National Semiconductor

# MICROCIRCUIT DATA SHEET

## MJLM117-K REV 0B0

Original Creation Date: 06/27/95
Last Update Date: 03/31/97
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 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 diconnected.

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).

For applications requiring greater output current, see LM150 (3A) and LM138 (5A) data sheets. For the negative complement, see LM137 data sheet.

## Industry Part Number

LM117K

## NS Part Numbers

JL117BYA
JL117SYA

## Prime Die

LM117K

## Controlling Document

38510/11704,AMEND.3 REV A

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## Processing

MIL-STD-883, Method 5004

## Quality Conformance Inspection

MIL-STD-883, Method 5005

| Subgrp | Description | Temp ($^{O}$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

## (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) | 300 C |
| Thermal Resistance | |
| ThetaJA | |
| (Still Air) | 38 C/W |
| (500LF/Min Air flow) | TBD |
| ThetaJC | 3 C/W |
| ESD Tolerance (Note 3) | 3kV |

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 $\leq$ TA $\leq$ +125 C |

# Electrical Characteristics

## DC PARAMETERS

| 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 = -1.5A | | | 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 = -200mA | | | 1.2 | 1.3 | V | 1, 2, 3 |
| Vrline | Line Regulation | 4.25V ≤ Vin ≤ 41.25V, Il = -5mA | | | -9 | 9 | mV | 1 |
| | | 4.25V ≤ Vin ≤ 41.25V, Il = -5mA | | | -23 | 23 | mV | 2, 3 |
| Vrload | Load Regulation | Vin = 6.25V, -1.5A ≤ Il ≤ -5mA | | | -3.5 | 3.5 | mV | 1 |
| | | Vin = 6.25V, -1.5A ≤ Il ≤ -5mA | | | -12 | 12 | mV | 2, 3 |
| | | Vin = 41.25V, -200mA ≤ Il ≤ -5mA | | | -3.5 | 3.5 | mV | 1 |
| | | Vin = 41.25V, -200mA ≤ Il ≤ -5mA | | | -12 | 12 | mV | 2, 3 |
| Vrth | Thermal Regulation | Vin = 14.6V, Il = -1.5A | | | -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, -1.5A ≤ Il ≤ -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, Rl = 0.833 Ohms, Cl = 20uF | | | 1.2 | 1.3 | V | 1, 2, 3 |
| | | Vin = 40V, Rl = 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, Rl = 0.833 Ohms, Cl=20uF, Il = -1.5A | | | 1.2 | 1.3 | V | 1, 2, 3 |

# Electrical Characteristics

## DC PARAMETERS(Continued)

| SYMBOL | PARAMETER | CONDITIONS | NOTES | PIN-NAME | MIN | MAX | UNIT | SUB-GROUPS |
|---|---|---|---|---|---|---|---|---|
| Vout | Output Voltage | Vin = 6.25V, Il = -5mA | 1 | | 1.2 | 1.3 | V | 2 |

## AC PARAMETERS

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Vno | Output Noise Voltage | Vin = 6.25V, Il = -100mA | | | | 120 | uVrms | 7 |
| DeltaVout/ DeltaVin | Line Transient Response | Vin = 6.25V, Delta Vin = 3V, Il = -10mA | 2 | | | 18 | mV | 7 |
| DeltaVout/ Delta Il | Load Transient Response | Vin = 6.25V, Delta Il = -400mA, Il = -100mA | 3 | | | 120 | mV | 7 |
| Delta Vin/Delta Vout | Ripple Rejection | Vin = 6.25V, ei = 1Vrms at f = 2400Hz, Il = -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 JAN S and 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 = -1.5A | | | -0.01 | 0.01 | V | 1 |
| | | Vin = 41.25V, Il = -5mA | | | -0.01 | 0.01 | V | 1 |
| | | Vin = 41.25V, Il = -200mA | | | -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 |

