

# N-Channel NexFET™ Power MOSFETs

 Check for Samples: [CSD16409Q3](#)

## FEATURES

- Ultra Low  $Q_g$  and  $Q_{gd}$
- Low Thermal Resistance
- Avalanche Rated
- Pb Free Terminal Plating
- RoHS Compliant
- Halogen Free
- SON 3.3mm x 3.3mm Plastic Package

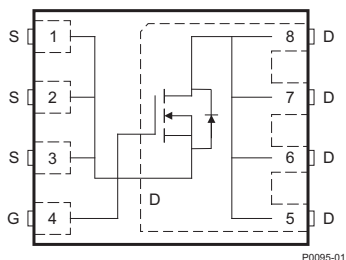
## APPLICATIONS

- Point-of-Load Synchronous Buck Converter for Applications 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.

Top View



P0095-01

## PRODUCT SUMMARY

$V_{DS}$	Drain to Source Voltage	25	V
$Q_g$	Gate Charge Total (4.5V)	4	nC
$Q_{gd}$	Gate Charge Gate to Drain	1	nC
$R_{DS(on)}$	Drain to Source On Resistance	$V_{GS} = 4.5V$	9.5 m $\Omega$
		$V_{GS} = 10V$	6.2 m $\Omega$
$V_{th}$	Threshold Voltage	2	V

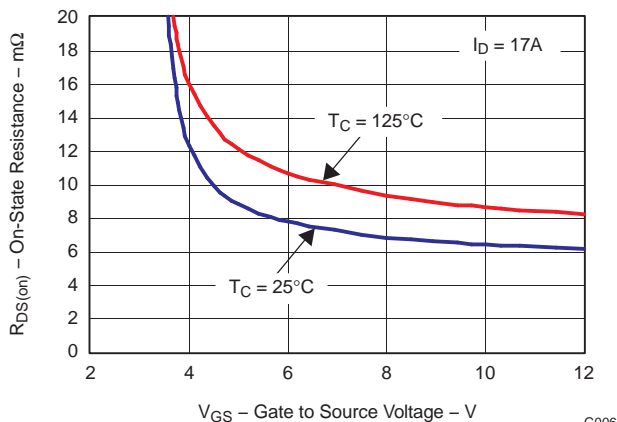
## ORDERING INFORMATION

Device	Package	Media	Qty	Ship
CSD16409Q3	SON 3.3 x 3.3 Plastic Package	13-inch reel	2500	Tape and Reel

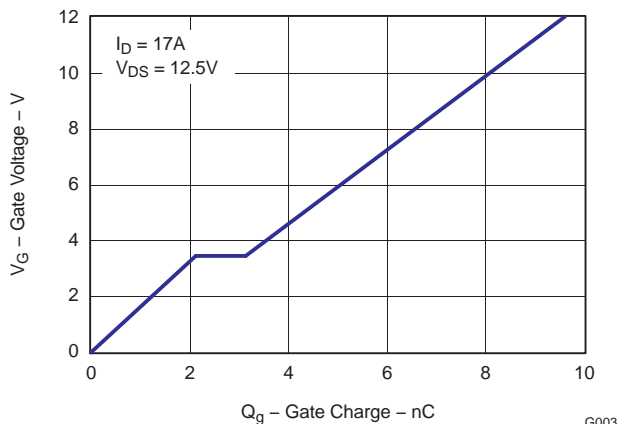
## ABSOLUTE MAXIMUM RATINGS

$T_A = 25^\circ\text{C}$ 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, $T_C = 25^\circ\text{C}$	60	A
	Continuous Drain Current <sup>(1)</sup>	15	A
$I_{DM}$	Pulsed Drain Current, $T_A = 25^\circ\text{C}$ <sup>(2)</sup>	90	A
$P_D$	Power Dissipation <sup>(1)</sup>	2.6	W
$T_J, T_{STG}$	Operating Junction and Storage Temperature Range	-55 to 150	$^\circ\text{C}$
$E_{AS}$	Avalanche Energy, single pulse $I_D = 38A, L = 0.1\text{mH}, R_G = 25\Omega$	72	mJ

