



CSD23203W –8-V P-Channel NexFET™ Power MOSFET

1 Features

- Ultra-Low Q_g and Q_{gd}
- Low $R_{DS(on)}$
- Small Footprint
- Low Profile 0.62-mm Height
- Lead Free
- RoHS Compliant
- Halogen Free
- CSP 1-mm x 1.5-mm Wafer Level Package

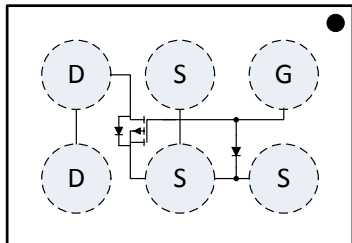
2 Applications

- Battery Management
- Load Switch
- Battery Protection

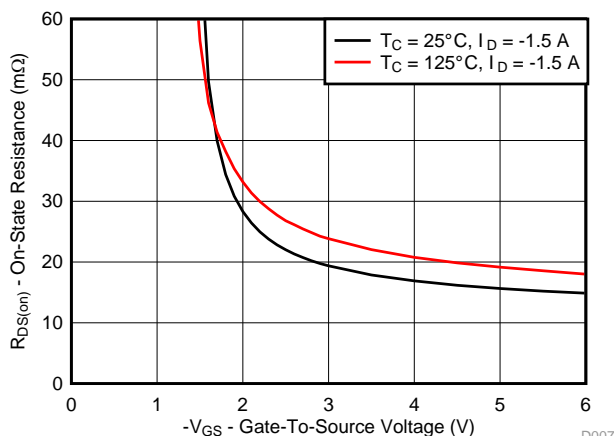
3 Description

This 16.2-m Ω , –8-V, P-Channel device is designed to deliver the lowest on-resistance and gate charge in a small 1 x 1.5 mm outline with excellent thermal characteristics in an ultra-low profile.

Top View



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



Product Summary

| $T_A = 25^\circ\text{C}$ | | TYPICAL VALUE | | UNIT |
|--------------------------|-------------------------------|--------------------------|------|------------|
| V_{DS} | Drain-to-Source Voltage | –8 | | V |
| Q_g | Gate Charge Total (–4.5 V) | 4.9 | | nC |
| Q_{gd} | Gate Charge Gate-to-Drain | 0.6 | | nC |
| $R_{DS(on)}$ | Drain-to-Source On-Resistance | $V_{GS} = -1.8\text{ V}$ | 35 | m Ω |
| | | $V_{GS} = -2.5\text{ V}$ | 22 | m Ω |
| | | $V_{GS} = -4.5\text{ V}$ | 16.2 | m Ω |
| $V_{GS(th)}$ | Voltage Threshold | –0.8 | | V |

Device Information⁽¹⁾

| DEVICE | QTY | MEDIA | PACKAGE | SHIP |
|------------|------|-------------|---------------------------------------|---------------|
| CSD23203W | 3000 | 7-Inch Reel | 1.00-mm x 1.50-mm Wafer Level Package | Tape and Reel |
| CSD23203WT | 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 | –8 | V |
| V_{GS} | Gate-to-Source Voltage | –6 | V |
| I_D | Continuous Drain Current ⁽¹⁾ | –3 | A |
| I_{DM} | Pulsed Drain Current ⁽²⁾ | –54 | A |
| P_D | Power Dissipation | 0.75 | W |
| T_J, T_{stg} | Operating Junction, Storage Temperature | –55 to 150 | $^\circ\text{C}$ |

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

(2) Typ $R_{\theta JA} = 170^\circ\text{C/W}$, pulse width $\leq 100\text{ }\mu\text{s}$, duty cycle $\leq 1\%$.

