

## N-Channel NexFET™ Power MOSFETs

Check for Samples: [CSD16407Q5](#)

### FEATURES

- Ultralow  $Q_g$  and  $Q_{gd}$
- Low Thermal Resistance
- Avalanche Rated
- SON 5-mm × 6-mm Plastic Package

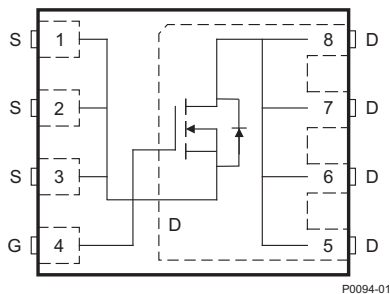
### APPLICATIONS

- 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.

Top View



### PRODUCT SUMMARY

V <sub>DS</sub>	Drain-to-source voltage	25		V
Q <sub>g</sub>	Gate charge, total (4.5 V)	13.3		nC
Q <sub>gd</sub>	Gate charge, gate-to-drain	3.5		nC
R <sub>DS(on)</sub>	Drain-to-source on-resistance	V <sub>GS</sub> = 4.5 V	2.5	mΩ
		V <sub>GS</sub> = 10 V	1.8	mΩ
V <sub>GS(th)</sub>	Threshold voltage	1.6		V

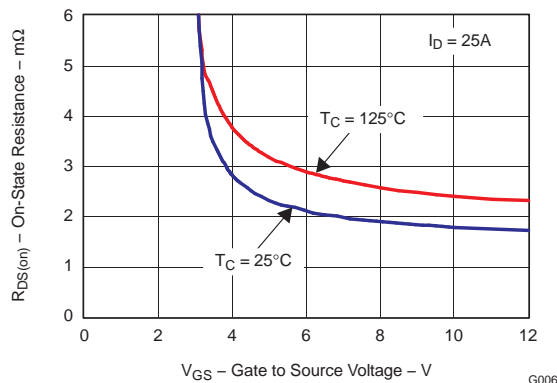
### ORDERING INFORMATION

Device	Package	Media	Qty	Ship
CSD16407Q5	SON 5 × 6 plastic package	13-inch reel	2500	Tape and reel

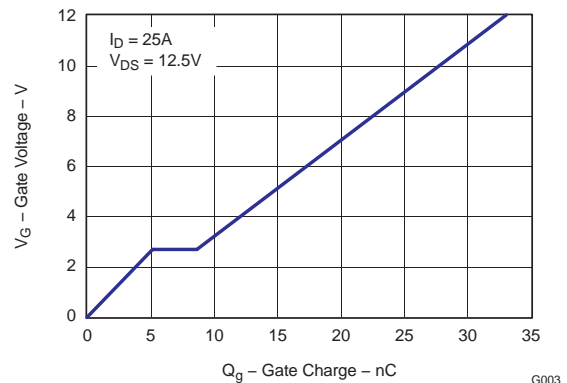
### ABSOLUTE MAXIMUM RATINGS

$T_A = 25^\circ\text{C}$ 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	°C
$E_{AS}$	Avalanche energy, single pulse $I_D = 66\text{ A}$ , $L = 0.1\text{ mH}$ , $R_G = 25\text{ }\Omega$	218	mJ

- (1)  $R_{\theta JA} = 40^\circ\text{C/W}$  on 1 in<sup>2</sup> (6.45 cm<sup>2</sup>) Cu [2 oz. (0.071 mm thick)] on 0.060-inch (1.52-mm) thick FR4 PCB.  
(2) Pulse duration  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$

 $r_{DS(on)}$  vs  $V_{GS}$ 


Gate Charge



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of the Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