- (1)  $R_{\theta JA} = 47^\circ\text{C/W}$  on  $1\text{in}^2$  Cu (2 oz.) on 0.060" thick FR4 PCB.  
 (2) Pulse width  $\leq 300\mu\text{s}$ , duty cycle  $\leq 2\%$

 **$R_{DS(ON)}$  vs  $V_{GS}$** 


G006

**Gate Charge**


G003



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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)

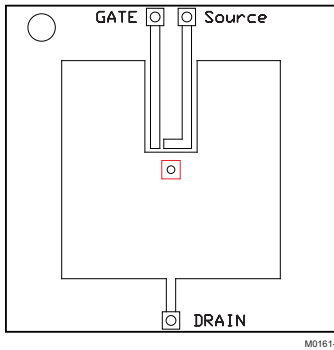
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>Static Characteristics</b>						
$V_{DSS}$	Drain to Source Voltage	$V_{GS} = 0V, I_D = 250\mu A$	25			V
$I_{DSS}$	Drain to Source Leakage Current	$V_{GS} = 0V, V_{DS} = 20V$			1	$\mu A$
$I_{GSS}$	Gate to Source Leakage Current	$V_{DS} = 0V, V_{GS} = +16/-12V$			100	nA
$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\mu A$	1.7	2	2.3	V
$R_{DS(on)}$	Drain to Source On Resistance	$V_{GS} = 4.5V, I_D = 17A$		9.5	12.4	m $\Omega$
		$V_{GS} = 10V, I_D = 17A$		6.2	8.2	m $\Omega$
$g_{fs}$	Transconductance	$V_{DS} = 15V, I_D = 17A$		38		S
<b>Dynamic Characteristics</b>						
$C_{ISS}$	Input Capacitance	$V_{GS} = 0V, V_{DS} = 12.5V, f = 1MHz$		600	800	pF
$C_{OSS}$	Output Capacitance			480	635	pF
$C_{RSS}$	Reverse Transfer Capacitance			40	55	pF
$R_g$	Series Gate Resistance			0.9	1.8	$\Omega$
$Q_g$	Gate Charge Total (4.5V)	$V_{DS} = 12.5V, I_D = 17A$		4	5.6	nC
$Q_{gd}$	Gate Charge Gate to Drain			1		nC
$Q_{gs}$	Gate Charge Gate to Source			2.1		nC
$Q_{g(th)}$	Gate Charge at $V_{th}$			1.1		nC
$Q_{OSS}$	Output Charge	$V_{DS} = 12.9V, V_{GS} = 0V$		9.1		nC
$t_{d(on)}$	Turn On Delay Time	$V_{DS} = 12.5V, V_{GS} = 4.5V, I_D = 17A, R_G = 2\Omega$		6.5		ns
$t_r$	Rise Time			10.6		ns
$t_{d(off)}$	Turn Off Delay Time			6.3		ns
$t_f$	Fall Time			3.4		ns
<b>Diode Characteristics</b>						
$V_{SD}$	Diode Forward Voltage	$I_S = 17A, V_{GS} = 0V$		0.85	1	V
$Q_{rr}$	Reverse Recovery Charge	$V_{DD} = 12.9V, I_F = 17A, di/dt = 300A/\mu s$		13.8		nC
$t_{rr}$	Reverse Recovery Time	$V_{DD} = 12.9V, I_F = 17A, di/dt = 300A/\mu s$		17.5		ns

## THERMAL CHARACTERISTICS

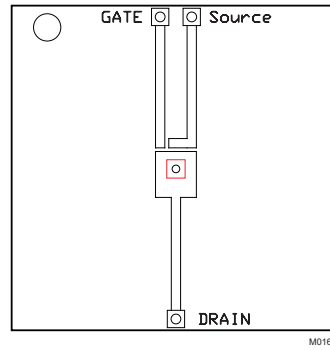
( $T_A = 25^\circ\text{C}$  unless otherwise stated)

