

# CSD25304W1015 20-V P-Channel NexFET™ Power MOSFET

## 1 Features

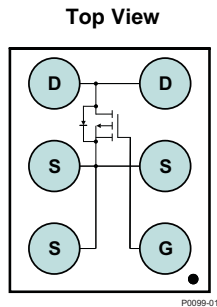
- Ultra-Low  $Q_g$  and  $Q_{gd}$
- Small Footprint
- Low Profile 0.62 mm Height
- Pb Free
- RoHS Compliant
- Halogen Free
- CSP 1 × 1.5 mm Wafer Level Package

## 2 Applications

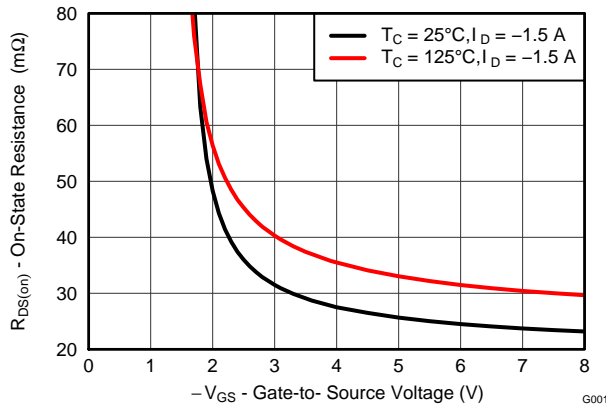
- Battery Management
- Load Switch
- Battery Protection

## 3 Description

This 27 mΩ, –20 V, P-Channel device is designed to deliver the lowest on-resistance and gate charge in a small 1.0 × 1.5 mm outline with excellent thermal characteristics in an ultra-low profile.



**$R_{DS(on)}$  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)     | 3.3                      |    | nC   |
| $Q_{gd}$                 | Gate Charge Gate-to-Drain     | 0.5                      |    | nC   |
| $R_{DS(on)}$             | Drain-to-Source On-Resistance | $V_{GS} = -1.8\text{ V}$ | 65 | mΩ   |
|                          |                               | $V_{GS} = -2.5\text{ V}$ | 36 | mΩ   |
|                          |                               | $V_{GS} = -4.5\text{ V}$ | 27 | mΩ   |
| $V_{GS(th)}$             | Voltage Threshold             | –0.8                     |    | V    |

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

| Device         | Qty  | Media       | Package                             | Ship          |
|----------------|------|-------------|-------------------------------------|---------------|
| CSD25304W1015  | 3000 | 7-Inch Reel | 1.0 mm × 1.5 mm Wafer Level Package | Tape and Reel |
| CSD25304W1015T | 250  | 7-Inch Reel |                                     |               |

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

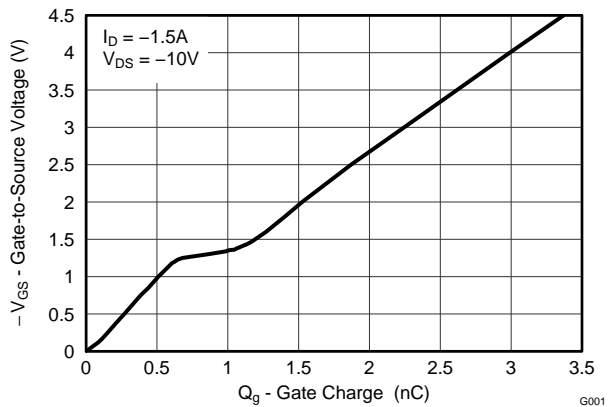
## Absolute Maximum Ratings

| $T_A = 25^\circ\text{C}$ |  | VALUE      | UNIT |
|--------------------------|--|------------|------|
| $V_{DS}$                 | Drain-to-Source Voltage                          | –20        | V    |
| $V_{GS}$                 | Gate-to-Source Voltage                           | ±8         | V    |
| $I_D$                    | Continuous Drain Current <sup>(1)</sup>          | –3.0       | A    |
| $I_{DM}$                 | Pulsed Drain Current <sup>(2)</sup>              | –41        | A    |
| $P_D$                    | Power Dissipation                                | 0.75       | W    |
| $T_{J, T_{stg}}$         | Operating Junction and Storage Temperature Range | –55 to 150 | °C   |