## ELECTRICAL CHARACTERISTICS

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

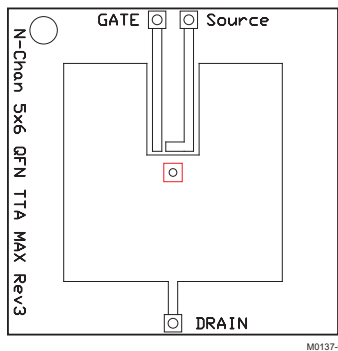
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
Static Characteristics						
BV <sub>DSS</sub>	Drain-to-source voltage	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	25			V
I <sub>DSS</sub>	Drain-to-source leakage current	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 20 V	1			μA
I <sub>GSS</sub>	Gate-to-source leakage current	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = 16 V to −12 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	1.3	1.6	1.9	V
r <sub>DS(on)</sub>	Drain-to-source on-resistance	V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 25 A	2.5		3.3	mΩ
		V <sub>GS</sub> = 10 V, I <sub>D</sub> = 25 A	1.8		2.4	mΩ
g <sub>fs</sub>	Transconductance	V <sub>DS</sub> = 15 V, I <sub>D</sub> = 25 A	111			S
Dynamic Characteristics						
C <sub>ISS</sub>	Input capacitance	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 12.5 V, f = 1 MHz	2040		2660	pF
C <sub>OSS</sub>	Output capacitance		1600		2080	pF
C <sub>RSS</sub>	Reverse transfer capacitance		115		160	pF
R <sub>g</sub>	Series gate resistance	V <sub>DS</sub> = 12.5 V, I <sub>D</sub> = 25 A	1.2		2.4	Ω
Q <sub>g</sub>	Gate charge total (4.5 V)		13.3		18	nC
Q <sub>gd</sub>	Gate charge, gate-to-drain		3.5			nC
Q <sub>gs</sub>	Gate charge, gate-to-source		5.3			nC
Q <sub>g(th)</sub>	Gate charge at V <sub>th</sub>		3.1			nC
Q <sub>OSS</sub>	Output charge	V <sub>DS</sub> = 13.5 V, V <sub>GS</sub> = 0 V	33			nC
t <sub>d(on)</sub>	Turnon delay time	V <sub>DS</sub> = 12.5 V, V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 25 A R <sub>G</sub> = 2 Ω	11.9			ns
t <sub>r</sub>	Rise time		18.4			ns
t <sub>d(off)</sub>	Turnoff delay time		16			ns
t <sub>f</sub>	Fall time		9			ns
Diode Characteristics						
V <sub>SD</sub>	Diode forward voltage	I <sub>S</sub> = 25 A, V <sub>GS</sub> = 0 V	0.8		1	V
Q <sub>rr</sub>	Reverse recovery charge	V <sub>DD</sub> = 13.5 V, I <sub>F</sub> = 25 A, di/dt = 300 A/μs	41			nC
t <sub>rr</sub>	Reverse recovery time	V <sub>DD</sub> = 13.5 V, I <sub>F</sub> = 25 A, di/dt = 300 A/μs	34			ns

## THERMAL CHARACTERISTICS

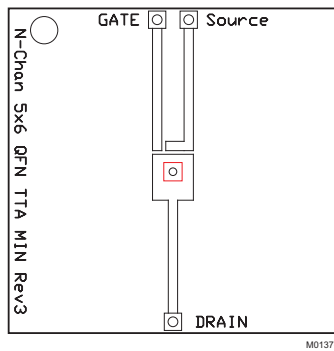
(T<sub>A</sub> = 25°C unless otherwise stated)

PARAMETER		MIN	TYP	MAX	UNIT
R <sub>θJC</sub>	Thermal resistance, junction-to-case <sup>(1)</sup>			1.1	°C/W
R <sub>θJA</sub>	Thermal resistance, junction-to-ambient <sup>(1) (2)</sup>			51	°C/W

- (1) R<sub>θJC</sub> is determined with the device mounted on a 1-inch (2.54-cm) square 2-oz (0.071-mm thick) Cu pad on a 1.5-inch (3.81-cm) × 1.5-inch (3.81-cm) × 0.060-inch (1.52-mm) thick FR4 board. 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>) of 2-oz. (0.071-mm thick) Cu.



Max  $R_{\theta JA} = 50^{\circ}\text{C/W}$   
when mounted on 1  
 $\text{inch}^2$  ( $6.45 \text{ cm}^2$ ) of  
2-oz. (0.071-mm thick)  
Cu.



