

**MNLM117-E REV 0B1**

 Original Creation Date: 06/27/95  
 Last Update Date: 05/02/00  
 Last Major Revision Date: 06/27/95

**POSITIVE THREE-TERMINAL ADJUSTABLE VOLTAGE REGULATOR**
**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, 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**

LM117E

**NS Part Numbers**

LM117E/883

**Prime Die**

LM117H

**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

**(Absolute Maximum Ratings)**

(Note 1)

Power Dissipation (Note 2)	Internally Limited
Input-Output Voltage Differential	+40V, -0.3V
Maximum Junction Temperature	150 C
Storage Temperature Range	-65 C to +150 C
Lead Temperature (Soldering, 10 seconds)	260 C
Thermal Resistance	
ThetaJA (Still Air)	88 C/W
(500LF/Min Air flow)	62 C/W
ThetaJC	12.0 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  $P_{dmax} = (T_{jmax} - T_A) / \Theta_{JA}$  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
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## Electrical Characteristics

### DC PARAMETERS

(The following conditions apply to all the following parameters, unless otherwise specified.)  
DC:  $V_{diff} = (V_{in} - V_{out})$ ,  $I_l = 8mA$ ,  $P_d \leq 1.5W$

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
Iadj	Adjustment Pin Current	$V_{diff} = 3V$				100	uA	1
		$V_{diff} = 3.3V$				100	uA	2, 3
		$V_{diff} = 40V$				100	uA	1, 2, 3
Iq	Minimum Load Current	$V_{diff} = 3V, V_{out} = 1.7V$				5	mA	1
		$V_{diff} = 3.3V, V_{out} = 1.7V$				5	mA	2, 3
		$V_{diff} = 40V, V_{out} = 1.7V$				5	mA	1, 2, 3
Vref	Reference Voltage	$V_{diff} = 3V$			1.2	1.3	V	1
		$V_{diff} = 3.3V$			1.2	1.3	V	2, 3
		$V_{diff} = 40V$			1.2	1.3	V	1, 2, 3
Vrline	Line Regulation	$3V \leq V_{diff} \leq 40V, V_{out} = 1.2V$			-8.9	8.9	mV	1
		$3.3V \leq V_{diff} \leq 40V, V_{out} = 1.2V$			-22.2	22.2	mV	2, 3
Vrload	Load Regulation	$V_{diff} = 3V, I_l = 10mA \text{ to } 100mA$			-15	15	mV	1
		$V_{diff} = 3.3V, I_l = 10mA \text{ to } 100mA$			-15	15	mV	2, 3
		$V_{diff} = 40V, I_l = 10mA \text{ to } 100mA$			-15	15	mV	1, 2
		$V_{diff} = 3V, I_l = 10mA \text{ to } 500mA$			-25	25	mV	3
		$V_{diff} = 3.3V, I_l = 10mA \text{ to } 500mA$			-15	15	mV	2, 3
Delta Iadj	Adjustment Current Change	$V_{diff} = 3V, I_l = 10mA \text{ to } 500mA$			-5	5	uA	1
		$V_{diff} = 3.3V, I_l = 10mA \text{ to } 500mA$			-5	5	uA	2, 3
		$V_{diff} = 40V, I_l = 10mA \text{ to } 100mA$			-5	5	uA	1, 2, 3
		$3V \leq V_{diff} \leq 40V$			-5	5	uA	1
		$3.3V \leq V_{diff} \leq 40V$			-5	5	uA	2, 3
Ios	Short Circuit Current	$V_{diff} = 10V$			.45	1.6	A	1
Theta R	Thermal Regulation	$T_A = 25\text{ C}, t = 20mS, V_{diff} = 40V, I_l = 75mA$			-6	6	mV	1
Icl	Current Limit	$V_{diff} \leq 15V$	1		0.5		A	1, 2, 3
		$V_{diff} \leq 40V$	1		0.15		A	1

## Electrical Characteristics

### AC PARAMETERS

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
Rr	Ripple Rejection	Vin = +6.25V, Vout=Vref, f=120Hz, ei=1Vrms, I1=100mA, Cadj=10uF	2		66		dB	4, 5, 6

