3-TERMINAL ADJUSTABLE REGULATOR

Check for Samples: LM317

FEATURES

- Output Voltage Range Adjustable From 1.25 V to 37 V
- Output Current Greater Than 1.5 A
- Internal Short-Circuit Current Limiting
- Thermal Overload Protection
- Output Safe-Area Compensation

DESCRIPTION/ORDERING INFORMATION

The LM317 is an adjustable three-terminal positive-voltage regulator capable of supplying more than 1.5 A over an output-voltage range of 1.25 V to 37 V. It is exceptionally easy to use and requires only two external resistors to set the output voltage. Furthermore, both line and load regulation are better than standard fixed regulators.

In addition to having higher performance than fixed regulators, this device includes on-chip current limiting, thermal overload protection, and safe operating-area protection. All overload protection remains fully functional, even if the ADJUST terminal is disconnected.

The LM317 is versatile in its applications, including uses in programmable output regulation and local on-card regulation. Or, by connecting a fixed resistor between the ADJUST and OUTPUT terminals, the LM317 can function as a precision current regulator. An optional output capacitor can be added to improve transient response. The ADJUST terminal can be bypassed to achieve very high ripple-rejection ratios, which are difficult to achieve with standard three-terminal regulators.

Table 1. ORDERING INFORMATION

<table>
<thead>
<tr>
<th>TA</th>
<th>PACKAGE(2)</th>
<th>ORDERABLE PART NUMBER</th>
<th>TOP-SIDE MARKING</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°C to 125°C</td>
<td>PowerFLEX™ – KTE</td>
<td>LM317KTER</td>
<td>OBSOLETE</td>
</tr>
<tr>
<td></td>
<td>SOT-223 – DCY</td>
<td>LM317DCY</td>
<td>L3</td>
</tr>
<tr>
<td></td>
<td>Reel of 2000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tube of 80</td>
<td>LM317DCYR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tube of 2500</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TO-220 – KC</td>
<td>LM317KC</td>
<td>OBSOLETE</td>
</tr>
<tr>
<td></td>
<td>Tube of 50</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TO-220, short shoulder – KCS</td>
<td>LM317KCS</td>
<td>LM317</td>
</tr>
<tr>
<td></td>
<td>Tube of 20</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TO-220, short shoulder – KCT</td>
<td>LM317KCT</td>
<td>LM317</td>
</tr>
<tr>
<td></td>
<td>Tube of 20</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TO-263 – KTT</td>
<td>LM317KTTR</td>
<td>LM317</td>
</tr>
<tr>
<td></td>
<td>Reel of 500</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.

(2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.

Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

PowerFLEX, PowerPAD are trademarks of Texas Instruments.
Absolute Maximum Ratings \(^{(1)}\)

over virtual junction temperature range (unless otherwise noted)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>MIN</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(V_{I} - V_{O}) Input-to-output differential voltage</td>
<td>40</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>(T_{J}) Operating virtual junction temperature</td>
<td></td>
<td>150</td>
<td>°C</td>
</tr>
<tr>
<td>Lead temperature 1.6 mm (1/16 in) from case for 10 s</td>
<td>260</td>
<td></td>
<td>°C</td>
</tr>
<tr>
<td>(T_{stg}) Storage temperature range</td>
<td>–65</td>
<td>150</td>
<td>°C</td>
</tr>
</tbody>
</table>

(1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

Package Thermal Data \(^{(1)}\)

<table>
<thead>
<tr>
<th>PACKAGE</th>
<th>BOARD</th>
<th>(\theta_{JA})</th>
<th>(\theta_{JC})</th>
<th>(\theta_{JP}) (^{(2)})</th>
</tr>
</thead>
<tbody>
<tr>
<td>PowerFLEX™ (KTE)</td>
<td>High K, JESD 51-5</td>
<td>23°C/W</td>
<td>11.6°C/W</td>
<td></td>
</tr>
<tr>
<td>SOT-223 (DCY)</td>
<td>High K, JESD 51-7</td>
<td>53°C/W</td>
<td>30.6°C/W</td>
<td></td>
</tr>
<tr>
<td>TO-220 (KC/KCS/KCT)</td>
<td>High K, JESD 51-5</td>
<td>19°C/W</td>
<td>17°C/W</td>
<td>3°C/W</td>
</tr>
<tr>
<td>TO-263 (KTT)</td>
<td>High K, JESD 51-5</td>
<td>25.3°C/W</td>
<td>18°C/W</td>
<td>1.94°C/W</td>
</tr>
</tbody>
</table>

