



## DualCool™ N-Channel NexFET™ Power MOSFET

 Check for Samples: [CSD16407Q5C](#)

### FEATURES

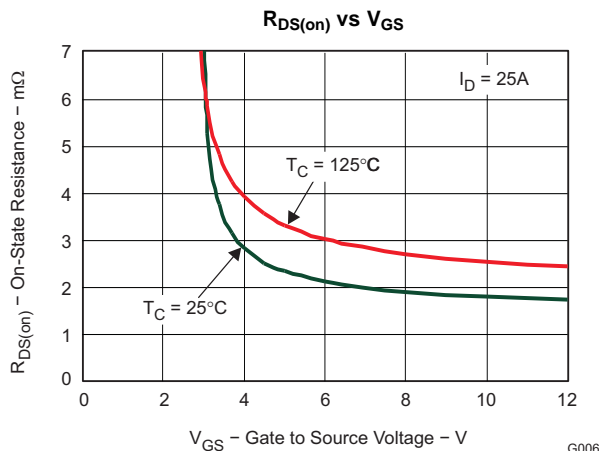
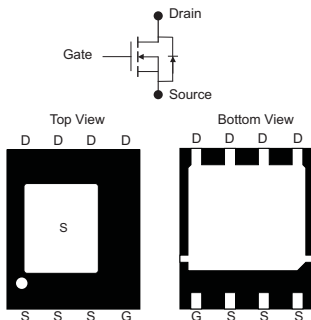
- **Ultralow  $Q_g$  and  $Q_{gd}$**
- **DualCool™ Package**
- **Optimized for Two Sided Cooling**
- **Avalanche Rated**
- **Pb Free Terminal Plating**
- **RoHS Compliant**
- **Halogen Free**
- **SON 5-mm x 6-mm Plastic Package**

### APPLICATIONS

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

### DESCRIPTION

The NexFET™ power MOSFET has been designed to minimize losses in power conversion applications.



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### PRODUCT SUMMARY

$V_{DS}$	Drain to Source Voltage	25	V
$Q_g$	Gate Charge Total (4.5V)	13.3	nC
$Q_{gd}$	Gate Charge Gate to Drain	3.5	nC
$R_{DS(on)}$	Drain to Source On Resistance	$V_{GS} = 4.5V$	2.5 mΩ
		$V_{GS} = 10V$	1.8 mΩ
$V_{(th)}$	Threshold Voltage	1.6	V

### ORDERING INFORMATION

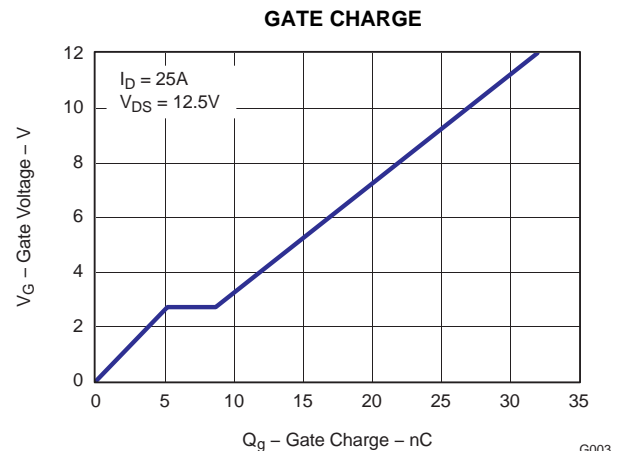
Device	Package	Media	Qty	Ship
CSD16407Q5C	SON 5-mm x 6-mm Plastic Package	13-Inch Reel	2500	Tape and Reel

### 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	+16 / -12	V
$I_D$	Continuous Drain Current, $T_C = 25^\circ\text{C}$	100	A
	Continuous Drain Current <sup>(1)</sup>	31	A
$I_{DM}$	Pulsed Drain Current, $T_A = 25^\circ\text{C}$ <sup>(2)</sup>	200	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 $I_D = 66A$ , $L = 0.1\text{mH}$ , $R_G = 25\Omega$	218	mJ

