

## N-Channel NexFET™ Power MOSFETs

Check for Samples: [CSD16406Q3](#)

### FEATURES

- Ultra Low Qg and Qgd
- Low Thermal Resistance
- Avalanche Rated
- Pb Free Terminal Plating
- RoHS Compliant
- Halogen Free
- SON 3.3mm x 3.3mm Plastic Package

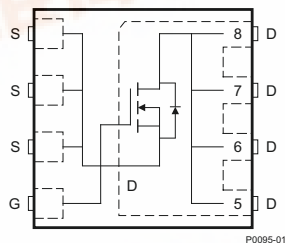
### APPLICATIONS

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

### DESCRIPTION

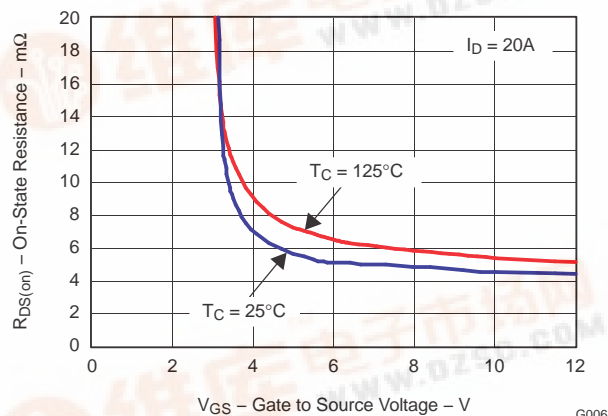
The NexFET™ power MOSFET has been designed to minimize losses in power conversion applications.

Top View



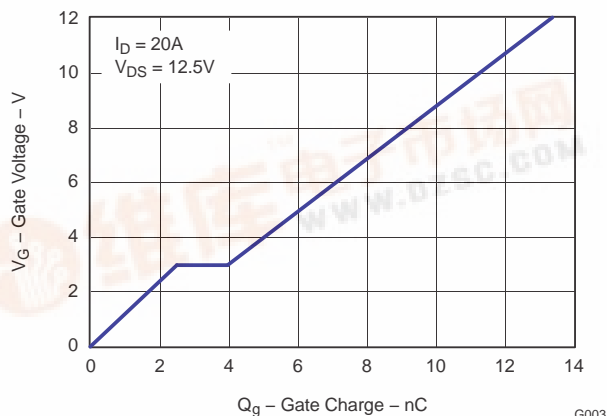
P0095-01

R<sub>DS(ON)</sub> VS V<sub>GS</sub>



G006

Gate Charge



G003

### PRODUCT SUMMARY

V <sub>DS</sub>	Drain to Source Voltage	25	V
Q <sub>g</sub>	Gate Charge Total (4.5V)	5.8	nC
Q <sub>gd</sub>	Gate Charge Gate to Drain	1.5	nC
R <sub>DS(on)</sub>	Drain to Source On Resistance	V <sub>GS</sub> = 4.5V	5.9 mΩ
		V <sub>GS</sub> = 10V	4.2 mΩ
V <sub>th</sub>	Threshold Voltage	1.8	V

### ORDERING INFORMATION

Device	Package	Media	Qty	Ship
CSD16406Q3	SON 3.3 × 3.3 Plastic Package	13-inch reel	2500	Tape and Reel

### ABSOLUTE MAXIMUM RATINGS

T <sub>A</sub> = 25°C unless otherwise stated		VALUE	UNIT
V <sub>DS</sub>	Drain to Source Voltage	25	V
V <sub>GS</sub>	Gate to Source Voltage	+16 / -12	V
I <sub>D</sub>	Continuous Drain Current, T <sub>C</sub> = 25°C	60	A
	Continuous Drain Current <sup>(1)</sup>	19	A
I <sub>DM</sub>	Pulsed Drain Current, T <sub>A</sub> = 25°C <sup>(2)</sup>	114	A
P <sub>D</sub>	Power Dissipation <sup>(1)</sup>	2.7	W
T <sub>J</sub> , T <sub>STG</sub>	Operating Junction and Storage Temperature Range	-55 to 150	°C
E <sub>AS</sub>	Avalanche Energy, single pulse I <sub>D</sub> = 45A, L = 0.1mH, R <sub>G</sub> = 25Ω	101	mJ

(1) R<sub>θJA</sub> = 46°C/W on 1in<sup>2</sup> Cu (2 oz.) on 0.060" thick FR4 PCB.