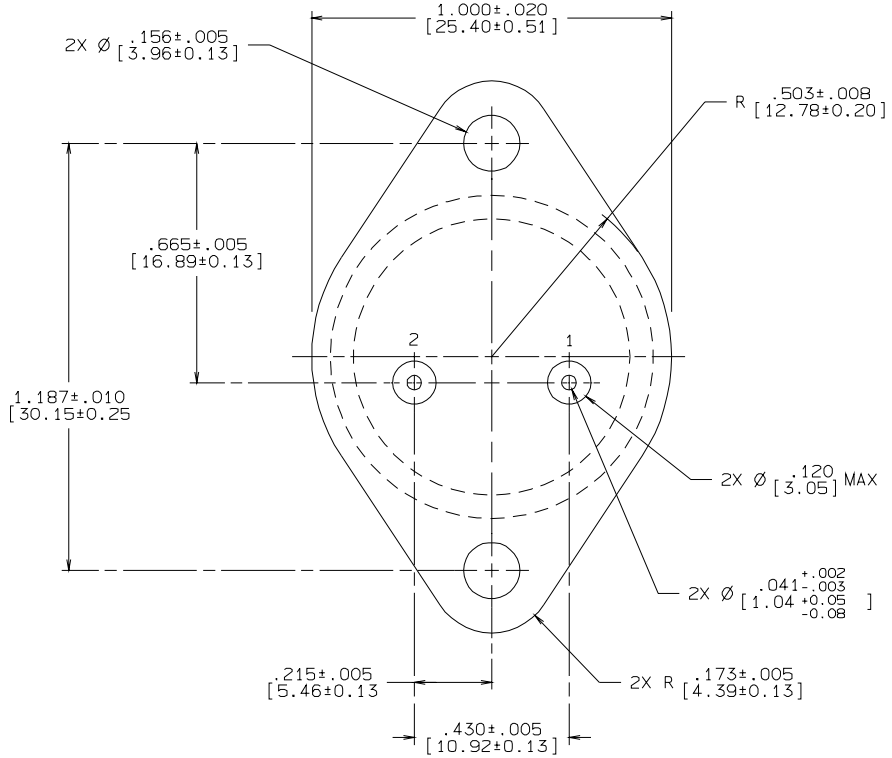
Note 1: Tested at TA = +125 C, correlated to TA = +150 C.
Note 2: S/S limit of 6mV/V is equivalent to 18mV.
Note 3: S/S limit of .3mV/V is equivalent to 120mV.

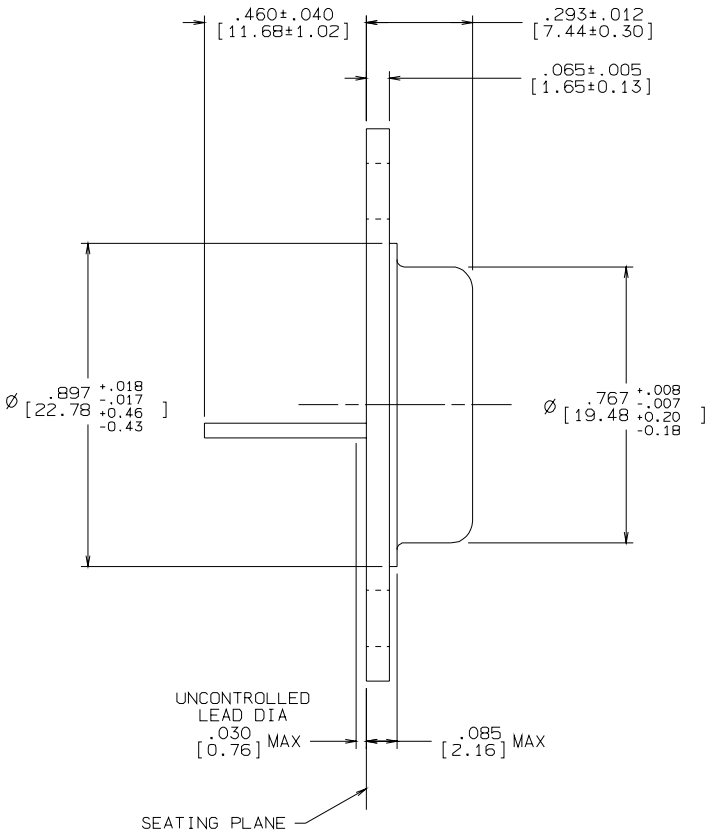
## Graphics and Diagrams

| GRAPHICS# | DESCRIPTION |
|---|---|
| 9757HRE2 | METAL CAN (KA), TO-3, 2LD, LOW PROFILE (B/I CKT) |
| K02CRD | METAL CAN (KA), TO-3, 2LD,LOW PROFILE (P/P DWG) |

**See attached graphics following this page.**

| REVISIONS | | | | |
|---|---|---|---|---|
| LTR | DESCRIPTION | E.C.N. | DATE | BY/APP'D |
| B | REV & REDRAW PER STD FORMAT; ADD NOTE 4; .420-.500 WAS .450 ±.030 | 08827 | 10/25/91 | TL/FL |
| C | REVISE AND REDRAW PER ECN. | 10487 | 08/17/94 | DEG/GY |
| D | DIM .293±.012 [7.44±0.30] WAS .295±.010 [7.49±0.25]; REPLACE MIL/AERO STAMPS WITH MIL-I-38535 CONFIG. CONTROL STAMP; REV NOTE 2 | 10852 | 02/27/95 | MS/ |




CONTROLLING DIMENSION: INCH

NOTES: UNLESS OTHERWISE SPECIFIED

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

MIL-I-38535
CONFIGURATION CONTROL

| APPROVALS | DATE |
|---|---|
| DRAWN T. LEQUANG | 10/25/91 |
| DFTG. CHK. | |
| ENGR. CHK. | |
| | |

PROJECTION
INCH
[MM]

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METAL CAN, TO-3,
2 LEAD, LOW PROFILE

| SCALE | SIZE | DRAWING NUMBER | REV |
|---|---|---|---|
| N/A | C | MKT-K02C | D |

DO NOT SCALE DRAWING | SHEET 1 OF 1