

## DualCool™ N-Channel NexFET™ Power MOSFETs

 Check for Samples: [CSD16322Q5C](#)

### FEATURES

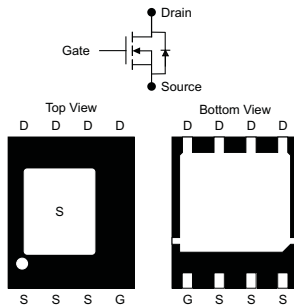
- DualCool™ Package SON 5x6mm
- Optimized for Two Sided Cooling
- Optimized for 5V Gate Drive
- Ultralow  $Q_g$  and  $Q_{gd}$
- Low Thermal Resistance
- Avalanche Rated
- Pb Free Terminal Plating
- RoHS Compliant and Halogen Free

### APPLICATIONS

- Point-of-Load Synchronous Buck in Networking, Telecom and Computing Systems
- Optimized for Synchronous or Control FET Applications

### DESCRIPTION

The NexFET™ power MOSFET has been designed to minimize losses in power conversion applications and optimized for 5V gate drive applications.



### PRODUCT SUMMARY

|              |                               |                 |        |
|--------------|-------------------------------|-----------------|--------|
| $V_{DS}$     | Drain to Source Voltage       | 25              | V      |
| $Q_g$        | Gate Charge Total (4.5V)      | 6.8             | nC     |
| $Q_{gd}$     | Gate Charge Gate to Drain     | 1.3             | nC     |
| $R_{DS(on)}$ | Drain to Source On Resistance | $V_{GS} = 3V$   | 5.4 mΩ |
|              |                               | $V_{GS} = 4.5V$ | 4.6 mΩ |
|              |                               | $V_{GS} = 8V$   | 3.9 mΩ |
| $V_{GS(th)}$ | Threshold Voltage             | 1.1             | V      |

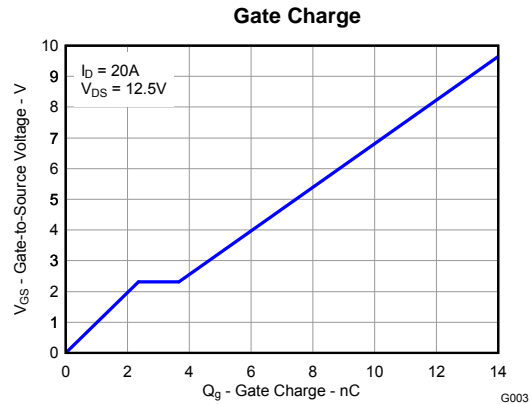
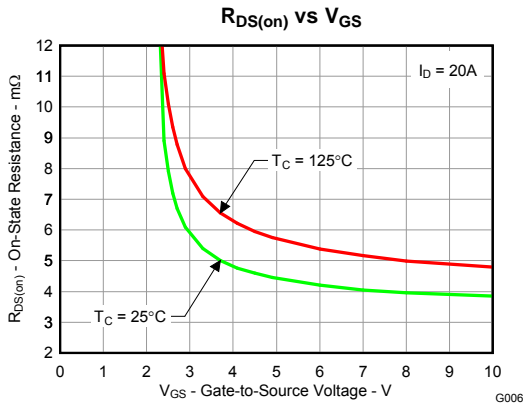
### ORDERING INFORMATION

| Device      | Package                    | Media        | Qty  | Ship          |
|-------------|----------------------------|--------------|------|---------------|
| CSD16322Q5C | SON 5x6-mm Plastic Package | 13-Inch Reel | 2500 | Tape and Reel |

### ABSOLUTE MAXIMUM RATINGS

| $T_A = 25^\circ\text{C}$ unless otherwise stated |  | VALUE      | UNIT             |
|--|--|------------|------------------|
| $V_{DS}$   | Drain to Source Voltage  | 25         | V                |
| $V_{GS}$   | Gate to Source Voltage   | +10 / -8   | V                |
| $I_D$  | Continuous Drain Current, $T_C = 25^\circ\text{C}$                                     | 97         | A                |
|  | Continuous Drain Current <sup>(1)</sup>  | 21         | A                |
| $I_{DM}$   | Pulsed Drain Current, $T_A = 25^\circ\text{C}$ <sup>(2)</sup>                          | 136        | A                |
| $P_D$  | Power Dissipation <sup>(1)</sup>   | 3.1        | W                |
| $T_J, T_{STG}$                                   | Operating Junction and Storage Temperature Range                                       | -55 to 150 | $^\circ\text{C}$ |
| $E_{AS}$   | Avalanche Energy, single pulse<br>$I_D = 50\text{A}, L = 0.1\text{mH}, R_G = 25\Omega$ | 125        | mJ               |

- (1)  $R_{\theta JA} = 39^\circ\text{C/W}$  on 1-inch<sup>2</sup> Cu, (2-oz.) on a 0.06" thick FR4 PCB.  
 (2) Pulse duration  $\leq 300\mu\text{s}$ , duty cycle  $\leq 2\%$



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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.

