

# CSD85301Q2 20 V Dual N-Channel NexFET™ Power MOSFETs

## 1 Features

- Low On-Resistance
- Dual Independent MOSFETs
- Space Saving SON 2 x 2 mm Plastic Package
- Optimized for 5 V Gate Driver
- Avalanche Rated
- Pb and Halogen Free
- RoHS Compliant

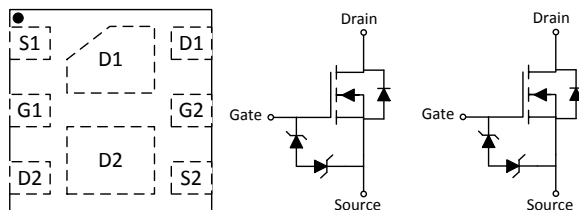
## 2 Applications

- Point-of-Load Synchronous Buck Converter for Applications in Networking, Telecom, and Computing Systems
- Adaptor or USB Input Protection for Notebook PCs and Tablets
- Battery Protection

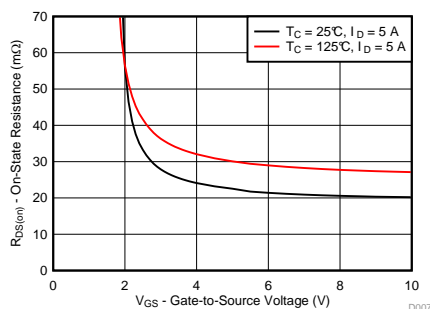
## 3 Description

The CSD85301Q2 is a 20 V, 23 mΩ N-Channel device with dual independent MOSFETs in a SON 2 x 2 mm plastic package. The two FETs were designed to be used in a half bridge configuration for synchronous buck and other power supply applications. Additionally, this part can be used for adaptor, USB input protection and battery charging applications. The dual FETs feature low drain to source on-resistance that minimizes losses and offers low component count for space constrained applications.

Top View and Circuit Image



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



## Product Summary

$T_A = 25^\circ\text{C}$		TYPICAL VALUE		UNIT
$V_{DS}$	Drain-to-Source Voltage	20		V
$Q_g$	Gate Charge Total (4.5 V)	4.2		nC
$Q_{gd}$	Gate Charge Gate to Drain	1.0		nC
$R_{DS(on)}$	Drain-to-Source On Resistance	$V_{GS} = 1.8\text{ V}$	65	mΩ
		$V_{GS} = 2.5\text{ V}$	33	mΩ
		$V_{GS} = 3.8\text{ V}$	25	mΩ
		$V_{GS} = 4.5\text{ V}$	23	mΩ
$V_{GS(th)}$	Threshold Voltage	0.9		V

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

Device	Media	Qty	Package	Ship
CSD85301Q2	7-Inch Reel	3000	SON 2 x 2 mm Plastic Package	Tape and Reel
CSD85301Q2T	7-Inch Reel	250		

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

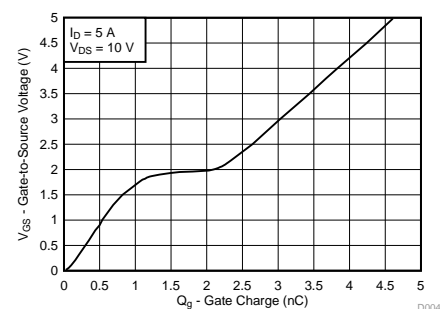
## Absolute Maximum Ratings

$T_A = 25^\circ\text{C}$		VALUE	UNIT
$V_{DS}$	Drain-to-Source Voltage	20	V
$V_{GS}$	Gate-to-Source Voltage	±10	V
$I_D$	Continuous Drain Current (Package limited)	5.0	A
$I_{DM}$	Pulsed Drain Current <sup>(1)</sup>	26	A
$P_D$	Power Dissipation <sup>(2)</sup>	2.3	W
$T_J, T_{stg}$	Operating Junction and Storage Temperature Range	-55 to 150	°C
$E_{AS}$	Avalanche Energy, single pulse $I_D = 8.7\text{ A}, L = 0.1\text{ mH}, R_G = 25\ \Omega$	3.8	mJ

(1) Max  $R_{\theta JA} = 185\ \text{°C/W}$ , pulse duration  $\leq 100\ \mu\text{s}$ , duty cycle  $\leq 1\%$ .