(1) Device operating at a temperature of 105°C

(2) Typ  $R_{\theta JA} = 165^\circ\text{C/W}$ , Pulse width  $\leq 100\ \mu\text{s}$ , duty cycle  $\leq 1\%$

**Gate Charge**



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## 4 Revision History

| Changes from Original (July 2014) to Revision A                         | Page |
|---|------|
| • Reduced power dissipation rating to 0.75 W (min Cu calculation) ..... | 1    |
| • Corrected Min Thermal Information from 85 to 165 .....                | 3    |
| • Corrected Max Thermal Information from 165 to 85 .....                | 3    |
| • Updated the mechanical drawing to add more precision .....            | 8    |

## 5 Specifications

### 5.1 Electrical Characteristics

(T<sub>A</sub> = 25°C unless otherwise stated)

| PARAMETER                      |                                  | TEST CONDITIONS   | MIN   | TYP  | MAX   | UNIT |
|--------------------------------|----------------------------------|---|-------|------|-------|------|
| <b>STATIC CHARACTERISTICS</b>  |                                  |   |       |      |       |      |
| B <sub>V</sub> DSS             | Drain-to-Source Voltage          | V <sub>GS</sub> = 0 V, I <sub>D</sub> = -250 μA   | -20   |      |       | V    |
| I <sub>DSS</sub>               | Drain-to-Source Leakage Current  | V <sub>GS</sub> = 0 V, V <sub>DS</sub> = -16 V  |       |      | -1    | μA   |
| I <sub>GSS</sub>               | Gate-to-Source Leakage Current   | V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ±8 V   |       |      | -100  | nA   |
| V <sub>GS(th)</sub>            | Gate-to-Source Threshold Voltage | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250 μA  | -0.55 | -0.8 | -1.15 | V    |
| R <sub>DS(on)</sub>            | Drain-to-Source On-Resistance    | V <sub>GS</sub> = -1.8 V, I <sub>D</sub> = -1.5 A   |       | 65   | 92    | mΩ   |
|                                |                                  | V <sub>GS</sub> = -2.5 V, I <sub>D</sub> = -1.5 A   |       | 36   | 45.5  | mΩ   |
|                                |                                  | V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -1.5 A   |       | 27   | 32.5  | mΩ   |
| g <sub>fs</sub>                | Transconductance                 | V <sub>DS</sub> = -10 V, I <sub>D</sub> = -1.5 A  |       | 12   |       | S    |
| <b>DYNAMIC CHARACTERISTICS</b> |                                  |   |       |      |       |      |
| C <sub>ISS</sub>               | Input Capacitance                | V <sub>GS</sub> = 0 V, V <sub>DS</sub> = -10 V, f = 1 MHz   |       | 458  | 595   | pF   |
| C <sub>OSS</sub>               | Output Capacitance               |   |       | 231  | 300   | pF   |
| C <sub>RSS</sub>               | Reverse Transfer Capacitance     |   |       | 12   | 15.6  | pF   |
| Q <sub>g</sub>                 | Gate Charge Total (-4.5 V)       |   |       | 3.3  | 4.4   | nC   |
| Q <sub>gd</sub>                | Gate Charge Gate-to-Drain        | V <sub>DS</sub> = -10 V, I <sub>D</sub> = -1.5 A  |       | 0.5  |       | nC   |
| Q <sub>gs</sub>                | Gate Charge Gate-to-Source       |   |       | 0.7  |       | nC   |
| Q <sub>g(th)</sub>             | Gate Charge at V <sub>th</sub>   |   |       | 0.4  |       | nC   |
| Q <sub>OSS</sub>               | Output Charge                    | V <sub>DS</sub> = -10 V, V <sub>GS</sub> = 0 V  |       | 3.7  |       | nC   |
| t <sub>d(on)</sub>             | Turn On Delay Time               | V <sub>DS</sub> = -10 V, V <sub>GS</sub> = -4.5 V, I <sub>D</sub> = -1.5 A<br>R <sub>G</sub> = 20 Ω |       | 6    |       | ns   |
| t <sub>r</sub>                 | Rise Time                        |   |       | 4    |       | ns   |
| t <sub>d(off)</sub>            | Turn Off Delay Time              |   |       | 24   |       | ns   |
| t <sub>f</sub>                 | Fall Time                        |   |       | 10   |       | ns   |
| <b>DIODE CHARACTERISTICS</b>   |                                  |   |       |      |       |      |
| V <sub>SD</sub>                | Diode Forward Voltage            | I <sub>S</sub> = -1.5 A, V <sub>GS</sub> = 0 V  | -0.75 |      | -1    | V    |
| Q <sub>rr</sub>                | Reverse Recovery Charge          | V <sub>DS</sub> = -10 V, I <sub>F</sub> = -1.5 A, di/dt = 200 A/μs                                  |       | 7.2  |       | nC   |
| t <sub>rr</sub>                | Reverse Recovery Time            | V <sub>DS</sub> = -10 V, I <sub>F</sub> = -1.5 A, di/dt = 200 A/μs                                  |       | 11.6 |       | ns   |