(2) Pulse width ≤300μs, duty cycle ≤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
<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	$V_{DS} = 0V, V_{GS} = +16/-12V$			100	nA
$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\mu A$	1.4	1.8	2.2	V
$R_{DS(on)}$	Drain to Source On Resistance	$V_{GS} = 4.5V, I_D = 20A$		5.9	7.4	m $\Omega$
		$V_{GS} = 10V, I_D = 20A$		4.2	5.3	m $\Omega$
$g_{fs}$	Transconductance	$V_{DS} = 15V, I_D = 20A$		53		S
<b>Dynamic Characteristics</b>						
$C_{ISS}$	Input Capacitance	$V_{GS} = 0V, V_{DS} = 12.5V, f = 1MHz$		840	1100	pF
$C_{OSS}$	Output Capacitance			680	950	pF
$C_{RSS}$	Reverse Transfer Capacitance			57	80	pF
$R_g$	Series Gate Resistance			1.2	2.4	$\Omega$
$Q_g$	Gate Charge Total (4.5V)	$V_{DS} = 12.5V, I_D = 20A$		5.8	8.1	nC
$Q_{gd}$	Gate Charge Gate to Drain			1.5		nC
$Q_{gs}$	Gate Charge Gate to Source			2.5		nC
$Q_{g(th)}$	Gate Charge at $V_{th}$			1.5		nC
$Q_{OSS}$	Output Charge	$V_{DS} = 13.6V, V_{GS} = 0V$		13.9		nC
$t_{d(on)}$	Turn On Delay Time	$V_{DS} = 12.5V, V_{GS} = 4.5V, I_D = 20A$ $R_G = 2\Omega$		7.3		ns
$t_r$	Rise Time			12.9		ns
$t_{d(off)}$	Turn Off Delay Time			8.5		ns
$t_f$	Fall Time			4.8		ns
<b>Diode Characteristics</b>						
$V_{SD}$	Diode Forward Voltage	$I_S = 20A, V_{GS} = 0V$		0.85	1.0	V
$Q_{rr}$	Reverse Recovery Charge	$V_{DD} = 13.6V, I_F = 20A, di/dt = 300A/\mu s$		18		nC
$t_{rr}$	Reverse Recovery Time	$V_{DD} = 13.6V, I_F = 20A, di/dt = 300A/\mu s$		22		ns

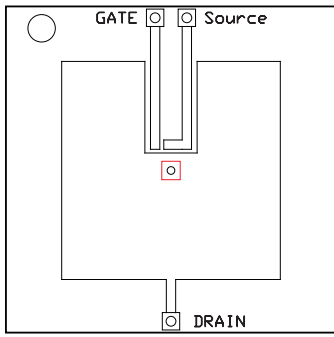
## THERMAL CHARACTERISTICS

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

PARAMETER		MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Thermal Resistance Junction to Case <sup>(1)</sup>			2.7	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance Junction to Ambient <sup>(1) (2)</sup>			58	$^\circ\text{C/W}$

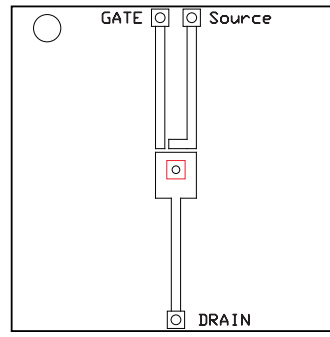
(1)  $R_{\theta JC}$  is determined with the device mounted on a 1 inch square 2 oz. Cu pad on a 1.5 × 1.5 in 0.06 inch thick FR4 board.  $R_{\theta JC}$  is specified by design while  $R_{\theta JA}$  is determined by the user's board design.

(2) Device mounted on FR4 Material with 1 inch<sup>2</sup> of 2 oz. Cu.



Max  $R_{\theta JA} = 58^{\circ}\text{C/W}$   
when mounted on 1  
 $\text{inch}^2$  of 2 oz. Cu.

