

## N-Channel NexFET™ Power MOSFETs

Check for Samples: [CSD16325Q5](#)

### FEATURES

- Optimized for 5V Gate Drive
- Ultralow  $Q_g$  and  $Q_{gd}$
- Low Thermal Resistance
- Avalanche Rated
- Pb Free Terminal Plating
- RoHS Compliant
- Halogen Free
- SON 5-mm × 6-mm Plastic Package

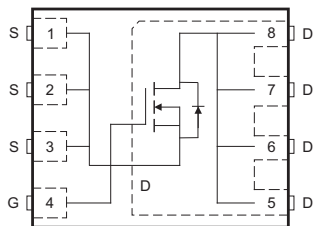
### APPLICATIONS

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

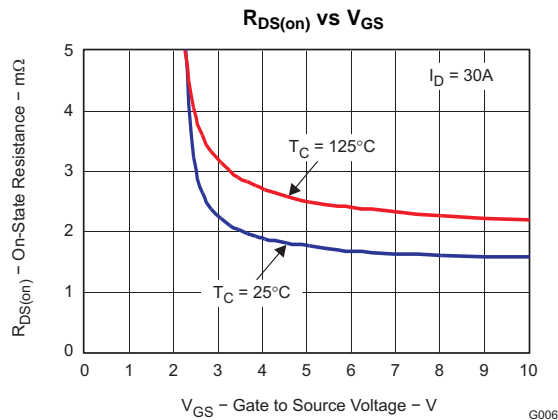
### DESCRIPTION

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

Top View



P0094-01



### PRODUCT SUMMARY

$V_{DS}$	Drain to Source Voltage	25	V
$Q_g$	Gate Charge Total (4.5V)	18	nC
$Q_{gd}$	Gate Charge Gate to Drain	3.5	nC
$R_{DS(on)}$	Drain to Source On Resistance	$V_{GS} = 3V$	2.1 mΩ
		$V_{GS} = 4.5V$	1.7 mΩ
		$V_{GS} = 8V$	1.5 mΩ
$V_{GS(th)}$	Threshold Voltage	1.1	V

### ORDERING INFORMATION

Device	Package	Media	Qty	Ship
CSD16325Q5	SON 5-mm × 6-mm Plastic Package	13-Inch Reel	2500	Tape and Reel

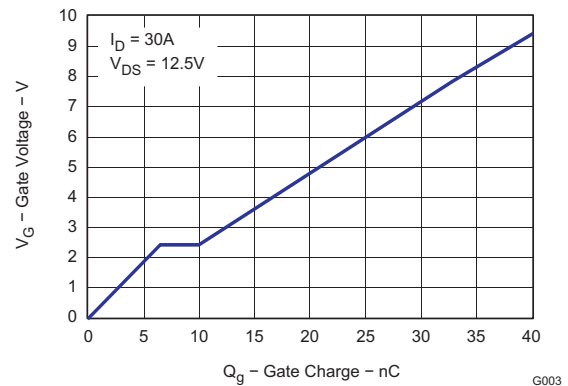
### ABSOLUTE MAXIMUM RATINGS

$T_A = 25^\circ C$ unless otherwise stated		VALUE	UNIT
$V_{DS}$	Drain to Source Voltage	25	V
$V_{GS}$	Gate to Source Voltage	+10 / -8	V
$I_D$	Continuous Drain Current, $T_C = 25^\circ C$	100	A
	Continuous Drain Current <sup>(1)</sup>	33	A
$I_{DM}$	Pulsed Drain Current, $T_A = 25^\circ C$ <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	$^\circ C$
$E_{AS}$	Avalanche Energy, single pulse $I_D = 100A$ , $L = 0.1mH$ , $R_G = 25\Omega$	500	mJ

(1) Typical  $R_{\theta JA} = 38^\circ C/W$  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  $\leq 300\mu s$ , duty cycle  $\leq 2\%$

Gate Charge



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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<sub>A</sub> = 25°C unless otherwise stated)

