

# CSD23202W10 12-V P-Channel NexFET™ Power MOSFET

## 1 Features

- Ultra-Low  $Q_g$  and  $Q_{gd}$
- Small Footprint 1 mm × 1 mm
- Low Profile 0.62-mm Height
- Pb Free
- Gate ESD Protection – 3 kV
- RoHS Compliant
- Halogen Free

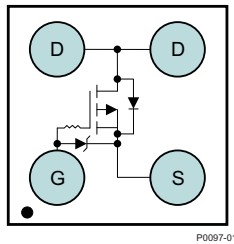
## 2 Applications

- Battery Management
- Load Switch
- Battery Protection

## 3 Description

This 12 V, 44 mΩ device is designed to deliver the lowest on-resistance and gate charge in a small 1 mm × 1 mm outline with excellent thermal characteristics in an ultra-low profile.

Top View



## Product Summary

$T_A = 25^\circ\text{C}$		TYPICAL VALUE		UNIT
$V_{DS}$	Drain-to-Source Voltage	-12		V
$Q_g$	Gate Charge Total (-4.5 V)	2.9		nC
$Q_{gd}$	Gate Charge Gate-to-Drain	0.28		nC
$R_{DS(on)}$	Drain-to-Source On-Resistance	$V_{GS} = -1.5\text{ V}$	82	mΩ
		$V_{GS} = -1.8\text{ V}$	67	mΩ
		$V_{GS} = -2.5\text{ V}$	54	mΩ
		$V_{GS} = -4.5\text{ V}$	44	mΩ
$V_{GS(th)}$	Threshold Voltage	-0.60		V

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

Device	Qty	Media	Package	Ship
CSD23202W10	3000	7-Inch Reel	1 × 1-mm Wafer Level Package	Tape and Reel
CSD23202W10T	250	7-Inch Reel		

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

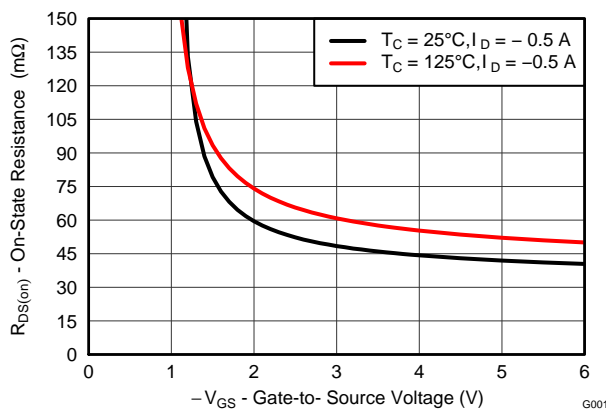
## Absolute Maximum Ratings

$T_A = 25^\circ\text{C}$		VALUE	UNIT
$V_{DS}$	Drain-to-Source Voltage	-12	V
$V_{GS}$	Gate-to-Source Voltage	-6	V
$I_D$	Continuous Drain Current <sup>(1)</sup>	-2.2	A
$I_{DM}$	Pulsed Drain Current <sup>(2)</sup>	-25	A
$I_G$	Continuous Gate Clamp Current	-0.5	A
	Pulsed Gate Clamp Current	-7	A
$P_D$	Power Dissipation <sup>(1)</sup>	1	W
$T_J, T_{stg}$	Operating Junction and Storage Temperature Range	-55 to 150	$^\circ\text{C}$

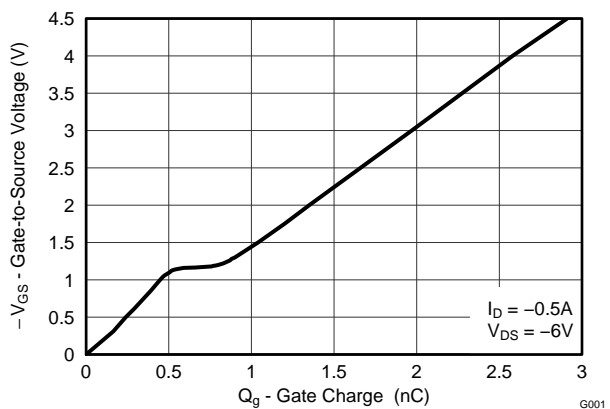
(1) Device operating at a temperature of 105 $^\circ\text{C}$

