

# LM5100A/B/C

## LM5101A/B/C 3A, 2A and 1A High Voltage High-Side and Low-Side Gate Drivers

Check for Samples: [LM5100A](#), [LM5100B](#), [LM5100C](#), [LM5101A](#), [LM5101B](#), [LM5101C](#)

## FEATURES

- **Drives Both a High-side and Low-side N-Channel MOSFETs**
- **Independent High and Low Driver Logic Inputs**
- **Bootstrap Supply Voltage up to 118V DC**
- **Fast Propagation Times (25 ns Typical)**
- **Drives 1000 pF Load with 8 ns Rise and Fall Times**
- **Excellent Propagation Delay Matching (3 ns typical)**
- **Supply Rail Under-voltage Lockout**
- **Low Power Consumption**
- **Pin Compatible with HIP2100/HIP2101**

## TYPICAL APPLICATIONS

- **Current Fed Push-pull Converters**
- **Half and Full Bridge Power Converters**
- **Synchronous Buck Converters**
- **Two Switch Forward Power Converters**
- **Forward with Active Clamp Converters**

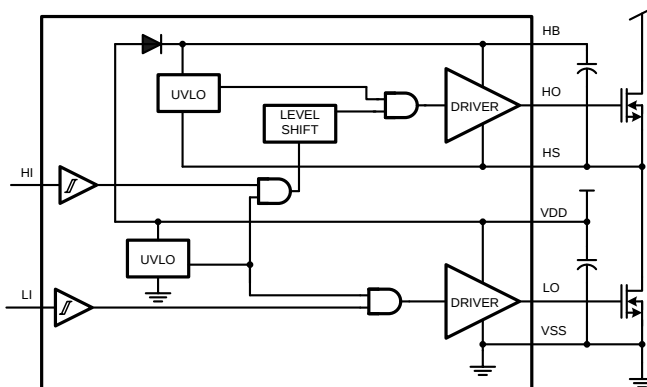
## DESCRIPTION

The LM5100A/B/C and LM5101A/B/C High Voltage Gate Drivers are designed to drive both the high-side and the low-side N-Channel MOSFETs in a synchronous buck or a half-bridge configuration. The floating high-side driver is capable of operating with supply voltages up to 100V. The “A” versions provide a full 3A of gate drive while the “B” and “C” versions provide 2A and 1A respectively. The outputs are independently controlled with CMOS input thresholds (LM5100A/B/C) or TTL input thresholds (LM5101A/B/C). An integrated high voltage diode is provided to charge the high-side gate drive bootstrap capacitor. A robust level shifter operates at high speed while consuming low power and providing clean level transitions from the control logic to the high-side gate driver. Under-voltage lockout is provided on both the low-side and the high-side power rails. These devices are available in the standard SOIC-8 pin, SO PowerPad-8 pin and the WSON-10 pin packages. The LM5100C and LM5101C are also available in MSOP-PowerPad-8 package. The LM5101A is also available in WSON-8 pin package.

## Package

- SOIC-8
- SO PowerPad-8
- WSON-8 (4 mm x 4 mm)
- WSON-10 (4 mm x 4 mm)
- MSOP-PowerPad-8

### Simplified Block Diagram

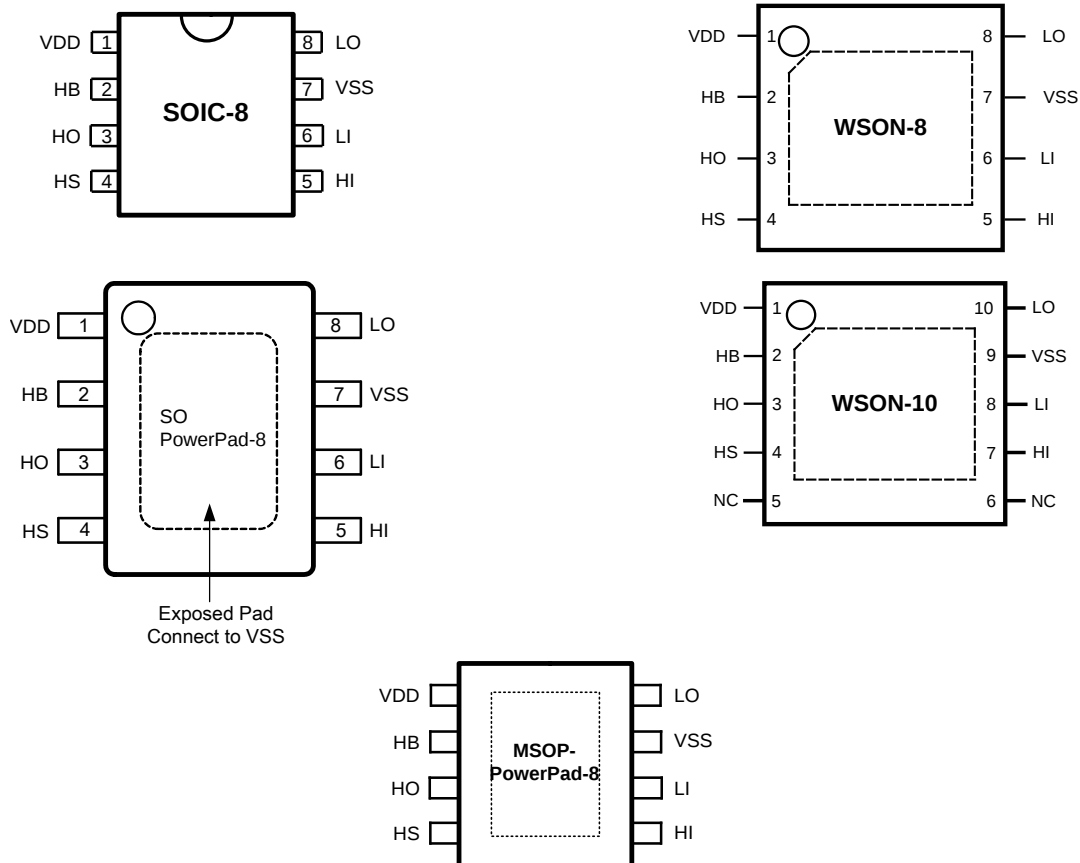


Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

All trademarks are the property of their respective owners.

**Table 1. Input/Output Options**

| Part Number | Input Thresholds | Peak Output Current |
|-------------|------------------|---------------------|
| LM5100A     | CMOS             | 3A                  |
| LM5101A     | TTL              | 3A                  |
| LM5100B     | CMOS             | 2A                  |
| LM5101B     | TTL              | 2A                  |
| LM5100C     | CMOS             | 1A                  |
| LM5101C     | TTL              | 1A                  |

**Connection Diagrams****PIN DESCRIPTIONS<sup>(1)</sup>**

| Pin #  |                |                       |                        |                                | Name | Description                          | Application Information                                                                                                                                                  |
|--------|----------------|-----------------------|------------------------|--------------------------------|------|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SOIC-8 | SO Power Pad-8 | WSON-8 <sup>(1)</sup> | WSON-10 <sup>(1)</sup> | MSOP-PowerPad-8 <sup>(1)</sup> |      |                                      |                                                                                                                                                                          |
| 1      | 1              | 1                     | 1                      | 1                              | VDD  | Positive gate drive supply           | Locally decouple to VSS using low ESR/ESL capacitor located as close to the IC as possible.                                                                              |
| 2      | 2              | 2                     | 2                      | 2                              | HB   | High-side gate driver bootstrap rail | Connect the positive terminal of the bootstrap capacitor to HB and the negative terminal to HS. The bootstrap capacitor should be placed as close to the IC as possible. |
| 3      | 3              | 3                     | 3                      | 3                              | HO   | High-side gate driver output         | Connect to the gate of high-side MOSFET with a short, low inductance path.                                                                                               |

- (1) Note: For WSON-8, WSON-10 and MSOP-PowerPad-8 package, it is recommended that the exposed pad on the bottom of the package is soldered to ground plane on the PC board, and that ground plane should extend out from beneath the IC to help dissipate heat. For WSON-10 package, pins 5 and 6 have no connection.

**PIN DESCRIPTIONS<sup>(1)</sup> (continued)**

| Pin #  |                |                      |                       |                                | Name                                                | Description                        | Application Information                                                                                                                                      |
|--------|----------------|----------------------|-----------------------|--------------------------------|-----------------------------------------------------|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SOIC-8 | SO Power Pad-8 | WSO-8 <sup>(1)</sup> | WSO-10 <sup>(1)</sup> | MSOP-PowerPad-8 <sup>(1)</sup> |                                                     |                                    |                                                                                                                                                              |
| 4      | 4              | 4                    | 4                     | 4                              | HS                                                  | High-side MOSFET source connection | Connect to the bootstrap capacitor negative terminal and the source of the high-side MOSFET.                                                                 |
| 5      | 5              | 5                    | 7                     | 5                              | HI                                                  | High-side driver control input     | The LM5100A/B/C inputs have CMOS type thresholds. The LM5101A/B/C inputs have TTL type thresholds. Unused inputs should be tied to ground and not left open. |
| 6      | 6              | 6                    | 8                     | 6                              | LI                                                  | Low-side driver control input      | The LM5100A/B/C inputs have CMOS type thresholds. The LM5101A/B/C inputs have TTL type thresholds. Unused inputs should be tied to ground and not left open. |
| 7      | 7              | 7                    | 9                     | 7                              | VSS                                                 | Ground return                      | All signals are referenced to this ground.                                                                                                                   |
| 8      | 8              | 8                    | 10                    | 8                              | LO                                                  | Low-side gate driver output        | Connect to the gate of the low-side MOSFET with a short, low inductance path.                                                                                |
|        | EP             | EP                   | EP                    | EP                             | EP (WSO and SO PowerPad and MSOP-PowerPad packages) |                                    | Solder to the ground plane under the IC to aid in heat dissipation.                                                                                          |



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

**Absolute Maximum Ratings<sup>(1)(2)</sup>**

|                               |                                                |
|-------------------------------|------------------------------------------------|
| VDD to VSS                    | -0.3V to +18V                                  |
| HB to HS                      | -0.3V to +18V                                  |
| LI or HI Input                | -0.3V to V <sub>DD</sub> +0.3V                 |
| LO Output                     | -0.3V to V <sub>DD</sub> +0.3V                 |
| HO Output                     | V <sub>HS</sub> -0.3V to V <sub>HB</sub> +0.3V |
| HS to VSS <sup>(3)</sup>      | -5V to +100V                                   |
| HB to VSS                     | 118V                                           |
| Junction Temperature          | +150°C                                         |
| Storage Temperature Range     | -55°C to +150°C                                |
| ESD Rating HBM <sup>(4)</sup> | 2 kV                                           |

- (1) Absolute Maximum Ratings indicate limits beyond which damage to the component may occur. Operating Ratings are conditions under which operation of the device is specified. Operating Ratings do not imply performance limits. For performance limits and associated test conditions, see the Electrical Characteristics [Electrical Characteristics](#) tables.
- (2) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/ Distributors for availability and specifications.
- (3) In the application the HS node is clamped by the body diode of the external lower N-MOSFET, therefore the HS node will generally not exceed -1V. However, in some applications, board resistance and inductance may result in the HS node exceeding this stated voltage transiently. If negative transients occur, the HS voltage must never be more negative than VDD-15V. For example if VDD = 10V, the negative transients at HS must not exceed -5V.
- (4) The Human Body Model (HBM) is a 100 pF capacitor discharged through a 1.5kΩ resistor into each pin. 2 kV for all pins except Pin 2, Pin 3 and Pin 4 which are rated at 1000V for HBM. Machine Model (MM) ratings are : 100V(MM) for Options B and C; 50V(MM) for Option A.

