# LP3990 150mA Linear Voltage Regulator for Digital Applications

**Check for Samples: LP3990**

## FEATURES

- **1% Voltage Accuracy at Room Temperature**
- **Stable with Ceramic Capacitor**
- **Logic Controlled Enable**
- **No Noise Bypass Capacitor Required**
- **Thermal-Overload and Short-Circuit Protection**

## KEY SPECIFICATIONS

- **Input Voltage Range, 2.0 to 6.0V**
- **Output Voltage Range, 0.8 to 3.3V**
- **Output Current, 150mA**
- **Output Stable - Capacitors, 1.0µF**
- **Virtually Zero $I_Q$ (Disabled), <10nA**
- **Very Low $I_Q$ (Enabled), 43µA**
- **Low Output Noise, 150µ$V_{RMS}$**
- **PSRR, 55dB at 1kHz**
- **Fast Start Up, 105µs**

## PACKAGE

**All available in Lead Free option.**

- **4-Pin DSBGA, 1 mm x 1.3 mm**
- **6-pin WQFN (SOT-23 Footprint)**
- **SOT-23**

**For other package options contact your Texas Instruments sales office.**

## APPLICATIONS

- **Cellular Handsets**
- **Hand-Held Information Appliances**

## DESCRIPTION

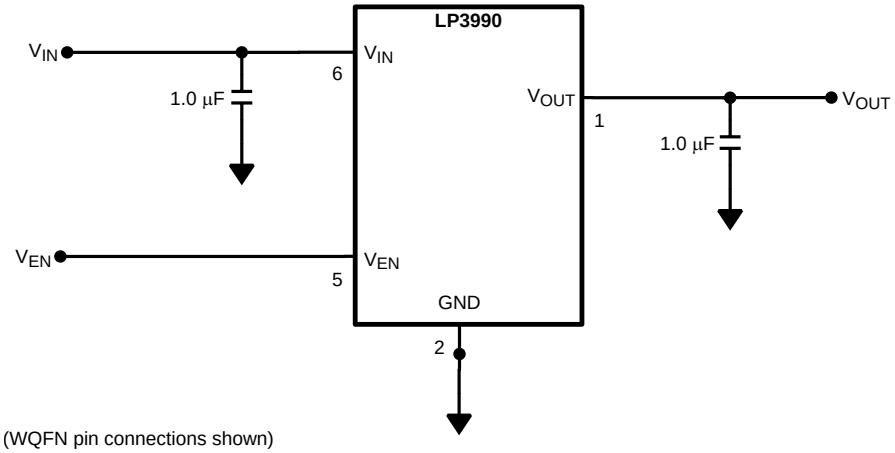
The LP3990 regulator is designed to meet the requirements of portable, battery-powered systems providing an accurate output voltage, low noise, and low quiescent current. The LP3990 will provide a 0.8V output from the low input voltage of 2V at up to 150mA load current. When switched into shutdown mode via a logic signal at the enable pin, the power consumption is reduced to virtually zero.

The LP3990 is designed to be stable with space saving ceramic capacitors as small as 1.0µF.

Performance is specified for a -40°C to 125°C junction temperature range.

For output voltages other than 0.8V, 1.2, 1.35V, 1.5V, 1.8V, 2.5V, 2.8V, or 3.3V please contact your local NSC sales office.

## Typical Application Circuit




(WQFN pin connections shown)

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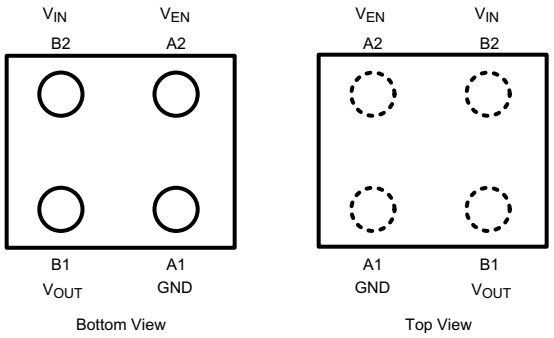
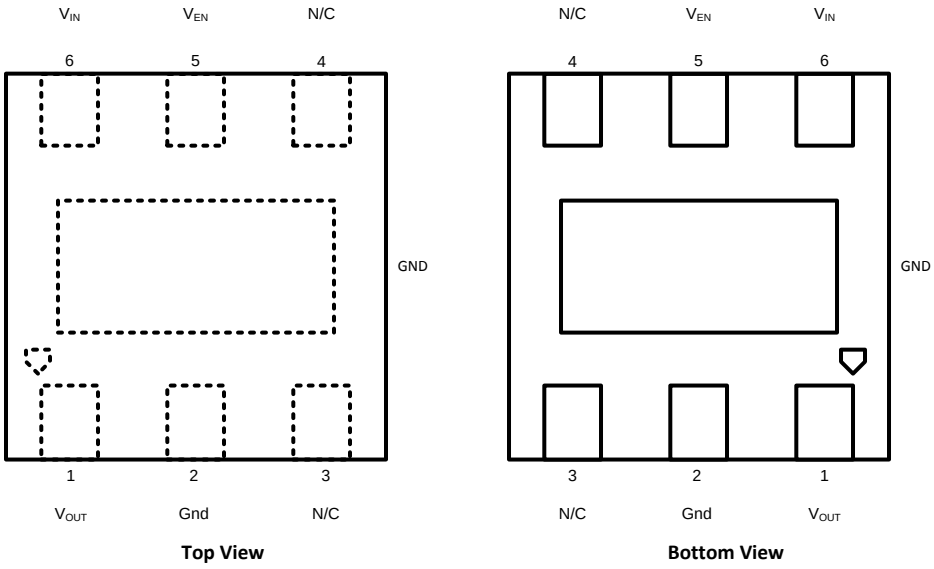
**PIN DESCRIPTIONS**

| Pin No | | | Symbol | Name and Function |
|---|---|---|---|---|
| WQFN | DSBGA | SOT-23 | | |
| 5 | A2 | 3 | $V_{EN}$ | Enable Input; Enables the Regulator when ≥ 0.95V.<br>Disables the Regulator when ≤ 0.4V.<br>Enable Input has 1MΩ pulldown resistor to GND. |
| 2 | A1 | 2 | GND | Common Ground. Connect to Pad. |
| 1 | B1 | 5 | $V_{OUT}$ | Voltage output. A 1.0µF Low ESR Capacitor should be connected to this Pin. Connect this output to the load circuit. |
| 6 | B2 | 1 | $V_{IN}$ | Voltage Supply Input. A 1.0µF capacitor should be connected at this input. |
| 3 | | 4 | N/C | No Connection. Do not connect to any other pin. |
| 4 | | | N/C | No Connection. Do not connect to any other pin. |
| Pad | | | GND | Common Ground. Connect to Pin 2. |

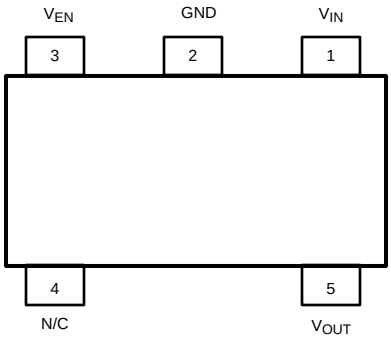
## Connection Diagram




**DSBGA, 4 Bump Package**
**See Package Number YZR0004**




**WQFN-6 Package**
**See Package Number NGG0006A**




**SOT-23 Package**
**See Package Number DBV**

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 (1)(2)(3)

| | |
|---|---|
| Input Voltage | -0.3 to 6.5V |
| Output Voltage | -0.3 to ($V_{IN}$ + 0.3V) with 6.5V (max) |
| Enable Input Voltage | -0.3 to ($V_{IN}$ + 0.3V) with 6.5V (max) |
| Junction Temperature | 150°C |
| Lead/Pad Temp. (4) | |
| WQFN/SOT-23 | 235°C |
| DSBGA | 260°C |
| Storage Temperature | -65 to 150°C |
| Continuous Power Dissipation Internally Limited (5) | |
| ESD (6) | |
| Human Body Model | 2KV |
| Machine Model | 200V |

(1) All Voltages are with respect to the potential at the GND pin.
(2) Absolute Maximum Ratings are limits beyond which damage can occur. Operating Ratings are conditions under which operation of the device is guaranteed. Operating Ratings do not imply guaranteed performance limits. For guaranteed performance limits and associated test conditions, see the Electrical Characteristics tables.
(3) If Military/Aerospace specified devices are required, please contact the TI Sales Office/Distributors for availability and specifications.
(4) For further information on these packages please refer to the following Application Notes; AN1112 DSBGA Package Wafer Level Chip Scale Package, AN1187 Leadless Leadframe Package.
(5) Internal thermal shutdown circuitry protects the device from permanent damage.
(6) The human body model is 100pF discharged through a 1.5kΩ resistor into each pin. The machine model is a 200pF capacitor discharged directly into each pin.

