

## LM1117-N/LM1117I 800mA Low-Dropout Linear Regulator

Check for Samples: [LM1117-N](#), [LM1117I](#)

### FEATURES

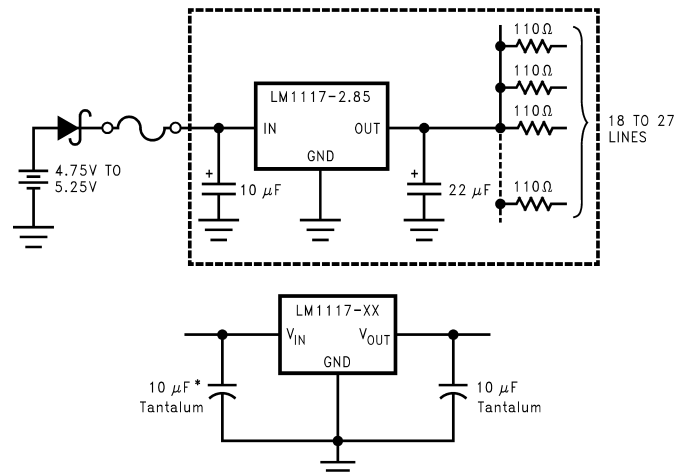
- Available in 1.8V, 2.5V, 2.85V, 3.3V, 5V, and Adjustable Versions
- Space Saving SOT-223 and WSON Packages
- Current Limiting and Thermal Protection
- Output Current 800mA
- Line Regulation 0.2% (Max)
- Load Regulation 0.4% (Max)
- Temperature Range
  - LM1117-N: 0°C to 125°C
  - LM1117I: –40°C to 125°C

### APPLICATIONS

- 2.85V Model for SCSI-2 Active Termination
- Post Regulator for Switching DC/DC Converter
- High Efficiency Linear Regulators
- Battery Charger
- Battery Powered Instrumentation

### TYPICAL APPLICATION

#### Active Terminator for SCSI-2 Bus



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

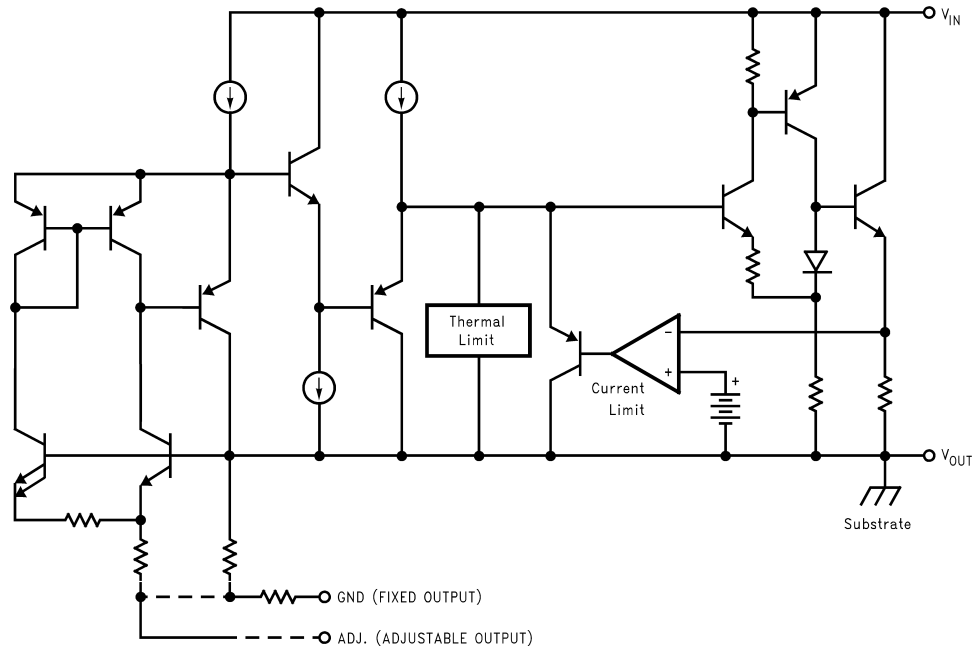
**Figure 1. Fixed Output Regulator**



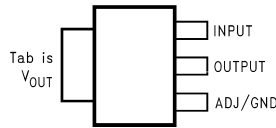
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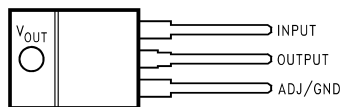
**Block Diagram**



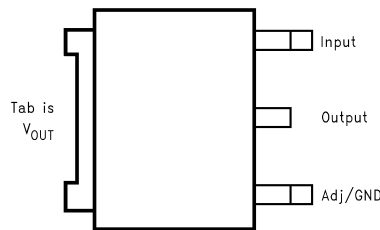
**Connection Diagrams**



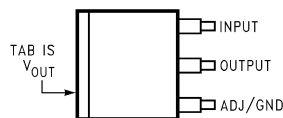
**Figure 2. SOT-223 Top View**



**Figure 3. TO-220 Top View**



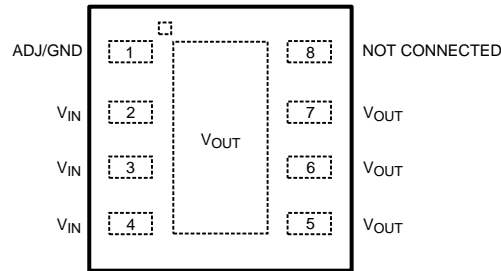
**Figure 4. PFM Top View**



**Figure 5. DDPAK/TO-263 Top View**



Figure 6. DDPAK/TO-263 Side View



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

Figure 7. WSON Top View



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

### ABSOLUTE MAXIMUM RATINGS<sup>(1)(2)</sup>

|   |                       |               |
|---|-----------------------|---------------|
| Maximum Input Voltage ( $V_{IN}$ to GND)      | 20V                   |               |
| Power Dissipation <sup>(3)</sup>              | Internally Limited    |               |
| Junction Temperature ( $T_J$ ) <sup>(3)</sup> | 150°C                 |               |
| Storage Temperature Range                     | -65°C to 150°C        |               |
| Lead Temperature                              | TO-220 (T) Package    | 260°C, 10 sec |
|   | SOT-223 (IMP) Package | 260°C, 4 sec  |
| ESD Tolerance <sup>(4)</sup>                  | 2000V                 |               |

- (1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not ensured. For ensured specifications and the test conditions, see the Electrical Characteristics.
- (2) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/Distributors for availability and specifications.
- (3) The maximum power dissipation is a function of  $T_{J(max)}$ ,  $\theta_{JA}$ , and  $T_A$ . The maximum allowable power dissipation at any ambient temperature is  $P_D = (T_{J(max)} - T_A) / \theta_{JA}$ . All numbers apply for packages soldered directly into a PC board.
- (4) For testing purposes, ESD was applied using human body model, 1.5k $\Omega$  in series with 100pF.

### OPERATING RATINGS<sup>(1)</sup>

|   |          |                |
|---|----------|----------------|
| Input Voltage ( $V_{IN}$ to GND)                    | 15V      |                |
| Junction Temperature Range ( $T_J$ ) <sup>(2)</sup> | LM1117-N | 0°C to 125°C   |
|   | LM1117I  | -40°C to 125°C |

- (1) Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not ensured. For ensured specifications and the test conditions, see the Electrical Characteristics.
- (2) The maximum power dissipation is a function of  $T_{J(max)}$ ,  $\theta_{JA}$ , and  $T_A$ . The maximum allowable power dissipation at any ambient temperature is  $P_D = (T_{J(max)} - T_A) / \theta_{JA}$ . All numbers apply for packages soldered directly into a PC board.

## LM1117-N ELECTRICAL CHARACTERISTICS

Typicals and limits appearing in normal type apply for  $T_J = 25^\circ\text{C}$ . Limits appearing in **Boldface** type apply over the entire junction temperature range for operation,  $0^\circ\text{C}$  to  $125^\circ\text{C}$ .

| Symbol                           | Parameter                      | Conditions   | Min <sup>(1)</sup> | Typ <sup>(2)</sup> | Max <sup>(1)</sup> | Units |
|----------------------------------|--------------------------------|--|--------------------|--------------------|--------------------|-------|
| $V_{\text{REF}}$                 | Reference Voltage              | LM1117-N-ADJ<br>$I_{\text{OUT}} = 10\text{mA}$ , $V_{\text{IN}} - V_{\text{OUT}} = 2\text{V}$ , $T_J = 25^\circ\text{C}$ | 1.238              | 1.250              | 1.262              | V     |
|                                  |                                | $10\text{mA} \leq I_{\text{OUT}} \leq 800\text{mA}$ , $1.4\text{V} \leq V_{\text{IN}} - V_{\text{OUT}} \leq 10\text{V}$  | <b>1.225</b>       | 1.250              | <b>1.270</b>       | V     |
| $V_{\text{OUT}}$                 | Output Voltage                 | LM1117-N-1.8<br>$I_{\text{OUT}} = 10\text{mA}$ , $V_{\text{IN}} = 3.8\text{V}$ , $T_J = 25^\circ\text{C}$                | 1.782              | 1.800              | 1.818              | V     |
|                                  |                                | $0 \leq I_{\text{OUT}} \leq 800\text{mA}$ , $3.2\text{V} \leq V_{\text{IN}} \leq 10\text{V}$                             | <b>1.746</b>       | 1.800              | <b>1.854</b>       | V     |
|                                  |                                | LM1117-N-2.5<br>$I_{\text{OUT}} = 10\text{mA}$ , $V_{\text{IN}} = 4.5\text{V}$ , $T_J = 25^\circ\text{C}$                | 2.475              | 2.500              | 2.525              | V     |
|                                  |                                | $0 \leq I_{\text{OUT}} \leq 800\text{mA}$ , $3.9\text{V} \leq V_{\text{IN}} \leq 10\text{V}$                             | <b>2.450</b>       | 2.500              | <b>2.550</b>       | V     |
|                                  |                                | LM1117-N-2.85<br>$I_{\text{OUT}} = 10\text{mA}$ , $V_{\text{IN}} = 4.85\text{V}$ , $T_J = 25^\circ\text{C}$              | 2.820              | 2.850              | 2.880              | V     |
|                                  |                                | $0 \leq I_{\text{OUT}} \leq 800\text{mA}$ , $4.25\text{V} \leq V_{\text{IN}} \leq 10\text{V}$                            | <b>2.790</b>       | 2.850              | <b>2.910</b>       | V     |
| $\Delta V_{\text{OUT}}$          | Line Regulation <sup>(3)</sup> | LM1117-N-ADJ<br>$I_{\text{OUT}} = 10\text{mA}$ , $1.5\text{V} \leq V_{\text{IN}} - V_{\text{OUT}} \leq 13.75\text{V}$    |                    | 0.035              | <b>0.2</b>         | %     |
|                                  |                                | LM1117-N-1.8<br>$I_{\text{OUT}} = 0\text{mA}$ , $3.2\text{V} \leq V_{\text{IN}} \leq 10\text{V}$                         |                    | 1                  | <b>6</b>           | mV    |
|                                  |                                | LM1117-N-2.5<br>$I_{\text{OUT}} = 0\text{mA}$ , $3.9\text{V} \leq V_{\text{IN}} \leq 10\text{V}$                         |                    | 1                  | <b>6</b>           | mV    |
|                                  |                                | LM1117-N-2.85<br>$I_{\text{OUT}} = 0\text{mA}$ , $4.25\text{V} \leq V_{\text{IN}} \leq 10\text{V}$                       |                    | 1                  | <b>6</b>           | mV    |
|                                  |                                | LM1117-N-3.3<br>$I_{\text{OUT}} = 0\text{mA}$ , $4.75\text{V} \leq V_{\text{IN}} \leq 15\text{V}$                        |                    | 1                  | <b>6</b>           | mV    |
|                                  |                                | LM1117-N-5.0<br>$I_{\text{OUT}} = 0\text{mA}$ , $6.5\text{V} \leq V_{\text{IN}} \leq 15\text{V}$                         |                    | 1                  | <b>10</b>          | mV    |
| $\Delta V_{\text{OUT}}$          | Load Regulation <sup>(3)</sup> | LM1117-N-ADJ<br>$V_{\text{IN}} - V_{\text{OUT}} = 3\text{V}$ , $10 \leq I_{\text{OUT}} \leq 800\text{mA}$                |                    | 0.2                | <b>0.4</b>         | %     |
|                                  |                                | LM1117-N-1.8<br>$V_{\text{IN}} = 3.2\text{V}$ , $0 \leq I_{\text{OUT}} \leq 800\text{mA}$                                |                    | 1                  | <b>10</b>          | mV    |
|                                  |                                | LM1117-N-2.5<br>$V_{\text{IN}} = 3.9\text{V}$ , $0 \leq I_{\text{OUT}} \leq 800\text{mA}$                                |                    | 1                  | <b>10</b>          | mV    |
|                                  |                                | LM1117-N-2.85<br>$V_{\text{IN}} = 4.25\text{V}$ , $0 \leq I_{\text{OUT}} \leq 800\text{mA}$                              |                    | 1                  | <b>10</b>          | mV    |
|                                  |                                | LM1117-N-3.3<br>$V_{\text{IN}} = 4.75\text{V}$ , $0 \leq I_{\text{OUT}} \leq 800\text{mA}$                               |                    | 1                  | <b>10</b>          | mV    |
|                                  |                                | LM1117-N-5.0<br>$V_{\text{IN}} = 6.5\text{V}$ , $0 \leq I_{\text{OUT}} \leq 800\text{mA}$                                |                    | 1                  | <b>15</b>          | mV    |
| $V_{\text{IN}} - V_{\text{OUT}}$ | Dropout Voltage <sup>(4)</sup> | $I_{\text{OUT}} = 100\text{mA}$  |                    | 1.10               | <b>1.20</b>        | V     |
|                                  |                                | $I_{\text{OUT}} = 500\text{mA}$  |                    | 1.15               | <b>1.25</b>        | V     |
|                                  |                                | $I_{\text{OUT}} = 800\text{mA}$  |                    | 1.20               | <b>1.30</b>        | V     |

