

# 150 mA, Low $I_Q$ , Low-Dropout Regulator for Portables

Check for Samples: [TLV717](#)

## FEATURES

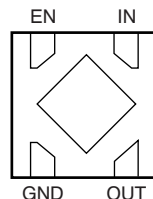
- **Very Low Dropout:** 250 mV at 150 mA
- **Accuracy:** 0.5% (typical)
- **Low  $I_Q$ :** 35  $\mu$ A
- **Available in Fixed-Output Voltages:** 1.2 V to 5.0 V
- **High PSRR:**
  - 70 dB at 1 kHz
  - 50 dB at 1 MHz
- **Stable with Effective Output Capacitance:** 0.1  $\mu$ F
- **Foldback Current Limit**
- **Package:** 1-mm  $\times$  1-mm DFN

- (1) See the Package Option Addendum at the end of this document for a complete list of available voltage options.
- (2) See the [Input and Output Capacitor Requirements](#) section in the [Application Information](#) for more details.

## APPLICATIONS

- **Wireless Handsets, Smart Phones, PDAs**
- **MP3 Players**
- **Other Hand-Held Products**

TLV717x  
1-mm  $\times$  1-mm DQN  
(Bottom View)



## DESCRIPTION

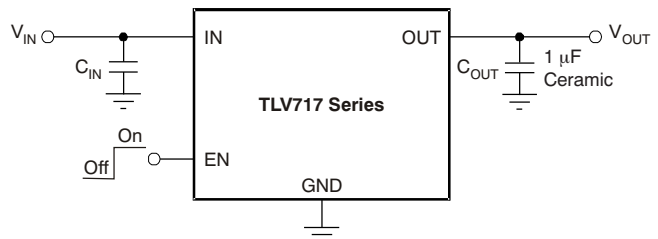
The TLV717xx series of low-dropout (LDO) linear regulators are low quiescent current LDOs with excellent line and load transient performance and are designed for power-sensitive applications. These devices provide a typical accuracy of 0.5%.

The TLV717xx series offer current foldback which throttles down the output current with a decrease in load resistance. The typical value at which current foldback kicks in is 350 mA; the typical value of the output short current limit value is 40 mA.

Furthermore, these devices are stable with an effective output capacitance of only 0.1  $\mu$ F. This feature enables the use of cost-effective capacitors that have higher bias voltages and temperature derating. The devices regulate to specified accuracy with no output load.

The TLV717xx series is available in a 1-mm  $\times$  1-mm DQN package that makes them ideal for hand-held applications. The TLV717xxP provides an active pull-down circuit to quickly discharge output loads.

### Typical Application Circuit



PRODUCT PREVIEW



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PRODUCT PREVIEW information concerns products in the formative or design phase of development. Characteristic data and other specifications are design goals. Texas Instruments reserves the right to change or discontinue these products without notice.

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This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

### ORDERING INFORMATION<sup>(1)</sup>

| PRODUCT             | V <sub>OUT</sub>  |
|---------------------|---|
| TLV717xx(x) P yyy z | <p><b>XX(X)</b> is nominal output voltage. For output voltages with a resolution of 100 mV, two digits are used in the ordering number; otherwise, three digits are used (for example, 28 = 2.8 V; 475 = 4.75 V).</p> <p><b>P</b> is optional; devices with P have an LDO regulator with an active output discharge.</p> <p><b>YYY</b> is package designator.</p> <p><b>Z</b> is package quantity. R is for reel (3000 pieces), T is for tape (250 pieces).</p> |

- (1) For the most current package and ordering information see the Package Option Addendum at the end of this document, or visit the device product folder on [www.ti.com](http://www.ti.com).

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

At T<sub>J</sub> = –25°C, unless otherwise noted. All voltages are with respect to GND.

|   |  | VALUE   |                       | UNIT |
|---|--|---|-----------------------|------|
|   |  | MIN   | MAX                   |      |
| Voltage   | Input range, V <sub>IN</sub>             | –0.3  | 6.0                   | V    |
|   | Enable range, V <sub>EN</sub>            | –0.3  | V <sub>IN</sub> + 0.3 | V    |
|   | Output range, V <sub>OUT</sub>           | –0.3  | 6.0                   | V    |
| Current   | Maximum output, I <sub>OUT</sub>         | Internally limited                            |                       |      |
| Output short-circuit duration                         |  | Indefinite                                    |                       |      |
| Continuous total power dissipation, P <sub>DISS</sub> |  | See <a href="#">Thermal Information</a> table |                       |      |
| Temperature   | Junction range, T <sub>J</sub>           | –55   | +150                  | °C   |
|   | Storage junction range, T <sub>stg</sub> | –55   | +150                  | °C   |
| Electrostatic discharge rating                        | Human body model (HBM)                   |   | 2000                  | V    |
|   | Charged device model (CDM)               |   | 500                   | V    |

- (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 is not implied. Exposure to absolute-maximum rated conditions for extended periods may affect device reliability.

### THERMAL INFORMATION

| THERMAL METRIC <sup>(1)</sup> |  | TLV71713PDQN | UNITS |
|-------------------------------|--|--------------|-------|
|                               |  | DQN          |       |
|                               |  | 4 PINS       |       |
| θ <sub>JA</sub>               | Junction-to-ambient thermal resistance       | 393.3        | °C/W  |
| θ <sub>JC(top)</sub>          | Junction-to-case(top) thermal resistance     | 140.3        |       |
| θ <sub>JB</sub>               | Junction-to-board thermal resistance         | 330          |       |
| ψ <sub>JT</sub>               | Junction-to-top characterization parameter   | 6.5          |       |
| ψ <sub>JB</sub>               | Junction-to-board characterization parameter | 329          |       |
| θ <sub>JC(bottom)</sub>       | Junction-to-case(bottom) thermal resistance  | N/A          |       |

- (1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, [SPRA953](#).

## ELECTRICAL CHARACTERISTICS

At operating temperature range ( $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ),  $T_A = +25^{\circ}\text{C}$ ,  $V_{IN} = V_{OUT(NOM)} + 0.5\text{ V}$  or  $1.7\text{ V}$  (whichever is greater),  $I_{OUT} = 10\text{ mA}$ ,  $V_{EN} = V_{IN}$ , and  $C_{OUT} = 1\text{ }\mu\text{F}$ , unless otherwise noted.

