

CSD19538Q2 100-V N-Channel NexFET™ Power MOSFET

1 Features

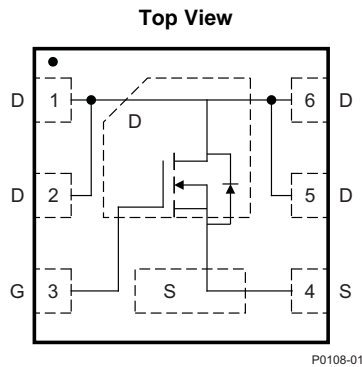
- Ultra-Low Q_g and Q_{gd}
- Low-Thermal Resistance
- Avalanche Rated
- Lead Free
- RoHS Compliant
- Halogen Free
- SON 2-mm x 2-mm Plastic Package

2 Applications

- Power Over Ethernet (PoE)
- Power Sourcing Equipment (PSE)
- Motor Control

3 Description

This 100-V, 49-m Ω , SON 2-mm x 2-mm NexFET™ power MOSFET is designed to minimize losses in power conversion applications.



Product Summary

$T_A = 25^\circ\text{C}$		TYPICAL VALUE		UNIT
V_{DS}	Drain-to-Source Voltage	100		V
Q_g	Gate Charge Total (10 V)	4.3		nC
Q_{gd}	Gate Charge Gate-to-Drain	0.8		nC
$R_{DS(on)}$	Drain-to-Source On Resistance	$V_{GS} = 6\text{ V}$	58	m Ω
		$V_{GS} = 10\text{ V}$	49	
$V_{GS(th)}$	Threshold Voltage	3.2		V

Device Information⁽¹⁾

DEVICE	QTY	MEDIA	PACKAGE	SHIP
CSD19538Q2	3000	7-Inch Reel	SON	Tape and Reel
CSD19538Q2T	250		2.00-mm x 2.00-mm Plastic Package	

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

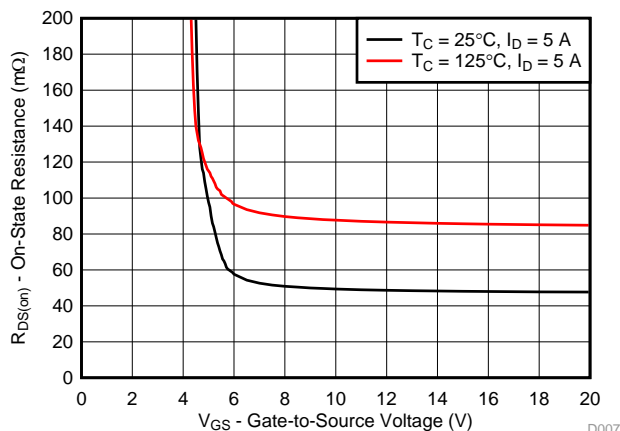
Absolute Maximum Ratings

$T_A = 25^\circ\text{C}$		VALUE	UNIT
V_{DS}	Drain-to-Source Voltage	100	V
V_{GS}	Gate-to-Source Voltage	± 20	V
I_D	Continuous Drain Current (Package Limited)	14.4	A
	Continuous Drain Current (Silicon Limited), $T_C = 25^\circ\text{C}$	13.1	
	Continuous Drain Current ⁽¹⁾	4.6	
I_{DM}	Pulsed Drain Current ⁽²⁾	34.4	A
P_D	Power Dissipation ⁽¹⁾	2.5	W
	Power Dissipation, $T_C = 25^\circ\text{C}$	20.2	
T_J, T_{stg}	Operating Junction Temperature, Storage Temperature	-55 to 150	$^\circ\text{C}$
E_{AS}	Avalanche Energy, Single Pulse $I_D = 12.6\text{ A}$, $L = 0.1\text{ mH}$, $R_G = 25\text{ }\Omega$	8	mJ

(1) Typical $R_{\theta JA} = 50^\circ\text{C/W}$ on a 1-in², 2-oz Cu pad on a 0.06-in thick FR4 PCB.

(2) Max $R_{\theta JC} = 6.2^\circ\text{C/W}$, pulse duration $\leq 100\text{ }\mu\text{s}$, duty cycle $\leq 1\%$.

