



**THE DATASHEET OF  
CSD17559Q5**



# CSD17559Q5 30-V N-Channel NexFET™ Power MOSFET

## 1 Features

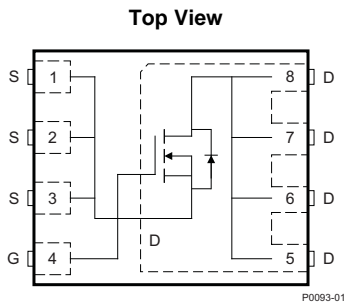
- Extremely Low Resistance
- Ultra-Low  $Q_g$  and  $Q_{gd}$
- Low Thermal Resistance
- Avalanche Rated
- Pb Free Terminal Plating
- RoHS Compliant
- Halogen Free
- SON 5 mm x 6 mm Plastic Package

## 2 Applications

- Point of Load Synchronous Buck in Networking, Telecom, and Computing Systems
- Synchronous Rectification
- Active ORing and Hotswap Applications

## 3 Description

This 30 V, 0.95 mΩ, 5 × 6 mm SON NexFET™ power MOSFET is designed to minimize losses in synchronous rectification and other power conversion applications.



### Product Summary

$T_A = 25^\circ\text{C}$		TYPICAL VALUE		UNIT
$V_{DS}$	Drain-to-Source Voltage	30		V
$Q_g$	Gate Charge Total (4.5 V)	39		nC
$Q_{gd}$	Gate Charge Gate-to-Drain	9.3		nC
$R_{DS(on)}$	Drain-to-Source On-Resistance	$V_{GS} = 4.5\text{ V}$	1.15	mΩ
		$V_{GS} = 10\text{ V}$	0.95	mΩ
$V_{GS(th)}$	Threshold Voltage	1.4		V

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

Device	Qty	Media	Package	Ship
CSD17559Q5	2500	13-Inch Reel	SON 5 × 6 mm Plastic Package	Tape and Reel
CSD17559Q5T	250	13-Inch Reel		

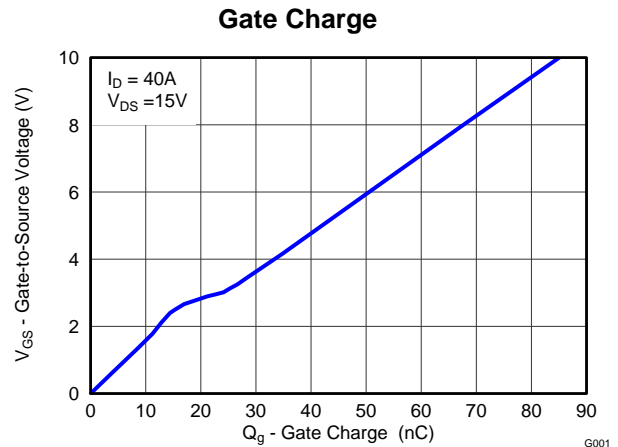
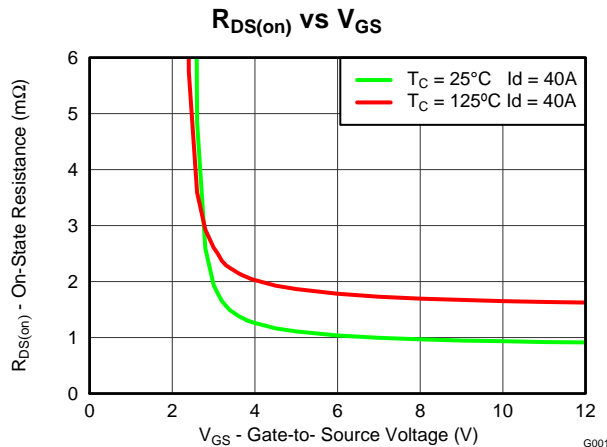
(1) For all available packages, see the orderable addendum at the end of the data sheet.