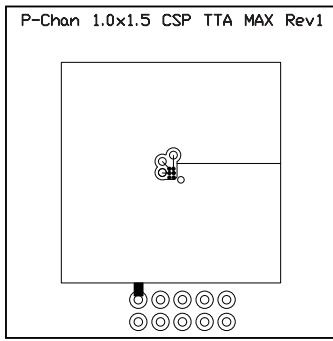
### 5.2 Thermal Information

(T<sub>A</sub> = 25°C unless otherwise stated)

| THERMAL METRIC   |   | MIN | TYP | MAX | UNIT |
|------------------|---|-----|-----|-----|------|
| R <sub>θJA</sub> | Junction-to-Ambient Thermal Resistance <sup>(1)</sup> |     | 165 |     | °C/W |
|                  | Junction-to-Ambient Thermal Resistance <sup>(2)</sup> |     | 85  |     |      |

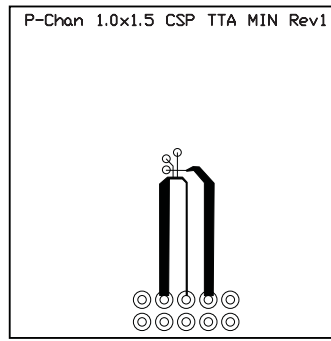
(1) Device mounted on FR4 material with minimum Cu mounting area.

(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.



M0155-01

Typ  $R_{\theta JA} = 85^{\circ}\text{C/W}$   
when mounted on  
1 inch<sup>2</sup> of 2 oz. Cu.



M0156-01

Typ  $R_{\theta JA} = 165^{\circ}\text{C/W}$   
when mounted on  
minimum pad area of  
2 oz. Cu.

