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## CSD18535KCS 60 V N-Channel NexFET™ Power MOSFET

### 1 Features

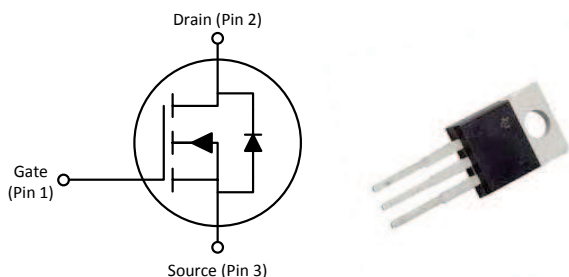
- Ultra-Low  $Q_g$  and  $Q_{gd}$
- Low Thermal Resistance
- Avalanche Rated
- Pb-Free Terminal Plating
- RoHS Compliant
- Halogen Free
- TO-220 Plastic Package

### 2 Applications

- Secondary Side Synchronous Rectifier
- Motor Control

### 3 Description

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



### Product Summary

$T_A = 25^\circ\text{C}$		TYPICAL VALUE		UNIT
$V_{DS}$	Drain-to-Source Voltage	60		V
$Q_g$	Gate Charge Total (10 V)	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

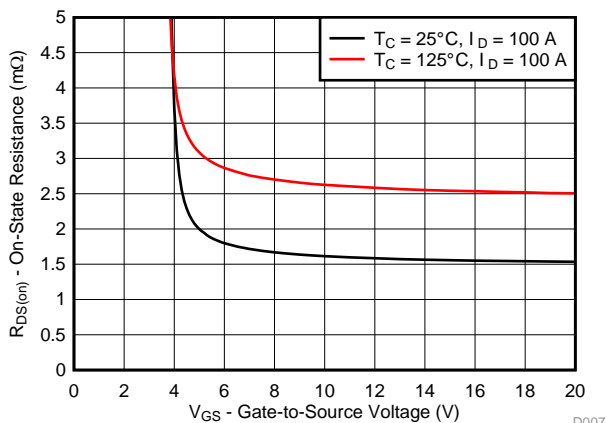
(1) For all available packages, see the orderable addendum at the end of the data sheet.

### Absolute Maximum Ratings

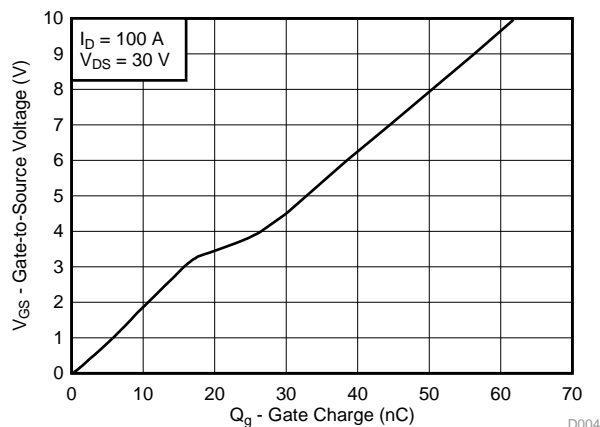
$T_A = 25^\circ\text{C}$		VALUE	UNIT
$V_{DS}$	Drain-to-Source Voltage	60	V
$V_{GS}$	Gate-to-Source Voltage	$\pm 20$	V
$I_D$	Continuous Drain Current (Package limited)	200	A
	Continuous Drain Current (Silicon limited), $T_C = 25^\circ\text{C}$	279	
	Continuous Drain Current (Silicon limited), $T_C = 100^\circ\text{C}$	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 $I_D = 111\text{ A}, L = 0.1\text{ mH}, R_G = 25\ \Omega$	616	mJ

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

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



Gate Charge



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**4 Revision History**

DATE	REVISION	NOTES
March 2015	*	Initial release.

