1 Features

- Output Adjustable From 1.25 V to 125 V when Used with an External Resistor Divider
- 700-mA Output Current
- Full Short-Circuit, Safe-Operating-Area, and Thermal-Shutdown Protection
- 0.001%/V Typical Input Voltage Regulation
- 0.15% Typical Output Voltage Regulation
- 76-dB Typical Ripple Rejection

2 Applications

- Electronic Point of Sale
- Medical, Health, and Fitness Applications
- Printers
- Applications and White Goods

3 Description

The TL783 device is an adjustable three-terminal high-voltage regulator with an output range of 1.25 V to 125 V and a DMOS output transistor capable of sourcing more than 700 mA. It is designed for use in high-voltage applications where standard bipolar regulators cannot be used. Excellent performance specifications, superior to those of most bipolar regulators, are achieved through circuit design and advanced layout techniques.

4 Simplified Schematic
Table of Contents

1 Features ................................................................. 1
2 Applications .......................................................... 1
3 Description ............................................................ 1
4 Simplified Schematic ................................................. 1
5 Revision History ....................................................... 2
6 Pin Configuration and Functions ................................. 3
7 Specifications .......................................................... 4
  7.1 Absolute Maximum Ratings .................................... 4
  7.2 ESD Ratings ........................................................ 4
  7.3 Recommended Operating Conditions ....................... 4
  7.4 Thermal Information ............................................. 4
  7.5 Electrical Characteristics ..................................... 5
  7.6 Typical Characteristics ....................................... 6
8 Detailed Description .................................................. 8
  8.1 Overview .......................................................... 8
  8.2 Functional Block Diagram ..................................... 8
  8.3 Feature Description ............................................. 8
  8.4 Device Functional Modes ..................................... 8
9 Application and Implementation ................................. 9
  9.1 Application Information ....................................... 9
  9.2 Typical Application ........................................... 12
10 Power Supply Recommendations ................................ 16
11 Layout ............................................................... 16
  11.1 Layout Guidelines ........................................... 16
  11.2 Layout Example ............................................... 16
12 Device and Documentation Support ............................ 16
  12.1 Trademarks ..................................................... 16
  12.2 Electrostatic Discharge Caution ......................... 16
  12.3 Glossary ....................................................... 16
13 Mechanical, Packaging, and Orderable Information ......... 16

5 Revision History

Changes from Revision M (April 2008) to Revision N

• Added Applications, Device Information table, Pin Functions table, ESD Ratings table, Thermal Information table, Typical Characteristics, Feature Description section, Device Functional Modes, Application and Implementation section, Power Supply Recommendations section, Layout section, Device and Documentation Support section, and Mechanical, Packaging, and Orderable Information section. ................................................................. 1

• Deleted Ordering Information table.  ................................................................. 1
6 Pin Configuration and Functions

<table>
<thead>
<tr>
<th>PIN</th>
<th>TYPE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADJ</td>
<td>I/O</td>
<td>Voltage adjustment pin. Connect a resistor divider to determine the output voltage.</td>
</tr>
<tr>
<td>IN</td>
<td>I</td>
<td>Supply Input</td>
</tr>
<tr>
<td>OUT</td>
<td>O</td>
<td>Voltage Output</td>
</tr>
</tbody>
</table>

Pin Functions
7 Specifications

7.1 Absolute Maximum Ratings

Over operating temperature range (unless otherwise noted)\(^{(1)}\)

<table>
<thead>
<tr>
<th></th>
<th>MIN</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(V_{I-O})</td>
<td>125</td>
<td>150</td>
<td>V</td>
</tr>
<tr>
<td>(T_J)</td>
<td>0</td>
<td>125</td>
<td>°C</td>
</tr>
<tr>
<td>(T_{stg})</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.

