

Excellent Integrated System Limited

Stocking Distributor

Click to view price, real time Inventory, Delivery & Lifecycle Information:

[Texas Instruments](#)
[CSD16406Q3](#)

For any questions, you can email us directly:

sales@integrated-circuit.com

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

Product Summary

$T_A = 25^\circ\text{C}$		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	$V_{GS} = 4.5\text{ V}$	5.9	$\text{m}\Omega$
		$V_{GS} = 10\text{ V}$	4.2	$\text{m}\Omega$
V_{th}	Threshold Voltage	1.8		V

2 Applications

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

Ordering Information⁽¹⁾

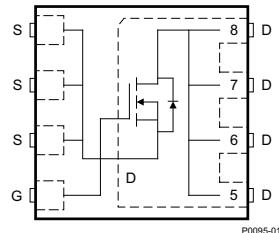
DEVICE	MEDIA	QTY	PACKAGE	SHIP
CSD16406Q3	13-Inch Reel	2500	SON 3.3 x 3.3 mm Plastic Package	Tape and Reel
CSD16406Q3T	13-Inch Reel	250		

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

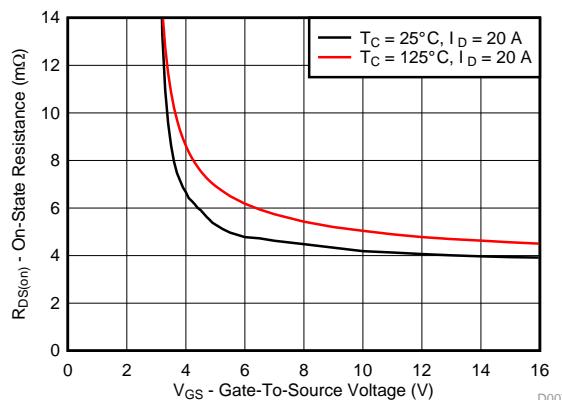
3 Description

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.

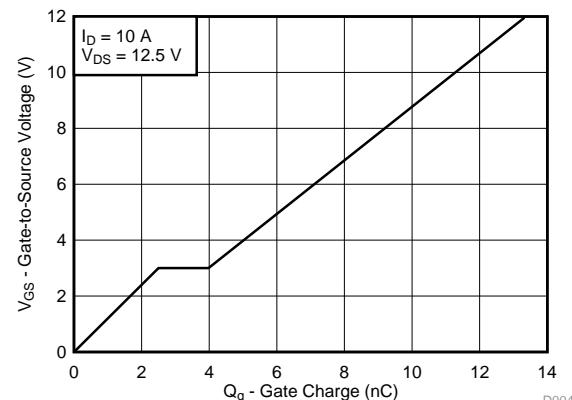
Top View



$R_{DS(on)}$ 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**.

CSD16406Q3

SLPS202B – AUGUST 2009 – REVISED DECEMBER 2015

www.ti.com**Table of Contents**

1 Features	1	6.1 Community Resources	7
2 Applications	1	6.2 Trademarks	7
3 Description	1	6.3 Electrostatic Discharge Caution	7
4 Revision History	2	6.4 Glossary	7
5 Specifications	3	7 Mechanical, Packaging, and Orderable	
5.1 Electrical Characteristics	3	Information	8
5.2 Thermal Information	3	7.1 Q3 Package Dimensions	8
5.3 Typical MOSFET Characteristics	4	7.2 Recommended PCB Pattern	9
6 Device and Documentation Support	7	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 , $T_C = 25^\circ C$	1
• Added Power Dissipation, $T_C = 25^\circ C$	1
• Updated Typical $R_{\theta JA}$	1
• Updated pulsed current conditions	1
• Added <i>Device and Documentation Support</i> section	7
• Updated <i>Mechanical, Packaging, and Orderable Information</i>	8

Changes from Original (August 2009) to Revision A	Page
• Deleted the Package Marking Information section	8

