National Semiconductor

MICROCIRCUIT DATA SHEET

MNLM158A-X-RH REV 0D1

Original Creation Date: 01/14/99
Last Update Date: 05/15/00
Last Major Revision Date: 01/14/99

LOW POWER, DUAL OPERATIONAL AMPLIFIER: ALSO AVAILABLE GUARANTEED TO 50K RAD (Si) TESTED TO MIL-STD-883, METHOD 1019.5

General Description

The LM158A 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 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 LM158A 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

Prime Die

LM158

Controlling Document

SEE FEATURES SECTION

NS Part Numbers

LM158AH-QMLV
LM158AH/883
LM158AHLQML
LM158AHLQMLV
LM158AJ-QMLV
LM158AJ/883
LM158AJLQML
LM158AJLQMLV
LM158AWG-QMLV
LM158AWG/883
LM158AWGLQML
LM158AWGLQMLV

Processing

MIL-STD-883, Method 5004

Quality Conformance Inspection

MIL-STD-883, Method 5005

Subgrp	Description	Temp (^{O}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 ±1.5V to ±16V
- Very low supply current drain (500uA) - essentiely 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+ - 1.5V
- CONTROLLING DOCUMENTS:

LM158AH-QMLV	5962-8771002VGA
LM158AH/883	5962-8771002GA
LM158AHLQML	5962L8771002QGA
LM158AHLQMLV	5962L8771002VGA
LM158AJ-QMLV	5962-8771002VPA
LM158AJ/883	5962-8771002PA
LM158AJLQML	5962L8771002QPA
LM158AJLQMLV	5962L8771002VPA
LM158AWG-QMLV	5962-8771002VXA
LM158AWG/883	5962-8771002QXA
LM158AWGLQML	5962L8771002QXA
LM158AWGLQMLV	5962L8771002VXA

(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+ ≤ 15Vdc and TA = 25 C		Continuous
Maximum Junction Temperature		150 C
Input Current (Vin < -0.3Vdc) (Note 4)		50mA
Operating Temperature Range		-55 C ≤ Ta ≤ +125 C
Storage Temperature Range		-65 C ≤ Ta ≤ +150 C
Lead Temperature (Soldering, 10 seconds)		
METAL CAN		300 C
CERDIP		260 C
CERAMIC SOIC		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
CERAMIC SOIC	(Still Air)	195 C/W
	(500LF/Min Air Flow)	131 C/W
ThetaJC		
METAL CAN		42 C/W
CERDIP		23 C/W
CERAMIC SOIC		33 C/W
Package Weight (Typcial)		
METAL CAN		1000mg
CERDIP		1100mg
CERAMIC SOIC		220mg
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 Tjmax (maximum junction temperature), ThetaJA (package junction to ambient thermal resistance), and TA (ambient temperature). The maximum allowable power dissipation at any temperature is Pdmax = (Tjmax - TA)/ThetaJA 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.

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 baised 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 that -0.3Vdc (at 25C).

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
Icc	Power Supply Current	V+ = 5V, Rl = 100K, Vo = 1.4V				1.2	mA	1, 2, 3
		V+ = 30V, Rl = 100K, Vo = 1.4V				3	mA	1
						4	mA	2, 3
Voh	Output Voltage High	V+ = 30V, Rl = 2K Ohms			26		V	1, 2, 3
		V+ = 30V, Rl = 10K Ohms			27		V	1, 2, 3
Vol	Output Voltage Low	V+ = 30V, Rl = 10K Ohms				40	mV	1
						100	mV	2, 3
		V+ = 30V, Isink = 1uA				40	mV	1
						100	mV	2, 3
		V+ = 5V, Rl = 10K Ohms				40	mV	1
						100	mV	2, 3
Isink	Output Sink Current	V+ = 15V, Vout = 200mV, Vin = 65 mV			12		uA	1
		V+ = 15V, Vout = 2V, Vin = 65mV			10		mA	1
					5		mA	2, 3
Isource	Output Source Current	V+ = 15V, Vin = 65mV, Vout = 2V				-20	mA	1
						-10	mA	2, 3
Ios	Short Circuit Current	V+ = 5V, Vout = 0V			-60		mA	1
Vio	Input Offset Voltage	V+ = 30V, Vcm = 0V, Rs = 50 Ohms, Vo = 1.4V			-2	2	mV	1
					-4	4	mV	2, 3
		V+ = 30V, Vcm = 28V, Rs = 50 Ohms, Vo = 1.4V			-4	4	mV	2, 3
		V+ = 5V, Vcm = 0V, Rs = 50 Ohms, Vo = 1.4V			-2	2	mV	1
					-4	4	mV	2, 3
		V+ = 30V, Vcm = 28.5V, Rs = 50 Ohms,Vo = 1.4V			-2	2	mV	1
CMRR	Common Mode Rejection Ratio	V+ = 30V, Vin = 0V to 28.5V, Rs = 50 Ohms			70		dB	1
Iib+	Input BIas Current	V+ = 5V, Vcm = 0V			-50	-1	nA	1
					-100	-1	nA	2, 3

