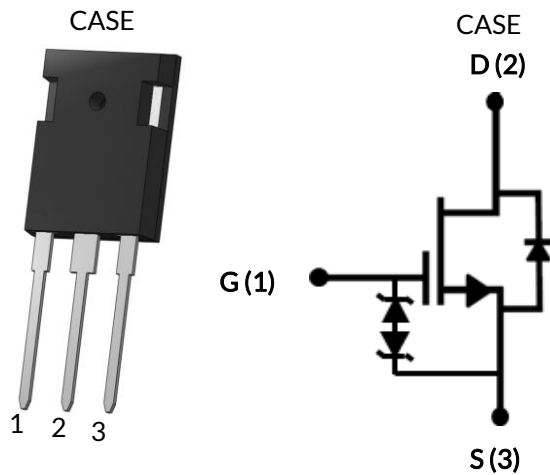


DATASHEET

UF3C170400K3S



1700V-410mΩ SiC FET

Rev. A, January 2020

Description

This SiC FET device is based on a unique ‘cascode’ circuit configuration, in which a normally-on SiC JFET is co-packaged with a Si MOSFET to produce a normally-off SiC FET device. The device’s standard gate-drive characteristics allows for a true “drop-in replacement” to Si IGBTs, Si FETs, SiC MOSFETs or Si superjunction devices. Available in the TO-247-3L package, this device exhibits ultra-low gate charge and exceptional reverse recovery characteristics, making it ideal for switching inductive loads, and any application requiring standard gate drive.

Features

- ◆ Typical on-resistance $R_{DS(on),typ}$ of 410mΩ
- ◆ Maximum operating temperature of 175°C
- ◆ Excellent reverse recovery
- ◆ Low gate charge
- ◆ Low intrinsic capacitance
- ◆ ESD protected, HBM class 2

Typical applications

- ◆ EV charging
- ◆ PV inverters
- ◆ Switch mode power supplies
- ◆ Power factor correction modules
- ◆ Motor drives
- ◆ Induction heating

Part Number	Package	Marking
UF3C170400K3S	TO-247-3L	UF3C170400K3S



Maximum Ratings

Parameter	Symbol	Test Conditions	Value	Units
Drain-source voltage	V_{DS}		1700	V
Gate-source voltage	V_{GS}	DC	-25 to +25	V
Continuous drain current ¹	I_D	$T_C = 25^\circ\text{C}$	7.6	A
		$T_C = 100^\circ\text{C}$	5.9	A
Pulsed drain current ²	I_{DM}	$T_C = 25^\circ\text{C}$	14	A
Single pulsed avalanche energy ³	E_{AS}	$L = 15\text{mH}, I_{AS} = 1.25\text{A}$	11.7	mJ
Power dissipation	P_{tot}	$T_C = 25^\circ\text{C}$	100	W
Maximum junction temperature	$T_{J,max}$		175	$^\circ\text{C}$
Operating and storage temperature	T_J, T_{STG}		-55 to 175	$^\circ\text{C}$
Max. lead temperature for soldering, 1/8" from case for 5 seconds	T_L		250	$^\circ\text{C}$

1. Limited by $T_{J,max}$

2. Pulse width t_p limited by $T_{J,max}$

3. Starting $T_J = 25^\circ\text{C}$

Thermal Characteristics

Parameter	Symbol	Test Conditions	Value			Units
			Min	Typ	Max	
Thermal resistance, junction-to-case	$R_{\theta JC}$			1.2	1.5	$^\circ\text{C}/\text{W}$

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}	$V_{GS}=0V, I_D=1mA$	1700			V
Total drain leakage current	I_{DSS}	$V_{DS}=1700V, V_{GS}=0V, T_J=25^\circ\text{C}$		1.5	60	μA
		$V_{DS}=1700V, V_{GS}=0V, T_J=175^\circ\text{C}$		5.5		
Total gate leakage current	I_{GSS}	$V_{DS}=0V, T_J=25^\circ\text{C}, V_{GS}=-20V / +20V$		6	± 20	μA
Drain-source on-resistance	$R_{DS(on)}$	$V_{GS}=12V, I_D=5A, T_J=25^\circ\text{C}$		410	515	m Ω
		$V_{GS}=12V, I_D=5A, T_J=175^\circ\text{C}$		1070		
Gate threshold voltage	$V_{G(th)}$	$V_{DS}=5V, I_D=10mA$	3	4.7	6	V
Gate resistance	R_G	$f=1\text{MHz}, \text{open drain}$		4.1		Ω

