

## P-Channel NexFET™ Power MOSFET

Check for Samples: [CSD25213W10](#)

### FEATURES

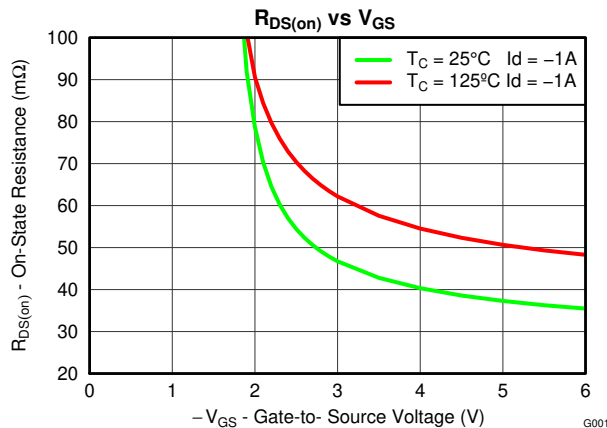
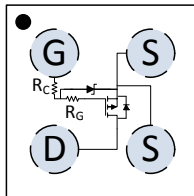
- Ultra Low Qg and Qgd
- Small Footprint 1mm × 1mm
- Low Profile 0.62mm Height
- Pb Free
- Gate-Source Voltage Clamp
- Gate ESD Protection
- RoHS Compliant
- Halogen Free

### APPLICATIONS

- Battery Management
- Load Switch
- Battery Protection

### DESCRIPTION

The device has been designed to deliver the lowest on resistance and gate charge in the smallest outline possible with excellent thermal characteristics in an ultra low profile.

**Top View**


### PRODUCT SUMMARY

V <sub>DS</sub>	Drain to Source Voltage	-20	V
Q <sub>g</sub>	Gate Charge Total (4.5V)	2.2	nC
Q <sub>gd</sub>	Gate Charge Gate to Drain	0.14	nC
R <sub>DS(on)</sub>	Drain to Source On Resistance	V <sub>GS</sub> = -2.5V	54 mΩ
		V <sub>GS</sub> = -4.5V	39 mΩ
V <sub>GS(th)</sub>	Threshold Voltage	-0.85	V

### ORDERING INFORMATION

Device	Package	Media	Qty	Ship
CSD25213W10	1 × 1 Wafer Level Package	7-inch reel	3000	Tape and Reel

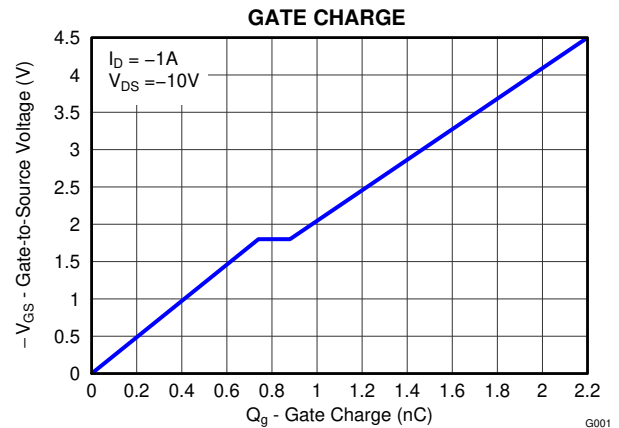
### ABSOLUTE MAXIMUM RATINGS

T <sub>A</sub> = 25°C unless otherwise stated		VALUE	UNIT
V <sub>DS</sub>	Drain to Source Voltage	-20	V
V <sub>GS</sub>	Gate to Source Voltage	-6.0	V
I <sub>D</sub>	Continuous Drain Current, T <sub>A</sub> = 25°C <sup>(1)</sup>	-1.6	A
I <sub>DM</sub>	Pulsed Drain Current, T <sub>A</sub> = 25°C <sup>(2)</sup>	-16	A
I <sub>G</sub>	Continuous Gate Clamp Current <sup>(3)</sup>	-5	mA
P <sub>D</sub>	Power Dissipation <sup>(1)</sup>	1	W
T <sub>J</sub> , T <sub>STG</sub>	Operating Junction and Storage Temperature Range	-55 to 150	°C

(1) R<sub>θJA</sub> = 75°C/W on 1in<sup>2</sup> Cu (2 oz.) on 0.060" thick FR4 PCB.

