

Description

The DFS600HF12I4C1 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
- $R_{DS(on)} = 3.2m\Omega$
- Low thermal resistance with Si₃N₄ 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

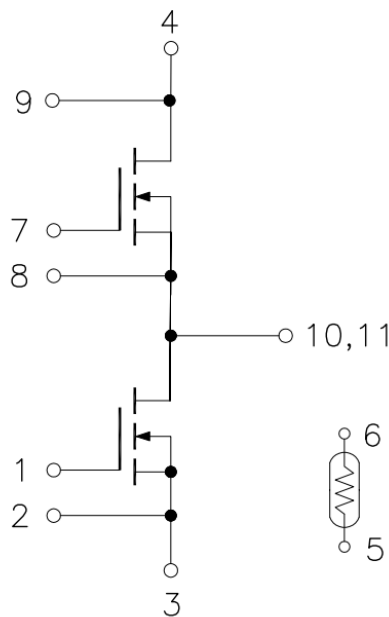


Figure 1. Out drawing & circuit diagram for DFS600HF12I4C1

Pin Configuration and Marking Information

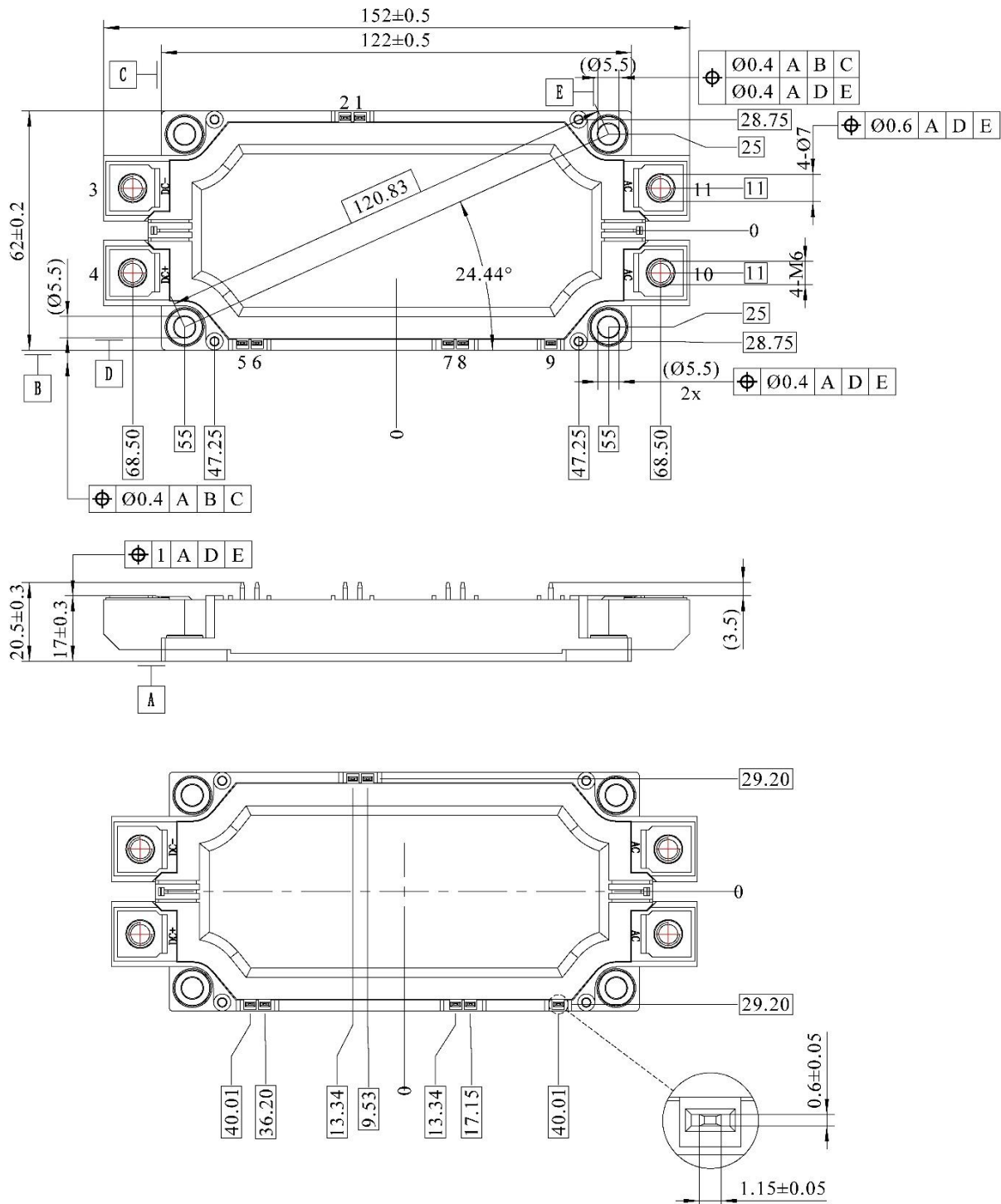


Figure 2. Pin configuration

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	710	A
I _{DS}	DC Continuous Drain Current	T _C =60°C, V _{GS} =18V	620	A
I _{SD}	Source (Body diode) Current	T _C =25°C, with ON signal	710	A
I _{SD}	Source (Body diode) Current	T _C =60°C, with ON signal	620	A
I _{DSM}	Pulse Forward Current	T _C =25°C, Pulse width =1ms, V _{GS} =20V, Note2	1200	A
P _{tot}	Total Power Dissipation	T _C =25°C	2250	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 K))]	-	3375	-	K
B _{25/80}	B-value	R ₂ =R ₂₅ exp [B _{25/80} (1/T ₂ - 1/(298,15 K))]	-	3411	-	K
B _{25/100}	B-value	R ₂ =R ₂₅ exp [B _{25/100} (1/T ₂ - 1/(298,15 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 =600μA	1200	-	-	V	
I _{DSS}	Zero gate voltage drain Current	V _{DS} =1200V, V _{GS} =0V	-	20	-	μA	
V _{GS(th)}	Gate-source threshold Voltage	I _D =210mA 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	-	-	600	nA	
R _{DS(on)} (Chip)	Static drain-source On-state resistance	I _D =600A V _{GS} =+15V	T _j =25°C	-	3.6	5.0	mΩ
