

# CSD18503Q5A 40 V N-Channel NexFET™ Power MOSFET

## 1 Features

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

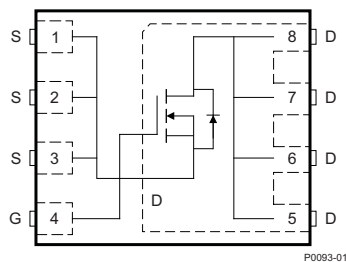
## 2 Applications

- DC-DC Conversion
- Secondary Side Synchronous Rectifier
- Battery Motor Control

## 3 Description

This 40 V, 3.4 mΩ, 5 × 6 mm SON NexFET™ power MOSFET is designed to minimize losses in power conversion applications.

**Top View**



P0093-01

### Product Summary

| $T_A = 25^\circ\text{C}$ |                               | TYPICAL VALUE           |     | UNIT |
|--------------------------|-------------------------------|-------------------------|-----|------|
| $V_{DS}$                 | Drain-to-source voltage       | 40                      |     | V    |
| $Q_g$                    | Gate charge total (4.5 V)     | 13                      |     | nC   |
| $Q_{gd}$                 | Gate charge gate-to-drain     | 4.3                     |     | nC   |
| $R_{DS(on)}$             | Drain-to-source on-resistance | $V_{GS} = 4.5\text{ V}$ | 4.7 | mΩ   |
|                          |                               | $V_{GS} = 10\text{ V}$  | 3.4 | mΩ   |
| $V_{GS(th)}$             | Threshold voltage             | 1.8                     |     | V    |

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

| DEVICE       | QTY  | MEDIA        | PACKAGE                         | SHIP          |
|--------------|------|--------------|---------------------------------|---------------|
| CSD18503Q5A  | 2500 | 13-Inch Reel | SON 5 mm × 6 mm Plastic Package | Tape and Reel |
| CSD18503Q5AT | 250  | 7-Inch Reel  |                                 |               |

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

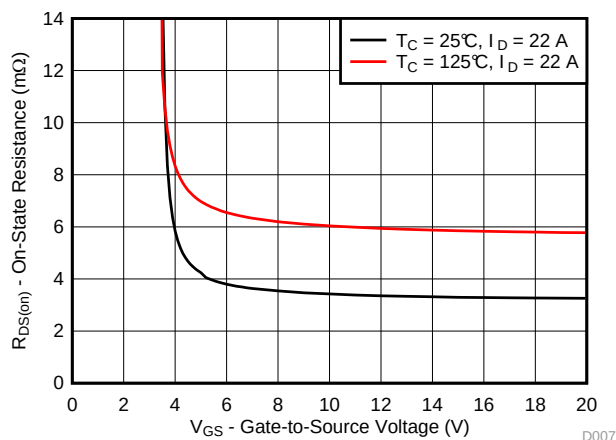
### Absolute Maximum Ratings

| $T_A = 25^\circ\text{C}$ |                                                                                                        | VALUE      | UNIT |
|--------------------------|--------------------------------------------------------------------------------------------------------|------------|------|
| $V_{DS}$                 | Drain-to-source voltage                                                                                | 40         | V    |
| $V_{GS}$                 | Gate-to-source voltage                                                                                 | ±20        | V    |
| $I_D$                    | Continuous drain current (package limited), $T_C = 25^\circ\text{C}$                                   | 100        | A    |
|                          | Continuous drain current (silicon limited), $T_C = 25^\circ\text{C}$                                   | 121        |      |
|                          | Continuous drain current, $T_A = 25^\circ\text{C}^{(1)}$                                               | 19         |      |
| $I_{DM}$                 | Pulsed drain current, $T_A = 25^\circ\text{C}^{(2)}$                                                   | 321        | A    |
| $P_D$                    | Power dissipation <sup>(1)</sup>                                                                       | 3.1        | W    |
|                          | Power dissipation, $T_C = 25^\circ\text{C}$                                                            | 120        |      |
| $T_J, T_{stg}$           | Operating junction, Storage temperature                                                                | –55 to 150 | °C   |
| $E_{AS}$                 | Avalanche energy, single pulse<br>$I_D = 56\text{ A}$ , $L = 0.1\text{ mH}$ , $R_G = 25\text{ }\Omega$ | 157        | 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.

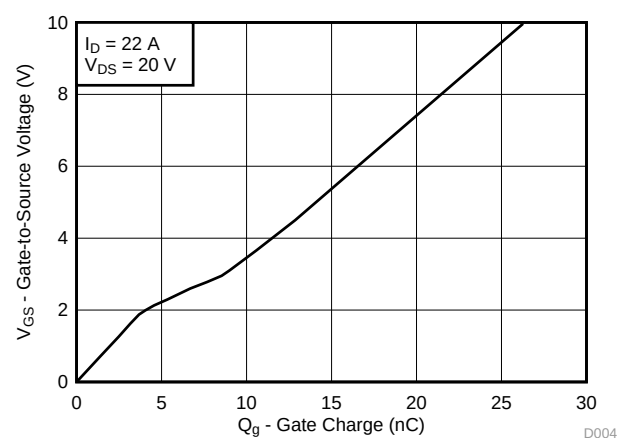
(2) Max  $R_{\theta JC} = 1.3^\circ\text{C/W}$ , pulse duration ≤100 μs, duty cycle ≤1%

