

# CSD18502KCS 40-V N-Channel NexFET™ Power MOSFET

## 1 Features

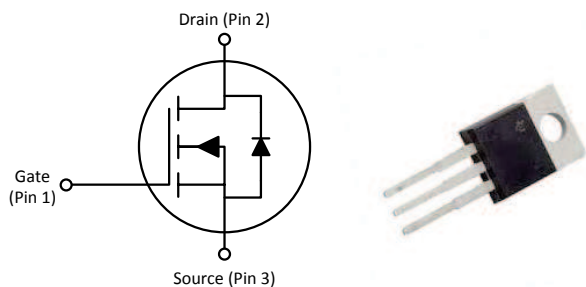
- Ultra-Low  $Q_g$  and  $Q_{gd}$
- Low Thermal Resistance
- Avalanche Rated
- Logic Level
- Pb Free Terminal Plating
- RoHS Compliant
- Halogen Free
- TO-220 Plastic Package

## 2 Applications

- DC-DC Conversion
- Secondary Side Synchronous Rectifier
- Motor Control

## 3 Description

This 2.4 mΩ, 40 V, 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	40		V
$Q_g$	Gate Charge Total (10V)	52		nC
$Q_{gd}$	Gate Charge Gate-to-Drain	8.4		nC
$R_{DS(on)}$	Drain-to-Source On Resistance	$V_{GS} = 4.5\text{ V}$	3.3	mΩ
		$V_{GS} = 10\text{ V}$	2.4	mΩ
$V_{GS(th)}$	Threshold Voltage	1.8		V

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

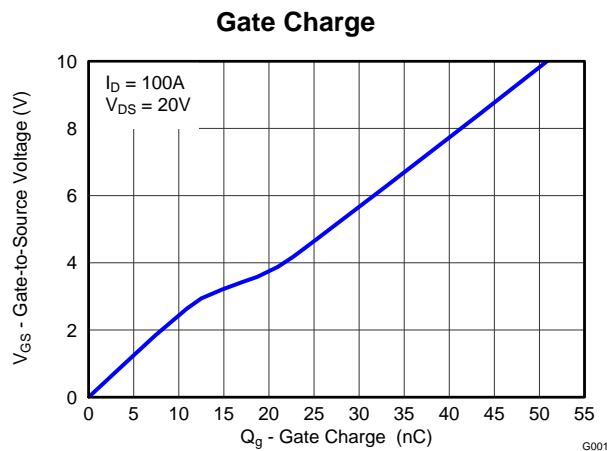
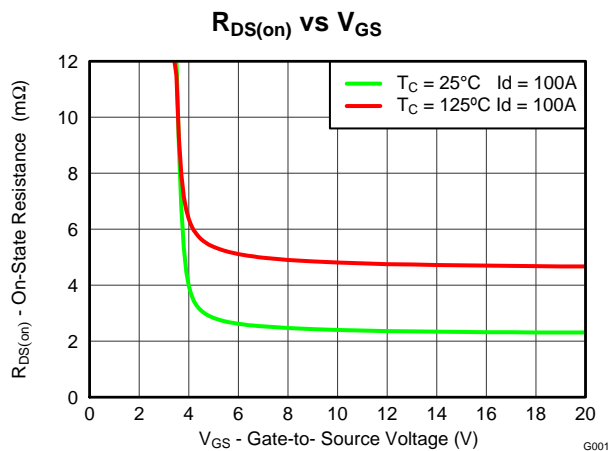
Device	Package	Media	Qty	Ship
CSD18502KCS	TO-220 Plastic Package	Tube	50	Tube