Gate Charge

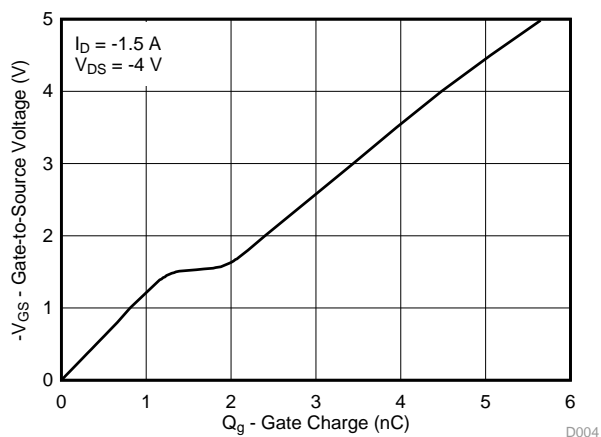


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4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

| Changes from Original (December 2014) to Revision A | Page |
|--|----------|
| • Corrected MOSFET body tie in <i>Top View</i> image. | 1 |
| • Added <i>Receiving Notification of Documentation Updates</i> and <i>Community Resources</i> sections | 7 |

5 Specifications

5.1 Electrical Characteristics

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

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-------------------------|----------------------------------|--|-------|------|------|------|
| STATIC CHARACTERISTICS | | | | | | |
| BV _{DSS} | Drain-to-source voltage | V _{GS} = 0 V, I _D = −250 μA | −8 | | | V |
| I _{DSS} | Drain-to-source leakage current | V _{GS} = 0 V, V _{DS} = −6.4 V | | | −1 | μA |
| I _{GSS} | Gate-to-source leakage current | V _{DS} = 0 V, V _{GS} = −6 V | | | −100 | nA |
| V _{GS(th)} | Gate-to-source threshold voltage | V _{DS} = V _{GS} , I _D = −250 μA | −0.6 | −0.8 | −1.1 | V |
| R _{DS(on)} | Drain-to-source on-resistance | V _{GS} = −1.8 V, I _D = −1.5 A | 35 | | 53 | mΩ |
| | | V _{GS} = −2.5 V, I _D = −1.5 A | 22 | | 26.5 | mΩ |
| | | V _{GS} = −4.5 V, I _D = −1.5 A | 16.2 | | 19.4 | mΩ |
| | | | | | | |
| g _{fs} | Transconductance | V _{DS} = −0.8 V, I _D = −1.5 A | 14 | | | S |
| DYNAMIC CHARACTERISTICS | | | | | | |
| C _{ISS} | Input capacitance | V _{GS} = 0 V, V _{DS} = −4 V, f = 1 MHz | 703 | | 914 | pF |
| C _{OSS} | Output capacitance | | 391 | | 508 | pF |
| C _{RSS} | Reverse transfer capacitance | | 133 | | 172 | pF |
| Q _g | Gate charge total (−4.5 V) | V _{DS} = −4 V, I _D = −1.5 A | 4.9 | | 6.3 | nC |
| Q _{gd} | Gate charge gate-to-drain | | 0.6 | | | nC |
| Q _{gs} | Gate charge gate-to-source | | 1.3 | | | nC |
| Q _{g(th)} | Gate charge at V _{th} | | 0.6 | | | nC |
| Q _{OSS} | Output charge | V _{DS} = −4 V, V _{GS} = 0 V | 1.9 | | | nC |
| t _{d(on)} | Turnon delay time | V _{DS} = −4 V, V _{GS} = −4.5 V, I _D = −1.5 A R _G = 10 Ω | 14 | | | ns |
| t _r | Rise time | | 12 | | | ns |
| t _{d(off)} | Turnoff delay time | | 58 | | | ns |
| t _f | Fall time | | 27 | | | ns |
| DIODE CHARACTERISTICS | | | | | | |
| V _{SD} | Diode forward voltage | I _S = −1.5 A, V _{GS} = 0 V | −0.75 | | −1 | V |
| Q _{rr} | Reverse recovery charge | V _{DS} = −4.7 V, I _F = −1.5 A | 6.1 | | | nC |
| t _{rr} | Reverse recovery time | di/dt = 100 A/μs | 21 | | | ns |