### Absolute Maximum Ratings

$T_A = 25^\circ\text{C}$		VALUE	UNIT
$V_{DS}$	Drain-to-Source Voltage	30	V
$V_{GS}$	Gate-to-Source Voltage	±20	V
$I_D$	Continuous Drain Current (Package limited)	100	A
	Continuous Drain Current (Silicon limited), $T_C = 25^\circ\text{C}$	257	
	Continuous Drain Current <sup>(1)</sup>	40	
$I_{DM}$	Pulsed Drain Current <sup>(2)</sup>	400	A
$P_D$	Power Dissipation <sup>(1)</sup>	3.2	W
	Power Dissipation, $T_C = 25^\circ\text{C}$	96	
$T_J, T_{stg}$	Operating Junction and Storage Temperature Range	-55 to 150	°C
$E_{AS}$	Avalanche Energy, single pulse $I_D = 104\text{ A}, L = 0.1\text{ mH}, R_G = 25\ \Omega$	541	mJ

(1) Typical  $R_{\theta JA} = 40^\circ\text{C/W}$  on 1 inch<sup>2</sup> (6.45 cm<sup>2</sup>), 2 oz. (0.071 mm thick) Cu pad on a 0.06 inch (1.52 mm) thick FR4 PCB.

(2) Max  $R_{\theta JC} = 1.2^\circ\text{C/W}$ , pulse duration ≤100 μs, duty cycle ≤1%



## Table of Contents

<b>1 Features</b> ..... 1 <b>2 Applications</b> ..... 1 <b>3 Description</b> ..... 1 <b>4 Revision History</b> ..... 2 <b>5 Specifications</b> ..... 3 5.1 Electrical Characteristics..... 3 5.2 Thermal Information ..... 3 5.3 Typical MOSFET Characteristics..... 4	<b>6 Device and Documentation Support</b> ..... 7 6.1 Trademarks ..... 7 6.2 Electrostatic Discharge Caution..... 7 6.3 Glossary ..... 7 <b>7 Mechanical, Packaging, and Orderable Information</b> ..... 8 7.1 Q5 Package Dimensions ..... 8 7.2 Q5 Tape and Reel Information..... 9
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## 4 Revision History

### Changes from Original (November 2012) to Revision A

**Page**

<ul style="list-style-type: none"> <li>• ..... 1</li> <li>• Added small reel information ..... 1</li> <li>• Increased max pulsed drain current to 400 A ..... 1</li> <li>• Added line for max power dissipation with case temperature held to 25°..... 1</li> <li>• Updated max pulsed current conditions ..... 1</li> <li>• Updated <a href="#">Figure 1</a> to a normalized <math>R_{\theta JC}</math> curve ..... 4</li> <li>• Updated the SOA in <a href="#">Figure 10</a> ..... 6</li> </ul>	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>4</p> <p>6</p>
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## 5 Specifications

### 5.1 Electrical Characteristics

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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>STATIC CHARACTERISTICS</b>						
B <sub>V</sub> DSS	Drain-to-Source Voltage	V <sub>GS</sub> = 0 V, I <sub>DS</sub> = 250 μA	30			V
I <sub>DSS</sub>	Drain-to-Source Leakage Current	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 24 V			1	μA
I <sub>GSS</sub>	Gate-to-Source Leakage Current	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = 20 V			100	nA
V <sub>GS(th)</sub>	Gate-to-Source Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>DS</sub> = 250 μA	1.2	1.4	1.7	V
R <sub>DS(on)</sub>	Drain-to-Source On-Resistance	V <sub>GS</sub> = 4.5 V, I <sub>DS</sub> = 40 A		1.15	1.5	mΩ
		V <sub>GS</sub> = 10 V, I <sub>DS</sub> = 40 A		0.95	1.15	mΩ
g <sub>fs</sub>	Transconductance	V <sub>DS</sub> = 15 V, I <sub>DS</sub> = 40 A		235		S
<b>DYNAMIC CHARACTERISTICS</b>						
C <sub>iss</sub>	Input Capacitance	V <sub>GS</sub> = 0 V, V <sub>DS</sub> = 15 V, f = 1 MHz		7070	9200	pF
C <sub>oss</sub>	Output Capacitance			1780	2314	pF
C <sub>rss</sub>	Reverse Transfer Capacitance			87	113	pF
R <sub>G</sub>	Series Gate Resistance			1.2	2.4	Ω
Q <sub>g</sub>	Gate Charge Total (4.5 V)	V <sub>DS</sub> = 15 V, I <sub>DS</sub> = 40 A		39	51	nC
Q <sub>gd</sub>	Gate Charge Gate-to-Drain			9.3		nC
Q <sub>gs</sub>	Gate Charge Gate-to-Source			14.4		nC
Q <sub>g(th)</sub>	Gate Charge at V <sub>th</sub>			8.3		nC
Q <sub>oss</sub>	Output Charge	V <sub>DS</sub> = 15 V, V <sub>GS</sub> = 0 V		50		nC
t <sub>d(on)</sub>	Turn On Delay Time	V <sub>DS</sub> = 15 V, V <sub>GS</sub> = 4.5 V, I <sub>DS</sub> = 40 A, R <sub>G</sub> = 2 Ω		20		ns
t <sub>r</sub>	Rise Time			41		ns
t <sub>d(off)</sub>	Turn Off Delay Time			32		ns
t <sub>f</sub>	Fall Time			14		ns
<b>DIODE CHARACTERISTICS</b>						
V <sub>SD</sub>	Diode Forward Voltage	I <sub>SD</sub> = 40 A, V <sub>GS</sub> = 0 V		0.8	1	V
Q <sub>rr</sub>	Reverse Recovery Charge	V <sub>DD</sub> = 15 V, I <sub>F</sub> = 40 A, di/dt = 300 A/μs		80		nC
t <sub>rr</sub>	Reverse Recovery Time			37		ns