Note 1: Guaranteed Parameter, Not tested

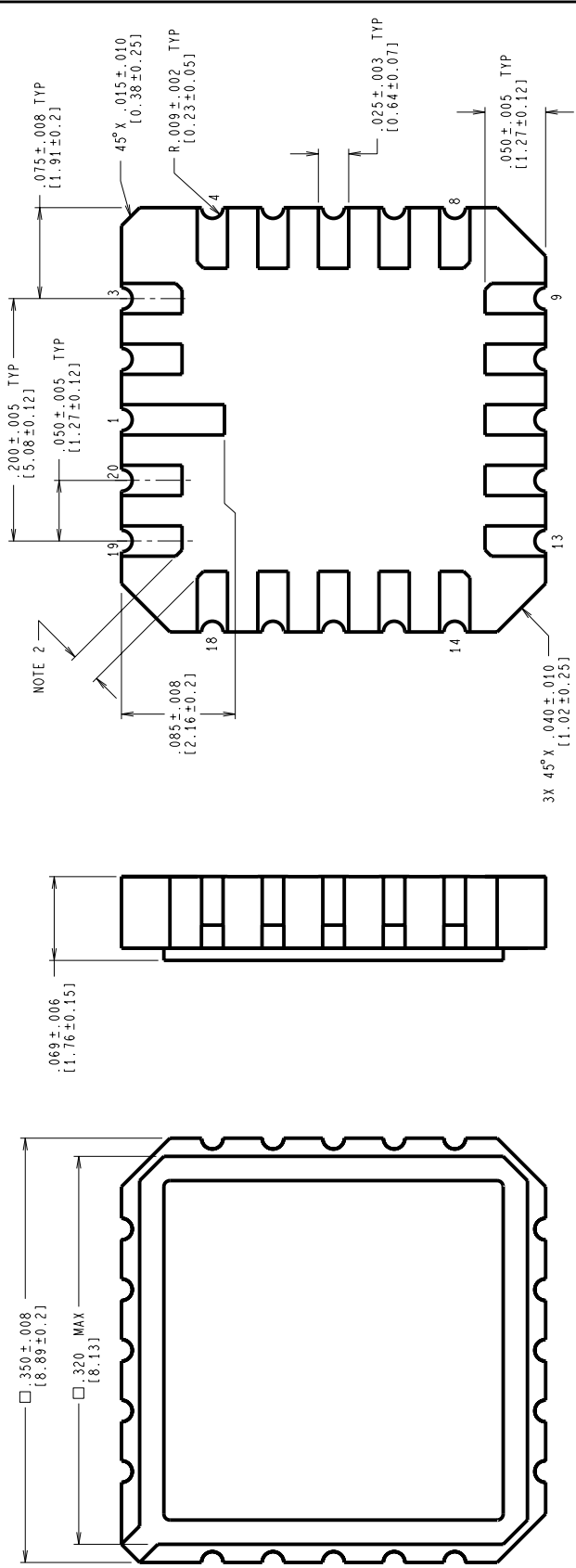
Note 2: Tested at +25 C; Guaranteed, But not tested at +125 C and -55 C

## Graphics and Diagrams

GRAPHICS#	DESCRIPTION
06145HRA2	LCC (E), TYPE C, 20 TERMINAL(B/I CKT)
E20ARE	LCC (E), TYPE C, 20 TERMINAL(P/P DWG)
P000228A	LCC (E), TYPE C, 20 TERMINAL (PINOUT)

See attached graphics following this page.

REVISIONS			
LTR	DESCRIPTION	E.C.N.	DATE
E	REVISE AND REDRAW	10005	02/10/94 DEG/



- NOTES: UNLESS OTHERWISE SPECIFIED.
- LEAD FINISH TO BE ONE OF THE FOLLOWING:
    - 50 MICRONS/12.7 MICROMETERS MINIMUM GOLD PLATING OVER 50-350 MICRONS/1.27-8.89 MICROMETERS NICKEL.
    - SOLDER DIP. SOLDER THICKNESS PER LATEST REVISION OF MIL-STD-1835.
  - CORNER PADS MAY HAVE A  $45^\circ$  X  $0.20$  IN/0.51mm MAXIMUM CHAMFER TO ACCOMPLISH THE  $0.015$  IN/0.38mm DIMENSION.
  - REFERENCE JEDEC REGISTRATION MS-004, VARIATION CB, DATED 7/90.

