LM1117 800-mA, Low-Dropout Linear Regulator

1 Features

- For a newer drop-in alternative, see the TLV1117
- For drop-in replacements in fixed output SOT-223 package configuration and improved functionality, see the TLV761
- Available in 1.8 V, 2.5 V, 3.3 V, 5 V, and adjustable versions
- Space-saving SOT-223 and WSON packages
- Current limiting and thermal protection
- Output current: 800 mA
- Line regulation: 0.2% (maximum)
- Load regulation: 0.4% (maximum)
- Temperature range:
  - LM1117: 0°C to +125°C
  - LM1117I: –40°C to +125°C

2 Applications

- AC drive power stage modules
- Merchant network and server PSU
- Industrial AC/DC
- Ultrasound scanners
- Servo drive control modules

3 Description

The LM1117 is a low dropout voltage regulator with a dropout of 1.2 V at 800 mA of load current.

The LM1117 is available in an adjustable version, which can set the output voltage from 1.25 V to 13.8 V with only two external resistors. In addition, the device is available in five fixed voltages, 1.8 V, 2.5 V, 3.3 V, and 5 V.

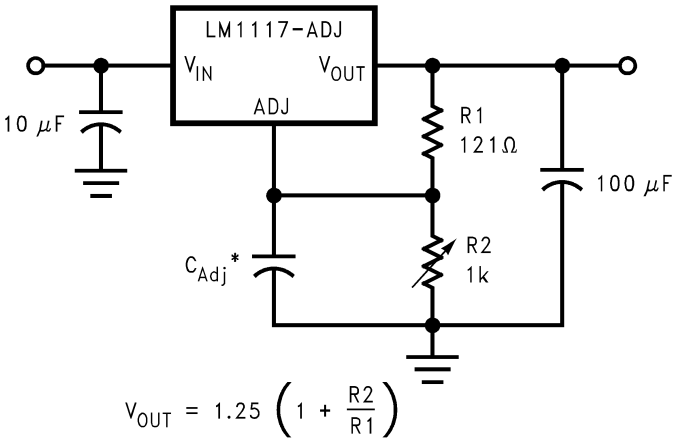
The LM1117 offers current limiting and thermal shutdown. The circuit includes a Zener trimmed band-gap reference to assure output voltage accuracy to within ±1%.

A minimum of 10-µF tantalum capacitor is required at the output to improve the transient response and stability.

Package Information

PART NUMBER	PACKAGE(1)	BODY SIZE (NOM)
LM1117, LM1117I	DCY (SOT-223, 4)	6.50 mm × 3.50 mm
	NDE (TO-220, 3)	14.986 mm × 10.16 mm
	NDP (TO-252, 3)	6.58 mm × 6.10 mm
	NGN (WSON, 8)	4.00 mm × 4.00 mm
	KTT (TO-263, 3)	10.18 mm × 8.41 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.



*C_{Adj} is optional, however it will improve ripple rejection.

Adjustable Output Regulator

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4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision P (July 2022) to Revision Q (January 2023)	Page
• Added drop-in replacement bullet for TLV761 to *Features* section	1

Changes from Revision O (June 2020) to Revision P (July 2022)	Page
• Updated the numbering format for tables, figures, and cross-references throughout the document	1

5 Device Comparison Table

I_{OUT}	PARAMETER	LM1117	TLV1117	UNIT
800 mA	Input voltage range (max)	15	15	V
	Load regulation accuracy	1.6	1.6	%
	PSRR (120 Hz)	75	75	dB
	Recommended operating temperature	0 – 125	-40 – 125	°C
	SOT-223 T_{JA}	61.6	104.3	°C/W
	TO-220 T_{JA}	23.8	30.1	°C/W
	TO-252 T_{JA}	45.1	50.9	°C/W
	TO-263 T_{JA}	41.3	27.5	°C/W
	WSON-8 T_{JA}	39.3	38.3	°C/W

6 Pin Configuration and Functions

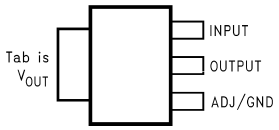


Figure 6-1. DCY Package, 4-Pin SOT (Top View)

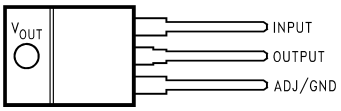


Figure 6-2. NDE Package, 3-Pin TO-220 (Top View)

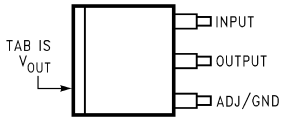


Figure 6-3. KTT Package, 3-Pin TO-263 (Top View)

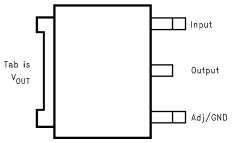
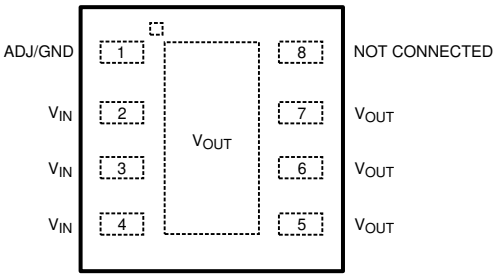


Figure 6-4. NDP Package, 3-Pin TO-252 (Top View)



When using the WSON package pins 2, 3, and 4 must be connected together and pins 5, 6, and 7 must be connected together.

Figure 6-5. NGN Package, 8-Pin WSON (Top View)

Table 6-1. Pin Functions

PIN						I/O	DESCRIPTION
NAME	TO-252	WSON	SOT-223	TO-263	TO-220		
ADJ/GND	1	1	1	1	1	—	Adjust pin for adjustable output option. Ground pin for fixed output option.
V_{IN}	3	2, 3, 4	3	3	3	I	Input voltage pin for the regulator
V_{OUT}	2 , TAB	5, 6, 7, TAB	2, 4	2, TAB	2, TAB	O	Output voltage pin for the regulator

7 Specifications

7.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1)

	MIN	MAX	UNIT
Maximum input voltage (V_{IN} to GND)		20	V
Power dissipation(2)	Internally Limited		
Junction temperature (T_J)(2)		150	°C
Storage temperature, T_{stg}	–65	150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

(2) The maximum power dissipation is a function of $T_{J(max)}$, $R_{\theta JA}$, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(max)}–T_A)/R_{\theta JA}$. All numbers apply for packages soldered directly into a PCB.

7.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001(1)	±2000	V

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process. Pins listed as ±2000 V may actually have higher performance.

7.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

		MIN	MAX	UNIT
Input voltage (V_{IN} to GND)			15	V
Junction temperature (T_J)(1)	LM1117	0	125	°C
	LM1117I	−40	125	

(1) The maximum power dissipation is a function of $T_{J(max)}$, $R_{\theta JA}$, and T_A. The maximum allowable power dissipation at any ambient temperature is $P_D = (T_{J(max)}–T_A)/R_{\theta JA}$. All numbers apply for packages soldered directly into a PCB.

7.4 Thermal Information

THERMAL METRIC(1)		LM1117, LM1117I					UNIT
		DCY (SOT-223)	NDE (TO-220)	NDP (TO-252)	NGN (WSON)	KTT (TO-263)	
		4 PINS	3 PINS	3 PINS	8 PINS	3 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	61.6	23.8	45.1	39.3	41.3	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	42.5	16.6	52.1	31.4	44.1	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	10.4	5.3	29.8	16.5	24.2	°C/W
ψ_{JT}	Junction-to-top characterization parameter	2.9	3.1	4.5	0.3	10.9	°C/W
ψ_{JB}	Junction-to-board characterization parameter	10.3	5.3	29.4	16.7	23.2	°C/W
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	—	1.5	1.3	5.6	1.3	°C/W

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC package thermal metrics* application report.

7.5 LM1117 Electrical Characteristics

unless otherwise specified, T_J = 25°C

PARAMETER		TEST CONDITIONS		MIN[1]	TYP[2]	MAX[1]	UNIT
V_{REF}	Reference voltage	LM1117-ADJ I_{OUT} = 10 mA, V_{IN} – V_{OUT} = 2 V, T_J = 25°C		1.238	1.25	1.262	V
		LM1117-ADJ 10 mA ≤ I_{OUT} ≤ 800 mA, 1.4 V ≤ V_{IN} – V_{OUT} ≤ 10 V	T_J = 25°C		1.25		
			over the junction temperature range 0°C to 125°C	1.225		1.27	
V_{OUT}	Output voltage	LM1117-1.8 I_{OUT} = 10 mA, V_{IN} = 3.8 V, T_J = 25°C		1.782	1.8	1.818	V
		LM1117-1.8 0 ≤ I_{OUT} ≤ 800 mA, 3.2 V ≤ V_{IN} ≤ 10 V	T_J = 25°C		1.8		
			over the junction temperature range 0°C to 125°C	1.746		1.854	
		LM1117-2.5 I_{OUT} = 10 mA, V_{IN} = 4.5 V, T_J = 25°C		2.475	2.5	2.525	V
		LM1117-2.5 0 ≤ I_{OUT} ≤ 800 mA, 3.9 V ≤ V_{IN} ≤ 10 V	T_J = 25°C		2.5		
			over the junction temperature range 0°C to 125°C	2.45		2.55	
		LM1117-3.3 I_{OUT} = 10 mA, V_{IN} = 5 V T_J = 25°C		3.267	3.3	3.333	V
		LM1117-3.3 0 ≤ I_{OUT} ≤ 800 mA, 4.75 V ≤ V_{IN} ≤ 10 V	T_J = 25°C		3.3		
			over the junction temperature range 0°C to 125°C	3.235		3.365	
		LM1117-5.0 I_{OUT} = 10 mA, V_{IN} = 7 V, T_J = 25°C		4.95	5	5.05	V
		LM1117-5.0 0 ≤ I_{OUT} ≤ 800 mA, 6.5 V ≤ V_{IN} ≤ 12 V	T_J = 25°C		5		
			over the junction temperature range 0°C to 125°C	4.9		5.1	
ΔV_{OUT}	Line regulation[3]	LM1117-ADJ I_{OUT} = 10mA, 1.5V ≤ V_{IN}-V_{OUT} ≤ 13.75V	T_J = 25°C		0.035%		
			over the junction temperature range 0°C to 125°C			0.2%	
		LM1117-1.8 I_{OUT} = 0 mA, 3.2 V ≤ V_{IN} ≤ 10 V	T_J = 25°C		1		mV
			over the junction temperature range 0°C to 125°C			6	
		LM1117-2.5 I_{OUT} = 0 mA, 3.9 V ≤ V_{IN} ≤ 10 V	T_J = 25°C		1		mV
			over the junction temperature range 0°C to 125°C			6	
		LM1117-3.3 I_{OUT} = 0 mA, 4.75 V ≤ V_{IN} ≤ 15 V	T_J = 25°C		1		mV
			over the junction temperature range 0°C to 125°C			6	
		LM1117-5.0 I_{OUT} = 0 mA, 6.5 V ≤ V_{IN} ≤ 15 V	T_J = 25°C		1		mV
			over the junction temperature range 0°C to 125°C			10	
ΔV_{OUT}	Load regulation[3]	LM1117-ADJ V_{IN} – V_{OUT} = 3 V, 10 ≤ I_{OUT} ≤ 800 mA	T_J = 25°C		0.2%		
			over the junction temperature range 0°C to 125°C			0.4%	
		LM1117-1.8 V_{IN} = 3.2 V, 0 ≤ I_{OUT} ≤ 800 mA	T_J = 25°C		1		mV
			over the junction temperature range 0°C to 125°C			10	
		LM1117-2.5 V_{IN} = 3.9 V, 0 ≤ I_{OUT} ≤ 800 mA	T_J = 25°C		1		mV
			over the junction temperature range 0°C to 125°C			10	
		LM1117-3.3 V_{IN} = 4.75 V, 0 ≤ I_{OUT} ≤ 800 mA	T_J = 25°C		1		mV
			over the junction temperature range 0°C to 125°C			10	
		LM1117-5.0 V_{IN} = 6.5 V, 0 ≤ I_{OUT} ≤ 800 mA	T_J = 25°C		1		mV
			over the junction temperature range 0°C to 125°C			15	

7.5 LM1117 Electrical Characteristics (continued)

unless otherwise specified, T_J = 25°C

PARAMETER		TEST CONDITIONS		MIN(1)	TYP(2)	MAX(1)	UNIT
V_{IN} – V_{OUT}	Dropout voltage(4)	I_{OUT} = 100 mA	T_J = 25°C		1.1		V
			over the junction temperature range 0°C to 125°C			1.2	
		I_{OUT} = 500 mA	T_J = 25°C		1.15		V
			over the junction temperature range 0°C to 125°C			1.25	
		I_{OUT} = 800 mA	T_J = 25°C		1.2		V
			over the junction temperature range 0°C to 125°C			1.3	
I_{LIMIT}	Current limit	V_{IN} – V_{OUT} = 5 V, T_J = 25°C		800	1200	1500	mA
	Minimum load current(5)	LM1117-ADJ V_{IN} = 15 V	T_J = 25°C		1.7		mA
			over the junction temperature range 0°C to 125°C			5	
	Quiescent current	LM1117-1.8 V_{IN} ≤ 15 V	T_J = 25°C		5		mA
			over the junction temperature range 0°C to 125°C			10	
		LM1117-2.5 V_{IN} ≤ 15 V	T_J = 25°C		5		mA
			over the junction temperature range 0°C to 125°C			10	
		LM1117-3.3 V_{IN} ≤ 15 V	T_J = 25°C		5		mA
			over the junction temperature range 0°C to 125°C			10	
		LM1117-5.0 V_{IN} ≤ 15 V	T_J = 25°C		5		mA
			over the junction temperature range 0°C to 125°C			10	
	Thermal regulation	T_A = 25°C, 30-ms pulse			0.01	0.1	%/W
	Ripple regulation	f_{RIPPLE} = 1 20 Hz, V_{IN} – V_{OUT} = 3 V V_{RIPPLE} = 1 V_{PP}	T_J = 25°C		75		dB
			over the junction temperature range 0°C to 125°C	60			
	Adjust pin current	T_J = 25°C			60		µA
		over the junction temperature range 0°C to 125°C				120	
	Adjust pin current change	10 ≤ I_{OUT} ≤ 80 0mA, 1.4 V ≤ V_{IN} – V_{OUT} ≤ 10 V	T_J = 25°C		0.2		µA
			over the junction temperature range 0°C to 125°C			5	
	Temperature stability				0.5%		
	Long term stability	T_A = 125°C, 1000 hours			0.3%		
	RMS output noise	(% of V_{OUT}), 10 Hz ≤ f ≤ 10 kHz			0.003%		

(1) All limits are ensured by testing or statistical analysis.
(2) Typical Values represent the most likely parametric normal.
(3) Load and line regulation are measured at constant junction room temperature.
(4) The dropout voltage is the input/output differential at which the circuit ceases to regulate against further reduction in input voltage. This voltage is measured when the output voltage has dropped 100 mV from the nominal value obtained at V_{IN} = V_{OUT} + 1.5 V.
(5) The minimum output current required to maintain regulation.

