

**MNLF156-X REV 2A0**

 Original Creation Date: 06/20/95  
 Last Update Date: 09/12/02  
 Last Major Revision Date: 09/05/02

**MONOLITHIC JFET INPUT OPERATIONAL AMPLIFIERS**
**General Description**

This is the first monolithic JFET input operational amplifier to incorporate well matched, high voltage JFETs on the same chip with standard bipolar transistors (BI-FET(TM) Technology). This amplifier features low input bias and offset currents/low offset voltage and offset voltage drift, coupled with offset adjust which does not degrade drift or common-mode rejection. The device is also designed for high slew rate, wide bandwidth, extremely fast settling time, low voltage and current noise and a low 1/f noise corner.

**Industry Part Number**

LF156

**NS Part Numbers**

LF156H/883

**Prime Die**

LF156

**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**

- Low input bias current	30 pA
- Low input offset current	3 pA
- High input impedance	10e12 Ohms
- Low input offset voltage	1 mV
- Low input offset voltage temp. drift	3 uV/ C
- Low input noise current	0.01 pA/sqrtHz
- High common-mode rejection ratio	100 dB
- Large dc voltage gain	106 dB
- Extremely fast settling time to 0.01%	1.5 uS
- Fast slew rate	12 V/uS
- Wide gain bandwidth	5 MHz
- Low input noise voltage	12 nV/sqrtHz

**(Absolute Maximum Ratings)**

(Note 1)

Supply Voltage	±22V
Differential Input Voltage	±40V
Input Voltage Range (Note 4)	±20V
Output Short Circuit Duration	Continuous
Tjmax	150 C
Power Dissipation at TA=25 C (Note 2, 3)	
Still Air	560mW
500 LF/Min Air Flow	1200mW
Thermal Resistance	
ThetaJA (Still Air)	162 C/W
(500LF/Min Air flow)	89 C/W
ThetaJC (Typical)	32 C/W
Storage Temperature Range	-65 C ≤ Ta ≤ +150 C
Lead Temperture (Soldering 10 sec.)	300 C
ESD Tolerance (Note 5)	1200V

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate condition 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 conditons.

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  $P_{dmax} = (T_{jmax} - T_A) / \Theta_{JA}$  or the number given in the Absolute Maximum Ratings, whichever is lower.

Note 3: Max. Power dissipation is defined by the package characteristics. Operating the part near the Maximum Power Dissipation may cause the part to operate outside guaranteed limits.

Note 4: Unless otherwise specified the absolute maximum negative input voltage is equal to the negative power supply voltage.

Note 5: Human body model, 100pF discharged through 1.5K Ohms.

## Electrical Characteristics

### DC PARAMETERS

(The following conditions apply to all the following parameters, unless otherwise specified.)  
 DC:  $V_{cc} = \pm 15V$ ,  $V_{cm} = 0V$ ,  $R_s = 50 \text{ Ohms}$

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS	
Vio	Input Offset Voltage				-5	5	mV	1	
					-7	7	mV	2, 3	
					$V_{cc} = \pm 20V$	-5	5	mV	1
					-7	7	mV	2, 3	
Iio	Input Offset Current	$V_{cc} = \pm 20V$			-0.02	0.02	nA	1	
					-20	20	nA	2, 3	
+Iib	Input Bias Current	$V_{cc} = \pm 20V$			-0.1	0.1	nA	1	
					-10	50	nA	2, 3	
		$V_{cc} = \pm 20V$ , $V_{cm} = -16V$			-0.1	0.1	nA	1	
					-10	50	nA	2, 3	
		$V_{cc} = \pm 20V$ , $V_{cm} = 16V$			-0.1	3.5	nA	1	
					-10	60	nA	2, 3	
-Iib	Input Bias Current	$V_{cc} = \pm 20V$			-0.1	0.1	nA	1	
					-10	50	nA	2, 3	
		$V_{cc} = \pm 20V$ , $V_{cm} = -16V$			-0.1	0.1	nA	1	
					-10	50	nA	2, 3	
		$V_{cc} = \pm 20V$ , $V_{cm} = 16V$			-0.1	3.5	nA	1	
					-10	60	nA	2, 3	
+PSRR	Power Supply Rejection Ratio	$+V_{cc} = 20V \text{ to } 10V$ , $-V_{cc} = -20V$			85		dB	1, 2, 3	
-PSRR	Power Supply Rejection Ratio	$-V_{cc} = -20V \text{ to } -10V$ , $+V_{cc} = 20V$			85		dB	1, 2, 3	
CMRR	Common Mode Rejection Ratio	$V_{cm} = \pm 11V$			85		dB	1, 2, 3	
Icc	Power Supply Current					7	mA	1	
						14	mA	2, 3	
+Ios	Short Circuit Current	$V_{out} = 0V$			-45	-15	mA	1	
					-35	-10	mA	2	
					-65	-15	mA	3	
-Ios	Short Circuit Current	$V_{out} = 0V$			15	45	mA	1	
					10	35	mA	2	
					15	65	mA	3	

