unless otherwise specified.

3.3.1 Additional Electrical Performance Characteristics. 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 for the application, delete the three components and make no connections.

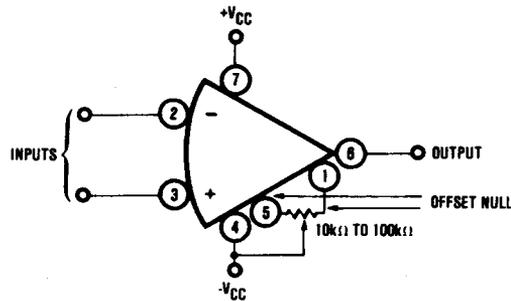


FIGURE 4. Offset Null Circuit.

3.3.3 **Frequency compensation.** No frequency compensation is required. The amplifier is free of oscillation when operated at any gain and when operated in any test condition specified herein.

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-STD-883. The following marking is placed on each microcircuit as a minimum.

- a. Part number (see paragraph 1.2)
- b. Inspection lot identification code<sup>1/</sup>
- c. Manufacturer's identification (  )
- d. Manufacturer's designating symbol (CEBS)
- e. Country of origin
- f. Electrostatic sensitivity identifier ( $\Delta$ )
- g. Compliance indicator "C"

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

3.7 **Traceability.** Traceability for /883B Hi-Rel 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, configuration, or manufacturing process which may affect the performance, quality or interchangeability of the microcircuit without full or partial requalification.

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

TABLE I. Electrical Performance Characteristics.

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

CHARACTERISTIC	SYM-BOL	CONDITIONS	OPA105WM/883B OPA105WM			OPA105VM/883B OPA105VM			OPA105UM/883B OPA105UM			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
<b>GAIN</b>												
Open-Loop Voltage Gain	$A_{vs}$	$R_L = 2\text{k}\Omega$ $V_O = \pm 10\text{V}$ , $F = 0\text{Hz}$	$T_A = +25^{\circ}\text{C}$		106	112		*	*	*	*	dB
			$-55^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$		95	102		*	*	*	*	dB
<b>RATED OUTPUT</b>												
Voltage	$V_O$	$R_L = 1\text{k}\Omega$	$\pm 10$				*	*	*	*		V
Current	$I_O$		$\pm 10$				*	*	*	*		mA
Impedance	$Z_O$			3			*	*	*	*		k $\Omega$
Load Capacitance	$C_L$		500	1000			*	*	*	*		pF
Short Circuit Current	$I_{OS}$	To Ground	10	25			*	*	*	*		mA
<b>DYNAMIC RESPONSE</b>												
Bandwidth	BW	Unity Gain-Small Signal	$T_A = +25^{\circ}\text{C}$	1			*	*	*	*		MHz
Bandwidth	BW	Full Power	$T_A = +25^{\circ}\text{C}$	20			*	*	*	*		kHz
Slew Rate	SR	$R_L = 2\text{k}\Omega$	$T_A = +25^{\circ}\text{C}$	1.3			*	*	*	*		V/ $\mu\text{sec}$
Settling Time - 0.1%	$T_s$		$T_A = +25^{\circ}\text{C}$	9			*	*	*	*		$\mu\text{sec}$
Settling Time - 0.01%	$T_s$		$T_A = +25^{\circ}\text{C}$	20			*	*	*	*		$\mu\text{sec}$
Overload Recovery 1/	$T_r$		$T_A = +25^{\circ}\text{C}$	4	15		*	*	*	*		$\mu\text{sec}$
<b>INPUT OFFSET VOLTAGE</b>												
Initial Offset	$V_{IO}$		$T_A = +25^{\circ}\text{C}$				$\pm 250$					$\mu\text{V}$
Temperature Sensitivity	$DV_{IO}$	$V_{IO}(T_A) - V_{IO}(+25^{\circ}\text{C})$					$\pm 2$		$\pm 5$			$\mu\text{V}/^{\circ}\text{C}$
		$\frac{\Delta T}{-55 \leq T_A \leq +125^{\circ}\text{C}}$										$\mu\text{V}/^{\circ}\text{C}$
		$-25 \leq T_A \leq +85^{\circ}\text{C}$										dB
vs Power Supply	PSRR	$V_{CC} = \pm 5$ , $V_{CC} = \pm 20\text{VDC}$					$\pm 74$					dB
<b>INPUT BIAS CURRENT</b>												
Initial Bias 2/ vs Supply Voltage	$I_{IB}$		$T_A = +25^{\circ}\text{C}$ $T_A = +25^{\circ}\text{C}$		0.005	1		*	*	*	*	pA pA/V
<b>INPUT OFFSET CURRENT</b>												
Initial Offset	$I_{IO}$		$T_A = +25^{\circ}\text{C}$		$\pm 0.2$			*	*	*	*	pA
<b>INPUT IMPEDANCE</b>												
Differential	$Z_{id}$		$T_A = +25^{\circ}\text{C}$		$10^{13} \parallel$			*	*	*	*	$\Omega \parallel \text{pF}$
Common-Mode	$Z_{icM}$		$T_A = +25^{\circ}\text{C}$		$1.6 \parallel$ $10^{15} \parallel$ $1.8 \parallel$			*	*	*	*	$\Omega \parallel \text{pF}$
<b>INPUT NOISE</b>												
Voltage	$e_n$	$f_o = 10\text{Hz}$ $f_o = 100\text{Hz}$ $f_o = 1\text{kHz}$ $f_o = 10\text{kHz}$	$T_A = +25^{\circ}\text{C}$ $T_A = +25^{\circ}\text{C}$ $T_A = +25^{\circ}\text{C}$ $T_A = +25^{\circ}\text{C}$		55 35 30 25			*	*	*	*	$\text{nV}/\sqrt{\text{Hz}}$ $\text{nV}/\sqrt{\text{Hz}}$ $\text{nV}/\sqrt{\text{Hz}}$ $\text{nV}/\sqrt{\text{Hz}}$
Current	$i_n$	$f_B = 0.1\text{Hz to } 10\text{Hz}$ $f_B = 0.1\text{Hz to } 10\text{Hz}$ $f_B = 10\text{Hz to } 10\text{kHz}$ $f_o = 1\text{kHz}$	$T_A = +25^{\circ}\text{C}$ $T_A = +25^{\circ}\text{C}$ $T_A = +25^{\circ}\text{C}$ $T_A = +25^{\circ}\text{C}$		3 0.01 0.03 0.6			*	*	*	*	$\mu\text{V}/\sqrt{\text{p-p}}$ pA, p-p pA, rms fA/ $\sqrt{\text{Hz}}$
<b>INPUT VOLTAGE RANGE</b>												
Differential	$V_{DI}$		$T_A = +25^{\circ}\text{C}$	$\pm 20$				*	*	*	*	V
Common-Mode			$T_A = +25^{\circ}\text{C}$	$\pm 10$	$\pm 12$			*	*	*	*	V
Common-Mode Rejection	CMRR	$V_{IN} = \pm 10\text{V}$	$T_A = +25^{\circ}\text{C}$	76	86			*	*	*	*	dB
<b>POWER SUPPLY</b>												
Rated Voltage	$V_{DI}$			$\pm 5$	$\pm 15$			*	*	*	*	VDC
Voltage Range					$\pm 20$			*	*	*	*	VDC
Quiescent Current	$I_Q$				1.0	1.5		*	*	*	*	mA
<b>TEMPERATURE RANGE (ambient)</b>												
Operating				-55	+125			*	*	*	*	$^{\circ}\text{C}$
Storage				-65	+150			*	*	*	*	$^{\circ}\text{C}$