			T _j =175°C	-	5.2	-	mΩ
		I _D =600A V _{GS} =+18V	T _j =25°C	-	3.2	-	mΩ
			T _j =175°C	-	4.4	-	mΩ
V _{DS(on)} (Chip)	Static drain-source On-state Voltage	I _D =600A V _{GS} =+15V	T _j =25°C	-	2.16	3.0	V
			T _j =175°C	-	3.12	-	V
		I _D =600A V _{GS} =+18V	T _j =25°C	-	1.92	-	V
			T _j =175°C	-	2.64	-	V
C _{iss}	Input Capacitance	V _D =1000V, V _{GS} =0V f =200kHz, V _{AC} =25mV	-	34.8	-	nF	
C _{oss}	Output Capacitance		-	1.06	-	nF	
C _{rss}	Reverse transfer Capacitance		-	0.086	-	nF	
R _{Gint}	Internal gate resistor	-	-	1.1	-	Ω	
Q _G	Total gate charge	V _{DD} =800V, I _D =360A, V _{GS} =+18/-5V	-	1240	-	nC	
t _{d(on)}	Turn-on delay time	V _{DD} =600V I _D =600A V _{GS} =+18/-4V R _{gon} /R _{goff} =5.1/3.3Ω Inductive load switching operation	T _j =25°C	-	49	-	ns
			T _j =150°C	-	46	-	
t _r	Rise time		T _j =25°C	-	30	-	ns
			T _j =150°C	-	24	-	
t _{d(off)}	Turn-off delay time		T _j =25°C	-	112	-	ns
			T _j =150°C	-	123	-	
t _f	Fall time		T _j =25°C	-	17	-	ns
			T _j =150°C	-	441	-	
E _{on}	Turn-on power dissipation		T _j =25°C	-	28.8	-	mJ
			T _j =150°C	-	26.8	-	
E _{off}	Turn-off power dissipation	T _j =25°C	-	12.4	-	mJ	
		T _j =150°C	-	13.8	-		
R _{th(j-c)}	FET Thermal Resistance	Junction to Case	-	0.066	-	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°C unless otherwise specified, chip)