**Recommended Operating Conditions**

|                      |                                             |
|----------------------|---------------------------------------------|
| VDD                  | +9V to +14V                                 |
| HS                   | -1V to 100V                                 |
| HB                   | V <sub>HS</sub> +8V to V <sub>HS</sub> +14V |
| HS Slew Rate         | < 50 V/ns                                   |
| Junction Temperature | -40°C to +125°C                             |

## Electrical Characteristics

Limits in standard type are for  $T_J = 25^\circ\text{C}$  only; limits in boldface type apply over the junction temperature ( $T_J$ ) range of  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$ . Minimum and Maximum limits are specified through test, design, or statistical correlation. Typical values represent the most likely parametric norm at  $T_J = 25^\circ\text{C}$ , and are provided for reference purposes only. Unless otherwise specified,  $V_{DD} = V_{HB} = 12\text{V}$ ,  $V_{SS} = V_{HS} = 0\text{V}$ , No Load on LO or HO <sup>(1)</sup>.

| Symbol                          | Parameter                                   | Conditions                                                                           | Min        | Typ  | Max         | Units         |
|---------------------------------|---------------------------------------------|--------------------------------------------------------------------------------------|------------|------|-------------|---------------|
| <b>SUPPLY CURRENTS</b>          |                                             |                                                                                      |            |      |             |               |
| $I_{DD}$                        | VDD Quiescent Current, LM5100A/B/C          | LI = HI = 0V                                                                         |            | 0.1  | <b>0.2</b>  | mA            |
|                                 | VDD Quiescent Current, LM5101A/B/C          | LI = HI = 0V                                                                         |            | 0.25 | <b>0.4</b>  |               |
| $I_{DDO}$                       | VDD Operating Current                       | f = 500 kHz                                                                          |            | 2.0  | <b>3</b>    | mA            |
| $I_{HB}$                        | Total HB Quiescent Current                  | LI = HI = 0V                                                                         |            | 0.06 | <b>0.2</b>  | mA            |
| $I_{HBO}$                       | Total HB Operating Current                  | f = 500 kHz                                                                          |            | 1.6  | <b>3</b>    | mA            |
| $I_{HBS}$                       | HB to VSS Current, Quiescent                | HS = HB = 100V                                                                       |            | 0.1  | <b>10</b>   | $\mu\text{A}$ |
| $I_{HBSO}$                      | HB to VSS Current, Operating                | f = 500 kHz                                                                          |            | 0.4  |             | mA            |
| <b>INPUT PINS</b>               |                                             |                                                                                      |            |      |             |               |
| $V_{IL}$                        | Input Voltage Threshold LM5100A/B/C         | Rising Edge                                                                          | <b>4.5</b> | 5.4  | <b>6.3</b>  | V             |
| $V_{IL}$                        | Input Voltage Threshold LM5101A/B/C         | Rising Edge                                                                          | <b>1.3</b> | 1.8  | <b>2.3</b>  | V             |
| $V_{IHYS}$                      | Input Voltage Hysteresis LM5100A/B/C        |                                                                                      |            | 500  |             | mV            |
| $V_{IHYS}$                      | Input Voltage Hysteresis LM5101A/B/C        |                                                                                      |            | 50   |             | mV            |
| $R_I$                           | Input Pulldown Resistance                   |                                                                                      | <b>100</b> | 200  | <b>400</b>  | k $\Omega$    |
| <b>UNDER VOLTAGE PROTECTION</b> |                                             |                                                                                      |            |      |             |               |
| $V_{DDR}$                       | VDD Rising Threshold                        |                                                                                      | <b>6.0</b> | 6.9  | <b>7.4</b>  | V             |
| $V_{DDH}$                       | VDD Threshold Hysteresis                    |                                                                                      |            | 0.5  |             | V             |
| $V_{HBR}$                       | HB Rising Threshold                         |                                                                                      | <b>5.7</b> | 6.6  | <b>7.1</b>  | V             |
| $V_{HBH}$                       | HB Threshold Hysteresis                     |                                                                                      |            | 0.4  |             | V             |
| <b>BOOT STRAP DIODE</b>         |                                             |                                                                                      |            |      |             |               |
| $V_{DL}$                        | Low-Current Forward Voltage                 | $I_{VDD-HB} = 100\text{ }\mu\text{A}$                                                |            | 0.52 | <b>0.85</b> | V             |
| $V_{DH}$                        | High-Current Forward Voltage                | $I_{VDD-HB} = 100\text{ mA}$                                                         |            | 0.8  | <b>1</b>    | V             |
| $R_D$                           | Dynamic Resistance LM5100A/B/C, LM5101A/B/C | $I_{VDD-HB} = 100\text{ mA}$                                                         |            | 1.0  | <b>1.65</b> | $\Omega$      |
| <b>LO &amp; HO GATE DRIVER</b>  |                                             |                                                                                      |            |      |             |               |
| $V_{OL}$                        | Low-Level Output Voltage LM5100A/LM5101A    | $I_{HO} = I_{LO} = 100\text{ mA}$                                                    |            | 0.12 | <b>0.25</b> | V             |
|                                 | Low-Level Output Voltage LM5100B/LM5101B    |                                                                                      |            | 0.16 | <b>0.4</b>  |               |
|                                 | Low-Level Output Voltage LM5100C/LM5101C    |                                                                                      |            | 0.28 | <b>0.65</b> |               |
| $V_{OH}$                        | High-Level Output Voltage LM5100A/LM5101A   | $I_{HO} = I_{LO} = 100\text{ mA}$<br>$V_{OH} = V_{DD} - LO$ or<br>$V_{OH} = HB - HO$ |            | 0.24 | <b>0.45</b> | V             |
|                                 | High-Level Output Voltage LM5100B/LM5101B   |                                                                                      |            | 0.28 | <b>0.60</b> |               |
|                                 | High-Level Output Voltage LM5100C/LM5101C   |                                                                                      |            | 0.60 | <b>1.10</b> |               |
| $I_{OHL}$                       | Peak Pullup Current LM5100A/LM5101A         | HO, LO = 0V                                                                          |            | 3    |             | A             |
|                                 | Peak Pullup Current LM5100B/LM5101B         |                                                                                      |            | 2    |             |               |
|                                 | Peak Pullup Current LM5100C/LM5101C         |                                                                                      |            | 1    |             |               |
| $I_{OLL}$                       | Peak Pulldown Current LM5100A/LM5101A       | HO, LO = 12V                                                                         |            | 3    |             | A             |
|                                 | Peak Pulldown Current LM5100B/LM5101B       |                                                                                      |            | 2    |             |               |
|                                 | Peak Pulldown Current LM5100C/LM5101C       |                                                                                      |            | 1    |             |               |

- (1) Min and Max limits are 100% production tested at  $25^\circ\text{C}$ . Limits over the operating temperature range are specified through correlation using Statistical Quality Control (SQC) methods. Limits are used to calculate Average Outgoing Quality Level (AOQL).

## Electrical Characteristics (continued)

Limits in standard type are for  $T_J = 25^\circ\text{C}$  only; limits in boldface type apply over the junction temperature ( $T_J$ ) range of  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$ . Minimum and Maximum limits are specified through test, design, or statistical correlation. Typical values represent the most likely parametric norm at  $T_J = 25^\circ\text{C}$ , and are provided for reference purposes only. Unless otherwise specified,  $V_{DD} = V_{HB} = 12\text{V}$ ,  $V_{SS} = V_{HS} = 0\text{V}$ , No Load on LO or HO <sup>(1)</sup>.

| Symbol                    | Parameter           | Conditions                     | Min | Typ | Max | Units              |
|---------------------------|---------------------|--------------------------------|-----|-----|-----|--------------------|
| <b>THERMAL RESISTANCE</b> |                     |                                |     |     |     |                    |
| $\theta_{JA}^{(2)}$       | Junction to Ambient | SOIC-8                         |     | 170 |     | $^\circ\text{C/W}$ |
|                           |                     | WSO-8 <sup>(3)</sup>           |     | 40  |     |                    |
|                           |                     | WSO-10 <sup>(3)</sup>          |     | 40  |     |                    |
|                           |                     | SO PowerPad-8                  |     | 40  |     |                    |
|                           |                     | MSOP-PowerPad-8 <sup>(3)</sup> |     | 80  |     |                    |

(2) The  $\theta_{JA}$  is not a given constant for the package and depends on the printed circuit board design and the operating environment.

(3) 4 layer board with Cu finished thickness 1.5/1/1/1.5 oz. Maximum die size used. 5x body length of Cu trace on PCB top. 50 x 50mm ground and power planes embedded in PCB. See Application Note AN-1187.

