

CSD18540Q5B 60-V, N-Channel NexFET™ Power MOSFETs

1 Features

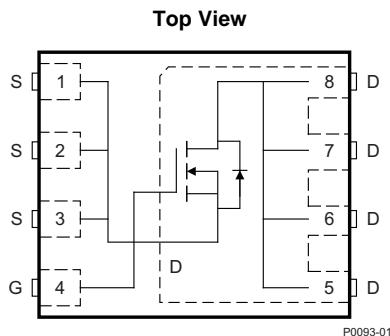
- Ultra-Low Q_g and Q_{gd}
- Low-Thermal Resistance
- Avalanche Rated
- Lead-Free Terminal Plating
- RoHS Compliant
- Halogen Free
- SON 5-mm × 6-mm Plastic Package

2 Applications

- DC-DC Conversion
- Secondary Side Synchronous Rectifier
- Isolated Converter Primary Side Switch
- Motor Control

3 Description

This 1.8-mΩ, 60-V NexFET™ power MOSFET is designed to minimize losses in power conversion applications with a SON 5-mm × 6-mm package.



Product Summary

$T_A = 25^\circ\text{C}$		TYPICAL VALUE	UNIT
V_{DS}	Drain-to-Source Voltage	60	V
Q_g	Gate Charge Total (10 V)	41	nC
Q_{gd}	Gate Charge Gate-to-Drain	6.7	nC
$R_{DS(on)}$	Drain-to-Source On Resistance	$V_{GS} = 4.5\text{ V}$ $V_{GS} = 10\text{ V}$	2.6 1.8 mΩ
$V_{GS(th)}$	Threshold Voltage	1.9	V

Device Information⁽¹⁾

DEVICE	QTY	MEDIA	PACKAGE	SHIP
CSD18540Q5B	2500	13-Inch Reel	SON 5.00-mm × 6.00-mm Plastic Package	Tape and Reel
CSD18540Q5BT	250	7-Inch Reel		

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

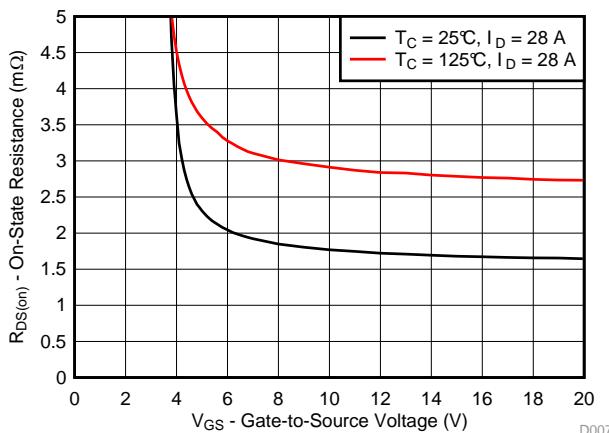
Absolute Maximum Ratings

$T_A = 25^\circ\text{C}$		VALUE	UNIT
V_{DS}	Drain-to-Source Voltage	60	V
V_{GS}	Gate-to-Source Voltage	± 20	V
I_D	Continuous Drain Current (Package Limited)	100	A
	Continuous Drain Current (Silicon Limited), $T_C = 25^\circ\text{C}$	205	
	Continuous Drain Current ⁽¹⁾	29	
I_{DM}	Pulsed Drain Current, $T_A = 25^\circ\text{C}$ ⁽²⁾	400	A
P_D	Power Dissipation ⁽¹⁾	3.8	W
	Power Dissipation, $T_C = 25^\circ\text{C}$	188	
T_J, T_{stg}	Operating Junction, Storage Temperature	-55 to 175	°C
E_{AS}	Avalanche Energy, Single Pulse $I_D = 80\text{ A}, L = 0.1\text{ mH}, R_G = 25\text{ }\Omega$	320	mJ

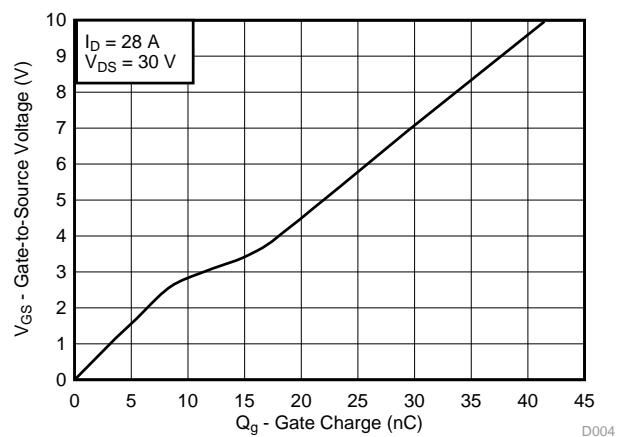
(1) Typical $R_{\theta JA} = 40^\circ\text{C/W}$ on a 1-in², 2-oz Cu pad on a 0.06-in thick FR4 PCB.

