

**MRLM117-K-RH REV 3A0**Original Creation Date: 10/19/99  
Last Update Date: 09/10/02  
Last Major Revision Date: 08/14/02**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 1.5A 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.

For the negative complement, see LM137 data sheet.

**Industry Part Number**

LM117K

**NS Part Numbers**

LM117KRQMLV

**Prime Die**

LM117K

**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 1.5A output current
- Adjustable output down to 1.2V
- Current limit constant with temperature
- 80 dB ripple rejection
- Output is short-circuit protected
- CONTROLLING DOCUMENT:  
LM117KRQMLV      5962R9951704VYA

**(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)	39 C/W
(500LF/Min Air flow)	14 C/W
ThetaJC	1.9 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 Ratings, 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 41.25V

## Electrical Characteristics

DC PARAMETERS: (SEE NOTE 4)

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
Vout	Output Voltage	Vin = 4.25V, I <sub>l</sub> = -5mA			1.2	1.3	V	1, 2, 3
		Vin = 4.25V, I <sub>l</sub> = -1.5A			1.2	1.3	V	1, 2, 3
		Vin = 41.25V, I <sub>l</sub> = -5mA			1.2	1.3	V	1, 2, 3
		Vin = 41.25V, I <sub>l</sub> = -200mA			1.2	1.3	V	1, 2, 3
Vrline	Line Regulation	4.25V ≤ Vin ≤ 41.25V, I <sub>l</sub> = -5mA			-9	9	mV	1
					-23	23	mV	2, 3
Vrload	Load Regulation	Vin = 6.25V, -1.5A ≤ I <sub>l</sub> ≤ -5mA			-3.5	3.5	mV	1
					-12	12	mV	2, 3
		Vin = 41.25V, -200mA ≤ I <sub>l</sub> ≤ -5mA			-3.5	3.5	mV	1
					-12	12	mV	2, 3
Vrth	Thermal Regulation	Vin = 14.6V, I <sub>l</sub> = -1.5A			-12	12	mV	1
Iadj	Adjust Pin Current	Vin = 4.25V, I <sub>l</sub> = -5mA			-100	-15	uA	1, 2, 3
		Vin = 41.25V, I <sub>l</sub> = -5mA			-100	-15	uA	1, 2, 3
Delta Iadj/Line	Adjust Pin Current Change	4.25V ≤ Vin ≤ 41.25V, I <sub>l</sub> = -5mA			-5	5	uA	1, 2, 3
Delta Iadj/Load	Adjust Pin Current Change	Vin = 6.25V, -1.5A ≤ I <sub>l</sub> ≤ -5mA			-5	5	uA	1, 2, 3
Ios	Output Short Circuit Current	Vin = 4.25V			-3.5	-1.5	A	1, 2, 3
		Vin = 40V			-1	-0.18	A	1, 2, 3
Vout (Recov)	Output Voltage Recovery	Vin = 4.25V, R <sub>l</sub> = 0.833 Ohms, C <sub>l</sub> = 20uF			1.2	1.3	V	1, 2, 3
		Vin = 40V, R <sub>l</sub> = 250 Ohms			1.2	1.3	V	1, 2, 3
Iq	Minimum Load Current	Vin = 4.25V, Forced Vout = 1.4V			-3	-0.2	mA	1, 2, 3
		Vin = 14.25V, Forced Vout = 1.4V			-3	-0.2	mA	1, 2, 3
		Vin = 41.25V, Forced Vout = 1.4V			-5	-0.2	mA	1, 2, 3
Vstart	Voltage Start-Up	Vin = 4.25V, R <sub>l</sub> = 0.833 Ohms, C <sub>l</sub> =20uF, I <sub>l</sub> = -1.5A			1.2	1.3	V	1, 2, 3

## Electrical Characteristics

### DC PARAMETERS: (SEE NOTE 4) (Continued)

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
Vout	Output Voltage	Vin = 6.25V, I <sub>l</sub> = -5mA	1		1.2	1.3	V	2