(1) Typical  $R_{\theta JA} = 40^\circ\text{C}/\text{W}$  on 1-inch<sup>2</sup> (6.45-cm<sup>2</sup>), 2-oz. (0.071-mm thick) Cu pad on a 0.06-inch (1.52-mm) 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 specified

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>Static Characteristics</b>						
$BV_{DSS}$	Drain to Source Voltage	$V_{GS} = 0V, I_D = 250\mu A$	25			V
$I_{DSS}$	Drain to Source Leakage Current	$V_{GS} = 0V, V_{DS} = 20V$			1	$\mu A$
$I_{GSS}$	Gate to Source Leakage Current	$V_{DS} = 0V, V_{GS} = +16V / -12V$			100	nA
$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\mu A$	1.3	1.6	1.9	V
$R_{DS(on)}$	Drain to Source On Resistance	$V_{GS} = 4.5V, I_D = 25A$		2.5	3.3	m $\Omega$
		$V_{GS} = 10V, I_D = 25A$		1.8	2.4	m $\Omega$
$g_{fs}$	Transconductance	$V_{DS} = 15V, I_D = 25A$		111		S
<b>Dynamic Characteristics</b>						
$C_{ISS}$	Input Capacitance	$V_{GS} = 0V, V_{DS} = 12.5V, f = 1MHz$		2040	2660	pF
$C_{OSS}$	Output Capacitance			1600	2080	pF
$C_{RSS}$	Reverse Transfer Capacitance			115	160	pF
$R_g$	Series Gate Resistance			1.2	2.4	$\Omega$
$Q_g$	Gate Charge Total (4.5V)	$V_{DS} = 12.5V, I_D = 25A$		13.3	18	nC
$Q_{gd}$	Gate Charge Gate to Drain			3.5		nC
$Q_{gs}$	Gate Charge Gate to Source			5.3		nC
$Q_{g(th)}$	Gate Charge at $V_{th}$			3.1		nC
$Q_{OSS}$	Output Charge	$V_{DS} = 13.5V, V_{GS} = 0V$		33		nC
$t_{d(on)}$	Turn On Delay Time	$V_{DS} = 12.5V, V_{GS} = 4.5V, I_D = 25A, R_G = 2\Omega$		11.9		ns
$t_r$	Rise Time			18.4		ns
$t_{d(off)}$	Turn Off Delay Time			16		ns
$t_f$	Fall Time			9		ns
<b>Diode Characteristics</b>						
$V_{SD}$	Diode Forward Voltage	$I_S = 25A, V_{GS} = 0V$		0.8	1	V
$Q_{rr}$	Reverse Recovery Charge	$V_{DD} = 13.5V, I_F = 25A, di/dt = 300A/\mu s$		42		nC
$t_{rr}$	Reverse Recovery Time	$V_{DD} = 13.5V, I_F = 25A, di/dt = 300A/\mu s$		34		ns

## THERMAL CHARACTERISTICS

$T_A = 25^\circ\text{C}$ , unless otherwise specified

PARAMETER		MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Thermal Resistance Junction to Case (Top Source) <sup>(1)</sup>			1.2	$^\circ\text{C/W}$
$R_{\theta JC}$	Thermal Resistance Junction to Case (Bottom Drain) <sup>(1)</sup>			1.1	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance Junction to Ambient <sup>(1) (2)</sup>			51	$^\circ\text{C/W}$

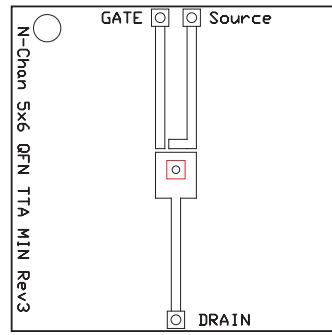
(1)  $R_{\theta JC}$  is determined with the device mounted on a 1-inch<sup>2</sup> (6.45-cm<sup>2</sup>), 2-oz. (0.071-mm thick) Cu pad on a 1.5-inch  $\times$  1.5-inch (3.81-cm  $\times$  3.81-cm), 0.06-inch (1.52-mm) thick FR4 PCB.  $R_{\theta JC}$  is specified by design, whereas  $R_{\theta JA}$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

(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.