(2) Pulse width ≤300μs, duty cycle ≤2%

(3) Limited by gate resistance.



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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.

## ELECTRICAL CHARACTERISTICS

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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>Static Characteristics</b>						
$BV_{DSS}$	Drain to Source Voltage	$V_{GS} = 0V, I_D = -250\mu A$	-20			V
$BV_{GSS}$	Gate to Source Voltage;	$V_{DS} = 0V, I_G = -250\mu A$	-6.0			V
$I_{DSS}$	Drain to Source Leakage Current	$V_{GS} = 0V, V_{DS} = -10V$			-1	$\mu A$
$I_{GSS}$	Gate to Source Leakage Current	$V_{DS} = 0V, V_{GS} = -6V$			-100	nA
$V_{GS(th)}$	Gate to Source Threshold Voltage	$V_{DS} = V_{GS}, I_D = -250\mu A$	-0.60	-0.85	-1.10	V
$R_{DS(on)}$	Drain to Source On Resistance	$V_{GS} = -2.5V, I_D = -1A$		54	67	m $\Omega$
		$V_{GS} = -4.5V, I_D = -1A$		39	47	m $\Omega$
$g_{fs}$	Transconductance	$V_{DS} = -10V, I_D = -1A$		6.2		S
<b>Dynamic Characteristics</b>						
$C_{ISS}$	Input Capacitance	$V_{GS} = 0V, V_{DS} = -10V, f = 10kHz$		368	478	pF
$C_{OSS}$	Output Capacitance			148	192	pF
$C_{RSS}$	Reverse Transfer Capacitance			7.8	10.1	pF
$R_G$	Series Gate Resistance			20		$\Omega$
$R_C$	Series Clamp Resistance			5000		$\Omega$
$Q_g$	Gate Charge Total (-4.5V)	$V_{DS} = -10V, I_D = -1A$		2.2	2.9	nC
$Q_{gd}$	Gate Charge Gate to Drain			0.14		nC
$Q_{gs}$	Gate Charge Gate to Source			0.74		nC
$Q_{g(th)}$	Gate Charge at $V_{th}$			0.43		nC
$Q_{OSS}$	Output Charge	$V_{DS} = -10V, V_{GS} = 0V$		2.5		nC
$t_{d(on)}$	Turn On Delay Time	$V_{DS} = -10V, V_{GS} = -2.5V, I_D = -1A$ $R_G = 10\Omega$		510		ns
$t_r$	Rise Time			520		ns
$t_{d(off)}$	Turn Off Delay Time			1000		ns
$t_f$	Fall Time			970		ns
<b>Diode Characteristics</b>						
$V_{SD}$	Diode Forward Voltage	$I_S = -1A, V_{GS} = 0V$		-0.77	-1	V
$Q_{rr}$	Reverse Recovery Charge	$V_{DS} = -10V, I_F = -1A,$ $di/dt = 200A/\mu s$		4.0		nC
$t_{rr}$	Reverse Recovery Time	$V_{DS} = -10V, I_F = -1A,$ $di/dt = 200A/\mu s$		11		ns

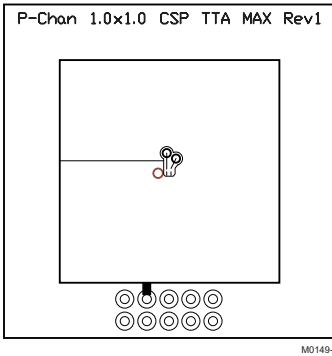
## THERMAL CHARACTERISTICS

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

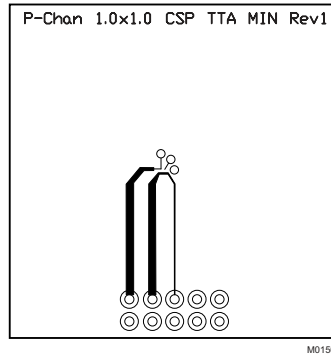
PARAMETER		MIN	TYP	MAX	UNIT
$R_{\theta JA}$	Junction to Ambient Thermal Resistance <sup>(1)</sup>		75		$^\circ\text{C}/\text{W}$
	Junction to Ambient Thermal Resistance <sup>(2)</sup>		265		$^\circ\text{C}/\text{W}$

(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  $R_{\theta JA} = 90^{\circ}\text{C/W}$   
when mounted on  
1 inch<sup>2</sup> of 2 oz. Cu.