(2) Max $R_{\theta JC} = 0.8^\circ\text{C/W}$, pulse duration $\leq 100\text{ }\mu\text{s}$, duty cycle $\leq 1\%$.

$R_{DS(on)}$ 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.

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4 Revision History

Changes from Revision A (June 2016) to Revision B	Page
• Corrected package size typo in the <i>Description</i> section.....	1

Changes from Original (June 2014) to Revision A	Page
• Updated I_D values.	1
• Updated P_D values.	1
• Increased maximum temperature to 175°C.	1
• Updated Figure 2	5
• Changed Figure 6 to extend temperature to 175°C.	5
• Changed Figure 8 to extend temperature to 175°C.	6
• Replotted Figure 10 using 175°C data.	6
• Changed Figure 12 to extend temperature to 175°C.	6
• Added Receiving Notification of Documentation Updates and Community Resources to <i>Device and Documentation Support</i> section.	7
• Updated the mechanical drawing.	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 $V_{\text{GS}} = 0 \text{ V}, I_D = 250 \mu\text{A}$	60			V
I_{DSS}	Drain-to-source leakage current $V_{\text{GS}} = 0 \text{ V}, V_{\text{DS}} = 48 \text{ V}$		1		μA
I_{GSS}	Gate-to-source leakage current $V_{\text{DS}} = 0 \text{ V}, V_{\text{GS}} = 20 \text{ V}$		100		nA
$V_{\text{GS(th)}}$	Gate-to-source threshold voltage $V_{\text{DS}} = V_{\text{GS}}, I = 250 \mu\text{A}$	1.5	1.9	2.3	V
$R_{\text{DS(on)}}$	$V_{\text{GS}} = 4.5 \text{ V}, I_D = 28 \text{ A}$		2.6	3.3	$\text{m}\Omega$
	$V_{\text{GS}} = 10 \text{ V}, I_D = 28 \text{ A}$		1.8	2.2	
g_{fs}	Transconductance $V_{\text{DS}} = 6 \text{ V}, I_D = 28 \text{ A}$	116			S
DYNAMIC CHARACTERISTICS					
C_{iss}	Input capacitance	3250	4230		pF
C_{oss}	Output capacitance	622	808		pF
C_{rss}	Reverse transfer capacitance	15	20		pF
R_G	Series gate resistance	0.8	1.6		Ω
Q_g	Gate charge total (4.5 V)	20	26		nC
Q_g	Gate charge total (10 V)	41	53		nC
Q_{gd}	Gate charge gate-to-drain	6.7			nC
Q_{gs}	Gate charge gate-to-source	8.8			nC
$Q_{\text{g(th)}}$	Gate charge at V_{th}	6.3			nC
Q_{oss}	Output charge	83			nC
$t_{\text{d(on)}}$	Turnon delay time	6			ns
t_r	Rise time	9			ns
$t_{\text{d(off)}}$	Turnoff delay time	20			ns
t_f	Fall time	3			ns
DIODE CHARACTERISTICS					
V_{SD}	Diode forward voltage $I_{\text{SD}} = 28 \text{ A}, V_{\text{GS}} = 0 \text{ V}$	0.8	1		V
Q_{rr}	Reverse recovery charge $V_{\text{DS}} = 30 \text{ V}, I_F = 28 \text{ A},$ $dI/dt = 300 \text{ A}/\mu\text{s}$	145			nC
t_{rr}	Reverse recovery time	82			ns

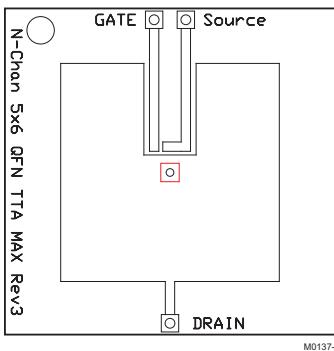
5.2 Thermal Information

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

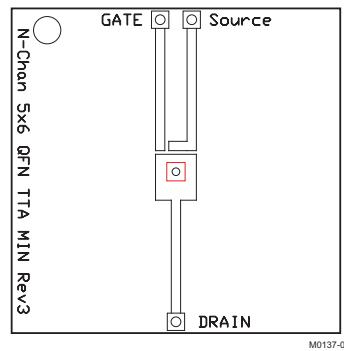
THERMAL METRIC		MIN	TYP	MAX	UNIT
$R_{\theta\text{JC}}$		0.8			$^\circ\text{C}/\text{W}$
$R_{\theta\text{JA}}$		50			

- (1) $R_{\theta\text{JC}}$ 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. $R_{\theta\text{JC}}$ is specified by design, whereas $R_{\theta\text{JA}}$ 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.