## 5 Specifications

### 5.1 Electrical Characteristics

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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>STATIC CHARACTERISTICS</b>						
$BV_{DSS}$	Drain-to-Source Voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	60			V
$I_{DSS}$	Drain-to-Source Leakage Current	$V_{GS} = 0\text{ V}, V_{DS} = 48\text{ V}$			1	$\mu\text{A}$
$I_{GSS}$	Gate-to-Source Leakage Current	$V_{DS} = 0\text{ V}, V_{GS} = 20\text{ V}$			100	nA
$V_{GS(th)}$	Gate-to-Source Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	1.4	1.9	2.4	V
$R_{DS(on)}$	Drain-to-Source On-Resistance	$V_{GS} = 4.5\text{ V}, I_D = 100\text{ A}$		2.3	2.9	$\text{m}\Omega$
		$V_{GS} = 10\text{ V}, I_D = 100\text{ A}$		1.6	2.0	$\text{m}\Omega$
$g_{fs}$	Transconductance	$V_{DS} = 6\text{ V}, I_D = 100\text{ A}$		263		S
<b>DYNAMIC CHARACTERISTICS</b>						
$C_{iss}$	Input Capacitance	$V_{GS} = 0\text{ V}, V_{DS} = 30\text{ V}, f = 1\text{ MHz}$		5090	6620	pF
$C_{oss}$	Output Capacitance			890	1150	pF
$C_{rss}$	Reverse Transfer Capacitance			24	31	pF
$R_G$	Series Gate Resistance			0.8	1.6	$\Omega$
$Q_g$	Gate Charge Total (10 V)	$V_{DS} = 30\text{ V}, I_D = 100\text{ A}$		63	81	nC
$Q_{gd}$	Gate Charge Gate-to-Drain			10.4		nC
$Q_{gs}$	Gate Charge Gate-to-Source			15.7		nC
$Q_{g(th)}$	Gate Charge at $V_{th}$			9.4		nC
$Q_{oss}$	Output Charge	$V_{DS} = 30\text{ V}, V_{GS} = 0\text{ V}$		140		nC
$t_{d(on)}$	Turn On Delay Time	$V_{DS} = 30\text{ V}, V_{GS} = 10\text{ V}, I_{DS} = 100\text{ A}, R_G = 0\ \Omega$		9		ns
$t_r$	Rise Time			3		ns
$t_{d(off)}$	Turn Off Delay Time			19		ns
$t_f$	Fall Time			3		ns
<b>DIODE CHARACTERISTICS</b>						
$V_{SD}$	Diode Forward Voltage	$I_{SD} = 100\text{ A}, V_{GS} = 0\text{ V}$		0.9	1.0	V
$Q_{rr}$	Reverse Recovery Charge	$V_{DS} = 30\text{ V}, I_F = 100\text{ A}, di/dt = 300\text{ A}/\mu\text{s}$		214		nC
$t_{rr}$	Reverse Recovery Time			63		ns

### 5.2 Thermal Information

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

THERMAL METRIC		MIN	TYP	MAX	UNIT
$R_{\theta JC}$	Junction-to-Case Thermal Resistance			0.5	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Junction-to-Ambient Thermal Resistance			62	

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**5.3 Typical MOSFET Characteristics**