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Max  $R_{\theta JA} = 51^{\circ}\text{C/W}$   
when mounted on  
1 inch<sup>2</sup> (6.45 cm<sup>2</sup>) of  
2-oz. (0.071-mm thick)  
Cu.

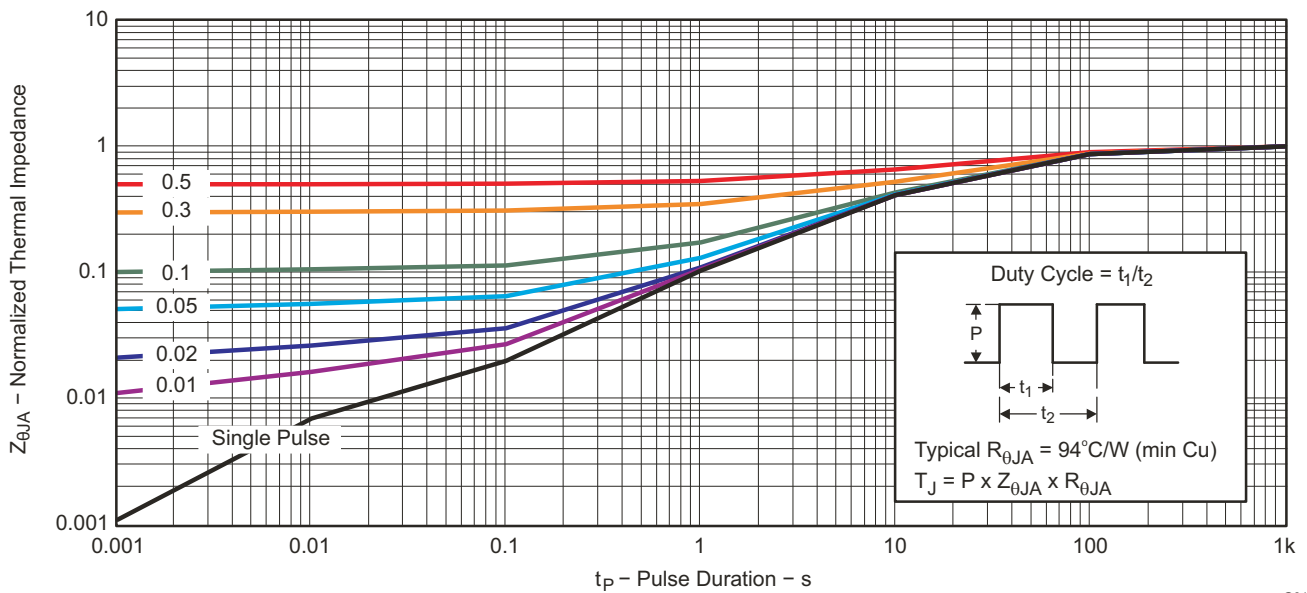


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Max  $R_{\theta JA} = 121^{\circ}\text{C/W}$   
when mounted on  
minimum pad area of  
2-oz. (0.071-mm thick)  
Cu.