## Operating Ratings (1)

| | |
|---|---|
| Input Voltage | 2V to 6V |
| Enable Input Voltage | 0 to ($V_{IN}$ + 0.3V) with 6.0V (max) |
| Junction Temperature | -40°C to 125°C |
| Ambient Temperature $T_A$ Range (2) | -40°C to 85°C |

(1) Absolute Maximum Ratings are limits beyond which damage can occur. Operating Ratings are conditions under which operation of the device is guaranteed. Operating Ratings do not imply guaranteed performance limits. For guaranteed performance limits and associated test conditions, see the Electrical Characteristics tables.
(2) The maximum ambient temperature ($T_{A(max)}$) is dependant on the maximum operating junction temperature ($T_{J(max-op)}$ = 125°C), the maximum power dissipation of the device in the application ($P_{D(max)}$), and the junction to ambient thermal resistance of the part/package in the application ($\theta_{JA}$), as given by the following equation: $T_{A(max)} = T_{J(max-op)} - (\theta_{JA} \times P_{D(max)})$.

## Thermal Properties(1)

| Junction To Ambient Thermal Resistance(2) | |
|---|---|
| $\theta_{JA}$(WQFN-6) | 88°C/W |
| $\theta_{JA}$(DSBGA) | 220°C/W |
| $\theta_{JA}$(SOT-23) | 220°C/W |

(1) Absolute Maximum Ratings are limits beyond which damage can occur. Operating Ratings are conditions under which operation of the device is guaranteed. Operating Ratings do not imply guaranteed performance limits. For guaranteed performance limits and associated test conditions, see the Electrical Characteristics tables.

(2) Junction to ambient thermal resistance is dependant on the application and board layout. In applications where high maximum power dissipation is possible, special care must be paid to thermal dissipation issues in board design.

## Electrical Characteristics

Unless otherwise noted, $V_{EN}$ =950mV, $V_{IN}$ = $V_{OUT}$ + 1.0V, or 2.0V, whichever is higher. $C_{IN}$ = 1 µF, $I_{OUT}$ = 1 mA, $C_{OUT}$ =0.47 µF.
Typical values and limits appearing in normal type apply for $T_J$ = 27°C. Limits appearing in **boldface** type apply over the full junction temperature range for operation, −40 to +125°C. (1)

| Symbol | Parameter | Conditions | | Typ | Limit | | Units |
|---|---|---|---|---|---|---|---|
| | | | | | Min | Max | |
| $V_{IN}$ | Input Voltage | (2) | | | 2 | 6 | V |
| $\Delta V_{OUT}$ | Output Voltage Tolerance | $I_{LOAD}$ = 1 mA | DSBGA | | -1 | +1 | % |
| | | | WQFN | | -1.5 | +1.5 | |
| | | | SOT-23 | | -1.5 | +1.5 | |
| | | Over full line and load regulation. | DSBGA | | **-2.5** | **+2.5** | |
| | | | WQFN | | **-3** | **+3** | |
| | | | SOT-23 | | **-4** | **+4** | |
| | Line Regulation Error | $V_{IN}$ = ($V_{OUT(NOM)}$ + 1.0V) to 6.0V, | | 0.02 | **-0.1** | **0.1** | %/V |
| | Load Regulation Error | $I_{OUT}$ = 1mA to 150mA | $V_{OUT}$ = 0.8 to 1.95V DSBGA | 0.002 | **-0.005** | **0.005** | %/mA |
| | | | $V_{OUT}$ = 0.8 to 1.95V WQFN, SOT-23 | 0.003 | **-0.008** | **0.008** | |
| | | | $V_{OUT}$ = 2.0 to 3.3V DSBGA | 0.0005 | **-0.002** | **0.002** | |
| | | | $V_{OUT}$ = 2.0 to 3.3V WQFN, SOT-23 | 0.002 | **-0.005** | **0.005** | |
| $V_{DO}$ | Dropout Voltage | $I_{OUT}$ = 150mA (3) (4) | | 120 | | **200** | mV |
| $I_{LOAD}$ | Load Current | See (5) (4) | | | 0 | | µA |
| $I_Q$ | Quiescent Current | $V_{EN}$ = 950mV, $I_{OUT}$ = 0mA | | 43 | | **80** | µA |
| | | $V_{EN}$ = 950mV, $I_{OUT}$ = 150mA | | 65 | | **120** | |
| | | $V_{EN}$ = 0.4V | | 0.002 | | 0.2 | |
| $I_{SC}$ | Short Circuit Current Limit | See (6) | | 550 | | **1000** | mA |
| $I_{OUT}$ | Maximum Output Current | | | | **150** | | mA |
| PSRR | Power Supply Rejection Ratio | f = 1kHz, $I_{OUT}$ = 1mA to 150mA | | 55 | | | dB |
| | | f = 10kHz, $I_{OUT}$ = 150mA | | 35 | | | |
| $e_n$ | Output noise Voltage (4) | BW = 10Hz to 100kHz, | $V_{OUT}$ = 0.8 | 60 | | | $\mu V_{RMS}$ |
| | | | $V_{OUT}$ = 1.5 | 125 | | | |
| | | | $V_{OUT}$ = 3.3 | 180 | | | |
| $T_{SHUTDOWN}$ | Thermal Shutdown | Temperature | | 155 | | | °C |
| | | Hysteresis | | 15 | | | |
| **Enable Control Characteristics** | | | | | | | |
| $I_{EN}$ (7) | Maximum Input Current at $V_{EN}$ Input | $V_{EN}$ = 0.0V | | 0.001 | | 0.1 | µA |
| | | $V_{EN}$ = 6V | | 6 | **2.5** | **10** | |
| $V_{IL}$ | Low Input Threshold | $V_{IN}$ = 2V to 6V | | | | **0.4** | V |
| $V_{IH}$ | High Input Threshold | $V_{IN}$ = 2V to 6V | | | **0.95** | | V |

(1) All limits are guaranteed. All electrical characteristics having room-temperature limits are tested during production at $T_J$ = 25°C or correlated using Statistical Quality Control methods. Operation over the temperature specification is guaranteed by correlating the electrical characteristics to process and temperature variations and applying statistical process control.
(2) $V_{IN(MIN)}$ = $V_{OUT(NOM)}$ + 0.5V, or 2.0V, whichever is higher.
(3) Dropout voltage is voltage difference between input and output at which the output voltage drops to 100mV below its nominal value. This parameter only for output voltages above 2.0V.
(4) This electrical specification is guaranteed by design.
(5) The device maintains the regulated output voltage without the load.
(6) Short circuit current is measured with $V_{OUT}$ pulled to 0V and $V_{IN}$ worst case = 6.0V.
(7) Enable Pin has 1MΩ typical, resistor connected to GND.

## Electrical Characteristics (continued)

Unless otherwise noted, $V_{EN}$ =950mV, $V_{IN}$ = $V_{OUT}$ + 1.0V, or 2.0V, whichever is higher. $C_{IN}$ = 1 µF, $I_{OUT}$ = 1 mA, $C_{OUT}$ =0.47 µF.
Typical values and limits appearing in normal type apply for $T_J$ = 27°C. Limits appearing in **boldface** type apply over the full junction temperature range for operation, −40 to +125°C. (1)

| Symbol | Parameter | Conditions | | Typ | Limit | | Units |
|---|---|---|---|---|---|---|---|
| | | | | | Min | Max | |
| **Timing Characteristics** | | | | | | | |
| $T_{ON}$ | Turn On Time (8) | To 95% Level $V_{IN(MIN)}$ to 6.0V | $V_{OUT}$ = 0.8 | 80 | | **150** | µs |
| | | | $V_{OUT}$ = 1.5 | 105 | | **200** | |
| | | | $V_{OUT}$ = 3.3 | 175 | | **250** | |
| Transient Response | Line Transient Response $\|\delta V_{OUT}\|$ | $T_{rise}$ = $T_{fall}$ = 30µs (8)$\delta V_{IN}$ = 600mV | | 8 | | **16** | mV (pk - pk) |
| | Load Transient Response $\|\delta V_{OUT}\|$ | $T_{rise}$ = $T_{fall}$ = 1µs (8)$I_{OUT}$ = 1mA to 150mA $C_{OUT}$ = 1µF | | 55 | | **100** | mV |

(8) This electrical specification is guaranteed by design.