5 Specifications

5.1 Electrical Characteristics

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

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
STATIC CHARACTERISTICS					
BV_{DSS}	Drain-to-source voltage $V_{\text{GS}} = 0 \text{ V}$, $I_D = 250 \mu\text{A}$	25			V
I_{DSS}	Drain-to-source leakage current $V_{\text{GS}} = 0 \text{ V}$, $V_{\text{DS}} = 20 \text{ V}$		1		μA
I_{GSS}	Gate-to-source leakage current $V_{\text{DS}} = 0 \text{ V}$, $V_{\text{GS}} = +16/-12 \text{ V}$		100		nA
$\text{V}_{\text{GS}(\text{th})}$	Gate-to-source threshold voltage $V_{\text{DS}} = V_{\text{GS}}$, $I_D = 250 \mu\text{A}$	1.4	1.8	2.2	V
$\text{R}_{\text{DS}(\text{on})}$	$V_{\text{GS}} = 4.5 \text{ V}$, $I_D = 20 \text{ A}$		5.9	7.4	$\text{m}\Omega$
	$V_{\text{GS}} = 10 \text{ V}$, $I_D = 20 \text{ A}$		4.2	5.3	$\text{m}\Omega$
g_{fs}	Transconductance $V_{\text{DS}} = 15 \text{ V}$, $I_D = 20 \text{ A}$		53		S
DYNAMIC CHARACTERISTICS					
C_{ISS}	Input capacitance	840	1100		pF
C_{OSS}	$V_{\text{GS}} = 0 \text{ V}$, $V_{\text{DS}} = 12.5 \text{ V}$, $f = 1 \text{ MHz}$	680	950		pF
C_{RSS}		57	80		pF
R_g		1.2	2.4		Ω
Q_g	Gate charge total (4.5 V)	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
$\text{Q}_{\text{g}(\text{th})}$	Gate charge at V_{th}	1.5			nC
Q_{OSS}	Output charge $V_{\text{DS}} = 13.6 \text{ V}$, $V_{\text{GS}} = 0 \text{ V}$	13.9			nC
$t_{\text{d}(\text{on})}$	Turn on delay time	7.3			ns
t_r	Rise time $V_{\text{DS}} = 12.5 \text{ V}$, $V_{\text{GS}} = 4.5 \text{ V}$, $I_D = 20 \text{ A}$	12.9			ns
$t_{\text{d}(\text{off})}$	Turn off delay time $R_G = 2 \Omega$	8.5			ns
t_f	Fall time	4.8			ns
DIODE CHARACTERISTICS					
V_{SD}	Diode forward voltage $I_S = 20 \text{ A}$, $V_{\text{GS}} = 0 \text{ V}$	0.85	1.0		V
Q_{rr}	Reverse recovery charge $V_{\text{DD}} = 13.6 \text{ V}$, $I_F = 20 \text{ A}$, $\text{di}/\text{dt} = 300 \text{ A}/\mu\text{s}$	18			nC
t_{rr}	Reverse recovery time $V_{\text{DD}} = 13.6 \text{ V}$, $I_F = 20 \text{ A}$, $\text{di}/\text{dt} = 300 \text{ A}/\mu\text{s}$	22			ns

5.2 Thermal Information

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

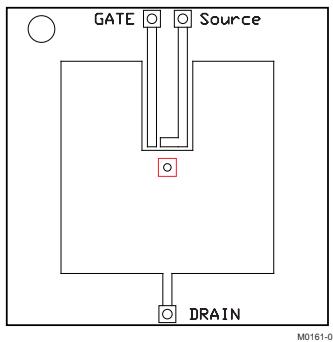
THERMAL METRIC		MIN	TYP	MAX	UNIT
$\text{R}_{\text{θJC}}$	Junction-to-case thermal resistance ⁽¹⁾			2.7	$^\circ\text{C}/\text{W}$
$\text{R}_{\text{θJA}}$	Junction-to-ambient thermal resistance ⁽¹⁾⁽²⁾			55	$^\circ\text{C}/\text{W}$