Typical Performance - Reverse Diode

Parameter	Symbol	Test Conditions	Value			Units
			Min	Typ	Max	
Diode continuous forward current ¹	I_S	$T_C=25^\circ\text{C}$			7.6	A
Diode pulse current ²	$I_{S,pulse}$	$T_C=25^\circ\text{C}$			14	A
Forward voltage	V_{FSD}	$V_{GS}=0V, I_F=2A, T_J=25^\circ\text{C}$		1.5	1.75	V
		$V_{GS}=0V, I_F=2A, T_J=175^\circ\text{C}$		2.4		
Reverse recovery charge	Q_{rr}	$V_R=1200V, I_F=5A, V_{GS}=-5V, R_{G,EXT}=10\Omega, di/dt=4000A/\mu\text{s}, T_J=25^\circ\text{C}$		70		nC
Reverse recovery time	t_{rr}	$T_J=25^\circ\text{C}$		29		ns
Reverse recovery charge	Q_{rr}	$V_R=1200V, I_F=5A, V_{GS}=-5V, R_{G,EXT}=10\Omega, di/dt=4000A/\mu\text{s}, T_J=150^\circ\text{C}$		67		nC
Reverse recovery time	t_{rr}	$T_J=150^\circ\text{C}$		27		ns

Typical Performance - Dynamic

Parameter	Symbol	Test Conditions	Value			Units
			Min	Typ	Max	
Input capacitance	C_{iss}	$V_{DS}=100V, V_{GS}=0V$ $f=100kHz$		740		pF
Output capacitance	C_{oss}			27		
Reverse transfer capacitance	C_{rss}			2		
Effective output capacitance, energy related	$C_{oss(er)}$	$V_{DS}=0V$ to 1200V, $V_{GS}=0V$		15.5		pF
Effective output capacitance, time related	$C_{oss(tr)}$	$V_{DS}=0V$ to 1200V, $V_{GS}=0V$		28		pF
C_{oss} stored energy	E_{oss}	$V_{DS}=1200V, V_{GS}=0V$		11.2		μJ
Total gate charge	Q_G	$V_{DS}=1200V, I_D=5A,$ $V_{GS} = -5V$ to 15V		27.5		nC
Gate-drain charge	Q_{GD}			6.5		
Gate-source charge	Q_{GS}			10		
Turn-on delay time	$t_{d(on)}$	$V_{DS}=1200V, I_D=5A, \text{Gate}$ $\text{Driver} = -5V$ to +15V, Turn-on $R_{G,EXT}=1\Omega,$ Turn-off $R_{G,EXT}=22\Omega$ Inductive Load,		17		ns
Rise time	t_r			13		
Turn-off delay time	$t_{d(off)}$			34		
Fall time	t_f			27		
Turn-on energy	E_{ON}	FWD: same device with $V_{GS} = -5V$ and $R_G = 10\Omega,$ $T_J=25^\circ C$		189		μJ
Turn-off energy	E_{OFF}			43		
Total switching energy	E_{TOTAL}			232		
Turn-on delay time	$t_{d(on)}$	$V_{DS}=1200V, I_D=5A, \text{Gate}$ $\text{Driver} = -5V$ to +15V, Turn-on $R_{G,EXT}=1\Omega,$ Turn-off $R_{G,EXT}=22\Omega$ Inductive Load,		17		ns
Rise time	t_r			11		
Turn-off delay time	$t_{d(off)}$			35		
Fall time	t_f			28		
Turn-on energy	E_{ON}	FWD: same device with $V_{GS} = -5V$ and $R_G = 10\Omega,$ $T_J=150^\circ C$		158		μJ
Turn-off energy	E_{OFF}			50		
Total switching energy	E_{TOTAL}			208		