Symbol	Item	Condition	Value			Unit	
			Min.	Typ.	Max.		
V _{SD}	Body Diode Forward Voltage	V _{GS} = -5V I _{SD} = 600A	T _j = 25°C	-	6.3	-	V
			T _j = 175°C	-	5.6	-	
T _{rr}	Reverse recovery time	V _{DD} = 600V I _D = 600A	T _j = 25°C	-	26	-	ns
			T _j = 150°C	-	49	-	
Q _{rr}	Reverse recovery charge	V _{GS} = +18/-4V R _{gon} /R _{goff} = 5.1/3.3Ω	T _j = 25°C	-	2.3	-	uC
			T _j = 150°C	-	9.6	-	
E _{rr}	Diode switching power dissipation	Inductive load switching operation	T _j = 25°C	-	1.15	-	mJ
			T _j = 150°C	-	4.12	-	

Test Conditions

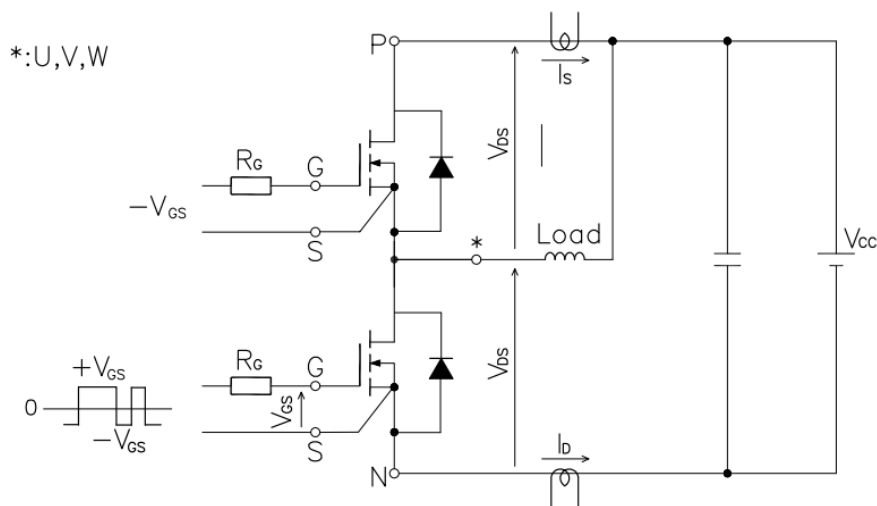