## Switching Characteristics

Limits in standard type are for  $T_J = 25^\circ\text{C}$  only; limits in boldface type apply over the junction temperature ( $T_J$ ) range of  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$ . Minimum and Maximum limits are specified through test, design, or statistical correlation. Typical values represent the most likely parametric norm at  $T_J = 25^\circ\text{C}$ , and are provided for reference purposes only. Unless otherwise specified,  $V_{DD} = V_{HB} = 12\text{V}$ ,  $V_{SS} = V_{HS} = 0\text{V}$ , No Load on LO or HO <sup>(1)</sup>.

| Symbol           | Parameter                                         | Conditions                                       | Min | Typ | Max       | Units |
|------------------|---------------------------------------------------|--------------------------------------------------|-----|-----|-----------|-------|
| $t_{LPHL}$       | LO Turn-Off Propagation Delay<br>LM5100A/B/C      | LI Falling to LO Falling                         |     | 20  | <b>45</b> | ns    |
|                  | LO Turn-Off Propagation Delay<br>LM5101A/B/C      |                                                  |     | 22  | <b>56</b> |       |
| $t_{LPLH}$       | LO Turn-On Propagation Delay<br>LM5100A/B/C       | LI Rising to LO Rising                           |     | 20  | <b>45</b> | ns    |
|                  | LO Turn-On Propagation Delay<br>LM5101A/B/C       |                                                  |     | 26  | <b>56</b> |       |
| $t_{HPHL}$       | HO Turn-Off Propagation Delay<br>LM5100A/B/C      | HI Falling to HO Falling                         |     | 20  | <b>45</b> | ns    |
|                  | HO Turn-Off Propagation Delay<br>LM5101A/B/C      |                                                  |     | 22  | <b>56</b> |       |
| $t_{HPLH}$       | LO Turn-On Propagation Delay<br>LM5100A/B/C       | HI Rising to HO Rising                           |     | 20  | <b>45</b> | ns    |
|                  | LO Turn-On Propagation Delay<br>LM5101A/B/C       |                                                  |     | 26  | <b>56</b> |       |
| $t_{MON}$        | Delay Matching: LO on & HO off<br>LM5100A/B/C     |                                                  |     | 1   | <b>10</b> | ns    |
|                  | Delay Matching: LO on & HO off<br>LM5101A/B/C     |                                                  |     | 4   | <b>10</b> |       |
| $t_{MOFF}$       | Delay Matching: LO off & HO on<br>LM5100A/B/C     |                                                  |     | 1   | <b>10</b> | ns    |
|                  | Delay Matching: LO on & HO off<br>LM5101A/B/C     |                                                  |     | 4   | <b>10</b> |       |
| $t_{RC}, t_{FC}$ | Either Output Rise/Fall Time                      | $C_L = 1000\text{ pF}$                           |     | 8   |           | ns    |
| $t_R$            | Output Rise Time (3V to 9V)<br>LM5100A/LM5101A    | $C_L = 0.1\text{ }\mu\text{F}$                   |     | 430 |           | ns    |
|                  | Output Rise Time (3V to 9V)<br>LM5100B/LM5101B    |                                                  |     | 570 |           |       |
|                  | Output Rise Time (3V to 9V)<br>LM5100C/LM5101C    |                                                  |     | 990 |           |       |
| $t_F$            | Output Fall Time (3V to 9V)<br>LM5100A/LM5101A    | $C_L = 0.1\text{ }\mu\text{F}$                   |     | 260 |           | ns    |
|                  | Output Fall Time (3V to 9V)<br>LM5100B/LM5101B    |                                                  |     | 430 |           |       |
|                  | Output Fall Time (3V to 9V)<br>LM5100C/LM5101C    |                                                  |     | 715 |           |       |
| $t_{PW}$         | Minimum Input Pulse Width that Changes the Output |                                                  |     | 50  |           | ns    |
| $t_{BS}$         | Bootstrap Diode Reverse Recovery Time             | $I_F = 100\text{ mA}$ ,<br>$I_R = 100\text{ mA}$ |     | 37  |           | ns    |

- (1) Min and Max limits are 100% production tested at  $25^\circ\text{C}$ . Limits over the operating temperature range are specified through correlation using Statistical Quality Control (SQC) methods. Limits are used to calculate Average Outgoing Quality Level (AOQL).

## Typical Performance Characteristics

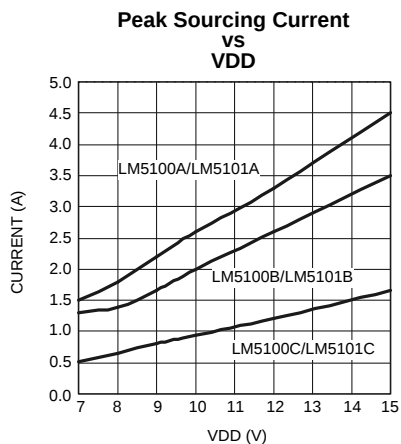


Figure 1.

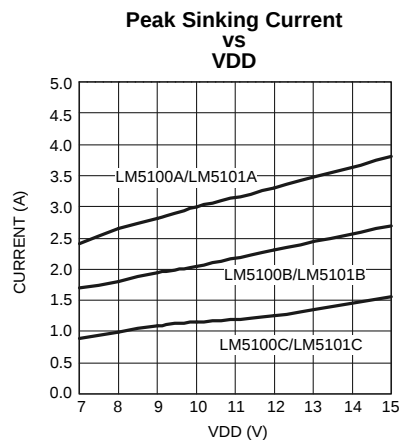


Figure 2.

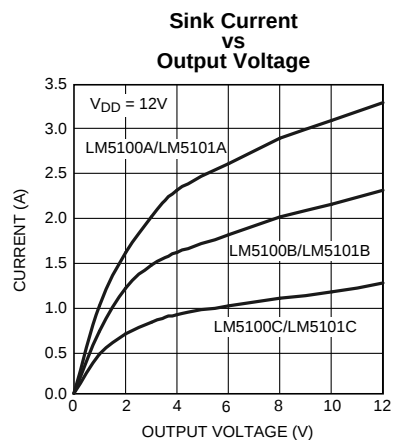


Figure 3.

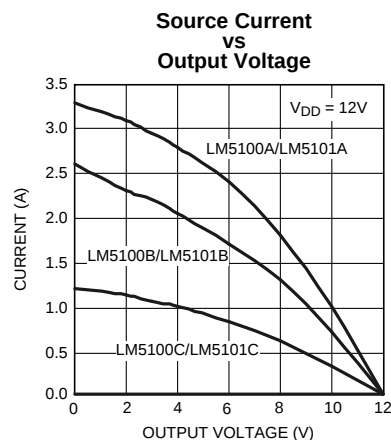


Figure 4.

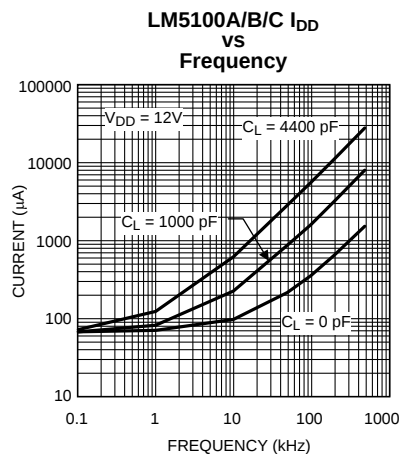


Figure 5.

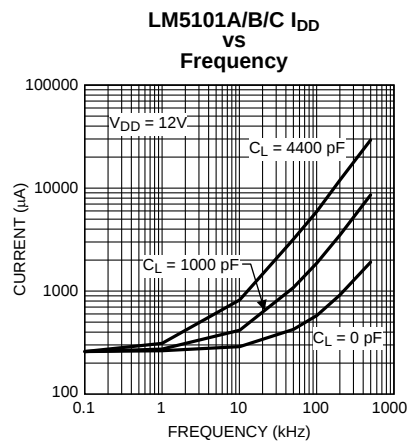


Figure 6.

### Typical Performance Characteristics (continued)

#### Operating Current vs Temperature

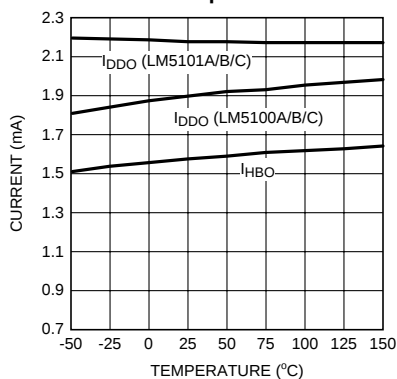


Figure 7.

#### $I_{HB}$ vs Frequency

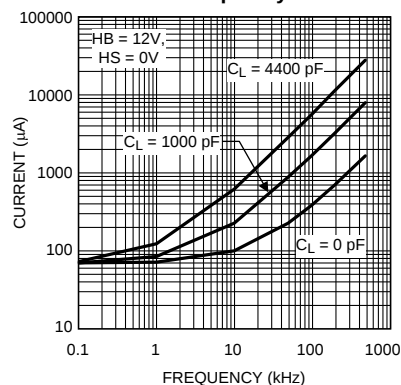


Figure 8.

#### Quiescent Current vs Supply Voltage

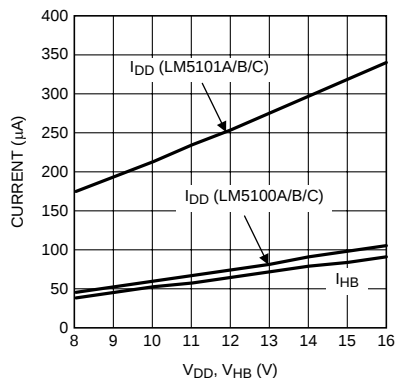


Figure 9.

#### Quiescent Current vs Temperature

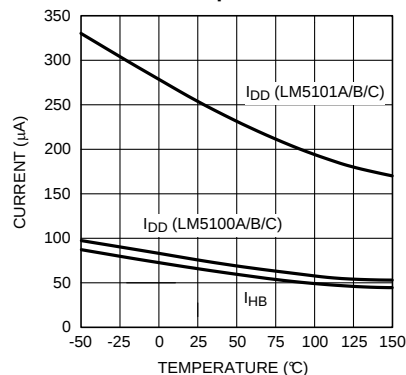


Figure 10.

#### Undervoltage Rising Thresholds vs Temperature

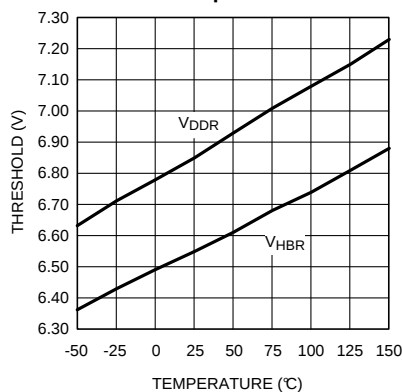


Figure 11.