**$R_{DS(on)}$  vs  $V_{GS}$**



D007

**Gate Charge**



D004



## Table of Contents

|                                                 |          |                                                                 |           |
|-------------------------------------------------|----------|-----------------------------------------------------------------|-----------|
| <b>1 Features</b> .....                         | <b>1</b> | 6.1 Community Resources.....                                    | <b>7</b>  |
| <b>2 Applications</b> .....                     | <b>1</b> | 6.2 Trademarks .....                                            | <b>7</b>  |
| <b>3 Description</b> .....                      | <b>1</b> | 6.3 Electrostatic Discharge Caution .....                       | <b>7</b>  |
| <b>4 Revision History</b> .....                 | <b>2</b> | 6.4 Glossary .....                                              | <b>7</b>  |
| <b>5 Specifications</b> .....                   | <b>3</b> | <b>7 Mechanical, Packaging, and Orderable Information</b> ..... | <b>8</b>  |
| 5.1 Electrical Characteristics.....             | <b>3</b> | 7.1 Q5A Package Dimensions .....                                | <b>8</b>  |
| 5.2 Thermal Information .....                   | <b>3</b> | 7.2 Recommended PCB Pattern.....                                | <b>9</b>  |
| 5.3 Typical MOSFET Characteristics.....         | <b>4</b> | 7.3 Recommended Stencil Opening .....                           | <b>10</b> |
| <b>6 Device and Documentation Support</b> ..... | <b>7</b> | 7.4 Q5A Tape and Reel Information .....                         | <b>10</b> |

## 4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

| Changes from Revision B (November 2012) to Revision C   | Page      |
|---------------------------------------------------------|-----------|
| • Added part number to title .....                      | <b>1</b>  |
| • Added 7-inch reel to Ordering Information table ..... | <b>1</b>  |
| • Updated Continuous Drain Current .....                | <b>1</b>  |
| • Updated Pulsed Drain Current .....                    | <b>1</b>  |
| • Updated pulsed current conditions .....               | <b>1</b>  |
| • Updated Max $R_{\theta JC}$ .....                     | <b>3</b>  |
| • Updated <a href="#">Figure 1</a> .....                | <b>4</b>  |
| • Updated SOA in <a href="#">Figure 10</a> .....        | <b>6</b>  |
| • Updated <a href="#">Figure 12</a> .....               | <b>6</b>  |
| • Added <a href="#">Community Resources</a> .....       | <b>7</b>  |
| • Updated package dimensions .....                      | <b>8</b>  |
| • Added Recommended Stencil Opening .....               | <b>10</b> |

| Changes from Revision A (October 2012) to Revision B                                                        | Page     |
|-------------------------------------------------------------------------------------------------------------|----------|
| • Added line for max power dissipation with case temperature held to 25° C.....                             | <b>1</b> |
| • Changed the $R_{DS(on)}$ vs $V_{GS}$ and GATE CHARGE graphs.....                                          | <b>1</b> |
| • Changed Max $R_{\theta JA} = 121^{\circ}\text{C/W}$ To: Max $R_{\theta JA} = 125^{\circ}\text{C/W}$ ..... | <b>4</b> |
| • Changed the Typical MOSFET Characteristics section .....                                                  | <b>4</b> |

| Changes from Original (June 2012) to Revision A                                                                                                                                         | Page     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| • Changed the Transconductance TYP value From: 127 S To: 100 S.....                                                                                                                     | <b>3</b> |
| • Changed the Turn On and Turn Off Delay Time, Rise and Fall Time Test Conditions From: $I_{DS} = 22\text{ A}$ , $R_G = 2\ \Omega$ To: $I_{DS} = 22\text{ A}$ , $R_G = 0\ \Omega$ ..... | <b>3</b> |
| • Changed the $Q_{rr}$ Reverse Recovery Charge TYP value From: 22 nC To: 52 nC .....                                                                                                    | <b>3</b> |