## ELECTRICAL CHARACTERISTICS

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

| PARAMETER                      |                                  | TEST CONDITIONS   | MIN  | TYP  | MAX | UNIT       |
|--------------------------------|----------------------------------|---|------|------|-----|------------|
| <b>Static Characteristics</b>  |                                  |   |      |      |     |            |
| $BV_{DSS}$                     | Drain to Source Voltage          | $V_{GS} = 0V, I_{DS} = 250\mu A$                                  | 25   |      |     | V          |
| $I_{DSS}$                      | Drain to Source Leakage          | $V_{GS} = 0V, V_{DS} = 20V$                                       |      |      | 1   | $\mu A$    |
| $I_{GSS}$                      | Gate to Source Leakage           | $V_{DS} = 0V, V_{GS} = +10/-8V$                                   |      |      | 100 | nA         |
| $V_{GS(th)}$                   | Gate to Source Threshold Voltage | $V_{DS} = V_{GS}, I_D = 250\mu A$                                 | 0.9  | 1.1  | 1.4 | V          |
| $R_{DS(on)}$                   | Drain to Source On Resistance    | $V_{GS} = 3V, I_{DS} = 20A$                                       |      | 5.4  | 7.2 | m $\Omega$ |
|                                |                                  | $V_{GS} = 4.5V, I_{DS} = 20A$                                     |      | 4.6  | 5.8 | m $\Omega$ |
|                                |                                  | $V_{GS} = 8V, I_{DS} = 20A$                                       |      | 3.9  | 5   | m $\Omega$ |
| $g_{fs}$                       | Transconductance                 | $V_{DS} = 15V, I_{DS} = 20A$                                      |      | 106  |     | S          |
| <b>Dynamic Characteristics</b> |                                  |   |      |      |     |            |
| $C_{iss}$                      | Input Capacitance                | $V_{GS} = 0V, V_{DS} = 12.5V,$<br>$f = 1MHz$                      | 1050 | 1365 |     | pF         |
| $C_{oss}$                      | Output Capacitance               |   | 740  | 950  |     | pF         |
| $C_{rss}$                      | Reverse Transfer Capacitance     |   | 55   | 70   |     | pF         |
| $R_G$                          | Series Gate Resistance           |   | 1.1  | 2.2  |     | $\Omega$   |
| $Q_g$                          | Gate Charge Total (4.5V)         | $V_{DS} = 12.5V,$<br>$I_{DS} = 20A$                               | 6.8  | 9.7  |     | nC         |
| $Q_{gd}$                       | Gate Charge – Gate to Drain      |   | 1.3  |      |     | nC         |
| $Q_{gs}$                       | Gate Charge – Gate to Source     |   | 2.4  |      |     | nC         |
| $Q_{g(th)}$                    | Gate Charge at $V_{th}$          |   | 1.3  |      |     | nC         |
| $Q_{oss}$                      | Output Charge                    | $V_{DS} = 13V, V_{GS} = 0V$                                       | 17   |      |     | nC         |
| $t_{d(on)}$                    | Turn On Delay Time               | $V_{DS} = 12.5V, V_{GS} = 4.5V,$<br>$I_{DS} = 20A, R_G = 2\Omega$ | 6.1  |      |     | ns         |
| $t_r$                          | Rise Time                        |   | 10.7 |      |     | ns         |
| $t_{d(off)}$                   | Turn Off Delay Time              |   | 12.3 |      |     | ns         |
| $t_f$                          | Fall Time                        |   | 3.7  |      |     | ns         |
| <b>Diode Characteristics</b>   |                                  |   |      |      |     |            |
| $V_{SD}$                       | Diode Forward Voltage            | $I_{DS} = 20A, V_{GS} = 0V$                                       | 0.8  | 1    |     | V          |
| $Q_{rr}$                       | Reverse Recovery Charge          | $V_{DD} = 13V, I_F = 20A, di/dt = 300A/\mu s$                     | 19   |      |     | nC         |
| $t_{rr}$                       | Reverse Recovery Time            |   | 21   |      |     | ns         |