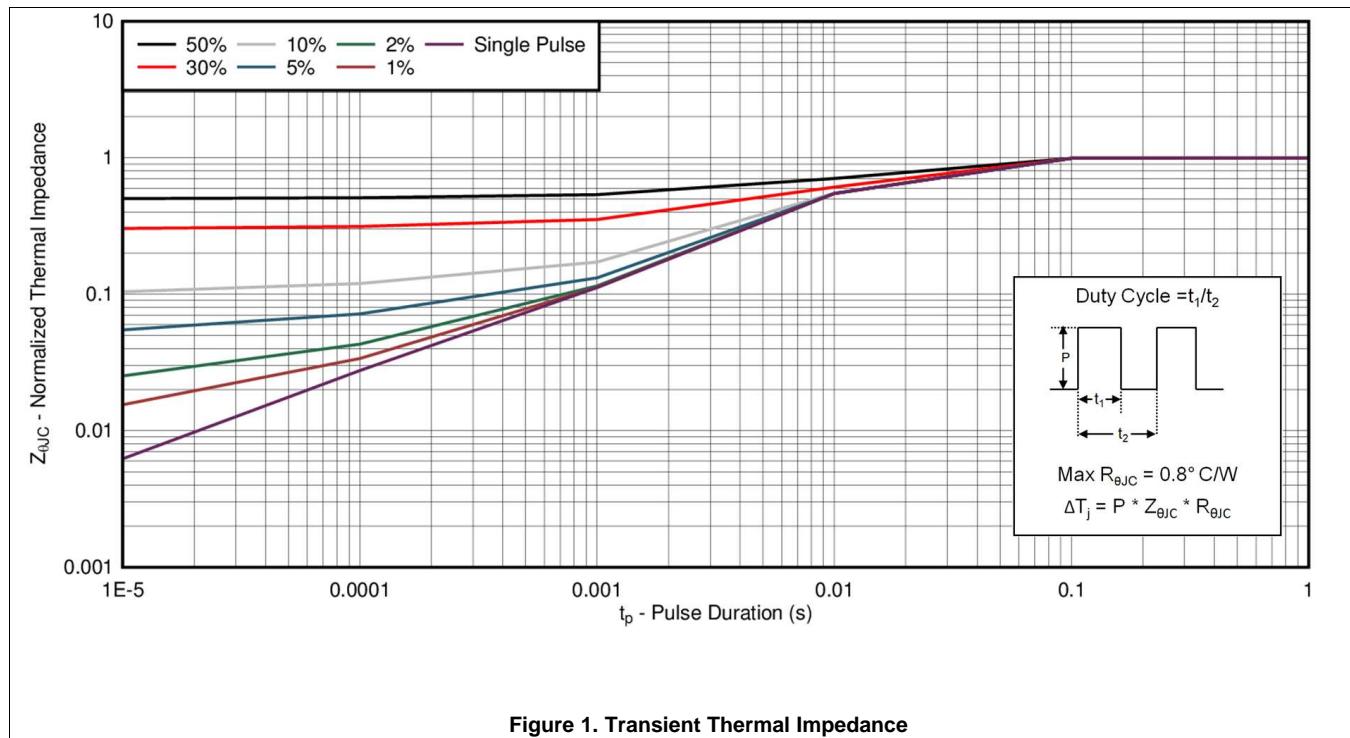
Max $R_{\theta JA} = 50^{\circ}\text{C/W}$
when mounted on 1 in²
(6.45 cm²) of
2-oz (0.071-mm) thick
Cu.



Max $R_{\theta JA} = 125^{\circ}\text{C/W}$
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)