(2) Typical  $R_{\theta JA} = 55\ \text{°C/W}$  on a 1 inch<sup>2</sup>, 2 oz. Cu pad on a 0.06 inch thick FR4 PCB.

## Gate Charge



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## 4 Revision History

DATE	REVISION	NOTES
December 2014	*	Initial release.

## 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	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	20			V
$I_{DSS}$	Drain-to-Source Leakage Current	$V_{GS} = 0\text{ V}, V_{DS} = 16\text{ V}$			1	$\mu\text{A}$
$I_{GSS}$	Gate-to-Source Leakage Current	$V_{DS} = 0\text{ V}, V_{GS} = 10\text{ V}$			10	$\mu\text{A}$
$V_{GS(th)}$	Gate-to-Source Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	0.6	0.9	1.2	V
$R_{DS(on)}$	Drain-to-Source On-Resistance	$V_{GS} = 1.8\text{ V}, I_D = 0.5\text{ A}$		65	99	m $\Omega$
		$V_{GS} = 2.5\text{ V}, I_D = 5\text{ A}$		33	39	m $\Omega$
		$V_{GS} = 3.8\text{ V}, I_D = 5\text{ A}$		25	29	m $\Omega$
		$V_{GS} = 4.5\text{ V}, I_D = 5\text{ A}$		23	27	m $\Omega$
$g_{fs}$	Transconductance	$V_{DS} = 2\text{ V}, I_D = 5\text{ A}$		20		S
<b>DYNAMIC CHARACTERISTICS</b>						
$C_{iss}$	Input Capacitance	$V_{GS} = 0\text{ V}, V_{DS} = 10\text{ V}, f = 1\text{ MHz}$		361	469	pF
$C_{oss}$	Output Capacitance			68	89	pF
$C_{rss}$	Reverse Transfer Capacitance			48	62	pF
$R_G$	Series Gate Resistance			7.3		$\Omega$
$Q_g$	Gate Charge Total (4.5 V)	$V_{DS} = 10\text{ V}, I_D = 5\text{ A}$		4.2	5.4	nC
$Q_{gd}$	Gate Charge Gate-to-Drain			1.0		nC
$Q_{gs}$	Gate Charge Gate-to-Source			1.1		nC
$Q_{g(th)}$	Gate Charge at $V_{th}$			0.5		nC
$Q_{oss}$	Output Charge	$V_{DS} = 10\text{ V}, V_{GS} = 0\text{ V}$		1.3		nC
$t_{d(on)}$	Turn On Delay Time	$V_{DS} = 10\text{ V}, V_{GS} = 5\text{ V}, I_{DS} = 5\text{ A}, R_G = 0\ \Omega$		6		ns
$t_r$	Rise Time			26		ns
$t_{d(off)}$	Turn Off Delay Time			14		ns
$t_f$	Fall Time			15		ns
<b>DIODE CHARACTERISTICS</b>						
$V_{SD}$	Diode Forward Voltage	$I_{SD} = 5\text{ A}, V_{GS} = 0\text{ V}$		0.8	1.0	V
$Q_{rr}$	Reverse Recovery Charge	$V_{DS} = 10\text{ V}, I_F = 5\text{ A}, di/dt = 300\text{ A}/\mu\text{s}$		7.2		nC
$t_{rr}$	Reverse Recovery Time			14		ns

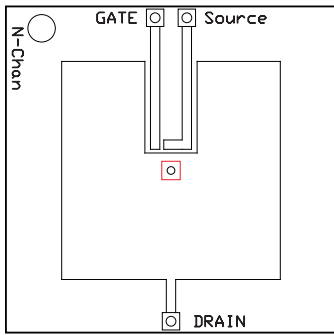
### 5.2 Thermal Information

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

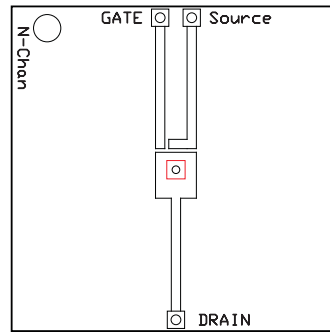
THERMAL METRIC		MIN	TYP	MAX	UNIT
$R_{\theta JA}$	Junction-to-Ambient Thermal Resistance <sup>(1)</sup>			70	$^\circ\text{C}/\text{W}$
	Junction-to-Ambient Thermal Resistance <sup>(2)</sup>			185	

(1) Device mounted on FR4 material with 1 inch<sup>2</sup> (6.45 cm<sup>2</sup>), 2 oz. (0.071 mm thick) Cu.