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



Gate Charge

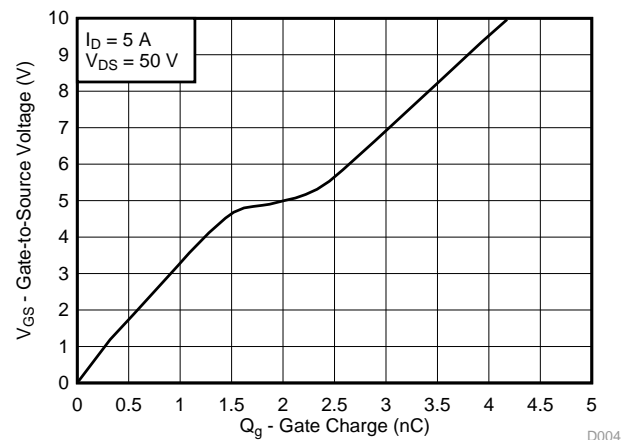


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4 Revision History

Changes from Original (July 2016) to Revision A	Page
• Changed test voltage V_{DS} from 100 V : to 50 V in Gate Charge curve	1
• Changed test voltage V_{DS} from 100 V : to 50 V in Figure 4	4

5 Specifications

5.1 Electrical Characteristics

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

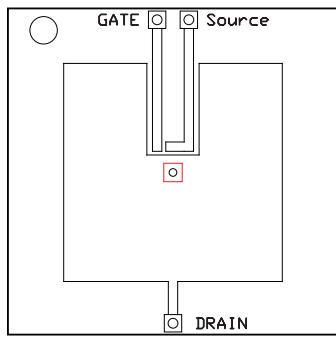
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
STATIC CHARACTERISTICS						
BV _{DSS}	Drain-to-source voltage	V _{GS} = 0 V, I _D = 250 μA	100			V
I _{DSS}	Drain-to-source leakage current	V _{GS} = 0 V, V _{DS} = 80 V			1	μA
I _{GSS}	Gate-to-source leakage current	V _{DS} = 0 V, V _{GS} = 20 V			100	nA
V _{GS(th)}	Gate-to-source threshold voltage	V _{DS} = V _{GS} , I _D = 250 μA	2.8	3.2	3.8	V
R _{DS(on)}	Drain-to-source on resistance	V _{GS} = 6 V, I _D = 5 A	58		72	mΩ
		V _{GS} = 10 V, I _D = 5 A	49		59	
g _{fs}	Transconductance	V _{DS} = 10 V, I _D = 5 A	19			S
DYNAMIC CHARACTERISTICS						
C _{iss}	Input capacitance	V _{GS} = 0 V, V _{DS} = 50 V, f = 1 MHz		349	454	pF
C _{oss}	Output capacitance			69	90	pF
C _{rss}	Reverse transfer capacitance			12.6	16.4	pF
R _G	Series gate resistance			4.6	9.2	Ω
Q _g	Gate charge total (10 V)	V _{DS} = 50 V, I _D = 5 A		4.3	5.6	nC
Q _{gd}	Gate charge gate-to-drain			0.8		nC
Q _{gs}	Gate charge gate-to-source			1.6		nC
Q _{g(th)}	Gate charge at V _{th}			1.0		nC
Q _{oss}	Output charge	V _{DS} = 50 V, V _{GS} = 0 V		12.3		nC
t _{d(on)}	Turnon delay time	V _{DS} = 50 V, V _{GS} = 10 V, I _{DS} = 5 A, R _G = 0 Ω		5		ns
t _r	Rise time			3		ns
t _{d(off)}	Turnoff delay time			7		ns
t _f	Fall time			2		ns
DIODE CHARACTERISTICS						
V _{SD}	Diode forward voltage	I _{SD} = 5 A, V _{GS} = 0 V		0.85	1.0	V
Q _{rr}	Reverse recovery charge	V _{DS} = 50 V, I _F = 5 A, di/dt = 300 A/μs		94		nC
t _{rr}	Reverse recovery time			32		ns

5.2 Thermal Information

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

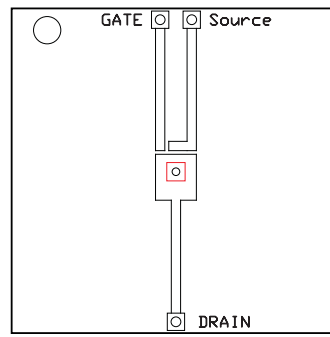
THERMAL METRIC		MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction-to-case thermal resistance ⁽¹⁾			6.2	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Junction-to-ambient thermal resistance ⁽¹⁾⁽²⁾			65	$^\circ\text{C}/\text{W}$

- (1) $R_{\theta JC}$ is determined with the device mounted on a 1-in² (6.45-cm²), 2-oz (0.071-mm) thick Cu pad on a 1.5-in × 1.5-in (3.81-cm × 3.81-cm), 0.06-in (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-in² (6.45-cm²), 2-oz (0.071-mm) thick Cu.