(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	40	V
$V_{GS}$	Gate-to-Source Voltage	±20	V
$I_D$	Continuous Drain Current (Package limited)	100	A
	Continuous Drain Current (Silicon limited), $T_C = 25^\circ\text{C}$	212	
	Continuous Drain Current (Silicon limited), $T_C = 100^\circ\text{C}$	150	
$I_{DM}$	Pulsed Drain Current <sup>(1)</sup>	400	A
$P_D$	Power Dissipation	259	W
$T_J, T_{stg}$	Operating Junction and Storage Temperature Range	-55 to 175	°C
$E_{AS}$	Avalanche Energy, single pulse $I_D = 81\text{ A}, L = 0.1\text{ mH}, R_G = 25\ \Omega$	330	mJ

(1) Max  $R_{\theta JC} = 0.6^\circ\text{C/W}$ , pulse duration  $\leq 100\ \mu\text{s}$ , duty cycle  $\leq 1\%$



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## 4 Revision History

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

<b>Changes from Revision A (October 2012) to Revision B</b>	<b>Page</b>
• Increased the $T_C = 25^\circ$ continuous drain current to 212 A .....	<b>1</b>
• Increased the $T_C = 125^\circ$ continuous drain current to 150 A .....	<b>1</b>
• Increased the pulsed drain current to 400 A .....	<b>1</b>
• Increased the max power dissipation to 259 W .....	<b>1</b>
• Increased the max operating junction and storage temperature to $175^\circ$ .....	<b>1</b>
• Updated the pulsed current conditions .....	<b>1</b>
• Updated <a href="#">Figure 1</a> from a normalized $R_{\theta JA}$ to an $R_{\theta JC}$ curve .....	<b>4</b>
• Updated <a href="#">Figure 6</a> to extend to $175^\circ\text{C}$ .....	<b>5</b>
• Updated <a href="#">Figure 8</a> to extend to $175^\circ\text{C}$ .....	<b>5</b>
• Updated the SOA in <a href="#">Figure 10</a> .....	<b>6</b>
• Updated <a href="#">Figure 12</a> to extend to $175^\circ\text{C}$ .....	<b>6</b>

<b>Changes from Original (August 2012) to Revision A</b>	<b>Page</b>
• Changed the Transconductance TYP value From: 149 S To: 138 S .....	<b>3</b>
• Changed $R_{\theta JA}$ From: $65^\circ\text{C/W}$ To: $62^\circ\text{C/W}$ .....	<b>3</b>

## 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>						
$V_{DSS}$	Drain-to-Source Voltage	$V_{GS} = 0\text{ V}, I_D = 250\ \mu\text{A}$	40			V
$I_{DSS}$	Drain-to-Source Leakage Current	$V_{GS} = 0\text{ V}, V_{DS} = 32\text{ V}$			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	$V_{DS} = V_{GS}, I_D = 250\ \mu\text{A}$	1.5	1.8	2.1	V
$R_{DS(on)}$	Drain-to-Source On Resistance	$V_{GS} = 4.5\text{ V}, I_D = 100\text{ A}$		3.3	4.3	m $\Omega$
		$V_{GS} = 10\text{ V}, I_D = 100\text{ A}$		2.4	2.9	m $\Omega$
$g_{fs}$	Transconductance	$V_{DS} = 20\text{ V}, I_D = 100\text{ A}$		138		S
<b>DYNAMIC CHARACTERISTICS</b>						
$C_{iss}$	Input Capacitance	$V_{GS} = 0\text{ V}, V_{DS} = 20\text{ V}, f = 1\text{ MHz}$		3900	4680	pF
$C_{oss}$	Output Capacitance			900	1080	pF
$C_{rss}$	Reverse Transfer Capacitance			21	26	pF
$R_G$	Series Gate Resistance			1.2	2.4	$\Omega$
$Q_g$	Gate Charge Total (4.5 V)	$V_{DS} = 20\text{ V}, I_D = 100\text{ A}$		25	30	nC
$Q_g$	Gate Charge Total (10 V)			52	62	nC
$Q_{gd}$	Gate Charge Gate-to-Drain			8.4		nC
$Q_{gs}$	Gate Charge Gate-to-Source			10.3		nC
$Q_{g(th)}$	Gate Charge at $V_{th}$			7.5		nC
$Q_{oss}$	Output Charge		$V_{DS} = 20\text{ V}, V_{GS} = 0\text{ V}$		52	
$t_{d(on)}$	Turn On Delay Time	$V_{DS} = 20\text{ V}, V_{GS} = 10\text{ V}, I_{DS} = 100\text{ A}, R_G = 0\ \Omega$		11		ns
$t_r$	Rise Time			7.3		ns
$t_{d(off)}$	Turn Off Delay Time			33		ns
$t_f$	Fall Time			9.3		ns
<b>DIODE CHARACTERISTICS</b>						
$V_{SD}$	Diode Forward Voltage	$I_{SD} = 100\text{ A}, V_{GS} = 0\text{ V}$		0.8	1	V
$Q_{rr}$	Reverse Recovery Charge	$V_{DS} = 20\text{ V}, I_F = 100\text{ A}, di/dt = 300\text{ A}/\mu\text{s}$		105		nC
$t_{rr}$	Reverse Recovery Time			48		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			0.6	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Junction-to-Ambient Thermal Resistance			62	

