

CSD16321Q5 25V N-Channel NexFET™ Power MOSFET

1 Features

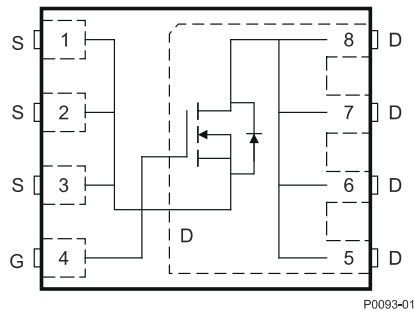
- Optimized for 5V gate drive
- Ultra-low Q_g and Q_{gd}
- Low-thermal resistance
- Avalanche rated
- Lead-free terminal plating
- RoHS compliant
- SON 5mm × 6mm plastic package

2 Applications

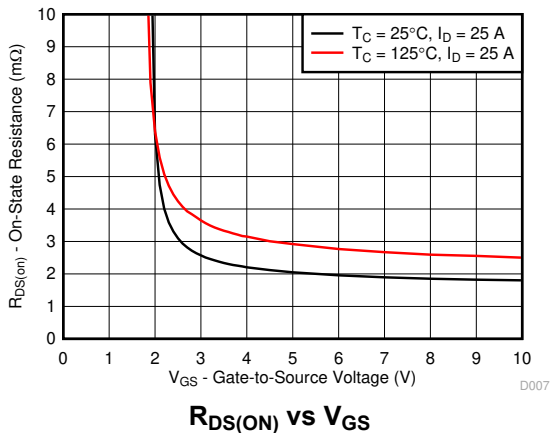
- Point-of-load synchronous buck converter for applications in networking, telecom, and computing systems
- Optimized for synchronous FET applications

3 Description

This 25V, 1.9mΩ, 5mm × 6mm SON NexFET™ power MOSFET has been designed to minimize losses in power conversion and optimized for 5V gate drive applications.



Top View



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

Product Summary

$T_A = 25^\circ\text{C}$		TYPICAL VALUE	UNIT
V_{DS}	Drain-to-Source Voltage	25	V
Q_g	Gate Charge Total (4.5V)	14	nC
Q_{gd}	Gate Charge Gate-to-Drain	2.5	nC
$R_{DS(on)}$	Drain-to-Source On Resistance	$V_{GS} = 3\text{V}$	2.8
		$V_{GS} = 4.5\text{V}$	2.1
		$V_{GS} = 8\text{V}$	1.9
$V_{GS(th)}$	Threshold Voltage	1.1	V

Device Information⁽¹⁾

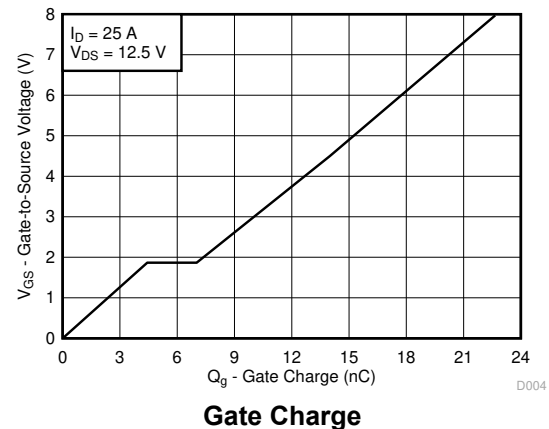
DEVICE	MEDIA	QTY	PACKAGE	SHIP
CSD16321Q5	13-Inch Reel	2500	SON 5.00mm × 6.00mm	Tape and Reel
CSD16321Q5T	7-Inch Reel	250	Plastic Package	

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

Absolute Maximum Ratings

$T_A = 25^\circ\text{C}$		VALUE	UNIT
V_{DS}	Drain-to-Source Voltage	25	V
V_{GS}	Gate-to-Source Voltage	+10 / -8	V
I_D	Continuous Drain Current (Package Limited)	100	A
	Continuous Drain Current (Silicon Limited), $T_C = 25^\circ\text{C}$	177	
	Continuous Drain Current ⁽¹⁾	29	
I_{DM}	Pulsed Drain Current ⁽²⁾	400	A
P_D	Power Dissipation ⁽¹⁾	3.1	W
	Power Dissipation, $T_C = 25^\circ\text{C}$	113	
T_J , T_{stg}	Operating Junction, Storage Temperature	-55 to 150	$^\circ\text{C}$
E_{AS}	Avalanche Energy, Single Pulse $I_D = 66\text{A}$, $L = 0.1\text{mH}$, $R_G = 25\Omega$	218	mJ

- (1) Typical $R_{\theta JA} = 40^\circ\text{C/W}$ on 1in², 2oz Cu pad on 0.06in thick FR4 PCB.
 (2) Max $R_{\theta JC} = 1.1^\circ\text{C/W}$, pulse duration $\leq 100\mu\text{s}$, duty cycle $\leq 1\%$.