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Max $R_{\theta JA} = 65^{\circ}\text{C/W}$
when mounted on 1 in²
(6.45 cm²) of 2-oz
(0.071-mm) thick Cu.

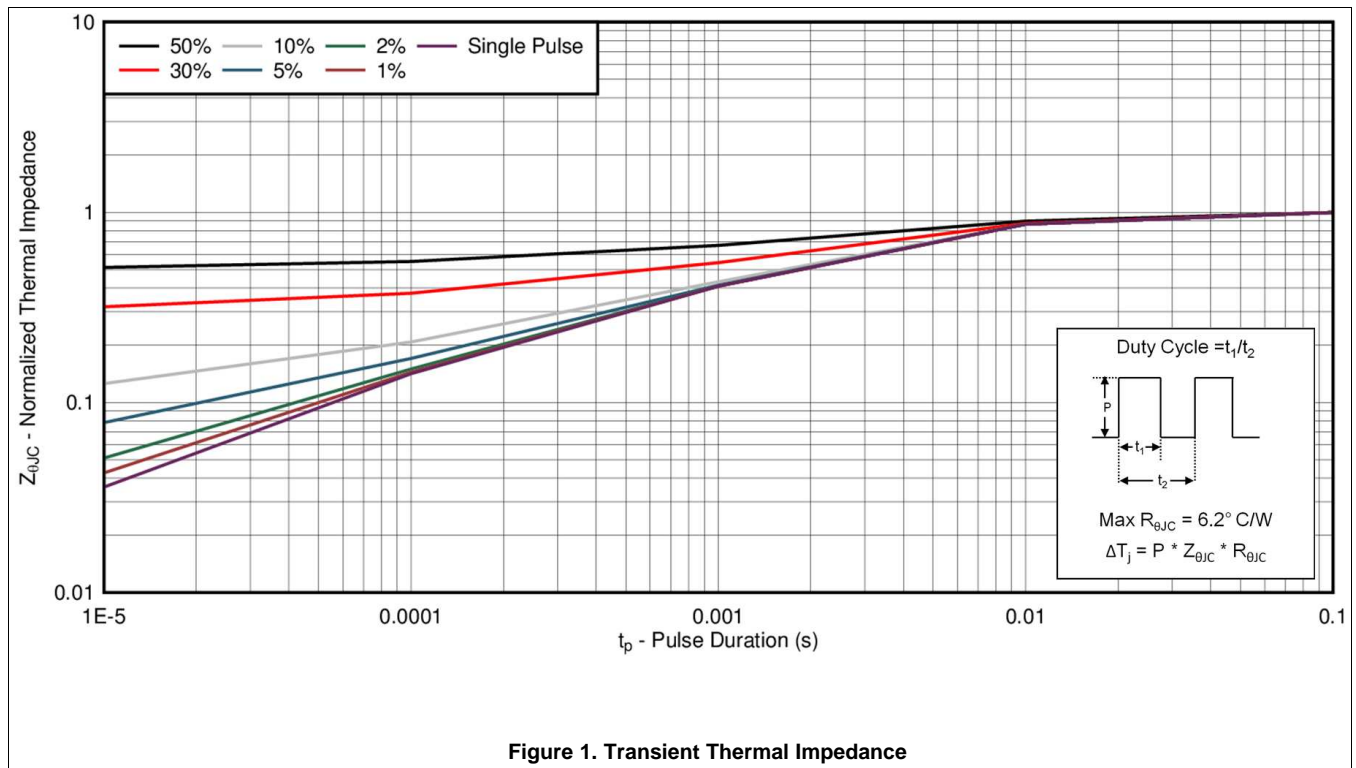


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Max $R_{\theta JA} = 250^{\circ}\text{C/W}$
when mounted on a
minimum pad area of
2-oz (0.071-mm) thick
Cu.

