

MRLM117-X-RH REV 2A0Original Creation Date: 09/21/00
Last Update Date: 05/20/04
Last Major Revision Date: 05/18/04**POSITIVE THREE TERMINAL ADJUSTABLE VOLTAGE REGULATOR
GUARANTEED TO 100k rd(Si) TESTED TO MIL-STD-883 METHOD
1019, CONDITION A****General Description**

The LM117 adjustable 3-terminal positive voltage regulator is capable of supplying in excess of 0.5A over a 1.2V to 37V output range. It is exceptionally easy to use and requires only two external resistors to set the output voltage. Further, both line and load regulation are better than standard fixed regulators.

In addition to higher performance than fixed regulators, the LM117 offers full overload protection available only in IC's. Included on the chip are current limit, thermal overload protection and safe area protection. All overload protection circuitry remains fully functional even if the adjustment terminal is disconnected.

Normally, no capacitors are needed unless the device is situated more than 6 inches from the input filter capacitors in which case an input bypass is needed. An optional output capacitor can be added to improve transient response. The adjustment terminal can be bypassed to achieve very high ripple rejection ratios which are difficult to achieve with standard 3-terminal regulators.

Besides replacing fixed regulators, the LM117 is useful in a wide variety of other applications. Since the regulator is "Floating" and sees only the input-to-output differential voltage, supplies of several hundred volts can be regulated as long as the maximum input to output differential is not exceeded, (i.e., avoid short-circuiting the output).

Also, it makes an especially simple adjustable switching regulator, a programmable output regulator, or by connecting a fixed resistor between the adjustment pin and output, the LM117 can be used as a precision current regulator. Supplies with electronic shutdown can be achieved by clamping the adjustment terminal to ground which programs the output to 1.2V where most loads draw little current.

Industry Part Number

LM117H

Prime Die

LM117H

NS Part Numbers

LM117HRQMLV
 LM117WG-QMLV
 LM117WGRQMLV

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

- Guaranteed 0.5A output current
- Adjustable output down to 1.2V
- Current limit constant with temperature
- 80 dB ripple rejection
- Output is short-circuit protected

- CONTROLLING DOCUMENTS:

LM117HRQMLV	5962R9951703VXA
LM117WG-QMLV	5962-9951703VZA
LM117WGRQMLV	5962R9951703VZA

(Absolute Maximum Ratings)

(Note 1)

Power Dissipation	Internally Limited
Input-Output Voltage Differential	+40V, -0.3V
Maximum Junction Temperature	150 C
Storage Temperature Range	-65 C ≤ Ta ≤ +150 C
Lead Temperature (Soldering, 10 seconds)	300 C
Thermal Resistance	
ThetaJA	
Metal Can	
(Still Air)	186 C/W
(500LF/Min Air flow)	64 C/W
CERAMIC SOIC	
(Still Air)	115 C/W
(500LF/Min Air Flow)	66 C/W
ThetaJC	
Metal Can	21 C/W
CERAMIC SOIC	3.4 C/W
(Note 3, 4)	
Package Weight	
(Typical)	
Metal Can	TBD
CERAMIC SOIC	365mg
ESD Tolerance	
(Note 5)	3000V

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 Rating, whichever is lower.

Note 3: For the CERAMIC SOIC device to function properly, the "Output" and "Output/Sense" pins must be connected on the users printed circuit board.

Note 4: The package material for these devices allows much improved heat transfer over our standard ceramic packages. In order to take full advantage of this improved heat transfer, heat sinking must be provided between the package base (directly beneath the die), and either metal traces on, or thermal vias through, the printed circuit board. Without this additional heat sinking, device power dissipation must be calculated using junction-to-ambient, rather than junction -to-case, thermal resistance. It must not be assumed that the device leads will provide substantial heat transfer out the package, since the thermal resistance of the leadframe material is very poor, relative to the material of the package base. The stated junction-to-case thermal resistance is for the package material only, and does not account for the additional thermal resistance between the package base and the printed circuit board. The user must determine the value of the additional thermal resistance and must combine this with the stated value for the package, to calculate the total allowed power dissipation for the device.

Note 5: Human body model, 1.5K Ohms in series with 100pF.