(2) Device mounted on FR4 material with minimum Cu mounting area.



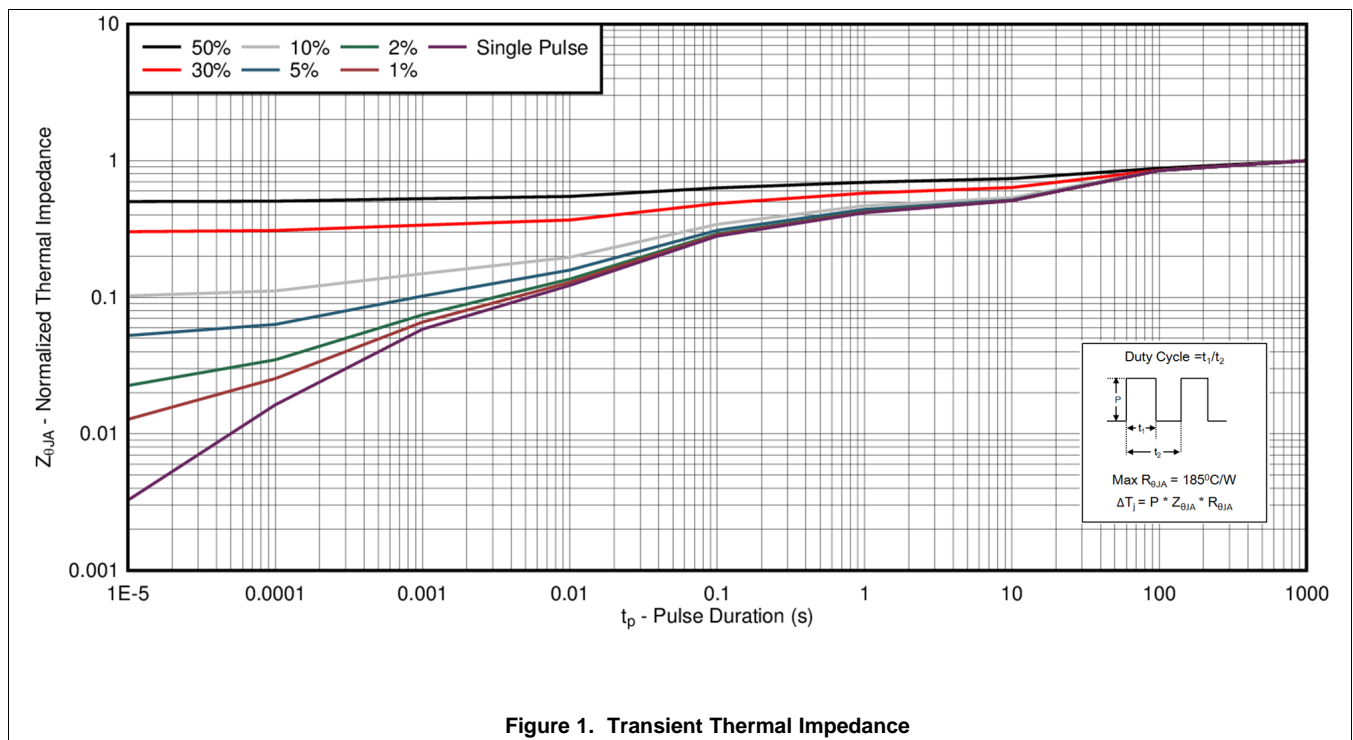
Max  $R_{\theta JA} = 70$  when mounted on 1 inch<sup>2</sup> (6.45 cm<sup>2</sup>) of 2 oz. (0.071 mm thick) Cu.



