# CSD18533KCS 60V N-Channel NexFET™ Power MOSFET

## 1 Features

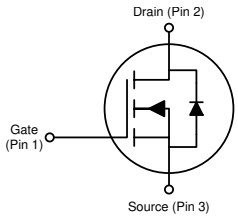
- Ultra-low $Q_g$ and $Q_{gd}$
- Low thermal resistance
- Avalanche rated
- Logic level
- Pb-free terminal plating
- RoHS compliant
- Halogen free
- TO-220 plastic package

## 2 Applications

- DC-DC conversion
- Secondary side synchronous rectifier
- Motor control

## 3 Description

This 60V, 5.0mΩ, TO-220 NexFET™ power MOSFET is designed to minimize losses in power conversion applications.




### Product Summary

| $T_A$ = 25°C | | TYPICAL VALUE | | UNIT |
|---|---|---|---|---|
| $V_{DS}$ | Drain-to-source voltage | 60 | | V |
| $Q_g$ | Gate charge total (10V) | 28 | | nC |
| $Q_{gd}$ | Gate charge gate-to-drain | 3.9 | | nC |
| $R_{DS(on)}$ | Drain-to-source on-resistance | $V_{GS}$ = 4.5V | 6.9 | mΩ |
| | | $V_{GS}$ = 10V | 5.0 | mΩ |
| $V_{GS(th)}$ | Threshold voltage | 1.9 | | V |

### Ordering Information(1)

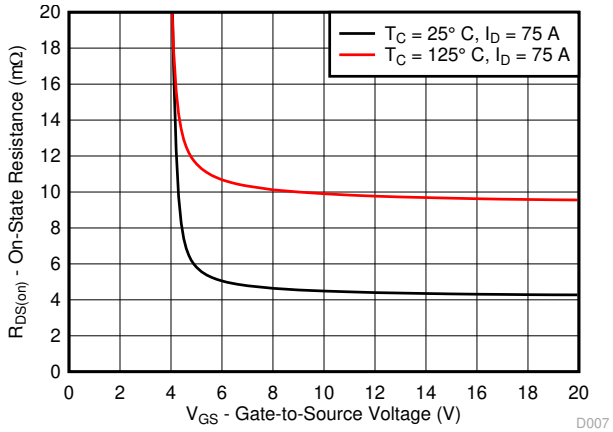
| DEVICE | QTY | MEDIA | PACKAGE | SHIP |
|---|---|---|---|---|
| CSD18533KCS | 50 | Tube | TO-220 Plastic Package | Tube |

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

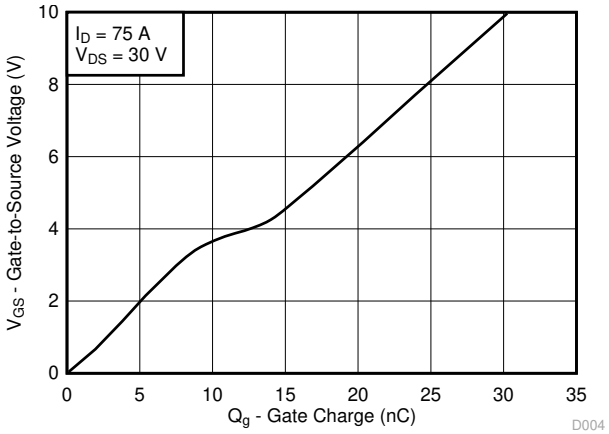
### Absolute Maximum Ratings

| $T_A$ = 25°C | | VALUE | UNIT |
|---|---|---|---|
| $V_{DS}$ | Drain-to-source voltage | 60 | V |
| $V_{GS}$ | Gate-to-source voltage | ±20 | V |
| $I_D$ | Continuous drain current (package limited) | 100 | A |
| | Continuous drain current (silicon limited), $T_C$ = 25°C | 118 | |
| | Continuous drain current (silicon limited), $T_C$ = 100°C | 84 | |
| $I_{DM}$ | Pulsed drain current (1) | 294 | A |
| $P_D$ | Power dissipation | 192 | W |
| $T_J$, $T_{stg}$ | Operating junction, Storage temperature | –55 to 175 | °C |
| $E_{AS}$ | Avalanche energy, single pulse $I_D$ = 52A, L = 0.1mH, $R_G$ = 25Ω | 135 | mJ |