M0161-01

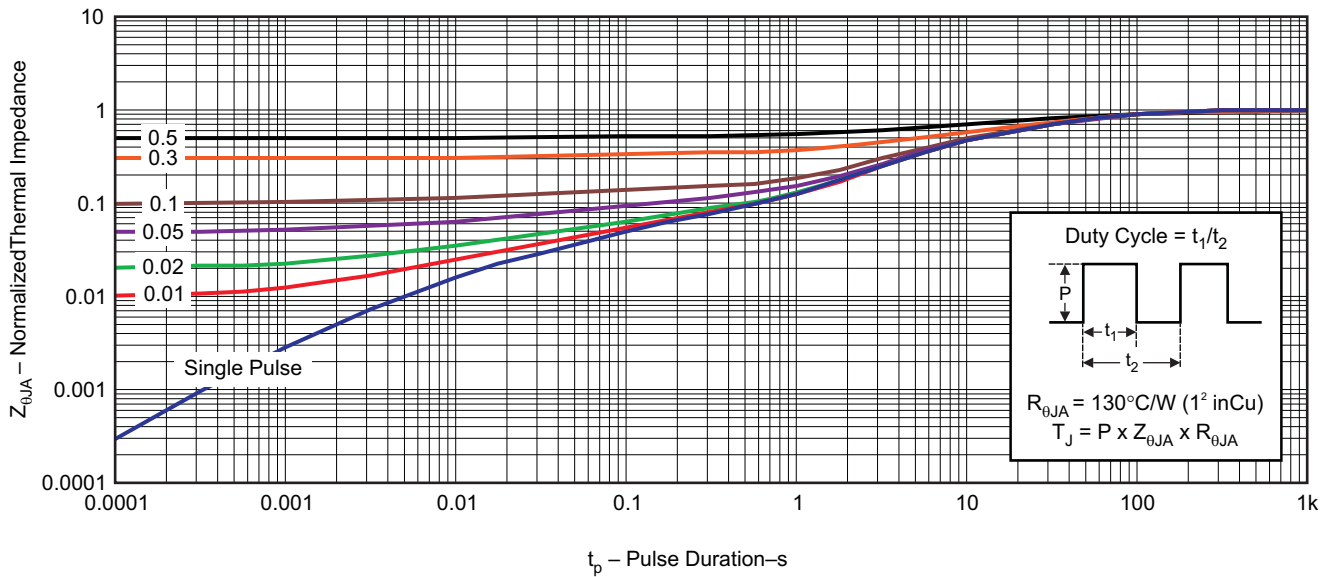


Max  $R_{\theta JA} = 162^{\circ}\text{C/W}$   
when mounted on  
minimum pad area of 2  
oz. Cu.

