

# CSD18535KCS 60V N-Channel NexFET™ Power MOSFET

## 1 Features

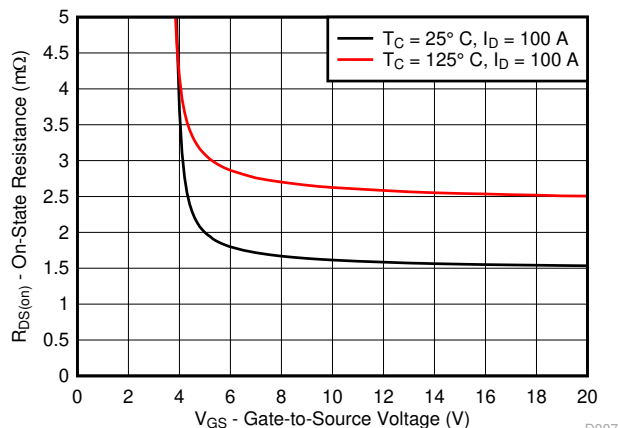
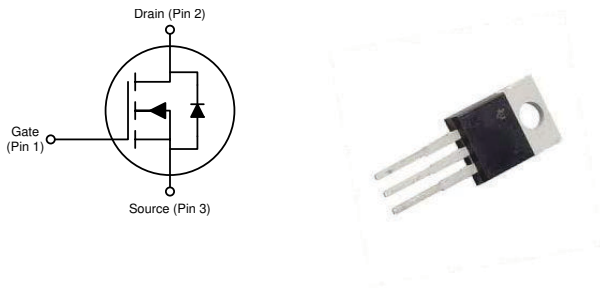
- Ultra-low  $Q_g$  and  $Q_{gd}$
- Low thermal resistance
- Avalanche rated
- Pb-Free terminal plating
- RoHS compliant
- Halogen free
- TO-220 plastic package

## 2 Applications

- Secondary side synchronous rectifier
- Motor control

## 3 Description

This 60V, 1.6m $\Omega$ , TO-220 NexFET™ power MOSFET is designed to minimize losses in power conversion applications.



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

D007

## Product Summary

| $T_A = 25^\circ\text{C}$ |                               | TYPICAL VALUE          |     | UNIT       |
|--------------------------|-------------------------------|------------------------|-----|------------|
| $V_{DS}$                 | Drain-to-Source Voltage       | 60                     |     | V          |
| $Q_g$                    | Gate Charge Total (10V)       | 63                     |     | nC         |
| $Q_{gd}$                 | Gate Charge Gate-to-Drain     | 10.4                   |     | nC         |
| $R_{DS(on)}$             | Drain-to-Source On-Resistance | $V_{GS} = 4.5\text{V}$ | 2.3 | m $\Omega$ |
|                          |                               | $V_{GS} = 10\text{V}$  | 1.6 | m $\Omega$ |
| $V_{GS(th)}$             | Threshold Voltage             | 1.9                    |     | V          |

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

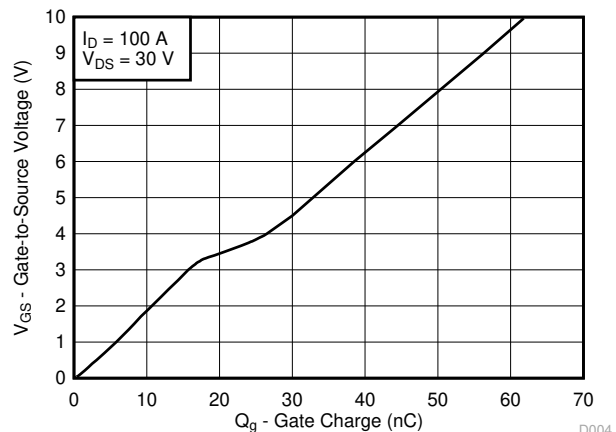
| Device      | Package                | Media | Qty | Ship |
|-------------|------------------------|-------|-----|------|
| CSD18535KCS | TO-220 Plastic Package | Tube  | 50  | Tube |