Typical Performance Diagrams

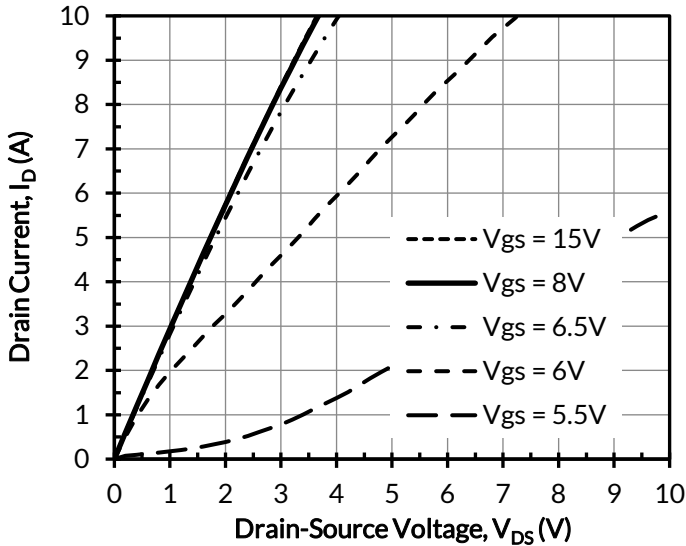


Figure 1. Typical output characteristics at $T_J = -55^\circ\text{C}$, $t_p < 250\mu\text{s}$

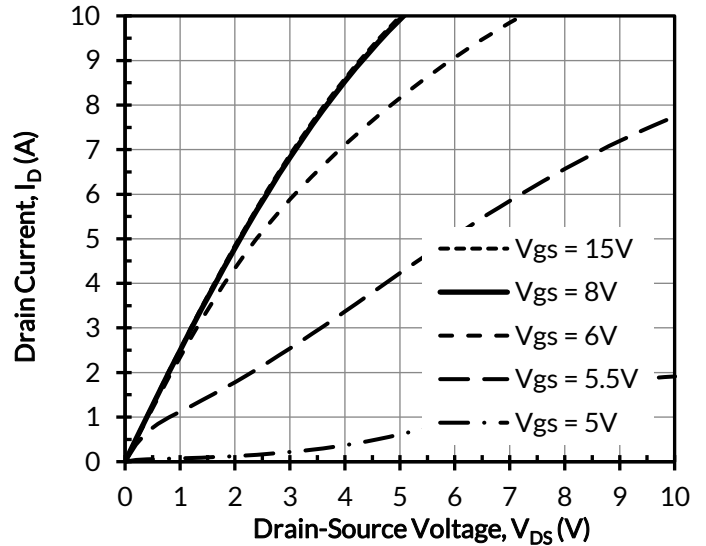


Figure 2. Typical output characteristics at $T_J = 25^\circ\text{C}$, $t_p < 250\mu\text{s}$

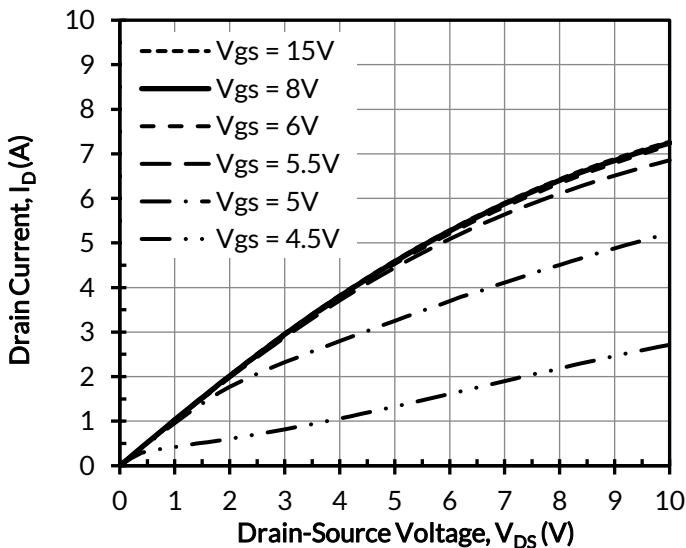


Figure 3. Typical output characteristics at $T_J = 175^\circ\text{C}$, $t_p < 250\mu\text{s}$

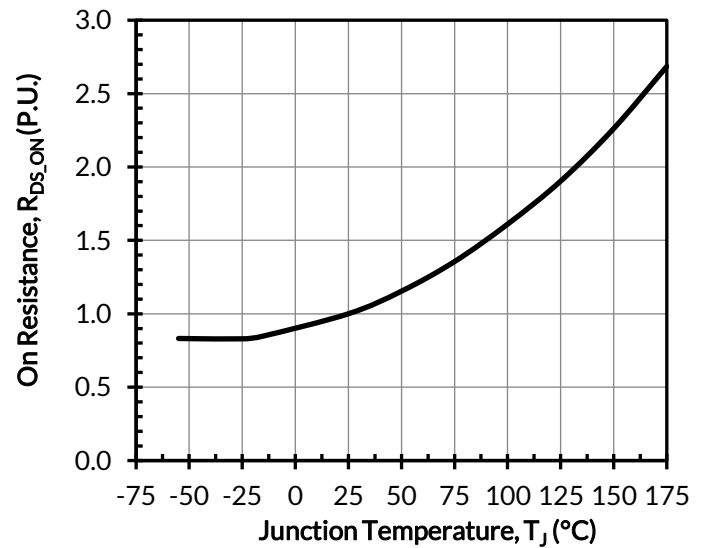


Figure 4. Normalized on-resistance vs. temperature at $V_{GS} = 12\text{V}$ and $I_D = 5\text{A}$