(1) Max $R_{\theta JC}$ = 0.8°C/W, pulse duration ≤100µs, duty cycle ≤1%




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




**Gate Charge**

# Table of Contents

# 4 Specifications

## 4.1 Electrical Characteristics

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

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| **STATIC CHARACTERISTICS** | | | | | | |
| $BV_{DSS}$ | Drain-to-source voltage | $V_{GS}$ = 0V, $I_D$ = 250µA | 60 | | | V |
| $I_{DSS}$ | Drain-to-source leakage current | $V_{GS}$ = 0V, $V_{DS}$ = 48V | | | 1 | µA |
| $I_{GSS}$ | Gate-to-source leakage current | $V_{DS}$ = 0V, $V_{GS}$ = 20V | | | 100 | nA |
| $V_{GS(th)}$ | Gate-to-source threshold voltage | $V_{DS}$ = $V_{GS}$, $I_D$ = 250µA | 1.5 | 1.9 | 2.3 | V |
| $R_{DS(on)}$ | Drain-to-source on-resistance | $V_{GS}$ = 4.5V, $I_D$ = 75A | | 6.9 | 9.0 | mΩ |
| | | $V_{GS}$ = 10V, $I_D$ = 75A | | 5.0 | 6.3 | mΩ |
| $g_{fs}$ | Transconductance | $V_{DS}$ = 30V, $I_D$ = 75A | | 150 | | S |
| **DYNAMIC CHARACTERISTICS** | | | | | | |
| $C_{iss}$ | Input capacitance | $V_{GS}$ = 0V, $V_{DS}$ = 30V, $f$ = 1MHz | | 2420 | 3025 | pF |
| $C_{oss}$ | Output capacitance | | | 300 | 375 | pF |
| $C_{rss}$ | Reverse transfer capacitance | | | 7 | 9.1 | pF |
| $R_G$ | Series gate resistance | | | 1.4 | 2.8 | Ω |
| $Q_g$ | Gate charge total (4.5V) | $V_{DS}$ = 30V, $I_D$ = 75A | | 14 | 17 | nC |
| $Q_g$ | Gate charge total (10V) | | | 28 | 34 | nC |
| $Q_{gd}$ | Gate charge gate-to-drain | | | 3.9 | | nC |
| $Q_{gs}$ | Gate charge gate-to-source | | | 9.4 | | nC |
| $Q_{g(th)}$ | Gate charge at $V_{th}$ | | | 4.6 | | nC |
| $Q_{oss}$ | Output charge | $V_{DS}$ = 30V, $V_{GS}$ = 0V | | 31 | | nC |
| $t_{d(on)}$ | Turn on delay time | $V_{DS}$ = 30V, $V_{GS}$ = 10V, $I_{DS}$ = 75A, $R_G$ = 0Ω | | 5.7 | | ns |
| $t_r$ | Rise time | | | 4.8 | | ns |
| $t_{d(off)}$ | Turn off delay time | | | 13 | | ns |
| $t_f$ | Fall time | | | 3.2 | | ns |
| **DIODE CHARACTERISTICS** | | | | | | |
| $V_{SD}$ | Diode forward voltage | $I_{SD}$ = 75A, $V_{GS}$ = 0V | | 0.8 | 1 | V |
| $Q_{rr}$ | Reverse recovery charge | $V_{DS}$= 30V, $I_F$ = 75A, di/dt = 300A/µs | | 97 | | nC |
| $t_{rr}$ | Reverse recovery time | | | 49 | | ns |