7.2 ESD Ratings

<table>
<thead>
<tr>
<th></th>
<th>VALUE</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(V_{(ESD)})</td>
<td>2500</td>
<td>V</td>
</tr>
<tr>
<td>Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins(^{(1)})</td>
<td>2500</td>
<td>V</td>
</tr>
<tr>
<td>Charged device model (CDM), per JEDEC specification JESD22-C101, all pins(^{(2)})</td>
<td>1000</td>
<td>V</td>
</tr>
</tbody>
</table>

\(^{(1)}\) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
\(^{(2)}\) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

7.3 Recommended Operating Conditions

<table>
<thead>
<tr>
<th></th>
<th>MIN</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(V_{I-O})</td>
<td>125</td>
<td>150</td>
<td>V</td>
</tr>
<tr>
<td>(I_O)</td>
<td>15</td>
<td>700</td>
<td>mA</td>
</tr>
<tr>
<td>(T_J)</td>
<td>0</td>
<td>125</td>
<td>°C</td>
</tr>
</tbody>
</table>

7.4 Thermal Information

<table>
<thead>
<tr>
<th>THERMAL METRIC(^{(1)})</th>
<th>TL783</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>KTE</td>
</tr>
<tr>
<td>(R_{JA})</td>
<td>23</td>
</tr>
<tr>
<td>Junction-to-ambient thermal resistance</td>
<td></td>
</tr>
<tr>
<td>(R_{JC(top)})</td>
<td>N/A</td>
</tr>
<tr>
<td>Junction-to-case (top) thermal resistance</td>
<td></td>
</tr>
<tr>
<td>(R_{JP})</td>
<td>2.7</td>
</tr>
<tr>
<td>Junction-to-exposed-pad thermal resistance</td>
<td></td>
</tr>
</tbody>
</table>

\(^{(1)}\) For more information about traditional and new thermal metrics, see the **IC Package Thermal Metrics** application report, SPRA953.
## 7.5 Electrical Characteristics

\( V_I - V_O = 25 \text{ V}, \ I_O = 0.5 \text{ A}, \ T_J = 0^\circ\text{C} \text{ to } 125^\circ\text{C} \) (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>Input voltage regulation(^{(2)})</td>
<td>( V_I - V_O = 20 \text{ V} \text{ to } 125 \text{ V}, \ P \leq \text{ rated dissipation } )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>( T_J = 25^\circ\text{C} )</td>
<td>0.001</td>
<td>0.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>( T_J = 0^\circ\text{C} \text{ to } 125^\circ\text{C} )</td>
<td>0.004</td>
<td>0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ripple rejection</td>
<td>( \Delta V_{IPPR} = 10 \text{ V}, \ V_O = 10 \text{ V}, f = 120 \text{ Hz} )</td>
<td>66</td>
<td>76</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Output voltage regulation</td>
<td>( I_O = 15 \text{ mA} \text{ to } 700 \text{ mA}, \ T_J = 25^\circ\text{C} )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>( V_O \leq 5 \text{ V} )</td>
<td>7.5</td>
<td>25</td>
<td></td>
<td>mV</td>
</tr>
<tr>
<td></td>
<td>( V_O \geq 5 \text{ V} )</td>
<td>0.15%</td>
<td>0.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output voltage regulation</td>
<td>( I_O = 15 \text{ mA} \text{ to } 700 \text{ mA}, \ P \leq \text{ rated dissipation} )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>( V_O \leq 5 \text{ V} )</td>
<td>20</td>
<td>70</td>
<td></td>
<td>mV</td>
</tr>
<tr>
<td></td>
<td>( V_O \geq 5 \text{ V} )</td>
<td>0.3%</td>
<td>1.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output voltage change with temperature</td>
<td></td>
<td>0.4%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output voltage long-term drift</td>
<td>1000 hours at ( T_J = 125^\circ\text{C}, \ V_I - V_O = 125 \text{ V} )</td>
<td>0.2%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output noise voltage</td>
<td>( f = 10 \text{ Hz} \text{ to } 10 \text{ kHz}, T_J = 25^\circ\text{C} )</td>
<td>0.003%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum output current to maintain regulation</td>
<td>( V_I - V_O = 125 \text{ V} )</td>
<td>15</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Peak output current</td>
<td>( V_I - V_O = 25 \text{ V}, t = 1 \text{ ms} )</td>
<td>1100</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td>( V_I - V_O = 15 \text{ V}, t = 30 \text{ ms} )</td>
<td>715</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>( V_I - V_O = 25 \text{ V}, t = 30 \text{ ms} )</td>
<td>700</td>
<td>900</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>( V_I - V_O = 125 \text{ V}, t = 30 \text{ ms} )</td>
<td>100</td>
<td>250</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADJ input current</td>
<td></td>
<td>83</td>
<td>110</td>
<td></td>
<td>( \mu\text{A} )</td>
</tr>
<tr>
<td>Change in ADJ input current</td>
<td>( V_I - V_O = 15 \text{ V} \text{ to } 125 \text{ V}, \ I_O = 15 \text{ mA} \text{ to } 700 \text{ mA}, \ P \leq \text{ rated dissipation} )</td>
<td>0.5</td>
<td>5</td>
<td></td>
<td>( \mu\text{A} )</td>
</tr>
<tr>
<td>Reference voltage (OUT to ADJ)(^{(3)})</td>
<td>( V_I - V_O = 10 \text{ V} \text{ to } 125 \text{ V}, \ I_O = 15 \text{ mA} \text{ to } 700 \text{ mA}, \ P \leq \text{ rated dissipation} )</td>
<td>1.2</td>
<td>1.27</td>
<td>1.3</td>
<td>V</td>
</tr>
</tbody>
</table>