5.3 Typical MOSFET Characteristics

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



Typical MOSFET Characteristics (continued)

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

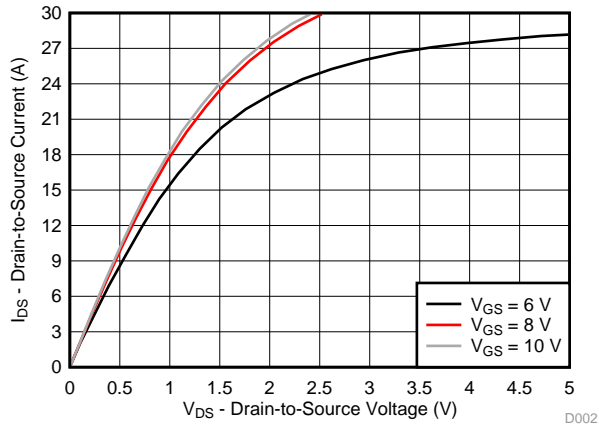


Figure 2. Saturation Characteristics

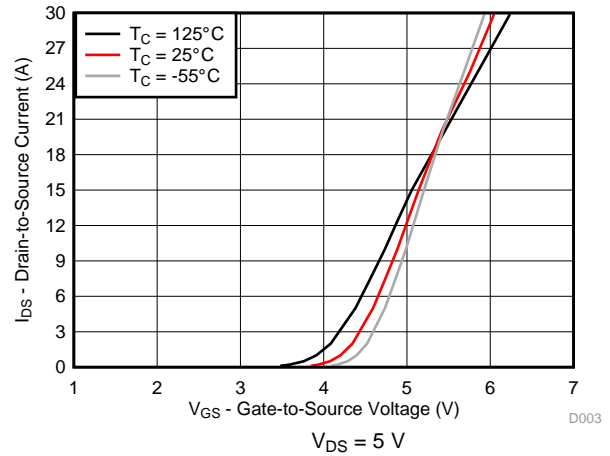


Figure 3. Transfer Characteristics

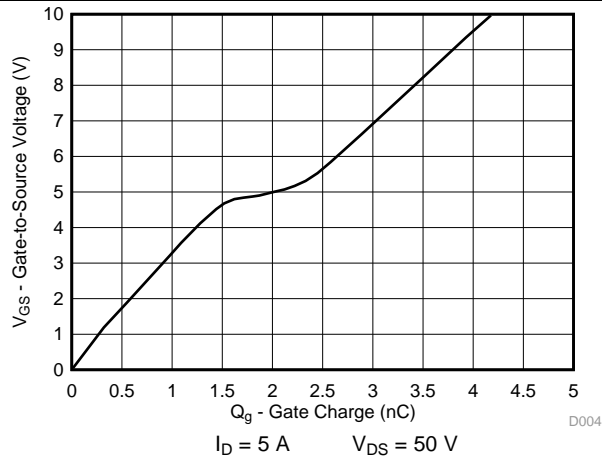


Figure 4. Gate Charge

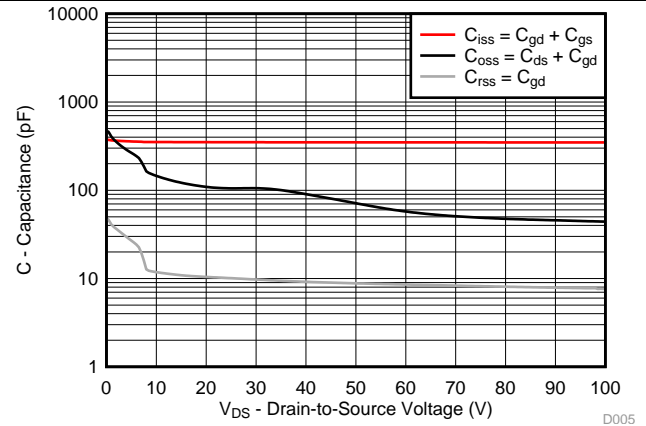


Figure 5. Capacitance

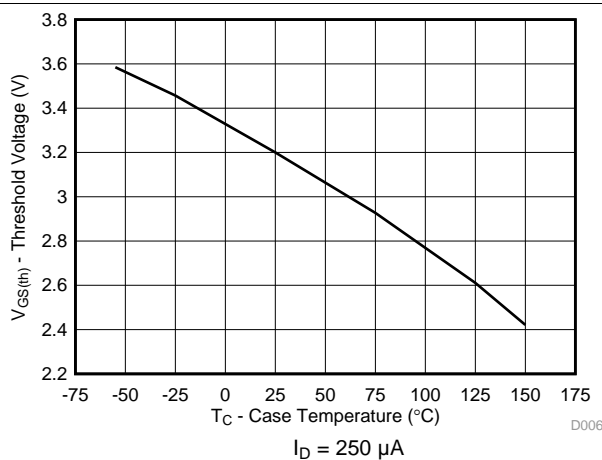


Figure 6. Threshold Voltage vs Temperature

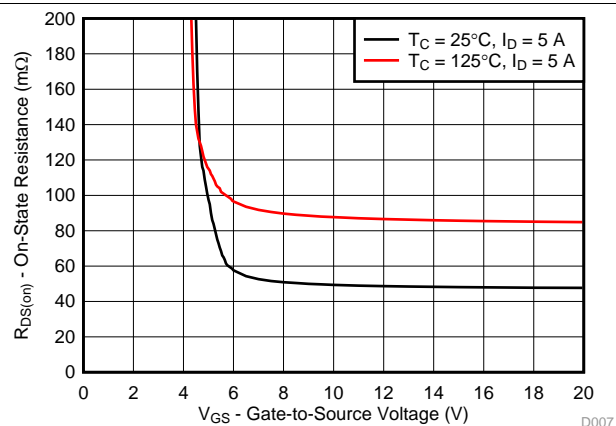


Figure 7. On-State Resistance vs Gate-to-Source Voltage

Typical MOSFET Characteristics (continued)