### 5.3 Typical MOSFET Characteristics

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

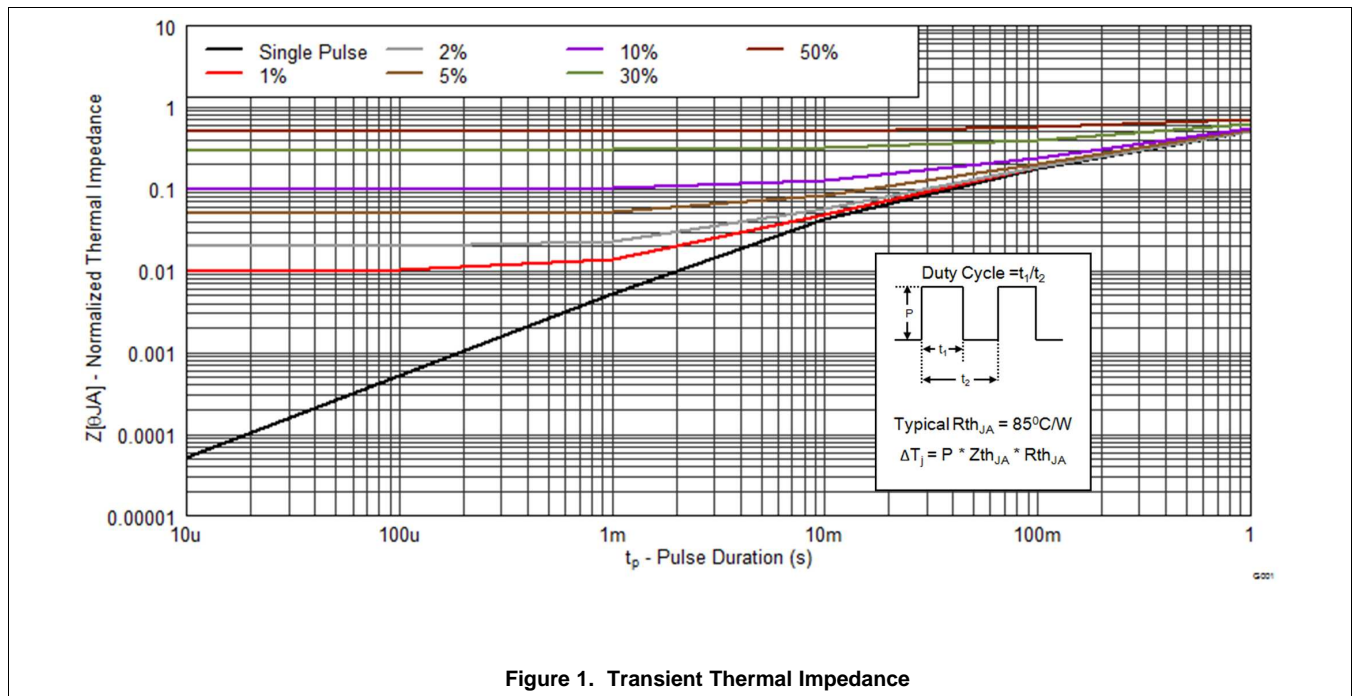


Figure 1. Transient Thermal Impedance

Typical MOSFET Characteristics (continued)