PARAMETER		MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Thermal Resistance Junction to Case <sup>(1)</sup>			3.5	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance Junction to Ambient <sup>(1) (2)</sup>			59	$^\circ\text{C}/\text{W}$

- $R_{\theta JC}$  is determined with the device mounted on a 1 inch square 2 oz. Cu pad on a 1.5 x 1.5 in 0.06 inch thick FR4 board.  $R_{\theta JC}$  is specified by design while  $R_{\theta JA}$  is determined by the user's board design.
- Device mounted on FR4 Material with 1 inch<sup>2</sup> of 2 oz. Cu.



Max  $R_{\theta JA} = 59^{\circ}\text{C/W}$   
when mounted on 1  
 $\text{inch}^2$  of 2 oz. Cu.



Max  $R_{\theta JA} = 157^{\circ}\text{C/W}$   
when mounted on  
minimum pad area of 2  
oz. Cu.

### TYPICAL MOSFET CHARACTERISTICS

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

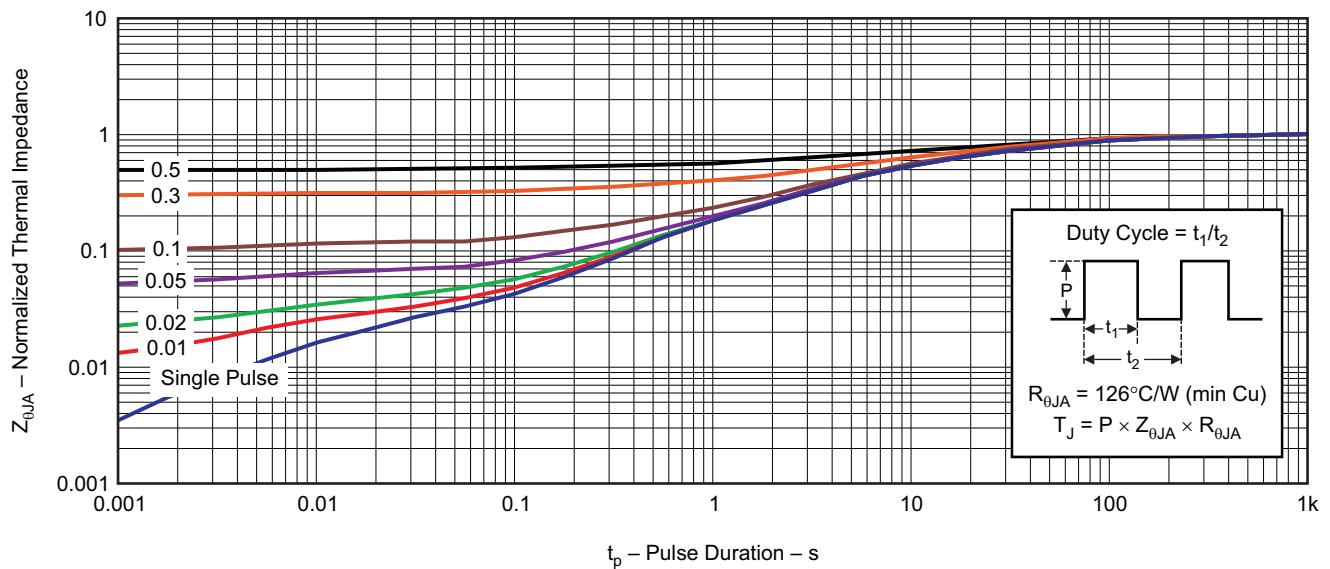
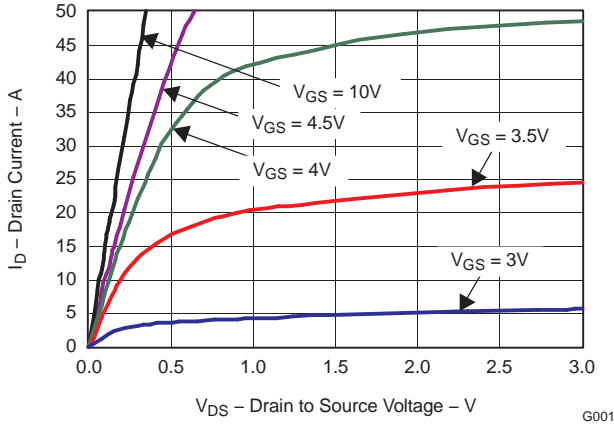