### TYPICAL MOSFET CHARACTERISTICS

$T_A = 25^{\circ}\text{C}$ , unless otherwise specified

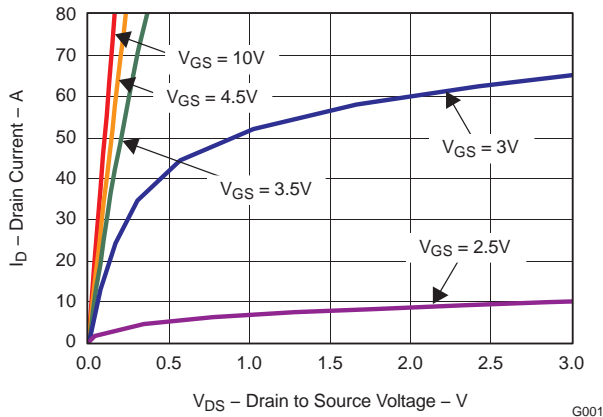


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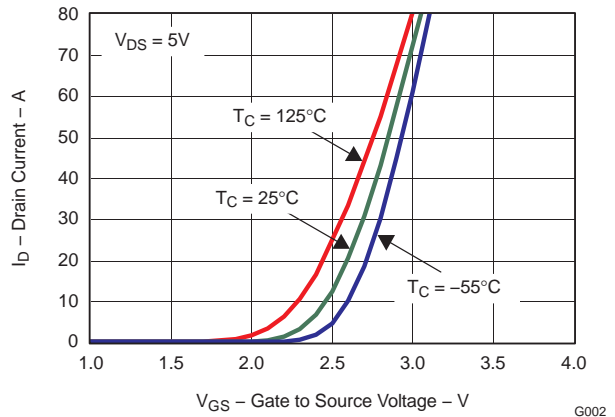
Figure 1. Transient Thermal Impedance

**TYPICAL MOSFET CHARACTERISTICS (continued)**

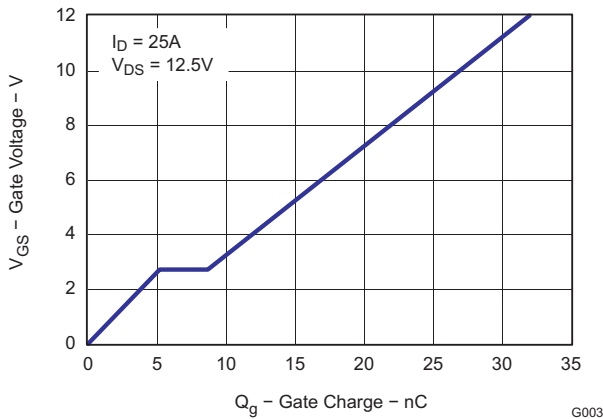
$T_A = 25^\circ\text{C}$ , unless otherwise specified



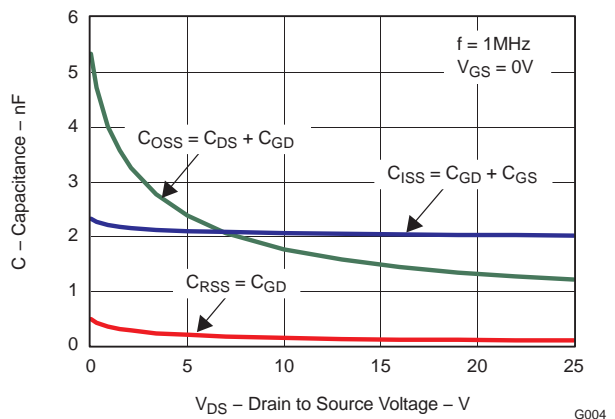
**Figure 2. Saturation Characteristics**



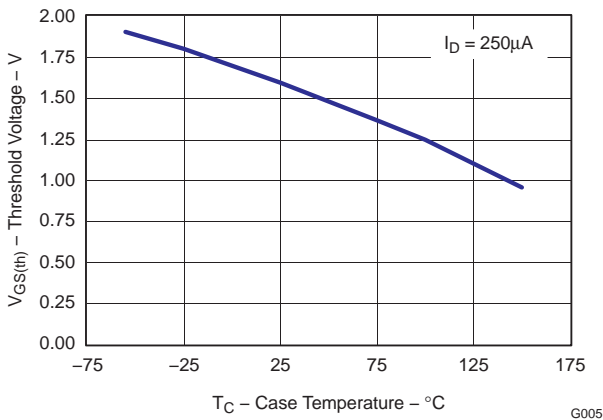
**Figure 3. Transfer Characteristics**



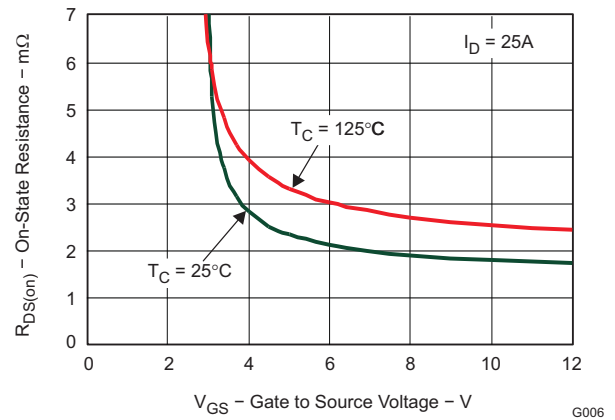
**Figure 4. Gate Charge**



**Figure 5. Capacitance**



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



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

TYPICAL MOSFET CHARACTERISTICS (continued)