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

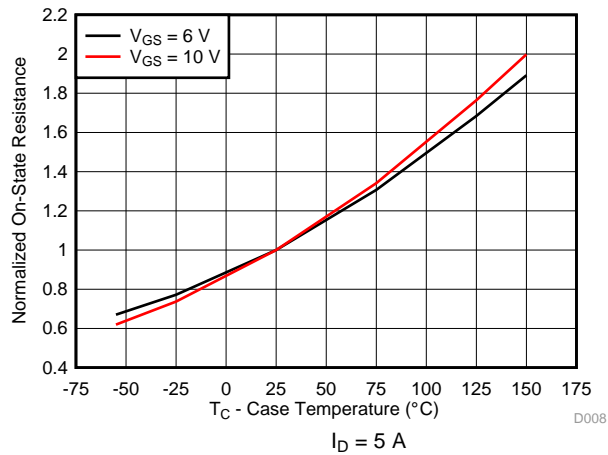


Figure 8. Normalized On-State Resistance vs Temperature

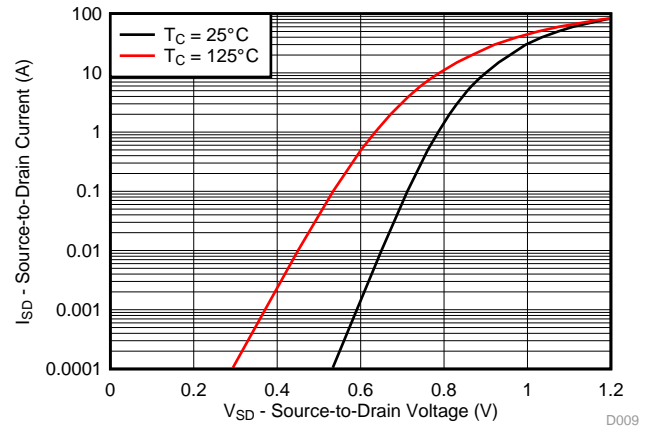


Figure 9. Typical Diode Forward Voltage

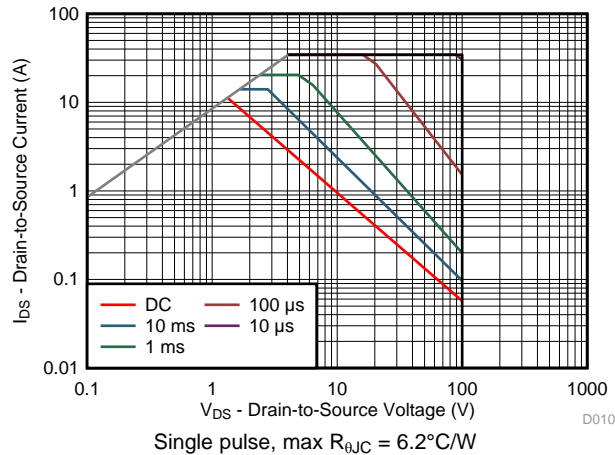


Figure 10. Maximum Safe Operating Area

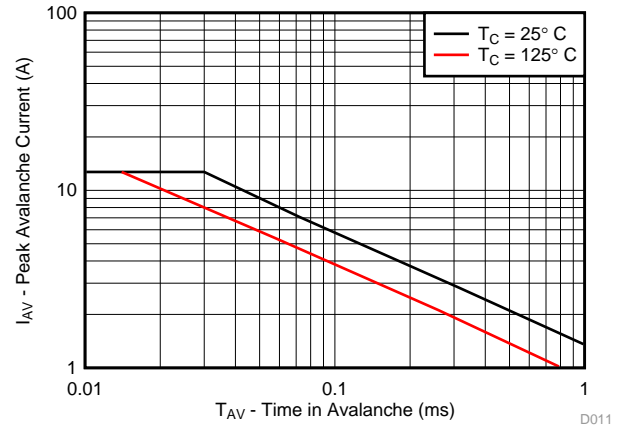


Figure 11. Single Pulse Unclamped Inductive Switching

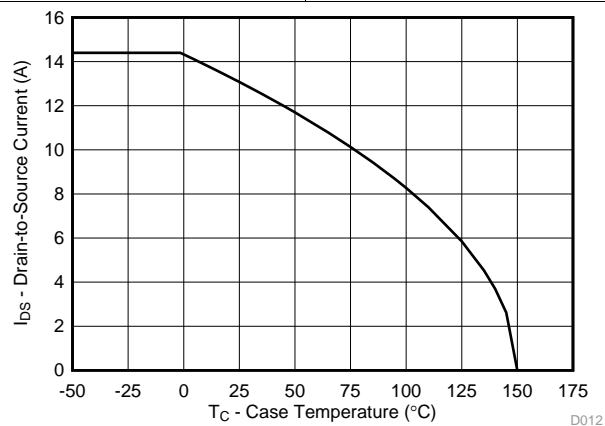


Figure 12. Maximum Drain Current vs Temperature

6 Device and Documentation Support

6.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* 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.

6.2 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.

6.3 Trademarks

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

6.4 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.