## Output Capacitor, Recommended Specifications

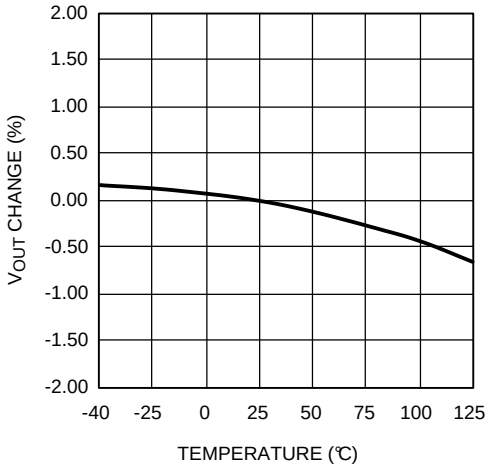
| Symbol | Parameter | Conditions | Nom | Limit | | Units |
|---|---|---|---|---|---|---|
| | | | | Min | Max | |
| $C_{OUT}$ | Output Capacitance | Capacitance(1) | 1.0 | **0.7** | | µF |
| | | ESR | | 5 | 500 | mΩ |

(1) The full operating conditions for the application should be considered when selecting a suitable capacitor to ensure that the minimum value of capacitance is always met. Recommended capacitor type is X7R. However, dependent on application, X5R, Y5V, and Z5U can also be used. (See Application Hints)

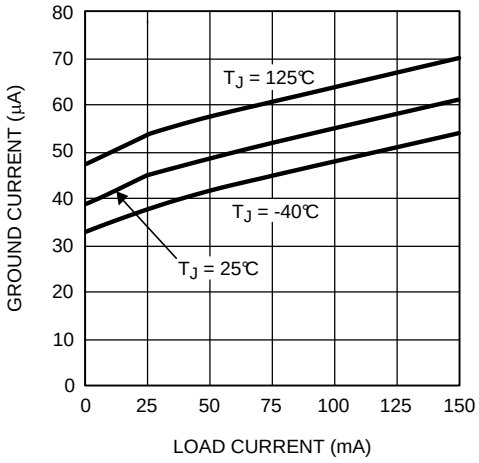
## Typical Performance Characteristics

Unless otherwise specified, $C_{IN}$ = 1.0µF Ceramic, $C_{OUT}$ = 0.47 µF Ceramic, $V_{IN}$ = $V_{OUT(NOM)}$ + 1.0V, $T_A$ = 25°C, $V_{OUT(NOM)}$ = 1.5V , Shutdown pin is tied to $V_{IN}$.

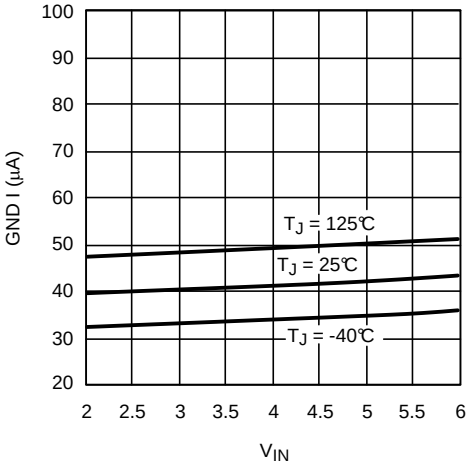
**Output Voltage Change vs Temperature**



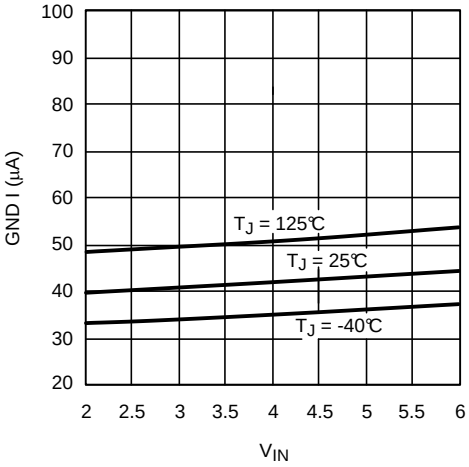

**Ground Current vs Load Current**



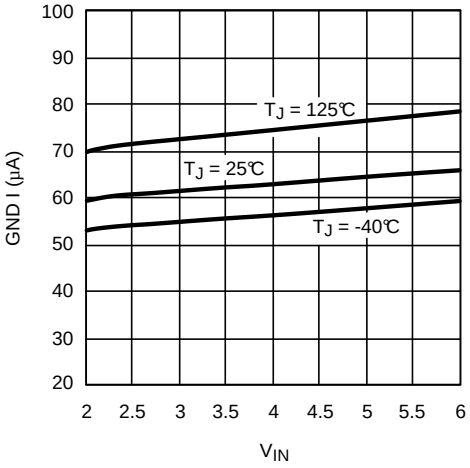

**Ground Current vs $V_{IN}$. $I_{LOAD}$ = 0mA**



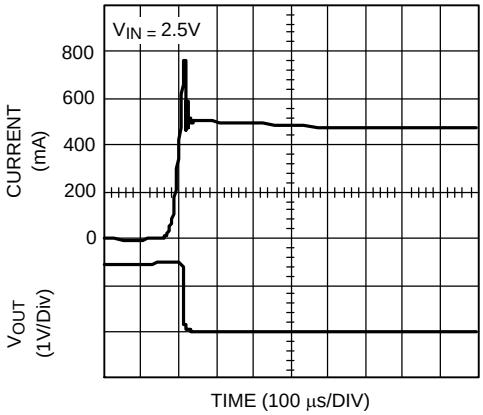

**Ground Current vs $V_{IN}$. $I_{LOAD}$ = 1mA**




**Ground Current vs $V_{IN}$. $I_{LOAD}$ = 150mA**



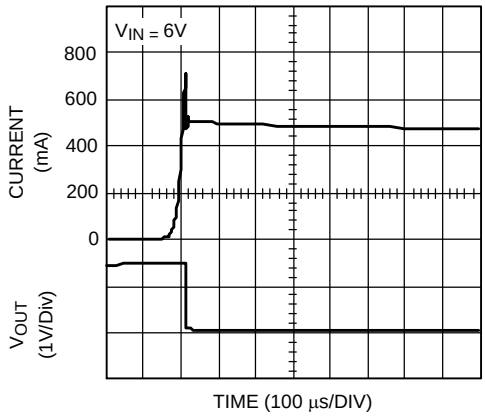

**Short Circuit Current**



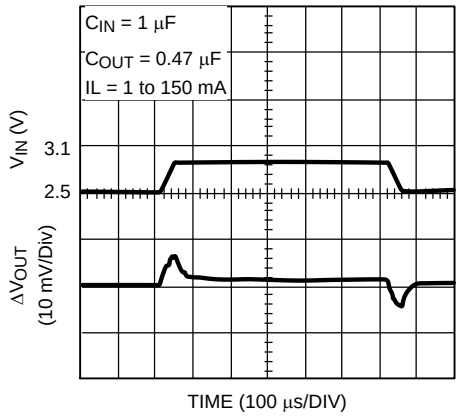
## Typical Performance Characteristics (continued)

Unless otherwise specified, $C_{IN}$ = 1.0µF Ceramic, $C_{OUT}$ = 0.47 µF Ceramic, $V_{IN}$ = $V_{OUT(NOM)}$ + 1.0V, $T_A$ = 25°C, $V_{OUT(NOM)}$ = 1.5V , Shutdown pin is tied to $V_{IN}$.