Max  $R_{\theta JA} = 333^{\circ}\text{C/W}$   
when mounted on  
minimum pad area of 2  
oz. Cu.

### TYPICAL MOSFET CHARACTERISTICS

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

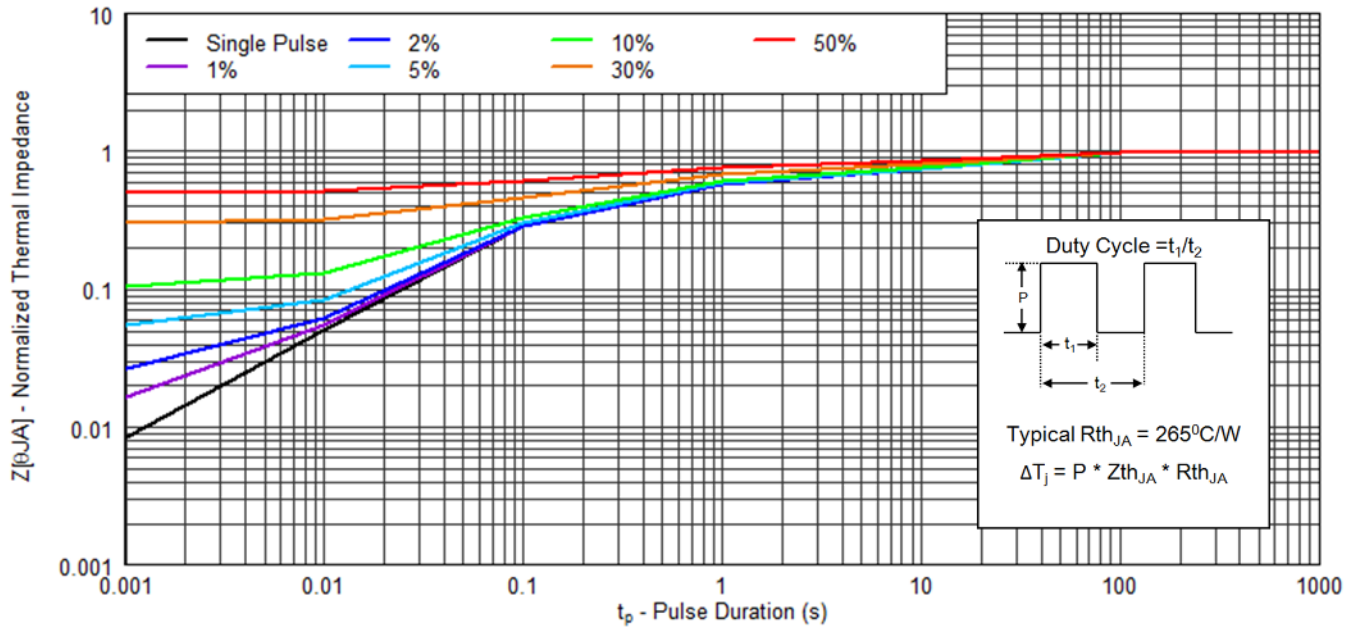
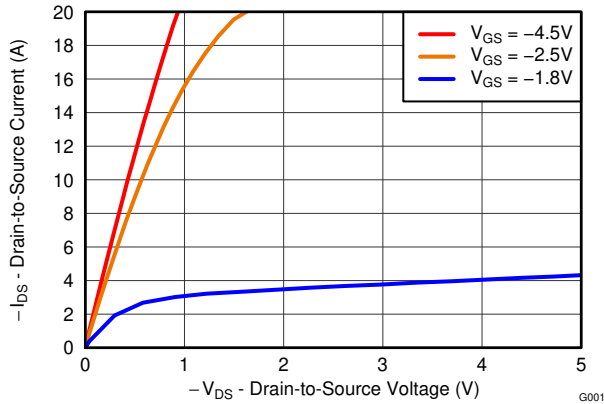