(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 100mV from the nominal value obtained at  $V_{\text{IN}} = V_{\text{OUT}} + 1.5\text{V}$ .

**LM1117-N ELECTRICAL CHARACTERISTICS (continued)**

Typicals and limits appearing in normal type apply for  $T_J = 25^\circ\text{C}$ . Limits appearing in **Boldface** type apply over the entire junction temperature range for operation,  $0^\circ\text{C}$  to  $125^\circ\text{C}$ .

| Symbol   | Parameter                                   | Conditions   | Min <sup>(1)</sup> | Typ <sup>(2)</sup> | Max <sup>(1)</sup> | Units              |                    |
|--|---|--|--------------------|--------------------|--------------------|--------------------|--------------------|
| $I_{LIMIT}$  | Current Limit                               | $V_{IN}-V_{OUT} = 5V, T_J = 25^\circ\text{C}$                            | 800                | 1200               | 1500               | mA                 |                    |
|  | Minimum Load Current <sup>(5)</sup>         | LM1117-N-ADJ<br>$V_{IN} = 15V$   |                    | 1.7                | <b>5</b>           | mA                 |                    |
|  | Quiescent Current                           | LM1117-N-1.8<br>$V_{IN} \leq 15V$  |                    |                    | 5                  | <b>10</b>          | mA                 |
|  |   | LM1117-N-2.5<br>$V_{IN} \leq 15V$  |                    |                    | 5                  | <b>10</b>          | mA                 |
|  |   | LM1117-N-2.85<br>$V_{IN} \leq 10V$                                       |                    |                    | 5                  | <b>10</b>          | mA                 |
|  |   | LM1117-N-3.3<br>$V_{IN} \leq 15V$  |                    |                    | 5                  | <b>10</b>          | mA                 |
|  |   | LM1117-N-5.0<br>$V_{IN} \leq 15V$  |                    |                    | 5                  | <b>10</b>          | mA                 |
|  | Thermal Regulation                          | $T_A = 25^\circ\text{C}, 30\text{ms Pulse}$                              |                    |                    | 0.01               | 0.1                | %/W                |
|  | Ripple Regulation                           | $f_{RIPPLE} = 1\ 20\text{Hz}, V_{IN}-V_{OUT} = 3V, V_{RIPPLE} = 1V_{PP}$ | <b>60</b>          | 75                 |                    |                    | dB                 |
|  | Adjust Pin Current                          |  |                    | 60                 | <b>120</b>         |                    | $\mu\text{A}$      |
|  | Adjust Pin Current Change                   | $10 \leq I_{OUT} \leq 800\text{mA}, 1.4V \leq V_{IN}-V_{OUT} \leq 10V$   |                    | 0.2                | <b>5</b>           |                    | $\mu\text{A}$      |
|  | Temperature Stability                       |  |                    | 0.5                |                    |                    | %                  |
|  | Long Term Stability                         | $T_A = 125^\circ\text{C}, 1000\text{Hrs}$                                |                    |                    | 0.3                |                    | %                  |
|  | RMS Output Noise                            | (% of $V_{OUT}$ ), $10\text{Hz} \leq f \leq 10\text{kHz}$                |                    |                    | 0.003              |                    | %                  |
|  | Thermal Resistance Junction-to-Case         | 3-Lead SOT-223   |                    |                    | 15.0               |                    | $^\circ\text{C/W}$ |
|  |   | 3-Lead TO-220  |                    |                    | 3.0                |                    | $^\circ\text{C/W}$ |
| 3-Lead TO-263  |   |  |                    | 10                 |                    | $^\circ\text{C/W}$ |                    |
| Thermal Resistance Junction-to-Ambient (No air flow) | 3-Lead SOT-223 (No heat sink)               |  |                    | 136                |                    | $^\circ\text{C/W}$ |                    |
|  | 3-Lead TO-220 (No heat sink)                |  |                    | 79                 |                    | $^\circ\text{C/W}$ |                    |
|  | 3-Lead TO-263 <sup>(6)</sup> (No heat sink) |  |                    | 92                 |                    | $^\circ\text{C/W}$ |                    |
|  | 3-Lead PFM                                  |  |                    | 55                 |                    | $^\circ\text{C/W}$ |                    |
|  | 8-Lead WSON <sup>(7)</sup>                  |  |                    | 40                 |                    | $^\circ\text{C/W}$ |                    |

(5) The minimum output current required to maintain regulation.

(6) Minimum pad size of  $0.038\text{in}^2$

(7) Thermal Performance for the WSON was obtained using JESD51-7 board with six vias and an ambient temperature of  $22^\circ\text{C}$ . For information about improved thermal performance and power dissipation for the WSON, refer to Application Note AN-1187 ([SNOA401](#)).

**LM1117I ELECTRICAL CHARACTERISTICS**

Typicals and limits appearing in normal type apply for  $T_J = 25^\circ\text{C}$ . Limits appearing in **Boldface** type apply over the entire junction temperature range for operation,  $-40^\circ\text{C}$  to  $125^\circ\text{C}$ .

| Symbol    | Parameter         | Conditions  | Min <sup>(1)</sup> | Typ <sup>(2)</sup> | Max <sup>(1)</sup> | Units |
|-----------|-------------------|---|--------------------|--------------------|--------------------|-------|
| $V_{REF}$ | Reference Voltage | LM1117I-ADJ<br>$I_{OUT} = 10\text{mA}, V_{IN}-V_{OUT} = 2V, T_J = 25^\circ\text{C}$ | 1.238              | 1.250              | 1.262              | V     |
|           |                   | $10\text{mA} \leq I_{OUT} \leq 800\text{mA}, 1.4V \leq V_{IN}-V_{OUT} \leq 10V$     | <b>1.200</b>       | 1.250              | <b>1.290</b>       | V     |
| $V_{OUT}$ | Output Voltage    | LM1117I-3.3<br>$I_{OUT} = 10\text{mA}, V_{IN} = 5V, T_J = 25^\circ\text{C}$         | 3.267              | 3.300              | 3.333              | V     |
|           |                   | $0 \leq I_{OUT} \leq 800\text{mA}, 4.75V \leq V_{IN} \leq 10V$                      | <b>3.168</b>       | 3.300              | <b>3.432</b>       | V     |
| $V_{OUT}$ | Output Voltage    | LM1117I-5.0<br>$I_{OUT} = 10\text{mA}, V_{IN} = 7V, T_J = 25^\circ\text{C}$         | 4.950              | 5.000              | 5.050              | V     |
|           |                   | $0 \leq I_{OUT} \leq 800\text{mA}, 6.5V \leq V_{IN} \leq 12V$                       | <b>4.800</b>       | 5.000              | <b>5.200</b>       | V     |

(1) All limits are ensured by testing or statistical analysis.

(2) Typical Values represent the most likely parametric normal.

## LM1117I ELECTRICAL CHARACTERISTICS (continued)

Typicals and limits appearing in normal type apply for  $T_J = 25^\circ\text{C}$ . Limits appearing in **Boldface** type apply over the entire junction temperature range for operation,  $-40^\circ\text{C}$  to  $125^\circ\text{C}$ .