### 5.3 Typical MOSFET Characteristics

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

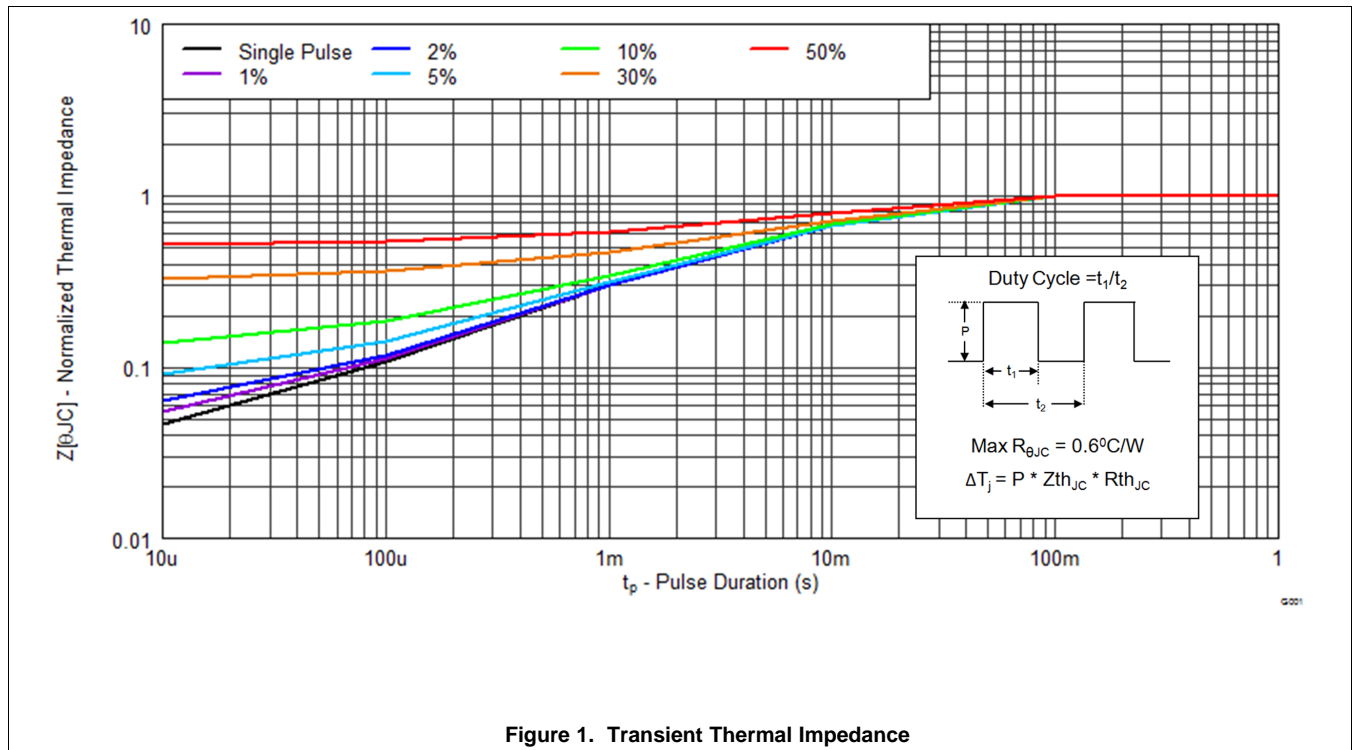


