

## DualCool™ N-Ch NexFET™ Power MOSFET

### FEATURES

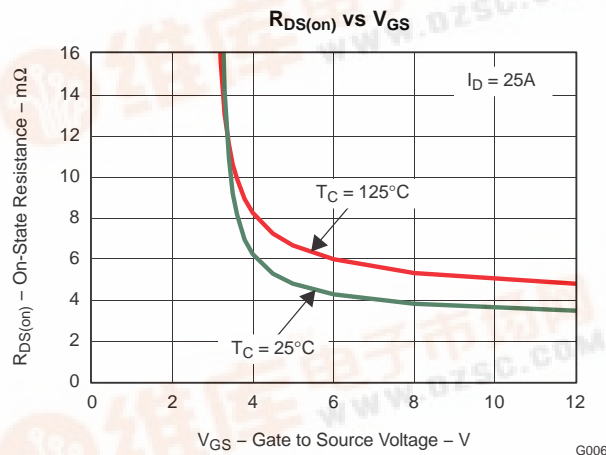
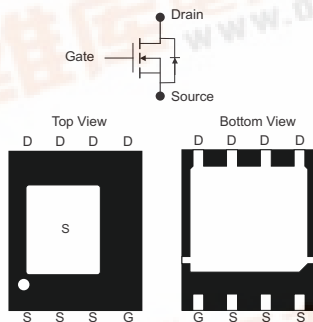
- Ultra Low  $Q_g$  and  $Q_{gd}$
- DualCool™ Package
- Optimized for 2-Sided Cooling
- Low Thermal Resistance
- Avalanche Rated
- Pb Free Terminal Plating
- RoHS Compliant
- Halogen Free
- SON 5-mm x 6-mm Plastic Package

### APPLICATIONS

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

### DESCRIPTION

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



### PRODUCT SUMMARY

$V_{DS}$	Drain to Source Voltage	25	V
$Q_g$	Gate Charge Total (4.5V)	6.7	nC
$Q_{gd}$	Gate Charge Gate to Drain	1.9	nC
$R_{DS(on)}$	Drain to Source On Resistance	$V_{GS} = 4.5V$	5.4 mΩ
		$V_{GS} = 10V$	3.6 mΩ
$V_{GS(th)}$	Threshold Voltage	1.8	V

### ORDERING INFORMATION

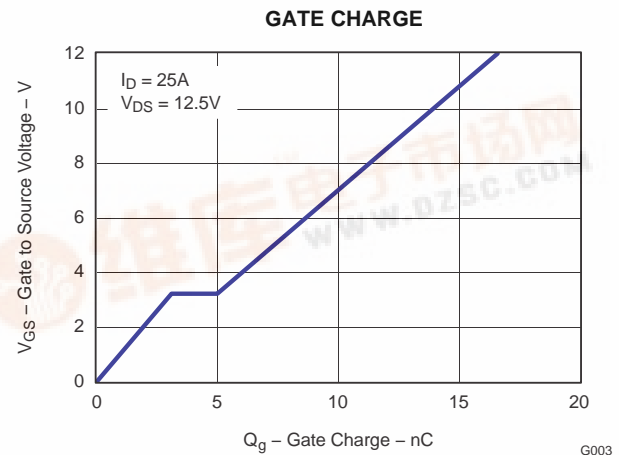
Device	Package	Media	Qty	Ship
CSD16408Q5C	SON 5-mm x 6-mm Plastic Package	13-Inch Reel	2500	Tape and Reel

### ABSOLUTE MAXIMUM RATINGS

$T_A = 25^\circ C$ 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, $T_C = 25^\circ C$	113	A
	Continuous Drain Current <sup>(1)</sup>	22	A
$I_{DM}$	Pulsed Drain Current, $T_A = 25^\circ C$ <sup>(2)</sup>	141	A
$P_D$	Power Dissipation <sup>(1)</sup>	3.1	W
$T_J, T_{STG}$	Operating Junction and Storage Temperature Range	-55 to 150	$^\circ C$
$E_{AS}$	Avalanche Energy, single pulse $I_D = 23A, L = 0.1mH, R_G = 25\Omega$	126	mJ