M0161-02

### TYPICAL MOSFET CHARACTERISTICS

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

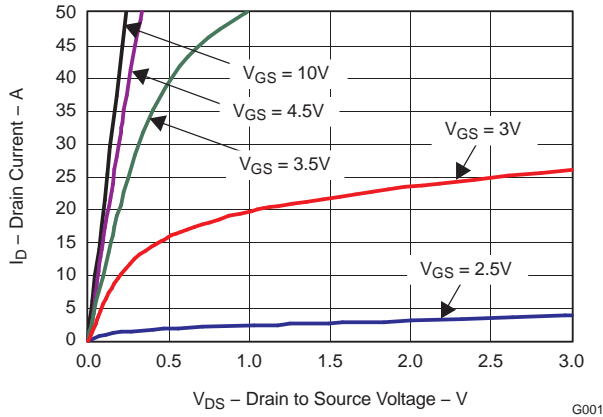


G012

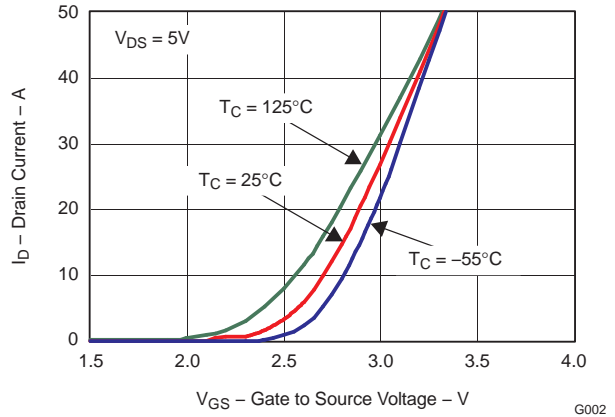
Figure 1. Transient Thermal Impedance

**TYPICAL MOSFET CHARACTERISTICS (continued)**

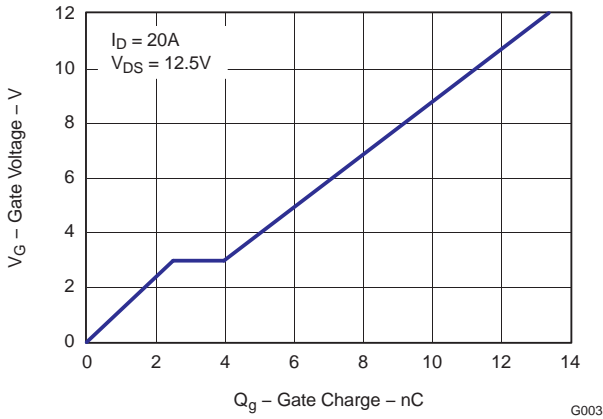
( $T_A = 25^\circ\text{C}$  unless otherwise stated)



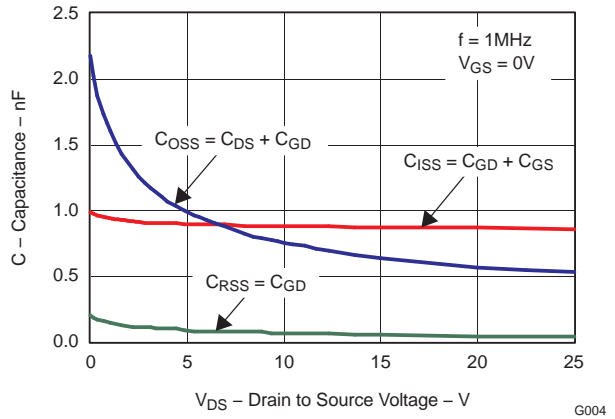
**Figure 2. Saturation Characteristics**



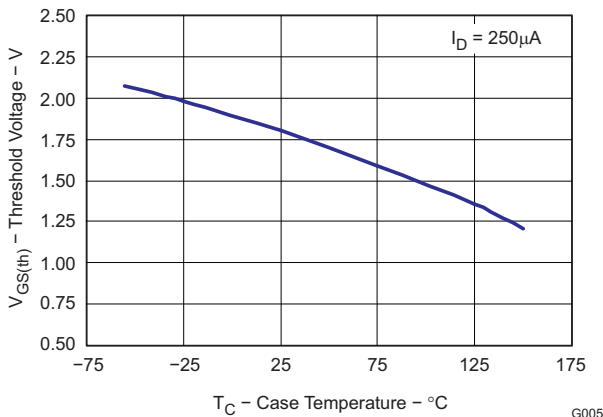
**Figure 3. Transfer Characteristics**



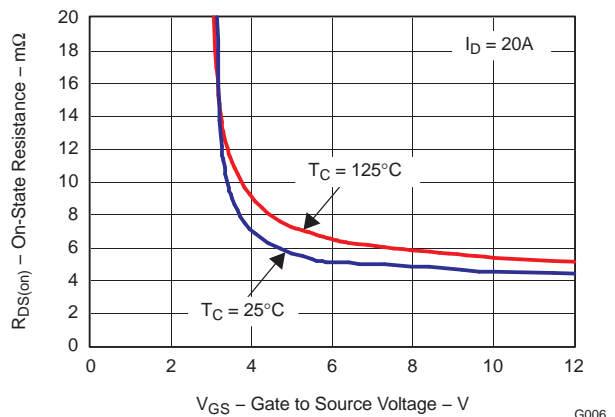
**Figure 4. Gate Charge**



**Figure 5. Capacitance**



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



**Figure 7. On Resistance vs. Gate Voltage**

TYPICAL MOSFET CHARACTERISTICS (continued)