Figure 1. Transient Thermal Impedance

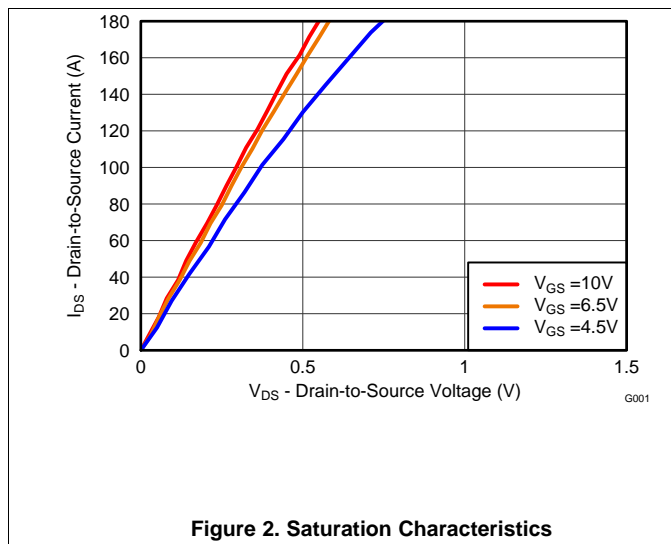


Figure 2. Saturation Characteristics