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

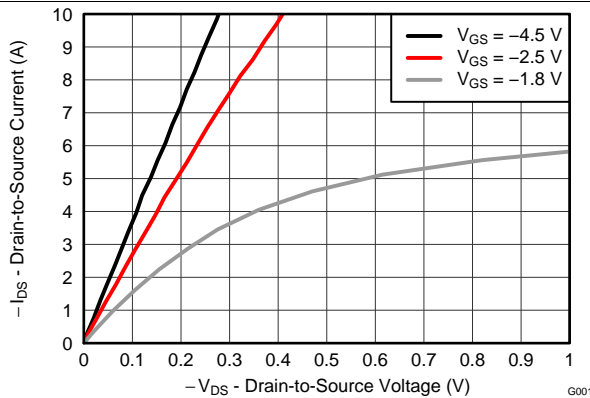


Figure 2. Saturation Characteristics

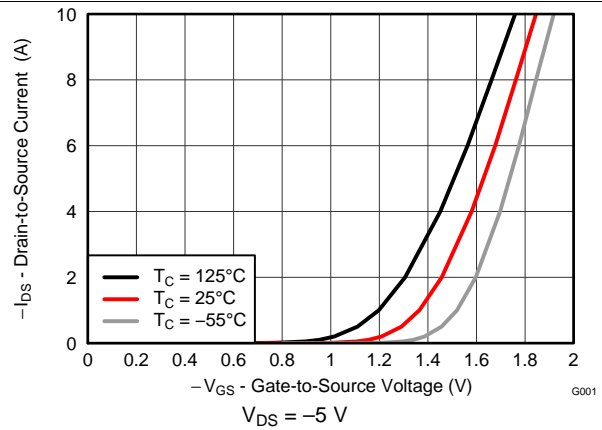


Figure 3. Transfer Characteristics

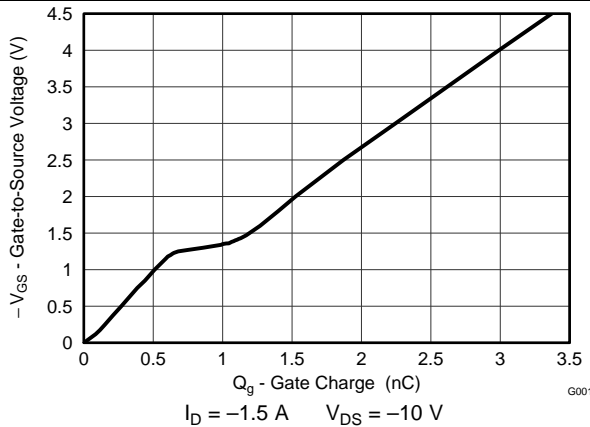


Figure 4. Gate Charge

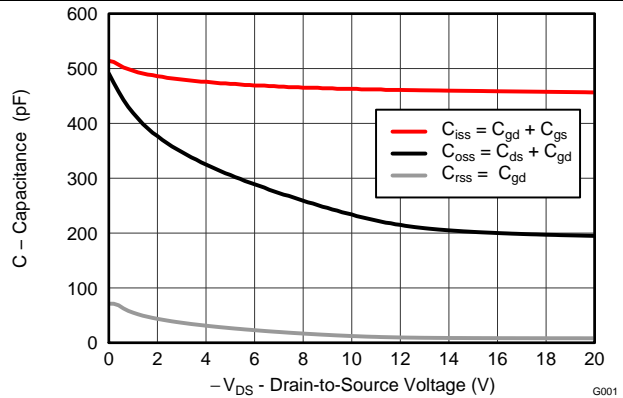


Figure 5. Capacitance

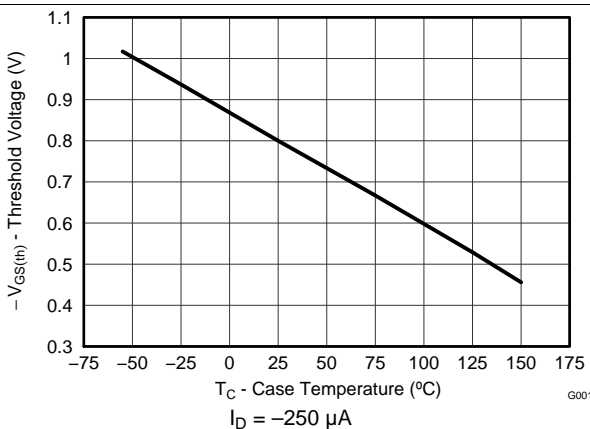


Figure 6. Threshold Voltage vs Temperature

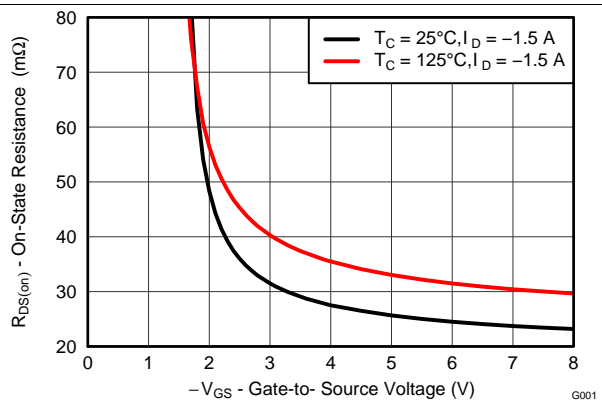


Figure 7. On-State Resistance vs Gate-to-Source Voltage

Typical MOSFET Characteristics (continued)