7.6 LM1117I Electrical Characteristics

unless otherwise specified, T_J = 25°C

PARAMETER		TEST CONDITIONS		MIN[1]	TYP[2]	MAX[1]	UNIT
V_{REF}	Reference voltage	LM1117I-ADJ I_{OUT} = 10 mA, V_{IN} – V_{OUT} = 2 V, T_J = 25°C		1.238	1.25	1.262	V
		LM1117I-ADJ 10 mA ≤ I_{OUT} ≤ 800 mA, 1.4 V ≤ V_{IN} – V_{OUT} ≤ 10 V	T_J = 25°C		1.25		
			over the junction temperature range – 40°C to 125°C	1.2		1.29	
V_{OUT}	Output voltage	LM1117I-3.3 I_{OUT} = 10 mA, V_{IN} = 5 V, T_J = 25°C		3.267	3.3	3.333	V
		LM1117I-3.3 0 ≤ I_{OUT} ≤ 800 mA, 4.75 V ≤ V_{IN} ≤ 10 V	T_J = 25°C		3.3		
			over the junction temperature range – 40°C to 125°C	3.168		3.432	
		LM1117I-5.0 I_{OUT} = 10 mA, V_{IN} = 7 V, T_J = 25°C		4.95	5	5.05	V
		LM1117I-5.0 0 ≤ I_{OUT} ≤ 800 mA, 6.5 V ≤ V_{IN} ≤ 12 V	T_J = 25°C		5		
			over the junction temperature range – 40°C to 125°C	4.8		5.2	
ΔV_{OUT}	Line regulation[3]	LM1117I-ADJ I_{OUT} = 10 mA, 1.5 V ≤ V_{IN} – V_{OUT} ≤ 13.75 V	T_J = 25°C		0.035%		
			over the junction temperature range – 40°C to 125°C			0.3%	
		LM1117I-3.3 I_{OUT} = 0 mA, 4.75 V ≤ V_{IN} ≤ 15 V	T_J = 25°C		1		mV
			over the junction temperature range – 40°C to 125°C			10	
		LM1117I-5.0 I_{OUT} = 0 mA, 6.5 V ≤ V_{IN} ≤ 15 V	T_J = 25°C		1		mV
			over the junction temperature range – 40°C to 125°C			15	
ΔV_{OUT}	Load regulation[3]	LM1117I-ADJ V_{IN} – V_{OUT} = 3 V, 10 ≤ I_{OUT} ≤ 800 mA	T_J = 25°C		0.2%		
			over the junction temperature range – 40°C to 125°C			0.5%	
		LM1117I-3.3 V_{IN} = 4.75 V, 0 ≤ I_{OUT} ≤ 800 mA	T_J = 25°C		1		mV
			over the junction temperature range – 40°C to 125°C			15	
		LM1117I-5.0 V_{IN} = 6.5 V, 0 ≤ I_{OUT} ≤ 800 mA	T_J = 25°C		1		mV
			over the junction temperature range – 40°C to 125°C			20	

7.6 LM1117I Electrical Characteristics (continued)

unless otherwise specified, T_J = 25°C

PARAMETER		TEST CONDITIONS		MIN(1)	TYP(2)	MAX(1)	UNIT
V_{IN}-V_{OUT}	Dropout voltage(4)	I_{OUT} = 100 mA	T_J = 25°C		1.1		V
			over the junction temperature range – 40°C to 125°C			1.3	
		I_{OUT} = 500 mA	T_J = 25°C		1.15		V
			over the junction temperature range – 40°C to 125°C			1.35	
		I_{OUT} = 800 mA	T_J = 25°C		1.2		V
			over the junction temperature range – 40°C to 125°C			1.4	
I_{LIMIT}	Current limit	V_{IN} – V_{OUT} = 5 V, T_J = 25°C		800	1200	1500	mA
	Minimum load current(5)	LM1117I-ADJ V_{IN} = 15 V	T_J = 25°C		1.7		mA
			over the junction temperature range – 40°C to 125°C			5	
	Quiescent current	LM1117I-3.3 V_{IN} ≤ 15 V	T_J = 25°C		5		mA
			over the junction temperature range – 40°C to 125°C			15	
		LM1117I-5.0 V_{IN} ≤ 15 V	T_J = 25°C		5		mA
			over the junction temperature range – 40°C to 125°C			15	
	Thermal regulation	T_A = 25°C, 30-ms pulse			0.01	0.1	%/W
	Ripple regulation	f_{RIPPLE} = 120 Hz, V_{IN} – V_{OUT} = 3 V V_{RIPPLE} = 1 V_{PP}	T_J = 25°C		75		dB
			over the junction temperature range – 40°C to 125°C	60			
	Adjust pin current	T_J = 25°C			60		µA
		over the junction temperature range –40°C to 125°C				120	
	Adjust pin current change	10 ≤ I_{OUT} ≤ 800 mA, 1.4 V ≤ V_{IN} – V_{OUT} ≤ 10 V	T_J = 25°C		0.2		µA
			over the junction temperature range – 40°C to 125°C			10	
	Temperature stability				0.5%		
	Long term stability	T_A = 125°C, 1000 hours			0.3%		
	RMS output noise	(% of V_{OUT}), 10 Hz ≤ f ≤ 10 kHz			0.003%		

(1) All limits are ensured by testing or statistical analysis.
(2) Typical Values represent the most likely parametric normal.
(3) Load and line regulation are measured at constant junction room temperature.
(4) The dropout voltage is the input/output differential at which the circuit ceases to regulate against further reduction in input voltage. This voltage is measured when the output voltage has dropped 100 mV from the nominal value obtained at V_{IN} = V_{OUT} + 1.5 V.
(5) The minimum output current required to maintain regulation.

7.7 Typical Characteristics

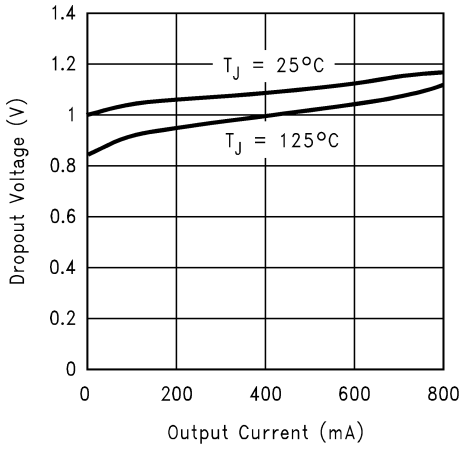


Figure 7-1. Dropout Voltage (V_{IN} – V_{OUT})

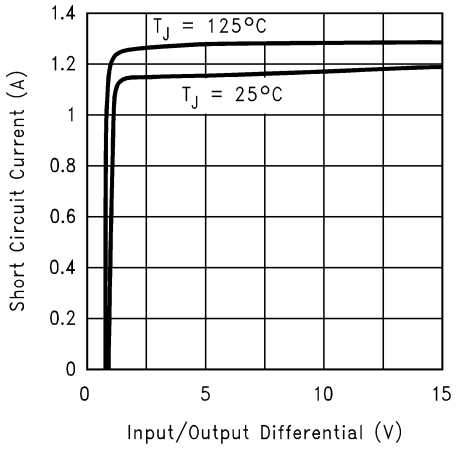


Figure 7-2. Short-Circuit Current

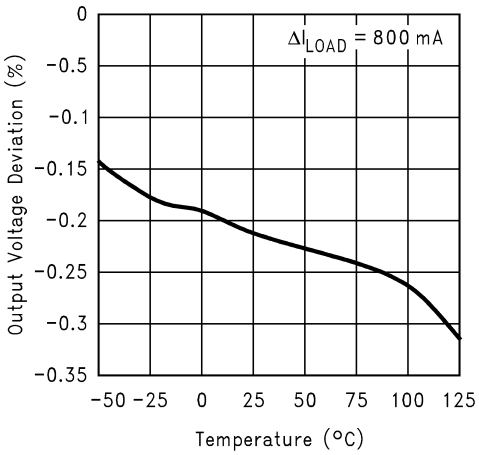


Figure 7-3. Load Regulation

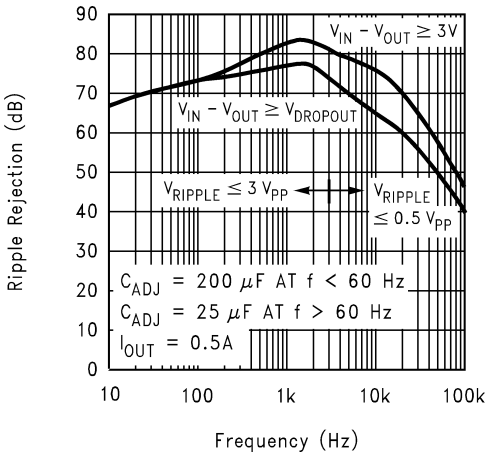


Figure 7-4. LM1117-ADJ Ripple Rejection

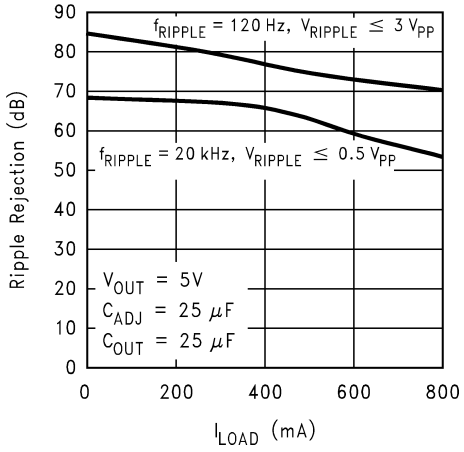


Figure 7-5. LM1117-ADJ Ripple Rejection vs Current

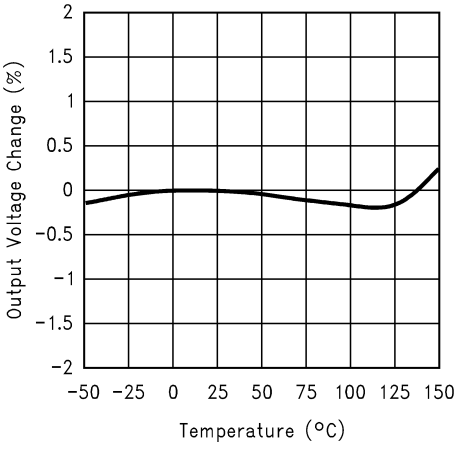


Figure 7-6. Temperature Stability

7.7 Typical Characteristics (continued)

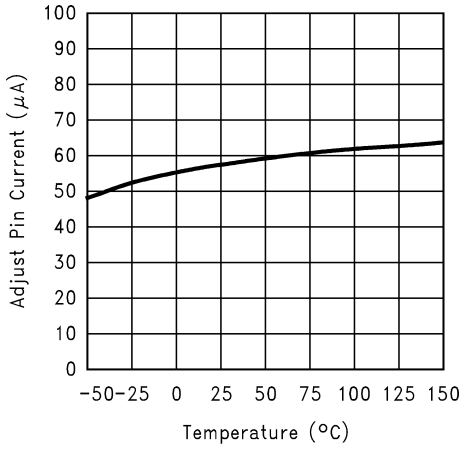


Figure 7-7. Adjust Pin Current

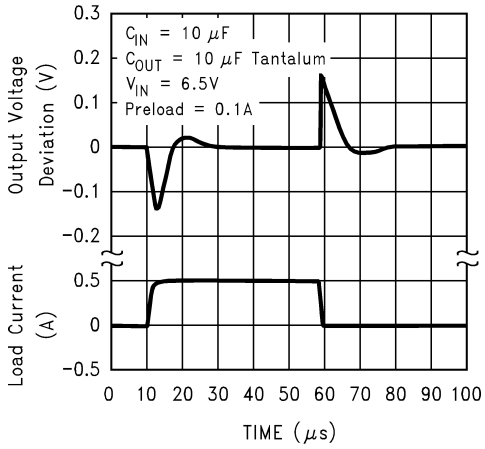


Figure 7-8. LM1117-5.0 Load Transient Response

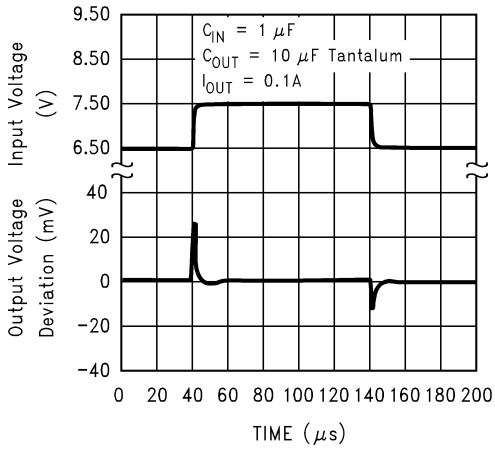


Figure 7-9. LM1117-5.0 Line Transient Response

8 Detailed Description

8.1 Overview

The LM1117 adjustable version develops a 1.25-V reference voltage, V_{REF}, between the output and the adjust pin. As shown in Figure 8-1, this voltage is applied across resistor R1 to generate a constant current I1. The current I_{ADJ} from the adjust pin can introduce error to the output, but because this current is very small (60 µA) compared to the I1 and very constant with line and load changes, the error can be ignored. The constant current I1 then flows through the output set resistor R2 and sets the output voltage to the desired level.

For fixed voltage devices, R1 and R2 are integrated inside the devices.

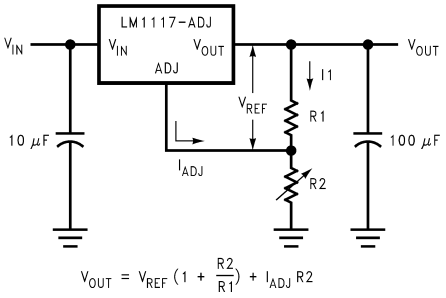
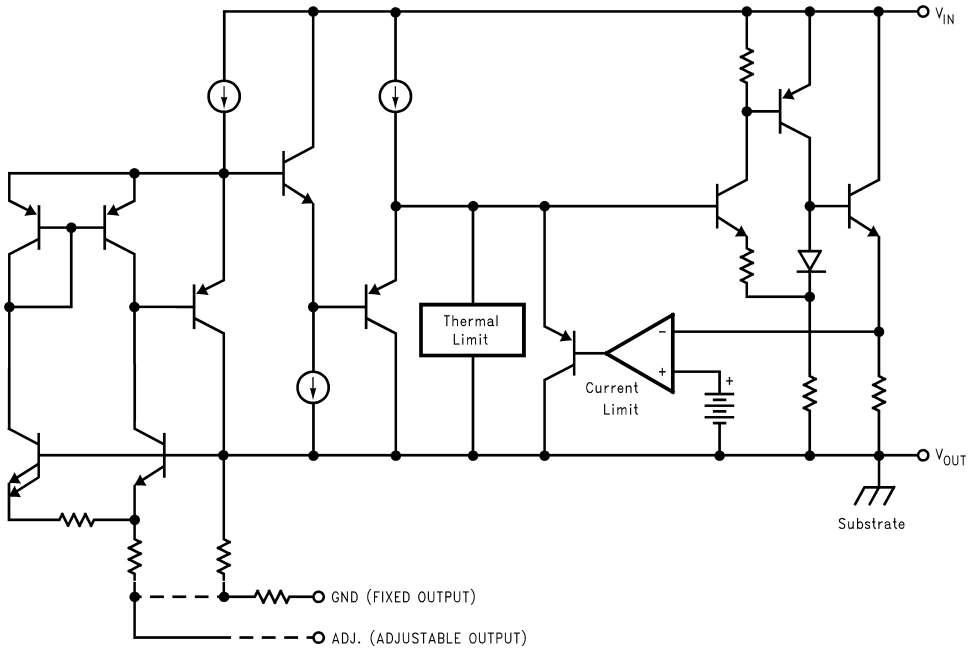


Figure 8-1. Basic Adjustable Regulator

8.2 Functional Block Diagram



8.3 Feature Description

8.3.1 Load Regulation

The LM1117 regulates the voltage that appears between the output and ground pins, or between the output and adjust pins. In some cases, line resistances can introduce errors to the voltage across the load. To obtain the best load regulation, a few precautions are needed.