## Electrical Characteristics

### DC PARAMETERS (Continued)

(The following conditions apply to all the following parameters, unless otherwise specified.)  
DC:  $V_{cc} = \pm 15V$ ,  $V_{cm} = 0V$ ,  $R_s = 50 \text{ Ohms}$

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
V <sub>cm</sub>	V <sub>cm</sub> Voltage Range		1		-11	11	V	1, 2, 3

### AC PARAMETERS

(The following conditions apply to all the following parameters, unless otherwise specified.)  
AC:  $V_{cc} = \pm 15V$ ,  $V_{cm} = 0V$ ,  $R_s = 50 \text{ Ohms}$

+V <sub>op</sub>	Output Voltage Swing	R <sub>l</sub> = 10K Ohms			12		V	4, 5, 6
		R <sub>l</sub> = 2K Ohms	1		10		V	4, 5, 6
-V <sub>op</sub>	Output Voltage Swing	R <sub>l</sub> = 10K Ohms				-12	V	4, 5, 6
		R <sub>l</sub> = 2K Ohms	1			-10	V	4, 5, 6
A <sub>vs</sub>	Large Signal Voltage Gain	R <sub>l</sub> = 2K Ohms, V <sub>out</sub> = 0 to 10V			50		V/mV	4
					25		V/mV	5, 6
		R <sub>l</sub> = 2K Ohms, V <sub>out</sub> = 0 to -10V			50		V/mV	4
					25		V/mV	5, 6
+S <sub>r</sub>	Slew Rate	A <sub>v</sub> = 1, R <sub>load</sub> = 2K Ohms, C <sub>load</sub> = 100pfd, V <sub>in</sub> = -5V to +5V			7.5		V/uS	7
-S <sub>r</sub>	Slew Rate	A <sub>v</sub> = 1, R <sub>load</sub> = 2K Ohms, C <sub>load</sub> = 100pfd, V <sub>in</sub> = +5V to -5V			7.5		V/uS	7

### DC PARAMETERS: DRIFT VALUES

(The following conditions apply to all the following parameters, unless otherwise specified.)  
DC:  $V_{cc} = \pm 15V$ ,  $V_{cm} = 0V$ ,  $R_s = 50 \text{ Ohms}$ . "Deltas not required on B-Level product. Deltas required for S-Level product ONLY as specified on Internal Processing Instructions (IPI)."

V <sub>io</sub>	Input Offset Voltage				-1.2	1.2	mV	1
I <sub>cc</sub>	Power Supply Current				-1	1	mA	1

Note 1: Parameter guaranteed by CMRR test.