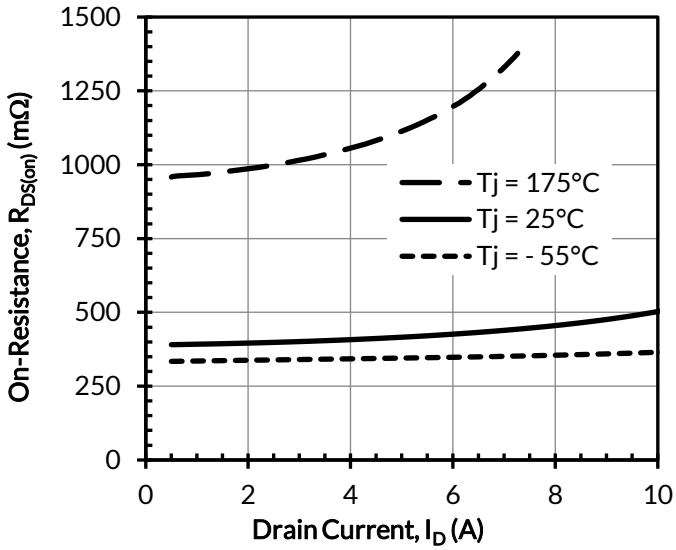


Figure 5. Typical drain-source on-resistances at $V_{GS} = 12V$

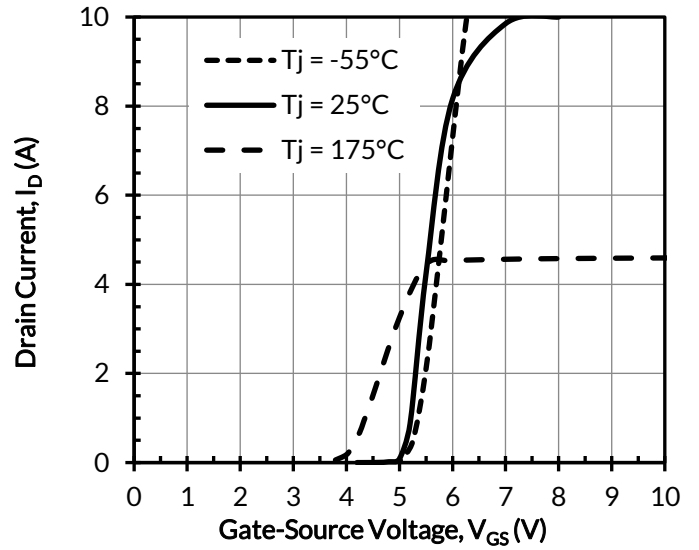


Figure 6. Typical transfer characteristics at $V_{DS} = 5V$

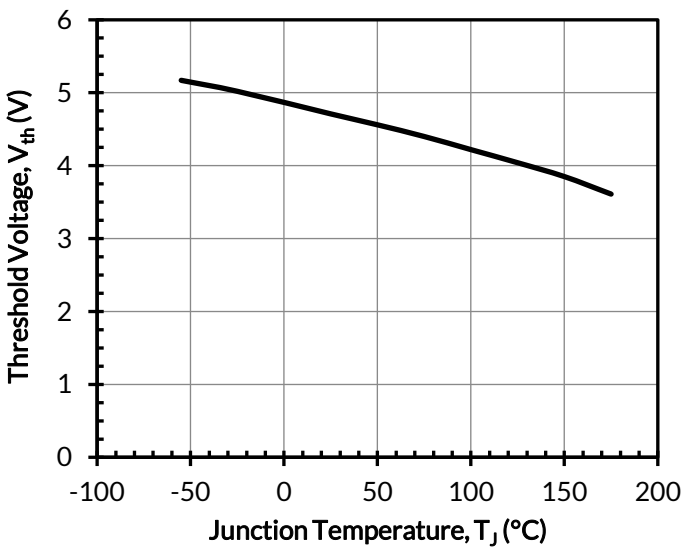


Figure 7. Threshold voltage vs. junction temperature at $V_{DS} = 5V$ and $I_D = 10mA$

