



**THE DATASHEET OF  
CSD19533Q5AT**



# CSD19533Q5A 100 V N-Channel NexFET™ Power MOSFET

## 1 Features

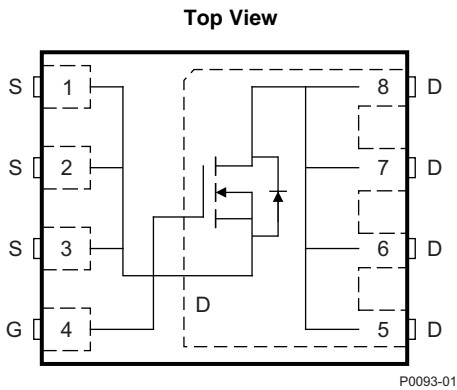
- Ultra-Low  $Q_g$  and  $Q_{gd}$
- Low Thermal Resistance
- Avalanche Rated
- Pb-Free Terminal Plating
- RoHS Compliant
- Halogen Free
- SON 5-mm x 6-mm Plastic Package

## 2 Applications

- Primary Side Telecom
- Secondary Side Synchronous Rectifier
- Motor Control

## 3 Description

This 100 V, 7.8 mΩ, SON 5 mm x 6 mm NexFET™ power MOSFET is designed to minimize losses in power conversion applications.



### Product Summary

| $T_A = 25^\circ\text{C}$ |                               | TYPICAL VALUE          |     | UNIT |
|--------------------------|-------------------------------|------------------------|-----|------|
| $V_{DS}$                 | Drain-to-Source Voltage       | 100                    |     | V    |
| $Q_g$                    | Gate Charge Total (10 V)      | 27                     |     | nC   |
| $Q_{gd}$                 | Gate Charge Gate to Drain     | 4.9                    |     | nC   |
| $R_{DS(on)}$             | Drain-to-Source On Resistance | $V_{GS} = 6\text{ V}$  | 8.7 | mΩ   |
|                          |                               | $V_{GS} = 10\text{ V}$ | 7.8 | mΩ   |
| $V_{GS(th)}$             | Threshold Voltage             | 2.8                    |     | V    |

### Ordering Information<sup>(1)</sup>

| Device       | Media        | Qty  | Package                      | Ship          |
|--------------|--------------|------|------------------------------|---------------|
| CSD19533Q5A  | 13-Inch Reel | 2500 | SON 5 x 6 mm Plastic Package | Tape and Reel |
| CSD19533Q5AT | 7-Inch Reel  | 250  |                              |               |

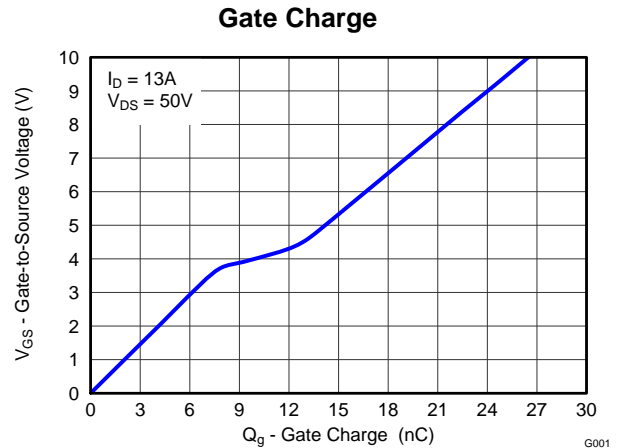
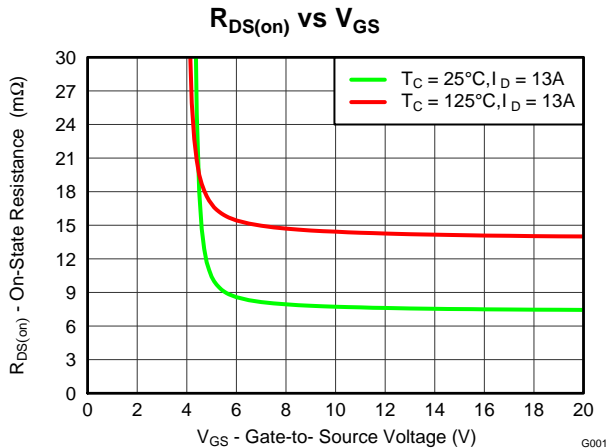
(1) For all available packages, see the orderable addendum at the end of the data sheet.