\*Same as OPA105W grade

NOTES:

- 1/ Overload recovery is defined as the time required for the output to return from saturation to linear operation following the removal of a 50% input overdrive signal.
- 2/ Bias current is tested and guaranteed at  $T_A = +25^{\circ}\text{C}$ . For higher temperature the bias current doubles every  $+10^{\circ}\text{C}$ .

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 Burr-Brown QC4118 internal visual inspection and stabilization bake, fine leak, gross leak, burn-in (72 hours performed preseal), temperature cycle, constant acceleration (condition B), and external visual inspection per MIL-STD-883, method 2009.

For the /883B Hi-Rel product designation, 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.

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.

TABLE II. Electrical Test Requirements.

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

MIL-STD-883 REQUIREMENTS (hybrid class)	MODELS	OPA105WM/883B OPA105WM	OPA105VM/883B OPA105VM	OPA105UM/883B OPA105UM
Interim electrical parameters pre burn-in (method 5008)		1, 4	1, 4	1, 4
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)	2/	1, 2, 3, 4,	1, 2, 3, 4	1, 2, 2U, 3, 3U, 4
Group C end point electrical parameters (method 5005)	2/	1	1	1
Additional electrical subgroups for Group C inspections	2/	5, 6	5, 6	---

\*PDA applies to subgroups 1, 4 see 4.3d

1/ LTPD for these additional tests is 15%.