| Symbol  | Parameter                                   | Conditions   | Min <sup>(1)</sup> | Typ <sup>(2)</sup> | Max <sup>(1)</sup> | Units                     |                           |
|---|---|--|--------------------|--------------------|--------------------|---------------------------|---------------------------|
| $\Delta V_{\text{OUT}}$                             | Line Regulation <sup>(3)</sup>              | LM1117I-ADJ<br>$I_{\text{OUT}} = 10\text{mA}$ , $1.5\text{V} \leq V_{\text{IN}} - V_{\text{OUT}} \leq 13.75\text{V}$           |                    | 0.035              | <b>0.3</b>         | %                         |                           |
|   |   | LM1117I-3.3<br>$I_{\text{OUT}} = 0\text{mA}$ , $4.75\text{V} \leq V_{\text{IN}} \leq 15\text{V}$                               |                    | 1                  | <b>10</b>          | mV                        |                           |
|   |   | LM1117I-5.0<br>$I_{\text{OUT}} = 0\text{mA}$ , $6.5\text{V} \leq V_{\text{IN}} \leq 15\text{V}$                                |                    | 1                  | <b>15</b>          | mV                        |                           |
| $\Delta V_{\text{OUT}}$                             | Load Regulation <sup>(3)</sup>              | LM1117I-ADJ<br>$V_{\text{IN}} - V_{\text{OUT}} = 3\text{V}$ , $10 \leq I_{\text{OUT}} \leq 800\text{mA}$                       |                    | 0.2                | <b>0.5</b>         | %                         |                           |
|   |   | LM1117I-3.3<br>$V_{\text{IN}} = 4.75\text{V}$ , $0 \leq I_{\text{OUT}} \leq 800\text{mA}$                                      |                    | 1                  | <b>15</b>          | mV                        |                           |
|   |   | LM1117I-5.0<br>$V_{\text{IN}} = 6.5\text{V}$ , $0 \leq I_{\text{OUT}} \leq 800\text{mA}$                                       |                    | 1                  | <b>20</b>          | mV                        |                           |
| $V_{\text{IN}} - V_{\text{OUT}}$                    | Dropout Voltage <sup>(4)</sup>              | $I_{\text{OUT}} = 100\text{mA}$  |                    | 1.10               | <b>1.30</b>        | V                         |                           |
|   |   | $I_{\text{OUT}} = 500\text{mA}$  |                    | 1.15               | <b>1.35</b>        | V                         |                           |
|   |   | $I_{\text{OUT}} = 800\text{mA}$  |                    | 1.20               | <b>1.40</b>        | V                         |                           |
| $I_{\text{LIMIT}}$                                  | Current Limit                               | $V_{\text{IN}} - V_{\text{OUT}} = 5\text{V}$ , $T_J = 25^\circ\text{C}$  | 800                | 1200               | 1500               | mA                        |                           |
|   | Minimum Load Current <sup>(5)</sup>         | LM1117I-ADJ<br>$V_{\text{IN}} = 15\text{V}$  |                    | 1.7                | <b>5</b>           | mA                        |                           |
|   | Quiescent Current                           | LM1117I-3.3<br>$V_{\text{IN}} \leq 15\text{V}$   |                    | 5                  | <b>15</b>          | mA                        |                           |
|   |   | LM1117I-5.0<br>$V_{\text{IN}} \leq 15\text{V}$   |                    | 5                  | <b>15</b>          | mA                        |                           |
|   | Thermal Regulation                          | $T_A = 25^\circ\text{C}$ , 30ms Pulse  |                    | 0.01               | 0.1                | %/W                       |                           |
|   | Ripple Regulation                           | $f_{\text{RIPPLE}} = 1\text{ 20Hz}$ , $V_{\text{IN}} - V_{\text{OUT}} = 3\text{V}$ $V_{\text{RIPPLE}} = 1\text{V}_{\text{PP}}$ | <b>60</b>          | 75                 |                    | dB                        |                           |
|   | Adjust Pin Current                          |  |                    | 60                 | <b>120</b>         | $\mu\text{A}$             |                           |
|   | Adjust Pin Current Change                   | $10 \leq I_{\text{OUT}} \leq 800\text{mA}$ ,<br>$1.4\text{V} \leq V_{\text{IN}} - V_{\text{OUT}} \leq 10\text{V}$              |                    | 0.2                | <b>10</b>          | $\mu\text{A}$             |                           |
|   | Temperature Stability                       |  |                    | 0.5                |                    | %                         |                           |
|   | Long Term Stability                         | $T_A = 125^\circ\text{C}$ , 1000Hrs  |                    | 0.3                |                    | %                         |                           |
|   | RMS Output Noise                            | (% of $V_{\text{OUT}}$ ), $10\text{Hz} \leq f \leq 10\text{kHz}$   |                    | 0.003              |                    | %                         |                           |
|   | Thermal Resistance Junction-to-Case         | 3-Lead SOT-223   |                    |                    | 15.0               |                           | $^\circ\text{C}/\text{W}$ |
|   |   | 3-Lead TO-263  |                    |                    | 10                 |                           | $^\circ\text{C}/\text{W}$ |
| Thermal Resistance Junction-to-Ambient No air flow) | 3-Lead SOT-223 (No heat sink)               |  |                    | 136                |                    | $^\circ\text{C}/\text{W}$ |                           |
|   | 3-Lead TO-263 (No heat sink) <sup>(6)</sup> |  |                    | 92                 |                    | $^\circ\text{C}/\text{W}$ |                           |
|   | 8-Lead WSON <sup>(7)</sup>                  |  |                    | 40                 |                    | $^\circ\text{C}/\text{W}$ |                           |

(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 100mV from the nominal value obtained at  $V_{\text{IN}} = V_{\text{OUT}} + 1.5\text{V}$ .

(5) The minimum output current required to maintain regulation.

(6) Minimum pad size of  $0.038\text{in}^2$

(7) Thermal Performance for the WSON was obtained using JESD51-7 board with six vias and an ambient temperature of  $22^\circ\text{C}$ . For information about improved thermal performance and power dissipation for the WSON, refer to Application Note AN-1187 ([SNOA401](#)).

TYPICAL PERFORMANCE CHARACTERISTICS

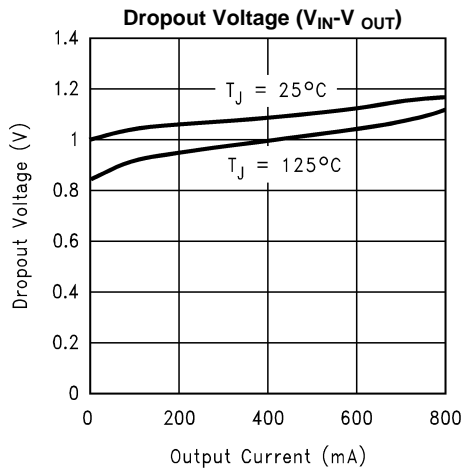


Figure 8.

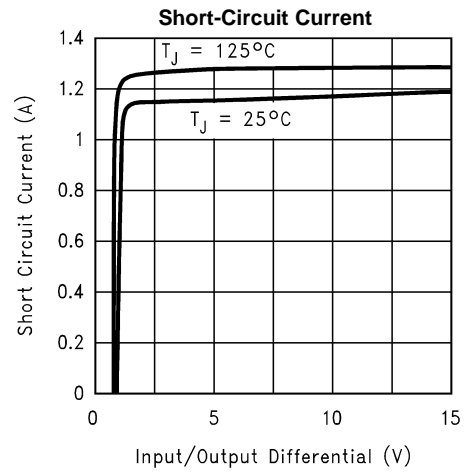


Figure 9.

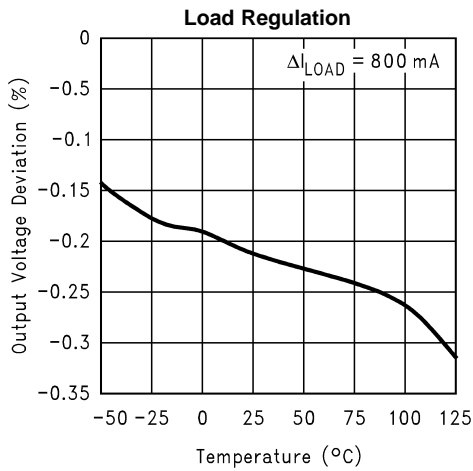


Figure 10.

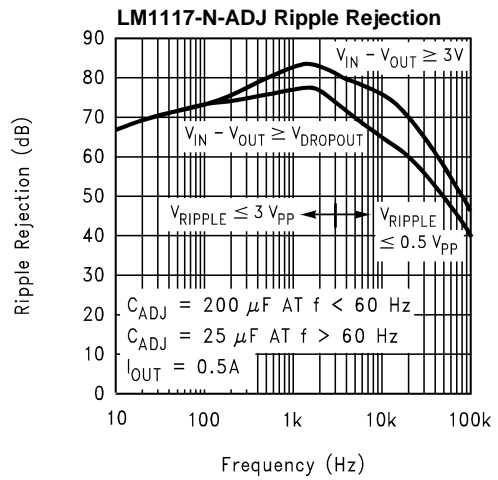


Figure 11.

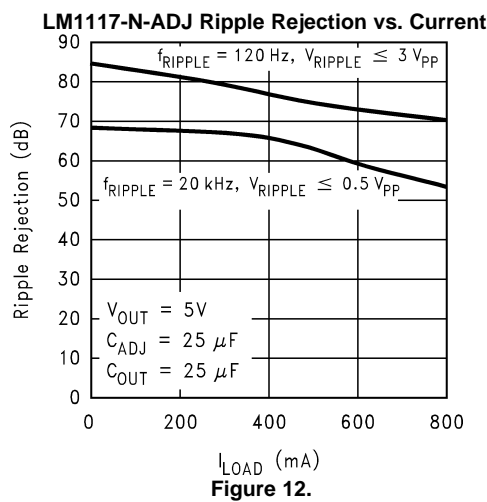


Figure 12.

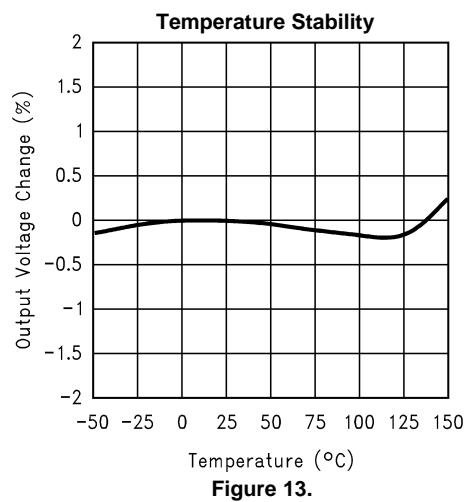


Figure 13.

**TYPICAL PERFORMANCE CHARACTERISTICS (continued)**

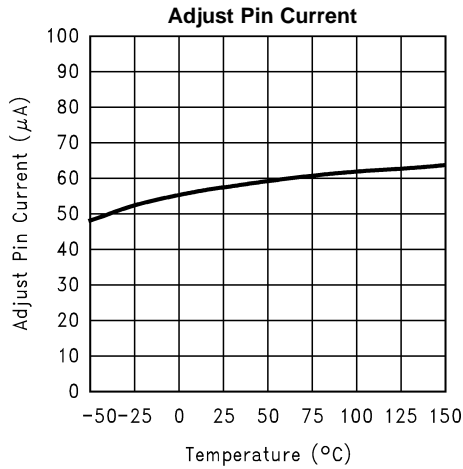


Figure 14.

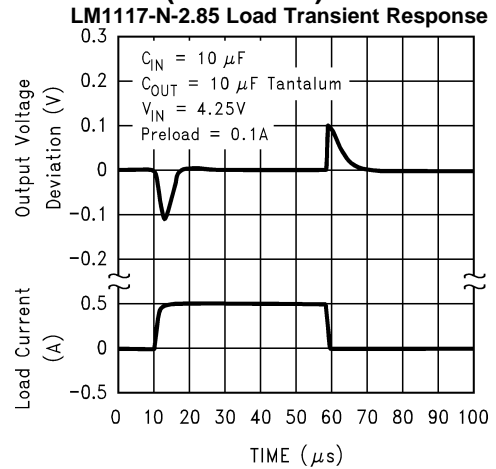


Figure 15.

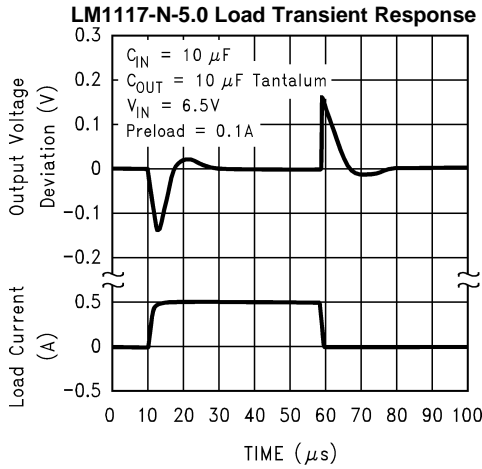


Figure 16.

