

Description

The DFS450HF12I4C1 is a Half Bridge SiC MOSFET Power Module. It integrates high performance SiC MOSFET chips designed for the applications such as Motor drives and Renewable energy.



Features

- Blocking voltage 1200V
- $R_{DS(on)} = 4.7m\Omega$
- Low thermal resistance with Si_3N_4 AMB
- 175°C maximum junction temperature
- Thermistor inside
- Low Switching Losses

Applications

- xEV Applications
- Motor Drives
- Vehicle Fast Chargers
- Smart-Grid/Grid-Tied Distributed Generation

Circuit diagram

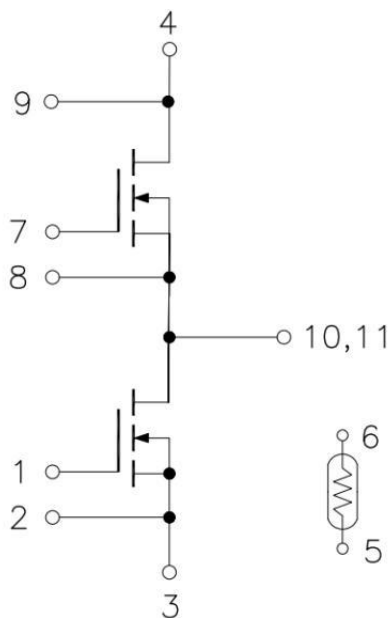


Figure 1. Out drawing & circuit diagram for DFS450HF12I4C1

Pin Configuration and Marking Information

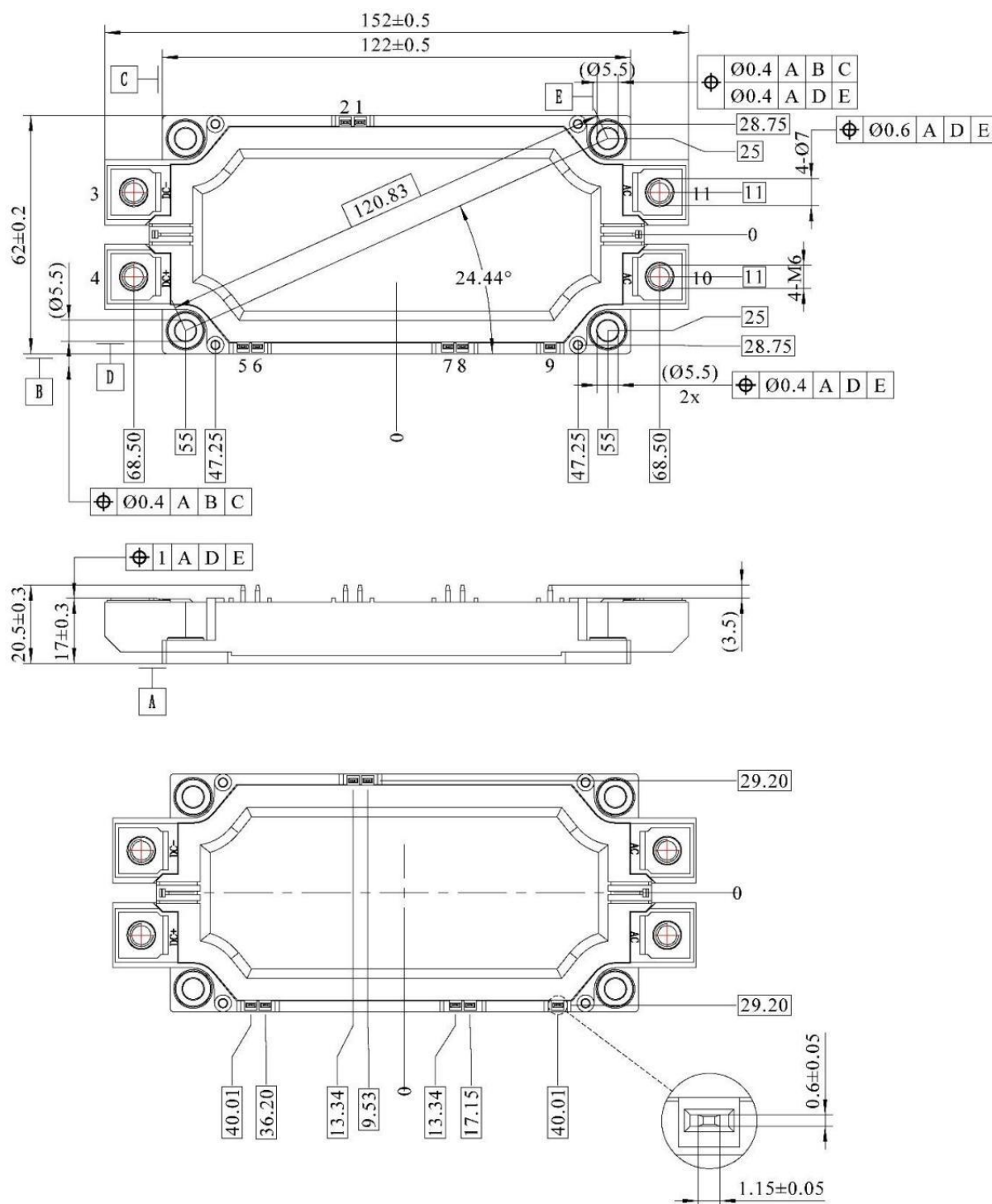


Figure 2. Pin configuration

Module

Parameter	Condition	Value	Unit
Isolation Voltage	RMS, f=50Hz, t=1min	3.4	KV
Material of module baseplate	-	Cu	-
Creepage distance	terminal to heatsink terminal to terminal	14.5 13	mm
Clearance	terminal to heatsink terminal to terminal	12.5 10	mm
CTI	-	>400	-
Module lead resistance, terminals–chip	T _C =25°C	0.5	mΩ
Mounting torque for module mounting	M5, M6	3 to 6	Nm
Weight	-	340	g

Maximum Ratings (T_j =25°C unless otherwise specified)

Symbol	Parameter	Condition	Ratings	Unit
V _{DSS}	Drain-Source Voltage	G-S Short	1200	V