Recommended Operating Conditions

Operating Temperature Range

$-55\text{ C} \leq T_a \leq +125\text{ C}$

Input Voltage Range

4.25V to 41.25

Electrical Characteristics

DC PARAMETERS: (SEE NOTE 1)

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
Vout	Output Voltage	Vin = 4.25V, I _l = -5mA			1.2	1.3	V	1, 2, 3
		Vin = 4.25V, I _l = -500mA			1.2	1.3	V	1, 2, 3
		Vin = 41.25V, I _l = -5mA			1.2	1.3	V	1, 2, 3
		Vin = 41.25V, I _l = -50mA			1.2	1.3	V	1, 2, 3
Vrline	Line Regulation	4.25V ≤ Vin ≤ 41.25V, I _l = -5mA			-9	9	mV	1
					-23	23	mV	2, 3
Vrload	Load Regulation	Vin = 6.25V, -500mA ≤ I _l ≤ -5mA			-12	12	mV	1, 2, 3
		Vin = 41.25V, -50mA ≤ I _l ≤ -5mA			-12	12	mV	1, 2, 3
Vrth	Thermal Regulation	Vin = 14.6V, I _l = -500mA			-12	12	mV	1
Iadj	Adjust Pin Current	Vin = 4.25V, I _l = -5mA			-100	-15	uA	1, 2, 3
		Vin = 41.25V, I _l = -5mA			-100	-15	uA	1, 2, 3
Delta Iadj/Line	Adjust Pin Current Change	4.25V ≤ Vin ≤ 41.25V, I _l = -5mA			-5	5	uA	1, 2, 3
Delta Iadj/Load	Adjust Pin Current Change	Vin = 6.25V, -500mA ≤ I _l ≤ -5mA			-5	5	uA	1, 2, 3
Iq	Minimum Load Current	Vin = 4.25V, Forced Vout = 1.4V			-3	-0.5	mA	1, 2, 3
		Vin = 14.25V, Forced Vout = 1.4V			-3	-0.5	mA	1, 2, 3
		Vin = 41.25V, Forced Vout = 1.4V			-5	-1	mA	1, 2, 3
Ios	Output Short Circuit Current	Vin = 4.25V			-1.8	-0.5	A	1, 2, 3
		Vin = 40V			-0.5	-0.05	A	1, 2, 3
Vout (Recov)	Output Voltage Recovery	Vin = 4.25V, R _l = 2.5 Ohms, C _l = 20uF			1.2	1.3	V	1, 2, 3
		Vin = 40V, R _l = 250 Ohms			1.2	1.3	V	1, 2, 3
Vout	Output Voltage Recovery	Vin = 6.25V, I _l = -5mA	2		1.2	1.3	V	2

Electrical Characteristics

DC PARAMETERS: (SEE NOTE 1) (Continued)

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
Vstart	Voltage Start-Up	Vin = 4.25V, Rl = 2.5 Ohms, Cl = 20uF, Il = -500mA			1.2	1.3	V	1, 2, 3

AC PARAMETERS: (SEE NOTE 1)

Delta Vin/Delta Vout	Ripple Rejection	Vin = 6.25V, ei = 1Vrms at f = 2400Hz, Il = -125mA			65		dB	4
Vno	Output Noise Voltage	Vin = 6.25V, Il = -50mA				120	uVrms	7
Delta Vout/Delta Vin	Line Transient Response	Vin = 6.25V, Delta Vin = 3V, Il = -10mA				6	mV/V	7
Delta Vout/Delta Il	Load Transient Response	Vin = 6.25V, Delta Il = -200mA, Il = -50mA				0.6	mV/mA	7

DC PARAMETERS: DRIFT VALUES

(The following conditions apply to all the following parameters, unless otherwise specified.)
 DC: "Delta calculations performed on QMLV devices at group B, subgroup 5 ONLY."