(1) Typical  $R_{\theta JA} = 41^\circ C/W$  on a 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  $\leq 300\mu s$ , 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	
Static Characteristics							
BV <sub>DSS</sub>	Drain to Source Voltage	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA	25			V	
I <sub>DSS</sub>	Drain to Source Leakage	V <sub>GS</sub> = 0V, V <sub>DS</sub> = 20V	1			μA	
I <sub>GSS</sub>	Gate to Source Leakage	V <sub>DS</sub> = 0V, V <sub>GS</sub> = +16/-12V	100			nA	
V <sub>GS(th)</sub>	Gate to Source Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA	1.4	1.8	2.1	V	
R <sub>DS(on)</sub>	Drain to Source On Resistance	V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 25A	5.4			6.8	mΩ
		V <sub>GS</sub> = 10V, I <sub>D</sub> = 25A	3.6			4.5	mΩ
g <sub>fs</sub>	Transconductance	V <sub>DS</sub> = 15V, I <sub>D</sub> = 25A	60			S	
Dynamic Characteristics							
C <sub>ISS</sub>	Input Capacitance	V <sub>GS</sub> = 0V, V <sub>DS</sub> = 12.5V , f = 1MHz	990			1300	pF
C <sub>OSS</sub>	Output Capacitance		760			1000	pF
C <sub>RSS</sub>	Reverse Transfer Capacitance		75			100	pF
R <sub>g</sub>	Series Gate Resistance		0.8			1.6	Ω
Q <sub>g</sub>	Gate Charge Total (4.5V)	V <sub>DS</sub> = 12.5V, I <sub>D</sub> = 25A	6.7			8.9	nC
Q <sub>gd</sub>	Gate Charge – Gate to Drain		1.9				nC
Q <sub>gs</sub>	Gate Charge – Gate to Source		3.1				nC
Q <sub>g(th)</sub>	Gate Charge at V <sub>th</sub>		1.8				nC
Q <sub>OSS</sub>	Output Charge	V <sub>DS</sub> = 13V, V <sub>GS</sub> = 0V	15.7				nC
t <sub>d(on)</sub>	Turn On Delay Time	V <sub>DS</sub> = 12.5V, V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 25A, R <sub>G</sub> = 2Ω	11.3				ns
t <sub>r</sub>	Rise Time		25				ns
t <sub>d(off)</sub>	Turn Off Delay Time		11				ns
t <sub>f</sub>	Fall Time		10.8				ns
Diode Characteristics							
V <sub>SD</sub>	Diode Forward Voltage	I <sub>S</sub> = 25A, V <sub>GS</sub> = 0V	0.8			1	V
Q <sub>rr</sub>	Reverse Recovery Charge	V <sub>DD</sub> = 13V, I <sub>F</sub> = 25A, di/dt = 300A/μs	17				nC
t <sub>rr</sub>	Reverse Recovery Time	V <sub>DD</sub> = 13V, I <sub>F</sub> = 25A, di/dt = 300A/μs	21				ns

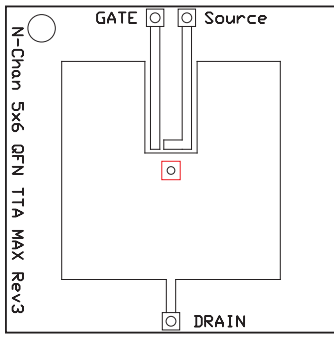
## THERMAL CHARACTERISTICS

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

PARAMETER		MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Thermal Resistance Junction to Case (Top Source) <sup>(1)</sup>			3.1	$^\circ\text{C/W}$
$R_{\theta JC}$	Thermal Resistance Junction to Case (Bottom Drain) <sup>(1)</sup>			1.9	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance Junction to Ambient <sup>(1) (2)</sup>			51	$^\circ\text{C/W}$

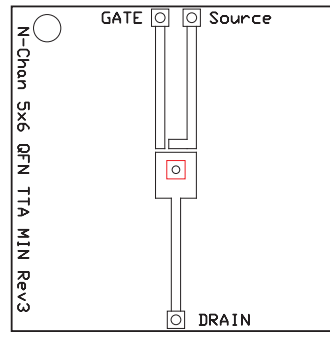
(1)  $R_{\theta JC}$  is determined with the device mounted on a 1-inch<sup>2</sup> (6.45-cm<sup>2</sup>), 2-oz. (0.071-mm thick) Cu pad on a 1.5-inch × 1.5-inch (3.81-cm × 3.81-cm), 0.06-inch (1.52-mm) thick FR4 PCB.  $R_{\theta JC}$  is specified by design, whereas  $R_{\theta JA}$  is determined by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



M0137-01

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.

