CSD16406Q3 N-Channel NexFET™ Power MOSFET

1 Features

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

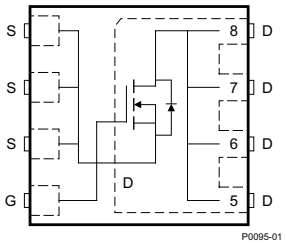
2 Applications

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

3 Description

This 25 V, 4.2 mΩ, 3.3 mm × 3.3 mm SON NexFET™ power MOSFET has been designed to minimize losses in power conversion applications.

Top View



Product Summary

T_A = 25°C		TYPICAL VALUE		UNIT
V_{DS}	Drain-to-Source Voltage	25		V
Q_g	Gate Charge Total (4.5 V)	5.8		nC
Q_{gd}	Gate Charge Gate to Drain	1.5		nC
$R_{DS(on)}$	Drain-to-Source On-Resistance	V_{GS} = 4.5 V	5.9	mΩ
		V_{GS} = 10 V	4.2	mΩ
V_{th}	Threshold Voltage	1.8		V

Ordering Information(1)

DEVICE	MEDIA	QTY	PACKAGE	SHIP
CSD16406Q3	13-Inch Reel	2500	SON 3.3 x 3.3 mm Plastic Package	Tape and Reel
CSD16406Q3T	13-Inch Reel	250		

(1) For all available packages, see the orderable addendum at the end of the data sheet.

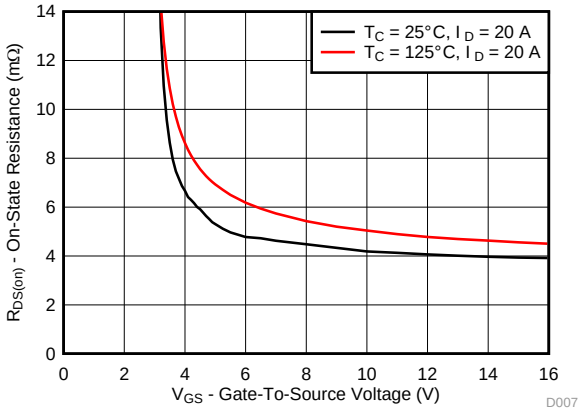
Absolute Maximum Ratings

T_A = 25°C		VALUE	UNIT
V_{DS}	Drain-to-Source Voltage	25	V
V_{GS}	Gate-to-Source Voltage	+16 / –12	V
I_D	Continuous Drain Current (Package limited)	60	A
	Continuous Drain Current (Silicon limited), T_C = 25°C	79	
	Continuous Drain Current(1)	19	
I_{DM}	Pulsed Drain Current(2)	240	A
P_D	Power Dissipation(1)	2.8	W
	Power Dissipation, T_C = 25°C	46	
T_J, T_{stg}	Operating Junction Temperature, Storage Temperature	–55 to 150	°C
E_{AS}	Avalanche Energy, single pulse I_D = 45 A, L = 0.1 mH, R_G = 25 Ω	101	mJ

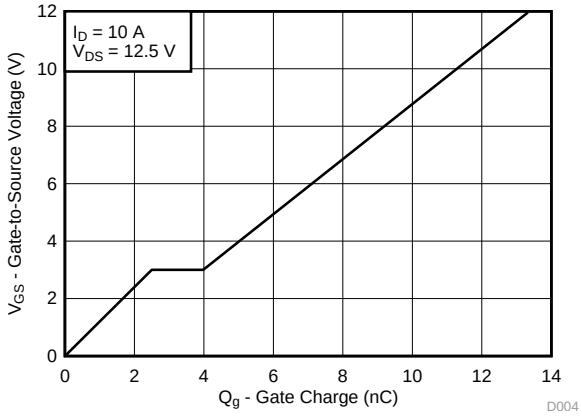
(1) Typical $R_{\theta JA}$ = 45°C/W on a 1 inch^2, 2 oz. Cu pad on a 0.06 inch thick FR4 PCB.

(2) Max $R_{\theta JC}$ = 2.7°C/W, pulse duration ≤100 µs, duty cycle ≤1%

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



Gate Charge



An IMPORTANT NOTICE at the end of this data sheet addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers. PRODUCTION DATA.