Gate Charge



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4 Specifications

4.1 Electrical Characteristics

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

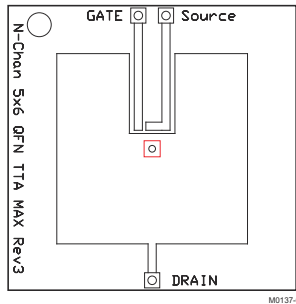
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT	
STATIC CHARACTERISTICS							
BV _{DSS}	Drain-to-source voltage	V _{GS} = 0V, I _D = 250μA	25			V	
I _{DSS}	Drain-to-source leakage current	V _{GS} = 0V, V _{DS} = 20V	1			μA	
I _{GSS}	Gate-to-source leakage current	V _{DS} = 0V, V _{GS} = +10 / −8V	100			nA	
V _{GS(th)}	Gate-to-source threshold voltage	V _{DS} = V _{GS} , I _D = 250μA	0.9	1.1	1.4	V	
R _{DS(on)}	Drain-to-source on resistance	V _{GS} = 3V, I _D = 25A	2.8			mΩ	
		V _{GS} = 4.5V, I _D = 25A	2.1				
		V _{GS} = 8V, I _D = 25A	1.9				
g _{fs}	Transconductance	V _{DS} = 12.5V, I _D = 25A	150			S	
DYNAMIC CHARACTERISTICS							
C _{iss}	Input capacitance	V _{GS} = 0V, V _{DS} = 12.5V, f = 1MHz	2360			3100	pF
C _{oss}	Output capacitance		1700			2200	pF
C _{rss}	Reverse transfer capacitance		115			150	pF
R _G	Series gate resistance		1.5			3	Ω
Q _g	Gate charge total (4.5 V)	V _{DS} = 12.5V, I _D = 25A	14			19	nC
Q _{gd}	Gate charge gate-to-drain		2.5				nC
Q _{gs}	Gate charge gate-to-source		4				nC
Q _{g(th)}	Gate charge at V _{th}		2.1				nC
Q _{oss}	Output charge	V _{DS} = 15V, V _{GS} = 0V	36				nC
t _{d(on)}	Turnon delay time	V _{DS} = 12.5V, V _{GS} = 4.5V, I _D = 25A, R _G = 2Ω	9				ns
t _r	Rise time		15				ns
t _{d(off)}	Turnoff delay time		27				ns
t _f	Fall time		17				ns
DIODE CHARACTERISTICS							
V _{SD}	Diode forward voltage	I _{SD} = 25A, V _{GS} = 0V	0.8			1	V
Q _{rr}	Reverse recovery charge	V _{DD} = 13V, I _F = 25A, di/dt = 300A/μs	33				nC
t _{rr}	Reverse recovery time	V _{DD} = 13V, I _F = 25A, di/dt = 300A/μs	32				ns

4.2 Thermal Information

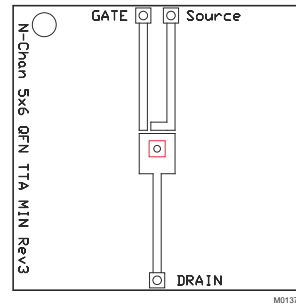
$T_A = 25^\circ\text{C}$ (unless otherwise stated)

PARAMETER		MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction-to-case thermal resistance ⁽¹⁾			1.1	$^\circ\text{C/W}$
$R_{\theta JA}$	Junction-to-ambient thermal resistance ^{(1) (2)}			50	$^\circ\text{C/W}$

- (1) $R_{\theta JC}$ is determined with the device mounted on a 1in², 2oz Cu pad on a 1.5in × 1.5in, 0.06in 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 in² of 2oz Cu.



