

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

## 1 Features

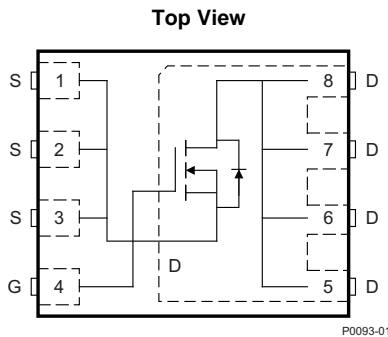
- Ultra-Low  $Q_g$  and  $Q_{gd}$
- Low-Thermal Resistance
- Avalanche Rated
- Lead-Free Terminal Plating
- RoHS Compliant
- Halogen Free
- SON 5-mm × 6-mm Plastic Package

## 2 Applications

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

## 3 Description

This 1.8-m $\Omega$ , 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	$V_{GS} = 4.5\text{ V}$	2.6	m $\Omega$
		$V_{GS} = 10\text{ V}$	1.8	
$V_{GS(th)}$	Threshold Voltage	1.9		V

### Device Information<sup>(1)</sup>

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

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

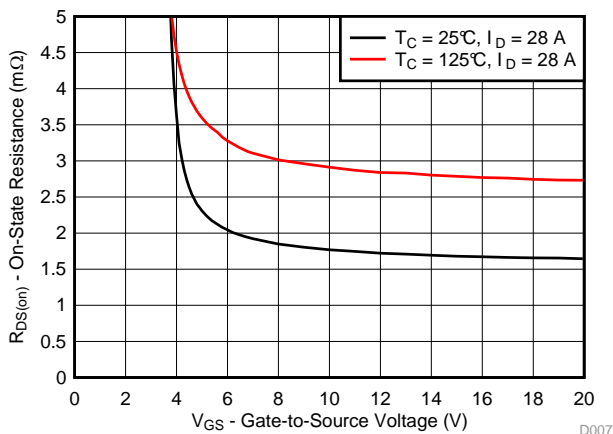
### Absolute Maximum Ratings

$T_A = 25^\circ\text{C}$		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 <sup>(1)</sup>	29	
$I_{DM}$	Pulsed Drain Current, $T_A = 25^\circ\text{C}$ <sup>(2)</sup>	400	A
$P_D$	Power Dissipation <sup>(1)</sup>	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 $I_D = 80\text{ A}, L = 0.1\text{ mH}, R_G = 25\ \Omega$	320	mJ

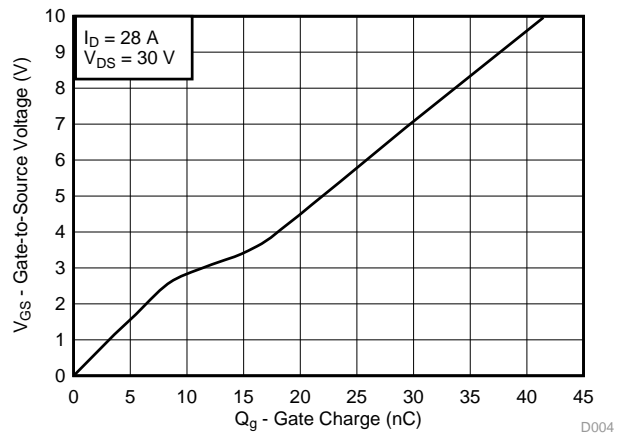
(1) Typical  $R_{\theta JA} = 40^\circ\text{C/W}$  on a 1-in<sup>2</sup>, 2-oz Cu pad on a 0.06-in thick FR4 PCB.