Table of Contents

1 **Features** ... 1
2 **Applications** ... 1
3 **Description** ... 1
4 **Revision History** ... 2
5 **Specifications** ... 3
5.1 Electrical Characteristics ... 3
5.2 Thermal Information ... 3
5.3 Typical MOSFET Characteristics ... 4
6 **Device and Documentation Support** ... 7
6.1 Community Resources ... 7
6.2 Trademarks ... 7
6.3 Electrostatic Discharge Caution ... 7
6.4 Glossary ... 7
7 **Mechanical, Packaging, and Orderable Information** ... 8
7.1 Q3 Package Dimensions ... 8
7.2 Recommended PCB Pattern ... 9
7.3 Recommended Stencil Opening ... 9
7.4 Q3 Tape and Reel Information ... 10

4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision A (September 2010) to Revision B **Page**

- Added part number to title ... 1
- Added Silicon Limited I_D, T_C = 25°C ... 1
- Added Power Dissipation, T_C = 25°C ... 1
- Updated Typical $R_{\theta JA}$ ... 1
- Updated pulsed current conditions ... 1
- Added *Device and Documentation Support* section ... 7
- Updated *Mechanical, Packaging, and Orderable Information* ... 8

Changes from Original (August 2009) to Revision A **Page**

- Deleted the Package Marking Information section. ... 8

Copyright © 2009–2015, Texas Instruments Incorporated

5 Specifications

5.1 Electrical Characteristics

(T_A = 25°C unless otherwise stated)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
STATIC CHARACTERISTICS						
BV_{DSS}	Drain-to-source voltage	V_{GS} = 0 V, I_D = 250 µA	25			V
I_{DSS}	Drain-to-source leakage current	V_{GS} = 0 V, V_{DS} = 20 V			1	µA
I_{GSS}	Gate-to-source leakage current	V_{DS} = 0 V, V_{GS} = +16/–12 V			100	nA
$V_{GS(th)}$	Gate-to-source threshold voltage	V_{DS} = V_{GS}, I_D = 250 µA	1.4	1.8	2.2	V
$R_{DS(on)}$	Drain-to-source on-resistance	V_{GS} = 4.5 V, I_D = 20 A		5.9	7.4	mΩ
		V_{GS} = 10 V, I_D = 20 A		4.2	5.3	mΩ
g_{fs}	Transconductance	V_{DS} = 15 V, I_D = 20 A		53		S
DYNAMIC CHARACTERISTICS						
C_{ISS}	Input capacitance	V_{GS} = 0 V, V_{DS} = 12.5 V, f = 1 MHz		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	Ω
Q_g	Gate charge total (4.5 V)	V_{DS} = 12.5 V, I_D = 20 A		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
Qg(th)	Gate charge at V_{th}			1.5		nC
Q_{OSS}	Output charge	V_{DS} = 13.6 V, V_{GS} = 0 V		13.9		nC
$t_{d(on)}$	Turn on delay time	V_{DS} = 12.5 V, V_{GS} = 4.5 V I_D = 20 A R_G = 2 Ω		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
DIODE CHARACTERISTICS						
V_{SD}	Diode forward voltage	I_S = 20 A, V_{GS} = 0 V		0.85	1.0	V
Q_{rr}	Reverse recovery charge	V_{DD} = 13.6 V, I_F = 20 A, di/dt = 300 A/µs		18		nC
t_{rr}	Reverse recovery time	V_{DD} = 13.6 V, I_F = 20 A, di/dt = 300 A/µs		22		ns

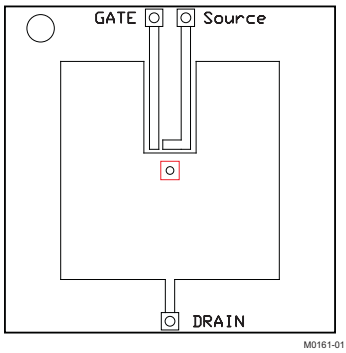
5.2 Thermal Information

(T_A = 25°C unless otherwise stated)