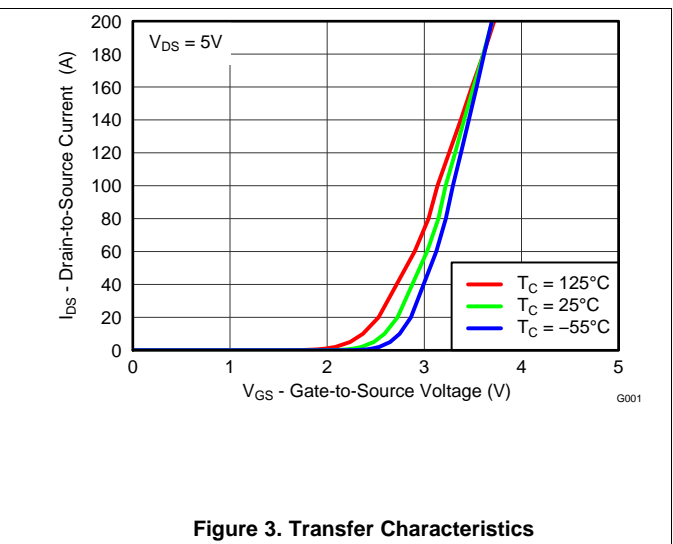
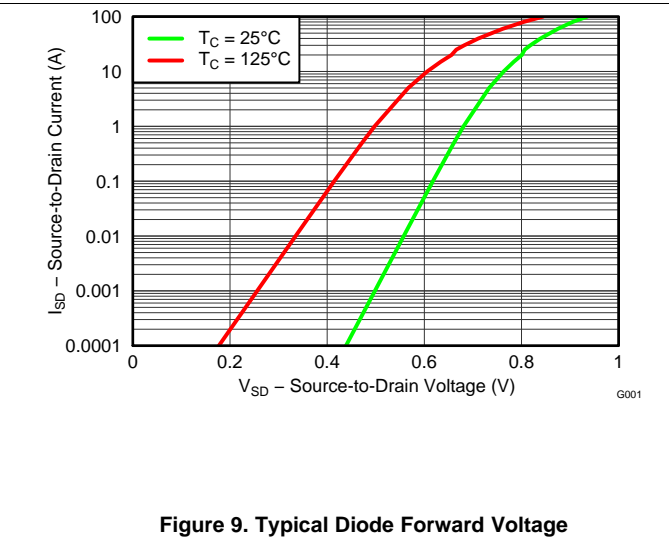
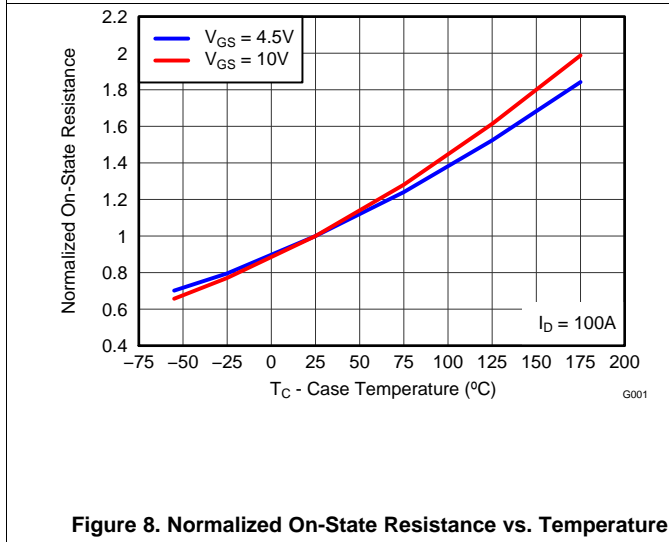
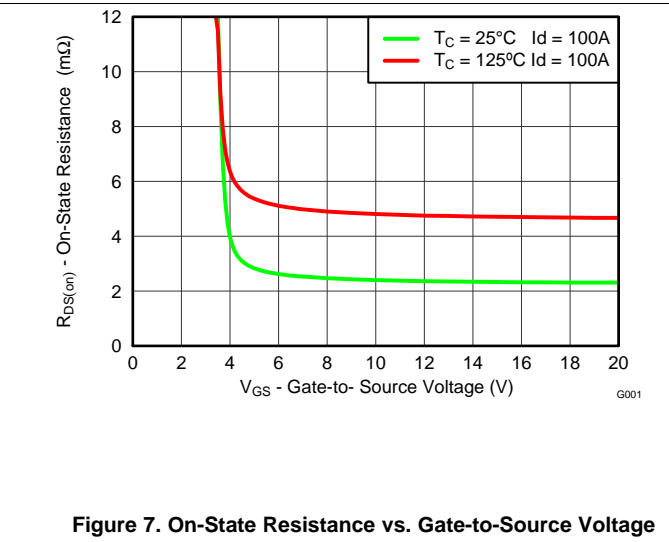