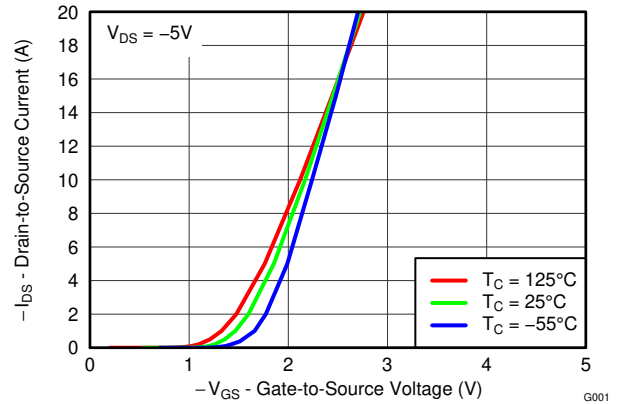
Figure 1. Transient Thermal Impedance

**TYPICAL MOSFET CHARACTERISTICS (continued)**

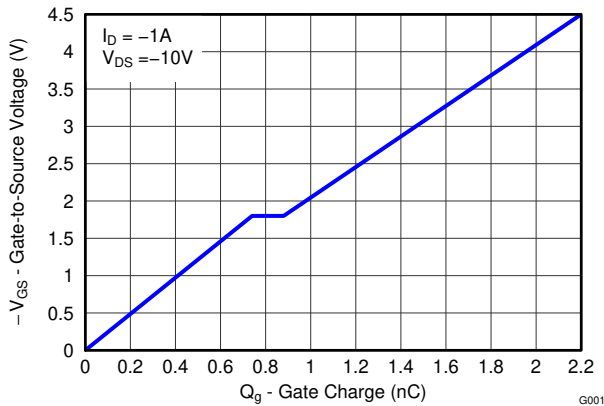
( $T_A = 25^\circ\text{C}$  unless otherwise stated)



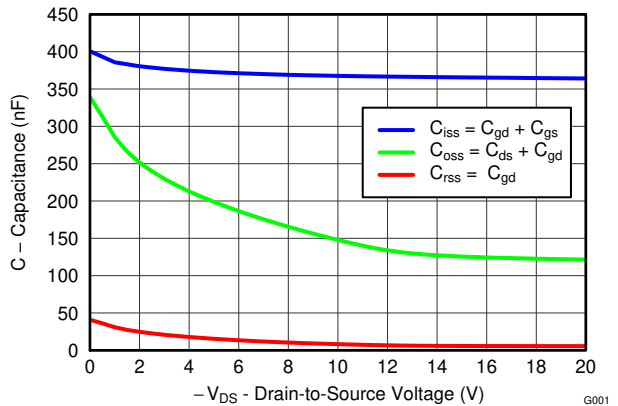
**Figure 2. Saturation Characteristics**