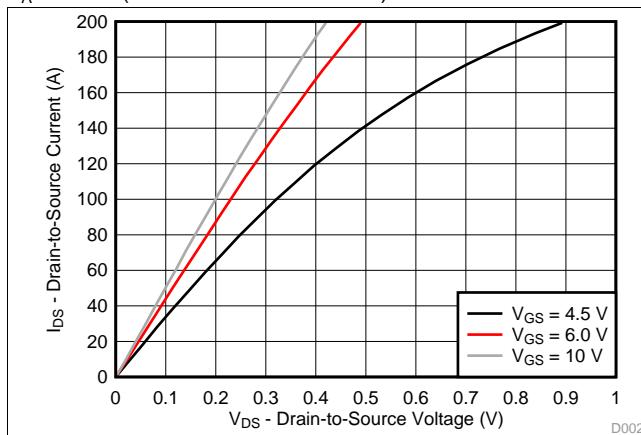


Figure 2. Saturation Characteristics

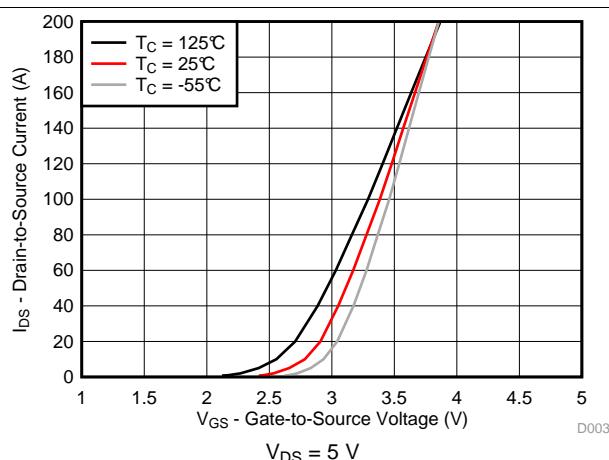


Figure 3. Transfer Characteristics

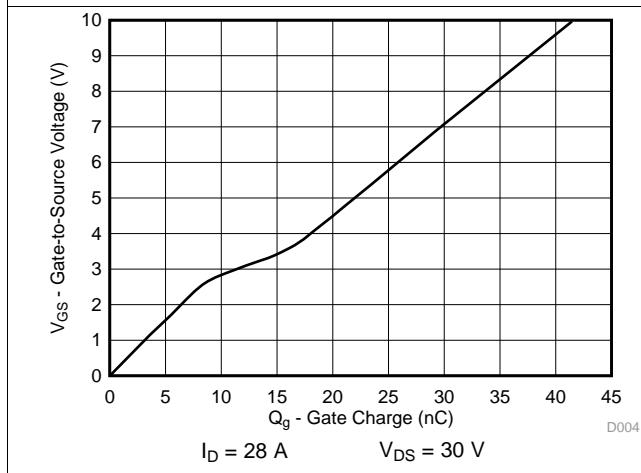


Figure 4. Gate Charge

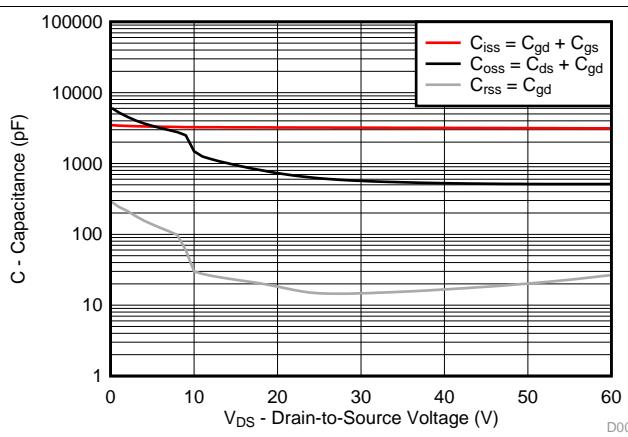


Figure 5. Capacitance

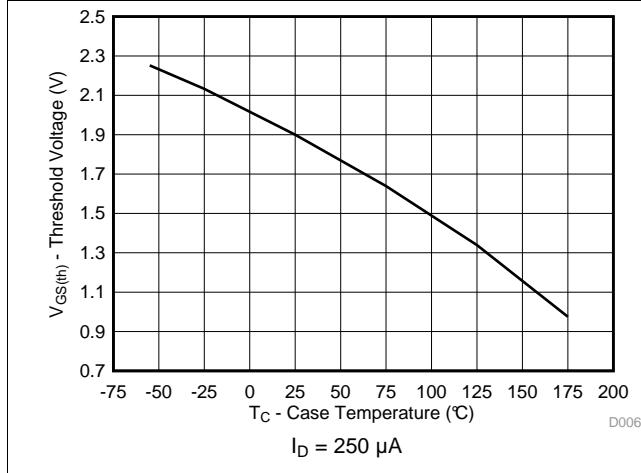


Figure 6. Threshold Voltage vs Temperature

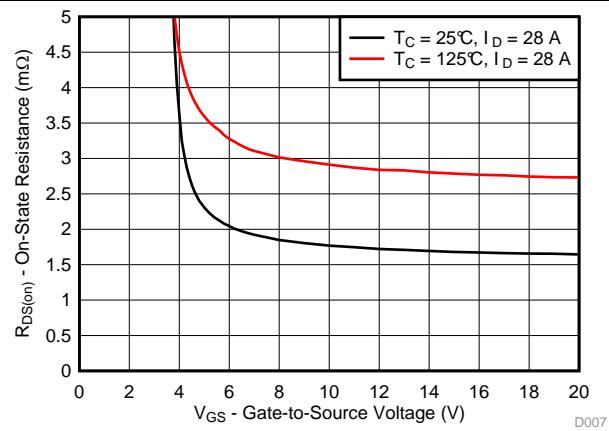


Figure 7. On-State Resistance vs Gate-to-Source Voltage

Typical MOSFET Characteristics (continued)