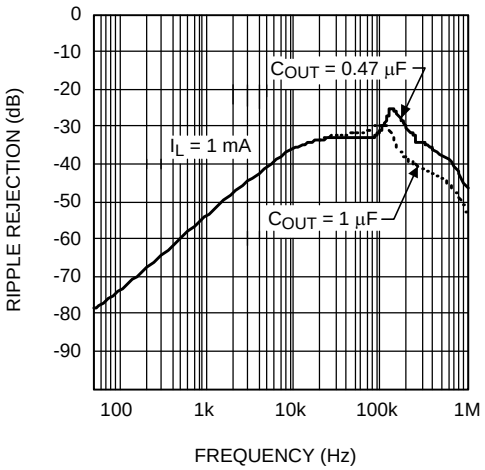
**Short Circuit Current**



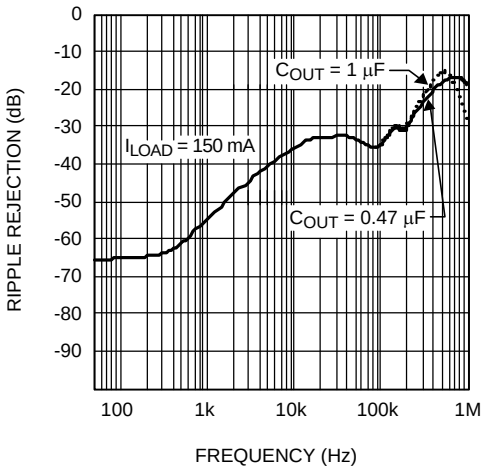

**Line transient**



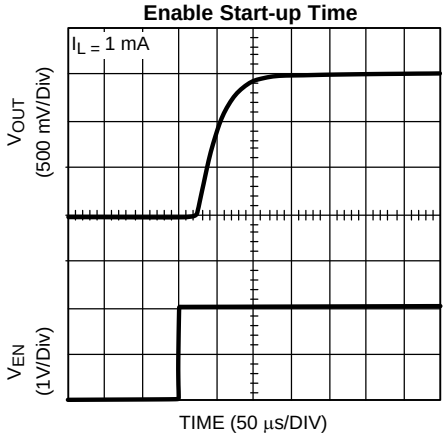

**Power Supply Rejection Ratio**



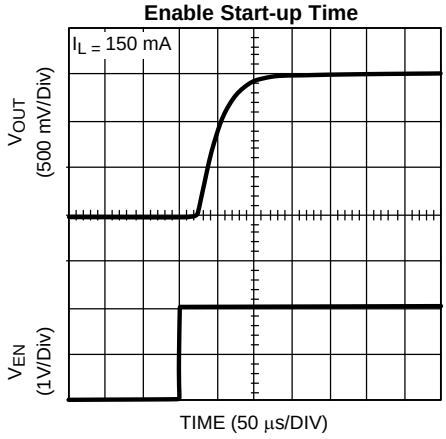

**Power Supply Rejection Ratio**




**Enable Start-up Time**



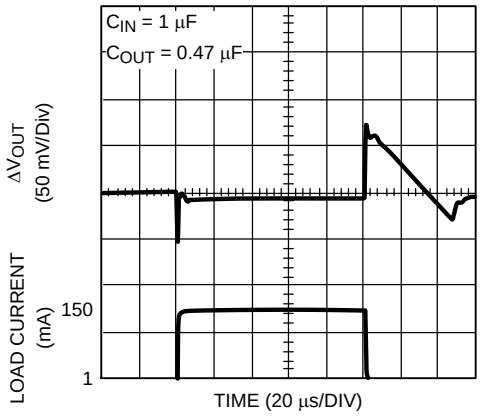

**Enable Start-up Time**



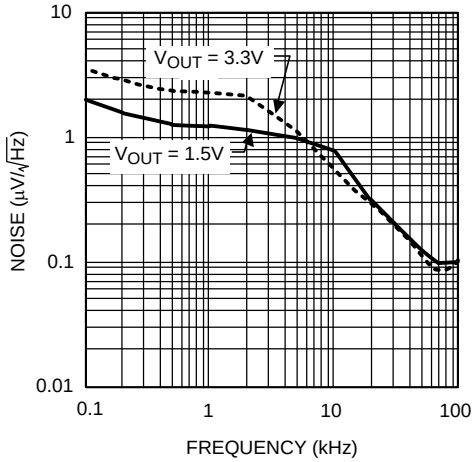
## Typical Performance Characteristics (continued)

Unless otherwise specified, $C_{IN}$ = 1.0µF Ceramic, $C_{OUT}$ = 0.47 µF Ceramic, $V_{IN}$ = $V_{OUT(NOM)}$ + 1.0V, $T_A$ = 25°C, $V_{OUT(NOM)}$ = 1.5V , Shutdown pin is tied to $V_{IN}$.

**Load Transient**




**Noise Density**



## APPLICATION HINTS

### EXTERNAL CAPACITORS

In common with most regulators, the LP3990 requires external capacitors for regulator stability. The LP3990 is specifically designed for portable applications requiring minimum board space and smallest components. These capacitors must be correctly selected for good performance.

### INPUT CAPACITOR

An input capacitor is required for stability. It is recommended that a 1.0µF capacitor be connected between the LP3990 input pin and ground (this capacitance value may be increased without limit).

This capacitor must be located a distance of not more than 1cm from the input pin and returned to a clean analogue ground. Any good quality ceramic, tantalum, or film capacitor may be used at the input.

**Important:** To ensure stable operation it is essential that good PCB design practices are employed to minimize ground impedance and keep input inductance low. If these conditions cannot be met, or if long leads are used to connect the battery or other power source to the LP3990, then it is recommended that the input capacitor is increased. Also, tantalum capacitors can suffer catastrophic failures due to surge current when connected to a low-impedance source of power (like a battery or a very large capacitor). If a tantalum capacitor is used at the input, it must be guaranteed by the manufacturer to have a surge current rating sufficient for the application.

There are no requirements for the ESR (Equivalent Series Resistance) on the input capacitor, but tolerance and temperature coefficient must be considered when selecting the capacitor to ensure the capacitance will remain approximately 1.0µF over the entire operating temperature range.

### OUTPUT CAPACITOR

The LP3990 is designed specifically to work with very small ceramic output capacitors. A 1.0µF ceramic capacitor (temperature types Z5U, Y5V or X7R) with ESR between 5mΩ to 500mΩ, is suitable in the LP3990 application circuit.

For this device the output capacitor should be connected between the $V_{OUT}$ pin and ground.

It is also possible to use tantalum or film capacitors at the device output, $C_{OUT}$ (or $V_{OUT}$), but these are not as attractive for reasons of size and cost (see CAPACITOR CHARACTERISTICS).

The output capacitor must meet the requirement for the minimum value of capacitance and also have an ESR value that is within the range 5mΩ to 500mΩ for stability.

### NO-LOAD STABILITY

The LP3990 will remain stable and in regulation with no external load. This is an important consideration in some circuits, for example CMOS RAM keep-alive applications.

### CAPACITOR CHARACTERISTICS

The LP3990 is designed to work with ceramic capacitors on the output to take advantage of the benefits they offer. For capacitance values in the range of 0.47µF to 4.7µF, ceramic capacitors are the smallest, least expensive and have the lowest ESR values, thus making them best for eliminating high frequency noise. The ESR of a typical 1.0µF ceramic capacitor is in the range of 20mΩ to 40mΩ, which easily meets the ESR requirement for stability for the LP3990.

For both input and output capacitors, careful interpretation of the capacitor specification is required to ensure correct device operation. The capacitor value can change greatly, depending on the operating conditions and capacitor type.

In particular, the output capacitor selection should take account of all the capacitor parameters, to ensure that the specification is met within the application. The capacitance can vary with DC bias conditions as well as temperature and frequency of operation. Capacitor values will also show some decrease over time due to aging. The capacitor parameters are also dependant on the particular case size, with smaller sizes giving poorer performance figures in general. As an example, Figure 1 shows a typical graph comparing different capacitor case sizes in a Capacitance vs. DC Bias plot. As shown in the graph, increasing the DC Bias condition can result

in the capacitance value falling below the minimum value given in the recommended capacitor specifications table (0.7µF in this case). Note that the graph shows the capacitance out of spec for the 0402 case size capacitor at higher bias voltages. It is therefore recommended that the capacitor manufacturers' specifications for the nominal value capacitor are consulted for all conditions, as some capacitor sizes (e.g. 0402) may not be suitable in the actual application.

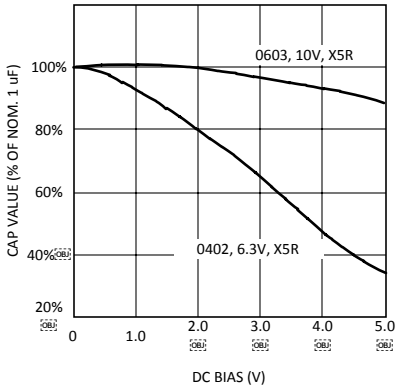



**Figure 1. Graph Showing a Typical Variation in Capacitance vs DC Bias**

The ceramic capacitor's capacitance can vary with temperature. The capacitor type X7R, which operates over a temperature range of -55°C to +125°C, will only vary the capacitance to within ±15%. The capacitor type X5R has a similar tolerance over a reduced temperature range of -55°C to +85°C. Many large value ceramic capacitors, larger than 1µF are manufactured with Z5U or Y5V temperature characteristics. Their capacitance can drop by more than 50% as the temperature varies from 25°C to 85°C. Therefore X7R is recommended over Z5U and Y5V in applications where the ambient temperature will change significantly above or below 25°C.

