RS1117A

1.0A Low Dropout Positive Voltage Regulator

General Description

The RS1117A is a 1A low-dropout positive voltage regulator. It is available in fixed and adjustable output voltage versions. Over current and thermal protection are integrated onto the chip. Output current will limit as while it reaches the pre-set current or temperature limit. The dropout voltage is specified at 1.40V Maximum at full rated output current. The RS1117A series provides excellent regulation over line, load and temperature variations.

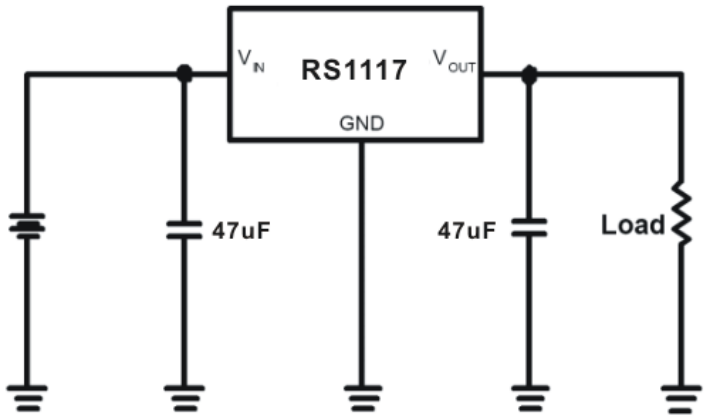
Features

- Low Dropout Voltage 1.40V (Max.) at 1.0A
- Adjustable or Fixed Voltage (1.2V, 1.8V, 2.5V, 3.3V and 5.0V)
- Over Current Protection
- Thermal Overload Protection
- Maximum Line Regulation 0.2%
- Maximum Load Regulation 1.0%
- Adjust Pin Current Less Than 120uA

Applications

- SCSI-2 Active Termination
- High Efficiency Linear Regulators
- 5V to 3.3V Voltage Converter
- Battery Charger
- Battery Management Circuits For Notebook And Palmtop PCs
- Core Voltage Supply: FPGA, PLD, DSP, CPU

Application Circuits

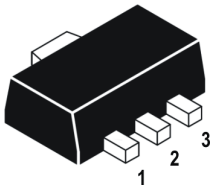


This integrated circuit can be damaged by ESD. Orister Corporation recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

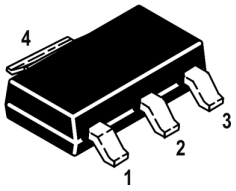
ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

Pin Assignments

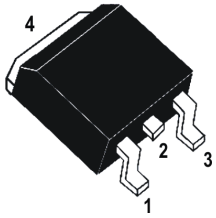
SOT-89



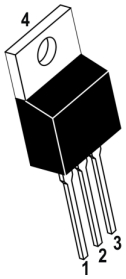
SOT-223



TO-252



TO-220-3



PACKAGE	PIN	SYMBOL	DESCRIPTION
SOT-89	1	ADJ/GND	Ground Pin or ADJ Terminal Pin for Adjustable.
	2	VOUT	Regulator Output Pin
	3	VIN	Regulator Input Pin

PACKAGE	PIN	SYMBOL	DESCRIPTION
SOT-223	1	ADJ/GND	Ground Pin or ADJ Terminal Pin for Adjustable.
	2, 4	VOUT	Regulator Output Pin
	3	VIN	Regulator Input Pin

PACKAGE	PIN	SYMBOL	DESCRIPTION
TO-252	1	ADJ/GND	Ground Pin or ADJ Terminal Pin for Adjustable.
	2, 4	VOUT	Regulator Output Pin
	3	VIN	Regulator Input Pin

PACKAGE	PIN	SYMBOL	DESCRIPTION
TO-220-3	1	ADJ/GND	Ground Pin or ADJ Terminal Pin for Adjustable.
	2, 4	VOUT	Regulator Output Pin
	3	VIN	Regulator Input Pin

Ordering Information

DEVICE	DEVICE CODE
RS1117A-XX YY Z	**XX** is nominal output voltage designator : AD: ADJ 12: 1.2V 18: 1.8V 25: 2.5V 33: 3.3V 50: 5.0V **YY** is package designator : M: SOT-89 SJ: SOT-223 J: TO-252 E: TO-220-3 **Z** is Lead Free designator : P: Commercial Standard, Lead (Pb) Free and Phosphorous (P) Free Package G: Green (Halogen Free with Commercial Standard)

Absolute Maximum Ratings

Parameter	Symbol	Maximum	Units
Input Voltage	V_{IN}	20	V
Power Dissipation	P_D	Internally Limited *	W
Operating Junction Temperature Range	T_{OPR}	0 To +125	°C
Storage Temperature Range	T_{STG}	-65 To +150	°C
Lead Temperature (Soldering) 5 Sec	T_{LEAD}	260	°C
HBM (Human Body Mode)		2	KV/Min

*: SOT-223: 0.9W(Max.), SOT-89: 0.6W(Max.), TO-252: 0.9W(Max.), TO-220: 2.1W(Max.)