Figure 3. Switching time measure circuit

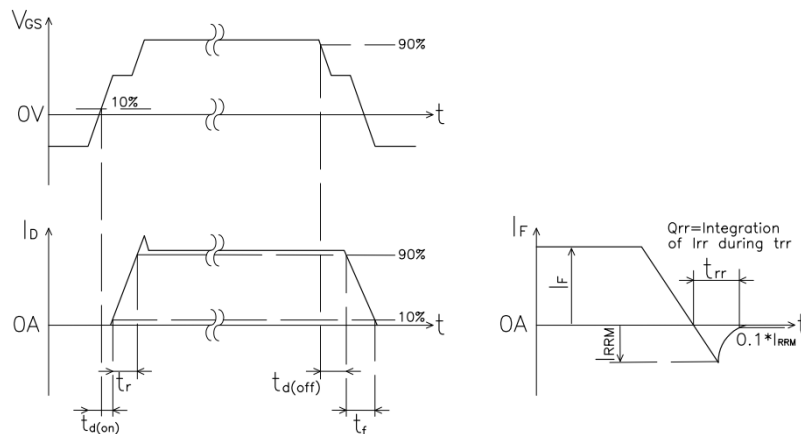


Figure 4. Switching time definition

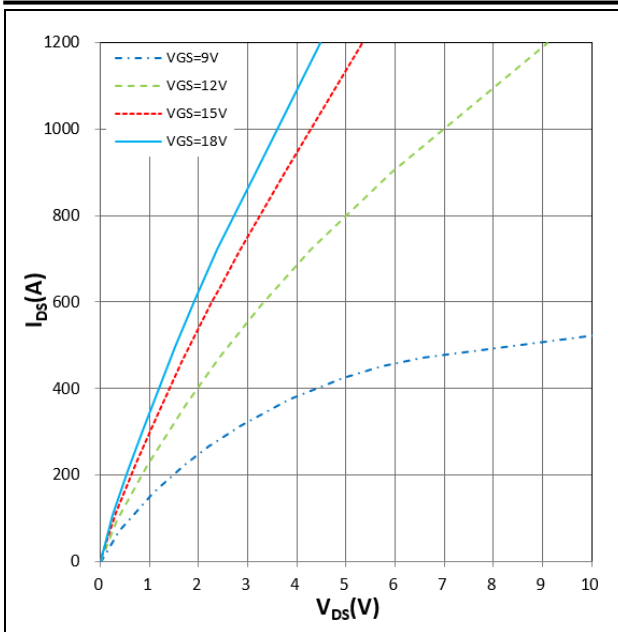


Figure 5. I_{DS} vs V_{DS}
 $T_j = 25^\circ\text{C}$, V_{GS} parameter

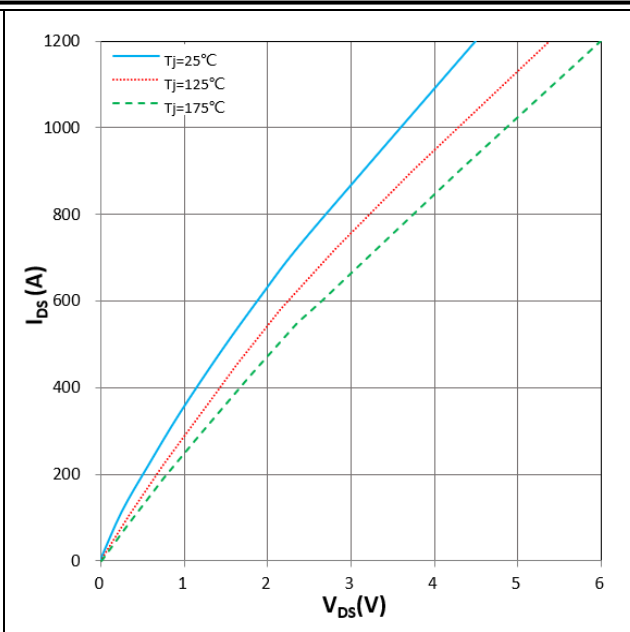


Figure 6. I_{DS} vs V_{DS}
 $V_{GS} = 18\text{V}$, T_j parameter

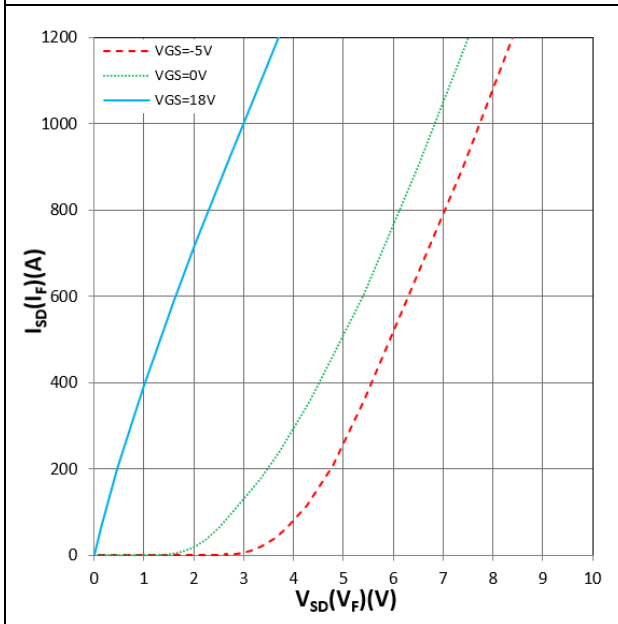


Figure 7. $I_{SD}(I_F)$ vs $V_{SD}(V_F)$
 $T_j = 25^\circ\text{C}$, V_{GS} parameter

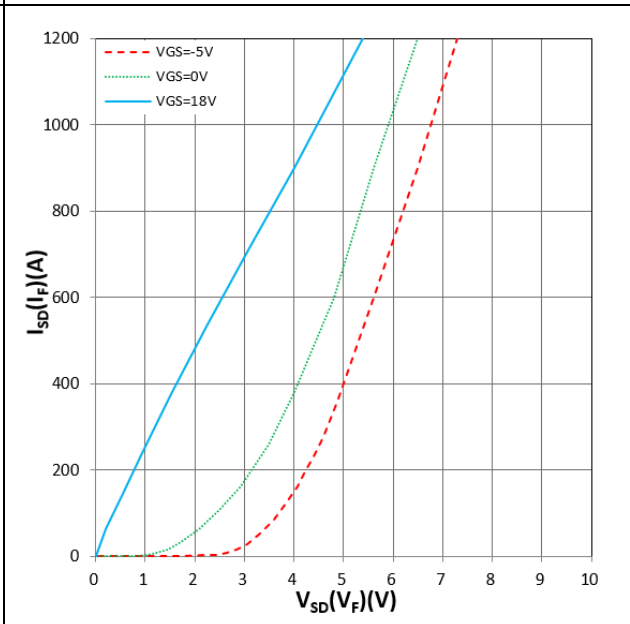


Figure 8. $I_{SD}(I_F)$ vs $V_{SD}(V_F)$
 $T_j = 175^\circ\text{C}$, V_{GS} parameter