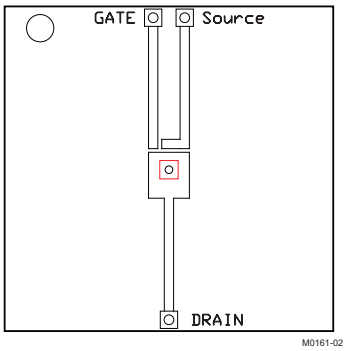
THERMAL METRIC		MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction-to-case thermal resistance (1)			2.7	°C/W
$R_{\theta JA}$	Junction-to-ambient thermal resistance (1) (2)			55	°C/W

(1) $R_{\theta JC}$ is determined with the device mounted on a 1 inch^2 (6.45 cm^2), 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^2 (6.45 cm^2), 2 oz. (0.071 mm thick) Cu.

Copyright © 2009–2015, Texas Instruments Incorporated



Max $R_{\theta JA}$ = 55°C/W when mounted on 1 inch^2 of 2 oz. Cu.



Max $R_{\theta JA}$ = 160°C/W when mounted on minimum pad area of 2 oz. Cu.

5.3 Typical MOSFET Characteristics

(T_A = 25°C unless otherwise stated)

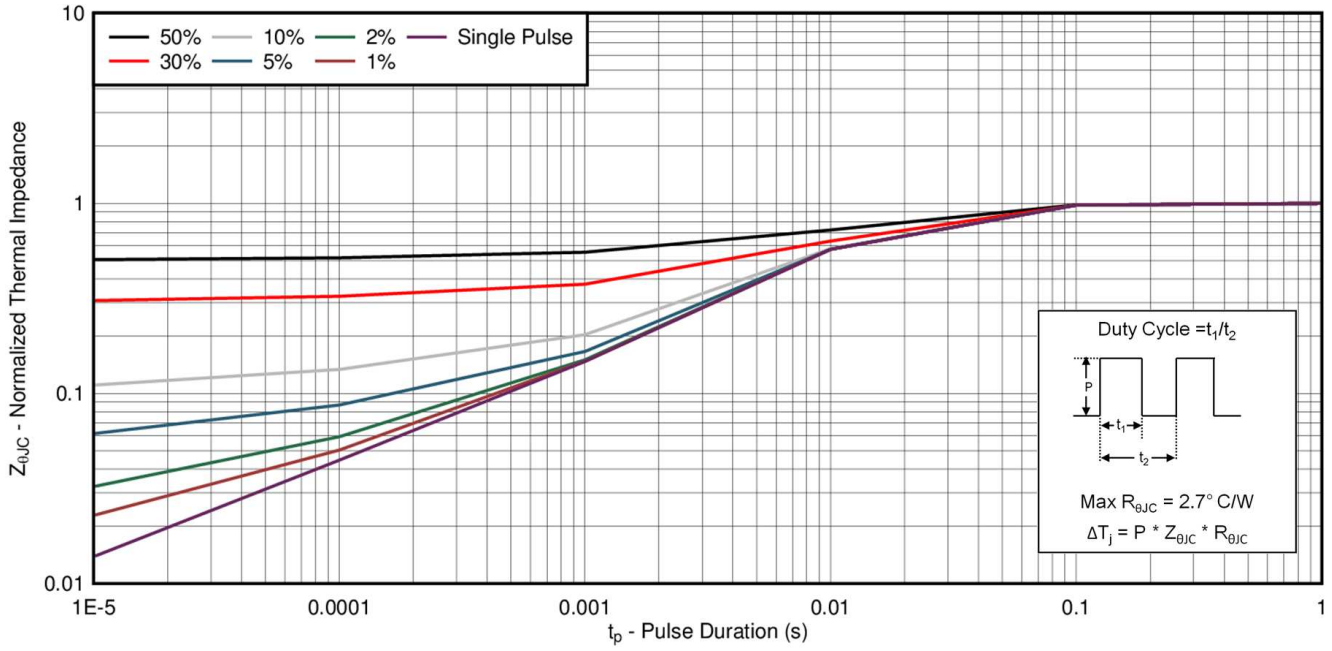


Figure 1. Transient Thermal Impedance

Copyright © 2009–2015, Texas Instruments Incorporated

Typical MOSFET Characteristics (continued)

(T_A = 25°C unless otherwise stated)