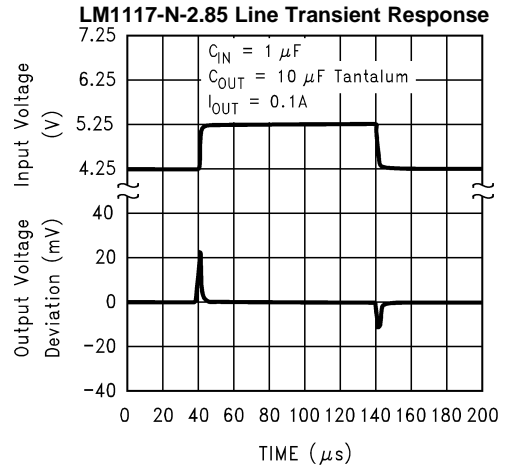


Figure 17.

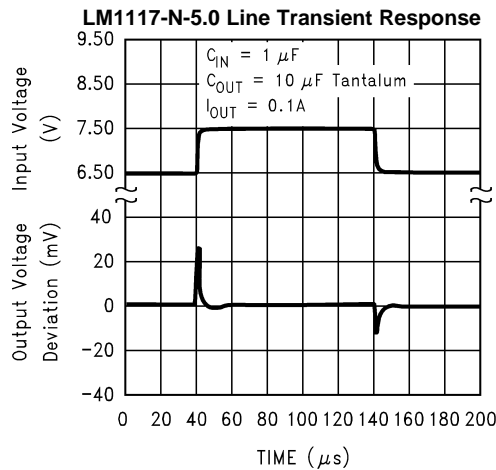


Figure 18.



## APPLICATION INFORMATION

### EXTERNAL CAPACITORS/STABILITY

#### Input Bypass Capacitor

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

#### 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:

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

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  $R1 = 124\Omega$  and  $f_{RIPPLE} = 120\text{Hz}$ , the  $C_{ADJ}$  should be  $> 11\mu\text{F}$ .

#### Output Capacitor

The output capacitor is critical in maintaining regulator stability, and must meet the required conditions for both minimum amount of capacitance and ESR (Equivalent Series Resistance). The minimum output capacitance required by the LM1117-N is 10µF, 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 0.3Ω - 22Ω. In the case of the adjustable regulator, when the  $C_{ADJ}$  is used, a larger output capacitance (22µF tantalum) is required.

### OUTPUT VOLTAGE

The LM1117-N adjustable version develops a 1.25V reference voltage,  $V_{REF}$ , between the output and the adjust terminal. As shown in Figure 19, this voltage is applied across resistor  $R1$  to generate a constant current  $I1$ . The current  $I_{ADJ}$  from the adjust terminal could introduce error to the output. But since it is very small (60µA) compared with 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.

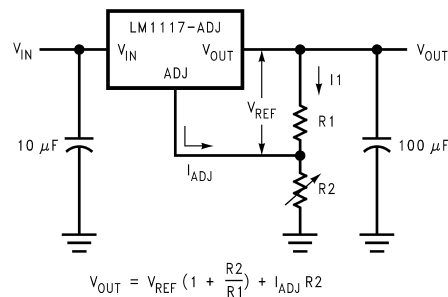
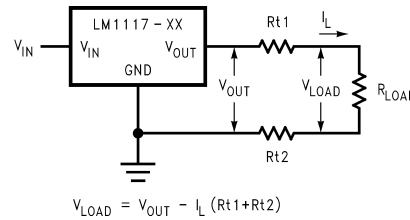


Figure 19. Basic Adjustable Regulator

### LOAD REGULATION

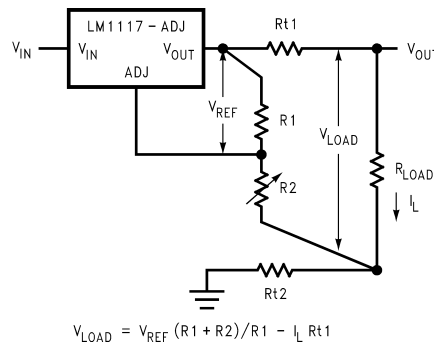
The LM1117-N regulates the voltage that appears between its output and ground pins, or between its output and adjust pins. In some cases, line resistances can introduce errors to the voltage across the load. To obtain the best load regulation, a few precautions are needed.

Figure 20, 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 20. Typical Application using Fixed Output Regulator**

When the adjustable regulator is used (Figure 21), 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<sub>L</sub>. 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 21. Best Load Regulation using Adjustable Output Regulator**

## PROTECTION DIODES

Under normal operation, the LM1117-N 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<sub>IN</sub>. In the LM1117-N 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 22.

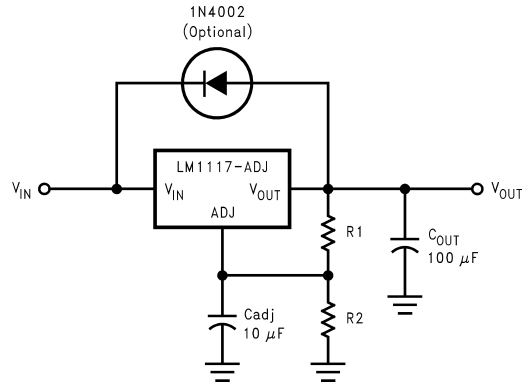
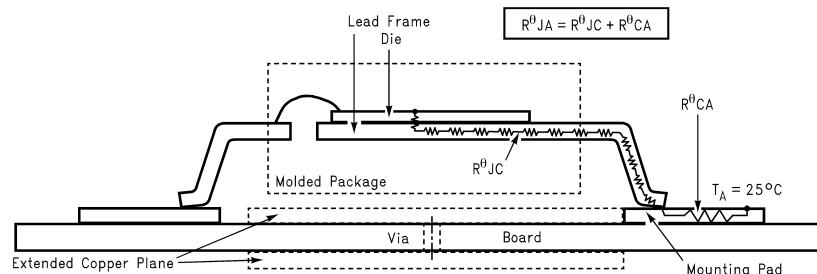


Figure 22. Regulator with Protection Diode

### 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 23. 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.

| $R\theta_{JC}$ (Component Variables) | $R\theta_{CA}$ (Application Variables)  |
|--------------------------------------|---|
| Leadframe Size & Material            | Mounting Pad Size, Material, & Location |
| No. of Conduction Pins               | Placement of Mounting Pad               |
| Die Size                             | PCB Size & Material                     |
| Die Attach Material                  | Traces Length & 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

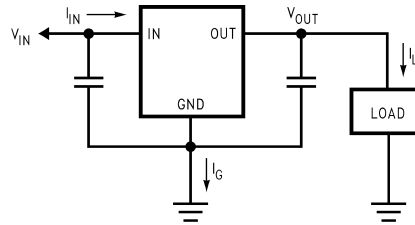
Figure 23. Cross-Sectional View of Integrated Circuit Mounted on a Printed Circuit Board

The LM1117-N regulators have internal thermal shutdown to protect the device from over-heating. Under all possible operating conditions, the junction temperature of the LM1117-N 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:

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

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

Figure 24 shows the voltages and currents which are present in the circuit.



**Figure 24. Power Dissipation Diagram**

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

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

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 ( $\theta_{JA}$ ) can be calculated:

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

If the maximum allowable value for  $\theta_{JA}$  is found to be  $\geq 136^\circ\text{C/W}$  for PFM package or  $\geq 79^\circ\text{C/W}$  for TO-220 package or  $\geq 92^\circ\text{C/W}$  for TO-263 package, no heatsink is needed since the package alone will dissipate enough heat to satisfy these requirements. If the calculated value for  $\theta_{JA}$  falls below these limits, a heatsink is required.

As a design aid, Table 1 shows the value of the  $\theta_{JA}$  of SOT-223 and PFM for different heatsink area. The copper patterns that we used to measure these  $\theta_{JA}$ s are shown at the end of APPLICATION INFORMATION. Figure 25 and Figure 26 reflects the same test results as what are in the Table 1

Figure 27 and Figure 28 shows the maximum allowable power dissipation vs. ambient temperature for the SOT-223 and PFM device. Figure 29 and Figure 30 shows the maximum allowable power dissipation vs. copper area ( $\text{in}^2$ ) for the SOT-223 and PFM devices. Please see AN1028 for power enhancement techniques to be used with SOT-223 and PFM packages.

Application Note AN-1187 (SNOA401) discusses improved thermal performance and power dissipation for the WSON.

**Table 1.  $\theta_{JA}$  Different Heatsink Area**

| Layout | Copper Area                               |                               | Thermal Resistance              |                             |
|--------|---|-------------------------------|---------------------------------|-----------------------------|
|        | Top Side ( $\text{in}^2$ ) <sup>(1)</sup> | Bottom Side ( $\text{in}^2$ ) | ( $\theta_{JA}$ , °C/W) SOT-223 | ( $\theta_{JA}$ , °C/W) PFM |
| 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                          |
| 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                          |

(1) Tab of device attached to topside copper

Table 1.  $\theta_{JA}$  Different Heatsink Area (continued)

| Layout | Copper Area |       | Thermal Resistance |    |
|--------|-------------|-------|--------------------|----|
|        |             |       |                    |    |
| 14     | 0.284       | 0.284 | 83                 | 61 |
| 15     | 0.392       | 0.392 | 75                 | 55 |
| 16     | 0.5         | 0.5   | 70                 | 53 |

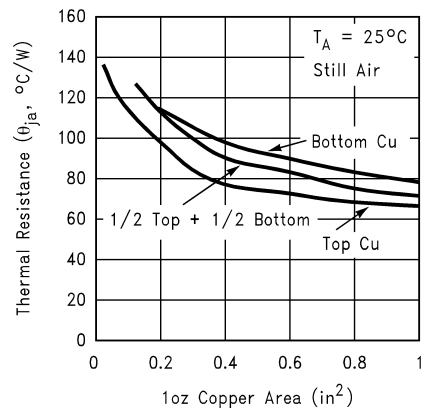


Figure 25.  $\theta_{JA}$  vs. 1oz Copper Area for SOT-223

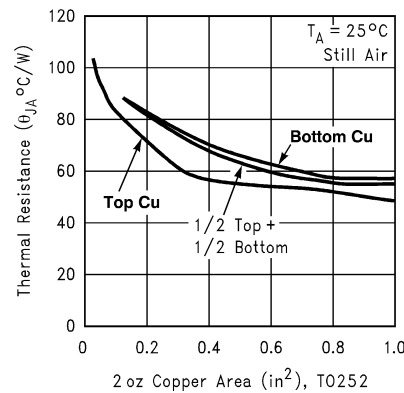


Figure 26.  $\theta_{JA}$  vs. 2oz Copper Area for PFM

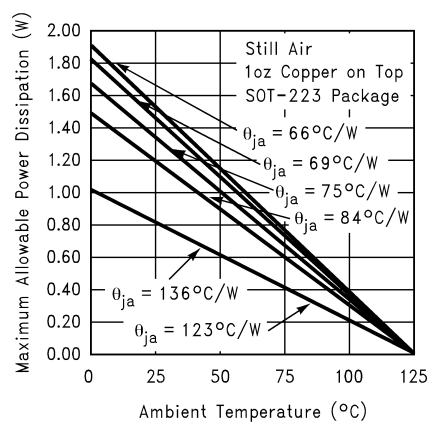


Figure 27. Maximum Allowable Power Dissipation vs. Ambient Temperature for SOT-223