\(^{(1)}\) Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately.

\(^{(2)}\) Input voltage regulation is expressed here as the percentage change in output voltage per 1-V change at the input

\(^{(3)}\) Due to the dropout voltage and output current-limiting characteristics of this device, output current is limited to less than 700 mA at input-to-output voltage differentials of less than 25 V.
7.6 Typical Characteristics

![Figure 1. Output Current Limit vs Input-to-Output Voltage Differential](image1)

![Figure 2. Output Current Limit vs Input-to-Output Voltage Differential](image2)

![Figure 3. Output Current Limit vs Time](image3)

![Figure 4. Ripple Rejection vs Output Voltage](image4)

![Figure 5. Ripple Rejection vs Output Current](image5)

![Figure 6. Ripple Rejection vs Frequency](image6)
Typical Characteristics (continued)

Figure 7. Output Impedance

Figure 8. Reference Voltage

Figure 9. Input Current at ADJ

Figure 10. Dropout Voltage

Figure 11. Output Voltage Deviation

Figure 12. Output Current

(1) This is the minimum current required to maintain voltage regulation.
8 Detailed Description

8.1 Overview

The TL783 device is an adjustable three-terminal high-voltage regulator with an output range of 1.25 V to 125 V and a DMOS output transistor capable of sourcing more than 700 mA. It is designed for use in high-voltage applications where standard bipolar regulators cannot be used. Excellent performance specifications, superior to those of most bipolar regulators, are achieved through circuit design and advanced layout techniques.

As a state-of-the-art regulator, the TL783 device combines standard bipolar circuitry with high-voltage double-diffused MOS transistors on one chip, to yield a device capable of withstanding voltages far higher than standard bipolar integrated circuits. Because of its lack of secondary-breakdown and thermal-runaway characteristics usually associated with bipolar outputs, the TL783 maintains full overload protection while operating at up to 125 V from input to output. Other features of the device include current limiting, safe-operating-area (SOA) protection, and thermal shutdown. Even if ADJ is disconnected inadvertently, the protection circuitry remains functional.

Only two external resistors are required to program the output voltage. An input bypass capacitor is necessary only when the regulator is situated far from the input filter. An output capacitor, although not required, improves transient response and protection from instantaneous output short circuits. Excellent ripple rejection can be achieved without a bypass capacitor at the adjustment terminal.