V _{GSS}	Gate-Source Voltage	D-S Short, AC frequency ≥1Hz, Note1	-10 to 22	V
I _{DS}	DC Continuous Drain Current	T _C =25°C, V _{GS} =18V	480	A
I _{DS}	DC Continuous Drain Current	T _C =60°C, V _{GS} =18V	420	A
I _{SD}	Source (Body diode) Current	T _C =25°C, with ON signal	480	A
I _{SD}	Source (Body diode) Current	T _C =60°C, with ON signal	420	A
I _{DSM}	Pulse Forward Current	T _C =25°C, Pulse width =1ms, V _{GS} =20V, Note2	900	A
P _{tot}	Total Power Dissipation	T _C =25°C	1500	W
T _{jmax}	Max Junction Temperature	-	175	°C
T _{stg}	Storage Temperature	-	-40 to 125	°C

Note1: Recommended Operating Value, +18V/-5V, +18V/-4V, +15V/-4V

Note2: Pulse width limited by maximum junction temperature

NTC characteristics

Symbol	Parameter	Condition	Value			Unit
			Min.	Typ.	Max.	
R ₂₅	Resistance	T _C =25°C	-	5	-	kΩ
ΔR/R	Deviation of R ₁₀₀	T _C =100°C, R ₁₀₀ =493Ω	-5	-	5	%
P ₂₅	Power dissipation	T _C =25°C	-	-	20	mW
B _{25/50}	B-value	$R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298,15 \text{ K}))]$	-	3375	-	K
B _{25/80}	B-value	$R_2 = R_{25} \exp [B_{25/80}(1/T_2 - 1/(298,15 \text{ K}))]$	-	3411	-	K
B _{25/100}	B-value	$R_2 = R_{25} \exp [B_{25/100}(1/T_2 - 1/(298,15 \text{ K}))]$	-	3433	-	K

MOSFET Electrical characteristics (T_j=25°C unless otherwise specified, chip)

