

LM1117 800-mA, Low-Dropout Linear Regulator

1 Features

- For a newer drop-in alternative, see the [TLV1117](#)
- 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 to 13.8 V with only two external resistors. In addition, it is available in five fixed voltages, 1.8 V, 2.5 V, 3.3 V, and 5 V.

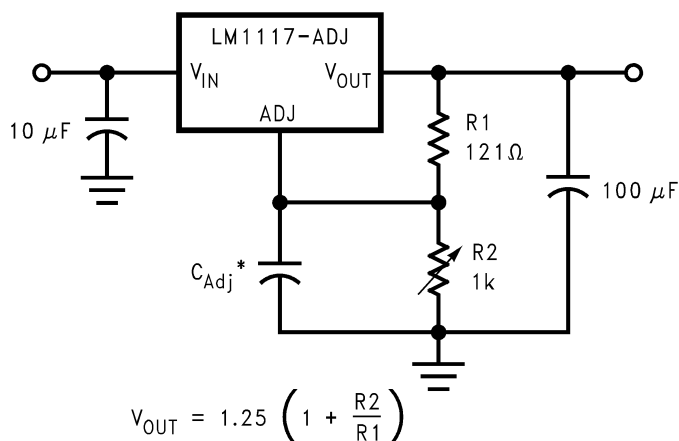
The LM1117 offers current limiting and thermal shutdown. Its circuit includes a Zener trimmed bandgap reference to assure output voltage accuracy to within ±1%.

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

Device Information⁽¹⁾

| PART NUMBER | PACKAGE | BODY SIZE (NOM) |
|--------------------|-------------|----------------------|
| LM1117, LM1117I | SOT-223 (4) | 6.50 mm × 3.50 mm |
| | TO-220 (3) | 14.986 mm × 10.16 mm |
| | TO-252 (3) | 6.58 mm × 6.10 mm |
| | WSON (8) | 4.00 mm × 4.00 mm |
| | 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 O (June 2020) to Revision P (July 2022) | Page |
|---|-------------|
| • Updated the numbering format for tables, figures, and cross-references throughout the document..... | 1 |

| Changes from Revision N (January 2016) to Revision O (June 2020) | Page |
|---|-------------|
| • Added alternative device <i>Features</i> bullet | 1 |
| • Changed <i>Applications</i> section | 1 |
| • Added <i>Device Comparison Table</i> | 3 |
| • Added <i>Related Documentation</i> section..... | 23 |

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

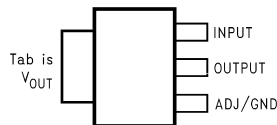


Figure 6-1. 4-Pin SOT DCY Package (Top View)

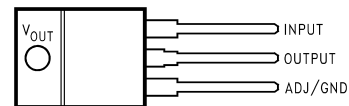


Figure 6-2. 3-Pin TO-220 NDE Package (Top View)

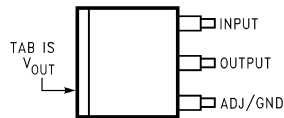


Figure 6-3. 3-Pin TO-263 KTT Package (Top View)

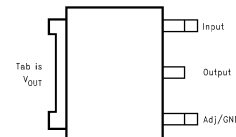
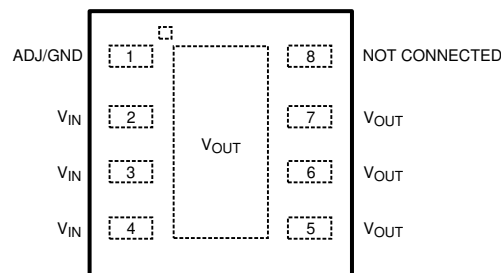


Figure 6-4. 3-Pin TO-252 NDP Package (Top View)



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. 8-Pin WSON NGN Package (Top View)

Table 6-1. Pin Functions

| NAME | PIN | | | | | I/O | DESCRIPTION |
|-----------|--------|--------------|---------|--------|--------|-----|--|
| | 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, $T_J = 25^\circ\text{C}$

| PARAMETER | | TEST CONDITIONS | MIN ⁽¹⁾ | TYP ⁽²⁾ | MAX ⁽¹⁾ | UNIT | | |
|--|-------------------|--|--------------------------------|---|--------------------|--------|------|----|
| V_{REF} | Reference voltage | LM1117-ADJ $I_{OUT} = 10\text{ mA}$, $V_{IN} - V_{OUT} = 2\text{ V}$, $T_J = 25^\circ\text{C}$ | 1.238 | 1.25 | 1.262 | V | | |
| | | LM1117-ADJ $10\text{ mA} \leq I_{OUT} \leq 800\text{ mA}$, $1.4\text{ V} \leq V_{IN} - V_{OUT} \leq 10\text{ V}$ | 1.225 | 1.25 | 1.27 | | | |
| V_{OUT} | Output voltage | LM1117-1.8 $I_{OUT} = 10\text{ mA}$, $V_{IN} = 3.8\text{ V}$, $T_J = 25^\circ\text{C}$ | 1.782 | 1.8 | 1.818 | V | | |
| | | LM1117-1.8 $0 \leq I_{OUT} \leq 800\text{ mA}$, $3.2\text{ V} \leq V_{IN} \leq 10\text{ V}$ | 1.746 | 1.8 | 1.854 | | | |
| | | LM1117-2.5 $I_{OUT} = 10\text{ mA}$, $V_{IN} = 4.5\text{ V}$, $T_J = 25^\circ\text{C}$ | 2.475 | 2.5 | 2.525 | V | | |
| | | LM1117-2.5 $0 \leq I_{OUT} \leq 800\text{ mA}$, $3.9\text{ V} \leq V_{IN} \leq 10\text{ V}$ | 2.45 | 2.5 | 2.55 | | | |
| | | LM1117-3.3 $I_{OUT} = 10\text{ mA}$, $V_{IN} = 5\text{ V}$, $T_J = 25^\circ\text{C}$ | 3.267 | 3.3 | 3.333 | V | | |
| | | LM1117-3.3 $0 \leq I_{OUT} \leq 800\text{ mA}$, $4.75\text{ V} \leq V_{IN} \leq 10\text{ V}$ | 3.235 | 3.3 | 3.365 | | | |
| | | LM1117-5.0 $I_{OUT} = 10\text{ mA}$, $V_{IN} = 7\text{ V}$, $T_J = 25^\circ\text{C}$ | 4.95 | 5 | 5.05 | V | | |
| | | LM1117-5.0 $0 \leq I_{OUT} \leq 800\text{ mA}$, $6.5\text{ V} \leq V_{IN} \leq 12\text{ V}$ | 4.9 | 5 | 5.1 | | | |
| | | ΔV_{OUT} | Line regulation ⁽³⁾ | LM1117-ADJ $I_{OUT} = 10\text{ mA}$, $1.5\text{ V} \leq V_{IN} - V_{OUT} \leq 13.75\text{ V}$ | | 0.035% | 0.2% | mV |
| | | | | LM1117-1.8 $I_{OUT} = 0\text{ mA}$, $3.2\text{ V} \leq V_{IN} \leq 10\text{ V}$ | | 1 | 6 | |
| LM1117-2.5 $I_{OUT} = 0\text{ mA}$, $3.9\text{ V} \leq V_{IN} \leq 10\text{ V}$ | | | | 1 | 6 | mV | | |
| LM1117-3.3 $I_{OUT} = 0\text{ mA}$, $4.75\text{ V} \leq V_{IN} \leq 15\text{ V}$ | | | | 1 | 6 | mV | | |
| LM1117-5.0 $I_{OUT} = 0\text{ mA}$, $6.5\text{ V} \leq V_{IN} \leq 15\text{ V}$ | | | | 1 | 10 | mV | | |
| LM1117-ADJ $V_{IN} - V_{OUT} = 3\text{ V}$, $10 \leq I_{OUT} \leq 800\text{ mA}$ | | | | 0.2% | 0.4% | mV | | |
| LM1117-1.8 $V_{IN} = 3.2\text{ V}$, $0 \leq I_{OUT} \leq 800\text{ mA}$ | | 1 | 10 | | | | | |
| LM1117-2.5 $V_{IN} = 3.9\text{ V}$, $0 \leq I_{OUT} \leq 800\text{ mA}$ | | 1 | 10 | | | | | |
| LM1117-3.3 $V_{IN} = 4.75\text{ V}$, $0 \leq I_{OUT} \leq 800\text{ mA}$ | | 1 | 10 | | | | | |
| LM1117-5.0 $V_{IN} = 6.5\text{ V}$, $0 \leq I_{OUT} \leq 800\text{ mA}$ | | 1 | 15 | | | | | |