Electrical Characteristics (V_{IN}=V_{LX}=3.6V, T_A=25°C, unless otherwise specified)

RS1117A-12 (1.2V)

Parameter	Symbol	Test Conditions		Min.	Typ.	Max.	Units
Output Voltage	V_{OUT}	V_{IN}=5V, I_O=0A	T_J=0 °C to 125 °C	1.176	1.200	1.224	V
Line Regulation	REG_{LINE}	V_{IN}=4.75V to 6V, I_O=0A	T_J=0 °C to 125°C	-	-	0.2	%
Load Regulation	REG_{LOAD}	V_{IN}=5V, I_O=0A to 1A	T_J=0 °C to 125 °C	-	0.1	1.0	
Dropout Voltage	$V_{DROPOUT}$	ΔV_O=±1%, I_O=0A to 1A	T_J=0 °C to 125 °C	-	1.2	1.4	V
Current Limit	I_S	V_{IN}=4.75V to 6V	T_J=0 °C to 125 °C	1.0	1.5	-	A
Quiescent Current	I_Q	V_{IN}=5V, I_O=0A to 1A	T_J=0 °C to 125 °C	-	6.0	13	mA
Temp. Coefficient	T_C	V_{IN}=4.75V to 6V, I_O=0A to 1A		-	0.005	-	%/ °C
Temp. Stability	T_S	V_{IN}=5V, I_O=100mA	T_J=0 °C to 125 °C	-	0.5	-	%
RMS Output Noise	V_N	10Hz ≤ f ≤ 10KHz	T_J=25 °C	-	0.003	-	%ΔV_O
Ripple Rejection Ratio	R_A	V_{IN}=5V, I_O=1A	T_J=0 °C to 125 °C	60	72	-	dB

RS1117A-18 (1.8V)

Parameter	Symbol	Test Conditions		Min.	Typ.	Max.	Units
Output Voltage	V_{OUT}	V_{IN}=5V, I_O=0A	T_J=0 °C to 125 °C	1.764	1.800	1.836	V
Line Regulation	REG_{LINE}	V_{IN}=4.75V to 7V, I_O=0A	T_J=0 °C to 125°C	-	-	0.2	%
Load Regulation	REG_{LOAD}	V_{IN}=5V, I_O=0A to 1A	T_J=0 °C to 125 °C	-	0.1	1.0	
Dropout Voltage	$V_{DROPOUT}$	ΔV_O=±1%, I_O=0A to 1A	T_J=0 °C to 125 °C	-	1.2	1.4	V
Current Limit	I_S	V_{IN}=4.75V to 7V	T_J=0 °C to 125 °C	1.0	1.5	-	A
Quiescent Current	I_Q	V_{IN}=5V, I_O=0A to 1A	T_J=0 °C to 125 °C	-	6.0	13	mA
Temp. Coefficient	T_C	V_{IN}=4.75V to 7V, I_O=0A to 1A		-	0.005	-	%/ °C
Temp. Stability	T_S	V_{IN}=5V, I_O=100mA	T_J=0 °C to 125 °C	-	0.5	-	%
RMS Output Noise	V_N	10Hz ≤ f ≤ 10KHz	T_J=25 °C	-	0.003	-	%ΔV_O
Ripple Rejection Ratio	R_A	V_{IN}=5V, I_O=1A	T_J=0 °C to 125 °C	60	72	-	dB

RS1117A-50 (5.0V)

Parameter	Symbol	Test Conditions		Min.	Typ.	Max.	Units
Output Voltage	V_{OUT}	V_{IN}=7V, I_O=0A	T_J=0 °C to 125 °C	4.900	5.000	5.100	V
Line Regulation	REG_{LINE}	V_{IN}=7V to 9V, I_O=0A	T_J=0 °C to 125 °C	-	-	0.2	%
Load Regulation	REG_{LOAD}	V_{IN}=7V, I_O=0A to 1A	T_J=0 °C to 125 °C	-	0.1	1.0	
Dropout Voltage	$V_{DROPOUT}$	ΔV_O=±1%, I_O=0A to 1A	T_J=0 °C to 125 °C	-	1.2	1.4	V
Current Limit	I_S	V_{IN}=7V to 10V	T_J=0 °C to 125 °C	1.0	1.5	-	A
Quiescent Current	I_Q	V_{IN}=7V, I_O=0A to 1A	T_J=0 °C to 125 °C	-	6.0	13	mA
Temp. Coefficient	T_C	V_{IN}=7V to 10V, I_O=0A to 1A		-	0.005	-	%/ °C
Temp. Stability	T_S	V_{IN}=5V, I_O=100mA	T_J=0 °C to 125 °C	-	0.5	-	%
RMS Output Noise	V_N	10Hz ≤ f ≤ 10KHz	T_J=25 °C	-	0.003	-	%ΔV_O
Ripple Rejection Ratio	R_A	V_{IN}=5V, I_O=1A	T_J=0 °C to 125 °C	60	72	-	dB

RS1117A-33 (3.3V)

Parameter	Symbol	Test Conditions		Min.	Typ.	Max.	Units
Output Voltage	V_{OUT}	V_{IN}=5V, I_O=0A	T_J=0 °C to 125 °C	3.234	3.300	3.370	V
Line Regulation	REG_{LINE}	V_{IN}=4.75V to 7V, I_O=0A	T_J=0 °C to 125 °C	-	-	0.2	%
Load Regulation	REG_{LOAD}	V_{IN}=5V, I_O=0A to 1A	T_J=0 °C to 125 °C	-	0.1	1.0	
Dropout Voltage	$V_{DROPOUT}$	ΔV_O=±1%, I_O=0A to 1A	T_J=0 °C to 125 °C	-	1.2	1.4	V
Current Limit	I_S	V_{IN}=4.75V to 7V	T_J=0 °C to 125 °C	1.0	1.5	-	A
Quiescent Current	I_Q	V_{IN}=5V, I_O=0A to 1A	T_J=0 °C to 125 °C	-	6.0	13	mA
Temp. Coefficient	T_C	V_{IN}=4.75V to 7V, I_O=0A to 1A		-	0.005	-	%/ °C
Temp. Stability	T_S	V_{IN}=5V, I_O=100mA	T_J=0 °C to 125 °C	-	0.5	-	%
RMS Output Noise	V_N	10Hz ≤ f ≤ 10KHz	T_J=25 °C	-	0.003	-	%ΔV_O
Ripple Rejection Ratio	R_A	V_{IN}=5V, I_O=1A	T_J=0 °C to 125 °C	60	72	-	dB

RS1117A-25 (2.5V)