## 5 Specifications

### 5.1 Electrical Characteristics

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

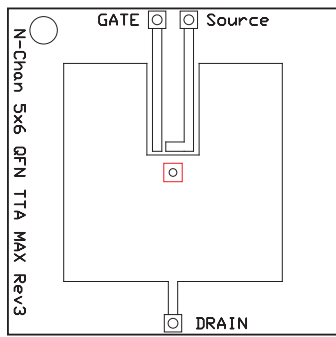
| PARAMETER               |                                  | TEST CONDITIONS                                                                               | MIN  | TYP | MAX  | UNIT |
|-------------------------|----------------------------------|-----------------------------------------------------------------------------------------------|------|-----|------|------|
| STATIC CHARACTERISTICS  |                                  |                                                                                               |      |     |      |      |
| BV <sub>DSS</sub>       | Drain to-source voltage          | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA                                                | 40   |     |      | V    |
| I <sub>DSS</sub>        | Drain-to-source leakage current  | V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 32 V                                                 |      |     | 1    | μA   |
| I <sub>GSS</sub>        | Gate-to-source leakage current   | V <sub>DS</sub> = 0 V, V <sub>GS</sub> = 20 V                                                 |      |     | 100  | nA   |
| V <sub>GS(th)</sub>     | Gate-to-source threshold voltage | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA                                   | 1.5  | 1.8 | 2.3  | V    |
| R <sub>DS(on)</sub>     | Drain-to-source on-resistance    | V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 22 A                                                | 4.7  |     | 6.2  | mΩ   |
|                         |                                  | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 22 A                                                 | 3.4  |     | 4.3  | mΩ   |
| g <sub>fs</sub>         | Transconductance                 | V <sub>DS</sub> = 20 V, I <sub>D</sub> = 22 A                                                 | 100  |     |      | S    |
| DYNAMIC CHARACTERISTICS |                                  |                                                                                               |      |     |      |      |
| C <sub>iss</sub>        | Input capacitance                | V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 20 V, f = 1 MHz                                      | 2200 |     | 2640 | pF   |
| C <sub>oss</sub>        | Output capacitance               |                                                                                               | 510  |     | 612  | pF   |
| C <sub>rss</sub>        | Reverse transfer capacitance     |                                                                                               | 13   |     | 16   | pF   |
| R <sub>G</sub>          | Series gate resistance           |                                                                                               | 1.2  | 2.4 |      | Ω    |
| Q <sub>g</sub>          | Gate charge total (4.5 V)        | V <sub>DS</sub> = 20 V, I <sub>D</sub> = 22 A                                                 | 13   |     | 16   | nC   |
| Q <sub>g</sub>          | Gate charge total (10 V)         |                                                                                               | 27   |     | 32   |      |
| Q <sub>gd</sub>         | Gate charge gate-to-drain        |                                                                                               | 4.3  |     |      |      |
| Q <sub>gs</sub>         | Gate charge gate-to-source       |                                                                                               | 4.5  |     |      |      |
| Q <sub>g(th)</sub>      | Gate charge at V <sub>th</sub>   |                                                                                               | 3.8  |     |      |      |
| Q <sub>oss</sub>        | Output charge                    | V <sub>DS</sub> = 20 V, V <sub>GS</sub> = 0 V                                                 | 30   |     |      | nC   |
| t <sub>d(on)</sub>      | Turn on delay time               | V <sub>DS</sub> = 20 V, V <sub>GS</sub> = 10 V,<br>I <sub>DS</sub> = 22 A, R <sub>G</sub> = 0 | 4.5  |     |      | ns   |
| t <sub>r</sub>          | Rise time                        |                                                                                               | 8.8  |     |      | ns   |
| t <sub>d(off)</sub>     | Turn off delay time              |                                                                                               | 15   |     |      | ns   |
| t <sub>f</sub>          | Fall time                        |                                                                                               | 2.6  |     |      | ns   |
| DIODE CHARACTERISTICS   |                                  |                                                                                               |      |     |      |      |
| V <sub>SD</sub>         | Diode forward voltage            | I <sub>SD</sub> = 22 A, V <sub>GS</sub> = 0 V                                                 | 0.8  |     | 1    | V    |
| Q <sub>rr</sub>         | Reverse recovery charge          | V <sub>DS</sub> = 20 V, I <sub>F</sub> = 22 A,<br>di/dt = 300 A/μs                            | 52   |     |      | nC   |
| t <sub>rr</sub>         | Reverse recovery time            |                                                                                               | 37   |     |      | ns   |

### 5.2 Thermal Information

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

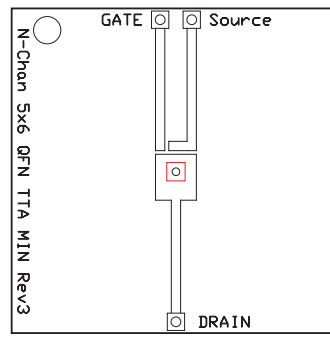
| THERMAL METRIC  |                                                          | MIN | TYP | MAX | UNIT                      |
|-----------------|----------------------------------------------------------|-----|-----|-----|---------------------------|
| $R_{\theta JC}$ | Junction-to-case thermal resistance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

- $R_{\theta JC}$  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 inch  $\times$  1.5 inch (3.81 cm  $\times$  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.
- Device mounted on FR4 material with 1 inch<sup>2</sup> (6.45 cm<sup>2</sup>), 2 oz. (0.071 mm thick) Cu.



M0137-01

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.