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 stated)

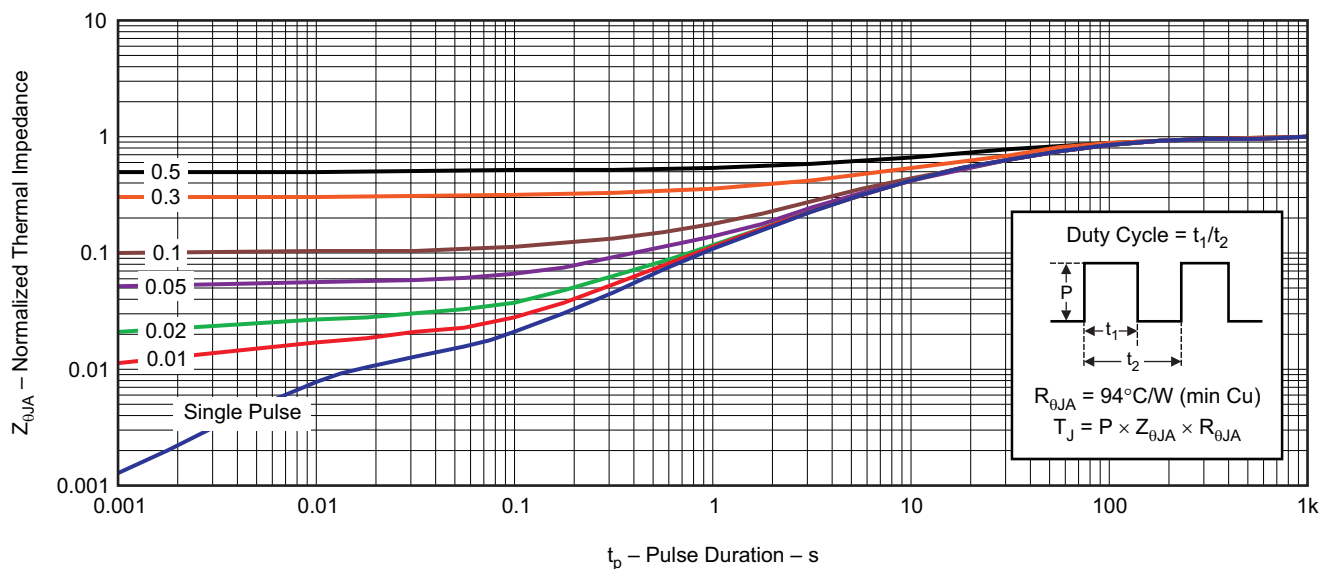


Figure 1. Transient Thermal Impedance

G012

## TYPICAL MOSFET CHARACTERISTICS (continued)

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

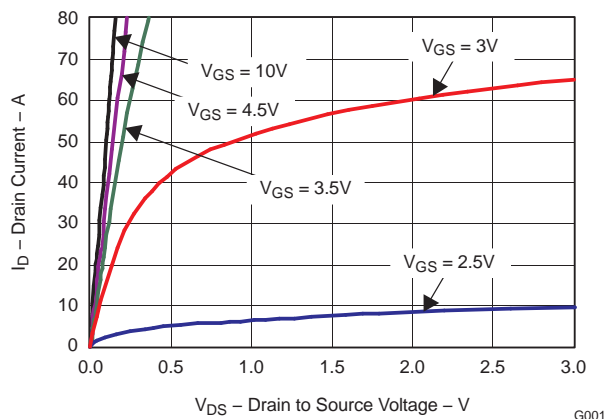


Figure 2. Saturation Characteristics

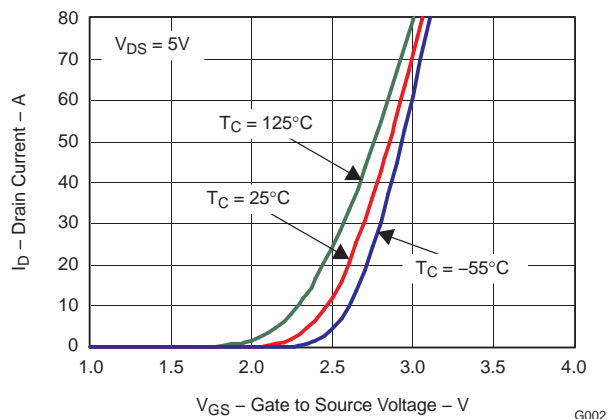