8.2 Functional Block Diagram

8.3 Feature Description

- Output Adjustable From 1.25 V to 125 V when Used with an External Resistor Divider
- 700-mA Output Current
- Full Short-Circuit, Safe-Operating-Area, and Thermal-Shutdown Protection
- 0.001%/V Typical Input Voltage Regulation
- 0.15% Typical Output Voltage Regulation
- 76-dB Typical Ripple Rejection

8.4 Device Functional Modes

8.4.1 Active Mode

The TL783 acts as a high-voltage adjustable regulator. The device works to keep the voltage at the OUT pin 1.25 V higher than the voltage at the ADJ pin. Therefore, a resistor divider can be used to set the output voltage.
9 Application and Implementation

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

9.1 Application Information

9.1.1 General Configurations

Figure 13. 125-V Short-Circuit-Protected Off-Line Regulator

Figure 14. 50-V Regulator With Current Boost

Copyright © 1981–2015, Texas Instruments Incorporated

Submit Documentation Feedback
Application Information (continued)

Figure 15. Adjustable Regulator With Current Boost and Current Limit

Figure 16. Current-Sinking Regulator
Application Information (continued)

Figure 17. Current-Sourcing Regulator

Figure 18. High-Voltage Unity-Gain Offset Amplifier
Application Information (continued)

![Circuit Diagram](image)

**Figure 19. 48-V 200-mA Float Charger**

### 9.2 Typical Application

The TL783 is typically used as an adjustable regulator.

![Circuit Diagram](image)

**Figure 20. 1.25-V to 115-V Adjustable Regulator**

#### 9.2.1 Design Requirements

- Input and output decoupling capacitors for noise filtering.
- Resistor divider consisting of R1 and R2 to set the output voltage.

A. Needed if device is more than 4 inches from filter capacitor
Typical Application (continued)

9.2.2 Detailed Design Procedure

The internal reference (see Simplified Schematic) generates 1.25 V nominal \( V_{\text{ref}} \) between OUT and ADJ. This voltage is developed across R1 and causes a constant current to flow through R1 and the programming resistor R2, giving an output voltage of:

\[
V_O = V_{\text{ref}} \left(1 + \frac{R2}{R1}\right) + I_{I(\text{ADJ})}(R2)
\]

or

\[
V_O \neq V_{\text{ref}} \left(1 + \frac{R2}{R1}\right)
\]

The TL783 was designed to minimize the input current at ADJ and maintain consistency over line and load variations, thereby minimizing the associated \( R2 \) error term.

To maintain \( I_{I(\text{ADJ})} \) at a low level, all quiescent operating current is returned to the output terminal. This quiescent current must be sunk by the external load and is the minimum load current necessary to prevent the output from rising. The recommended R1 value of 82 \( \Omega \) provides a minimum load current of 15 mA. Larger values can be used when the input-to-output differential voltage is less than 125 V (see the output-current curve in Figure 12) or when the load sinks some portion of the minimum current.

9.2.2.1 Bypass Capacitors

The TL783 regulator is stable without bypass capacitors; however, any regulator becomes unstable with certain values of output capacitance if an input capacitor is not used. Therefore, the use of input bypassing is recommended whenever the regulator is located more than four inches from the power-supply filter capacitor. A 1-\( \mu \)F tantalum or aluminum electrolytic capacitor usually is sufficient.

Adjustment-terminal capacitors are not recommended for use on the TL783 because they can seriously degrade load transient response, as well as create a need for extra protection circuitry. Excellent ripple rejection presently is achieved without this added capacitor.

Due to the relatively low gain of the MOS output stage, output voltage dropout may occur under large-load transient conditions. The addition of an output bypass capacitor greatly enhances load transient response and prevents dropout. For most applications, it is recommended that an output bypass capacitor be used, with a minimum value of:

\[
C_o (\mu F) = \frac{15}{V_O}
\]

Larger values provide proportionally better transient-response characteristics.
Typical Application (continued)

9.2.2.2 Protection Circuitry

The TL783 regulator includes built-in protection circuits capable of guarding the device against most overload conditions encountered in normal operation. These protective features are current limiting, safe-operating-area protection, and thermal shutdown. These circuits protect the device under occasional fault conditions only. Continuous operation in the current limit or thermal shutdown mode is not recommended.