## 4.2 Thermal Information

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

| THERMAL METRIC | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-case thermal resistance | | | 0.8 | °C/W |
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance | | | 62 | °C/W |

## 4.3 Typical MOSFET Characteristics

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

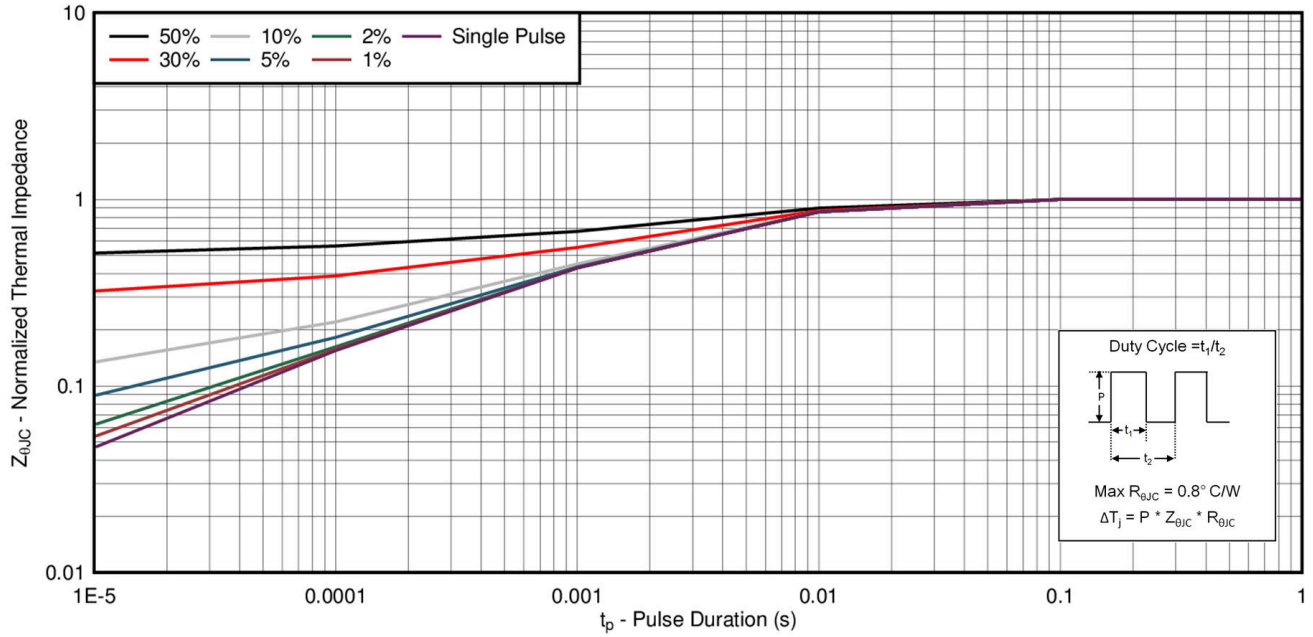