- (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                                                                 | 60             | V                |
| $V_{GS}$                 | Gate-to-Source Voltage                                                                  | $\pm 20$       | V                |
| $I_D$                    | Continuous Drain Current (Package limited)                                              | 200            | A                |
|                          | Continuous Drain Current (Silicon limited), $T_C = 25^\circ\text{C}$                    | 279            |                  |
|                          | Continuous Drain Current (Silicon limited), $T_C = 100^\circ\text{C}$                   | 197            |                  |
| $I_{DM}$                 | Pulsed Drain Current <sup>(1)</sup>                                                     | 400            | A                |
| $P_D$                    | Power Dissipation                                                                       | 300            | W                |
| $T_J, T_{stg}$           | Operating Junction and Storage Temperature Range                                        | $-55$ to $175$ | $^\circ\text{C}$ |
| $E_{AS}$                 | Avalanche Energy, single pulse<br>$I_D = 111\text{A}, L = 0.1\text{mH}, R_G = 25\Omega$ | 616            | mJ               |

- (1) Max  $R_{\theta JC} = 0.5^\circ\text{C/W}$ , pulse duration  $\leq 100\mu\text{s}$ , duty cycle  $\leq 1\%$



**Gate Charge**

D004



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## 4 Specifications

### 4.1 Electrical Characteristics

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

| PARAMETER               |                                  | TEST CONDITIONS                                                                              | MIN | TYP  | MAX  | UNIT |
|-------------------------|----------------------------------|----------------------------------------------------------------------------------------------|-----|------|------|------|
| STATIC CHARACTERISTICS  |                                  |                                                                                              |     |      |      |      |
| BV <sub>DSS</sub>       | Drain-to-Source Voltage          | V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA                                                 | 60  |      |      | V    |
| I <sub>DSS</sub>        | Drain-to-Source Leakage Current  | V <sub>GS</sub> = 0V, V <sub>DS</sub> = 48V                                                  |     |      | 1    | μA   |
| I <sub>GSS</sub>        | Gate-to-Source Leakage Current   | V <sub>DS</sub> = 0V, V <sub>GS</sub> = 20V                                                  |     |      | 100  | nA   |
| V <sub>GS(th)</sub>     | Gate-to-Source Threshold Voltage | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA                                   | 1.4 | 1.9  | 2.4  | V    |
| R <sub>DS(on)</sub>     | Drain-to-Source On-Resistance    | V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 100A                                                | 2.3 |      | 2.9  | mΩ   |
|                         |                                  | V <sub>GS</sub> = 10V, I <sub>D</sub> = 100A                                                 | 1.6 |      | 2.0  | mΩ   |
| g <sub>fs</sub>         | Transconductance                 | V <sub>DS</sub> = 6V, I <sub>D</sub> = 100A                                                  | 263 |      |      | S    |
| DYNAMIC CHARACTERISTICS |                                  |                                                                                              |     |      |      |      |
| C <sub>iss</sub>        | Input Capacitance                | V <sub>GS</sub> = 0V, V <sub>DS</sub> = 30V, f = 1MHz                                        |     | 5090 | 6620 | pF   |
| C <sub>oss</sub>        | Output Capacitance               |                                                                                              |     | 890  | 1150 | pF   |
| C <sub>rss</sub>        | Reverse Transfer Capacitance     |                                                                                              |     | 24   | 31   | pF   |
| R <sub>G</sub>          | Series Gate Resistance           | V <sub>DS</sub> = 30V, I <sub>D</sub> = 100A                                                 |     | 0.8  | 1.6  | Ω    |
| Q <sub>g</sub>          | Gate Charge Total (10V)          |                                                                                              |     | 63   | 81   | nC   |
| Q <sub>gd</sub>         | Gate Charge Gate-to-Drain        |                                                                                              |     | 10.4 |      | nC   |
| Q <sub>gs</sub>         | Gate Charge Gate-to-Source       |                                                                                              |     | 15.7 |      | nC   |
| Q <sub>g(th)</sub>      | Gate Charge at V <sub>th</sub>   |                                                                                              |     | 9.4  |      | nC   |
| Q <sub>oss</sub>        | Output Charge                    | V <sub>DS</sub> = 30V, V <sub>GS</sub> = 0V                                                  |     | 140  |      | nC   |
| t <sub>d(on)</sub>      | Turn On Delay Time               | V <sub>DS</sub> = 30V, V <sub>GS</sub> = 10V,<br>I <sub>DS</sub> = 100A, R <sub>G</sub> = 0Ω |     | 9    |      | ns   |
| t <sub>r</sub>          | Rise Time                        |                                                                                              |     | 3    |      | ns   |
| t <sub>d(off)</sub>     | Turn Off Delay Time              |                                                                                              |     | 19   |      | ns   |
| t <sub>f</sub>          | Fall Time                        |                                                                                              |     | 3    |      | ns   |
| DIODE CHARACTERISTICS   |                                  |                                                                                              |     |      |      |      |
| V <sub>SD</sub>         | Diode Forward Voltage            | I <sub>SD</sub> = 100A, V <sub>GS</sub> = 0V                                                 |     | 0.9  | 1.0  | V    |
| Q <sub>rr</sub>         | Reverse Recovery Charge          | V <sub>DS</sub> = 30V, I <sub>F</sub> = 100A,                                                |     | 214  |      | nC   |
| t <sub>rr</sub>         | Reverse Recovery Time            | di/dt = 300A/μs                                                                              |     | 63   |      | ns   |