Tantalum capacitors are less desirable than ceramic for use as output capacitors because they are more expensive when comparing equivalent capacitance and voltage ratings in the 0.47µF to 4.7µF range.

Another important consideration is that tantalum capacitors have higher ESR values than equivalent size ceramics. This means that while it may be possible to find a tantalum capacitor with an ESR value within the stable range, it would have to be larger in capacitance (which means bigger and more costly) than a ceramic capacitor with the same ESR value. It should also be noted that the ESR of a typical tantalum will increase about 2:1 as the temperature goes from 25°C down to -40°C, so some guard band must be allowed.

## ENABLE CONTROL

The LP3990 features an active high Enable pin, $V_{EN}$, which turns the device on when pulled high. When not enabled the regulator output is off and the device typically consumes 2nA.

If the application does not require the Enable switching feature, the $V_{EN}$ pin should be tied to $V_{IN}$ to keep the regulator output permanently on.

To ensure proper operation, the signal source used to drive the $V_{EN}$ input must be able to swing above and below the specified turn-on/off voltage thresholds listed in the Electrical Characteristics section under $V_{IL}$ and $V_{IH}$.

## DSBGA MOUNTING

The DSBGA package requires specific mounting techniques, which are detailed in Application Note AN1112.

For best results during assembly, alignment ordinals on the PC board may be used to facilitate placement of the DSBGA device.

## DSBGA LIGHT SENSITIVITY

Exposing the DSBGA device to direct light may affect the operation of the device. Light sources, such as halogen lamps, can affect electrical performance, if placed in close proximity to the device.

Light with wavelengths in the infra-red portion of the spectrum is the most detrimental, and so, fluorescent lighting used inside most buildings, has little or no effect on performance.

## REVISION HISTORY

| Changes from Revision H (May 2013) to Revision I | Page |
|---|---|
| • Changed layout of National Data Sheet to TI format | 12 |

## PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LP3990MF-1.2/NOPB | ACTIVE | SOT-23 | DBV | 5 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | SCDB | Samples |
| LP3990MF-1.8 | ACTIVE | SOT-23 | DBV | 5 | 1000 | TBD | Call TI | Call TI | -40 to 125 | SCFB | Samples |
| LP3990MF-1.8/NOPB | ACTIVE | SOT-23 | DBV | 5 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | SCFB | Samples |
| LP3990MF-2.5 | ACTIVE | SOT-23 | DBV | 5 | 1000 | TBD | Call TI | Call TI | -40 to 125 | SCJB | Samples |
| LP3990MF-2.5/NOPB | ACTIVE | SOT-23 | DBV | 5 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | SCJB | Samples |
| LP3990MF-2.8/NOPB | ACTIVE | SOT-23 | DBV | 5 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | SCKB | Samples |
| LP3990MF-3.3/NOPB | ACTIVE | SOT-23 | DBV | 5 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | SCLB | Samples |
| LP3990MFX-1.2/NOPB | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | SCDB | Samples |
| LP3990MFX-1.8/NOPB | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | SCFB | Samples |
| LP3990MFX-3.3 | ACTIVE | SOT-23 | DBV | 5 | 3000 | TBD | Call TI | Call TI | -40 to 125 | SCLB | Samples |
| LP3990MFX-3.3/NOPB | ACTIVE | SOT-23 | DBV | 5 | 3000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | SCLB | Samples |
| LP3990SD-1.2/NOPB | ACTIVE | WSON | NGG | 6 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | L086B | Samples |
| LP3990SD-1.5/NOPB | ACTIVE | WSON | NGG | 6 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | L087B | Samples |
| LP3990SD-1.8/NOPB | ACTIVE | WSON | NGG | 6 | 1000 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | -40 to 125 | L088B | Samples |
| LP3990TL-0.8/NOPB | ACTIVE | DSBGA | YZR | 4 | 250 | Green (RoHS & no Sb/Br) | SNAGCU | Level-1-260C-UNLIM | -40 to 125 | | Samples |
| LP3990TL-1.2/NOPB | ACTIVE | DSBGA | YZR | 4 | 250 | Green (RoHS & no Sb/Br) | SNAGCU | Level-1-260C-UNLIM | -40 to 125 | | Samples |
| LP3990TL-1.35/NOPB | ACTIVE | DSBGA | YZR | 4 | 250 | Green (RoHS & no Sb/Br) | SNAGCU | Level-1-260C-UNLIM | -40 to 125 | | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LP3990TL-1.5/NOPB | ACTIVE | DSBGA | YZR | 4 | 250 | Green (RoHS & no Sb/Br) | SNAGCU | Level-1-260C-UNLIM | -40 to 125 | | Samples |
| LP3990TL-1.8/NOPB | ACTIVE | DSBGA | YZR | 4 | 250 | Green (RoHS & no Sb/Br) | SNAGCU | Level-1-260C-UNLIM | -40 to 125 | | Samples |
| LP3990TL-2.5/NOPB | ACTIVE | DSBGA | YZR | 4 | 250 | Green (RoHS & no Sb/Br) | SNAGCU | Level-1-260C-UNLIM | -40 to 125 | | Samples |
| LP3990TL-2.8/NOPB | ACTIVE | DSBGA | YZR | 4 | 250 | Green (RoHS & no Sb/Br) | SNAGCU | Level-1-260C-UNLIM | -40 to 125 | | Samples |
| LP3990TLX-0.8/NOPB | ACTIVE | DSBGA | YZR | 4 | 3000 | Green (RoHS & no Sb/Br) | SNAGCU | Level-1-260C-UNLIM | -40 to 125 | | Samples |
| LP3990TLX-1.2/NOPB | ACTIVE | DSBGA | YZR | 4 | 3000 | Green (RoHS & no Sb/Br) | SNAGCU | Level-1-260C-UNLIM | -40 to 125 | | Samples |
| LP3990TLX-1.35/NOPB | ACTIVE | DSBGA | YZR | 4 | 3000 | Green (RoHS & no Sb/Br) | SNAGCU | Level-1-260C-UNLIM | -40 to 125 | | Samples |
| LP3990TLX-1.5/NOPB | ACTIVE | DSBGA | YZR | 4 | 3000 | Green (RoHS & no Sb/Br) | SNAGCU | Level-1-260C-UNLIM | -40 to 125 | | Samples |
| LP3990TLX-1.8/NOPB | ACTIVE | DSBGA | YZR | 4 | 3000 | Green (RoHS & no Sb/Br) | SNAGCU | Level-1-260C-UNLIM | -40 to 125 | | Samples |
| LP3990TLX-2.5/NOPB | ACTIVE | DSBGA | YZR | 4 | 3000 | Green (RoHS & no Sb/Br) | SNAGCU | Level-1-260C-UNLIM | -40 to 125 | | Samples |
| LP3990TLX-2.8/NOPB | ACTIVE | DSBGA | YZR | 4 | 3000 | Green (RoHS & no Sb/Br) | SNAGCU | Level-1-260C-UNLIM | -40 to 125 | | Samples |

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

(2) 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)

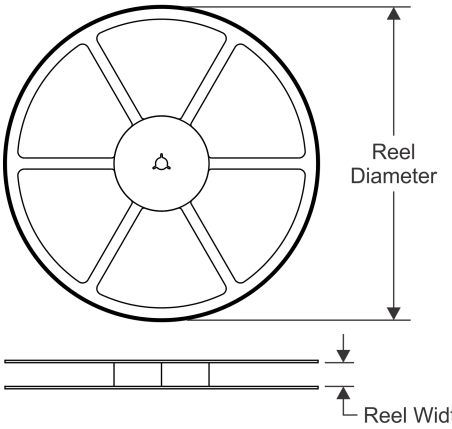
**(3)** MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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

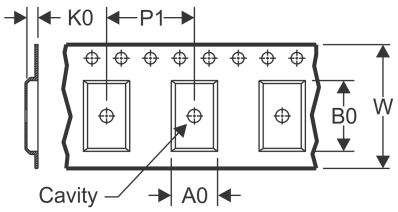
**(5)** Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