6.5 Glossary

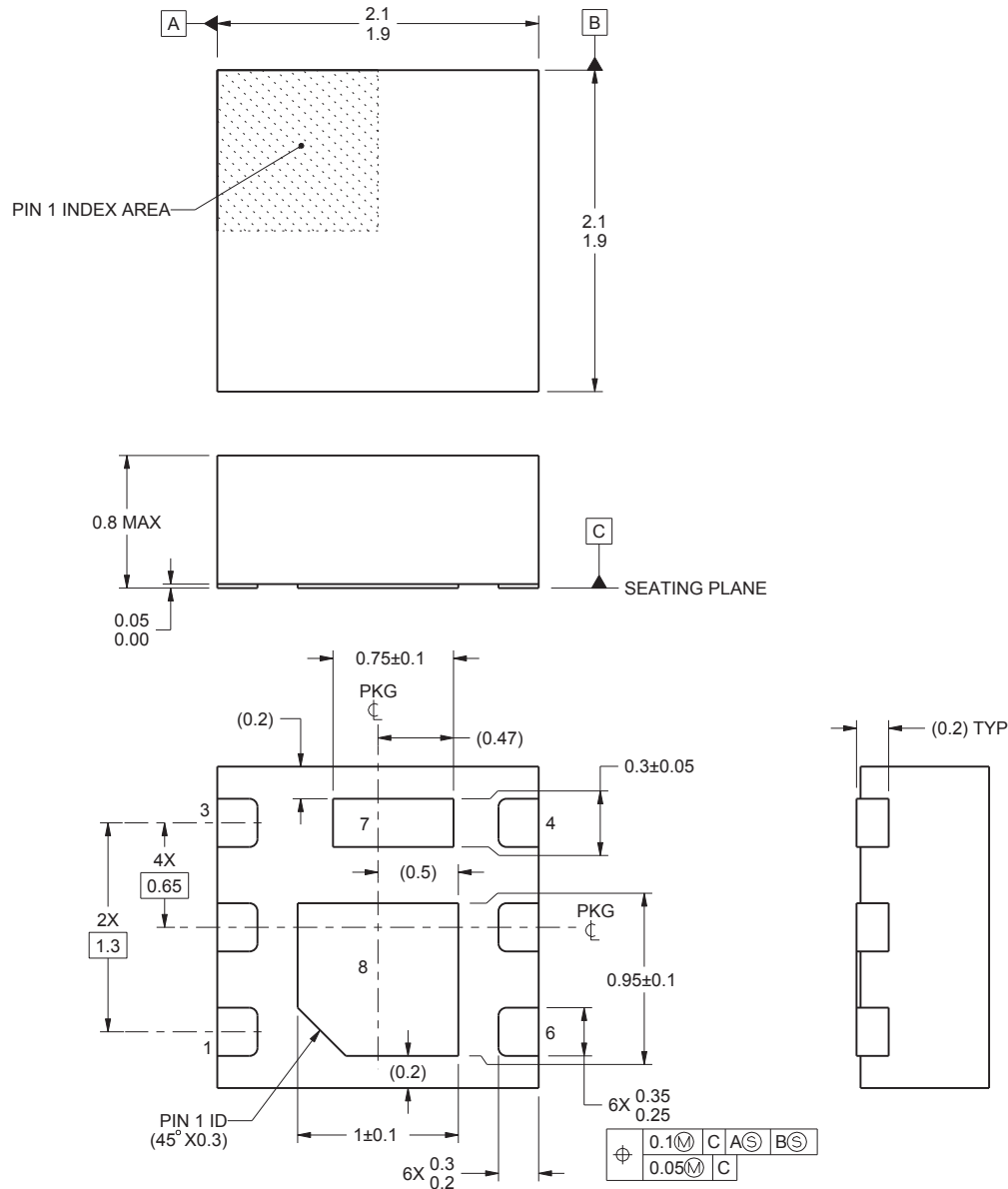
[SLYZ022](#) — *TI Glossary*.

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

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.

