# CSD25211W1015, P-Channel NexFET™ Power MOSFET

## 1 Features

- Ultra-low on resistance
- Ultra-low $Q_g$ and $Q_{gd}$
- Small footprint 1.0 mm × 1.5 mm
- Low profile 0.62 mm height
- Pb Free
- Gate-source voltage clamp
- Gate ESD protection – 3 kV
- RoHS compliant
- Halogen free

## 2 Applications

- Battery Management
- Load Switch
- Battery Protection

## 3 Description

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

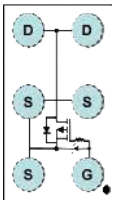



**Figure 3-1. Top View**

### Product Summary

| $T_A$ = 25°C unless otherwise stated | | TYPICAL VALUE | | UNIT |
|---|---|---|---|---|
| $V_{DS}$ | Drain-to-Source Voltage | –20 | | V |
| $Q_g$ | Gate Charge Total (–4.5V) | 3.4 | | nC |
| $Q_{gd}$ | Gate Charge Gate to Drain | 0.2 | | nC |
| $R_{DS(on)}$ | Drain-to-Source On Resistance | $V_{GS}$ = –2.5 V | 36 | mΩ |
| | | $V_{GS}$ = –4.5 V | 27 | mΩ |
| $V_{GS(th)}$ | Voltage Threshold | –0.8 | | V |

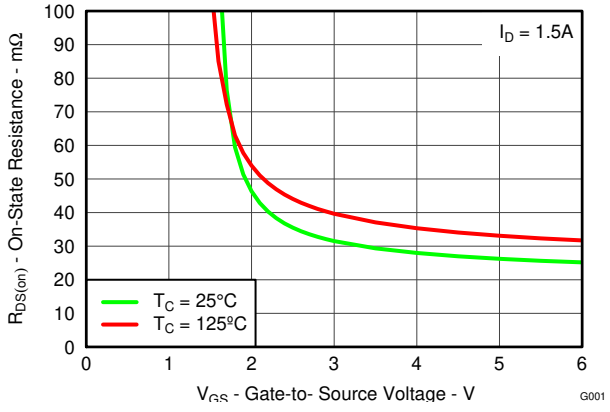
### Ordering Information

| Device | Package | Media | Qty | Ship |
|---|---|---|---|---|
| CSD25211W1015 | 1 × 1.5 Wafer Level Package | 7-inch reel | 3000 | Tape and Reel |

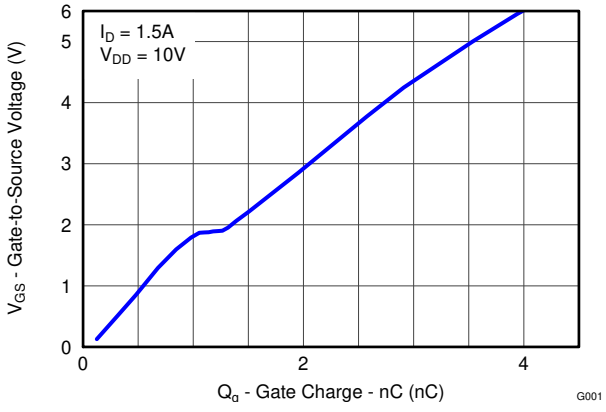
### Absolute Maximum Ratings

| $T_A$ = 25°C unless otherwise stated | | VALUE | UNIT |
|---|---|---|---|
| $V_{DS}$ | Drain-to-Source Voltage | -20 | V |
| $V_{GS}$ | Gate-to-Source Voltage | -6 | V |
| $I_D$ | Continuous Drain Current, $T_A$ = 25°C(1) | -3.2 | A |
| $I_{DM}$ | Pulsed Drain Current, $T_A$ = 25°C(2) | -9.5 | A |
| $I_G$ | Continuous Gate Current, $T_A$ = 25°C | -0.5 | A |
| | Pulsed Gate Current | -7 | A |
| $P_D$ | Power Dissipation(1) | 1 | W |
| $T_{STG}$ | Storage Temperature Range | –55 to 150 | °C |
| $T_J$ | Operating Junction Temperature Range | | |