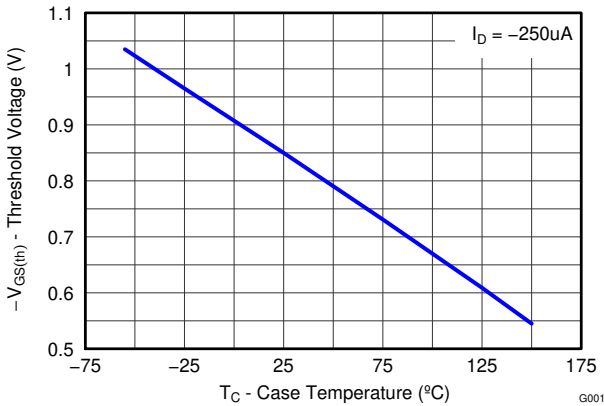
**Figure 3. Transfer Characteristics**



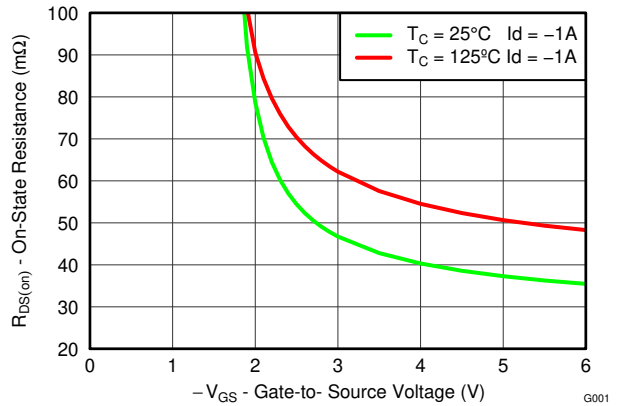
**Figure 4. Gate Charge**



**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)

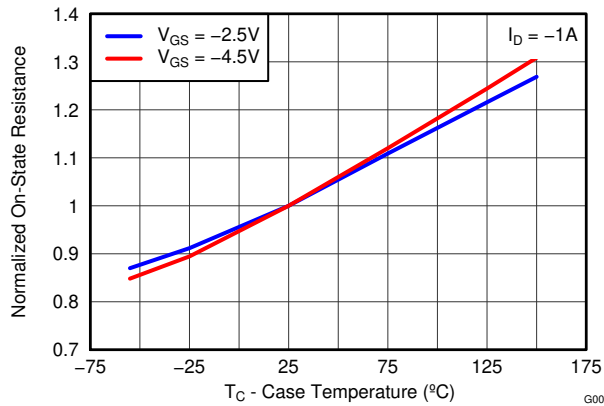


Figure 8. Normalized On-State Resistance vs. Temperature