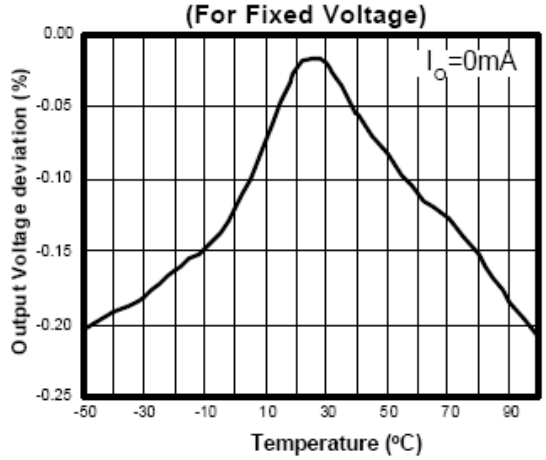
Parameter	Symbol	Test Conditions		Min.	Typ.	Max.	Units
Output Voltage	V_{OUT}	V_{IN}=5V, I_O=0A	T_J=0 °C to 125 °C	2.450	2.500	2.550	V
Line Regulation	REG_{LINE}	V_{IN}=4.75V to 7V, I_O=0A	T_J=0 °C to 125 °C	-	-	0.2	%
Load Regulation	REG_{LOAD}	V_{IN}=5V, I_O=0A to 1A	T_J=0 °C to 125 °C	-	0.1	1.0	
Dropout Voltage	$V_{DROPOUT}$	ΔV_O=±1%, I_O=0A to 1A	T_J=0 °C to 125 °C	-	1.2	1.4	V
Current Limit	I_S	V_{IN}=4.75V to 7V	T_J=0 °C to 125 °C	1.0	1.5	-	A
Quiescent Current	I_Q	V_{IN}=5V, I_O=0A to 1A	T_J=0 °C to 125 °C	-	6.0	13	mA
Temp. Coefficient	T_C	V_{IN}=4.75V to 7V, I_O=0A to 1A		-	0.005	-	%/ °C
Temp. Stability	T_S	V_{IN}=5V, I_O=100mA	T_J=0 °C to 125 °C	-	0.5	-	%
RMS Output Noise	V_N	10Hz ≤ f ≤ 10KHz	T_J=25 °C	-	0.003	-	%ΔV_O
Ripple Rejection Ratio	R_A	V_{IN}=5V, I_O=1A	T_J=0 °C to 125 °C	60	72	-	dB

RS1117A-AD (ADJ)

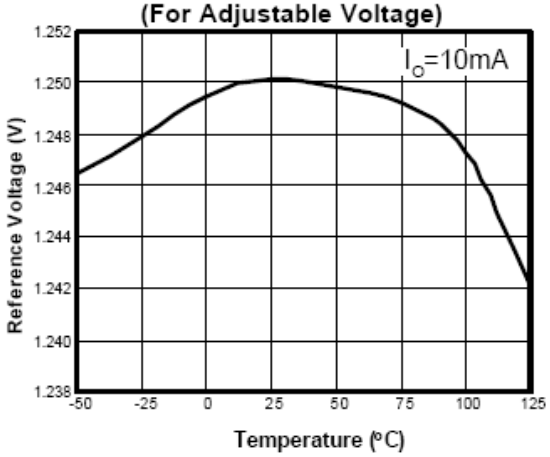
Parameter	Symbol	Test Conditions		Min.	Typ.	Max.	Units
Reference Voltage	V_{REF}	V_{IN}=5V, I_O=10mA	T_J=0 °C to 125 °C	1.225	1.250	1.275	V
Line Regulation	REG_{LINE}	V_{IN}=4.75V to 7V, I_O=10mA	T_J=0 °C to 125 °C	-	-	0.2	%
Load Regulation	REG_{LOAD}	V_{IN}=5V, I_O=10mA to 1A	T_J=0 °C to 125 °C	-	0.1	1.0	
Dropout Voltage	$V_{DROPOUT}$	ΔV_O=±1%, I_O=10mA to 1A	T_J=0 °C to 125 °C	-	1.2	1.4	V
Current Limit	I_S	V_{IN}=2.7V to 7V	T_J=0 °C to 125 °C	1.0	1.5	-	A
Temp. Coefficient	T_C	V_{IN}=2.75V to 7V, I_O=10mA to 1A		-	0.005	-	%/ °C
Adjust Pin Current	I_{ADJ}	V_{IN}=2.75V to 7V, I_O=10mA to 1A	T_J=0 °C to 125 °C	-	55	120	uA
Adjust Pin Current Change	ΔI_{ADJ}	V_{IN}=2.75V to 7V, I_O=10mA to 1A	T_J=0 °C to 125 °C	-	0.2	5.0	
Temp. Stability	T_S	V_{IN}=5V, I_O=100mA	T_J=0 °C to 125 °C	-	0.5	-	%
Minimum Load Current	I_O	V_{IN}=5V		-	5.0	10	mA
RMS Output Noise	V_N	10Hz ≤ f ≤ 10KHz	T_J=25 °C	-	0.003	-	%ΔV_O
Ripple Rejection Ratio	R_A	V_{IN}=5V, I_O=1A	T_J=0 °C to 125 °C	60	72	-	dB

Characteristics Curve

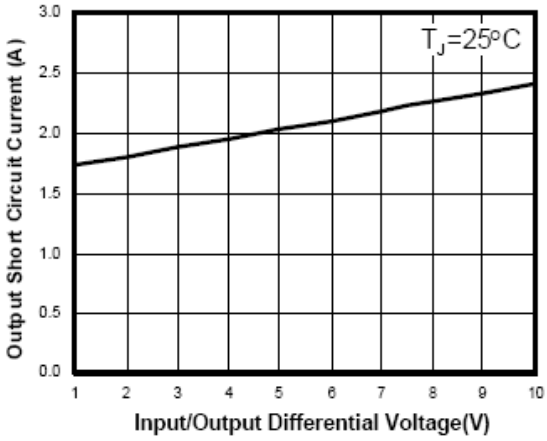
Temperature Stability
(For Fixed Voltage)