(1) Typical $R_{\theta JA}$ = 119°C/W on 1 inch² of 2 oz. Cu on 0.06-inch thick FR4 PCB.
(2) Pulse width ≤ 10 µs, duty cycle ≤ 2%




**$R_{DS(ON)}$ vs $V_{GS}$**




**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 Revision A (January 2014) to Revision B (September 2022) | Page |
|---|---|
| • In the Absolute Maximum Ratings table Continuous Drain Current was changed to Continuous Gate Current. | 1 |
| • In the Absolute Maximum Ratings table Pulsed Drain Current was changed to Pulsed Gate Current. | 1 |

# 5 Electrical Characteristics

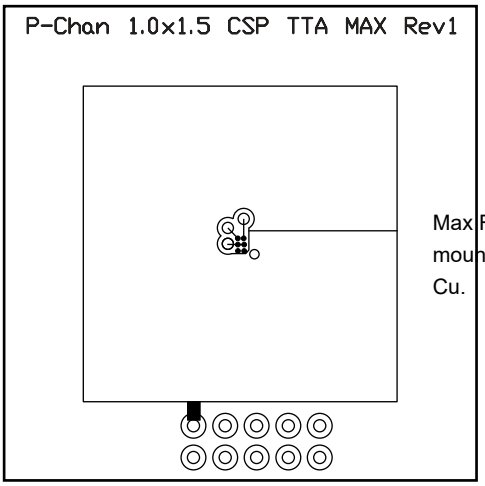
($T_A$ = 25°C unless otherwise stated)

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| **Static Characteristics** | | | | | | |
| $BV_{DSS}$ | Drain-to-Source Voltage | $V_{GS}$ = 0 V, $I_D$ = –250 µA | –20 | | | V |
| $BV_{GSS}$ | Gate-to-Source Voltage | $V_{DS}$ = 0 V, $I_G$ = –250 µA | –6.1 | | –7.2 | V |
| $I_{DSS}$ | Drain-to-Source Leakage Current | $V_{GS}$ = 0 V, $V_{DS}$ = –16 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 | –0.5 | –0.8 | –1.1 | V |
| $R_{DS(on)}$ | Drain-to-Source On Resistance | $V_{GS}$ = –2.5 V, $I_D$ = –1.5 A | | 36 | 44 | mΩ |
| | | $V_{GS}$ = –4.5 V, $I_D$ = –1.5 A | | 27 | 33 | mΩ |
| $g_{fs}$ | Transconductance | $V_{DS}$ = –10 V, $I_D$ = –1.5 A | | 12 | | S |
| **Dynamic Characteristics** | | | | | | |
| $C_{ISS}$ | Input Capacitance | $V_{GS}$ = 0 V, $V_{DS}$ = –10 V, $f$ = 1 MHz | | 475 | 570 | pF |
| $C_{OSS}$ | Output Capacitance | | | 234 | 281 | pF |
| $C_{RSS}$ | Reverse Transfer Capacitance | | | 10.5 | 13.1 | pF |
| $Q_g$ | Gate Charge Total (–4.5 V) | $V_{DS}$ = –10 V, $I_D$ = –1.5 A | | 3.4 | 4.1 | nC |
| $Q_{gd}$ | Gate Charge Gate to Drain | | | 0.2 | | nC |
| $Q_{gs}$ | Gate Charge Gate to Source | | | 1.1 | | nC |
| $Q_{g(th)}$ | Gate Charge at $V_{th}$ | | | 0.6 | | nC |
| $Q_{OSS}$ | Output Charge | $V_{DS}$ = –10 V, $V_{GS}$ = 0 V | | 3.8 | | nC |
| $t_{d(on)}$ | Turn On Delay Time | $V_{DS}$ = –10 V, $V_{GS}$ = –4.5 V, $I_D$ = –1.5 A<br>$R_G$ = 4 Ω | | 13.6 | | ns |
| $t_r$ | Rise Time | | | 8.8 | | ns |
| $t_{d(off)}$ | Turn Off Delay Time | | | 36.9 | | ns |
| $t_f$ | Fall Time | | | 14.2 | | ns |
| **Diode Characteristics** | | | | | | |
| $V_{SD}$ | Diode Forward Voltage | $I_S$ = –1.5 A, $V_{GS}$ = 0 V | | –0.8 | –1 | V |
| $Q_{rr}$ | Reverse Recovery Charge | $V_{dd}$= –10 V, $I_F$ = –1.5 A, di/dt = 200 A/µs | | 6.9 | | nC |
| $t_{rr}$ | Reverse Recovery Time | | | 11.6 | | ns |