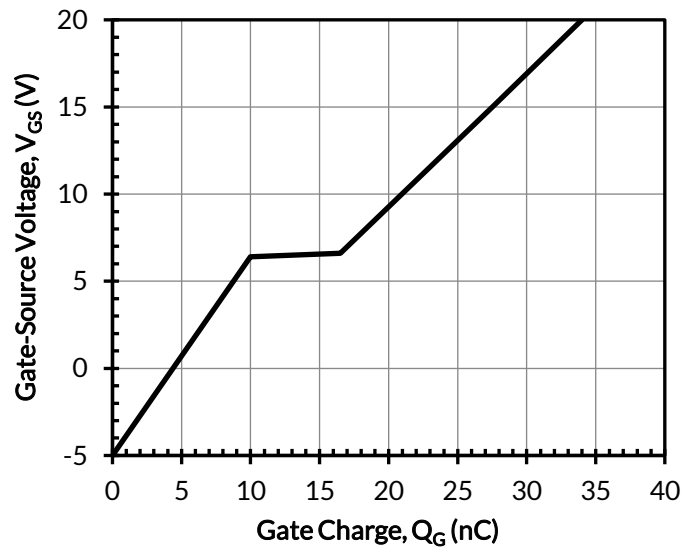


Figure 8. Typical gate charge at $V_{DS} = 1200V$ and $I_D = 5A$

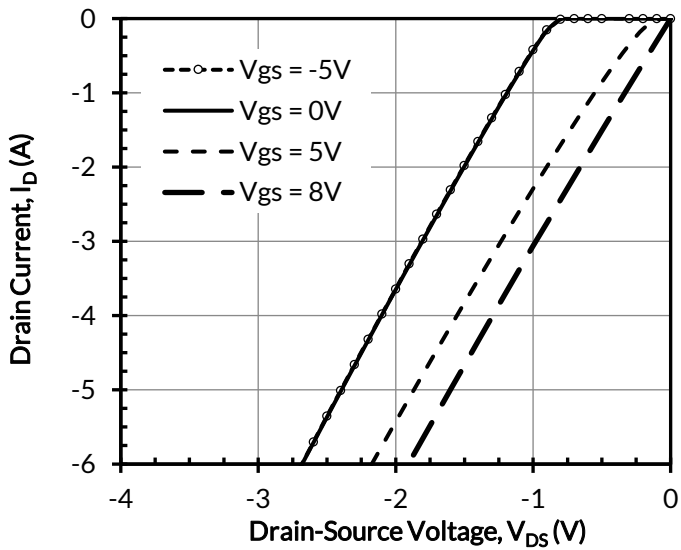


Figure 9. 3rd quadrant characteristics at $T_j = -55^\circ\text{C}$

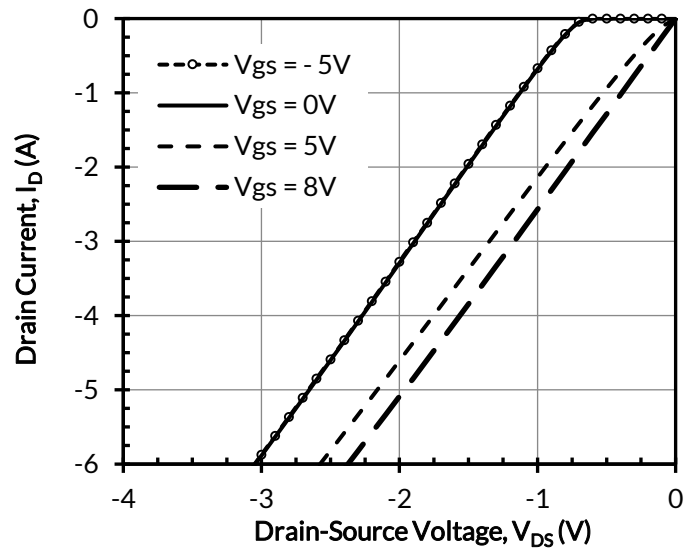


Figure 10. 3rd quadrant characteristics at $T_j = 25^\circ\text{C}$