(1) $\text{R}_{\text{θJC}}$ is determined with the device mounted on a 1 inch² (6.45 cm²), 2 oz. (0.071 mm thick) Cu pad on a 1.5 inch \times 1.5 inch (3.81 cm \times 3.81 cm), 0.06 inch (1.52 mm) thick FR4 PCB. $\text{R}_{\text{θJC}}$ is specified by design, whereas $\text{R}_{\text{θJA}}$ is determined by the user's board design.
 (2) Device mounted on FR4 material with 1 inch² (6.45 cm²), 2 oz. (0.071 mm thick) Cu.

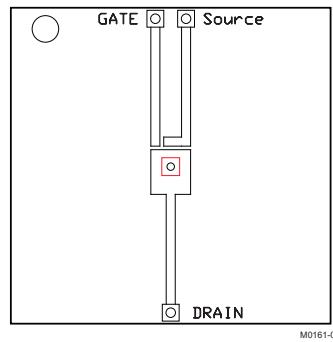
CSD16406Q3

SLPS202B – AUGUST 2009 – REVISED DECEMBER 2015

www.ti.com



Max $R_{\theta JA} = 55^{\circ}\text{C}/\text{W}$
when mounted on 1
inch² of 2 oz. Cu.



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

5.3 Typical MOSFET Characteristics

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

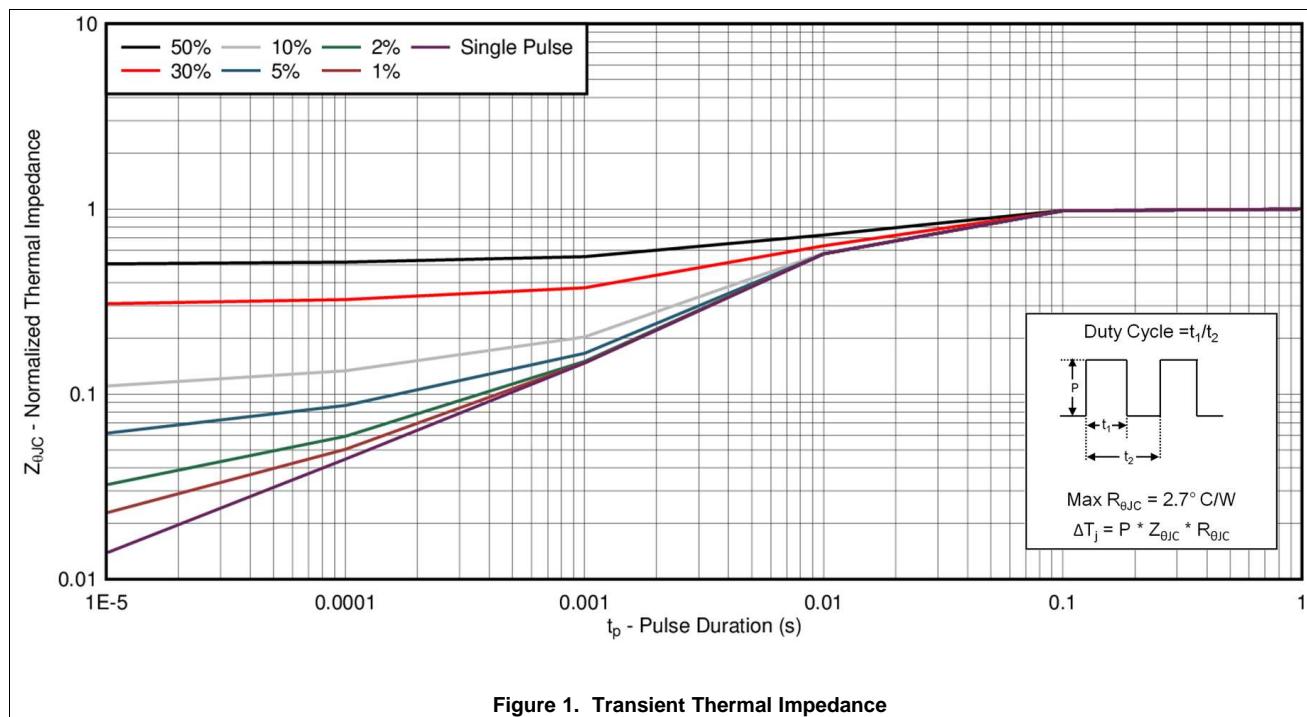


Figure 1. Transient Thermal Impedance

Typical MOSFET Characteristics (continued)