(2) Typ  $R_{\theta JA} = 195^\circ\text{C/W}$ , Pulse width  $\leq 100\ \mu\text{s}$ , duty cycle  $\leq 1\%$

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



Gate Charge



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## 4 Revision History

DATE	REVISION	NOTES
August 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>						
$BV_{DSS}$	Drain-to-Source Voltage	$V_{GS} = 0\text{ V}, I_D = -250\ \mu\text{A}$	-12			V
$BV_{GSS}$	Gate-to-Source Voltage;	$V_{DS} = 0\text{ V}, I_G = -250\ \mu\text{A}$	-6		-7.2	V
$I_{DSS}$	Drain-to-Source Leakage Current	$V_{GS} = 0\text{ V}, V_{DS} = -9.6\text{ V}$			-1	$\mu\text{A}$
$I_{GSS}$	Gate-to-Source Leakage Current	$V_{DS} = 0\text{ V}, V_{GS} = -6\text{ V}$			-100	nA
$V_{GS(th)}$	Gate-to-Source Threshold Voltage	$V_{DS} = V_{GS}, I_D = -250\ \mu\text{A}$	-0.4	-0.6	-0.9	V
$R_{DS(on)}$	Drain-to-Source On-Resistance	$V_{GS} = -1.5\text{ V}, I_D = -0.5\text{ A}$		82	123	m $\Omega$
		$V_{GS} = -1.8\text{ V}, I_D = -0.5\text{ A}$		67	92	m $\Omega$
		$V_{GS} = -2.5\text{ V}, I_D = -0.5\text{ A}$		54	66	m $\Omega$
		$V_{GS} = -4.5\text{ V}, I_D = -0.5\text{ A}$		44	53	m $\Omega$
$g_{fs}$	Transconductance	$V_{DS} = -1.2\text{ V}, I_D = -0.5\text{ A}$		5.6		S
<b>DYNAMIC CHARACTERISTICS</b>						
$C_{ISS}$	Input Capacitance	$V_{GS} = 0\text{ V}, V_{DS} = -6.0\text{ V}, f = 1\text{ MHz}$		394	512	pF
$C_{OSS}$	Output Capacitance			238	310	pF
$C_{RSS}$	Reverse Transfer Capacitance			29	37	pF
$Q_g$	Gate Charge Total (-4.5 V)	$V_{DS} = -6\text{ V}, I_D = -0.5\text{ A}$		2.9	3.8	nC
$Q_{gd}$	Gate Charge Gate-to-Drain			0.28		nC
$Q_{gs}$	Gate Charge Gate-to-Source			0.55		nC
$Q_{g(th)}$	Gate Charge at $V_{th}$			0.29		nC
$Q_{OSS}$	Output Charge	$V_{DS} = -6\text{ V}, V_{GS} = 0\text{ V}$		2.0		nC
$t_{d(on)}$	Turn On Delay Time	$V_{DS} = -6\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -0.5\text{ A}, R_G = 0\ \Omega$		9		ns
$t_r$	Rise Time			4		ns
$t_{d(off)}$	Turn Off Delay Time			58		ns
$t_f$	Fall Time			21		ns
<b>DIODE CHARACTERISTICS</b>						
$V_{SD}$	Diode Forward Voltage	$I_S = -0.5\text{ A}, V_{GS} = 0\text{ V}$	-0.66		-1	V
$Q_{rr}$	Reverse Recovery Charge	$V_{DS} = -6\text{ V}, I_F = -0.5\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$		3.7		nC
$t_{rr}$	Reverse Recovery Time			12		ns

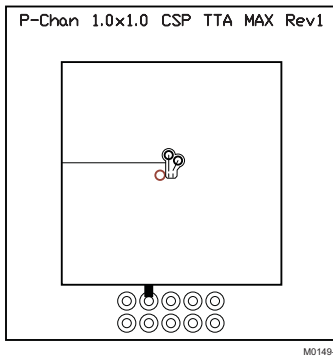
### 5.2 Thermal Information

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

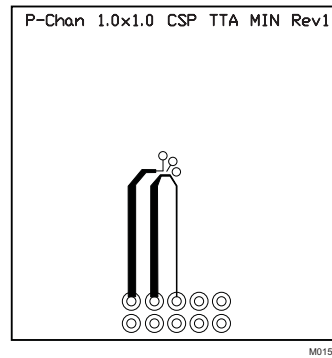
THERMAL METRIC		MIN	TYP	MAX	UNIT
$R_{\theta JA}$	Junction-to-Ambient Thermal Resistance <sup>(1)</sup>		195		$^\circ\text{C}/\text{W}$
	Junction-to-Ambient Thermal Resistance <sup>(2)</sup>		65		

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

(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.