### 5.2 Thermal Information

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

THERMAL METRIC		MIN	TYP	MAX	UNIT
R <sub>θJC</sub>	Junction-to-Case Thermal Resistance <sup>(1)</sup>			1.2	°C/W
R <sub>θJA</sub>	Junction-to-Ambient Thermal Resistance <sup>(1)(2)</sup>			50	

- (1) R<sub>θJC</sub> is determined with the device mounted on a 1 inch<sup>2</sup> (6.45 cm<sup>2</sup>), 2 oz. (0.071 mm thick) Cu pad on a 1.5 inches × 1.5 inches (3.81 cm × 3.81 cm), 0.06 inch (1.52 mm) thick FR4 PCB. R<sub>θJC</sub> is specified by design, whereas R<sub>θJA</sub> is determined by the user's board design.
- (2) Device mounted on FR4 material with 1 inch<sup>2</sup> (6.45 cm<sup>2</sup>), 2 oz. (0.071 mm thick) Cu.

**CSD17559Q5**

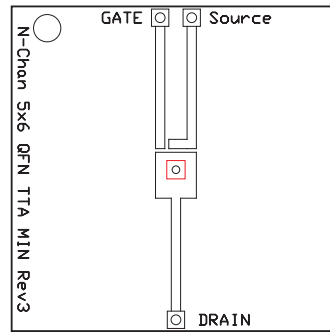
SLPS374A –NOVEMBER 2012–REVISED SEPTEMBER 2014

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M0137-01

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



M0137-02

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)