### AC PARAMETERS: (SEE NOTE 4)

Vno	Output Noise Voltage	Vin = 6.25V, I <sub>l</sub> = -100mA				120	uVrms	7
DeltaVout/DeltaVin	Line Transient Response	Vin = 6.25V, Delta Vin = 3V, I <sub>l</sub> = -10mA	2			18	mV	7
DeltaVout/Delta I <sub>l</sub>	Load Transient Response	Vin = 6.25V, Delta I <sub>l</sub> = -400mA, I <sub>l</sub> = -100mA	3			120	mV	7
Delta Vin/Delta Vout	Ripple Rejection	Vin = 6.25V, ei = 1Vrms at f = 2400Hz, I <sub>l</sub> = -500mA			65		dB	4

### 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, I <sub>l</sub> = -5mA			-0.01	0.01	V	1
		Vin = 4.25V, I <sub>l</sub> = -1.5A			-0.01	0.01	V	1
		Vin = 41.25V, I <sub>l</sub> = -5mA			-0.01	0.01	V	1
		Vin = 41.25V, I <sub>l</sub> = -200mA			-0.01	0.01	V	1
Vrline	Line Regulation	4.25V ≤ Vin ≤ 41.25V, I <sub>l</sub> = -5mA			-4	4	mV	1
Iadj	Adjust Pin Current	Vin = 4.25V, I <sub>l</sub> = -5mA			-10	10	uA	1
		Vin = 41.25V, I <sub>l</sub> = -5mA			-10	10	uA	1

## Electrical Characteristics

### AC/DC PARAMETERS: POST RADIATION LIMITS +25C (SEE NOTE 4)

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
Vout	Output Voltage	Vin = 4.25V, I <sub>l</sub> = -5mA			1.2	1.350	V	1
		Vin = 4.25V, I <sub>l</sub> = -1.5A			1.2	1.350	V	1
		Vin = 41.25V, I <sub>l</sub> = -5mA			1.2	1.350	V	1
		Vin = 41.25V, I <sub>l</sub> = -200mA			1.2	1.350	V	1
V <sub>rline</sub>	Line Regulation	4.25V ≤ Vin ≤ 41.25V, I <sub>l</sub> = -5mA			-25	25	mV	1
V <sub>rload</sub>	Load Regulation	Vin = 6.25V, -1.5A ≤ I <sub>l</sub> ≤ -5mA			-7.0	7.0	mV	1
		Vin = 41.25V, -200mA ≤ I <sub>l</sub> ≤ -5mA			-7.0	7.0	mV	1
Delta Vin/Delta Vout	Ripple Rejection	Vin = 6.25V, e <sub>i</sub> = 1V <sub>rms</sub> at f = 2400Hz, I <sub>l</sub> = -500mA			60		dB	4
Vout (Recov)	Output Voltage Recovery	Vin = 4.25V, R <sub>l</sub> = 0.833 Ohms, C <sub>l</sub> = 20uS			1.20	1.350	V	1
		Vin = 40V, R <sub>l</sub> = 250 Ohms			1.20	1.350	V	1

Note 1: Tested at TA = +125 C, correlated to TA = +150 C.

Note 2: S/S limit of 6mV/V is equivalent to 18mV.

Note 3: S/S limit of .3mV/V is equivalent to 120mV.

Note 4: 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.