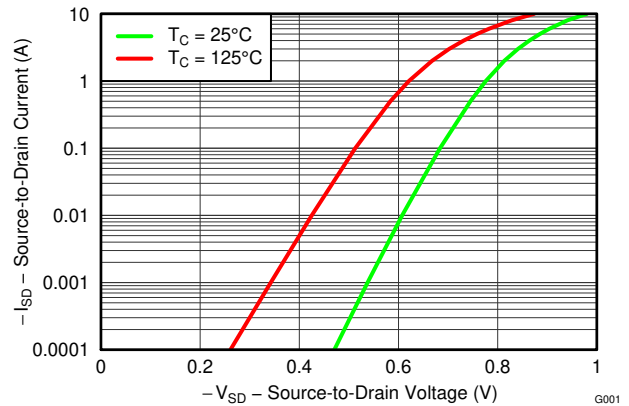


Figure 9. Typical Diode Forward Voltage

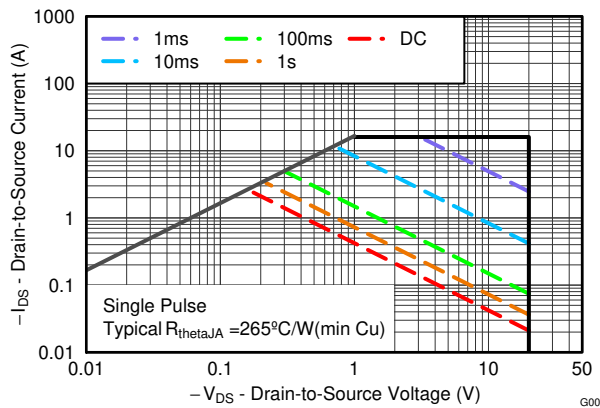


Figure 10. Maximum Safe Operating Area

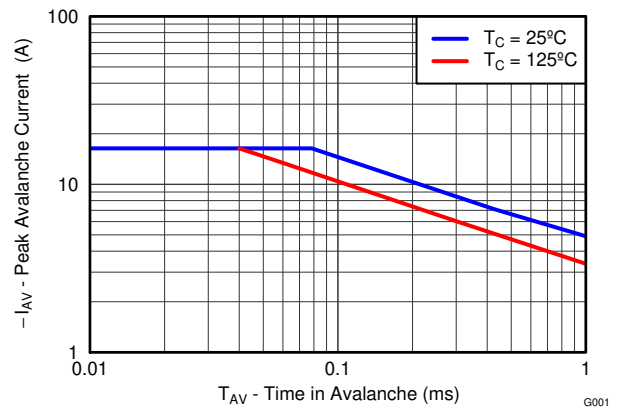


Figure 11. Single Pulse Unclamped Inductive Switching

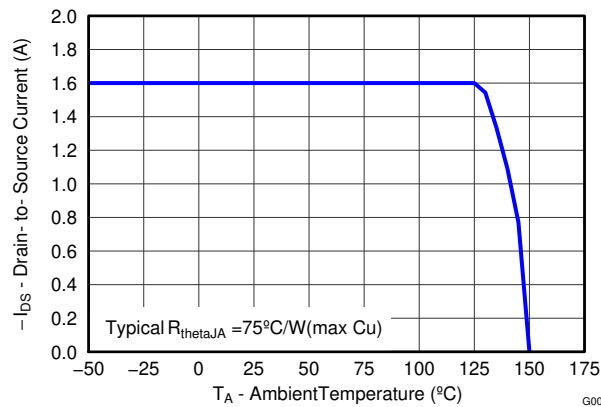
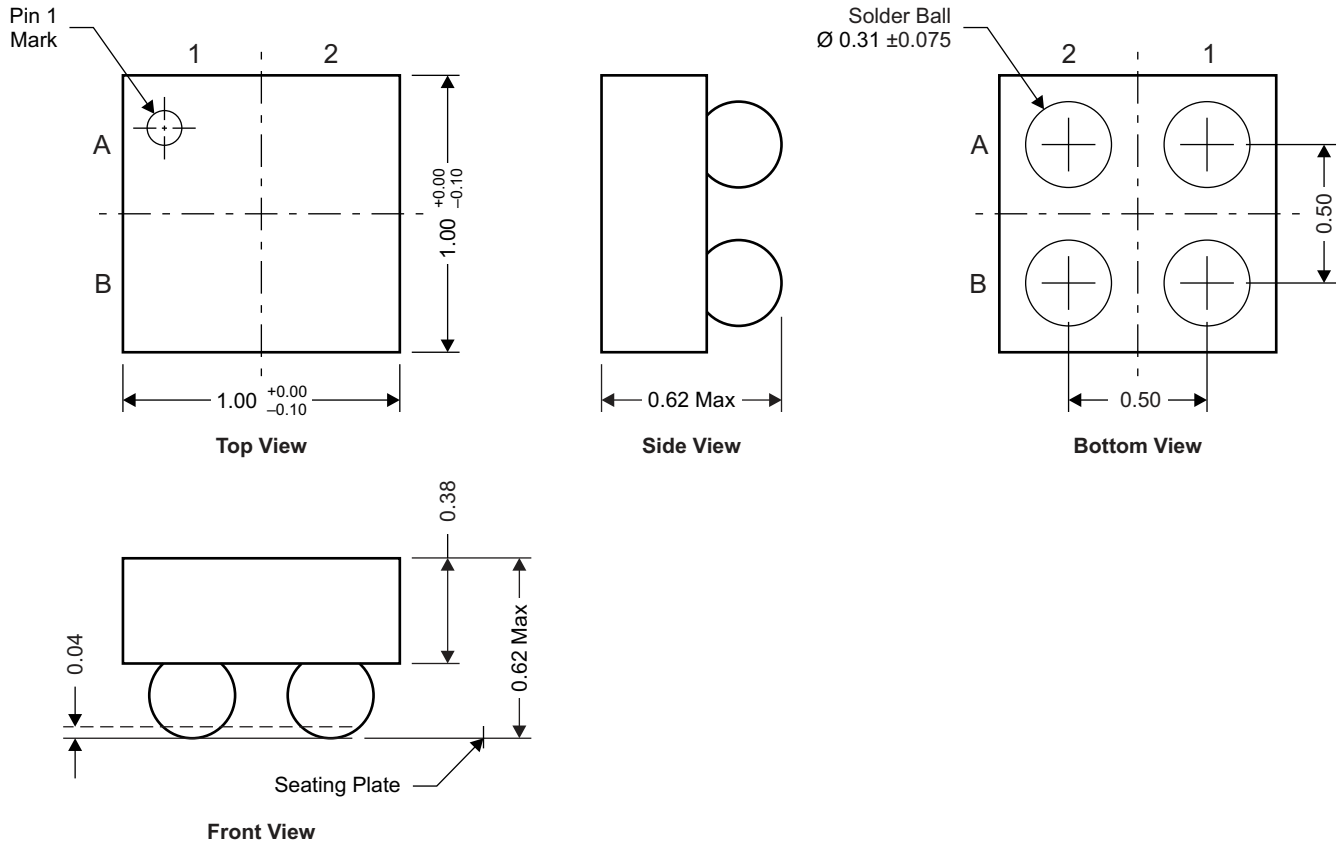