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 unless otherwise specified, $T_J = 25^\circ\text{C}$

| PARAMETER | | TEST CONDITIONS | | MIN ⁽¹⁾ | TYP ⁽²⁾ | MAX ⁽¹⁾ | UNIT |
|--------------------|-------------------------------------|--|--|--------------------|--------------------|--------------------|---------------|
| $V_{IN} - V_{OUT}$ | Dropout voltage ⁽⁴⁾ | $I_{OUT} = 100\text{ mA}$ | $T_J = 25^\circ\text{C}$ | 1.1 | | 1.2 | V |
| | | | over the junction temperature range 0°C to 125°C | | | | |
| | | $I_{OUT} = 500\text{ mA}$ | $T_J = 25^\circ\text{C}$ | 1.15 | | 1.25 | V |
| | | | over the junction temperature range 0°C to 125°C | | | | |
| | | $I_{OUT} = 800\text{ mA}$ | $T_J = 25^\circ\text{C}$ | 1.2 | | 1.3 | V |
| | | | over the junction temperature range 0°C to 125°C | | | | |
| I_{LIMIT} | Current limit | $V_{IN} - V_{OUT} = 5\text{ V}$, $T_J = 25^\circ\text{C}$ | | 800 | 1200 | 1500 | mA |
| | Minimum load current ⁽⁵⁾ | LM1117-ADJ $V_{IN} = 15\text{ V}$ | $T_J = 25^\circ\text{C}$ | 1.7 | | 5 | mA |
| | | | over the junction temperature range 0°C to 125°C | | | | |
| | Quiescent current | LM1117-1.8 $V_{IN} \leq 15\text{ V}$ | $T_J = 25^\circ\text{C}$ | 5 | | 10 | mA |
| | | | over the junction temperature range 0°C to 125°C | | | | |
| | | LM1117-2.5 $V_{IN} \leq 15\text{ V}$ | $T_J = 25^\circ\text{C}$ | 5 | | 10 | mA |
| | | | over the junction temperature range 0°C to 125°C | | | | |
| | | LM1117-3.3 $V_{IN} \leq 15\text{ V}$ | $T_J = 25^\circ\text{C}$ | 5 | | 10 | mA |
| | | | over the junction temperature range 0°C to 125°C | | | | |
| | | LM1117-5.0 $V_{IN} \leq 15\text{ V}$ | $T_J = 25^\circ\text{C}$ | 5 | | 10 | mA |
| | | | over the junction temperature range 0°C to 125°C | | | | |
| | Thermal regulation | $T_A = 25^\circ\text{C}$, 30-ms pulse | | 0.01 | 0.1 | | %/W |
| | Ripple regulation | $f_{RIPPLE} = 120\text{ Hz}$, $V_{IN} - V_{OUT} = 3\text{ V}$ $V_{RIPPLE} = 1\text{ V}_{PP}$ | $T_J = 25^\circ\text{C}$ | 75 | | 60 | dB |
| | | | over the junction temperature range 0°C to 125°C | | | | |
| | Adjust pin current | $T_J = 25^\circ\text{C}$ | | 60 | | 120 | μA |
| | | over the junction temperature range 0°C to 125°C | | | | | |
| | Adjust pin current change | $10 \leq I_{OUT} \leq 80\text{ mA}$, $1.4\text{ V} \leq V_{IN} - V_{OUT} \leq 10\text{ V}$ | $T_J = 25^\circ\text{C}$ | 0.2 | | 5 | μA |
| | | | over the junction temperature range 0°C to 125°C | | | | |
| | Temperature stability | | | 0.5% | | | |
| | Long term stability | $T_A = 125^\circ\text{C}$, 1000 hours | | 0.3% | | | |
| | RMS output noise | (% of V_{OUT}), $10\text{ Hz} \leq f \leq 10\text{ kHz}$ | | 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. It is measured when the output voltage has dropped 100 mV from the nominal value obtained at $V_{IN} = V_{OUT} + 1.5\text{ V}$.
- (5) The minimum output current required to maintain regulation.

7.6 LM1117I Electrical Characteristics

unless otherwise specified, $T_J = 25^\circ\text{C}$

| PARAMETER | | TEST CONDITIONS | MIN ⁽¹⁾ | TYP ⁽²⁾ | MAX ⁽¹⁾ | UNIT |
|------------------|--------------------------------|---|--|--------------------|--------------------|------|
| V_{REF} | Reference voltage | LM1117I-ADJ $I_{OUT} = 10\text{ mA}$, $V_{IN} - V_{OUT} = 2\text{ V}$, $T_J = 25^\circ\text{C}$ | 1.238 | 1.25 | 1.262 | V |
| | | LM1117I-ADJ $10\text{ mA} \leq I_{OUT} \leq 800\text{ mA}$, $1.4\text{ V} \leq V_{IN} - V_{OUT} \leq 10\text{ V}$ | $T_J = 25^\circ\text{C}$ over the junction temperature range – 40°C to 125°C | | 1.25 | |
| V_{OUT} | Output voltage | LM1117I-3.3 $I_{OUT} = 10\text{ mA}$, $V_{IN} = 5\text{ V}$, $T_J = 25^\circ\text{C}$ | 3.267 | 3.3 | 3.333 | V |
| | | LM1117I-3.3 $0 \leq I_{OUT} \leq 800\text{ mA}$, $4.75\text{ V} \leq V_{IN} \leq 10\text{ V}$ | $T_J = 25^\circ\text{C}$ over the junction temperature range – 40°C to 125°C | | 3.3 | |
| | | LM1117I-5.0 $I_{OUT} = 10\text{ mA}$, $V_{IN} = 7\text{ V}$, $T_J = 25^\circ\text{C}$ | 4.95 | 5 | 5.05 | V |
| | | LM1117I-5.0 $0 \leq I_{OUT} \leq 800\text{ mA}$, $6.5\text{ V} \leq V_{IN} \leq 12\text{ V}$ | $T_J = 25^\circ\text{C}$ over the junction temperature range – 40°C to 125°C | | 5 | |
| ΔV_{OUT} | Line regulation ⁽³⁾ | LM1117I-ADJ $I_{OUT} = 10\text{ mA}$, $1.5\text{ V} \leq V_{IN} - V_{OUT} \leq 13.75\text{ V}$ | $T_J = 25^\circ\text{C}$ over the junction temperature range – 40°C to 125°C | | 0.035% | mV |
| | | LM1117I-3.3 $I_{OUT} = 0\text{ mA}$, $4.75\text{ V} \leq V_{IN} \leq 15\text{ V}$ | $T_J = 25^\circ\text{C}$ over the junction temperature range – 40°C to 125°C | | 1 | |
| | | LM1117I-5.0 $I_{OUT} = 0\text{ mA}$, $6.5\text{ V} \leq V_{IN} \leq 15\text{ V}$ | $T_J = 25^\circ\text{C}$ over the junction temperature range – 40°C to 125°C | | 1 | 15 |
| ΔV_{OUT} | Load regulation ⁽³⁾ | LM1117I-ADJ $V_{IN} - V_{OUT} = 3\text{ V}$, $10 \leq I_{OUT} \leq 800\text{ mA}$ | $T_J = 25^\circ\text{C}$ over the junction temperature range – 40°C to 125°C | | 0.2% | mV |
| | | LM1117I-3.3 $V_{IN} = 4.75\text{ V}$, $0 \leq I_{OUT} \leq 800\text{ mA}$ | $T_J = 25^\circ\text{C}$ over the junction temperature range – 40°C to 125°C | | 1 | |
| | | LM1117I-5.0 $V_{IN} = 6.5\text{ V}$, $0 \leq I_{OUT} \leq 800\text{ mA}$ | $T_J = 25^\circ\text{C}$ over the junction temperature range – 40°C to 125°C | | 1 | 20 |

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 unless otherwise specified, $T_J = 25^\circ\text{C}$

| PARAMETER | | TEST CONDITIONS | | MIN ⁽¹⁾ | TYP ⁽²⁾ | MAX ⁽¹⁾ | UNIT |
|---|-------------------------------------|--|---|--------------------|--------------------|--------------------|---------------|
| $V_{IN}-V_{OUT}$ | Dropout voltage ⁽⁴⁾ | $I_{OUT} = 100\text{ mA}$ | $T_J = 25^\circ\text{C}$ | 1.1 | | 1.3 | V |
| | | | over the junction temperature range – 40°C to 125°C | | | | |
| | | $I_{OUT} = 500\text{ mA}$ | $T_J = 25^\circ\text{C}$ | 1.15 | | 1.35 | V |
| over the junction temperature range – 40°C to 125°C | | | | | | | |
| | | $I_{OUT} = 800\text{ mA}$ | $T_J = 25^\circ\text{C}$ | 1.2 | | 1.4 | V |
| | | | over the junction temperature range – 40°C to 125°C | | | | |
| I_{LIMIT} | Current limit | $V_{IN} - V_{OUT} = 5\text{ V}$, $T_J = 25^\circ\text{C}$ | | 800 | 1200 | 1500 | mA |
| | Minimum load current ⁽⁵⁾ | LM1117I-ADJ $V_{IN} = 15\text{ V}$ | $T_J = 25^\circ\text{C}$ | 1.7 | | 5 | mA |
| | | | over the junction temperature range – 40°C to 125°C | | | | |
| | Quiescent current | LM1117I-3.3 $V_{IN} \leq 15\text{ V}$ | $T_J = 25^\circ\text{C}$ | 5 | | 15 | mA |
| | | | over the junction temperature range – 40°C to 125°C | | | | |
| | | LM1117I-5.0 $V_{IN} \leq 15\text{ V}$ | $T_J = 25^\circ\text{C}$ | 5 | | 15 | mA |
| | | | over the junction temperature range – 40°C to 125°C | | | | |
| | Thermal regulation | $T_A = 25^\circ\text{C}$, 30-ms pulse | | 0.01 | 0.1 | %/W | |
| | Ripple regulation | $f_{RIPPLE} = 120\text{ Hz}$, $V_{IN} - V_{OUT} = 3\text{ V}$ $V_{RIPPLE} = 1\text{ V}_{PP}$ | $T_J = 25^\circ\text{C}$ | 75 | | 60 | dB |
| | | | over the junction temperature range – 40°C to 125°C | | | | |
| | Adjust pin current | $T_J = 25^\circ\text{C}$ | | 60 | | 120 | μA |
| | | over the junction temperature range – 40°C to 125°C | | | | | |
| | Adjust pin current change | $10 \leq I_{OUT} \leq 800\text{ mA}$, $1.4\text{ V} \leq V_{IN} - V_{OUT} \leq 10\text{ V}$ | $T_J = 25^\circ\text{C}$ | 0.2 | | 10 | μA |
| | | | over the junction temperature range – 40°C to 125°C | | | | |
| | Temperature stability | | | 0.5% | | | |
| | Long term stability | $T_A = 125^\circ\text{C}$, 1000 hours | | 0.3% | | | |
| | RMS output noise | (% of V_{OUT}), $10\text{ Hz} \leq f \leq 10\text{ kHz}$ | | 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. It is measured when the output voltage has dropped 100 mV from the nominal value obtained at $V_{IN} = V_{OUT} + 1.5\text{ V}$.
- (5) The minimum output current required to maintain regulation.