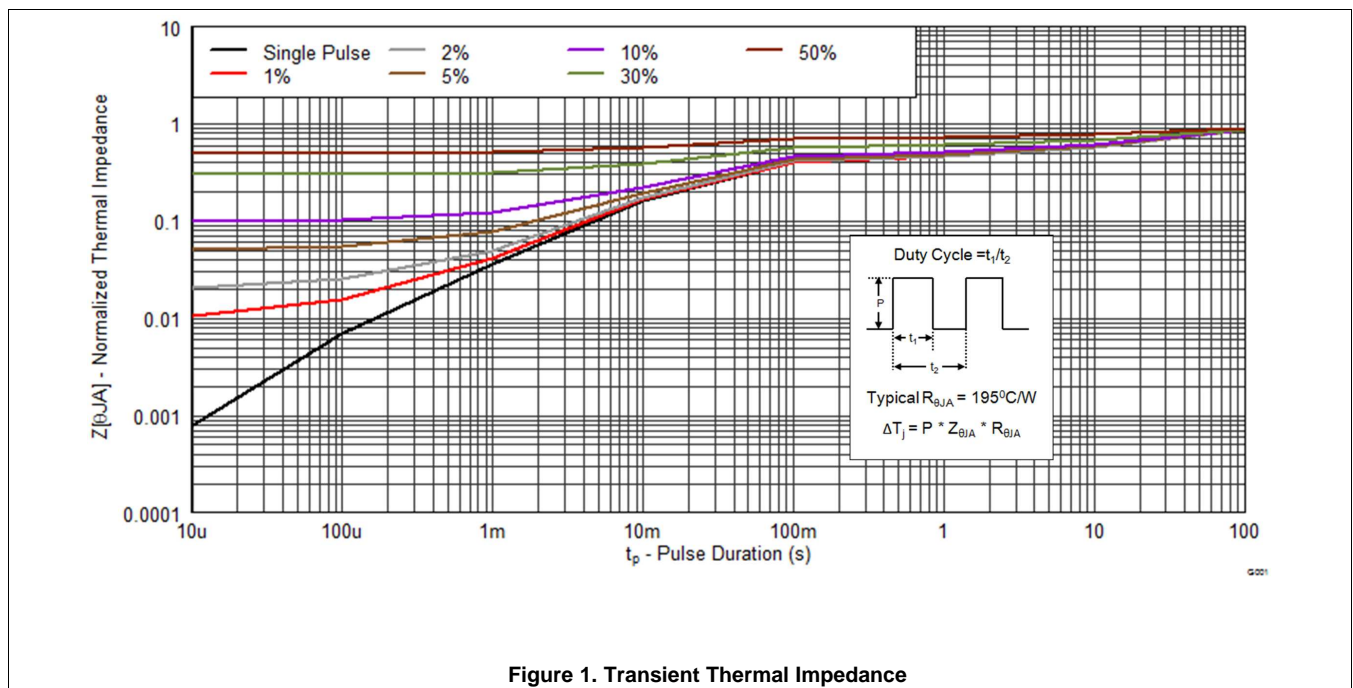
Typical  $R_{\theta JA} = 65^{\circ}\text{C/W}$   
when mounted on  
1 inch<sup>2</sup> of 2 oz. Cu.



Typical  $R_{\theta JA} = 195^{\circ}\text{C/W}$   
when mounted on minimum  
pad area of 2 oz. 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)