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

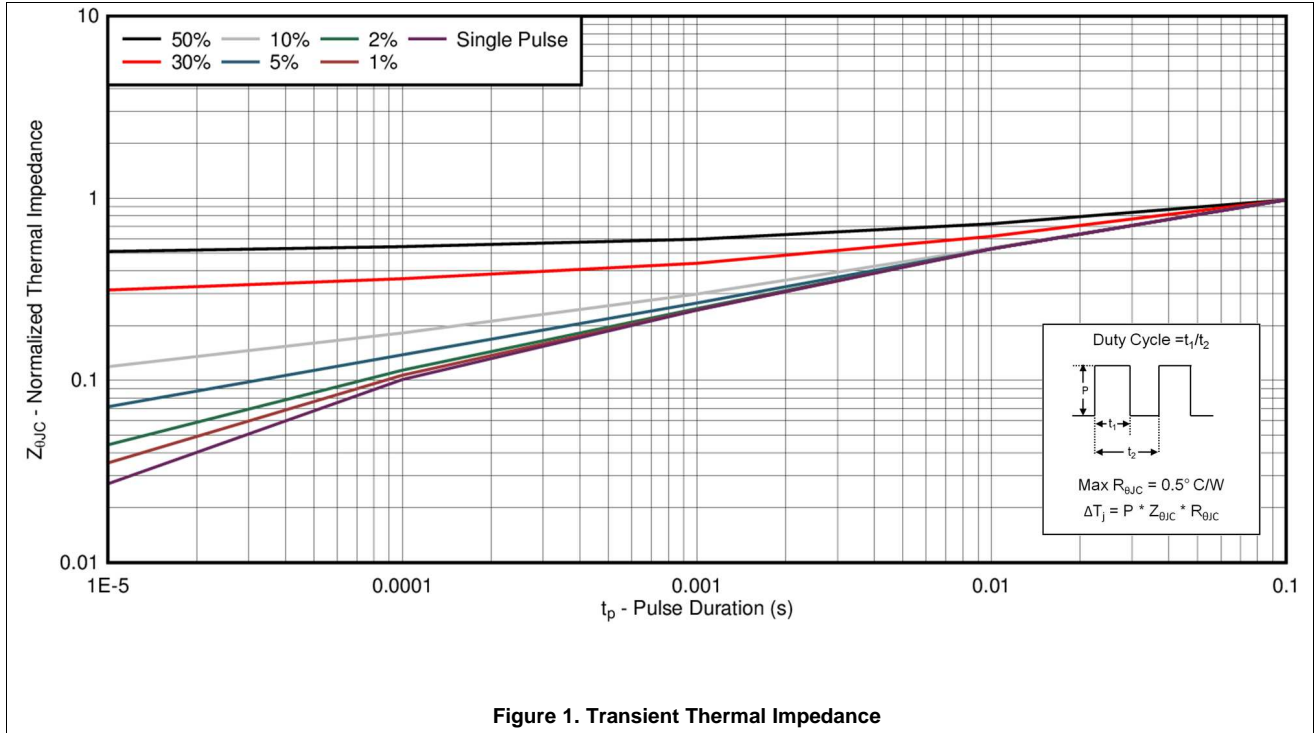


Figure 1. Transient Thermal Impedance

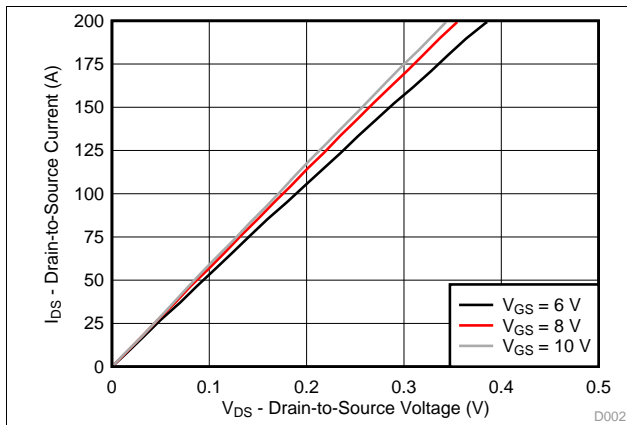


Figure 2. Saturation Characteristics

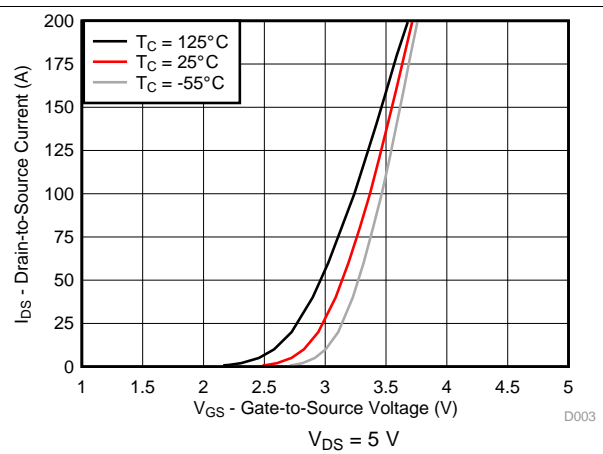