Max  $R_{\theta JA} = 185$  when mounted on 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)

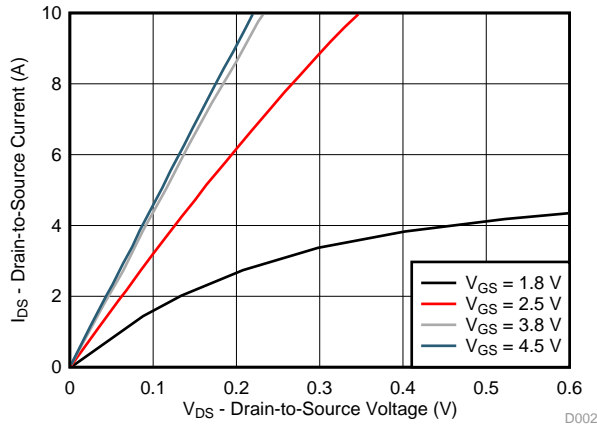


Figure 2. Saturation Characteristics

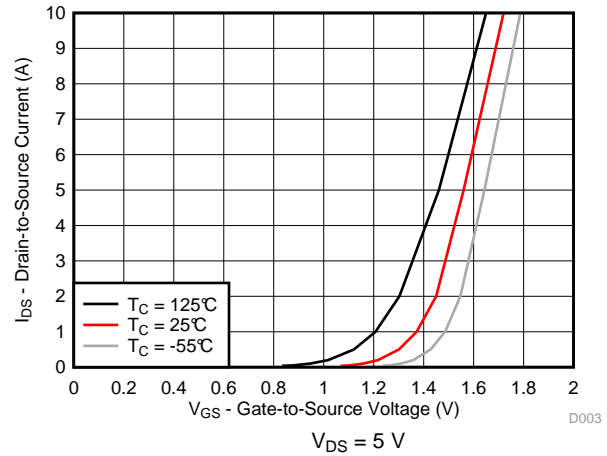


Figure 3. Transfer Characteristics

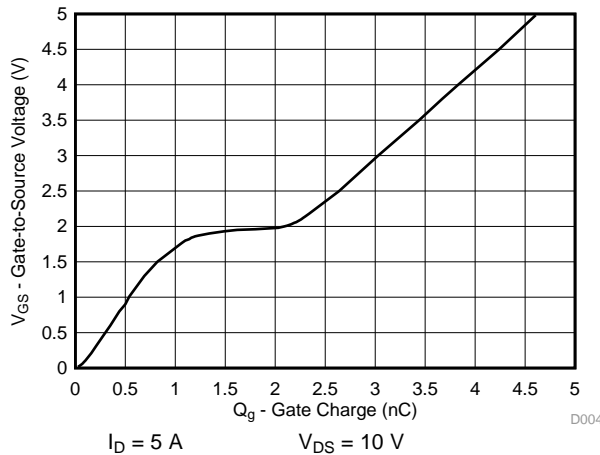


Figure 4. Gate Charge

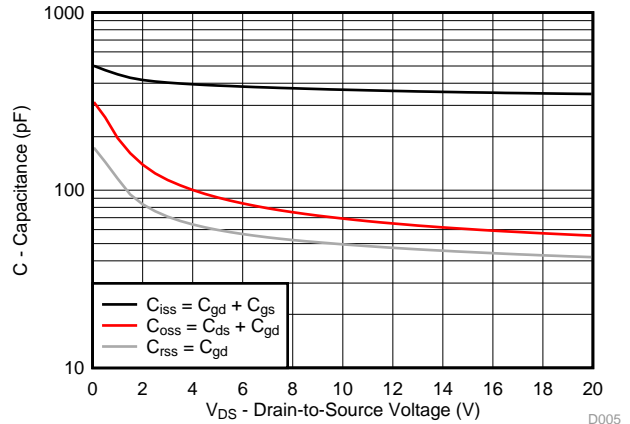


Figure 5. Capacitance

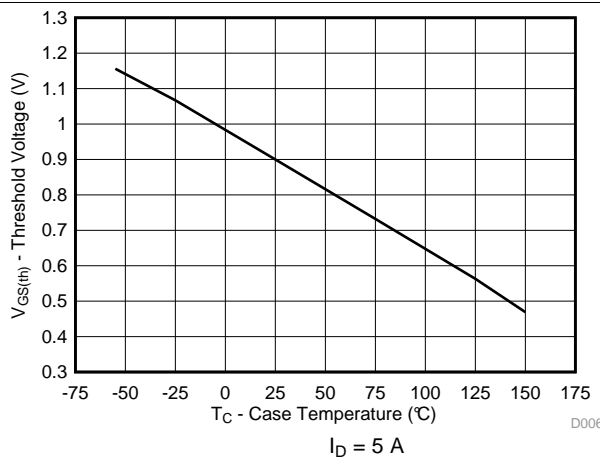


Figure 6. Threshold Voltage vs Temperature

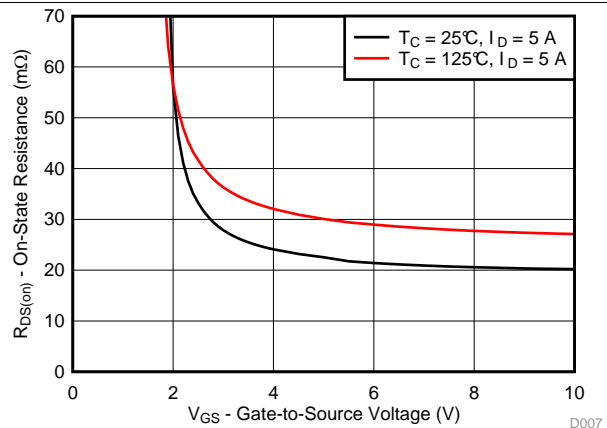


Figure 7. On-State Resistance vs Gate-to-Source Voltage

Typical MOSFET Characteristics (continued)