Figure 8-2 illustrates a typical application using a fixed output regulator. The Rt1 and Rt2 are the line resistances. Obviously the V_{LOAD} is less than the V_{OUT} by the sum of the voltage drops along the line resistances. In this case, the load regulation at the R_{LOAD} is degraded from the data sheet specification. To improve this degradation, the load must be tied directly to the output terminal on the positive side and directly tied to the ground terminal on the negative side.

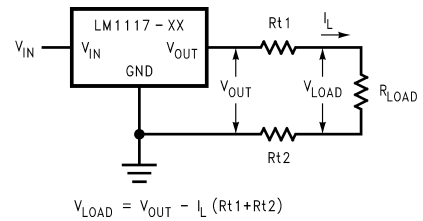


Figure 8-2. Typical Application Using Fixed Output Regulator

When the adjustable regulator is used (Figure 8-3), the best performance is obtained with the positive side of the resistor R1 tied directly to the output terminal of the regulator rather than near the load. This eliminates line drops from appearing effectively in series with the reference and degrading regulation. For example, a 5-V regulator with 0.05-Ω resistance between the regulator and load has a load regulation resulting from the line resistance of 0.05 Ω × I_L. If R1 (= 125 Ω) is connected near the load, the effective line resistance is 0.05 Ω (1 + R2 / R1) or in this case, four times worse. In addition, the ground side of the resistor R2 can be returned near the ground of the load to provide remote ground sensing and improve load regulation.

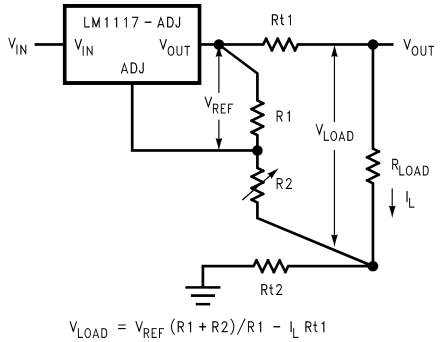


Figure 8-3. Best Load Regulation Using Adjustable Output Regulator

8.4 Device Functional Modes

8.4.1 Protection Diodes

Under normal operation, the LM1117 regulators do not need any protection diode. With the adjustable device, the internal resistance between the adjust and output terminals limits the current. No diode is needed to divert the current around the regulator even with capacitor on the adjust terminal. The adjust pin can take a transient signal of ±25V with respect to the output voltage without damaging the device.

When a output capacitor is connected to a regulator and the input is shorted to ground, the output capacitor will discharge into the output of the regulator. The discharge current depends on the value of the capacitor, the output voltage of the regulator, and rate of decrease of V_{IN}. In the LM1117 regulators, the internal diode between the output and input pins can withstand microsecond surge currents of 10A to 20A. With an extremely large output capacitor (≥1000 µF), and with input instantaneously shorted to ground, the regulator could be damaged.

In this case, an external diode is recommended between the output and input pins to protect the regulator, as shown in Figure 8-4.

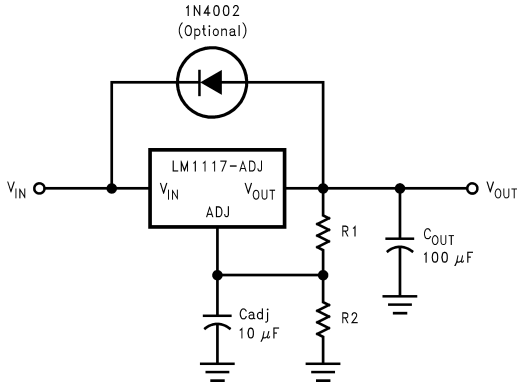


Figure 8-4. Regulator With Protection Diode

9 Application and Implementation

Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes, as well as validating and testing their design implementation to confirm system functionality.

9.1 Application Information

The LM1117 is a versatile and high performance linear regulator with a wide temperature range and tight line/load regulation operation. An output capacitor is required to further improve transient response and stability. For the adjustable option, the ADJ pin can also be bypassed to achieve very high ripple-rejection ratios. The LM1117 is versatile in its applications, including being used as a post regulator for DC/DC converters, battery chargers, and microprocessor supplies.

9.2 Typical Application

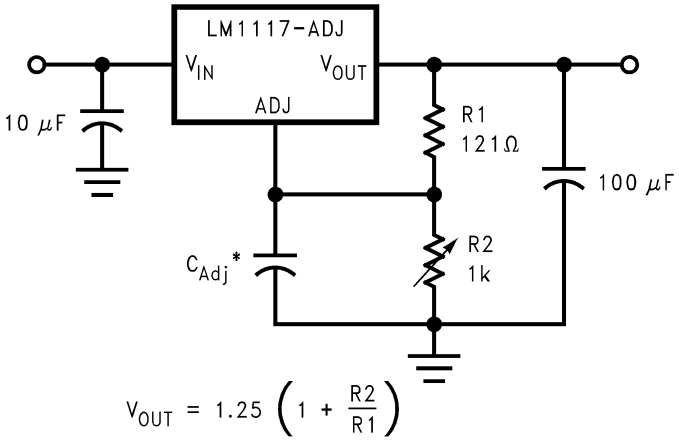


Figure 9-1. 1.25-V to 10-V Adjustable Regulator With Improved Ripple Rejection

9.2.1 Design Requirements

The device component count is very minimal, employing two resistors as part of a voltage divider circuit and an output capacitor for load regulation. A 10-µF tantalum on the input is a suitable input capacitor for almost all applications. An optional bypass capacitor across R2 can also be used to improve PSRR. See the *Recommended Operating Conditions* table for more information.

9.2.2 Detailed Design Procedure

The output voltage is set based on the selection of the two resistors, R1 and R2, as shown in Figure 9-1. For details on capacitor selection, see the *External Capacitors* section.

9.2.2.1 External Capacitors

9.2.2.1.1 Input Bypass Capacitor

An input capacitor is recommended. A 10-µF tantalum on the input is a suitable input capacitor for almost all applications.

9.2.2.1.2 Adjust Terminal Bypass Capacitor

The adjust terminal can be bypassed to ground with a bypass capacitor (C_{ADJ}) to improve ripple rejection. This bypass capacitor prevents ripple from being amplified as the output voltage is increased. At any ripple frequency, the impedance of the C_{ADJ} must be less than R1 to prevent the ripple from being amplified:

$$1 / (2\pi \times f_{RIPPLE} \times C_{ADJ}) < R1 \quad (1)$$

The R1 is the resistor between the output and the adjust pin. The value is normally in the range of 100 Ω to 200 Ω. For example, with R1 = 124 Ω and f_{RIPPLE} = 120 Hz, the C_{ADJ} must be > 11µF.

9.2.2.1.3 Output Capacitor

The output capacitor is critical in maintaining regulator stability, and must meet the required conditions for both minimum amount of capacitance and equivalent series resistance (ESR). The minimum output capacitance required by the LM1117 is 10 µF, if a tantalum capacitor is used. Any increase of the output capacitance will merely improve the loop stability and transient response. The ESR of the output capacitor should range between 0.3 Ω to 22 Ω. In the case of the adjustable regulator, when the C_{ADJ} is used, a larger output capacitance (22-µF tantalum) is required.

9.2.3 Application Curve

As shown in Figure 9-2, the dropout voltage will vary with output current and temperature. Care should be taken during design to ensure the dropout voltage requirement is met across the entire operating temperature and output current range.

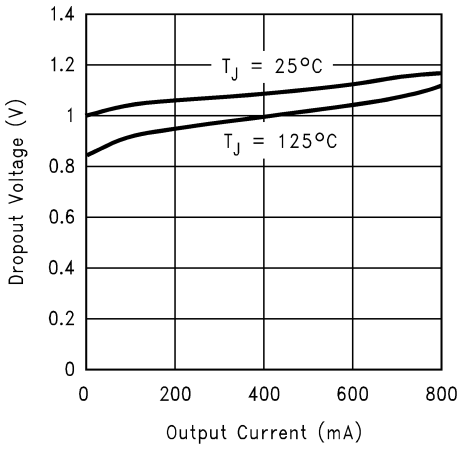


Figure 9-2. Dropout Voltage (V_{IN} – V_{OUT})

9.3 System Examples

Several circuits can be realized with the LM1117. The circuit diagrams in this section demonstrate multiple system examples that can be utilized in many applications.

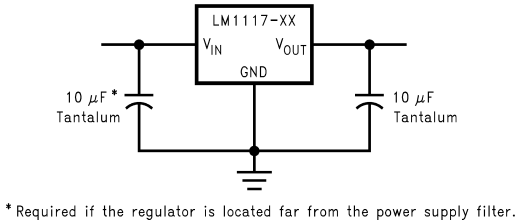


Figure 9-3. Fixed Output Regulator

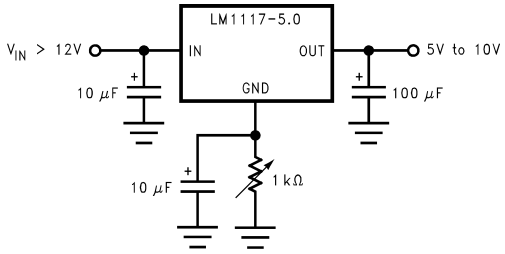


Figure 9-4. Adjusting Output of Fixed Regulators

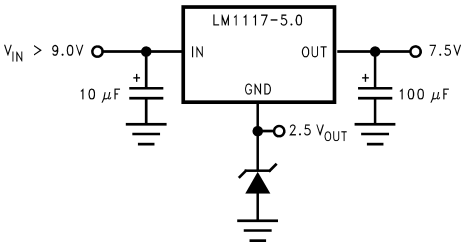


Figure 9-5. Regulator With Reference

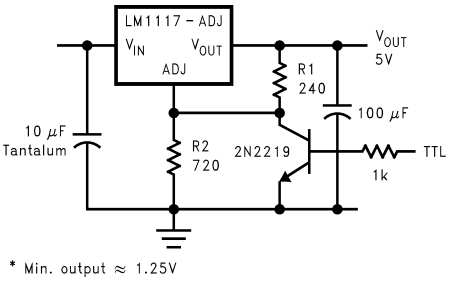


Figure 9-6. 5-V Logic Regulator With Electronic Shutdown*

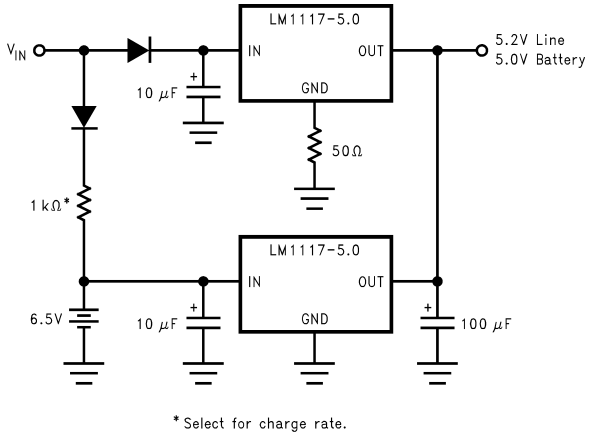


Figure 9-7. Battery Backed-Up Regulated Supply

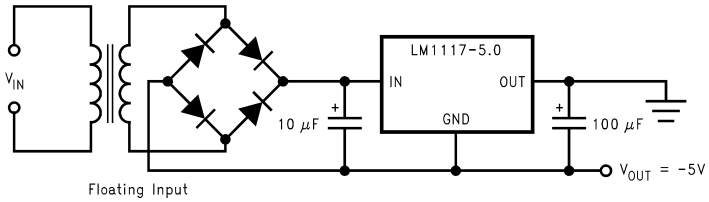


Figure 9-8. Low Dropout Negative Supply

9.4 Power Supply Recommendations

The input supply to the LM1117 must be kept at a voltage level such that the maximum rating is not exceeded. The minimum dropout voltage must also be met with extra headroom when possible to keep the LM1117 in regulation. An input capacitor is recommended. For more information regarding capacitor selection, see the *External Capacitors* section.

9.5 Layout

9.5.1 Layout Guidelines

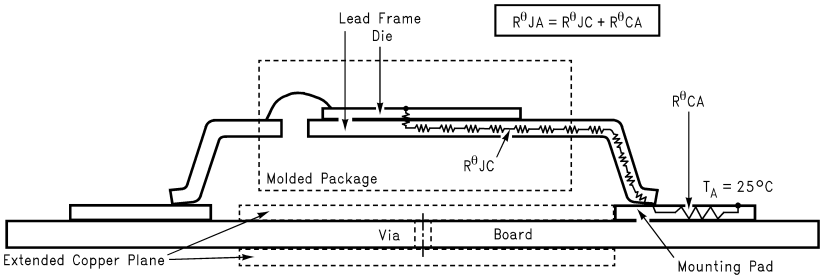
Some layout guidelines must be followed to ensure proper regulation of the output voltage with minimum noise. Traces carrying the load current must be wide to reduce the amount of parasitic trace inductance and the feedback loop from V_{OUT} to ADJ must be kept as short as possible. To improve PSRR, a bypass capacitor can be placed at the ADJ pin and must be located as close as possible to the IC. In cases when V_{IN} shorts to ground, an external diode must be placed from V_{OUT} to V_{IN} to divert the surge current from the output capacitor and protect the IC. The diode must be placed close to the corresponding IC pins to increase their effectiveness.

9.5.1.1 Heat Sink Requirements

When an integrated circuit operates with an appreciable current, the junction temperature is elevated. The thermal limits must be quantified in order to achieve acceptable performance and reliability. This limit is determined by summing the individual parts consisting of a series of temperature rises from the semiconductor junction to the operating environment. A one-dimensional steady-state model of conduction heat transfer is demonstrated in Figure 9-9. The heat generated at the device junction flows through the die to the die attach pad, through the lead frame to the surrounding case material, to the printed circuit board, and eventually to the ambient environment. Below is a list of variables that may affect the thermal resistance and in turn the need for a heat sink.

Table 9-1. Component and Application Variables

$R_{\theta JC}$ (COMPONENT VARIABLES)	$R_{\theta JA}$ (Application Variables)
Lead frame size and material	Mounting pad size, material, and location
No. of conduction pins	Placement of mounting pad
Die size	PCB size and material
Die attach material	Traces length and width
Molding compound size and material	Adjacent heat sources
	Volume of air
	Ambient temperature
	Shape of mounting pad



The case temperature is measured at the point where the leads contact with the mounting pad surface

Figure 9-9. Cross-Sectional View of Integrated Circuit Mounted on a Printed Circuit Board

The LM1117 regulators have internal thermal shutdown to protect the device from over-heating. Under all possible operating conditions, the junction temperature of the LM1117 must be within the range of 0°C to +125°C. A heat sink can be required depending on the maximum power dissipation and maximum ambient temperature of the application. To determine if a heat sink is needed, the power dissipated by the regulator, P_D , must be calculated:

$$I_{IN} = I_L + I_G \quad (2)$$

$$P_D = (V_{IN}-V_{OUT})I_L + V_{IN}I_G \quad (3)$$

Figure 9-10 shows the voltages and currents which are present in the circuit.