Symbol	Item	Condition		Value			Unit
				Min.	Typ.	Max	
V _{(BR)DSS}	Drain-Source Breakdown Voltage	V _{GS} =0V, I _D =400μA		1200	-	-	V
I _{DSS}	Zero gate voltage drain Current	V _{DS} =1200V, V _{GS} =0V		-	15	-	μA
V _{GS(th)}	Gate-source threshold Voltage	I _D =150mA V _{DS} =V _{GS}	T _j =25°C	1.8	2.7	-	V
			T _j =175°C	-	2.1	-	V
I _{GSS}	Gate-Source Leakage Current	V _{GS} =20V, V _{DS} =0V, T _j =25°C		-	-	400	nA
R _{DS(on)} (Chip)	Static drain-source On-state resistance	I _D =450A V _{GS} =+15V	T _j =25°C	-	5.6	8.2	mΩ
			T _j =175°C	-	7.8	-	mΩ
		I _D =450A V _{GS} =+18V	T _j =25°C	-	4.7	-	mΩ
			T _j =175°C	-	6.5	-	mΩ
V _{DS(on)} (Chip)	Static drain-source On-state Voltage	I _D =450A V _{GS} =+15V	T _j =25°C	-	2.52	3.69	V
			T _j =175°C	-	3.51	-	V
		I _D =450A V _{GS} =+18V	T _j =25°C	-	2.11	-	V
			T _j =175°C	-	2.93	-	V
C _{iss}	Input Capacitance	V _D =1000V, V _{GS} =0V f =200kHz, V _{AC} =25mV		-	23.3	-	nF
C _{oss}	Output Capacitance			-	0.70	-	nF
C _{rss}	Reverse transfer Capacitance			-	0.057	-	nF
R _{Gint}	Internal gate resistor	-		-	1.6	-	Ω
Q _G	Total gate charge	V _{DD} =800V, I _D =250A, V _{GS} =+18/-5V		-	825	-	nC
t _{d(on)}	Turn-on delay time	V _{DD} =600V I _D =450A V _{GS} =+18/-4V R _{gon} /R _{goff} =5.1/3.3Ω Inductive load	T _j =25°C	-	57	-	ns
			T _j =150°C	-	49	-	
t _r	Rise time		T _j =25°C	-	33	-	ns
			T _j =150°C	-	28	-	
t _{d(off)}	Turn-off delay time		T _j =25°C	-	120	-	ns
			T _j =150°C	-	131	-	
t _f	Fall time		T _j =25°C	-	21	-	ns
			T _j =150°C	-	49	-	

E _{on}	Turn-on power dissipation	switching operation	T _j =25°C	-	16.8	-	mJ	
			T _j =150°C	-	14.7	-		
E _{off}	Turn-off power dissipation		T _j =25°C	-	6.5	-	mJ	
			T _j =150°C	-	7.1	-		
R _{th(j-c)}	FET Thermal Resistance	Junction to Case			-	0.10	-	K/W
R _{th(c-f)}	Contact thermal Resistance	With thermal conductive grease, Note3			-	0.015	-	K/W

Note3: Assumes Thermal Conductivity of grease is 0.9W/m · K and thickness is 50um.

Body Diode Electrical characteristics ($T_j=25^\circ\text{C}$ unless otherwise specified, chip)

Symbol	Item	Condition		Value			Unit
				Min.	Typ.	Max	
V_{SD}	Body Diode Forward Voltage	$V_{GS} = -5\text{V}$ $I_{SD} = 450\text{A}$	$T_j = 25^\circ\text{C}$	-	6.6	-	V
			$T_j = 175^\circ\text{C}$	-	5.8	-	
T_{rr}	Reverse recovery time	$V_{DD} = 600\text{V}$ $I_D = 450\text{A}$ $V_{GS} = +18/-4\text{V}$	$T_j = 25^\circ\text{C}$	-	33	-	ns
			$T_j = 150^\circ\text{C}$	-	64	-	
Q_{rr}	Reverse recovery charge	$R_{gon}/R_{goff} = 5.1/3.3\Omega$ Inductive load switching operation	$T_j = 25^\circ\text{C}$	-	1.7	-	uC
			$T_j = 150^\circ\text{C}$	-	6.6	-	
E_{rr}	Diode switching power dissipation	switching operation	$T_j = 25^\circ\text{C}$	-	1.2	-	mJ
			$T_j = 150^\circ\text{C}$	-	2.5	-	