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

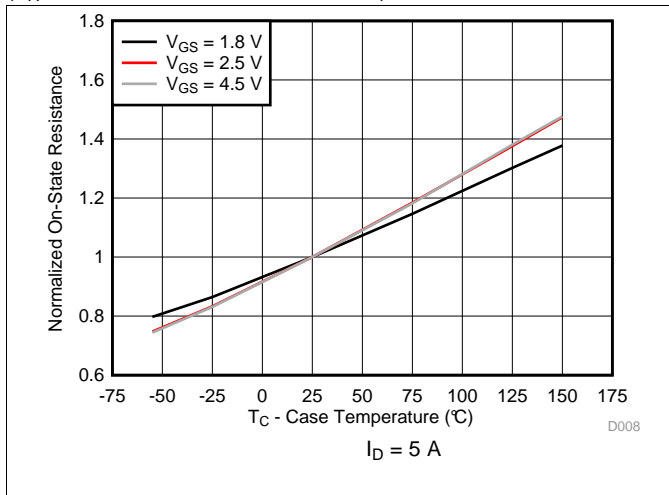


Figure 8. Normalized On-State Resistance vs Temperature

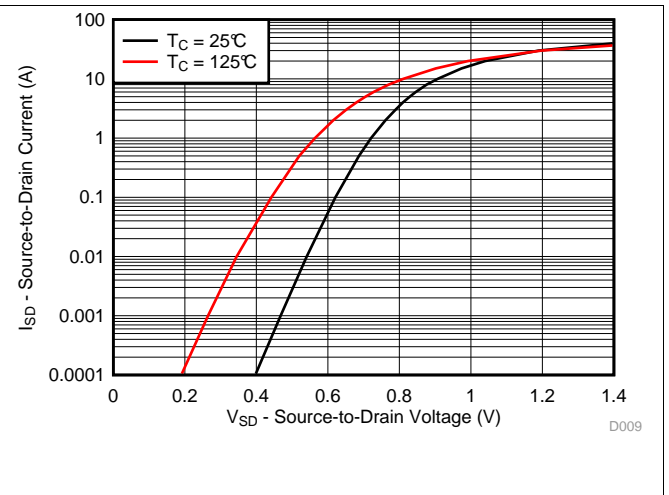


Figure 9. Typical Diode Forward Voltage

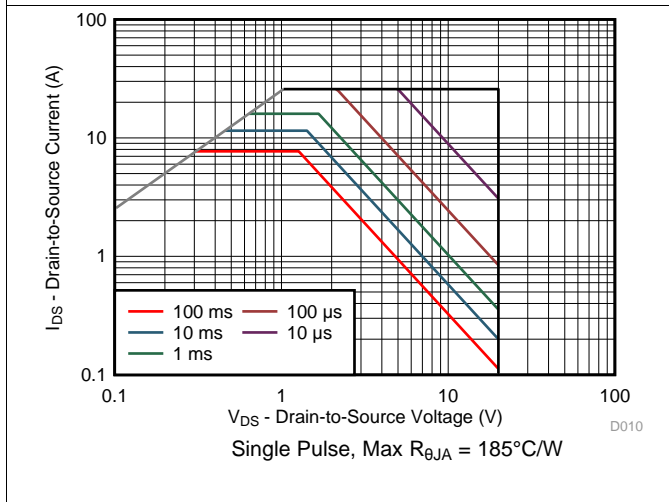


Figure 10. Maximum Safe Operating Area