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

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



**Gate Charge**



## Table of Contents

<b>1 Features</b> .....	<b>1</b>	6.2 Community Resources.....	<b>7</b>
<b>2 Applications</b> .....	<b>1</b>	6.3 Trademarks .....	<b>7</b>
<b>3 Description</b> .....	<b>1</b>	6.4 Electrostatic Discharge Caution .....	<b>7</b>
<b>4 Revision History</b> .....	<b>2</b>	6.5 Glossary .....	<b>7</b>
<b>5 Specifications</b> .....	<b>3</b>	<b>7 Mechanical, Packaging, and Orderable Information</b> .....	<b>8</b>
5.1 Electrical Characteristics.....	<b>3</b>	7.1 Q5B Package Dimensions .....	<b>8</b>
5.2 Thermal Information .....	<b>3</b>	7.2 Recommended PCB Pattern.....	<b>9</b>
5.3 Typical MOSFET Characteristics.....	<b>4</b>	7.3 Recommended Stencil Pattern .....	<b>9</b>
<b>6 Device and Documentation Support</b> .....	<b>7</b>	7.4 Q5B Tape and Reel Information .....	<b>10</b>
6.1 Receiving Notification of Documentation Updates....	<b>7</b>		

## 4 Revision History

### Changes from Revision A (June 2016) to Revision B

**Page**

• Corrected package size typo in the <i>Description</i> section.....	<b>1</b>
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### Changes from Original (June 2014) to Revision A

**Page**

• Updated $I_D$ values. ....	<b>1</b>
• Updated $P_D$ values. ....	<b>1</b>
• Increased maximum temperature to 175°C. ....	<b>1</b>
• Updated <a href="#">Figure 2</a> .....	<b>5</b>
• Changed <a href="#">Figure 6</a> to extend temperature to 175°C. ....	<b>5</b>
• Changed <a href="#">Figure 8</a> to extend temperature to 175°C. ....	<b>6</b>
• Replotted <a href="#">Figure 10</a> using 175°C data. ....	<b>6</b>
• Changed <a href="#">Figure 12</a> to extend temperature to 175°C. ....	<b>6</b>
• Added <i>Receiving Notification of Documentation Updates</i> and <i>Community Resources</i> to <i>Device and Documentation Support</i> section. ....	<b>7</b>
• Updated the mechanical drawing. ....	<b>8</b>

## 5 Specifications

### 5.1 Electrical Characteristics

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

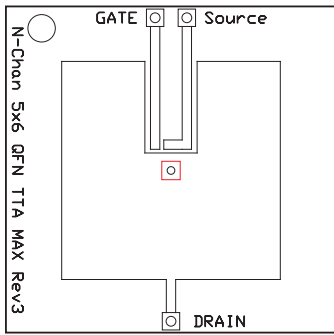
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>STATIC CHARACTERISTICS</b>						
$V_{DSS}$	Drain-to-source voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	60			V
$I_{DSS}$	Drain-to-source leakage current	$V_{GS} = 0\text{ V}, V_{DS} = 48\text{ V}$			1	$\mu\text{A}$
$I_{GSS}$	Gate-to-source leakage current	$V_{DS} = 0\text{ V}, V_{GS} = 20\text{ V}$			100	nA
$V_{GS(th)}$	Gate-to-source threshold voltage	$V_{DS} = V_{GS}, I = 250\ \mu\text{A}$	1.5	1.9	2.3	V
$R_{DS(on)}$	Drain-to-source on resistance	$V_{GS} = 4.5\text{ V}, I_D = 28\text{ A}$		2.6	3.3	m $\Omega$
		$V_{GS} = 10\text{ V}, I_D = 28\text{ A}$		1.8	2.2	
$g_{fs}$	Transconductance	$V_{DS} = 6\text{ V}, I_D = 28\text{ A}$		116		S
<b>DYNAMIC CHARACTERISTICS</b>						
$C_{iss}$	Input capacitance	$V_{GS} = 0\text{ V}, V_{DS} = 30\text{ V}, f = 1\text{ MHz}$		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	$\Omega$
$Q_g$	Gate charge total (4.5 V)	$V_{DS} = 30\text{ V}, I_{DD} = 28\text{ A}$		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
$Q_{g(th)}$	Gate charge at $V_{th}$			6.3		nC
$Q_{oss}$	Output charge		$V_{DS} = 30\text{ V}, V_{GS} = 0\text{ V}$		83	
$t_{d(on)}$	Turnon delay time	$V_{DS} = 30\text{ V}, V_{GS} = 10\text{ V}, I_{DS} = 28\text{ A}, R_G = 0\ \Omega$		6		ns
$t_r$	Rise time			9		ns
$t_{d(off)}$	Turnoff delay time			20		ns
$t_f$	Fall time			3		ns
<b>DIODE CHARACTERISTICS</b>						
$V_{SD}$	Diode forward voltage	$I_{SD} = 28\text{ A}, V_{GS} = 0\text{ V}$		0.8	1	V
$Q_{rr}$	Reverse recovery charge	$V_{DS} = 30\text{ V}, I_F = 28\text{ A}, di/dt = 300\text{ A}/\mu\text{s}$		145		nC
$t_{rr}$	Reverse recovery time			82		ns