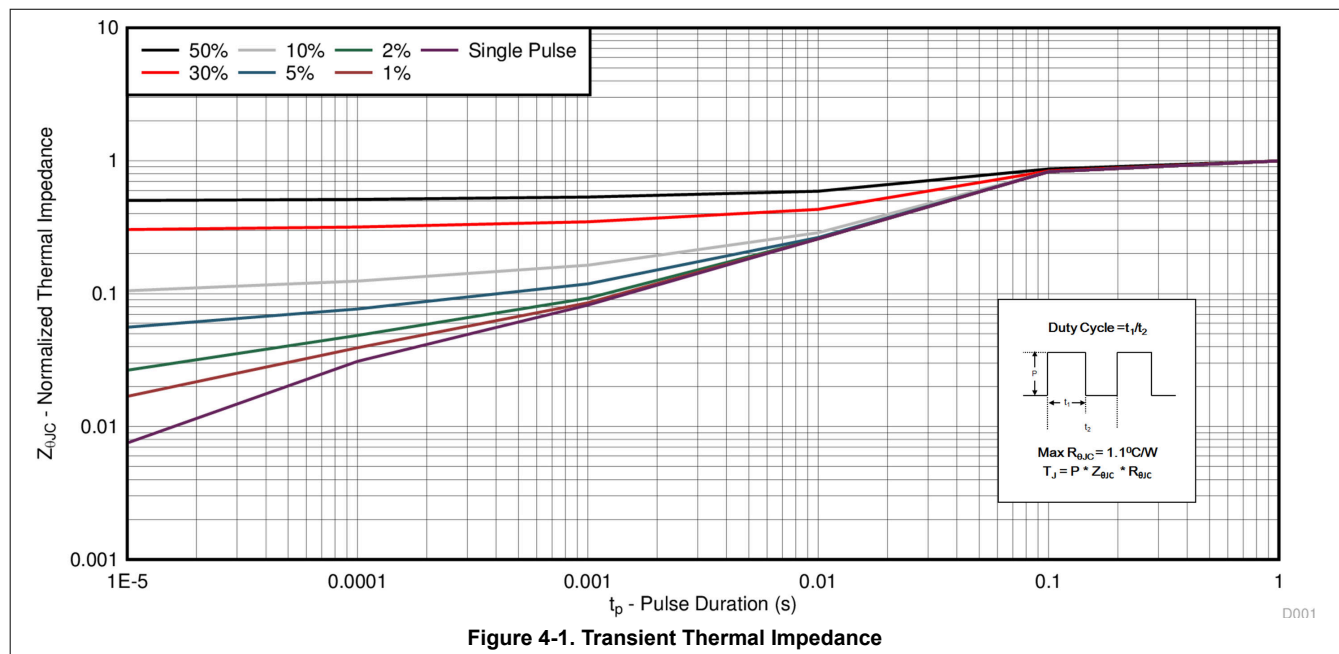
Max $R_{\theta JA} = 50^{\circ}\text{C/W}$ when mounted on 1in^2 of 2oz Cu.



Max $R_{\theta JA} = 125^{\circ}\text{C/W}$ when mounted on minimum pad area of 2oz Cu.