(1) Maximum power dissipation is a function of \(T_{J}(\text{max})\), \(\theta_{JA}\), and \(T_{A}\). The maximum allowable power dissipation at any allowable ambient temperature is \(P_{D} = (T_{J}(\text{max}) - T_{A})/\theta_{JA}\). Operating at the absolute maximum \(T_{J}\) of 150°C can affect reliability.

(2) For packages with exposed thermal pads, such as QFN, PowerPAD™, or PowerFLEX™, \(\theta_{JP}\) is defined as the thermal resistance between the die junction and the bottom of the exposed pad.
**Recommended Operating Conditions**

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>MIN</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_i - V_o$ Input-to-output differential voltage</td>
<td>3</td>
<td>40</td>
<td>V</td>
</tr>
<tr>
<td>$I_o$ Output current</td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>$T_j$ Operating virtual junction temperature</td>
<td>0</td>
<td>125</td>
<td>°C</td>
</tr>
</tbody>
</table>

**Electrical Characteristics**

over recommended ranges of operating virtual junction temperature (unless otherwise noted)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TEST CONDITIONS(1)</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line regulation $V_i - V_o$ = 3 V to 40 V</td>
<td>$T_j = 25^\circ$C</td>
<td>0.01</td>
<td>0.04</td>
<td></td>
<td>%/V</td>
</tr>
<tr>
<td></td>
<td>$T_j = 0^\circ$C to 125°C</td>
<td>0.02</td>
<td>0.07</td>
<td></td>
<td>%/V</td>
</tr>
<tr>
<td>Load regulation $I_o = 10$ mA to 1500 mA</td>
<td>$C_{ADJ} = 10$ μF $T_j = 25^\circ$C</td>
<td>$V_o \leq 5$ V</td>
<td>25</td>
<td>mV</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$T_j = 0^\circ$C to 125°C</td>
<td>$V_o \geq 5$ V</td>
<td>0.1</td>
<td>0.5</td>
<td>%V</td>
</tr>
<tr>
<td>Thermal regulation 20-ms pulse, $T_j = 25^\circ$C</td>
<td>$T_j = 0^\circ$C to 125°C</td>
<td>$V_o \leq 5$ V</td>
<td>20</td>
<td>mV</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_o \geq 5$ V</td>
<td>0.3</td>
<td>1.5</td>
<td>%V</td>
</tr>
<tr>
<td><strong>ADJUST terminal current</strong></td>
<td></td>
<td>50</td>
<td>100</td>
<td>μA</td>
<td></td>
</tr>
<tr>
<td><strong>Change in ADJUST terminal current</strong></td>
<td>$V_i - V_o = 2.5$ V to 40 V, $P_D \leq 20$ W, $I_o = 10$ mA to 1500 mA</td>
<td>0.2</td>
<td>5</td>
<td>μA</td>
<td></td>
</tr>
<tr>
<td>Reference voltage $V_i - V_o = 3$ V to 40 V, $P_D \leq 20$ W, $I_o = 10$ mA to 1500 mA</td>
<td>$T_j = 0^\circ$C to 125°C</td>
<td>1.2</td>
<td>1.25</td>
<td>1.3</td>
<td>V</td>
</tr>
<tr>
<td>Output-voltage temperature stability</td>
<td>$T_j = 0^\circ$C to 125°C</td>
<td>0.7</td>
<td></td>
<td>%V</td>
<td></td>
</tr>
<tr>
<td><strong>Minimum load current to maintain regulation</strong></td>
<td>$V_i - V_o = 40$ V</td>
<td>3.5</td>
<td>10</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Maximum output current $V_i - V_o \leq 15$ V, $P_D &lt; P_{MAX}$</td>
<td>$T_j = 25^\circ$C</td>
<td>1.5</td>
<td>2.2</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_i - V_o \leq 40$ V, $P_D &lt; P_{MAX}$</td>
<td>0.15</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>RMS output noise voltage (% of $V_o$) $f = 10$ Hz to 10 kHz, $T_j = 25^\circ$C</td>
<td>$C_{ADJ} = 0$ μF $C_{ADJ} = 10$ μF</td>
<td>0.003</td>
<td>%V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ripple rejection $V_o = 10$ V, $f = 120$ Hz</td>
<td>$C_{ADJ} = 0$ μF</td>
<td>57</td>
<td></td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$C_{ADJ} = 10$ μF</td>
<td>62</td>
<td>64</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long-term stability $T_j = 25^\circ$C</td>
<td></td>
<td>0.3</td>
<td>1</td>
<td>%/1k hr</td>
<td></td>
</tr>
</tbody>
</table>