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
Iib-	Input BIas Current	V+ = 5V, Vcm = 0V			-50	-1	nA	1
					-100	-1	nA	2, 3
Iio	Input Offset Current	V+ = 5V, Vcm = 0V			-10	10	nA	1
					-30	30	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			28.0	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. "Delta calculations performed on Jan "S" and "QMLV" devices at Group B, Subgroup 5 only."

Vio	Input Offset Voltage	V+ = 30V, Vcm = 0V, Rs = 50 Ohms, Vo = 1.4V			-0.5	0.5	mV	1
		V+ = 30V, Vcm = 28V, Rs = 50 Ohms, Vo = 1.4V			-0.5	0.5	mV	1
		V+ = 5V, Vcm = 0V, Rs = 50 Ohms, Vo = 1.4V			-0.5	0.5	mV	1
Iib+	Input Bias Current	V+ = 5V, Vcm = 0V			-10	10	nA	1
Iib-	Input Bias Current	V+ = 5V, Vcm = 0V			-10	10	nA	1

DC/AC PARAMETERS: POST RADIATION LIMITS +25 C

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

Vio	Input Offset Voltage	V+ = 30V, Vcm = 0V, Rs = 50 Ohms, Vo = 1.4V	3		-4	4	mV	1
		V+ = 30V, Vcm = 28V, Rs = 50 Ohms, Vo = 1.4V	3		-4	4	mV	1
		V+ = 5V, Vcm = 0V, Rs = 50 Ohms, Vo = 1.4V	3		-4	4	mV	1
±Iib	Input Bias Current	V+ = 5V, Vcm = 0V	3		-60	-1	nA	1

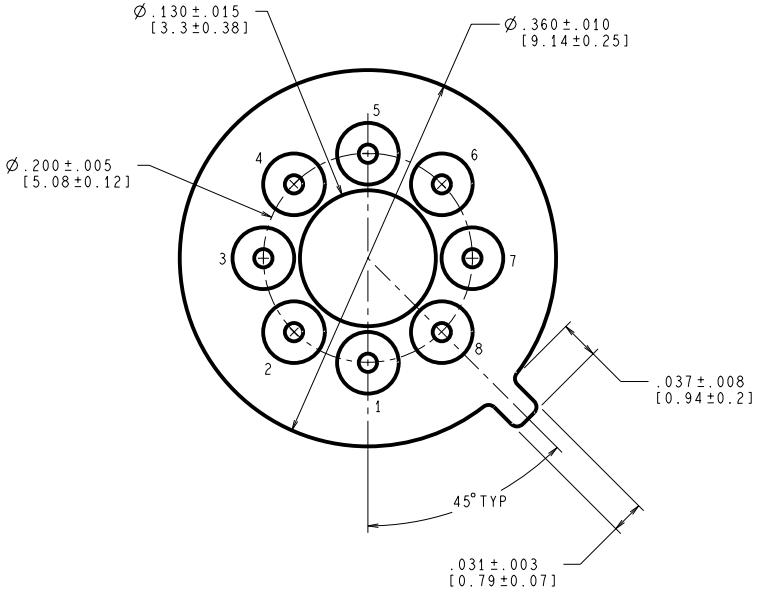
Note 1: Parameter tested go-no-go only.
Note 2: Guaranteed parameter not tested.
Note 3: Pre and post irradiation limits are identical to those listed under AC and DC electrical characteristics except as listed in the Post Radiation Limits Table. These parts may be dose rate sensitive in a space environment and demonstrate enhanced low dose rate effect. Radiation end point limits for the noted parameters are guaranteed only for the conditions as specified in MIL-STD-883, Method 1019.5.