7.7 Typical Characteristics

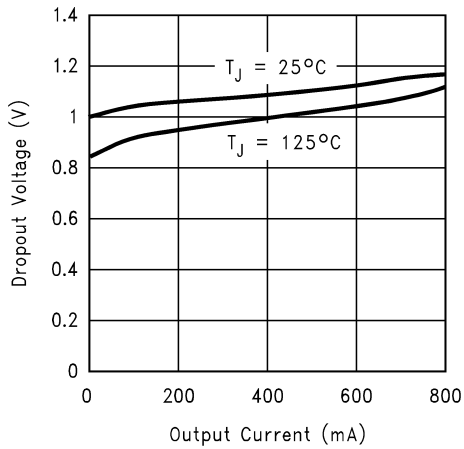


Figure 7-1. Dropout Voltage ($V_{IN} - V_{OUT}$)

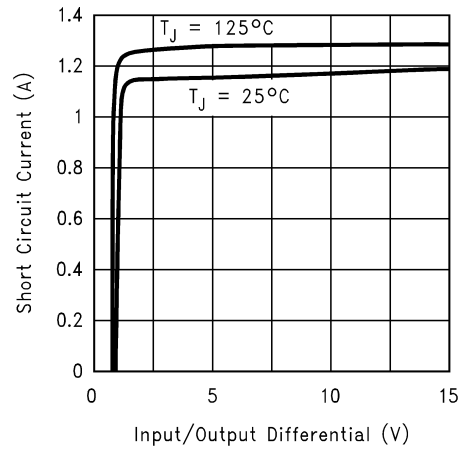


Figure 7-2. Short-Circuit Current

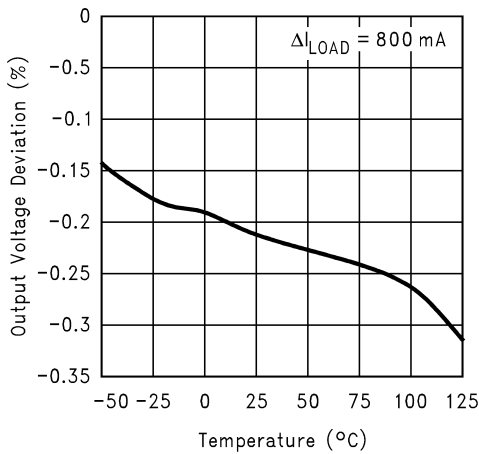


Figure 7-3. Load Regulation

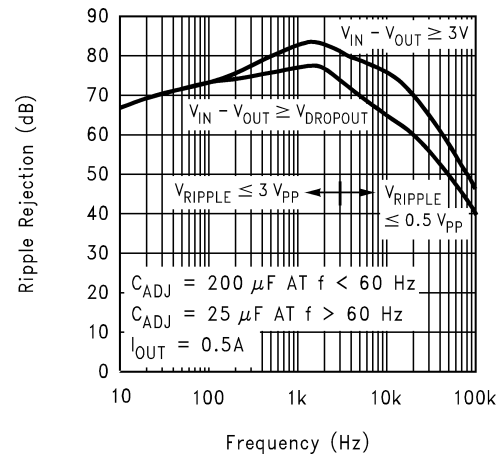


Figure 7-4. LM1117-ADJ Ripple Rejection

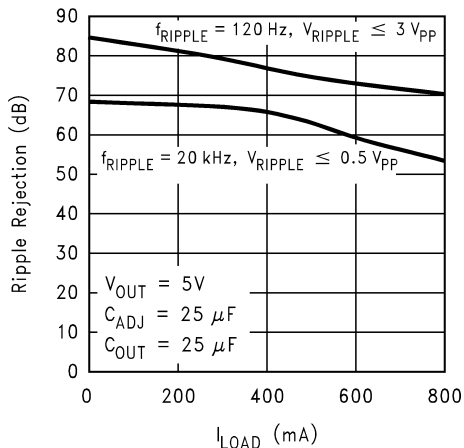


Figure 7-5. LM1117-ADJ Ripple Rejection vs Current

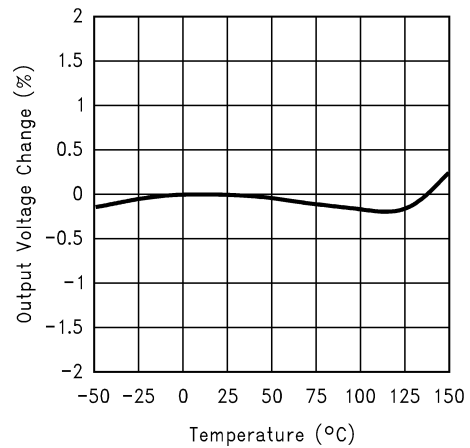


Figure 7-6. Temperature Stability

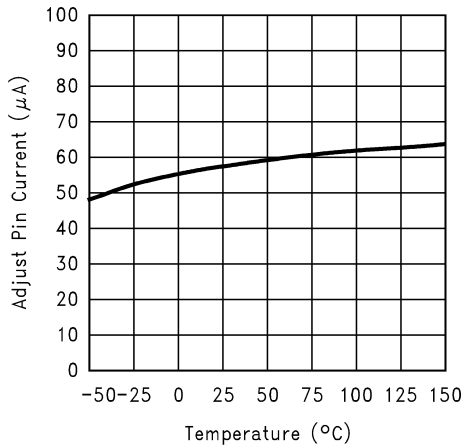


Figure 7-7. Adjust Pin Current

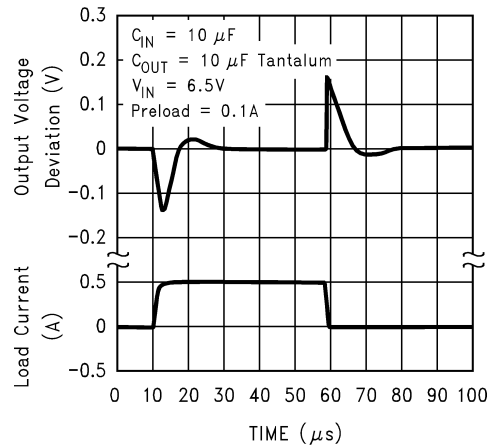


Figure 7-8. LM1117-5.0 Load Transient Response

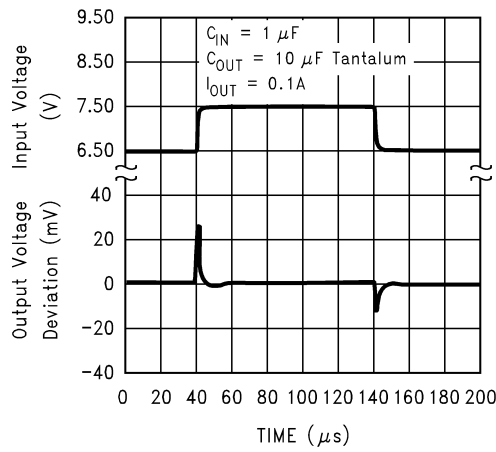


Figure 7-9. LM1117-5.0 Line Transient Response

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 since it is very small (60 μ A) 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.

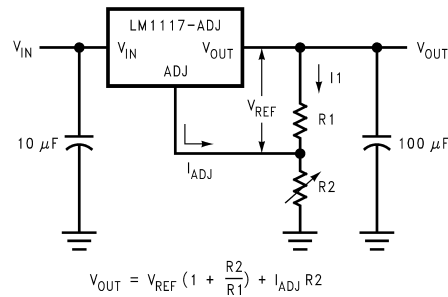
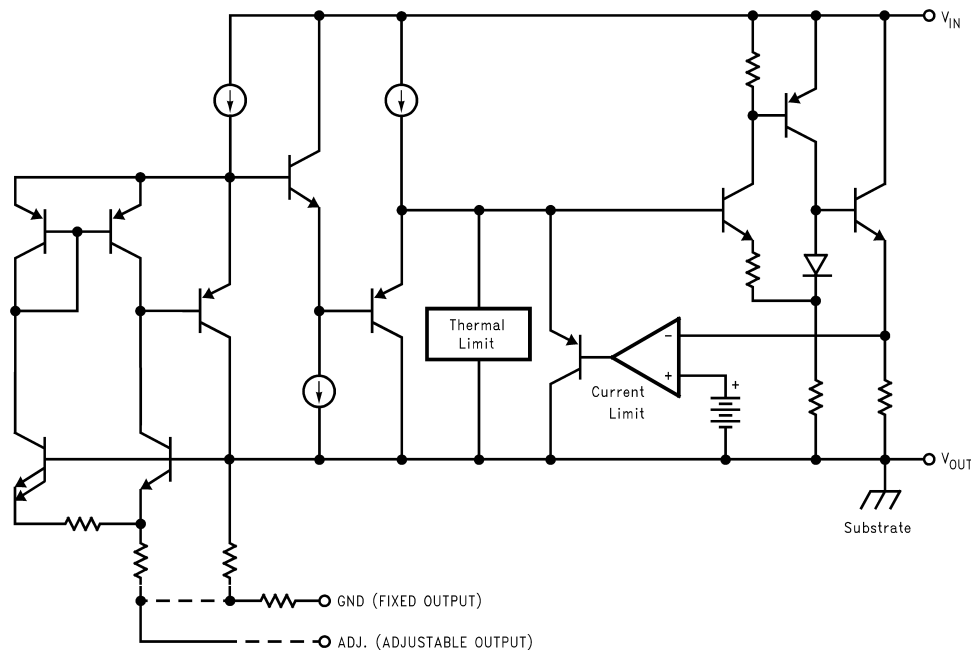


Figure 8-1. Basic Adjustable Regulator

8.2 Functional Block Diagram



8.3 Feature Description

8.3.1 Load Regulation

The LM1117 regulates the voltage that appears between its output and ground pins, or between its 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 shows a typical application using a fixed output regulator. The R_{t1} and R_{t2} are the line resistances. It is obvious that 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 seen at the R_{LOAD} would be degraded from the data sheet specification. To improve this, the load should be tied directly to the output terminal on the positive side and directly tied to the ground terminal on the negative side.