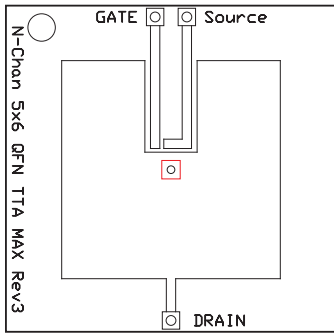
## THERMAL CHARACTERISTICS

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

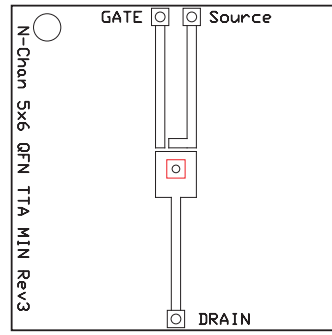
| PARAMETER       |   | MIN | TYP | MAX | UNIT               |
|-----------------|---|-----|-----|-----|--------------------|
| $R_{\theta JC}$ | Thermal Resistance Junction to Case (Top Source) <sup>(1)</sup>   |     |     | 3.5 | $^\circ\text{C/W}$ |
| $R_{\theta JC}$ | Thermal Resistance Junction to Case (Bottom drain) <sup>(1)</sup> |     |     | 2.4 | $^\circ\text{C/W}$ |
| $R_{\theta JA}$ | Thermal Resistance Junction to Ambient <sup>(1)(2)</sup>          |     |     | 50  | $^\circ\text{C/W}$ |

(1)  $R_{\theta JC}$  is determined with the device mounted on a 1-inch<sup>2</sup> 2-oz. Cu pad on a 1.5 × 1.5-inch 0.06-inch thick FR4 board.  $R_{\theta JC}$  is specified by design, whereas  $R_{\theta CA}$  is determined by the user's board design.

(2) Device mounted on FR4 material with 1-inch<sup>2</sup> of 2-oz. Cu.



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



Max  $R_{\theta JA} = 123^{\circ}\text{C/W}$   
when mounted on  
minimum pad area of  
2-oz. Cu.

### TYPICAL MOSFET CHARACTERISTICS

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

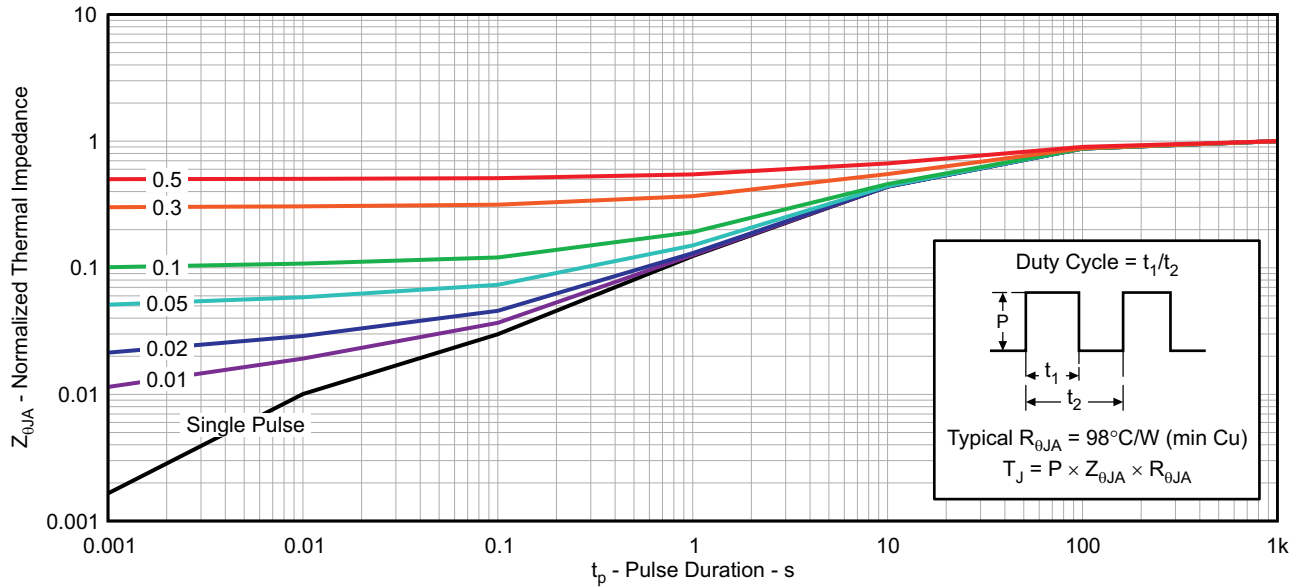
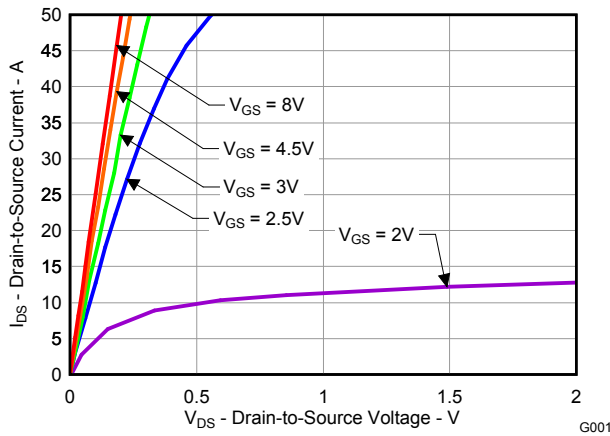