Vout	Output Voltage	Vin = 4.25V, Il = -5mA			-0.01	0.01	V	1
		Vin = 4.25V, Il = -500mA			-0.01	0.01	V	1
		Vin = 41.25V, Il = -5mA			-0.01	0.01	V	1
		Vin = 41.25V, Il = -50mA			-0.01	0.01	V	1
Vrline	Line Regulation	4.25V ≤ Vin ≤ 41.25V, Il = -5mA			-4	4	mV	1
Iadj	Adjust Pin Current	Vin = 4.25V, Il = -5mA			-10	10	uA	1
		Vin = 41.25V, Il = -5mA			-10	10	uA	1

AC/DC PARAMETERS: POST RADIATION LIMITS +25 C (SEE NOTE 1)

Vout	Output Voltage	Vin = 4.25V, Il = -5mA			1.2	1.350	V	1
		Vin = 4.25V, Il = -500mA			1.2	1.350	V	1
		Vin = 41.25V, Il = -5mA			1.2	1.350	V	1
		Vin = 41.25V, Il = -50mA			1.2	1.350	V	1
Vrline	Line Regulation	4.25V ≤ Vin ≤ 41.25V, Il = -5mA			-25	25	mV	1
Delta Vin/Delta Vout	Ripple Rejection	Vin = 6.25V, ei = 1Vrms at f = 2400Hz, Il = -125mA			60		dB	4
Vout (Recov)	Output Voltage Recovery	Vin = 4.25V, Rl = 2.5 Ohms, Cl = 20uS			1.20	1.350	V	1
		Vin = 40V, Rl = 250 Ohms			1.20	1.350	V	1

- Note 1: 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, Condition A.
- Note 2: Tested at TA = 125 C, correlated to TA = 150 C.

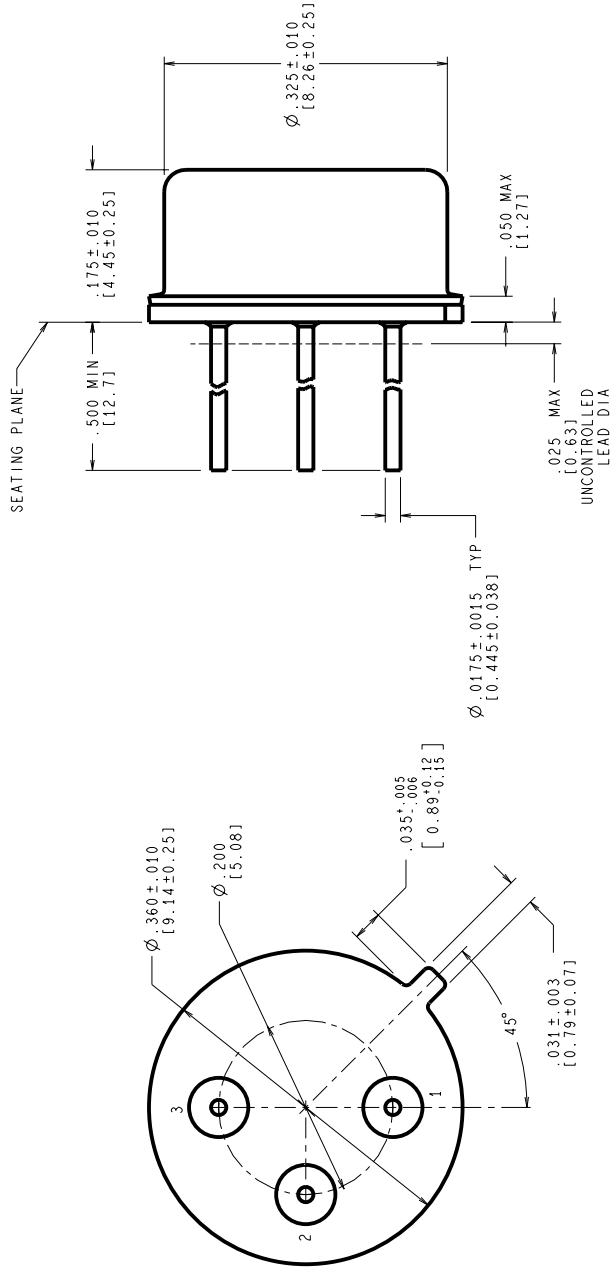
Graphics and Diagrams

GRAPHICS#	DESCRIPTION
06368HRA1	CERAMIC SOIC (WG), 16 LEAD (B/I CKT)
09784HRB3	METAL CAN (H), TO-39, 3LD, .200 DIA P.C. (B/I CKT)
H03ARD	METAL CAN (H), TO-39, 3LD, .200 DIA P.C. (P/P DWG)
P000174A	METAL CAN (H), TO-39, 3LD, .200 DIA P.C. (PINOUT)
P000385B	CERAMIC SOIC (WG), 16 LEAD (PINOUT)
WG16ARC	CERAMIC SOIC (WG), 16 LEAD (P/P DWG)

See attached graphics following this page.