### 5.2 Thermal Information

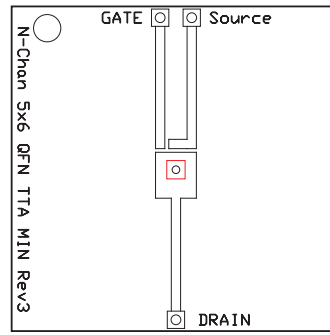
 $T_A = 25^\circ\text{C}$  (unless otherwise stated)

THERMAL METRIC		MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction-to-case thermal resistance <sup>(1)</sup>			0.8	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Junction-to-ambient thermal resistance <sup>(1)(2)</sup>			50	

- $R_{\theta JC}$  is determined with the device mounted on a 1-in<sup>2</sup> (6.45-cm<sup>2</sup>), 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.
- Device mounted on FR4 material with 1-in<sup>2</sup> (6.45-cm<sup>2</sup>), 2-oz (0.071-mm) thick Cu.



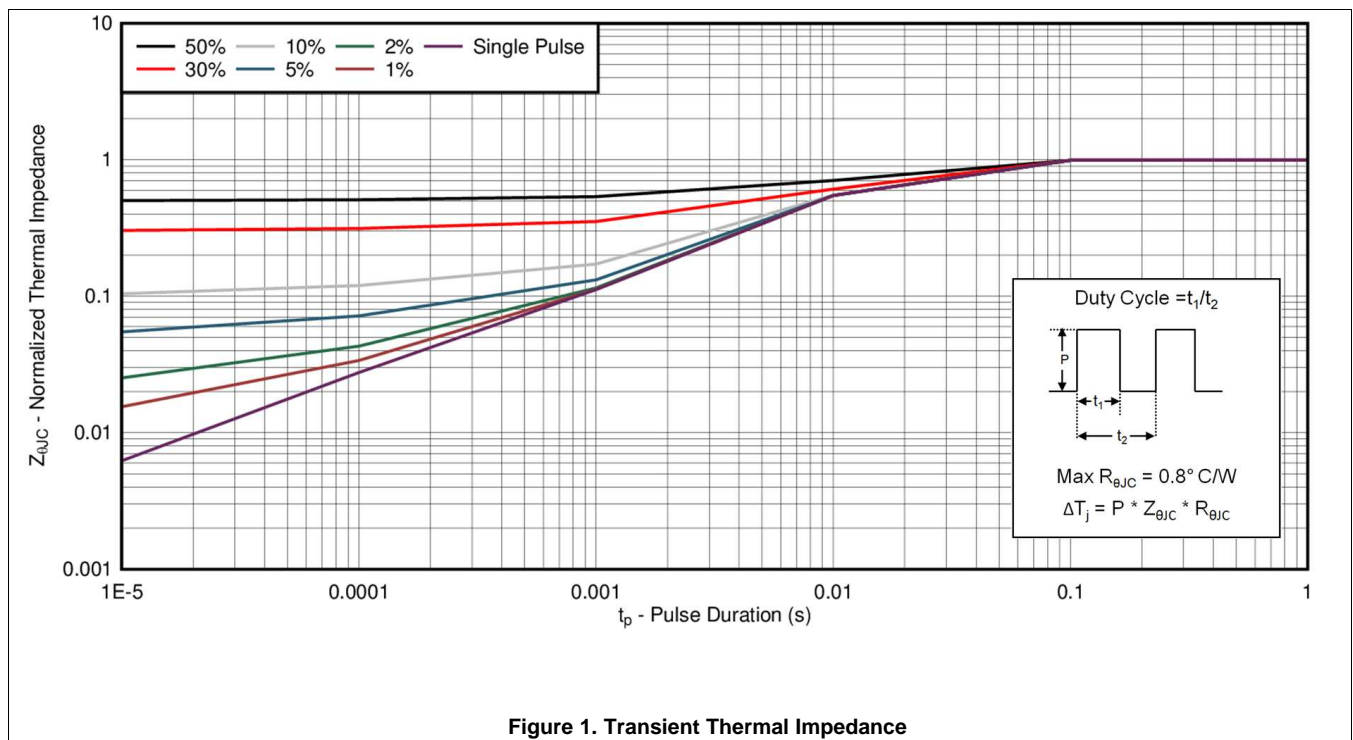
Max  $R_{\theta JA} = 50^{\circ}\text{C/W}$   
when mounted on 1 in<sup>2</sup>  
(6.45 cm<sup>2</sup>) of  
2-oz (0.071-mm) thick  
Cu.