| PARAMETER  | TEST CONDITIONS   | TLV717  |      |          | UNIT                |
|--|---|---|------|----------|---------------------|
|  |   | MIN   | TYP  | MAX      |                     |
| $V_{IN}$ Input voltage range                     |   | 1.7   |      | 5.5      | V                   |
| $V_{OUT}$ Output voltage range                   |   | 1.2   |      | 5.0      | V                   |
| $I_{OUT}$ Output current                         |   | 150   |      |          | mA                  |
| DC output accuracy                               | $T_A = +25^{\circ}\text{C}$   |   | 0.5  |          | %                   |
|  | $V_{OUT} \geq 1.2\text{ V}$ , $-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$                                     | -1.5  |      | +1.5     | %                   |
|  | $V_{OUT} \leq 1.2\text{ V}$   |   |      | 25       | mV                  |
| $\Delta V_O/V_{IN}$ Line regulation              | $V_{OUT(NOM)} + 0.5\text{ V} \leq V_{IN} \leq 5.5\text{ V}$   |   | 1    | 5        | mV                  |
| $\Delta V_O/I_{OUT}$ Load regulation             | $0\text{ mA} \leq I_{OUT} \leq 150\text{ mA}$   |   | 10   | 20       | mV                  |
| $V_{DO}$ Dropout voltage                         | $V_{IN} = 0.98 \times V_{OUT(NOM)}$ ,<br>$I_{OUT} = 150\text{ mA}$  | $1.2\text{ V} \leq V_{OUT} < 1.8\text{ V}$    | 330  | 450      | mV                  |
|  |   | $1.8\text{ V} \leq V_{OUT} \leq 5.0\text{ V}$ | 215  | 350      | mV                  |
| $I_{GND}$ Ground pin current                     | $I_{OUT} = 0\text{ mA}$   |   | 35   | 55       | $\mu\text{A}$       |
| $I_{SHDN}$ Shutdown current                      | $V_{EN} \leq 0.4\text{ V}$ , $2.0\text{ V} \leq V_{IN} \leq 4.5\text{ V}$   |   | 0.1  | 0.5      | $\mu\text{A}$       |
| PSRR Power-supply rejection ratio                | $V_{IN} = 2.3\text{ V}$ , $V_{OUT} = 1.8\text{ V}$ ,<br>$I_{OUT} = 10\text{ mA}$  | $f = 10\text{ Hz}$                            | 75   |          | dB                  |
|  |   | $f = 100\text{ Hz}$                           | 75   |          | dB                  |
|  |   | $f = 1\text{ kHz}$                            | 75   |          | dB                  |
|  |   | $f = 10\text{ kHz}$                           | 60   |          | dB                  |
|  |   | $f = 100\text{ kHz}$                          | 50   |          | dB                  |
| $V_{NOISE}$ Output noise voltage                 | $BW = 100\text{ Hz to }100\text{ kHz}$ , $V_{IN} = 2.3\text{ V}$ , $V_{OUT} = 1.8\text{ V}$ ,<br>$I_{OUT} = 10\text{ mA}$ |   | 55   |          | $\mu\text{V}_{RMS}$ |
| $t_{STR}$ Startup time                           | $C_{OUT} = 1.0\text{ }\mu\text{F}$ , $I_{OUT} = 150\text{ mA}$  |   | 100  |          | $\mu\text{s}$       |
| $I_{SC}$ Short current limit                     | $V_{IN} = \min(V_{OUT(NOM)} + 1\text{ V}, 5.5\text{ V})$ , $V_{OUT} = 0\text{ V}$   |   | 40   |          | mA                  |
| $V_{HI}$ Enable high (enabled)                   |   | 0.9   |      | $V_{IN}$ | V                   |
| $V_{LO}$ Enable low (disabled)                   |   | 0   |      | 0.4      | V                   |
| $I_{EN}$ EN pin current                          | $EN = 5.5\text{ V}$   |   | 0.01 |          | $\mu\text{A}$       |
| $R_{PULLDOWN}$ Pull-down resistor (TLV717P only) |   |   | 120  |          | $\Omega$            |
| UVLO Undervoltage lockout                        | $V_{IN}$ rising   |   | 1.6  |          | V                   |
| $T_J$ Operating junction temperature range       |   | -40   |      | +125     | $^{\circ}\text{C}$  |

## DEVICE INFORMATION

### FUNCTIONAL BLOCK DIAGRAMS

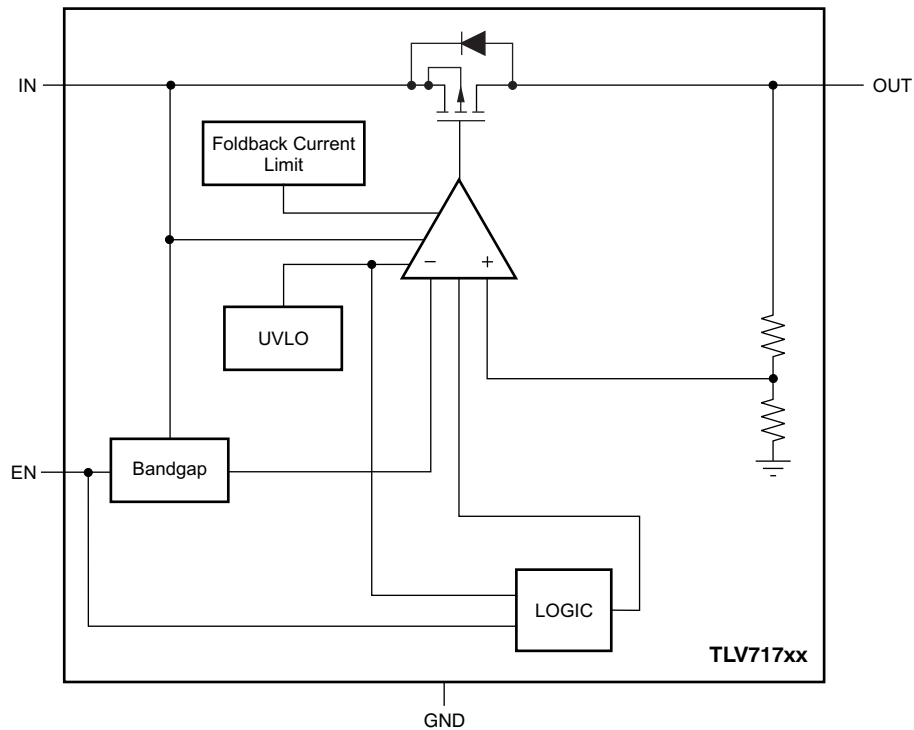


Figure 1. TLV717xx Block Diagram

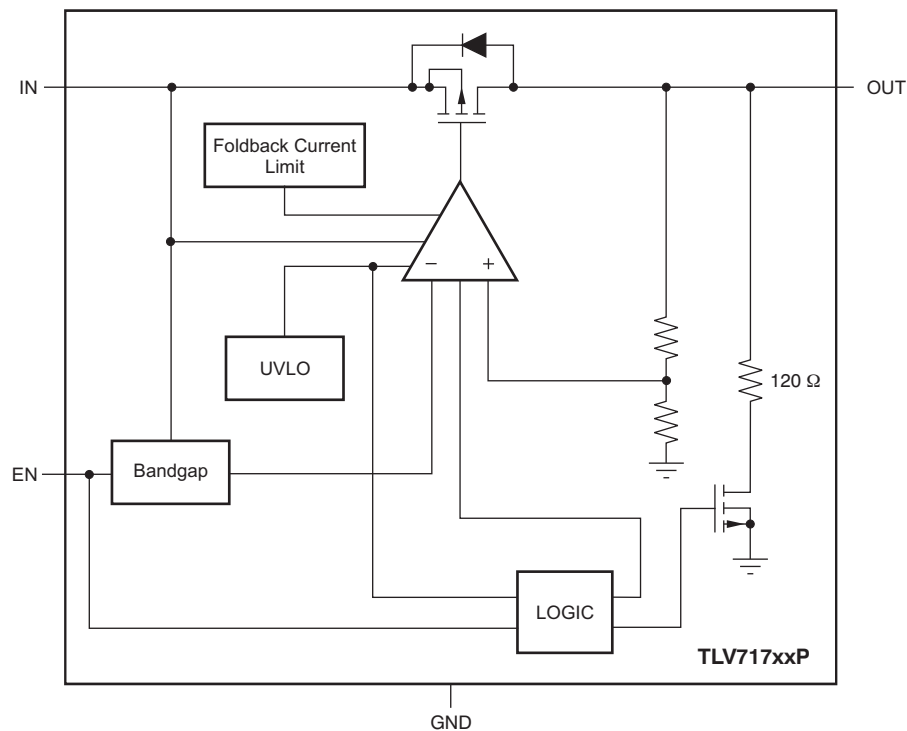
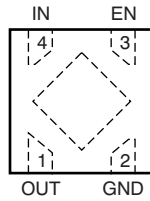


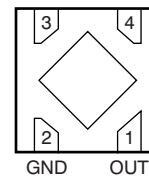
Figure 2. TLV717xxP Block Diagram

## PIN CONFIGURATIONS

**DQN PACKAGE**  
1-mm × 1-mm TBD  
(Top View)



**DQN PACKAGE**  
1-mm × 1-mm TBD  
(Bottom View)



## PIN DESCRIPTIONS

| PIN |             | DESCRIPTION  |
|-----|-------------|--|
| NO. | NAME        |  |
| 1   | OUT         | Regulated output voltage pin. A small 1-μF ceramic capacitor is needed from this pin to ground to assure stability. See the <a href="#">Input and Output Capacitor Requirements</a> section in the <a href="#">Application Information</a> for more details. |
| 2   | GND         | Ground pin   |
| 3   | EN          | Enable pin. Driving EN over 1.2 V turns on the regulator. Driving EN below 0.4 V puts the regulator into shutdown mode.  |
| 4   | IN          | Input pin. A small capacitor is needed from this pin to ground to assure stability. See the <a href="#">Input and Output Capacitor Requirements</a> section in the <a href="#">Application Information</a> for more details.                                 |
| —   | Thermal pad | This pin can be left open or tied to any voltage between GND and IN. It is recommended to connect this pin to GND to minimize noise and maximize thermal performance.  |

**PRODUCT PREVIEW**

## TYPICAL CHARACTERISTICS

At operating temperature range ( $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ ),  $T_A = +25^\circ\text{C}$ ,  $V_{IN} = V_{OUT(NOM)} + 0.5\text{ V}$  or  $1.7\text{ V}$  (whichever is greater),  $I_{OUT} = 10\text{ mA}$ ,  $V_{EN} = V_{IN}$ , and  $C_{OUT} = 1\text{ }\mu\text{F}$ , unless otherwise noted.