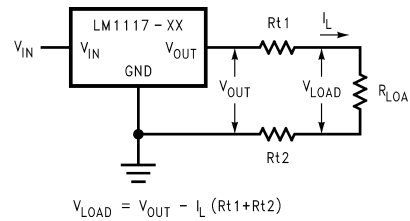


Figure 8-2. Typical Application Using Fixed Output Regulator

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 5V regulator with 0.05Ω resistance between the regulator and load will have a load regulation due to line resistance of 0.05Ω × I_L. If R1 (=125Ω) is connected near the load, the effective line resistance will be 0.05Ω (1+R2/R1) or in this case, it is 4 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.

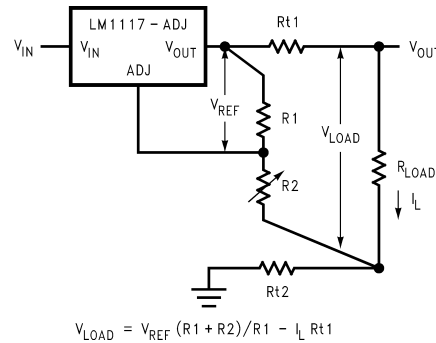


Figure 8-3. Best Load Regulation Using Adjustable Output Regulator

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 $\pm 25\text{V}$ 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 ($\geq 1000 \mu\text{F}$), 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](#).

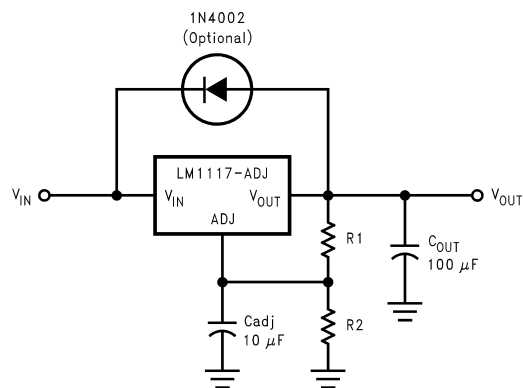


Figure 8-4. Regulator With Protection Diode

9 Application and Implementation

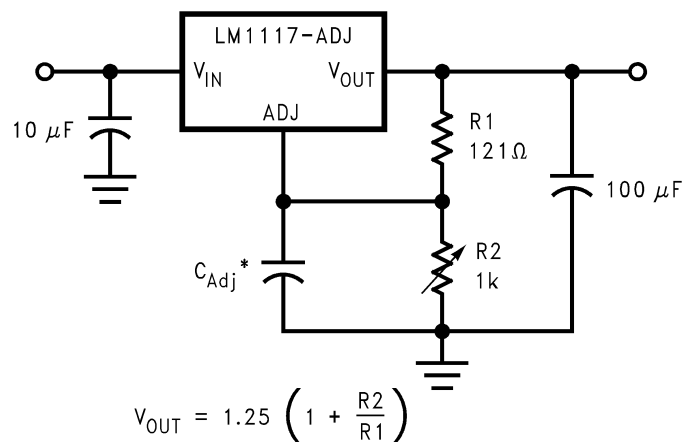
Note

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 its uses as a post regulator for DC/DC converters, battery chargers, and microprocessor supplies.

9.2 Typical Application



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

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 [Section 7.3](#) 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, refer to [Section 9.2.2.1](#).

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} should be less than R1 to prevent the ripple from being amplified:

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

The R1 is the resistor between the output and the adjust pin. Its value is normally in the range of 100-200Ω. For example, with R1 = 124Ω and $f_{\text{RIPPLE}} = 120\text{Hz}$, the C_{ADJ} should 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.

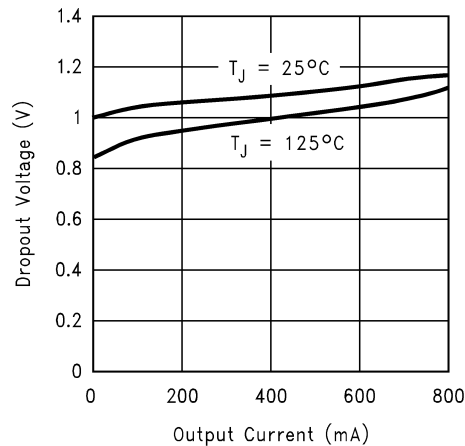
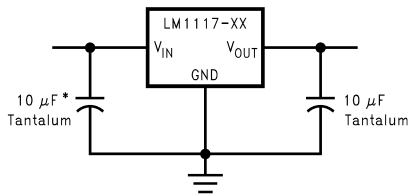


Figure 9-2. Dropout Voltage ($V_{\text{IN}} - V_{\text{OUT}}$)

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.



* Required if the regulator is located far from the power supply filter.

Figure 9-3. Fixed Output Regulator

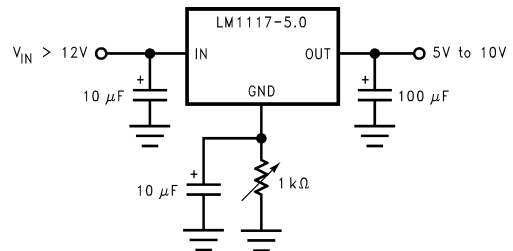


Figure 9-4. Adjusting Output of Fixed Regulators

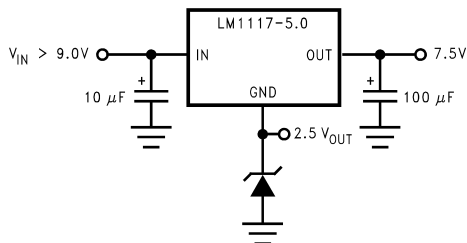
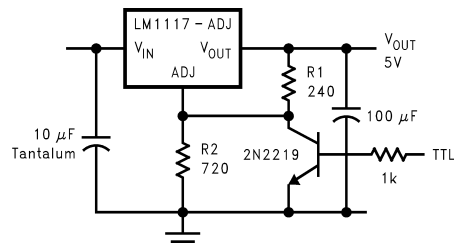
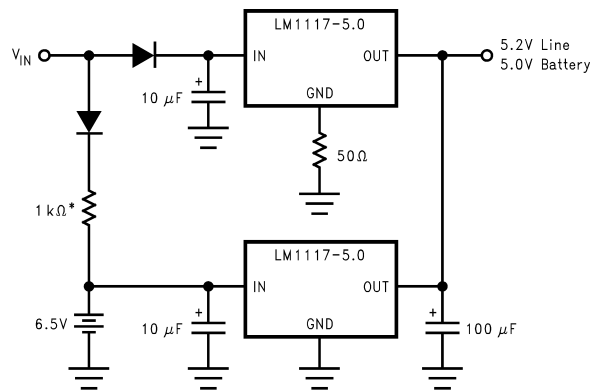


Figure 9-5. Regulator With Reference



* Min. output \approx 1.25V

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



* Select for charge rate.

Figure 9-7. Battery Backed-Up Regulated Supply

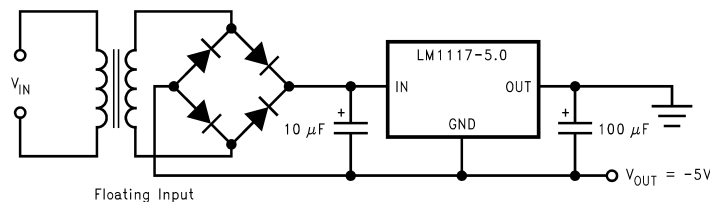


Figure 9-8. Low Dropout Negative Supply

10 Power Supply Recommendations

The input supply to the LM1117 must be kept at a voltage level such that its 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, refer to [Section 9.2.2.1](#).

11 Layout

11.1 Layout Guidelines

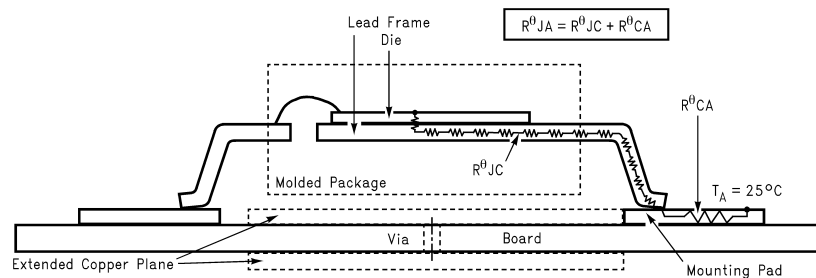
Some layout guidelines must be followed to ensure proper regulation of the output voltage with minimum noise. Traces carrying the load current must be wide to reduce the amount of parasitic trace inductance and the feedback loop from V_{OUT} to ADJ must be kept as short as possible. To improve PSRR, 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.

11.1.1 Heatsink Requirements

When an integrated circuit operates with an appreciable current, its junction temperature is elevated. It is important to quantify its thermal limits 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 11-1](#). 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 heatsink.

Table 11-1. Component and Application Variables

| $R_{\theta JC}$ (COMPONENT VARIABLES) | $R_{\theta JA}$ (APPLICATION VARIABLES) |
|---------------------------------------|---|
| Leadframe 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 11-1. 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 heatsink may be required depending on the maximum power dissipation and maximum ambient temperature of the application. To determine if a heatsink is needed, the power dissipated by the regulator, P_D , must be calculated:

$$I_{IN} = I_L + I_G \tag{2}$$

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

Figure 11-2 shows the voltages and currents which are present in the circuit.

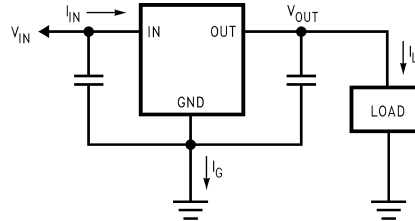


Figure 11-2. Power Dissipation Diagram

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

$$T_R(\max) = T_J(\max) - T_A(\max) \tag{4}$$

where

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

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

For the maximum allowable value for θ_{JA} , refer to the [Section 7.4](#) table.