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<sub>A</sub> = 25°C (unless otherwise stated)

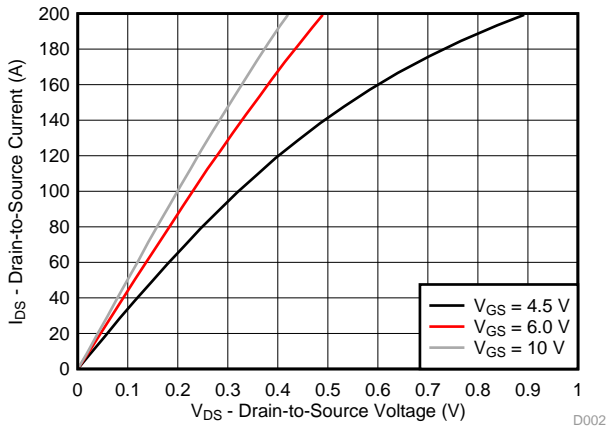


Figure 2. Saturation Characteristics

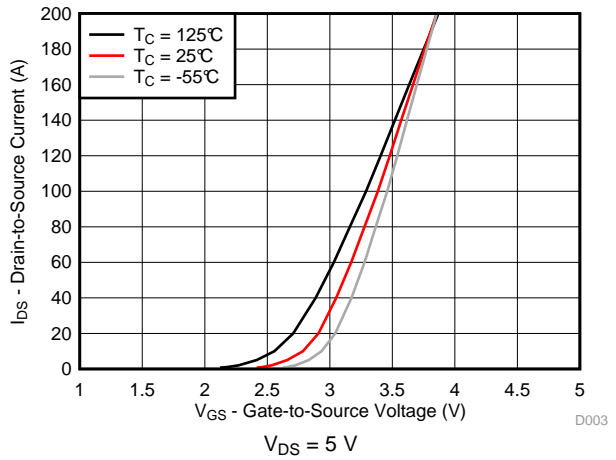


Figure 3. Transfer Characteristics

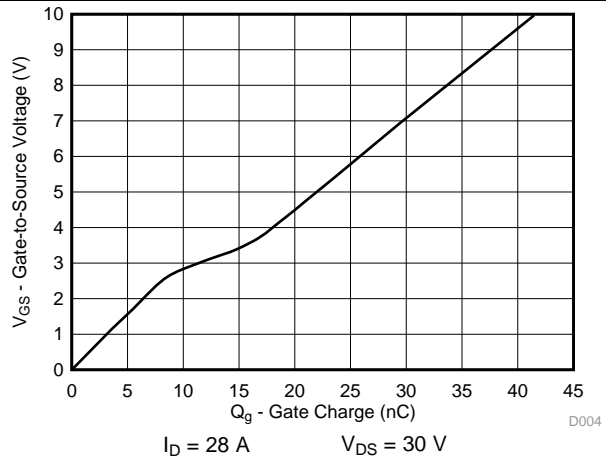


Figure 4. Gate Charge