T<sub>A</sub> = 25°C, unless otherwise specified

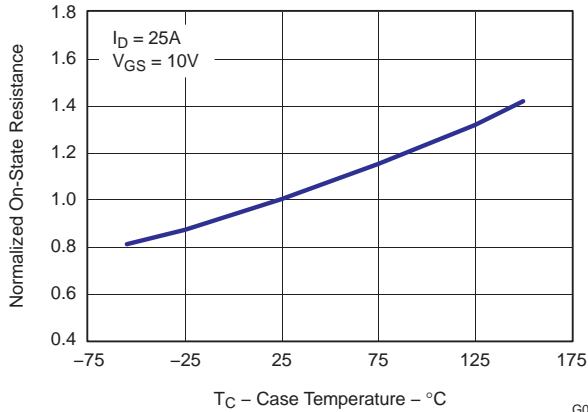


Figure 8. Normalized On-State Resistance vs. Temperature

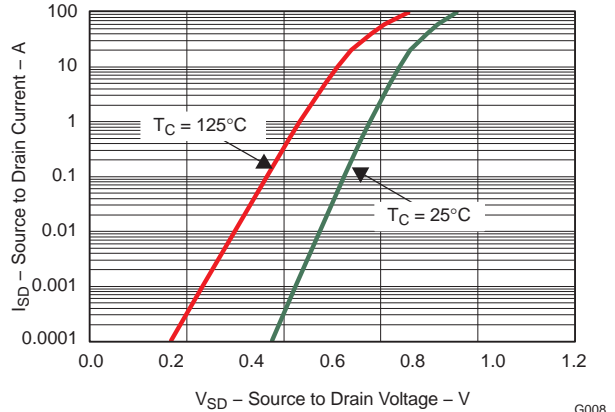


Figure 9. Typical Diode Forward Voltage