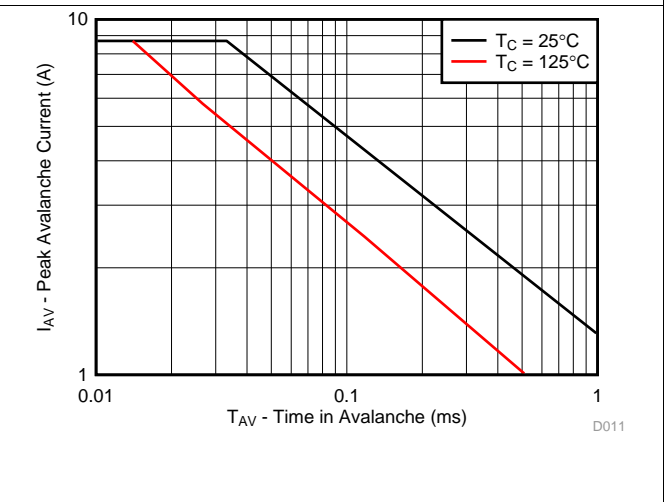


Figure 11. Single Pulse Unclamped Inductive Switching

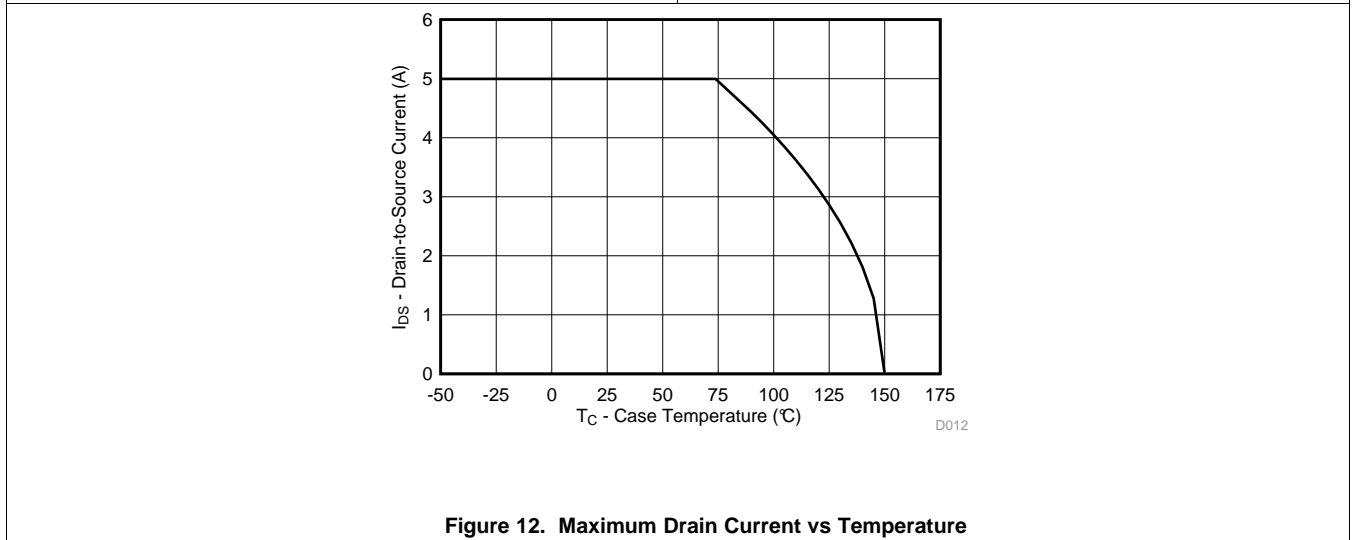


Figure 12. Maximum Drain Current vs Temperature

## 6 Device and Documentation Support

### 6.1 Trademarks

NexFET is a trademark of Texas Instruments.  
All other trademarks are the property of their respective owners.

