

Description

The DFS400HF14I3Q1 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 1400V
- $R_{DS(on)} = 4.8m\Omega @ T_j = 25^\circ C, V_{GS} = 20V$
- Low thermal resistance with Si₃N₄ AMB
- 175°C maximum junction temperature
- Low Inductive Design
- Thermistor inside
- Low Switching Losses

Applications

- xEV Applications
- Motor Drives
- Vehicle Fast Chargers
- Renewable energy

Circuit diagram

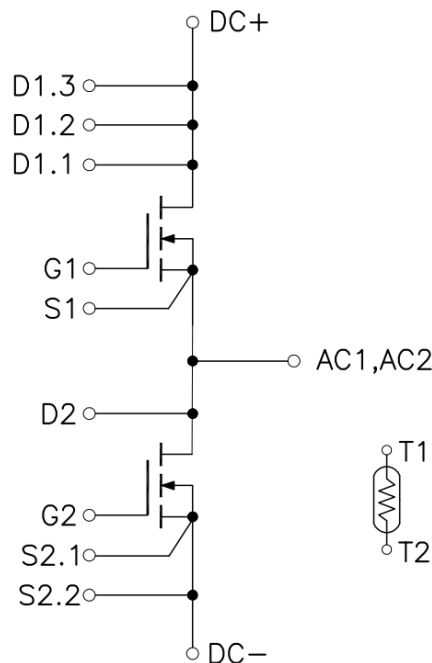


Figure 1. Out drawing & circuit diagram for DFS400HF14I3Q1

Note: Please use S2.1 for the low side drive signal and do not connect it to S2.2 which is power terminal