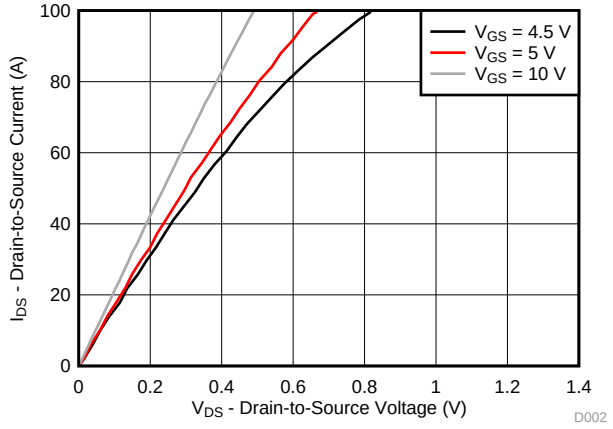


Figure 2. Saturation Characteristics

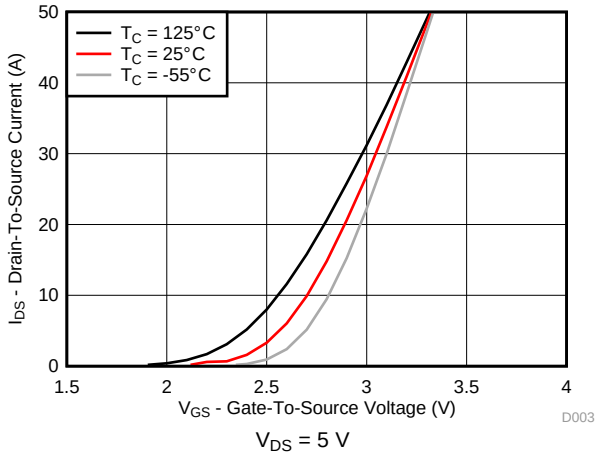


Figure 3. Transfer Characteristics

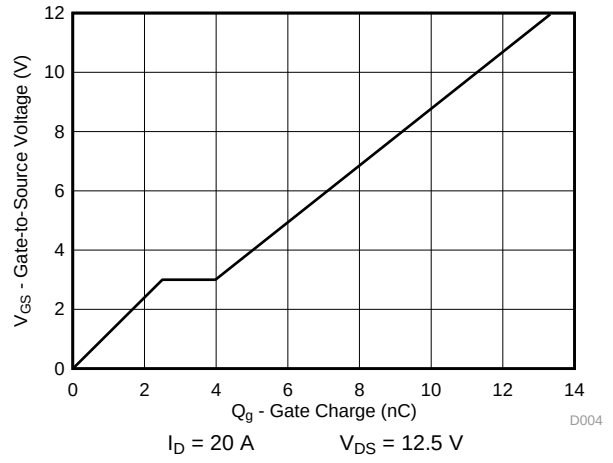


Figure 4. Gate Charge

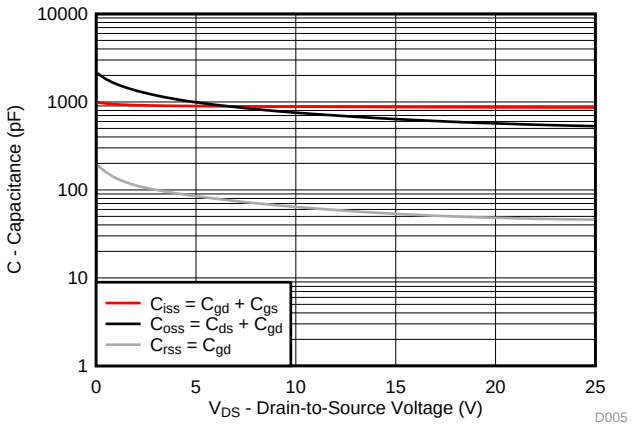


Figure 5. Capacitance