Figure 1. Transient Thermal Impedance

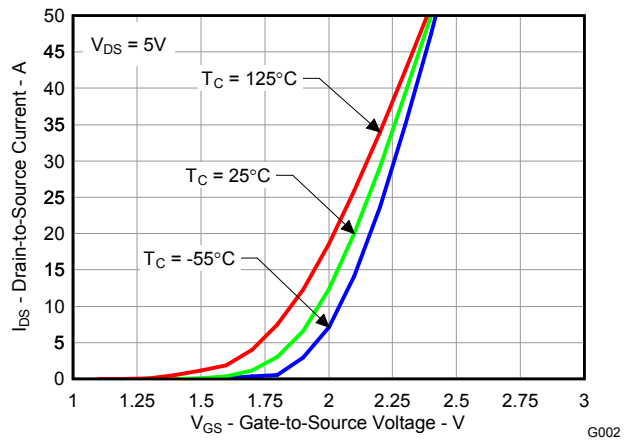
G012

**TYPICAL MOSFET CHARACTERISTICS (continued)**

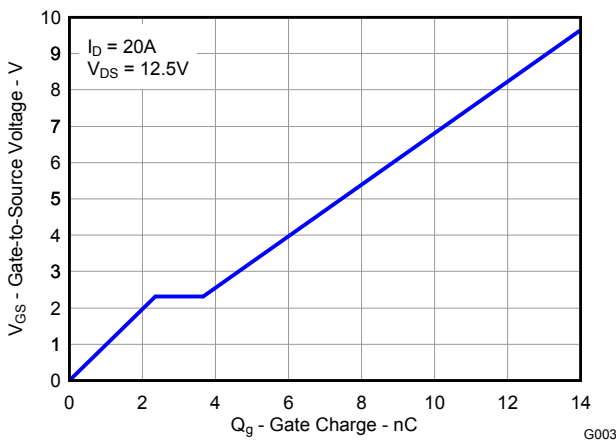
( $T_A = 25^\circ\text{C}$  unless otherwise stated)



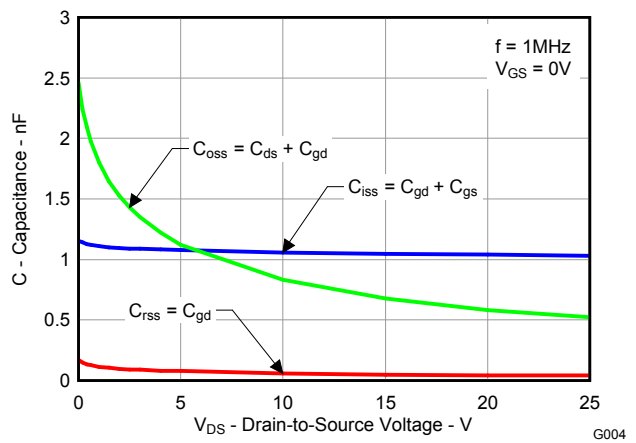
**Figure 2. Saturation Characteristics**