(1) Unless otherwise noted, the following test conditions apply: $|V_i - V_o| = 5$ V and $I_{OMAX} = 1.5$ A, $T_j = 0^\circ$C to 125°C. Pulse testing techniques are used to maintain the junction temperature as close to the ambient temperature as possible.

(2) Line regulation is expressed here as the percentage change in output voltage per 1-V change at the input.

(3) $C_{ADJ}$ is connected between the ADJUST terminal and GND.

(4) Maximum power dissipation is a function of $T_j$(max), $\theta_{JA}$, and $T_A$. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_j$(max) $- T_A)/\theta_{JA}$. Operating at the absolute maximum $T_j$ of 150°C can affect reliability.
TYPICAL CHARACTERISTICS

LOAD REGULATION

![Graph showing load regulation for different temperatures: Ta = 25°C, Ta = -40°C, Ta = 125°C. The output voltage (V_out) is plotted against load current (I_out). V_out is 10 V Nom.]

LOAD TRANSIENT RESPONSE

![Graph showing load transient response with capacitance (C_adj) for different conditions: C_adj = 0 µF, C_adj = 10 µF. The voltage (V_out) and current (I_out) are plotted against time (µs).]
TYPICAL CHARACTERISTICS (continued)

LINE REGULATION

LINE TRANSIENT RESPONSE

RIPPLE REJECTION VS FREQUENCY

Copyright © 1997–2013, Texas Instruments Incorporated

Product Folder Links: LM317
TYPICAL CHARACTERISTICS (continued)

RIPPLE REJECTION

\[
\text{V_{IN}} = 15 \text{ V} \\
\text{V_{OUT}} = 10 \text{ V} \\
f = 120 \text{ Hz} \\
T_A = 25^\circ\text{C}
\]

Ripple Rejection – dB

\[
\text{I}_{\text{OUT}} = 500 \text{ mA} \\
f = 120 \text{ Hz} \\
T_A = 25^\circ\text{C}
\]

RIPPLE REJECTION

\[
\text{V_{IN}} - \text{V_{OUT}} = 15 \text{ V} \\
\text{I}_{\text{OUT}} = 500 \text{ mA} \\
f = 120 \text{ Hz} \\
T_A = 25^\circ\text{C}
\]

Ripple Rejection – dB

\[
\text{V_{OUT}} \rightarrow \text{V_{OUT}}
\]
NOTES:  

A.  $C_i$ is not required, but is recommended, particularly if the regulator is not in close proximity to the power-supply filter capacitors.  A 0.1-µF disc or 1-µF tantalum provides sufficient bypassing for most applications, especially when adjustment and output capacitors are used.

B.  $C_O$ improves transient response, but is not needed for stability.

C.  $V_O$ is calculated as shown:

$$V_O = V_{ref} \left( 1 + \frac{R_2}{R_1} \right) + \left( I_{Adj} \times R_2 \right)$$

Because $I_{Adj}$ typically is 50 µA, it is negligible in most applications.

D.  $C_{ADJ}$ is used to improve ripple rejection; it prevents amplification of the ripple as the output voltage is adjusted higher. If $C_{ADJ}$ is used, it is best to include protection diodes.

