

## Linear Voltage Regulators

### Introduction

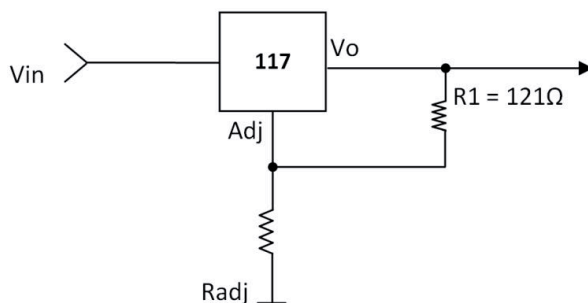
The MHL117/A/B/Q linear voltage regulators are space-qualified, wide-input range, hermetically packaged, and are designed for military and space flight applications. They provide up to 1.5A of output current. The devices also feature internal thermal shutdown, output current-limiting circuitry, and one model  $\pm 1.5\%$  initial output accuracy. These are a recommended choice for applications requiring high radiation tolerance, low noise, and high-power supply rejection ratios.

These devices are available in adjustable output voltage configurations. The adjustable version requires only two external resistors to program the output from 1.25V to 37V.

**Figure 1. MHL117 Device—3D View**



**Figure 2. MHL117 Device—Schematic**



#### Formula for $V_{OUT}$

$$V_O = 1.25 (1 + R_{adj}/R_1) + I_{ADJ}R_{ADJ}$$

All ratings  $T_C = 25^\circ\text{C}$ , unless otherwise specified.

## Features

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The following are the key features of MHL117 device:

- Rad-Tolerant to 300K rad TID<sup>1</sup>
- ELDRS effects free through 50K Rad TID<sup>1</sup>
- Wide Input Voltage: 40V
- Space level screening
- Excellent Temperature Stability
- 1.5% Accuracy –55°C to 125°C for MHL117A only

## Applications/Benefits

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The following are the applications/benefits of MHL117 device:

- Adjustable over a wide range of output voltages.

## 1. Electrical Specifications

This section provides the electrical specifications of the MHL117 device.

### 1.1 Absolute Maximum Ratings

The following table lists the absolute maximum ratings of the MHL117 device.

**Table 1-1. Absolute Maximum Ratings**

Symbol	Parameters/Test Conditions	Value	Unit
$V_{In}-V_O$	DC input-output differential	40	V
$V_O$	DC output voltage	1.2 to 37	V
$I_O$	Output current	1.5	A
$P_D$	Power dissipation $T_{CASE} = 25\text{ }^{\circ}\text{C}$	50	W
$R_{thJC}$	Junction-to-case thermal resistance	2.5	$^{\circ}\text{C}/\text{W}$
$T_{STG}$	Storage temperature	-65 to 150	$^{\circ}\text{C}$
$T_{OP}$	Operating temperature range	-55 to 125	$^{\circ}\text{C}$
$T_J$	Maximum junction temperature	175	$^{\circ}\text{C}$
W	Package weight	5	G
$T_{solder}$	Maximum soldering temperature, 10 sec	300	$^{\circ}\text{C}$

### 1.2 Electrical Characteristics

The following table lists the electrical characteristics of the MHL117 device.

**Note:**  $T_A = -55^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  unless otherwise specified.

**Table 1-2. Electrical Characteristics**

Symbol	Parameters/Test Conditions	Test Conditions	MHL117			MHL117A and MHL117Q			MHL117B			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
$V_{REF}$	Reference voltage accuracy <sup>9</sup>	$V_{diff} = 3.25\text{V}$ $I_L = 10\text{ mA}$ (5.25 mA for 117)	1.200	1.25	1.300	1.231	1.25	1.269	1.225	1.25	1.275	V
$V_{REF}$	Reference voltage accuracy <sup>7, 10</sup>	$V_{diff} = 40\text{V}$ $I_L = 10\text{ mA}$	1.200	1.25	1.300	1.225	1.25	1.275	1.200	1.25	1.300	V
$V_{LINE}$	Line Regulation <sup>2, 7</sup>	$V_{out} = V_{ref}$ $I_L = 10\text{ mA}$ , $3.0 \leq V_{diff} \leq 40\text{V}$	-10	—	10	-10	—	10	-10	—	10	mV
$V_{load}$	Load Regulation <sup>2, 8</sup>	$V_{diff} = 5.25\text{V}$ $10\text{ mA} \leq I_L \leq 1.5\text{A}$	-15	—	15	-15	—	15	-15	—	15	mV