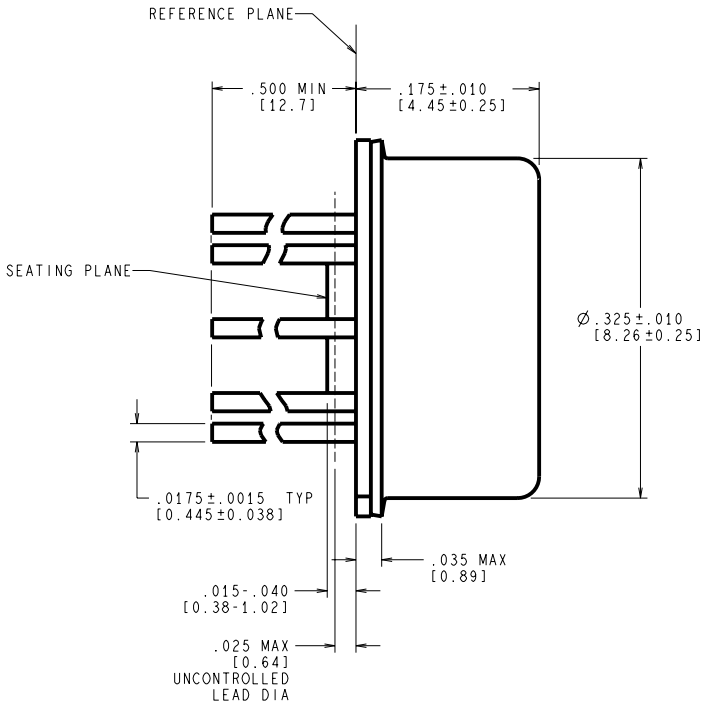
Graphics and Diagrams

GRAPHICS#	DESCRIPTION
06354HRB2	CERAMIC SOIC (WG), 10 LEAD (B/I CKT)
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)
P000461A	CERAMIC SOIC (WG), 10 LEAD (PINOUT)
WG10ARC	CERAMIC SOIC (WG), 10 LEAD (P/P DWG)

See attached graphics following this page.

REVISIONS				
LTR	DESCRIPTION	E.C.N.	DATE	BY/APP'D
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

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

APPROVALS	DATE
DRAWN: MARTA SUCHY	06/22/95
DFTG. CHK.	
ENGR. CHK.	

National Semiconductor
2900 Semiconductor dr, Santa Clara, CA 95052-8090

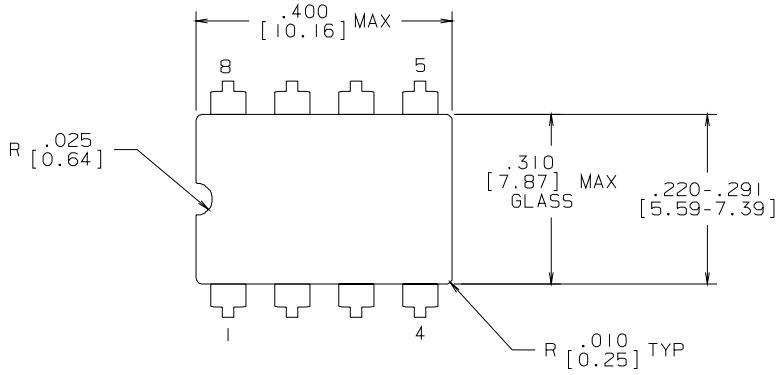
METAL CAN, TO-99, 8 LEAD, .200 DIA P.C.

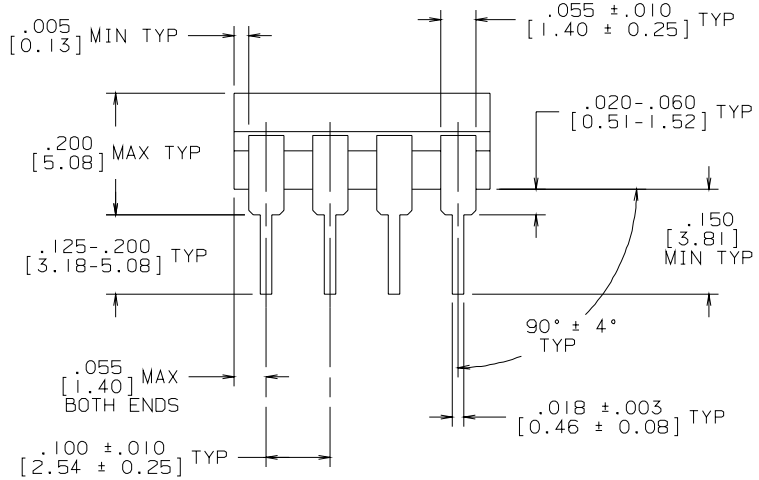
PROJECTION — INCH [MM]