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

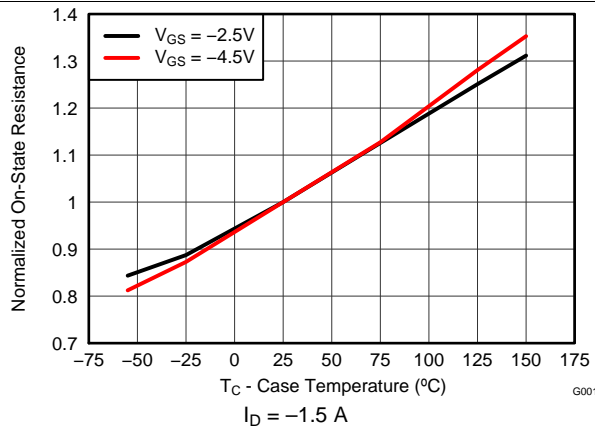


Figure 8. Normalized On-State Resistance vs Temperature

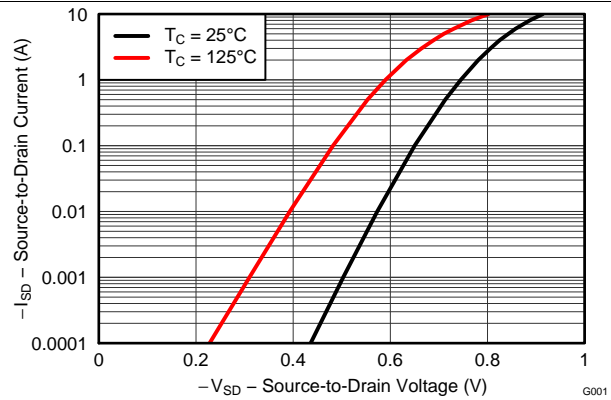


Figure 9. Typical Diode Forward Voltage

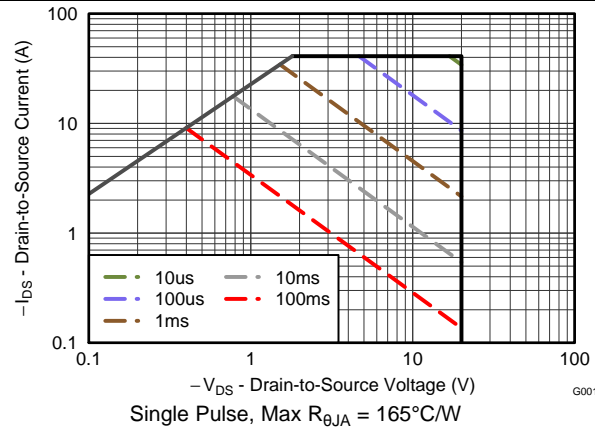


Figure 10. Maximum Safe Operating Area

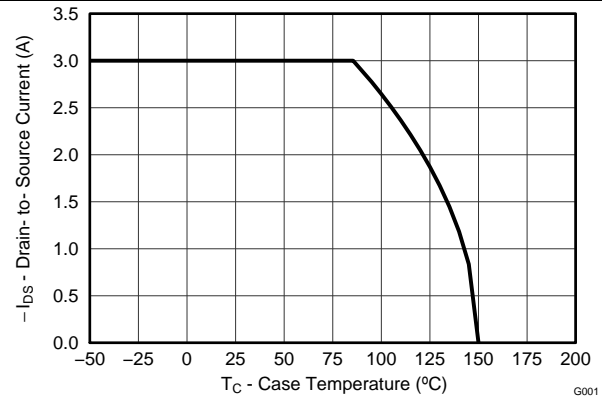