**Figure 4-1. Transient Thermal Impedance**

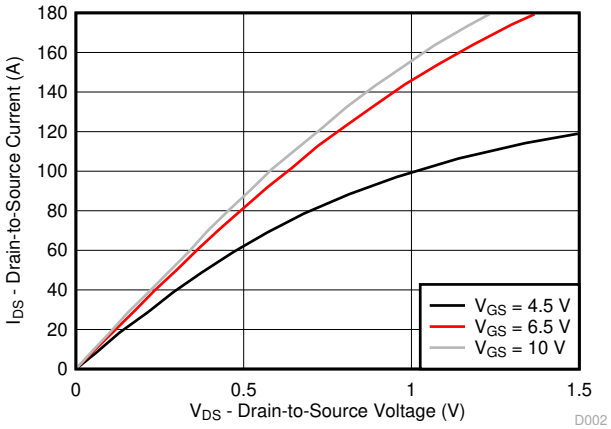
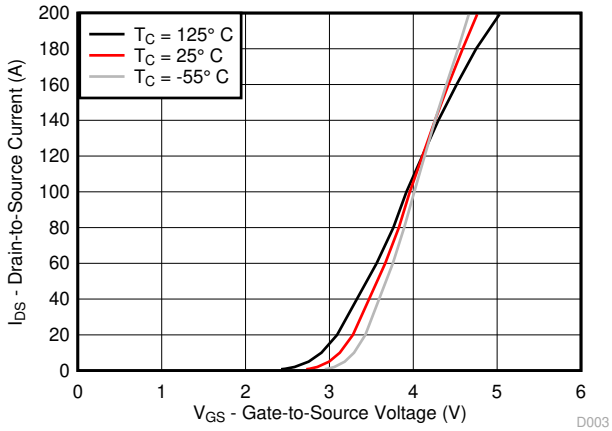
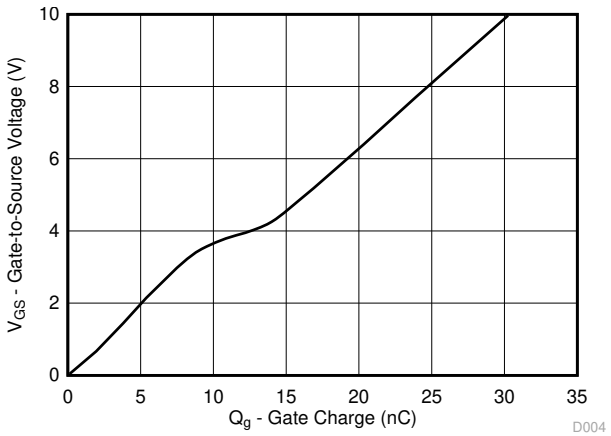



**Figure 4-2. Saturation Characteristics**




VDS = 5V

**Figure 4-3. Transfer Characteristics**




$I_D$ = 75A $V_{DS}$ = 30V

**Figure 4-4. Gate Charge**

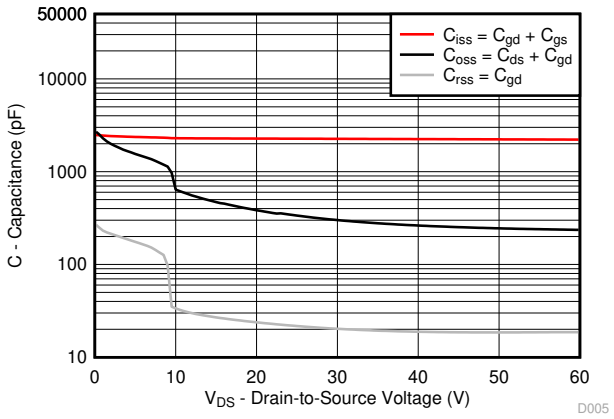
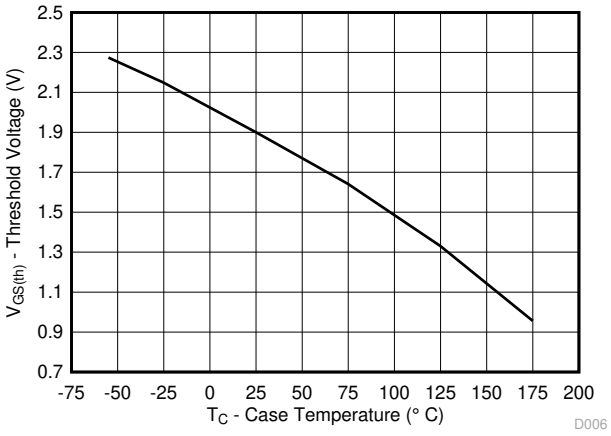