The internal protection circuits of the TL783 protect the device up to maximum-rated $V_I$ as long as certain precautions are taken. If $V_I$ is switched on instantaneously, transients exceeding maximum input ratings may occur, which can destroy the regulator. Usually, these are caused by lead inductance and bypass capacitors causing a ringing voltage on the input. In addition, when rise times in excess of 10 V/ns are applied to the input, a parasitic npn transistor in parallel with the DMOS output can be turned on, causing the device to fail. If the device is operated over 50 V and the input is switched on, rather than ramped on, a low-Q capacitor, such as tantalum or aluminum electrolytic, should be used, rather than ceramic, paper, or plastic bypass capacitors. A Q factor of 0.015, or greater, usually provides adequate damping to suppress ringing. Normally, no problems occur if the input voltage is allowed to ramp upward through the action of an ac line rectifier and filter network.

Similarly, when an instantaneous short circuit is applied to the output, both ringing and excessive fall times can result. A tantalum or aluminum electrolytic bypass capacitor is recommended to eliminate this problem. However, if a large output capacitor is used, and the input is shorted, addition of a protection diode may be necessary to prevent capacitor discharge through the regulator. The amount of discharge current delivered is dependent on output voltage, size of capacitor, and fall time of $V_I$. A protective diode (see Figure 21) is required only for capacitance values greater than:

$$C_o (\mu F) = 3 \times 10^4 / (V_O)^2$$

Care always should be taken to prevent insertion of regulators into a socket with power on. Power should be turned off before removing or inserting regulators.

![Regulator With Protective Diode](imageurl)
Typical Application (continued)

9.2.2.3 Load Regulation

The current-set resistor (R1) should be located close to the regulator output terminal, rather than near the load. This eliminates long line drops from being amplified, through the action of R1 and R2, to degrade load regulation. To provide remote ground sensing, R2 should be near the load ground.

![Regulator With Current-Set Resistor](image)

Figure 22. Regulator With Current-Set Resistor

9.2.3 Application Curves

![Line Transient Response](image)

Figure 23. Line Transient Response

![Load Transient Response](image)

Figure 24. Load Transient Response
10 Power Supply Recommendations

A decoupling capacitor is needed on the IN pin of the TL783 if the TL783 is more than 4 inches from its power supply's filter capacitor. The differential input and output voltage levels are detailed in Recommended Operating Conditions.

11 Layout

11.1 Layout Guidelines

Input and output traces should be thick enough to handle desired currents, which can reach up to 700 mA on the output. ADJ pin traces can be smaller because the adjustment current is negligible.

11.2 Layout Example

![Figure 25. Layout Example](image)

12 Device and Documentation Support

12.1 Trademarks

All trademarks are the property of their respective owners.

12.2 Electrostatic Discharge Caution

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.

12.3 Glossary

**SLYZ022** — *TI Glossary.*

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

13 Mechanical, Packaging, and Orderable Information

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

<table>
<thead>
<tr>
<th>Orderable Device</th>
<th>Status</th>
<th>Package Type</th>
<th>Package Drawing</th>
<th>Pins</th>
<th>Package Qty</th>
<th>Eco Plan</th>
<th>Lead/Ball Finish</th>
<th>MSL Peak Temp</th>
<th>Op Temp (°C)</th>
<th>Device Marking</th>
<th>Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>TL783CKCE3</td>
<td>ACTIVE</td>
<td>TO-220</td>
<td>KCS</td>
<td>3</td>
<td>50</td>
<td>Pb-Free</td>
<td>CU SN</td>
<td>N / A for Pkg Type</td>
<td>0 to 125</td>
<td>TL783C</td>
<td>Samples</td>
</tr>
<tr>
<td>TL783CKTTR</td>
<td>ACTIVE</td>
<td>DDPAK/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>TL783C</td>
<td>Samples</td>
</tr>
<tr>
<td>TL783CKTTRG3</td>
<td>ACTIVE</td>
<td>DDPAK/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>TL783C</td>
<td>Samples</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