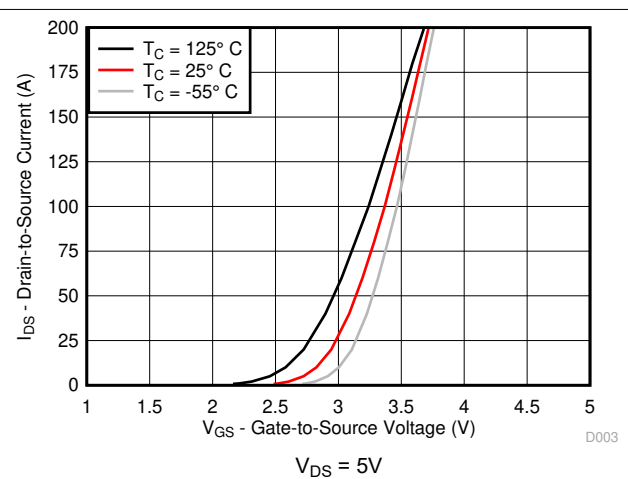
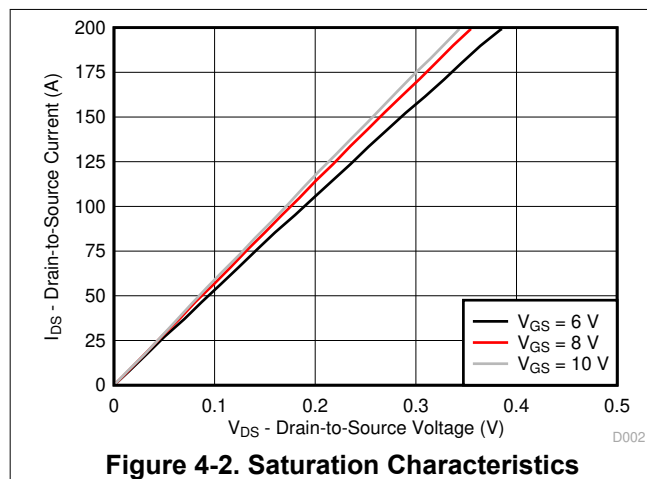
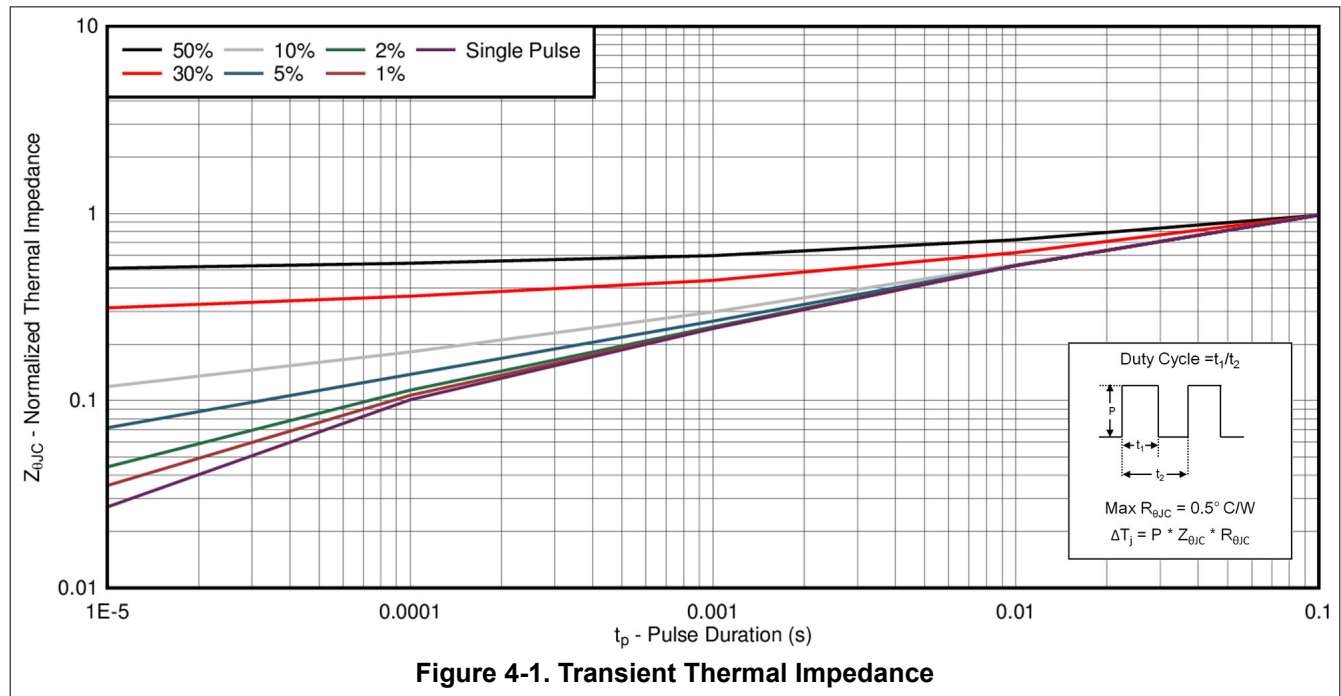
### 4.2 Thermal Information