Figure 1. Transient Thermal Impedance

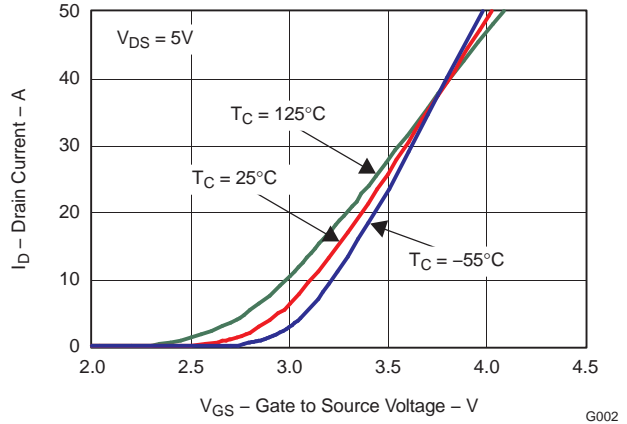
G012

**TYPICAL MOSFET CHARACTERISTICS (continued)**

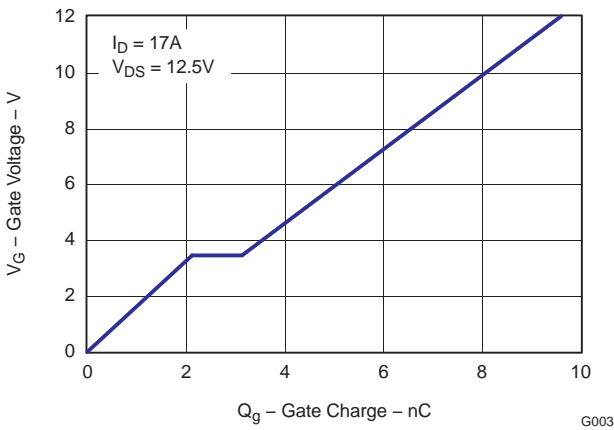
( $T_A = 25^\circ\text{C}$  unless otherwise stated)



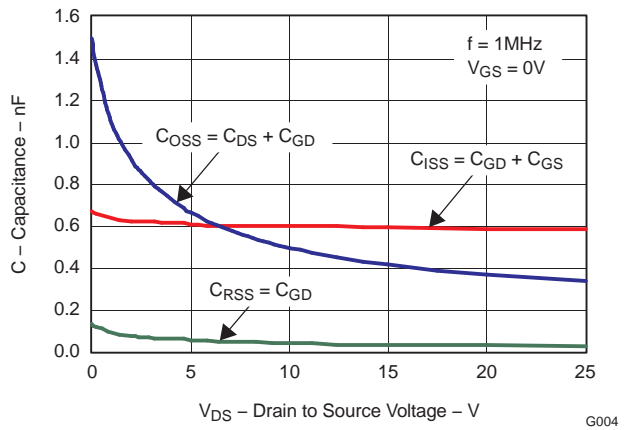
**Figure 2. Saturation Characteristics**