<table>
<thead>
<tr>
<th>Device</th>
<th>Package Type</th>
<th>Package Drawing</th>
<th>Pins</th>
<th>SPQ</th>
<th>Reel Diameter (mm)</th>
<th>Reel Width W1 (mm)</th>
<th>A0 (mm)</th>
<th>B0 (mm)</th>
<th>K0 (mm)</th>
<th>P1 (mm)</th>
<th>W (mm)</th>
<th>Pin1 Quadrant</th>
</tr>
</thead>
<tbody>
<tr>
<td>TL783CKTTR</td>
<td>DDPAK/TO-263</td>
<td>KTT</td>
<td>3</td>
<td>500</td>
<td>330.0</td>
<td>24.4</td>
<td>10.8</td>
<td>16.3</td>
<td>5.11</td>
<td>16.0</td>
<td>24.0</td>
<td>Q2</td>
</tr>
<tr>
<td>TL783CKTTR</td>
<td>DDPAK/TO-263</td>
<td>KTT</td>
<td>3</td>
<td>500</td>
<td>330.0</td>
<td>24.4</td>
<td>10.8</td>
<td>16.1</td>
<td>4.9</td>
<td>16.0</td>
<td>24.0</td>
<td>Q2</td>
</tr>
</tbody>
</table>

*All dimensions are nominal.*
# 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>TL783CKTTR</td>
<td>DDPAK/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>
<tr>
<td>TL783CKTTR</td>
<td>DDPAK/TO-263</td>
<td>KTT</td>
<td>3</td>
<td>500</td>
<td>350.0</td>
<td>334.0</td>
<td>47.0</td>
</tr>
</tbody>
</table>
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.
D. 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:

1. Dimensions are in millimeters. Any dimension in brackets or parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC registration TO-220.
EXAMPLE BOARD LAYOUT

KCS0003B
TO-220 - 19.65 mm max height

TO-220

LAND PATTERN EXAMPLE
NON-SOLDER MASK DEFINED
SCALE: 15X
<table>
<thead>
<tr>
<th>REV</th>
<th>DESCRIPTION</th>
<th>ECR</th>
<th>DATE</th>
<th>ENGINEER / DRAFSTMAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>RELEASE NEW DRAWING</td>
<td>2151829</td>
<td>10/22/2015</td>
<td>J. NOQUIL / T. LEQUANG</td>
</tr>
<tr>
<td>A</td>
<td>CORRECT NOTE 1</td>
<td>2175971</td>
<td>08/17/2018</td>
<td>E. PREISS / K. SINCERBOX</td>
</tr>
</tbody>
</table>
Texas Instruments Incorporated (TI) reserves 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.

TI's published terms of sale for semiconductor products (http://www.ti.com/sc/docs/stdterms.htm) apply to the sale of packaged integrated circuit products that TI has qualified and released to market. Additional terms may apply to the use or sale of other types of TI products and services.

Reproduction of significant portions of TI information in TI 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 reproduced documentation. Information of third parties may be subject to additional restrictions. Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and/or implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyers and others who are developing systems that incorporate TI products (collectively, “Designers”) understand and agree that Designers remain responsible for using their independent analysis, evaluation and judgment in designing their applications and that Designers have full and exclusive responsibility to assure the safety of Designers’ applications and compliance of their applications (and of all TI products used in or for Designers’ applications) with all applicable regulations, laws and other applicable requirements. Designer represents that, with respect to their applications, Designer has all the necessary expertise to create and implement safeguards that (1) anticipate dangerous consequences of failures, (2) monitor failures and their consequences, and (3) lessen the likelihood of failures that might cause harm and take appropriate actions. Designer agrees that prior to using or distributing any applications that include TI products, Designer will thoroughly test such applications and the functionality of such TI products as used in such applications.