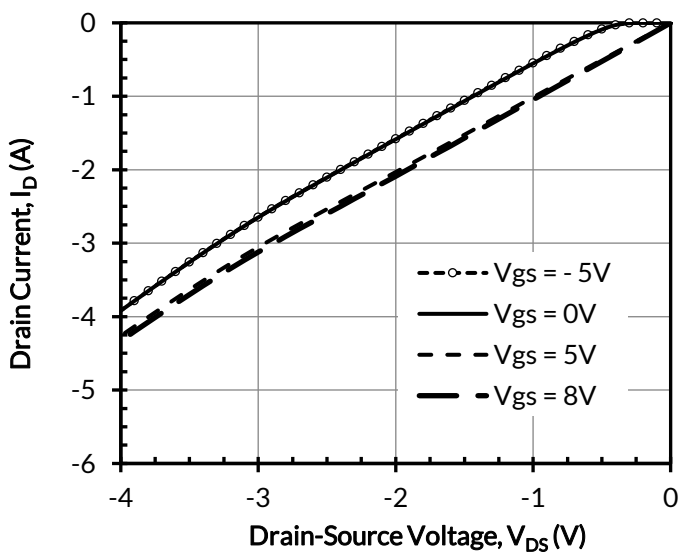


Figure 11. 3rd quadrant characteristics at $T_j = 175^\circ\text{C}$

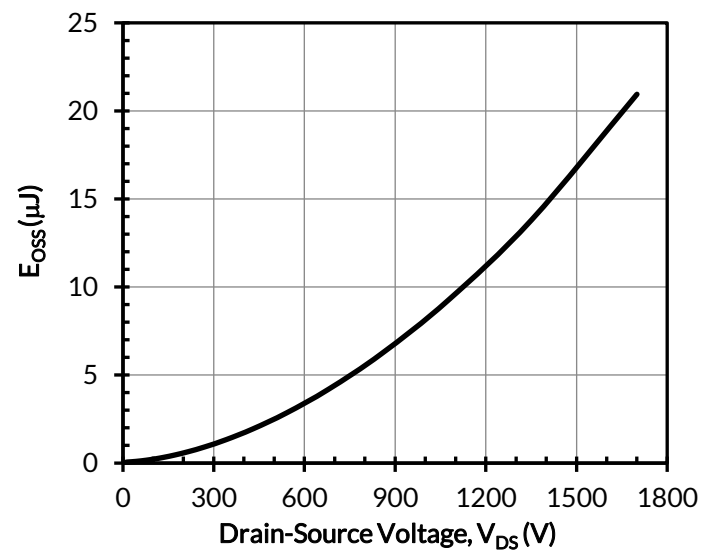


Figure 12. Typical stored energy in C_{OSS} at $V_{GS} = 0\text{V}$

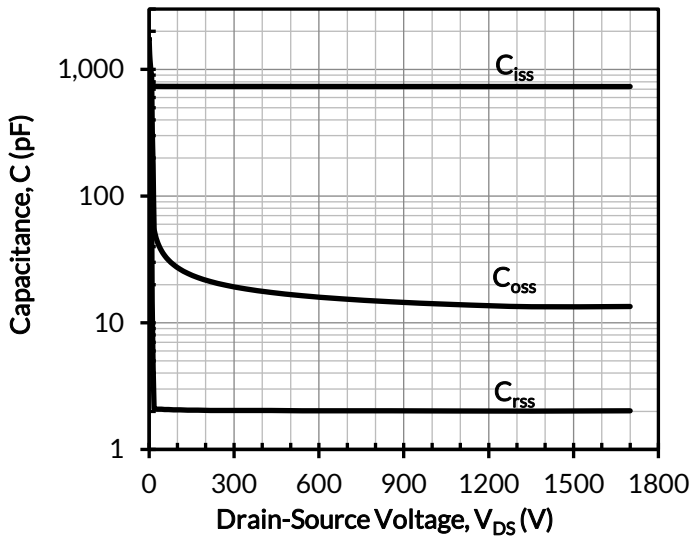


Figure 13. Typical capacitances at $f = 100\text{kHz}$ and $V_{GS} = 0\text{V}$

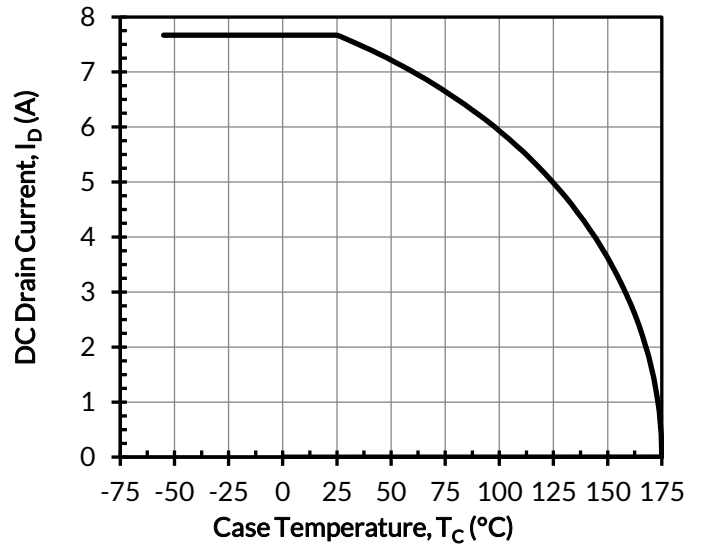