### Absolute Maximum Ratings

| $T_A = 25^\circ\text{C}$ |  | VALUE      | UNIT             |
|--------------------------|--|------------|------------------|
| $V_{DS}$                 | Drain-to-Source Voltage  | 100        | V                |
| $V_{GS}$                 | Gate-to-Source Voltage   | $\pm 20$   | V                |
| $I_D$                    | Continuous Drain Current (Package limited)   | 100        | A                |
|                          | Continuous Drain Current (Silicon limited), $T_C = 25^\circ\text{C}$                       | 75         |                  |
|                          | Continuous Drain Current, $T_A = 25^\circ\text{C}^{(1)}$                                   | 13         |                  |
| $I_{DM}$                 | Pulsed Drain Current, $T_A = 25^\circ\text{C}^{(2)}$                                       | 231        | A                |
| $P_D$                    | Power Dissipation <sup>(1)</sup>   | 3.2        | W                |
|                          | Power Dissipation, $T_C = 25^\circ\text{C}$  | 96         |                  |
| $T_J, T_{stg}$           | Operating Junction and Storage Temperature Range   | -55 to 150 | $^\circ\text{C}$ |
| $E_{AS}$                 | Avalanche Energy, single pulse<br>$I_D = 46\text{ A}, L = 0.1\text{ mH}, R_G = 25\ \Omega$ | 106        | mJ               |

(1) Typical  $R_{\theta JA} = 40\ ^\circ\text{C/W}$  on a 1-inch<sup>2</sup>, 2-oz. Cu pad on a 0.06-inch thick FR4 PCB.

(2) Max  $R_{\theta JC} = 1.3^\circ\text{C/W}$ , pulse duration  $\leq 100\ \mu\text{s}$ , duty cycle  $\leq 1\%$



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## 4 Revision History

| Changes from Original (December 2013) to Revision A   | Page     |
|---|----------|
| • Added small reel order number .....   | <b>1</b> |
| • Increased pulsed drain current to 231A .....  | <b>1</b> |
| • Added line for max power dissipation with case temperature held to 25°C .....                         | <b>1</b> |
| • Updated the pulsed drain current conditions .....   | <b>1</b> |
| • Fixed y-axis on <a href="#">Figure 1</a> to state that it is a normalized $R_{\theta JC}$ curve ..... | <b>4</b> |
| • Updated the safe operating area in <a href="#">Figure 10</a> .....                                    | <b>6</b> |

## 5 Specifications

### 5.1 Electrical Characteristics

( $T_A = 25^\circ\text{C}$  unless otherwise stated)

| PARAMETER                      |                                  | TEST CONDITIONS  | MIN | TYP  | MAX  | UNIT          |
|--------------------------------|----------------------------------|--|-----|------|------|---------------|
| <b>STATIC CHARACTERISTICS</b>  |                                  |  |     |      |      |               |
| $V_{DSS}$                      | Drain-to-Source Voltage          | $V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$                                    | 100 |      |      | V             |
| $I_{DSS}$                      | Drain-to-Source Leakage Current  | $V_{GS} = 0\text{ V}, V_{DS} = 80\text{ V}$                                      |     |      | 1    | $\mu\text{A}$ |
| $I_{GSS}$                      | Gate-to-Source Leakage Current   | $V_{DS} = 0\text{ V}, V_{GS} = 20\text{ V}$                                      |     |      | 100  | nA            |
| $V_{GS(th)}$                   | Gate-to-Source Threshold Voltage | $V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$  | 2.2 | 2.8  | 3.4  | V             |
| $R_{DS(on)}$                   | Drain-to-Source On Resistance    | $V_{GS} = 6\text{ V}, I_D = 13\text{ A}$   |     | 8.7  | 11.1 | m $\Omega$    |
|                                |                                  | $V_{GS} = 10\text{ V}, I_D = 13\text{ A}$  |     | 7.8  | 9.4  | m $\Omega$    |
| $g_{fs}$                       | Transconductance                 | $V_{DS} = 10\text{ V}, I_D = 13\text{ A}$  |     | 63   |      | S             |
| <b>DYNAMIC CHARACTERISTICS</b> |                                  |  |     |      |      |               |
| $C_{iss}$                      | Input Capacitance                | $V_{GS} = 0\text{ V}, V_{DS} = 50\text{ V}, f = 1\text{ MHz}$                    |     | 2050 | 2670 | pF            |
| $C_{oss}$                      | Output Capacitance               |  |     | 395  | 514  | pF            |
| $C_{rss}$                      | Reverse Transfer Capacitance     |  |     | 9.6  | 12.5 | pF            |
| $R_G$                          | Series Gate Resistance           |  |     | 1.2  | 2.4  | $\Omega$      |
| $Q_g$                          | Gate Charge Total (10 V)         | $V_{DS} = 50\text{ V}, I_D = 13\text{ A}$  |     | 27   | 35   | nC            |
| $Q_{gd}$                       | Gate Charge Gate to Drain        |  |     | 4.9  |      | nC            |
| $Q_{gs}$                       | Gate Charge Gate to Source       |  |     | 7.9  |      | nC            |
| $Q_{g(th)}$                    | Gate Charge at $V_{th}$          |  |     | 5.7  |      | nC            |
| $Q_{oss}$                      | Output Charge                    | $V_{DS} = 50\text{ V}, V_{GS} = 0\text{ V}$                                      |     | 75   |      | nC            |
| $t_{d(on)}$                    | Turn On Delay Time               | $V_{DS} = 50\text{ V}, V_{GS} = 10\text{ V}, I_D = 13\text{ A}, R_G = 0\ \Omega$ |     | 6    |      | ns            |
| $t_r$                          | Rise Time                        |  |     | 6    |      | ns            |
| $t_{d(off)}$                   | Turn Off Delay Time              |  |     | 16   |      | ns            |
| $t_f$                          | Fall Time                        |  |     | 5    |      | ns            |
| <b>DIODE CHARACTERISTICS</b>   |                                  |  |     |      |      |               |
| $V_{SD}$                       | Diode Forward Voltage            | $I_{SD} = 13\text{ A}, V_{GS} = 0\text{ V}$                                      |     | 0.8  | 1.0  | V             |
| $Q_{rr}$                       | Reverse Recovery Charge          | $V_{DS} = 50\text{ V}, I_F = 13\text{ A}, di/dt = 300\text{ A}/\mu\text{s}$      |     | 163  |      | nC            |
| $t_{rr}$                       | Reverse Recovery Time            |  |     | 62   |      | ns            |