Test Conditions

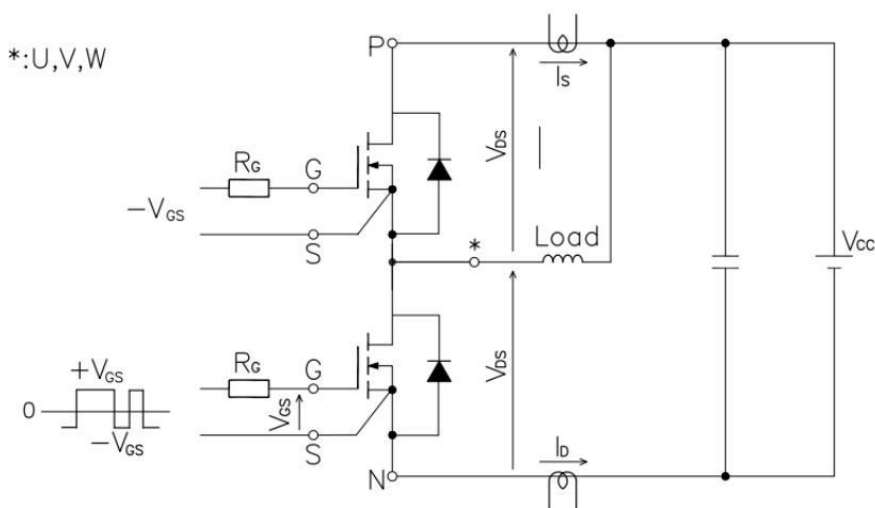


Figure 3. Switching time measure circuit

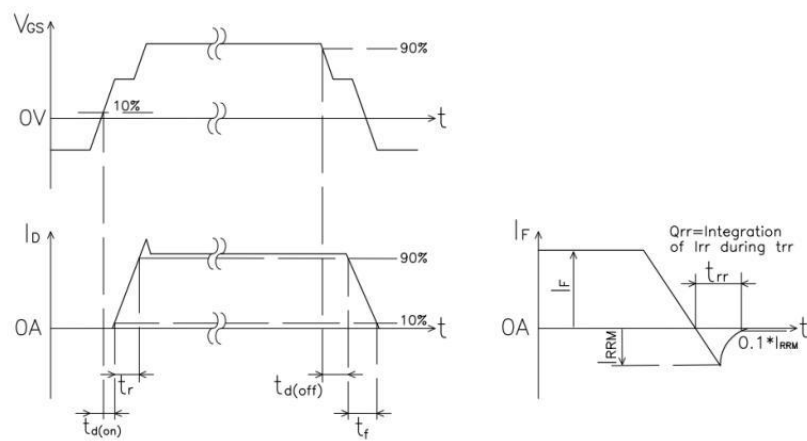


Figure 4. Switching time definition

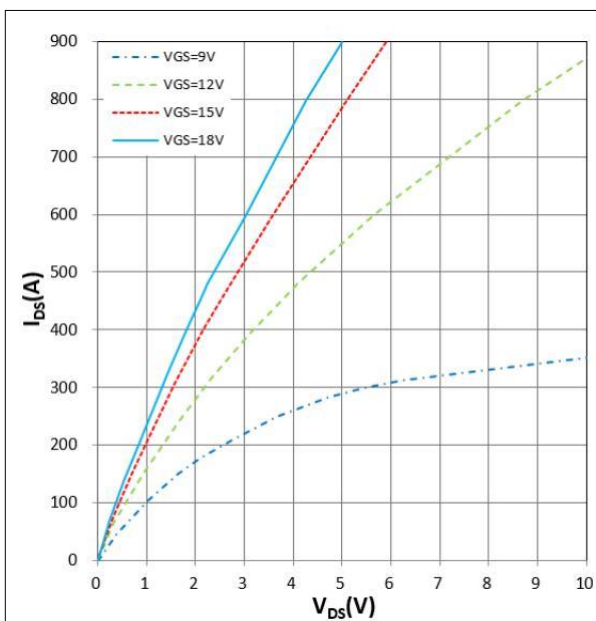


Figure 5. I_{DS} vs V_{DS}
 $T_j = 25^\circ\text{C}$, V_{GS} parameter

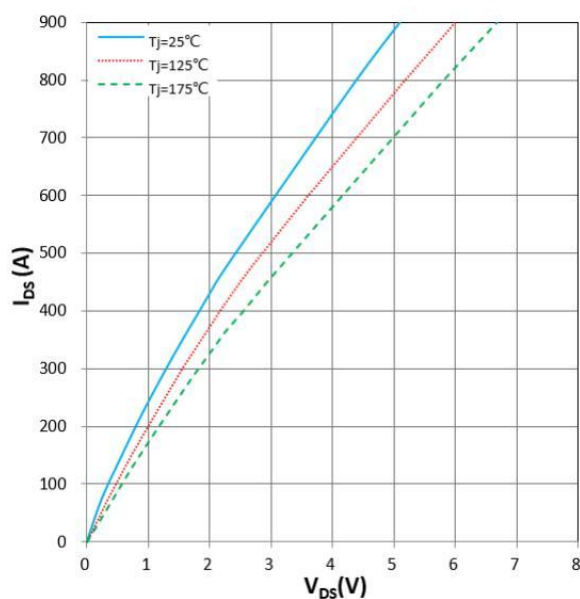