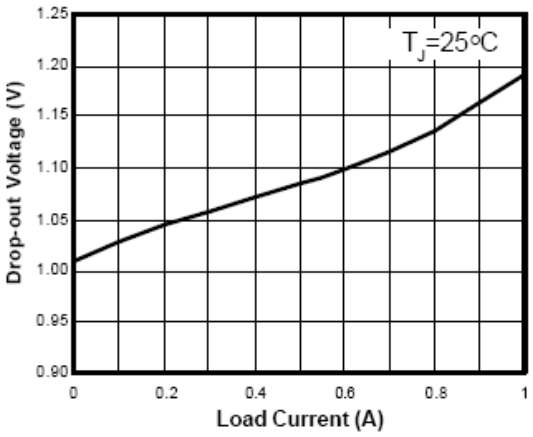
Temperature Stability
(For Adjustable Voltage)



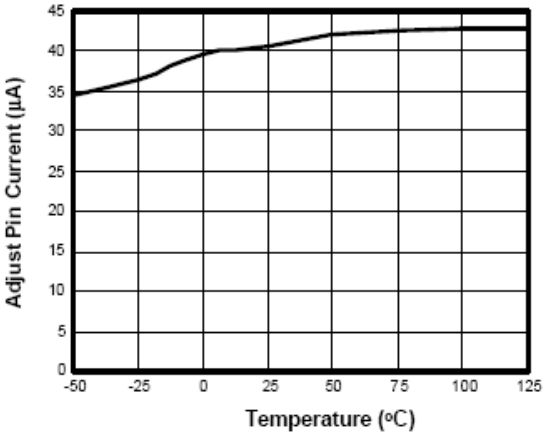
Short Circuit Current



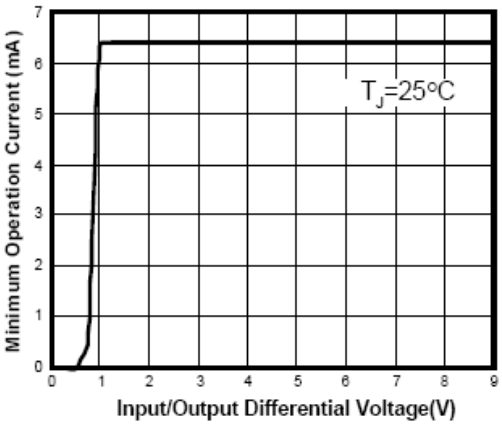
Dropout Voltage



Adjust Pin Current



Minimum Operating Current

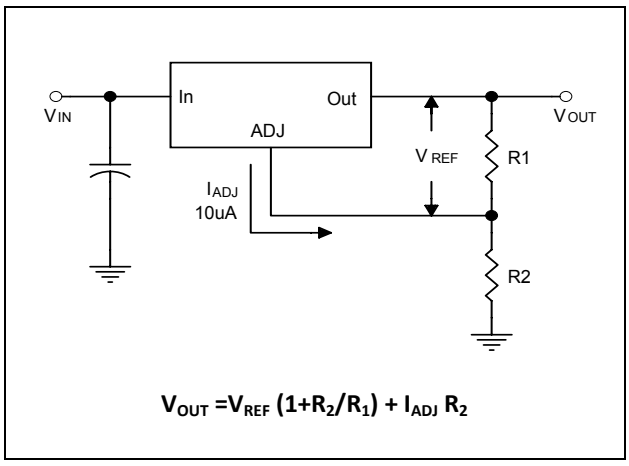


Detail Description

Output Voltage Adjustment

Like most regulators, RS1117A series regulate the output by comparing the output voltage to an internally generated reference voltage. On the adjustable version, the V_{REF} is available externally as 1.25V between V_{OUT} and ADJ. The voltage ratio formed by R_1 and R_2 should be set to conduct 10mA (minimum output load). The output voltage is given by the following equation: $V_{OUT} = V_{REF} (1+R_2/R_1) + I_{ADJ} R_2$

On fixed versions of RS1117A series, the voltage divider is provided internally.



Thermal Protection

RS1117A series have thermal protection which limits junction temperature to 150°C. However, device functionality is only guaranteed to a maximum junction temperature of +125°C.

The power dissipation and junction temperature for RS1117A in all packages given by $P_D=(V_{IN}-V_{OUT})I_{OUT}$, $T_{JUNCTION}=T_{AMBIENT}+(P_D x \theta_{JA})$, Note: $T_{JUNCTION}$ must not exceed 125°C

Current Limit Protection

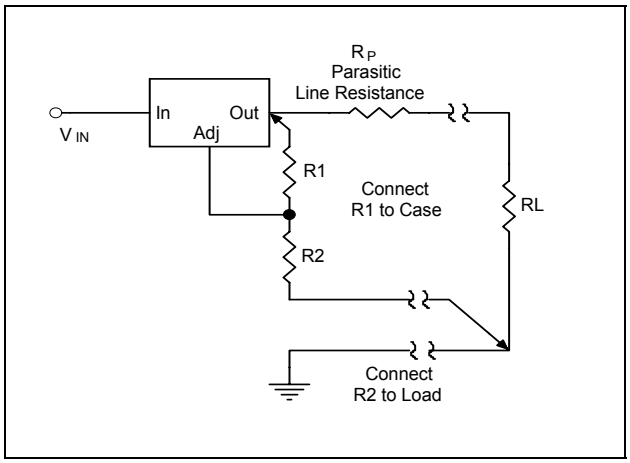
RS1117A series are protected against overload conditions. Current protection is triggered at typically 1.5A.