Figure 11. Maximum Drain Current vs Temperature

## 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

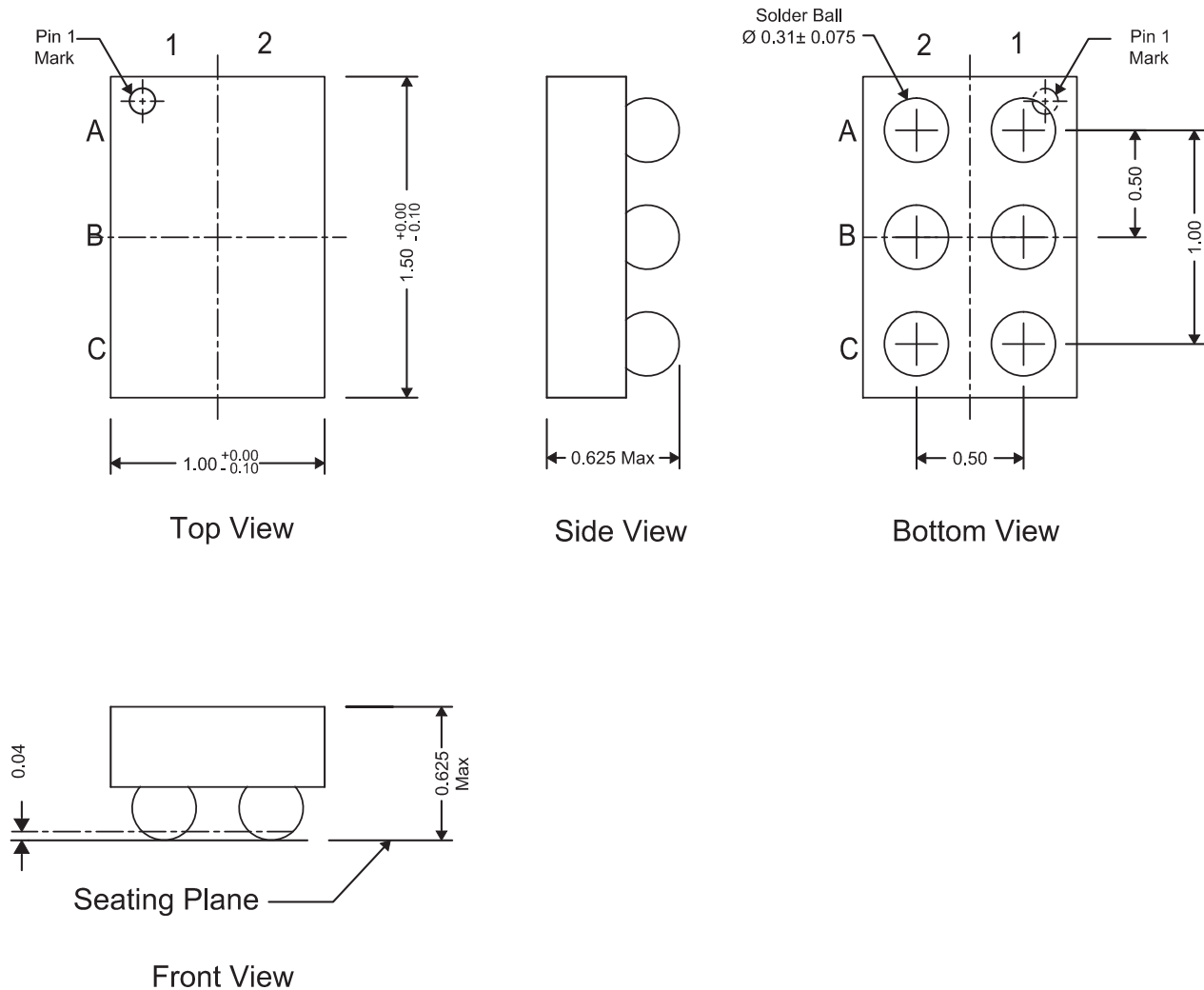
[SLYZ022](#) — *TI Glossary*.

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 CSD25304W1015 Package Dimensions



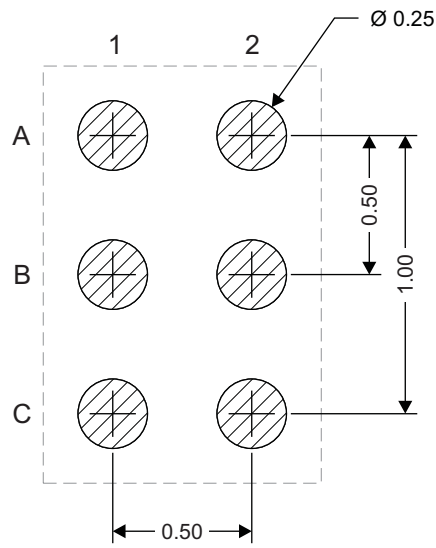
NOTE: All dimensions are in mm (unless otherwise specified).