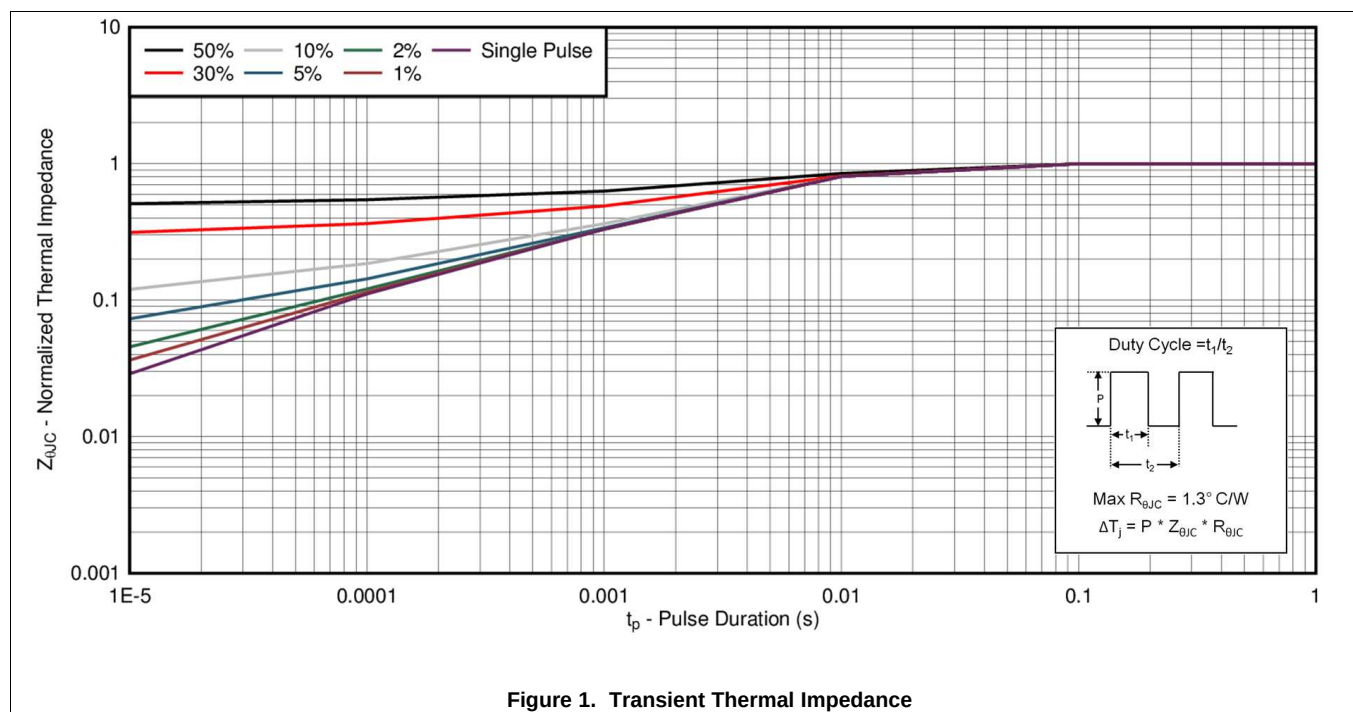


M0137-02

Max  $R_{\theta JA} = 125^{\circ}\text{C/W}$   
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)