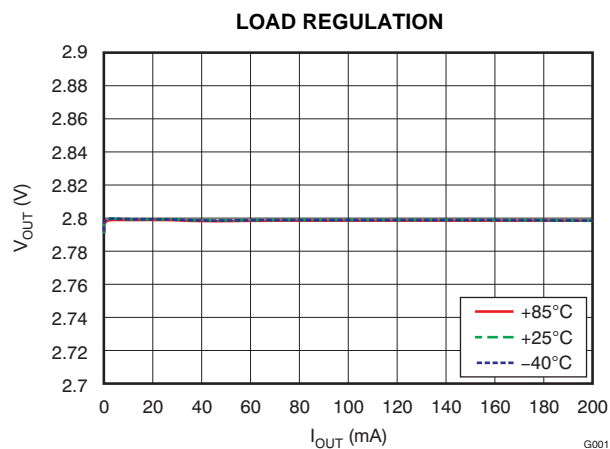


Figure 3.

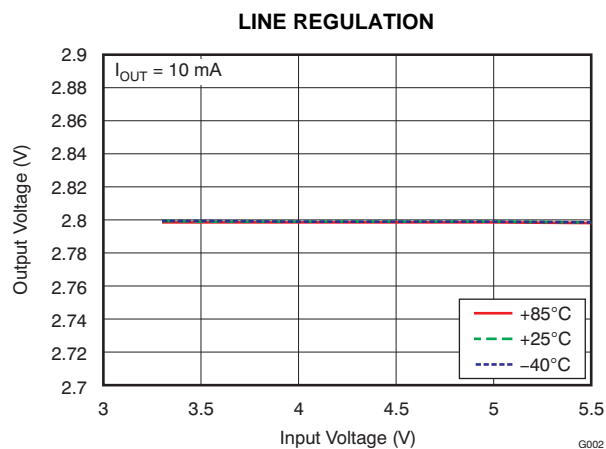


Figure 4.

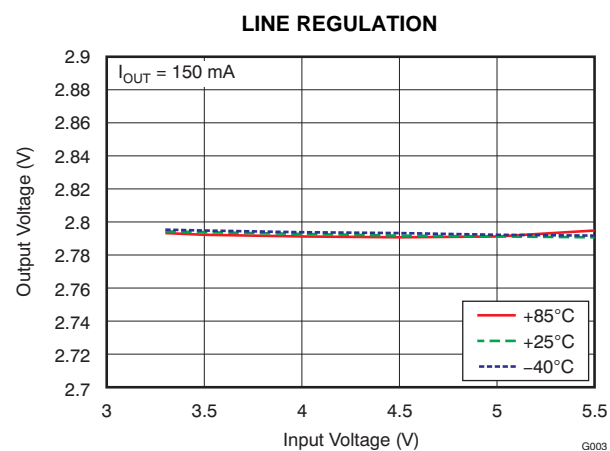


Figure 5.

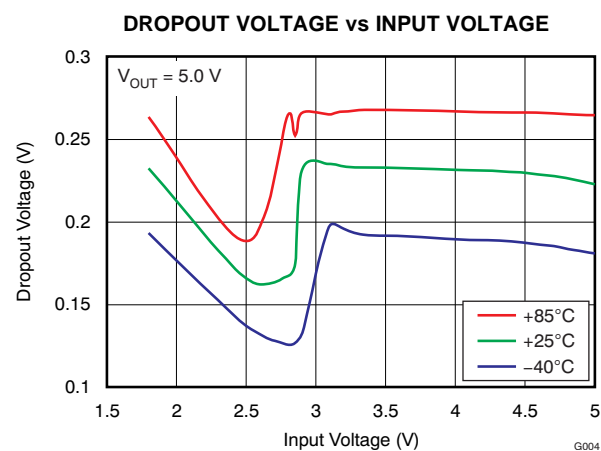


Figure 6.

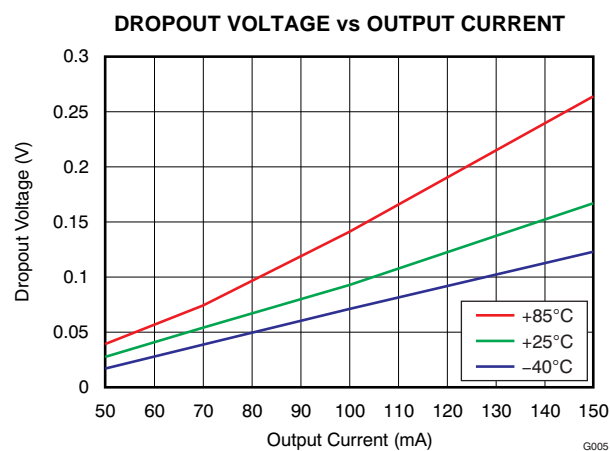


Figure 7.