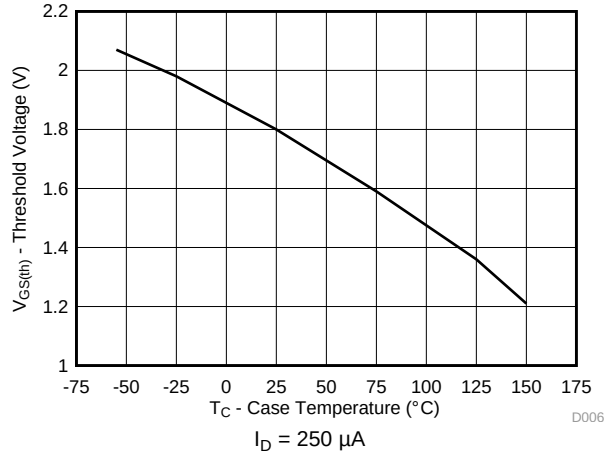


Figure 6. Threshold Voltage vs Temperature

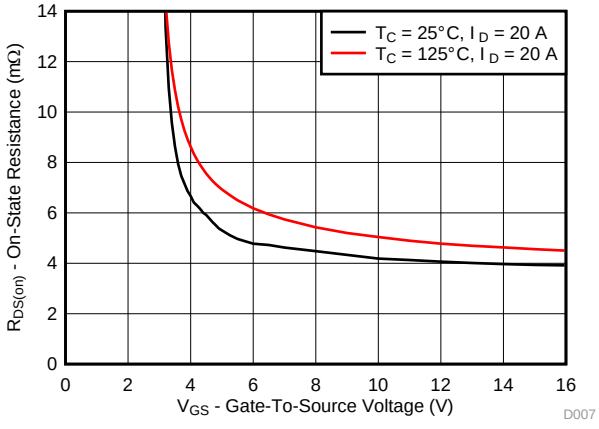


Figure 7. On Resistance vs Gate Voltage

Copyright © 2009–2015, Texas Instruments Incorporated

Typical MOSFET Characteristics (continued)

(T_A = 25°C unless otherwise stated)