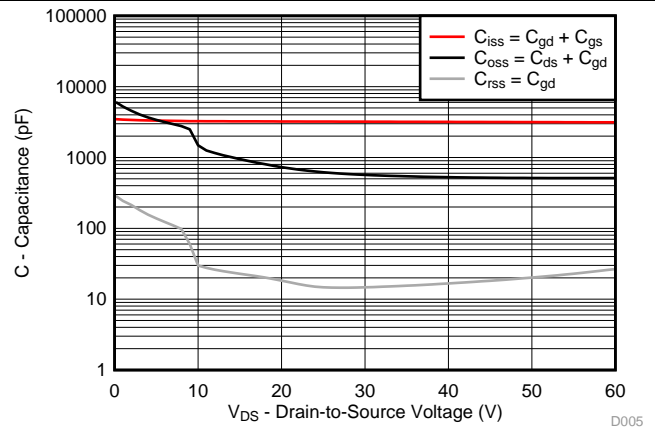


Figure 5. Capacitance

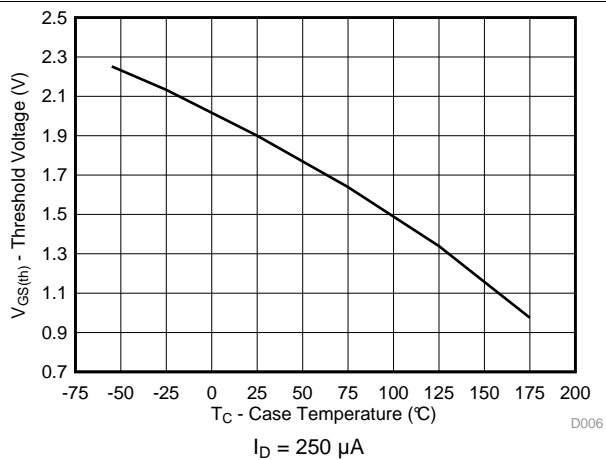


Figure 6. Threshold Voltage vs Temperature

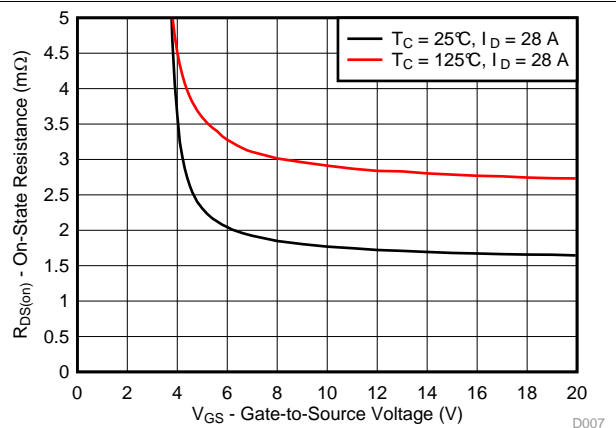


Figure 7. On-State Resistance vs Gate-to-Source Voltage

Typical MOSFET Characteristics (continued)

T<sub>A</sub> = 25°C (unless otherwise stated)