Stability and Load Regulation

RS1117A series require a capacitor from V_{OUT} to GND to provide compensation feedback to the internal gain stage. This is to ensure stability at the output terminal. Typically, a 47uF tantalum or 100uF aluminum electrolytic is sufficient.

Note : It is important that the ESR for this capacitor does not exceed 0.5Ω.

The output capacitor does not have a theoretical upper limit and increasing its value will increase stability. C_{OUT}=100uF or more is typical for high current regulator design.



RS1117A series load regulation are limited by the resistance of the wire connecting it to the load(R_P). For the adjustable version, the best load regulation is accomplished when the top of the resistor divider(R_1) is connected directly to the output pin of the RS1117A series. When so connected, R_P is not multiplied by the divider ratio. For fixed output versions, the top of R_1 is internally connected to the output and ground pin can be connected to low side of the load as a negative side sense if, so desired.

Thermal Consideration

The RS1117A series contain thermal limiting circuitry designed to protect itself for over-temperature conditions. Even for normal load conditions, maximum junction temperature ratings must not be exceeded. As mention in thermal protection section, we need to consider all sources of thermal resistance between junction and ambient. It contains junction-to-case, case-to-heat-sink interface and heat sink resistance itself. An additional heat sink is applied externally sometimes. It can increase the maximum power dissipation. For example, the equivalent junction temperature of 300mA output current is 115°C without external heat sink. Under the same junction temperature IC can operates 500mA with an adequate heat sink. Therefore, to attach an extra heat sink is recommended.

Junction-to-case thermal resistance is specified from the IC junction to the bottom of the case directly below the die. The bonding wires are appending paths. The former is the lowest resistance path. Proper mounting is required to ensure the best possible thermal flow this area of the package to the heat sink. Thermal compound at the case-to-heat-sink interface is strongly recommended. The case of all devices in this series is electrically connected to the output. Therefore, if the case of the device must be electrically isolated, a thermally conductive spacer can be used, as long its thermal resistance is considered.

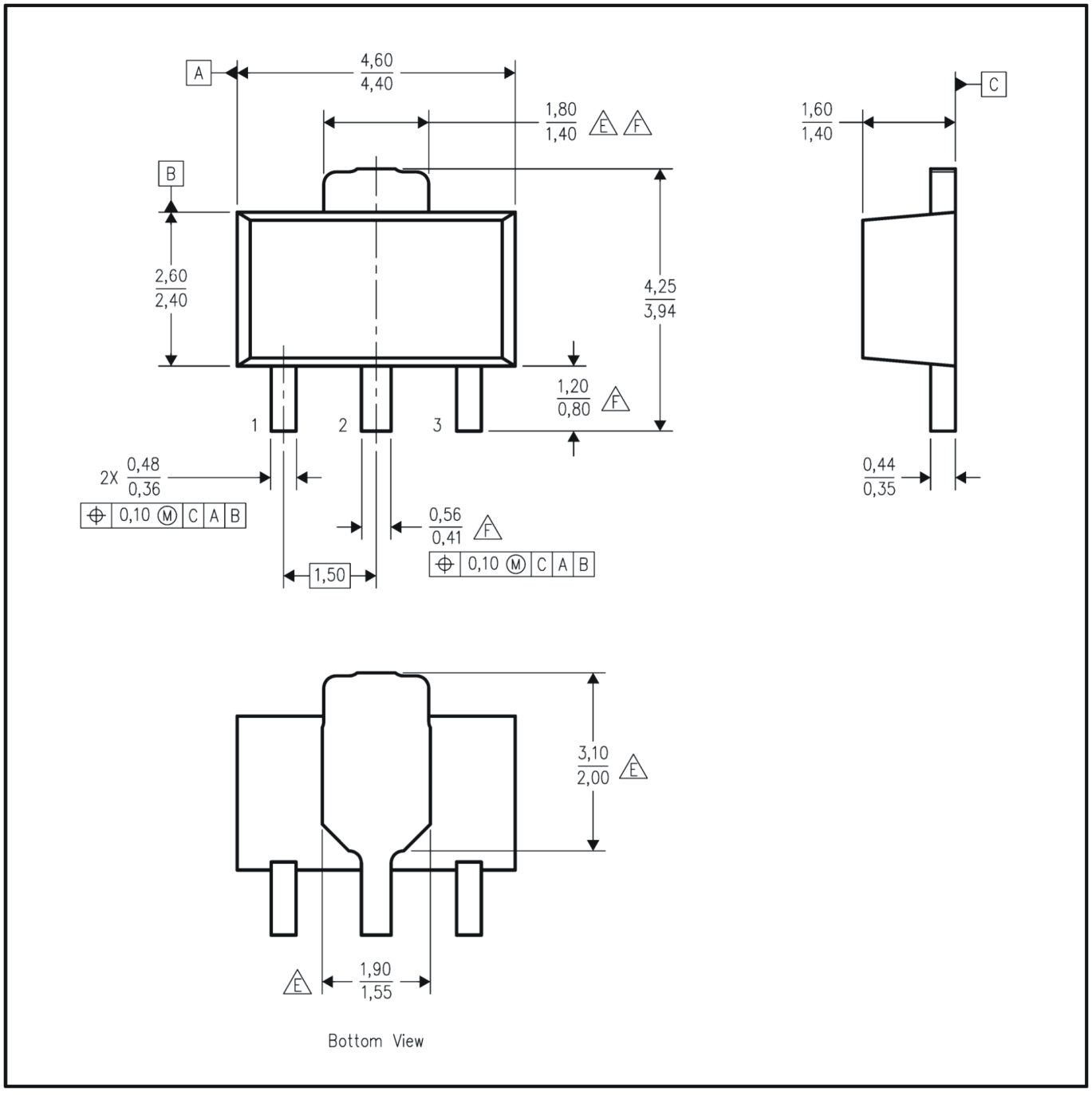
Protection Diode

In general operation, RS1117A series don't need any protection diodes. From the cross-section structure of RS1117A series, the output pin is connected to P+ substrate, and the input pin is connected to N- well. There is a parasitic reverse diode between them. It can handle microsecond surge currents of 5A to 10A. Even with large output capacitance, it is very difficult to get those values of surge currents in normal operation. Only with high value output capacitors, such as 1000uF. And with the input pin instantaneously shorted to ground, can damage occur. A crowbar circuit at the input of the RS1117A series can generate those kinds of currents, and a diode from output to input is recommended. Normal power supply cycling or even plugging and unplugging in the system will not generate currents large enough to do any damage.