As a design aid, [Table 11-2](#) shows the value of the θ_{JA} of SOT-223 and TO-252 for different heatsink area. [Figure 11-3](#) and [Figure 11-4](#) reflects the same test results as what are in the [Table 11-2](#)

[Figure 11-5](#) and [Figure 11-6](#) shows the maximum allowable power dissipation vs. ambient temperature for the SOT-223 and TO-252 device. [Figure 11-7](#) and [Figure 11-8](#) shows the maximum allowable power dissipation vs. copper area (in²) 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 11-2. $R_{\theta JA}$ Different Heatsink 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 11-2. $R_{\theta JA}$ Different Heatsink Area (continued)

| LAYOUT | COPPER AREA | | THERMAL RESISTANCE | |
|--------|-------------|--------|-----------------------|--------------------------|
| | Top | Bottom | $R_{\theta JA}$ (Top) | $R_{\theta JA}$ (Bottom) |
| 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

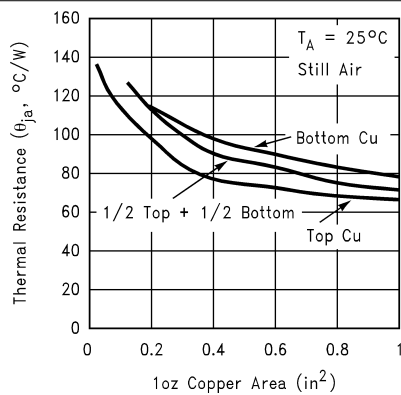


Figure 11-3. $R_{\theta JA}$ vs 1-oz Copper Area for SOT-223

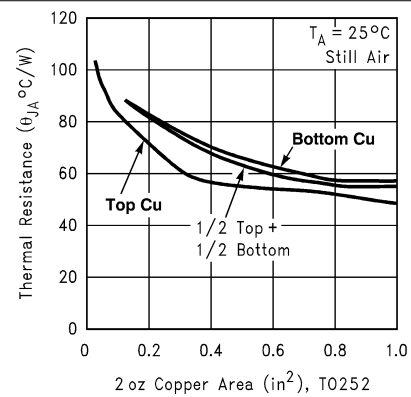


Figure 11-4. $R_{\theta JA}$ vs 2-oz Copper Area for TO-252

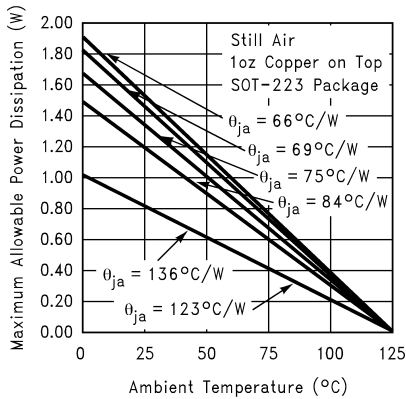


Figure 11-5. Maximum Allowable Power Dissipation vs Ambient Temperature for SOT-223

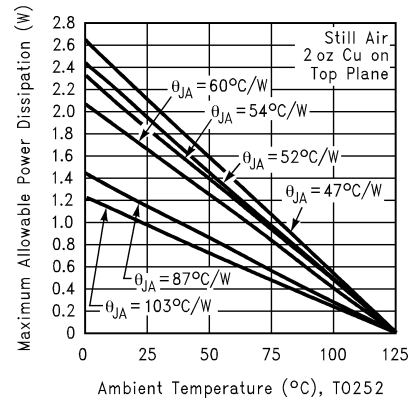


Figure 11-6. Maximum Allowable Power Dissipation vs Ambient Temperature for TO-252

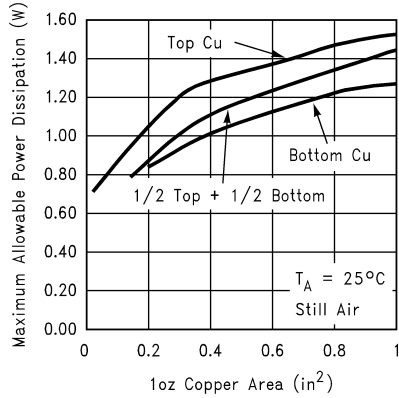


Figure 11-7. Maximum Allowable Power Dissipation vs 1-oz Copper Area for SOT-223

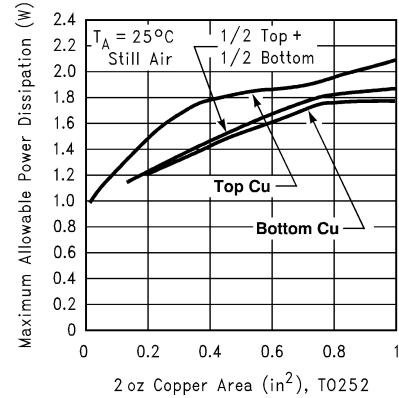


Figure 11-8. Maximum Allowable Power Dissipation vs 2-oz Copper Area for TO-252

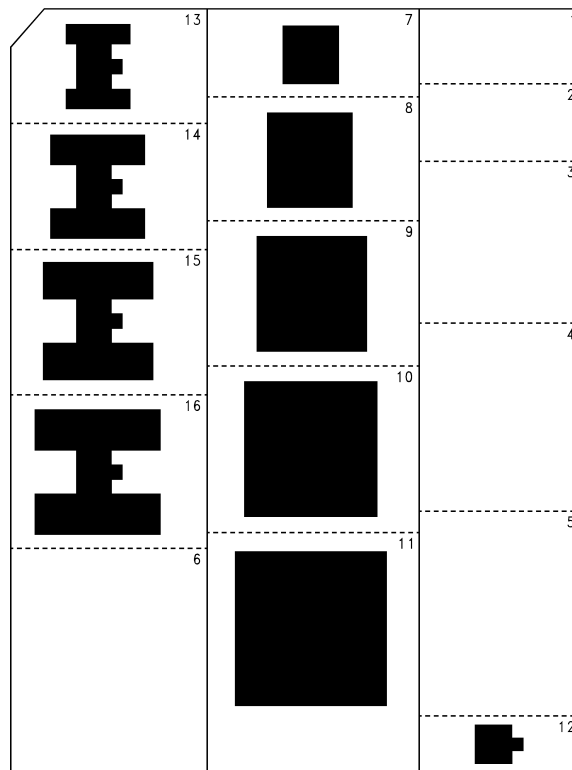


Figure 11-9. Top View of the Thermal Test Pattern in Actual Scale

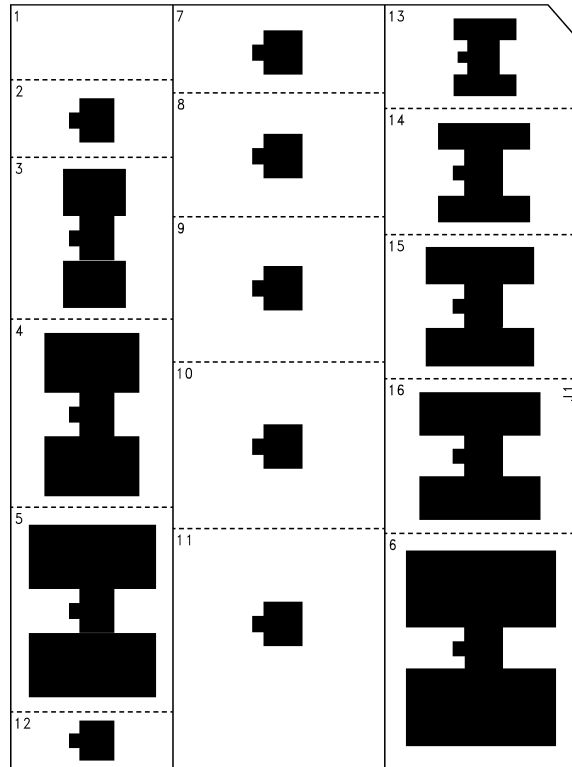


Figure 11-10. Bottom View of the Thermal Test Pattern in Actual Scale

11.2 Layout Example

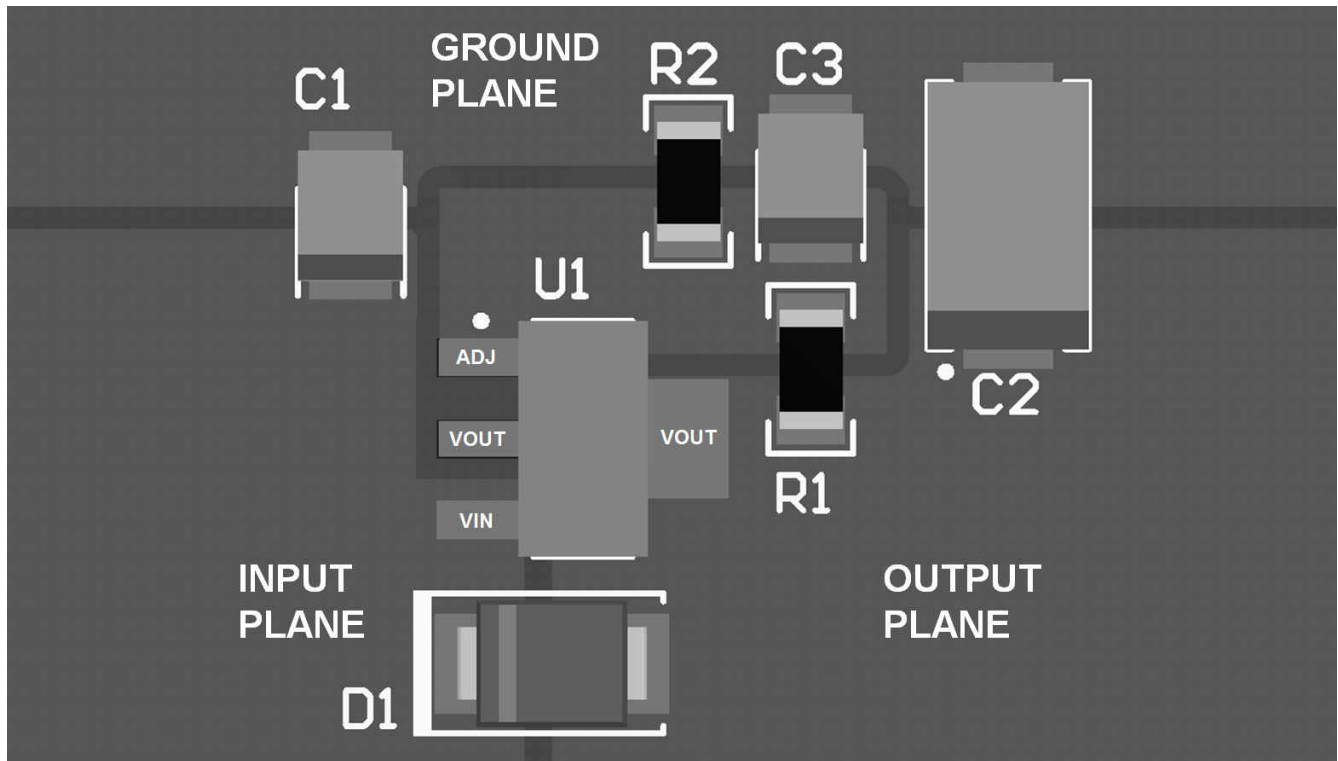


Figure 11-11. Layout Example (SOT-223)