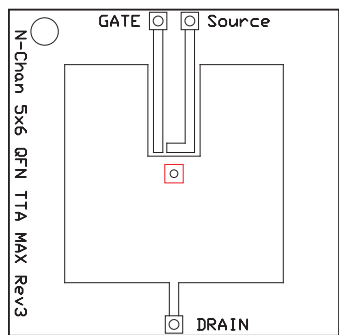
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
Static Characteristics						
B <sub>V</sub> DSS	Drain to Source Voltage	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA	25			V
I <sub>DSS</sub>	Drain to Source Leakage Current	V <sub>GS</sub> = 0V, V <sub>DS</sub> = 20V	1			μA
I <sub>GSS</sub>	Gate to Source Leakage Current	V <sub>DS</sub> = 0V, V <sub>GS</sub> = +10/−8V	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	0.9	1.1	1.4	V
R <sub>DS(on)</sub>	Drain to Source On Resistance	V <sub>GS</sub> = 3V, I <sub>D</sub> = 30A	2.1		2.9	mΩ
		V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 30A	1.7		2.2	mΩ
		V <sub>GS</sub> = 8V, I <sub>D</sub> = 30A	1.5		2	mΩ
g <sub>fs</sub>	Transconductance	V <sub>DS</sub> = 15V, I <sub>D</sub> = 30A	159			S
Dynamic Characteristics						
C <sub>iss</sub>	Input Capacitance	V <sub>GS</sub> = 0V, V <sub>DS</sub> = 12.5V, f = 1MHz	3070		4000	pF
C <sub>oss</sub>	Output Capacitance		2190		2850	pF
C <sub>rss</sub>	Reverse Transfer Capacitance		120		150	pF
R <sub>G</sub>	Series Gate Resistance		1.6		3.2	Ω
Q <sub>g</sub>	Gate Charge Total (4.5V)	V <sub>DS</sub> = 12.5V, I <sub>DS</sub> = 30A	18		25	nC
Q <sub>gd</sub>	Gate Charge – Gate to Drain		3.5			nC
Q <sub>gs</sub>	Gate Charge – Gate to Source		6.6			nC
Q <sub>g(th)</sub>	Gate Charge at V <sub>th</sub>		3.3			nC
Q <sub>oss</sub>	Output Charge	V <sub>DS</sub> = 13V, V <sub>GS</sub> = 0V	43			nC
t <sub>d(on)</sub>	Turn On Delay Time	V <sub>DS</sub> = 12.5V, V <sub>GS</sub> = 4.5V, I <sub>DS</sub> = 30A, R <sub>G</sub> =2Ω	10.5			ns
t <sub>r</sub>	Rise Time		16			ns
t <sub>d(off)</sub>	Turn Off Delay Time		32			ns
t <sub>f</sub>	Fall Time		12			ns
Diode Characteristics						
V <sub>SD</sub>	Diode Forward Voltage	I <sub>DS</sub> = 30A, V <sub>GS</sub> = 0V	0.8		1	V
Q <sub>rr</sub>	Reverse Recovery Charge	V <sub>DD</sub> = 10V, I <sub>F</sub> = 30A, di/dt = 300A/μs	63			nC
t <sub>rr</sub>	Reverse Recovery Time	V <sub>DD</sub> = 10V, I <sub>F</sub> = 30A, di/dt = 300A/μs	47			ns

## THERMAL CHARACTERISTICS

(T<sub>A</sub> = 25°C unless otherwise stated)

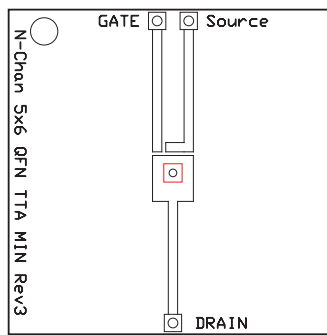
PARAMETER		MIN	TYP	MAX	UNIT
R <sub>θJC</sub>	Thermal Resistance Junction to Case <sup>(1)</sup>			1	°C/W
R <sub>θJA</sub>	Thermal Resistance Junction to Ambient <sup>(1) (2)</sup>			50	°C/W

- (1) R<sub>θJC</sub> 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<sub>θJC</sub> is specified by design, whereas R<sub>θJA</sub> 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  $R_{\theta JA} = 50^{\circ}\text{C/W}$   
when mounted on  
1 inch<sup>2</sup> (6.45 cm<sup>2</sup>) of  
2-oz. (0.071-mm thick)  
Cu.