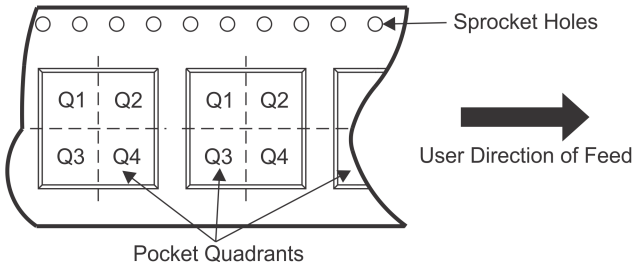



**TAPE DIMENSIONS**




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

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

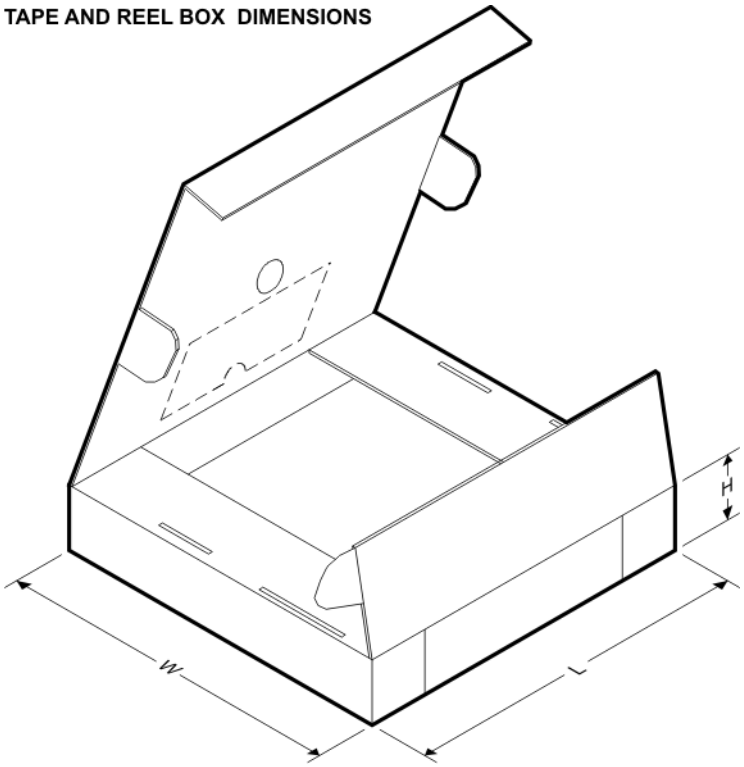



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LP3990MF-1.2/NOPB | SOT-23 | DBV | 5 | 1000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LP3990MF-1.8 | SOT-23 | DBV | 5 | 1000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LP3990MF-1.8/NOPB | SOT-23 | DBV | 5 | 1000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LP3990MF-2.5 | SOT-23 | DBV | 5 | 1000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LP3990MF-2.5/NOPB | SOT-23 | DBV | 5 | 1000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LP3990MF-2.8/NOPB | SOT-23 | DBV | 5 | 1000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LP3990MF-3.3/NOPB | SOT-23 | DBV | 5 | 1000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LP3990MFX-1.2/NOPB | SOT-23 | DBV | 5 | 3000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LP3990MFX-1.8/NOPB | SOT-23 | DBV | 5 | 3000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LP3990MFX-3.3 | SOT-23 | DBV | 5 | 3000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LP3990MFX-3.3/NOPB | SOT-23 | DBV | 5 | 3000 | 178.0 | 8.4 | 3.2 | 3.2 | 1.4 | 4.0 | 8.0 | Q3 |
| LP3990SD-1.2/NOPB | WSON | NGG | 6 | 1000 | 178.0 | 12.4 | 3.3 | 3.3 | 1.0 | 8.0 | 12.0 | Q1 |
| LP3990SD-1.5/NOPB | WSON | NGG | 6 | 1000 | 178.0 | 12.4 | 3.3 | 3.3 | 1.0 | 8.0 | 12.0 | Q1 |
| LP3990SD-1.8/NOPB | WSON | NGG | 6 | 1000 | 178.0 | 12.4 | 3.3 | 3.3 | 1.0 | 8.0 | 12.0 | Q1 |
| LP3990TL-0.8/NOPB | DSBGA | YZR | 4 | 250 | 178.0 | 8.4 | 1.09 | 1.35 | 0.76 | 4.0 | 8.0 | Q1 |
| LP3990TL-1.2/NOPB | DSBGA | YZR | 4 | 250 | 178.0 | 8.4 | 1.09 | 1.35 | 0.76 | 4.0 | 8.0 | Q1 |
| LP3990TL-1.35/NOPB | DSBGA | YZR | 4 | 250 | 178.0 | 8.4 | 1.09 | 1.35 | 0.76 | 4.0 | 8.0 | Q1 |
| LP3990TL-1.5/NOPB | DSBGA | YZR | 4 | 250 | 178.0 | 8.4 | 1.09 | 1.35 | 0.76 | 4.0 | 8.0 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LP3990TL-1.8/NOPB | DSBGA | YZR | 4 | 250 | 178.0 | 8.4 | 1.09 | 1.35 | 0.76 | 4.0 | 8.0 | Q1 |
| LP3990TL-2.5/NOPB | DSBGA | YZR | 4 | 250 | 178.0 | 8.4 | 1.09 | 1.35 | 0.76 | 4.0 | 8.0 | Q1 |
| LP3990TL-2.8/NOPB | DSBGA | YZR | 4 | 250 | 178.0 | 8.4 | 1.09 | 1.35 | 0.76 | 4.0 | 8.0 | Q1 |
| LP3990TLX-0.8/NOPB | DSBGA | YZR | 4 | 3000 | 178.0 | 8.4 | 1.09 | 1.35 | 0.76 | 4.0 | 8.0 | Q1 |
| LP3990TLX-1.2/NOPB | DSBGA | YZR | 4 | 3000 | 178.0 | 8.4 | 1.09 | 1.35 | 0.76 | 4.0 | 8.0 | Q1 |
| LP3990TLX-1.35/NOPB | DSBGA | YZR | 4 | 3000 | 178.0 | 8.4 | 1.09 | 1.35 | 0.76 | 4.0 | 8.0 | Q1 |
| LP3990TLX-1.5/NOPB | DSBGA | YZR | 4 | 3000 | 178.0 | 8.4 | 1.09 | 1.35 | 0.76 | 4.0 | 8.0 | Q1 |
| LP3990TLX-1.8/NOPB | DSBGA | YZR | 4 | 3000 | 178.0 | 8.4 | 1.09 | 1.35 | 0.76 | 4.0 | 8.0 | Q1 |
| LP3990TLX-2.5/NOPB | DSBGA | YZR | 4 | 3000 | 178.0 | 8.4 | 1.09 | 1.35 | 0.76 | 4.0 | 8.0 | Q1 |
| LP3990TLX-2.8/NOPB | DSBGA | YZR | 4 | 3000 | 178.0 | 8.4 | 1.09 | 1.35 | 0.76 | 4.0 | 8.0 | Q1 |