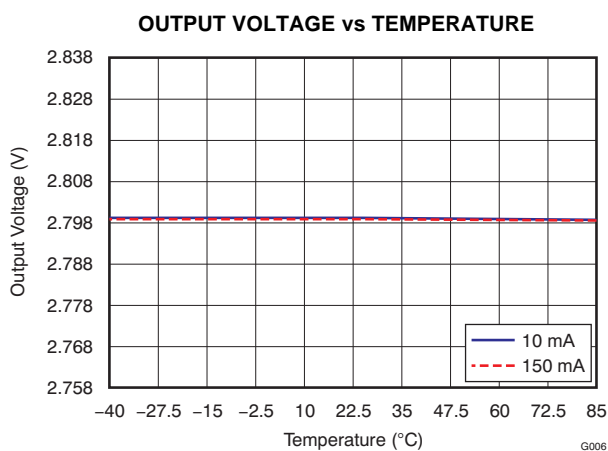
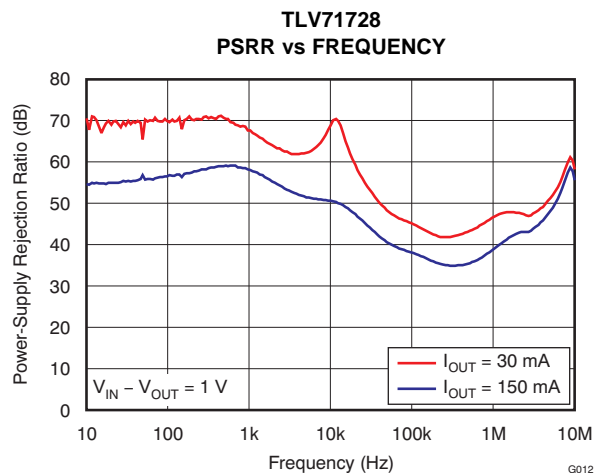
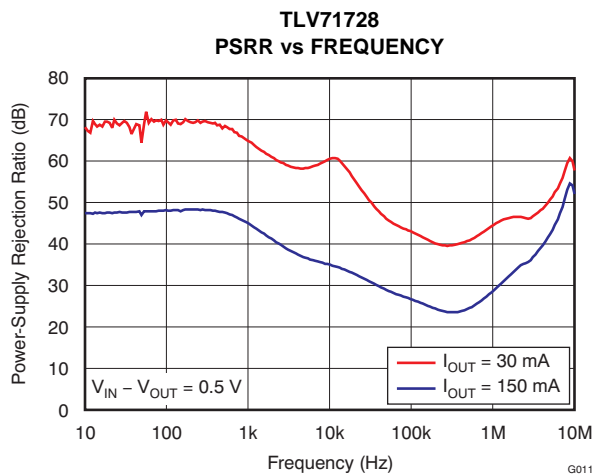
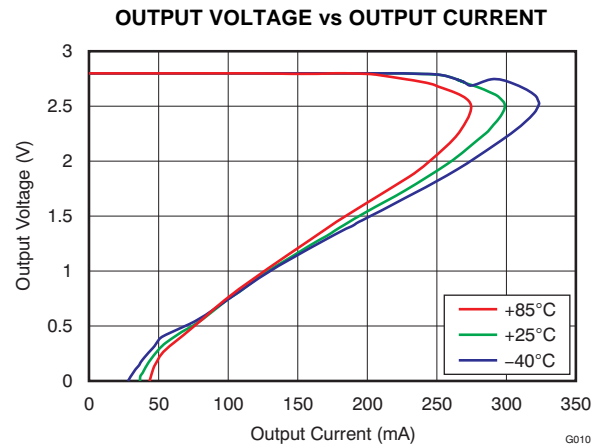
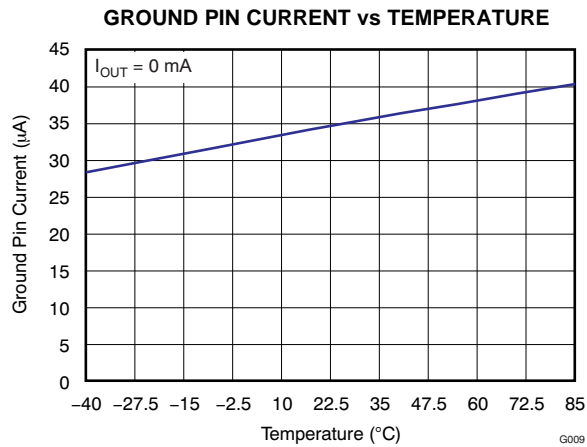
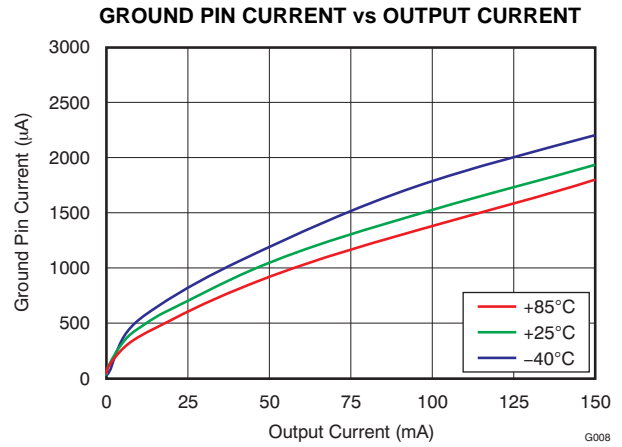
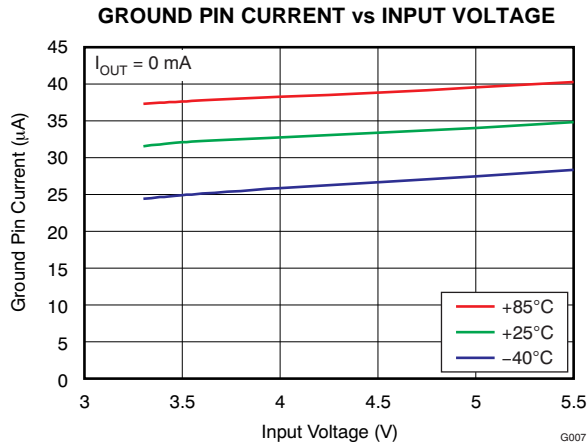


Figure 8.

## TYPICAL CHARACTERISTICS (continued)

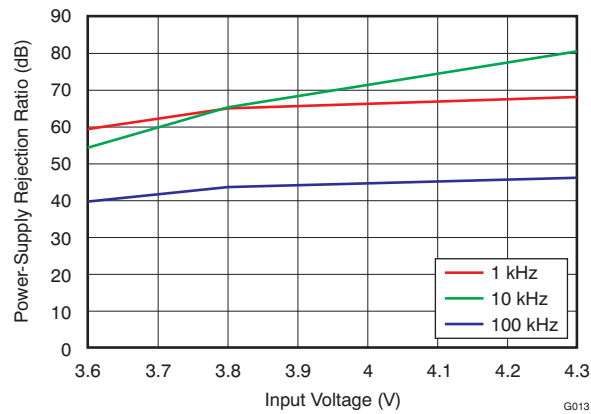
At operating temperature range ( $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ),  $T_A = +25^{\circ}\text{C}$ ,  $V_{IN} = V_{OUT(NOM)} + 0.5\text{ V}$  or  $1.7\text{ V}$  (whichever is greater),  $I_{OUT} = 10\text{ mA}$ ,  $V_{EN} = V_{IN}$ , and  $C_{OUT} = 1\text{ }\mu\text{F}$ , unless otherwise noted.



### TYPICAL CHARACTERISTICS (continued)

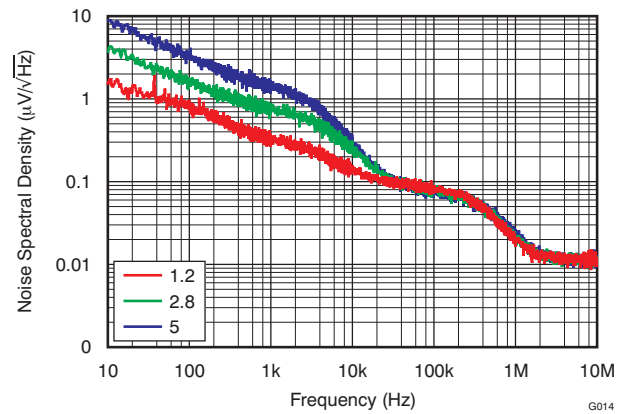
At operating temperature range ( $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ ),  $T_A = +25^\circ\text{C}$ ,  $V_{IN} = V_{OUT(NOM)} + 0.5\text{ V}$  or  $1.7\text{ V}$  (whichever is greater),  $I_{OUT} = 10\text{ mA}$ ,  $V_{EN} = V_{IN}$ , and  $C_{OUT} = 1\text{ }\mu\text{F}$ , unless otherwise noted.

**PSRR vs INPUT VOLTAGE**



**Figure 15.**

**OUTPUT SPECTRAL NOISE DENSITY vs FREQUENCY**



**Figure 16.**



## APPLICATION INFORMATION

The TLV717xx belongs to a new family of next-generation value LDO regulators. These devices consume low quiescent current and deliver excellent line and load transient performance. These characteristics, combined with low noise, very good PSRR with little ( $V_{IN} - V_{OUT}$ ) headroom, make this family of devices ideal for RF portable applications.

This family of regulators offers current foldback. Operating junction temperature of the device is  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ .

### INPUT AND OUTPUT CAPACITOR REQUIREMENTS

X5R- and X7R-type ceramic capacitors are recommended because these capacitors have minimal variation in value and equivalent series resistance (ESR) over temperature. The TLV717xx is designed to be stable with an effective capacitance of 0.1  $\mu\text{F}$  or larger at the output, though a 1- $\mu\text{F}$  ceramic capacitor is recommended for typical applications. Thus, the device is stable with capacitors of other dielectric types as well, as long as the effective capacitance under operating bias voltage and temperature is greater than 0.1  $\mu\text{F}$ . This effective capacitance refers to the capacitance that the LDO sees under operating bias voltage and temperature conditions; that is, the capacitance after taking both bias voltage and temperature derating into consideration. In addition to allowing the use of cheaper dielectrics, this capability of being stable with 0.1- $\mu\text{F}$  effective capacitance also enables the use of smaller footprint capacitors that have higher derating in size- and space-constrained applications. Note that using a 0.1- $\mu\text{F}$  rated capacitor at the output of the LDO does not ensure stability because the effective capacitance under the specified operating conditions would be less than 0.1  $\mu\text{F}$ . Maximum ESR should be less than 200 m $\Omega$ .