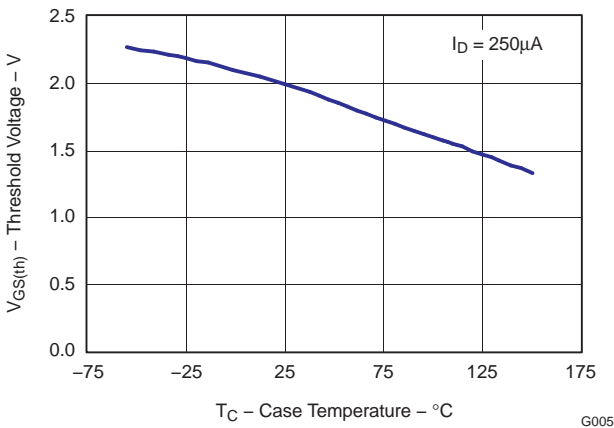
**Figure 3. Transfer Characteristics**



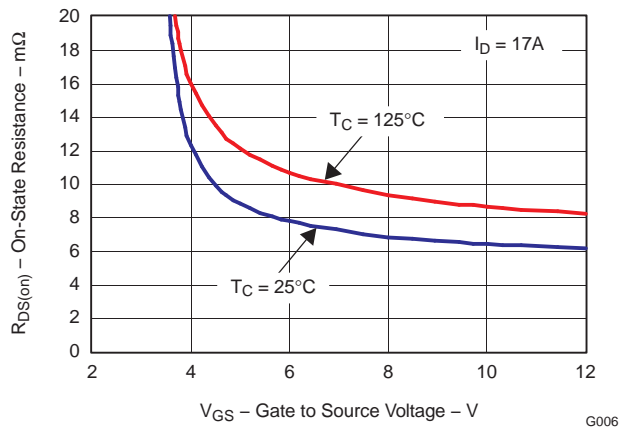
**Figure 4. Gate Charge**



**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)