Figure 12. Maximum Drain Current vs. Temperature

**MECHANICAL DATA**

**CSD25213W10 Package Dimensions**



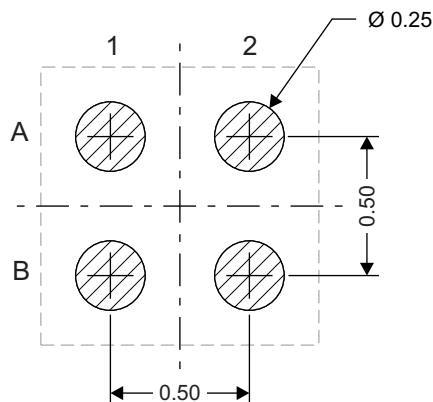
NOTE: All dimensions are in mm (unless otherwise specified)

M0151-01

**Pin Configuration Table**

POSITION	DESIGNATION
A1	Gate
B1	Drain
A2, B2	Source

**Land Pattern Recommendation**



M0152-01

NOTE: All dimensions are in mm (unless otherwise specified)

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
CSD25213W10	ACTIVE	DSBGA	YZB	4	3000	RoHS & Green	SNAGCU	Level-1-260C-UNLIM	-55 to 150	213	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.

**OBSELETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

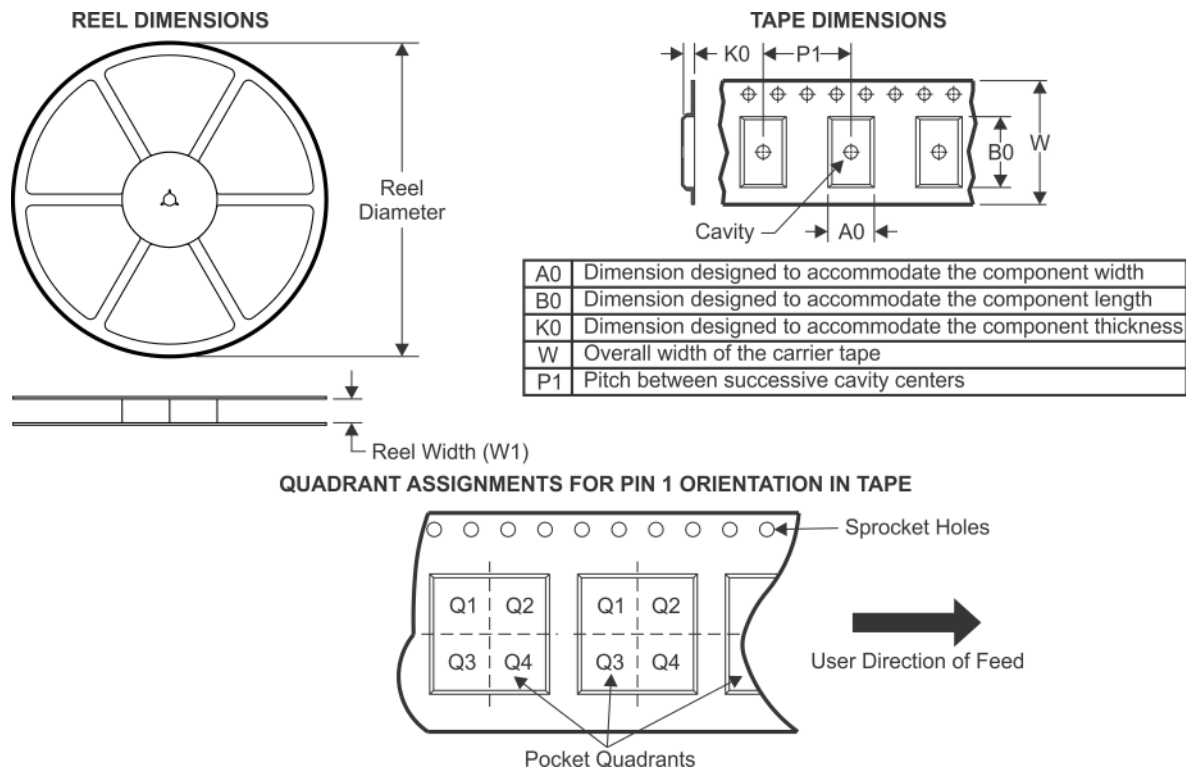
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(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 finish/Ball material - Orderable Devices 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.

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**TAPE AND REEL INFORMATION**


\*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
CSD25213W10	DSBGA	YZB	4	3000	180.0	8.4	1.06	1.06	0.69	2.0	8.0	Q1



**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CSD25213W10	DSBGA	YZB	4	3000	182.0	182.0	20.0

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