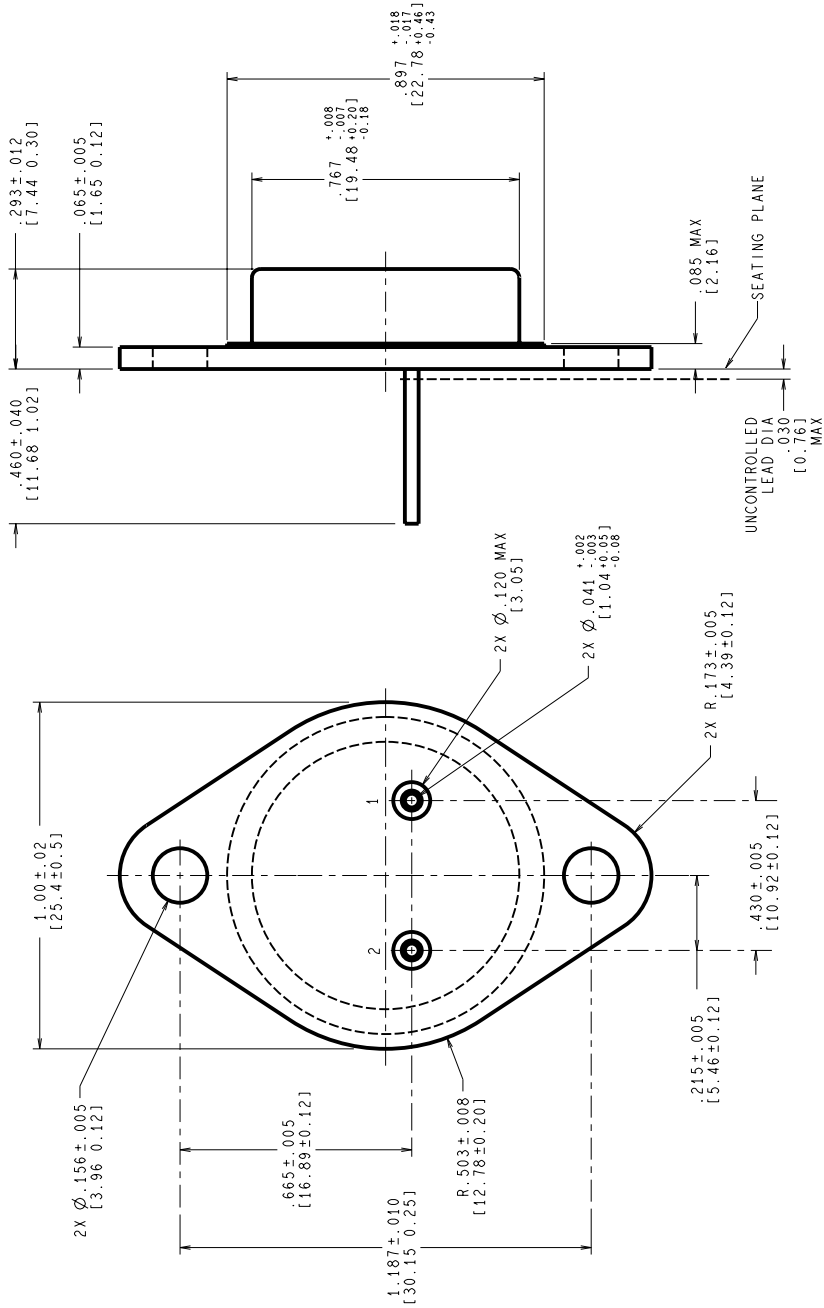
## Graphics and Diagrams

GRAPHICS#	DESCRIPTION
09757HRE4	METAL CAN (KA), TO-3, 2LD, LOW PROFILE (B/I CKT)
K02CRE	METAL CAN TO-3, 2LD, LOW PROFILE (P/P DWG)
P000173A	METAL CAN (KA), TO-3, 2LD, LOW PROFILE (PINOUT)

See attached graphics following this page.



REVISIONS			
LTR	DESCRIPTION	E.C.N.	DATE
E	REDRAW ON PROFILE: UPDATE MIL/AERO STAMP: NOTE 2: MIL-PRF-38535 WAS MIL-I-38535.	11155	09/15/95 MS/