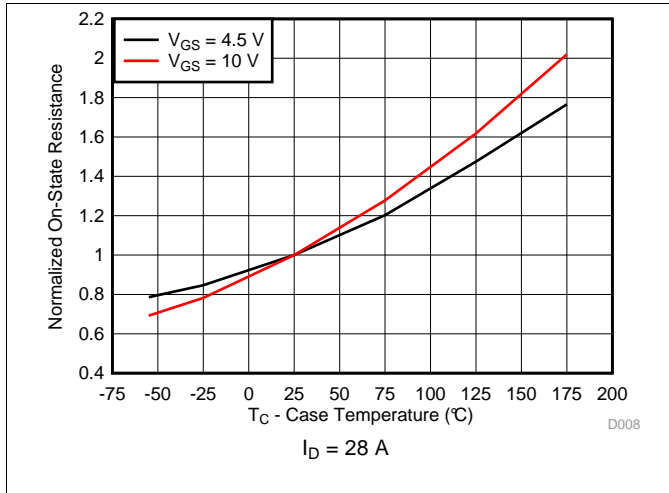


Figure 8. Normalized On-State Resistance vs Temperature

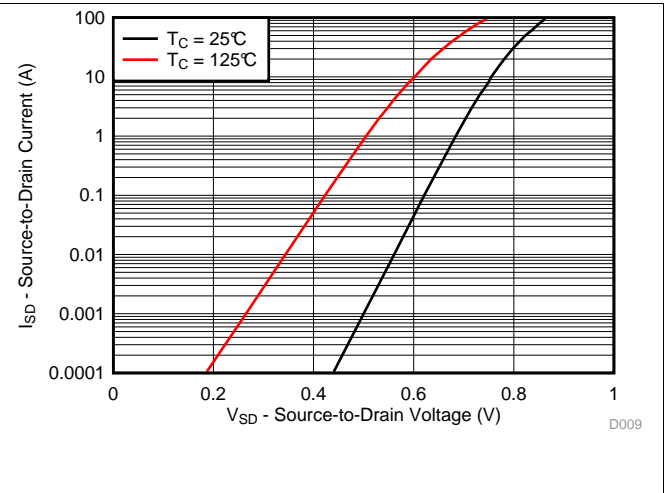


Figure 9. Typical Diode Forward Voltage

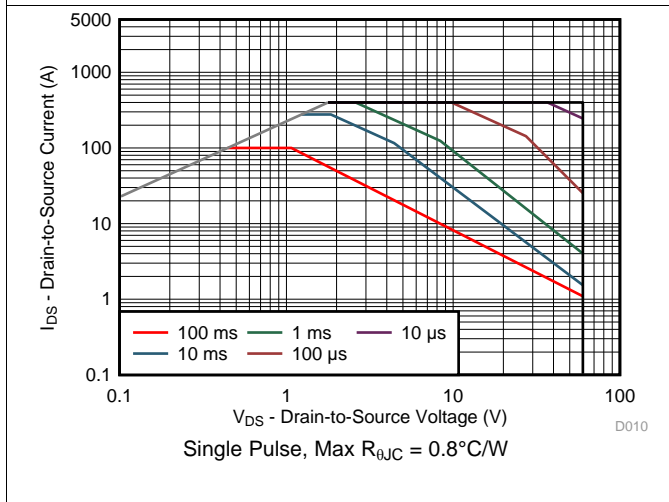


Figure 10. Maximum Safe Operating Area

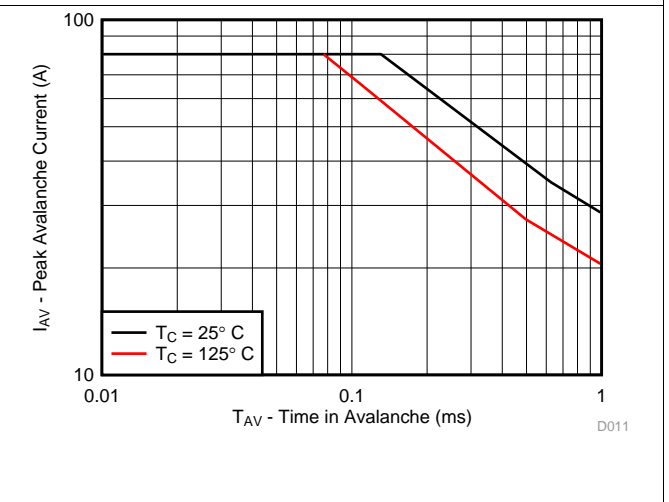