CONTROLLING DIMENSION IS INCH  
VALUES IN [ ] ARE MILLIMETERS

**MIL/AERO**  
**CONFIGURATION CONTROL**

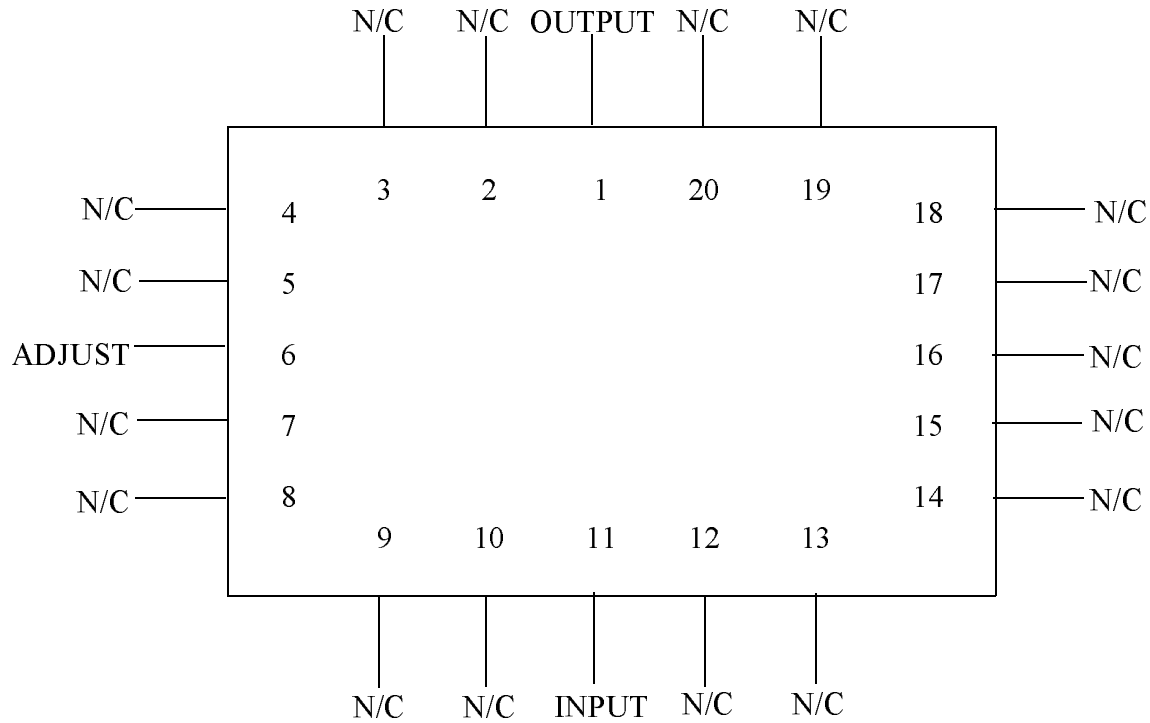
**NATIONAL SEMICONDUCTOR CORPORATION**  
2300 Semiconductor Drive, Santa Clara, Ca. 95052-8090

**LEADLESS CHIP CARRIER,**  
**TYPE C,**  
**20 TERMINAL**

APPROVALS	DATE	SCALE	SIZE	DRAWING NUMBER	REV.
DRN: <i>Deane Gedy</i>	02/10/94	N/A	C	MKT-E20A	E
DFTG. CHK.					
ENGR. CHK.					
APPROVAL					

PROJECTION  
  
 INCH  
 MM

DO NOT SCALE DRAWING SHEET 1 of 1



**LM117E**  
**20 - LEAD LCC**  
**CONNECTION DIAGRAM**  
**TOP VIEW**  
**P000228A**



National Semiconductor™

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

**Revision History**

Rev	ECN #	Rel Date	Originator	Changes
0B1	M0003658	05/02/00	Rose Malone	Update MDS: MNL117-E, Rev. 0A0 to MNL117-E, Rev. 0B1. Added Power Dissipation note and reference to note. Updated Thermal Data - ThetaJA (Still Air) from 90 C/W to 88 C/W and (500LF/Min Air Flow) from 63 C/W to 62 C/W, ThetaJc from 47 C/W to 12.0 C/W. Added Pin Out graphic and Updated B/I ckt in graphics section.