REVISIONS

LTR	DESCRIPTION	E.C. N.	DATE	BY/APP'D
C	REVISE & REDRAW PER NEW STANDARD	10403	05/24/94	TL/GM
D	UPDATE MILAERO STAMP: Ø .325 WAS Ø .326; REVISE TOLERANCES	10798	02/28/95	TL/L



CONTROLLING DIMENSION IS INCH
VALUES IN [] ARE MILLIMETERS

NOTES: UNLESS OTHERWISE SPECIFIED

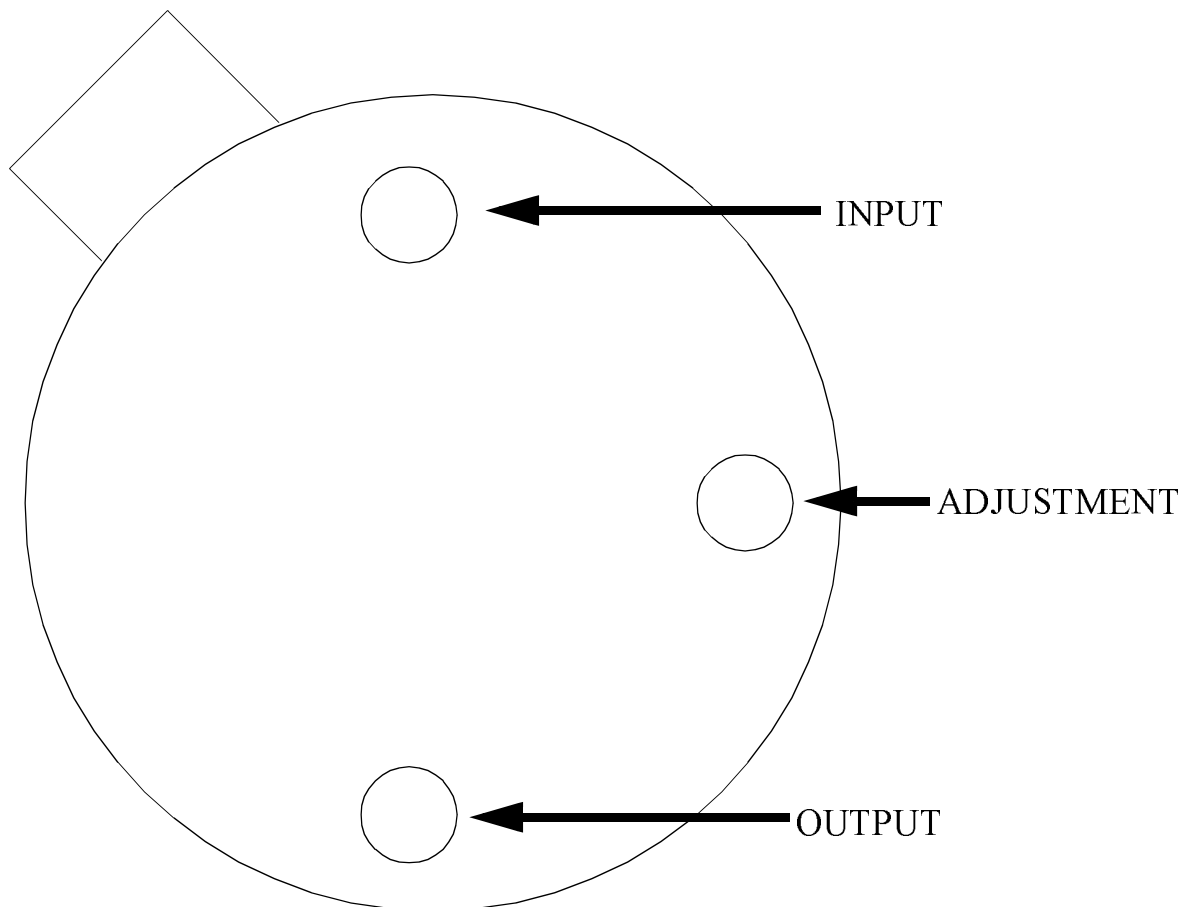
- LEADS TO BE LOCATED WITHIN .010 IN/ 0.25 mm OF THEIR TRUE POSITIONS RELATIVE TO A MAXIMUM WIDTH TAB.
- STANDARD METAL CAN TYPE: SOLID BASE, KOVAR.
- APPLIES TO MIL-AERO AND LINEAR PRODUCTS.
- REFERENCE JEDEC REGISTRATION TO-39, JEDEC PUBLICATION No. 95.