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

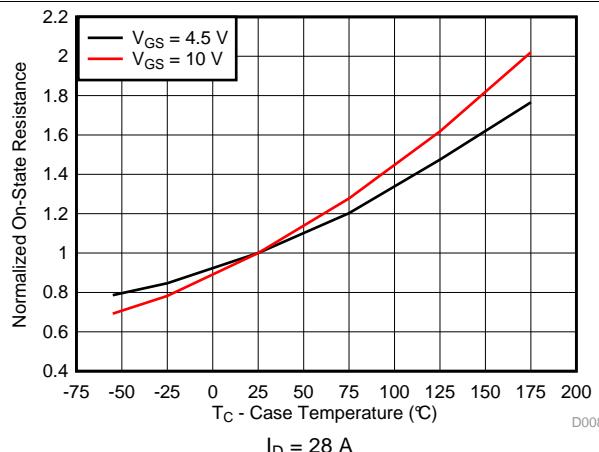


Figure 8. Normalized On-State Resistance vs Temperature

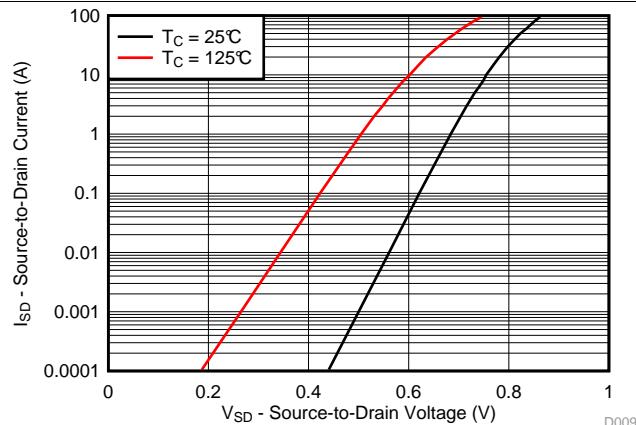


Figure 9. Typical Diode Forward Voltage

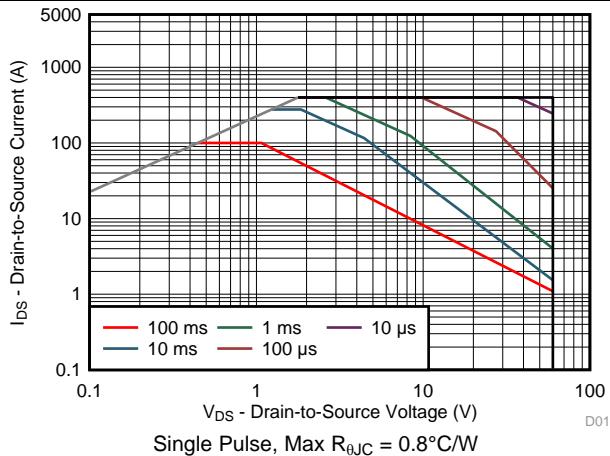


Figure 10. Maximum Safe Operating Area