Although an input capacitor is not required for stability, it is good analog design practice to connect a 0.1- $\mu\text{F}$  to 1.0- $\mu\text{F}$ , low ESR capacitor across the IN pin and GND pin of the regulator. This capacitor counteracts reactive input sources and improves transient response, noise rejection, and ripple rejection. A higher-value capacitor may be necessary if large, fast, rise-time load transients are anticipated, or if the device is not located close to the power source. If source impedance is more than 2  $\Omega$ , a 0.1- $\mu\text{F}$  input capacitor may be necessary to ensure stability.

### BOARD LAYOUT RECOMMENDATIONS TO IMPROVE PSRR AND NOISE PERFORMANCE

Input and output capacitors should be placed as close to the device pins as possible. To improve ac performance such as PSRR, output noise, and transient response, it is recommended that the board be designed with separate ground planes for  $V_{IN}$  and  $V_{OUT}$ , with the ground plane connected only at the GND pin of the device. In addition, the ground connection for the output capacitor should be connected directly to the GND pin of the device. High ESR capacitors may degrade PSRR performance.

### INTERNAL CURRENT LIMIT

The TLV717xx has an internal foldback current limit that helps to protect the regulator during fault conditions. The current supplied by the device is gradually throttled down as the output voltage decreases. When the output is shorted, the LDO supplies a typical current of 40 mA. Output voltage is not regulated when the device is in current limit, and is  $V_{OUT} = I_{LIMIT} \times R_{LOAD}$ . The advantage of foldback current limit is that the  $I_{LIMIT}$  value is less than the fixed current limit. Therefore, the power that the PMOS pass transistor dissipates  $(V_{IN} - V_{OUT}) \times I_{LIMIT}$  is much less.

The PMOS pass element in the TLV717xx has a built-in body diode that conducts current when the voltage at OUT exceeds the voltage at IN. This current is not limited, so if extended reverse voltage operation is anticipated, external limiting to 5% of the rated output current is recommended.

### SHUTDOWN

The enable pin (EN) is active high. The device is enabled when the voltage at the EN pin goes above 0.9 V. This relatively lower value of voltage that is required to turn the LDO on can be exploited to power the LDO with a GPIO of recent processors whose GPIO logic 1 voltage level is lower than traditional microcontrollers. The device is turned off when the EN pin is held at less than 0.4 V. When shutdown capability is not required, EN can be connected to the IN pin.

## DROPOUT VOLTAGE

The TLV717xx uses a PMOS pass transistor to achieve low dropout. When  $(V_{IN} - V_{OUT})$  is less than the dropout voltage ( $V_{DO}$ ), the PMOS pass device is in the linear region of operation and the input-to-output resistance is the  $R_{DS(ON)}$  of the PMOS pass element.  $V_{DO}$  scales approximately with output current because the PMOS device behaves as a resistor in dropout. As with any linear regulator, PSRR and transient response are degraded as  $(V_{IN} - V_{OUT})$  approaches dropout.

## TRANSIENT RESPONSE

As with any regulator, increasing the size of the output capacitor reduces over-/undershoot magnitude but increases the duration of the transient response.

## UNDERVOLTAGE LOCKOUT (UVLO)

The TLV717xx uses an undervoltage lockout circuit ( $UVLO = 1.6\text{ V}$ ) to keep the output shut off until internal circuitry is operating properly.

## POWER DISSIPATION

The ability to remove heat from the die is different for each package type, presenting different considerations in the printed circuit board (PCB) layout. The PCB area around the device that is free of other components moves the heat from the device to ambient air. Performance data for JEDEC low and high-K boards are given in the [Thermal Information](#) table. Using heavier copper increases the effectiveness in removing heat from the device. The addition, plated through-holes to heat-dissipating layers also improves heatsink effectiveness.

Power dissipation depends on input voltage and load conditions. Power dissipation ( $P_D$ ) is equal to the product of the output current and the voltage drop across the output pass element, as shown in [Equation 1](#).

$$P_D = (V_{IN} - V_{OUT}) \times I_{OUT} \quad (1)$$

**PACKAGING INFORMATION**

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup>    | Lead/<br>Ball Finish | MSL Peak Temp <sup>(3)</sup> | Samples<br>(Requires Login) |
|------------------|-----------------------|--------------|-----------------|------|-------------|----------------------------|----------------------|------------------------------|-----------------------------|
| TLV71712PDQNR    | ACTIVE                | X2SON        | DQN             | 4    | 3000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71712PDQNT    | ACTIVE                | X2SON        | DQN             | 4    | 250         | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71713PDQNR    | ACTIVE                | X2SON        | DQN             | 4    | 3000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71713PDQNT    | ACTIVE                | X2SON        | DQN             | 4    | 250         | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71715PDQNR    | ACTIVE                | X2SON        | DQN             | 4    | 3000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71715PDQNT    | ACTIVE                | X2SON        | DQN             | 4    | 250         | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71718PDBVR    | PREVIEW               | SOT-23       | DBV             | 5    | 3000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71718PDBVT    | PREVIEW               | SOT-23       | DBV             | 5    | 250         | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71718PDQNR    | ACTIVE                | X2SON        | DQN             | 4    | 3000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71718PDQNT    | ACTIVE                | X2SON        | DQN             | 4    | 250         | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71721PDQNR    | PREVIEW               | X2SON        | DQN             | 4    | 3000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71721PDQNT    | PREVIEW               | X2SON        | DQN             | 4    | 250         | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71727PDQNR    | PREVIEW               | X2SON        | DQN             | 4    | 3000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71727PDQNT    | PREVIEW               | X2SON        | DQN             | 4    | 250         | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV717285PDQNT   | ACTIVE                | X2SON        | DQN             | 4    | 250         | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV717285PQNR    | PREVIEW               | X2SON        | DQN             | 5    | 3000        | TBD                        | Call TI              | Call TI                      |                             |
| TLV71728PDQNR    | ACTIVE                | X2SON        | DQN             | 4    | 3000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |

| Orderable Device | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup>    | Lead/<br>Ball Finish | MSL Peak Temp <sup>(3)</sup> | Samples<br>(Requires Login) |
|------------------|-----------------------|--------------|-----------------|------|-------------|----------------------------|----------------------|------------------------------|-----------------------------|
| TLV71728PDQNT    | ACTIVE                | X2SON        | DQN             | 4    | 250         | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71729PDQNR    | PREVIEW               | X2SON        | DQN             | 4    | 3000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71729PDQNT    | PREVIEW               | X2SON        | DQN             | 4    | 250         | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71730PDBVR    | PREVIEW               | SOT-23       | DBV             | 5    | 3000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71730PDBVT    | PREVIEW               | SOT-23       | DBV             | 5    | 250         | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71730PDQNR    | ACTIVE                | X2SON        | DQN             | 4    | 3000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71730PDQNT    | ACTIVE                | X2SON        | DQN             | 4    | 250         | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71733PDBVR    | PREVIEW               | SOT-23       | DBV             | 5    | 3000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71733PDBVT    | PREVIEW               | SOT-23       | DBV             | 5    | 250         | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71733PDQNR    | ACTIVE                | X2SON        | DQN             | 4    | 3000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71733PDQNT    | ACTIVE                | X2SON        | DQN             | 4    | 250         | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71736PDBVR    | PREVIEW               | SOT-23       | DBV             | 5    | 3000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71736PDBVT    | PREVIEW               | SOT-23       | DBV             | 5    | 250         | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71736PDQNR    | ACTIVE                | X2SON        | DQN             | 4    | 3000        | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |
| TLV71736PDQNT    | ACTIVE                | X2SON        | DQN             | 4    | 250         | Green (RoHS<br>& no Sb/Br) | CU NIPDAU            | Level-1-260C-UNLIM           |                             |