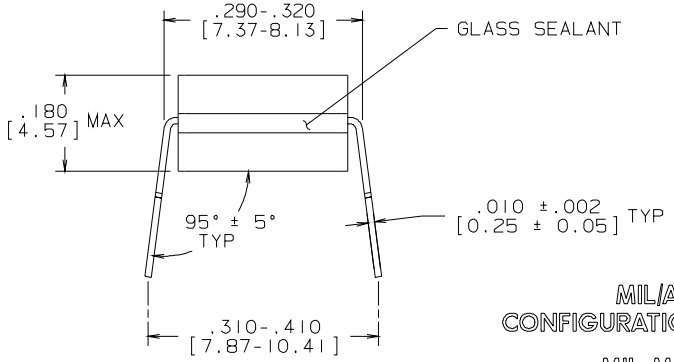
SCALE	SIZE	DRAWING NUMBER	REV
N/A	C	MKT-H08C	F

DO NOT SCALE DRAWING — SHEET 1 of 1

REVISIONS				
LTR	DESCRIPTION	E.C.N.	DATE	BY/APP'D
L	REVISE PER CURRENT STD; REDRAW	10002	09/21/93	TL/







MIL/AERO
CONFIGURATION CONTROL

MIL-M-38510
CONFIGURATION CONTROL

NOTES: UNLESS OTHERWISE SPECIFIED

1. LEAD FINISH TO BE 200 MICROINCHES / 5.08 MICROMETERS MINIMUM SOLDER MEASURED AT THE CREST OF THE MAJOR FLATS.
2. JEDEC REGISTRATION MO-036, VARIATION AA, DATED 04/1981.