4.3 Typical MOSFET Characteristics

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



4.3 Typical MOSFET Characteristics (continued)

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

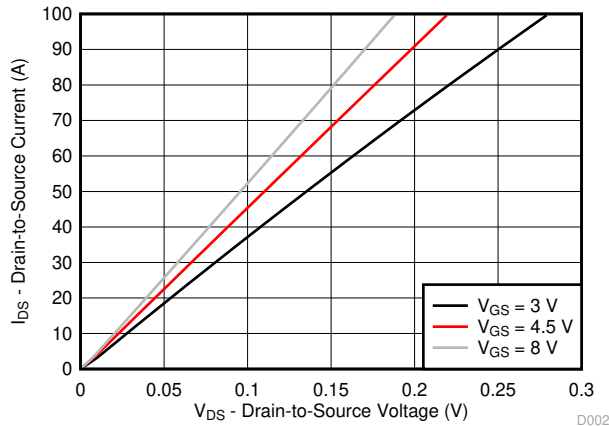


Figure 4-2. Saturation Characteristics

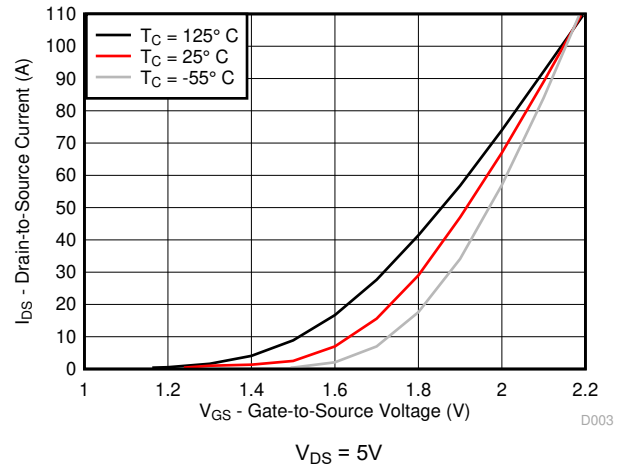


Figure 4-3. Transfer Characteristics

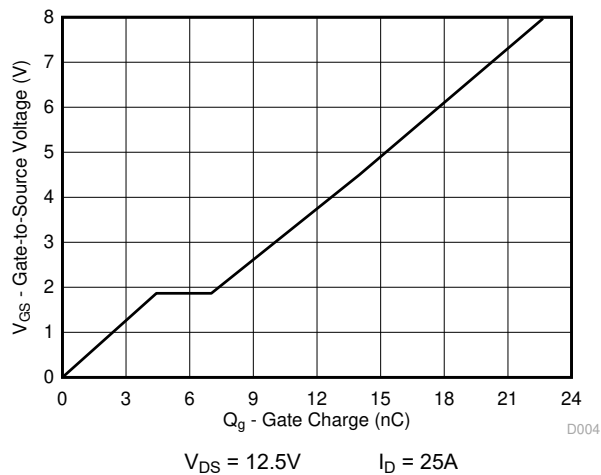


Figure 4-4. Gate Charge

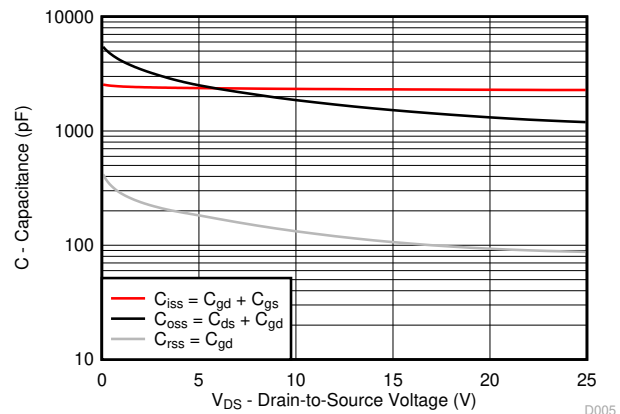


Figure 4-5. Capacitance

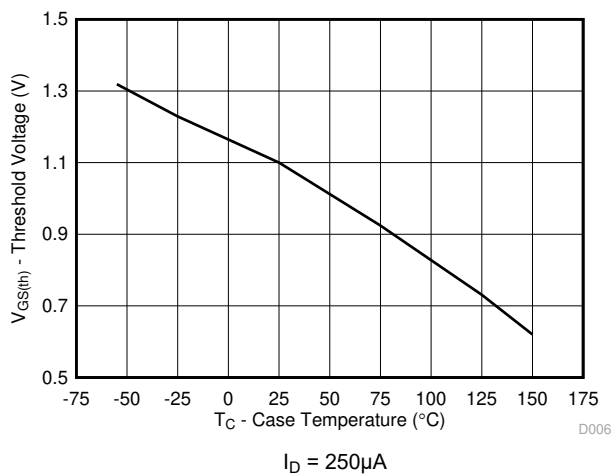


Figure 4-6. Threshold Voltage vs Temperature

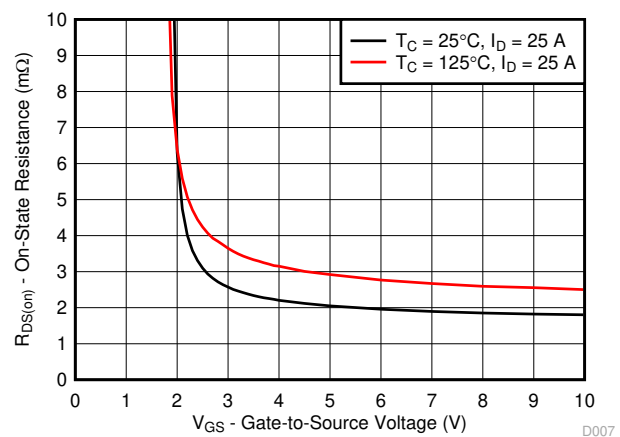


Figure 4-7. On Resistance vs Gate Voltage

4.3 Typical MOSFET Characteristics (continued)

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

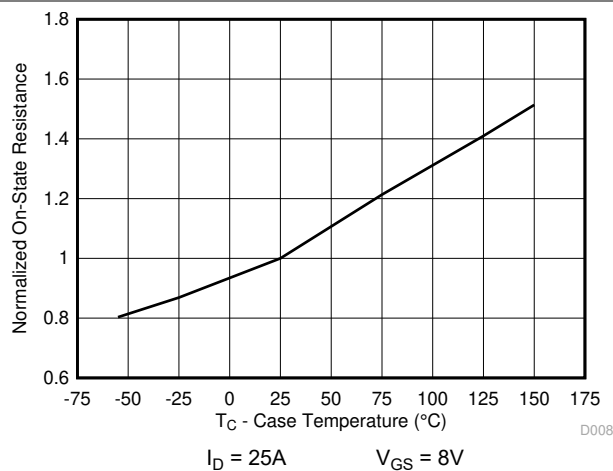


Figure 4-8. On Resistance vs Temperature

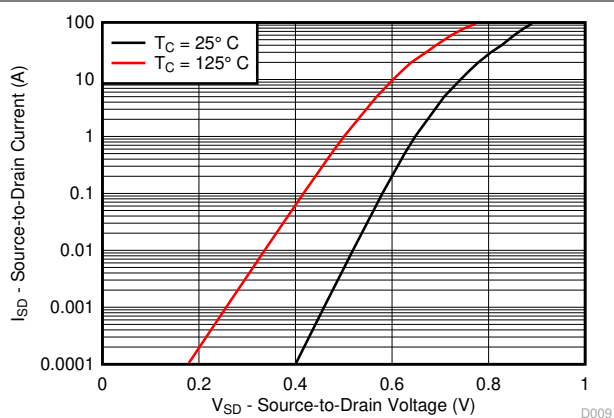


Figure 4-9. Typical Diode Forward Voltage

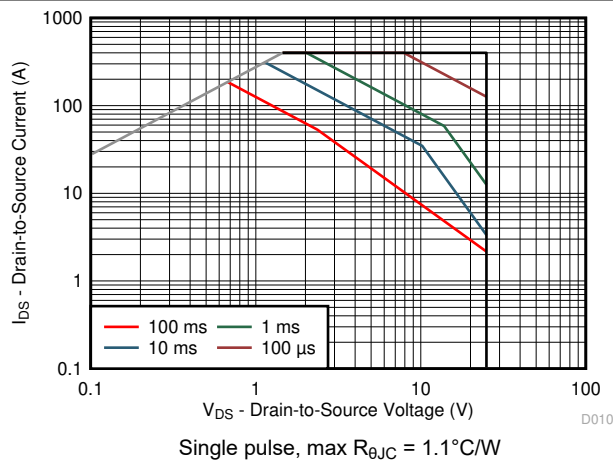


Figure 4-10. Maximum Safe Operating Area

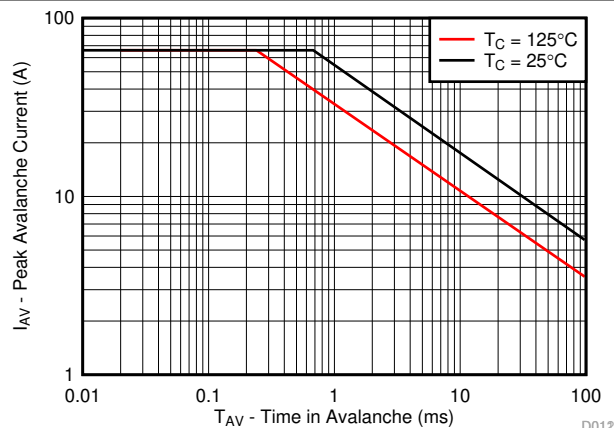


Figure 4-11. Single Pulse Unclamped Inductive Switching

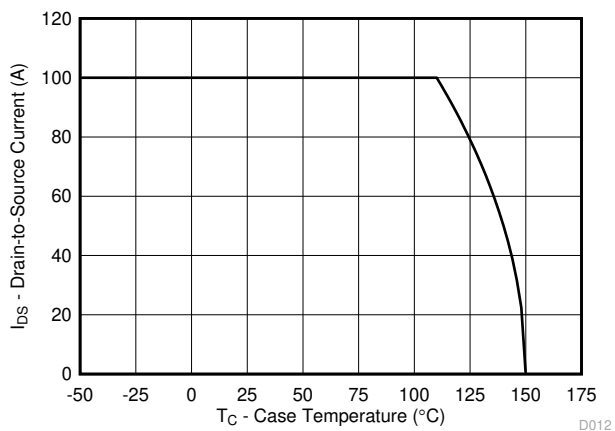


Figure 4-12. Maximum Drain Current vs Temperature

5 Device and Documentation Support

5.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Notifications* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

5.2 Support Resources

[TI E2E™ support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

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5.3 Trademarks

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5.4 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

5.5 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

6 Revision History

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

Changes from Revision D (May 2017) to Revision E (December 2023) Page

- Updated the numbering format for tables, figures, and cross-references throughout the document..... 1

Changes from Revision C (December 2016) to Revision D (May 2017) Page

- Changed the $R_{DS(ON)}$ values at 3 V, 4.5 V, 8 V & the [Description](#) to match the values on the *Electrical Characteristics* table. 1

Changes from Revision B (May 2010) to Revision C (December 2016) Page

- Changed *Description* text..... 1
- Added silicon limited continuous drain current to *Absolute Maximum Ratings* table.....1
- Added max power dissipation at $T_C = 25^\circ\text{C}$ to *Absolute Maximum Ratings* table.....1
- Changed Note 2 in *Absolute Maximum Ratings* table..... 1
- Changed $R_{\theta JA}$ max from 48°C/W : to 50°C/W 3
- Changed the SOA in [Figure 4-10](#) to reflect measured data..... 4
- Changed *MECHANICAL DATA* section to *Mechanical, Packaging, and Orderable Information* section.....9