Voltage Code Information

Voltage Code	Output Voltage	Package	Output Voltage	Output Voltage	Package
RS1117ASJ-A	ADJ	SOT-223	RS1117AJ-A	ADJ	TO-252
RS1117ASJ-B	1.8V		RS1117AJ-B	1.8V	
RS1117ASJ-C	2.5V		RS1117AJ-C	2.5V	
RS1117ASJ-D	3.3V		RS1117AJ-D	3.3V	
RS1117ASJ-E	5.0V		RS1117AJ-E	5.0V	
RS1117AM-A	ADJ	SOT-89	RS1117AE-A	ADJ	TO-220AB
RS1117AM-B	1.8V		RS1117AE-B	1.8V	
RS1117AM-C	2.5V		RS1117AE-C	2.5V	
RS1117AM-D	3.3V		RS1117AE-D	3.3V	
RS1117AM-E	5.0V		RS1117AE-E	5.0V	

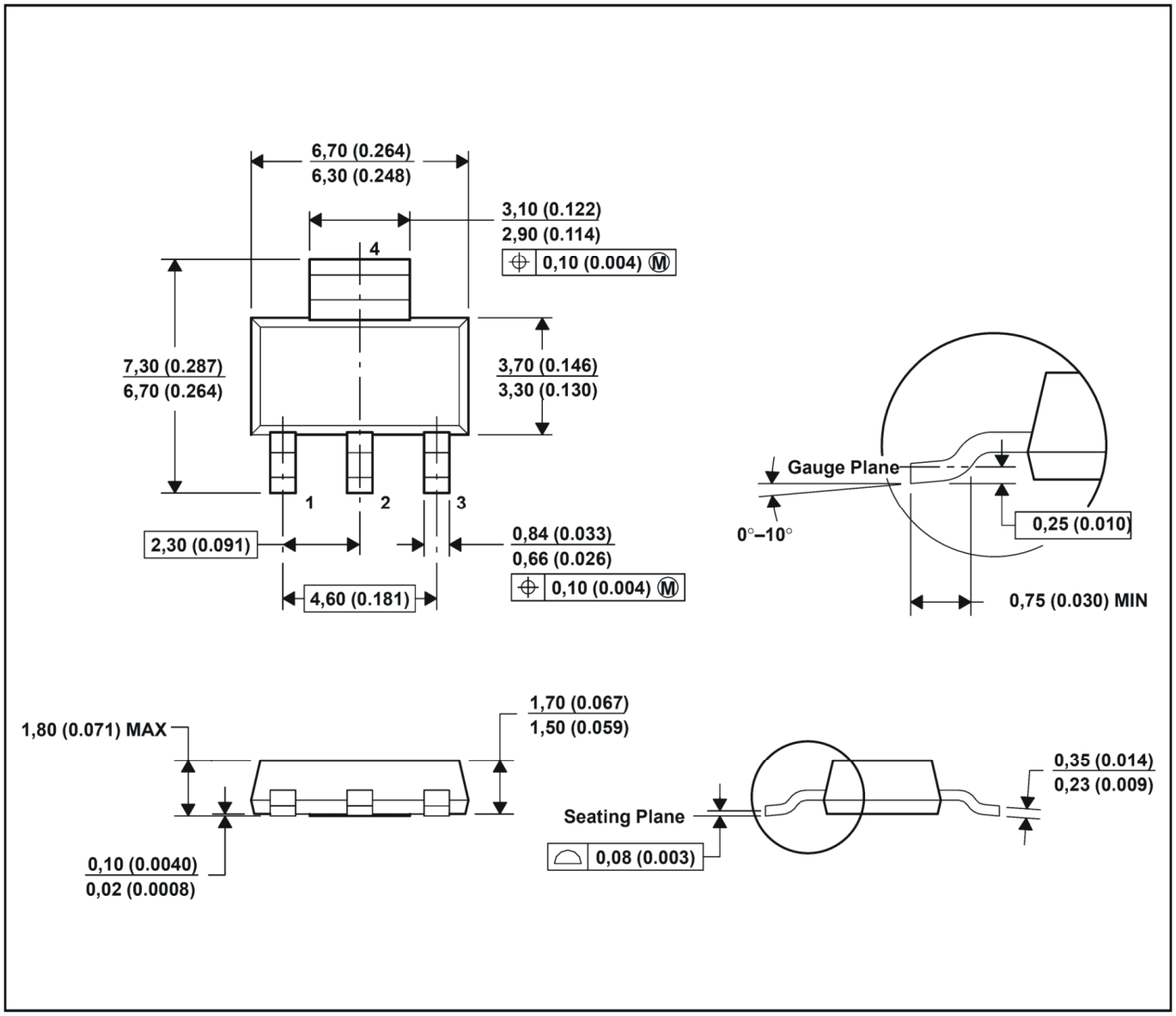
SOT-89 Dimension



NOTES:

A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. The center lead is in electrical contact with the tab.
D. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
E. Thermal pad contour optional within these dimensions.
F. Falls within JEDEC TO-243 variation AA, except minimum lead length, pin 2 minimum lead width, minimum tab width.