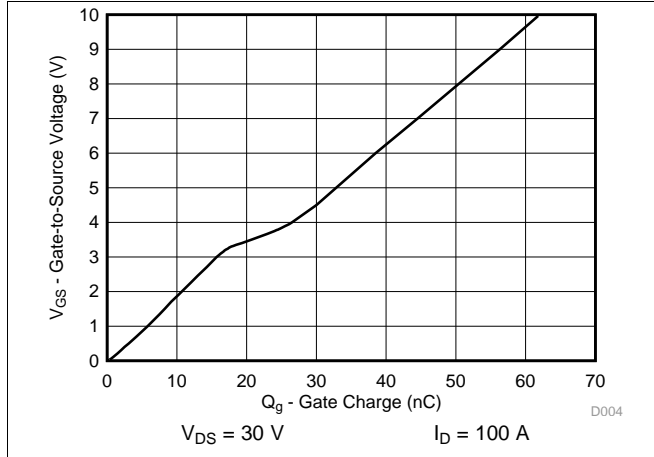


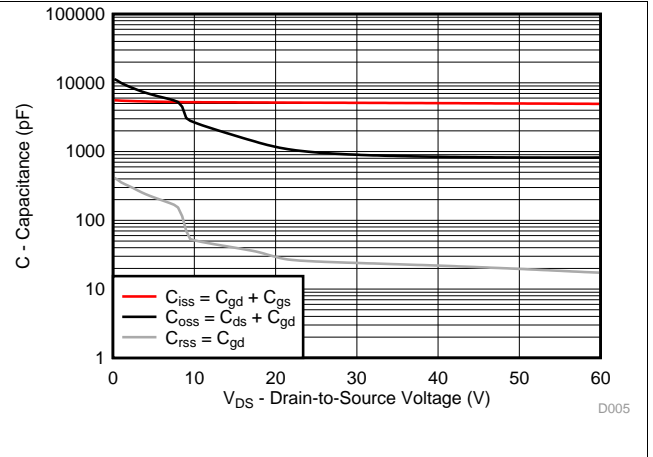
Figure 3. Transfer Characteristics

**Typical MOSFET Characteristics (continued)**

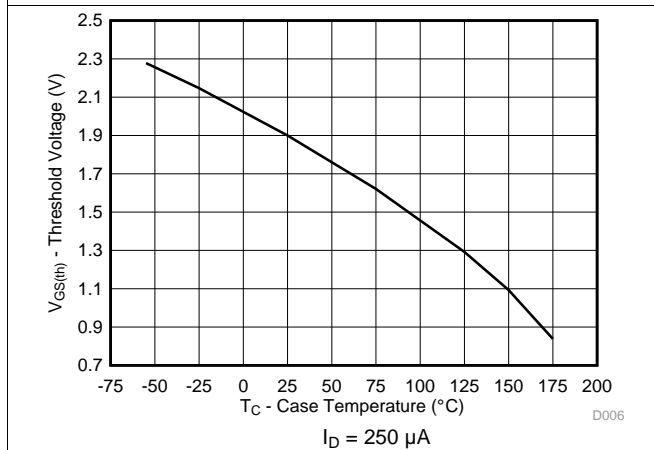
( $T_A = 25^\circ\text{C}$  unless otherwise stated)