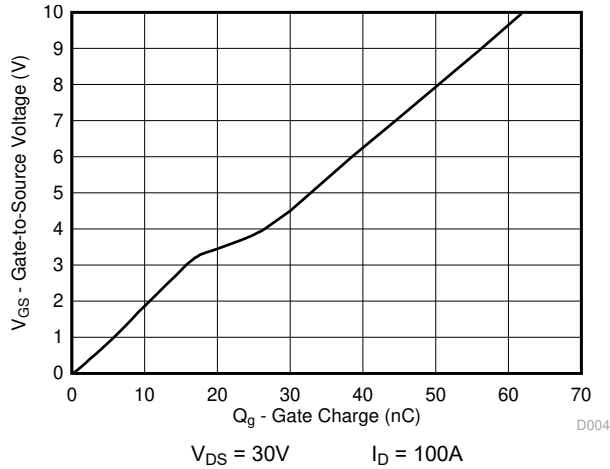
(T<sub>A</sub> = 25°C unless otherwise stated)

| THERMAL METRIC   |                                        | MIN | TYP | MAX | UNIT |
|------------------|----------------------------------------|-----|-----|-----|------|
| R <sub>θJC</sub> | Junction-to-Case Thermal Resistance    |     |     | 0.5 | °C/W |
| R <sub>θJA</sub> | Junction-to-Ambient Thermal Resistance |     |     | 62  |      |