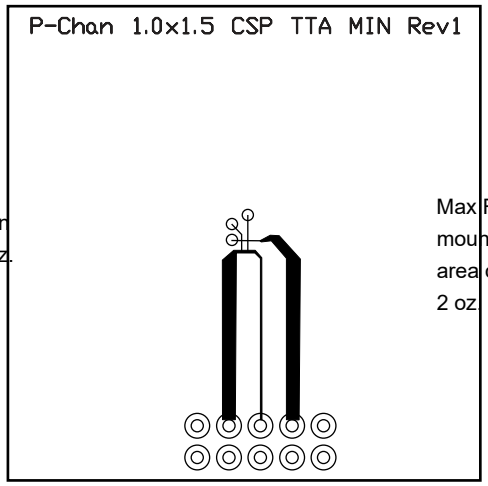
# 6 Thermal Characteristics

($T_A$ = 25°C unless otherwise stated)

| PARAMETER | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|
| $R_{\theta JA}$ | Thermal Resistance Junction to Ambient (Minimum Cu area) | | | 230 | °C/W |
| | Thermal Resistance Junction to Ambient (1 $in^2$ Cu area) | | | 149 | °C/W |




Max $R_{\theta JA}$ = 149°C/W when mounted on 1 $inch^2$ of 2 oz. Cu.




Max $R_{\theta JA}$ = 230°C/W when mounted on minimum pad area of 2 oz. Cu.

## 7 Typical MOSFET Characteristics

($T_A$ = 25°C unless otherwise stated)