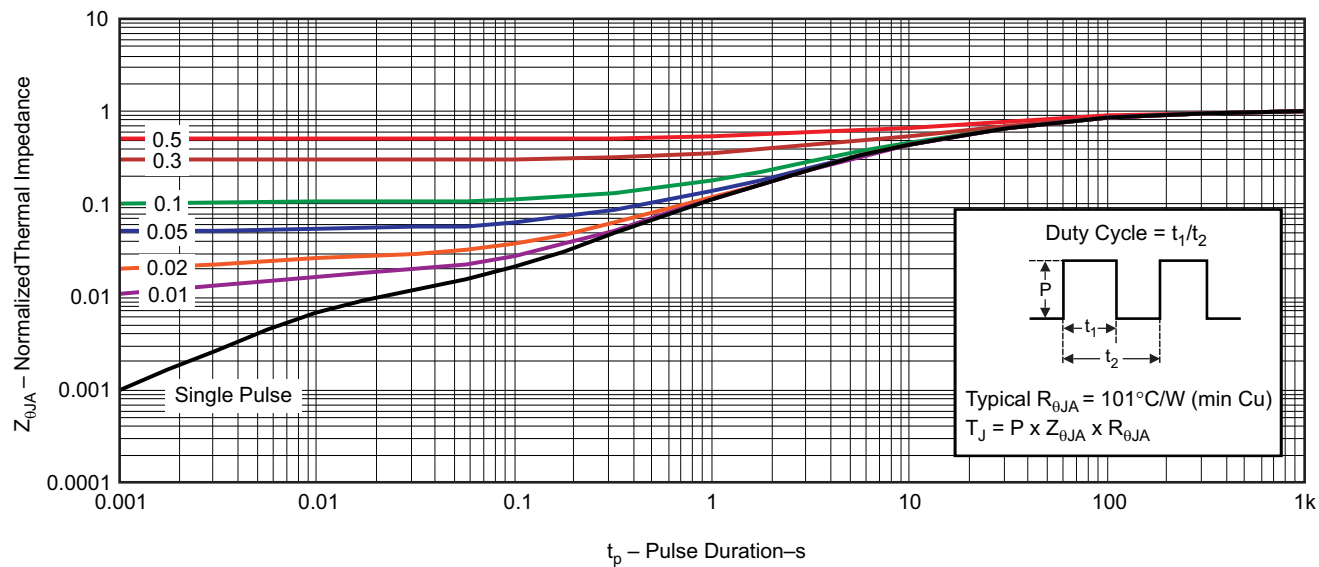


M0137-02

Max  $R_{\theta JA} = 126^{\circ}\text{C/W}$   
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)