## Typical MOSFET Characteristics (continued)

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

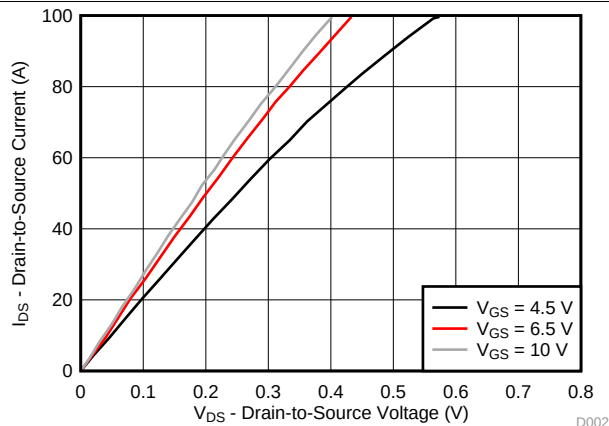


**Figure 2. Saturation Characteristics**

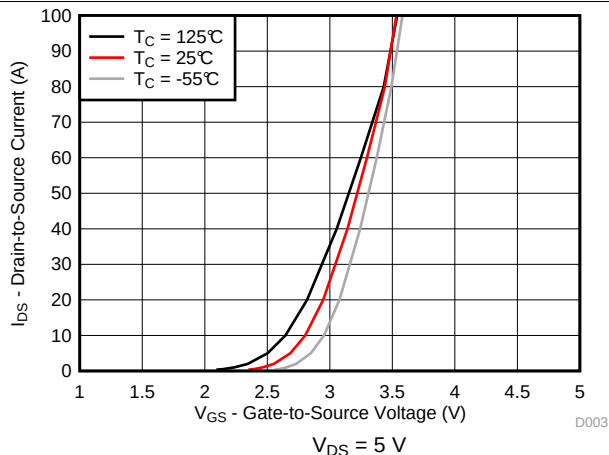


**Figure 3. Transfer Characteristics**

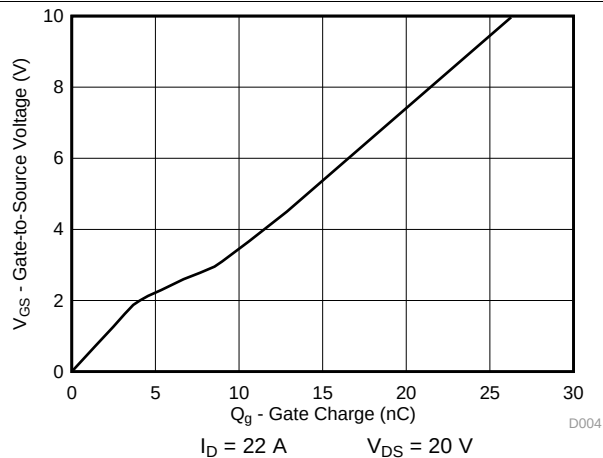


**Figure 4. Gate Charge**

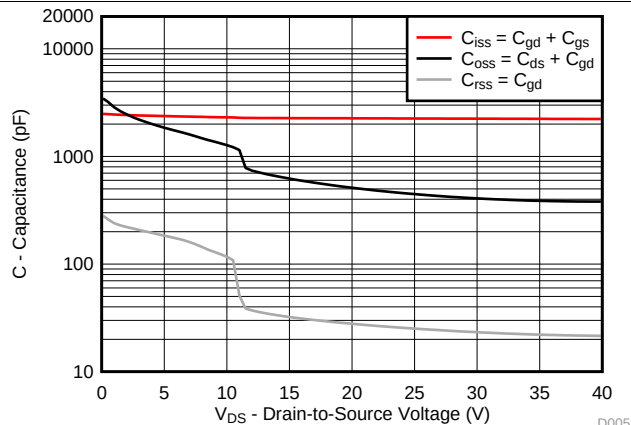


**Figure 5. Capacitance**

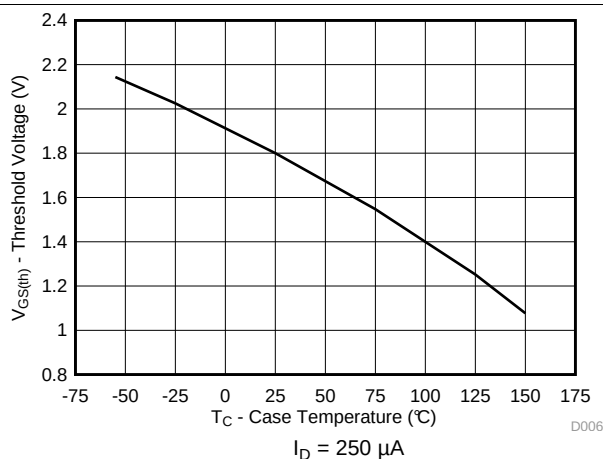


**Figure 6. Threshold Voltage vs Temperature**

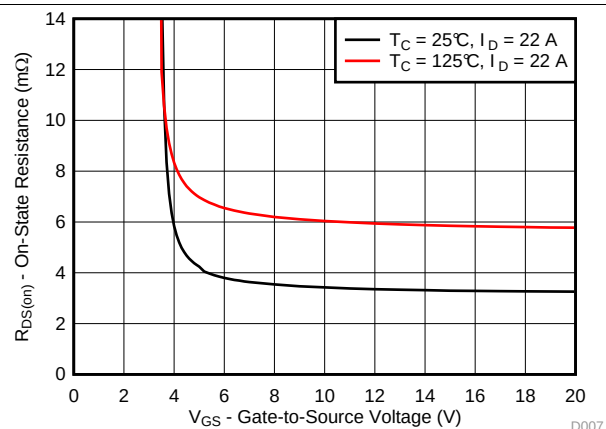


**Figure 7. On-State Resistance vs Gate-to-Source Voltage**

## Typical MOSFET Characteristics (continued)

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

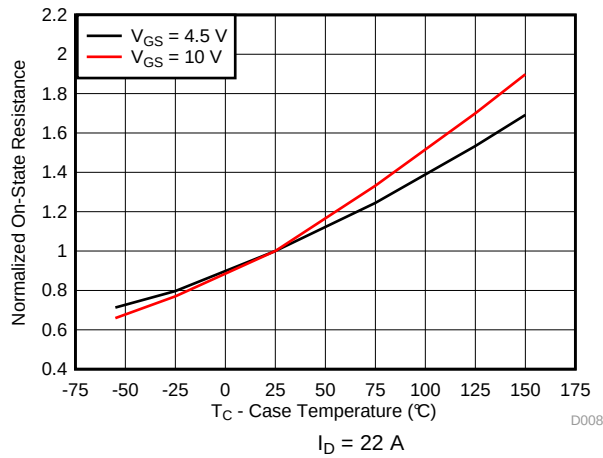


Figure 8. Normalized On-State Resistance vs Temperature