12 Device and Documentation Support

12.1 Documentation Support

12.1.1 Related Documentation

For related documentation see the following:

Texas Instruments, [AN-1187 Leadless Leadframe Package \(LLP\) application note](#)

12.2 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.

12.3 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](#).

12.4 Trademarks

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All trademarks are the property of their respective owners.

12.5 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.

12.6 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

13 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 | ACTIVE | SOT-223 | DCY | 4 | 2000 | Non-RoHS & Green | Call TI | Level-1-260C-UNLIM | | N05A | Samples |
| 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.

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TAPE AND REEL INFORMATION

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 | 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 | 35.0 |
| LM1117DTX-2.5/NOPB | TO-252 | NDP | 3 | 2500 | 356.0 | 356.0 | 35.0 |
| LM1117DTX-3.3/NOPB | TO-252 | NDP | 3 | 2500 | 356.0 | 356.0 | 35.0 |
| LM1117DTX-5.0/NOPB | TO-252 | NDP | 3 | 2500 | 356.0 | 356.0 | 35.0 |
| LM1117DTX-ADJ/NOPB | TO-252 | NDP | 3 | 2500 | 356.0 | 356.0 | 35.0 |
| LM1117IDTX-3.3/NOPB | TO-252 | NDP | 3 | 2500 | 356.0 | 356.0 | 35.0 |
| LM1117IDTX-5.0/NOPB | TO-252 | NDP | 3 | 2500 | 356.0 | 356.0 | 35.0 |
| LM1117IDTX-ADJ/NOPB | TO-252 | NDP | 3 | 2500 | 356.0 | 356.0 | 35.0 |
| 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 |

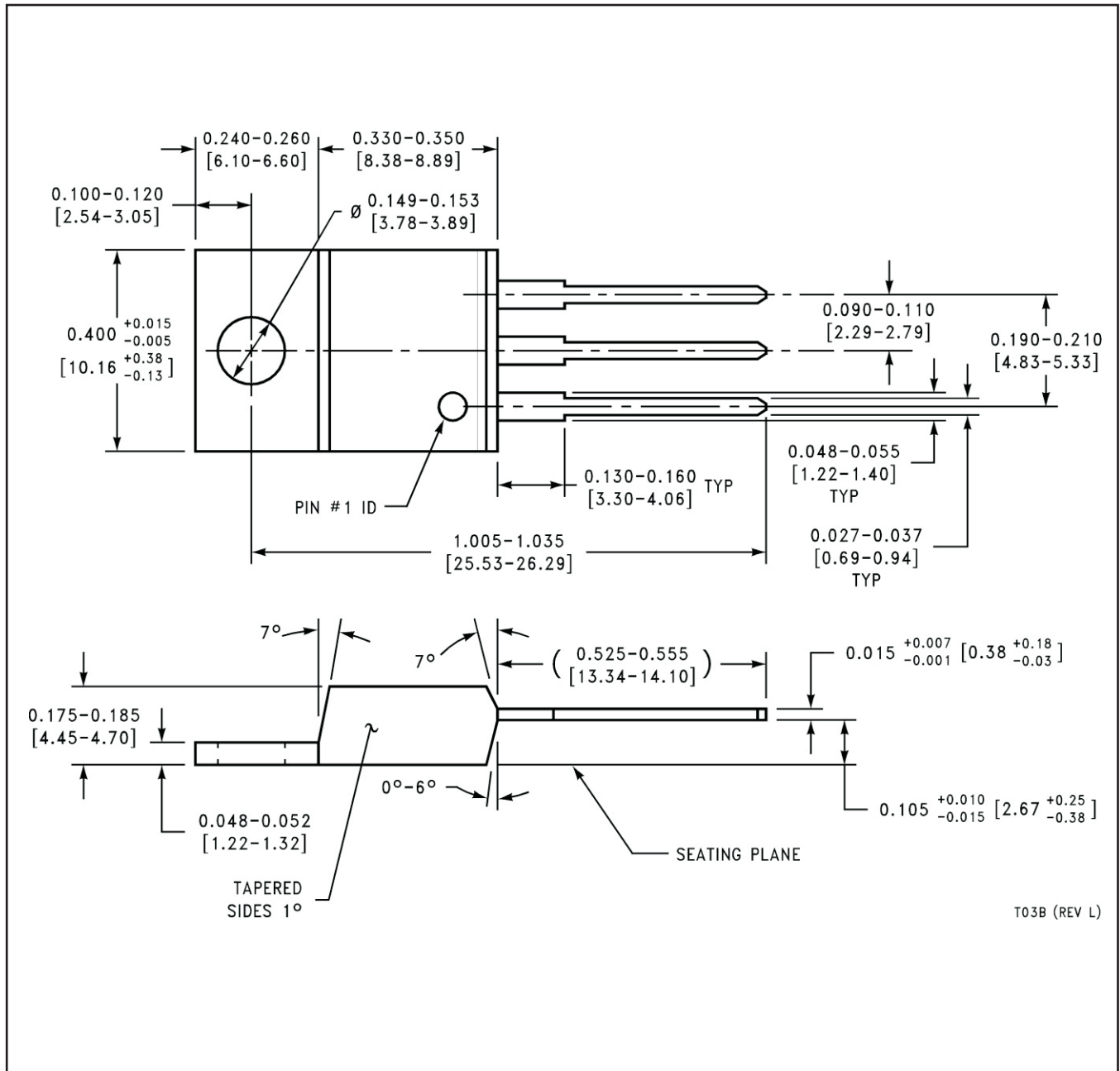
| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|--------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LM1117LD-ADJ/NOPB | WSON | NGN | 8 | 1000 | 208.0 | 191.0 | 35.0 |
| LM1117LDX-1.8/NOPB | WSON | NGN | 8 | 4500 | 356.0 | 356.0 | 35.0 |
| LM1117LDX-ADJ/NOPB | WSON | NGN | 8 | 4500 | 356.0 | 356.0 | 35.0 |
| 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 | 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 | 367.0 | 367.0 | 45.0 |
| LM1117SX-5.0/NOPB | DDPAK/TO-263 | KTT | 3 | 500 | 367.0 | 367.0 | 45.0 |
| LM1117SX-ADJ/NOPB | DDPAK/TO-263 | KTT | 3 | 500 | 367.0 | 367.0 | 45.0 |

