

**MNLM158-X REV 1A1**

Original Creation Date: 08/14/95

Last Update Date: 05/24/01

Last Major Revision Date: 05/18/01

## LOW POWER, DUAL OPERATIONAL AMPLIFIER

### General Description

The LM158 consists of two independent, high gain, internally frequency compensated operational amplifiers which were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

Application areas include transducer amplifiers, dc gain blocks and all the conventional op amp circuits which now can be more easily implemented in single power supply systems. For example, the LM158 can be directly operated off of the standard +5V DC power supply voltage which is used in digital systems and will easily provide the required interface electronics without requiring the additional  $\pm 15V$  DC power supplies.

### Industry Part Number

LM158

### NS Part Numbers

LM158H-SMD  
LM158H/883  
LM158J/883

### Prime Die

LM158

### Controlling Document

SEE FEATURES SECTION

### Processing

MIL-STD-883, Method 5004

### Quality Conformance Inspection

MIL-STD-883, Method 5005

Subgrp	Description	Temp ( °C)
1	Static tests at	+25
2	Static tests at	+125
3	Static tests at	-55
4	Dynamic tests at	+25
5	Dynamic tests at	+125
6	Dynamic tests at	-55
7	Functional tests at	+25
8A	Functional tests at	+125
8B	Functional tests at	-55
9	Switching tests at	+25
10	Switching tests at	+125
11	Switching tests at	-55

**Features**

- Internally frequency compensated for unity gain
- Large dc voltage gain 100dB
- Wide bandwidth (unity gain temperature compensated) 1MHz
- Wide power supply range:
  - Single supply 3V to 32V or dual supplies  $\pm 1.5\text{V}$  to  $\pm 16\text{V}$
- Very low supply current drain (500uA) - essentially independent of supply voltage
- Low input offset voltage 2mV
- Input common-mode voltage range includes ground
- Differential input voltage range equal to the power supply voltage
- Large output voltage swing 0V to  $V^+ - 1.5\text{V}$

CONTROLLING DOCUMENTS:

LM158H-SMD	5962-8771001GA
LM158J/883	5962-8771001PA

**(Absolute Maximum Ratings)**

(Note 1)

Supply Voltage, V+	32Vdc
Differential Input Voltage	32Vdc
Input Voltage	-0.3Vdc to +32Vdc
Power Dissipation (Note 2)	830 mW
Output Short-Circuit to GND (Note 3) (One Amplifier) $V^+ \leq 15\text{Vdc}$ and $T_A = 25^\circ\text{C}$	Continuous
Input Current ( $V_{in} < -0.3\text{Vdc}$ ) (Note 4)	50mA
Operating Temperature Range	$-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$
Storage Temperature Range	$-65^\circ\text{C} \leq T_A \leq +150^\circ\text{C}$
Lead Temperature (Soldering, 10 Seconds)	
METAL CAN	300 °C
CERDIP	260 °C
Thermal Resistance	
ThetaJA	
METAL CAN (Still Air)	155 °C/W
(500LF/Min Air Flow)	80 °C/W
CERDIP (Still Air)	132 °C/W
(500LF/Min Air Flow)	81 °C/W
ThetaJC	
METAL CAN	42 °C/W
CERDIP	23 °C/W
Package Weight (Typical)	
METAL CAN	1000mg
CERDIP	1100mg
ESD Tolerance (Note 5)	250V

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the Electrical Characteristics. The guaranteed specifications apply only for the test conditions listed. Some performance characteristics may degrade when the device is not operated under the listed test conditions.

Note 2: The maximum power dissipation must be derated at elevated temperatures and is dictated by  $T_{jmax}$  (maximum junction temperature),  $\Theta_{JA}$  (package junction to ambient thermal resistance), and  $T_A$  (ambient temperature). The maximum allowable power dissipation at any temperature is  $P_{dmax} = (T_{jmax} - T_A)/\Theta_{JA}$  or the number given in the Absolute Maximum Ratings, whichever is lower.