Figure 11. Single Pulse Unclamped Inductive Switching

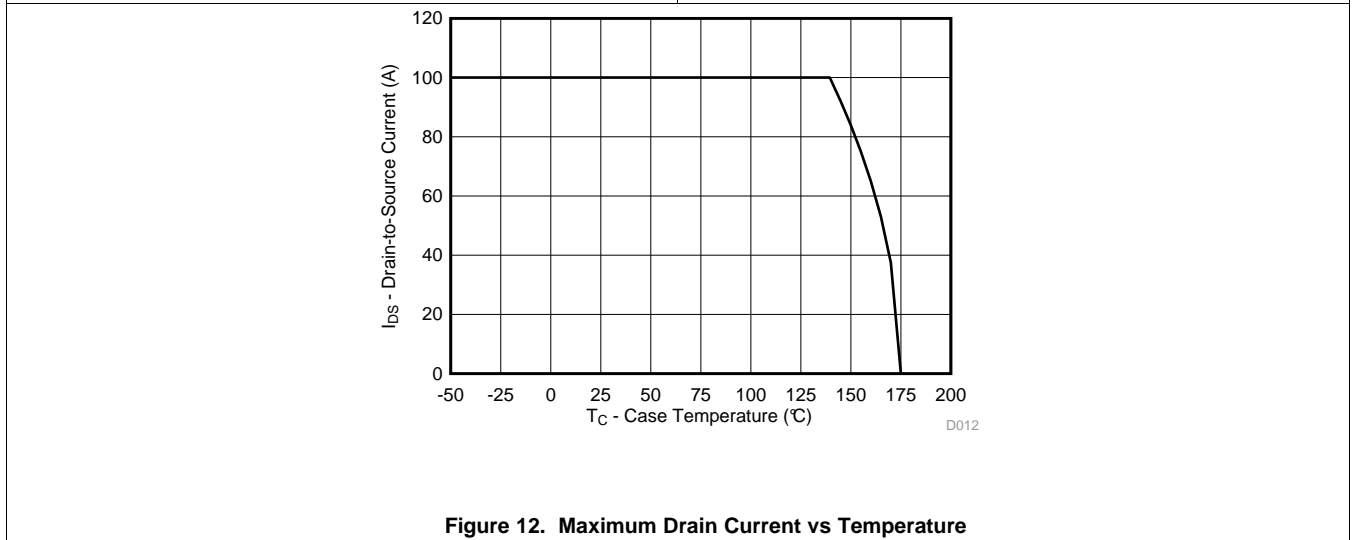


Figure 12. Maximum Drain Current vs Temperature

## 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

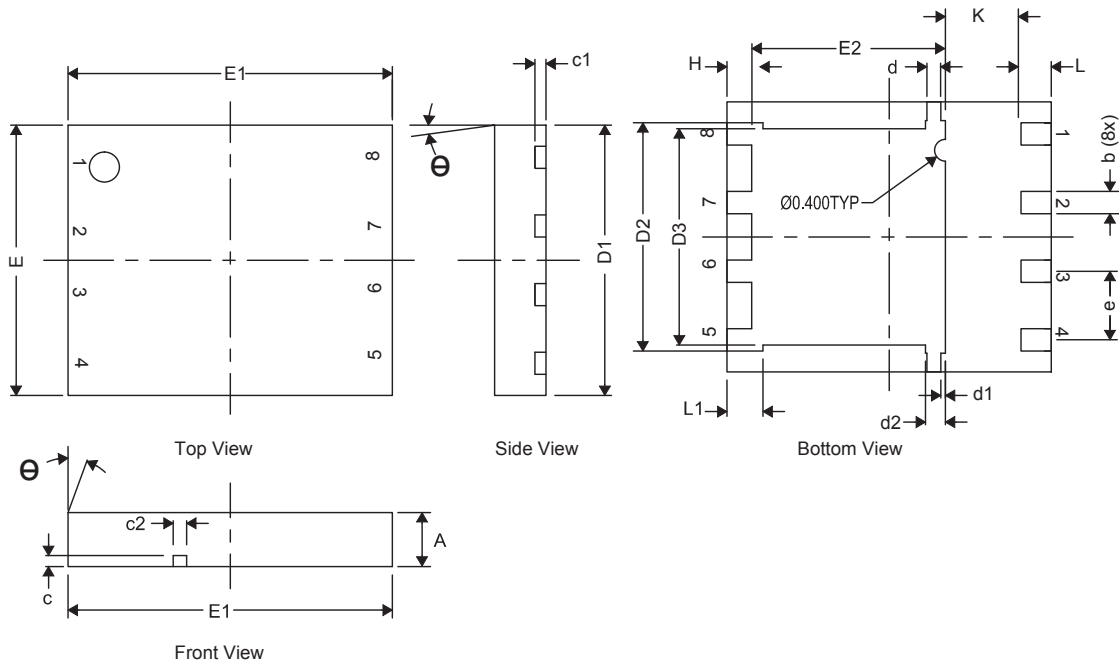
[SLYZ022](#) — *TI Glossary*.