Figure 3. Transfer Characteristics

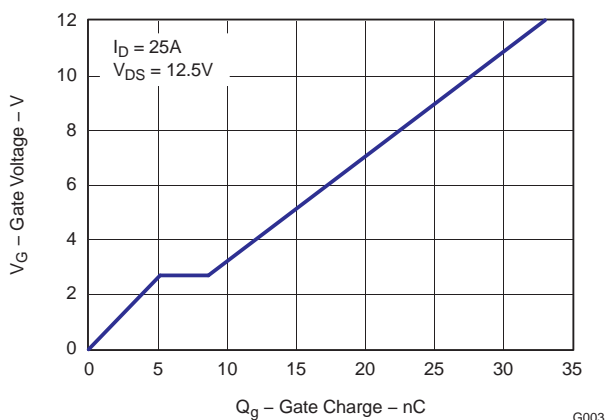


Figure 4. Gate Charge

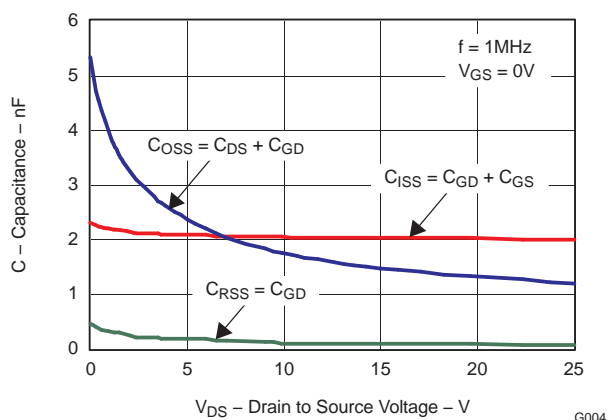


Figure 5. Capacitance

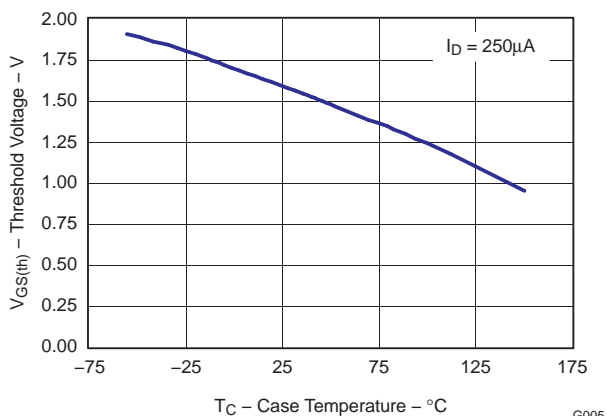


Figure 6. Threshold Voltage vs. Temperature

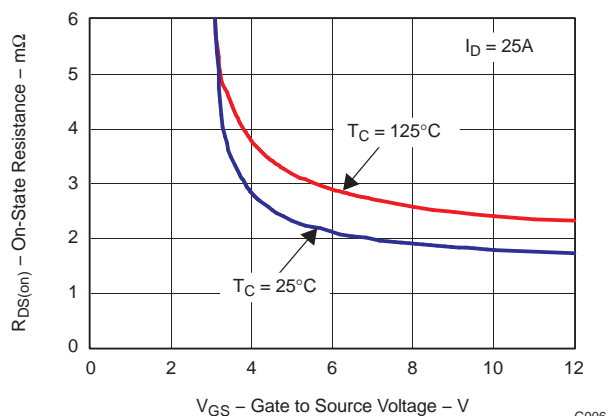
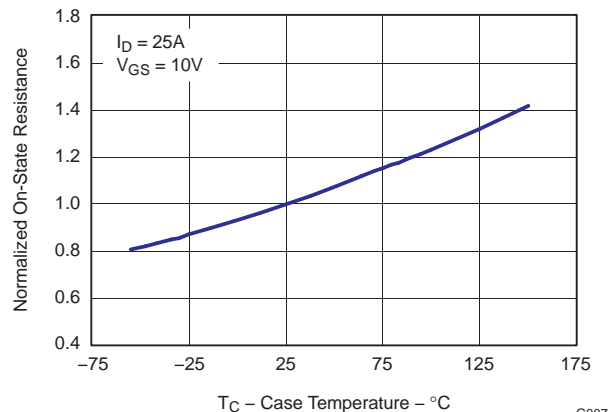