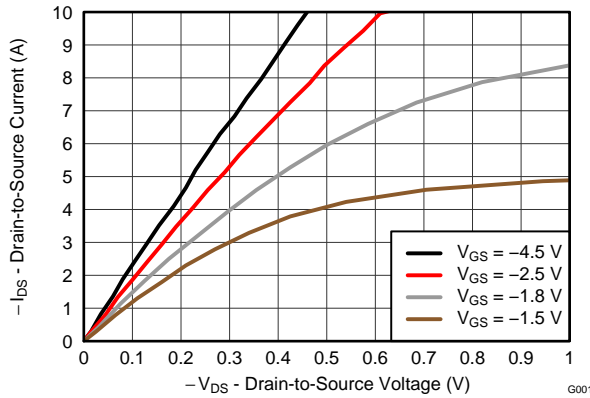


Figure 2. Saturation Characteristics

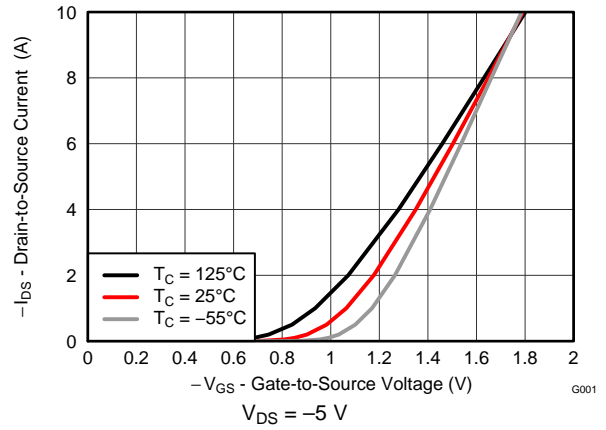


Figure 3. Transfer Characteristics

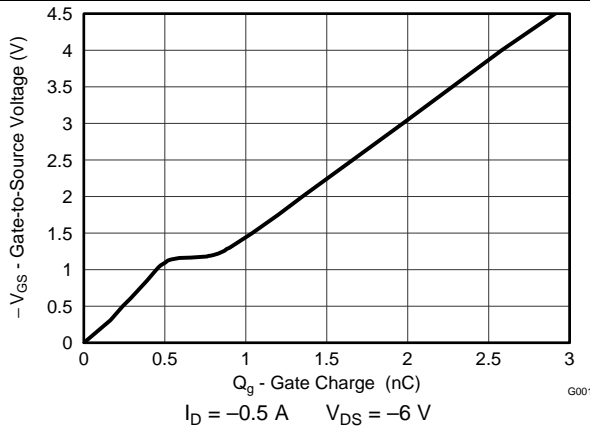


Figure 4. Gate Charge

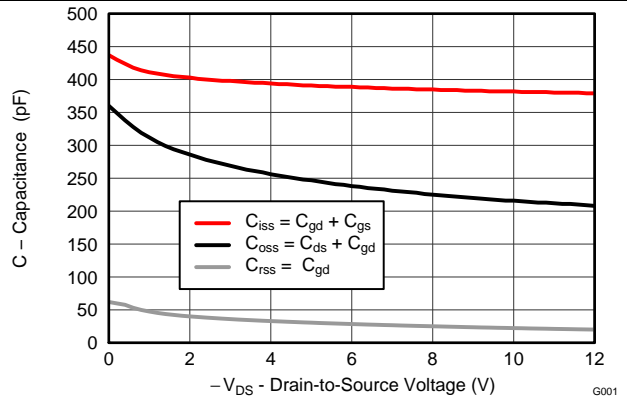


Figure 5. Capacitance

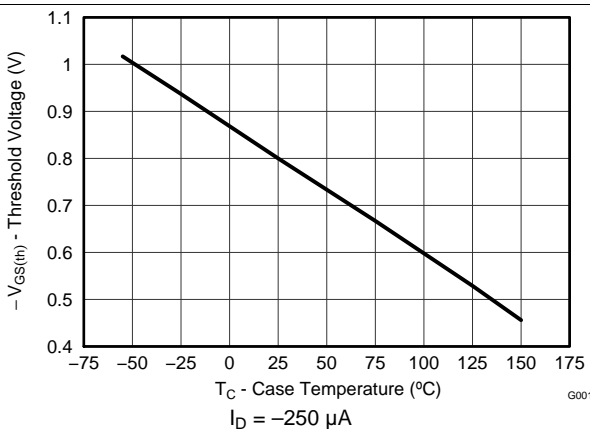


Figure 6. Threshold Voltage vs Temperature

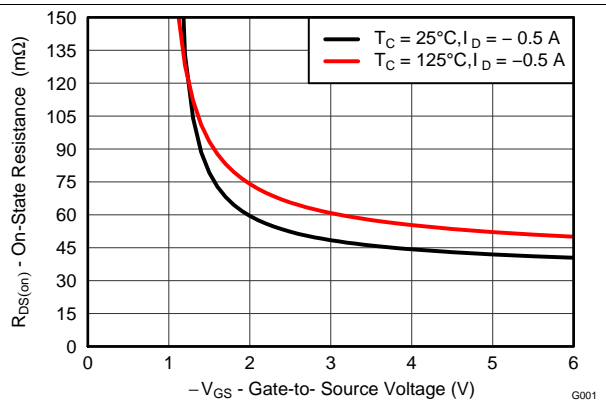


Figure 7. On-State Drain-to-Source Resistance vs Gate-to-Source Voltage

Typical MOSFET Characteristics (continued)

