National Semiconductor

MICROCIRCUIT DATA SHEET

MRLM117-H-RH REV 1A0

Original Creation Date: 10/19/99
Last Update Date: 07/19/00
Last Major Revision Date: 07/05/00

POSITIVE THREE TERMINAL ADJUSTABLE VOLTAGE REGULATOR GUARANTEED TO 100K RAD(Si) TESTED TO MIL-STD-883 METHOD 1019.5, 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

NS Part Numbers

LM117HRQML
LM117HRQMLV

Prime Die

LM117H

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:

LM117HRQML	5962R9951703QXA
LM117HRQMLV	5962R9951703VXA

(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	
(Still Air)	186 C/W
(500LF/Min Air flow)	64 C/W
ThetaJC	21 C/W
ESD Tolerance (Note 3)	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: Human body model, 1.5K Ohms in series with 100pF.

Recommended Operating Conditions

Operating Temperature Range	-55 C ≤ Ta ≤ +125 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, Il = -5mA			1.2	1.3	V	1, 2, 3
		Vin = 4.25V, Il = -500mA			1.2	1.3	V	1, 2, 3
		Vin = 41.25V, Il = -5mA			1.2	1.3	V	1, 2, 3
		Vin = 41.25V, Il = -50mA			1.2	1.3	V	1, 2, 3
Vrline	Line Regulation	4.25V ≤ Vin ≤ 41.25V, Il = -5mA			-9	9	mV	1
					-23	23	mV	2, 3
Vrload	Load Regulation	Vin = 6.25V, -500mA ≤ Il ≤ -5mA			-12	12	mV	1, 2, 3
		Vin = 41.25V, -50mA ≤ Il ≤ -5mA			-12	12	mV	1, 2, 3
Vrth	Thermal Regulation	Vin = 14.6V, Il = -500mA			-12	12	mV	1
Iadj	Adjust Pin Current	Vin = 4.25V, Il = -5mA			-100	-15	uA	1, 2, 3
		Vin = 41.25V, Il = -5mA			-100	-15	uA	1, 2, 3
Delta Iadj/Line	Adjust Pin Current Change	4.25V ≤ Vin ≤ 41.25V, Il = -5mA			-5	5	uA	1, 2, 3
Delta Iadj/Load	Adjust Pin Current Change	Vin = 6.25V, -500mA ≤ Il ≤ -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, Rl = 2.5 Ohms, Cl = 20uF			1.2	1.3	V	1, 2, 3
		Vin = 40V, Rl = 250 Ohms			1.2	1.3	V	1, 2, 3
Vout	Output Voltage Recovery	Vin = 6.25V, Il = -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 $\leq$ Vin $\leq$ 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
Vout (Recov)	Output Voltage Recovery	Vin = 4.25V, Rl = 2.5 Ohms, Cl = 20uF			-0.01	0.01	V	1
		Vin = 40V, Rl = 250 Ohms			-0.01	0.01	V	1

Electrical Characteristics

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

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
Vout	Output Voltage	Vin = 4.25V, Il = -5mA			1.2	1.325	V	1
		Vin = 4.25V, Il = -500mA			1.2	1.325	V	1
		Vin = 41.25V, Il = -5mA			1.2	1.325	V	1
		Vin = 41.25V, Il = -50mA			1.2	1.325	V	1
Vrline	Line Regulation	4.25V $\leq$ Vin $\leq$ 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	1.325	V	1
		Vin = 40V, Rl = 250 Ohms			1.20	1.325	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. Radiaton end point limits for the noted parameters are guaranteed only for the conditions as specified in MIL-STD-883, Method 1019.5, Condition A.

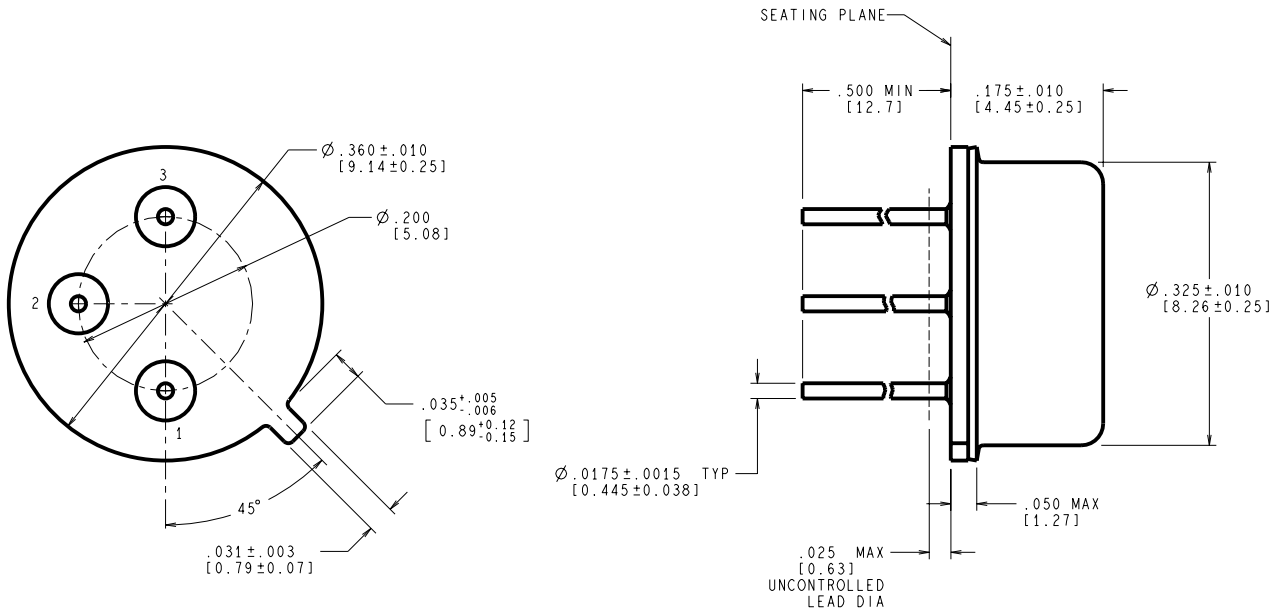
Note 2: Tested at TA = 125 C, correlated to TA = 150 C.