Changes from Revision A (January 2010) to Revision B (May 2010) Page

- Changed $R_{DS(on)} - V_{GS} = 3\text{V}$, $I_D = 25\text{A}$ MAX value From: 3.5 To: 3.8.....3

Changes from Revision * (August 2009) to Revision A (January 2010) Page

- Changed the labels on the Top View pinout image..... 1
- Changed Note 1 of the *Absolute Maximum Ratings* From: $R_{\theta JA} = 39^\circ\text{C/W}$ To: Typical $R_{\theta JA} = 39^\circ\text{C/W}$ 1
- Changed [Figure 4-1](#) text From: $R_{\theta JA} = 92^\circ\text{C/W}$ To: Typical $R_{\theta JA} = 93^\circ\text{C/W}$ 4
- Changed [Figure 4-10](#) text From: $R_{\theta JA} = 92^\circ\text{C/W}$ To: Typical $R_{\theta JA} = 93^\circ\text{C/W}$ 4
- Changed [Figure 4-11](#) X-axis values..... 4

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.

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
CSD16321Q5	Active	Production	VSON-CLIP (DQH) 8	2500 LARGE T&R	ROHS Exempt	SN	Level-1-260C-UNLIM	-55 to 150	CSD16321
CSD16321Q5.B	Active	Production	VSON-CLIP (DQH) 8	2500 LARGE T&R	ROHS Exempt	SN	Level-1-260C-UNLIM	-55 to 150	CSD16321
CSD16321Q5T	Active	Production	VSON-CLIP (DQH) 8	250 SMALL T&R	ROHS Exempt	SN	Level-1-260C-UNLIM	-55 to 150	CSD16321
CSD16321Q5T.B	Active	Production	VSON-CLIP (DQH) 8	250 SMALL T&R	ROHS Exempt	SN	Level-1-260C-UNLIM	-55 to 150	CSD16321

⁽¹⁾ **Status:** For more details on status, see our [product life cycle](#).