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

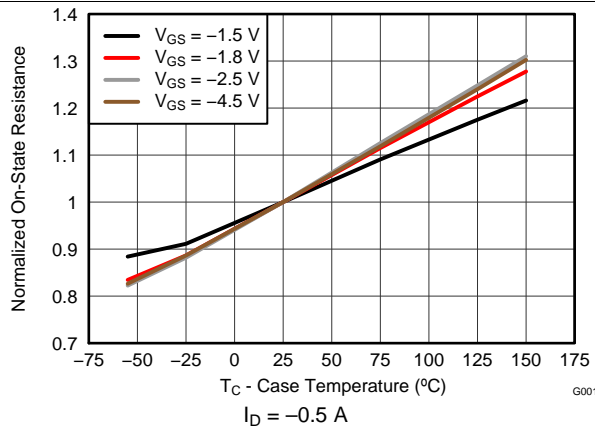


Figure 8. Normalized On-State Resistance vs Temperature

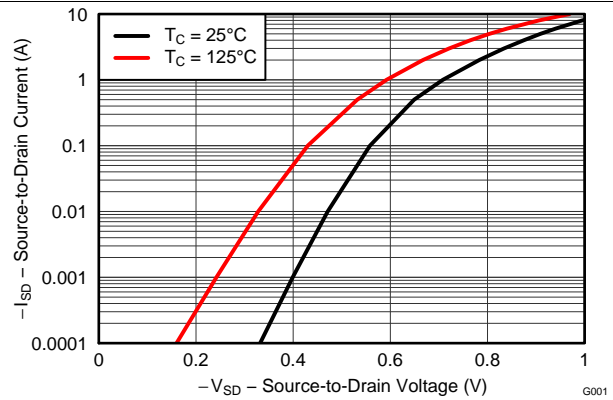


Figure 9. Typical Diode Forward Voltage

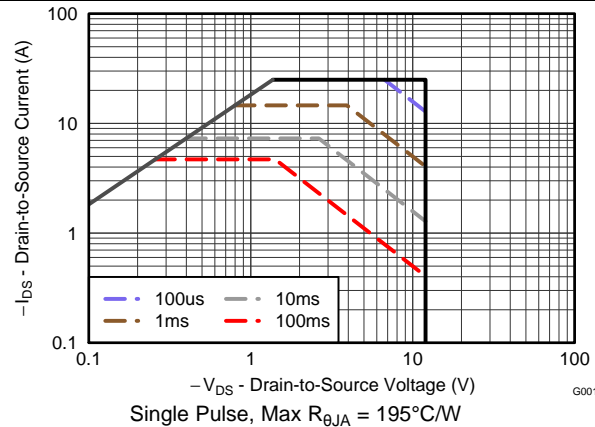


Figure 10. Maximum Safe Operating Area

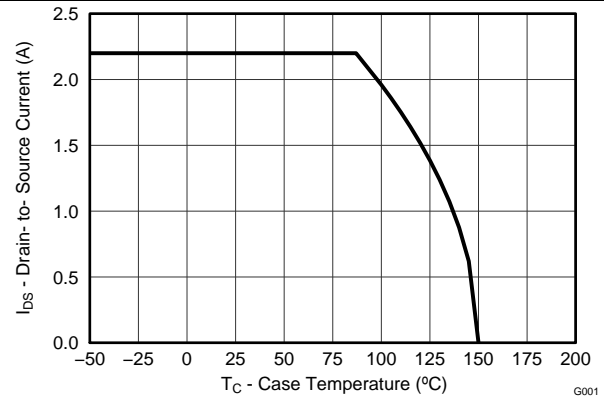