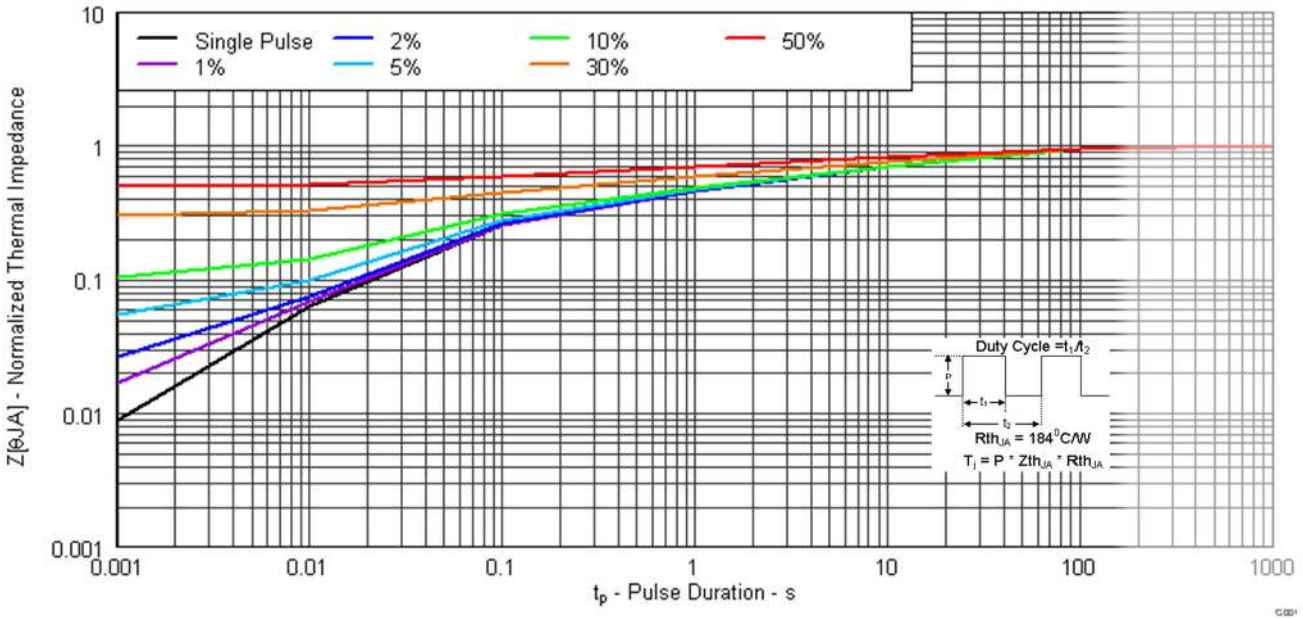



**Figure 7-1. Transient Thermal Impedance**

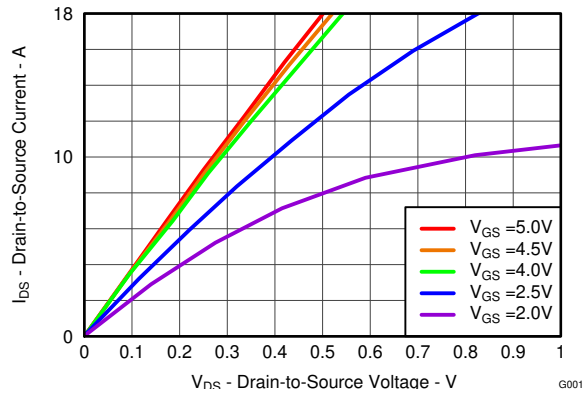



**Figure 7-2. Saturation Characteristics**

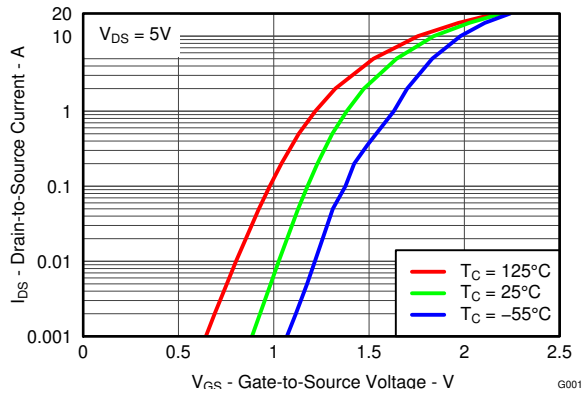



**Figure 7-3. Transfer Characteristics**

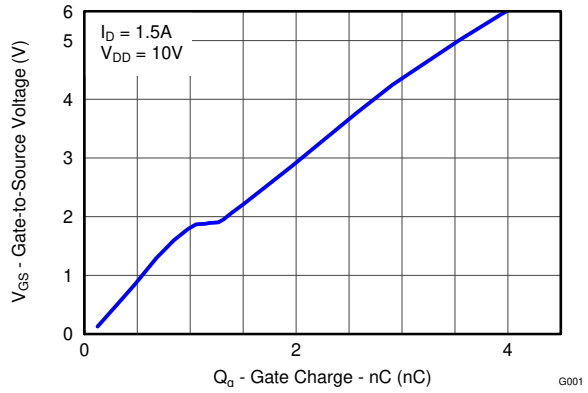



**Figure 7-4. Gate Charge**

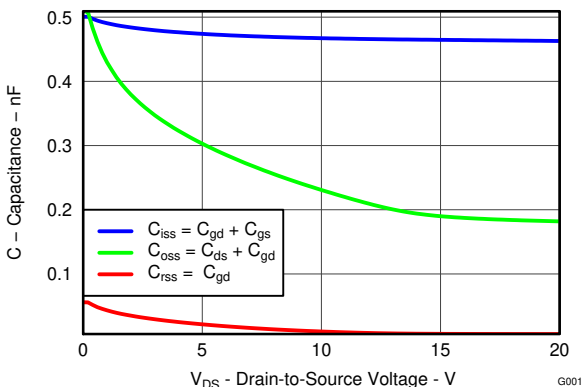