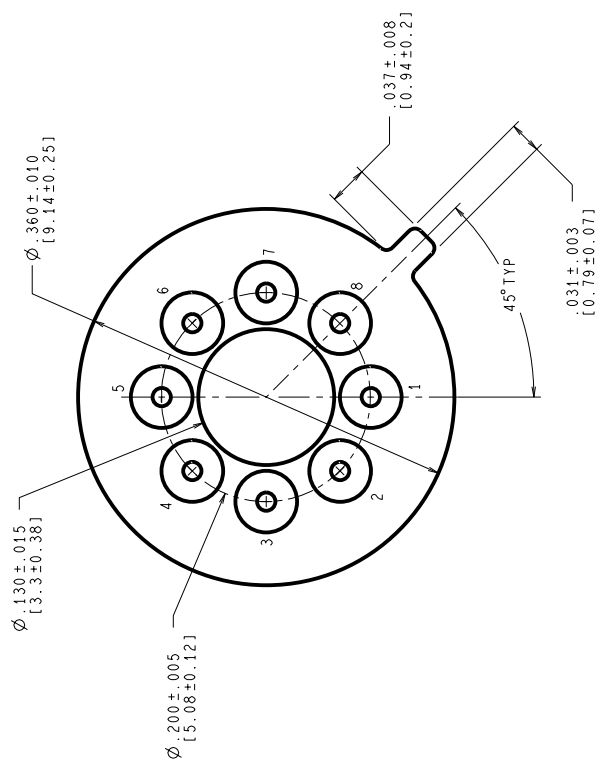
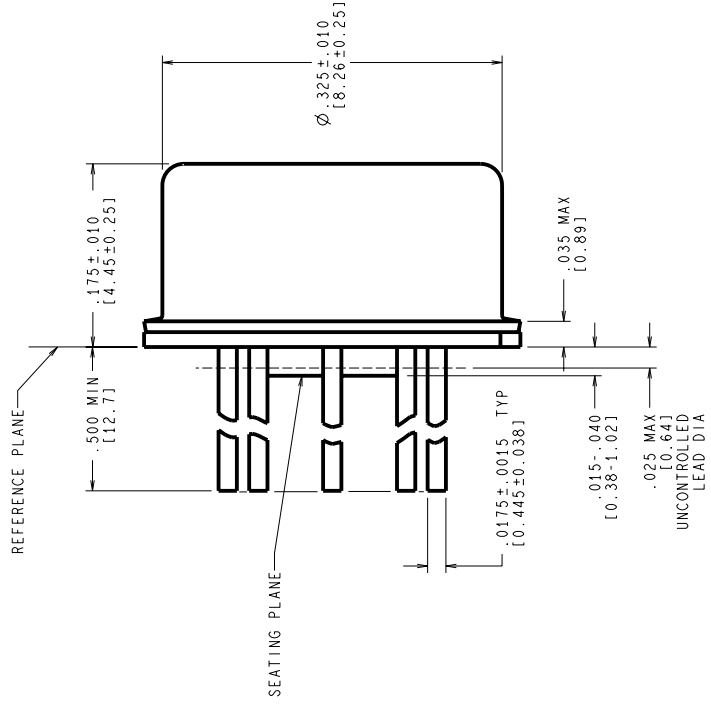
## Graphics and Diagrams

GRAPHICS#	DESCRIPTION
05094HRB3	METAL CAN (H), TO-99, 8LD .200 DIA P.C. (B/I CKT)
H08CRF	METAL CAN (H), TO-99, 8LD, .200 DIA P.C. (P/P DWG)
P000175A	METAL CAN (H), TO-39, 8LD .200 DIA P.O. (PINOUT)