MIL-I-38535
CONFIGURATION CONTROL

APPROVALS	DATE		
DRW: T. LEQUANG	05/24/94		
DATE: 05/24/94			
DRG. CHK:			
ENGR. CHK:			
PROJECTION			
SCALE	SIZE	DRAWING NUMBER	REV
N/A	C	MKT-H03A	D
DO NOT SCALE DRAWING SHEET 1 of 1			

National Semiconductor
2500 Semiconductor Dr., Santa Clara, CA 95052-8090

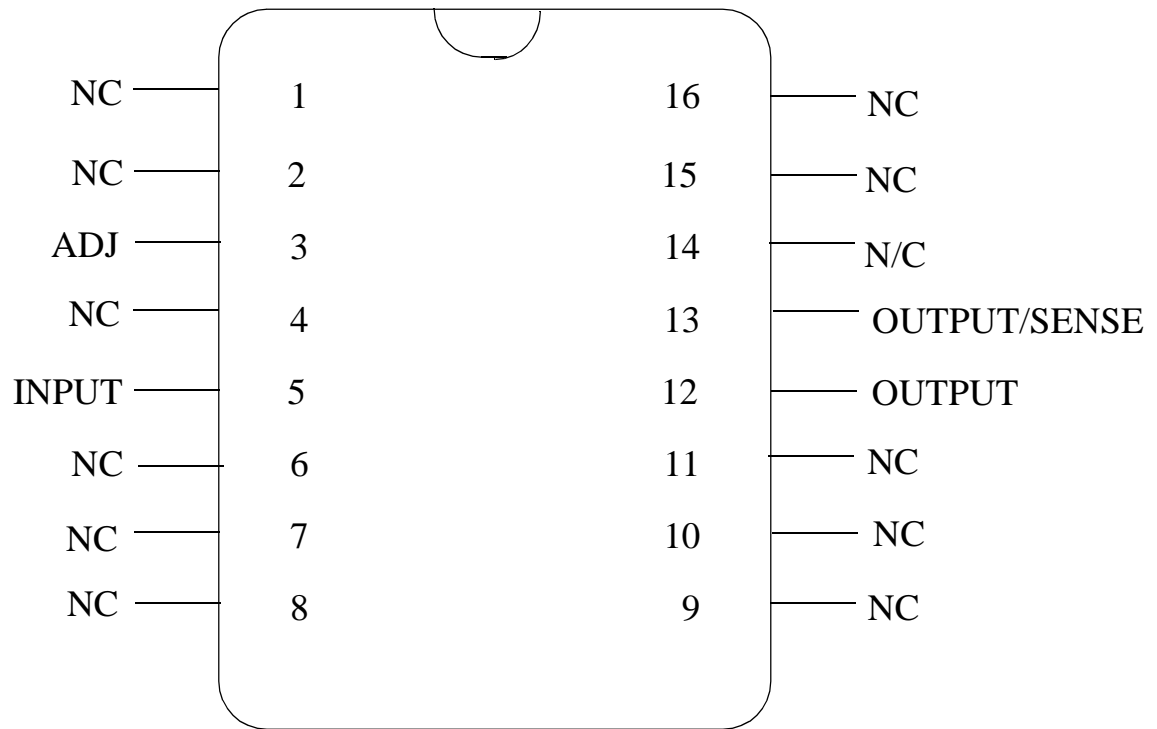
METAL CAN,
TO-39, 3 LEAD,
.200 DIA P.C.