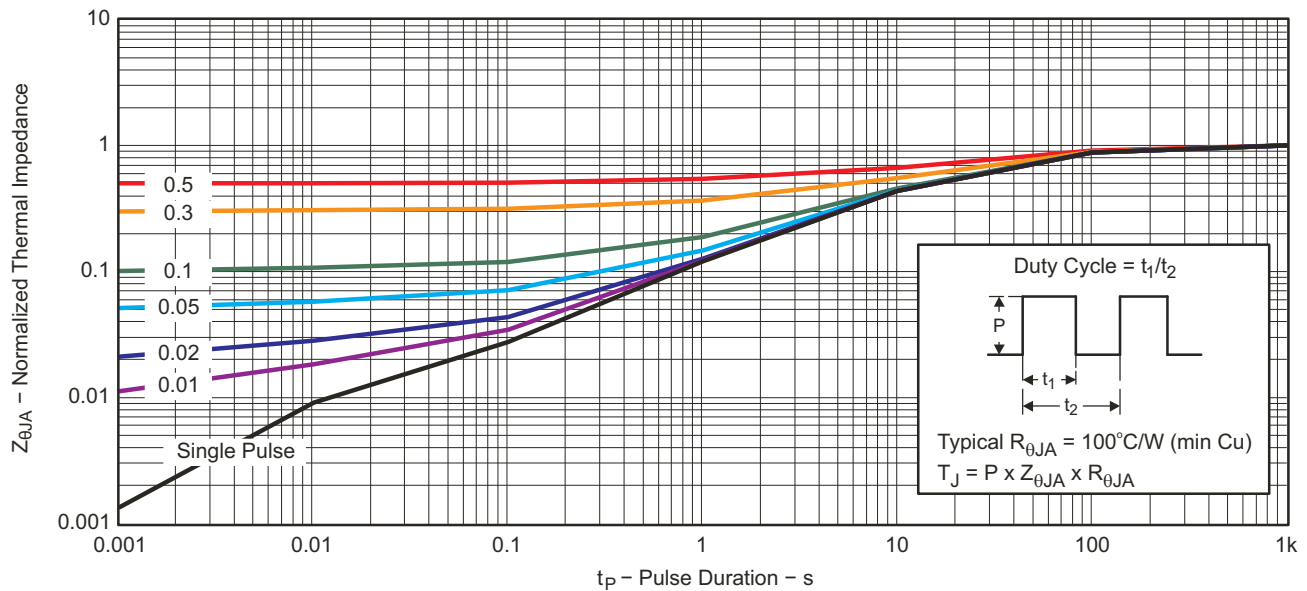


M0137-02

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



G012

Figure 1. Transient Thermal Impedance

## TYPICAL MOSFET CHARACTERISTICS (continued)

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

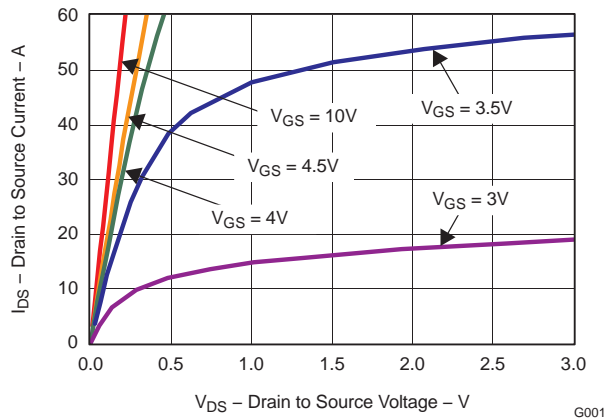


Figure 2. Saturation Characteristics

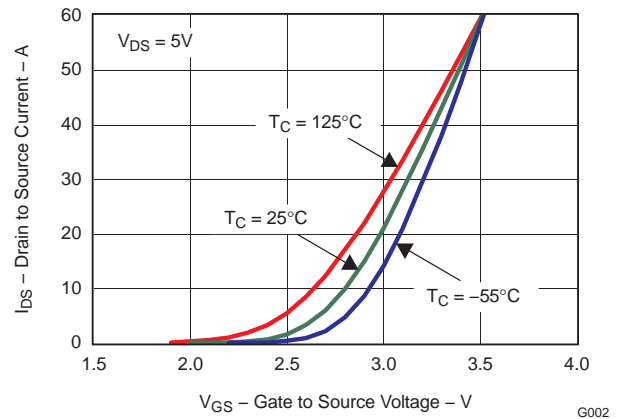


Figure 3. Transfer Characteristics