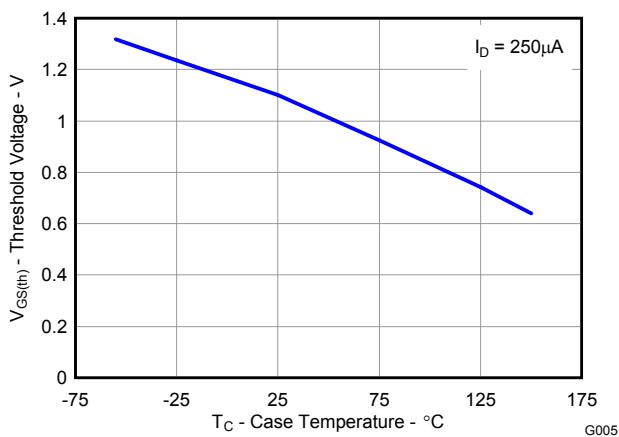
**Figure 3. Transfer Characteristics**



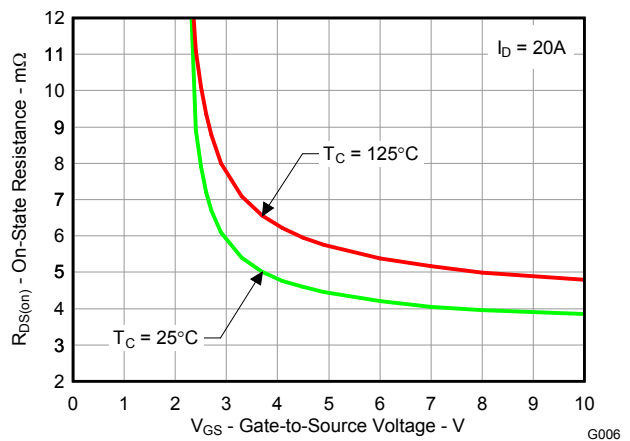
**Figure 4. Gate Charge**



**Figure 5. Capacitance**



**Figure 6. Threshold Voltage vs. Temperature**



**Figure 7. On Resistance vs. Gate Voltage**

TYPICAL MOSFET CHARACTERISTICS (continued)