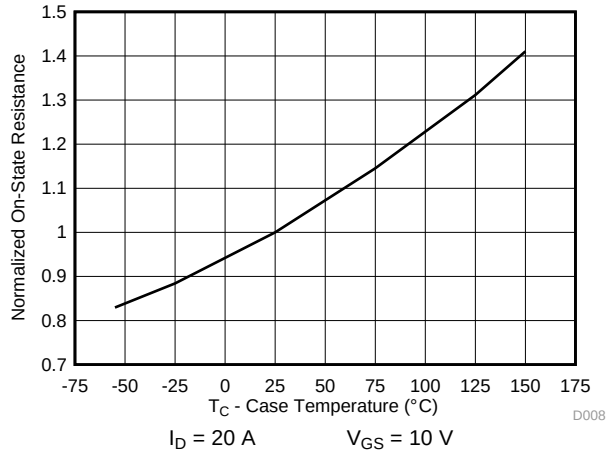


Figure 8. Normalized On-Resistance vs Temperature

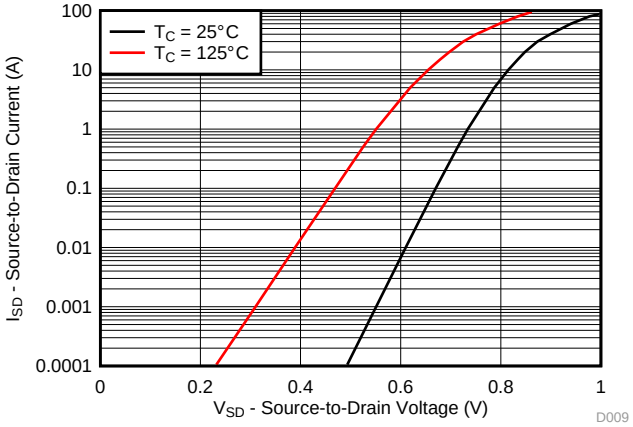


Figure 9. Typical Diode Forward Voltage

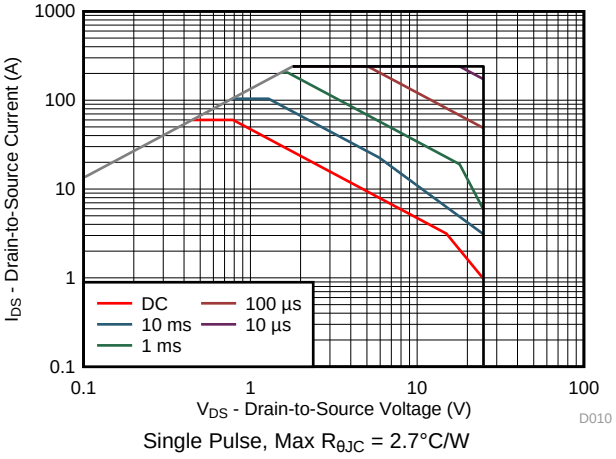


Figure 10. Maximum Safe Operating Area

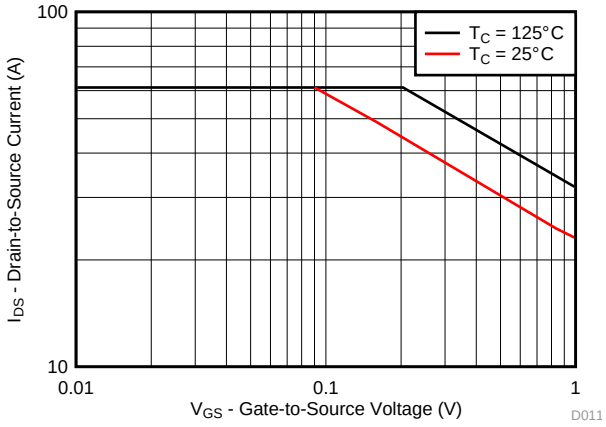


Figure 11. Single Pulse Unclamped Inductive Switching

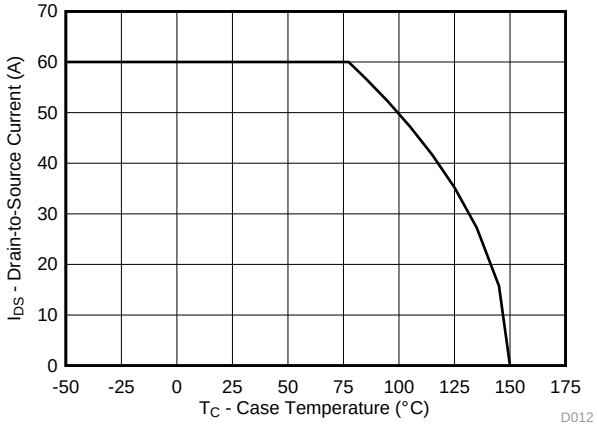


Figure 12. Maximum Drain Current vs Temperature

Copyright © 2009–2015, Texas Instruments Incorporated

6 Device and Documentation Support

6.1 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

TI E2E™ Online Community ***TI's Engineer-to-Engineer (E2E) Community.*** Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

Design Support ***TI's Design Support*** Quickly find helpful E2E forums along with design support tools and contact information for technical support.

6.2 Trademarks

NexFET, E2E are trademarks of Texas Instruments.
All other trademarks are the property of their respective owners.

6.3 Electrostatic Discharge Caution



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.

6.4 Glossary

SLYZ022 — *TI Glossary*.