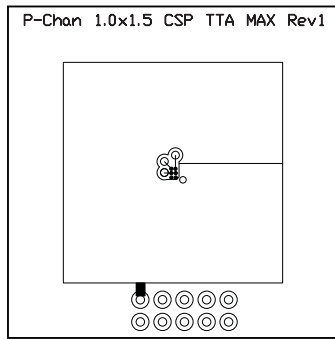
5.2 Thermal Information

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

| THERMAL METRIC | | MIN | TYP | MAX | UNIT |
|-----------------|---|-----|-----|-----|---------------------------|
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance ⁽¹⁾ | | 170 | | $^\circ\text{C}/\text{W}$ |
| | Junction-to-ambient thermal resistance ⁽²⁾ | | 55 | | |

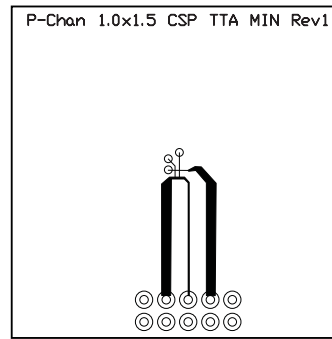
(1) Device mounted on FR4 material with minimum Cu mounting area.

(2) Device mounted on FR4 material with 1-in² (6.45-cm²), 2-oz (0.071-mm) thick Cu.



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Typ $R_{\theta JA} = 55^{\circ}\text{C/W}$
when mounted on
1 in² of 2-oz Cu.

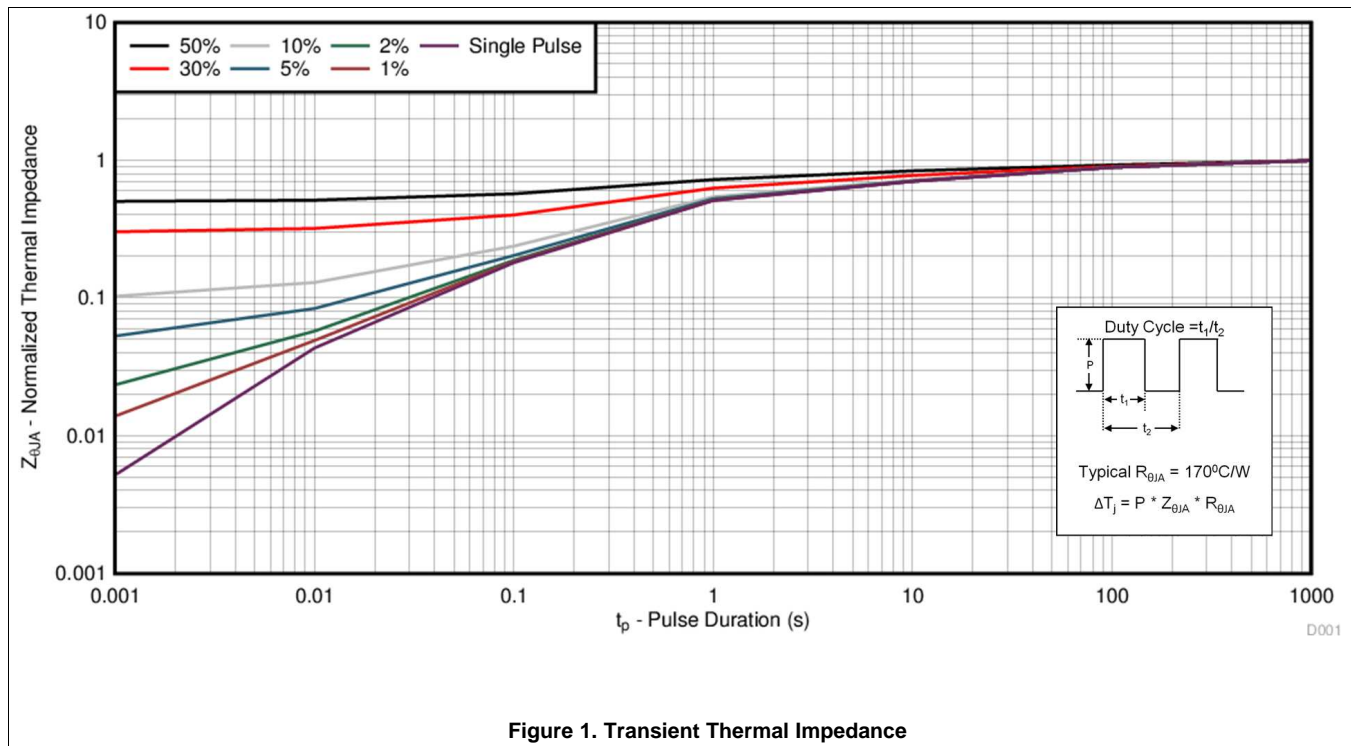


M0156-01

Typ $R_{\theta JA} = 170^{\circ}\text{C/W}$
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)