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

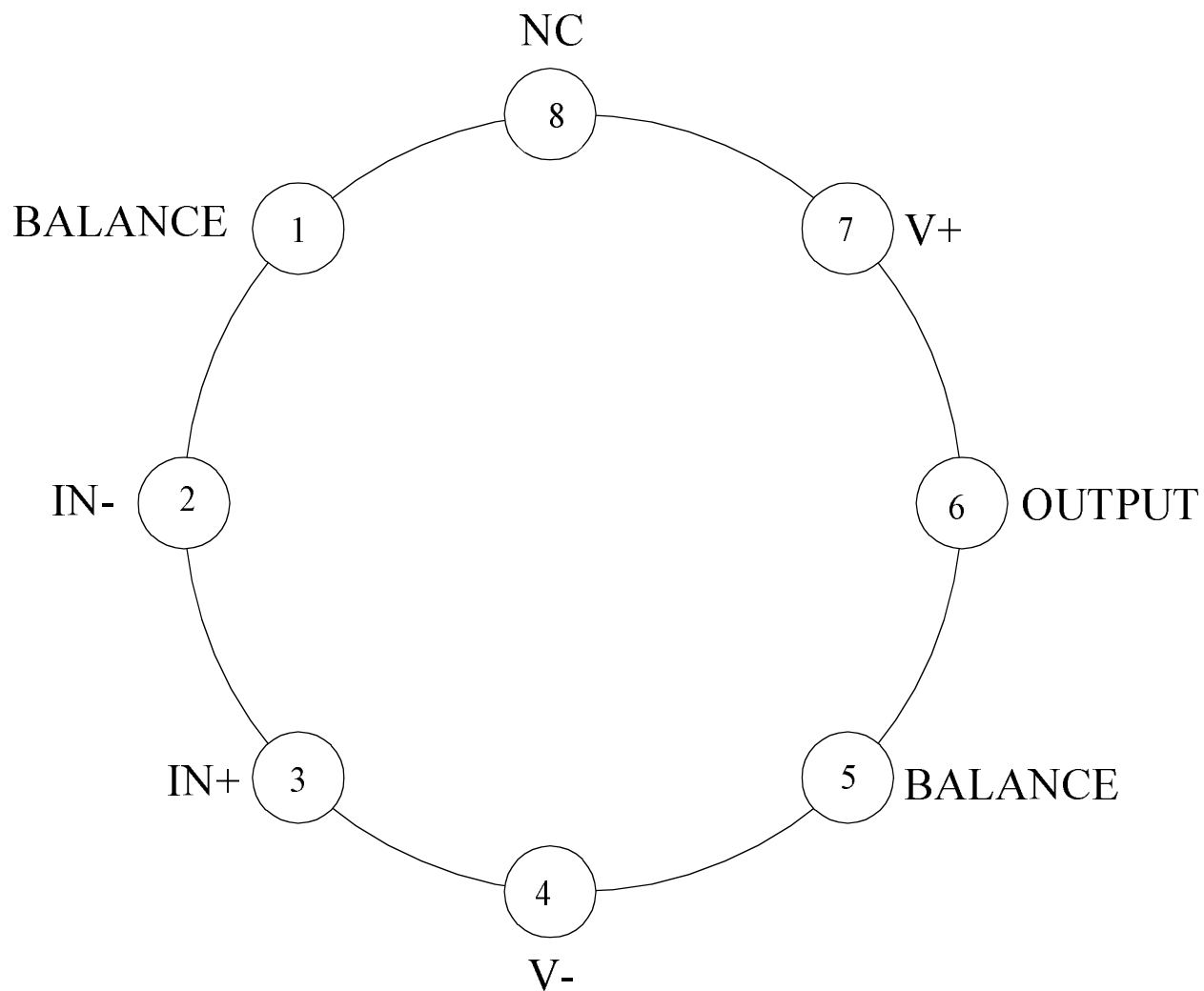
- LEADS TO BE LOCATED WITHIN .007 IN/ 0.18 mm OF THEIR TRUE POSITIONS RELATIVE TO A MAXIMUM WIDTH TAB.
- STANDARD METAL CAN TYPE: SOLID BASE WITH CERAMIC STANDOFF.
- APPLIES TO MIL-AERO AND LINEAR PRODUCTS.
- REFERENCE JEDEC REGISTRATION TO-99, JEDEC PUBLICATION No. 95.

APPROVALS	DATE
DRN: MARTA SUCHY	06/22/95
DWG. CHK.	
ENGR. CHK.	
PROJECTION	
SCALE	N/A
SIZE	C
DRAWING NUMBER	MKT-H08C
REV	F

**National Semiconductor**  
2800 Semiconductor Dr., Santa Clara, CA 95052-8090

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

DO NOT SCALE DRAWING SHEET 1 of 1



LF156AH, LF156H  
8 - PIN METAL CAN  
CONNECTION DIAGRAM  
TOP VIEW  
P000175A

**Revision History**

Rev	ECN #	Rel Date	Originator	Changes
1A0	M0003942	09/12/02	Rose Malone	Update to Fully Released MDS, MNLF156-X, Rev. 0BL to MNLF156-X, Rev. 1A0.
2A0	M0004063	09/12/02	Rose Malone	Update MDS datasheet: MNLF156-X, Rev. 1A0 to MNLF156-X, Rev. 2A0. Changed AC Parameters Section, Slew Rate Condition From: AV = 1 To: +Sr Condition: Av = 1, Rload = 2K Ohms, Cload = 100pfd, Vin = -5V to +5V and -Sr Condition: Av = 1, Rload = 2K Ohms, Cload = 100pfd, Vin = +5V to -5V . Change made to match Test Tape.