#### Undervoltage Threshold Hysteresis vs Temperature

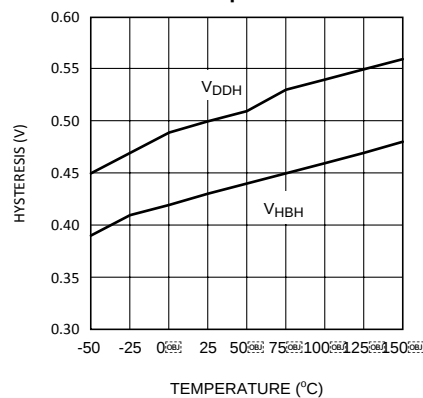


Figure 12.

## Typical Performance Characteristics (continued)

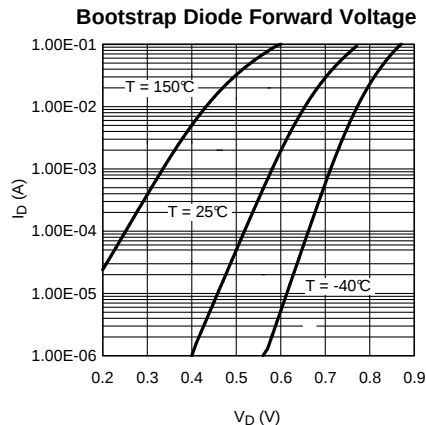


Figure 13.

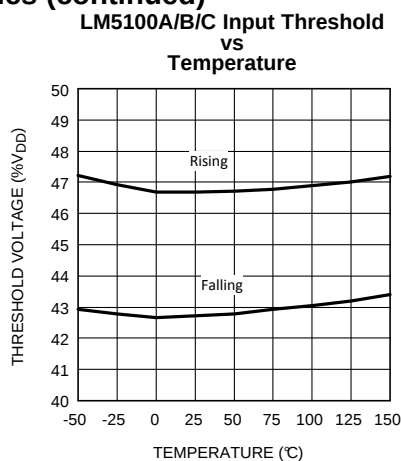


Figure 14.

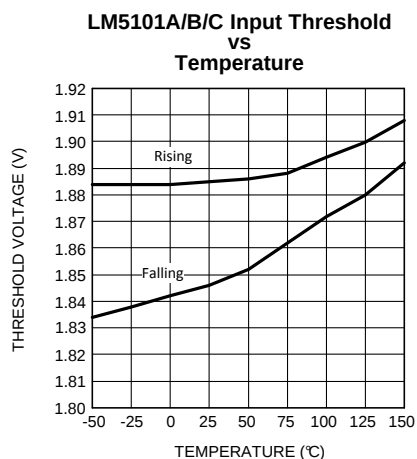


Figure 15.

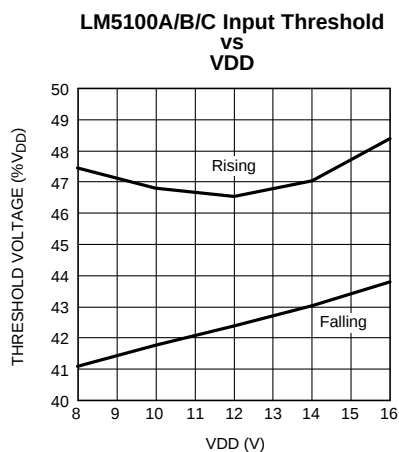


Figure 16.

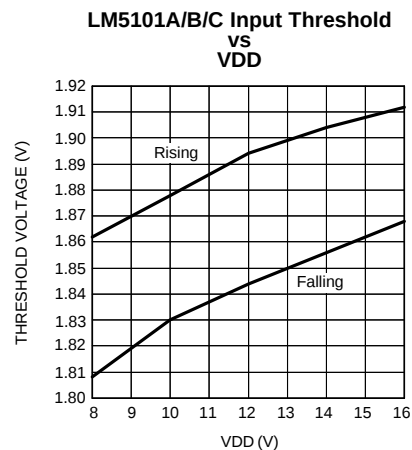


Figure 17.

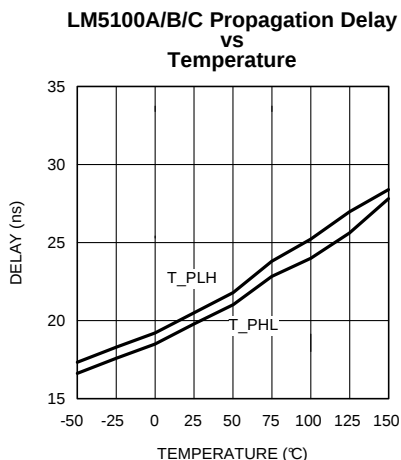
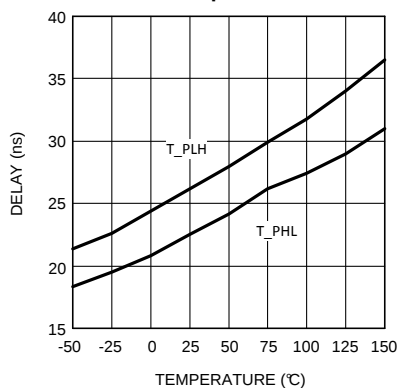
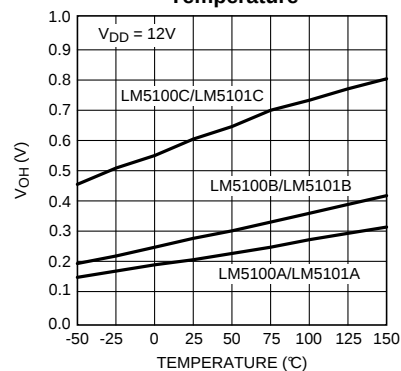
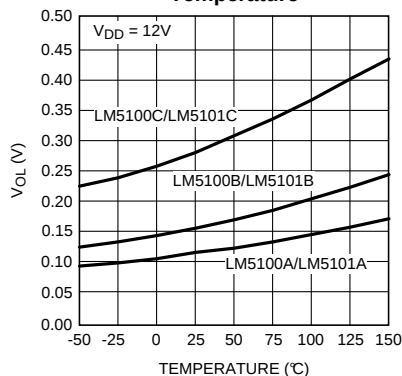
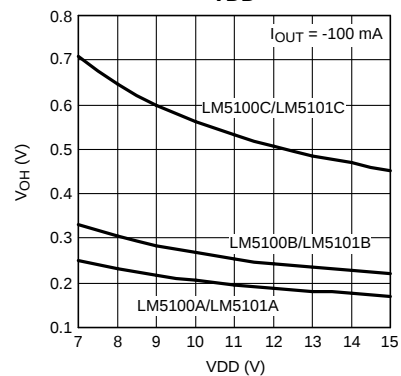
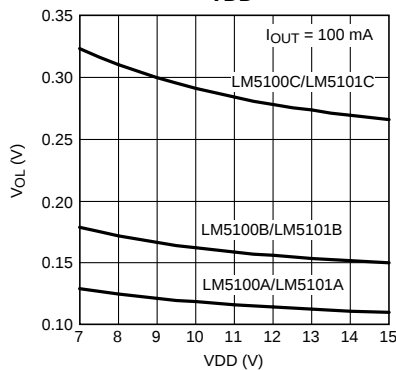
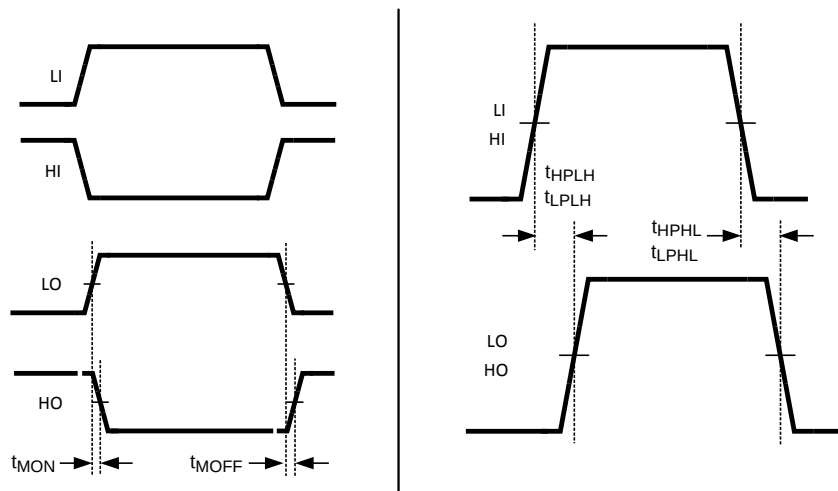


Figure 18.

**Typical Performance Characteristics (continued)****LM5101A/B/C Propagation Delay  
vs  
Temperature****Figure 19.****LO & HO Gate Drive - High Level Output Voltage  
vs  
Temperature****Figure 20.****LO & HO Gate Drive - Low Level Output Voltage  
vs  
Temperature****Figure 21.****LO & HO Gate Drive - Output High Voltage  
vs  
V\_DD****Figure 22.****LO & HO Gate Drive - Output Low Voltage  
vs  
V\_DD****Figure 23.**

### TIMING DIAGRAM



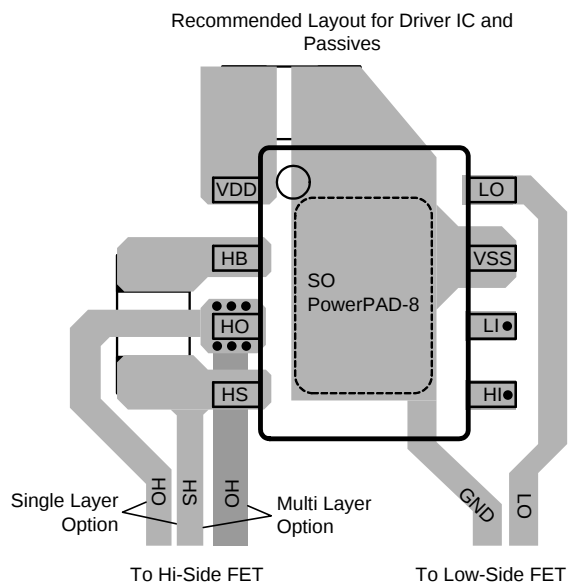
**Figure 24.**

### Layout Considerations

The optimum performance of high and low-side gate drivers cannot be achieved without taking due considerations during circuit board layout. Following points are emphasized.