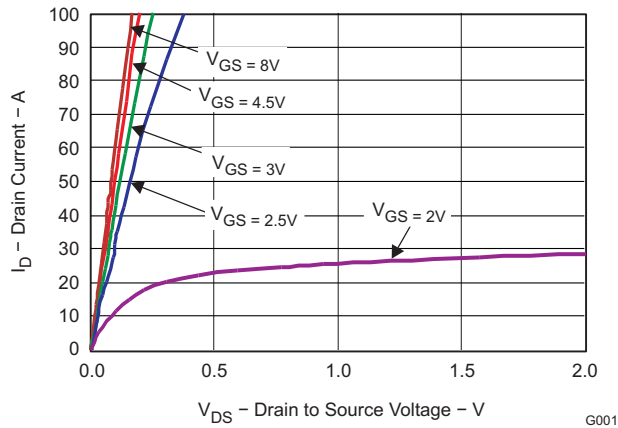


Figure 2. Saturation Characteristics

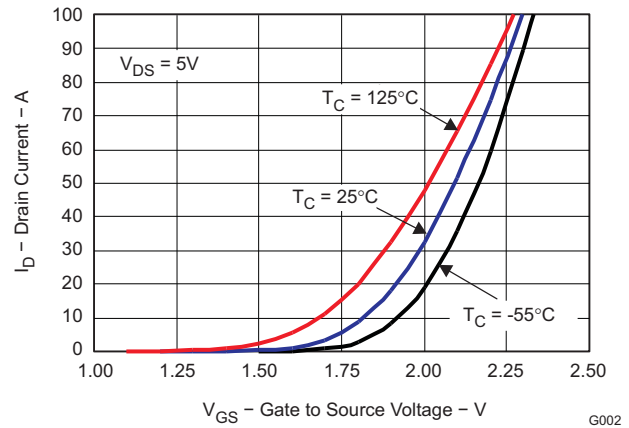


Figure 3. Transfer Characteristics

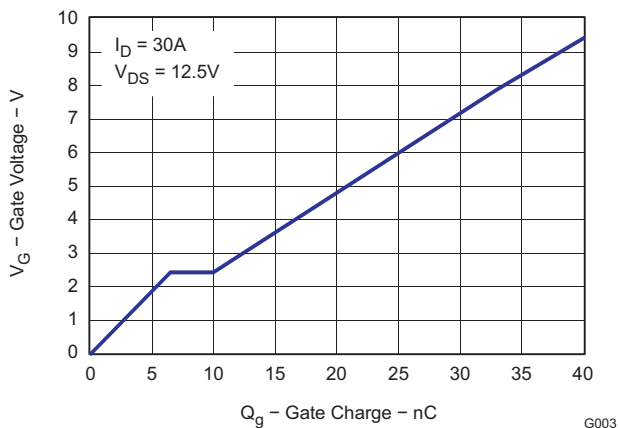


Figure 4. Gate Charge

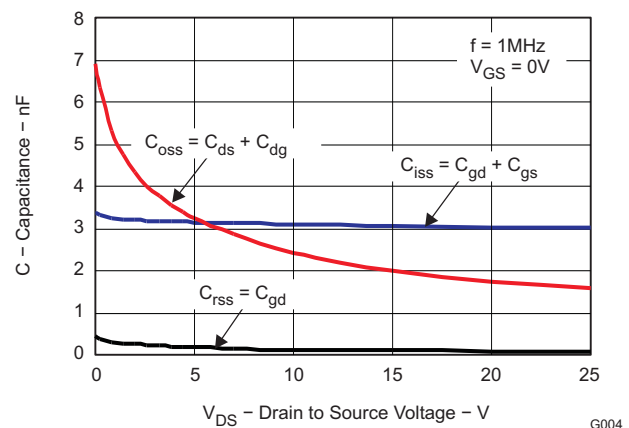


Figure 5. Capacitance

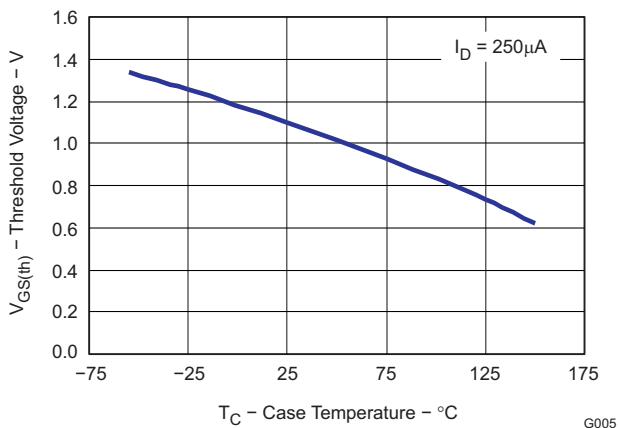