E.  If the input is shorted to ground during a fault condition, protection diodes provide measures to prevent the possibility of external capacitors discharging through low-impedance paths in the IC. By providing low-impedance discharge paths for $C_O$ and $C_{ADJ}$, respectively, D1 and D2 prevent the capacitors from discharging into the output of the regulator.

Figure 1. Adjustable Voltage Regulator
$V_O$ is calculated as:

$$V_O = V_{ref} \left(1 + \frac{R_2 + R_3}{R_1}\right) + I_{Adj}(R_2 + R_3) - 10 \text{ V}$$

Since $I_{Adj}$ typically is 50 $\mu$A, it is negligible in most applications.

Figure 2. 0-V to 30-V Regulator Circuit

Note A: D1 discharges C2 if the output is shorted to ground.

Figure 3. Adjustable Regulator Circuit With Improved Ripple Rejection

Figure 4. Precision Current-Limiter Circuit
Figure 5. Tracking Preregulator Circuit

Figure 6. 1.25-V to 20-V Regulator Circuit With Minimum Program Current

Figure 7. Adjusting Multiple On-Card Regulators With a Single Control

NOTE A: Minimum load current from each output is 10 mA. All output voltages are within 200 mV of each other.
NOTE A: $R_S$ controls the output impedance of the charger.

\[ Z_{OUT} = R_S \left( 1 + \frac{R_2}{R_1} \right) \]

The use of $R_S$ allows for low charging rates with a fully charged battery.

**Figure 8. Battery-Charger Circuit**

**Figure 9. 50-mA Constant-Current Battery-Charger Circuit**

**Figure 10. Slow Turn-On 15-V Regulator Circuit**
Figure 11. AC Voltage-Regulator Circuit

Figure 12. Current-Limited 6-V Charger Circuit

NOTE A: R3 sets the peak current (0.6 A for a 1-Ω resistor).
NOTES:
A. The minimum load current is 30 mA.
B. This optional capacitor improves ripple rejection.

Figure 13. Adjustable 4-A Regulator Circuit

Figure 14. High-Current Adjustable Regulator Circuit
Changes from Revision U (Apr 2008) to Revision V