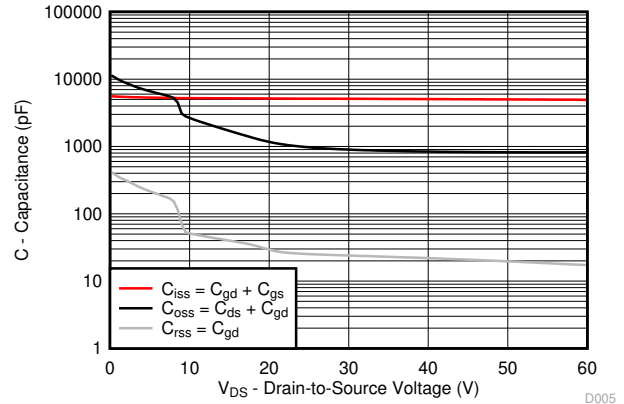
### 4.3 Typical MOSFET Characteristics

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

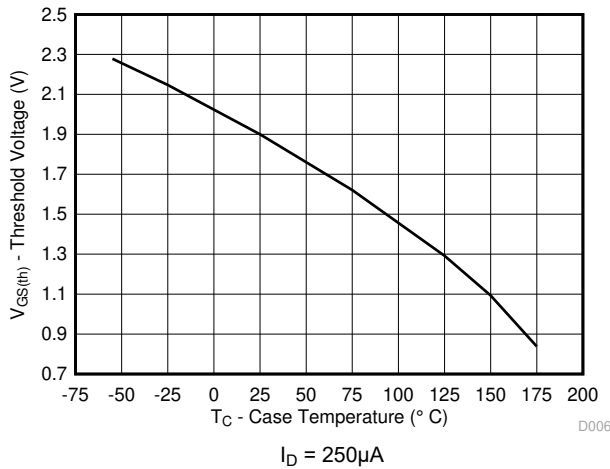




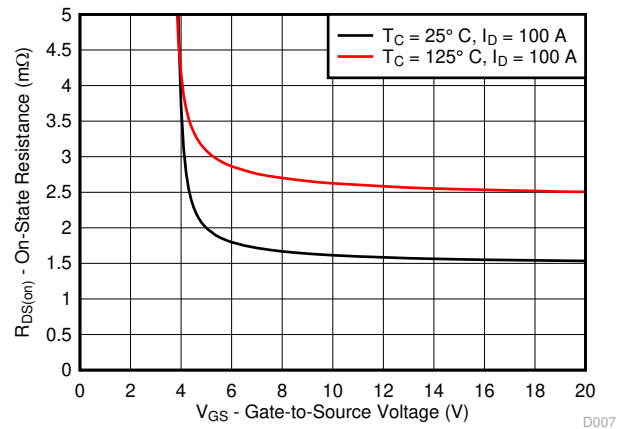
**Figure 4-4. Gate Charge**



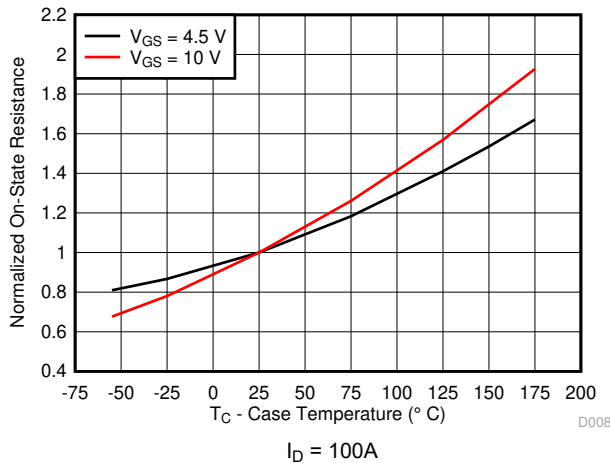
**Figure 4-5. Capacitance**



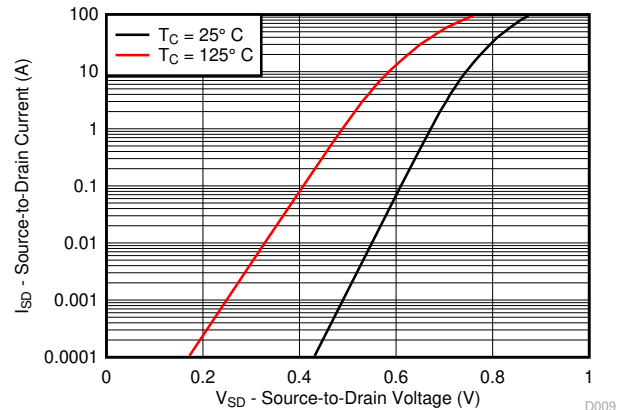
**Figure 4-6. Threshold Voltage vs Temperature**