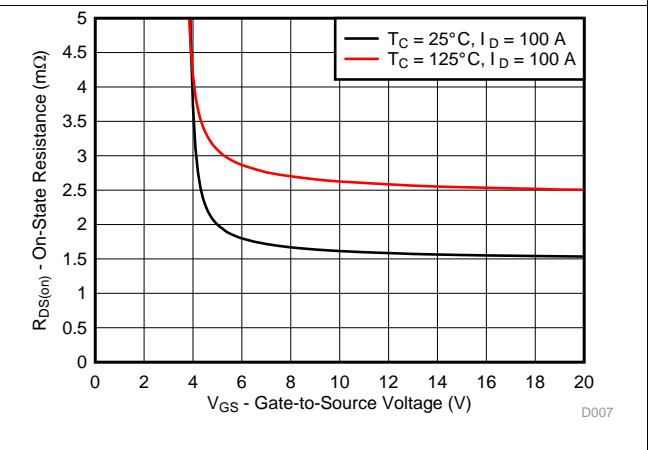
**Figure 4. Gate Charge**



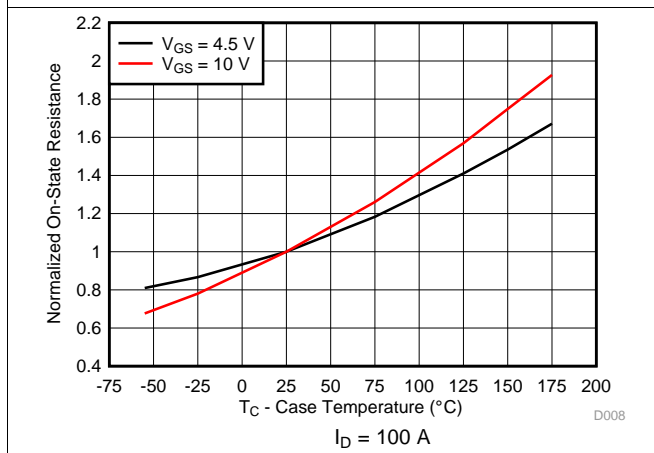
**Figure 5. Capacitance**



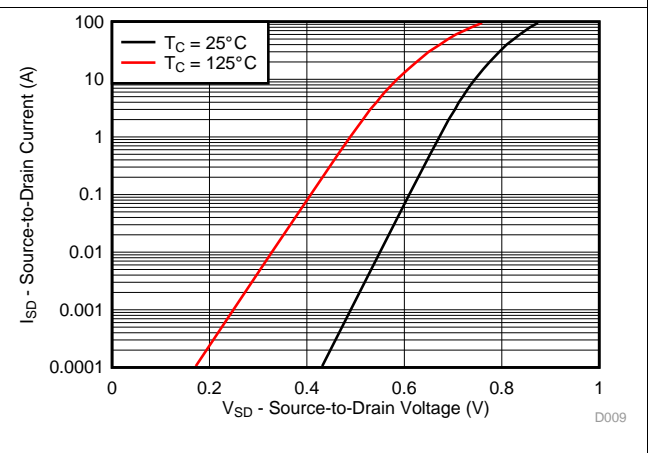
**Figure 6. Threshold Voltage vs Temperature**