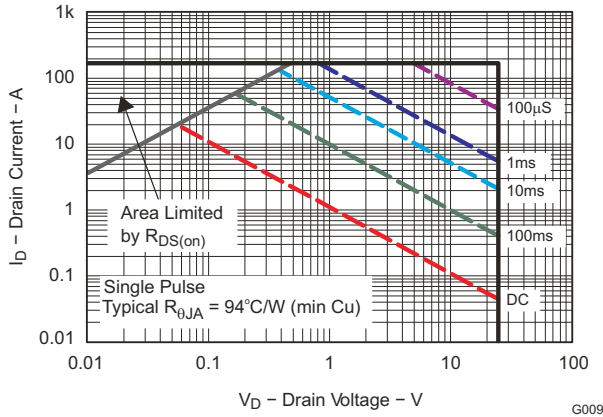


Figure 10. Maximum Safe Operating Area

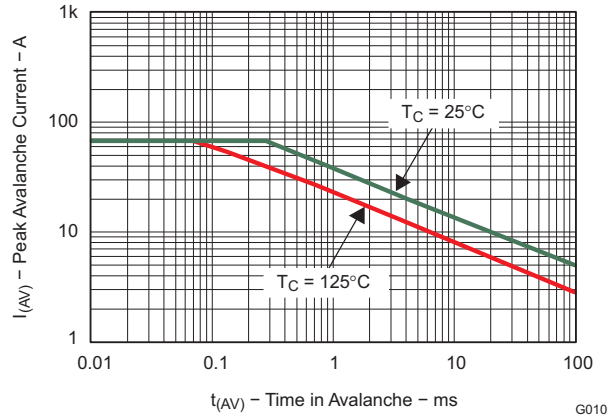


Figure 11. Single Pulse Unclamped Inductive Switching

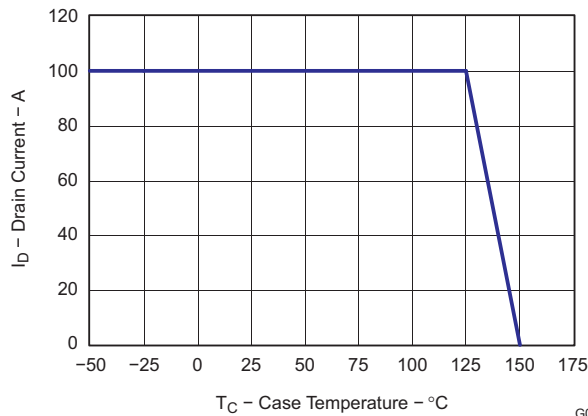
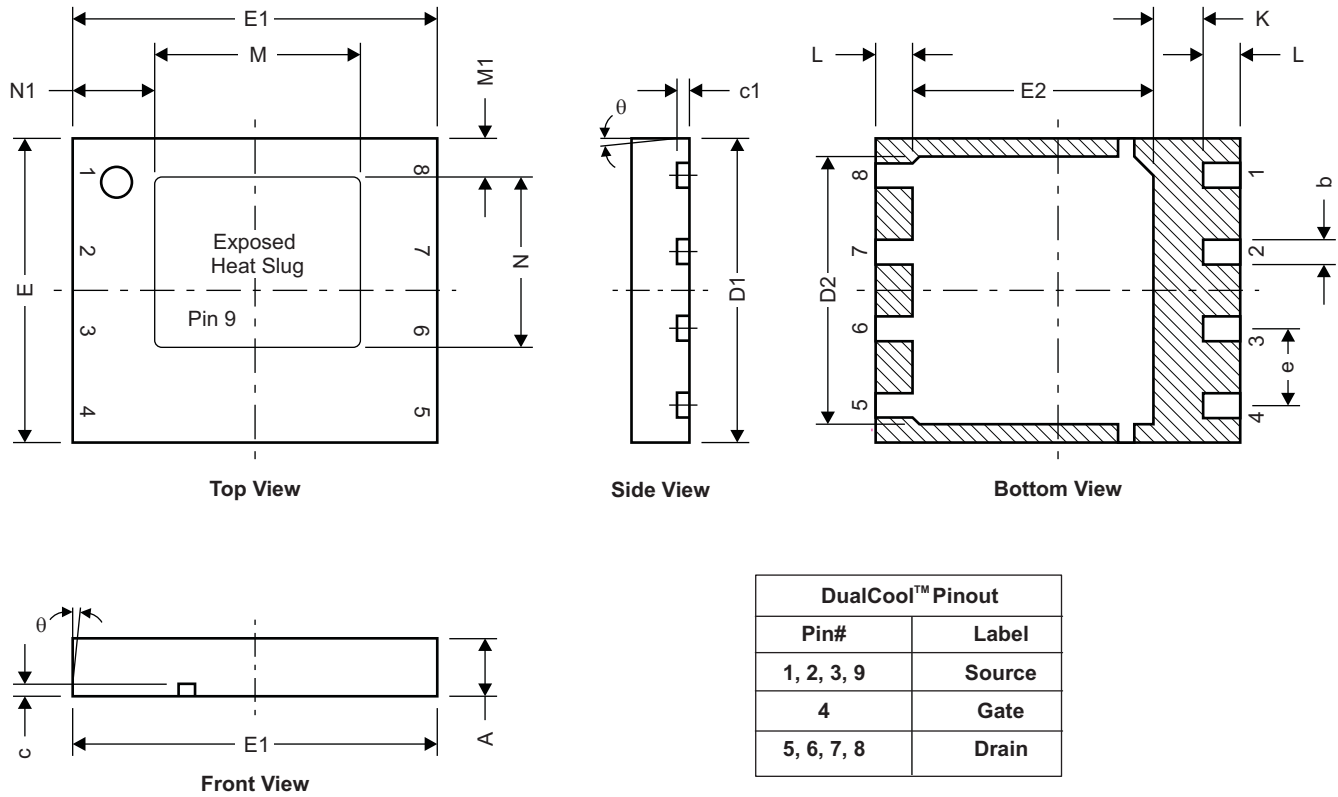