CONTROLLING DIMENSION: INCH

APPROVALS	DATE
DRAWN T. LEQUANG	09/21/93
DFTG. CHK.	
ENGR. CHK.	
APPROVAL	

PROJECTION

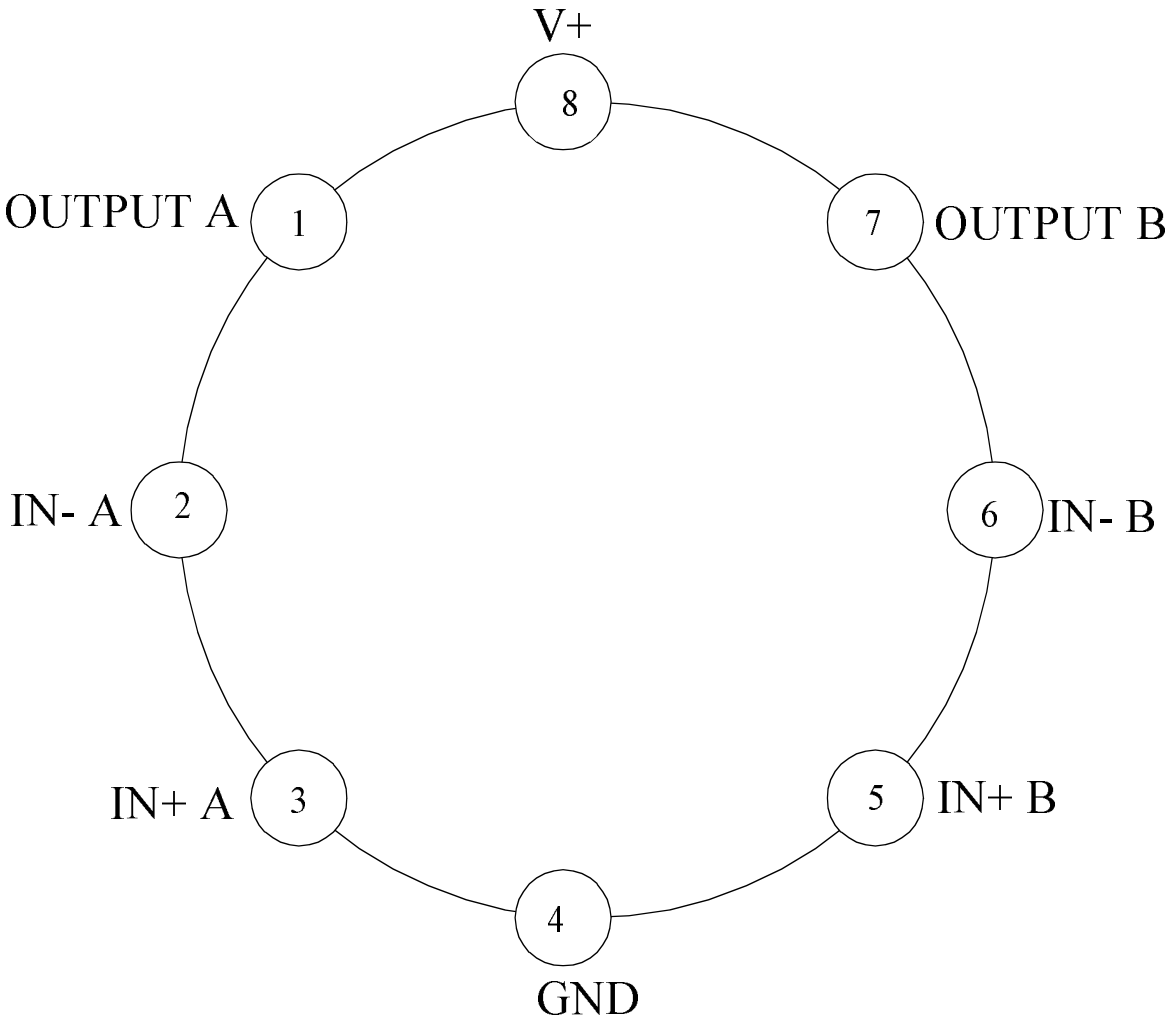
INCH
[MM]

NATIONAL SEMICONDUCTOR CORPORATION
2900 Semiconductor Drive, Santa Clara, CA 95052-8090

CERDIP (J), 8 LEAD

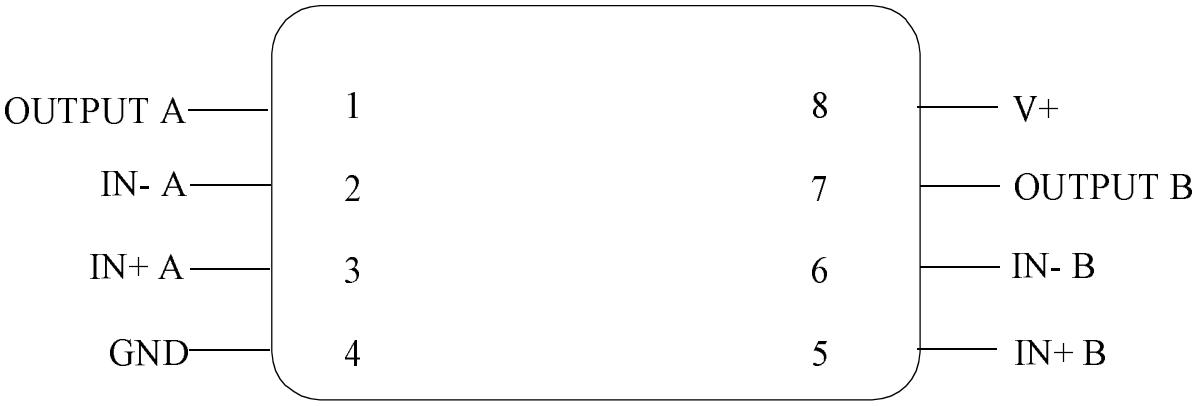
SCALE	SIZE	DRAWING NUMBER	REV
N/A	B	MKT-J08A	L