Graphics and Diagrams

GRAPHICS#	DESCRIPTION
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)

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/



CONTROLLING DIMENSION IS INCH
VALUES IN [ ] ARE MILLIMETERS

NOTES: UNLESS OTHERWISE SPECIFIED

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

MIL-I-38535
CONFIGURATION CONTROL

APPROVALS	DATE
DRAWN T. LEQUANG	05/24/94
DFTG. CHK.	
ENGR. CHK.	

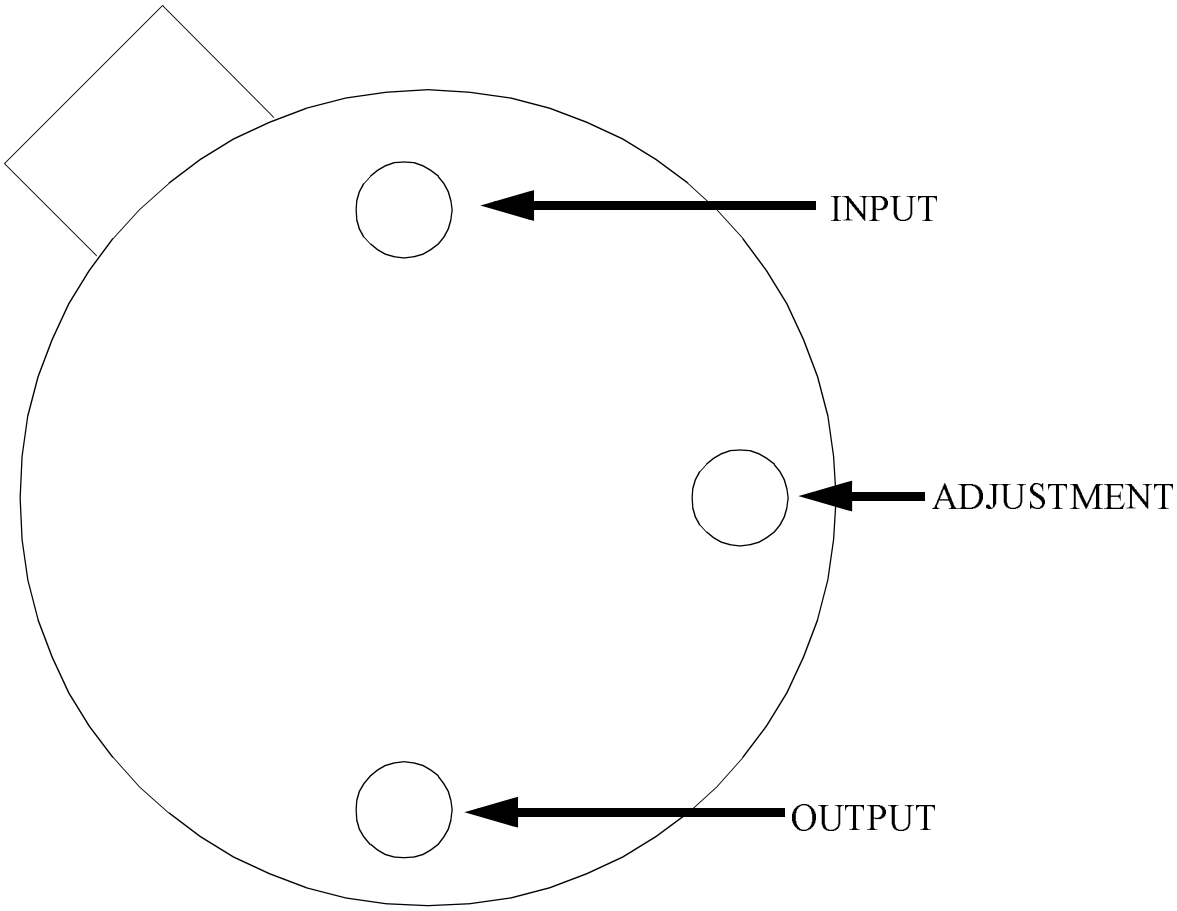
National Semiconductor
2900 Semiconductor dr, Santa Clara, CA 95052-8090

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

PROJECTION
INCH [MM]

SCALE	SIZE	DRAWING NUMBER	REV
N/A	C	MKT-H03A	D

DO NOT SCALE DRAWING | SHEET 1 of 1



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

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

Revision History

Rev	ECN #	Rel Date	Originator	Changes
0A0	M0003584	07/19/00	Rose Malone	Initial MDS Release: MRLM117-H-RH, Rev. 0A0
1A0	M0003732	07/19/00	Rose Malone	Update MDS: MRLM117-H-RH, Rev. 0A0 to MRLM117-H-RH, Rev. 1A0. Changes made in Absolute and Recommended Section, Post Radiaton Section, Vrline Parameter from -18mV Min, 18mV Max to -25mV Min, 25mV Max, Delta Vin/Delta Vout Parameter from 63dB to 60dB, Added Vout (Recov) parameter in Post Radiaton Section.