- Added KCT orderable part information
### PACKAGING INFORMATION

<table>
<thead>
<tr>
<th>Orderable Device</th>
<th>Status (1)</th>
<th>Package Type</th>
<th>Package Drawing</th>
<th>Pins</th>
<th>Package Qty</th>
<th>Eco Plan (2)</th>
<th>Lead/Ball Finish</th>
<th>MSL Peak Temp</th>
<th>Op Temp (°C)</th>
<th>Device Marking (4/5)</th>
<th>Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM317DCY</td>
<td>ACTIVE</td>
<td>SOT-223</td>
<td>DCY</td>
<td>4</td>
<td>80</td>
<td>Green (RoHS &amp; no Sb/Br)</td>
<td>CU SN</td>
<td>Level-2-260C-1 YEAR</td>
<td>0 to 125</td>
<td>L3</td>
<td>Samples</td>
</tr>
<tr>
<td>LM317DCY3G3</td>
<td>ACTIVE</td>
<td>SOT-223</td>
<td>DCY</td>
<td>4</td>
<td>80</td>
<td>Green (RoHS &amp; no Sb/Br)</td>
<td>CU SN</td>
<td>Level-2-260C-1 YEAR</td>
<td>0 to 125</td>
<td>L3</td>
<td>Samples</td>
</tr>
<tr>
<td>LM317DCYR</td>
<td>ACTIVE</td>
<td>SOT-223</td>
<td>DCY</td>
<td>4</td>
<td>2500</td>
<td>Green (RoHS &amp; no Sb/Br)</td>
<td>CU SN</td>
<td>Level-2-260C-1 YEAR</td>
<td>0 to 125</td>
<td>L3</td>
<td>Samples</td>
</tr>
<tr>
<td>LM317DCYRG3</td>
<td>ACTIVE</td>
<td>SOT-223</td>
<td>DCY</td>
<td>4</td>
<td>2500</td>
<td>Green (RoHS &amp; no Sb/Br)</td>
<td>CU SN</td>
<td>Level-2-260C-1 YEAR</td>
<td>0 to 125</td>
<td>L3</td>
<td>Samples</td>
</tr>
<tr>
<td>LM317KC</td>
<td>OBSOLETE</td>
<td>TO-220</td>
<td>KC</td>
<td>3</td>
<td>TBD</td>
<td>Call TI</td>
<td>Call TI</td>
<td>0 to 125</td>
<td>LM317</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LM317KCE3</td>
<td>OBSOLETE</td>
<td>TO-220</td>
<td>KC</td>
<td>3</td>
<td>TBD</td>
<td>Call TI</td>
<td>Call TI</td>
<td>0 to 125</td>
<td>LM317</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LM317KCS</td>
<td>ACTIVE</td>
<td>TO-220</td>
<td>KCS</td>
<td>3</td>
<td>50</td>
<td>Pb-Free (RoHS)</td>
<td>CU SN</td>
<td>N / A for Pkg Type</td>
<td>0 to 125</td>
<td>LM317</td>
<td></td>
</tr>
<tr>
<td>LM317KCSE3</td>
<td>ACTIVE</td>
<td>TO-220</td>
<td>KCS</td>
<td>3</td>
<td>50</td>
<td>Pb-Free (RoHS)</td>
<td>CU SN</td>
<td>N / A for Pkg Type</td>
<td>0 to 125</td>
<td>LM317</td>
<td></td>
</tr>
<tr>
<td>LM317KCT</td>
<td>ACTIVE</td>
<td>TO-220</td>
<td>KCT</td>
<td>3</td>
<td>50</td>
<td>Pb-Free (RoHS)</td>
<td>CU SN</td>
<td>N / A for Pkg Type</td>
<td>0 to 125</td>
<td>LM317</td>
<td></td>
</tr>
<tr>
<td>LM317KTER</td>
<td>OBSOLETE</td>
<td>PFM</td>
<td>KTE</td>
<td>3</td>
<td>TBD</td>
<td>Call TI</td>
<td>Call TI</td>
<td>0 to 125</td>
<td>LM317</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LM317KTTR</td>
<td>OBSOLETE</td>
<td>DPAK/TO-263</td>
<td>KTT</td>
<td>3</td>
<td>500</td>
<td>Green (RoHS &amp; no Sb/Br)</td>
<td>CU SN</td>
<td>Level-3-245C-168 HR</td>
<td>0 to 125</td>
<td>LM317</td>
<td></td>
</tr>
<tr>
<td>LM317KTTRG3</td>
<td>ACTIVE</td>
<td>DPAK/TO-263</td>
<td>KTT</td>
<td>3</td>
<td>500</td>
<td>Green (RoHS &amp; no Sb/Br)</td>
<td>CU SN</td>
<td>Level-3-245C-168 HR</td>
<td>0 to 125</td>
<td>LM317</td>
<td></td>
</tr>
</tbody>
</table>

(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) 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](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)

(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/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.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.
### TAPE AND REEL INFORMATION

**Device** | **Package Type** | **Package Drawing** | **Pins** | **SPQ** | **Reel Diameter (mm)** | **Reel Width W1 (mm)** | **A0 (mm)** | **B0 (mm)** | **K0 (mm)** | **P1 (mm)** | **W (mm)** | **Pin 1 Quadrant**  
---|---|---|---|---|---|---|---|---|---|---|---|---  
LM317DCYR | SOT-223 | DCY | 4 | 2500 | 330.0 | 12.4 | 7.05 | 7.4 | 1.9 | 8.0 | 12.0 | Q3  
LM317KTT | DDPAK/TO-263 | KTT | 3 | 500 | 330.0 | 24.4 | 10.8 | 16.3 | 5.11 | 16.0 | 24.0 | Q2

---

*All dimensions are nominal.*

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

---

**TAPE DIMENSIONS**

- **K0**: Cavity
- **A0**: Reel Diameter
- **P1**: Reel Width (W1)