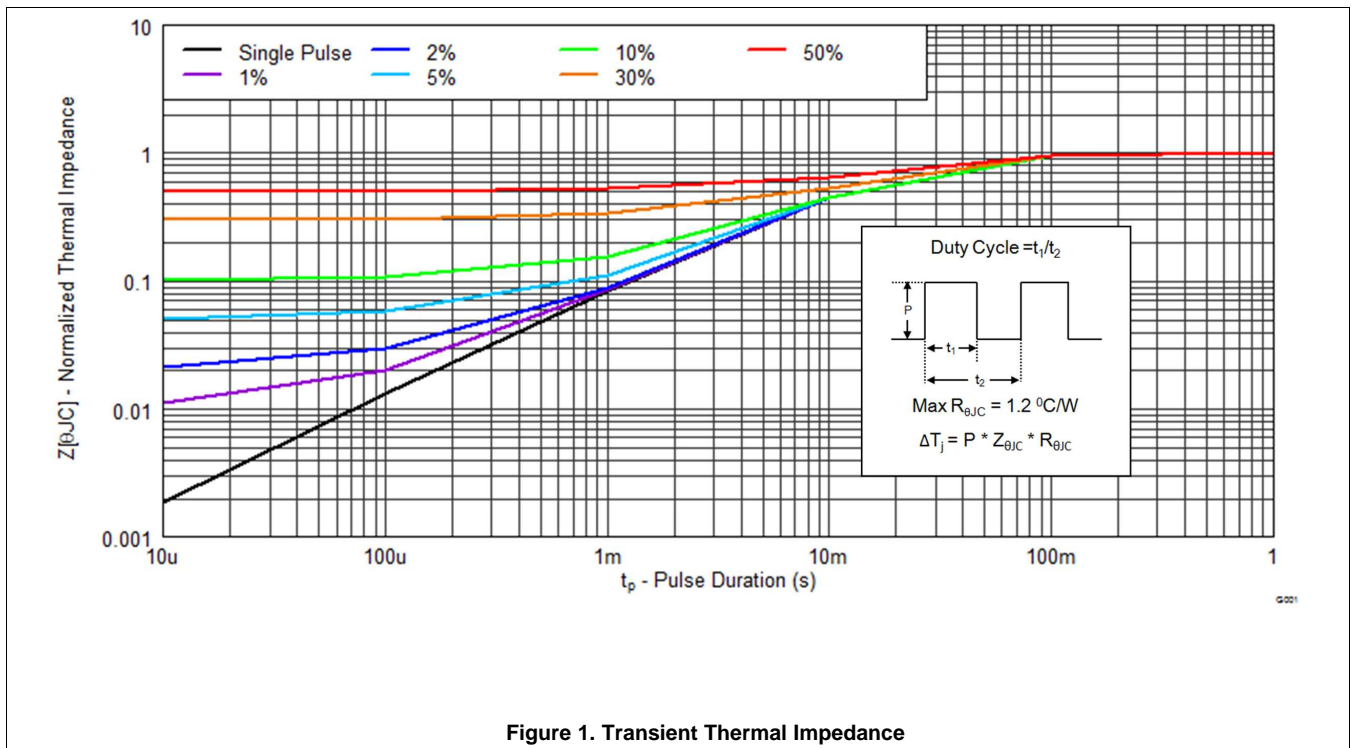


Figure 1. Transient Thermal Impedance

Typical MOSFET Characteristics (continued)