**Figure 4-5. Capacitance**




$I_D$ = 250µA

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

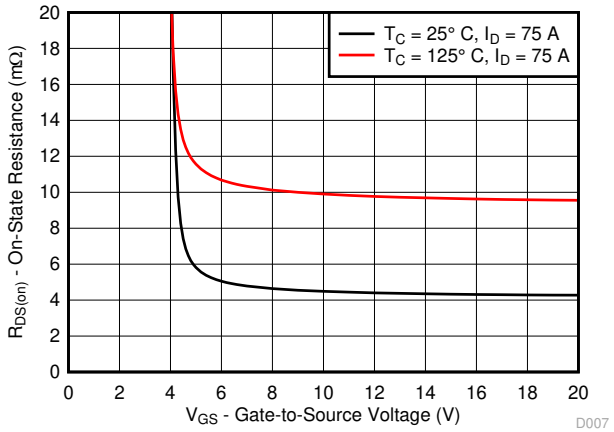
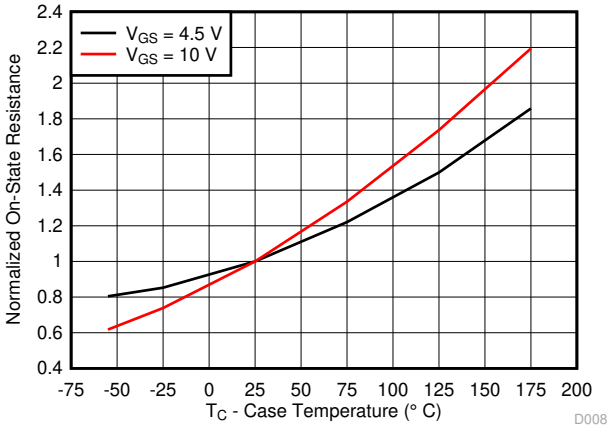



**Figure 4-7. On-State Resistance vs Gate-to-Source Voltage**




$I_D$ = 75A

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

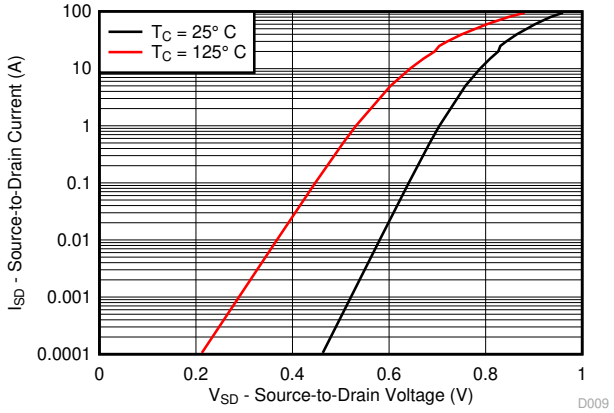
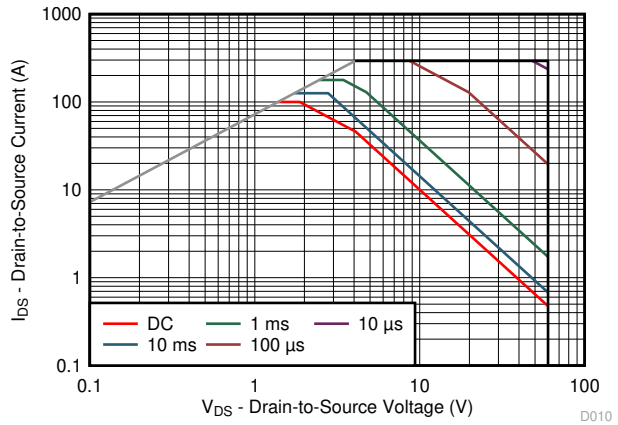