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

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

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

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

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

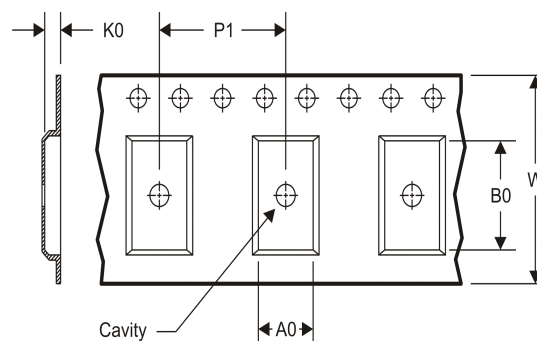
**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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**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                   |

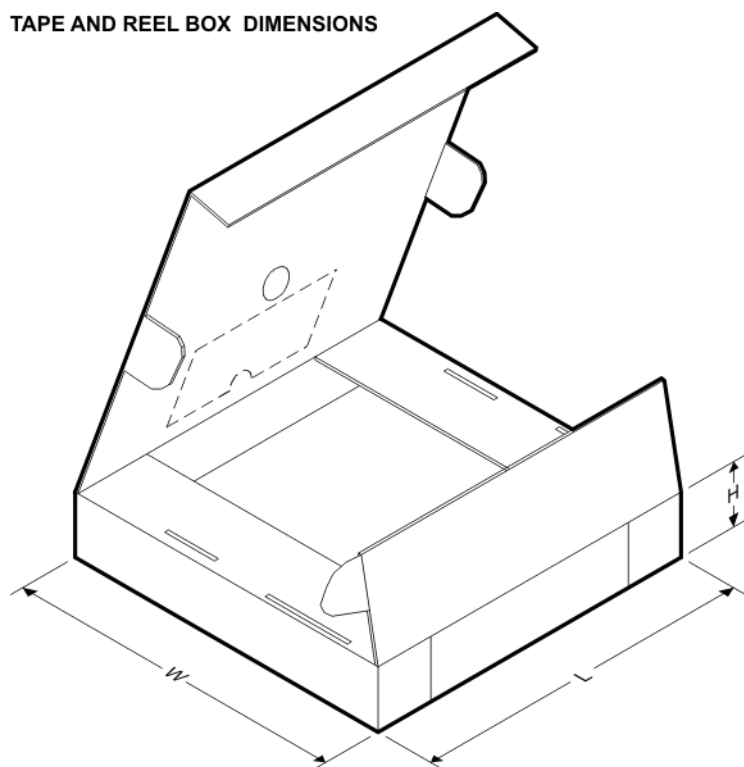
**TAPE AND REEL INFORMATION**

\*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 |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLV71712PDQNR  | X2SON        | DQN             | 4    | 3000 | 180.0              | 9.5                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71712PDQNR  | X2SON        | DQN             | 4    | 3000 | 180.0              | 8.4                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71712PDQNT  | X2SON        | DQN             | 4    | 250  | 180.0              | 8.4                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71712PDQNT  | X2SON        | DQN             | 4    | 250  | 180.0              | 9.5                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71713PDQNR  | X2SON        | DQN             | 4    | 3000 | 180.0              | 8.4                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71713PDQNR  | X2SON        | DQN             | 4    | 3000 | 180.0              | 9.5                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71713PDQNT  | X2SON        | DQN             | 4    | 250  | 180.0              | 8.4                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71713PDQNT  | X2SON        | DQN             | 4    | 250  | 180.0              | 9.5                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71715PDQNR  | X2SON        | DQN             | 4    | 3000 | 180.0              | 8.4                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71715PDQNR  | X2SON        | DQN             | 4    | 3000 | 180.0              | 9.5                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71715PDQNT  | X2SON        | DQN             | 4    | 250  | 180.0              | 9.5                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71715PDQNT  | X2SON        | DQN             | 4    | 250  | 180.0              | 8.4                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71718PDQNR  | X2SON        | DQN             | 4    | 3000 | 180.0              | 8.4                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71718PDQNR  | X2SON        | DQN             | 4    | 3000 | 180.0              | 9.5                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71718PDQNT  | X2SON        | DQN             | 4    | 250  | 180.0              | 9.5                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71718PDQNT  | X2SON        | DQN             | 4    | 250  | 180.0              | 8.4                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV717285PDQNT | X2SON        | DQN             | 4    | 250  | 180.0              | 9.5                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV717285PDQNT | X2SON        | DQN             | 4    | 250  | 180.0              | 8.4                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |

| 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 |
|---------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TLV71728PDQNR | X2SON        | DQN             | 4    | 3000 | 180.0              | 8.4                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71728PDQNR | X2SON        | DQN             | 4    | 3000 | 180.0              | 9.5                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71728PDQNT | X2SON        | DQN             | 4    | 250  | 180.0              | 9.5                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71728PDQNT | X2SON        | DQN             | 4    | 250  | 180.0              | 8.4                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71730PDQNR | X2SON        | DQN             | 4    | 3000 | 180.0              | 9.5                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71730PDQNR | X2SON        | DQN             | 4    | 3000 | 180.0              | 8.4                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71730PDQNT | X2SON        | DQN             | 4    | 250  | 180.0              | 9.5                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71730PDQNT | X2SON        | DQN             | 4    | 250  | 180.0              | 8.4                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71733PDQNR | X2SON        | DQN             | 4    | 3000 | 180.0              | 8.4                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71733PDQNR | X2SON        | DQN             | 4    | 3000 | 180.0              | 9.5                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71733PDQNT | X2SON        | DQN             | 4    | 250  | 180.0              | 9.5                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71733PDQNT | X2SON        | DQN             | 4    | 250  | 180.0              | 8.4                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71736PDQNR | X2SON        | DQN             | 4    | 3000 | 180.0              | 9.5                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |
| TLV71736PDQNT | X2SON        | DQN             | 4    | 250  | 180.0              | 9.5                | 1.16    | 1.16    | 0.63    | 4.0     | 8.0    | Q2            |

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

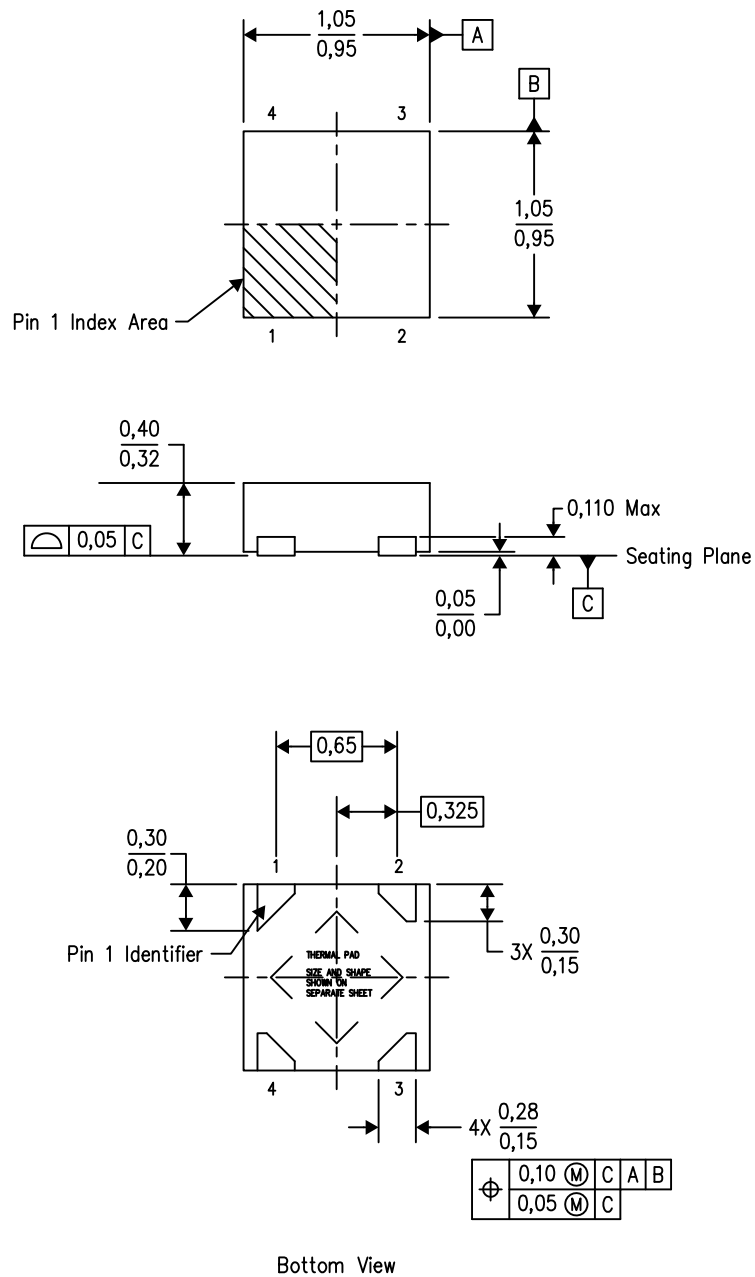
| Device        | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|---------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLV71712PDQNR | X2SON        | DQN             | 4    | 3000 | 180.0       | 180.0      | 30.0        |
| TLV71712PDQNR | X2SON        | DQN             | 4    | 3000 | 202.0       | 201.0      | 28.0        |
| TLV71712PDQNT | X2SON        | DQN             | 4    | 250  | 202.0       | 201.0      | 28.0        |