**Figure 7-5. Capacitance**

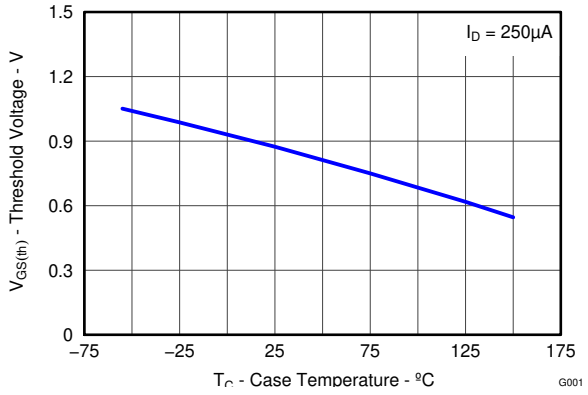



**Figure 7-6. Threshold Voltage vs Temperature**

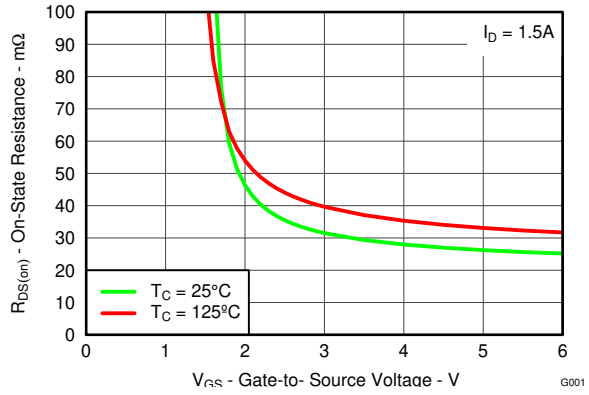



**Figure 7-7. On Resistance vs Gate Voltage**

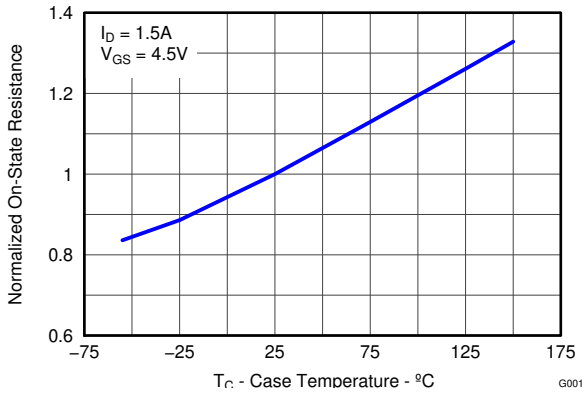



**Figure 7-8. Normalized On Resistance vs Temperature**

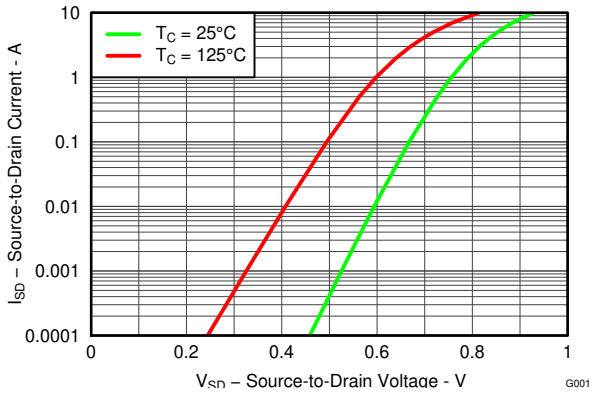