Figure 6. I_{DS} vs V_{DS}
 $V_{GS} = 18\text{V}$, T_j parameter

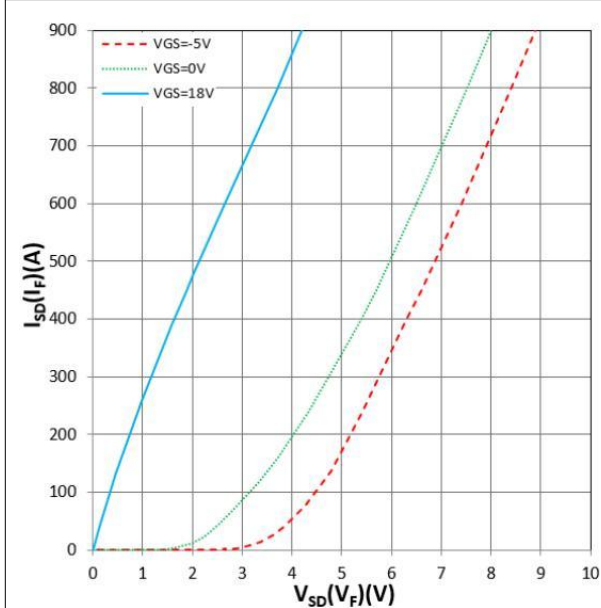


Figure 7. $I_{SD}(I_F)$ vs $V_{SD}(V_F)$
 $T_j = 25^\circ\text{C}$, V_{GS} parameter

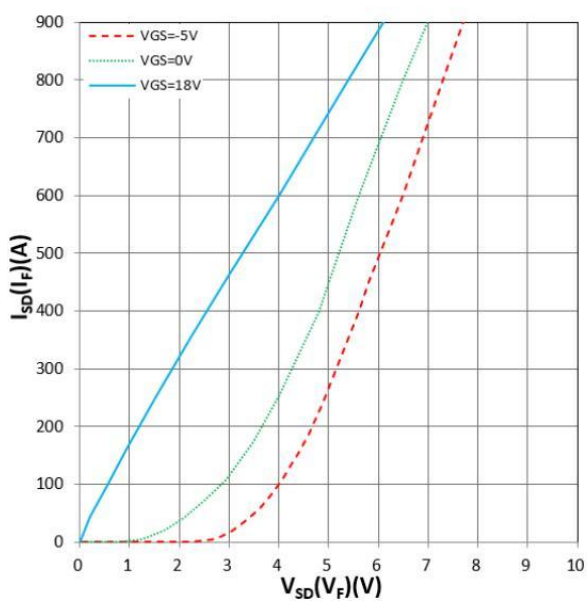


Figure 8. $I_{SD}(I_F)$ vs $V_{SD}(V_F)$
 $T_j = 175^\circ\text{C}$, V_{GS} parameter