#### Pinout

| Position   | Designation |
|------------|-------------|
| C1, C2     | Drain       |
| A1         | Gate        |
| A2, B1, B2 | Source      |



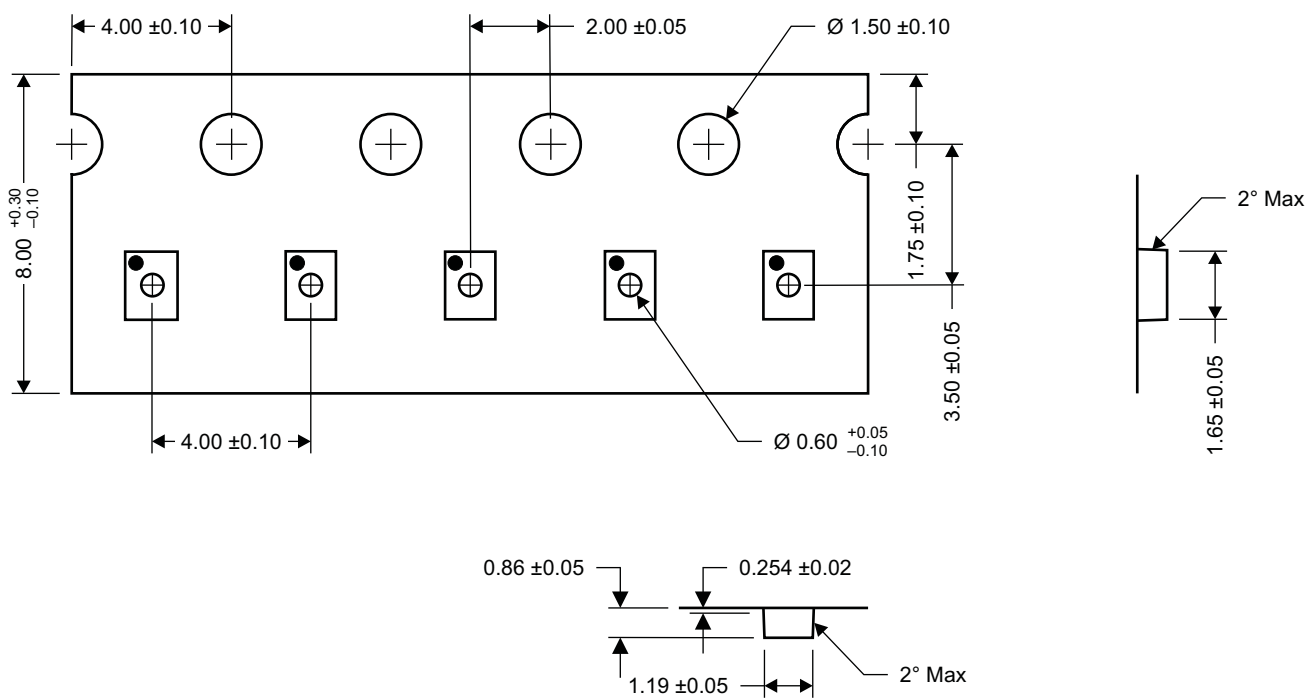
### 7.2 Land Pattern Recommendation



M0158-01

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

### 7.3 Tape and Reel Information



M0159-01

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

**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2)         | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| CSD25304W1015    | ACTIVE        | DSBGA        | YZC             | 6    | 3000        | Green (RoHS & no Sb/Br) | SNAGCU                  | Level-1-260C-UNLIM   |              | 25304                   | <a href="#">Samples</a> |
| CSD25304W1015T   | ACTIVE        | DSBGA        | YZC             | 6    | 250         | Green (RoHS & no Sb/Br) | SNAGCU                  | Level-1-260C-UNLIM   | -55 to 150   | 25304                   | <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) **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/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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