Figure 11. Maximum Drain Current vs Temperature

## 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

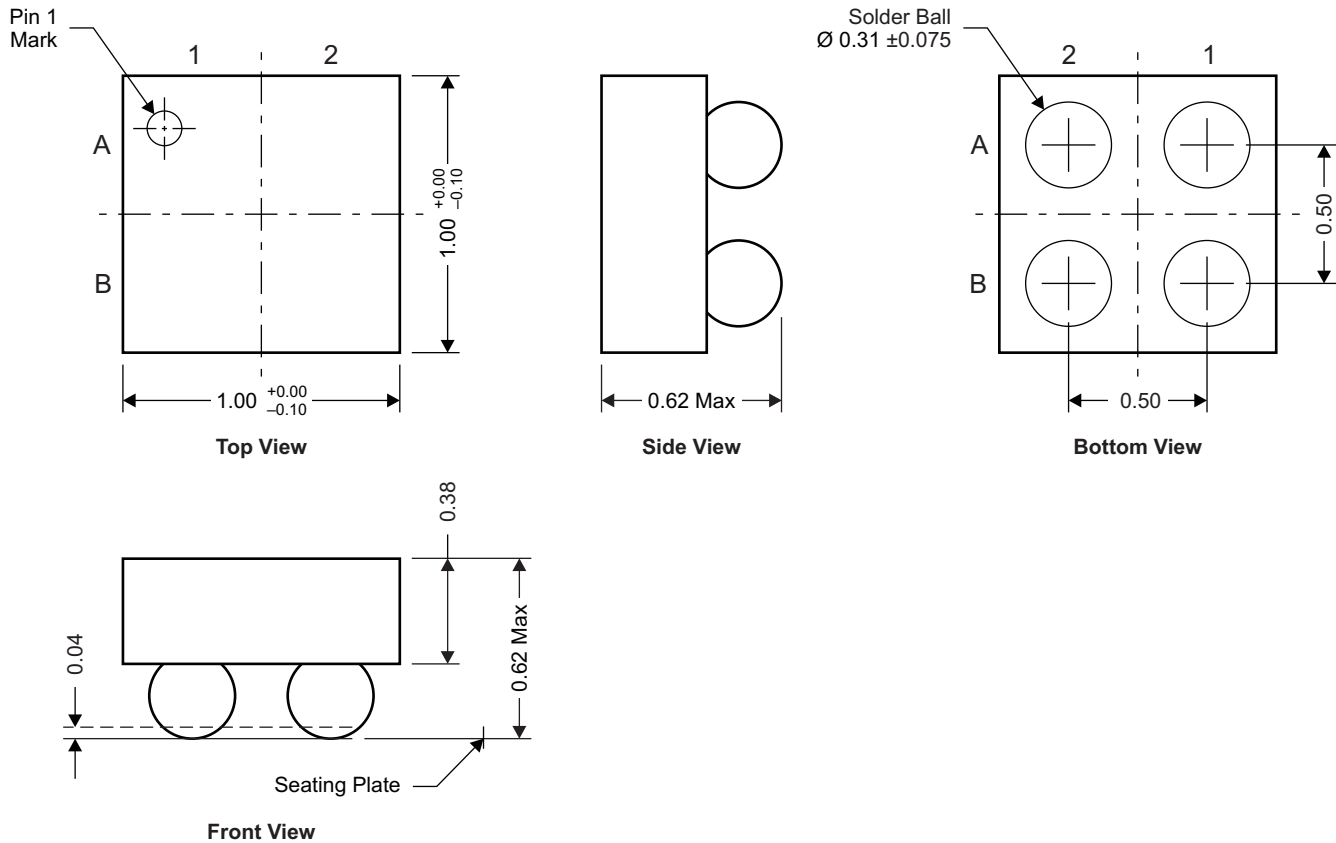
[SLYZ022](#) — *TI Glossary*.

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 CSD23202W10 Package Dimensions



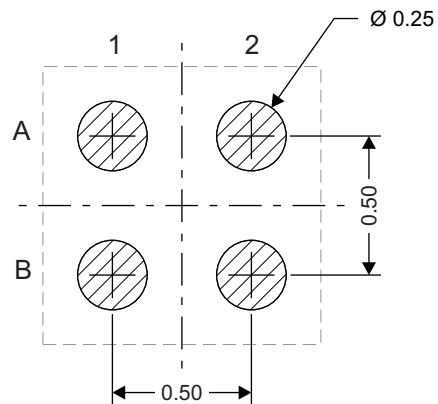
NOTE: All dimensions are in mm (unless otherwise specified).