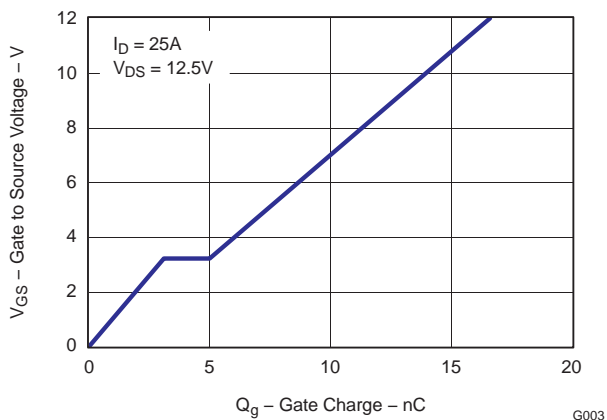


Figure 4. Gate Charge

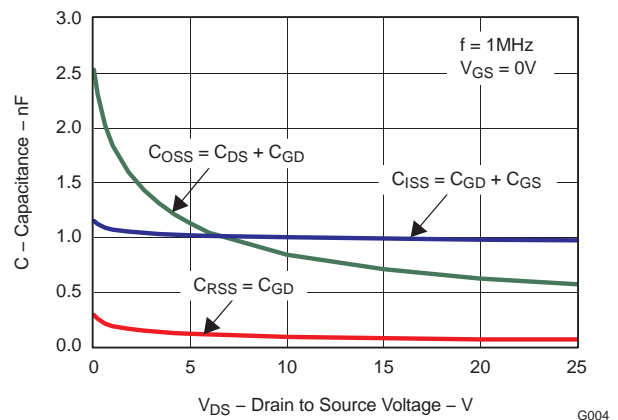


Figure 5. Capacitance

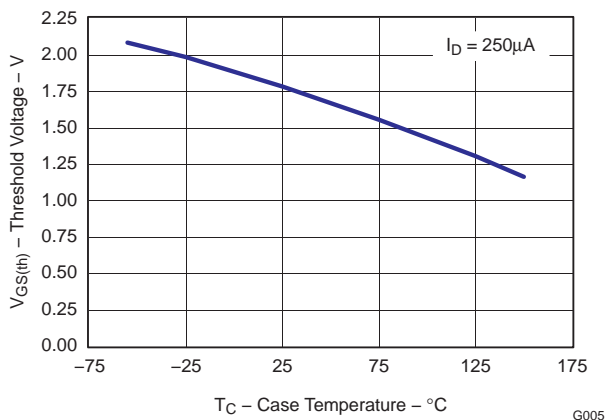


Figure 6. Threshold Voltage vs. Temperature

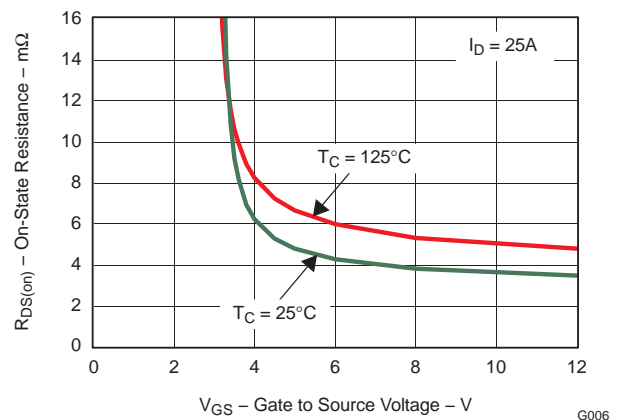


Figure 7. On-State Resistance vs. Gate to Source Voltage

## TYPICAL MOSFET CHARACTERISTICS (continued)

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