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

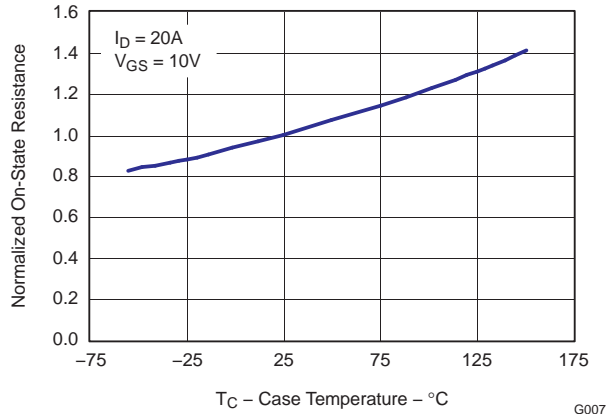


Figure 8. Normalized On Resistance vs. Temperature

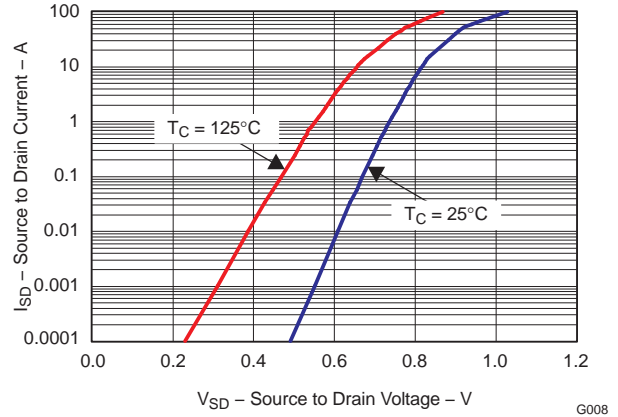


Figure 9. Typical Diode Forward Voltage