# MHL117/A/B/Q

## Electrical Specifications

.....continued												
Symbol	Parameters/Test Conditions	Test Conditions	MHL117			MHL117A and MHL117Q			MHL117B			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
I <sub>ADJ</sub>	Adjust-pin Current <sup>7</sup>	V <sub>diff</sub> = 3.3V–40V I <sub>load</sub> = 10 mA	—	—	100	—	—	100	—	—	100	μA
ΔI <sub>adj</sub>	Adjust-pin Current Change <sup>7</sup>	V <sub>diff</sub> = 5.25V–40V I <sub>L</sub> = 10 mA	–5	—	5	–5	—	5	–5	—	5	μA
ΔI <sub>adj</sub>	Adjust-pin current change <sup>8</sup>	V <sub>diff</sub> = 5.25V 10 mA ≤ I <sub>L</sub> ≤ 1.5A	–5	—	5	–5	—	5	–5	—	5	μA
PSRR	Ripple rejection	F = 120 Hz I <sub>out</sub> = 50 mA V <sub>diff</sub> = 5.25V V <sub>r</sub> = 2V <sub>p-p</sub>	65	—	—	65	—	—	65	—	—	dB
I <sub>OS</sub>	Short-circuit current	V <sub>diff</sub> = 3V	1.5	—	—	1.5	—	—	1.5	—	—	A
V <sub>rth</sub>	Thermal Regulation <sup>4</sup>	T <sub>A</sub> = 25°C V <sub>in</sub> = 14.6V I <sub>L</sub> = 1.5A P <sub>d</sub> = 20W t = 20 mS	–5	—	5	–5	—	5	–5	—	5	mV

## 2. Radiation Ratings

The following table lists the radiation ratings of MHL117 device.

**Table 2-1. Radiation Ratings**

Symbol	Parameters/Test Conditions	Value	Unit
TID	Maximum total dose (Dose rate: 50–300 rad (Si)/s)	300	Krads (Si)
ELDRS	ELDRS (Low dose rate $\leq 10$ mrad (Si)/s)	50	Krads (Si)
SET	Linear energy threshold, single event transient $< 100$ mV	15	MeV/mg/cm <sup>2</sup>
SEL/SEB	Single-event latch-up linear energy threshold <sup>5</sup>	87.4	MeV/mg/cm <sup>2</sup>

### 3. Screening Options

Table 3-1. Screening Options

Tests	Screening Levels	MIL-STD-883 Method
	Space	
	MIL-PRF-38534 Certified	
100% Non-destruct wire-pull	100%	2023
Pre-cap visual	100%	2017
Temperature cycle	100%	1010
Constant acceleration	100%	2001
PIND	100%	2020
Pre-burn-in electrical ( $T_A = 25^\circ\text{C}$ )	100%	—
Burn-in	100% (320 hours)	1015
Final electrical	100%	—
Hermeticity (Fine and gross leak)	100%	1014
X-Ray <sup>11</sup>	100%	2012
External visual	100%	2009