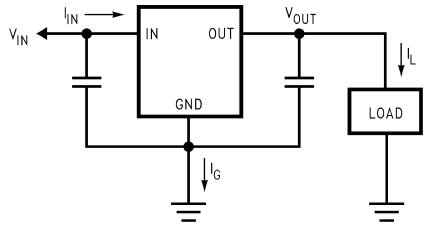


Figure 9-10. Power Dissipation Diagram

The next parameter which must be calculated is the maximum allowable temperature rise, T_R(max):

$$T_R(max) = T_J(max)-T_A(max) \quad (4)$$

where

- T_J(max) is the maximum allowable junction temperature (125°C) which is encountered in the application
- T_A(max) is the maximum ambient temperature which is encountered in the application

Using the calculated values for T_R(max) and P_D, the maximum allowable value for the junction-to-ambient thermal resistance ($R_{\theta JA}$) can be calculated:

$$R_{\theta JA} = T_R(max) / P_D \quad (5)$$

For the maximum allowable value for θ_{JA}, see the *Thermal Information* table.

As a design aid, Table 9-2 shows the value of the θ_{JA} of SOT-223 and TO-252 for different heat sink area. Figure 9-11 and Figure 9-12 reflects the same test results as what are in the Table 9-2

Figure 9-13 and Figure 9-14 shows the maximum allowable power dissipation vs. ambient temperature for the SOT-223 and TO-252 device. Figure 9-15 and Figure 9-16 shows the maximum allowable power dissipation vs. copper area (in^2) for the SOT-223 and TO-252 devices. Please see AN1028 for power enhancement techniques to be used with SOT-223 and TO-252 packages.

The *AN-1187 Leadless Leadframe Package (LLP)* application note discusses improved thermal performance and power dissipation for the WSON.

Table 9-2. $R_{\theta JA}$ Different Heat Sink Area

LAYOUT	COPPER AREA		THERMAL RESISTANCE	
	Top Side (in^2)(1)	Bottom Side (in^2)	(θ_{JA},°C/W) SOT-223	(θ_{JA},°C/W) TO-252
1	0.0123	0	136	103
2	0.066	0	123	87
3	0.3	0	84	60
4	0.53	0	75	54
5	0.76	0	69	52
6	1	0	66	47
7	0	0.2	115	84

Table 9-2. $R_{\theta JA}$ Different Heat Sink Area (continued)

LAYOUT	COPPER AREA		THERMAL RESISTANCE	
8	0	0.4	98	70
9	0	0.6	89	63
10	0	0.8	82	57
11	0	1	79	57
12	0.066	0.066	125	89
13	0.175	0.175	93	72
14	0.284	0.284	83	61
15	0.392	0.392	75	55
16	0.5	0.5	70	53

(1) Tab of device attached to topside copper

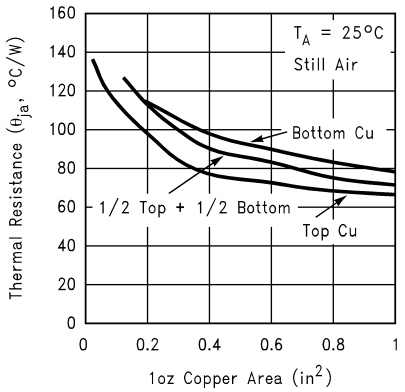


Figure 9-11. $R_{\theta JA}$ vs 1-oz Copper Area for SOT-223

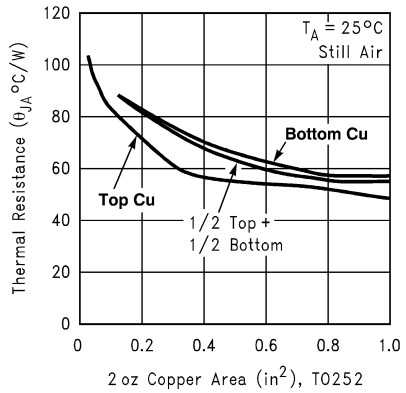


Figure 9-12. $R_{\theta JA}$ vs 2-oz Copper Area for TO-252

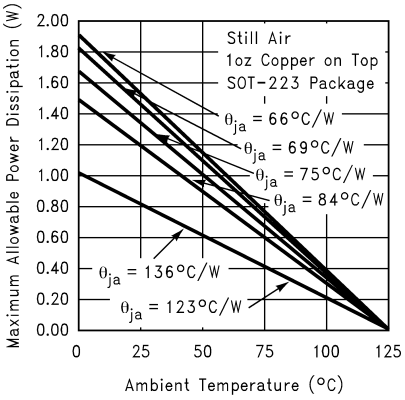


Figure 9-13. Maximum Allowable Power Dissipation vs Ambient Temperature for SOT-223

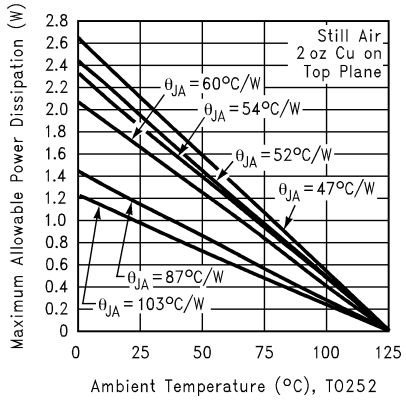


Figure 9-14. Maximum Allowable Power Dissipation vs Ambient Temperature for TO-252

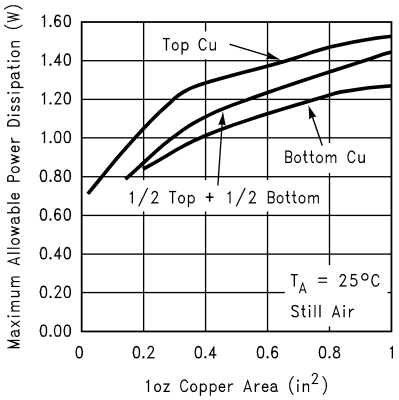


Figure 9-15. Maximum Allowable Power Dissipation vs 1-oz Copper Area for SOT-223

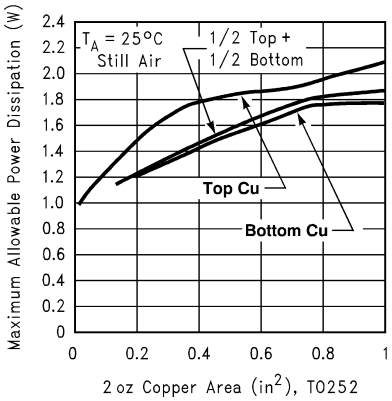


Figure 9-16. Maximum Allowable Power Dissipation vs 2-oz Copper Area for TO-252

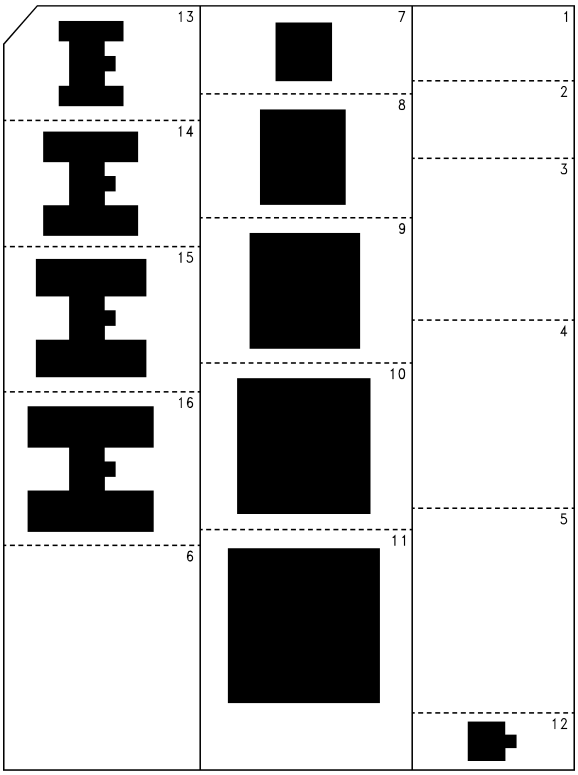


Figure 9-17. Top View of the Thermal Test Pattern in Actual Scale

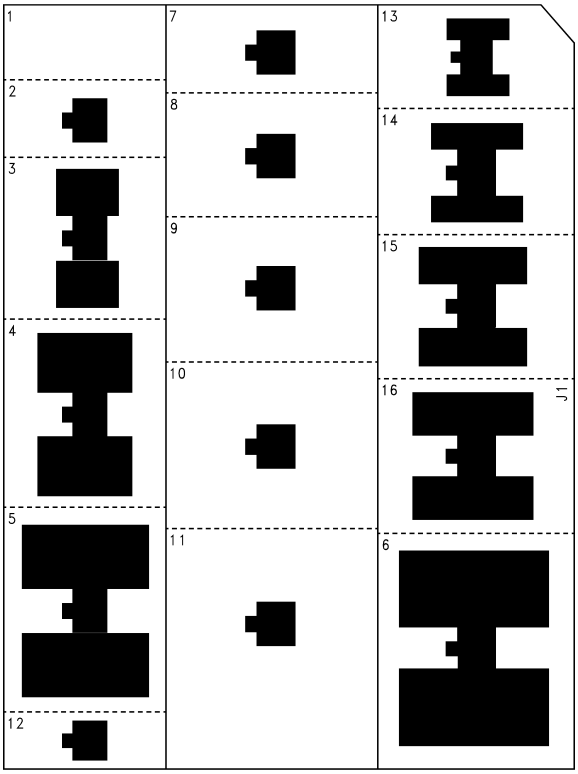


Figure 9-18. Bottom View of the Thermal Test Pattern in Actual Scale

9.5.2 Layout Example

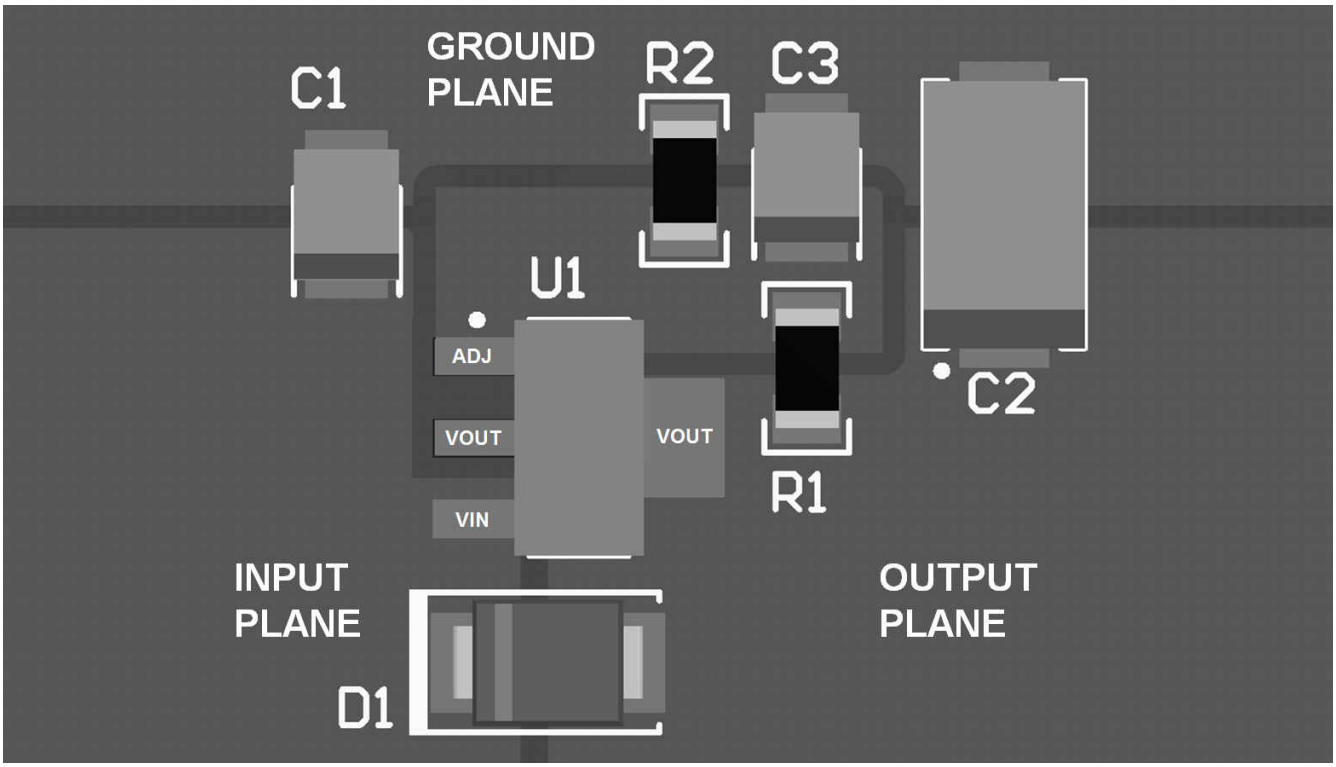


Figure 9-19. Layout Example (SOT-223)

10 Device and Documentation Support

10.1 Documentation Support

10.1.1 Related Documentation

For related documentation see the following:

Texas Instruments, *AN-1187 Leadless Leadframe Package (LLP)* application note

10.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Subscribe to updates* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

10.3 Support Resources

TI E2E™ support forums are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

10.4 Trademarks

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All trademarks are the property of their respective owners.

10.5 Electrostatic Discharge Caution

This integrated circuit can be damaged by ESD. Texas Instruments 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.

10.6 Glossary

TI Glossary	This glossary lists and explains terms, acronyms, and definitions.