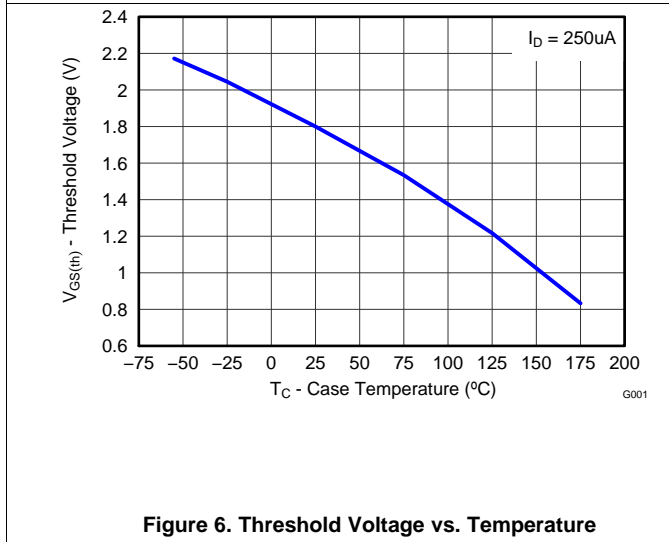
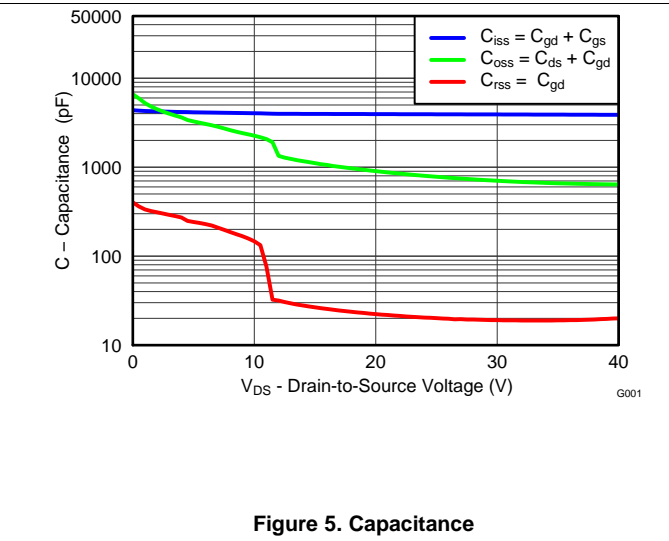
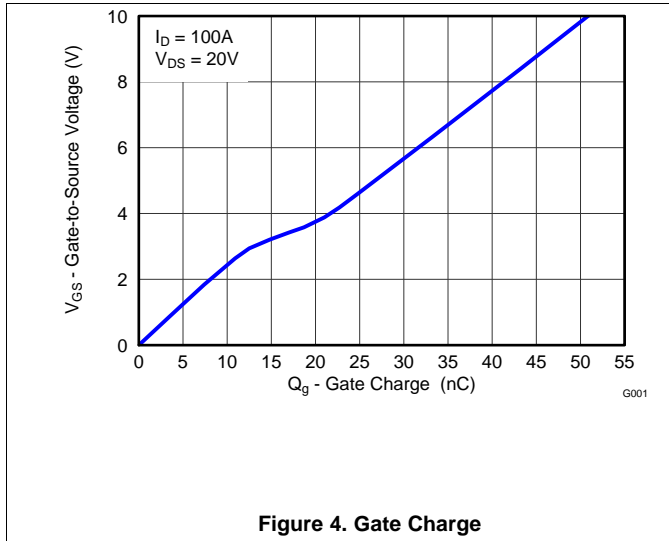


Figure 3. Transfer Characteristics

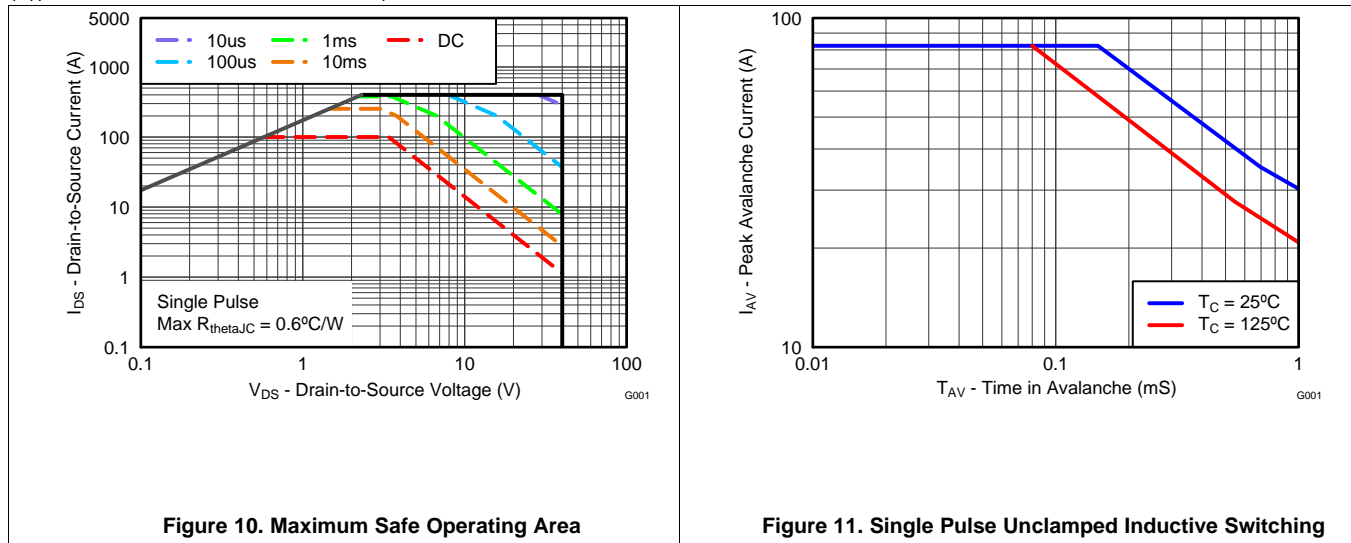
Typical MOSFET Characteristics (continued)

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



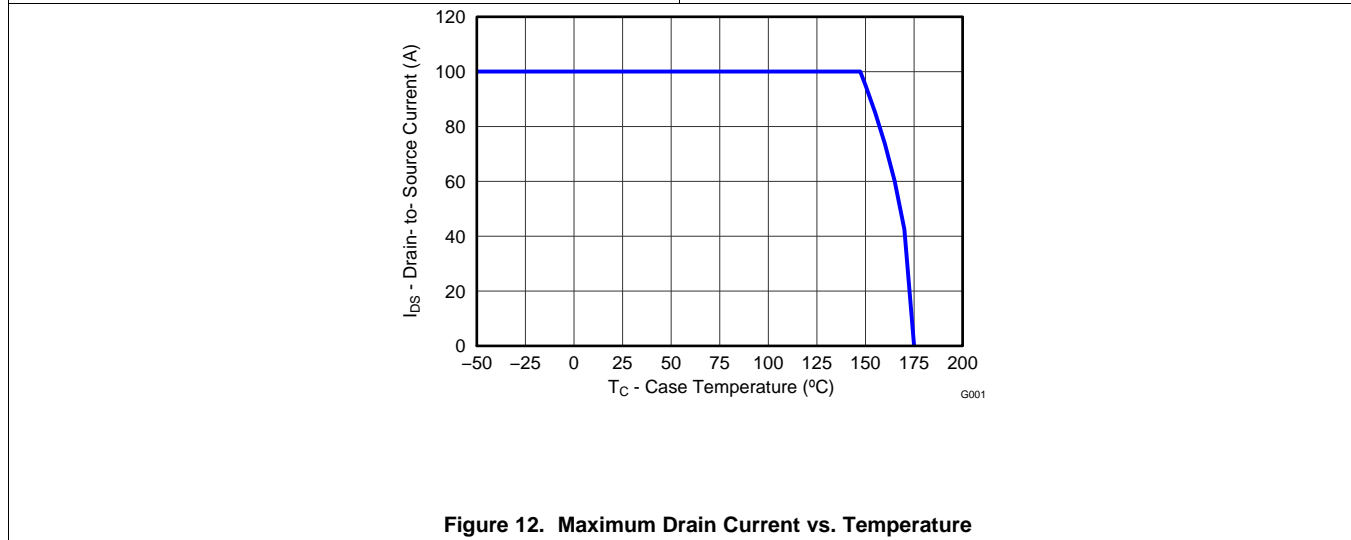
**Typical MOSFET Characteristics (continued)**

( $T_A = 25^\circ\text{C}$  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.

### 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

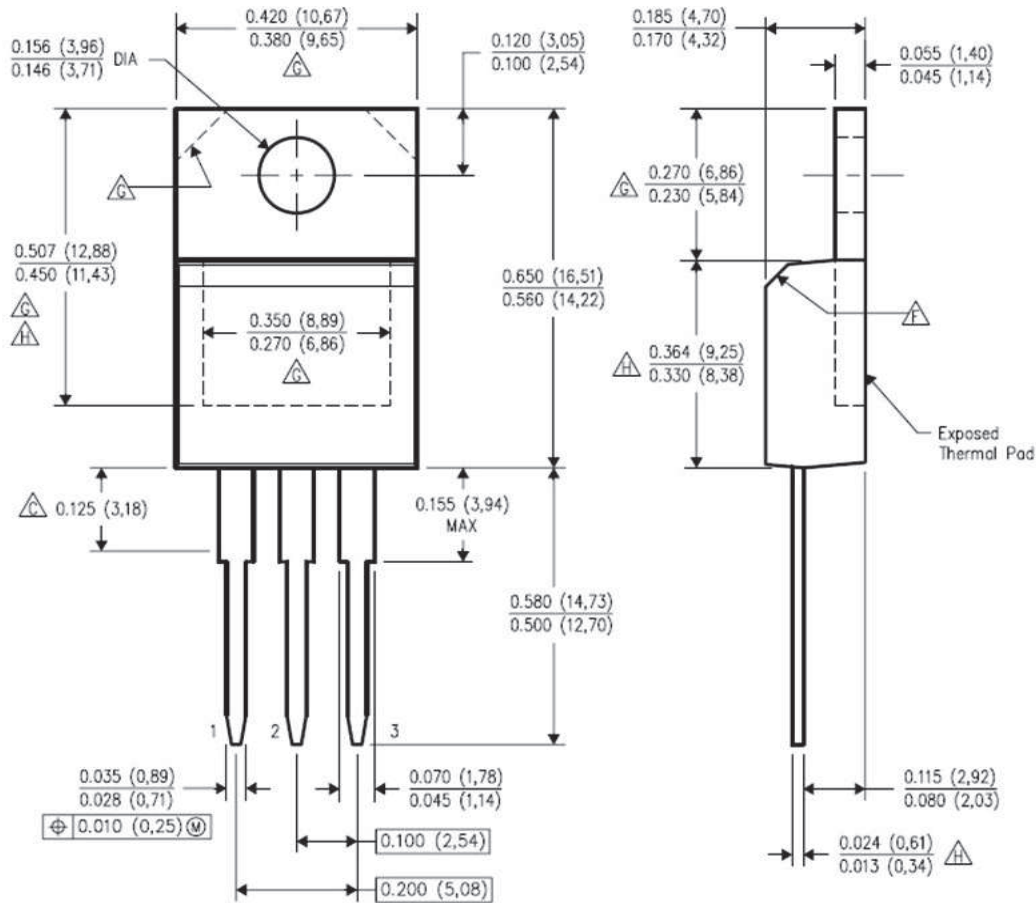
[SLYZ022](#) — *TI Glossary*.

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 KCS Package Dimensions



#### Notes:


1. All linear dimensions are in inches.
2. This drawing is subject to change without notice.
3. Lead dimensions are not controlled within 'C' area
4. All lead dimensions apply before solder dip.
5. The center lead is in electrical contact with the mounting tab.
6. The chamfer at 'F' is optional.
7. Thermal pad contour at 'G' optional with these dimensions
8. '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 finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
CSD18502KCS	ACTIVE	TO-220	KCS	3	50	RoHS-Exempt & Green	SN	N / A for Pkg Type	-55 to 175	CSD18502KCS	

(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) **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 <=100ppm 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.

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