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

- **Q1**: User Direction of Feed
- **Q2**, **Q3**, **Q4**: Pocket Quadrants
- **Sprocket Holes**
## TAPE AND REEL BOX DIMENSIONS

*All dimensions are nominal

<table>
<thead>
<tr>
<th>Device</th>
<th>Package Type</th>
<th>Package Drawing</th>
<th>Pins</th>
<th>SPQ</th>
<th>Length (mm)</th>
<th>Width (mm)</th>
<th>Height (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM317DCYR</td>
<td>SOT-223</td>
<td>DCY</td>
<td>4</td>
<td>2500</td>
<td>340.0</td>
<td>340.0</td>
<td>38.0</td>
</tr>
<tr>
<td>LM317KTTR</td>
<td>DDPACK/TO-263</td>
<td>KTT</td>
<td>3</td>
<td>500</td>
<td>340.0</td>
<td>340.0</td>
<td>38.0</td>
</tr>
</tbody>
</table>
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.
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.
NOTES:  
A. All linear dimensions are in inches (millimeters).  
B. This drawing is subject to change without notice.  
C. The center lead is in electrical contact with the thermal tab.  
D. Dimensions do not include mold protrusions, not to exceed 0.006 (0,15).  
E. Falls within JEDEC MO-169.
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion. Mold flash or protrusion not to exceed 0.005 (0.13) per side.
Δ Falls within JEDEC TO-263 variation AA, except minimum lead thickness and minimum exposed pad length.
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Publication IPC–SM–782 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 design recommendations. Refer to IPC–7525.
E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.
F. This package is designed to be soldered to a thermal pad on the board. Refer to the Product Datasheet for specific thermal information, via requirements, and recommended thermal pad size. For thermal pad sizes larger than shown a solder mask defined pad is recommended in order to maintain the solderable pad geometry while increasing copper area.
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Lead dimensions are not controlled within this area.
D. All lead dimensions apply before solder dip.
E. The center lead is in electrical contact with the mounting tab.
F. The chamfer is optional.
G. Thermal pad contour optional within these dimensions.
H. Falls within JEDEC TO-220 variation AB, except minimum lead thickness, minimum exposed pad length, and maximum body length.
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Lead dimensions are not controlled within this area.
D. All lead dimensions apply before solder dip.
E. The center lead is in electrical contact with the mounting tab.
F. The chamfer is optional.
G. Thermal pad contour optional within these dimensions.
H. Falls within JEDEC TO-220 variation AB, except minimum tab thickness.
**NOTES:**
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Lead dimensions are not controlled within this area.
D. All lead dimensions apply before solder dip.
E. The center lead is in electrical contact with the mounting tab.
F. The chamfer is optional.
G. Thermal pad contour optional within these dimensions.
H. Falls within JEDEC TO-220 variation AB, except minimum lead thickness.
**IMPORTANT NOTICE**

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have not been so designated is solely at the Buyer’s risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

<table>
<thead>
<tr>
<th>Products</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audio</td>
<td>Automotive and Transportation</td>
</tr>
<tr>
<td>Amplifiers</td>
<td>Communications and Telecom</td>
</tr>
<tr>
<td>Data Converters</td>
<td>Computers and Peripherals</td>
</tr>
<tr>
<td>DLP® Products</td>
<td>Consumer Electronics</td>
</tr>
<tr>
<td>DSP</td>
<td>Energy and Lighting</td>
</tr>
<tr>
<td>Clocks and Timers</td>
<td>Industrial</td>
</tr>
<tr>
<td>Interface</td>
<td>Medical</td>
</tr>
<tr>
<td>Logic</td>
<td>Security</td>
</tr>
<tr>
<td>Power Mgmt</td>
<td>Space, Avionics and Defense</td>
</tr>
<tr>
<td>Microcontrollers</td>
<td>Video and Imaging</td>
</tr>
<tr>
<td>RFID</td>
<td></td>
</tr>
<tr>
<td>OMAP Applications Processors</td>
<td>TI E2E Community</td>
</tr>
<tr>
<td>Wireless Connectivity</td>
<td>e2e.ti.com</td>
</tr>
</tbody>
</table>

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2014, Texas Instruments Incorporated