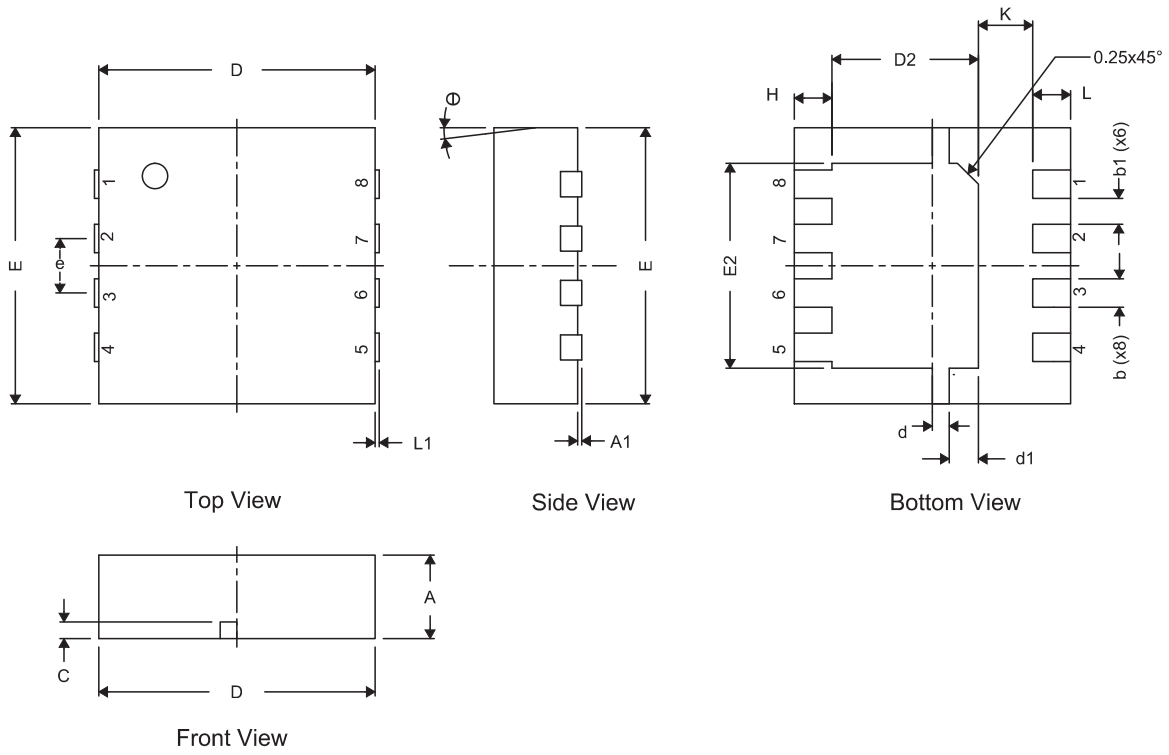
This glossary lists and explains terms, acronyms, and definitions.

Copyright © 2009–2015, Texas Instruments Incorporated

7 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

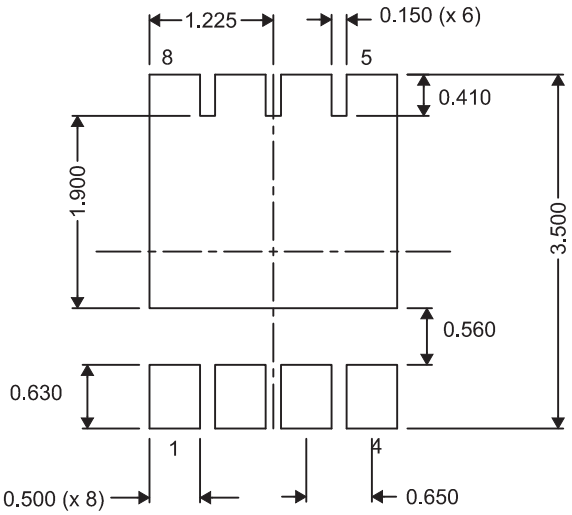
7.1 Q3 Package Dimensions



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
b1		0.310 NOM			0.012 NOM	
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
D2	1.650	1.750	1.800	0.065	0.069	0.071
d	0.150	0.200	0.250	0.006	0.008	0.010
d1	0.300	0.350	0.400	0.012	0.014	0.016
E	3.200	3.300	3.400	0.126	0.130	0.134
E2	2.350	2.450	2.550	0.093	0.096	0.100
e		0.650 TYP			0.026 TYP	
H	0.35	0.450	0.550	0.014	0.018	0.022
K		0.650 TYP			0.026 TYP	
L	0.35	0.450	0.550	0.014	0.018	0.022
L1	0	—	0	0	—	0
θ	0	—	0	0	—	0