**TAPE AND REEL BOX DIMENSIONS**

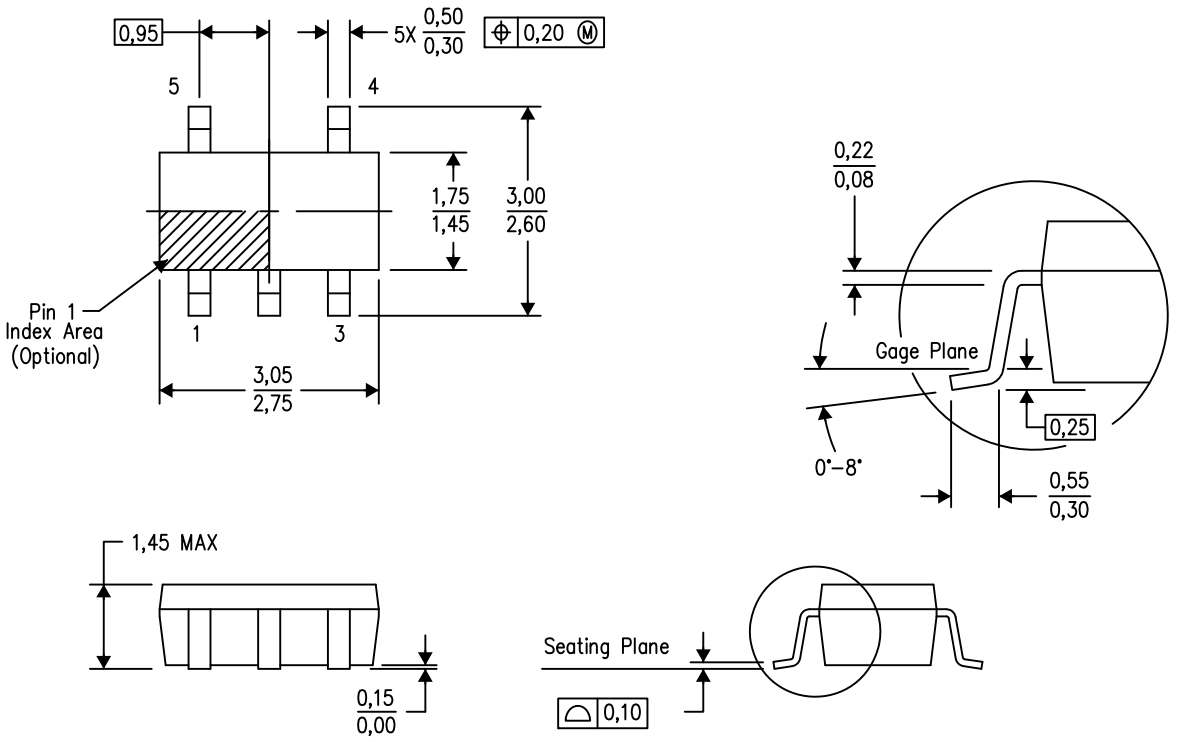



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| LP3990MF-1.2/NOPB | SOT-23 | DBV | 5 | 1000 | 210.0 | 185.0 | 35.0 |
| LP3990MF-1.8 | SOT-23 | DBV | 5 | 1000 | 210.0 | 185.0 | 35.0 |
| LP3990MF-1.8/NOPB | SOT-23 | DBV | 5 | 1000 | 210.0 | 185.0 | 35.0 |
| LP3990MF-2.5 | SOT-23 | DBV | 5 | 1000 | 210.0 | 185.0 | 35.0 |
| LP3990MF-2.5/NOPB | SOT-23 | DBV | 5 | 1000 | 210.0 | 185.0 | 35.0 |
| LP3990MF-2.8/NOPB | SOT-23 | DBV | 5 | 1000 | 210.0 | 185.0 | 35.0 |
| LP3990MF-3.3/NOPB | SOT-23 | DBV | 5 | 1000 | 210.0 | 185.0 | 35.0 |

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|---|---|---|---|---|---|---|---|
| LP3990MFX-1.2/NOPB | SOT-23 | DBV | 5 | 3000 | 210.0 | 185.0 | 35.0 |
| LP3990MFX-1.8/NOPB | SOT-23 | DBV | 5 | 3000 | 210.0 | 185.0 | 35.0 |
| LP3990MFX-3.3 | SOT-23 | DBV | 5 | 3000 | 210.0 | 185.0 | 35.0 |
| LP3990MFX-3.3/NOPB | SOT-23 | DBV | 5 | 3000 | 210.0 | 185.0 | 35.0 |
| LP3990SD-1.2/NOPB | WSON | NGG | 6 | 1000 | 210.0 | 185.0 | 35.0 |
| LP3990SD-1.5/NOPB | WSON | NGG | 6 | 1000 | 210.0 | 185.0 | 35.0 |
| LP3990SD-1.8/NOPB | WSON | NGG | 6 | 1000 | 210.0 | 185.0 | 35.0 |
| LP3990TL-0.8/NOPB | DSBGA | YZR | 4 | 250 | 210.0 | 185.0 | 35.0 |
| LP3990TL-1.2/NOPB | DSBGA | YZR | 4 | 250 | 210.0 | 185.0 | 35.0 |
| LP3990TL-1.35/NOPB | DSBGA | YZR | 4 | 250 | 210.0 | 185.0 | 35.0 |
| LP3990TL-1.5/NOPB | DSBGA | YZR | 4 | 250 | 210.0 | 185.0 | 35.0 |
| LP3990TL-1.8/NOPB | DSBGA | YZR | 4 | 250 | 210.0 | 185.0 | 35.0 |
| LP3990TL-2.5/NOPB | DSBGA | YZR | 4 | 250 | 210.0 | 185.0 | 35.0 |
| LP3990TL-2.8/NOPB | DSBGA | YZR | 4 | 250 | 210.0 | 185.0 | 35.0 |
| LP3990TLX-0.8/NOPB | DSBGA | YZR | 4 | 3000 | 210.0 | 185.0 | 35.0 |
| LP3990TLX-1.2/NOPB | DSBGA | YZR | 4 | 3000 | 210.0 | 185.0 | 35.0 |
| LP3990TLX-1.35/NOPB | DSBGA | YZR | 4 | 3000 | 210.0 | 185.0 | 35.0 |
| LP3990TLX-1.5/NOPB | DSBGA | YZR | 4 | 3000 | 210.0 | 185.0 | 35.0 |
| LP3990TLX-1.8/NOPB | DSBGA | YZR | 4 | 3000 | 210.0 | 185.0 | 35.0 |
| LP3990TLX-2.5/NOPB | DSBGA | YZR | 4 | 3000 | 210.0 | 185.0 | 35.0 |
| LP3990TLX-2.8/NOPB | DSBGA | YZR | 4 | 3000 | 210.0 | 185.0 | 35.0 |

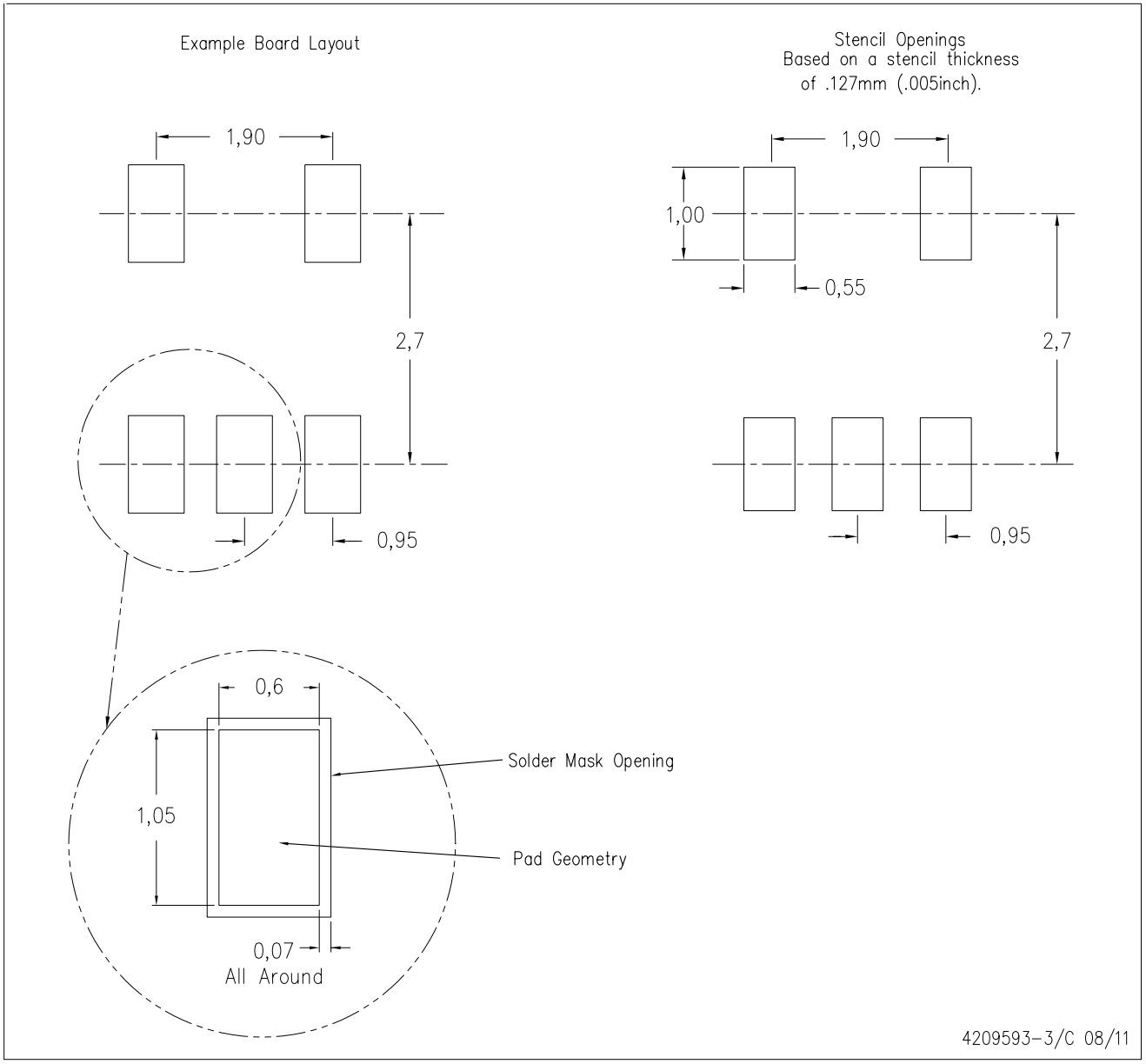
DBV (R–PDSO–G5) PLASTIC SMALL–OUTLINE PACKAGE