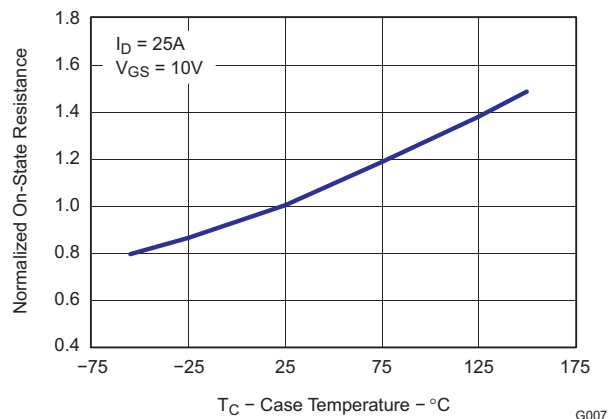


Figure 8. Normalized On-State Resistance vs. Temperature

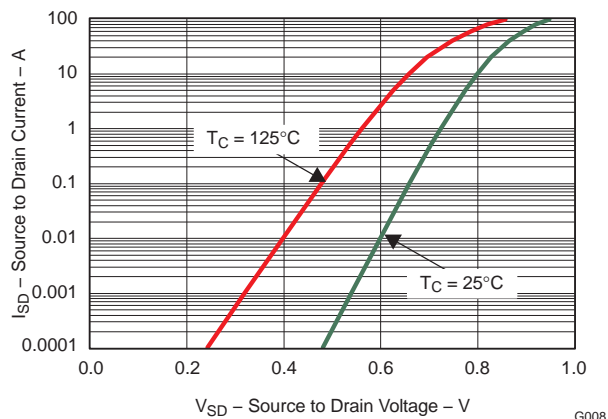


Figure 9. Typical Diode Forward Voltage

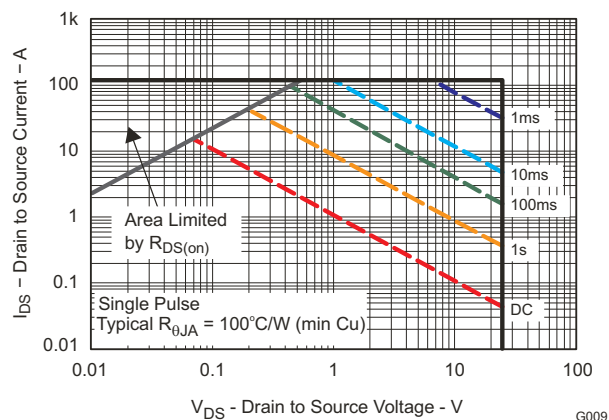


Figure 10. Maximum Safe Operating Area

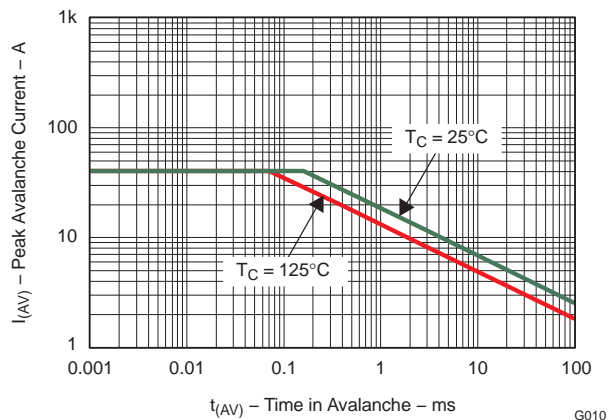


Figure 11. Single Pulse Unclamped Inductive Switching

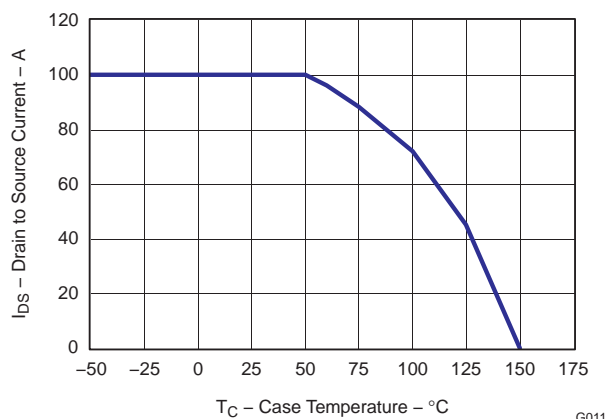