M0151-01

**Pin Configuration Table**

POSITION	DESIGNATION
B1	Source
A1	Gate
A2, B2	Drain

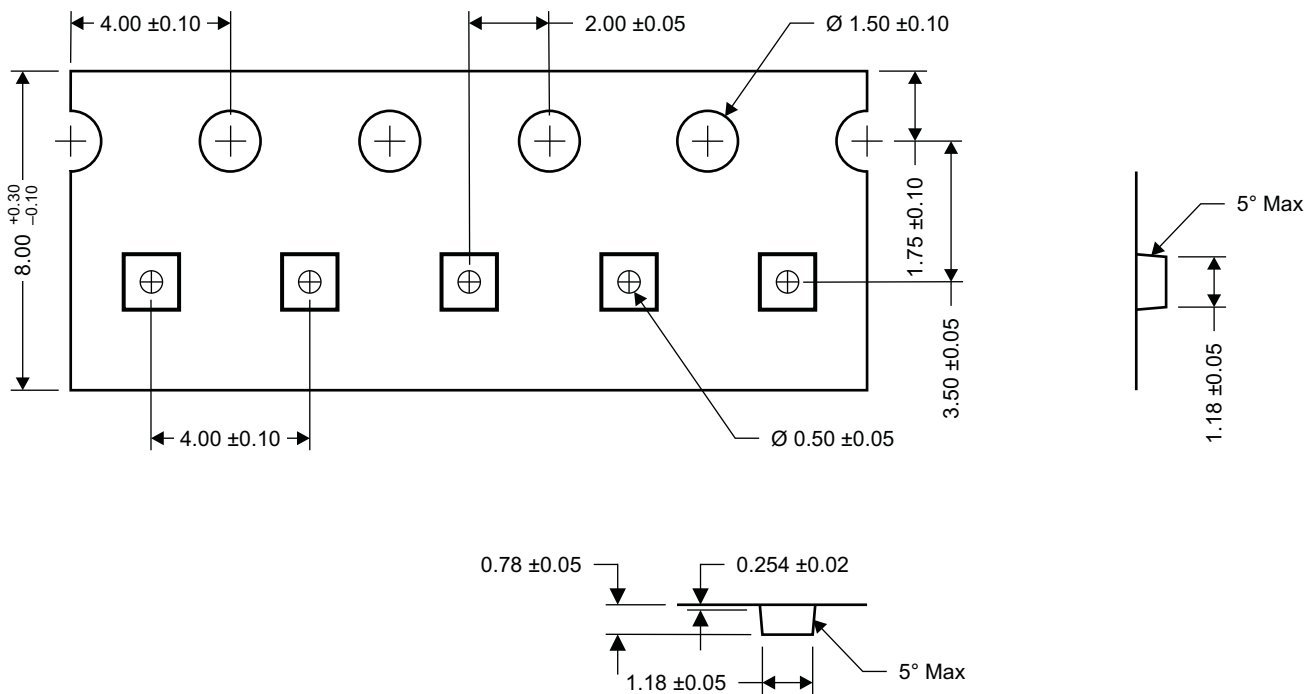
### 7.2 Land Pattern Recommendation



M0152-01

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

### 7.3 Tape and Reel Information



M0153-01

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/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
CSD23202W10	ACTIVE	DSBGA	YZB	4	3000	Green (RoHS & no Sb/Br)	Call TI	Level-1-260C-UNLIM		202	<a href="#">Samples</a>
CSD23202W10T	ACTIVE	DSBGA	YZB	4	250	Green (RoHS & no Sb/Br)	Call TI	Level-1-260C-UNLIM		202	<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
CSD23202W10	DSBGA	YZB	4	3000	180.0	9.0	1.16	1.16	0.63	4.0	8.0	Q1
CSD23202W10T	DSBGA	YZB	4	250	180.0	9.0	1.16	1.16	0.63	4.0	8.0	Q1