11 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM1117DT-1.8/NOPB	ACTIVE	TO-252	NDP	3	75	RoHS & Green	SN	Level-2-260C-1 YEAR	0 to 125	LM1117 DT-1.8	Samples
LM1117DT-2.5/NOPB	ACTIVE	TO-252	NDP	3	75	RoHS & Green	SN	Level-2-260C-1 YEAR	0 to 125	LM1117 DT-2.5	Samples
LM1117DT-3.3/NOPB	ACTIVE	TO-252	NDP	3	75	RoHS & Green	SN	Level-2-260C-1 YEAR	0 to 125	LM1117 DT-3.3	Samples
LM1117DT-5.0/NOPB	ACTIVE	TO-252	NDP	3	75	RoHS & Green	SN	Level-2-260C-1 YEAR	0 to 125	LM1117 DT-5.0	Samples
LM1117DT-ADJ/NOPB	ACTIVE	TO-252	NDP	3	75	RoHS & Green	SN	Level-2-260C-1 YEAR	0 to 125	LM1117 DT-ADJ	Samples
LM1117DTX-1.8/NOPB	ACTIVE	TO-252	NDP	3	2500	RoHS & Green	SN	Level-2-260C-1 YEAR	0 to 125	LM1117 DT-1.8	Samples
LM1117DTX-2.5/NOPB	ACTIVE	TO-252	NDP	3	2500	RoHS & Green	SN	Level-2-260C-1 YEAR	0 to 125	LM1117 DT-2.5	Samples
LM1117DTX-3.3/NOPB	ACTIVE	TO-252	NDP	3	2500	RoHS & Green	SN	Level-2-260C-1 YEAR	0 to 125	LM1117 DT-3.3	Samples
LM1117DTX-5.0/NOPB	ACTIVE	TO-252	NDP	3	2500	RoHS & Green	SN	Level-2-260C-1 YEAR	0 to 125	LM1117 DT-5.0	Samples
LM1117DTX-ADJ/NOPB	ACTIVE	TO-252	NDP	3	2500	RoHS & Green	SN	Level-2-260C-1 YEAR	0 to 125	LM1117 DT-ADJ	Samples
LM1117IDT-3.3/NOPB	ACTIVE	TO-252	NDP	3	75	RoHS & Green	SN	Level-2-260C-1 YEAR	-40 to 125	LM1117 IDT-3.3	Samples
LM1117IDT-5.0/NOPB	ACTIVE	TO-252	NDP	3	75	RoHS & Green	SN	Level-2-260C-1 YEAR	-40 to 125	LM1117 IDT-5.0	Samples
LM1117IDT-ADJ/NOPB	ACTIVE	TO-252	NDP	3	75	RoHS & Green	SN	Level-2-260C-1 YEAR	-40 to 125	LM1117 IDT-ADJ	Samples
LM1117IDTX-3.3/NOPB	ACTIVE	TO-252	NDP	3	2500	RoHS & Green	SN	Level-2-260C-1 YEAR	-40 to 125	LM1117 IDT-3.3	Samples
LM1117IDTX-5.0/NOPB	ACTIVE	TO-252	NDP	3	2500	RoHS & Green	SN	Level-2-260C-1 YEAR	-40 to 125	LM1117 IDT-5.0	Samples
LM1117IDTX-ADJ/NOPB	ACTIVE	TO-252	NDP	3	2500	RoHS & Green	SN	Level-2-260C-1 YEAR	-40 to 125	LM1117 IDT-ADJ	Samples
LM1117ILD-ADJ/NOPB	ACTIVE	WSON	NGN	8	1000	RoHS & Green	SN	Level-3-260C-168 HR	-40 to 125	1117IAD	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM1117IMP-3.3/NOPB	ACTIVE	SOT-223	DCY	4	1000	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 125	N05B	Samples
LM1117IMP-5.0/NOPB	ACTIVE	SOT-223	DCY	4	1000	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 125	N06B	Samples
LM1117IMP-ADJ/NOPB	ACTIVE	SOT-223	DCY	4	1000	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 125	N03B	Samples
LM1117IMPX-3.3/NOPB	ACTIVE	SOT-223	DCY	4	2000	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 125	N05B	Samples
LM1117IMPX-5.0/NOPB	ACTIVE	SOT-223	DCY	4	2000	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 125	N06B	Samples
LM1117IMPX-ADJ/NOPB	ACTIVE	SOT-223	DCY	4	2000	RoHS & Green	SN	Level-1-260C-UNLIM	-40 to 125	N03B	Samples
LM1117LD-1.8/NOPB	ACTIVE	WSON	NGN	8	1000	RoHS & Green	SN	Level-3-260C-168 HR	0 to 125	1117-18	Samples
LM1117LD-2.5/NOPB	ACTIVE	WSON	NGN	8	1000	RoHS & Green	SN	Level-3-260C-168 HR	0 to 125	1117-25	Samples
LM1117LD-3.3/NOPB	ACTIVE	WSON	NGN	8	1000	RoHS & Green	SN	Level-3-260C-168 HR	0 to 125	1117-33	Samples
LM1117LD-ADJ/NOPB	ACTIVE	WSON	NGN	8	1000	RoHS & Green	SN	Level-3-260C-168 HR	0 to 125	1117ADJ	Samples
LM1117LDX-1.8/NOPB	ACTIVE	WSON	NGN	8	4500	RoHS & Green	SN	Level-3-260C-168 HR	0 to 125	1117-18	Samples
LM1117LDX-ADJ/NOPB	ACTIVE	WSON	NGN	8	4500	RoHS & Green	SN	Level-3-260C-168 HR	0 to 125	1117ADJ	Samples
LM1117MP-1.8/NOPB	ACTIVE	SOT-223	DCY	4	1000	RoHS & Green	SN	Level-1-260C-UNLIM	0 to 125	N12A	Samples
LM1117MP-2.5/NOPB	ACTIVE	SOT-223	DCY	4	1000	RoHS & Green	SN	Level-1-260C-UNLIM	0 to 125	N13A	Samples
LM1117MP-3.3/NOPB	ACTIVE	SOT-223	DCY	4	1000	RoHS & Green	SN	Level-1-260C-UNLIM	0 to 125	N05A	Samples
LM1117MP-5.0/NOPB	ACTIVE	SOT-223	DCY	4	1000	RoHS & Green	SN	Level-1-260C-UNLIM	0 to 125	N06A	Samples
LM1117MP-ADJ/NOPB	ACTIVE	SOT-223	DCY	4	1000	RoHS & Green	SN	Level-1-260C-UNLIM	0 to 125	N03A	Samples
LM1117MPX-1.8/NOPB	ACTIVE	SOT-223	DCY	4	2000	RoHS & Green	SN	Level-1-260C-UNLIM	0 to 125	N12A	Samples
LM1117MPX-2.5/NOPB	ACTIVE	SOT-223	DCY	4	2000	RoHS & Green	SN	Level-1-260C-UNLIM	0 to 125	N13A	Samples
LM1117MPX-3.3	OBSOLETE	SOT-223	DCY	4		TBD	Call TI	Call TI		N05A	
LM1117MPX-3.3/NOPB	ACTIVE	SOT-223	DCY	4	2000	RoHS & Green	SN	Level-1-260C-UNLIM	0 to 125	N05A	Samples

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM1117MPX-5.0/NOPB	ACTIVE	SOT-223	DCY	4	2000	RoHS & Green	SN	Level-1-260C-UNLIM	0 to 125	N06A	Samples
LM1117MPX-ADJ/NOPB	ACTIVE	SOT-223	DCY	4	2000	RoHS & Green	SN	Level-1-260C-UNLIM	0 to 125	N03A	Samples
LM1117S-ADJ/NOPB	ACTIVE	DDPAK/ TO-263	KTT	3	45	RoHS-Exempt & Green	SN	Level-3-245C-168 HR	0 to 125	LM1117S ADJ	Samples
LM1117SX-3.3/NOPB	ACTIVE	DDPAK/ TO-263	KTT	3	500	RoHS-Exempt & Green	SN	Level-3-245C-168 HR	0 to 125	LM1117S 3.3	Samples
LM1117SX-5.0/NOPB	ACTIVE	DDPAK/ TO-263	KTT	3	500	RoHS-Exempt & Green	SN	Level-3-245C-168 HR	0 to 125	LM1117S 5.0	Samples
LM1117SX-ADJ/NOPB	ACTIVE	DDPAK/ TO-263	KTT	3	500	RoHS-Exempt & Green	SN	Level-3-245C-168 HR	0 to 125	LM1117S ADJ	Samples
LM1117T-2.5/NOPB	ACTIVE	TO-220	NDE	3	45	RoHS & Green	SN	Level-1-NA-UNLIM	0 to 125	LM1117T 2.5	Samples
LM1117T-3.3/NOPB	ACTIVE	TO-220	NDE	3	45	RoHS & Green	SN	Level-1-NA-UNLIM	0 to 125	LM1117T 3.3	Samples
LM1117T-5.0/NOPB	ACTIVE	TO-220	NDE	3	45	RoHS & Green	SN	Level-1-NA-UNLIM	0 to 125	LM1117T 5.0	Samples
LM1117T-ADJ/NOPB	ACTIVE	TO-220	NDE	3	45	RoHS & Green	SN	Level-1-NA-UNLIM	0 to 125	LM1117T ADJ	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

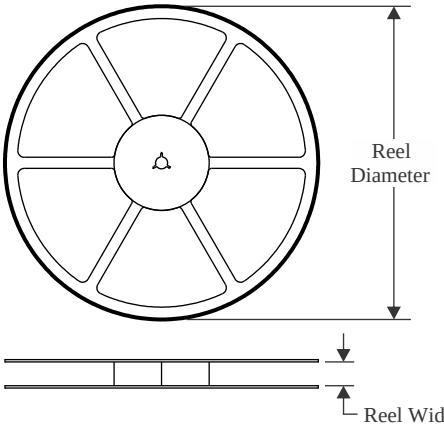
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

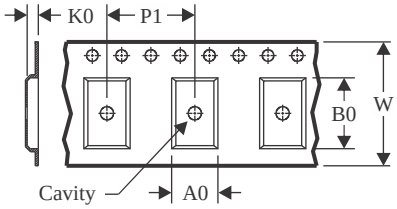
(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

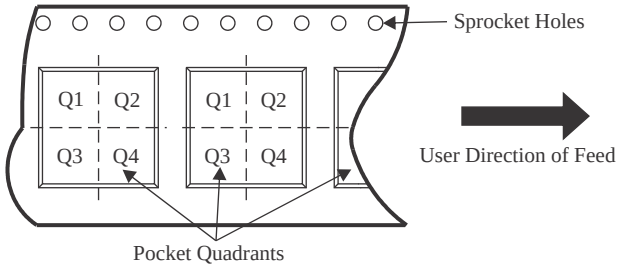


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE

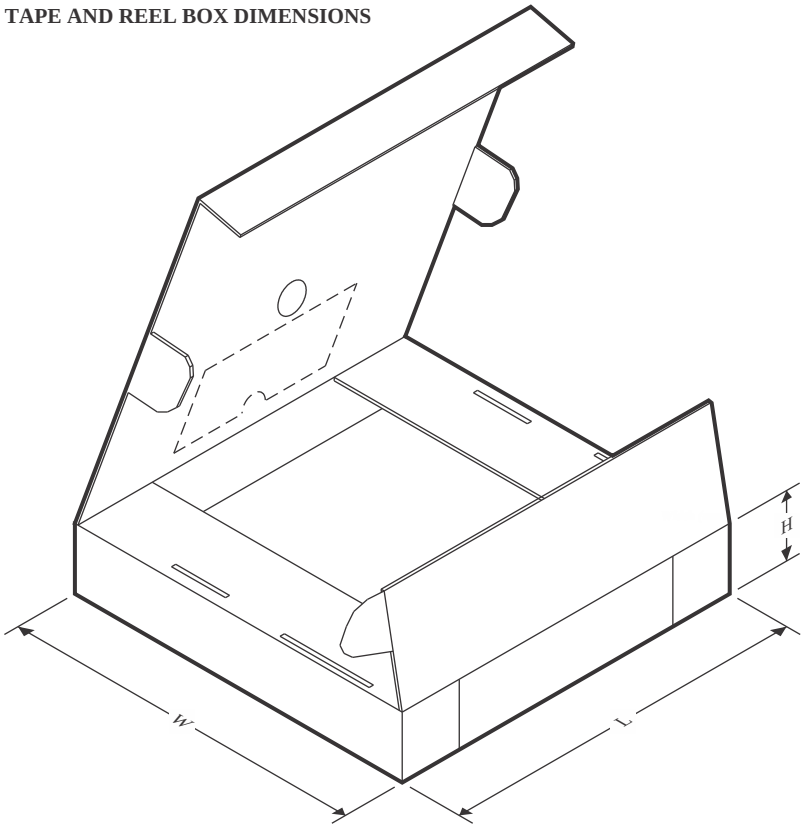


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
LM1117DTX-1.8/NOPB	TO-252	NDP	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2
LM1117DTX-2.5/NOPB	TO-252	NDP	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2
LM1117DTX-3.3/NOPB	TO-252	NDP	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2
LM1117DTX-5.0/NOPB	TO-252	NDP	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2
LM1117DTX-ADJ/NOPB	TO-252	NDP	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2
LM1117IDTX-3.3/NOPB	TO-252	NDP	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2
LM1117IDTX-5.0/NOPB	TO-252	NDP	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2
LM1117IDTX-ADJ/NOPB	TO-252	NDP	3	2500	330.0	16.4	6.9	10.5	2.7	8.0	16.0	Q2
LM1117ILD-ADJ/NOPB	WSON	NGN	8	1000	178.0	12.4	4.3	4.3	1.3	8.0	12.0	Q1
LM1117IMP-3.3/NOPB	SOT-223	DCY	4	1000	330.0	16.4	7.0	7.5	2.2	12.0	16.0	Q3
LM1117IMP-5.0/NOPB	SOT-223	DCY	4	1000	330.0	16.4	7.0	7.5	2.2	12.0	16.0	Q3
LM1117IMP-ADJ/NOPB	SOT-223	DCY	4	1000	330.0	16.4	7.0	7.5	2.2	12.0	16.0	Q3
LM1117IMPX-3.3/NOPB	SOT-223	DCY	4	2000	330.0	16.4	7.0	7.5	2.2	12.0	16.0	Q3
LM1117IMPX-5.0/NOPB	SOT-223	DCY	4	2000	330.0	16.4	7.0	7.5	2.2	12.0	16.0	Q3
LM1117IMPX-ADJ/NOPB	SOT-223	DCY	4	2000	330.0	16.4	7.0	7.5	2.2	12.0	16.0	Q3
LM1117LD-1.8/NOPB	WSON	NGN	8	1000	178.0	12.4	4.3	4.3	1.3	8.0	12.0	Q1

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
LM1117LD-2.5/NOPB	WSON	NGN	8	1000	178.0	12.4	4.3	4.3	1.3	8.0	12.0	Q1
LM1117LD-3.3/NOPB	WSON	NGN	8	1000	178.0	12.4	4.3	4.3	1.3	8.0	12.0	Q1
LM1117LD-ADJ/NOPB	WSON	NGN	8	1000	178.0	12.4	4.3	4.3	1.3	8.0	12.0	Q1
LM1117LDX-1.8/NOPB	WSON	NGN	8	4500	330.0	12.4	4.3	4.3	1.3	8.0	12.0	Q1
LM1117LDX-ADJ/NOPB	WSON	NGN	8	4500	330.0	12.4	4.3	4.3	1.3	8.0	12.0	Q1
LM1117MP-1.8/NOPB	SOT-223	DCY	4	1000	330.0	16.4	7.0	7.5	2.2	12.0	16.0	Q3
LM1117MP-2.5/NOPB	SOT-223	DCY	4	1000	330.0	16.4	7.0	7.5	2.2	12.0	16.0	Q3
LM1117MP-3.3/NOPB	SOT-223	DCY	4	1000	330.0	16.4	7.0	7.5	2.2	12.0	16.0	Q3
LM1117MP-5.0/NOPB	SOT-223	DCY	4	1000	330.0	16.4	7.0	7.5	2.2	12.0	16.0	Q3
LM1117MP-ADJ/NOPB	SOT-223	DCY	4	1000	330.0	16.4	7.0	7.5	2.2	12.0	16.0	Q3
LM1117MPX-1.8/NOPB	SOT-223	DCY	4	2000	330.0	16.4	7.0	7.5	2.2	12.0	16.0	Q3
LM1117MPX-2.5/NOPB	SOT-223	DCY	4	2000	330.0	16.4	7.0	7.5	2.2	12.0	16.0	Q3
LM1117MPX-3.3/NOPB	SOT-223	DCY	4	2000	330.0	16.4	7.0	7.5	2.2	12.0	16.0	Q3
LM1117MPX-5.0/NOPB	SOT-223	DCY	4	2000	330.0	16.4	7.0	7.5	2.2	12.0	16.0	Q3
LM1117MPX-ADJ/NOPB	SOT-223	DCY	4	2000	330.0	16.4	7.0	7.5	2.2	12.0	16.0	Q3
LM1117SX-3.3/NOPB	DDPAK/ TO-263	KTT	3	500	330.0	24.4	10.75	14.85	5.0	16.0	24.0	Q2
LM1117SX-5.0/NOPB	DDPAK/ TO-263	KTT	3	500	330.0	24.4	10.75	14.85	5.0	16.0	24.0	Q2
LM1117SX-ADJ/NOPB	DDPAK/ TO-263	KTT	3	500	330.0	24.4	10.75	14.85	5.0	16.0	24.0	Q2