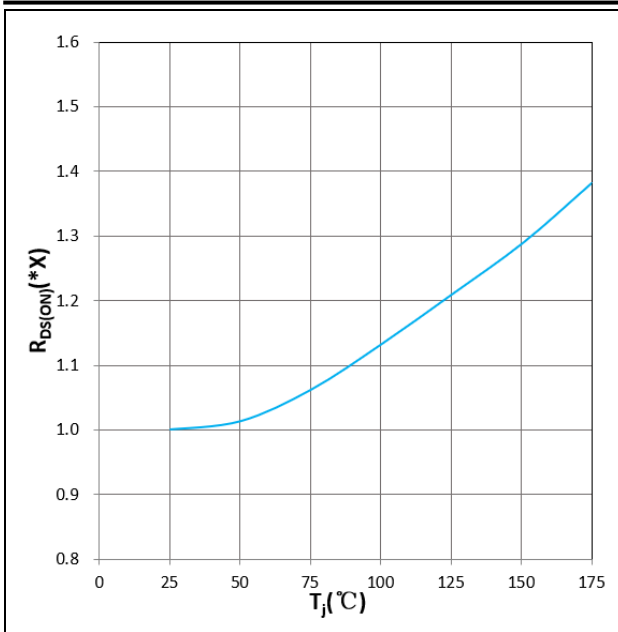


Figure 9. $R_{DS(on)}$ vs T_j
 $V_{GS}=+18V, I_D=600A, 1.0X=3.2m\Omega$

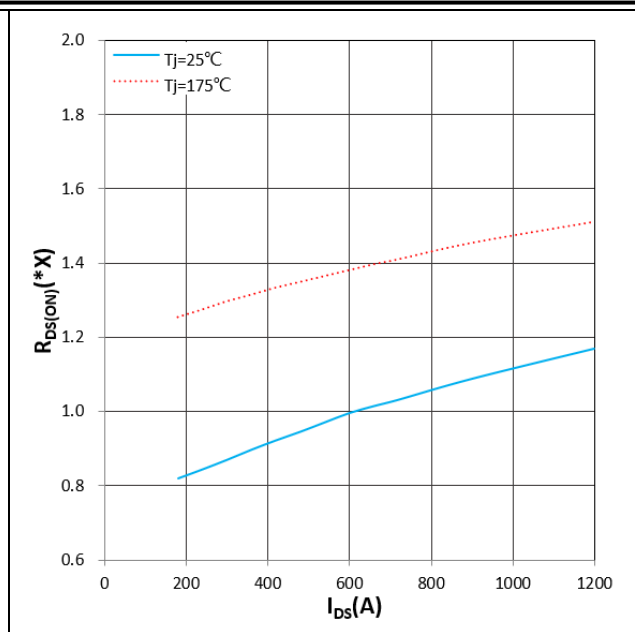


Figure 10. $R_{DS(on)}$ vs I_{DS}
 $T_j=25^\circ C/175^\circ C, V_{GS}=+18V, 1.0X=3.2m\Omega$