**Figure 7-9. Typical Diode Forward Voltage**

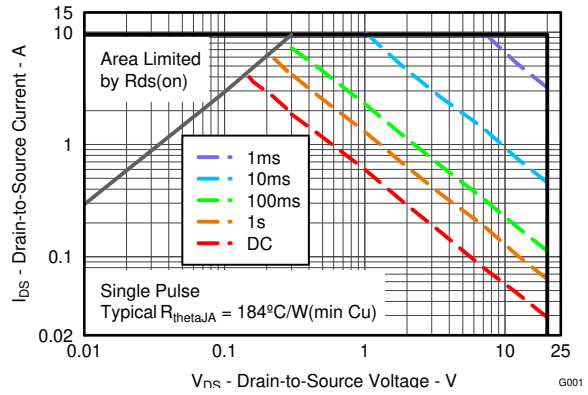



**Figure 7-10. Maximum Safe Operating Area**

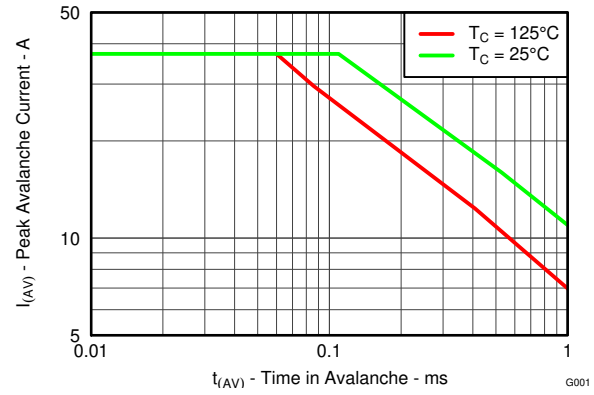



**Figure 7-11. Single Pulse Unclamped Inductive Switching**

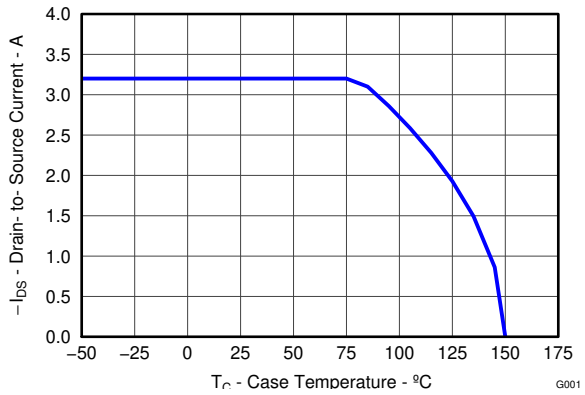
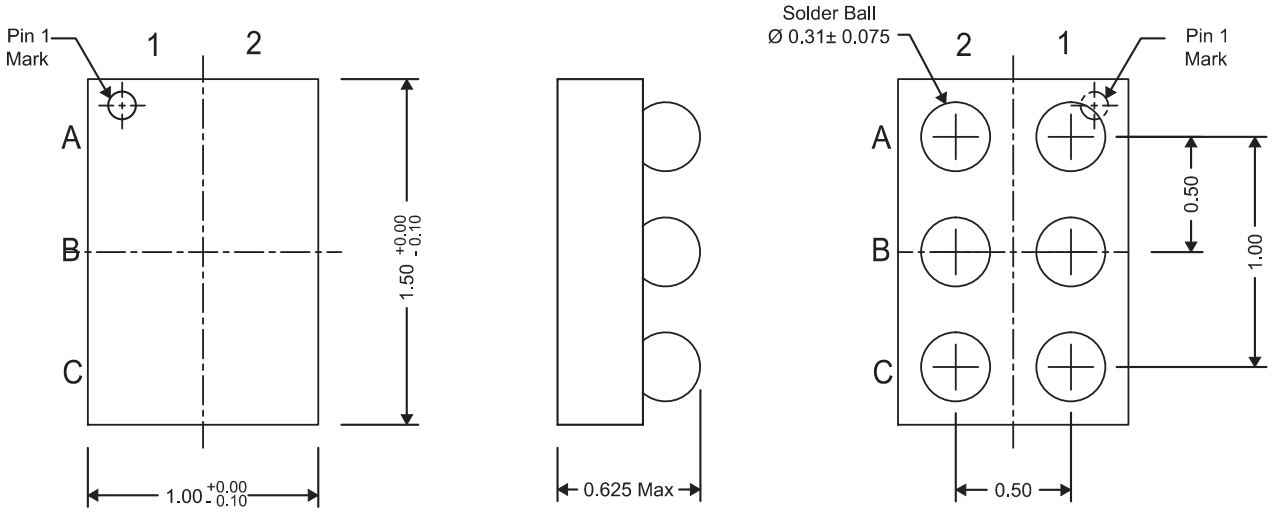
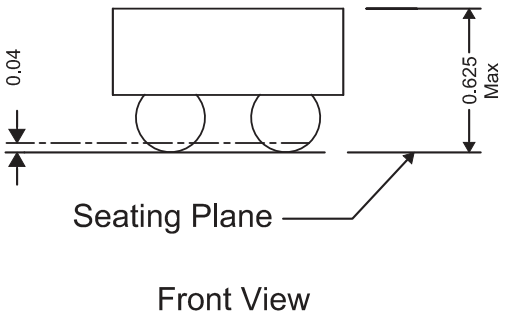