LM117H, LM117HVH
3 - LEAD TO-39
CONNECTION DIAGRAM
BOTTOM VIEW
P000174A



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



LM117WG
16 - LEAD CERAMIC SOIC
CONNECTION DIAGRAM
TOP VIEW
P000385B

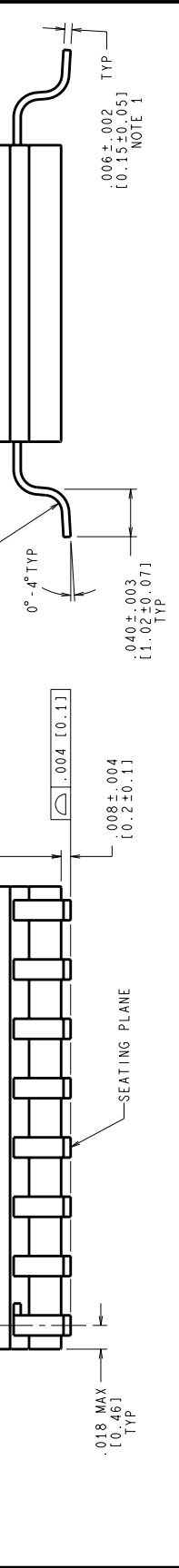
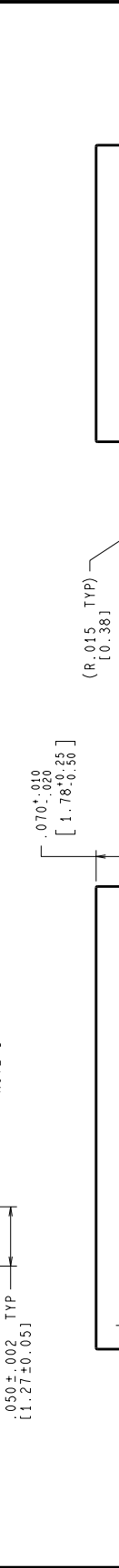
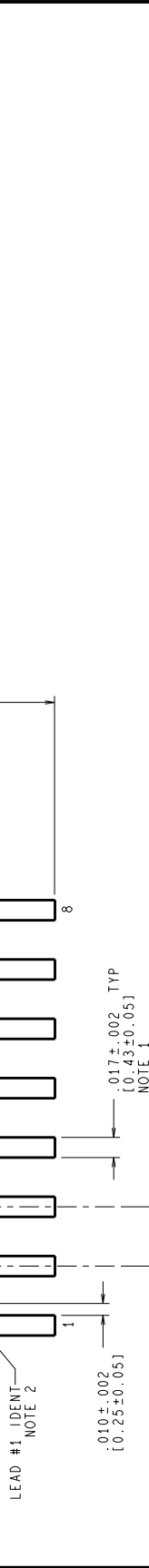
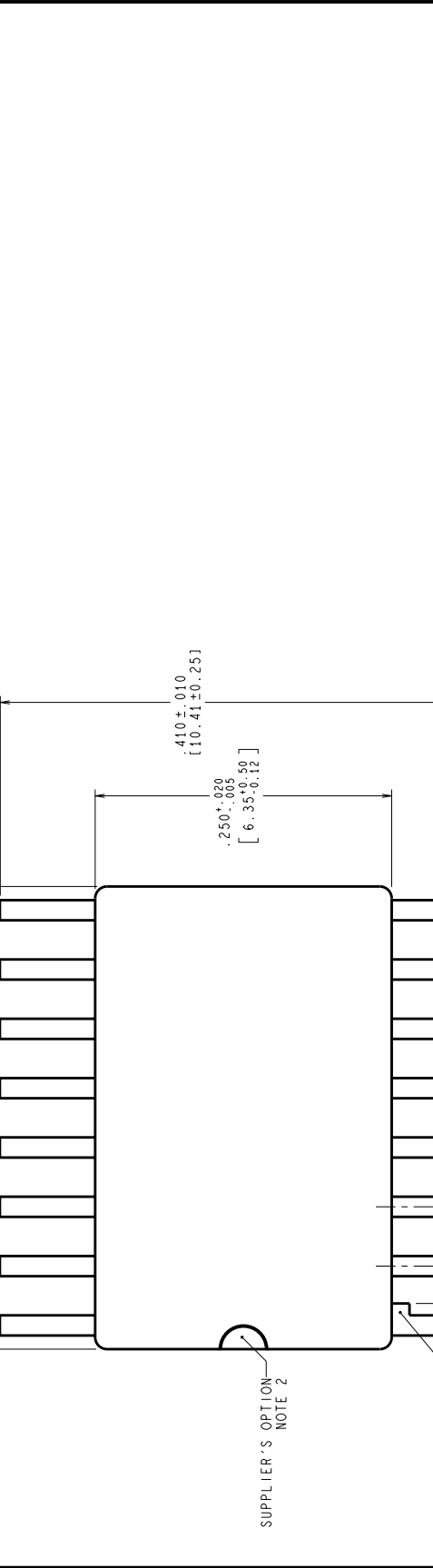