Figure 6. Threshold Voltage vs. Temperature

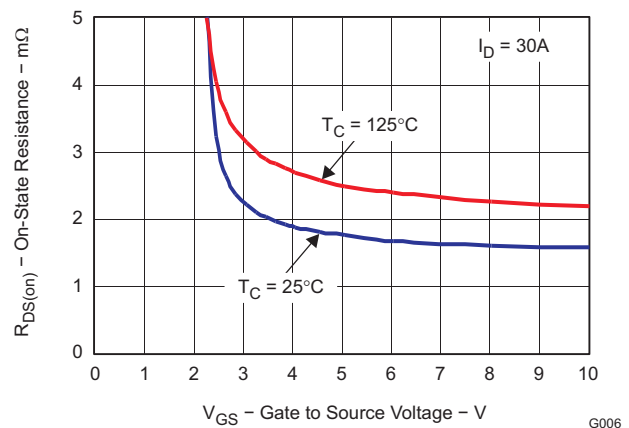
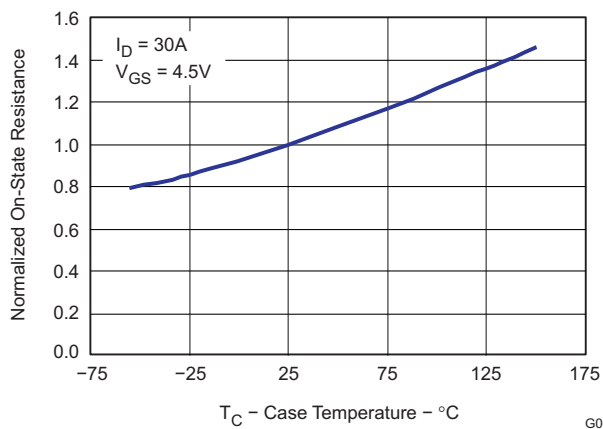


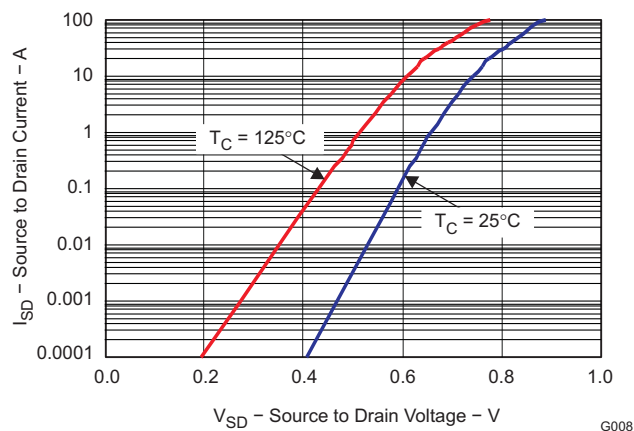
Figure 7. On-State Resistance vs. Gate to Source Voltage

## TYPICAL MOSFET CHARACTERISTICS (continued)

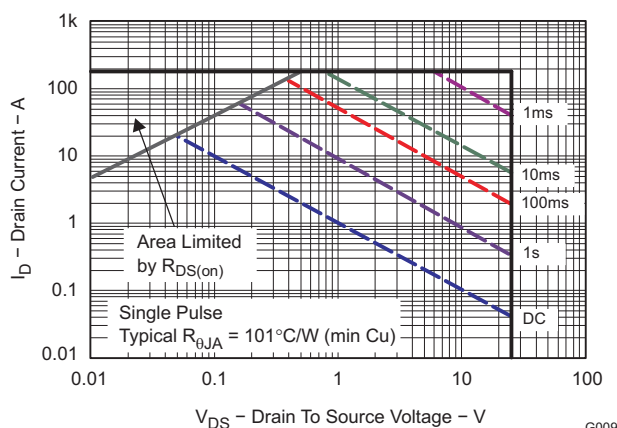
( $T_A = 25^\circ\text{C}$  unless otherwise stated)