1. Low ESR / ESL capacitors must be connected close to the IC, between VDD and VSS pins and between the HB and HS pins to support the high peak currents being drawn from VDD during turn-on of the external MOSFET.
2. To prevent large voltage transients at the drain of the top MOSFET, a low ESR electrolytic capacitor must be connected between MOSFET drain and ground (VSS).
3. In order to avoid large negative transients on the switch node (HS pin), the parasitic inductances in the source of top MOSFET and in the drain of the bottom MOSFET (synchronous rectifier) must be minimized.
4. Grounding Considerations:
  - a) The first priority in designing grounding connections is to confine the high peak currents that charge and discharge the MOSFET gate into a minimal physical area. This will decrease the loop inductance and minimize noise issues on the gate terminal of the MOSFET. The MOSFETs should be placed as close as possible to the gate driver.
  - b) The second high current path includes the bootstrap capacitor, the bootstrap diode, the local ground referenced bypass capacitor and low-side MOSFET body diode. The bootstrap capacitor is recharged on a cycle-by-cycle basis through the bootstrap diode from the ground referenced VDD bypass capacitor. The recharging occurs in a short time interval and involves high peak current. Minimizing this loop length and area on the circuit board is important to ensure reliable operation.

A recommended layout pattern for the driver is shown in the following figure. If possible a single layer placement is preferred.

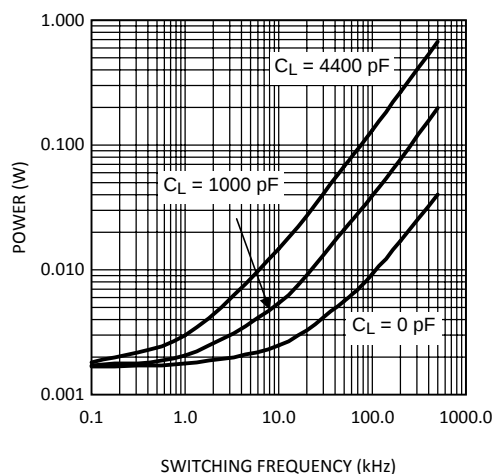


## Power Dissipation Considerations

The total IC power dissipation is the sum of the gate driver losses and the bootstrap diode losses. The gate driver losses are related to the switching frequency ( $f$ ), output load capacitance on LO and HO ( $C_L$ ), and supply voltage ( $V_{DD}$ ) and can be roughly calculated as:

$$P_{DGATES} = 2 \cdot f \cdot C_L \cdot V_{DD}^2 \quad (1)$$

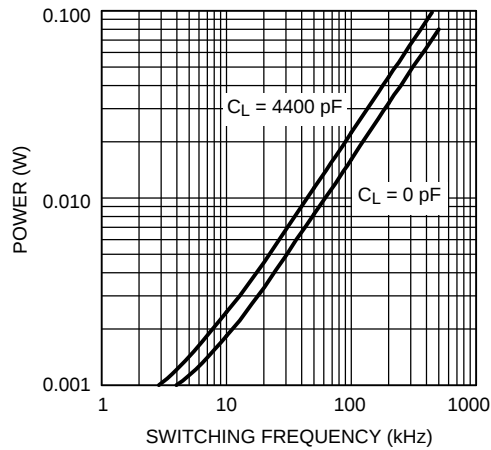
There are some additional losses in the gate drivers due to the internal CMOS stages used to buffer the LO and HO outputs. The following plot shows the measured gate driver power dissipation versus frequency and load capacitance. At higher frequencies and load capacitance values, the power dissipation is dominated by the power losses driving the output loads and agrees well with the above equation. [Equation 1](#) This plot can be used to approximate the power losses due to the gate drivers.



**Figure 25. Gate Driver Power Dissipation (LO + HO)**  
 $V_{DD} = 12V$ , Neglecting Diode Losses

The bootstrap diode power loss is the sum of the forward bias power loss that occurs while charging the bootstrap capacitor and the reverse bias power loss that occurs during reverse recovery. Since each of these events happens once per cycle, the diode power loss is proportional to frequency. Larger capacitive loads require more energy to recharge the bootstrap capacitor resulting in more losses. Higher input voltages ( $V_{IN}$ ) to the half bridge result in higher reverse recovery losses. The following plot was generated based on calculations and lab measurements of the diode recovery time and current under several operating conditions. This can be useful for approximating the diode power dissipation.

The total IC power dissipation can be estimated from the previous plots by summing the gate drive losses with the bootstrap diode losses for the intended application.



**Figure 26. Diode Power Dissipation  $V_{IN} = 50V$**

## REVISION HISTORY

### Changes from Revision O (March 2013) to Revision P

### Page

- Changed layout of National Data Sheet to TI format ..... [13](#)

**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type      | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|-------------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| LM5100AM/NOPB    | ACTIVE        | SOIC              | D                  | 8    | 95             | Green (RoHS<br>& no Sb/Br) | SN   CU SN              | Level-1-260C-UNLIM   | -40 to 125   | L5100<br>AM             | <a href="#">Samples</a> |
| LM5100AMR/NOPB   | ACTIVE        | SO PowerPAD       | DDA                | 8    | 95             | Green (RoHS<br>& no Sb/Br) | SN   CU SN              | Level-3-260C-168 HR  |              | L5100<br>AMR            | <a href="#">Samples</a> |
| LM5100AMRX/NOPB  | ACTIVE        | SO PowerPAD       | DDA                | 8    | 2500           | Green (RoHS<br>& no Sb/Br) | SN                      | Level-3-260C-168 HR  |              | L5100<br>AMR            | <a href="#">Samples</a> |
| LM5100AMX/NOPB   | ACTIVE        | SOIC              | D                  | 8    | 2500           | Green (RoHS<br>& no Sb/Br) | SN   CU SN              | Level-1-260C-UNLIM   | -40 to 125   | L5100<br>AM             | <a href="#">Samples</a> |
| LM5100ASD        | NRND          | WSO               | DPR                | 10   | 1000           | TBD                        | Call TI                 | Call TI              | -40 to 125   | 5100ASD                 |                         |
| LM5100ASD/NOPB   | ACTIVE        | WSO               | DPR                | 10   | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -40 to 125   | 5100ASD                 | <a href="#">Samples</a> |
| LM5100ASDX/NOPB  | ACTIVE        | WSO               | DPR                | 10   | 4500           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -40 to 125   | 5100ASD                 | <a href="#">Samples</a> |
| LM5100BMA/NOPB   | ACTIVE        | SOIC              | D                  | 8    | 95             | Green (RoHS<br>& no Sb/Br) | SN   CU SN              | Level-1-260C-UNLIM   | -40 to 125   | L5100<br>BMA            | <a href="#">Samples</a> |
| LM5100BMAX/NOPB  | ACTIVE        | SOIC              | D                  | 8    | 2500           | Green (RoHS<br>& no Sb/Br) | SN   CU SN              | Level-1-260C-UNLIM   | -40 to 125   | L5100<br>BMA            | <a href="#">Samples</a> |
| LM5100BSD/NOPB   | ACTIVE        | WSO               | DPR                | 10   | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -40 to 125   | 5100BSD                 | <a href="#">Samples</a> |
| LM5100BSDX/NOPB  | ACTIVE        | WSO               | DPR                | 10   | 4500           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -40 to 125   | 5100BSD                 | <a href="#">Samples</a> |
| LM5100CMA/NOPB   | ACTIVE        | SOIC              | D                  | 8    | 95             | Green (RoHS<br>& no Sb/Br) | SN   CU SN              | Level-1-260C-UNLIM   | -40 to 125   | L5100<br>CMA            | <a href="#">Samples</a> |
| LM5100CMAX/NOPB  | ACTIVE        | SOIC              | D                  | 8    | 2500           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -40 to 125   | L5100<br>CMA            | <a href="#">Samples</a> |
| LM5100CMY/NOPB   | ACTIVE        | MSOP-<br>PowerPAD | DGN                | 8    | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   |              | SXCB                    | <a href="#">Samples</a> |
| LM5100CMYE/NOPB  | ACTIVE        | MSOP-<br>PowerPAD | DGN                | 8    | 250            | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   |              | SXCB                    | <a href="#">Samples</a> |
| LM5100CMYX/NOPB  | ACTIVE        | MSOP-<br>PowerPAD | DGN                | 8    | 3500           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   |              | SXCB                    | <a href="#">Samples</a> |
| LM5100CSD/NOPB   | ACTIVE        | WSO               | DPR                | 10   | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -40 to 125   | 5100CSD                 | <a href="#">Samples</a> |