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

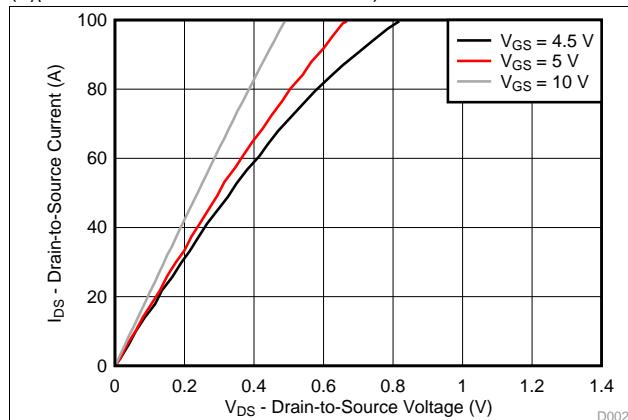


Figure 2. Saturation Characteristics

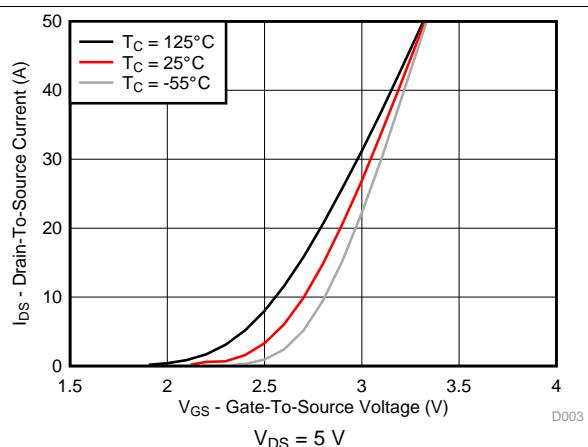


Figure 3. Transfer Characteristics

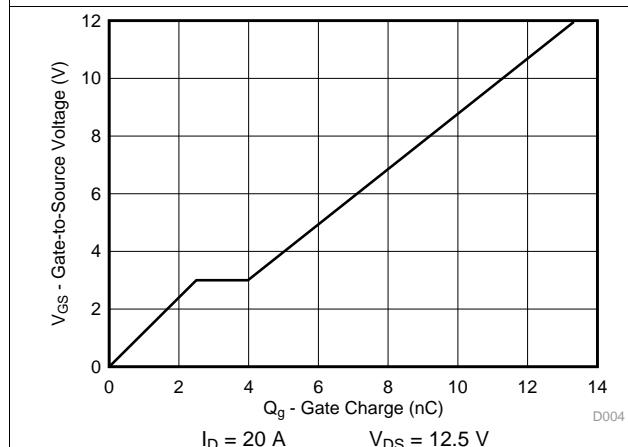


Figure 4. Gate Charge

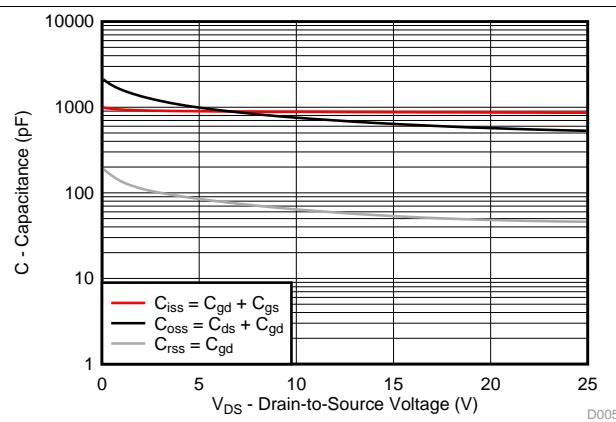