### 5.2 Thermal Information

( $T_A = 25^\circ\text{C}$  unless otherwise stated)

| THERMAL METRIC  |  | MIN | TYP | MAX | UNIT                      |
|-----------------|--|-----|-----|-----|---------------------------|
| $R_{\theta JC}$ | Junction-to-Case Thermal Resistance <sup>(1)</sup>       |     |     | 1.3 | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JA}$ | Junction-to-Ambient Thermal Resistance <sup>(1)(2)</sup> |     |     | 50  |                           |

- (1)  $R_{\theta JC}$  is determined with the device mounted on a 1-inch<sup>2</sup> (6.45-cm<sup>2</sup>), 2-oz. (0.071-mm thick) Cu pad on a 1.5-inches x 1.5-inches (3.81-cm x 3.81-cm), 0.06-inch (1.52-mm) thick FR4 PCB.  $R_{\theta JC}$  is specified by design, whereas  $R_{\theta JA}$  is determined by the user's board design.
- (2) Device mounted on FR4 material with 1-inch<sup>2</sup> (6.45-cm<sup>2</sup>), 2-oz. (0.071-mm thick) Cu.

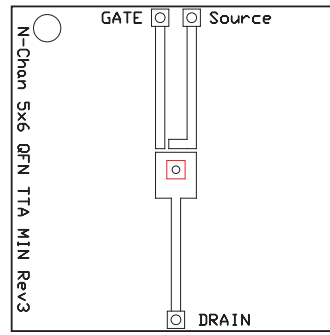
CSD19533Q5A

SLPS486A – DECEMBER 2013 – REVISED MAY 2014

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Max  $R_{\theta JA} = 50^{\circ}\text{C/W}$   
when mounted on  
1 inch<sup>2</sup> (6.45 cm<sup>2</sup>) of  
2-oz. (0.071-mm thick)  
Cu.



Max  $R_{\theta JA} = 115^{\circ}\text{C/W}$   
when mounted on a  
minimum pad area of  
2-oz. (0.071-mm thick)  
Cu.

5.3 Typical MOSFET Characteristics

( $T_A = 25^{\circ}\text{C}$  unless otherwise stated)