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

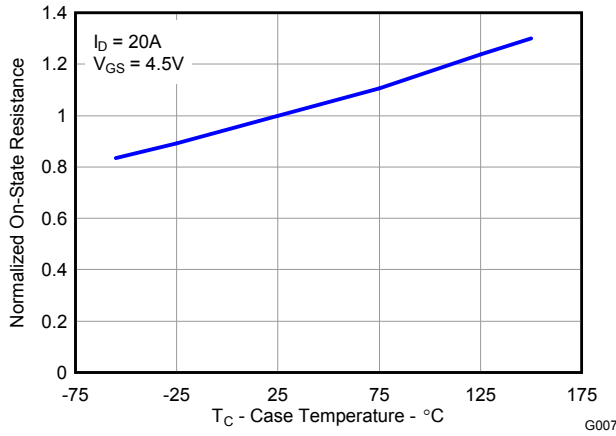


Figure 8. On Resistance vs. Temperature

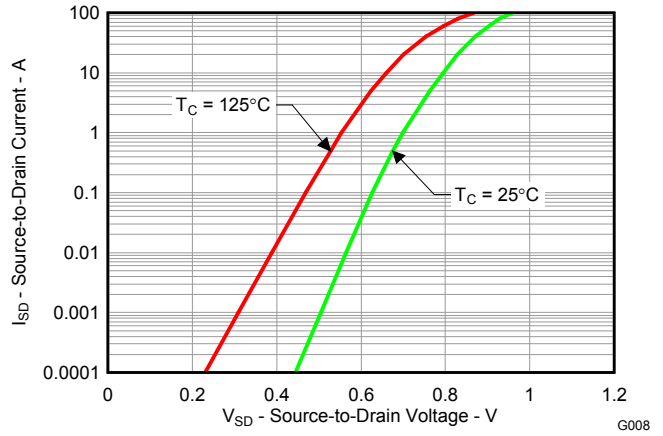


Figure 9. Typical Diode Forward Voltage

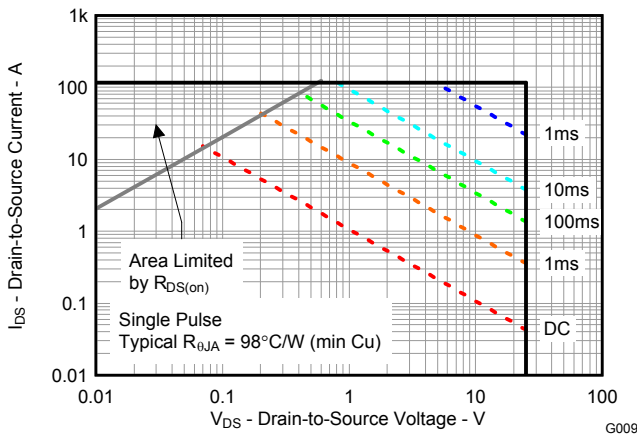


Figure 10. Maximum Safe Operating Area

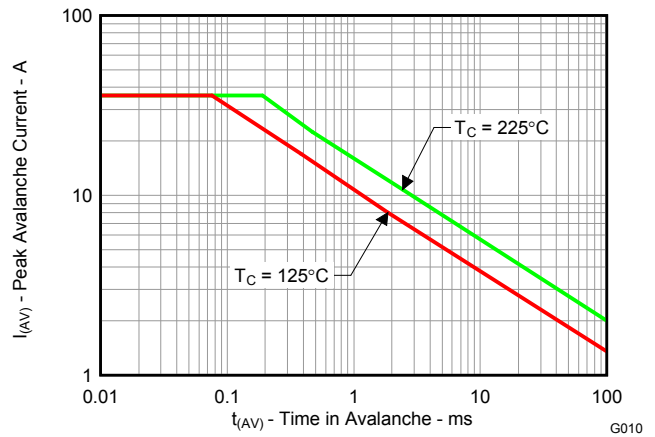


Figure 11. Single Pulse Unclamped Inductive Switching

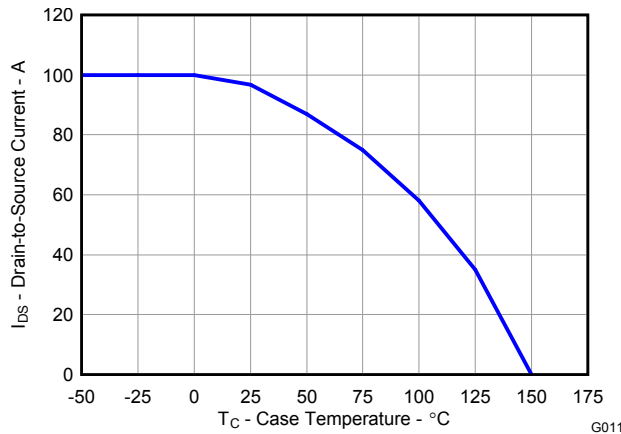
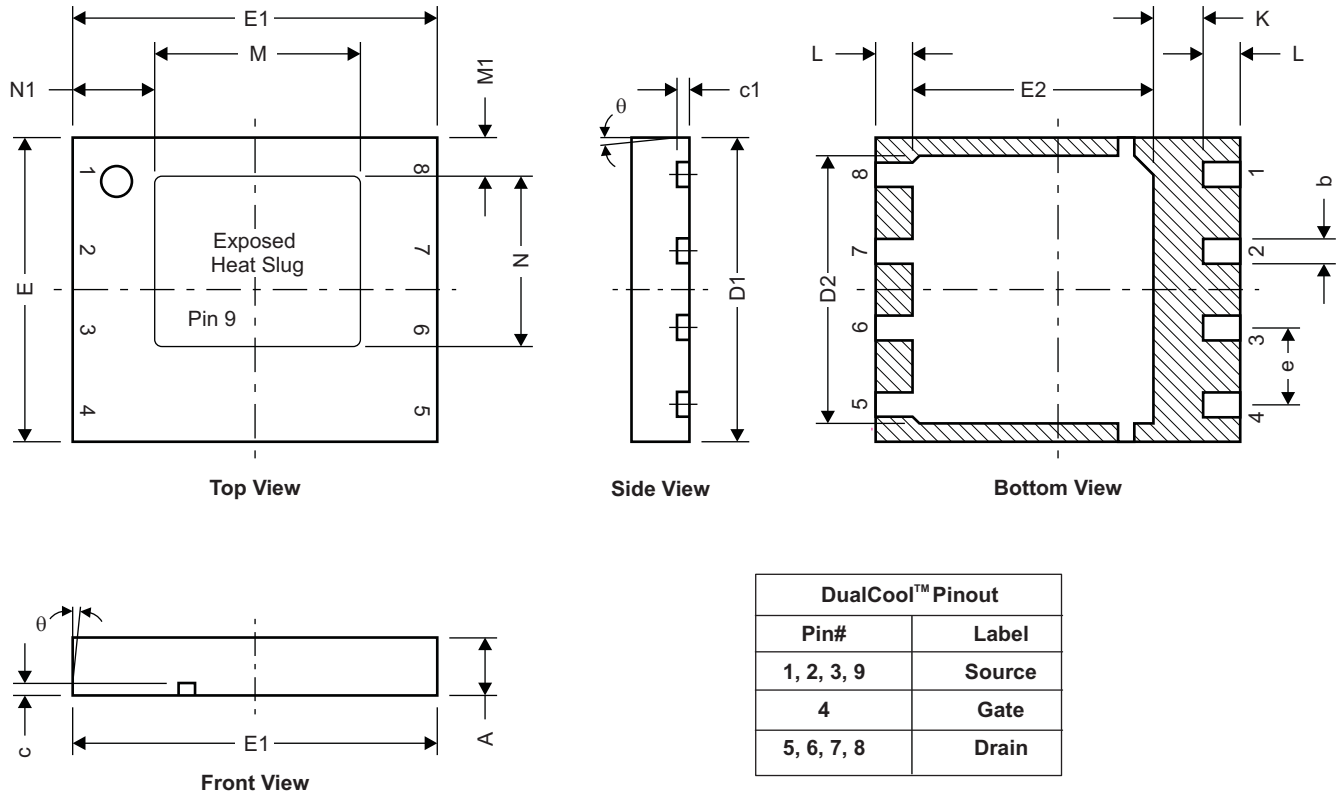