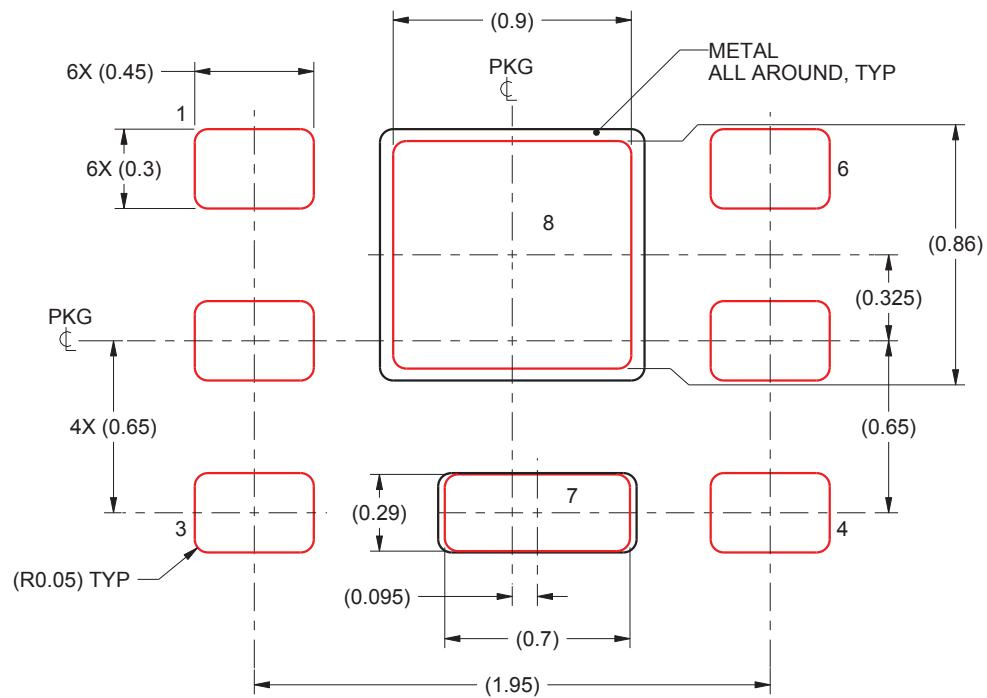
7.1 Q2 Package Dimensions



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 pads must be soldered to the printed circuit board for thermal and mechanical performance.