Figure 14. DC drain current derating

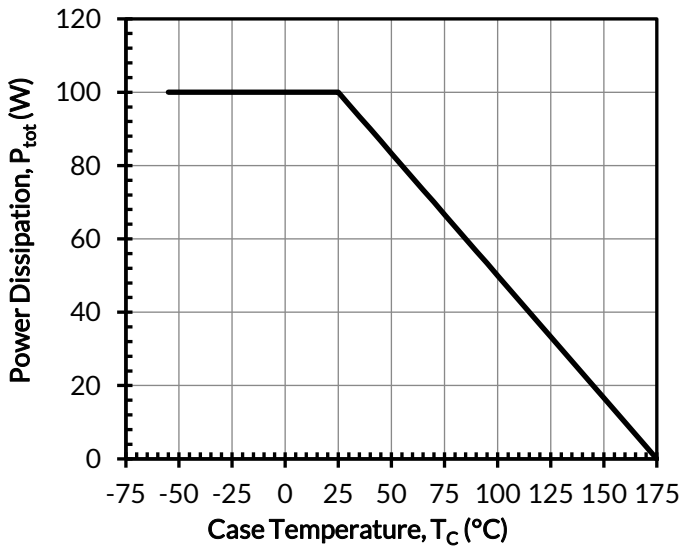


Figure 15. Total power dissipation

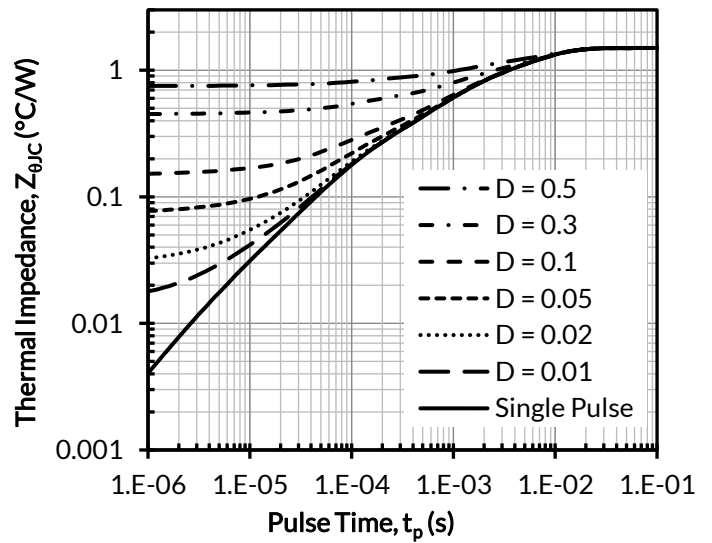


Figure 16. Maximum transient thermal impedance

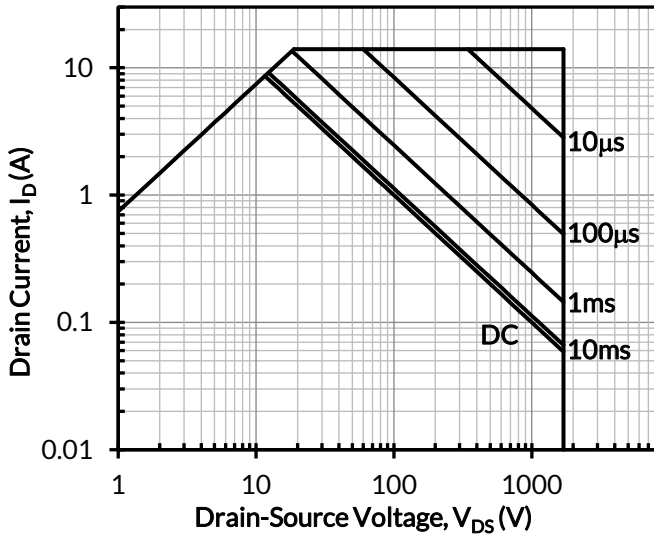


Figure 17. Safe operation area at $T_C = 25^\circ\text{C}$, $D = 0$, Parameter t_p