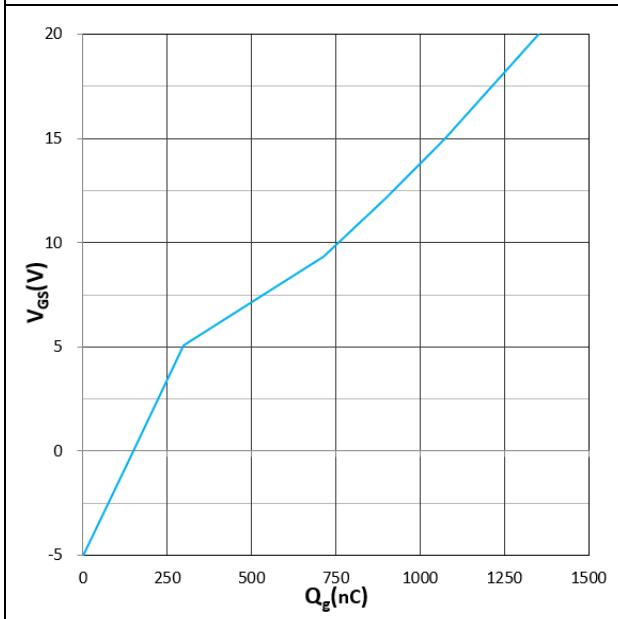


Figure 11. V_{GS} vs Q_g
 $T_j=25^\circ C, V_{DS}=800V, I_D=360A$

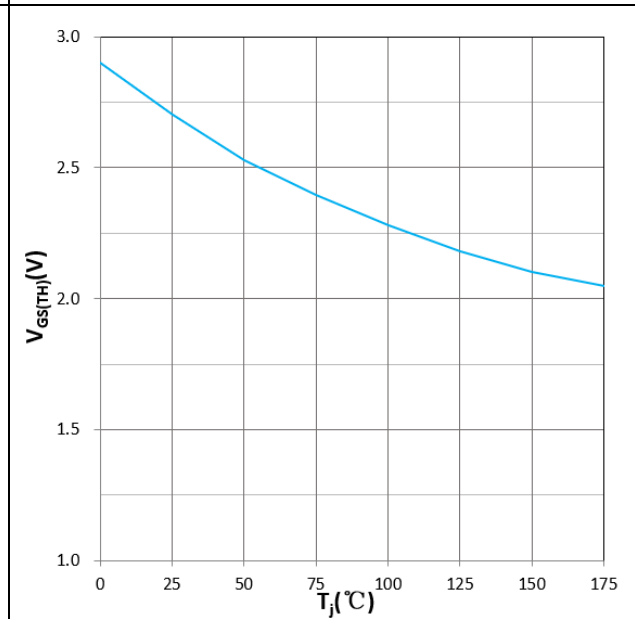


Figure 12. $V_{GS(th)}$ vs T_j
 $V_{GS}=V_{DS}, I_D=210mA$

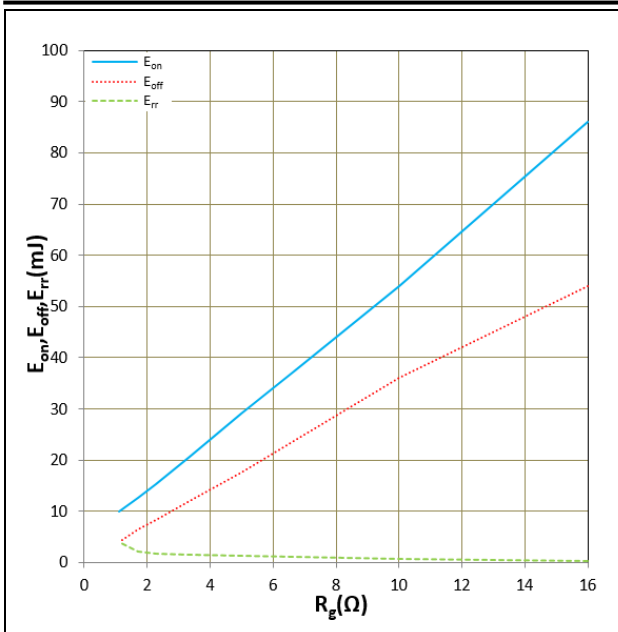


Figure 13. E_{on} , E_{off} , E_{rr} vs R_g
 $T_j=25^\circ\text{C}$, $V_{DD}=600\text{V}$, $V_{GS}=+18\text{V}/-4\text{V}$, $I_D=600\text{A}$
 Inductive Load