TAPE AND REEL BOX DIMENSIONS

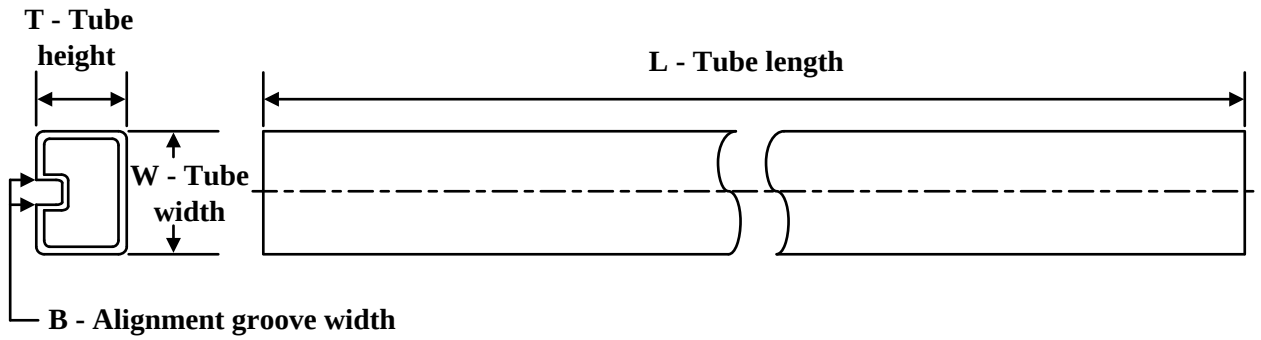


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM1117DTX-1.8/NOPB	TO-252	NDP	3	2500	356.0	356.0	36.0
LM1117DTX-2.5/NOPB	TO-252	NDP	3	2500	356.0	356.0	36.0
LM1117DTX-3.3/NOPB	TO-252	NDP	3	2500	356.0	356.0	36.0
LM1117DTX-5.0/NOPB	TO-252	NDP	3	2500	356.0	356.0	36.0
LM1117DTX-ADJ/NOPB	TO-252	NDP	3	2500	356.0	356.0	36.0
LM1117IDTX-3.3/NOPB	TO-252	NDP	3	2500	356.0	356.0	36.0
LM1117IDTX-5.0/NOPB	TO-252	NDP	3	2500	356.0	356.0	36.0
LM1117IDTX-ADJ/NOPB	TO-252	NDP	3	2500	356.0	356.0	36.0
LM1117ILD-ADJ/NOPB	WSON	NGN	8	1000	208.0	191.0	35.0
LM1117IMP-3.3/NOPB	SOT-223	DCY	4	1000	367.0	367.0	35.0
LM1117IMP-5.0/NOPB	SOT-223	DCY	4	1000	367.0	367.0	35.0
LM1117IMP-ADJ/NOPB	SOT-223	DCY	4	1000	367.0	367.0	35.0
LM1117IMPX-3.3/NOPB	SOT-223	DCY	4	2000	367.0	367.0	35.0
LM1117IMPX-5.0/NOPB	SOT-223	DCY	4	2000	367.0	367.0	35.0
LM1117IMPX-ADJ/NOPB	SOT-223	DCY	4	2000	367.0	367.0	35.0
LM1117LD-1.8/NOPB	WSON	NGN	8	1000	208.0	191.0	35.0
LM1117LD-2.5/NOPB	WSON	NGN	8	1000	208.0	191.0	35.0
LM1117LD-3.3/NOPB	WSON	NGN	8	1000	208.0	191.0	35.0

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM1117LD-ADJ/NOPB	WSON	NGN	8	1000	208.0	191.0	35.0
LM1117LDX-1.8/NOPB	WSON	NGN	8	4500	356.0	356.0	36.0
LM1117LDX-ADJ/NOPB	WSON	NGN	8	4500	356.0	356.0	36.0
LM1117MP-1.8/NOPB	SOT-223	DCY	4	1000	367.0	367.0	35.0
LM1117MP-2.5/NOPB	SOT-223	DCY	4	1000	367.0	367.0	35.0
LM1117MP-3.3/NOPB	SOT-223	DCY	4	1000	367.0	367.0	35.0
LM1117MP-5.0/NOPB	SOT-223	DCY	4	1000	367.0	367.0	35.0
LM1117MP-ADJ/NOPB	SOT-223	DCY	4	1000	367.0	367.0	35.0
LM1117MPX-1.8/NOPB	SOT-223	DCY	4	2000	367.0	367.0	35.0
LM1117MPX-2.5/NOPB	SOT-223	DCY	4	2000	367.0	367.0	35.0
LM1117MPX-3.3/NOPB	SOT-223	DCY	4	2000	367.0	367.0	35.0
LM1117MPX-5.0/NOPB	SOT-223	DCY	4	2000	367.0	367.0	35.0
LM1117MPX-ADJ/NOPB	SOT-223	DCY	4	2000	367.0	367.0	35.0
LM1117SX-3.3/NOPB	DDPAK/TO-263	KTT	3	500	356.0	356.0	45.0
LM1117SX-5.0/NOPB	DDPAK/TO-263	KTT	3	500	356.0	356.0	45.0
LM1117SX-ADJ/NOPB	DDPAK/TO-263	KTT	3	500	356.0	356.0	45.0

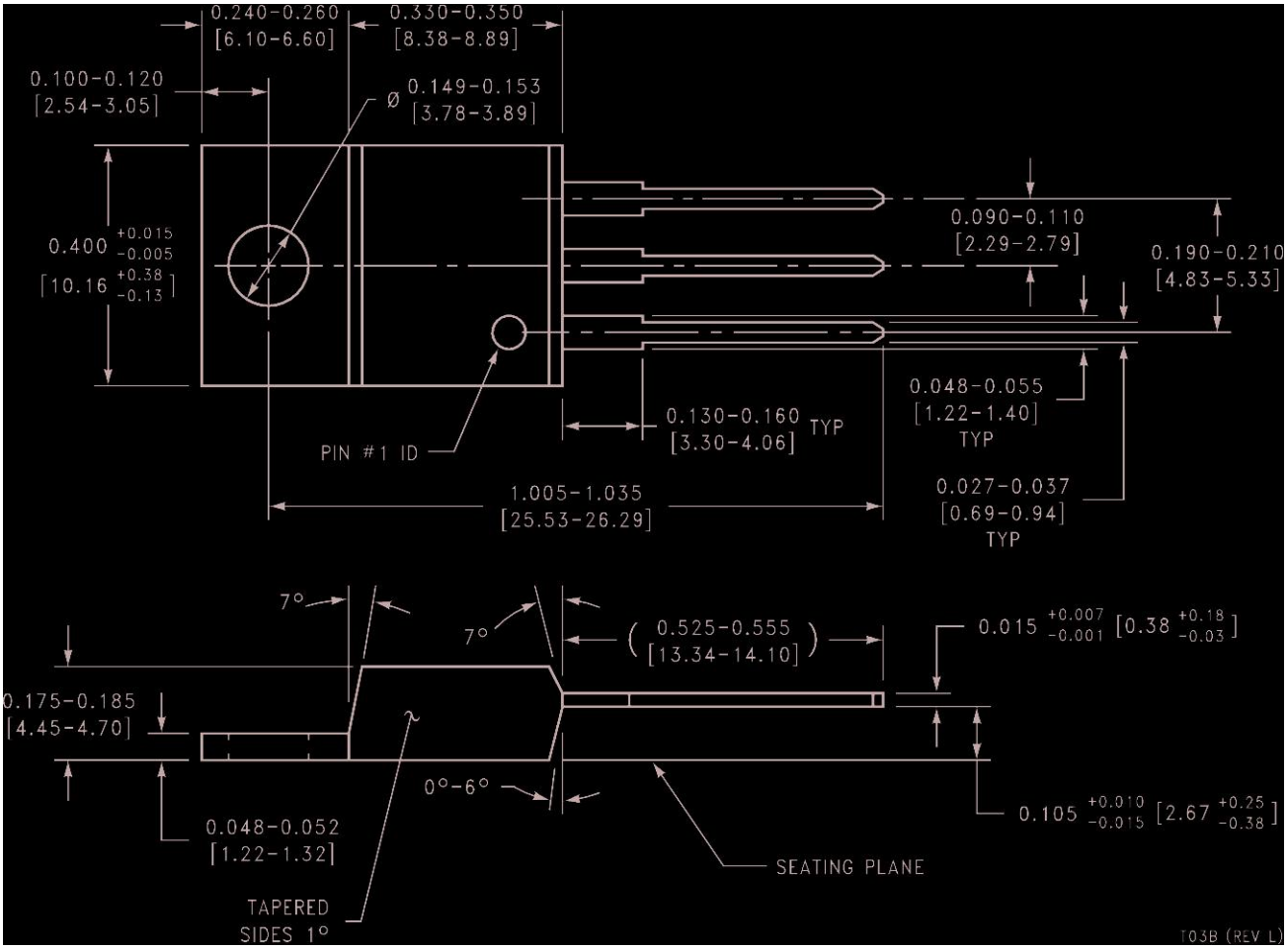
TUBE



*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
LM1117DT-1.8/NOPB	NDP	TO-252	3	75	508	20	4165.6	3.1
LM1117DT-2.5/NOPB	NDP	TO-252	3	75	508	20	4165.6	3.1
LM1117DT-3.3/NOPB	NDP	TO-252	3	75	508	20	4165.6	3.1
LM1117DT-5.0/NOPB	NDP	TO-252	3	75	508	20	4165.6	3.1
LM1117DT-ADJ/NOPB	NDP	TO-252	3	75	508	20	4165.6	3.1
LM1117IDT-3.3/NOPB	NDP	TO-252	3	75	508	20	4165.6	3.1
LM1117IDT-5.0/NOPB	NDP	TO-252	3	75	508	20	4165.6	3.1
LM1117IDT-ADJ/NOPB	NDP	TO-252	3	75	508	20	4165.6	3.1
LM1117S-ADJ/NOPB	KTT	TO-263	3	45	502	25	8204.2	9.19
LM1117T-2.5/NOPB	NDE	TO-220	3	45	502	33	6985	4.06
LM1117T-3.3/NOPB	NDE	TO-220	3	45	502	33	6985	4.06
LM1117T-5.0/NOPB	NDE	TO-220	3	45	502	33	6985	4.06
LM1117T-ADJ/NOPB	NDE	TO-220	3	45	502	33	6985	4.06

NDE0003B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[3.78-3.89]
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[10.16 +0.38 -0.13]
0.090-0.110
[2.29-2.79]
0.190-0.210
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0.048-0.055
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TYP
0.130-0.160 TYP
[3.30-4.06]
PIN #1 ID
1.005-1.035
[25.53-26.29]
0.027-0.037
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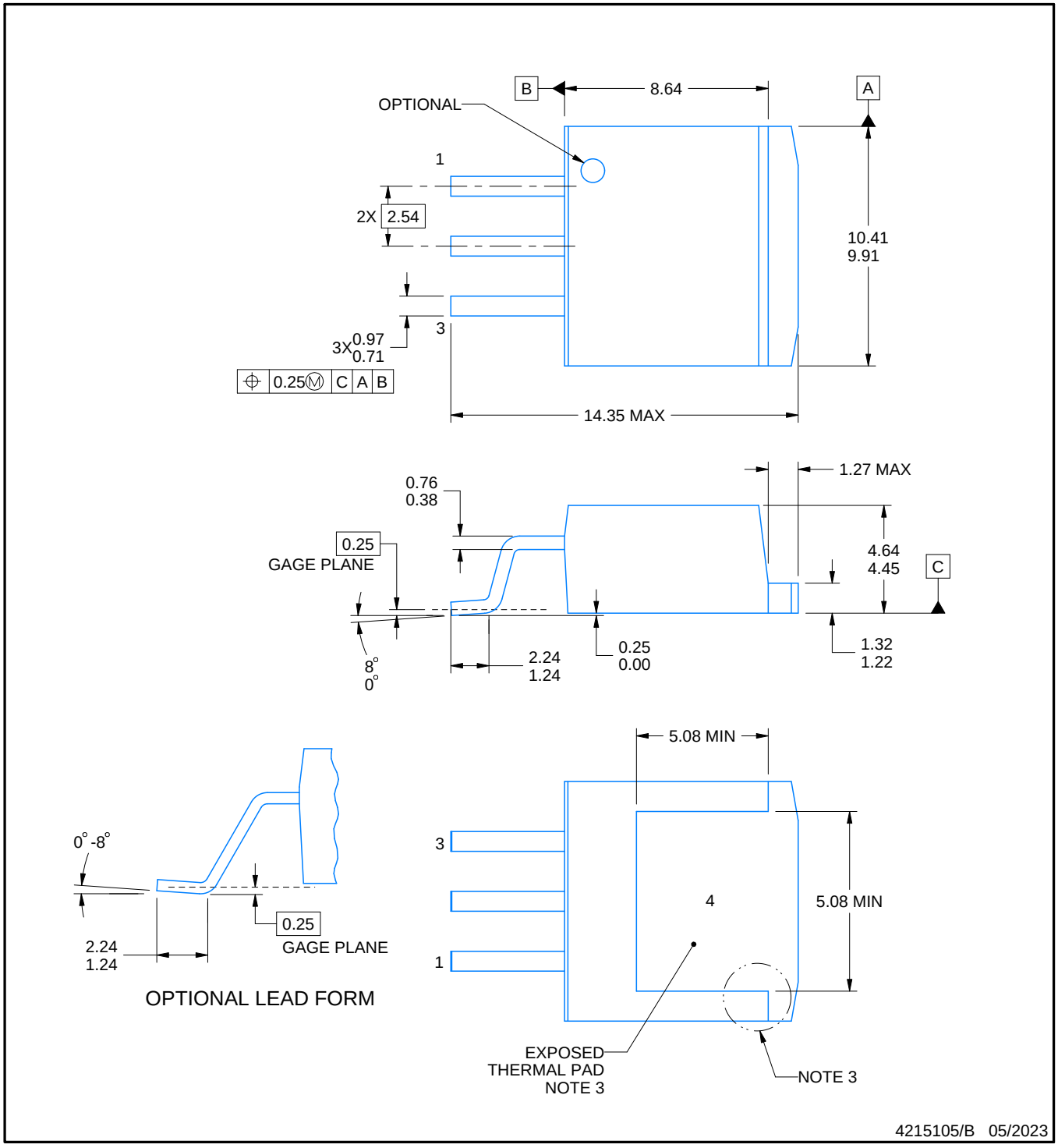
TYP
7°
7°
(0.525-0.555
[13.34-14.10])
0.015 +0.007 -0.001 [0.38 +0.18 -0.03]
0.175-0.185
[4.45-4.70]
0°-6°
0.105 +0.010 -0.015 [2.67 +0.25 -0.38]
0.048-0.052
[1.22-1.32]
SEATING PLANE
TAPERED
SIDES 1°
T03B (REV L)