Note 3: Short circuits from the output to  $V^+$ , can cause excessive heating and eventual destruction. When considering short circuits to ground, the maximum output current is approximately 40 mA independent of the magnitude of  $V^+$ . At values of supply voltage in excess of +15Vdc, continuous short-circuits can exceed the power dissipation ratings and cause eventual destruction. Destructive dissipation can result from simultaneous shorts on all amplifiers.

**(Continued)**

- Note 4: This input current will only exist when the voltage at any of the input leads is driven negative. It is due to the collector-base junction of the input PNP transistors becoming forward biased and thereby acting as input diode clamps. In addition to this diode action, there is also lateral NPN parasitic transistor action on the IC chip. This transistor action can cause the output voltages of the op amps to go to the V+ voltage level (or to ground for a large overdrive) for the time duration that an input is driven negative. This is not destructive and normal output states will re-establish when the input voltage, which was negative, again returns to a value greater than -0.3V DC (at 25 C).
- Note 5: Human body model, 1.5 K ohms in series with 100 pF.

## Electrical Characteristics

### DC PARAMETERS

(The following conditions apply to all the following parameters, unless otherwise specified.)  
DC: All voltages referenced to device ground.

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
I <sub>cc</sub>	Power Supply Current	V <sub>+</sub> = 5V, R <sub>L</sub> = 100K, V <sub>o</sub> = 1.4V				1.2	mA	1, 2, 3
		V <sub>+</sub> = 30V, R <sub>L</sub> = 100K, V <sub>o</sub> = 1.4V				3	mA	1
						4	mA	2, 3
V <sub>oh</sub>	Output Voltage High	V <sub>+</sub> = 30V, R <sub>L</sub> = 2K Ohms			26		V	1, 2, 3
		V <sub>+</sub> = 30V, R <sub>L</sub> = 10K Ohms			27		V	1, 2, 3
V <sub>ol</sub>	Output Voltage Low	V <sub>+</sub> = 30V, R <sub>L</sub> = 10K Ohms				20	mV	1, 2, 3
		V <sub>+</sub> = 30V, I <sub>sink</sub> = 1uA				20	mV	1, 2, 3
		V <sub>+</sub> = 5V, R <sub>L</sub> = 10K Ohms				20	mV	1, 2, 3
I <sub>sink</sub>	Output Sink Current	V <sub>+</sub> = 15V, V <sub>out</sub> = 200mV, +V <sub>in</sub> = 0V, -V <sub>in</sub> = +65mV			12		uA	1
		V <sub>+</sub> = 15V, V <sub>out</sub> = 2V, +V <sub>in</sub> = 0V, -V <sub>in</sub> = +65mV			10		mA	1
					5		mA	2, 3
I <sub>source</sub>	Output Source Current	V <sub>+</sub> = 15V, V <sub>out</sub> = 2V, +V <sub>in</sub> = 0V, -V <sub>in</sub> = -65mV,				-20	mA	1
						-10	mA	2, 3
I <sub>os</sub>	Short Circuit Current	V <sub>+</sub> = 5V, V <sub>out</sub> = 0V			-60		mA	1
V <sub>io</sub>	Input Offset Voltage	V <sub>+</sub> = 30V, V <sub>cm</sub> = 0V, R <sub>s</sub> = 50 Ohms, V <sub>o</sub> = 1.4V			-5	5	mV	1
					-7	7	mV	2, 3
		V <sub>+</sub> = 30V, V <sub>cm</sub> = 28V, R <sub>s</sub> = 50 Ohms, V <sub>o</sub> = 1.4V			-7	7	mV	2, 3
		V <sub>+</sub> = 5V, V <sub>cm</sub> = 0V, R <sub>s</sub> = 50 Ohms, V <sub>o</sub> = 1.4V			-5	5	mV	1
					-7	7	mV	2, 3
V <sub>+</sub>	Input Bias Current	V <sub>+</sub> = 5V, V <sub>cm</sub> = 0V			-150	-1	nA	1
					-300	-1	nA	2, 3
I <sub>ib-</sub>	Input Bias Current	V <sub>+</sub> = 5V, V <sub>cm</sub> = 0V			-150	-1	nA	1
					-300	-1	nA	2, 3
CMRR	Common Mode Rejection Ratio	V <sub>+</sub> = 30V, V <sub>in</sub> = 0V to 28.5V, R <sub>s</sub> = 50 Ohms			70		dB	1

## Electrical Characteristics

### DC PARAMETERS (Continued)

(The following conditions apply to all the following parameters, unless otherwise specified.)