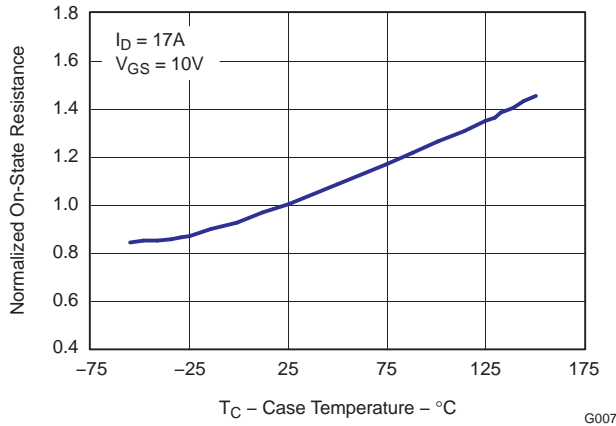


Figure 8. Normalized On Resistance vs. Temperature

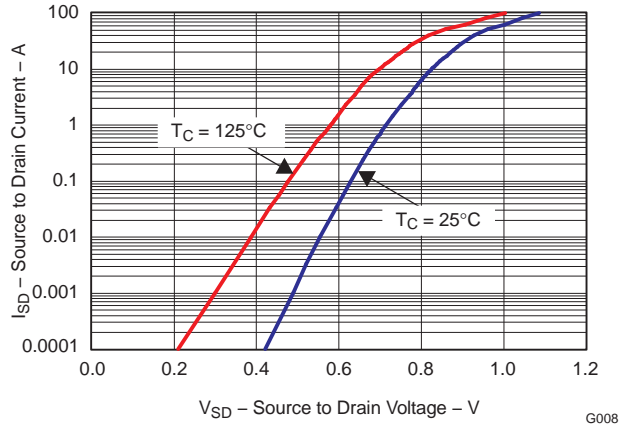


Figure 9. Typical Diode Forward Voltage

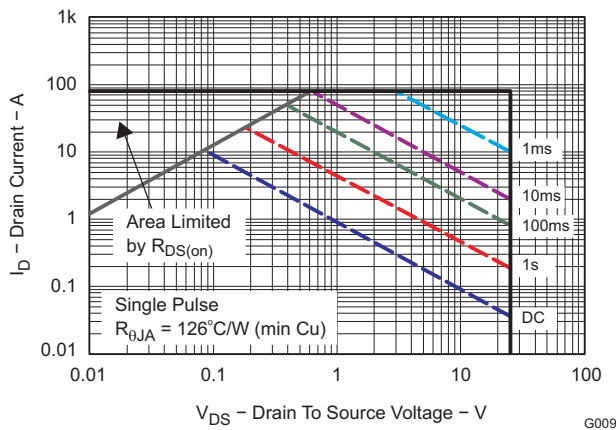