Figure 12. Maximum Drain Current vs. Temperature

**MECHANICAL DATA**

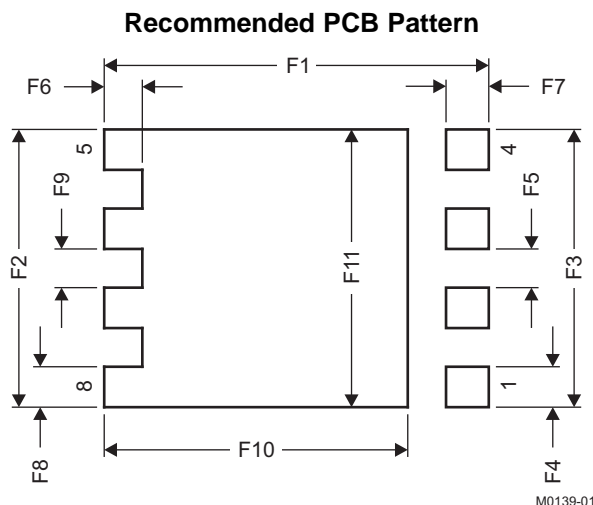
**Q5C Package Dimensions**



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

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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	
K	0.760	–	0.030	–
L	0.510	0.710	0.020	0.028
theta	–	–	–	–
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	4.460	4.560	0.176	0.180
F3	4.460	4.560	0.176	0.180
F4	0.650	0.700	0.026	0.028
F5	0.620	0.670	0.024	0.026
F6	0.630	0.680	0.025	0.027
F7	0.700	0.800	0.028	0.031
F8	0.650	0.700	0.026	0.028
F9	0.620	0.670	0.024	0.026
F10	4.900	5.000	0.193	0.197
F11	4.460	4.560	0.176	0.180

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.
- Thickness:  $0.30 \pm 0.05$  mm
- MSL1 260°C (IR and convection) PbF reflow compatible

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## REVISION HISTORY

Changes from Original (October 2009) to Revision A	Page
• Changed the device From: Procut Preview To: Production .....	1
• Changed Application - From: Optimized for Control FET Applications To: Optimized for Synchronous FET Applications .....	1
• Changed the pinout illustration. ....	1
• Changed the Q5C Package Dimensions illustration .....	6
Changes from Revision A (December 2009) to Revision B	Page
• Changed the ABSOLUTE MAXIMUM RATINGS table, $I_D$ - Continuous Drain Current value From: 30A To: 31A .....	1
• Changed Note 1 of the ABSOLUTE MAXIMUM RATINGS table From: Typical $R_{\theta JA} = 41^\circ\text{C}$ To: Typical $R_{\theta JA} = 40^\circ\text{C}$ .....	1
• Changed <a href="#">Figure 1</a> - From: Typical $R_{\theta JA} = 98^\circ\text{C/W}$ To: Typical $R_{\theta JA} = 94^\circ\text{C/W}$ .....	3
• Changed <a href="#">Figure 10</a> - From: Typical $R_{\theta JA} = 98^\circ\text{C/W}$ To: Typical $R_{\theta JA} = 94^\circ\text{C/W}$ .....	5
• Changed <a href="#">Figure 11</a> - X axis values .....	5
Changes from Revision B (January 2010) to Revision C	Page
• Changed the labels on the Bottom View pinout image .....	1
Changes from Revision C (February 2010) to Revision D	Page
• Deleted the Package Marking Information section .....	7



**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/ Ball Finish	MSL Peak Temp <sup>(3)</sup>	Samples (Requires Login)
CSD16407Q5C	ACTIVE	SON	DQU	8	2500	Pb-Free (RoHS Exempt)	CU SN	Level-1-260C-UNLIM	

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

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

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

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

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

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

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

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

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

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

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

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

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**TAPE AND REEL INFORMATION**

**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
CSD16407Q5C	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)
CSD16407Q5C	SON	DQU	8	2500	335.0	335.0	32.0

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DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
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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>
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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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