TUBE

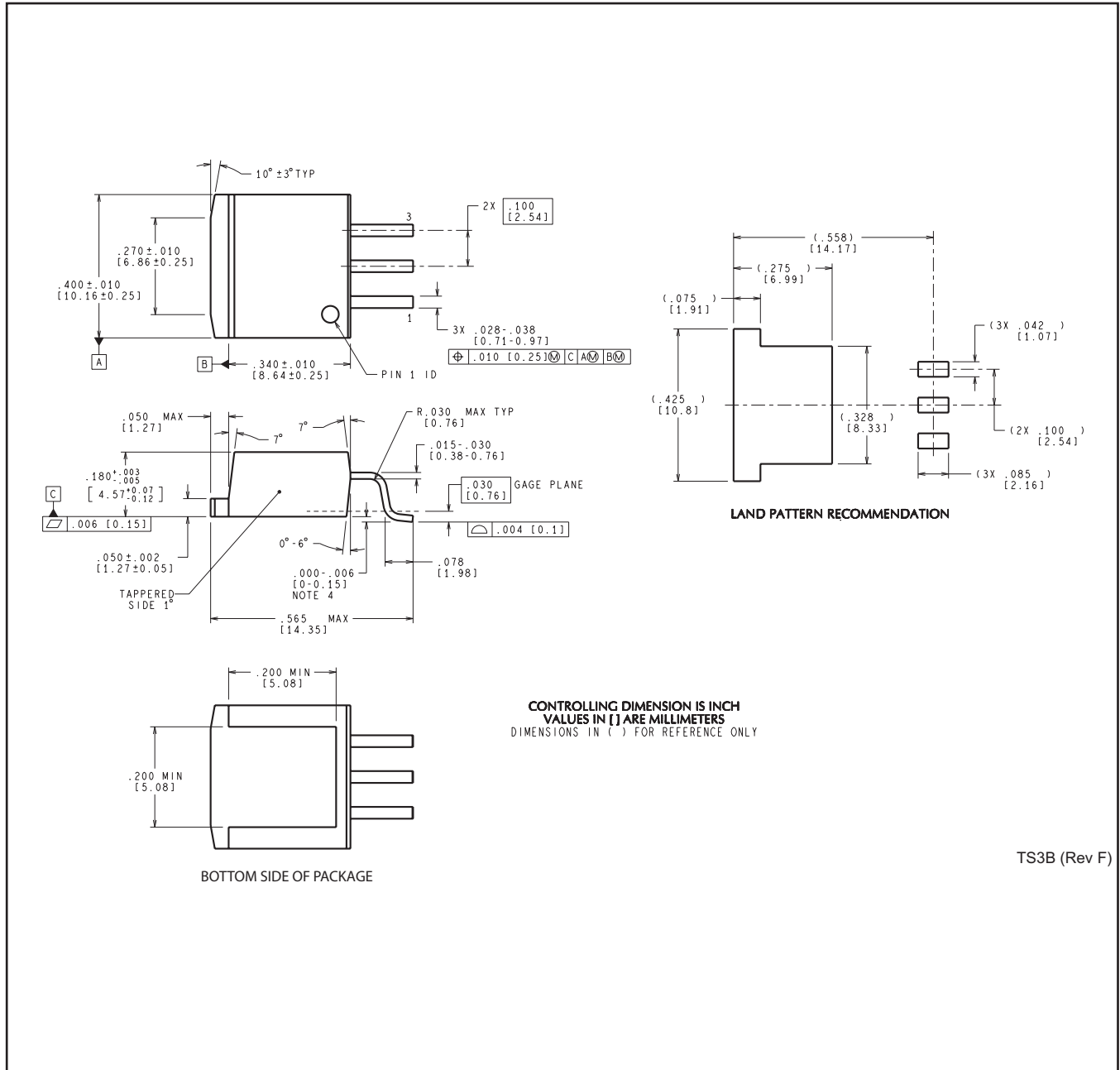

*All dimensions are nominal

| 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



KTT0003B



DCY (R-PDSO-G4)

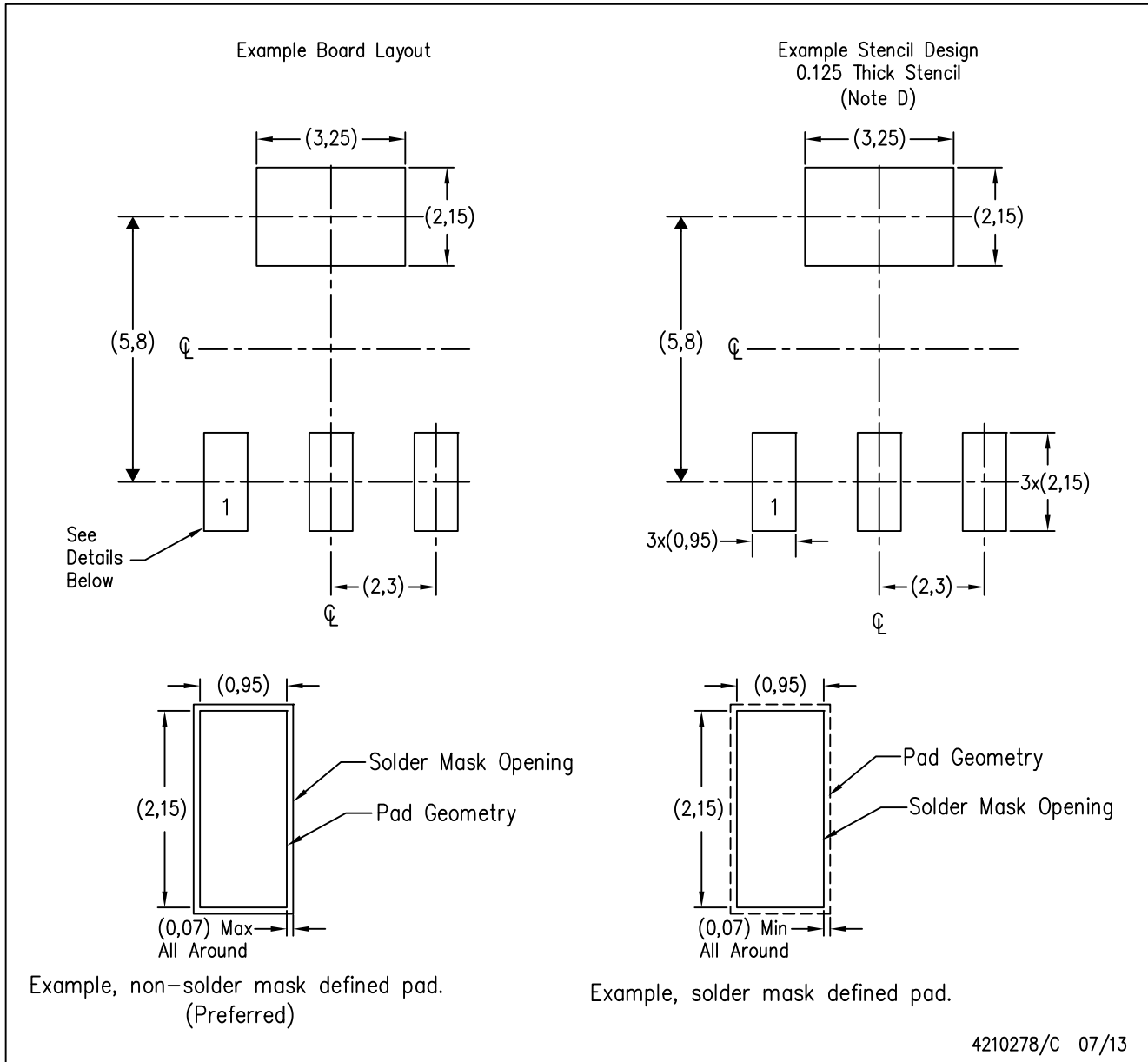
PLASTIC SMALL-OUTLINE



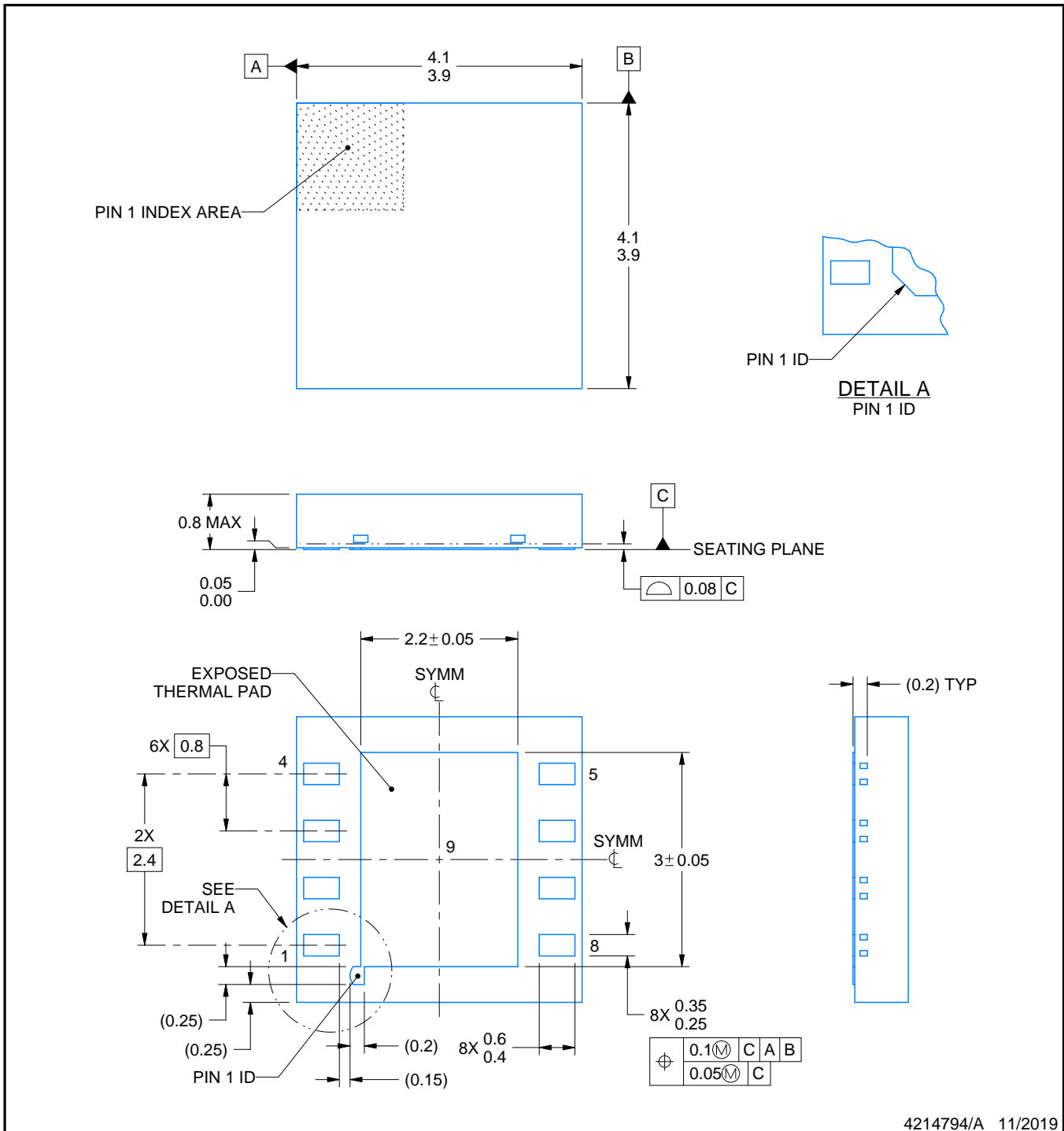
- NOTES: A. All linear dimensions are in millimeters (inches).
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion.
 D. Falls within JEDEC TO-261 Variation AA.

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.