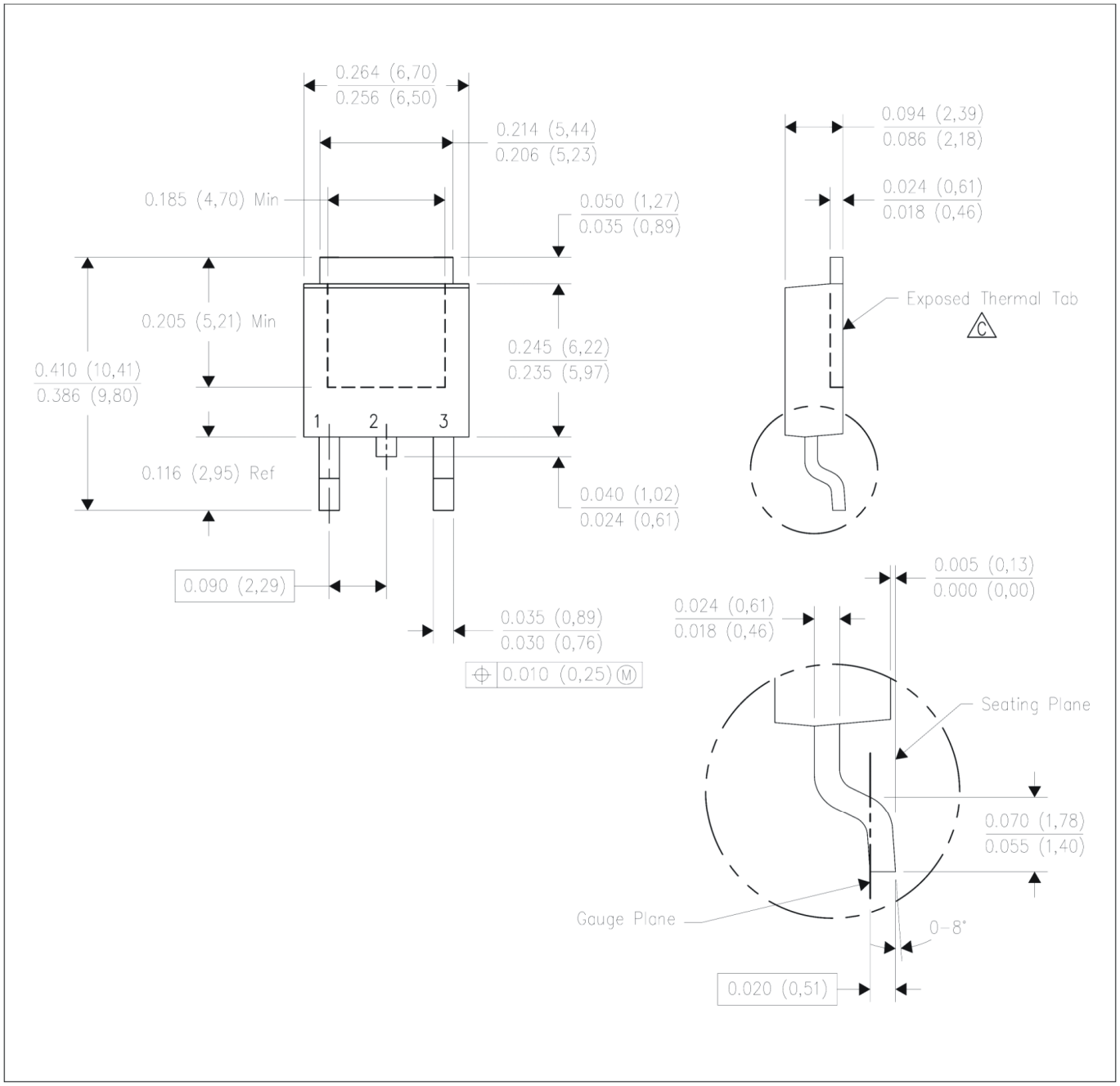
SOT-223 Dimension



NOTES:

A. All linear dimensions are in millimeters (inches).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion.
D. Falls within JEDEC TO-261 variation AA.