**Figure 4-9. Typical Diode Forward Voltage**




Single Pulse, Max RθJC = 0.8°C/W

**Figure 4-10. Maximum Safe Operating Area**

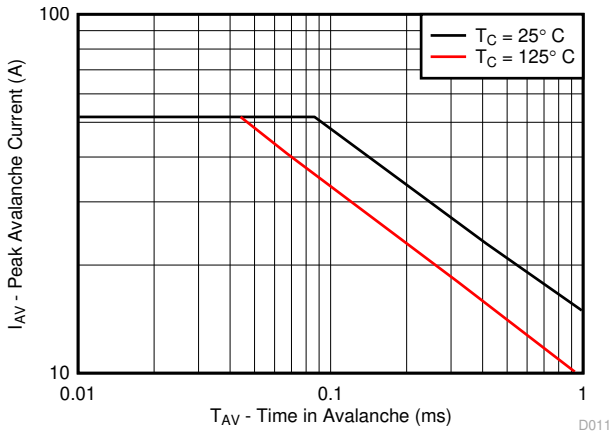



**Figure 4-11. Single Pulse Unclamped Inductive Switching**

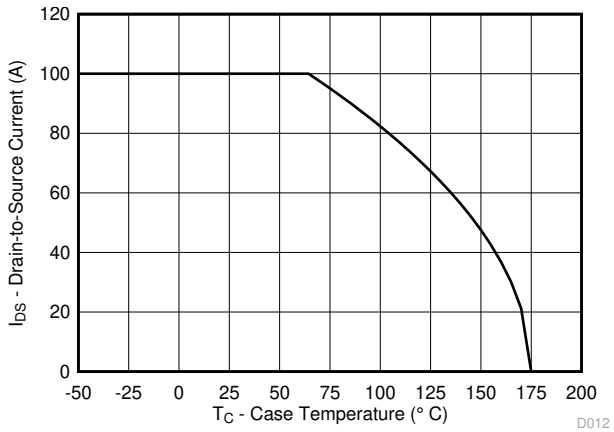



**Figure 4-12. Maximum Drain Current vs Temperature**

# 5 Device and Documentation Support

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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

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

| Changes from Revision C (June 2015) to Revision D (March 2024) | Page |
|---|---|
| • Updated the numbering format for tables, figures, and cross-references throughout the document | 1 |

| Changes from Revision B (April 2014) to Revision C (June 2015) | Page |
|---|---|
| • Updated Pulsed Drain Current | 1 |
| • Updated pulsed current conditions | 1 |
| • Updated Figure 4-1 | 4 |
| • Updated SOA in Figure 4-10 | 4 |

| Changes from Revision A (January 2013) to Revision B (April 2014) | Page |
|---|---|
| • Updated document title to include part number | 1 |
| • Updated part description | 1 |
| • Increased currents to reflect increase in max temperature | 1 |
| • Increased max power to reflect increase in max temperature | 1 |
| • Increased max temperature to 175°C | 1 |
| • Updated Figure 4-6 to extend to 175°C | 4 |
| • Updated Figure 4-8 to extend to 175°C | 4 |
| • Updated Figure 4-12 to extend to 175°C | 4 |

| Changes from Revision * (September 2012) to Revision A (January 2013) | Page |
|---|---|
| • Changed $Q_{g(th)}$, Gate Charge at $V_{th}$ value From: 7.3 To: 4.6 | 3 |

## 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 (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) |
|---|---|---|---|---|---|---|---|---|---|
| CSD18533KCS | Active | Production | TO-220 (KCS) \| 3 | 50 \| TUBE | ROHS Exempt | SN | N/A for Pkg Type | -55 to 175 | CSD18533KCS |
| CSD18533KCS.B | Active | Production | TO-220 (KCS) \| 3 | 50 \| TUBE | ROHS Exempt | SN | N/A for Pkg Type | -55 to 175 | CSD18533KCS |

(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.