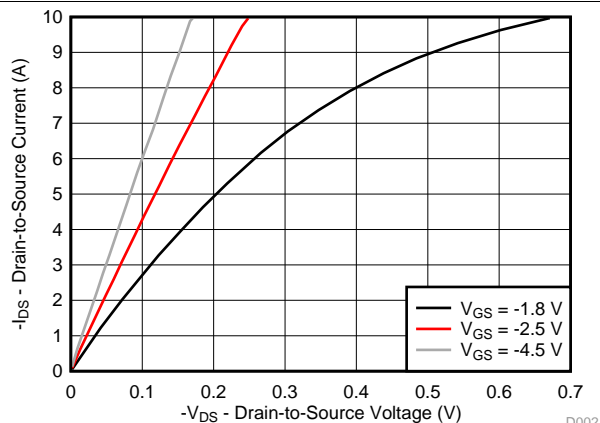


Figure 2. Saturation Characteristics

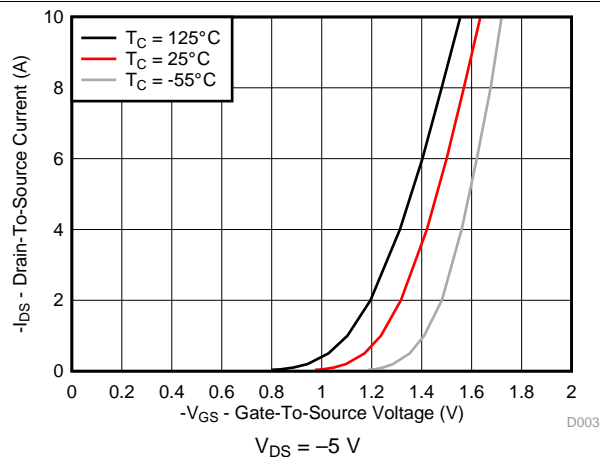


Figure 3. Transfer Characteristics

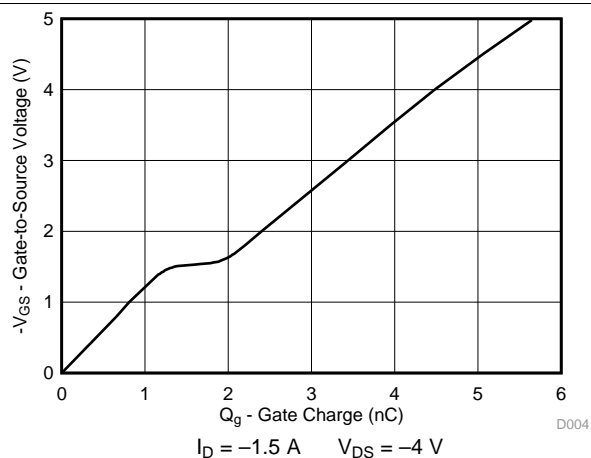


Figure 4. Gate Charge

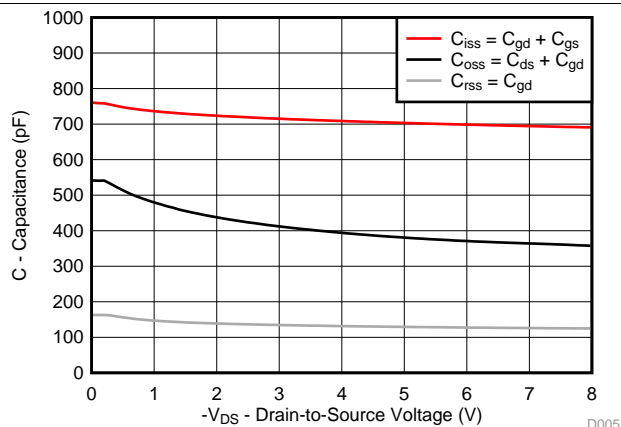


Figure 5. Capacitance

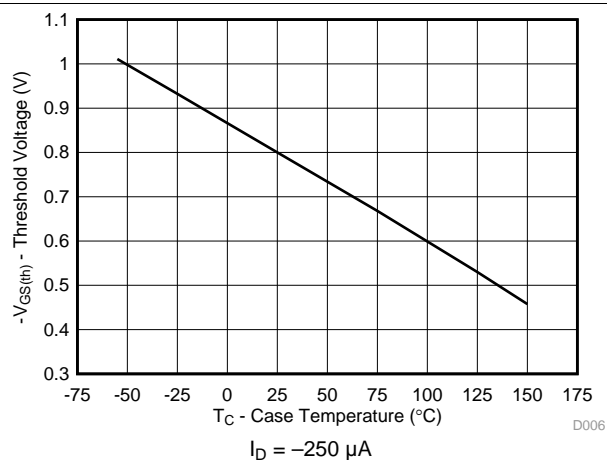


Figure 6. Threshold Voltage vs Temperature

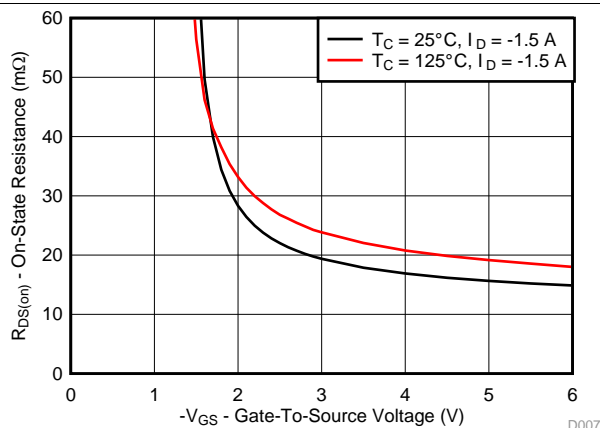


Figure 7. On-State Resistance vs Gate-to-Source Voltage

Typical MOSFET Characteristics (continued)