| Orderable Device  | Status<br>(1) | Package Type      | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|-------------------|---------------|-------------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| LM5100CSDX/NOPB   | ACTIVE        | WSON              | DPR                | 10   | 4500           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -40 to 125   | 5100CSD                 | <a href="#">Samples</a> |
| LM5101AM          | NRND          | SOIC              | D                  | 8    | 95             | TBD                        | Call TI                 | Call TI              | -40 to 125   | L5101<br>AM             |                         |
| LM5101AM/NOPB     | ACTIVE        | SOIC              | D                  | 8    | 95             | Green (RoHS<br>& no Sb/Br) | SN   CU SN              | Level-1-260C-UNLIM   | -40 to 125   | L5101<br>AM             | <a href="#">Samples</a> |
| LM5101AMR/NOPB    | ACTIVE        | SO PowerPAD       | DDA                | 8    | 95             | Green (RoHS<br>& no Sb/Br) | SN   CU SN              | Level-3-260C-168 HR  |              | L5101<br>AMR            | <a href="#">Samples</a> |
| LM5101AMRX/NOPB   | ACTIVE        | SO PowerPAD       | DDA                | 8    | 2500           | Green (RoHS<br>& no Sb/Br) | SN   CU SN              | Level-3-260C-168 HR  |              | L5101<br>AMR            | <a href="#">Samples</a> |
| LM5101AMX/NOPB    | ACTIVE        | SOIC              | D                  | 8    | 2500           | Green (RoHS<br>& no Sb/Br) | SN   CU SN              | Level-1-260C-UNLIM   | -40 to 125   | L5101<br>AM             | <a href="#">Samples</a> |
| LM5101ASD         | NRND          | WSON              | DPR                | 10   | 1000           | TBD                        | Call TI                 | Call TI              | -40 to 125   | 5101ASD                 |                         |
| LM5101ASD-1/NOPB  | ACTIVE        | WSON              | NGT                | 8    | 1000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU   CU SN       | Level-1-260C-UNLIM   |              | 5101A-1                 | <a href="#">Samples</a> |
| LM5101ASD/NOPB    | ACTIVE        | WSON              | DPR                | 10   | 1000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU   CU SN       | Level-1-260C-UNLIM   | -40 to 125   | 5101ASD                 | <a href="#">Samples</a> |
| LM5101ASDX        | NRND          | WSON              | DPR                | 10   | 4500           | TBD                        | Call TI                 | Call TI              | -40 to 125   | 5101ASD                 |                         |
| LM5101ASDX-1/NOPB | ACTIVE        | WSON              | NGT                | 8    | 4500           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   |              | 5101A-1                 | <a href="#">Samples</a> |
| LM5101ASDX/NOPB   | ACTIVE        | WSON              | DPR                | 10   | 4500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU   CU SN       | Level-1-260C-UNLIM   | -40 to 125   | 5101ASD                 | <a href="#">Samples</a> |
| LM5101BMA/NOPB    | ACTIVE        | SOIC              | D                  | 8    | 95             | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -40 to 125   | L5101<br>BMA            | <a href="#">Samples</a> |
| LM5101BMAX/NOPB   | ACTIVE        | SOIC              | D                  | 8    | 2500           | Green (RoHS<br>& no Sb/Br) | SN   CU SN              | Level-1-260C-UNLIM   | -40 to 125   | L5101<br>BMA            | <a href="#">Samples</a> |
| LM5101BSD/NOPB    | ACTIVE        | WSON              | DPR                | 10   | 1000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU   CU SN       | Level-1-260C-UNLIM   | -40 to 125   | (5101ASD ~<br>5101BSD)  | <a href="#">Samples</a> |
| LM5101BSDX/NOPB   | ACTIVE        | WSON              | DPR                | 10   | 4500           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -40 to 125   | 5101BSD                 | <a href="#">Samples</a> |
| LM5101CMA/NOPB    | ACTIVE        | SOIC              | D                  | 8    | 95             | Green (RoHS<br>& no Sb/Br) | SN   CU SN              | Level-1-260C-UNLIM   | -40 to 125   | L5101<br>CMA            | <a href="#">Samples</a> |
| LM5101CMAX/NOPB   | ACTIVE        | SOIC              | D                  | 8    | 2500           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -40 to 125   | L5101<br>CMA            | <a href="#">Samples</a> |
| LM5101CMY/NOPB    | ACTIVE        | MSOP-<br>PowerPAD | DGN                | 8    | 1000           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   |              | SXDB                    | <a href="#">Samples</a> |

| Orderable Device | Status<br>(1) | Package Type      | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|-------------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| LM5101CMYE/NOPB  | ACTIVE        | MSOP-<br>PowerPAD | DGN                | 8    | 250            | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   |              | SXDB                    | <a href="#">Samples</a> |
| LM5101CMYX/NOPB  | ACTIVE        | MSOP-<br>PowerPAD | DGN                | 8    | 3500           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   |              | SXDB                    | <a href="#">Samples</a> |
| LM5101CSD/NOPB   | ACTIVE        | WSON              | DPR                | 10   | 1000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU   CU SN       | Level-1-260C-UNLIM   | -40 to 125   | 5101CSD                 | <a href="#">Samples</a> |
| LM5101CSDX/NOPB  | ACTIVE        | WSON              | DPR                | 10   | 4500           | Green (RoHS<br>& no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | -40 to 125   | 5101CSD                 | <a href="#">Samples</a> |

(1) The marketing status values are defined as follows:

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

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

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

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

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

(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.

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

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and

continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

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

**TAPE AND REEL INFORMATION**


\*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 |
|-----------------|----------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LM5100AMRX/NOPB | SO Power PAD   | DDA             | 8    | 2500 | 330.0              | 12.4               | 6.5     | 5.4     | 2.0     | 8.0     | 12.0   | Q1            |
| LM5100AMX/NOPB  | SOIC           | D               | 8    | 2500 | 330.0              | 12.4               | 6.5     | 5.4     | 2.0     | 8.0     | 12.0   | Q1            |
| LM5100ASD       | WSO            | DPR             | 10   | 1000 | 178.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM5100ASD/NOPB  | WSO            | DPR             | 10   | 1000 | 178.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM5100ASDX/NOPB | WSO            | DPR             | 10   | 4500 | 330.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM5100BMAX/NOPB | SOIC           | D               | 8    | 2500 | 330.0              | 12.4               | 6.5     | 5.4     | 2.0     | 8.0     | 12.0   | Q1            |
| LM5100BSD/NOPB  | WSO            | DPR             | 10   | 1000 | 178.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM5100BSDX/NOPB | WSO            | DPR             | 10   | 4500 | 330.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM5100CMAX/NOPB | SOIC           | D               | 8    | 2500 | 330.0              | 12.4               | 6.5     | 5.4     | 2.0     | 8.0     | 12.0   | Q1            |
| LM5100CMY/NOPB  | MSOP-Power PAD | DGN             | 8    | 1000 | 178.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LM5100CMYE/NOPB | MSOP-Power PAD | DGN             | 8    | 250  | 178.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LM5100CMYX/NOPB | MSOP-Power PAD | DGN             | 8    | 3500 | 330.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |

| Device            | Package Type   | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|-------------------|----------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LM5100CSD/NOPB    | WSON           | DPR             | 10   | 1000 | 178.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM5100CSDX/NOPB   | WSON           | DPR             | 10   | 4500 | 330.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM5101AMRX/NOPB   | SO Power PAD   | DDA             | 8    | 2500 | 330.0              | 12.4               | 6.5     | 5.4     | 2.0     | 8.0     | 12.0   | Q1            |
| LM5101AMX/NOPB    | SOIC           | D               | 8    | 2500 | 330.0              | 12.4               | 6.5     | 5.4     | 2.0     | 8.0     | 12.0   | Q1            |
| LM5101ASD         | WSON           | DPR             | 10   | 1000 | 178.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM5101ASD-1/NOPB  | WSON           | NGT             | 8    | 1000 | 178.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM5101ASD/NOPB    | WSON           | DPR             | 10   | 1000 | 178.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM5101ASDX        | WSON           | DPR             | 10   | 4500 | 330.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM5101ASDX-1/NOPB | WSON           | NGT             | 8    | 4500 | 330.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM5101ASDX/NOPB   | WSON           | DPR             | 10   | 4500 | 330.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM5101BMAX/NOPB   | SOIC           | D               | 8    | 2500 | 330.0              | 12.4               | 6.5     | 5.4     | 2.0     | 8.0     | 12.0   | Q1            |
| LM5101BSD/NOPB    | WSON           | DPR             | 10   | 1000 | 178.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM5101BSDX/NOPB   | WSON           | DPR             | 10   | 4500 | 330.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM5101CMAX/NOPB   | SOIC           | D               | 8    | 2500 | 330.0              | 12.4               | 6.5     | 5.4     | 2.0     | 8.0     | 12.0   | Q1            |
| LM5101CMY/NOPB    | MSOP-Power PAD | DGN             | 8    | 1000 | 178.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LM5101CMYE/NOPB   | MSOP-Power PAD | DGN             | 8    | 250  | 178.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LM5101CMYX/NOPB   | MSOP-Power PAD | DGN             | 8    | 3500 | 330.0              | 12.4               | 5.3     | 3.4     | 1.4     | 8.0     | 12.0   | Q1            |
| LM5101CSD/NOPB    | WSON           | DPR             | 10   | 1000 | 178.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |
| LM5101CSDX/NOPB   | WSON           | DPR             | 10   | 4500 | 330.0              | 12.4               | 4.3     | 4.3     | 1.3     | 8.0     | 12.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS

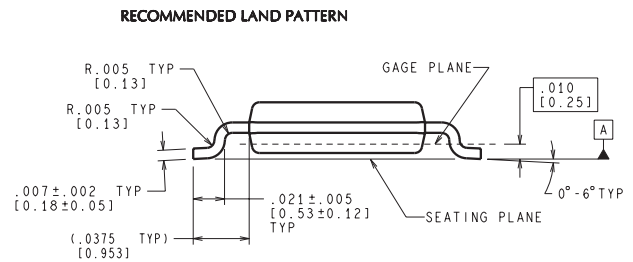
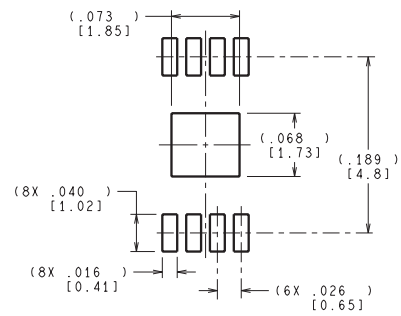
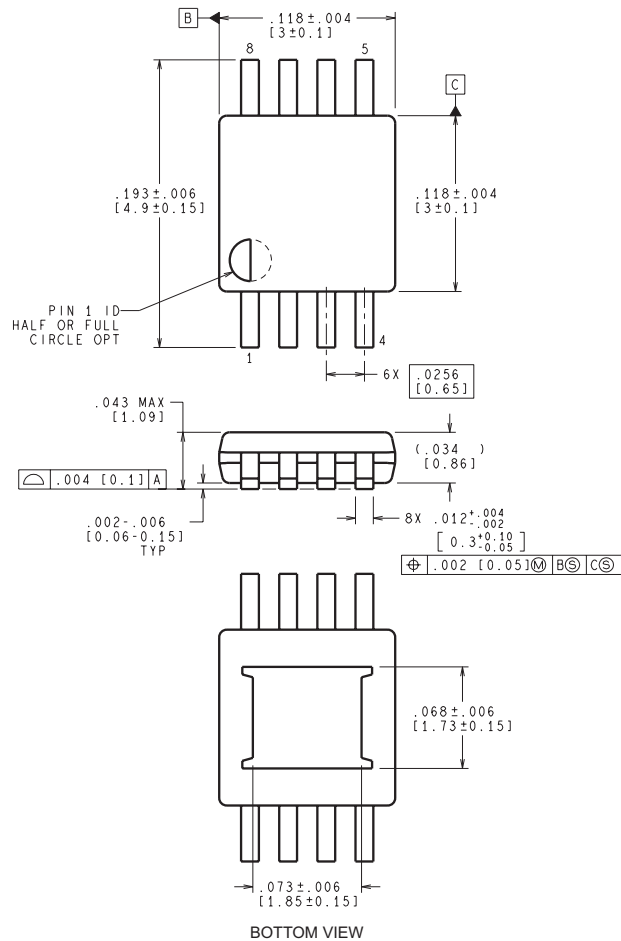