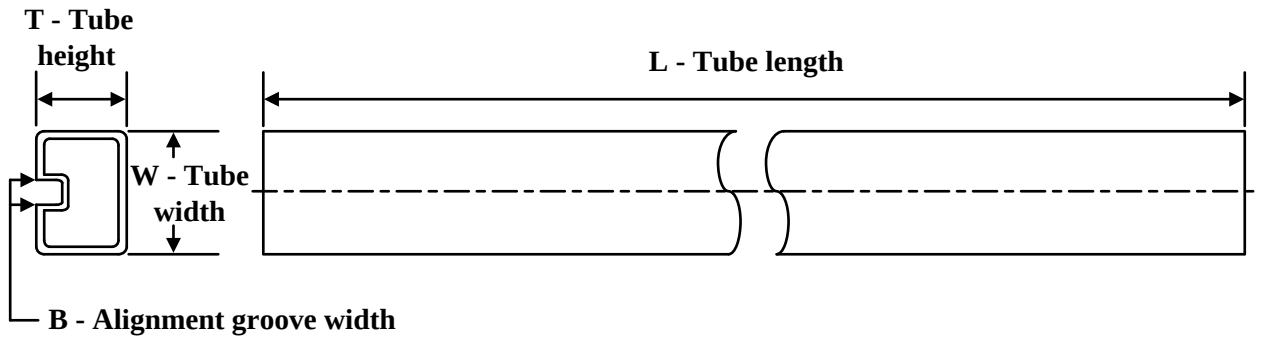
(4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

(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.

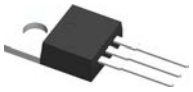
## TUBE




*All dimensions are nominal

| Device | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (µm) | B (mm) |
|---|---|---|---|---|---|---|---|---|
| CSD18533KCS | KCS | TO-220 | 3 | 50 | 532 | 34.1 | 700 | 9.6 |
| CSD18533KCS.B | KCS | TO-220 | 3 | 50 | 532 | 34.1 | 700 | 9.6 |