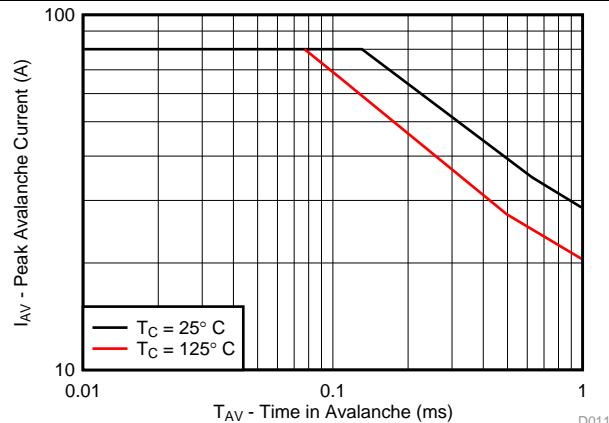


Figure 11. Single Pulse Unclamped Inductive Switching

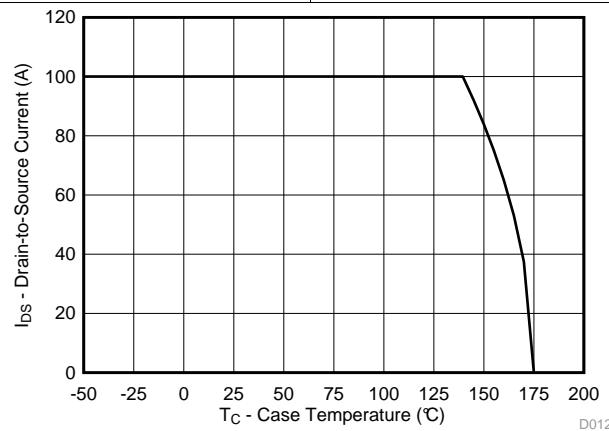


Figure 12. Maximum Drain Current vs Temperature

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

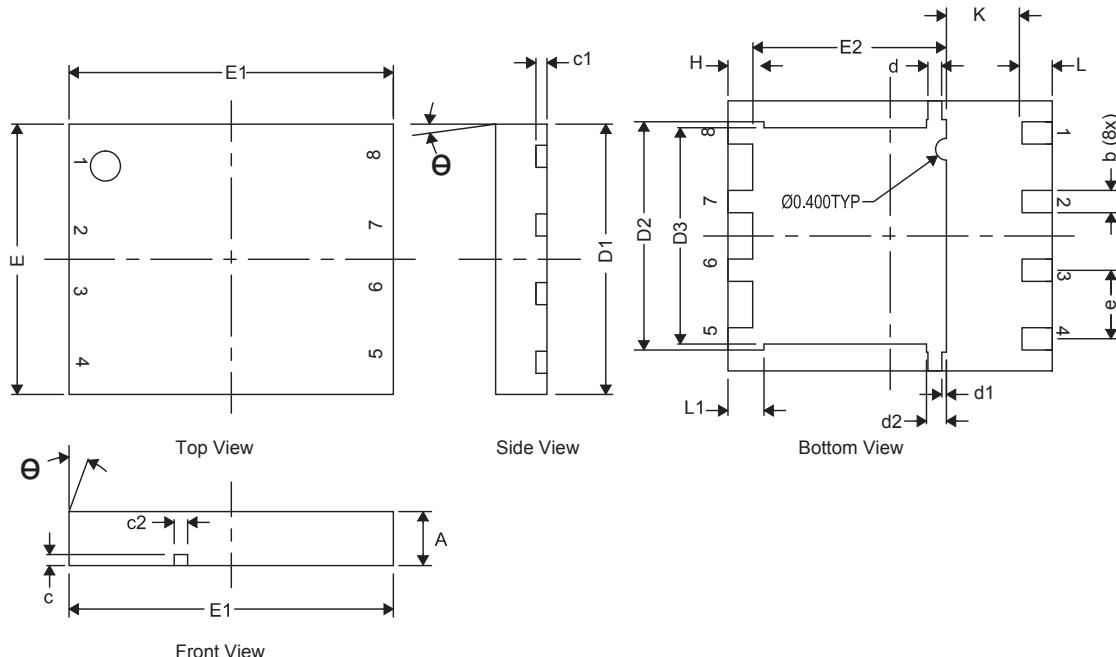
[SLYZ022 — TI Glossary](#).