**Figure 4-7. On-State Resistance vs Gate-to-Source Voltage**



**Figure 4-8. Normalized On-State Resistance vs Temperature**



**Figure 4-9. Typical Diode Forward Voltage**

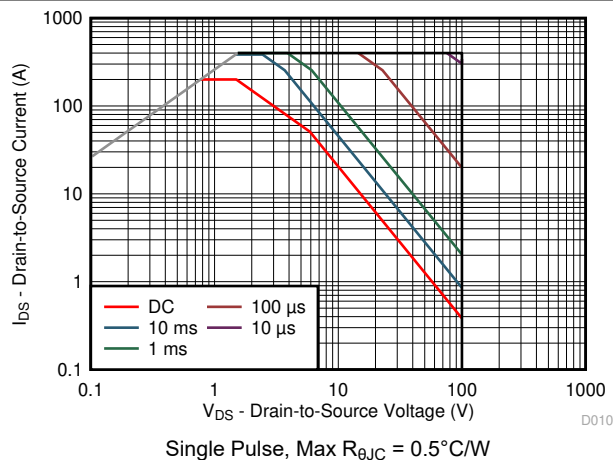


Figure 4-10. Maximum Safe Operating Area

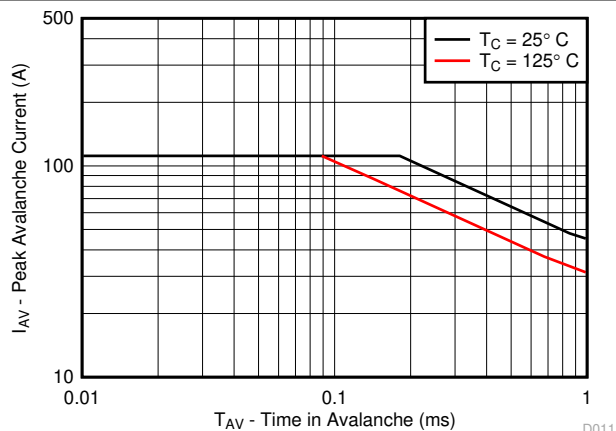


Figure 4-11. Single Pulse Unclamped Inductive Switching

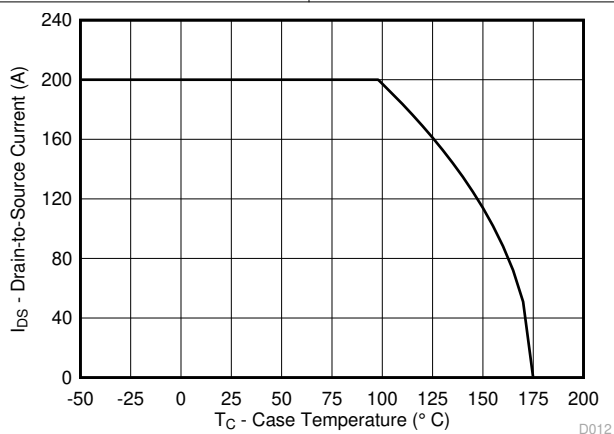


Figure 4-12. Maximum Drain Current vs Temperature

## 5 Device and Documentation Support

### 5.1 Third-Party Products Disclaimer

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### 5.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](http://ti.com). Click on *Notifications* 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.

### 5.3 Support Resources

[TI E2E™ support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

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### 5.4 Trademarks

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### 5.5 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.

### 5.6 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

## 6 Revision History

| Changes from Revision * (March 2015) to Revision A (April 2024)                                       | Page |
|-------------------------------------------------------------------------------------------------------|------|
| • Updated the numbering format for tables, figures, and cross-references throughout the document..... | 1    |

## 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.

PACKAGING INFORMATION

| Orderable part number       | Status<br>(1) | Material type<br>(2) | Package   Pins   | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|-----------------------------|---------------|----------------------|------------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">CSD18535KCS</a> | Active        | Production           | TO-220 (KCS)   3 | 50   TUBE             | ROHS Exempt | SN                                   | N/A for Pkg Type                  | -55 to 175   | CSD18535KCS         |
| CSD18535KCS.B               | Active        | Production           | TO-220 (KCS)   3 | 50   TUBE             | ROHS Exempt | SN                                   | N/A for Pkg Type                  | -55 to 175   | CSD18535KCS         |

- <sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).
- <sup>(2)</sup> **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.
- <sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.
- <sup>(4)</sup> **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.
- <sup>(5)</sup> **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.
- <sup>(6)</sup> **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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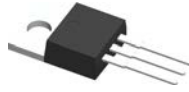
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## TUBE



\*All dimensions are nominal

| Device        | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|---------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| CSD18535KCS   | KCS          | TO-220       | 3    | 50  | 532    | 34.1   | 700    | 9.6    |
| CSD18535KCS.B | KCS          | TO-220       | 3    | 50  | 532    | 34.1   | 700    | 9.6    |