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

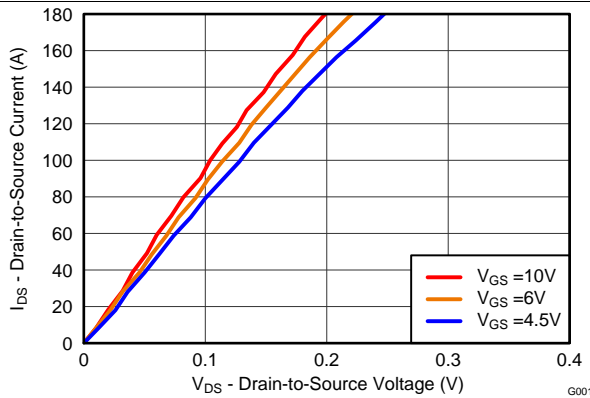


Figure 2. Saturation Characteristics

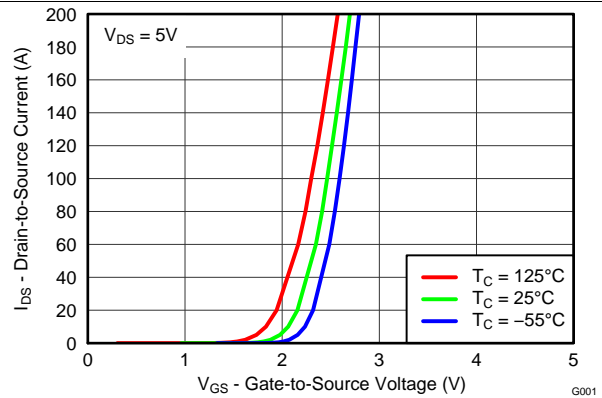


Figure 3. Transfer Characteristics

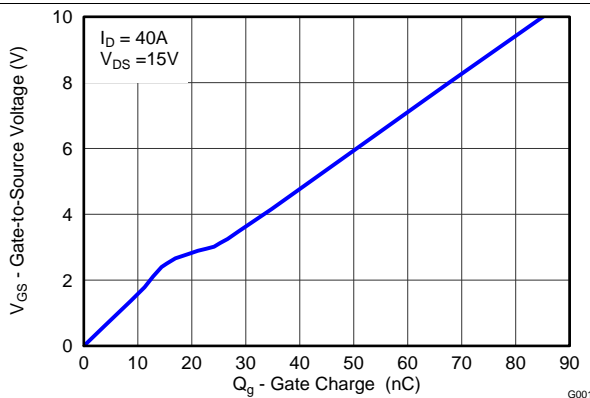


Figure 4. Gate Charge

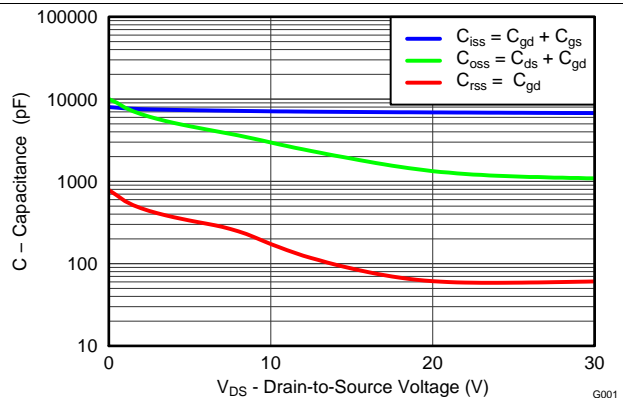


Figure 5. Capacitance

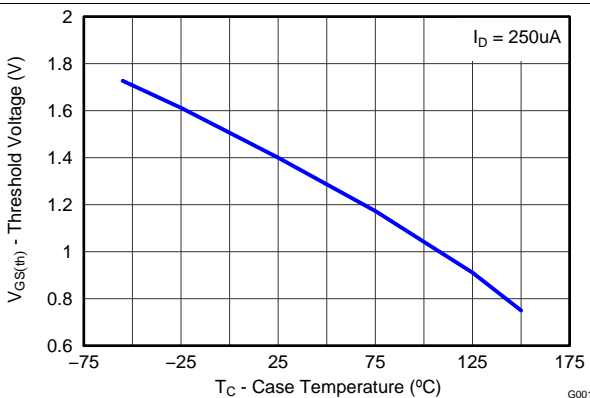


Figure 6. Threshold Voltage vs Temperature

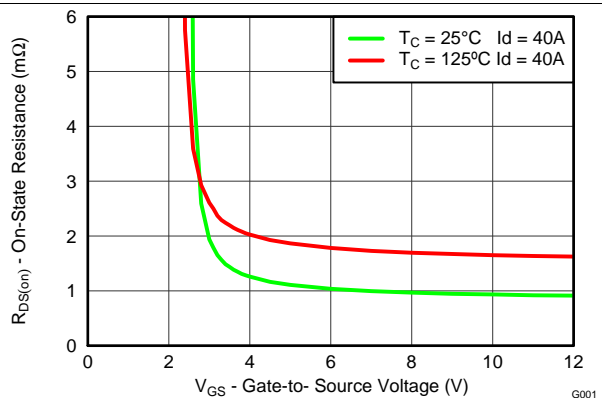


Figure 7. On-State Resistance vs Gate-to-Source Voltage

Typical MOSFET Characteristics (continued)