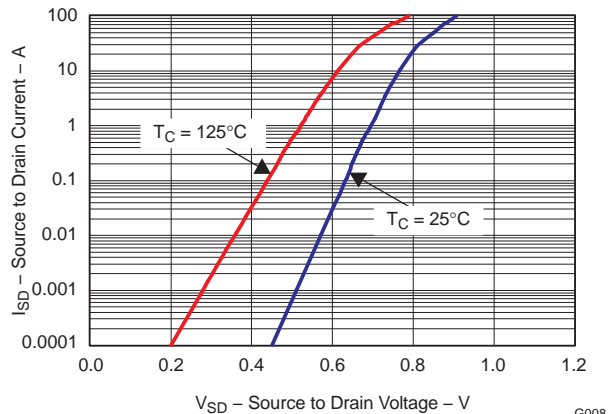
Figure 7. On Resistance vs. Gate Voltage

## TYPICAL MOSFET CHARACTERISTICS (continued)

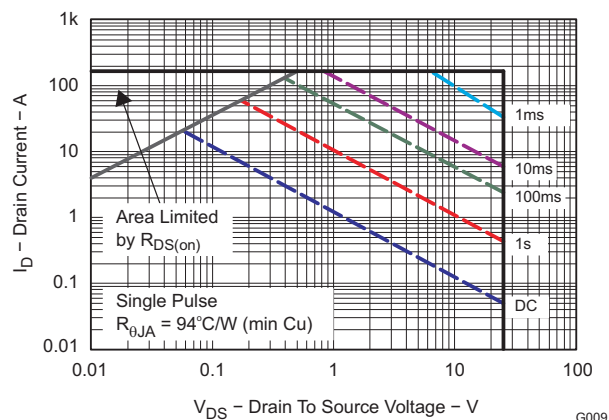
( $T_A = 25^\circ\text{C}$  unless otherwise stated)



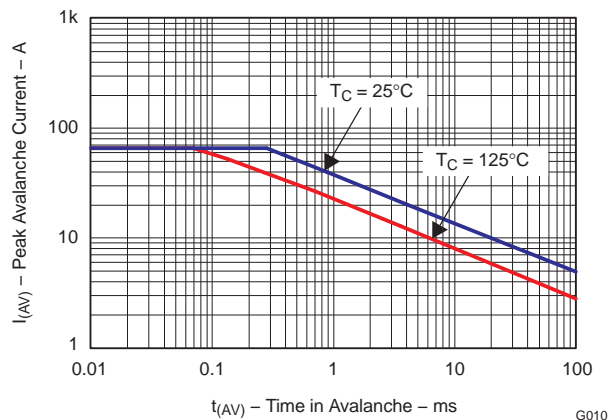
**Figure 8. On Resistance vs. Temperature**



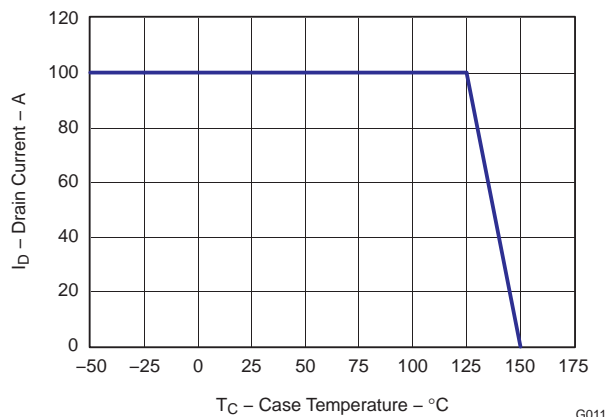
**Figure 9. Typical Diode Forward Voltage**