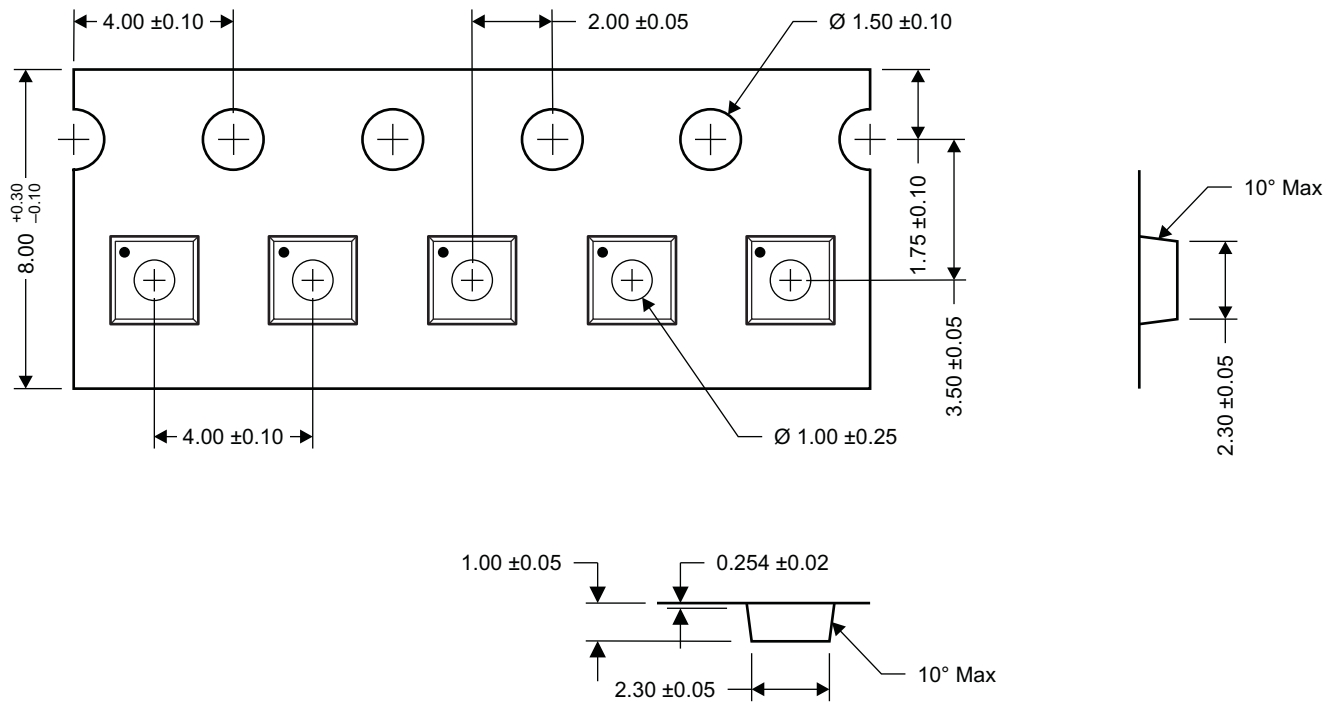
Q2 Package Dimensions (continued)

7.1.2 Recommended Stencil Pattern



1. All linear dimensions are in millimeters.
2. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

7.2 Q2 Tape and Reel Information



- Notes:
1. Measured from centerline of sprocket hole to centerline of pocket.
 2. Cumulative tolerance of 10 sprocket holes is ± 0.2 .
 3. Other material available.
 4. Typical SR of form tape Max 10^9 OHM/SQ.
 5. All dimensions are in mm, unless otherwise specified.

M0168-01

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
CSD19538Q2	ACTIVE	WSO	DQK	6	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-55 to 150	1958	Samples
CSD19538Q2T	ACTIVE	WSO	DQK	6	250	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM	-55 to 150	1958	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.

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