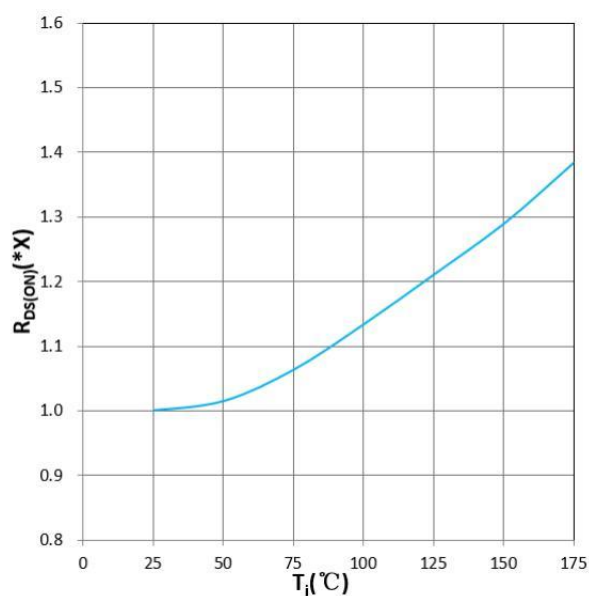


Figure 9. $R_{DS(ON)}$ vs T_j

$V_{GS}=+18\text{V}$, $I_D=450\text{A}$, $1.0X=4.7\text{m}\Omega$

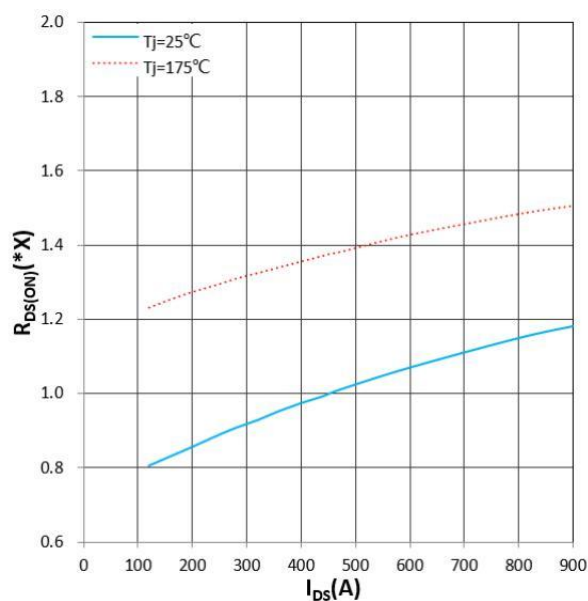


Figure 10. $R_{DS(ON)}$ vs I_{DS}

$T_j = 25^{\circ}\text{C}/175^{\circ}\text{C}$, $V_{GS}=+18\text{V}$, $1.0X=4.7\text{m}\Omega$