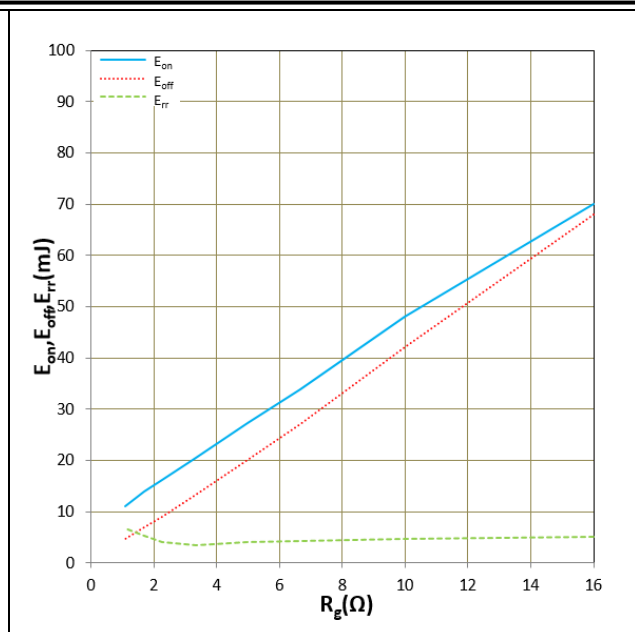


Figure 14. E_{on} , E_{off} , E_{rr} vs R_g
 $T_j=150^\circ\text{C}$, $V_{DD}=600\text{V}$, $V_{GS}=+18\text{V}/-4\text{V}$, $I_D=600\text{A}$
 Inductive Load

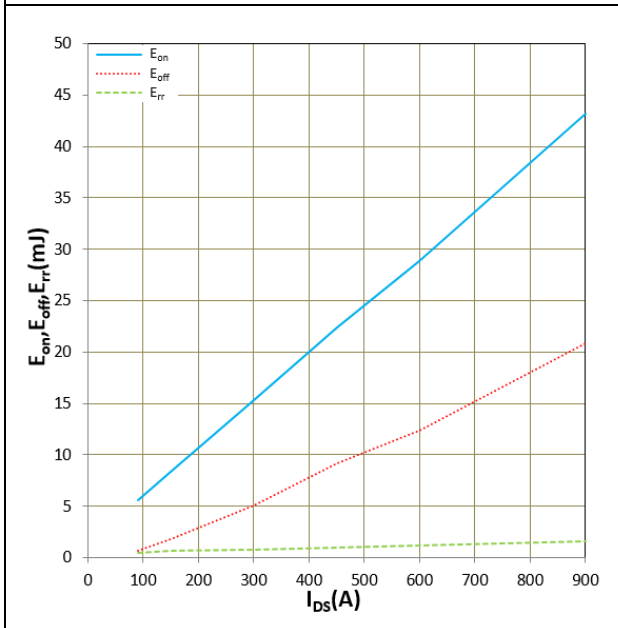


Figure 15. E_{on} , E_{off} , E_{rr} vs I_D
 $T_j=25^\circ\text{C}$, $V_{DD}=600\text{V}$, $V_{GS}=+18\text{V}/-4\text{V}$,
 $R_{gon}/R_{goff}=5.1/3.3\Omega$, Inductive Load

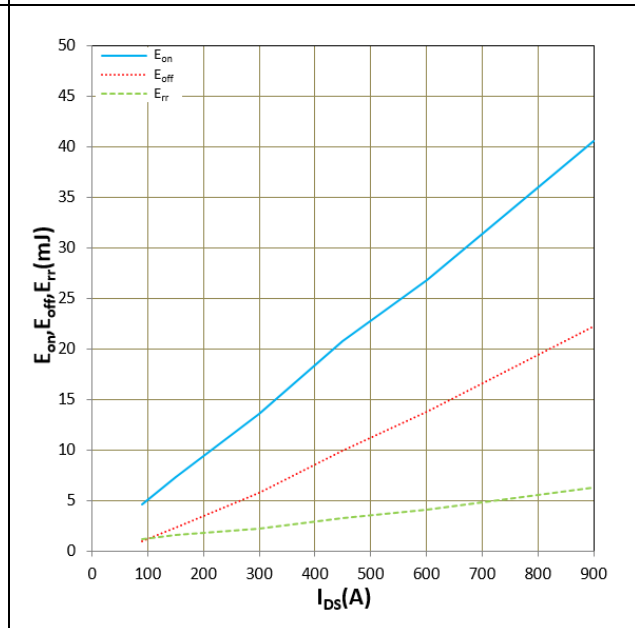


Figure 16. E_{on} , E_{off} , E_{rr} vs I_D
 $T_j=150^\circ\text{C}$, $V_{DD}=600\text{V}$, $V_{GS}=+18\text{V}/-4\text{V}$,
 $R_{gon}/R_{goff}=5.1/3.3\Omega$, Inductive Load

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