**Figure 10. Maximum Safe Operating Area**



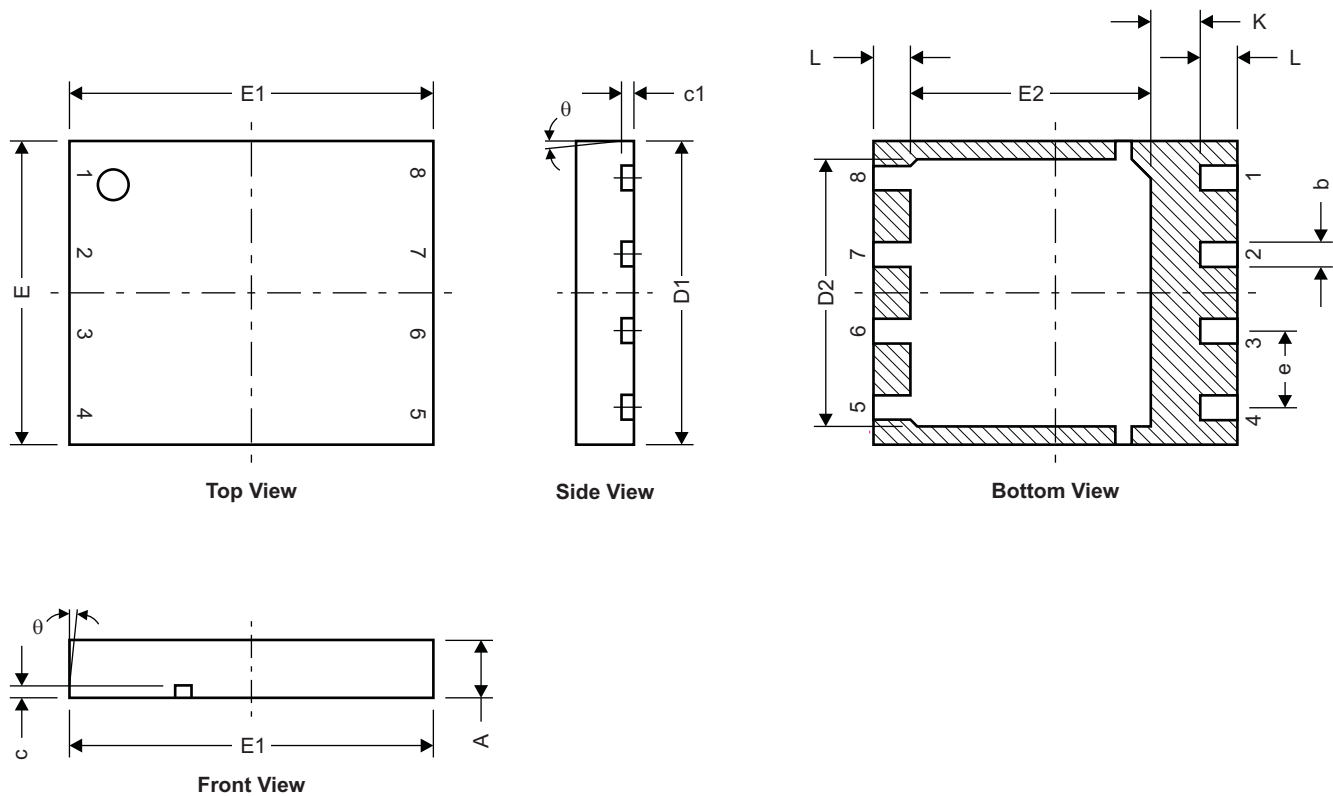
**Figure 11. Single Pulse Unclamped Inductive Switching**