Figure 10. Maximum Safe Operating Area

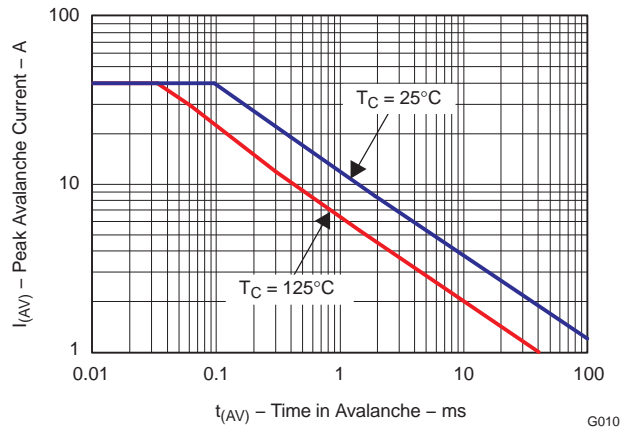


Figure 11. Single Pulse Unclamped Inductive Switching

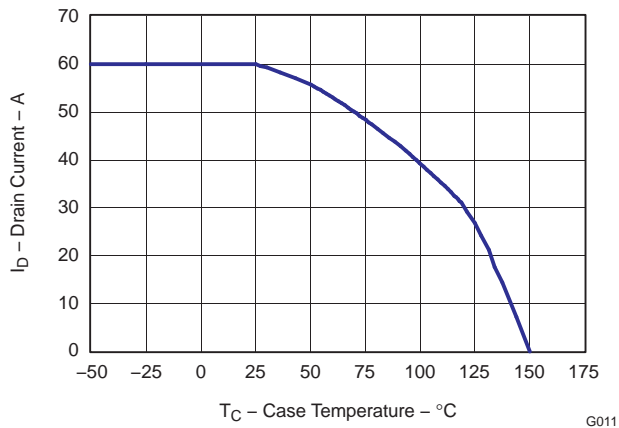
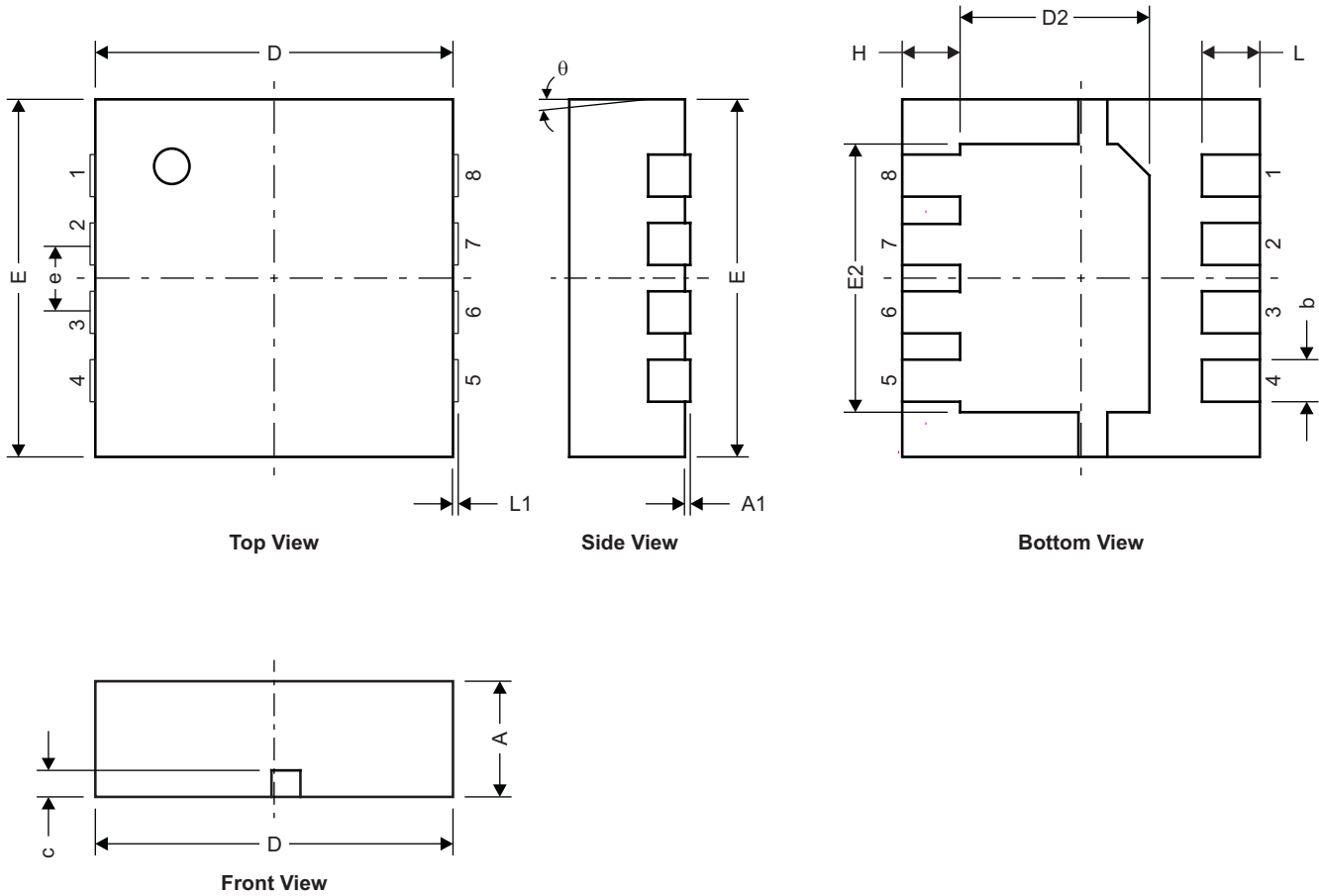