KTT0003B

PACKAGE OUTLINE

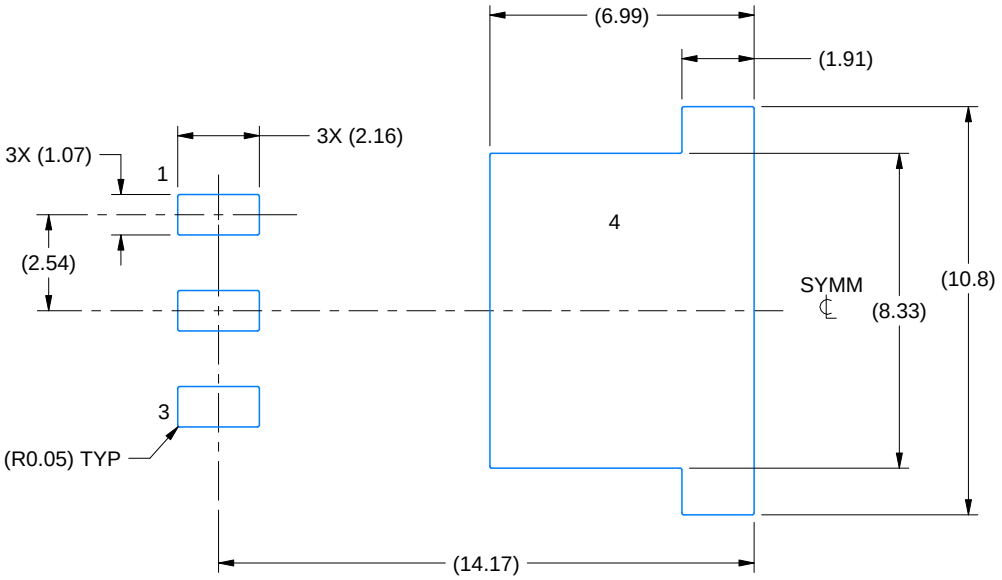
TO-263 - 4.83 mm max height

TO-263

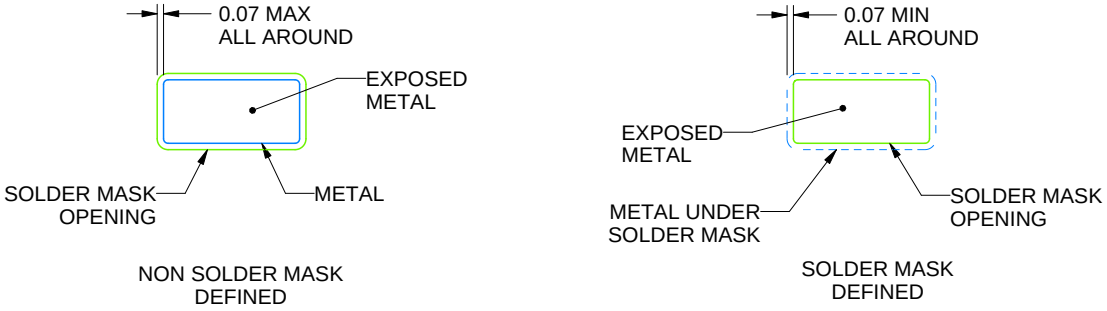


NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Features may not exist and shape may vary per different assembly sites.
4. Reference JEDEC registration TO-263, except minimum lead thickness and minimum exposed pad length.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:5X



SOLDER MASK DETAILS

4215105/B 05/2023

NOTES: (continued)

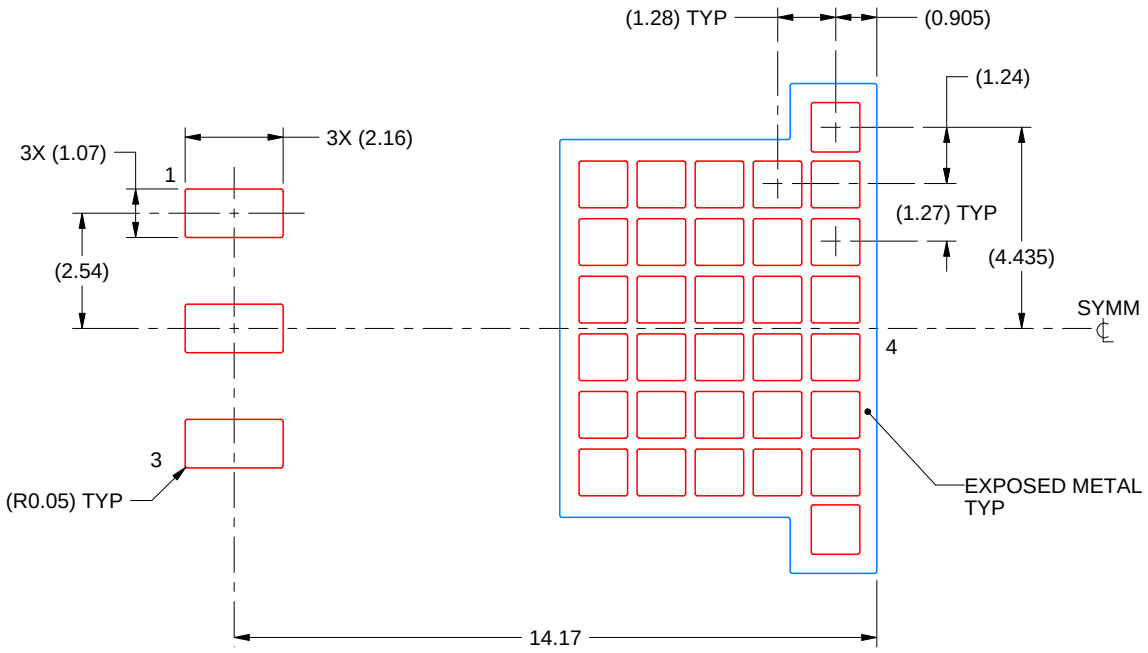
5. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature numbers SLMA002(www.ti.com/lit/slm002) and SLMA004 (www.ti.com/lit/slma004).
6. Vias are optional depending on application, refer to device data sheet. It is recommended that vias under paste be filled, plugged or tented.

EXAMPLE STENCIL DESIGN

KTT0003B

TO-263 - 4.83 mm max height

TO-263



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD
60% PRINTED SOLDER COVERAGE BY AREA
SCALE:6X

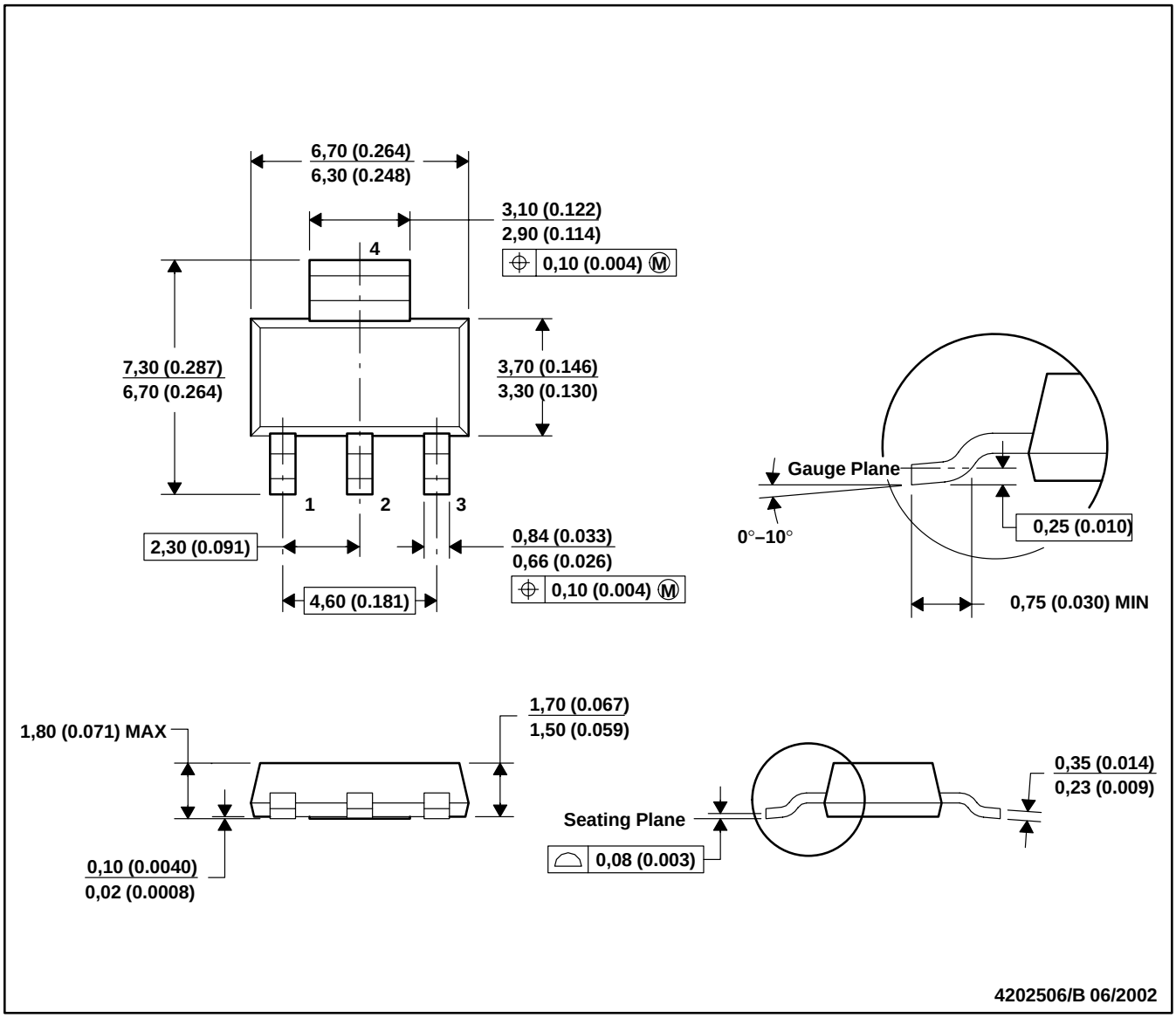
4215105/B 05/2023

NOTES: (continued)

7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
8. Board assembly site may have different recommendations for stencil design.

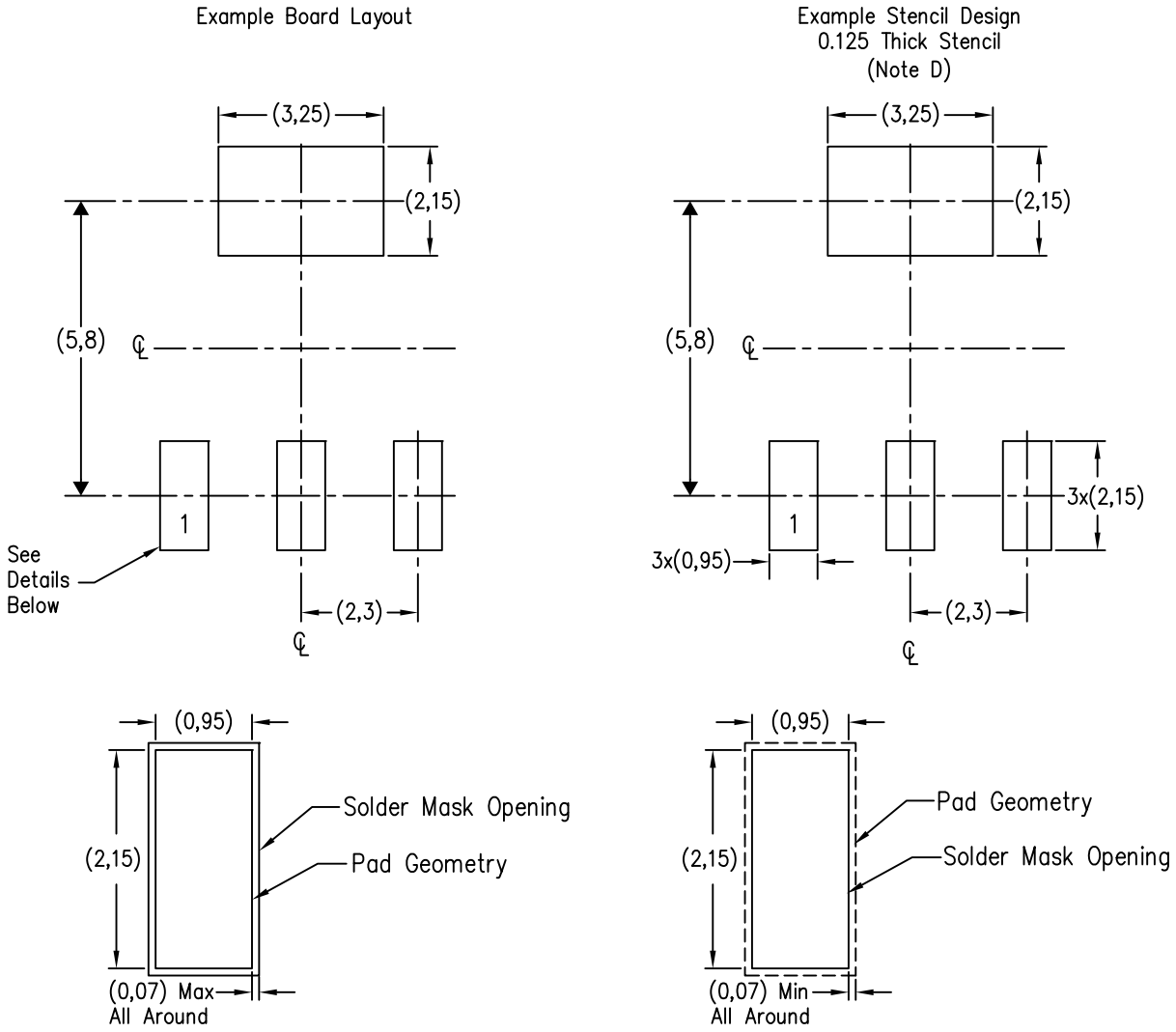
MPDS094A – APRIL 2001 – REVISED JUNE 2002

DCY (R-PDSO-G4) **PLASTIC SMALL-OUTLINE**



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.

DCY (R–PDSO–G4) PLASTIC SMALL OUTLINE



NOTES:

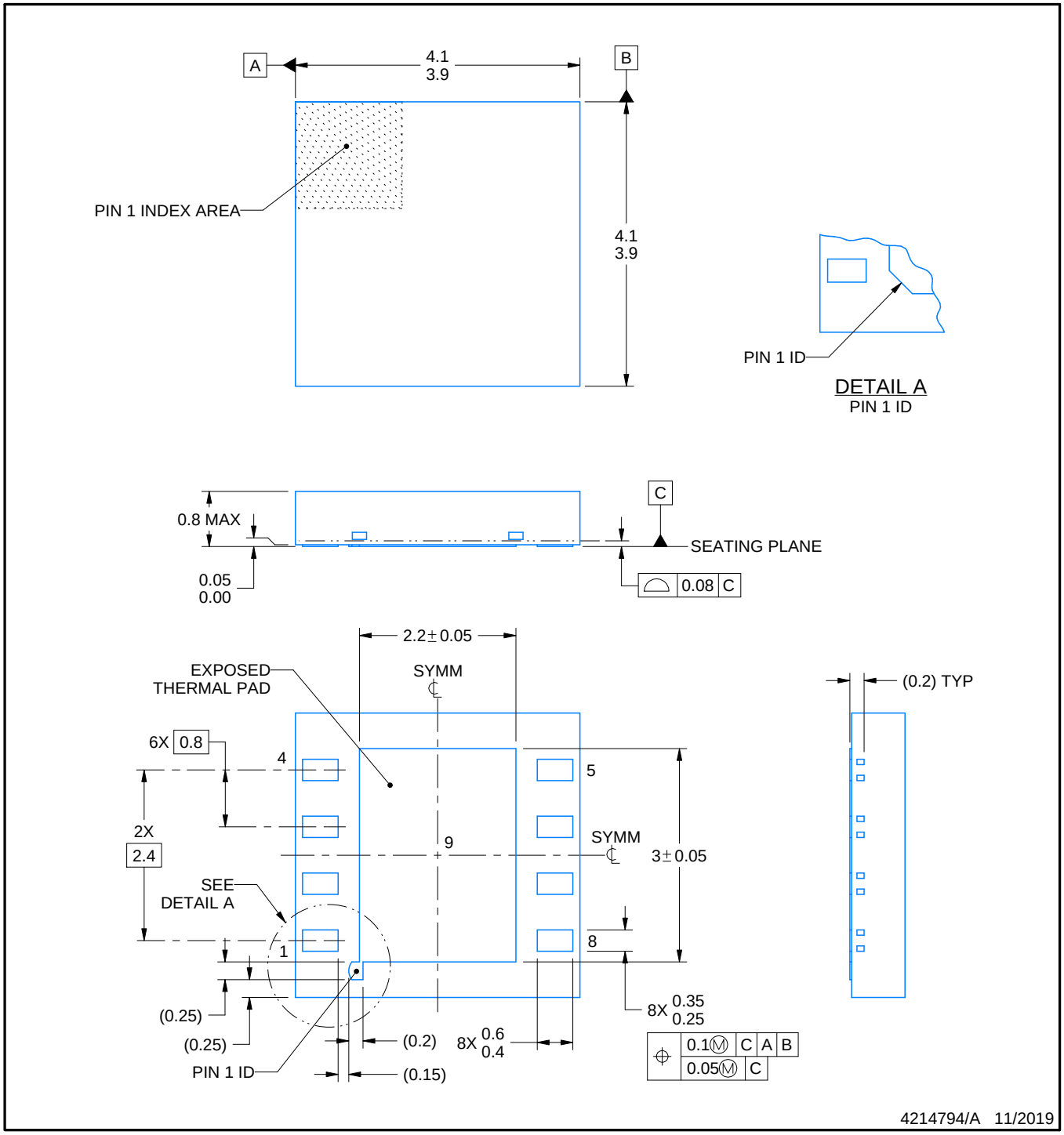
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–7351 is recommended for alternate designs.
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil recommendations. Refer to IPC 7525 for stencil design considerations.