TI’s provision of technical, application or other design advice, quality characterization, reliability data or other services or information, including, but not limited to, reference designs and materials relating to evaluation modules, (collectively, “TI Resources”) are intended to assist designers who are developing applications that incorporate TI products; by downloading, accessing or using TI Resources in any way, Designer (individually or, if Designer is acting on behalf of a company, Designer’s company) agrees to use any particular TI Resource solely for this purpose and subject to the terms of this Notice.

TI’s provision of TI Resources does not expand or otherwise alter TI’s applicable published warranties or warranty disclaimers for TI products, and no additional obligations or liabilities arise from TI providing such TI Resources. TI reserves the right to make corrections, enhancements, improvements and other changes to its TI Resources. TI has not conducted any testing other than that specifically described in the published documentation for a particular TI Resource.

Designer is authorized to use, copy and modify any individual TI Resource only in connection with the development of applications that include the TI product(s) identified in such TI Resource. NO OTHER LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE TO ANY TECHNOLOGY, INTELLECTUAL PROPERTY RIGHT OR ANY THIRD PARTY IS GRANTED HEREIN, including but not limited to any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information regarding or referencing third-party products or services does not constitute a license to use such products or services, or a warranty or endorsement thereof. Use of TI Resources 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.

TI RESOURCES ARE PROVIDED “AS IS” AND WITH ALL FAULTS. TI DISCLAIMS ALL OTHER WARRANTIES OR REPRESENTATIONS, EXPRESS OR IMPLIED, REGARDING RESOURCES OR USE THEREOF, INCLUDING BUT NOT LIMITED TO ACCURACY OR COMPLETENESS, TITLE, ANY EPIDEMIC FAILURE WARRANTY AND ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF ANY THIRD PARTY INTELLECTUAL PROPERTY RIGHTS. TI SHALL NOT BE LIABLE FOR AND SHALL NOT DEFEND OR INDEMNIFY DESIGNER AGAINST ANY CLAIM, INCLUDING BUT NOT LIMITED TO ANY INFRINGEMENT CLAIM THAT RELATES TO OR IS BASED ON ANY COMBINATION OF PRODUCTS EVEN IF DESCRIBED IN TI RESOURCES OR OTHERWISE. IN NO EVENT SHALL TI BE LIABLE FOR ANY ACTUAL, DIRECT, SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF TI RESOURCES OR USE THEREOF, AND REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Unless TI has explicitly designated an individual product as meeting the requirements of a particular industry standard (e.g., ISO/TS 16949 and ISO 26262), TI is not responsible for any failure to meet such industry standard requirements.

Where TI specifically promotes products as facilitating functional safety or as compliant with industry functional safety standards, such products are intended to help enable customers to design and create their own applications that meet applicable functional safety standards and requirements. Using products in an application does not by itself establish any safety features in the application. Designers must ensure compliance with safety-related requirements and standards applicable to their applications. Designers may not use any TI products in life-critical medical equipment unless authorized officers of the parties have executed a special contract specifically governing such use. Life-critical medical equipment is medical equipment where failure of such equipment would cause serious bodily injury or death (e.g., life support, pacemakers, defibrillators, heart pumps, neurostimulators, and implantables). Such equipment includes, without limitation, all medical devices identified by the U.S. Food and Drug Administration as Class III devices and equivalent classifications outside the U.S.

TI may expressly designate certain products as completing a particular qualification (e.g., Q100, Military Grade, or Enhanced Product). Designers agree that it has the necessary expertise to select the product with the appropriate qualification designation for their applications and that proper product selection is at Designers’ own risk. Designers are solely responsible for compliance with all legal and regulatory requirements in connection with such selection.

Designer will fully indemnify TI and its representatives against any damages, costs, losses, and/or liabilities arising out of Designer’s non-compliance with the terms and provisions of this Notice.