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

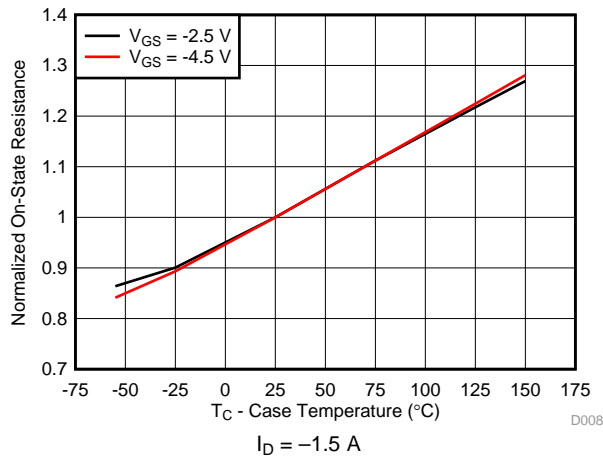


Figure 8. Normalized On-State Resistance vs Temperature

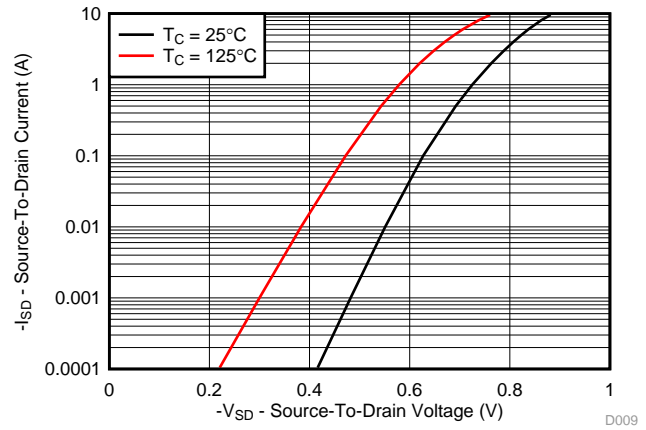


Figure 9. Typical Diode Forward Voltage

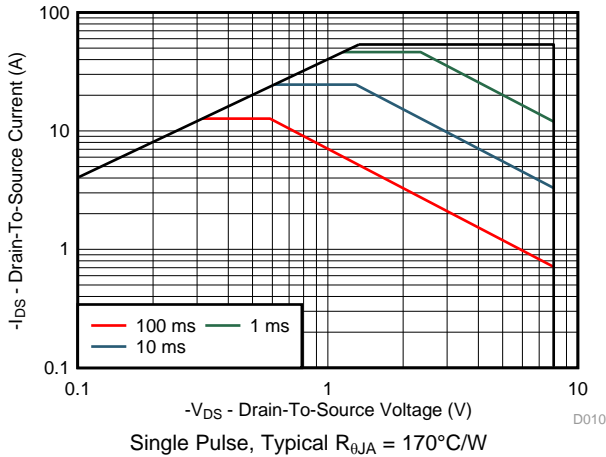


Figure 10. Maximum Safe Operating Area

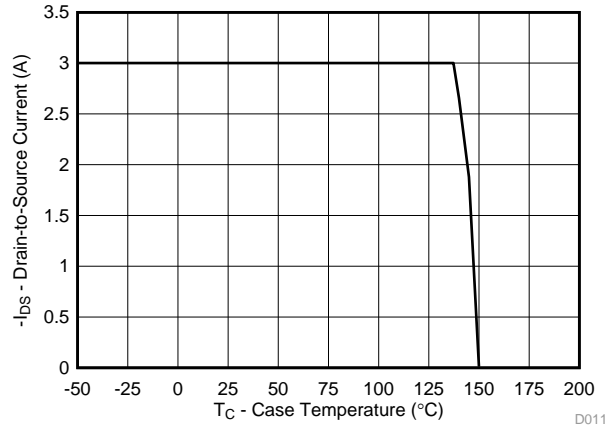


Figure 11. Maximum Drain Current vs Temperature

6 Device and Documentation Support

6.1 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

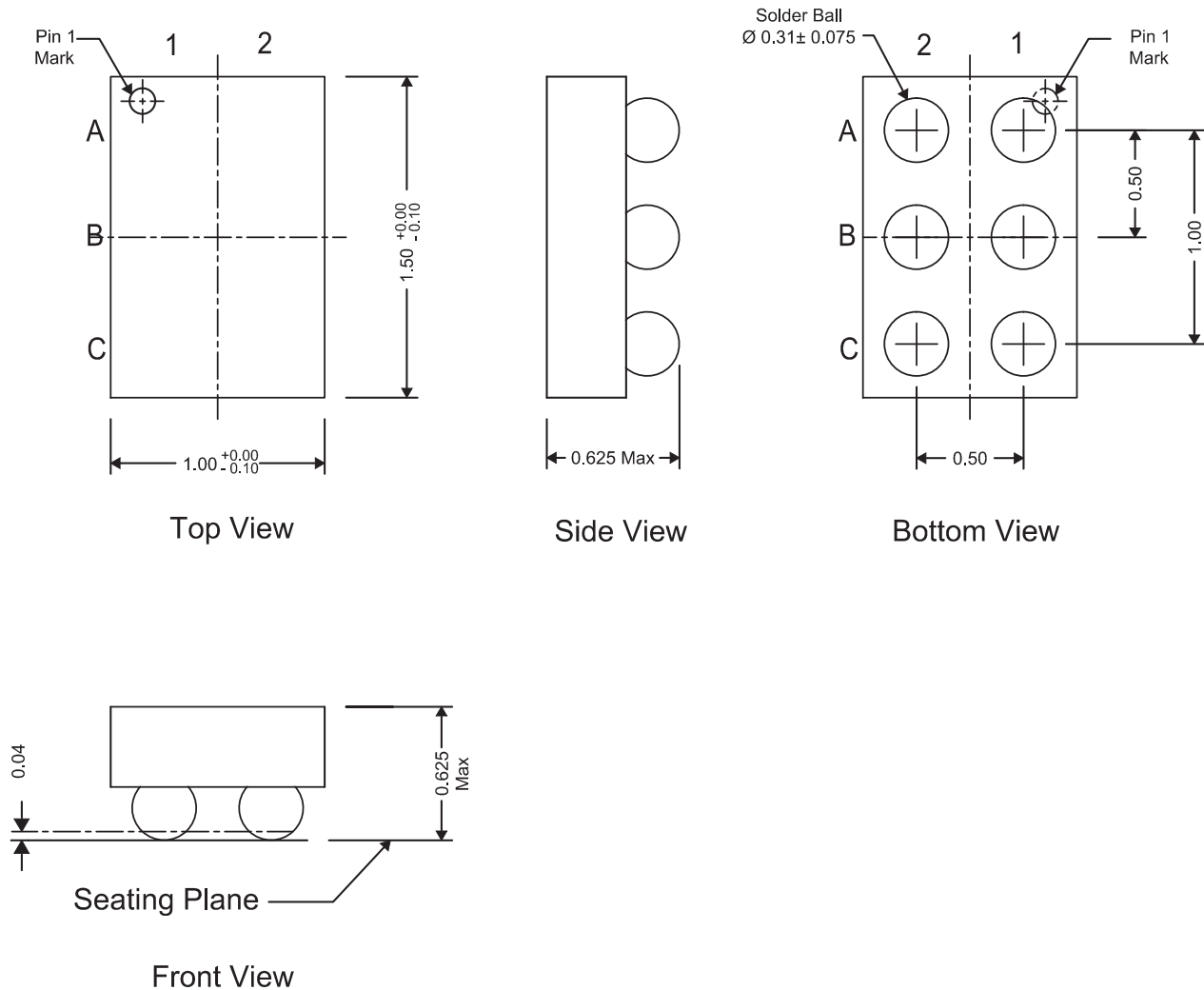
[SLYZ022](#) — *TI Glossary*.

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 CSD23203W Package Dimensions

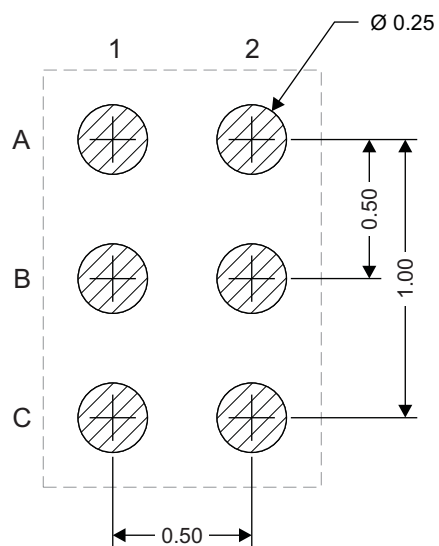


NOTE: All dimensions are in mm (unless otherwise specified).