2/ Applies for /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						UNITS
				OPA105WM/883B OPA105WM		OPA105VM/883B OPA105VM		OPA105UM/883B OPA105UM		
				MIN	MAX	MIN	MAX	MIN	MAX	
1 $T_A = +25^\circ C$	$V_{IO}$	4001	$R_L = 2k\Omega$	$\pm 10$	$\pm 250$	$\pm 10$	$\pm 250$	$\pm 10$	250	$\mu V$
	$I_{IB}$	4001		$\pm 1$	$\pm 1$					$\mu A$
2 $T_A = +125^\circ C$	$V_O$	4003	$V_{CM} \pm 10V$ $V_{CC} = \pm 5V, V_{CC} = \pm 20V$	76	1.5	76	1.5	76	1.5	V
	$I_O$	4003		74		74		74		mA
2U $T_A = +85^\circ C$	CMRR	4003								dB
	PSRR	4003								dB
3 $T_A = -55^\circ C$	DV <sub>IO</sub>	4001	$\frac{I_O(+125) - V_{IO}(+25)}{100}$		2		5			$\mu V/^\circ C$
	2U	4001	$\frac{V_{IO}(+85) - V_{IO}(+25)}{60^\circ C}$						15	$\mu V/^\circ C$
3U $T_A = -25^\circ C$	DV <sub>IO</sub>	4001	$\frac{V_{IO}(+25) - V_{IO}(-55)}{80}$		2		5			$\mu V/^\circ C$
	3U	4001	$\frac{V_{IO}(+25) - V_{IO}(-25)}{50}$						15	$\mu V/^\circ C$
4 $T_A = +25^\circ C$	A <sub>VS</sub>	4004	$f = 0Hz, R_L = 2k\Omega$	106		106		106		dB
	SR	4002	$R_L = 2k\Omega, V_O = \pm 10V$	0.9		0.9		0.9		V/ $\mu sec$
5 $T_A = +125^\circ C$	A <sub>VS</sub>	4004	$f = 0Hz, R_L = 2k\Omega$	95		95				dB
6 $T_A = -55^\circ C$	A <sub>VS</sub>	4004	$f = 0Hz, R_L = 2k\Omega$	95		95				dB

## COMPONENTS

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### 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, paragraph 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, the /883B Hi-Rel product designation, is in accordance with MIL-STD-883B, method 5008, class B, and is conducted on all devices. The following additional criteria apply:

- a. Constant acceleration test (MIL-STD-883, method 2001) is test condition B,  $Y_1$  axis only.
- b. Interim and final test parameters are specified in Table II. The interim electrical parameters test prior to burn-in is optional at the discretion of the manufacturer.
- c. Burn-in test (MIL-STD-883, method 1015) conditions:
  - (1) Test condition B
  - (2) Test circuit is Figure 5 herein
  - (3)  $T_A = +125^\circ\text{C}$  minimum
  - (4) Test duration is 160 hours minimum
- d. Percent defective allowable (PDA). The PDA, for the /883B Hi-Rel product designation only, is 5 percent and includes 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 5008, 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 prior to burn-in are omitted, all screening failures shall be included in the PDA. The verified failures of group A, subgroup 1, after burn-in in that lot are used to determine the percent defective for that lot, and the lot is accepted or rejected based on the PDA.
- e. External visual inspection need not include measurement of case and lead dimensions.

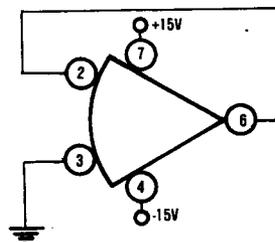


FIGURE 5. Test Circuit, Burn-in and Operating Life Test.

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, 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.

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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 D
- (2) Test circuit is Figure 5 herein
- (3)  $T_A = +125^\circ\text{C}$  minimum
- (4) Test duration is 1000 hours minimum

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

c. Additional electrical subgroups 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.

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.

4.6 Inspection of preparation for delivery. Inspection of preparation for delivery is in accordance with MIL-M-38510, except that the rough handling test does not apply.

## 5. PREPARATION FOR DELIVERY

5.1 Preservation-packaging and packing. Microcircuits are prepared for delivery 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 to this specification are intended for use in applications where the use of screened parts is desirable.