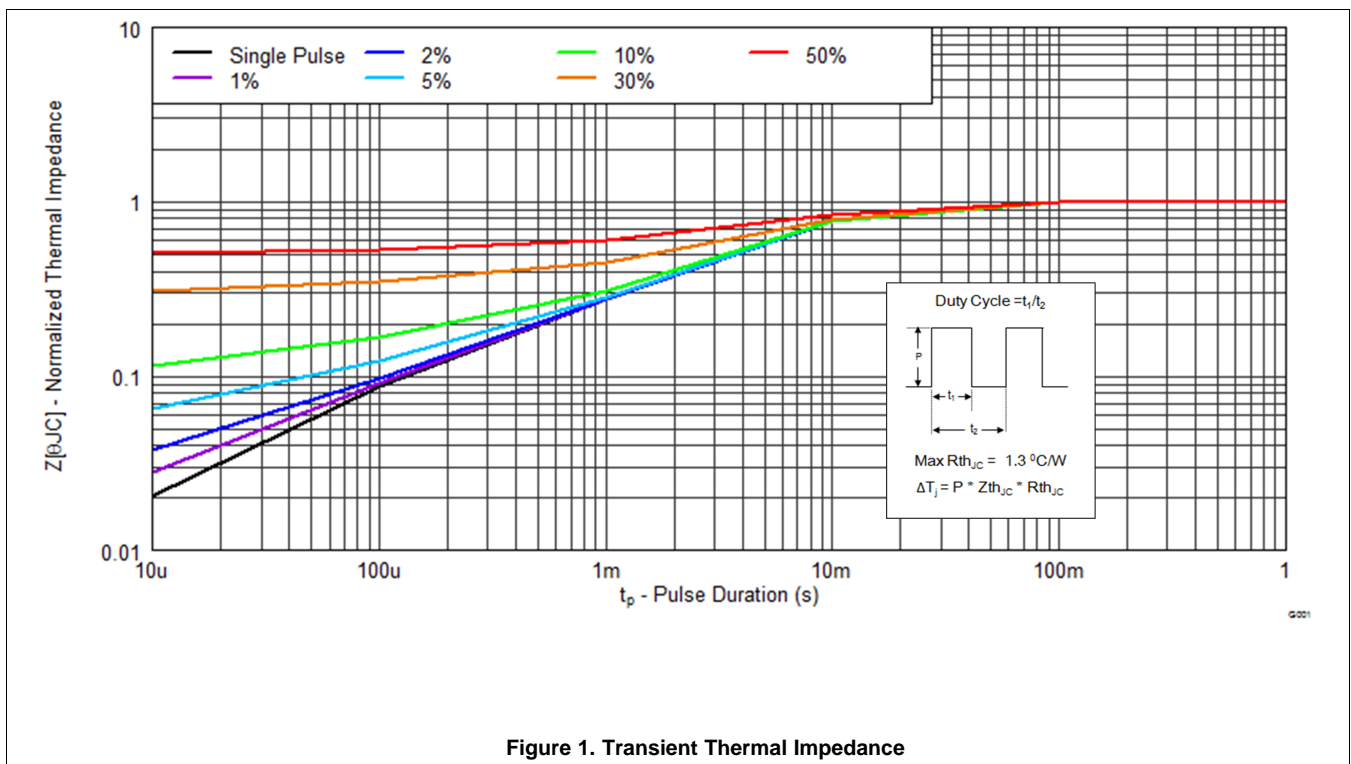


Figure 1. Transient Thermal Impedance

Typical MOSFET Characteristics (continued)

( $T_A = 25^\circ\text{C}$  unless otherwise stated)