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

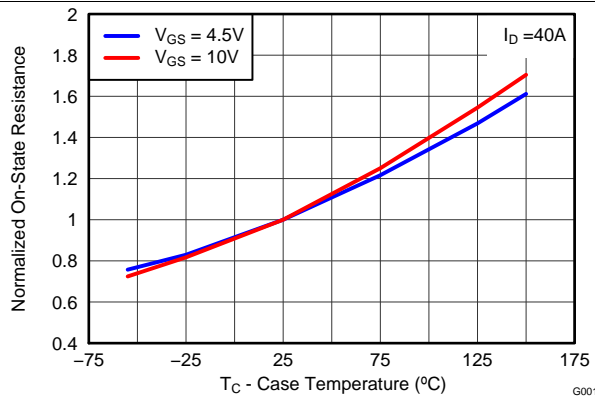


Figure 8. Normalized On-State Resistance vs Temperature

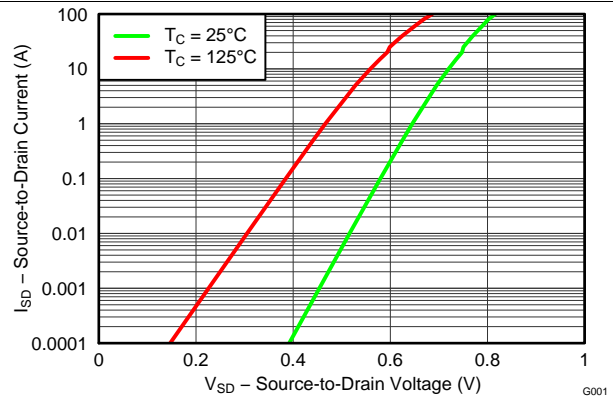


Figure 9. Typical Diode Forward Voltage

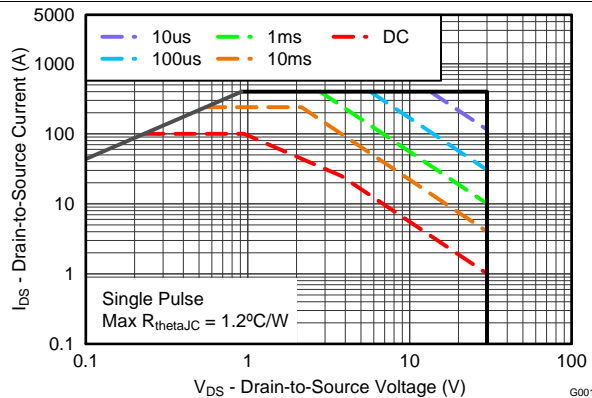


Figure 10. Safety Operating Area

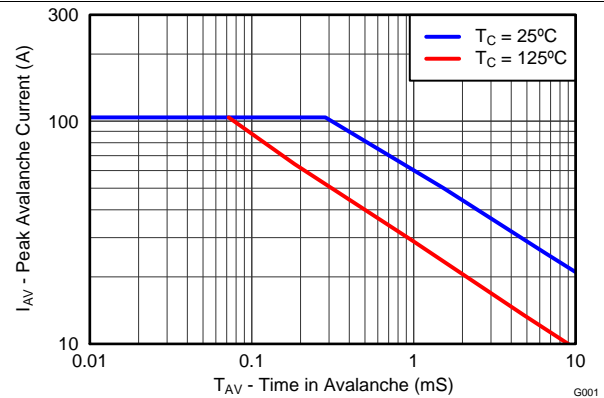


Figure 11. Single Pulse Unclamped Inductive Switching

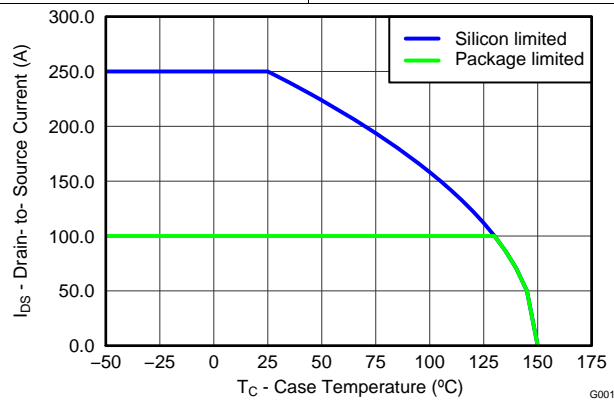


Figure 12. Maximum Drain Current vs Temperature

## 6 Device and Documentation Support

### 6.1 Trademarks

NexFET is a trademark of Texas Instruments.