\*All dimensions are nominal

| Device           | Package Type  | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|------------------|---------------|-----------------|------|------|-------------|------------|-------------|
| LM5100AMRX/NOPB  | SO PowerPAD   | DDA             | 8    | 2500 | 367.0       | 367.0      | 35.0        |
| LM5100AMX/NOPB   | SOIC          | D               | 8    | 2500 | 367.0       | 367.0      | 35.0        |
| LM5100ASD        | WSO           | DPR             | 10   | 1000 | 210.0       | 185.0      | 35.0        |
| LM5100ASD/NOPB   | WSO           | DPR             | 10   | 1000 | 210.0       | 185.0      | 35.0        |
| LM5100ASDX/NOPB  | WSO           | DPR             | 10   | 4500 | 367.0       | 367.0      | 35.0        |
| LM5100BMAX/NOPB  | SOIC          | D               | 8    | 2500 | 367.0       | 367.0      | 35.0        |
| LM5100BSD/NOPB   | WSO           | DPR             | 10   | 1000 | 210.0       | 185.0      | 35.0        |
| LM5100BSDX/NOPB  | WSO           | DPR             | 10   | 4500 | 367.0       | 367.0      | 35.0        |
| LM5100CMAX/NOPB  | SOIC          | D               | 8    | 2500 | 367.0       | 367.0      | 35.0        |
| LM5100CMY/NOPB   | MSOP-PowerPAD | DGN             | 8    | 1000 | 210.0       | 185.0      | 35.0        |
| LM5100CMYE/NOPB  | MSOP-PowerPAD | DGN             | 8    | 250  | 210.0       | 185.0      | 35.0        |
| LM5100CMYX/NOPB  | MSOP-PowerPAD | DGN             | 8    | 3500 | 367.0       | 367.0      | 35.0        |
| LM5100CSD/NOPB   | WSO           | DPR             | 10   | 1000 | 210.0       | 185.0      | 35.0        |
| LM5100CSDX/NOPB  | WSO           | DPR             | 10   | 4500 | 367.0       | 367.0      | 35.0        |
| LM5101AMRX/NOPB  | SO PowerPAD   | DDA             | 8    | 2500 | 367.0       | 367.0      | 35.0        |
| LM5101AMX/NOPB   | SOIC          | D               | 8    | 2500 | 367.0       | 367.0      | 35.0        |
| LM5101ASD        | WSO           | DPR             | 10   | 1000 | 210.0       | 185.0      | 35.0        |
| LM5101ASD-1/NOPB | WSO           | NGT             | 8    | 1000 | 210.0       | 185.0      | 35.0        |
| LM5101ASD/NOPB   | WSO           | DPR             | 10   | 1000 | 210.0       | 185.0      | 35.0        |
| LM5101ASDX       | WSO           | DPR             | 10   | 4500 | 367.0       | 367.0      | 35.0        |

| Device            | Package Type  | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-------------------|---------------|-----------------|------|------|-------------|------------|-------------|
| LM5101ASDX-1/NOPB | WSON          | NGT             | 8    | 4500 | 367.0       | 367.0      | 35.0        |
| LM5101ASDX/NOPB   | WSON          | DPR             | 10   | 4500 | 367.0       | 367.0      | 35.0        |
| LM5101BMAX/NOPB   | SOIC          | D               | 8    | 2500 | 367.0       | 367.0      | 35.0        |
| LM5101BSD/NOPB    | WSON          | DPR             | 10   | 1000 | 210.0       | 185.0      | 35.0        |
| LM5101BSDX/NOPB   | WSON          | DPR             | 10   | 4500 | 367.0       | 367.0      | 35.0        |
| LM5101CMAX/NOPB   | SOIC          | D               | 8    | 2500 | 367.0       | 367.0      | 35.0        |
| LM5101CMY/NOPB    | MSOP-PowerPAD | DGN             | 8    | 1000 | 210.0       | 185.0      | 35.0        |
| LM5101CMYE/NOPB   | MSOP-PowerPAD | DGN             | 8    | 250  | 210.0       | 185.0      | 35.0        |
| LM5101CMYX/NOPB   | MSOP-PowerPAD | DGN             | 8    | 3500 | 367.0       | 367.0      | 35.0        |
| LM5101CSD/NOPB    | WSON          | DPR             | 10   | 1000 | 210.0       | 185.0      | 35.0        |
| LM5101CSDX/NOPB   | WSON          | DPR             | 10   | 4500 | 367.0       | 367.0      | 35.0        |

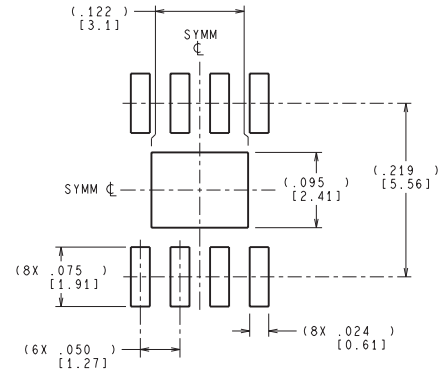
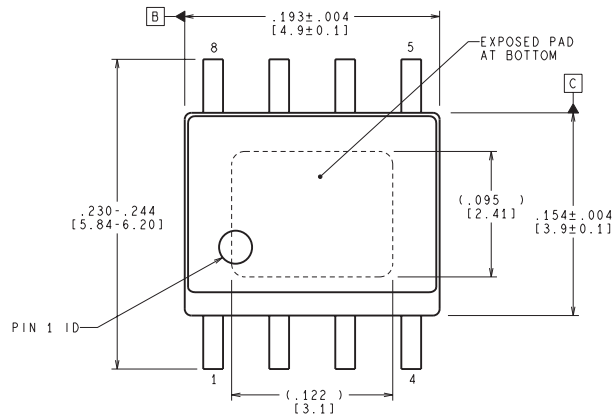
DGN0008A



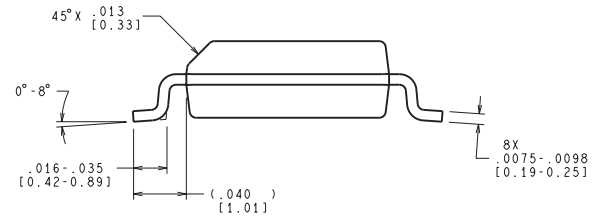
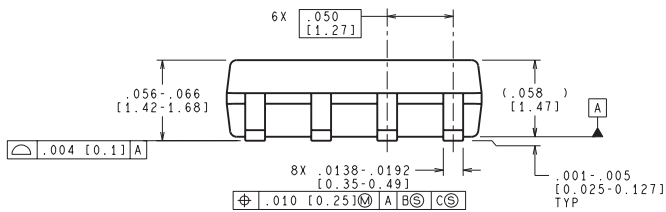
CONTROLLING DIMENSION IS INCH  
VALUES IN [ ] ARE MILLIMETERS

MUY08A (Rev A)

DDA0008B

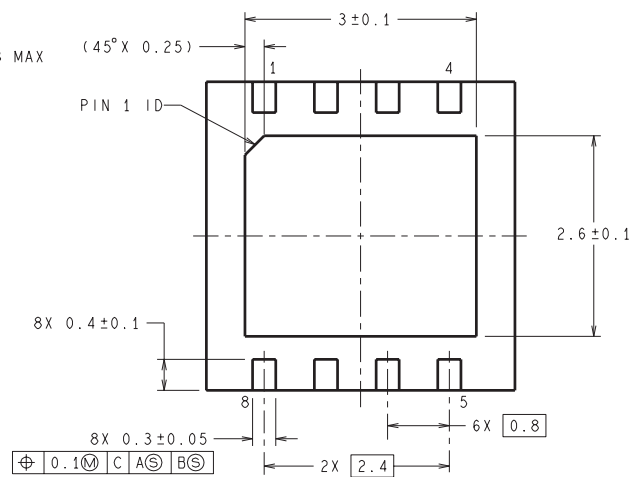


RECOMMENDED LAND PATTERN



CONTROLLING DIMENSION IS INCH  
VALUES IN [ ] ARE MILLIMETERS  
DIMENSIONS IN ( ) FOR REFERENCE ONLY

MRA08B (Rev B)



## THERMAL PAD MECHANICAL DATA

DPR (S-PWSON-N10)