CONTROLLING DIMENSION IS INCH  
VALUES IN [ ] ARE MILLIMETERS

MIL-PRF-38535  
CONFIGURATION CONTROL

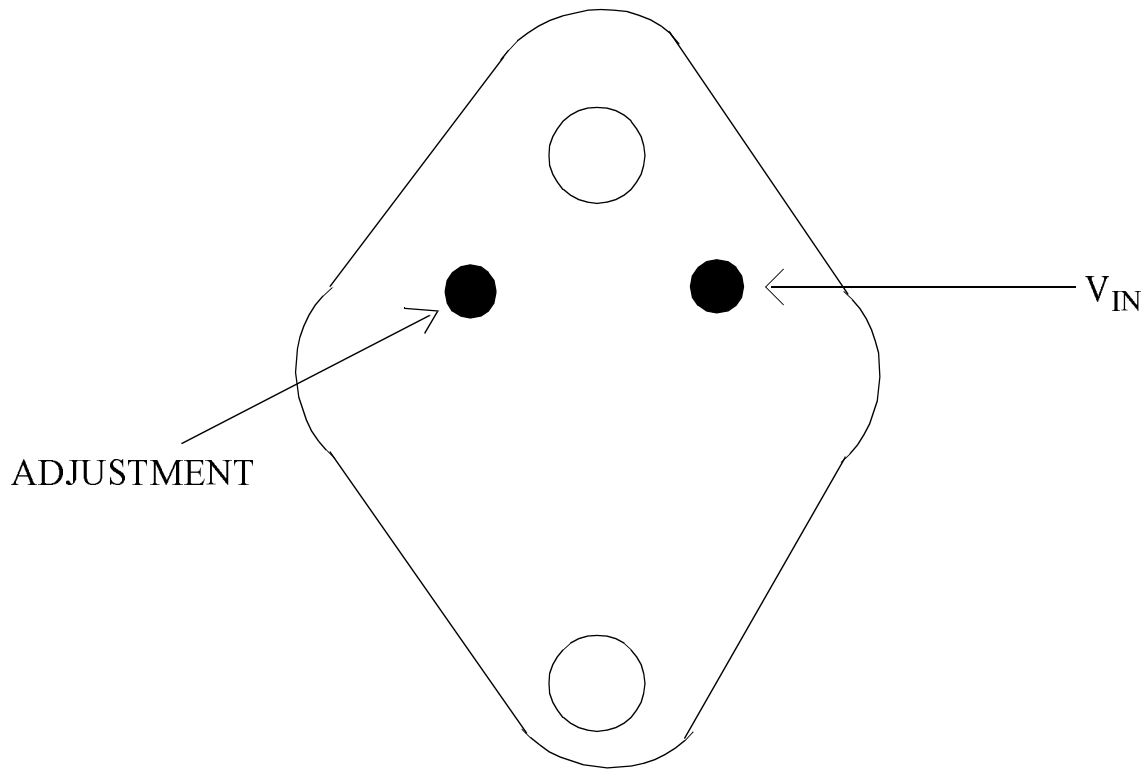
NOTES: UNLESS OTHERWISE SPECIFIED

- STANDARD HEADER TYPE SOLID BASE.
- STANDARD LEAD FINISH;  
PER MIL-PRF-38535 TYPE X OR EQUIVALENT.
- LEAD NOT BENT GREATER THAN 15°.
- DIMENSIONS BASED ON JEDEC STANDARD TO-3,  
PUBLICATION 95, PAGE 98.

APPROVALS		DATE
DRNWR	MARTA SUCHY	09/15/95
DATE	CHK.	
ENGR.	CHK.	
PROJECTION		
SCALE	SIZE	DRAWING NUMBER
N/A	C	MKT-K02C
DO NOT SCALE DRAWING		REV
		E

**National Semiconductor**  
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METAL CAN, TO-3,  
2 LEAD, LOW PROFILE



LM117K, LM117HVK  
2 - LEAD TO3  
CONNECTION DIAGRAM  
BOTTOM VIEW  
P000173A



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

## Revision History

Rev	ECN #	Rel Date	Originator	Changes
0A0	M0003588	05/02/00	Rose Malone	Initial MDS Release: MRLM117-K-RH, Rev. 0A0
1A0	M0003663	07/19/00	Rose Malone	Updated MRLM117-K-RH, Rev. 0A0 to MRLM117-K-RH, Rev. 1A0. Typo in Post Radiation Section, changed Vout limit from Vin = 4.25V, I1 = -1.5mA to Vin = 4.25V, I1 = -1.5A.
2A0	M0003733	04/08/02	Rose Malone	Update MDS: MRLM117-K-RH, Rev. 1A0 to MRLM117-K-RH, Rev. 2A0. Changes made in Absolute and Recommended Section, Post Radiation Section, Vrline Parameter from -18mV Min, 18mV Max to -25mV Min, 25mV Max, Vrload Parameter from -5.5mV Min, 5.5mV Max to -7.0mV Min, 7.0mV Max, Delta Vin/Delta Vout Parameter from 63dB to 60dB. Added Vout (Recov) parameter in Post Radiation Section.
2B0	M0003989	09/10/02	Rose Malone	Update MDS: MRLM117-K-RH, Rev. 2A0 to MRLM117-K-RH, Rev. 2B0. Deleted reference LM117KRQML from Main Table and Features Section product no longer available.
3A0	M0004037	09/10/02	Rose Malone	Update MDS: MRLM117-K-RH, Rev. 2B0 to MRLM117-K-RH, Rev. 3A0. Change to Electrical Section Post Radiation Limit: Vout and Vout (Recov) Max limit from 1.325V to 1.350V.