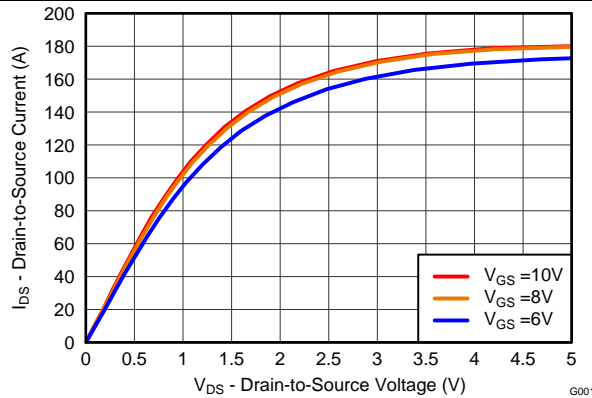


Figure 2. Saturation Characteristics

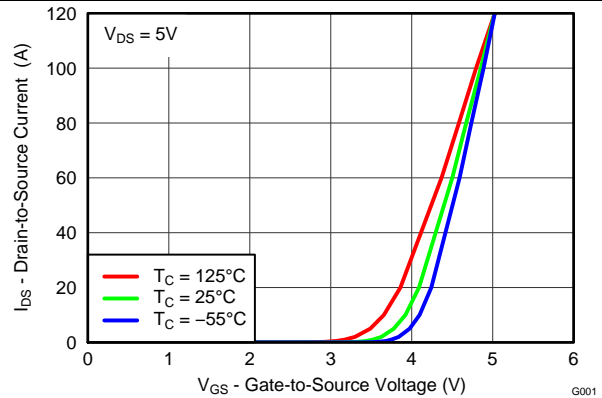


Figure 3. Transfer Characteristics

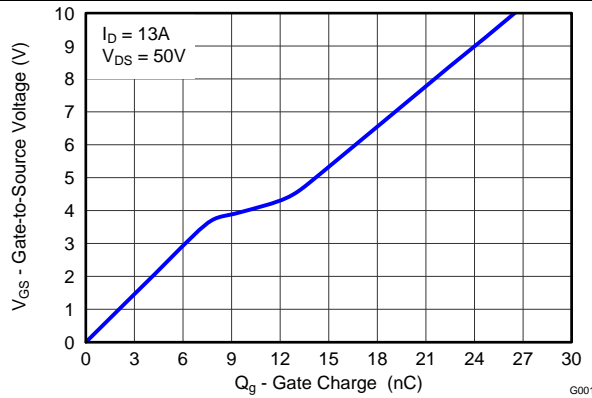


Figure 4. Gate Charge

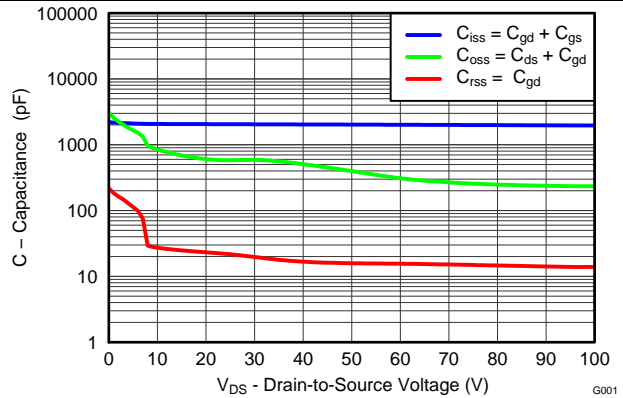


Figure 5. Capacitance

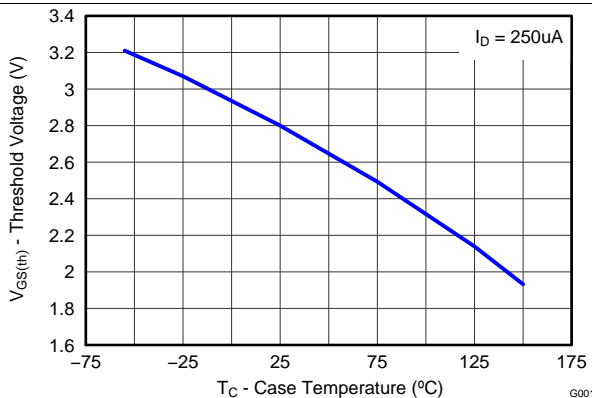


Figure 6. Threshold Voltage vs Temperature

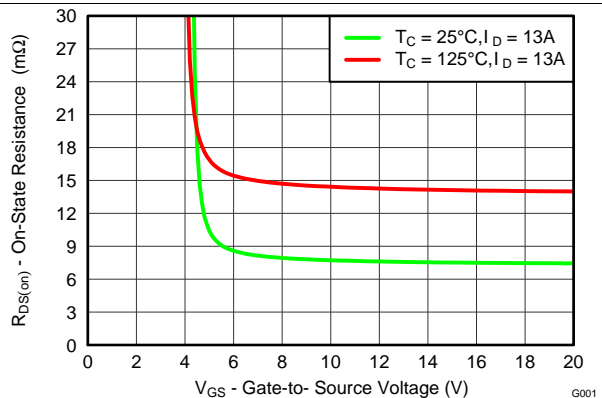
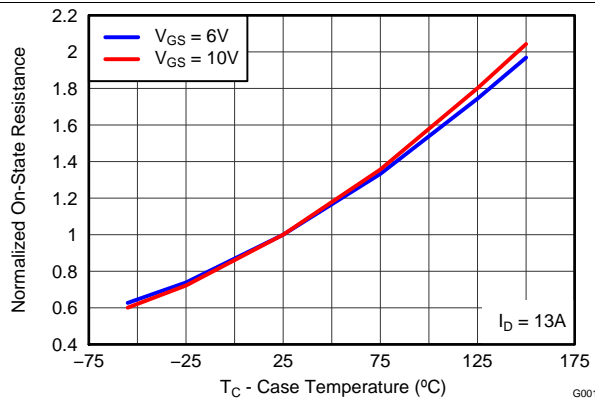


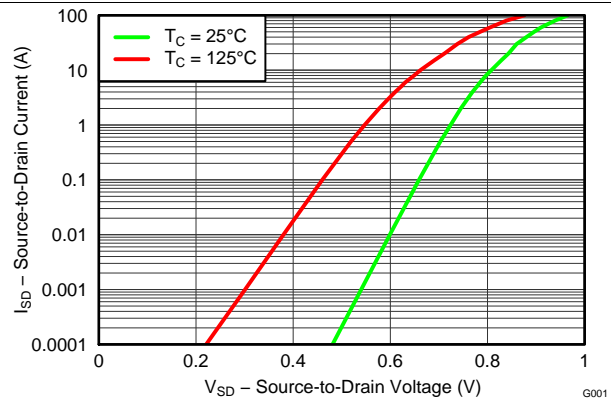
Figure 7. On-State Resistance vs Gate-to-Source Voltage

**Typical MOSFET Characteristics (continued)**

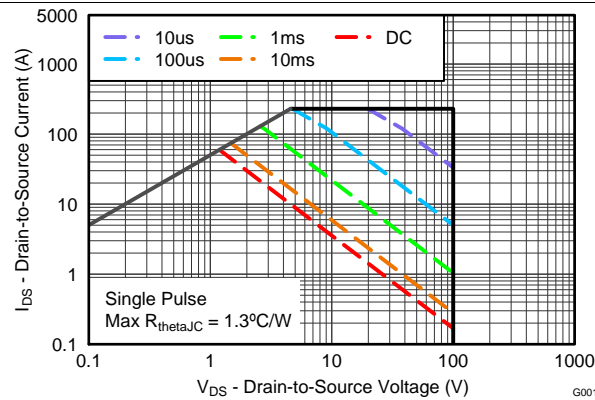
( $T_A = 25^\circ\text{C}$  unless otherwise stated)