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



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



**Figure 9. Typical Diode Forward Voltage**

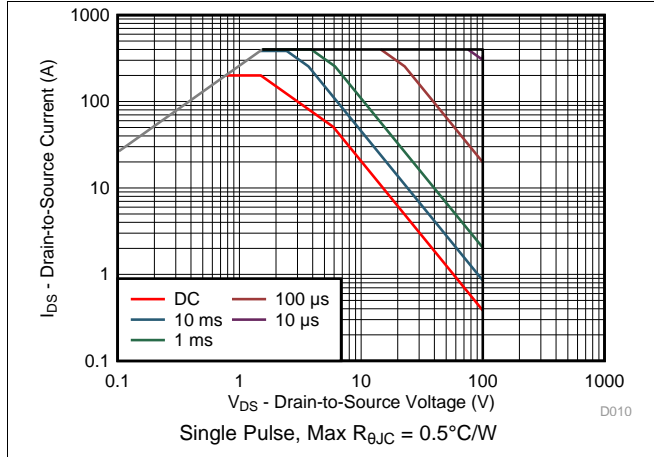
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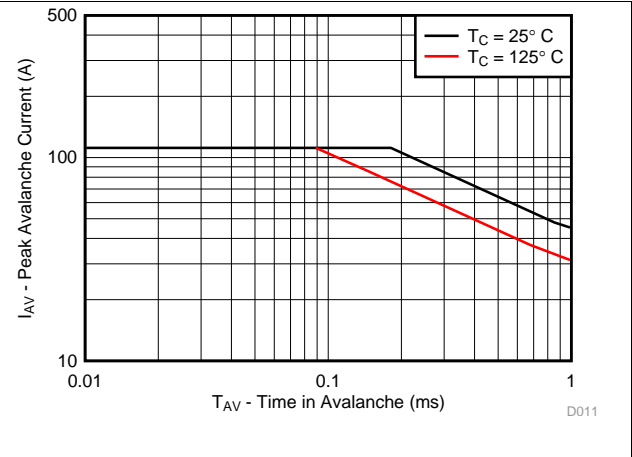
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**Typical MOSFET Characteristics (continued)**

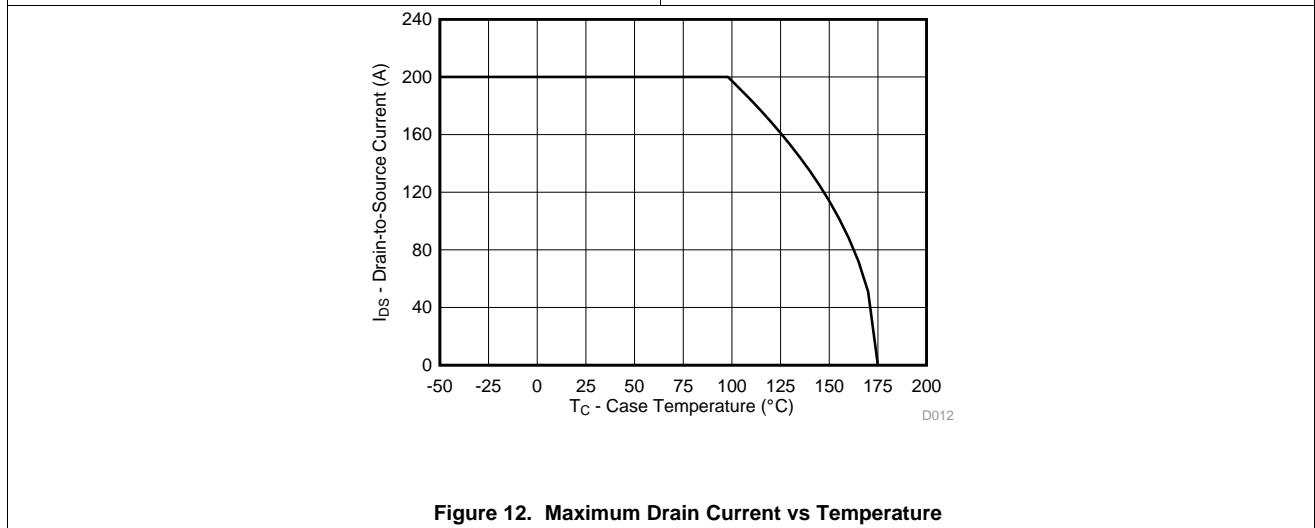
( $T_A = 25^\circ\text{C}$  unless otherwise stated)



**Figure 10. Maximum Safe Operating Area**



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



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

## 6 Device and Documentation Support

### 6.1 Trademarks

NexFET is a trademark of Texas Instruments.