Table 1. Pinout

| POSITION | DESIGNATION |
|------------|-------------|
| C1, C2 | Drain |
| A1 | Gate |
| A2, B1, B2 | Source |

7.2 Land Pattern Recommendation



M0158-01

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 |
|------------------|---------------|--------------|--------------------|------|----------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| CSD23203W | ACTIVE | DSBGA | YZC | 6 | 3000 | RoHS & Green | SNAGCU | Level-1-260C-UNLIM | | 23203 | Samples |
| CSD23203WT | ACTIVE | DSBGA | YZC | 6 | 250 | RoHS & Green | SNAGCU | Level-1-260C-UNLIM | -55 to 150 | 23203 | 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.

OBSOLETE: 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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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) |
|----------------------------|---------------|----------------------|-----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| CSD23203W | Active | Production | DSBGA (YZC) 6 | 3000 LARGE T&R | Yes | SNAGCU | Level-1-260C-UNLIM | - | 23203 |
| CSD23203W.B | Active | Production | DSBGA (YZC) 6 | 3000 LARGE T&R | Yes | SNAGCU | Level-1-260C-UNLIM | -55 to 150 | 23203 |
| CSD23203WT | Active | Production | DSBGA (YZC) 6 | 250 SMALL T&R | Yes | SNAGCU | Level-1-260C-UNLIM | -55 to 150 | 23203 |
| CSD23203WT.B | Active | Production | DSBGA (YZC) 6 | 250 SMALL T&R | Yes | SNAGCU | Level-1-260C-UNLIM | -55 to 150 | 23203 |

⁽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.