Figure 5. Capacitance

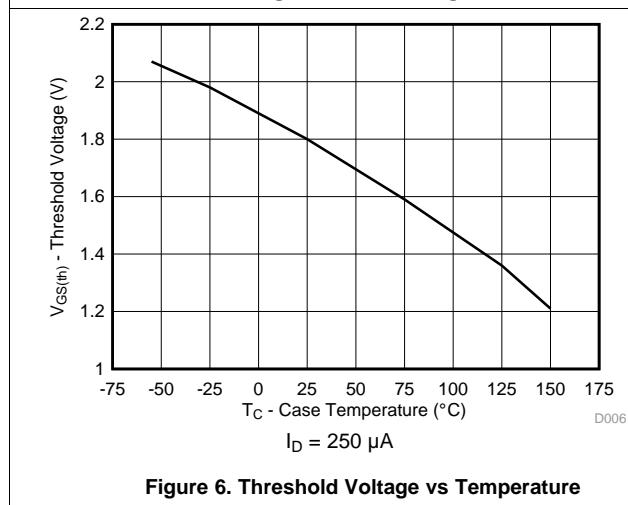


Figure 6. Threshold Voltage vs Temperature

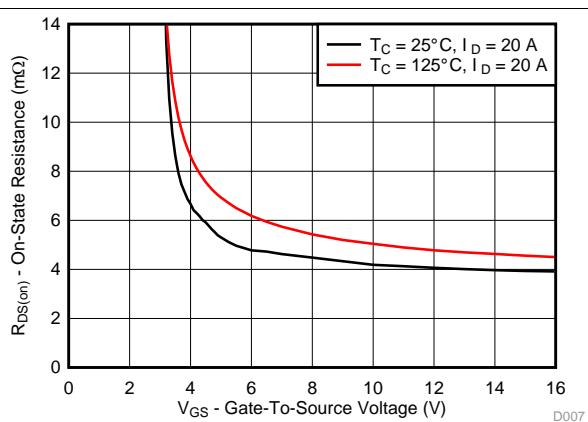


Figure 7. On Resistance vs Gate Voltage

CSD16406Q3

SLPS202B – AUGUST 2009 – REVISED DECEMBER 2015

www.ti.com

Typical MOSFET Characteristics (continued)