4073253–4/L 08/2013

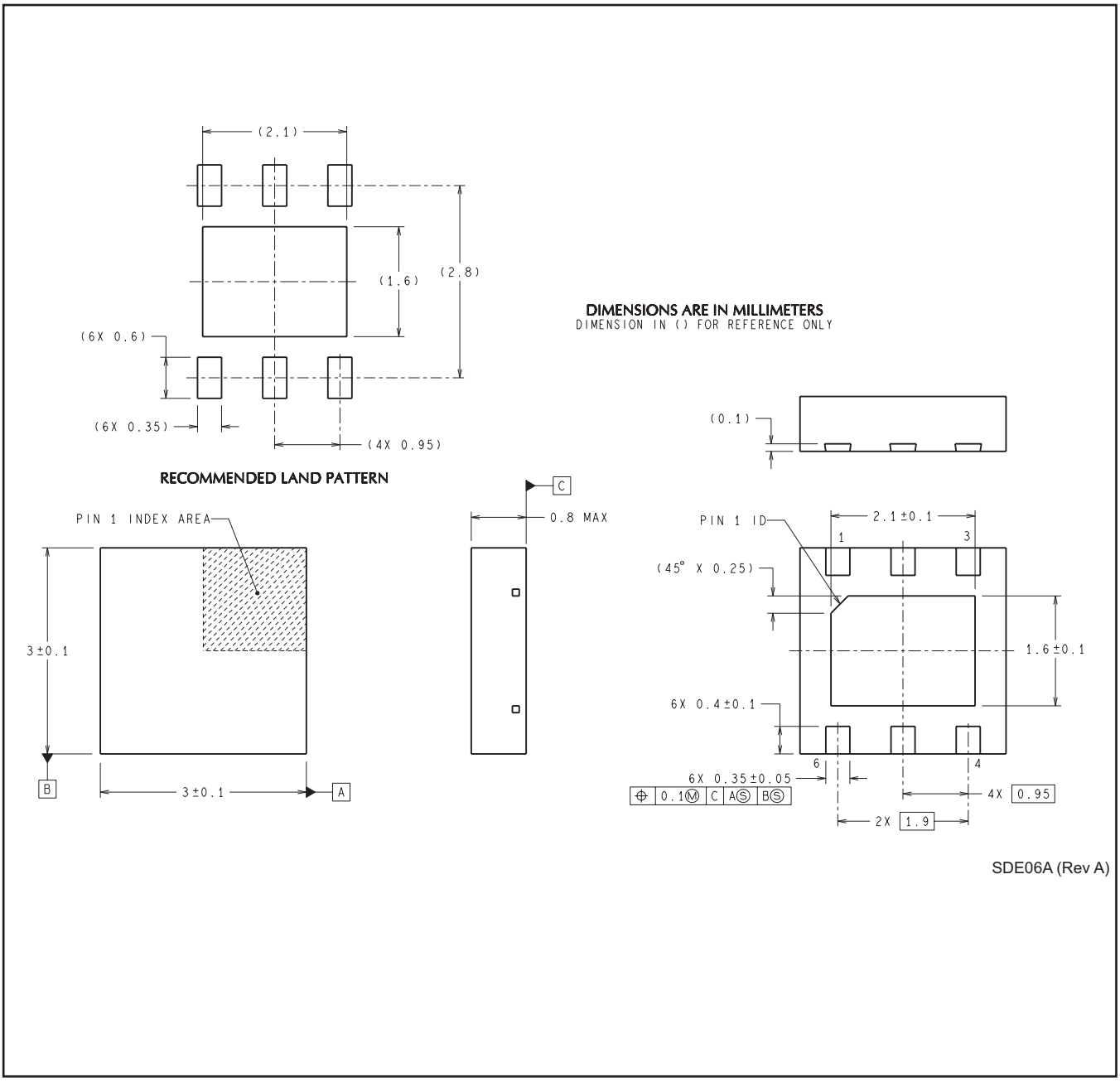
NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion. Mold flash and protrusion shall not exceed 0.15 per side.
D. Falls within JEDEC MO–178 Variation AA.

DBV (R–PDSO–G5) PLASTIC SMALL OUTLINE



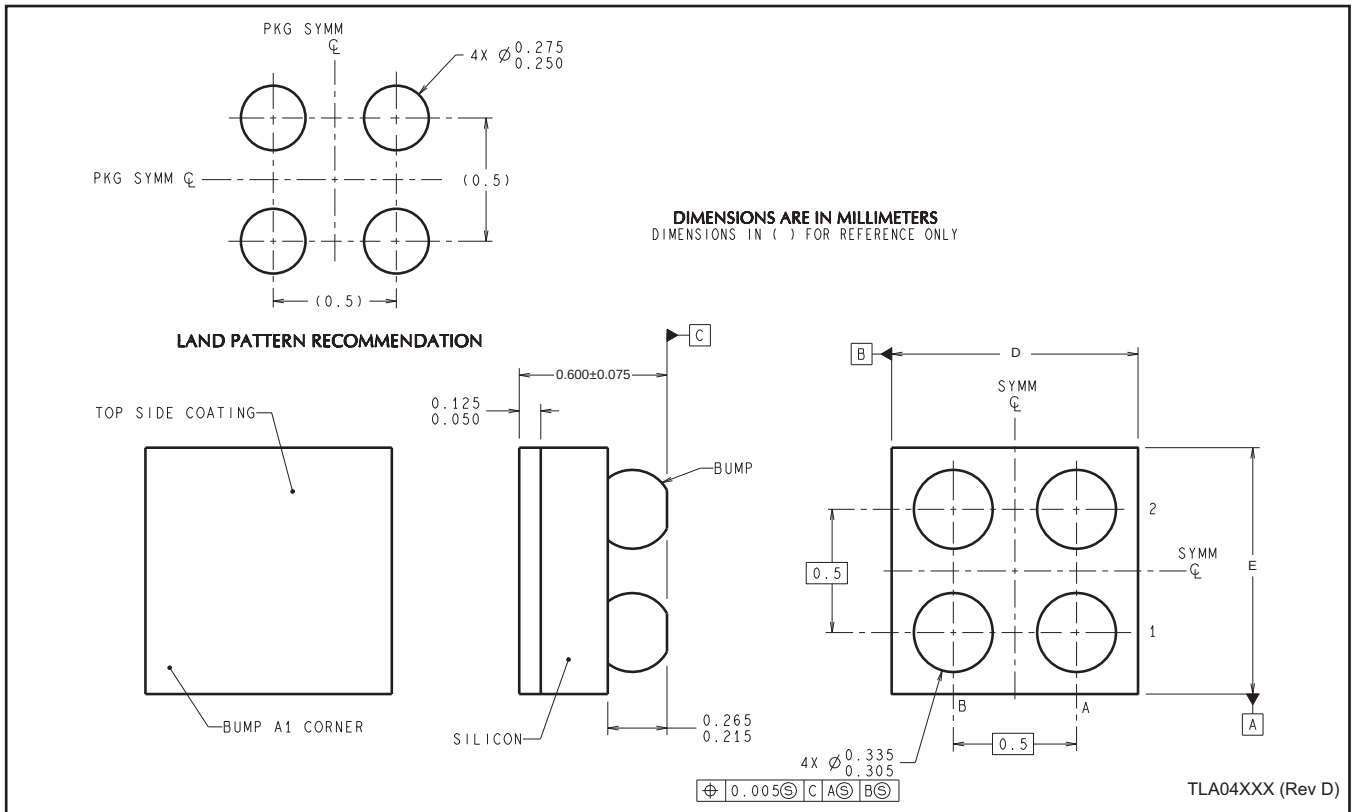

NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Customers should place a note on the circuit board fabrication drawing not to alter the center solder mask defined pad.
D. Publication IPC–7351 is recommended for alternate designs.
E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Example stencil design based on a 50% volumetric metal load solder paste. Refer to IPC–7525 for other stencil recommendations.

# NGG0006A




SDE06A (Rev A)

# YZR0004




D: Max = 1.324 mm, Min =1.263 mm

E: Max = 1.045 mm, Min =0.984 mm

4215042/A 12/12

NOTES: A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
B. This drawing is subject to change without notice.

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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.

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