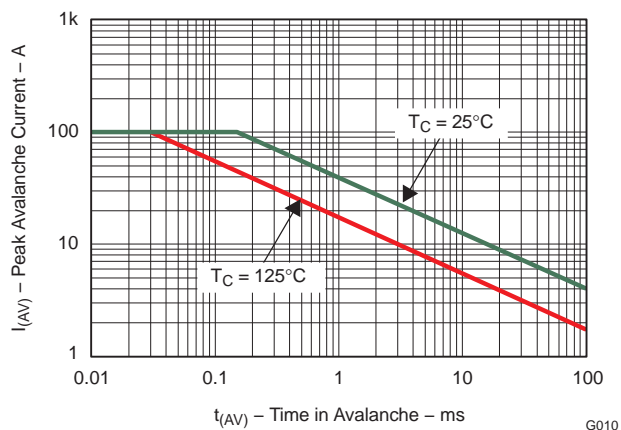
**Figure 8. Normalized On-State Resistance vs. Temperature**



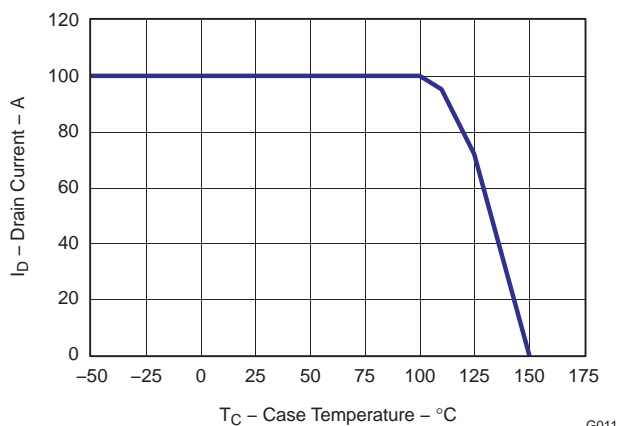
**Figure 9. Typical Diode Forward Voltage**