DC: All voltages referenced to device ground.

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
Iio	Input Offset Current	V+ = 5V, Vcm = 0V			-30	30	nA	1
					-100	100	nA	2, 3
PSRR	Power Supply Rejection Ratio	V+ = 5V to 30V, Vcm = 0V			65		dB	1
Vcm	Common Mode Voltage Range	V+ = 30V	1			28.5	V	1
			1			28	V	2, 3
Vdiff	Differential Input Voltage		2			32	V	1, 2, 3
Avs	Large Signal Gain	V+ = 15V, Rl = 2K Ohms, Vo = 1V to 11V			50		V/mV	4
					25		V/mV	5, 6

### DC PARAMETERS: DRIFT VALUES

(The following conditions apply to all the following parameters, unless otherwise specified.)

DC: All voltages referenced to device ground. "Deltas not required on B-Level product. Deltas required for S-Level product ONLY as specified on Internal Processing Instructions (IPI)."

Vio	Input Offset Voltage	V+ = 30V, Vcm = 0V, Rs = 50 Ohms, Vo = 1.4V			-1	1	mV	1
		V+ = 30V, Vcm = 28V, Rs = 50 Ohms, Vo = 1.4V			-1	1	mV	1
		V+ = 5V, Vcm = 0V, Rs = 50 Ohms, Vo = 1.4V			-1	1	mV	1
Iib+	Input Bias Current	V+ = 5V, Vcm = 0V			-30	30	nA	1
Iib-	Input Bias Current	V+ = 5V, Vcm = 0V			-30	30	nA	1

Note 1: Parameter tested go-no-go only.

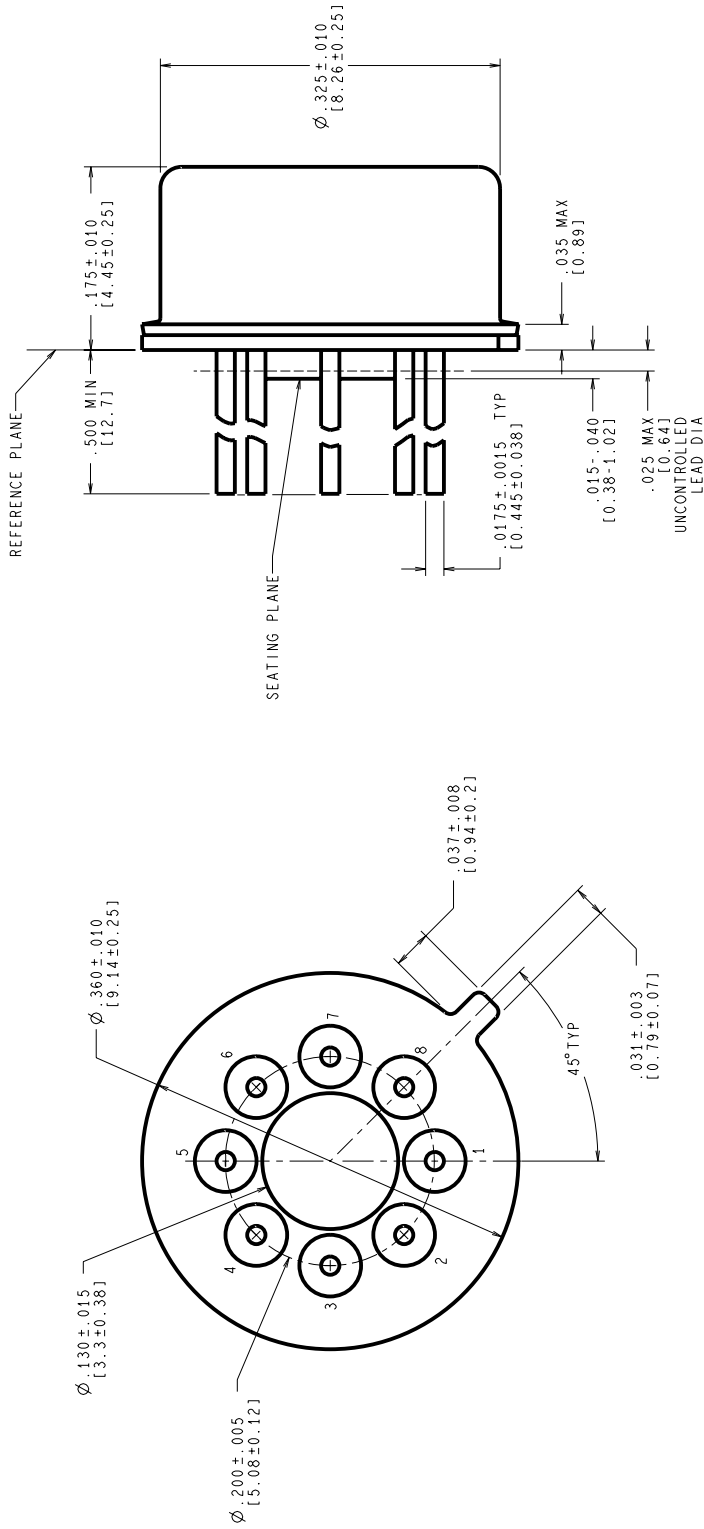
Note 2: Guaranteed parameter not tested.