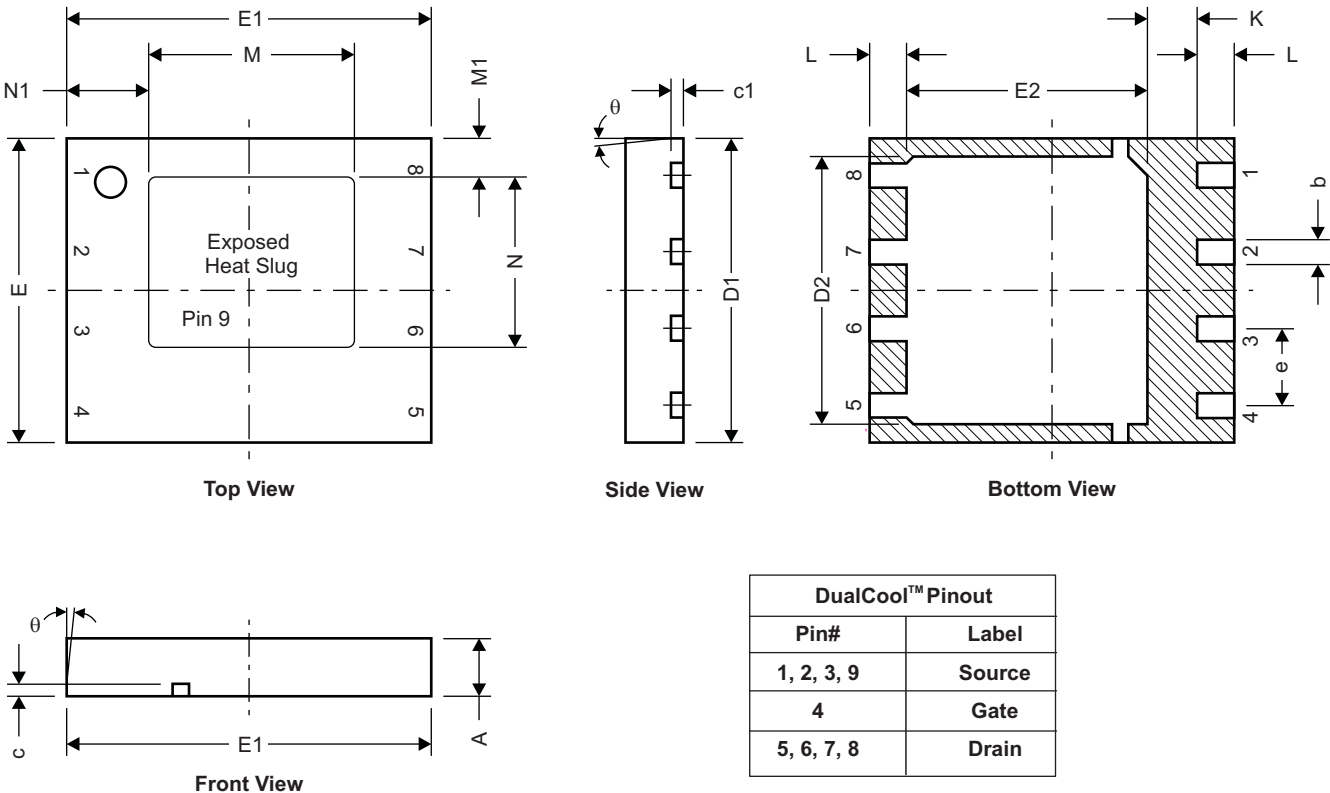


Figure 12. Maximum Drain Current vs. Temperature

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**MECHANICAL DATA**

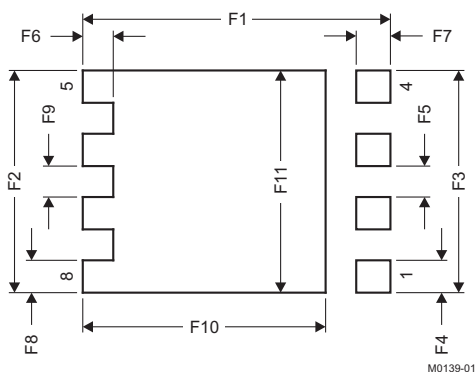
**Q5C Package Dimensions**



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	
K	0.760	–	0.030	–
L	0.510	0.710	0.020	0.028
θ	–	–	–	–
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