Figure 12. Maximum Drain Current vs. Temperature

**MECHANICAL DATA**

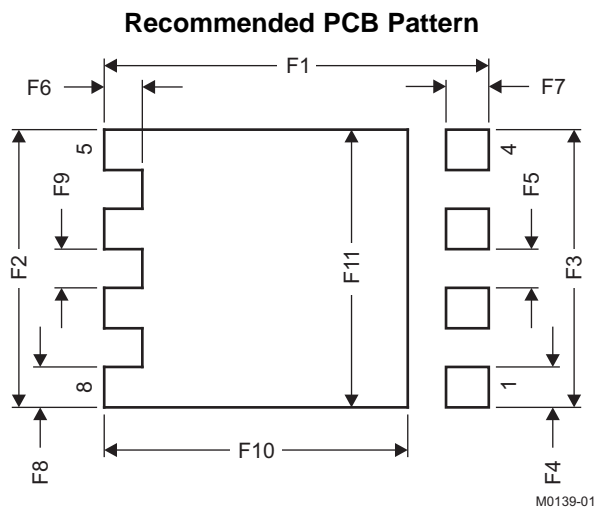
**Q5C Package Dimensions**



| DualCool™ Pinout |        |
|------------------|--------|
| Pin#             | Label  |
| 1, 2, 3, 9       | Source |
| 4                | Gate   |
| 5, 6, 7, 8       | Drain  |