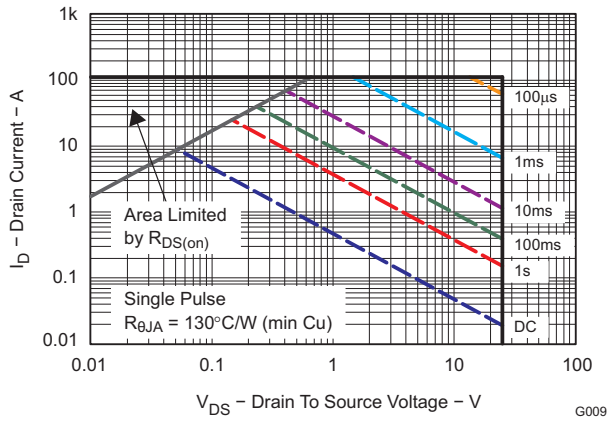


Figure 10. Maximum Safe Operating Area

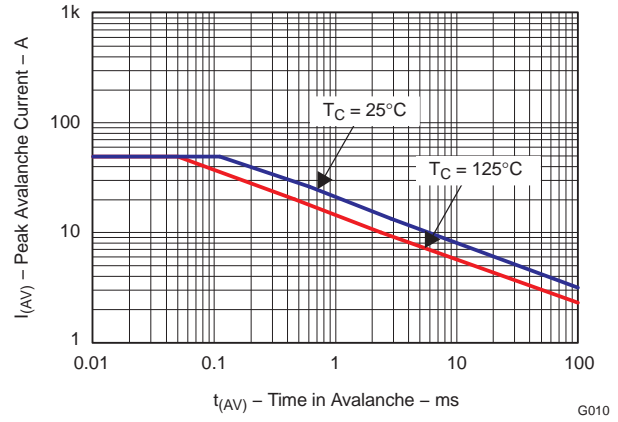


Figure 11. Single Pulse Unclamped Inductive Switching

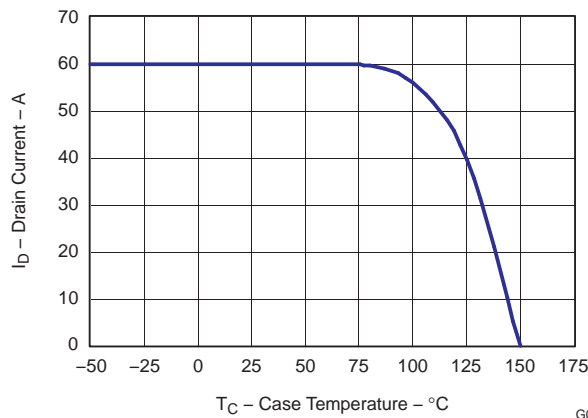
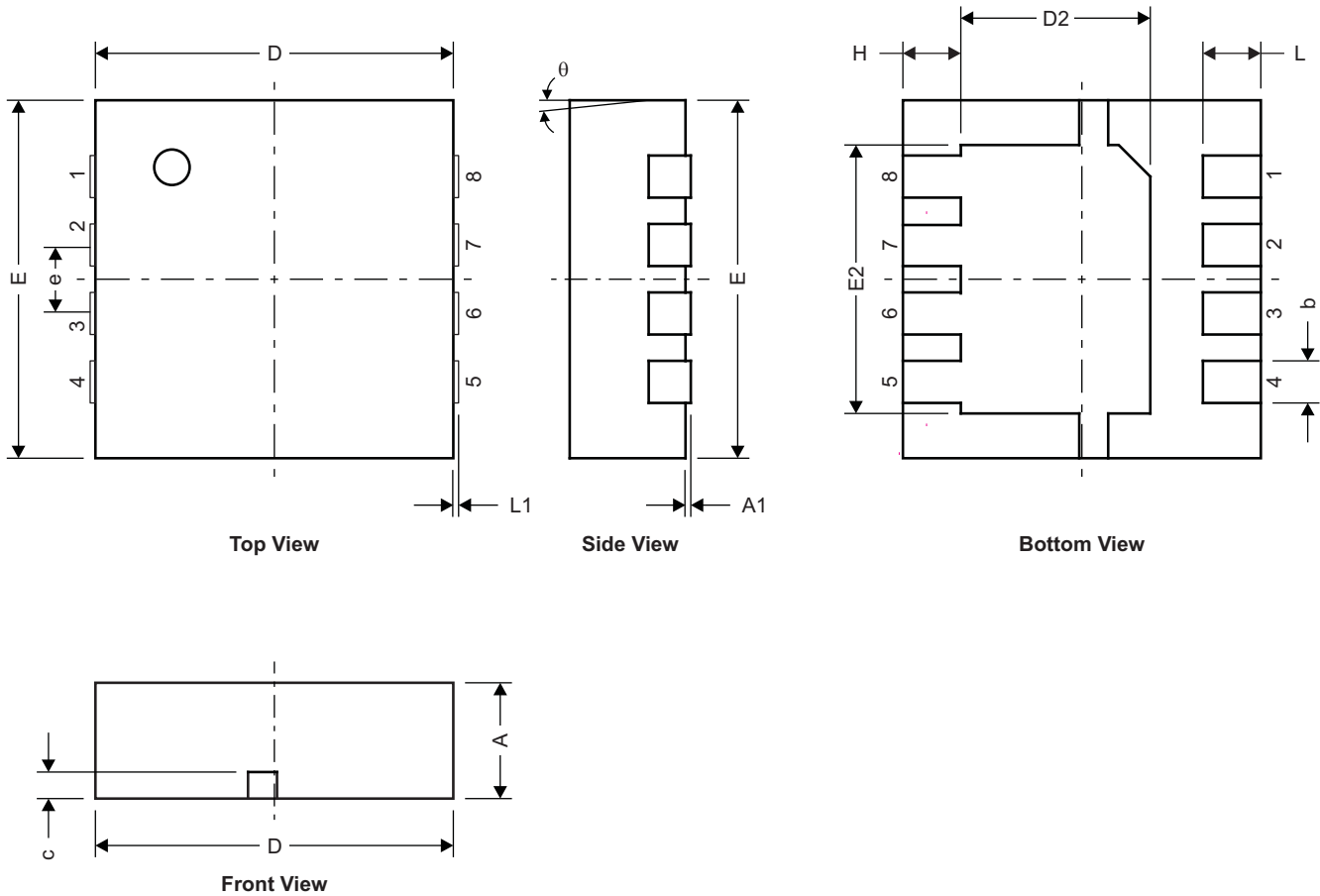