### 6.2 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.

### 6.3 Glossary

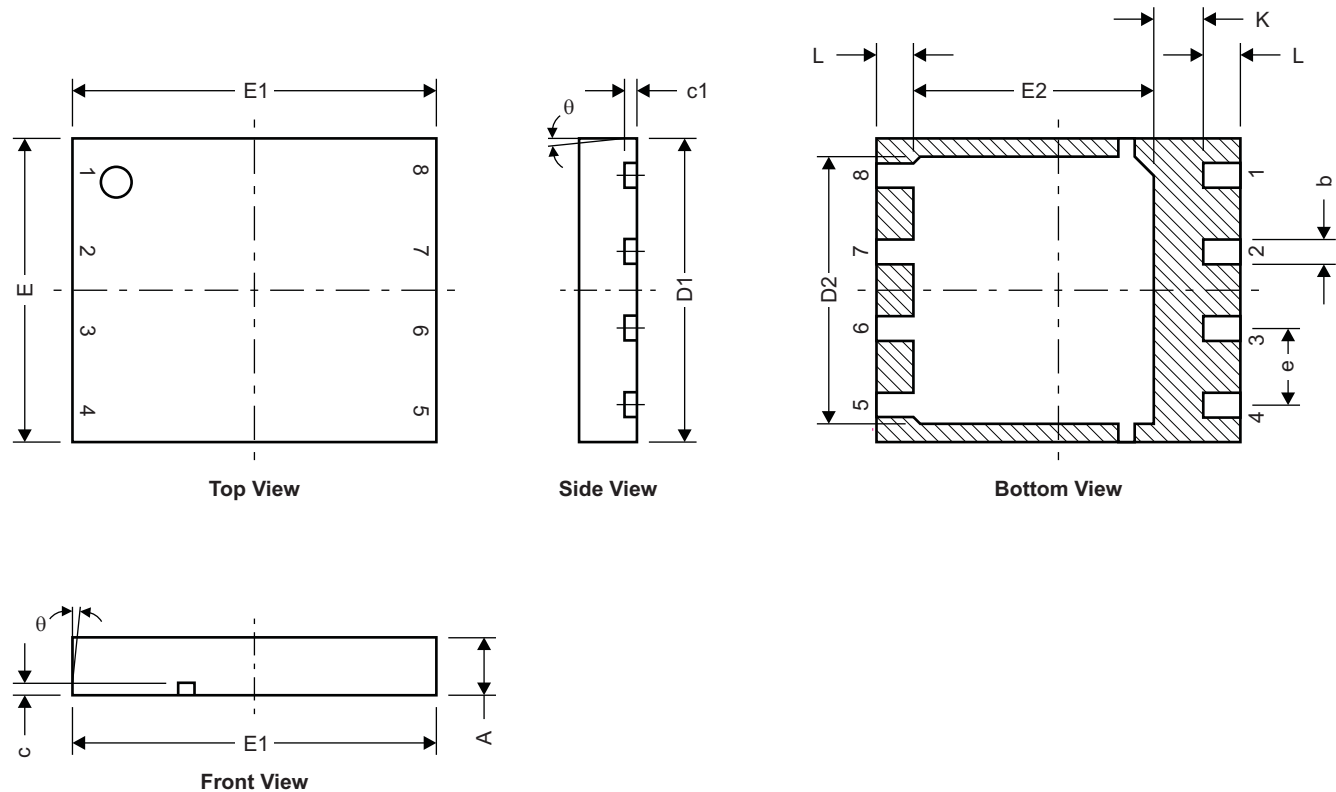
[SLYZ022](#) — *TI Glossary*.

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

## 7 Mechanical, Packaging, and Orderable Information

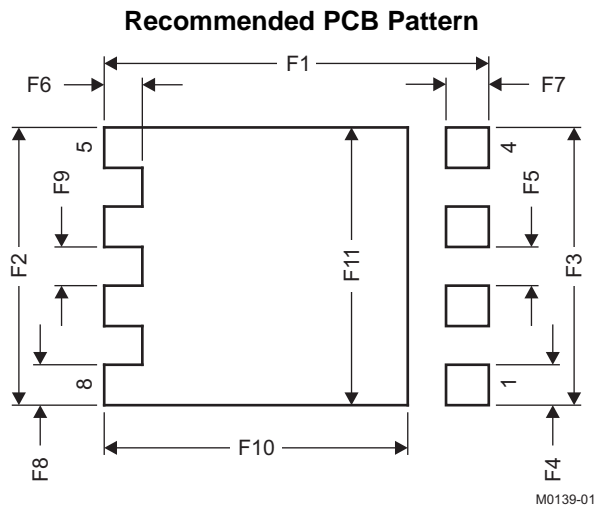
The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand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