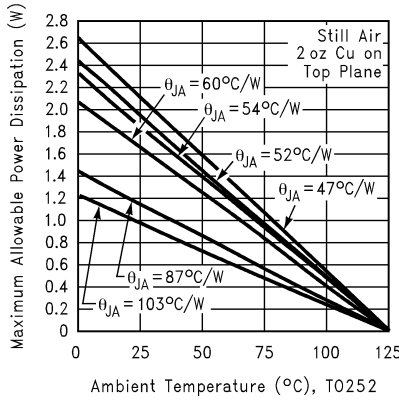


Figure 28. Maximum Allowable Power Dissipation vs. Ambient Temperature for PFM

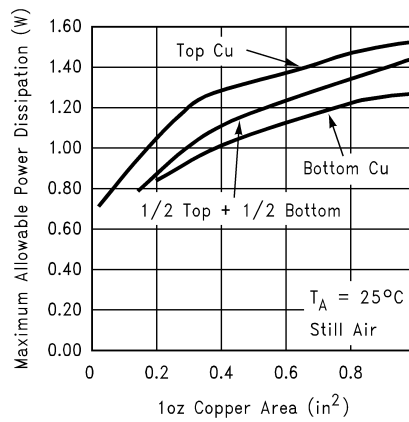


Figure 29. Maximum Allowable Power Dissipation vs. 1oz Copper Area for SOT-223

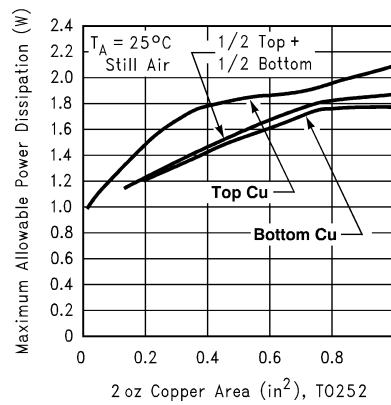


Figure 30. Maximum Allowable Power Dissipation vs. 2oz Copper Area for PFM

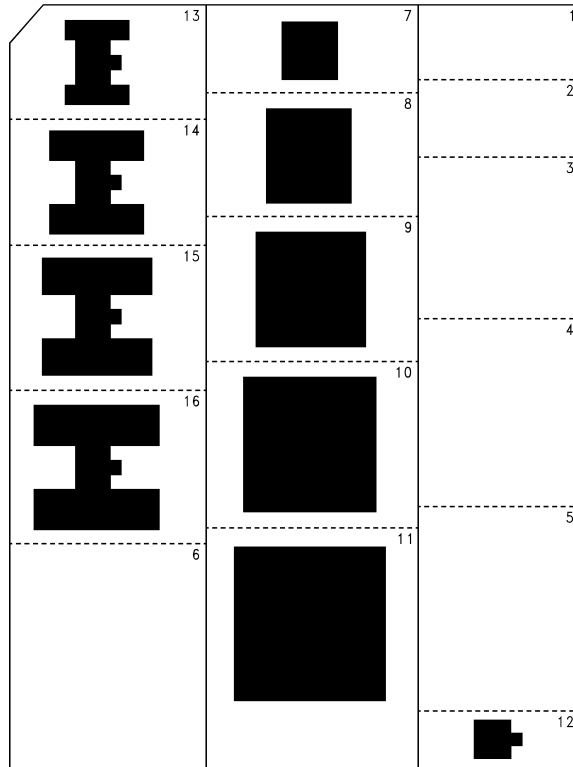


Figure 31. Top View of the Thermal Test Pattern in Actual Scale

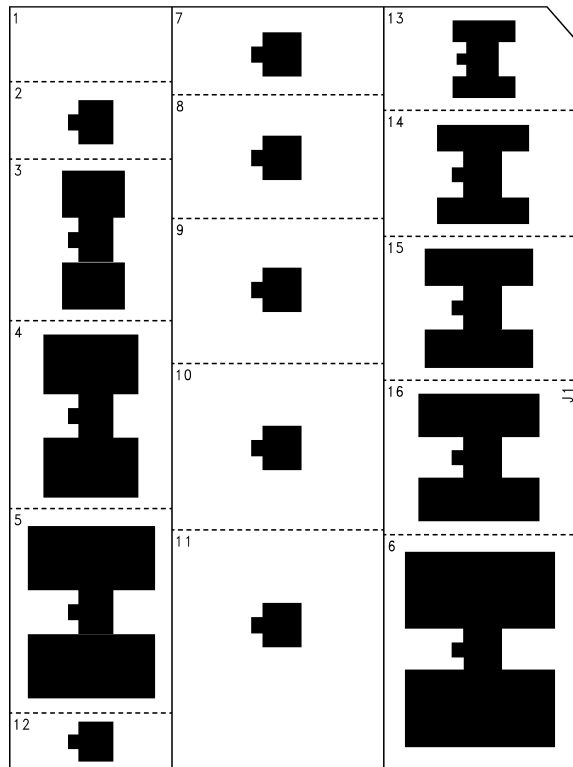


Figure 32. Bottom View of the Thermal Test Pattern in Actual Scale

TYPICAL APPLICATION CIRCUITS

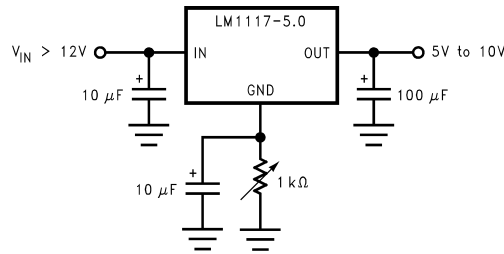


Figure 33. Adjusting Output of Fixed Regulators

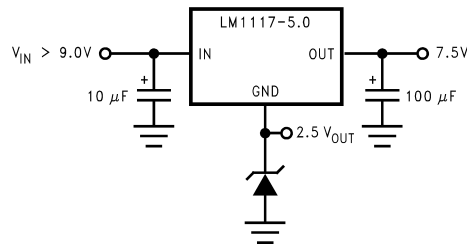
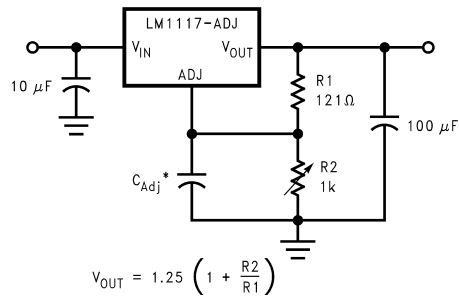
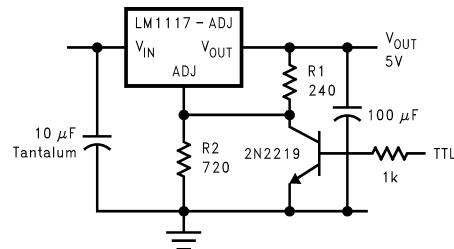


Figure 34. Regulator with Reference



\* C<sub>Adj</sub> is optional, however it will improve ripple rejection.

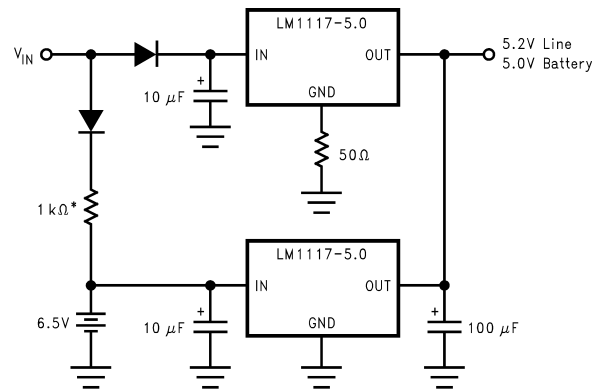
Figure 35. 1.25V to 10V Adjustable Regulator with Improved Ripple Rejection



\* Min. output ≈ 1.25V

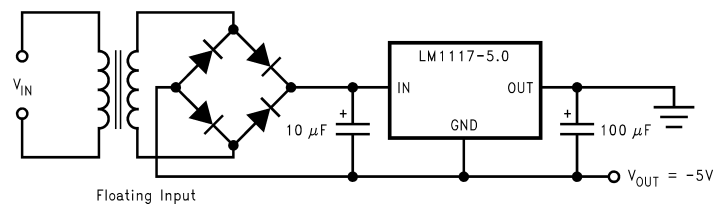
Figure 36. 5V Logic Regulator with Electronic Shutdown\*





\*Select for charge rate.

**Figure 37. Battery Backed-Up Regulated Supply**



**Figure 38. Low Dropout Negative Supply**

## REVISION HISTORY

| Changes from Revision L (March 2013) to Revision M         | Page               |
|--|--------------------|
| • Changed layout of National Data Sheet to TI format ..... | <a href="#">17</a> |

**PACKAGING INFORMATION**

| Orderable Device    | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|---------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| LM1117DT-1.8/NOPB   | ACTIVE        | TO-252       | NDP                | 3    | 75             | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | 0 to 125     | LM1117<br>DT-1.8        | <a href="#">Samples</a> |
| LM1117DT-2.5/NOPB   | ACTIVE        | TO-252       | NDP                | 3    | 75             | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | 0 to 125     | LM1117<br>DT-2.5        | <a href="#">Samples</a> |
| LM1117DT-3.3/NOPB   | ACTIVE        | TO-252       | NDP                | 3    | 75             | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | 0 to 125     | LM1117<br>DT-3.3        | <a href="#">Samples</a> |
| LM1117DT-5.0/NOPB   | ACTIVE        | TO-252       | NDP                | 3    | 75             | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | 0 to 125     | LM1117<br>DT-5.0        | <a href="#">Samples</a> |
| LM1117DT-ADJ/NOPB   | ACTIVE        | TO-252       | NDP                | 3    | 75             | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | 0 to 125     | LM1117<br>DT-ADJ        | <a href="#">Samples</a> |
| LM1117DTX-1.8/NOPB  | ACTIVE        | TO-252       | NDP                | 3    | 2500           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | 0 to 125     | LM1117<br>DT-1.8        | <a href="#">Samples</a> |
| LM1117DTX-2.5/NOPB  | ACTIVE        | TO-252       | NDP                | 3    | 2500           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | 0 to 125     | LM1117<br>DT-2.5        | <a href="#">Samples</a> |
| LM1117DTX-3.3/NOPB  | ACTIVE        | TO-252       | NDP                | 3    | 2500           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | 0 to 125     | LM1117<br>DT-3.3        | <a href="#">Samples</a> |
| LM1117DTX-5.0/NOPB  | ACTIVE        | TO-252       | NDP                | 3    | 2500           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | 0 to 125     | LM1117<br>DT-5.0        | <a href="#">Samples</a> |
| LM1117DTX-ADJ/NOPB  | ACTIVE        | TO-252       | NDP                | 3    | 2500           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | 0 to 125     | LM1117<br>DT-ADJ        | <a href="#">Samples</a> |
| LM1117IDT-3.3/NOPB  | ACTIVE        | TO-252       | NDP                | 3    | 75             | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | -40 to 125   | LM1117<br>IDT-3.3       | <a href="#">Samples</a> |
| LM1117IDT-5.0/NOPB  | ACTIVE        | TO-252       | NDP                | 3    | 75             | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | -40 to 125   | LM1117<br>IDT-5.0       | <a href="#">Samples</a> |
| LM1117IDT-ADJ/NOPB  | ACTIVE        | TO-252       | NDP                | 3    | 75             | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | -40 to 125   | LM1117<br>IDT-ADJ       | <a href="#">Samples</a> |
| LM1117IDTX-3.3/NOPB | ACTIVE        | TO-252       | NDP                | 3    | 2500           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | -40 to 125   | LM1117<br>IDT-3.3       | <a href="#">Samples</a> |
| LM1117IDTX-5.0/NOPB | ACTIVE        | TO-252       | NDP                | 3    | 2500           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | -40 to 125   | LM1117<br>IDT-5.0       | <a href="#">Samples</a> |
| LM1117IDTX-ADJ/NOPB | ACTIVE        | TO-252       | NDP                | 3    | 2500           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-2-260C-1 YEAR  | -40 to 125   | LM1117<br>IDT-ADJ       | <a href="#">Samples</a> |
| LM1117ILD-ADJ/NOPB  | ACTIVE        | WSON         | NGN                | 8    | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-3-260C-168 HR  | -40 to 125   | 1117IAD                 | <a href="#">Samples</a> |