Figure 12. Maximum Drain Current vs. Temperature

**MECHANICAL DATA**

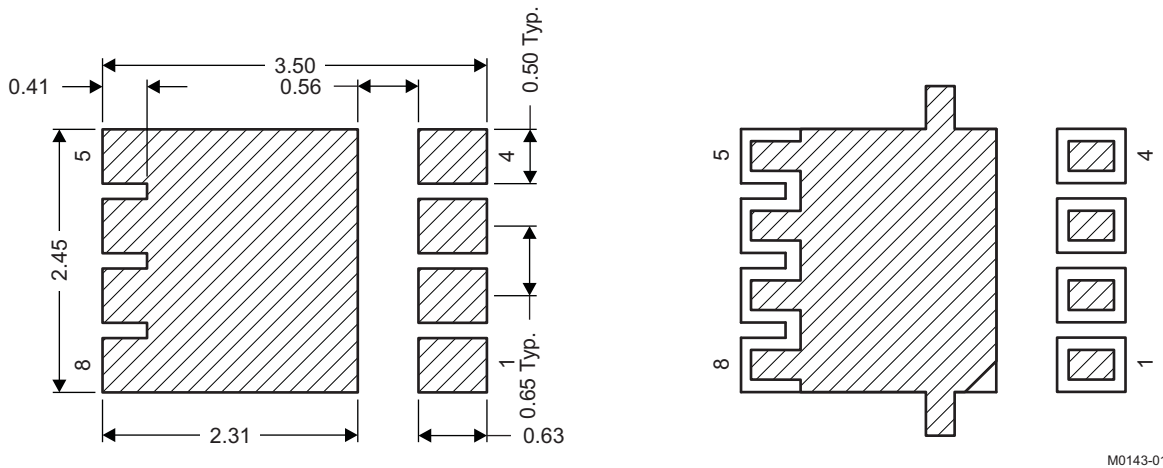
**Q3 Package Dimensions**



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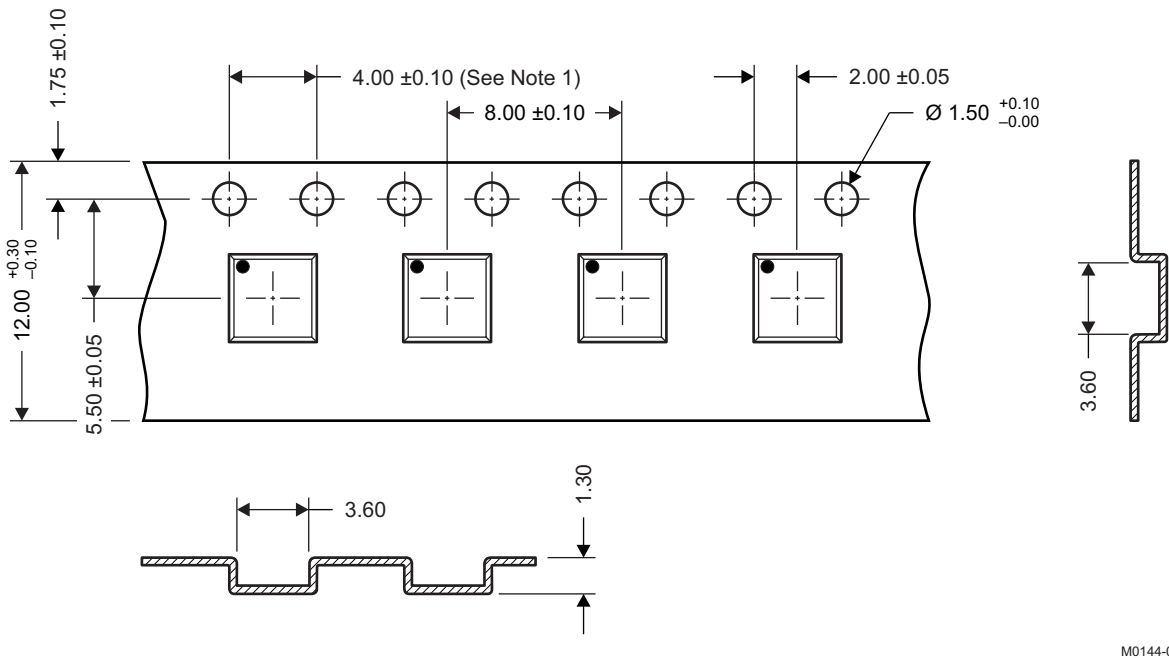
DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.950	1.000	1.100	0.037	0.039	0.043
A1	0.000	0.000	0.050	0.000	0.000	0.002
b	0.280	0.340	0.400	0.011	0.013	0.016
c	0.150	0.200	0.250	0.006	0.008	0.010
D	3.200	3.300	3.400	0.126	0.130	0.134
D1	-	-	-	-	-	-
D2	1.650	1.750	1.800	0.065	0.069	0.071
E	3.200	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 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

[查看 CSD16406Q3 快速指南](#)

## REVISION HISTORY

Changes from Original (August 2009) to Revision A	Page
• Deleted the Package Marking Information section .....	7





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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 Peak Temp <sup>(3)</sup>
CSD16406Q3	ACTIVE	SON	DQG	8	2500	Pb-Free (RoHS Exempt)	CU SN	Level-1-260C

<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 eutectic solder used between the leadframe leads and the die. 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 (both of which are RoHS compliant). TI Green products are suitable for use in applications where RoHS compliant parts are required.

<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>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>	Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>	Space, Avionics & Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
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>
		Wireless	<a href="http://www.ti.com/wireless-apps">www.ti.com/wireless-apps</a>