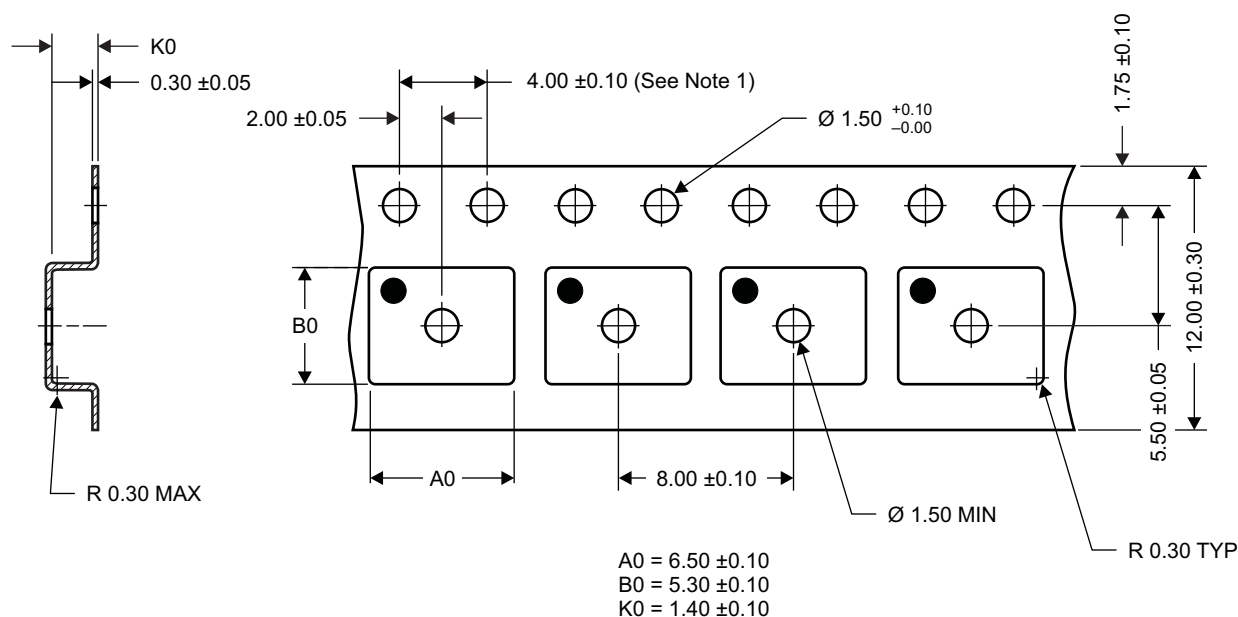
### Recommended PCB Pattern



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 *Reducing Ringing Through PCB Layout Techniques* (SLPA005).

### Q5 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

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REVISION HISTORY

Changes from Original (December 2009) to Revision A	Page
<ul style="list-style-type: none"><li>Changed the labels on the Bottom View pinout image .....</li></ul>	<a href="#">1</a>
Changes from Revision A (February) to Revision B	Page
<ul style="list-style-type: none"><li>the Package Marking Information section .....</li></ul>	<a href="#">7</a>





PACKAG

## PACKAGING INFORMATION

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/ Ball Finish	MSL Pea
CSD16408Q5C	ACTIVE	SON	DQU	8	2500	Pb-Free (RoHS Exempt)	Call TI	Level-1-2600

<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> for more 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 RoHS compliant products except that lead may 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 high temperature applications.

**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 attach 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 (RoHS). This Green label adorns TI parts that are RoHS compliant, free of Bromine (Br) and Antimony (Sb) based flame retardants (RoHS), and have no Pb, Br, or Sb in homogeneous material (above design limit).

<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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Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>	Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>	Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>	Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>	Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>	Energy	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>	Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>	Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
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RF/IF and ZigBee® Solutions	<a href="http://www.ti.com/lprf">www.ti.com/lprf</a>	Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>
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