| Orderable Device    | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2)         | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|---------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| LM1117IMP-3.3/NOPB  | ACTIVE        | SOT-223      | DCY             | 4    | 1000        | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -40 to 125   | N05B                    | <a href="#">Samples</a> |
| LM1117IMP-5.0/NOPB  | ACTIVE        | SOT-223      | DCY             | 4    | 1000        | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -40 to 125   | N06B                    | <a href="#">Samples</a> |
| LM1117IMP-ADJ/NOPB  | ACTIVE        | SOT-223      | DCY             | 4    | 1000        | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -40 to 125   | N03B                    | <a href="#">Samples</a> |
| LM1117IMPX-3.3      | NRND          | SOT-223      | DCY             | 4    |             | TBD                     | Call TI                 | Call TI              | -40 to 125   | N05B                    |                         |
| LM1117IMPX-3.3/NOPB | ACTIVE        | SOT-223      | DCY             | 4    | 2000        | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -40 to 125   | N05B                    | <a href="#">Samples</a> |
| LM1117IMPX-5.0      | NRND          | SOT-223      | DCY             | 4    | 2000        | TBD                     | Call TI                 | Call TI              | -40 to 125   | N06B                    |                         |
| LM1117IMPX-5.0/NOPB | ACTIVE        | SOT-223      | DCY             | 4    | 2000        | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -40 to 125   | N06B                    | <a href="#">Samples</a> |
| LM1117IMPX-ADJ/NOPB | ACTIVE        | SOT-223      | DCY             | 4    | 2000        | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -40 to 125   | N03B                    | <a href="#">Samples</a> |
| LM1117LD-1.8/NOPB   | ACTIVE        | WSON         | NGN             | 8    | 1000        | Green (RoHS & no Sb/Br) | CU SN                   | Level-3-260C-168 HR  | 0 to 125     | 1117-18                 | <a href="#">Samples</a> |
| LM1117LD-2.5/NOPB   | ACTIVE        | WSON         | NGN             | 8    | 1000        | Green (RoHS & no Sb/Br) | CU SN                   | Level-3-260C-168 HR  | 0 to 125     | 1117-25                 | <a href="#">Samples</a> |
| LM1117LD-3.3/NOPB   | ACTIVE        | WSON         | NGN             | 8    | 1000        | Green (RoHS & no Sb/Br) | CU SN                   | Level-3-260C-168 HR  | 0 to 125     | 1117-33                 | <a href="#">Samples</a> |
| LM1117LD-ADJ/NOPB   | ACTIVE        | WSON         | NGN             | 8    | 1000        | Green (RoHS & no Sb/Br) | CU SN                   | Level-3-260C-168 HR  | 0 to 125     | 1117ADJ                 | <a href="#">Samples</a> |
| LM1117LDX-1.8       | NRND          | WSON         | NGN             | 8    | 4500        | TBD                     | Call TI                 | Call TI              | 0 to 125     | 1117-18                 |                         |
| LM1117LDX-1.8/NOPB  | ACTIVE        | WSON         | NGN             | 8    | 4500        | Green (RoHS & no Sb/Br) | CU SN                   | Level-3-260C-168 HR  | 0 to 125     | 1117-18                 | <a href="#">Samples</a> |
| LM1117LDX-ADJ/NOPB  | ACTIVE        | WSON         | NGN             | 8    | 4500        | Green (RoHS & no Sb/Br) | CU SN                   | Level-3-260C-168 HR  | 0 to 125     | 1117ADJ                 | <a href="#">Samples</a> |
| LM1117MP-1.8/NOPB   | ACTIVE        | SOT-223      | DCY             | 4    | 1000        | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | 0 to 125     | N12A                    | <a href="#">Samples</a> |
| LM1117MP-2.5/NOPB   | ACTIVE        | SOT-223      | DCY             | 4    | 1000        | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | 0 to 125     | N13A                    | <a href="#">Samples</a> |
| LM1117MP-3.3/NOPB   | ACTIVE        | SOT-223      | DCY             | 4    | 1000        | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | 0 to 125     | N05A                    | <a href="#">Samples</a> |
| LM1117MP-5.0/NOPB   | ACTIVE        | SOT-223      | DCY             | 4    | 1000        | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | 0 to 125     | N06A                    | <a href="#">Samples</a> |

| Orderable Device   | Status<br>(1) | Package Type     | Package Drawing | Pins | Package Qty | Eco Plan<br>(2)         | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|--------------------|---------------|------------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| LM1117MP-ADJ/NOPB  | ACTIVE        | SOT-223          | DCY             | 4    | 1000        | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | 0 to 125     | N03A                    | <a href="#">Samples</a> |
| LM1117MPX-1.8/NOPB | ACTIVE        | SOT-223          | DCY             | 4    | 2000        | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | 0 to 125     | N12A                    | <a href="#">Samples</a> |
| LM1117MPX-2.5/NOPB | ACTIVE        | SOT-223          | DCY             | 4    | 2000        | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | 0 to 125     | N13A                    | <a href="#">Samples</a> |
| LM1117MPX-3.3      | NRND          | SOT-223          | DCY             | 4    | 2000        | TBD                     | Call TI                 | Call TI              |              | N05A                    |                         |
| LM1117MPX-3.3/NOPB | ACTIVE        | SOT-223          | DCY             | 4    | 2000        | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | 0 to 125     | N05A                    | <a href="#">Samples</a> |
| LM1117MPX-5.0      | NRND          | SOT-223          | DCY             | 4    | 2000        | TBD                     | Call TI                 | Call TI              | 0 to 125     | N06A                    |                         |
| LM1117MPX-5.0/NOPB | ACTIVE        | SOT-223          | DCY             | 4    | 2000        | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | 0 to 125     | N06A                    | <a href="#">Samples</a> |
| LM1117MPX-ADJ/NOPB | ACTIVE        | SOT-223          | DCY             | 4    | 2000        | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | 0 to 125     | N03A                    | <a href="#">Samples</a> |
| LM1117S-ADJ/NOPB   | ACTIVE        | DDPAK/<br>TO-263 | KTT             | 3    | 45          | Pb-Free (RoHS Exempt)   | CU SN                   | Level-3-245C-168 HR  | 0 to 125     | LM1117S<br>ADJ          | <a href="#">Samples</a> |
| LM1117SX-3.3/NOPB  | ACTIVE        | DDPAK/<br>TO-263 | KTT             | 3    | 500         | Pb-Free (RoHS Exempt)   | CU SN                   | Level-3-245C-168 HR  | 0 to 125     | LM1117S<br>3.3          | <a href="#">Samples</a> |
| LM1117SX-5.0/NOPB  | ACTIVE        | DDPAK/<br>TO-263 | KTT             | 3    | 500         | Pb-Free (RoHS Exempt)   | CU SN                   | Level-3-245C-168 HR  | 0 to 125     | LM1117S<br>5.0          | <a href="#">Samples</a> |
| LM1117SX-ADJ/NOPB  | ACTIVE        | DDPAK/<br>TO-263 | KTT             | 3    | 500         | Pb-Free (RoHS Exempt)   | CU SN                   | Level-3-245C-168 HR  | 0 to 125     | LM1117S<br>ADJ          | <a href="#">Samples</a> |
| LM1117T-2.5/NOPB   | ACTIVE        | TO-220           | NDE             | 3    | 45          | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-NA-UNLIM     | 0 to 125     | LM1117T<br>2.5          | <a href="#">Samples</a> |
| LM1117T-3.3/NOPB   | ACTIVE        | TO-220           | NDE             | 3    | 45          | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-NA-UNLIM     | 0 to 125     | LM1117T<br>3.3          | <a href="#">Samples</a> |
| LM1117T-5.0/NOPB   | ACTIVE        | TO-220           | NDE             | 3    | 45          | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-NA-UNLIM     | 0 to 125     | LM1117T<br>5.0          | <a href="#">Samples</a> |
| LM1117T-ADJ/NOPB   | ACTIVE        | TO-220           | NDE             | 3    | 45          | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-NA-UNLIM     | 0 to 125     | LM1117T<br>ADJ          | <a href="#">Samples</a> |

(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.

<sup>(2)</sup> Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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

<sup>(5)</sup> 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.

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

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**TAPE AND REEL INFORMATION**

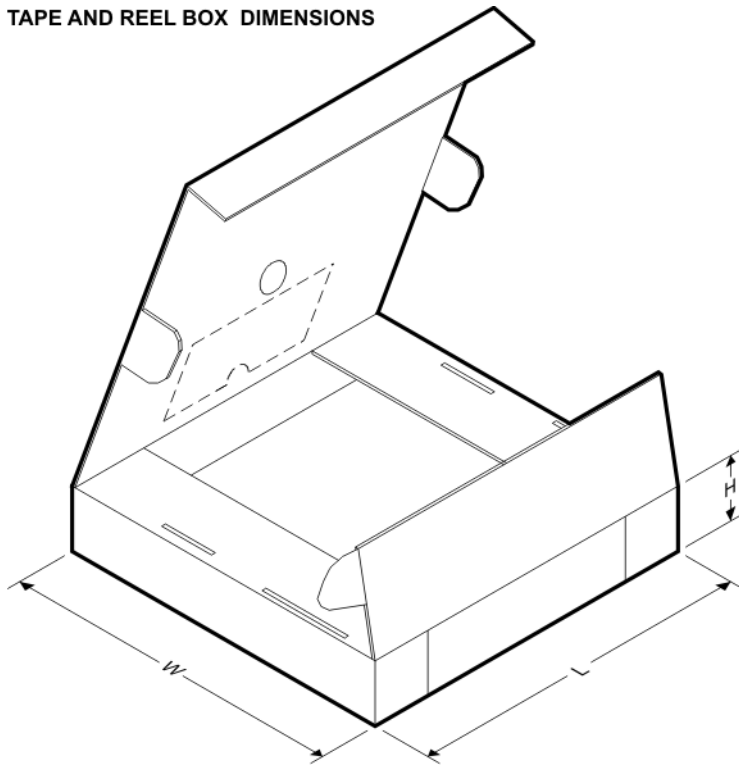
**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*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      | 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            |
| LM1117LD-2.5/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-3.3/NOPB  | WSO              | NGN             | 8    | 1000 | 178.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM1117LD-ADJ/NOPB  | WSO              | NGN             | 8    | 1000 | 178.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM1117LDX-1.8      | WSO              | NGN             | 8    | 4500 | 330.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM1117LDX-1.8/NOPB | WSO              | NGN             | 8    | 4500 | 330.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM1117LDX-ADJ/NOPB | WSO              | 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      | 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/<br>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/<br>TO-263 | KTT             | 3    | 500  | 330.0              | 24.4               | 10.75   | 14.85   | 5.0     | 16.0    | 24.0   | Q2            |
| LM1117SX-ADJ/NOPB  | DDPAK/<br>TO-263 | KTT             | 3    | 500  | 330.0              | 24.4               | 10.75   | 14.85   | 5.0     | 16.0    | 24.0   | Q2            |