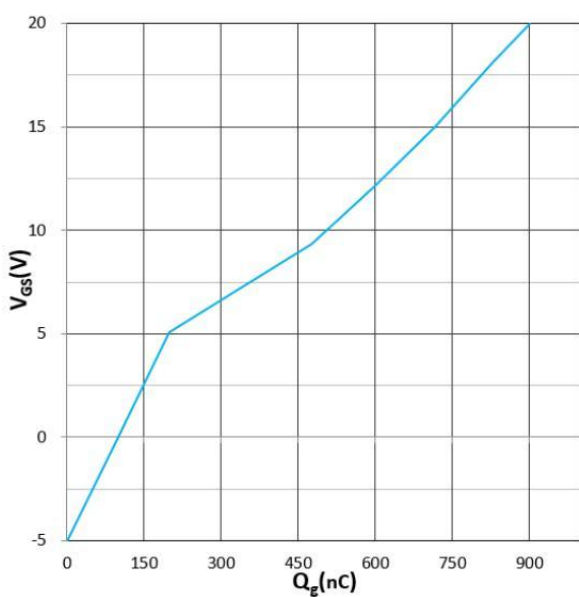


Figure 11. V_{GS} vs Q_g

$T_j = 25^{\circ}\text{C}$, $V_{DS}=800\text{V}$, $I_D=250\text{A}$

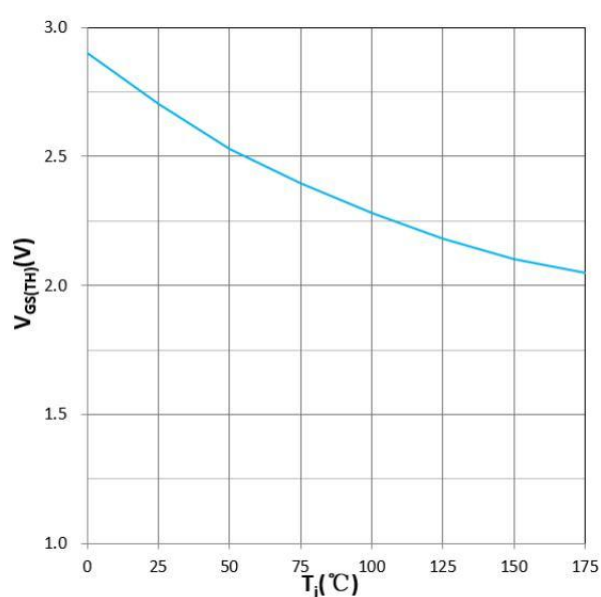


Figure 12. $V_{GS(TH)}$ vs T_j

$V_{GS}=V_{DS}$, $I_D=150\text{mA}$

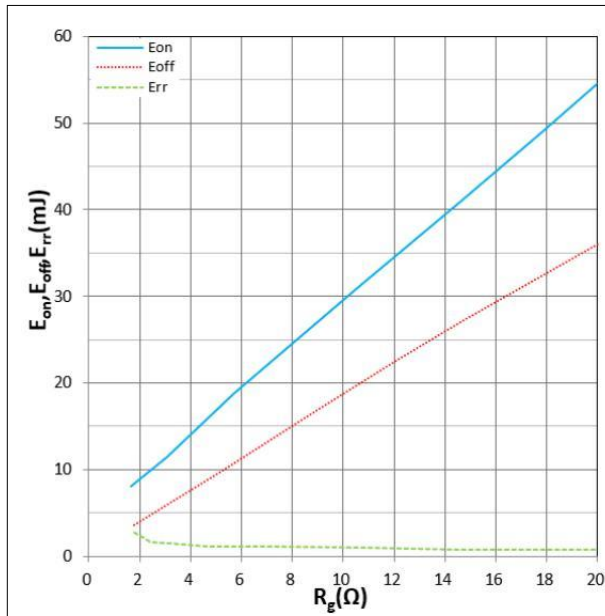


Figure 13. E_{on} , E_{off} , E_{rr} vs R_g
 $T_j = 25^\circ\text{C}$, $V_{DD} = 600\text{V}$, $V_{GS} = +18\text{V}/-4\text{V}$,
 $I_D = 450\text{A}$, Inductive Load