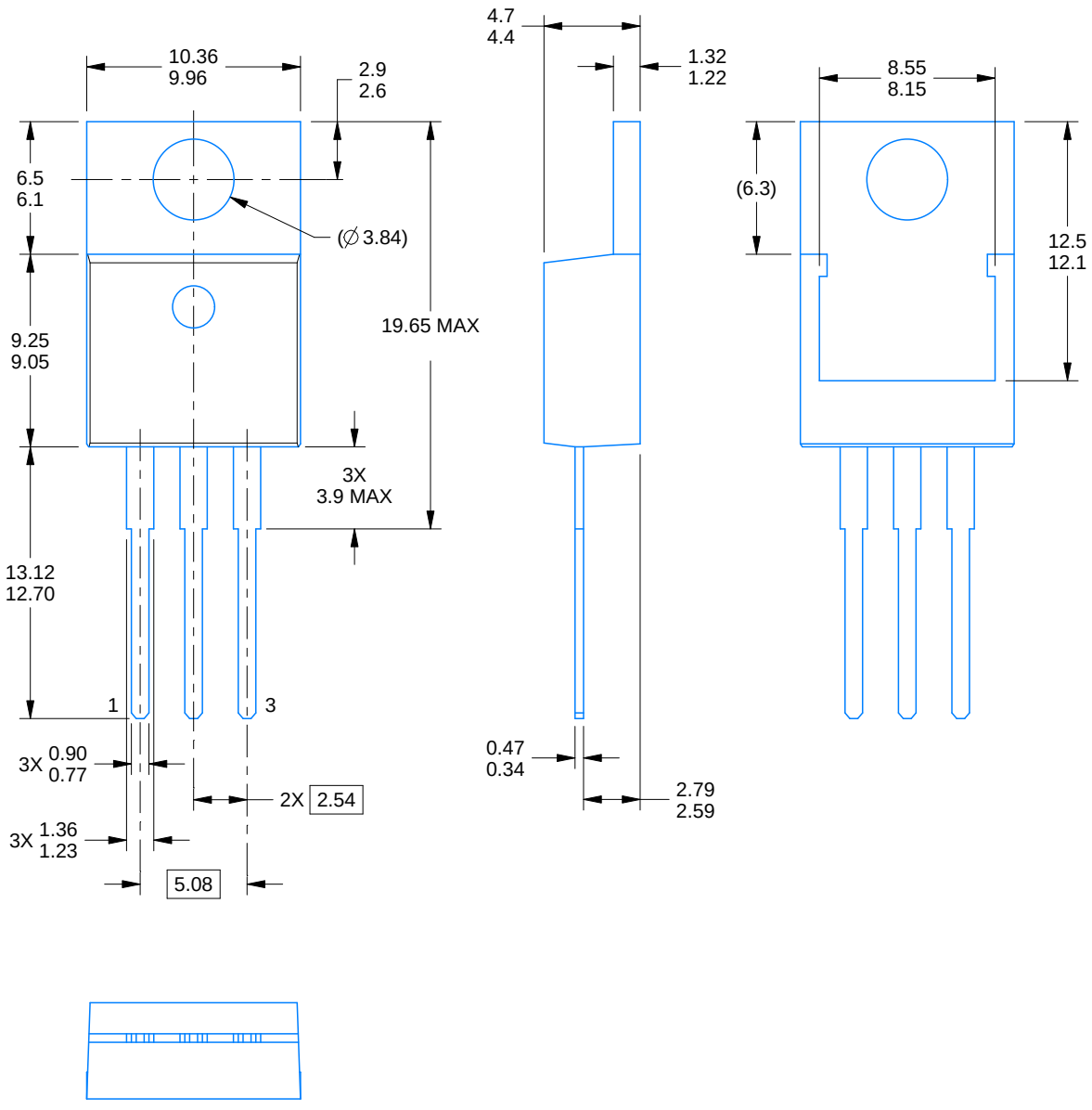
# KCS0003B



# PACKAGE OUTLINE

## TO-220 - 19.65 mm max height

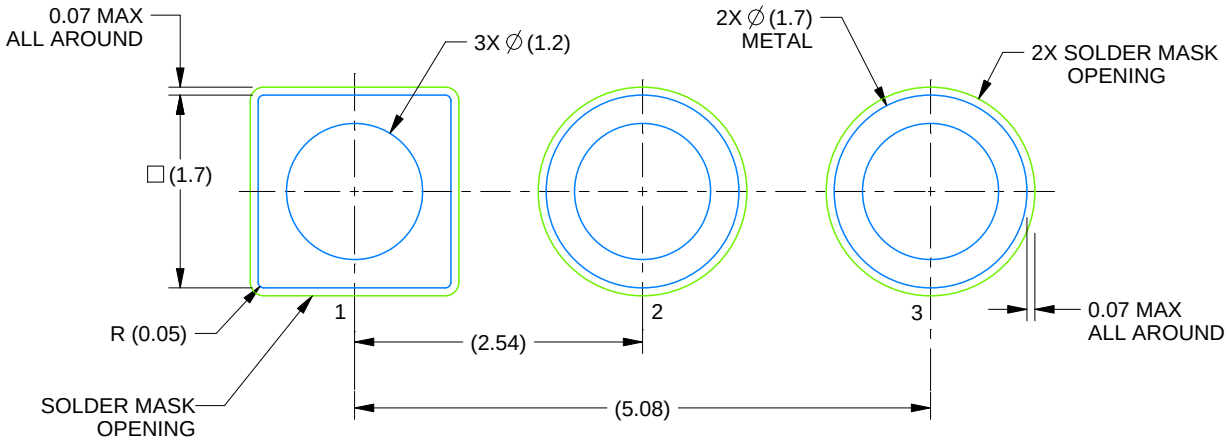
TO-220




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.




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

4222214/B 08/2018

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