| Device         | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TLV71712PDQNT  | X2SON        | DQN             | 4    | 250  | 180.0       | 180.0      | 30.0        |
| TLV71713PDQNR  | X2SON        | DQN             | 4    | 3000 | 202.0       | 201.0      | 28.0        |
| TLV71713PDQNR  | X2SON        | DQN             | 4    | 3000 | 180.0       | 180.0      | 30.0        |
| TLV71713PDQNT  | X2SON        | DQN             | 4    | 250  | 202.0       | 201.0      | 28.0        |
| TLV71713PDQNT  | X2SON        | DQN             | 4    | 250  | 180.0       | 180.0      | 30.0        |
| TLV71715PDQNR  | X2SON        | DQN             | 4    | 3000 | 202.0       | 201.0      | 28.0        |
| TLV71715PDQNR  | X2SON        | DQN             | 4    | 3000 | 180.0       | 180.0      | 30.0        |
| TLV71715PDQNT  | X2SON        | DQN             | 4    | 250  | 180.0       | 180.0      | 30.0        |
| TLV71715PDQNT  | X2SON        | DQN             | 4    | 250  | 202.0       | 201.0      | 28.0        |
| TLV71718PDQNR  | X2SON        | DQN             | 4    | 3000 | 202.0       | 201.0      | 28.0        |
| TLV71718PDQNR  | X2SON        | DQN             | 4    | 3000 | 180.0       | 180.0      | 30.0        |
| TLV71718PDQNT  | X2SON        | DQN             | 4    | 250  | 180.0       | 180.0      | 30.0        |
| TLV71718PDQNT  | X2SON        | DQN             | 4    | 250  | 202.0       | 201.0      | 28.0        |
| TLV717285PDQNT | X2SON        | DQN             | 4    | 250  | 180.0       | 180.0      | 30.0        |
| TLV717285PDQNT | X2SON        | DQN             | 4    | 250  | 202.0       | 201.0      | 28.0        |
| TLV71728PDQNR  | X2SON        | DQN             | 4    | 3000 | 202.0       | 201.0      | 28.0        |
| TLV71728PDQNR  | X2SON        | DQN             | 4    | 3000 | 180.0       | 180.0      | 30.0        |
| TLV71728PDQNT  | X2SON        | DQN             | 4    | 250  | 180.0       | 180.0      | 30.0        |
| TLV71728PDQNT  | X2SON        | DQN             | 4    | 250  | 202.0       | 201.0      | 28.0        |
| TLV71730PDQNR  | X2SON        | DQN             | 4    | 3000 | 180.0       | 180.0      | 30.0        |
| TLV71730PDQNR  | X2SON        | DQN             | 4    | 3000 | 202.0       | 201.0      | 28.0        |
| TLV71730PDQNT  | X2SON        | DQN             | 4    | 250  | 180.0       | 180.0      | 30.0        |
| TLV71730PDQNT  | X2SON        | DQN             | 4    | 250  | 202.0       | 201.0      | 28.0        |
| TLV71733PDQNR  | X2SON        | DQN             | 4    | 3000 | 202.0       | 201.0      | 28.0        |
| TLV71733PDQNR  | X2SON        | DQN             | 4    | 3000 | 180.0       | 180.0      | 30.0        |
| TLV71733PDQNT  | X2SON        | DQN             | 4    | 250  | 180.0       | 180.0      | 30.0        |
| TLV71733PDQNT  | X2SON        | DQN             | 4    | 250  | 202.0       | 201.0      | 28.0        |
| TLV71736PDQNR  | X2SON        | DQN             | 4    | 3000 | 180.0       | 180.0      | 30.0        |
| TLV71736PDQNT  | X2SON        | DQN             | 4    | 250  | 180.0       | 180.0      | 30.0        |



DQN (S-PX2SON-N4)

PLASTIC SMALL OUTLINE NO-LEAD



4210367/D 09/2012

- NOTES:
- All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - This drawing is subject to change without notice.
  - SON (Small Outline No-Lead) package configuration.
  - The package thermal pad must be soldered to the board for thermal and mechanical performance.
  - See the additional figure in the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.

## THERMAL PAD MECHANICAL DATA

DQN (S-PX2SON-N4)

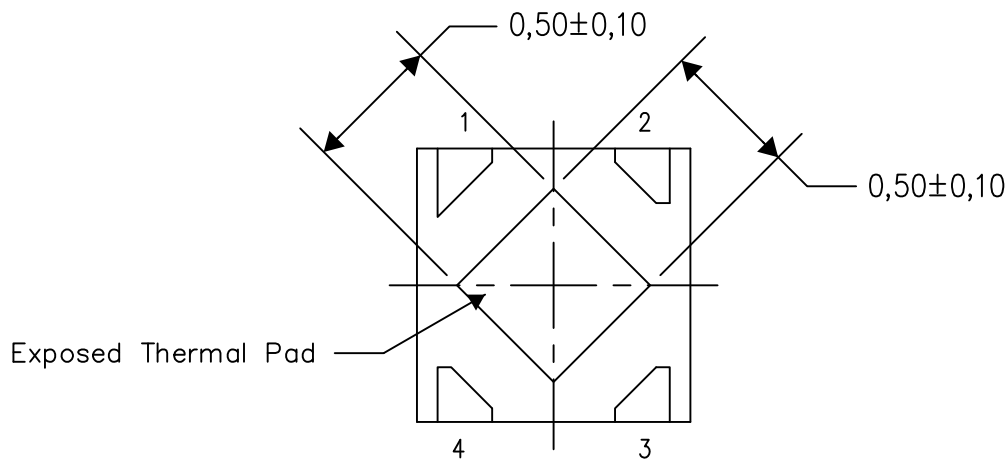
PLASTIC SMALL OUTLINE NO-LEAD

### THERMAL INFORMATION

This package incorporates an exposed thermal pad that is designed to be attached directly to an external heatsink. The thermal pad must be soldered directly to the printed circuit board (PCB). After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For information on the Quad Flatpack No-Lead (QFN) package and its advantages, refer to Application Report, QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271. This document is available at [www.ti.com](http://www.ti.com).

The exposed thermal pad dimensions for this package are shown in the following illustration.