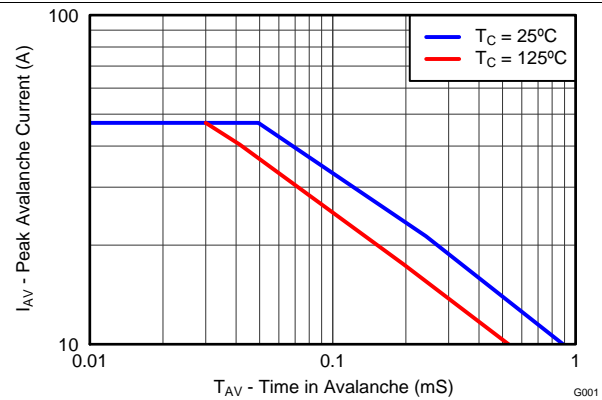
**Figure 8. Normalized On-State Resistance vs Temperature**



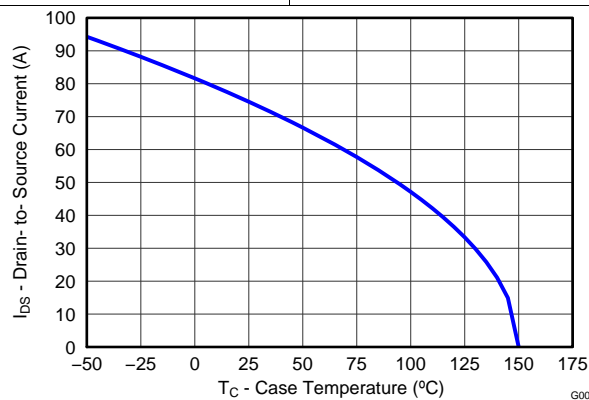
**Figure 9. Typical Diode Forward Voltage**



**Figure 10. Maximum Safe Operating Area**



**Figure 11. Single Pulse Unclamped Inductive Switching**



**Figure 12. Maximum Drain Current vs Temperature**

## 6 Device and Documentation Support

### 6.1 Trademarks

NexFET is a trademark of Texas Instruments.

### 6.2 Electrostatic Discharge Caution



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

### 6.3 Glossary

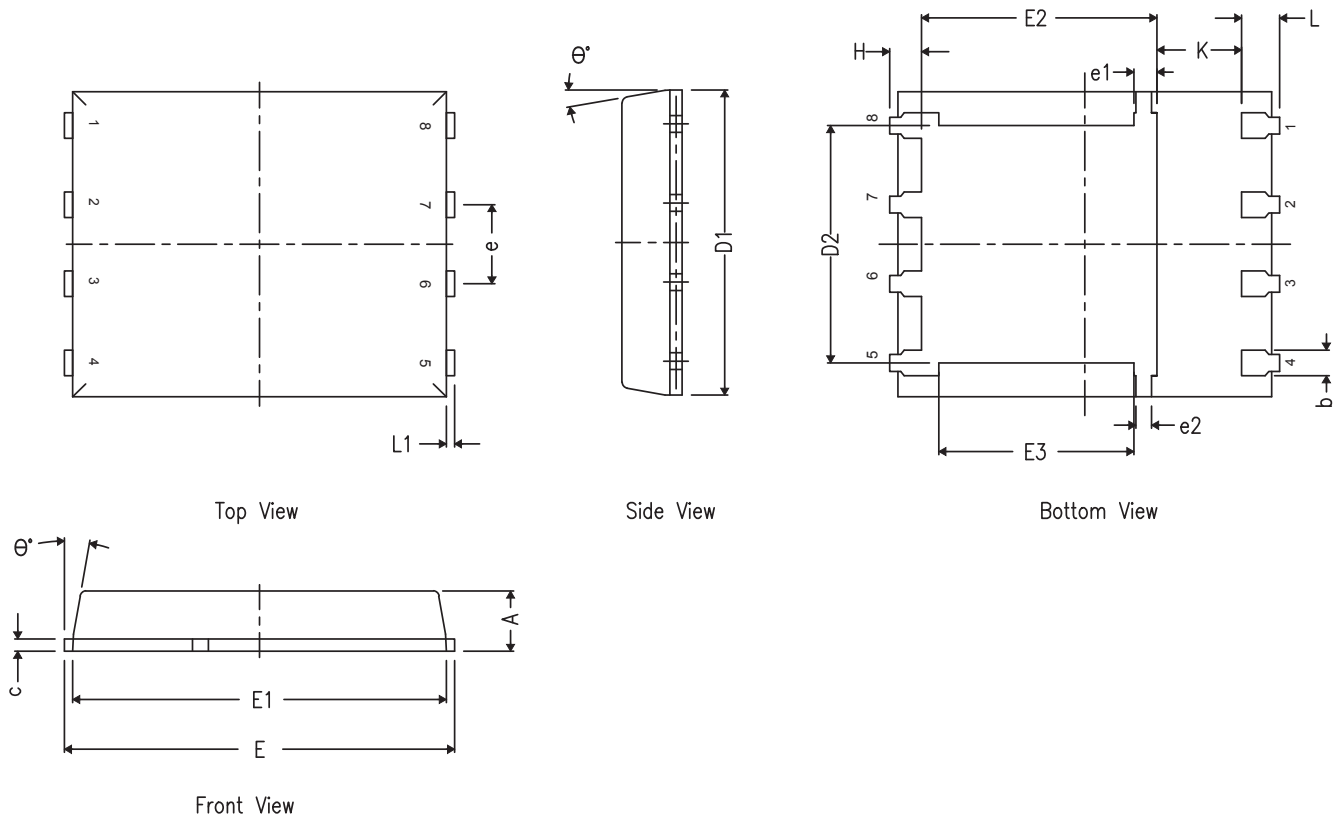
[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms and definitions.