**Figure 7-12. Maximum Drain Current vs Temperature**

# 8 Mechanical Data

## 8.1 CSD25211W1015 Package Dimensions



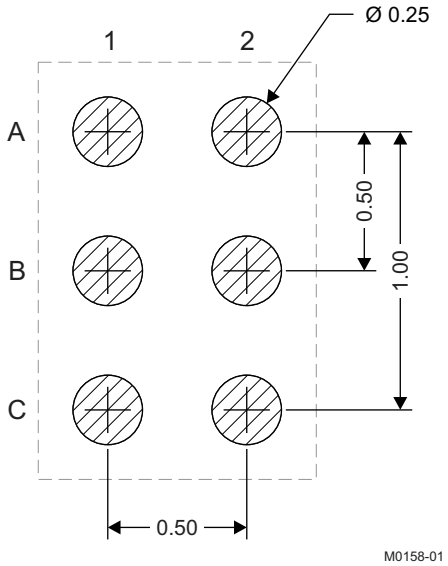




All dimensions are in mm (unless otherwise specified)

**Pinout**

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

## 8.2 Land Pattern Recommendation




All dimensions are in mm (unless otherwise specified)

# 9 Electrostatic Discharge Caution

This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

# 10 Device and Documentation Support

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## 10.6 Glossary

| | |
|---|---|
| TI Glossary | This glossary lists and explains terms, acronyms, and definitions. |

## 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CSD25211W1015 | ACTIVE | DSBGA | YZC | 6 | 3000 | RoHS & Green | SNAGCU | Level-1-260C-UNLIM | -55 to 150 | 25211 | 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.

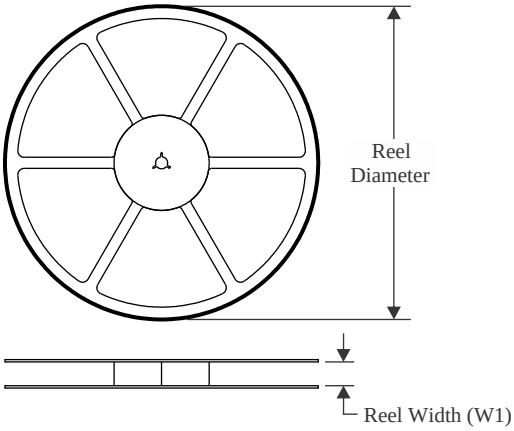
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(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.