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

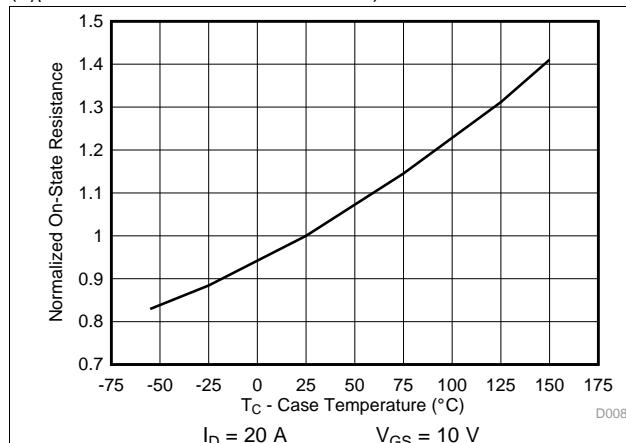


Figure 8. Normalized On-Resistance vs Temperature

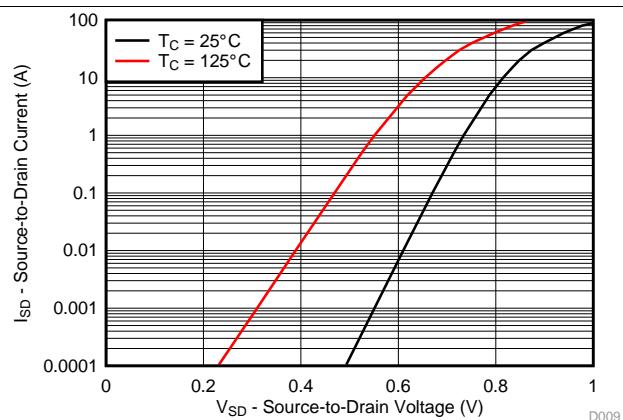


Figure 9. Typical Diode Forward Voltage

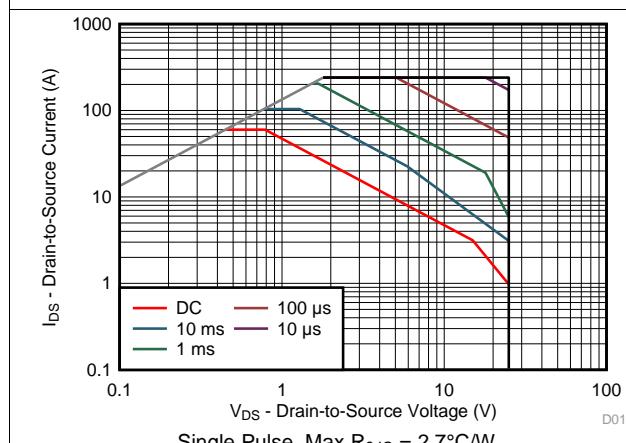


Figure 10. Maximum Safe Operating Area

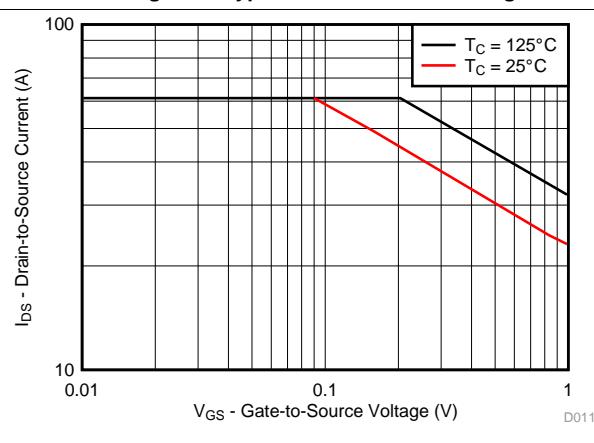


Figure 11. Single Pulse Unclamped Inductive Switching

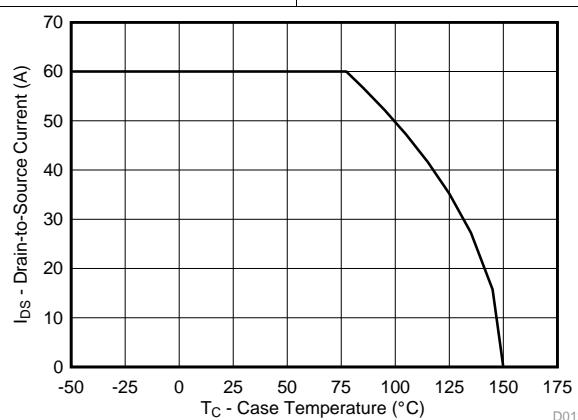


Figure 12. Maximum Drain Current vs Temperature

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.