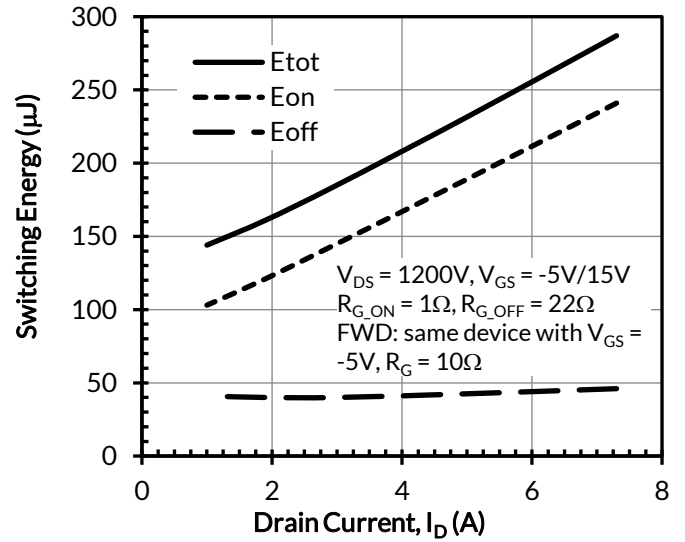


Figure 18. Clamped inductive switching energy vs. drain current at $T_J = 25^\circ\text{C}$

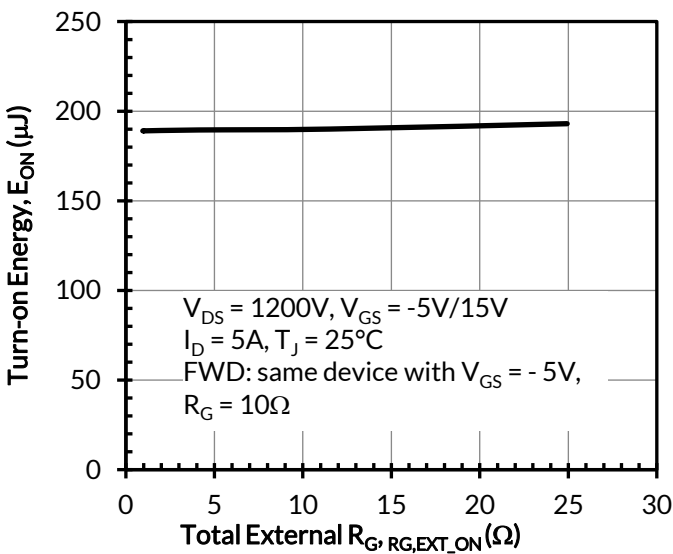


Figure 19. Clamped inductive switching turn-on energy vs. $R_{G,EXT,ON}$

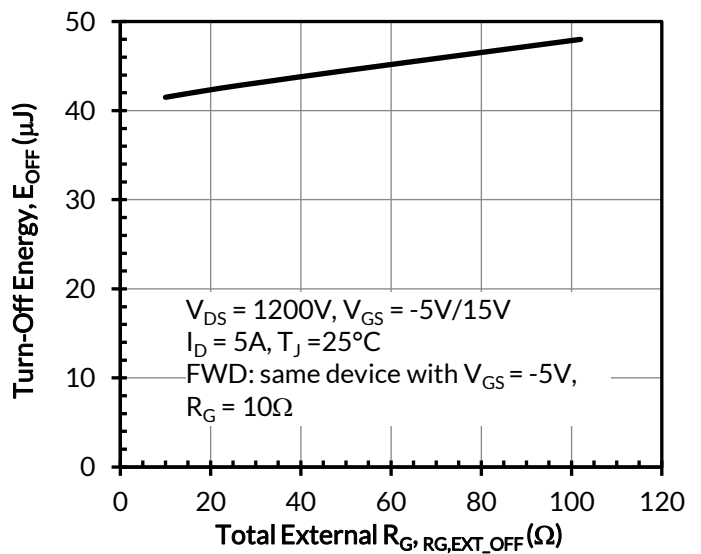


Figure 20. Clamped inductive switching turn-off energy vs. $R_{G,EXT,OFF}$