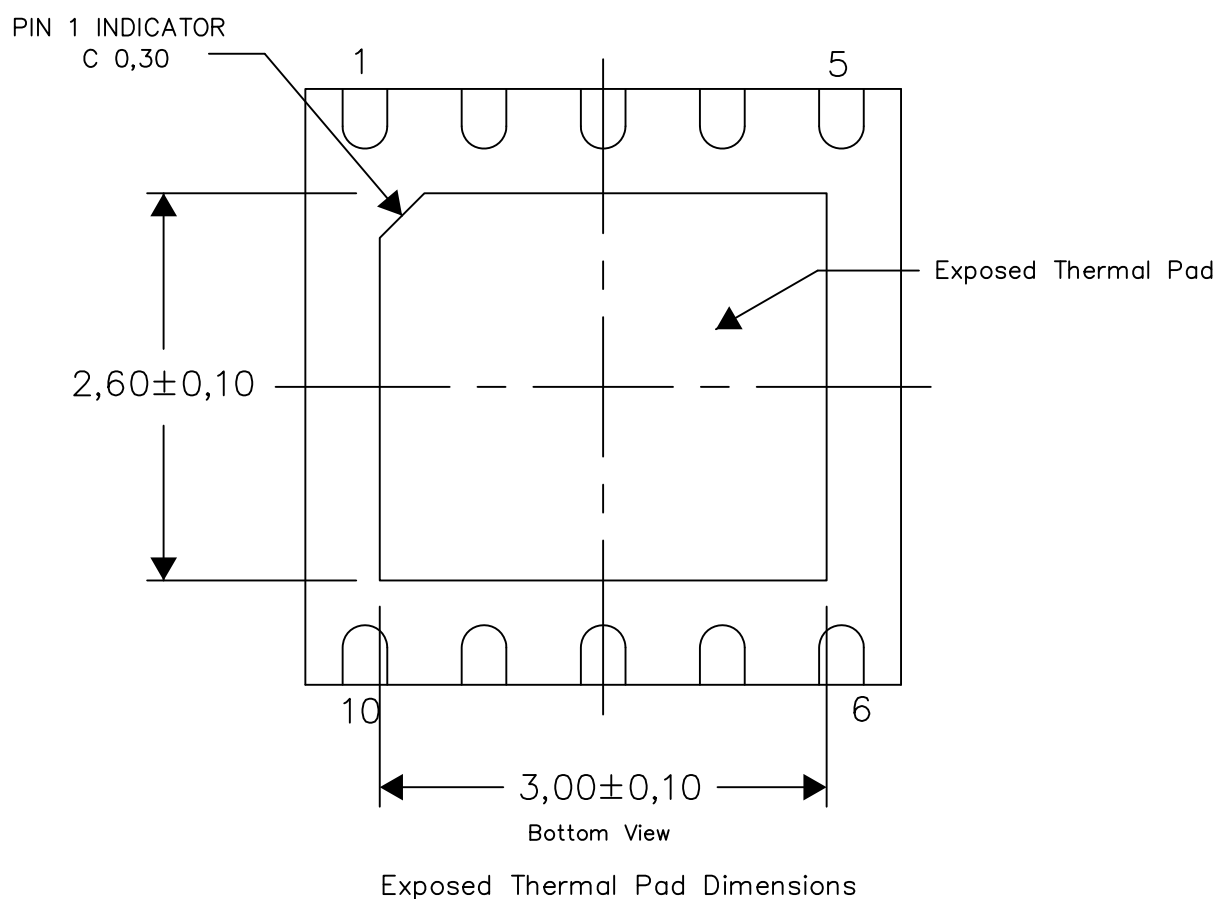
PLASTIC SMALL OUTLINE NO-LEAD

### 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.

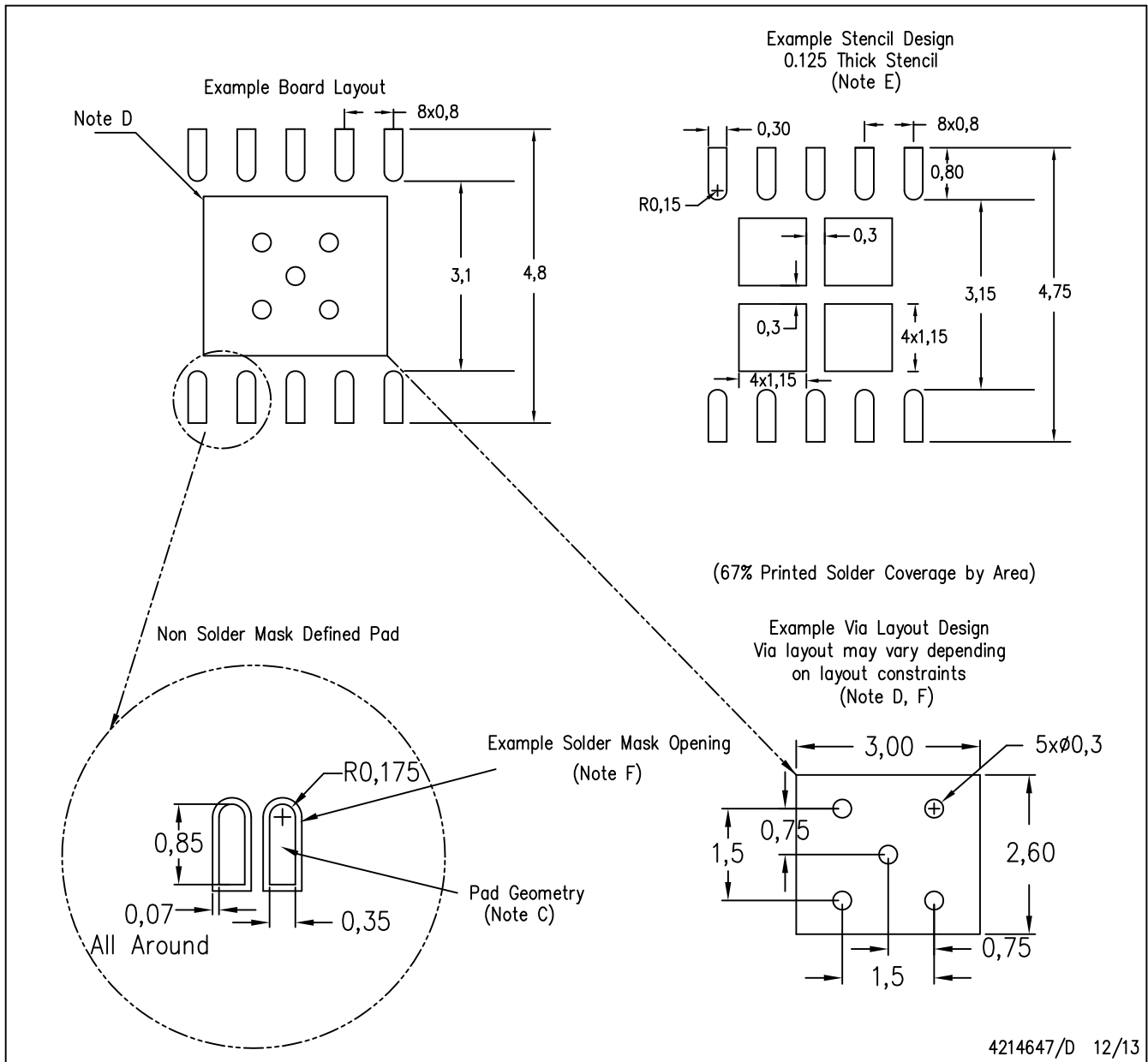


4211551/C 12/13

NOTES: All linear dimensions are in millimeters

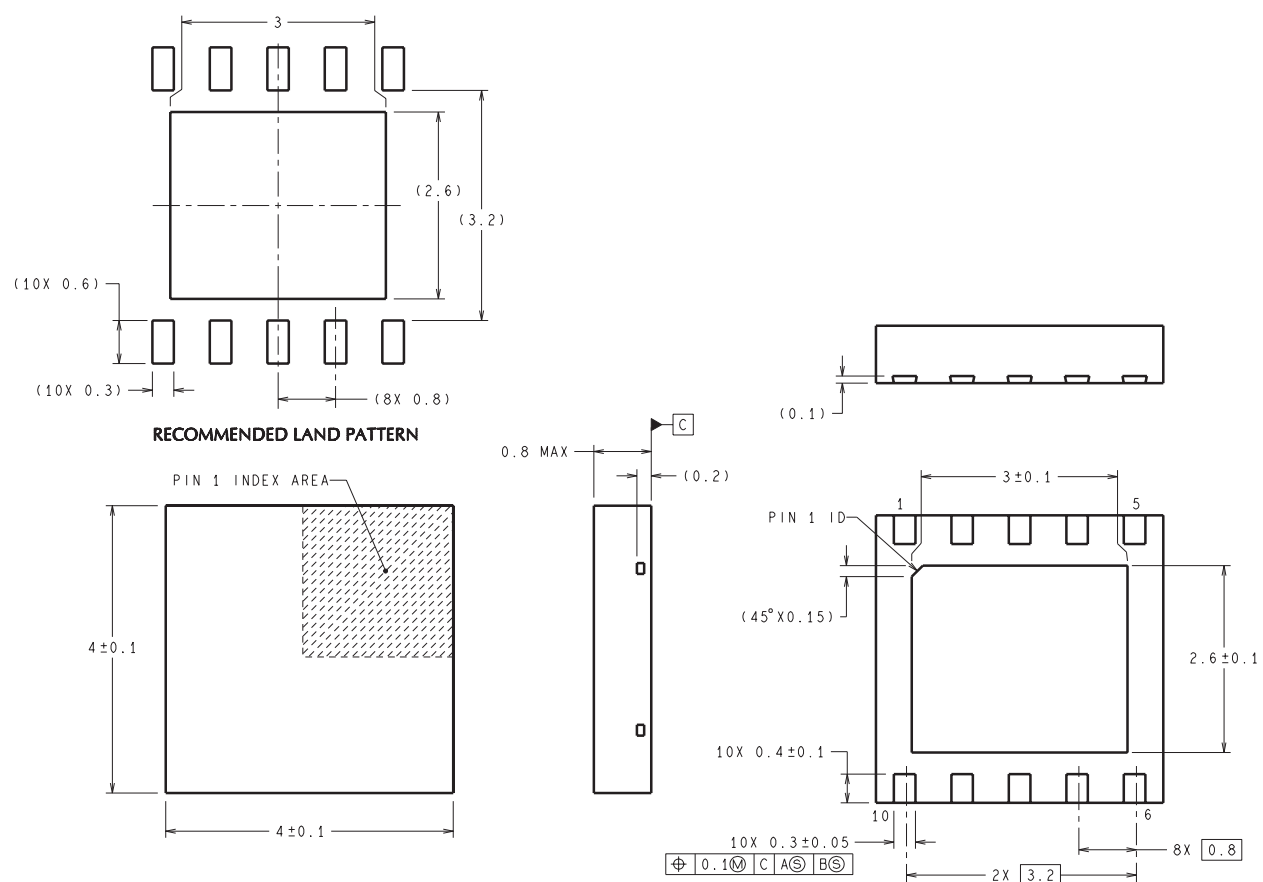
DPR (S-PWSON-N10)

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. This package is designed to be soldered to a thermal pad on the board. Refer to Application Note, Quad Flat-Pack Packages, Texas Instruments Literature No. SLUA271, and also the Product Data Sheets for specific thermal information, via requirements, and recommended board layout. These documents are available at [www.ti.com](http://www.ti.com) <<http://www.ti.com>>.
  - 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. Refer to IPC 7525 for stencil design considerations.
  - F. Customers should contact their board fabrication site for recommended solder mask tolerances and via tenting recommendations for vias placed in the thermal pad.

DPR0010A



D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



## NOTES:

- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- $\triangle C$  Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
- $\triangle D$  Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
- E. Reference JEDEC MS-012 variation AA.

## IMPORTANT NOTICE

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

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

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

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

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

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

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

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

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

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

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

### Products

|                              |                                                                                      |
|------------------------------|--------------------------------------------------------------------------------------|
| 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>                             |
| Space, Avionics and Defense   | <a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a> |
| Video and Imaging             | <a href="http://www.ti.com/video">www.ti.com/video</a>                                   |

### TI E2E Community

[e2e.ti.com](http://e2e.ti.com)