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

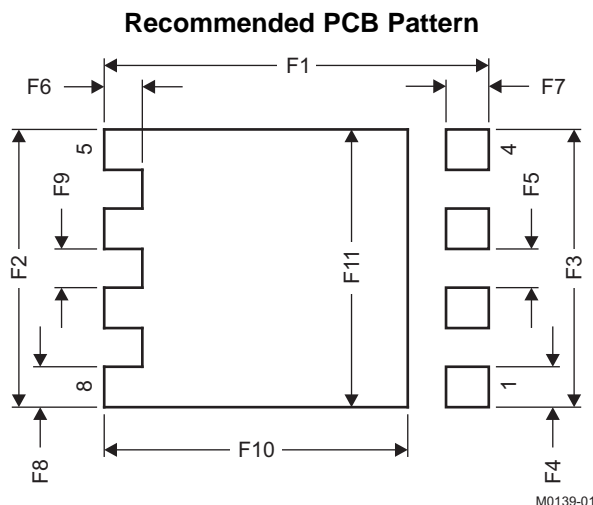
## MECHANICAL DATA

### Q5 Package Dimensions



M0140-01

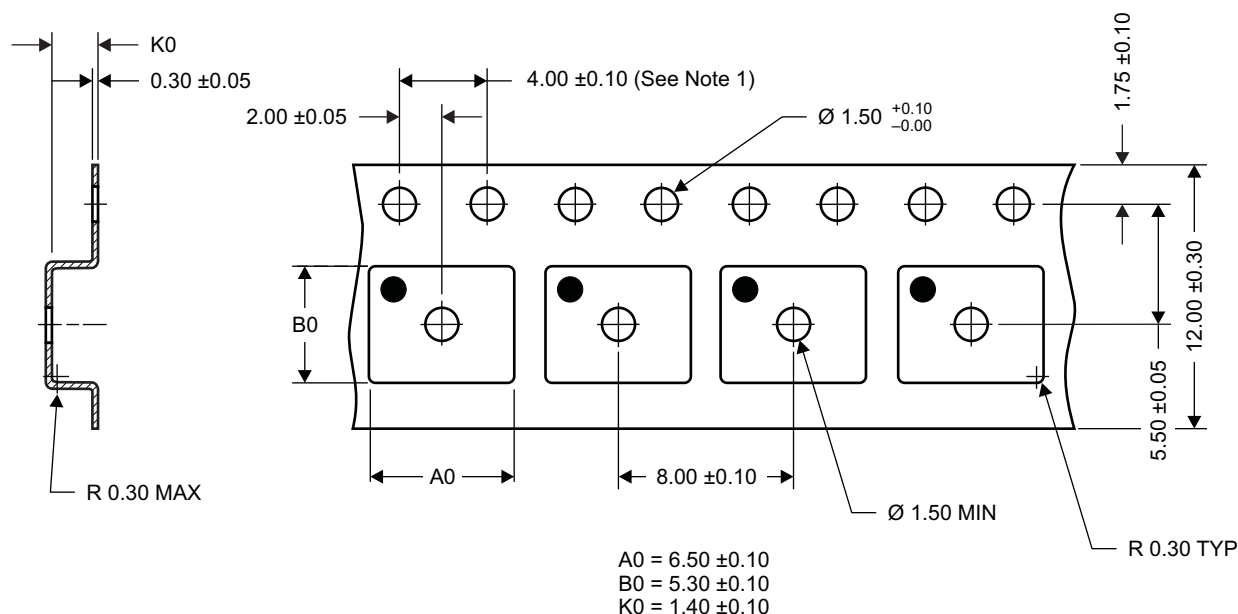
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	0.950	1.050	0.037	0.039
b	0.360	0.460	0.014	0.018
c	0.150	0.250	0.006	0.010
c1	0.150	0.250	0.006	0.010
D1	4.900	5.100	0.193	0.201
D2	4.320	4.520	0.170	0.178
E	4.900	5.100	0.193	0.201
E1	5.900	6.100	0.232	0.240
E2	3.920	4.12	0.154	0.162
e	1.27 TYP		0.050	
L	0.510	0.710	0.020	0.028
$\theta$	0.00	–	–	–
K	0.760	–	0.030	–



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
F1	6.205	6.305	0.2440	0.248
F2	4.460	4.560	0.1760	0.180
F3	4.460	4.560	0.1760	0.180
F4	0.650	0.700	0.0260	0.028
F5	0.620	0.670	0.0240	0.026
F6	0.630	0.680	0.0250	0.027
F7	0.70	0.800	0.0380	0.031
F8	0.650	0.700	0.0260	0.028
F9	0.620	0.670	0.0240	0.026
F10	4.900	5.000	0.1930	0.197
F11	4.460	4.560	0.1760	0.180

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 1 mm IN 100 mm, noncumulative over 250 mm
3. Material: black static dissipative polystyrene
4. All dimensions are in mm (unless otherwise specified)
5. Thickness:  $0.30 \pm 0.05$  mm
6. MSL1 260°C (IR and Convection) PbF Reflow Compatible

REVISION HISTORY

Changes from Revision Original (August 2009) to Revision A	Page
• Deleted environmental bullets from features list .....	<a href="#">1</a>
• Deleted package marking at end of data sheet .....	<a href="#">7</a>



## PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
CSD16407Q5	ACTIVE	VSON-CLIP	DQH	8	2500	Pb-Free (RoHS Exempt)	CU SN	Level-1-260C-UNLIM	-55 to 150	CSD16407	<a href="#">Samples</a>

(1) 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.

(2) 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)

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

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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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>
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RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

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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>
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