All other trademarks are the property of their respective owners.

### 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.



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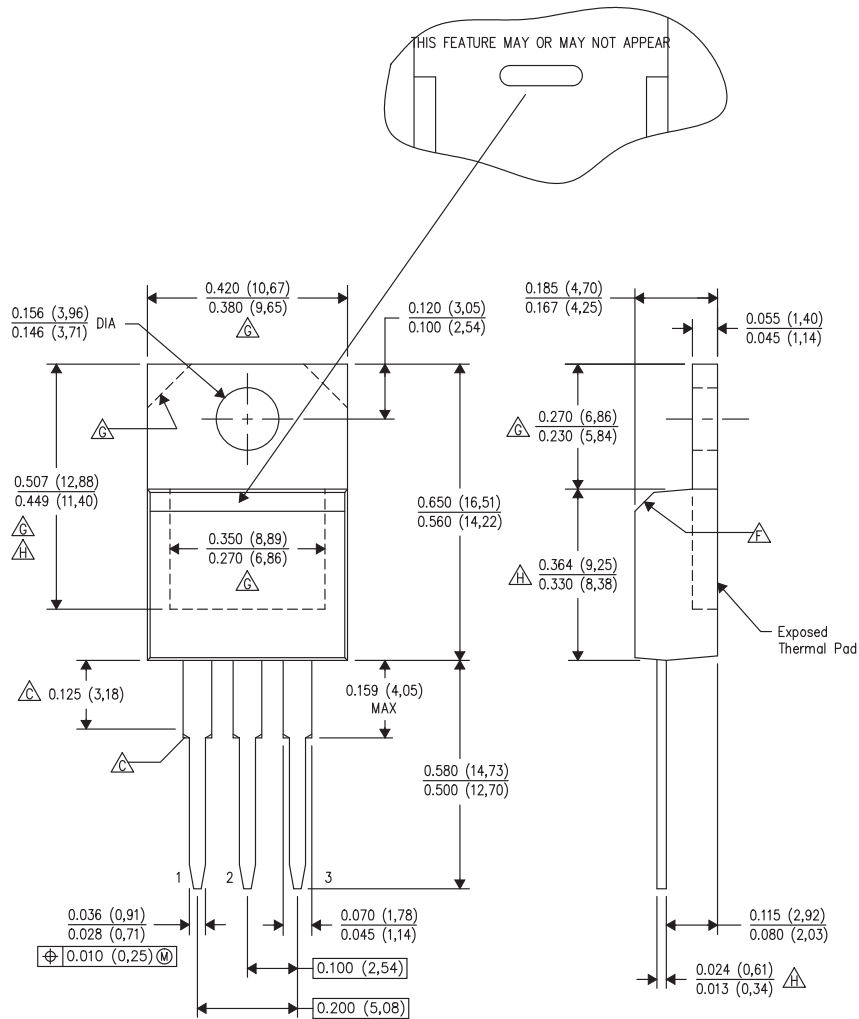
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**7 Mechanical, Packaging, and Orderable Information**

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 KCS Package Dimensions**



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Lead dimensions are not controlled within this area. Chamfer may or may not appear
  - D. All lead dimensions apply before solder dip.
  - E. The center lead is in electrical contact with the mounting tab.
  - F. The chamfer is optional.
  - G. Thermal pad contour optional within these dimensions.
  - H. Falls within JEDEC TO-220 variation AB, except minimum lead thickness, minimum exposed pad length, and maximum body length.

**Pin Configuration**

Position	Designation
Pin 1	Gate
Pin 2 / Tab	Drain
Pin 3	Source



PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
CSD18535KCS	ACTIVE	TO-220	KCS	3	50	Pb-Free (RoHS Exempt)	CU SN	N / A for Pkg Type		CSD18535KCS	

(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.

**OBSELETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(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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**PACKAGE OPTION ADDENDUM**

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