## 7 Mechanical, Packaging, and Orderable Information

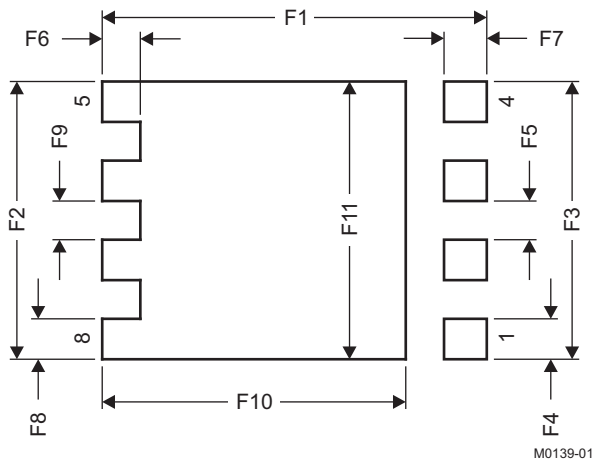
The following pages include mechanical packaging and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand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

**7.1 Q5A Package Dimensions**



| DIM      | MILLIMETERS |      |      |
|----------|-------------|------|------|
|          | MIN         | NOM  | MAX  |
| A        | 0.90        | 1.00 | 1.10 |
| b        | 0.33        | 0.41 | 0.51 |
| c        | 0.20        | 0.25 | 0.34 |
| D1       | 4.80        | 4.90 | 5.00 |
| D2       | 3.61        | 3.81 | 4.02 |
| E        | 5.90        | 6.00 | 6.10 |
| E1       | 5.70        | 5.75 | 5.80 |
| E2       | 3.38        | 3.58 | 3.78 |
| E3       | 3.03        | 3.13 | 3.23 |
| e        | 1.17        | 1.27 | 1.37 |
| e1       | 0.27        | 0.37 | 0.47 |
| e2       | 0.15        | 0.25 | 0.35 |
| H        | 0.41        | 0.56 | 0.71 |
| K        | 1.10        | –    | –    |
| L        | 0.51        | 0.61 | 0.71 |
| L1       | 0.06        | 0.13 | 0.20 |
| $\theta$ | 0°          | –    | 12°  |