## Graphics and Diagrams

GRAPHICS#	DESCRIPTION
08571HRC2	METAL CAN (H), TO-99, 8LD, .200 DIA P.C. (B/I CKT)
09294HR01	CERDIP (J), 8 LEAD (B/I CKT)
H08CRF	METAL CAN (H), TO-99, 8LD, .200 DIA P.C. (P/P DWG)
J08ARL	CERDIP (J), 8 LEAD (P/P DWG)
P000273A	METAL CAN (H), TO-99, 8 LD, .200 DIA P.C. (PINOUT)
P000274A	CERDIP (J), 8 LEAD (PINOUT)

See attached graphics following this page.

REVISIONS			
LTR	DESCRIPTION	E.C.N.	DATE
F	REVISE & REDRAW PER CURRENT STANDARD; UPDATE MIL/AERO STAMP & TITLE.	11002	06/22/95
			MS/



CONTROLLING DIMENSION IS INCH  
VALUES IN [ ] ARE MILLIMETERS

MIL-I-38535  
CONFIGURATION CONTROL

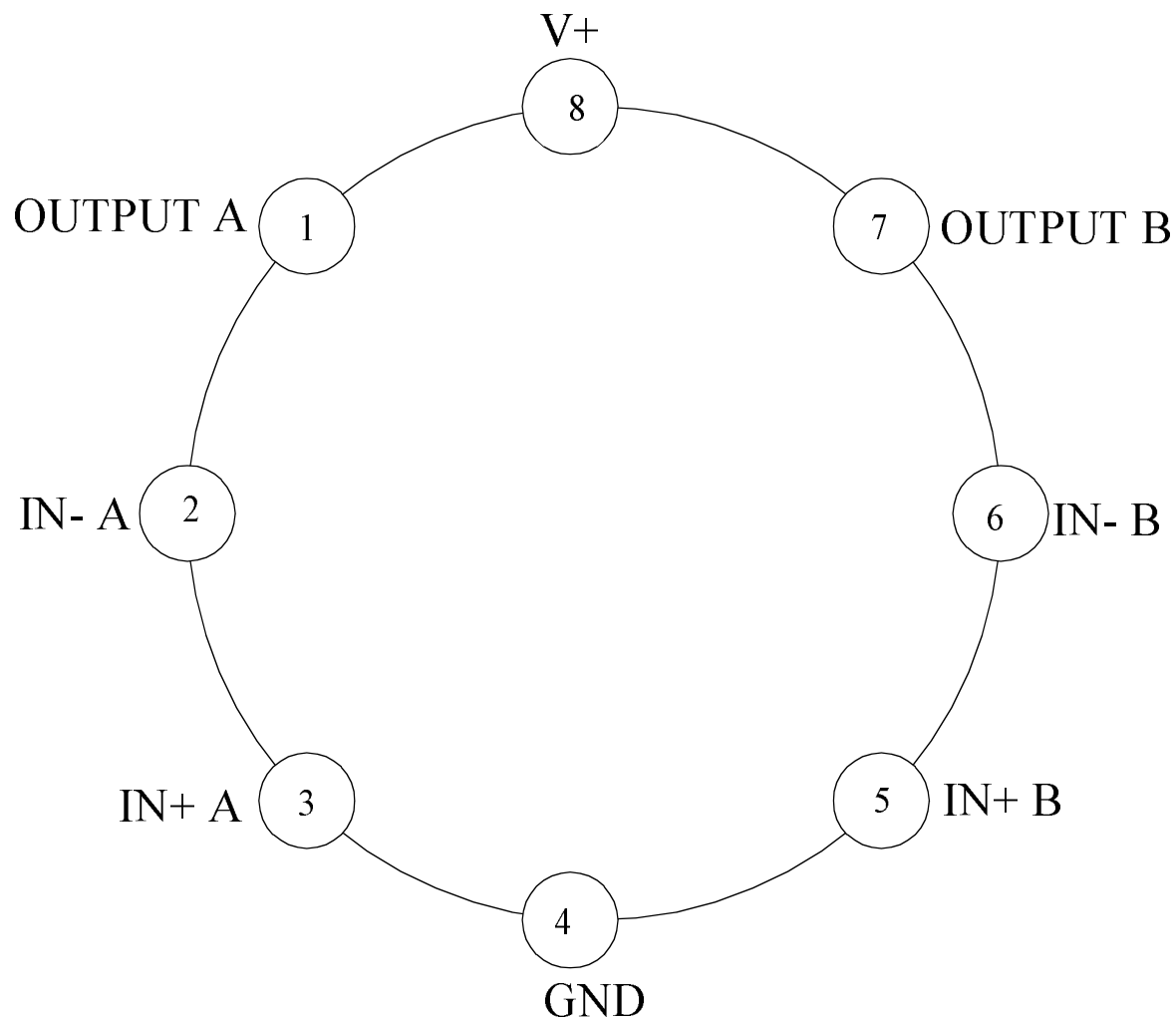
NOTES: UNLESS OTHERWISE SPECIFIED

- LEADS TO BE LOCATED WITHIN .007 IN/ 0.18 mm OF THEIR TRUE POSITIONS RELATIVE TO A MAXIMUM WIDTH TAB.
- STANDARD METAL CAN TYPE: SOLID BASE WITH CERAMIC STANDOFF.
- APPLIES TO MIL-AERO AND LINEAR PRODUCTS.
- REFERENCE JEDEC REGISTRATION TO-99, JEDEC PUBLICATION No.95.

APPROVALS	DATE	National Semiconductor			
DESIGN	06/22/95	2000 Semiconductor dr., Santa Clara, CA 95052-8000			
DRAWN		METAL CAN, TO-99, 8 LEAD, .200 DIA P.C.			
CHK					
CHK					
CHK					
PROJECTION		SCALE	SIZE	DRAWING NUMBER	REV
		N/A	C	MKT-H08C	F
		DO NOT SCALE DRAWING			
		SHEET 1 of 1			







LM158AH, LM158H  
8 - PIN METAL CAN  
CONNECTION DIAGRAM  
TOP VIEW  
P000273A



National Semiconductor™  
MIL/AEROSPACE OPERATIONS  
2900 SEMICONDUCTOR DRIVE  
SANTA CLARA, CA 95050



LM158AJ, LM158J  
8 - LEAD DIP  
CONNECTION DIAGRAM  
TOP VIEW  
P000274A



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