### 7.1 Q5 Package Dimensions



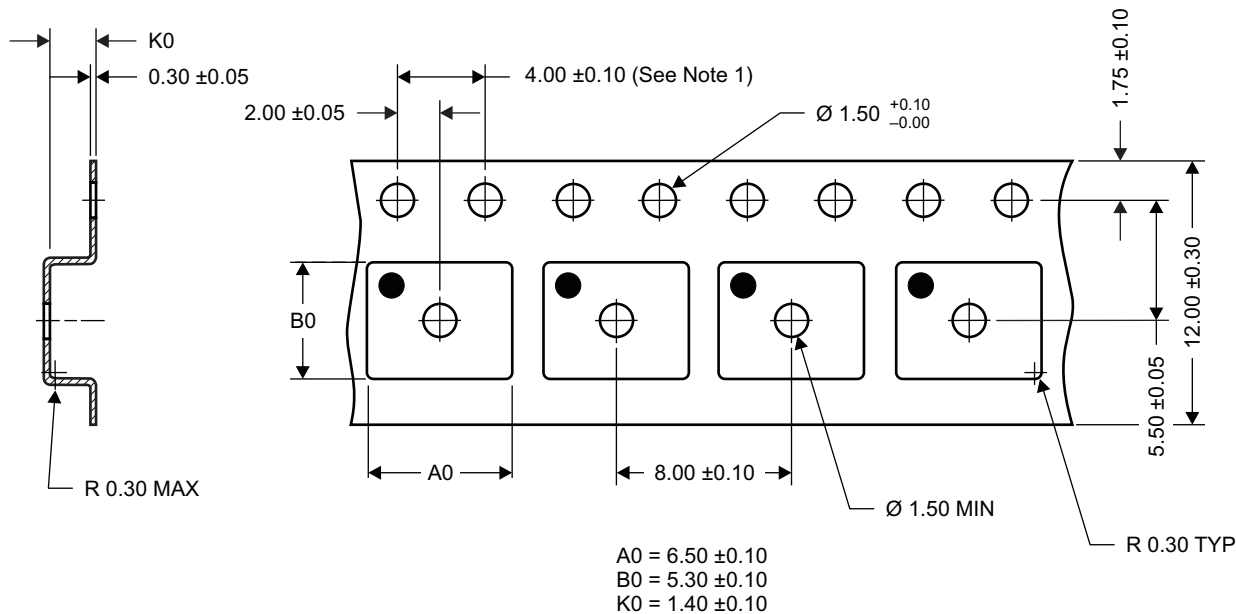
M0140-01

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	0.950	1.050	0.037	0.039
b	0.360	0.460	0.014	0.018
c	0.150	0.250	0.006	0.010
c1	0.150	0.250	0.006	0.010
D1	4.900	5.100	0.193	0.201
D2	4.320	4.520	0.170	0.178
E	4.900	5.100	0.193	0.201
E1	5.900	6.100	0.232	0.240
E2	3.920	4.12	0.154	0.162
e	1.27 TYP		0.050	
K	0.760		0.030	
L	0.510	0.710	0.020	0.028
$\theta$	0.00	—	—	—



DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
F1	6.205	6.305	0.244	0.248
F2	4.460	4.560	0.176	0.180
F3	4.460	4.560	0.176	0.180
F4	0.650	0.700	0.026	0.028
F5	0.620	0.670	0.024	0.026
F6	0.630	0.680	0.025	0.027
F7	0.700	0.800	0.028	0.031
F8	0.650	0.700	0.026	0.028
F9	0.620	0.670	0.024	0.026
F10	4.900	5.000	0.193	0.197
F11	4.460	4.560	0.176	0.180

**7.2 Q5 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
CSD17559Q5	ACTIVE	VSON-CLIP	DQH	8	2500	Pb-Free (RoHS Exempt)	CU SN	Level-1-260C-UNLIM	-55 to 150	CSD17559	<a href="#">Samples</a>
CSD17559Q5T	ACTIVE	VSON-CLIP	DQH	8	250	Pb-Free (RoHS Exempt)	CU SN	Level-1-260C-UNLIM	-55 to 150	CSD17559	<a href="#">Samples</a>

(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.

**OBSELETE:** 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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Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

Automotive and Transportation	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
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