Bottom View

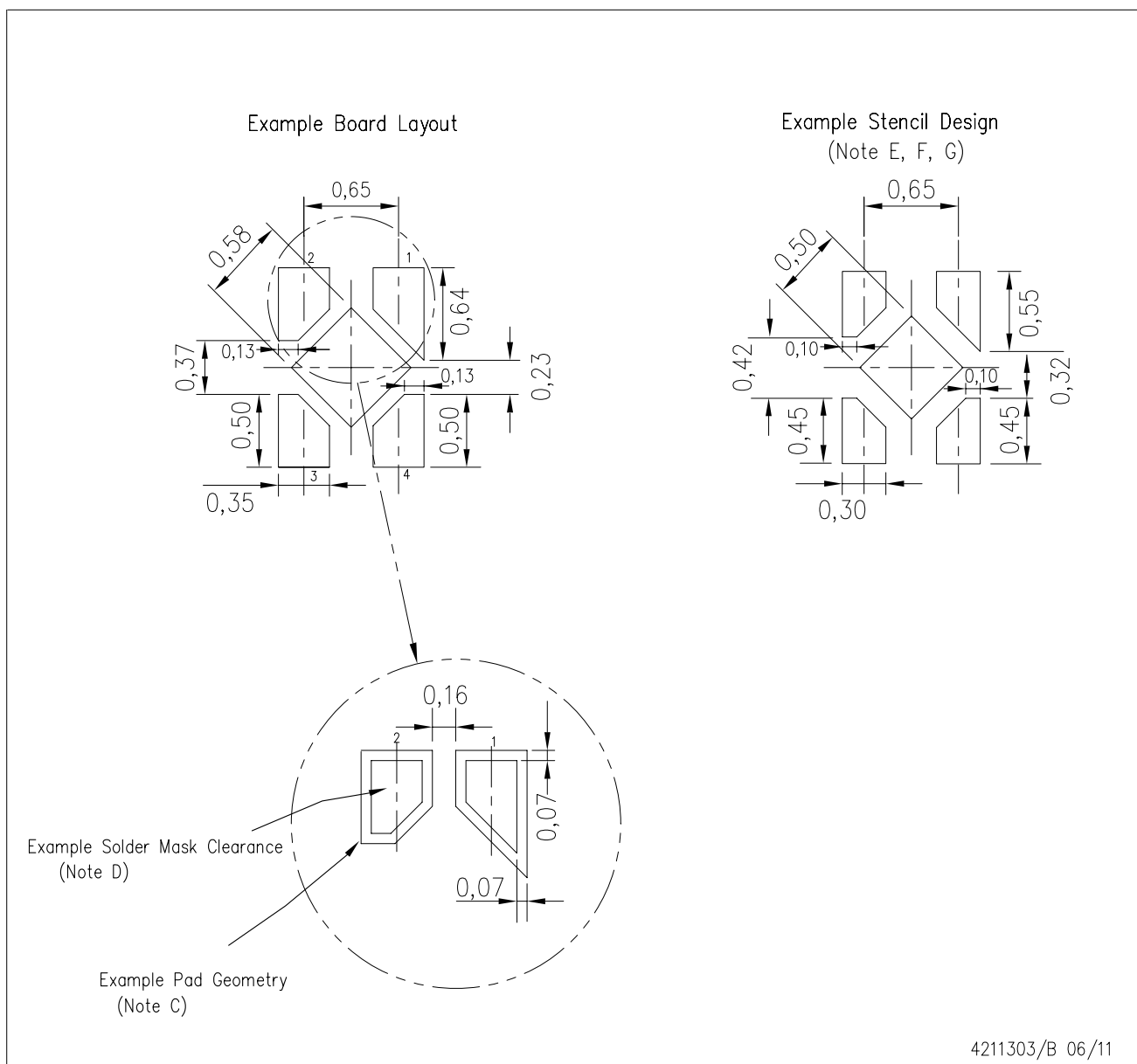
Exposed Thermal Pad Dimensions

4210393-2/E 04/12

NOTE: All linear dimensions are in millimeters

DQN (S-PX2SON-N4)

PLASTIC SMALL OUTLINE NO-LEAD



- 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. Customers should contact their board fabrication site for minimum solder mask web tolerances between signal pads.
  - E. Maximum stencil thickness 0,127 mm (5 mils). All linear dimensions are in millimeters.
  - F. 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 for stencil design considerations.
  - G. Side aperture dimensions over-print land for acceptable area ratio > 0.66. Customer may reduce side aperture dimensions if stencil manufacturing process allows for sufficient release at smaller opening.

## THERMAL PAD MECHANICAL DATA

DQN (S-PX2SON-N4)

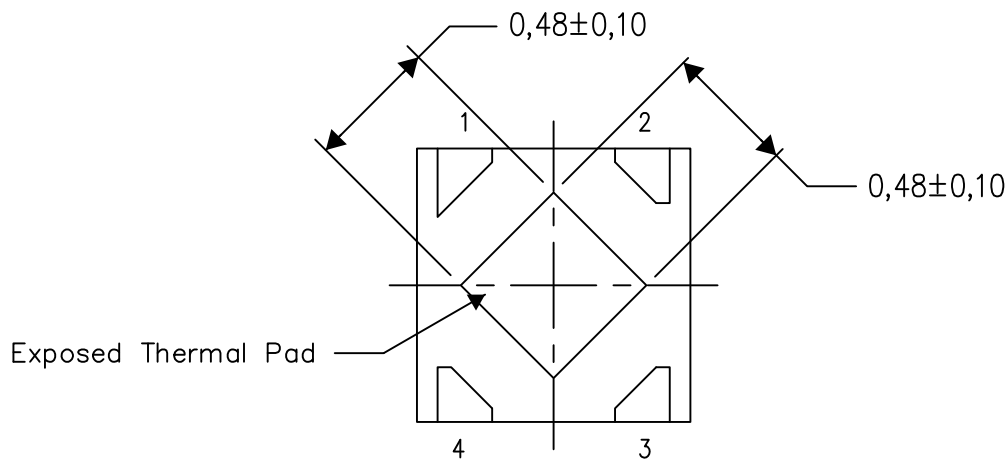
PLASTIC SMALL OUTLINE NO-LEAD

### THERMAL INFORMATION

This package incorporates an exposed thermal pad that is designed to be attached directly to an external heatsink. The thermal pad must be soldered directly to the printed circuit board (PCB). After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For information on the Quad Flatpack No-Lead (QFN) package and its advantages, refer to Application Report, QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271. This document is available at [www.ti.com](http://www.ti.com).

The exposed thermal pad dimensions for this package are shown in the following illustration.



Bottom View

Exposed Thermal Pad Dimensions

4210393-3/E 04/12

NOTE: All linear dimensions are in millimeters

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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 which meet ISO/TS16949 requirements, mainly for automotive use. Components which have not been so designated are neither designed nor intended for automotive use; and TI will not be responsible for any failure of such components to meet such requirements.

### Products

|                              |  |
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| Audio                        | <a href="http://www.ti.com/audio">www.ti.com/audio</a>                               |
| Amplifiers                   | <a href="http://amplifier.ti.com">amplifier.ti.com</a>                               |
| Data Converters              | <a href="http://dataconverter.ti.com">dataconverter.ti.com</a>                       |
| DLP® Products                | <a href="http://www.dlp.com">www.dlp.com</a>   |
| DSP                          | <a href="http://dsp.ti.com">dsp.ti.com</a>   |
| Clocks and Timers            | <a href="http://www.ti.com/clocks">www.ti.com/clocks</a>                             |
| Interface                    | <a href="http://interface.ti.com">interface.ti.com</a>                               |
| Logic                        | <a href="http://logic.ti.com">logic.ti.com</a>                                       |
| Power Mgmt                   | <a href="http://power.ti.com">power.ti.com</a>                                       |
| Microcontrollers             | <a href="http://microcontroller.ti.com">microcontroller.ti.com</a>                   |
| RFID                         | <a href="http://www.ti-rfid.com">www.ti-rfid.com</a>                                 |
| OMAP Applications Processors | <a href="http://www.ti.com/omap">www.ti.com/omap</a>                                 |
| Wireless Connectivity        | <a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a> |

### Applications

|                               |  |
|-------------------------------|--|
| Automotive and Transportation | <a href="http://www.ti.com/automotive">www.ti.com/automotive</a>                         |
| Communications and Telecom    | <a href="http://www.ti.com/communications">www.ti.com/communications</a>                 |
| Computers and Peripherals     | <a href="http://www.ti.com/computers">www.ti.com/computers</a>                           |
| Consumer Electronics          | <a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>                   |
| Energy and Lighting           | <a href="http://www.ti.com/energy">www.ti.com/energy</a>                                 |
| Industrial                    | <a href="http://www.ti.com/industrial">www.ti.com/industrial</a>                         |
| Medical                       | <a href="http://www.ti.com/medical">www.ti.com/medical</a>                               |
| Security                      | <a href="http://www.ti.com/security">www.ti.com/security</a>                             |
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