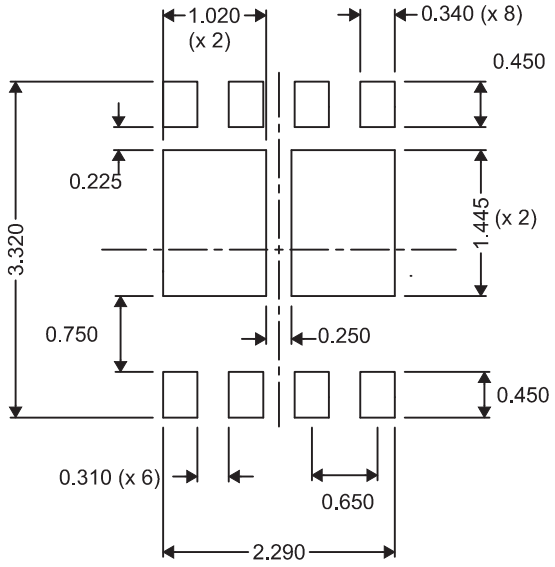
Copyright © 2009–2015, Texas Instruments Incorporated

7.2 Recommended PCB Pattern



For recommended circuit layout for PCB designs, see application note SLPA005 – *Reducing Ringing Through PCB Layout Techniques*.

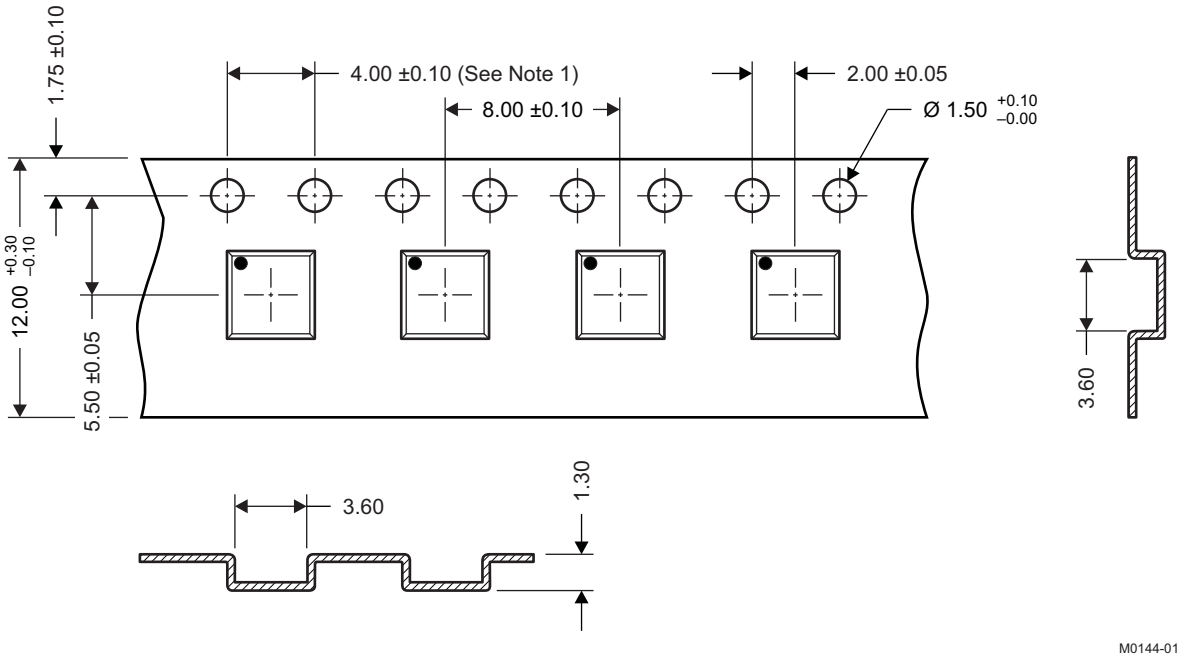
7.3 Recommended Stencil Opening



All dimensions are in mm, unless otherwise specified.

Copyright © 2009–2015, Texas Instruments Incorporated

7.4 Q3 Tape and Reel Information



Notes:

1. 10 sprocket hole pitch cumulative tolerance ±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 ±0.05 mm
6. MSL1 260°C (IR and Convection) PbF-Reflow Compatible

Copyright © 2009–2015, Texas Instruments Incorporated

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
CSD16406Q3	ACTIVE	VSON-CLIP	DQG	8	2500	Green (RoHS & no Sb/Br)	SN	Level-1-260C-UNLIM	-55 to 150	CSD16406	Samples

(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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".
RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.
Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(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.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI’s products are provided subject to TI’s Terms of Sale (www.ti.com/legal/termsofsale.html) or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2020, Texas Instruments Incorporated