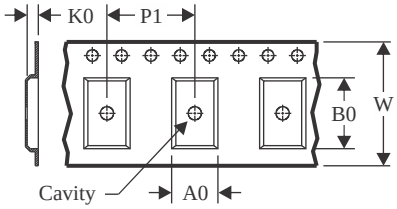
(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

## TAPE AND REEL INFORMATION

**REEL DIMENSIONS**

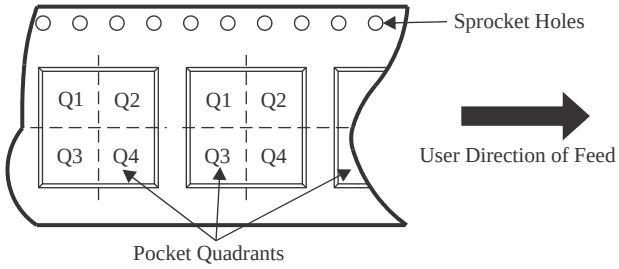



**TAPE DIMENSIONS**




| | |
|---|---|
| A0 | Dimension designed to accommodate the component width |
| B0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |

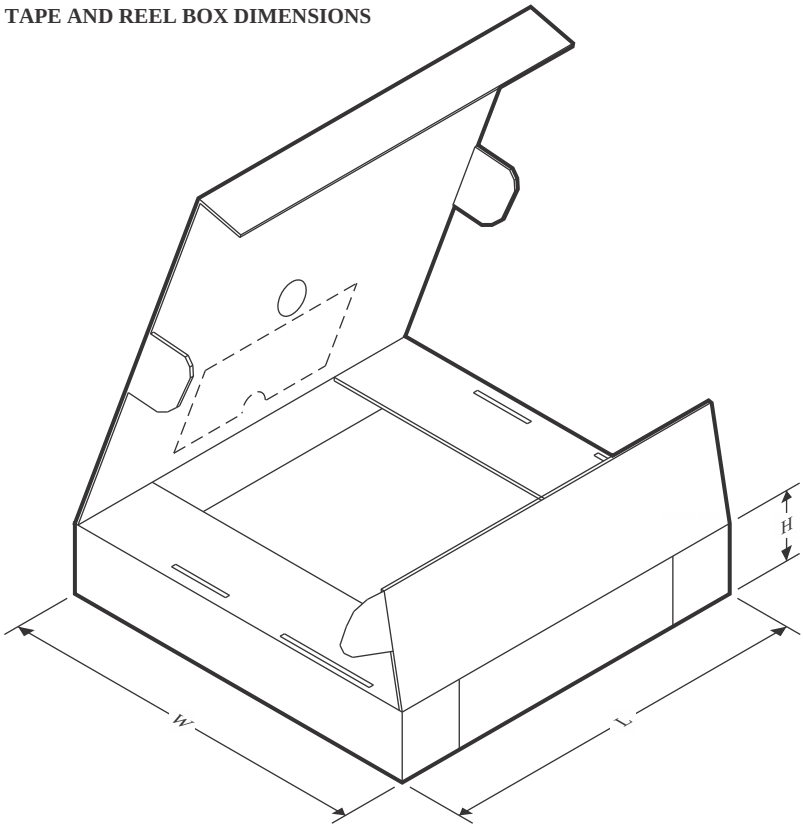
**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**




*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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CSD25211W1015 | DSBGA | YZC | 6 | 3000 | 180.0 | 8.4 | 1.09 | 1.56 | 0.65 | 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) |
|---|---|---|---|---|---|---|---|
| CSD25211W1015 | DSBGA | YZC | 6 | 3000 | 182.0 | 182.0 | 20.0 |

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