**Figure 10. Maximum Safe Operating Area**



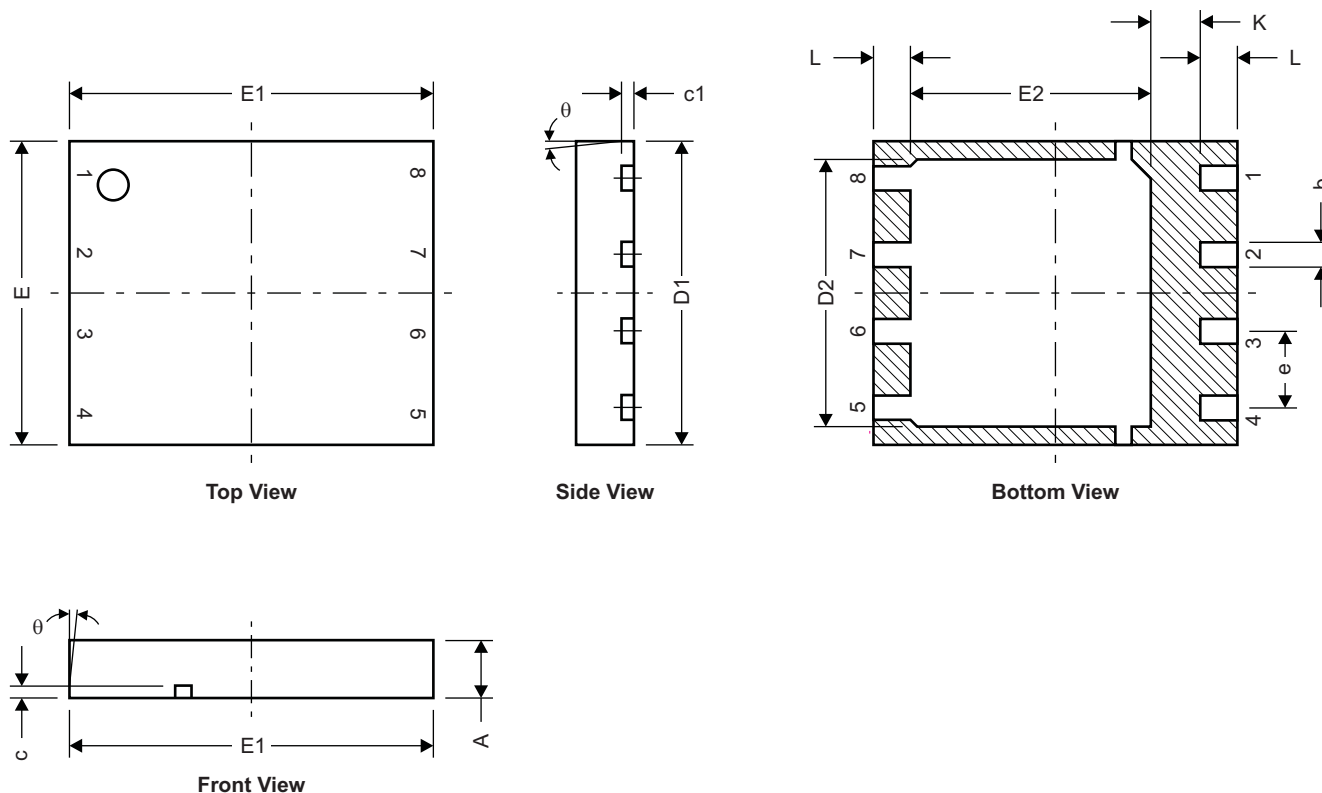
**Figure 11. Single Pulse Unclamped Inductive Switching**