National Semiconductor™

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

REVISIONS			
LTR	DESCRIPTION	E.C.N.	DATE
A	RELEASE TO DOCUMENT CONTROL	11376	02/29/1996
B	LD PITCH TOL WAS ±.005; CHANGE LD RADIUS TO REF DIM; REMOVE THE OTHER R.006±.002; DIM. .040±.003 WAS .037±.003	11443	04/19/1996
C	R.015(0.38) WAS R.006(0.15)	11840	10/08/1997

APPROVALS	DATE	BY/APP'D
DRN: <i>MARYA SUCHY</i>	02/29/96	MS/KH
ENGR. CHK.		MS/KH
PROJECTION		
		
SCALE	SIZE	REV
N/A	C	C
DO NOT SCALE DRAWING		



**MIL-PRF-38535
CONFIGURATION CONTROL**

CONTROLLING DIMENSION IS INCH
VALUES IN | ARE MILLIMETERS

- NOTES: UNLESS OTHERWISE SPECIFIED
- LEAD FINISH: SOLDER DIPPED WITH Sn60 OR Sn63 SOLDER CONFORMING TO MIL-PRF-38535 TO A MINIMUM THICKNESS OF 200 MICRONS / 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.
 - LEAD 1 IDENTIFICATION SHALL BE:
 - A NOTCH OR OTHER MARK WITHIN THIS AREA
 - A TAB ON LEAD 1, EITHER SIDE
 - NO JEDEC REGISTRATION AS OF FEBRUARY 1996.

National Semiconductor
2800 Semiconductor Dr., Santa Clara, CA 95052-8000

**CERPACK,
16 LEAD,
GULL WING**

SCALE: N/A C (SC) MKT-WG16A REV: C

DO NOT SCALE DRAWING SHEET 1 of 1

Revision History

Rev	ECN #	Rel Date	Originator	Changes
0A0	M0003760	03/15/02	Rose Malone	Initial MDS Release: MRLM117-X-RH, Rev. 0A0. Replaced MRLM117-H-RH, Rev. 2A0
0B0	M0003974	09/10/02	Rose Malone	Update MDS: MRLM117-X-RH, Rev. 0A0 to MRLM117-X-RH, Rev. 0B0. Removed NSID's and SMD Numbers from Main Table and Features Section on the following: LM117HRQML 5962R9951703QXA, LM117WGRQML 5962R9951703QZA, LM117WGRQMLV 5962R9951703VZA.
1A0	M0004038	03/03/04	Rose Malone	Update MDS: MRLM117-X-RH, Rev. 0B0 to MRLM117-X-RH, Rev. 1A0. Change to Electrical Section Post Radiation Limit: Vout and Vout (Recov) Max limit from 1.325V to 1.350V.
1B0	M0004366	03/11/04	Rose Malone	Update MDS: MRLM117-X-RH, Rev. 1A0 to MRLM117-X-RH, Rev. 1B0. Added reference to LM117WGRQMLV, 5962R9951703VZA back onto MDS in the Features Section. Inventory supply is now available.
1C0	M0004370	05/20/04	Rose Malone	Update MDS: MRLM117-X-RH, Rev. 1B0 to MRLM117-X-RH, Rev. 1C0. Added Note to Absolute Maximum Ratings Section - Power Dissipation, Note number reference was missing in previous revision.
2A0	M0004386	05/20/04	Rose Malone	Update MDS: MRLM117-X-RH, Rev. 1C0 to Rev. 2A0. Deleted Vout (Recovery) parameter from Drift Values Section, per CK's request Singapore.