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

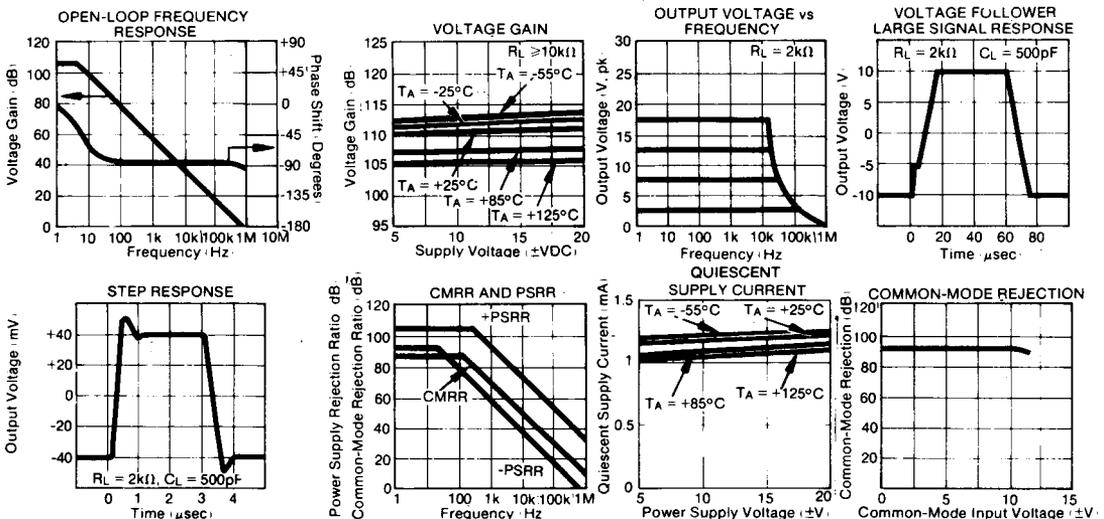
- a. Complete part number (see paragraph 1.2)
- b. Requirement for certificate of compliance, if desired.

6.4 Microcircuit group assignment. These microcircuits are assigned to Technology Group E with a microcircuit group number of 61 as defined in MIL-M-38510, Appendix E.

6.5 Electrostatic sensitivity. These microcircuits may be damaged by electrostatic discharge. Electrostatic sensitive precautions should be observed at all times.

## 7. ELECTRICAL PERFORMANCE CURVES.

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



8. APPLICATION INFORMATION

8.1 Offset voltage adjustment. Although the OPA105/883B Series has a low initial offset voltage (250μV), some applications may require external nulling of this small offset. Figure 4 shows the recommended circuit for adjustment of the offset voltage. External offset voltage adjustment changes the laser adjusted offset voltage temperature drift slightly. The drift will change approximately 0.3μV/°C for every 100μV of offset adjustment.

8.2 Guarding and shielding. The ultra-low bias current and high input impedance of the OPA105/883B Series are well-suited to a number of stringent applications, however, careless signal wiring of printed circuit board layout can degrade circuit performance several orders of magnitude below the capability of the OPA105/883B Series.

As in any situation where high impedances are involved, careful shielding is required to reduce "hum" pickup in input leads. If large feedback resistors are used, they should also be shielded along with the external input circuitry.

Leakage currents across printed circuit boards can easily exceed the amplifier's bias current of the OPA105/883B Series. To avoid leakage problems, it is recommended that the signal input lead of the OPA105/883B Series be wired to a Teflon standoff. If the OPA105/883B Series is to be soldered directly into a printed circuit board, utmost care must be used in planning the board layout. A "guard" pattern should completely surround the two amplifier input leads and should be connected to a low input impedance point which is at the signal input potential.

The amplifier case should be connected to any input shield or guard via pin 8. This insures that the amplifier itself is fully surrounded by guard potential, minimizing both leakage and noise pickup. Figure 6 illustrates the use of the guard. The resistor R<sub>3</sub> shown in Figure 6 is optional. It may be used to compensate effects of very large source resistances. However, note that its use would also increase the noise due to the thermal noise of R<sub>3</sub>.

8.3 Thermal response time. Thermal response time is an important parameter in low drift operational amplifiers like the OPA105 MIL Series. A low drift specification would be of little value if the amplifier took a long time to stabilize after turn-on or ambient temperature change. The TO-99 package and careful circuit design provide the necessary quick thermal response. Typical warm-up drift of the OPA105/883B Series is 20 seconds.

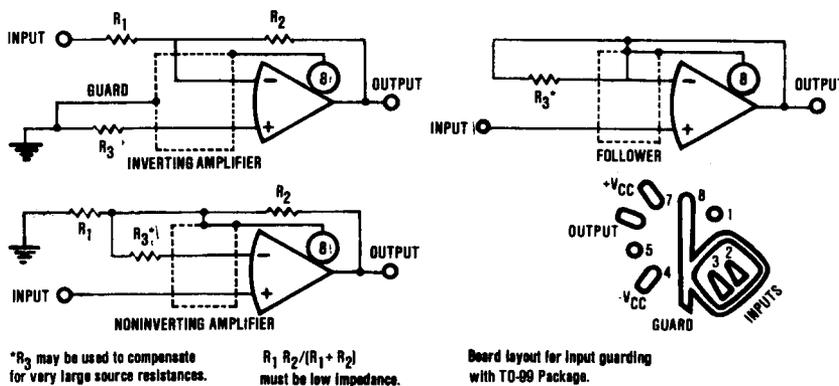


FIGURE 6. Connection of Input Guard.