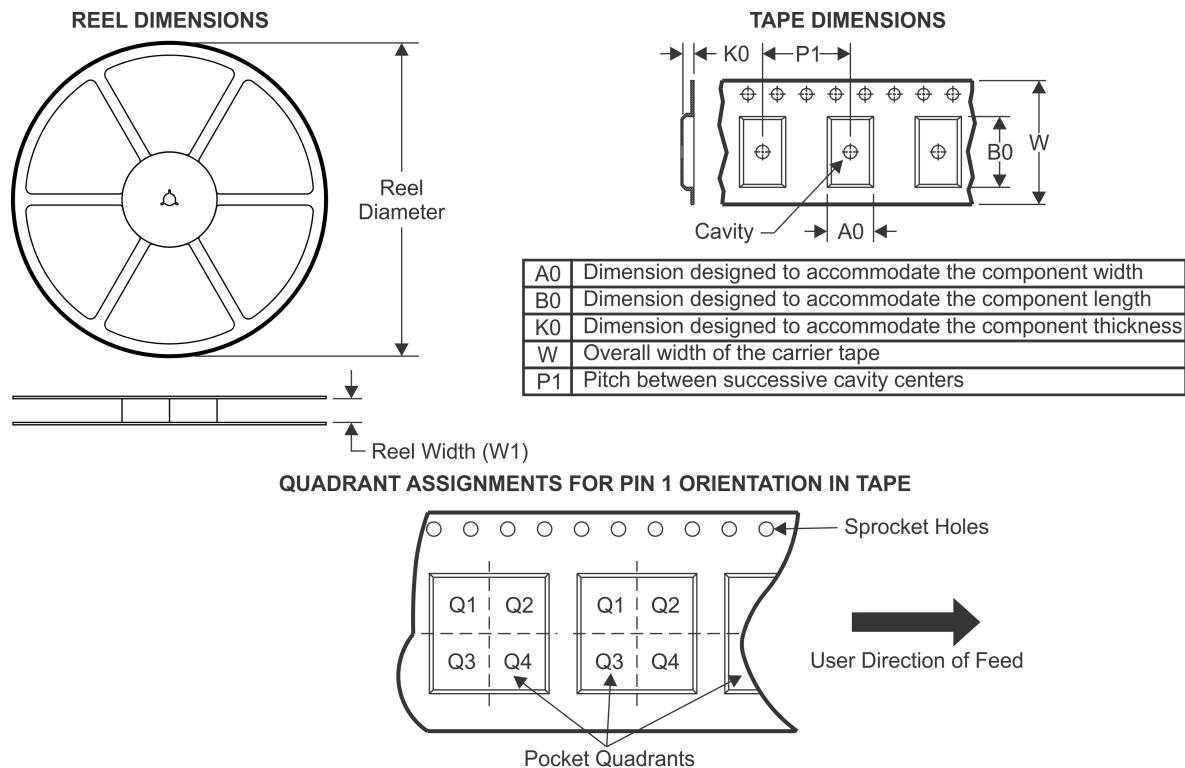
⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will 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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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 |
|------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| CSD23203W | DSBGA | YZC | 6 | 3000 | 180.0 | 8.4 | 1.18 | 1.68 | 0.83 | 4.0 | 8.0 | Q1 |
| CSD23203WT | DSBGA | YZC | 6 | 250 | 180.0 | 8.4 | 1.18 | 1.68 | 0.83 | 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) |
|------------|--------------|-----------------|------|------|-------------|------------|-------------|
| CSD23203W | DSBGA | YZC | 6 | 3000 | 182.0 | 182.0 | 20.0 |
| CSD23203WT | DSBGA | YZC | 6 | 250 | 182.0 | 182.0 | 20.0 |

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