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

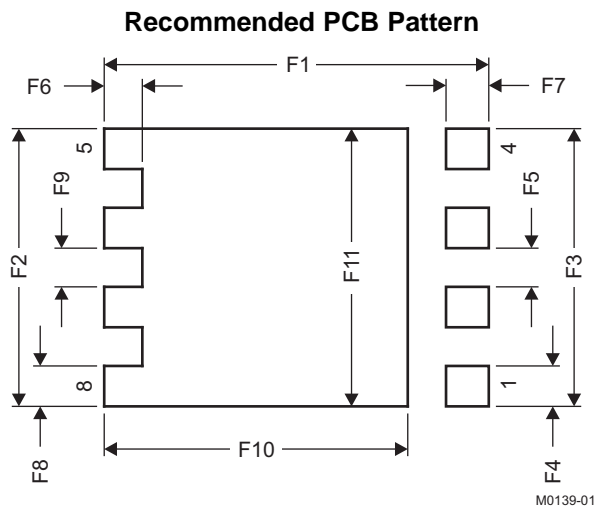
## MECHANICAL DATA

### Q5 Package Dimensions



M0140-01

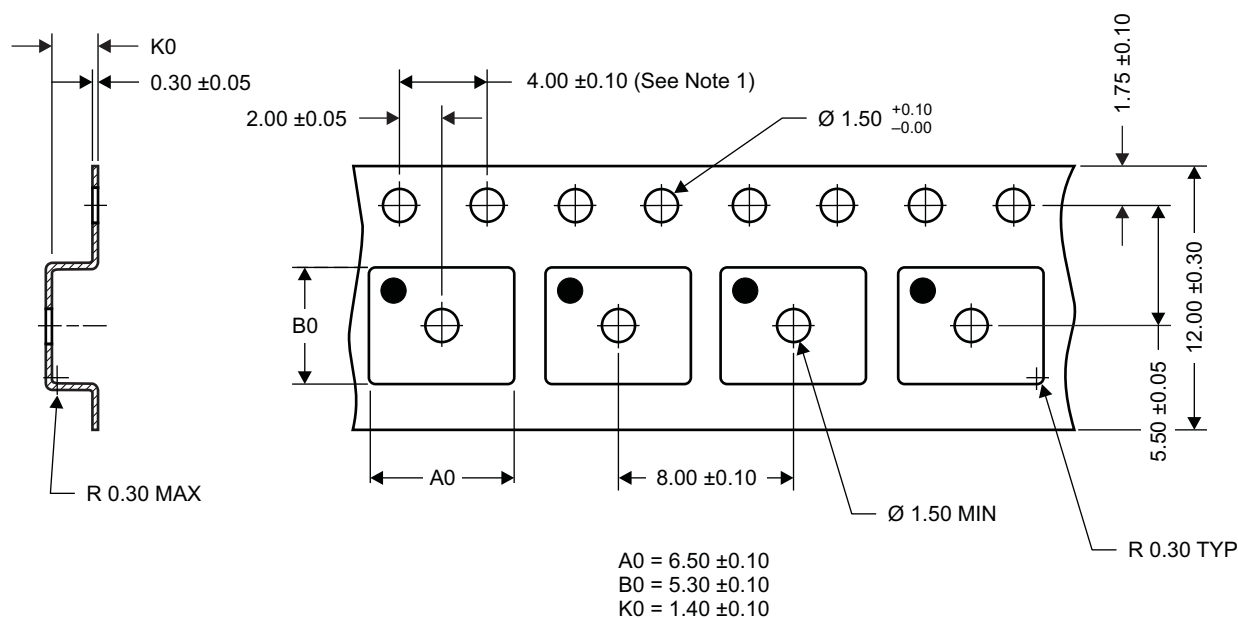
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	0.950	1.050	0.037	0.039
b	0.360	0.460	0.014	0.018
c	0.150	0.250	0.006	0.010
c1	0.150	0.250	0.006	0.010
D1	4.900	5.100	0.193	0.201
D2	4.320	4.520	0.170	0.178
E	4.900	5.100	0.193	0.201
E1	5.900	6.100	0.232	0.240
E2	3.920	4.12	0.154	0.162
e	1.27 TYP		0.050	
L	0.510	0.710	0.020	0.028
$\theta$	0.00			



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*.

## Q5 Tape and Reel Information



### Notes:

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

## REVISION HISTORY

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

Page

- Changed  $Q_{rr}$  Reverse Recovery Charge typical value From: 102nC To: 63nC ..... 2

### Changes from Revision A (September 2009) to Revision B

Page

- Changed Note 1 of the ABSOLUTE MAXIMUM RATINGS From:  $R_{\theta JA} = 38^{\circ}\text{C/W}$  To: Typical  $R_{\theta JA} = 38^{\circ}\text{C/W}$  ..... 1
- Changed  $I_{DM}$  Pulsed Drain Current in the ABSOLUTE MAXIMUM RATINGS From: 210A To: 200A ..... 1
- Changed From: Max  $R_{\theta JA} = 48^{\circ}\text{C/W}$  To: Max  $R_{\theta JA} = 50^{\circ}\text{C/W}$  ..... 3
- Changed From: Max  $R_{\theta JA} = 113^{\circ}\text{C/W}$  To: Max  $R_{\theta JA} = 126^{\circ}\text{C/W}$  ..... 3
- Changed Figure 1 text - From:  $R_{\theta JA} = 101^{\circ}\text{C/W}$  To: Typical  $R_{\theta JA} = 101^{\circ}\text{C/W}$  ..... 3
- Changed Figure 10 text - From:  $R_{\theta JA} = 101^{\circ}\text{C/W}$  To: Typical  $R_{\theta JA} = 101^{\circ}\text{C/W}$  ..... 5

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

Page

- Changed  $R_{DS(on)} - V_{GS} = 3\text{V}$  in the Electrical Characteristics table From: 2.7 to 2.9 in the max column ..... 2
- 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>
CSD16325Q5	ACTIVE	SON	DQH	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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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

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
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	<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>
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Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics & Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
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