Figure 12. Maximum Drain Current vs. Temperature

**MECHANICAL DATA**

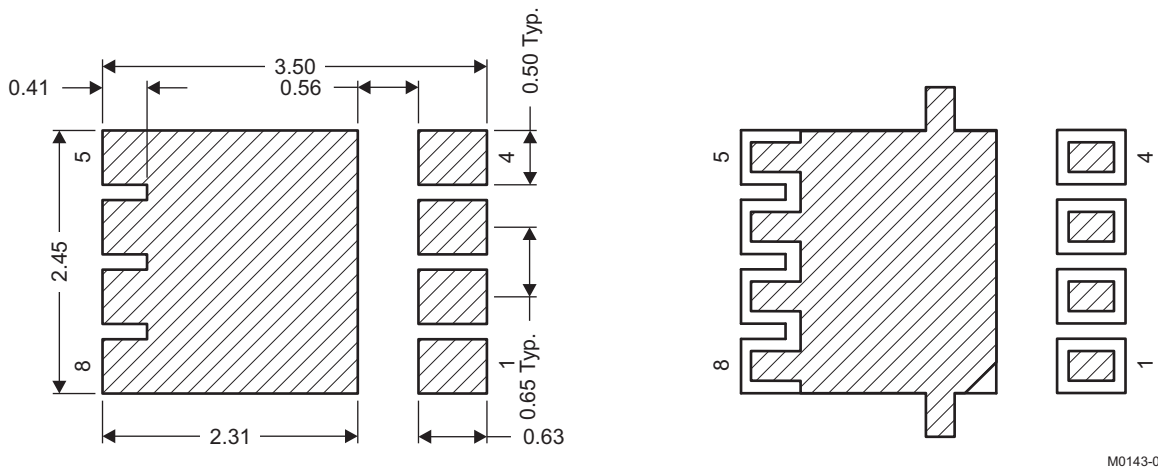
**Q3 Package Dimensions**



M0142-01

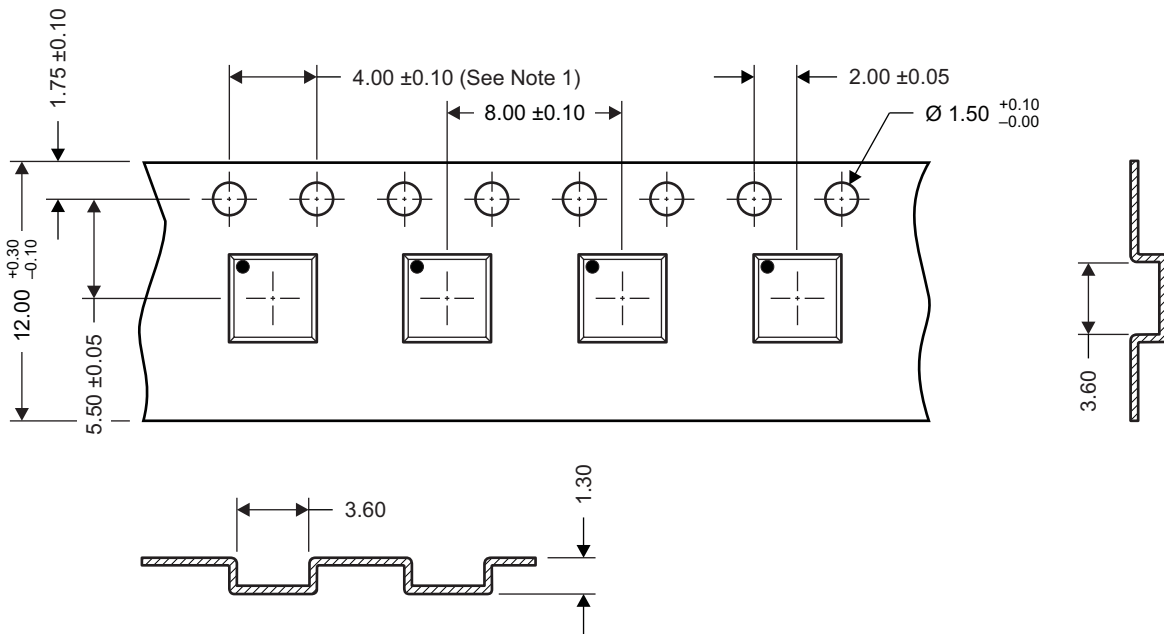
DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.950	1.000	1.100	0.037	0.039	0.043
A1	0.000	0.000	0.050	0.000	0.000	0.002
b	0.280	0.340	0.400	0.011	0.013	0.016
c	0.150	0.200	0.250	0.006	0.008	0.010
D	3.200	3.300	3.400	0.126	0.130	0.134
D1	-	-	-	-	-	-
D2	1.650	1.750	1.800	0.065	0.069	0.071
E	3.200	3.300	3.400	0.126	0.130	0.134
E1	-	-	-	-	-	-
E2	2.350	2.450	2.550	0.093	0.096	0.100
e	0.650 TYP			0.026		
H	0.35	0.450	0.550	0.014	0.018	0.022
L	0.35	0.450	0.550	0.014	0.018	0.022
L1	-	-	-	-	-	-
$\theta$	-	-	-	-	-	-

**Recommended PCB Land Pattern**



For recommended circuit layout for PCB designs, see application note [SLPA005 – Reducing Ringing Through PCB Layout Techniques](#).

**Q3 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. Thickness:  $0.30 \pm 0.05$ mm
6. MSL1 260°C (IR and Convection) PbF Reflow Compatible

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## REVISION HISTORY

Changes from Original (August 2009) to Revision A	Page
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- Deleted the Package Marking Information section ..... [7](#)
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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
CSD16409Q3	SON	DQG	8	2500	330.0	12.8	3.6	3.6	1.2	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)
CSD16409Q3	SON	DQG	8	2500	335.0	335.0	32.0

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

### Applications

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Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
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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>
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