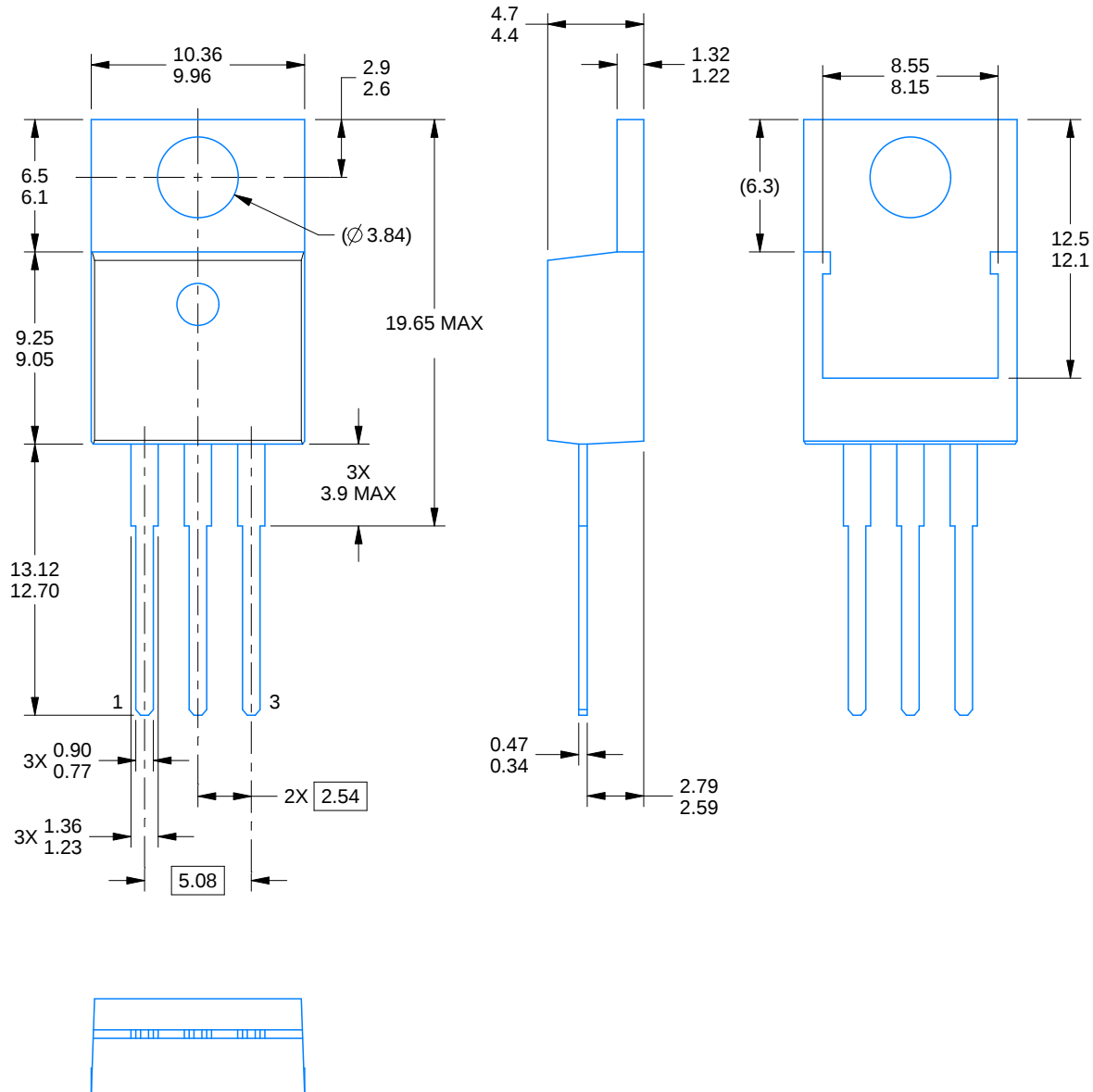


## PACKAGE OUTLINE

**KCS0003B**

**TO-220 - 19.65 mm max height**

TO-220



4222214/B 08/2018

### NOTES:

1. Dimensions are in millimeters. Any dimension in brackets or parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC registration TO-220.

# EXAMPLE BOARD LAYOUT

KCS0003B

TO-220 - 19.65 mm max height

TO-220



LAND PATTERN EXAMPLE  
NON-SOLDER MASK DEFINED  
SCALE:15X

4222214/B 08/2018

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