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

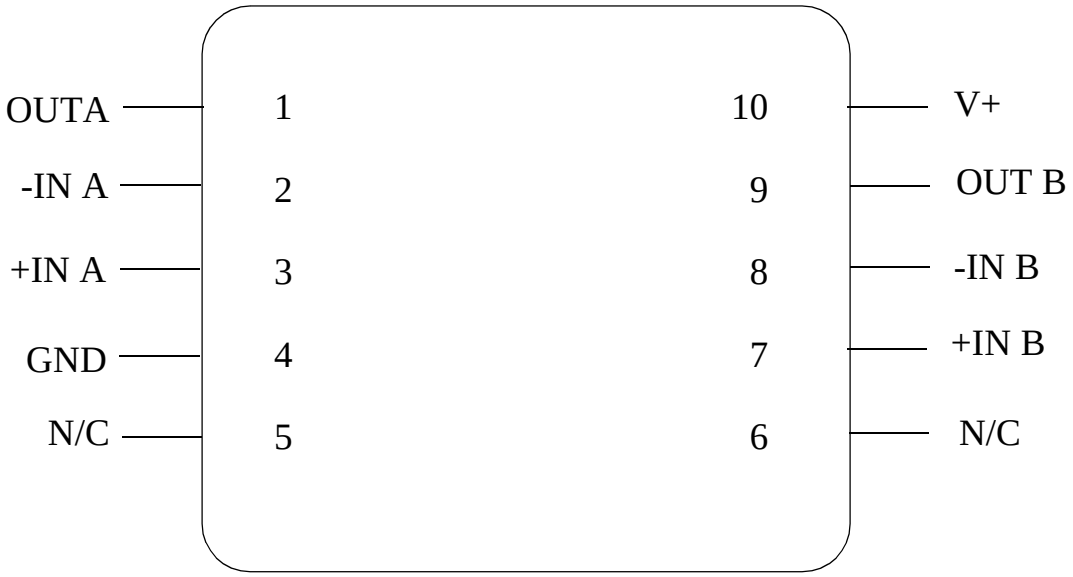
8 - LEAD DIP

CONNECTION DIAGRAM

TOP VIEW

P000274A

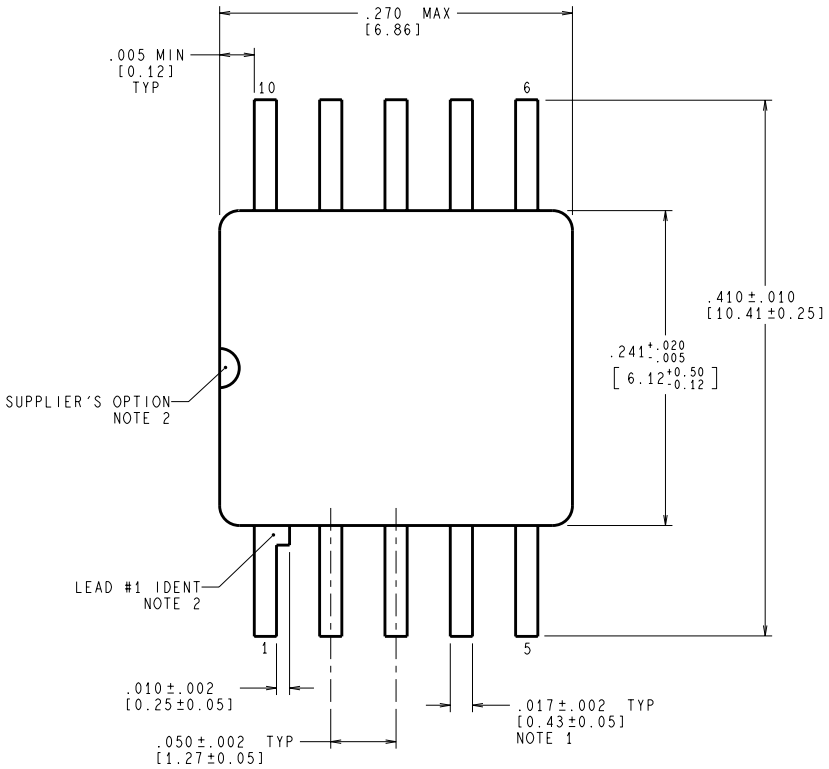
National Semiconductor™
MIL/AEROSPACE OPERATIONS
2900 SEMICONDUCTOR DRIVE
SANTA CLARA, CA 95050