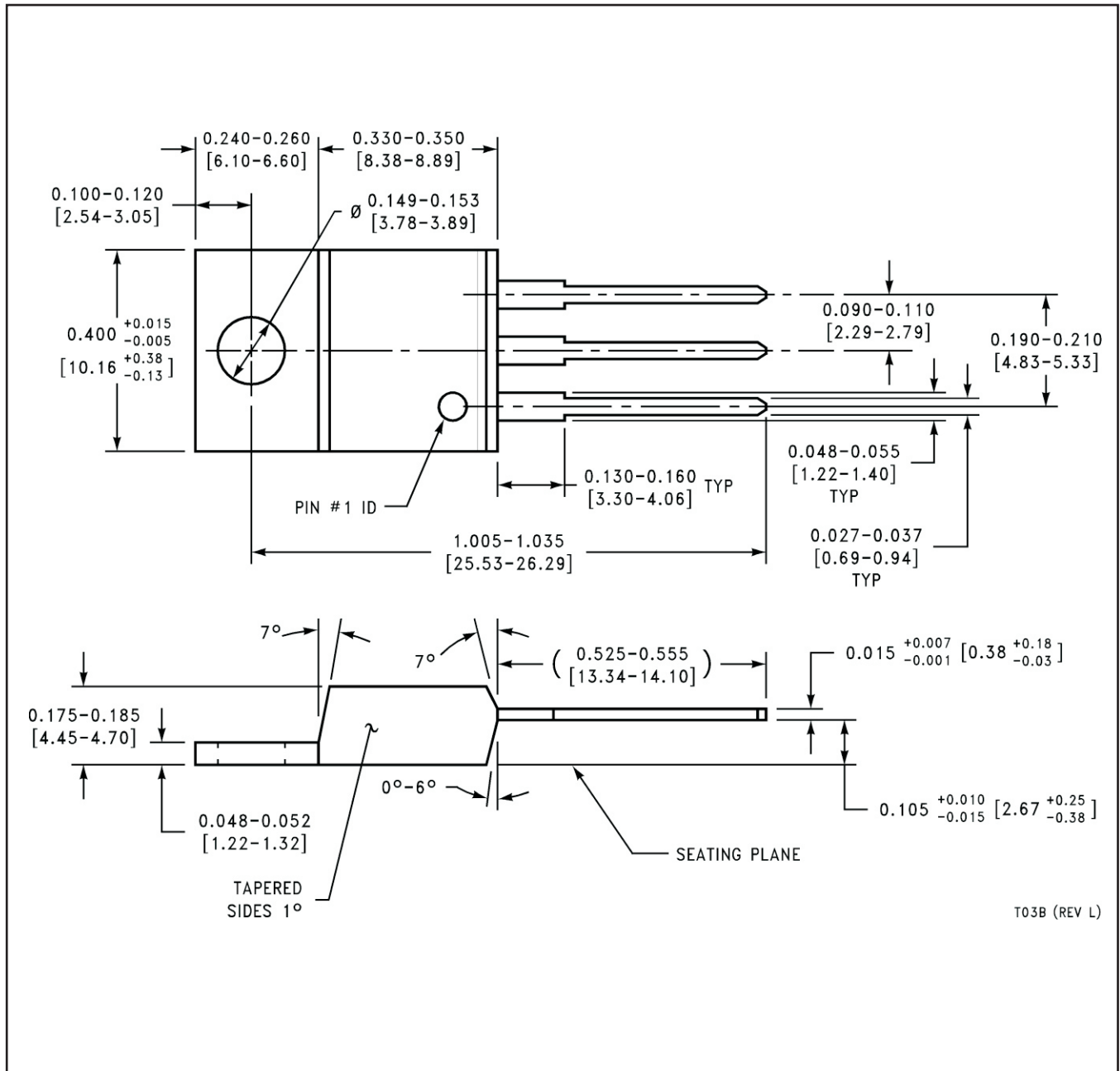
**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

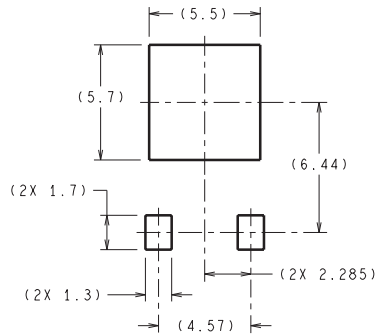
| Device              | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|---------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LM1117DTX-1.8/NOPB  | TO-252       | NDP             | 3    | 2500 | 367.0       | 367.0      | 38.0        |
| LM1117DTX-2.5/NOPB  | TO-252       | NDP             | 3    | 2500 | 367.0       | 367.0      | 38.0        |
| LM1117DTX-3.3/NOPB  | TO-252       | NDP             | 3    | 2500 | 367.0       | 367.0      | 38.0        |
| LM1117DTX-5.0/NOPB  | TO-252       | NDP             | 3    | 2500 | 367.0       | 367.0      | 38.0        |
| LM1117DTX-ADJ/NOPB  | TO-252       | NDP             | 3    | 2500 | 367.0       | 367.0      | 38.0        |
| LM1117IDTX-3.3/NOPB | TO-252       | NDP             | 3    | 2500 | 367.0       | 367.0      | 38.0        |
| LM1117IDTX-5.0/NOPB | TO-252       | NDP             | 3    | 2500 | 367.0       | 367.0      | 38.0        |
| LM1117IDTX-ADJ/NOPB | TO-252       | NDP             | 3    | 2500 | 367.0       | 367.0      | 38.0        |
| LM1117ILD-ADJ/NOPB  | WSON         | NGN             | 8    | 1000 | 213.0       | 191.0      | 55.0        |
| 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      | 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 | 213.0       | 191.0      | 55.0        |
| LM1117LD-2.5/NOPB   | WSON         | NGN             | 8    | 1000 | 213.0       | 191.0      | 55.0        |
| LM1117LD-3.3/NOPB   | WSON         | NGN             | 8    | 1000 | 213.0       | 191.0      | 55.0        |
| LM1117LD-ADJ/NOPB   | WSON         | NGN             | 8    | 1000 | 213.0       | 191.0      | 55.0        |

| Device             | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|--------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LM1117LDX-1.8      | WSON         | NGN             | 8    | 4500 | 367.0       | 367.0      | 35.0        |
| LM1117LDX-1.8/NOPB | WSON         | NGN             | 8    | 4500 | 367.0       | 367.0      | 35.0        |
| LM1117LDX-ADJ/NOPB | WSON         | NGN             | 8    | 4500 | 367.0       | 367.0      | 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      | 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        |

NDE0003B

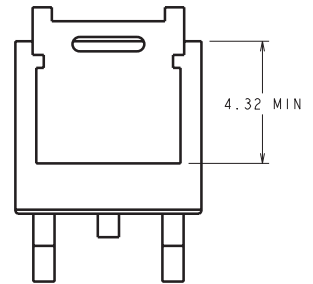
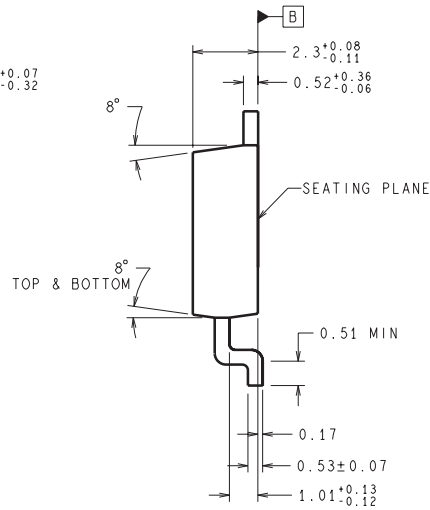
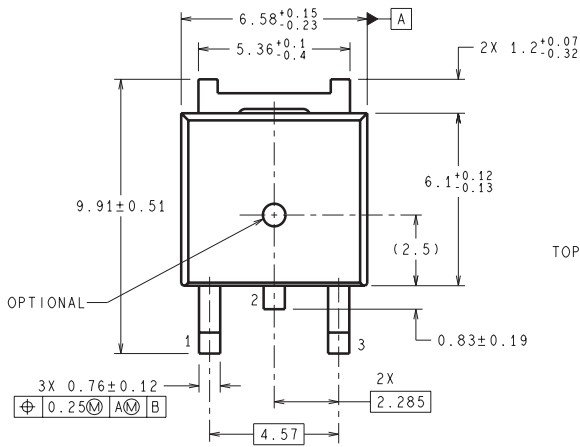


NDP0003B



DIMENSIONS ARE IN MILLIMETERS  
DIMENSIONS IN ( ) FOR REFERENCE ONLY

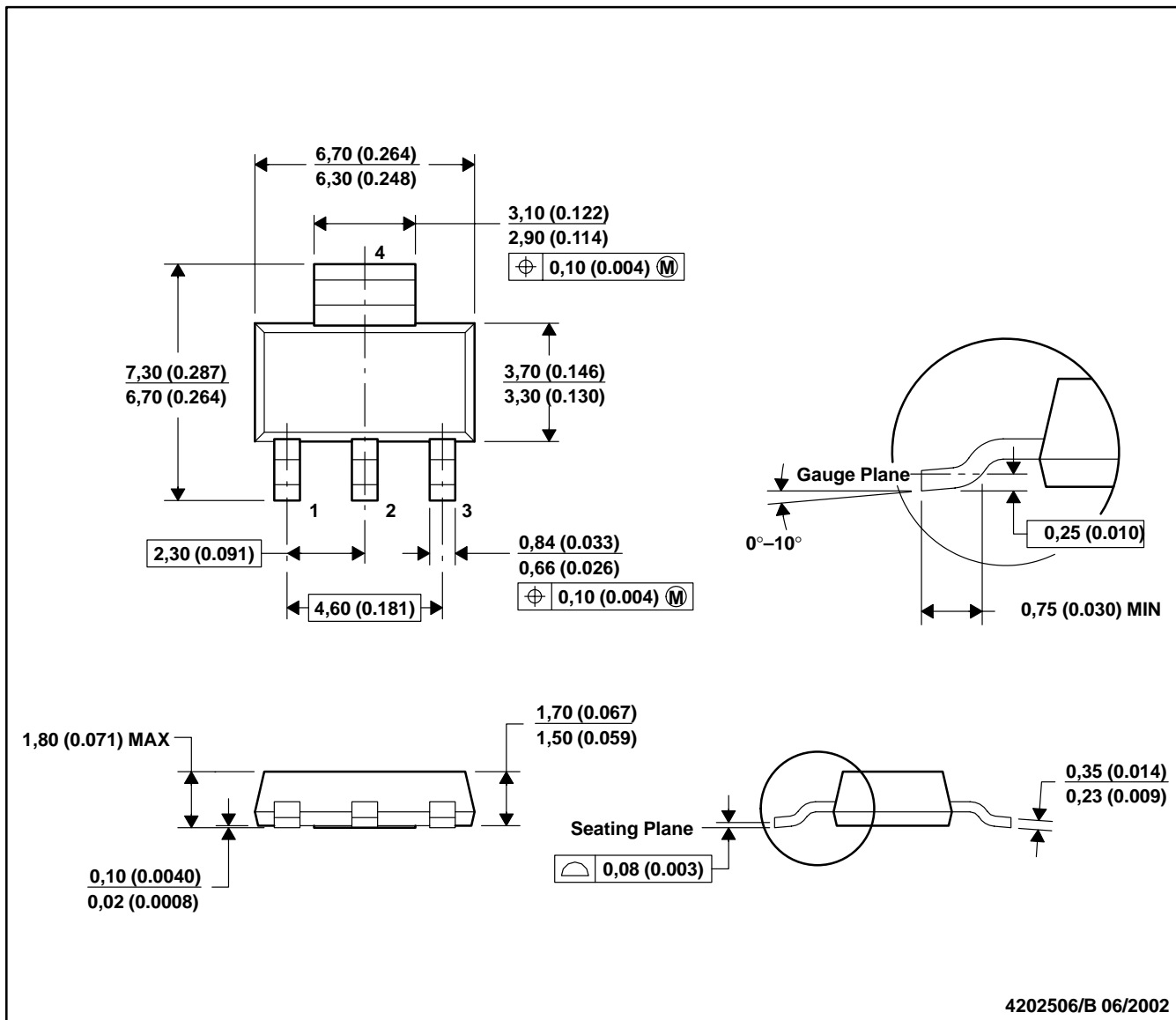
LAND PATTERN RECOMMENDATION



TD03B (Rev F)