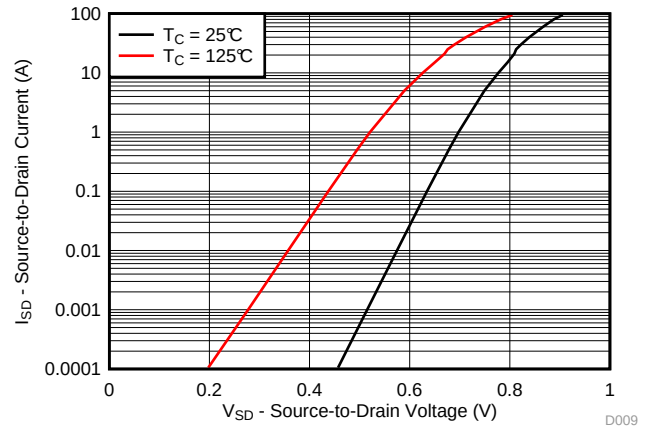


Figure 9. Typical Diode Forward Voltage

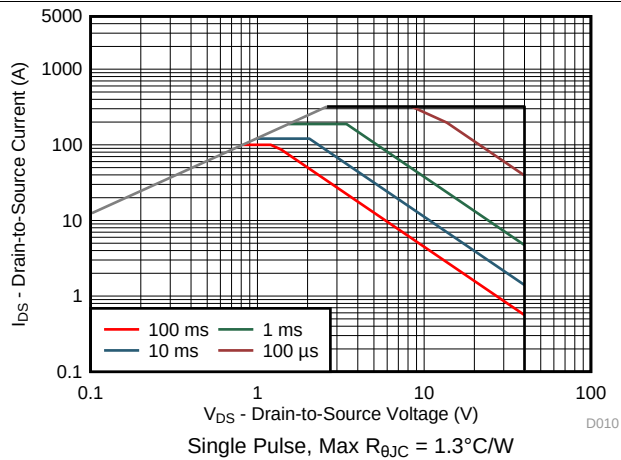


Figure 10. Maximum Safe Operating Area

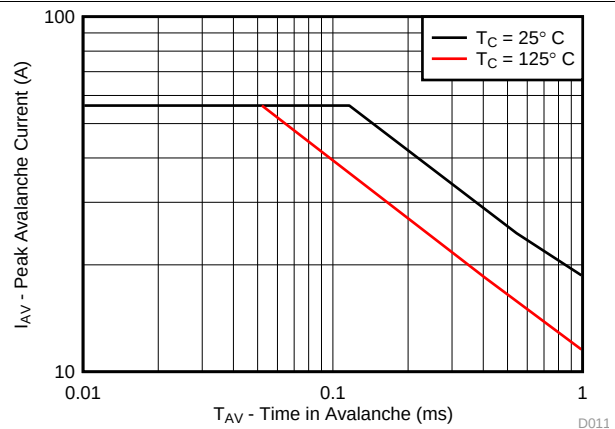


Figure 11. Single Pulse Unclamped Inductive Switching

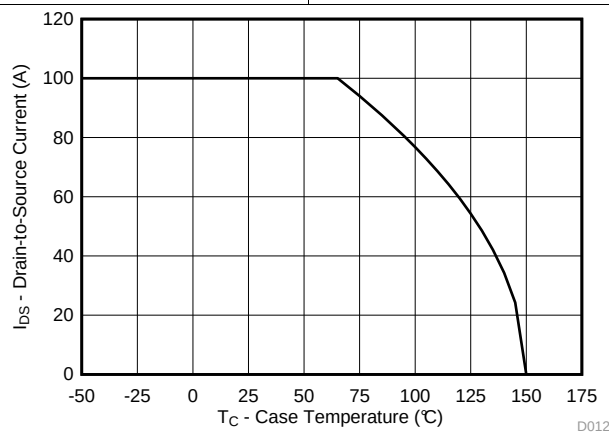


Figure 12. Maximum Drain Current vs Temperature

## 6 Device and Documentation Support

### 6.1 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

**TI E2E™ Online Community** *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At [e2e.ti.com](http://e2e.ti.com), you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

**Design Support** *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

### 6.2 Trademarks

NexFET, E2E are trademarks of Texas Instruments.  
All other trademarks are the property of their respective owners.