**Notes:**

1. Certified to Appendix G of MIL-PRF-38534 for Radiation Hardness Assurance (RHA) requirements for Hybrid Microcircuits and Multichip Modules effective June 27, 2013 (See [RHA Test Laboratory Suitability](#)).
2. Load & Line regulation is measured at constant ( $T_J$ ) junction temperature using a low duty cycle pulse. Changes in output voltage due to heating effects must be evaluated separately.
3. TID Radiation Testing is performed per MIL-STD-883, Method 1019. ELDRS tested per MIL-STD-883 method 1019 par. 3.13.11.
4. Not tested.
5. Latch up immune due to DI process.
6. Internal SOA protection limits output current with high input voltages.
7.  $V_{\text{diff}} = 39\text{V}$  at  $125^\circ\text{C}$ .
8. At  $125^\circ\text{C}$ , 1.5A is achievable at an I/O differential of 6.75V. At the stated 5.25V differential, 1.25 A is achievable at  $125^\circ\text{C}$ .
9. For MHL117Q, these specifications hold at  $25^\circ\text{C}$  only.
10. For MHL117Q, these specifications hold also for the above input conditions at temperature extremes.
11. Performed at a DLA approved facility.

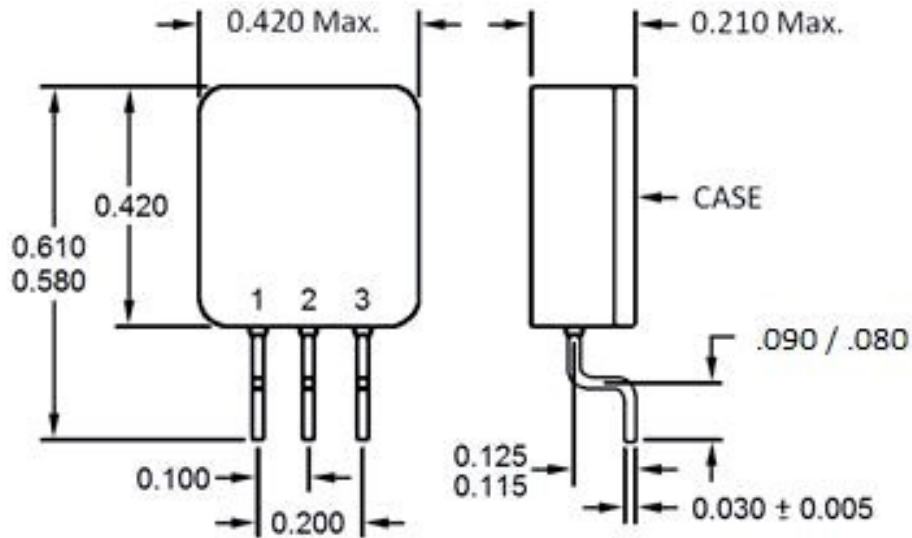
## 4. Package Specifications

The following section shows the package specification of the MHL117 device.

### 4.1 Package Outline

The following figure shows the package outline drawing of the MHL117 device. The dimensions in the following figure are in millimeters.

**Figure 4-1. Package Outline Drawing—Tabless TO-254 (D2) (SMT Lead Bend Shown)**



Pin Number	Pin Name	Pin Description
1	ADJ/GND	Adjust Pin
2	OUT	Output Voltage
3	IN	Input Voltage
	Case	No Connection-Isolated

## 5. Ordering Information

The following table lists the ordering information.

**Table 5-1. Ordering Information**

Part Number	Regulator Accuracy
MHL117 40K &# Consult factory for availability	40V Standard
MHL117A 40K &#	40V 1.5% Accuracy
MHL117B 40K &# Consult factory for availability	40V 2% Accuracy
MHL117Q 40K &# Consult factory for availability	40V 1.5% Accuracy at 25°C, 2% Accuracy at temperature extremes

Replace # with lead finish option letter:

- C = Gold plate
- A = Solder dip over gold plate

Replace & with the dash and number to indicate the following lead bend options:

**Table 5-2. Lead Bend Options**

-1	Straight <sup>1</sup>
-2	SMT
-3	Down <sup>1</sup>
-4	Up <sup>1</sup>

**Note:** Consult factory for latest package outline drawing and availability.



**6. Revision History**

Revision	Date	Description
A	09/2021	Initial Revision

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