### 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

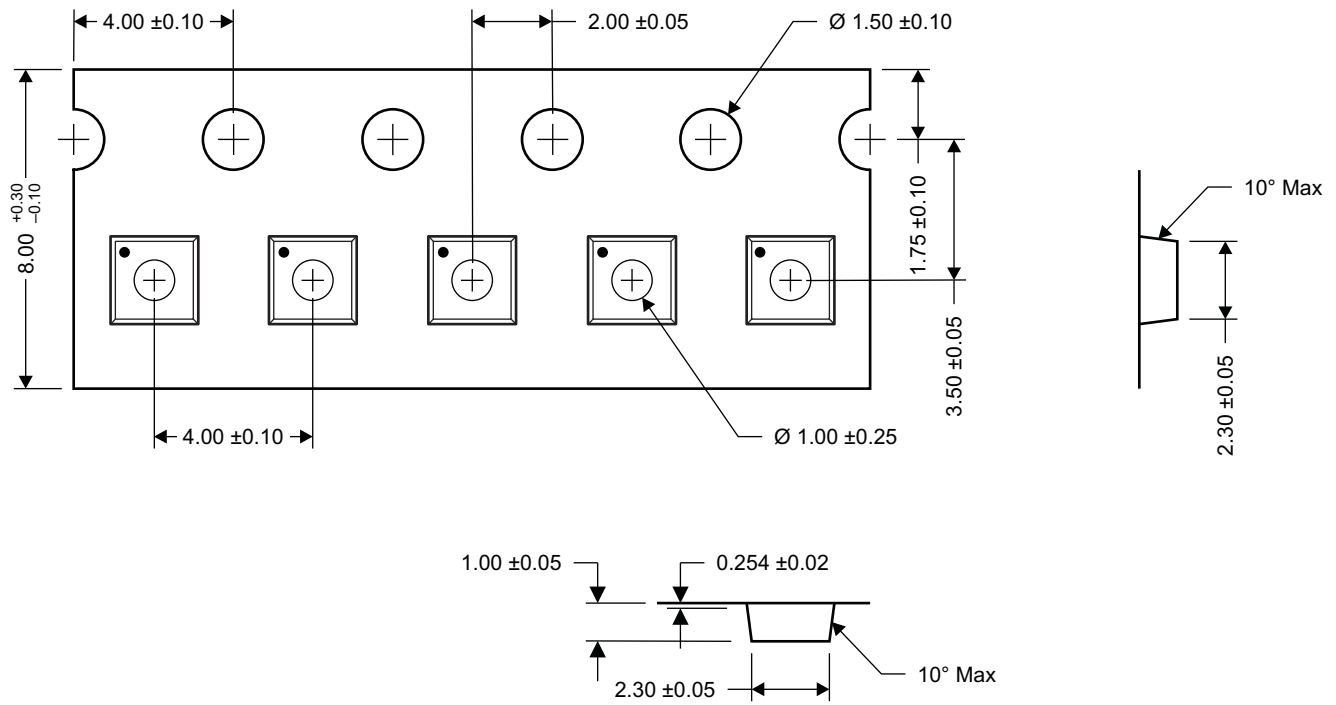
[SLYZ022](#) — *TI Glossary*.

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





## 7.4 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  $\pm 0.20$
  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
CSD85301Q2	ACTIVE	WSON	DQK	6	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM		8531	<a href="#">Samples</a>
CSD85301Q2T	ACTIVE	WSON	DQK	6	3000	Green (RoHS & no Sb/Br)	CU SN	Level-1-260C-UNLIM		8531	<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.

**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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**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*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
CSD85301Q2	WSON	DQK	6	3000	180.0	8.4	2.3	2.3	1.0	4.0	2.3	Q1
CSD85301Q2T	WSON	DQK	6	3000	180.0	8.4	2.3	2.3	1.0	4.0	2.3	Q1

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CSD85301Q2	WSON	DQK	6	3000	550.0	455.0	55.0
CSD85301Q2T	WSON	DQK	6	3000	550.0	455.0	55.0

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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>
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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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