⁽²⁾ **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

⁽³⁾ **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

⁽⁴⁾ **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

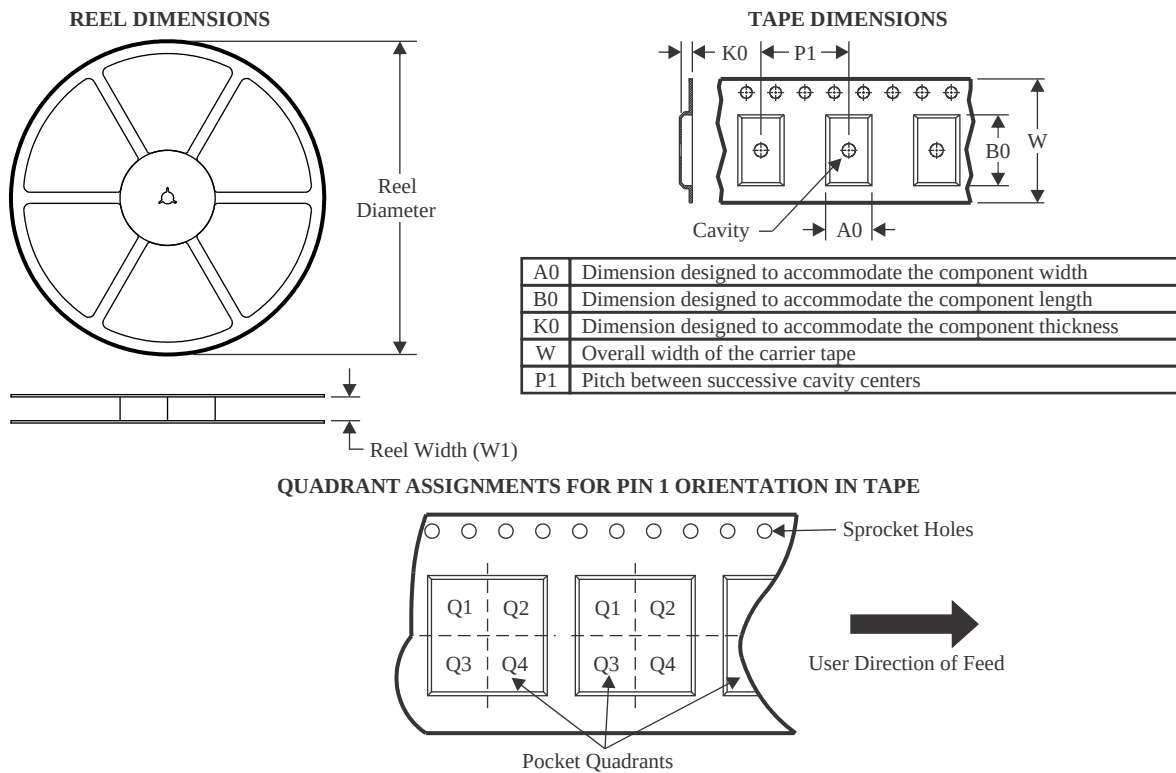
⁽⁶⁾ **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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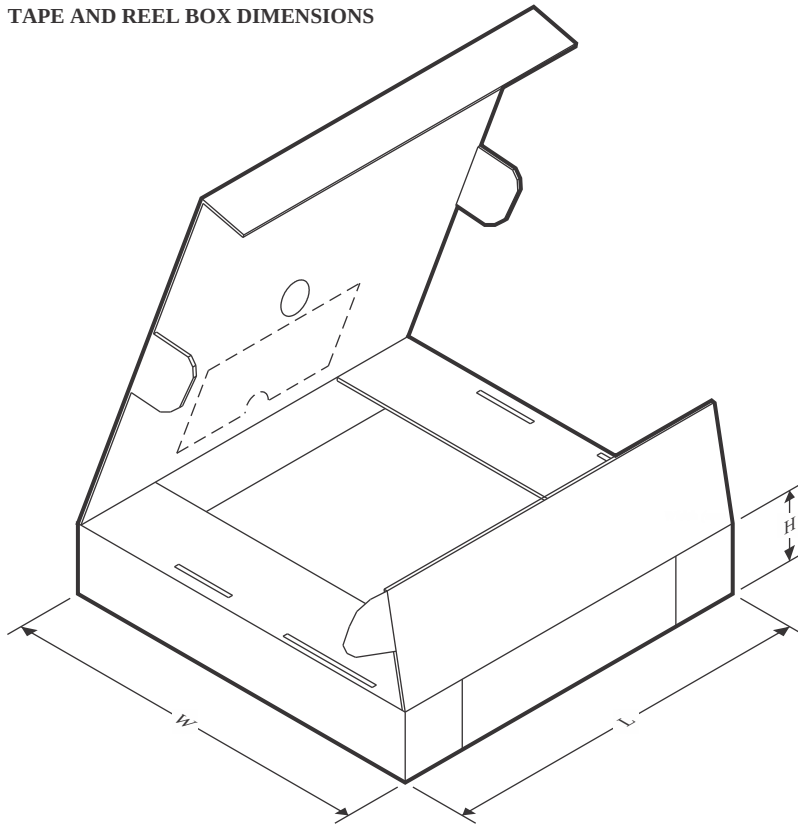
TAPE AND REEL INFORMATION



*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
CSD16321Q5T	VSON-CLIP	DQH	8	250	178.0	12.4	6.3	5.3	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)
CSD16321Q5T	VSON-CLIP	DQH	8	250	180.0	180.0	79.0