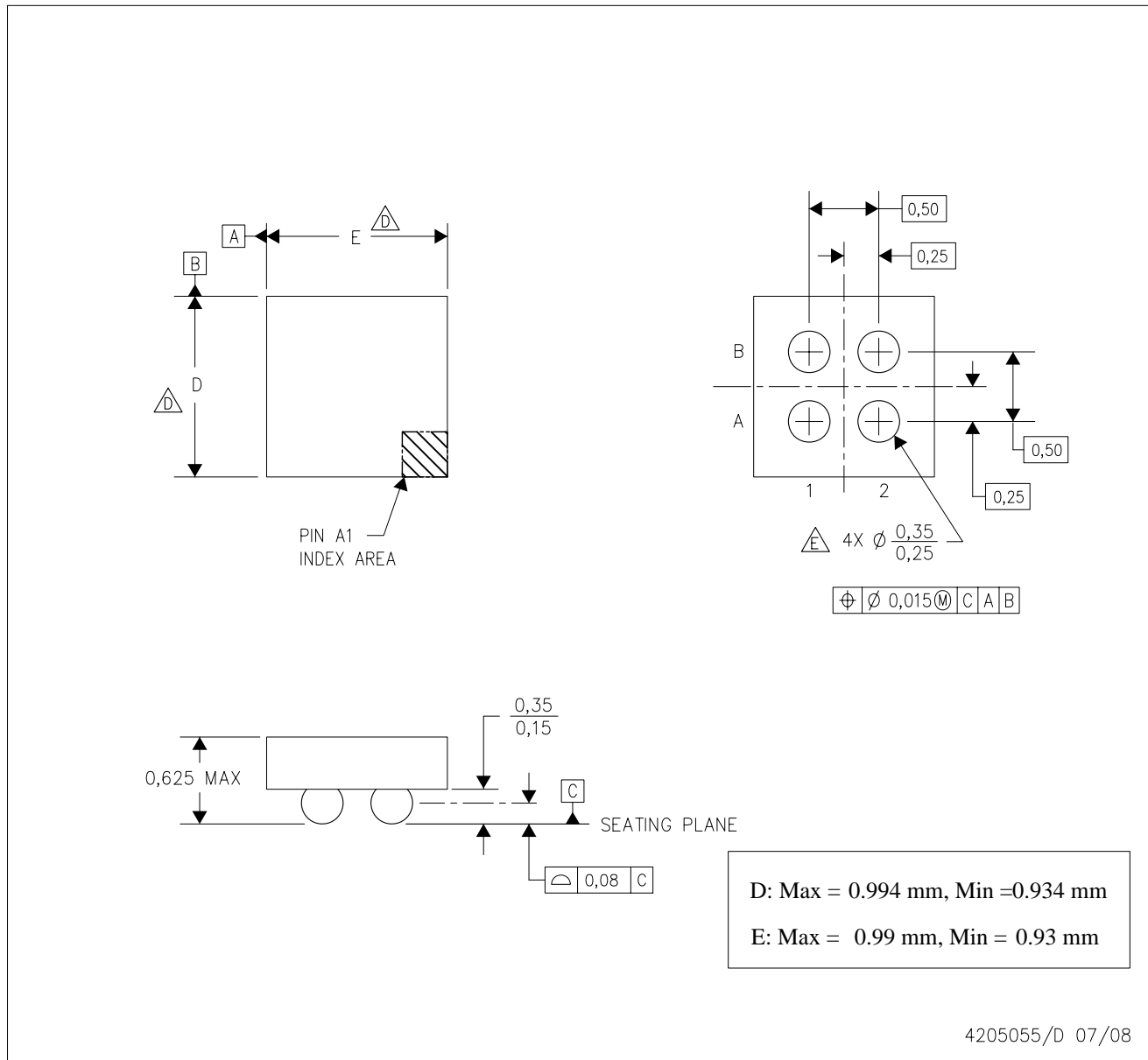
**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CSD23202W10	DSBGA	YZB	4	3000	195.0	210.0	39.0
CSD23202W10T	DSBGA	YZB	4	250	195.0	210.0	39.0

YZB (S-XBGA-N4)

DIE-SIZE BALL GRID ARRAY



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. NanoFree™ package configuration.
  - $\triangle D$  Devices in YZB package can have dimension D ranging from 0.94 to 1.65 mm and dimension E ranging from 0.94 to 1.65 mm. To determine the exact package size of a particular device, refer to the device datasheet or contact a local TI representative.
  - E. Reference Product Data Sheet for array population.  
2 x 2 matrix pattern is shown for illustration only.
  - F. This package contains lead-free balls.  
Refer to YEB (Drawing #4204178) for tin-lead (SnPb) balls.

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Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
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>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>

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