M0162-01

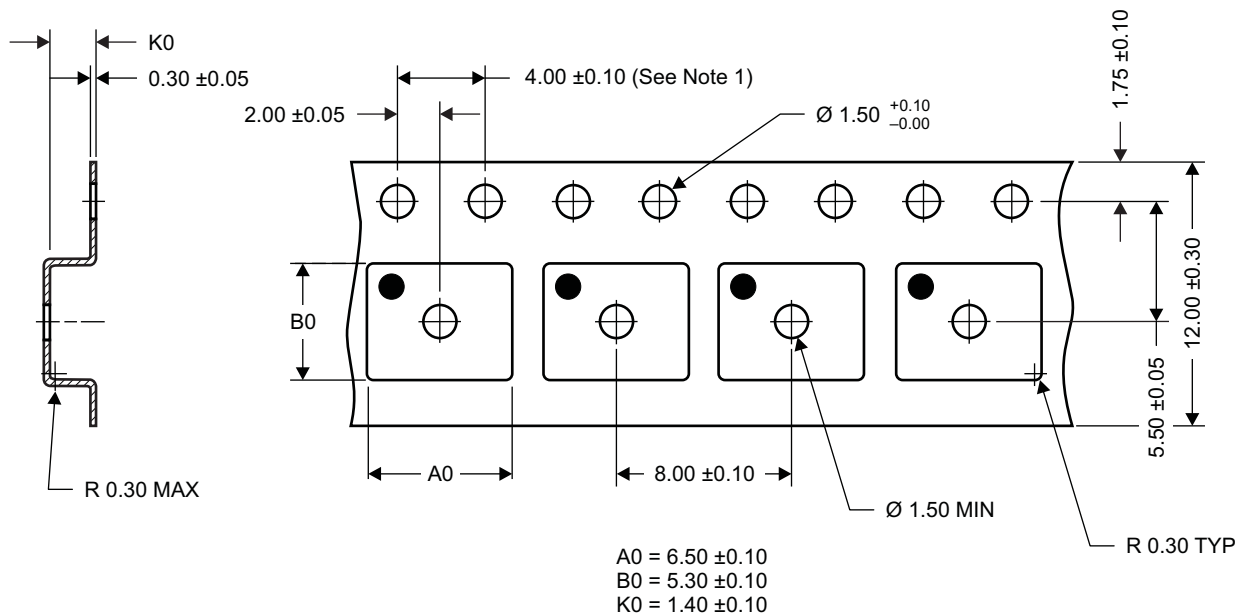
| DIM   | MILLIMETERS |       | INCHES |       |
|-------|-------------|-------|--------|-------|
|       | MIN         | MAX   | MIN    | MAX   |
| A     | 0.950       | 1.050 | 0.037  | 0.039 |
| b     | 0.360       | 0.460 | 0.014  | 0.018 |
| c     | 0.150       | 0.250 | 0.006  | 0.010 |
| c1    | 0.150       | 0.250 | 0.006  | 0.010 |
| D1    | 4.900       | 5.100 | 0.193  | 0.201 |
| D2    | 4.320       | 4.520 | 0.170  | 0.178 |
| E     | 4.900       | 5.100 | 0.193  | 0.201 |
| E1    | 5.900       | 6.100 | 0.232  | 0.240 |
| E2    | 3.920       | 4.12  | 0.154  | 0.162 |
| e     | 1.27 TYP    |       | 0.050  |       |
| L     | 0.510       | 0.710 | 0.020  | 0.028 |
| theta | -           | -     | -      | -     |
| K     | 0.760       | -     | 0.030  | -     |
| M     | 3.260       | 3.460 | 0.128  | 0.136 |
| M1    | 0.520       | 0.720 | 0.020  | 0.028 |
| N     | 2.720       | 2.920 | 0.107  | 0.115 |
| N1    | 1.227       | 1.427 | 0.048  | 0.056 |



| 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](#).

### Q5C Tape and Reel Information



### Notes:

- 10-sprocket hole-pitch cumulative tolerance  $\pm 0.2$
- Camber not to exceed 1mm in 100mm, noncumulative over 250mm
- Material: black static-dissipative polystyrene
- All dimensions are in mm, unless otherwise specified.
- A0 and B0 measured on a plane 0.3mm above the bottom of the pocket
- MSL1 260°C (IR and convection) PbF reflow compatible

## REVISION HISTORY

### Changes from Original (December 2009) to Revision A

Page

- Changed the labels on the Bottom View pinout image ..... 1
- Changed the Mechanical Data dimensions table. Added dimensions for M, M1, N and N1 ..... 6

### Changes from Revision A (April 2010) to Revision B

Page

- Changed  $R_{DS(on)} - V_{GS} = 3V$  in the Electrical Characteristics table From: 7 To: 7.2 in the max column ..... 2
- Deleted the Package Marking Information section ..... 7

## TAPE AND REEL INFORMATION



### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



\*All dimensions are nominal

| Device      | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|-------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| CSD16322Q5C | SON          | DQU             | 8    | 2500 | 330.0              | 12.8               | 6.5     | 5.3     | 1.4     | 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) |
|-------------|--------------|-----------------|------|------|-------------|------------|-------------|
| CSD16322Q5C | SON          | DQU             | 8    | 2500 | 335.0       | 335.0      | 32.0        |

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| 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>               |
| RF/IF and ZigBee® Solutions | <a href="http://www.ti.com/lprf">www.ti.com/lprf</a>               |

### Applications

|                               |  |
|-------------------------------|--|
| 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> |
| Transportation and Automotive | <a href="http://www.ti.com/automotive">www.ti.com/automotive</a>                         |
| Video and Imaging             | <a href="http://www.ti.com/video">www.ti.com/video</a>                                   |
| Wireless                      | <a href="http://www.ti.com/wireless-apps">www.ti.com/wireless-apps</a>                   |

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