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

7 Mechanical, Packaging, and Orderable Information

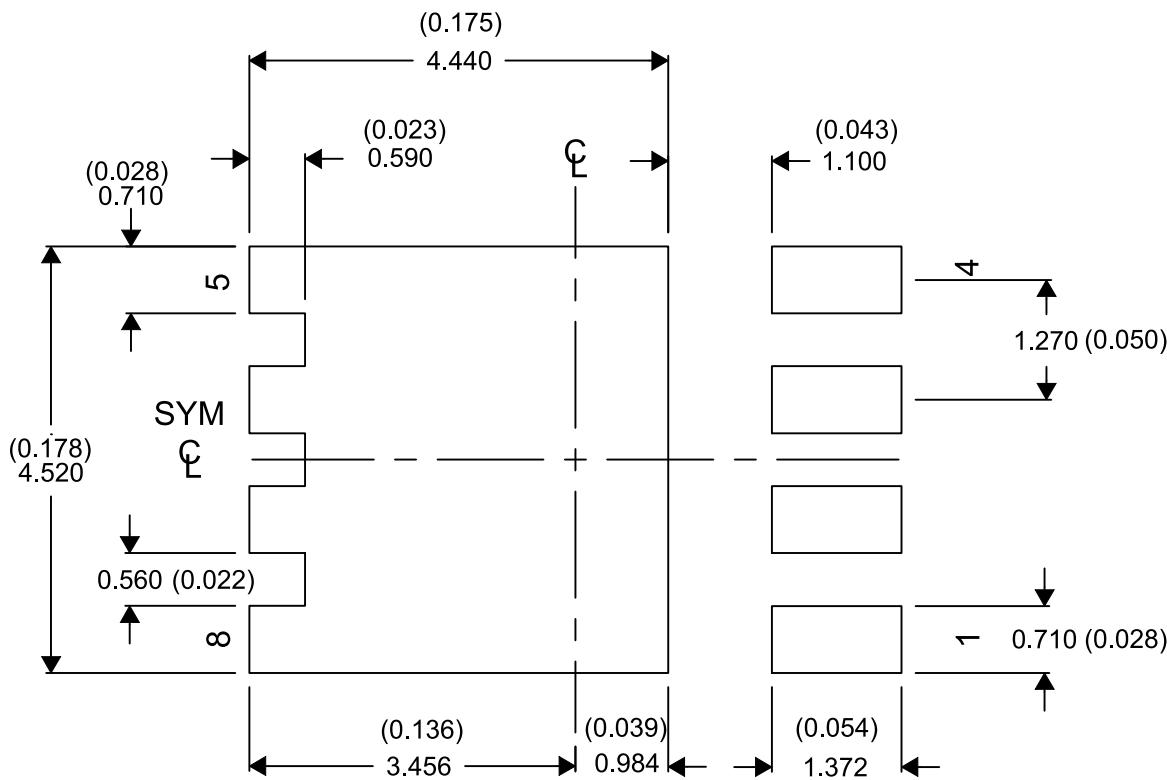
The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand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

7.1 Q5B Package Dimensions



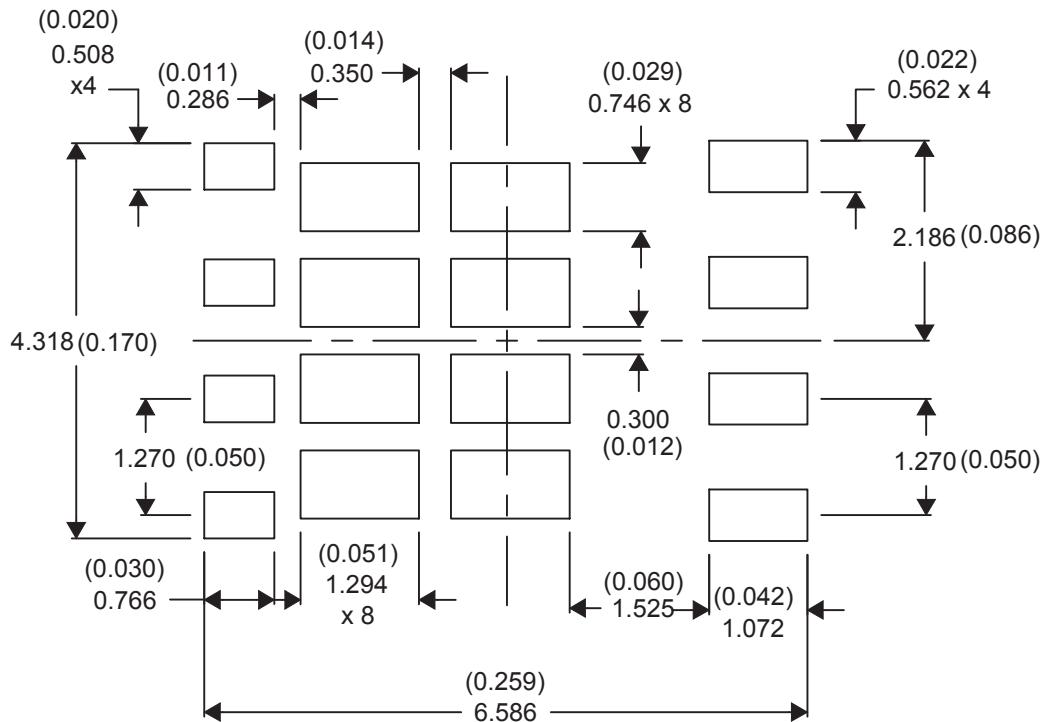
DIM	MILLIMETERS		
	MIN	NOM	MAX
A	0.80	1.00	1.05
b	0.36	0.41	0.46
c	0.15	0.20	0.25
c1	0.15	0.20	0.25
c2	0.20	0.25	0.30
D1	4.90	5.00	5.10
D2	4.12	4.22	4.32
D3	3.90	4.00	4.10
d	0.20	0.25	0.30
d1		0.085 TYP	
d2	0.319	0.369	0.419
E	4.90	5.00	5.10
E1	5.90	6.00	6.10
E2	3.48	3.58	3.68
e		1.27 TYP	
H	0.36	0.46	0.56
L	0.46	0.56	0.66
L1	0.57	0.67	0.77
θ	0°	—	—
K		1.40 TYP	