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

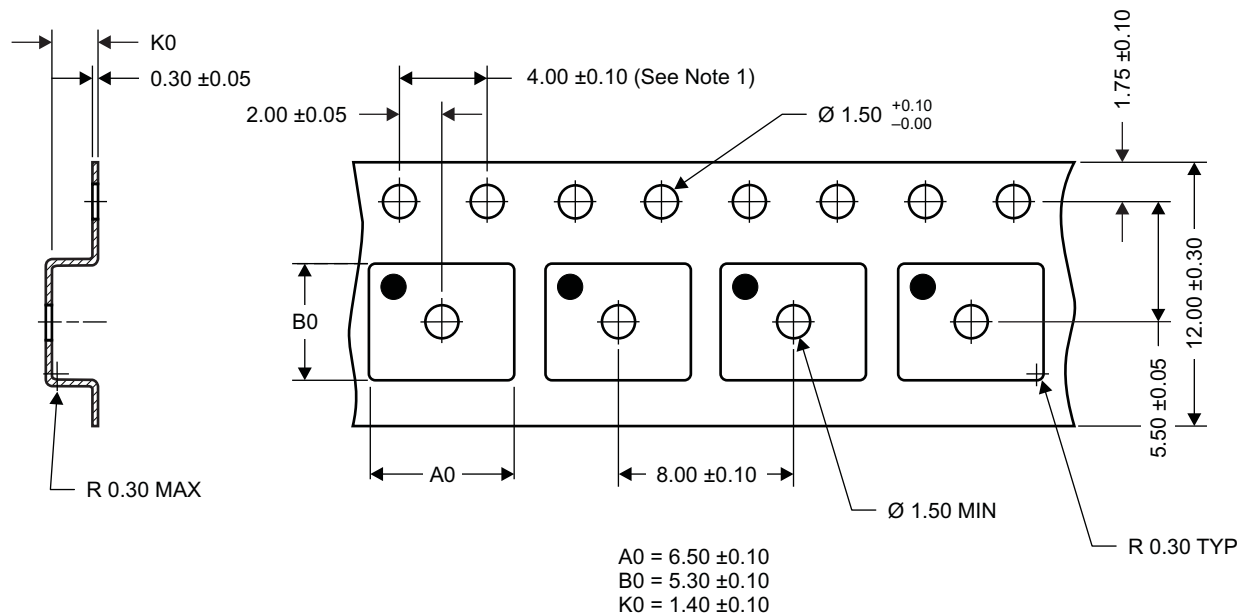


DIM	MILLIMETERS		
	MIN	NOM	MAX
A	0.80	1.00	1.05
b	0.36	0.41	0.46
c	0.15	0.20	0.25
c1	0.15	0.20	0.25
c2	0.20	0.25	0.30
D1	4.90	5.00	5.10
D2	4.12	4.22	4.32
D3	3.90	4.00	4.10
d	0.20	0.25	0.30
d1	0.085 TYP		
d2	0.319	0.369	0.419
E	4.90	5.00	5.10
E1	5.90	6.00	6.10
E2	3.48	3.58	3.68
e	1.27 TYP		
H	0.36	0.46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





## 7.4 Q5B Tape and Reel Information



M0138-01

### Notes:

- 10-sprocket hole-pitch cumulative tolerance  $\pm 0.2$ .
- Camber not to exceed 1 mm in 100 mm, noncumulative over 250 mm.
- Material: black static-dissipative polystyrene.
- All dimensions are in mm (unless otherwise specified).
- 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)
<a href="#">CSD18540Q5B</a>	Active	Production	VSON-CLIP (DNK)   8	2500   LARGE T&R	ROHS Exempt	NIPDAU   SN	Level-1-260C-UNLIM	-55 to 175	CSD18540
CSD18540Q5B.Z	Active	Production	VSON-CLIP (DNK)   8	2500   LARGE T&R	ROHS Exempt	NIPDAU	Level-1-260C-UNLIM	-55 to 175	CSD18540
CSD18540Q5BG4.Z	Active	Production	VSON-CLIP (DNK)   8	2500   LARGE T&R	ROHS Exempt	NIPDAU	Level-1-260C-UNLIM	-55 to 175	CSD18540
<a href="#">CSD18540Q5BT</a>	Active	Production	VSON-CLIP (DNK)   8	250   SMALL T&R	ROHS Exempt	NIPDAU   SN	Level-1-260C-UNLIM	-55 to 175	CSD18540
CSD18540Q5BT.Z	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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