VSON-CLIP - 1.05 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



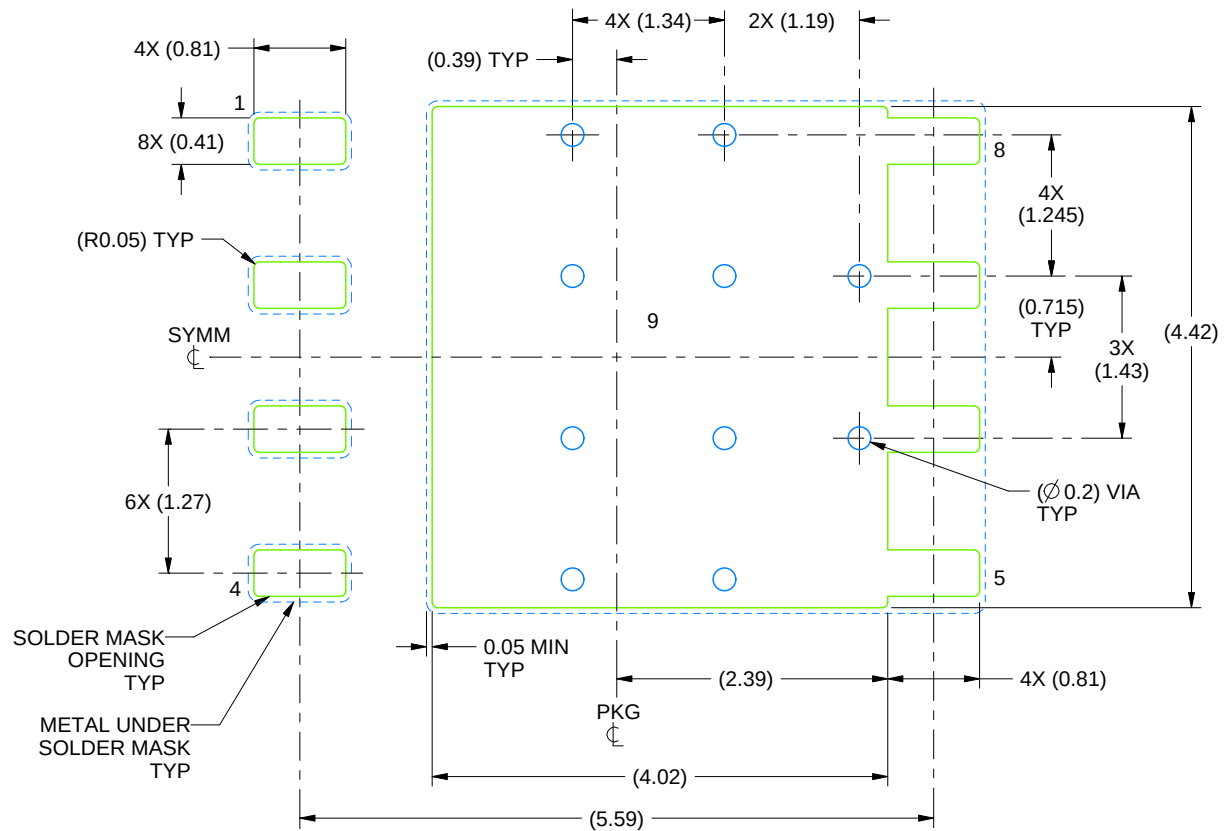
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

EXAMPLE BOARD LAYOUT

DQH0008A

VSON-CLIP - 1.05 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



LAND PATTERN EXAMPLE
SOLDER MASK DEFINED
SCALE:15X

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NOTES: (continued)

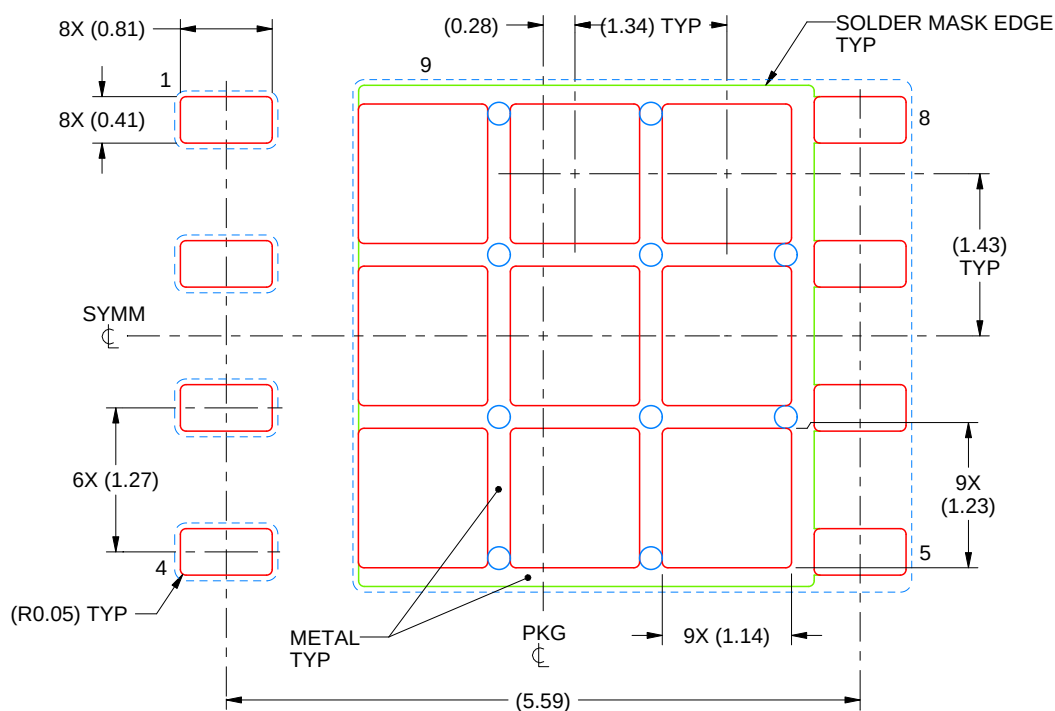
4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/sluea271).
5. Vias are optional depending on application, refer to device data sheet. If some or all are implemented, recommended via locations are shown.

EXAMPLE STENCIL DESIGN

DQH0008A

VSON-CLIP - 1.05 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



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NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

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