7.2 Recommended PCB Pattern

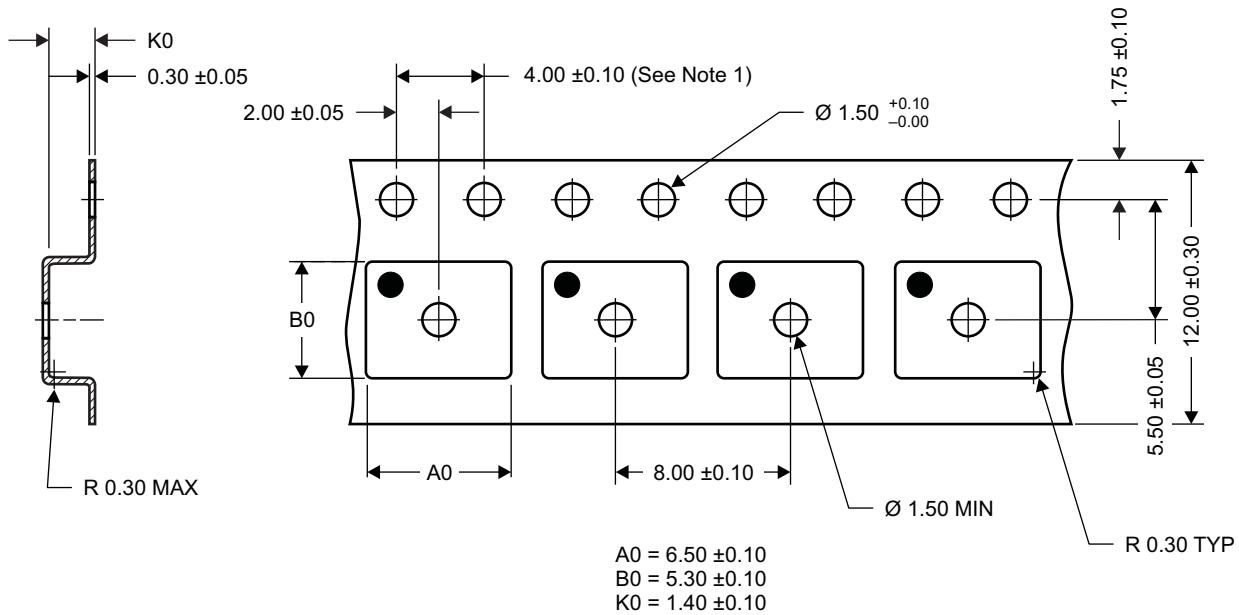


For recommended circuit layout for PCB designs, see [*Reducing Ringing Through PCB Layout Techniques*](#) (SLPA005).

7.3 Recommended Stencil Pattern



7.4 Q5B Tape and Reel Information



M0138-01

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. A0 and B0 measured on a plane 0.3 mm above the bottom of the pocket.

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)
CSD18540Q5B	Active	Production	VSON-CLIP (DNK) 8	2500 LARGE T&R	ROHS Exempt	NIPDAU SN	Level-1-260C-UNLIM	-55 to 175	CSD18540
CSD18540Q5B.B	Active	Production	VSON-CLIP (DNK) 8	2500 LARGE T&R	ROHS Exempt	NIPDAU	Level-1-260C-UNLIM	-55 to 175	CSD18540
CSD18540Q5BG4	Active	Production	VSON-CLIP (DNK) 8	2500 LARGE T&R	ROHS Exempt	NIPDAU	Level-1-260C-UNLIM	-55 to 175	CSD18540
CSD18540Q5BG4.B	Active	Production	VSON-CLIP (DNK) 8	2500 LARGE T&R	ROHS Exempt	NIPDAU	Level-1-260C-UNLIM	-55 to 175	CSD18540
CSD18540Q5BT	Active	Production	VSON-CLIP (DNK) 8	250 SMALL T&R	ROHS Exempt	NIPDAU SN	Level-1-260C-UNLIM	-55 to 175	CSD18540
CSD18540Q5BT.B	Active	Production	VSON-CLIP (DNK) 8	250 SMALL T&R	ROHS Exempt	NIPDAU	Level-1-260C-UNLIM	-55 to 175	CSD18540

⁽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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