### 6.3 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.

### 6.4 Glossary

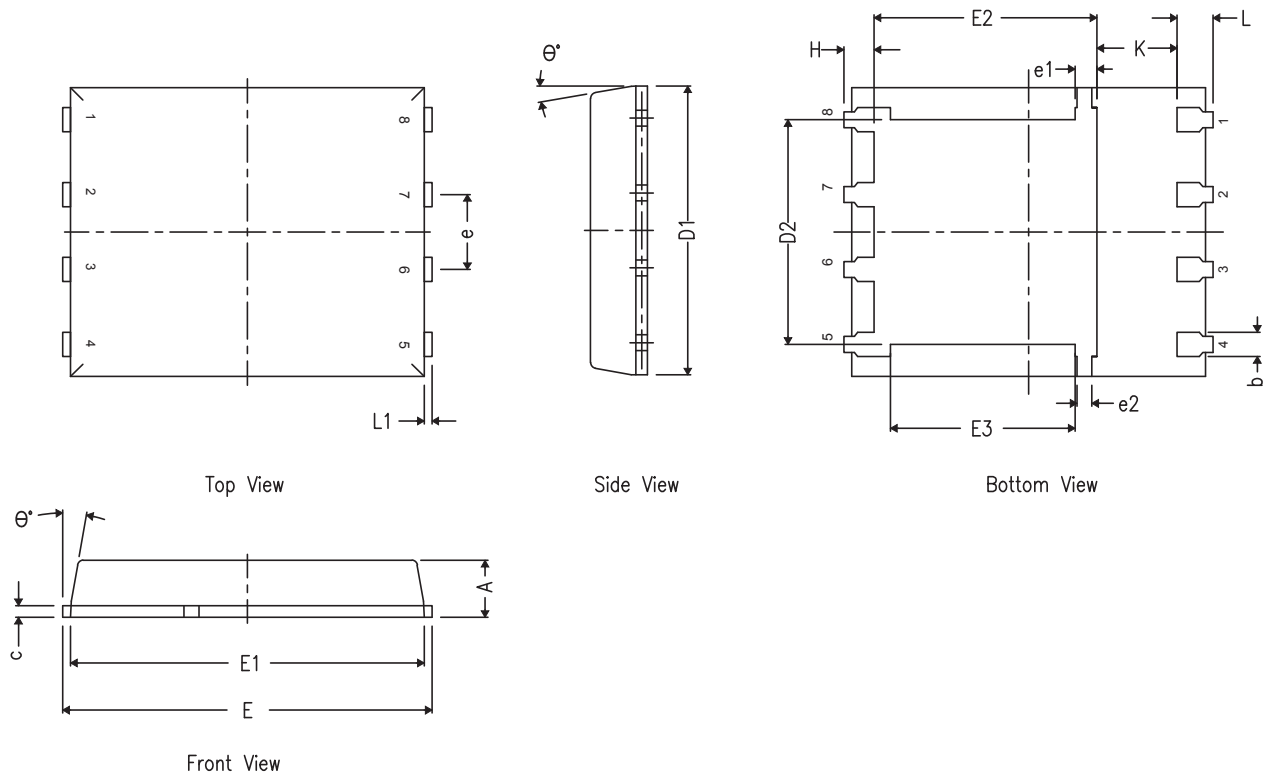
[SLYZ022](#) — *TI Glossary*.

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

## 7 Mechanical, Packaging, and Orderable Information

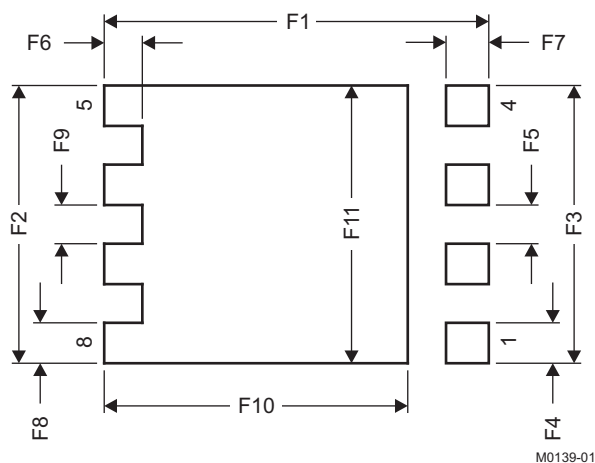
The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand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