CSD16406Q3

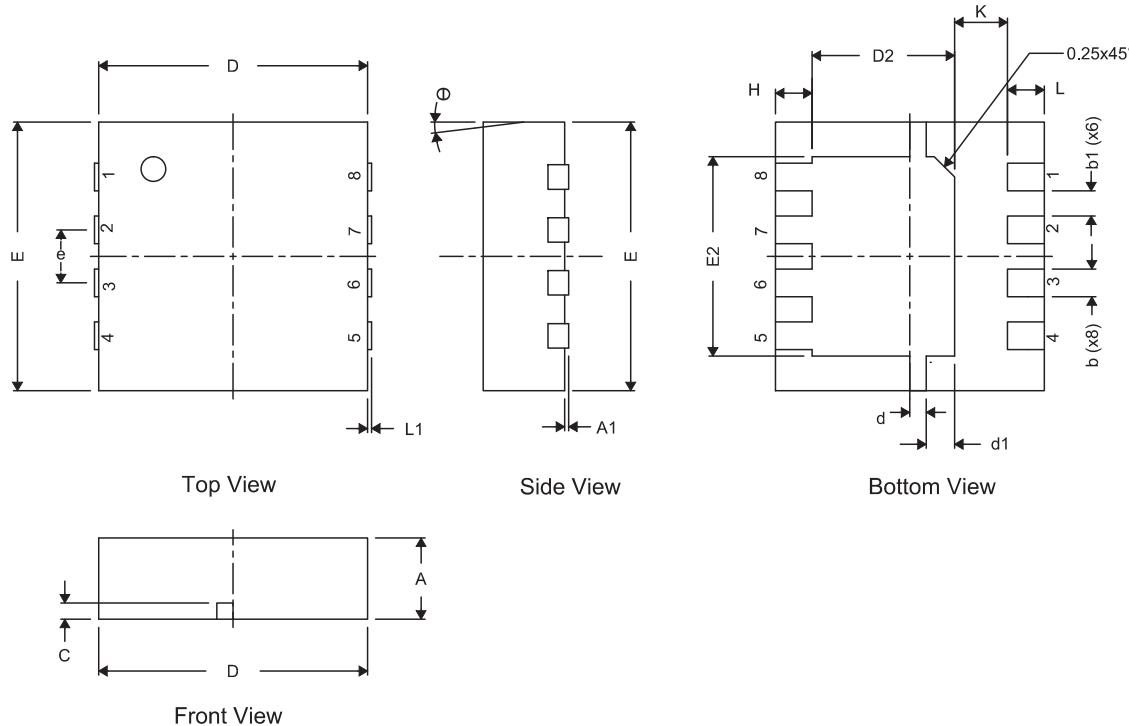
SLPS202B – AUGUST 2009 – REVISED DECEMBER 2015

www.ti.com

7 Mechanical, Packaging, and Orderable Information

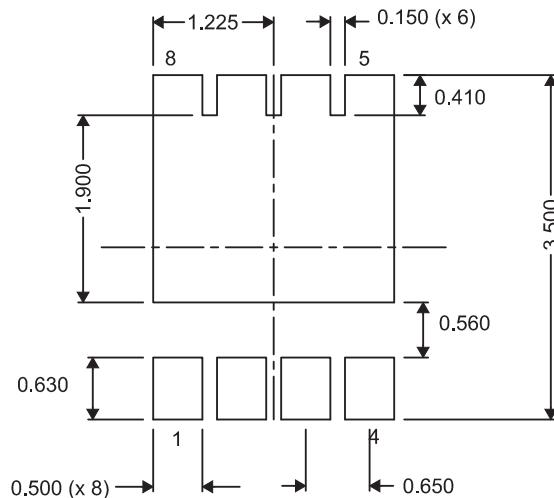
The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand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