DCY (R-PDSO-G4)

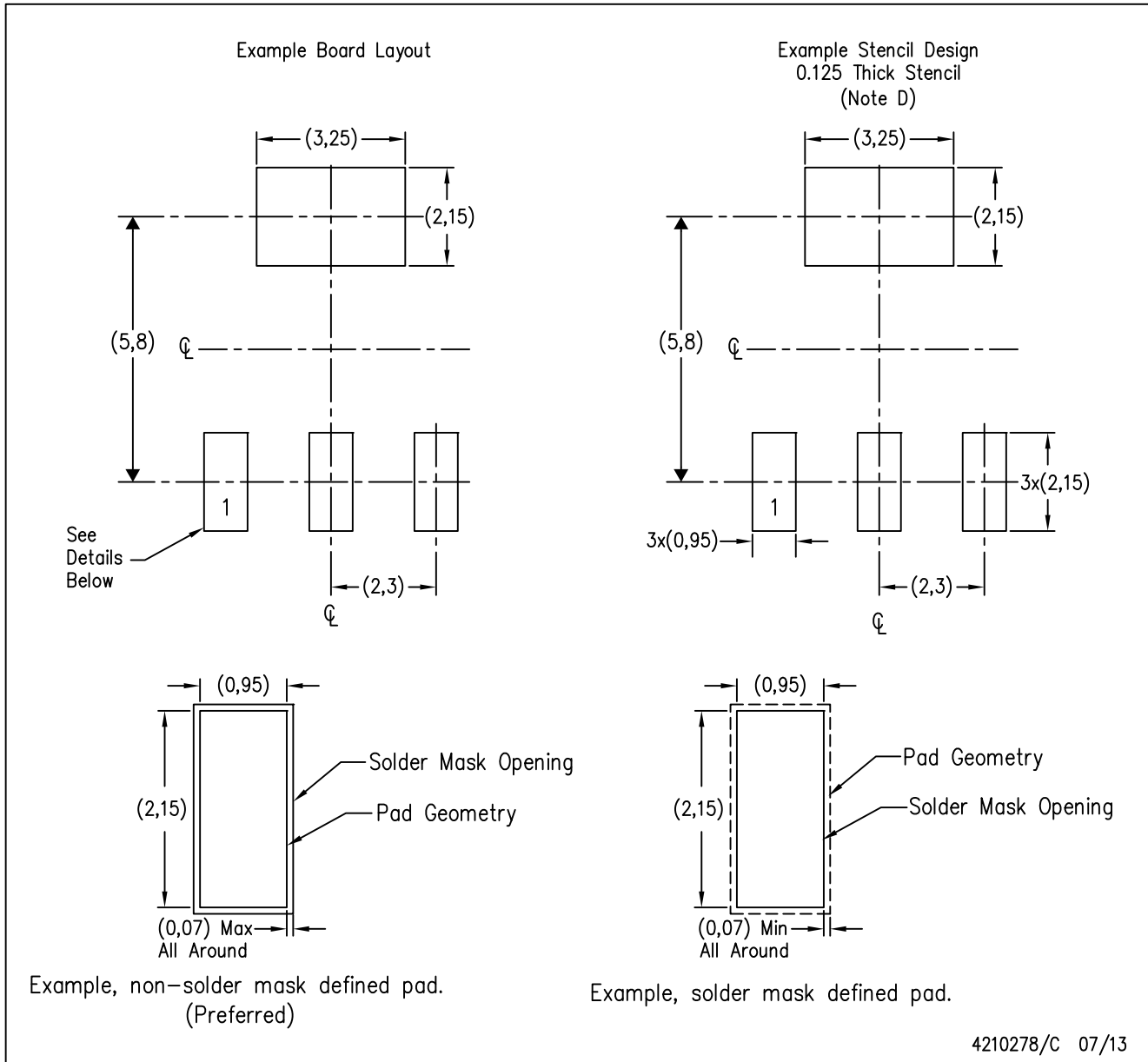
PLASTIC SMALL-OUTLINE



- 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.

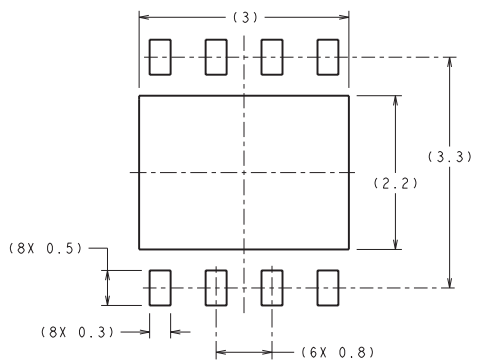
DCY (R-PDSO-G4)

PLASTIC SMALL OUTLINE

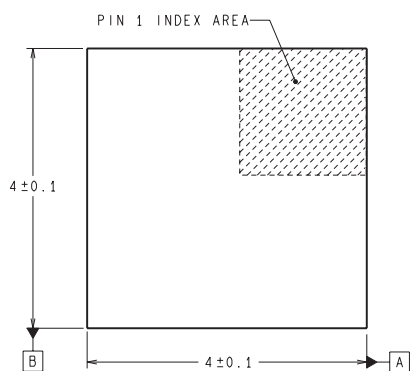


- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers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

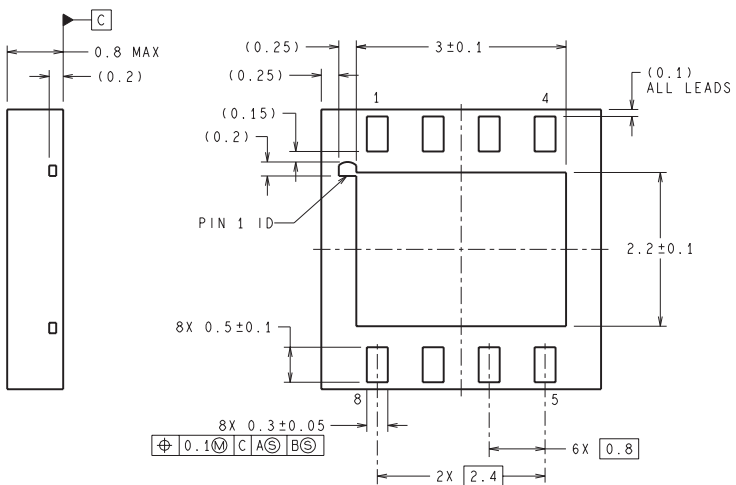
NGN0008A



**RECOMMENDED LAND PATTERN**  
1:1 RATION WITH PKG SOLDER PADS

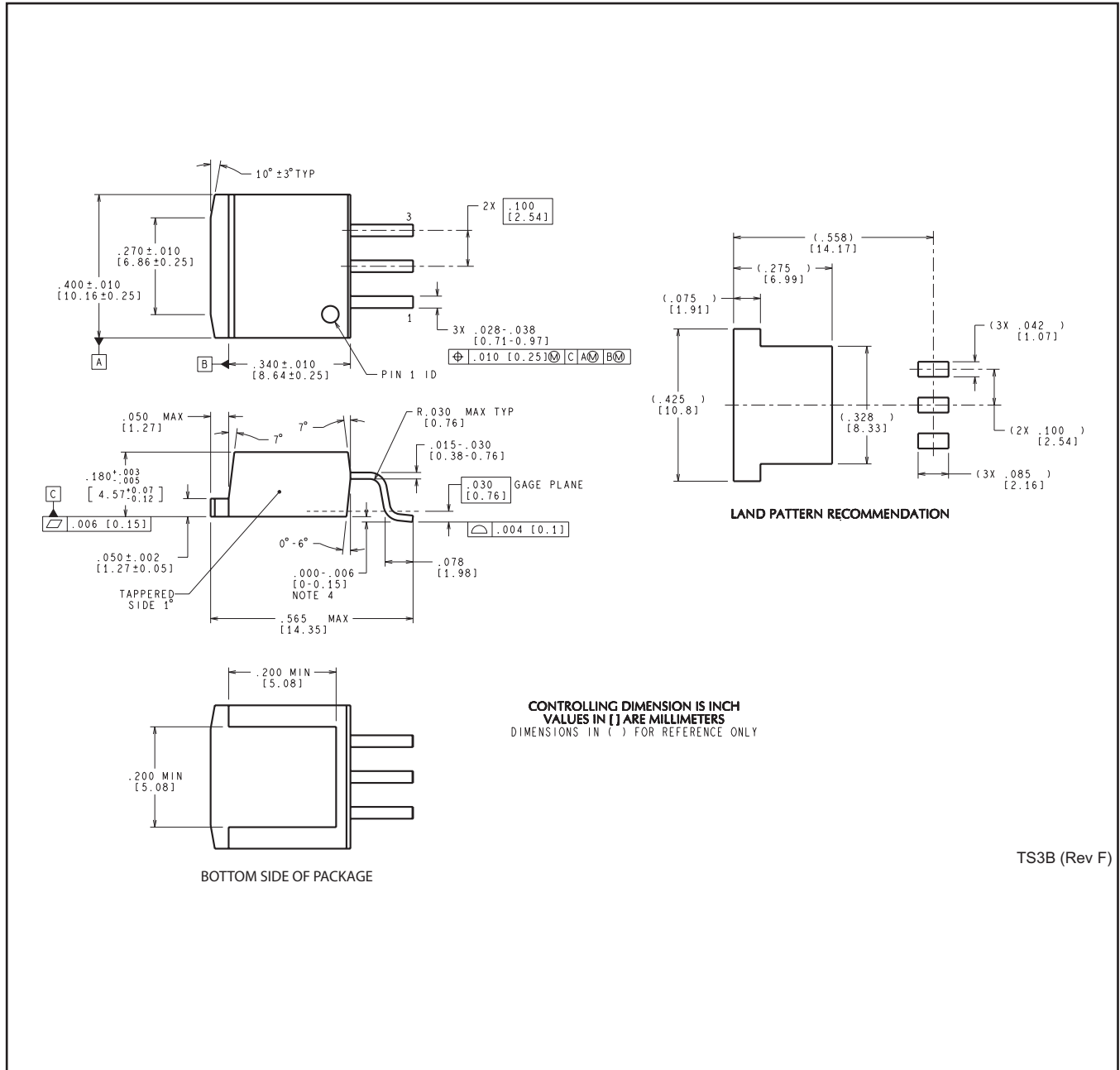


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LDC08A (Rev B)

KTT0003B



TS3B (Rev F)



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