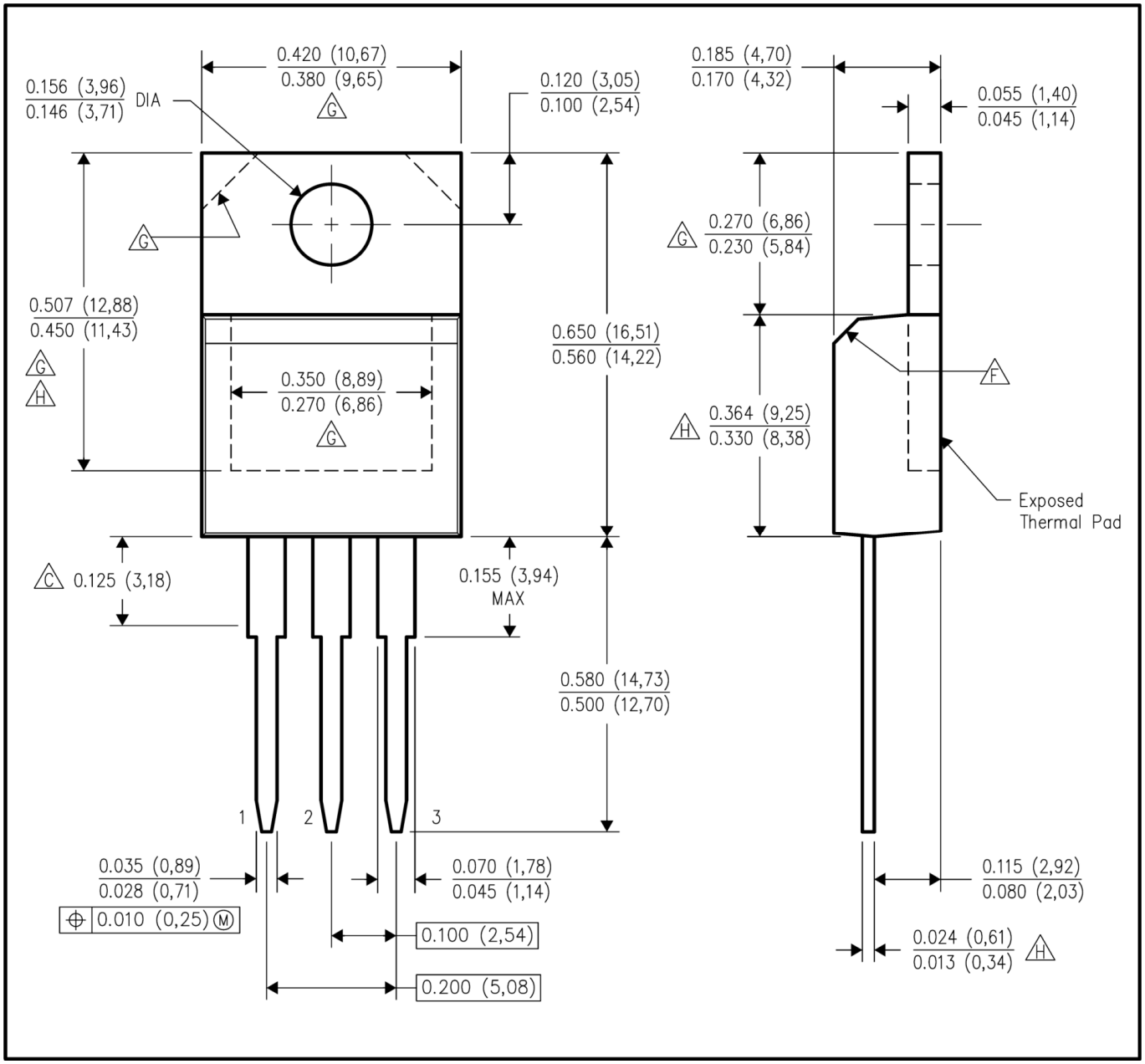
TO-252 Dimension



NOTES:

A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. The center lead is in electrical contact with the tab.
D. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
E. Thermal pad contour optional within these dimensions.
F. Falls within JEDEC TO-252 variation AA.

TO-220-3 Dimension



NOTES:

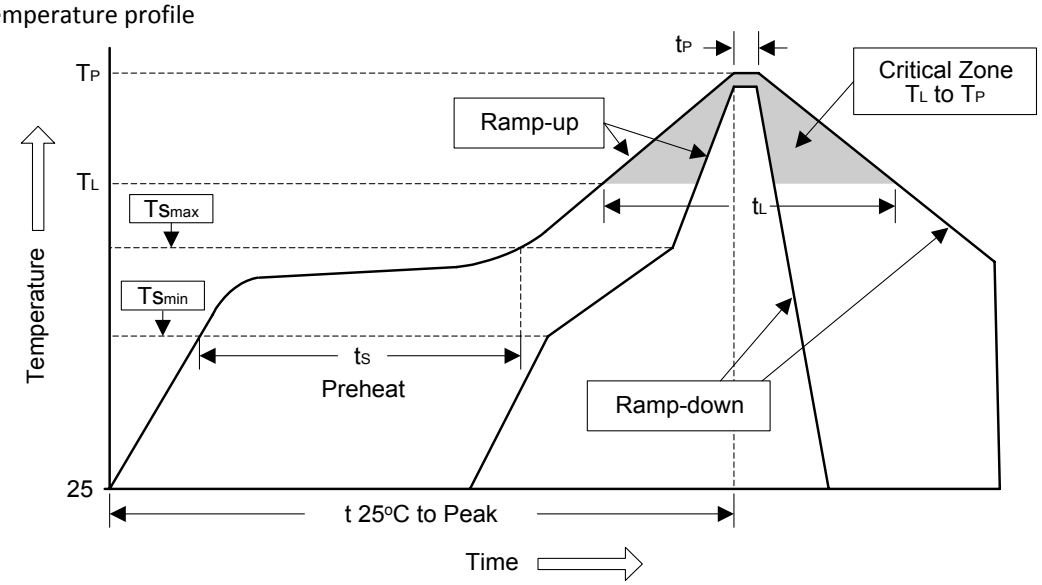
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Lead dimensions are not controlled within this area.
D. All lead dimensions apply before solder dip.
E. The center lead is in electrical contact with the tab.
F. The chamfer is optional.
G. Thermal pad contour optional within these dimensions.
H. Falls within JEDEC TO-220 variation AB. Except minimum lead thickness, minimum exposed pad length, and maximum body length.

Soldering Methods for Orister's Products

1. Storage environment: Temperature=10°C~35°C Humidity=65%±15%

2. Reflow soldering of surface-mount devices

Figure 1: Temperature profile



Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average ramp-up rate (T_L to T_P)	<3°C/sec	<3°C/sec
Preheat - Temperature Min (Ts_{min}) - Temperature Max (Ts_{max}) - Time (min to max) (ts)	 100°C 150°C 60~120 sec	 150°C 200°C 60~180 sec
Tsmax to T_L - Ramp-up Rate	 <3°C/sec	 <3°C/sec
Time maintained above: - Temperature (T_L) - Time (t_L)	 183°C 60~150 sec	 217°C 60~150 sec
Peak Temperature (T_P)	240°C +0/-5°C	260°C +0/-5°C
Time within 5°C of actual Peak Temperature (t_P)	10~30 sec	20~40 sec
Ramp-down Rate	<6°C/sec	<6°C/sec
Time 25°C to Peak Temperature	<6 minutes	<8 minutes

3. Flow (wave) soldering (solder dipping)

Products	Peak temperature	Dipping time
Pb devices.	245°C ±5°C	5sec ±1sec
Pb-Free devices.	260°C +0/-5°C	5sec ±1sec

Important Notice: