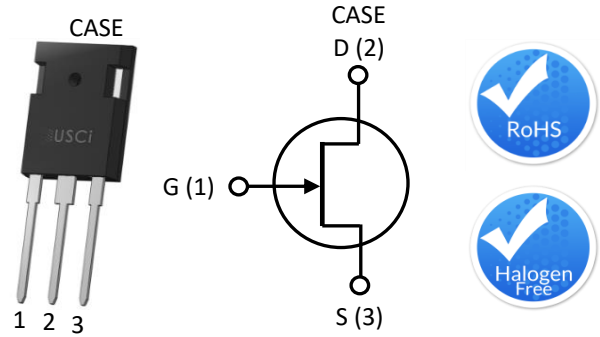


## Description

United Silicon Carbide, Inc offers the high-performance G3 SiC normally-on JFET transistors. This series exhibits ultra-low on resistance ( $R_{DS(ON)}$ ) and gate charge ( $Q_G$ ) allowing for low conduction and switching loss. The device normally-on characteristics with low  $R_{DS(ON)}$  at  $V_{GS} = 0\text{ V}$  is also ideal for current protection circuits without the need for active control, as well as for cascode operation.



Part Number	Package	Marking
UJ3N120035K3S	TO-247-3L	UJ3N120035K3S

## Features

- ◆ Typical on-resistance  $R_{DS(on),typ}$  of 35mΩ
- ◆ Voltage controlled
- ◆ Maximum operating temperature of 175°C
- ◆ Extremely fast switching not dependent on temperature
- ◆ Low gate charge
- ◆ Low intrinsic capacitance
- ◆ RoHS compliant

## Typical Applications

- ◆ Over current protection circuits
- ◆ DC-AC inverters
- ◆ Switch mode power supplies
- ◆ Power factor correction modules
- ◆ Motor drives
- ◆ Induction heating

## Maximum Ratings

Parameter	Symbol	Test Conditions	Value	Units
Drain-source voltage	$V_{DS}$		1200	V
Gate-source voltage	$V_{GS}$	DC	-20 to +3	V
		AC <sup>(1)</sup>	-20 to +20	
Continuous drain current <sup>(2)</sup>	$I_D$	$T_C = 25^\circ\text{C}$	63	A
		$T_C = 100^\circ\text{C}$	46	A
Pulsed drain current <sup>(3)</sup>	$I_{DM}$	$T_C = 25^\circ\text{C}$	185	A
Power dissipation	$P_{tot}$	$T_C = 25^\circ\text{C}$	429	W
Maximum junction temperature	$T_{J,max}$		175	°C
Operating and storage temperature	$T_J, T_{STG}$		-55 to 175	°C
Max. lead temperature for soldering, 1/8" from case for 5 seconds	$T_L$		250	°C

(1) +20V AC rating applies for turn-on pulses <200ns applied with external  $R_G > 1\Omega$ .

(2) Limited by  $T_{J,max}$

(3) Pulse width  $t_p$  limited by  $T_{J,max}$

**Electrical Characteristics** ( $T_J = +25^\circ\text{C}$  unless otherwise specified)

**Typical Performance - Static**

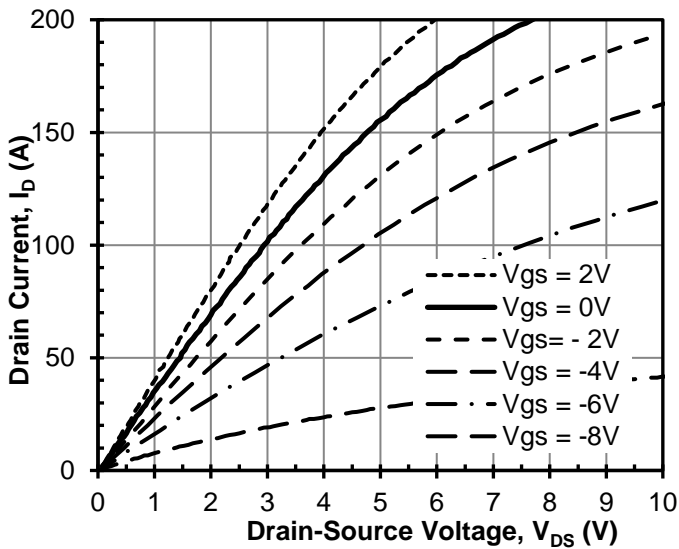
Parameter	Symbol	Test Conditions	Value			Units
			Min	Typ	Max	
Drain-source breakdown voltage	$BV_{DS}$	$V_{GS} = -20\text{V}, I_D = 1\text{mA}$	1200			V
Total drain leakage current	$I_D$	$V_{DS} = 1200\text{V},$ $V_{GS} = -20\text{V}, T_J = 25^\circ\text{C}$		10	60	$\mu\text{A}$
		$V_{DS} = 1200\text{V},$ $V_{GS} = -20\text{V}, T_J = 175^\circ\text{C}$		35		
Total gate leakage current	$I_G$	$V_{GS} = -20\text{V}, T_J = 25^\circ\text{C}$		12	100	$\mu\text{A}$
		$V_{GS} = -20\text{V}, T_J = 175^\circ\text{C}$		50		
Drain-source on-resistance	$R_{DS(on)}$	$V_{GS} = 2\text{V}, I_D = 20\text{A},$ $T_J = 25^\circ\text{C}$		31		mΩ
		$V_{GS} = 0\text{V}, I_D = 20\text{A},$ $T_J = 25^\circ\text{C}$		35	45	
		$V_{GS} = 2\text{V}, I_D = 20\text{A},$ $T_J = 175^\circ\text{C}$		68		
		$V_{GS} = 0\text{V}, I_D = 20\text{A},$ $T_J = 175^\circ\text{C}$		76		
Gate threshold voltage	$V_{G(th)}$	$V_{DS} = 5\text{V}, I_D = 70\text{mA}$	-14	-11.5	-6	V
Gate resistance	$R_G$	$f = 1\text{MHz}, \text{open drain}$		2.4		Ω

**Typical Performance - Dynamic**

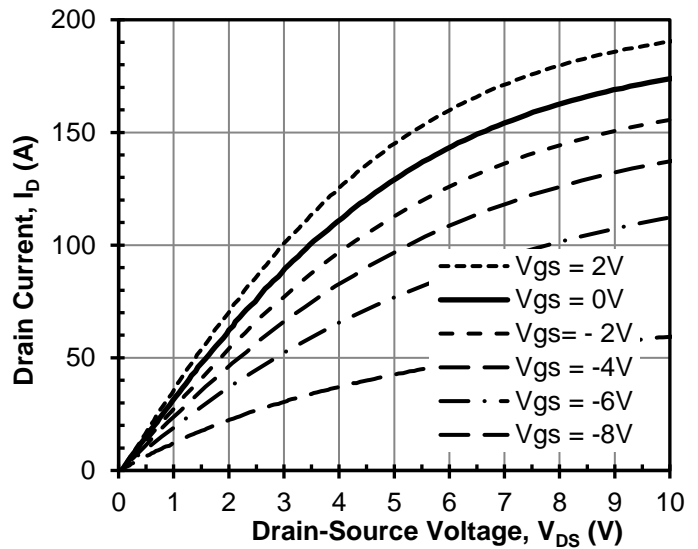
Parameter	symbol	Test Conditions	Value			Units	
			Min	Typ	Max		
Input capacitance	$C_{iss}$	$V_{DS} = 100V,$ $V_{GS} = -20V,$ $f = 100kHz$		2145		pF	
Output capacitance	$C_{oss}$			180			
Reverse transfer capacitance	$C_{rss}$			172			
Effective output capacitance, energy related	$C_{oss(er)}$	$V_{DS} = 0V$ to 800V, $V_{GS} = -20V$		105		pF	
Total gate charge	$Q_G$	$V_{DS}=800V, I_D = 40A,$ $V_{GS}=-18V$ to 0V		235		nC	
Gate-drain charge	$Q_{GD}$			130			
Gate-source charge	$Q_{GS}$			25			
Turn-on delay time	$t_{d(on)}$	$V_{DS}=800V, I_D=40A,$ Gate Driver = -18V to 0V, $R_{G,EXT} = 1\Omega,$ Inductive Load, FWD: UJ3D1220KSD $T_J = 25^\circ C$		25		ns	
Rise time	$t_r$			37			
Turn-off delay time	$t_{d(off)}$			48			
Fall time	$t_f$			39			
Turn-on energy	$E_{ON}$			935			$\mu J$
Turn-off energy	$E_{OFF}$			828			
Total switching energy	$E_{TOTAL}$		1763				
Turn-on delay time	$t_{d(on)}$	$V_{DS}=800V, I_D=40A,$ Gate Driver = -18V to 0V, $R_{G,EXT} = 1\Omega,$ Inductive Load, FWD: UJ3D1220KSD $T_J = 150^\circ C$		24		ns	
Rise time	$t_r$			35			
Turn-off delay time	$t_{d(off)}$			43			
Fall time	$t_f$			37			
Turn-on energy	$E_{ON}$			880			$\mu J$
Turn-off energy	$E_{OFF}$			800			
Total switching energy	$E_{TOTAL}$		1680				

**Thermal Characteristics**

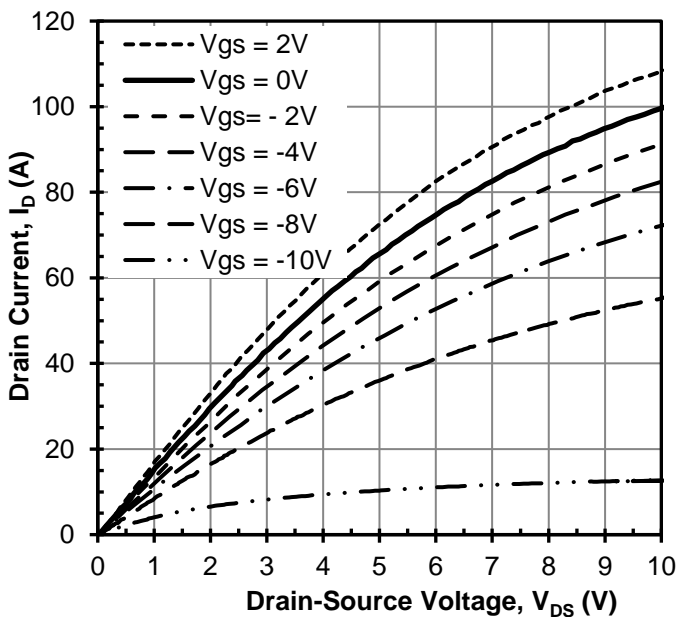
Parameter	symbol	Test Conditions	Value			Units
			Min	Typ	Max	
Thermal resistance, junction-to-case	$R_{\theta JC}$			0.27	0.35	$^\circ C/W$

**Typical Performance Diagrams**


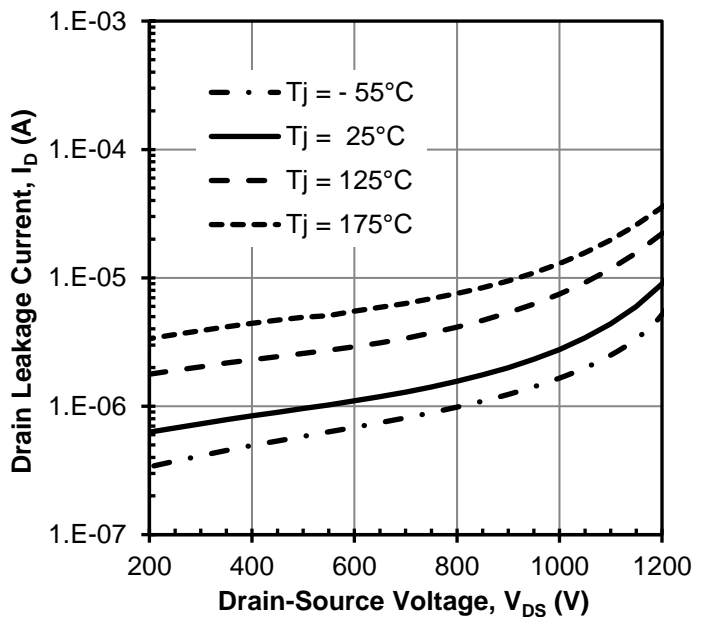
**Figure 1 Typical output characteristics**  
at  $T_J = -55^\circ\text{C}$



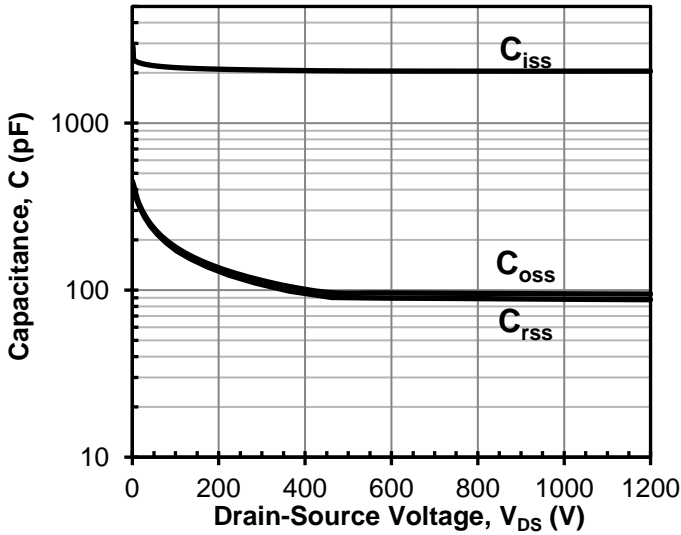
**Figure 2 Typical output characteristics**  
at  $T_J = 25^\circ\text{C}$



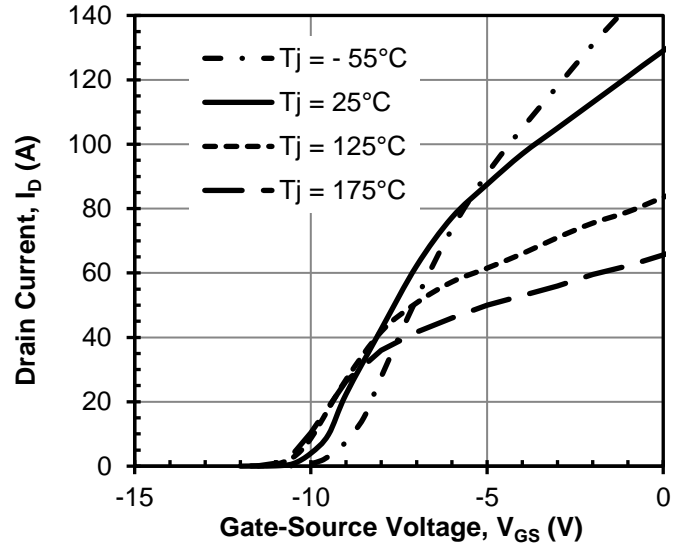
**Figure 3 Typical output characteristics**  
at  $T_J = 175^\circ\text{C}$



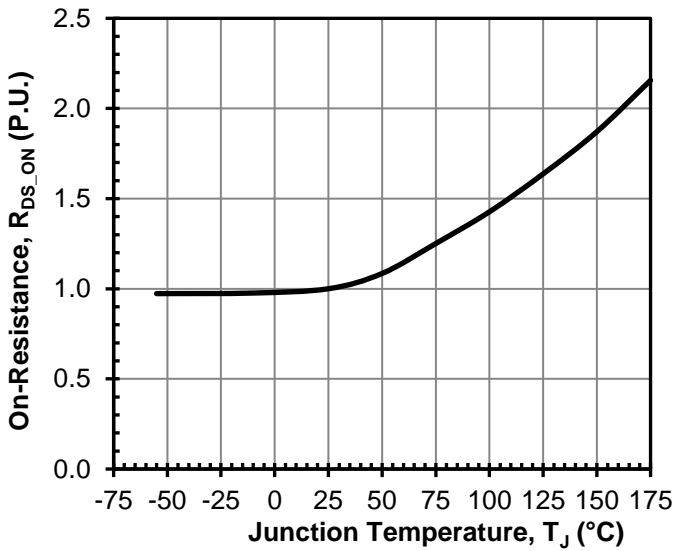
**Figure 4 Typical drain-source leakage**  
at  $V_{GS} = -20\text{V}$



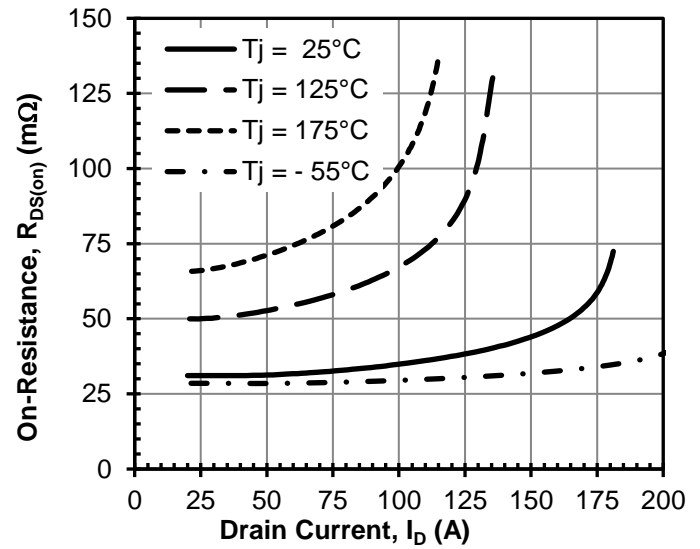
**Figure 5** Typical capacitances at 100kHz and  $V_{GS} = -20V$



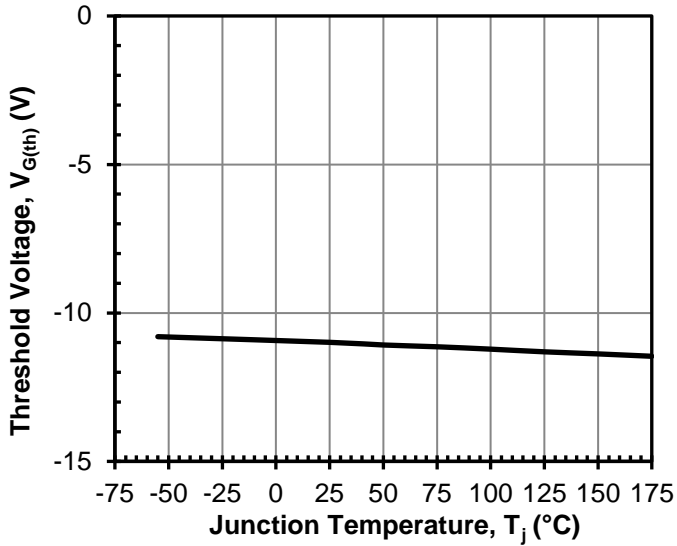
**Figure 6** Typical transfer characteristics at  $V_{DS} = 5V$



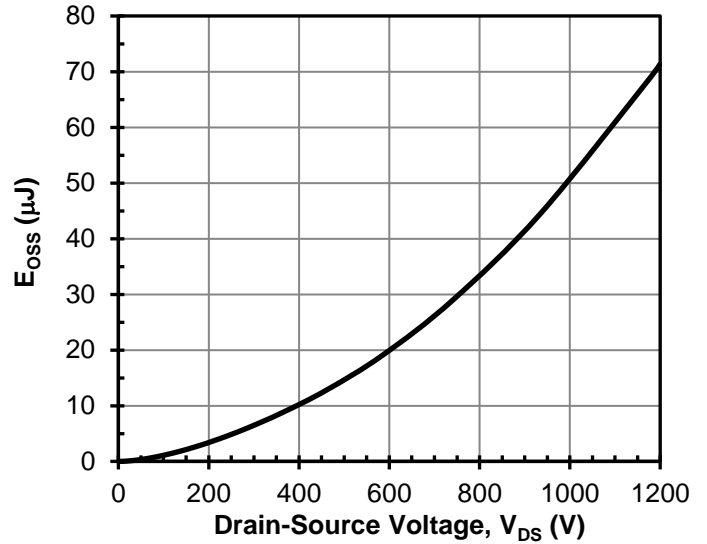
**Figure 7** Normalized on-resistance vs. temperature at  $V_{GS} = 0V$  and  $I_D = 20A$



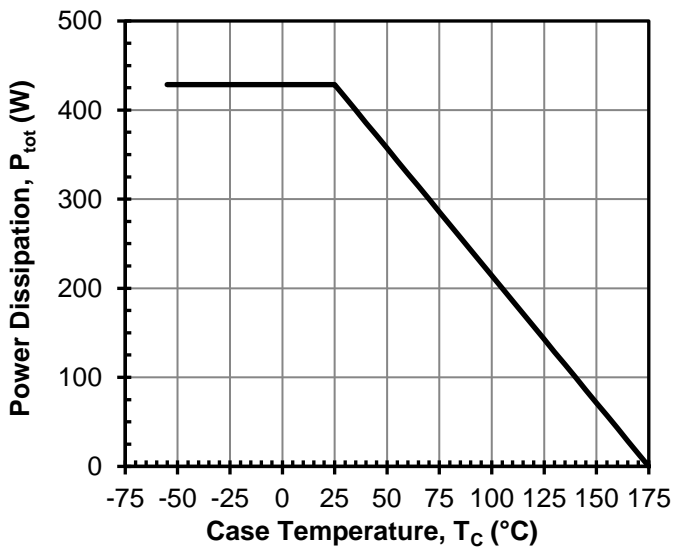
**Figure 8** Typical drain-source on-resistance at  $V_{GS} = 0V$



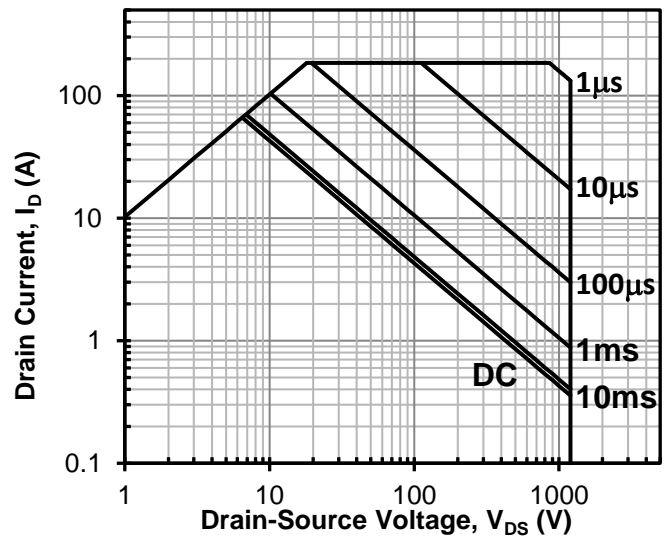
**Figure 9** Threshold voltage vs.  $T_j$   
at  $V_{DS} = 5V$  and  $I_D = 70mA$



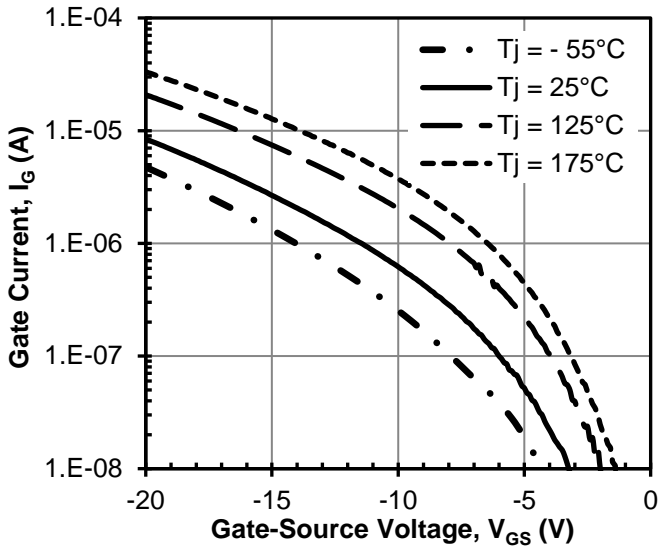
**Figure 10** Typical stored energy in  $C_{OSS}$   
at  $V_{GS} = -20V$



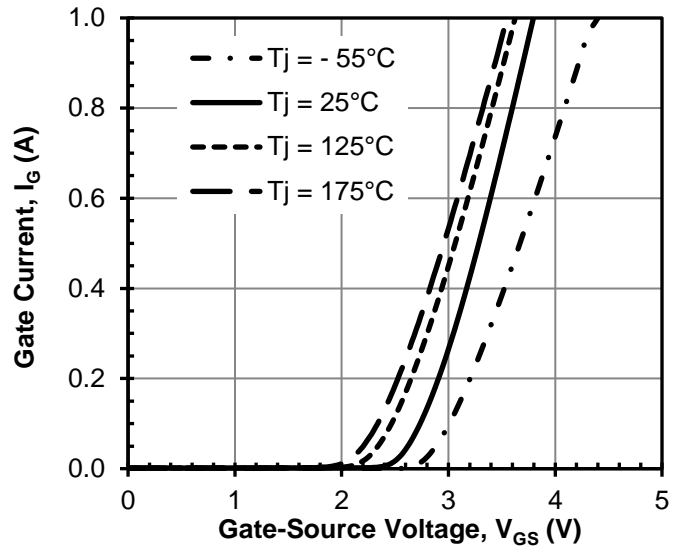
**Figure 11** Total power Dissipation



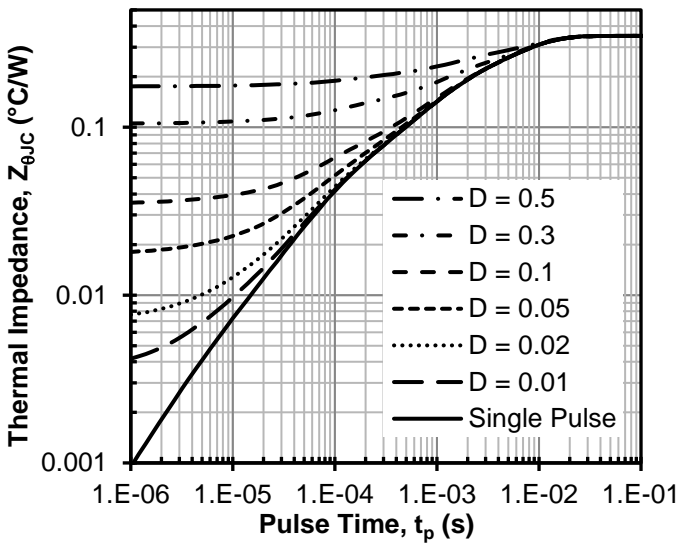
**Figure 12** Safe operation area  
 $T_c = 25^\circ C$ , Parameter  $t_p$



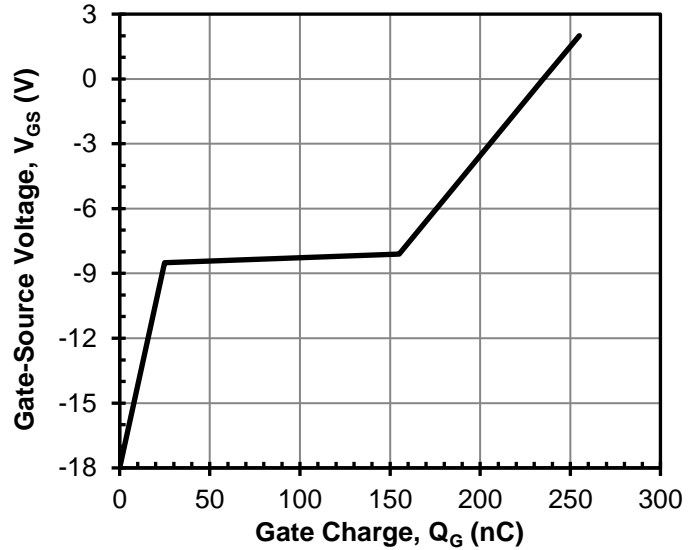
**Figure 13 Typical gate leakage current at  $V_{DS} = 0V$**



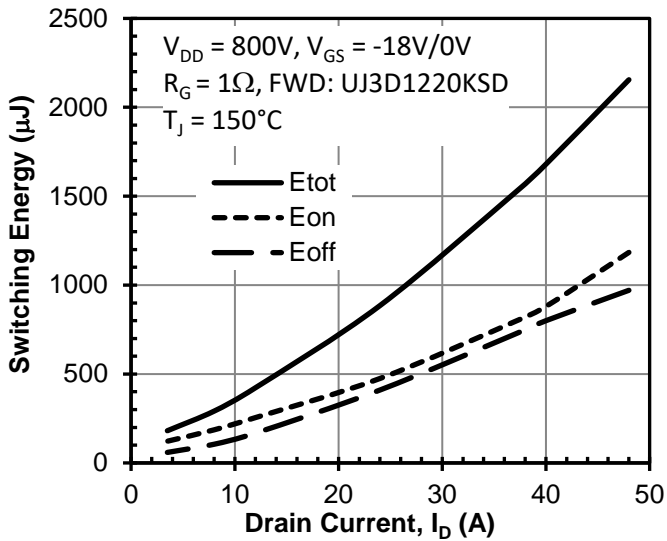
**Figure 14 Typical gate forward current at  $V_{DS} = 0V$**



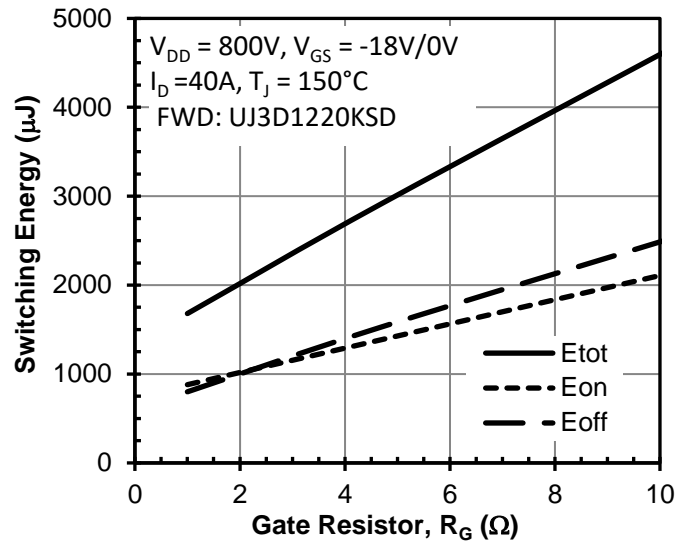
**Figure 15 Maximum transient thermal impedance**



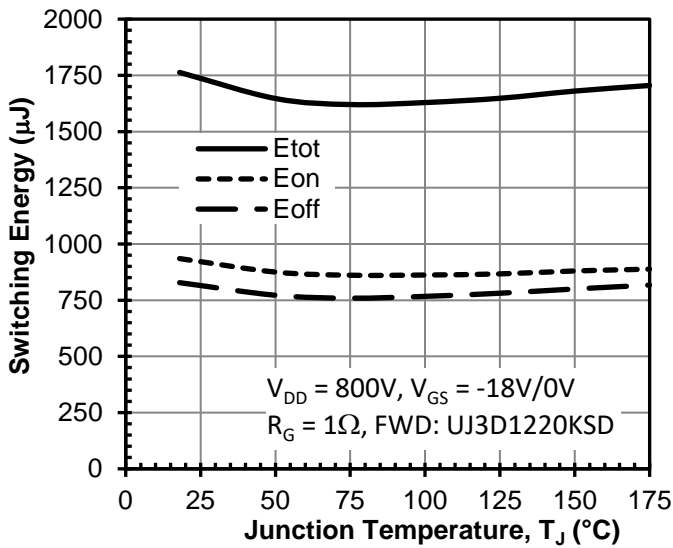
**Figure 16 Typical gate charge at  $V_{DS} = 800V$  and  $I_D = 40A$**



**Figure 17** Clamped inductive switching energy vs. drain current at  $T_J = 150^\circ\text{C}$



**Figure 18** Clamped inductive switching energy vs. gate resistor  $R_G$



**Figure 19** Clamped inductive switching energy vs. junction temperature at  $I_D = 40A$



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