7.1 Q3 Package Dimensions



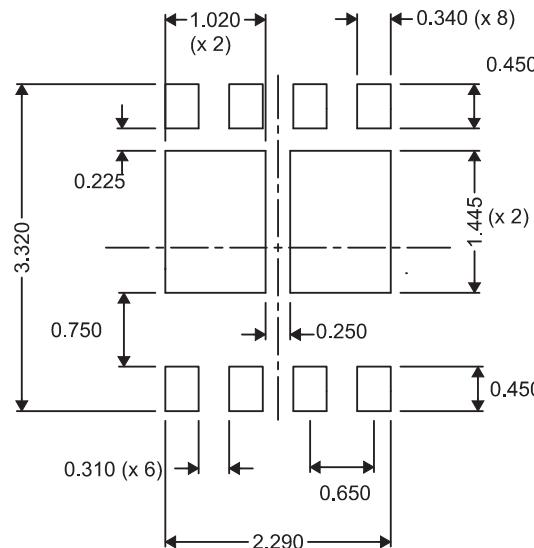
DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.950	1.000	1.100	0.037	0.039	0.043
A1	0.000	0.000	0.050	0.000	0.000	0.002
b	0.280	0.340	0.400	0.011	0.013	0.016
b1	0.310 NOM			0.012 NOM		
c	0.150	0.200	0.250	0.006	0.008	0.010
D	3.200	3.300	3.400	0.126	0.130	0.134
D2	1.650	1.750	1.800	0.065	0.069	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

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



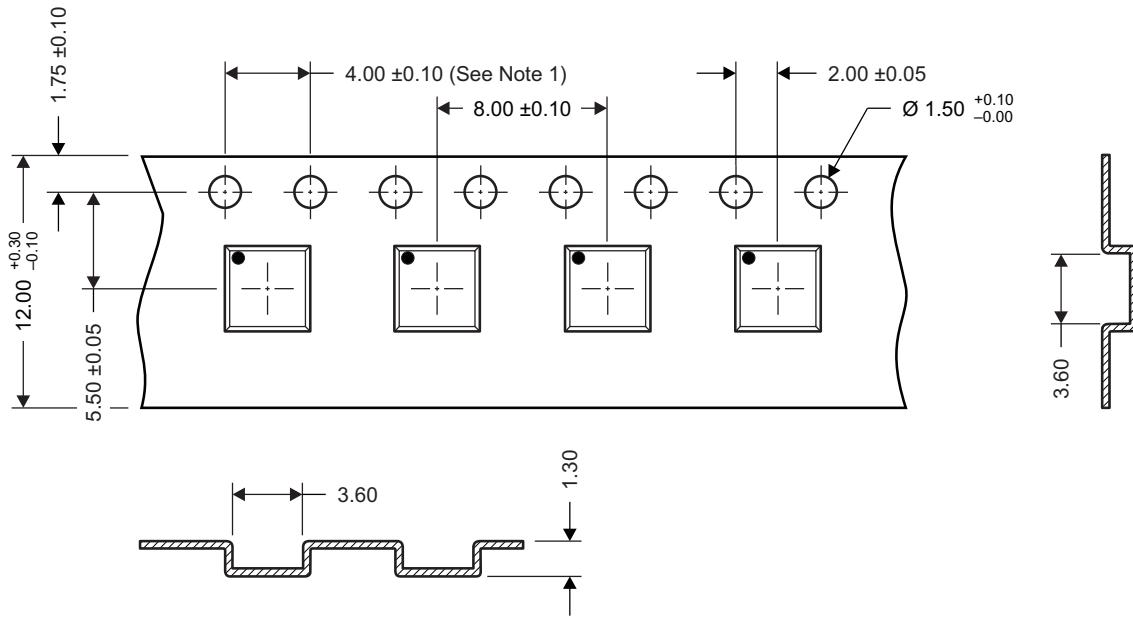
All dimensions are in mm, unless otherwise specified.

CSD16406Q3

SLPS202B – AUGUST 2009 – REVISED DECEMBER 2015

www.ti.com

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

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	Pb-Free (RoHS Exempt)	CU 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) 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.

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

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Communitye2e.ti.com