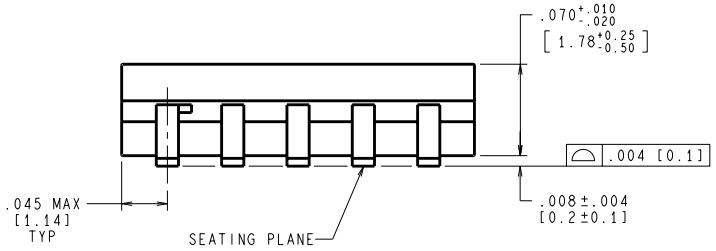


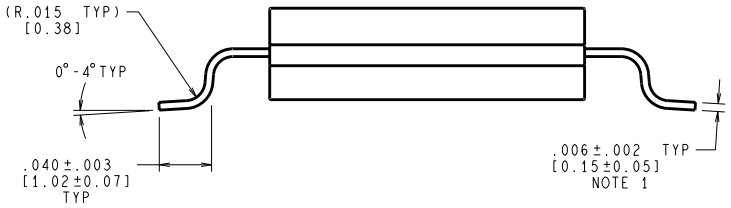
LM158AWG, LM158WG
10 - LEAD CERAMIC SOIC
CONNECTION DIAGRAM
TOP VIEW
P000461A

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

REVISIONS				
LTR	DESCRIPTION	E.C.N.	DATE	BY/APP'D
A	RELEASE TO DOCUMENT CONTROL	11374	02/29/1996	MS/KH
B	LD PITCH TOL WAS ±.005; CHANGE LD RADIUS TO REF DIM; REMOVE THE OTHER R.006±.002 DIM .040±.003 WAS .037±.003	11441	04/19/1996	MS/KH
C	R .015[0.38] WAS R .006[0.15]	11838	10/08/1997	TL/







NOTES: UNLESS OTHERWISE SPECIFIED

1. LEAD FINISH: SOLDER DIPPED WITH Sn60 OR Sn63 SOLDER CONFORMING TO MIL-PRF-38535 TO A MINIMUM THICKNESS OF 200 MICROINCHES/ 5.08 MICROMETERS. SOLDER MAY BE APPLIED OVER LEAD BASIS METAL OR Sn PLATE. MAXIMUM LIMIT MAY BE INCREASED BY .003 IN/ 0.08mm AFTER LEAD FINISH APPLIED.
2. LEAD 1 IDENTIFICATION SHALL BE:
   a) A NOTCH OR OTHER MARK WITHIN THIS AREA
   b) A TAB ON LEAD 1, EITHER SIDE
3. NO JEDEC REGISTRATION AS OF FEBRUARY 1996.

CONTROLLING DIMENSION IS INCH
VALUES IN [ ] ARE MILLIMETERS

MIL-PRF-38535
CONFIGURATION CONTROL

APPROVALS	DATE
DRAWN: MARTA SUCHY	02/29/96
DFTG. CHK.	
ENGR. CHK.	

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2900 Semiconductor dr, Santa Clara, CA 95052-8090

CERPACK, 10 LEAD, GULL WING

PROJECTION
INCH [MM]

SCALE	SIZE	DRAWING NUMBER	REV
N/A	C	(SC)MKT-WG10A	C

DO NOT SCALE DRAWING | SHEET 1 of 1

Revision History

Rev	ECN #	Rel Date	Originator	Changes
0A0	M0003236	03/10/00	Rose Malone	Initial MDS Release: MNLM158A-X-RH, Rev. 0A0 - Added Rad Hard Devices and Limits. Replaces MNLM158A-X, Rev. 3A0.
0B1	M0003533	03/23/00	Rose Malone	Update MDS: MNLM158A-X-RH, Rev. 0A0 to MNLM158A-X-RH, Rev. 0B1. Added reference to WG pkg - onto Main Table, Absolute Section and drawings to graphics section.
0C1	M0003643	05/15/00	Rose Malone	Update MDS - MNLM158A-X-RH, Rev. 0B1 to MNLM158A-X-RH, Rev. 0C1. Corrected typo Package Weight for CERAMIC SOIC from 200mg to 220mg, in Absolute Maximum Section.
0D1	M0003679	05/15/00	Rose Malone	Update MDS: MNLM158A-X-RH, Rev. 0C1 to MNLM158A-X-RH, Rev. 0D1. Corrected typo's on Main Table, Features Section and Absolute Section.