4214794/A 11/2019

NOTES:

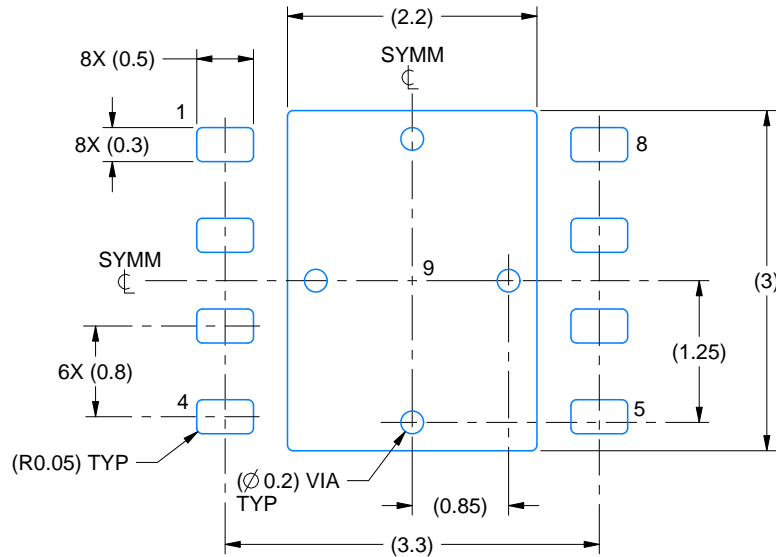
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

EXAMPLE BOARD LAYOUT

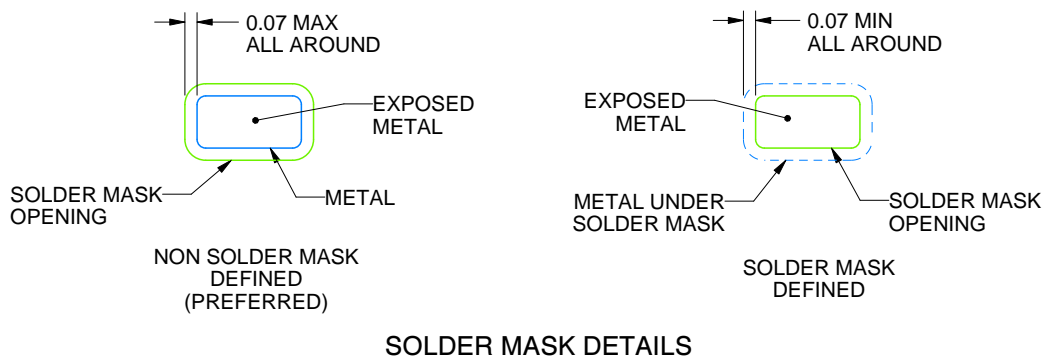
NGN0008A

WSON - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:15X



SOLDER MASK DETAILS

4214794/A 11/2019

NOTES: (continued)

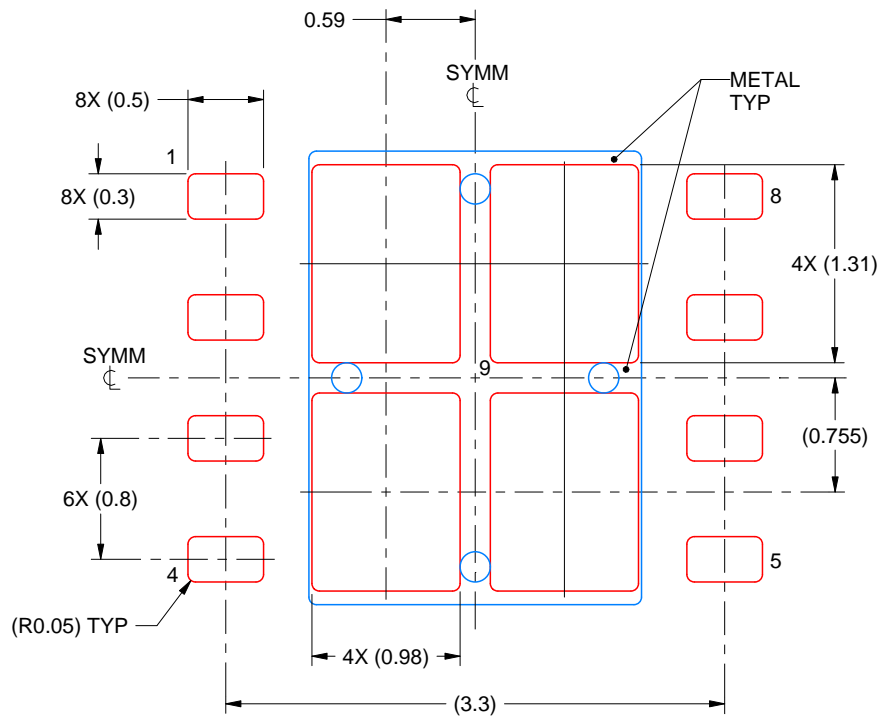
4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slue271).
5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

EXAMPLE STENCIL DESIGN

NGN0008A

WSON - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



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.

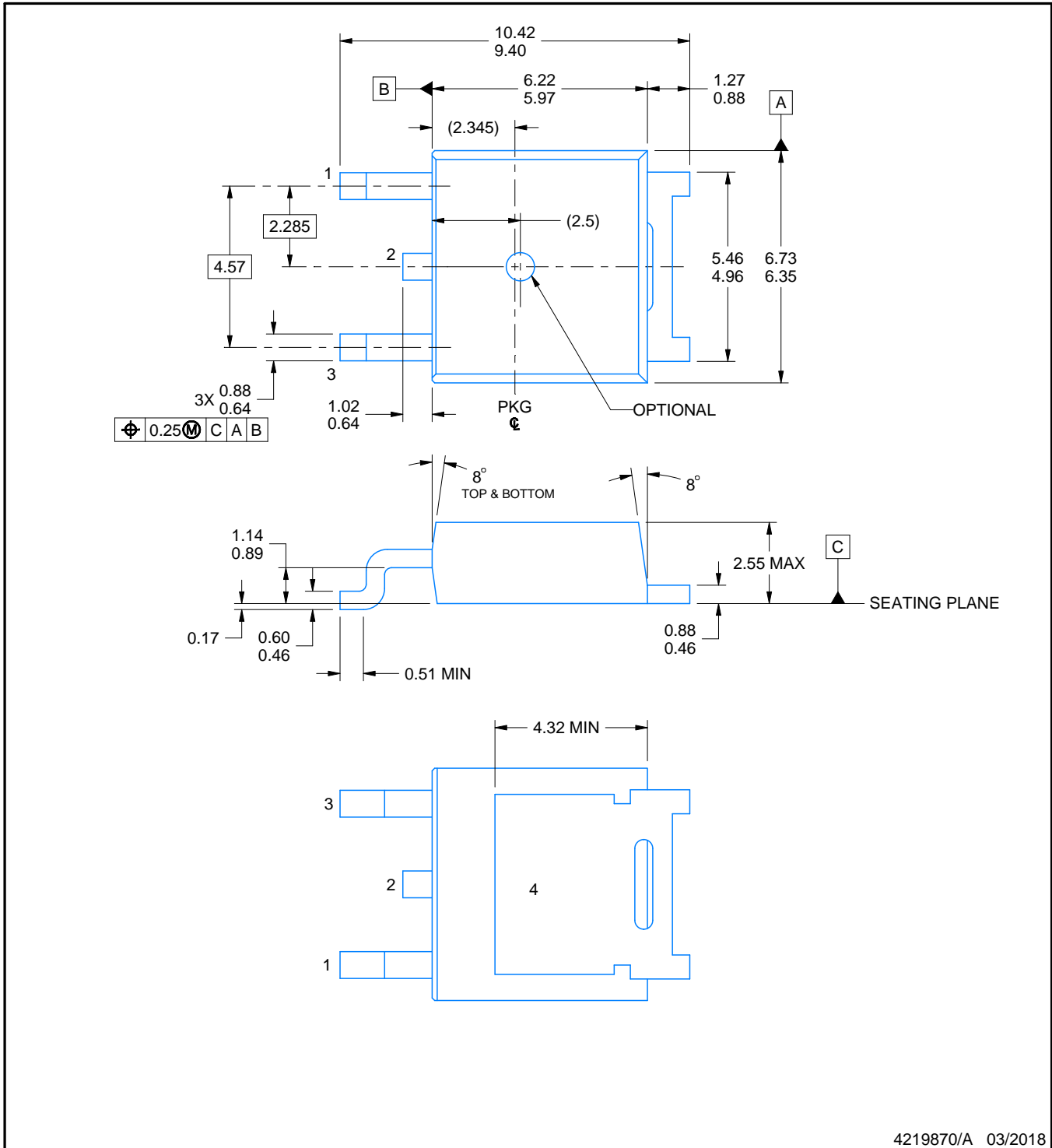
NDP0003B



PACKAGE OUTLINE

TO-252 - 2.55 mm max height

TRANSISTOR OUTLINE



4219870/A 03/2018

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.

EXAMPLE BOARD LAYOUT

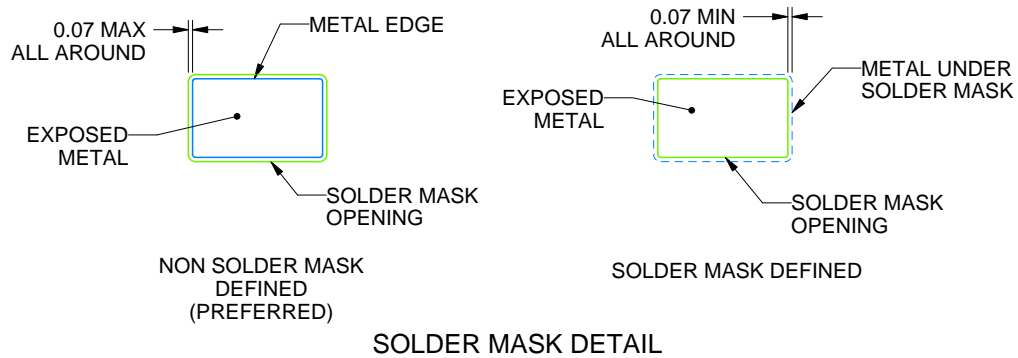
NDP0003B

TO-252 - 2.55 mm max height

TRANSISTOR OUTLINE



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.

EXAMPLE STENCIL DESIGN

NDP0003B

TO-252 - 2.55 mm max height

TRANSISTOR OUTLINE



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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