PACKAGE OUTLINE

NGN0008A

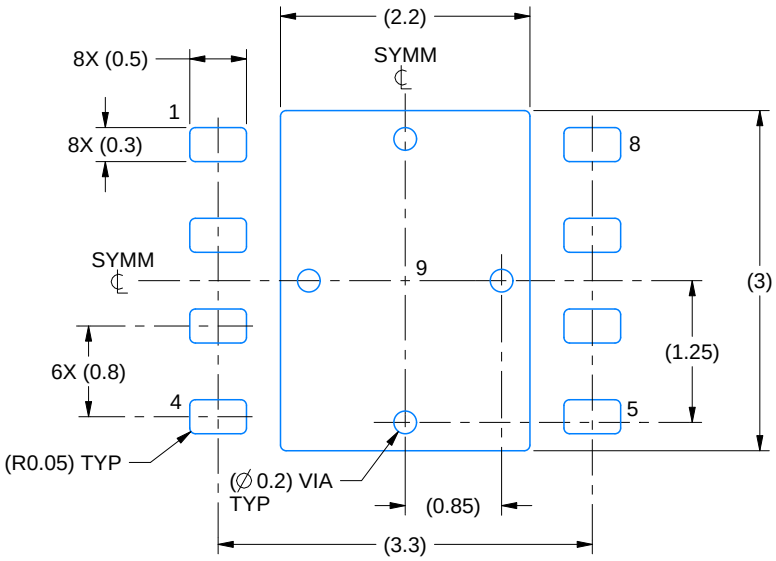
WSON - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD

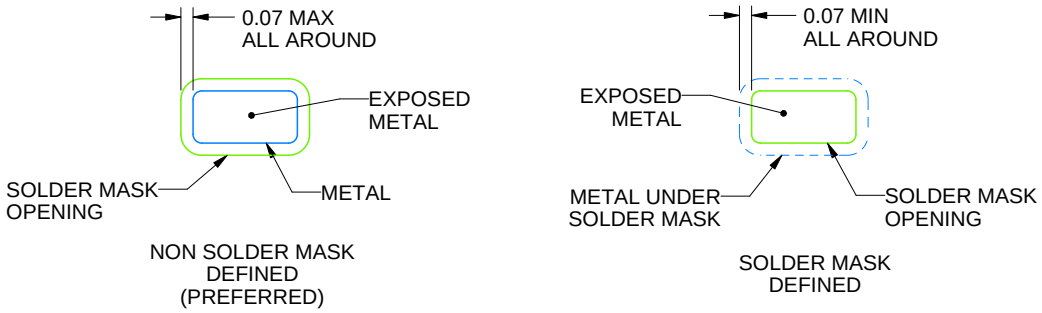


NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:15X

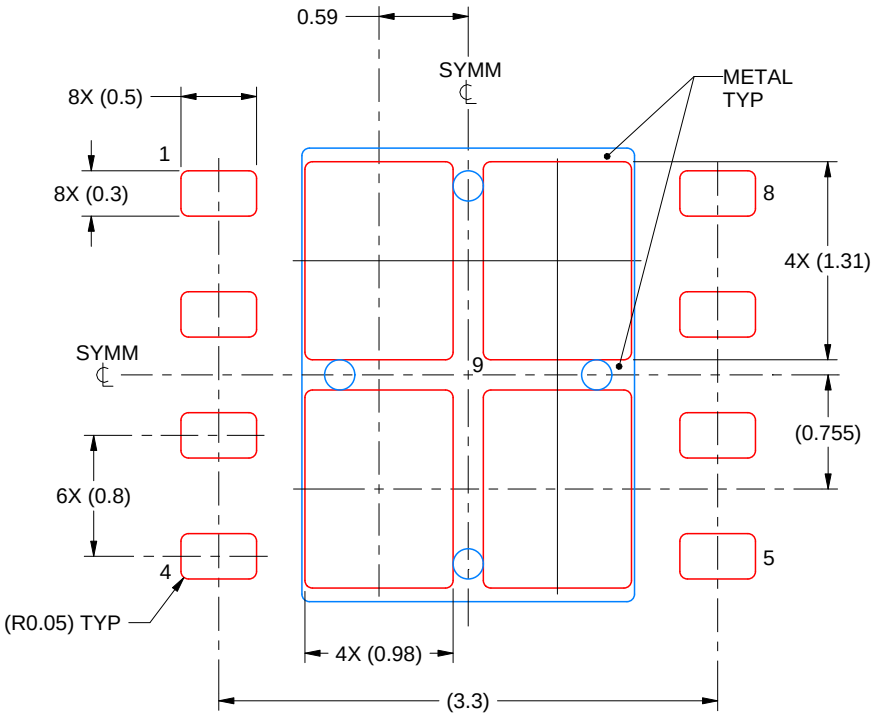


SOLDER MASK DETAILS

4214794/A 11/2019

NOTES: (continued)

4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD 9:
78% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE
SCALE:20X

4214794/A 11/2019

NOTES: (continued)

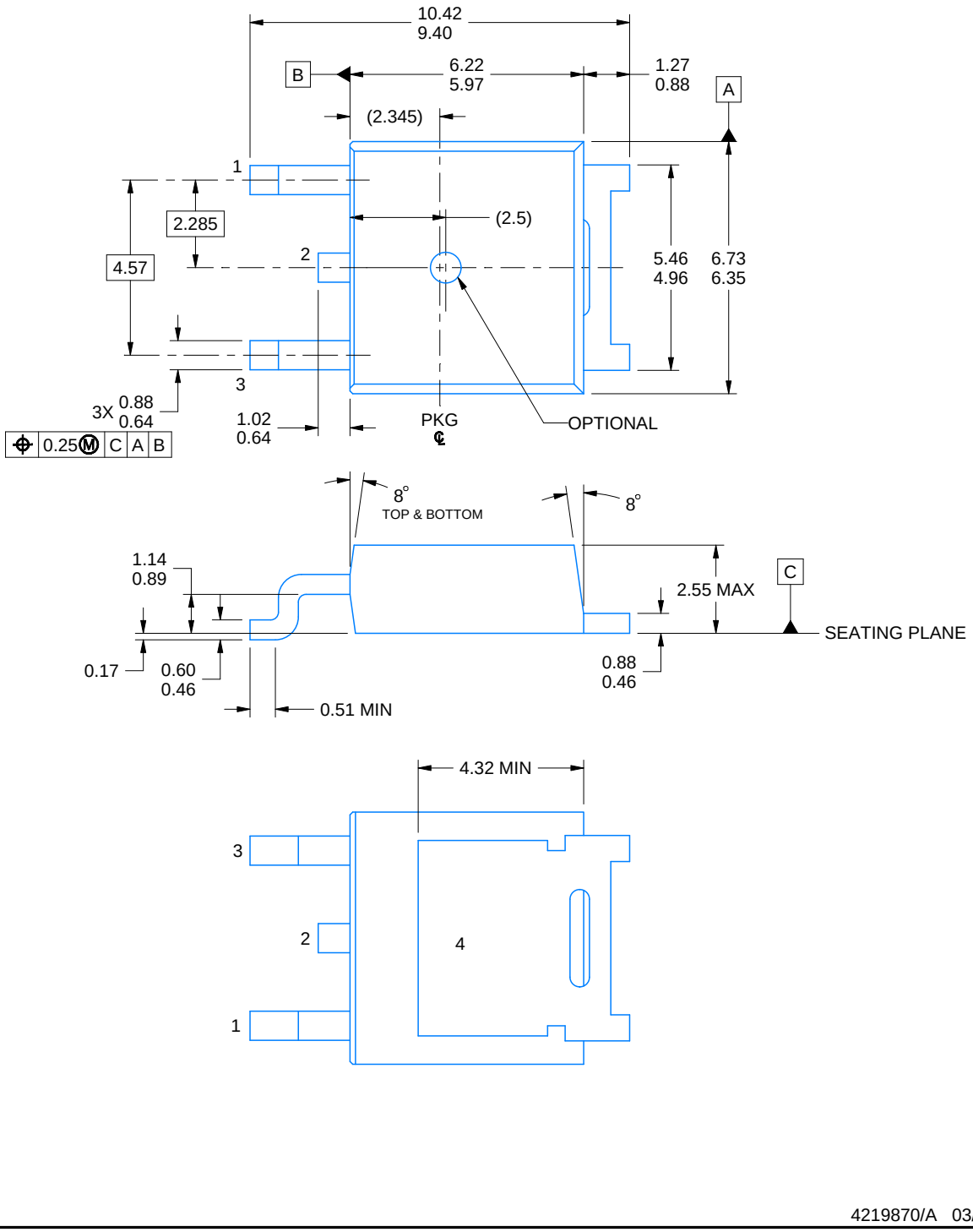
6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

NDP0003B

PACKAGE OUTLINE

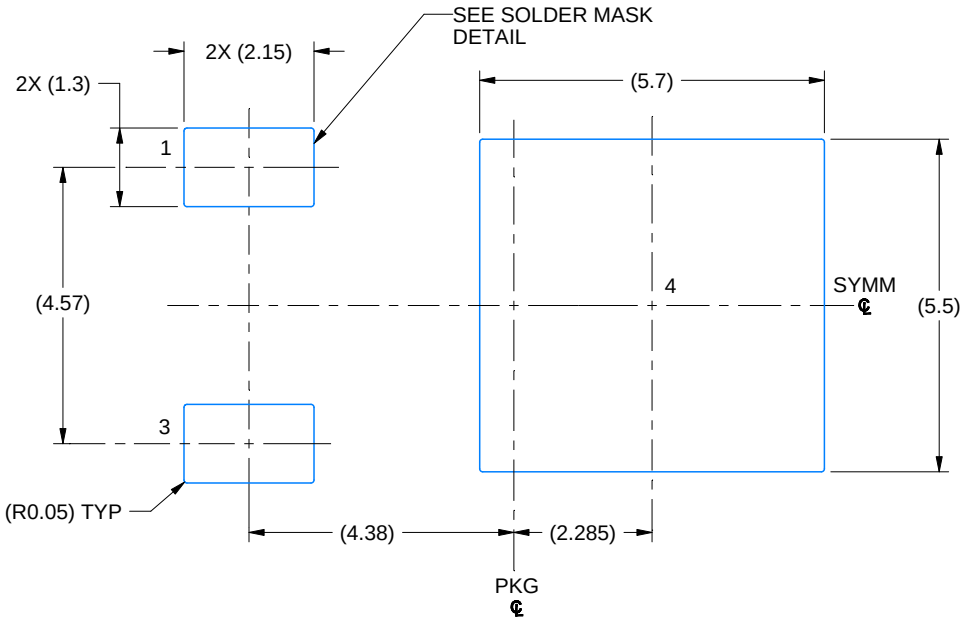
TO-252 - 2.55 mm max height

TRANSISTOR OUTLINE

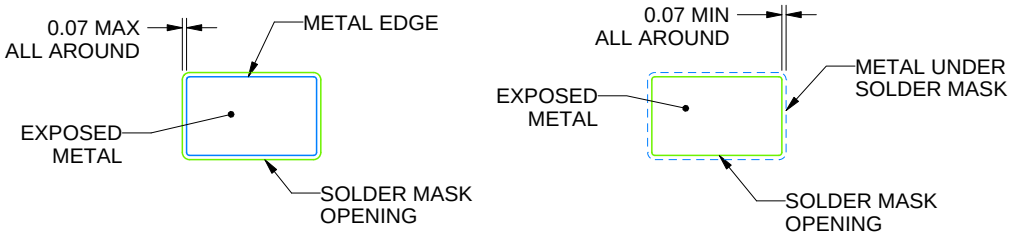


NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC registration TO-252.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 8X

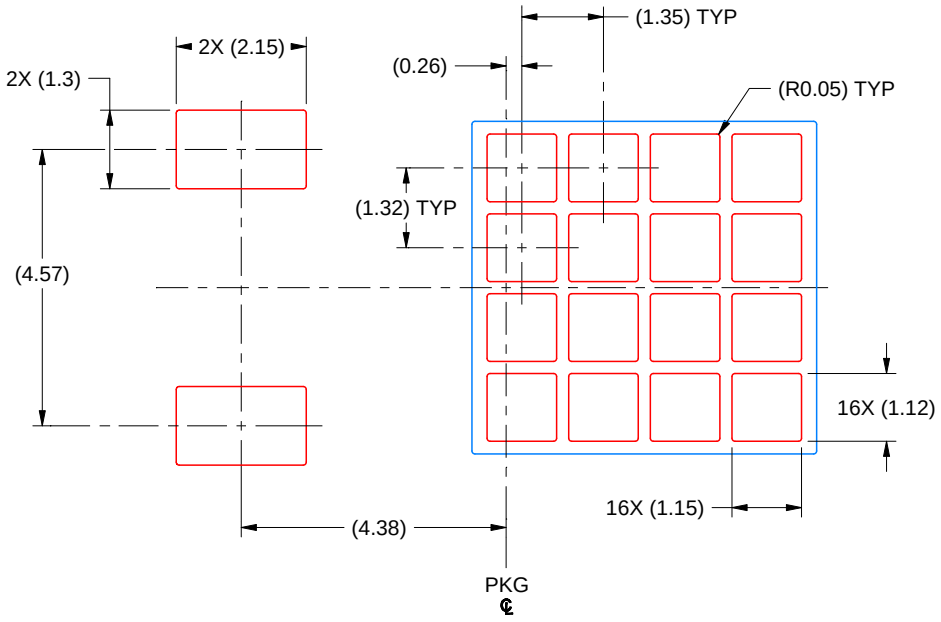


SOLDER MASK DETAIL

4219870/A 03/2018

NOTES: (continued)

4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature numbers SLMA002(www.ti.com/lit/slm002) and SLMA004 (www.ti.com/lit/slma004).
5. Vias are optional depending on application, refer to device data sheet. It is recommended that vias under paste be filled, plugged or tented.



SOLDER PASTE EXAMPLE
BASED ON 0.125 MM THICK STENCIL
SCALE: 8X

4219870/A 03/2018

NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
7. Board assembly site may have different recommendations for stencil design.

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