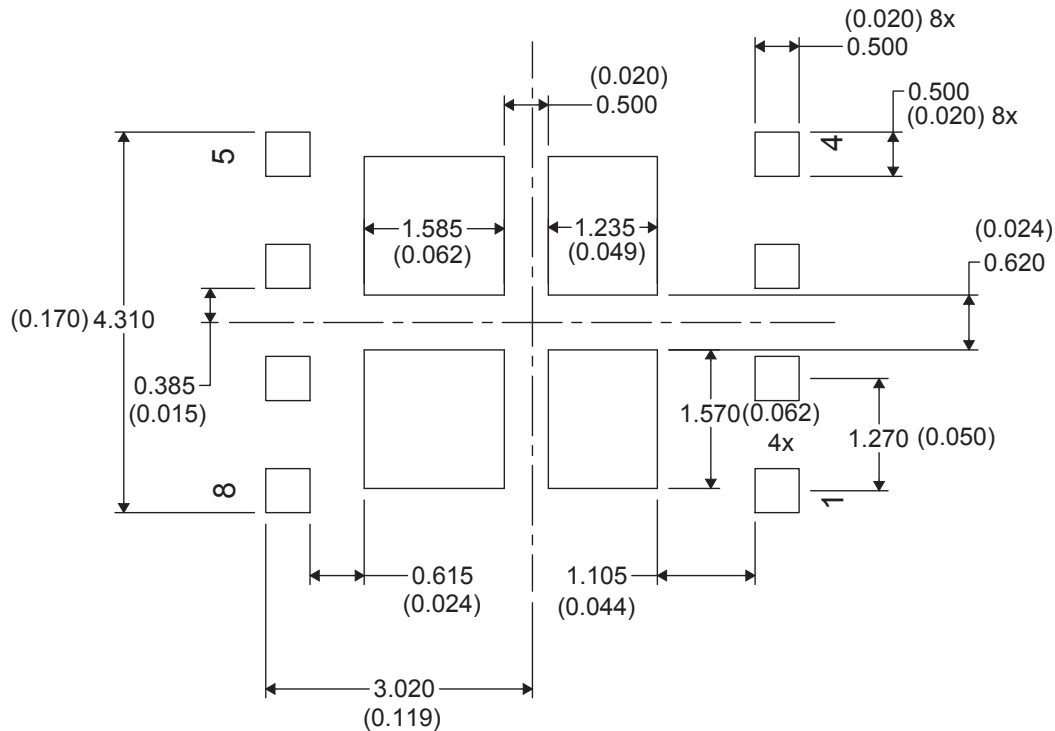
## 7.2 Recommended PCB Pattern



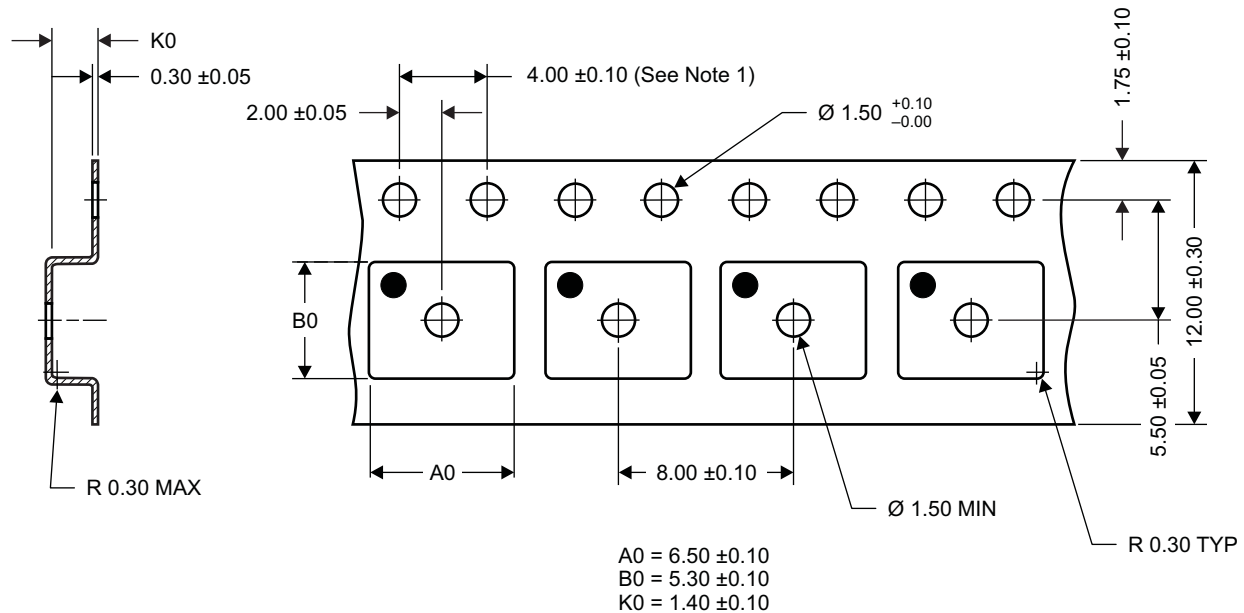
| DIM | MILLIMETERS |       | INCHES |       |
|-----|-------------|-------|--------|-------|
|     | MIN         | MAX   | MIN    | MAX   |
| F1  | 6.205       | 6.305 | 0.244  | 0.248 |
| F2  | 4.46        | 4.56  | 0.176  | 0.18  |
| F3  | 4.46        | 4.56  | 0.176  | 0.18  |
| F4  | 0.65        | 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



M0138-01

#### Notes:

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

## PACKAGING INFORMATION

| Orderable part number        | Status<br>(1) | Material type<br>(2) | Package   Pins  | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|------------------------------|---------------|----------------------|-----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">CSD18503Q5A</a>  | Active        | Production           | VSONP (DQJ)   8 | 2500   LARGE T&R      | ROHS Exempt | SN                                   | Level-1-260C-UNLIM                | -55 to 150   | CSD18503            |
| CSD18503Q5A.B                | Active        | Production           | VSONP (DQJ)   8 | 2500   LARGE T&R      | ROHS Exempt | SN                                   | Level-1-260C-UNLIM                | -55 to 150   | CSD18503            |
| <a href="#">CSD18503Q5AT</a> | Active        | Production           | VSONP (DQJ)   8 | 250   SMALL T&R       | ROHS Exempt | SN                                   | Level-1-260C-UNLIM                | -55 to 150   | CSD18503            |
| CSD18503Q5AT.B               | Active        | Production           | VSONP (DQJ)   8 | 250   SMALL T&R       | ROHS Exempt | SN                                   | Level-1-260C-UNLIM                | -55 to 150   | CSD18503            |

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

<sup>(4)</sup> **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

<sup>(5)</sup> **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

<sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

**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.

## IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on [ti.com](https://www.ti.com) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2025, Texas Instruments Incorporated