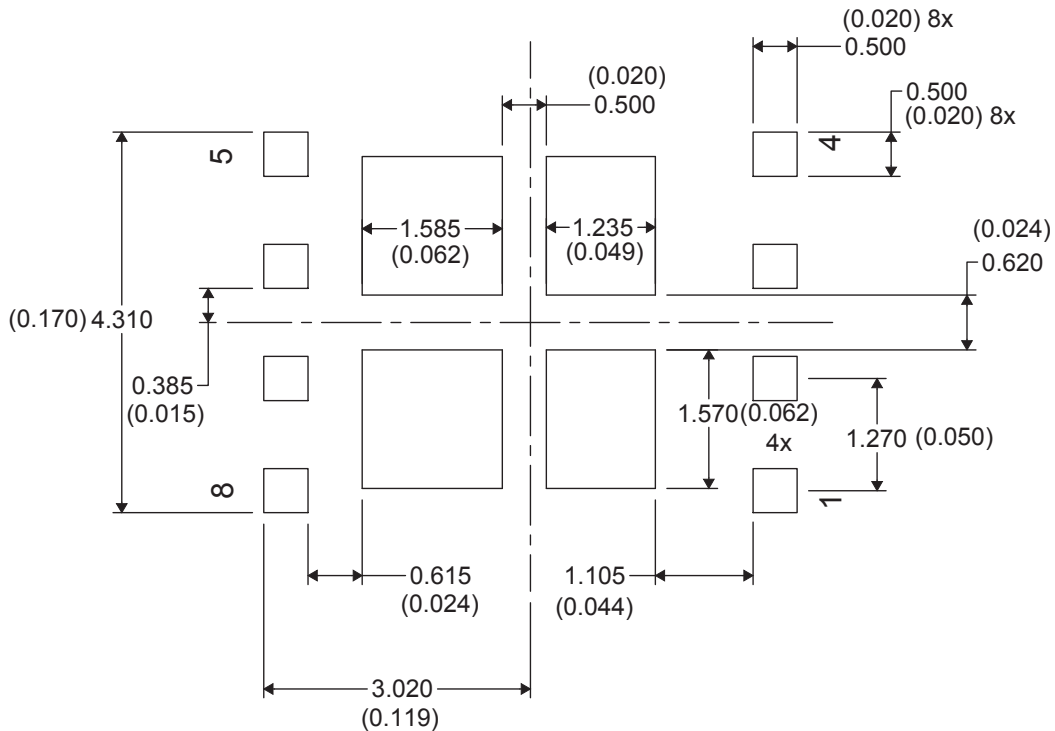
## 7.2 Recommended PCB Pattern



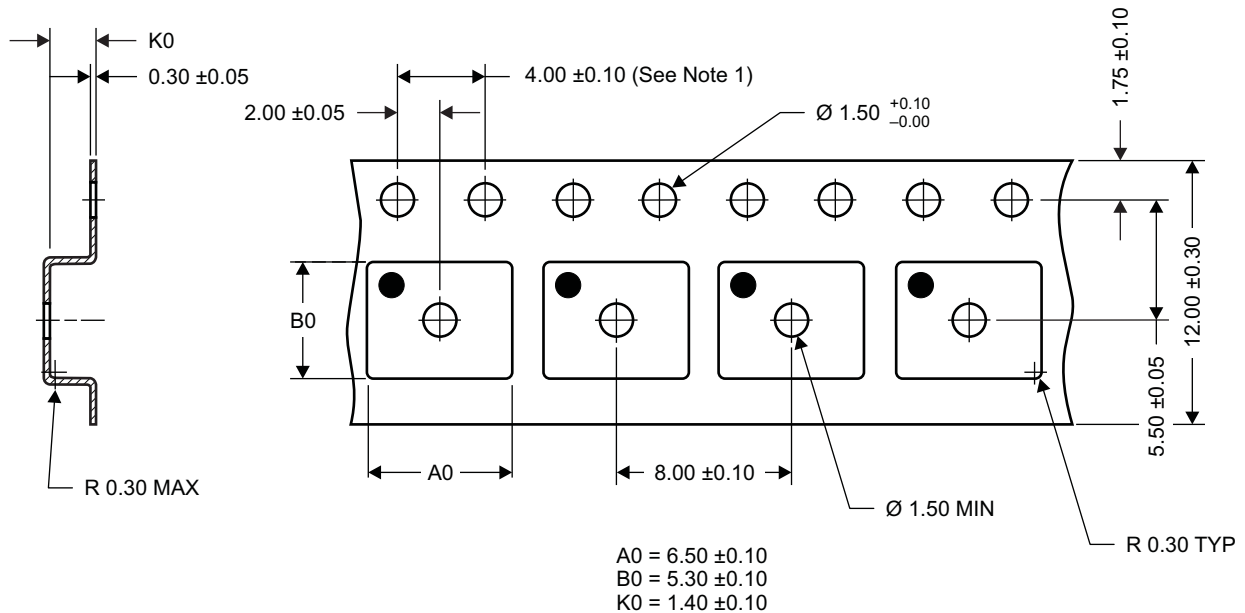
| DIM | MILLIMETERS |       | INCHES |       |
|-----|-------------|-------|--------|-------|
|     | MIN         | MAX   | MIN    | MAX   |
| F1  | 6.205       | 6.305 | 0.244  | 0.248 |
| F2  | 4.46        | 4.56  | 0.176  | 0.18  |
| F3  | 4.46        | 4.56  | 0.176  | 0.18  |
| F4  | 0.65        | 0.7   | 0.026  | 0.028 |
| F5  | 0.62        | 0.67  | 0.024  | 0.026 |
| F6  | 0.63        | 0.68  | 0.025  | 0.027 |
| F7  | 0.7         | 0.8   | 0.028  | 0.031 |
| F8  | 0.65        | 0.7   | 0.026  | 0.028 |
| F9  | 0.62        | 0.67  | 0.024  | 0.026 |
| F10 | 4.9         | 5     | 0.193  | 0.197 |
| F11 | 4.46        | 4.56  | 0.176  | 0.18  |

For recommended circuit layout for PCB designs, see application note [SLPA005](#) – *Reducing Ringing Through PCB Layout Techniques*.

### 7.3 Recommended Stencil Opening



### 7.4 Q5A Tape and Reel Information



**Notes:**

1. 10-sprocket hole-pitch cumulative tolerance  $\pm 0.2$
2. Camber not to exceed 1 mm in 100 mm, noncumulative over 250 mm
3. Material: black static-dissipative polystyrene
4. All dimensions are in mm (unless otherwise specified)
5. A0 and B0 measured on a plane 0.3 mm above the bottom of the pocket

**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2)       | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|-----------------|------|-------------|-----------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| CSD19533Q5A      | ACTIVE        | VSONP        | DQJ             | 8    | 2500        | Pb-Free (RoHS Exempt) | CU SN                   | Level-1-260C-UNLIM   | -55 to 150   | CSD19533                | <a href="#">Samples</a> |
| CSD19533Q5AT     | ACTIVE        | VSONP        | DQJ             | 8    | 250         | Pb-Free (RoHS Exempt) | CU SN                   | Level-1-260C-UNLIM   | -55 to 150   | CSD19533                | <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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

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(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.

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