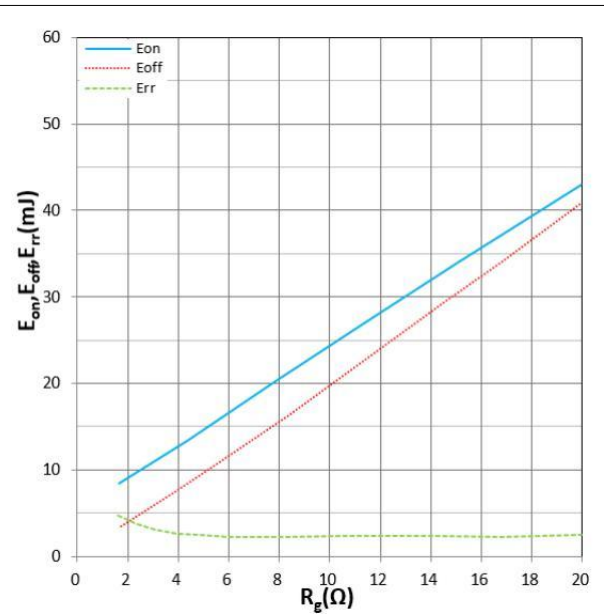


Figure 14. E_{on} , E_{off} , E_{rr} vs R_g
 $T_j = 150^\circ\text{C}$, $V_{DD} = 600\text{V}$, $V_{GS} = +18\text{V}/-4\text{V}$,
 $I_D = 450\text{A}$, Inductive Load

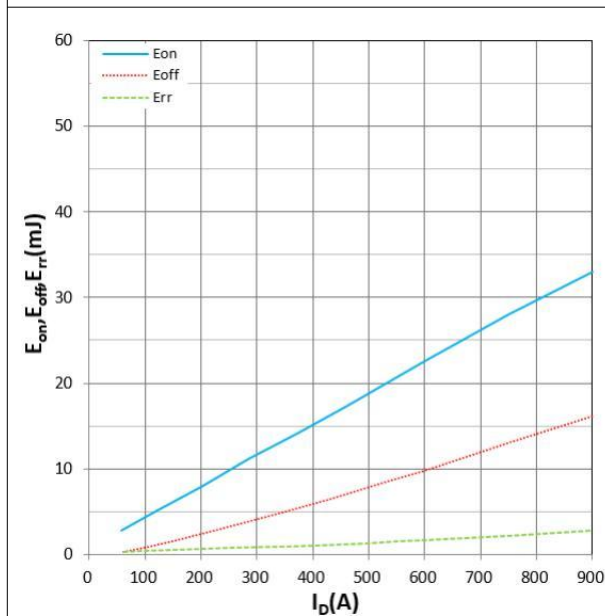


Figure 15. E_{on} , E_{off} , E_{rr} vs I_D
 $T_j = 25^\circ\text{C}$, $V_{DD} = 600\text{V}$, $V_{GS} = +18\text{V}/-4\text{V}$,
 $R_{gon}/R_{goff} = 5.1/3.3\Omega$, Inductive Load

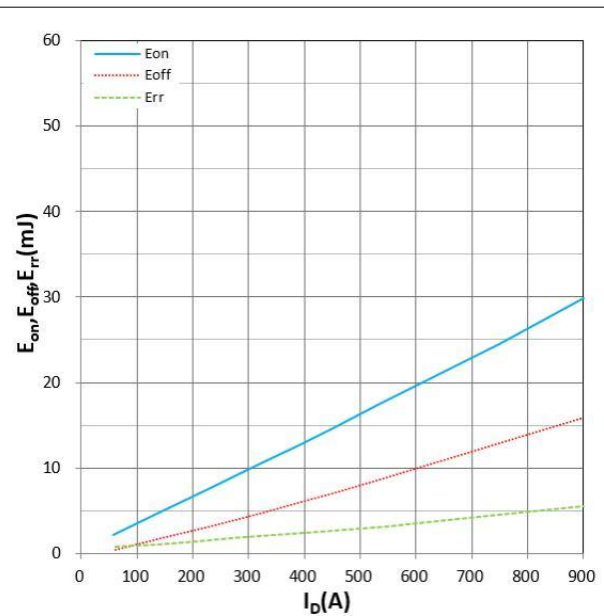


Figure 16. E_{on} , E_{off} , E_{rr} vs I_D
 $T_j = 150^\circ\text{C}$, $V_{DD} = 600\text{V}$, $V_{GS} = +18\text{V}/-4\text{V}$,
 $R_{gon}/R_{goff} = 5.1/3.3\Omega$, Inductive Load

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