Pin Configuration and Marking Information

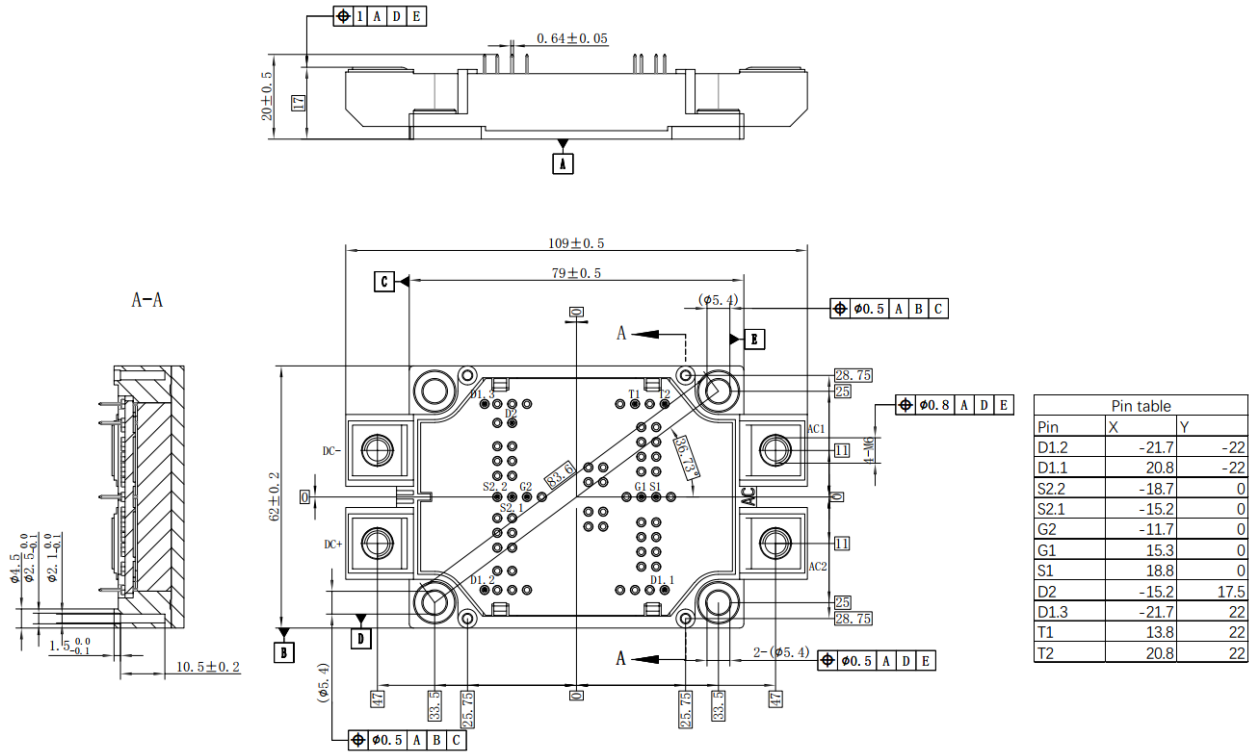


Figure 2. Pin configuration

Module

Parameter	Conditions	Value	Unit
Isolation Voltage	RMS, f =50Hz, t =1min	4.0	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	0.3	mΩ
Mounting torque for module mounting	M5, M6	3 to 6	Nm
Weight	-	250	g

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

Symbol	Parameter	Conditions	Ratings	Unit
V _{DSS}	Drain-Source Voltage	G-S Short	1400	V
V _{DS nom}	Continuous Operating DC Voltage	Not include surge voltage	1100	V
V _{GSS}	Gate-Source Voltage	D-S Short, AC frequency ≥ 1Hz, Note1	-10 to 25	V
I _{DS}	DC Continuous Drain Current	T _C = 80°C, V _{GS} = 20V	400	A
I _{DS}	DC Continuous Drain Current	T _C = 120°C, V _{GS} = 20V	300	A
I _{SD}	Source (Body diode) Current	T _C = 80°C, with ON signal	400	A
I _{SD}	Source (Body diode) Current	T _C = 120°C, with ON signal	300	A
I _{DSM}	Pulse Forward Current	T _C = 25°C, Pulse width = 1ms, V _{GS} = 20V, Note2	800	A
P _{tot}	Total Power Dissipation	T _C = 25°C	2500	W
T _{jmax}	Max Junction Temperature	-	175	°C
T _{stg}	Storage Temperature	-	-40 to 125	°C

Note1: Recommended Operating Value, +20V/-5V, +18V/-5V, +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 R100	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 =2mA		1400	-	-	V	
I _{DSS}	Zero gate voltage drain Current	V _{DS} =1400V, V _{GS} =0V		-	4	-	μA	
V _{GS(th)}	Gate-source threshold Voltage	I _D =80mA V _{DS} =V _{GS}	T _j =25°C	1.8	2.5	4.0	V	
			T _j =175°C	-	1.6	-	V	
I _{GSS}	Gate-Source Leakage Current	V _{GS} =20V, V _{DS} =0V, T _j =25°C		-	100	800	nA	
R _{DS(on)} (Chip)	Static drain-source On-state resistance	I _D =400A V _{GS} =20V	T _j =25°C	-	4.8	-	mΩ	
			T _j =175°C	-	9.3	-	mΩ	
		I _D =400A V _{GS} =18V	T _j =25°C	-	5.4	-	mΩ	
			T _j =175°C	-	9.7	-	mΩ	
V _{DS(on)} (Chip)	Static drain-source On-state Voltage	I _D =400A V _{GS} =20V	T _j =25°C	-	1.9	-	V	
			T _j =175°C	-	3.7	-	V	
		I _D =400A V _{GS} =18V	T _j =25°C	-	2.2	-	V	
			T _j =175°C	-	3.9	-	V	
C _{iss}	Input Capacitance	V _D =1000V, V _{GS} =0V f =200kHz, V _{AC} =25mV		-	25.3	-	nF	
C _{oss}	Output Capacitance			-	1.44	-	nF	
C _{rss}	Reverse transfer Capacitance			-	0.15	-	nF	
Q _G	Total gate charge	V _{DD} =800V, I _D =200A, V _{GS} =+20/-5V		-	865	-	nC	
R _{Gint}	Internal Gate Resistance	T _j =25°C		-	1.0	-	Ω	
t _{d(on)}	Turn-on delay time	V _{DD} =600V I _D =400A V _{GS} =+18/-5V R _{G(on)} =3.3Ω R _{G(off)} =3.3Ω Inductive load switching operation		T _j =25°C	-	48	-	ns
				T _j =150°C	-	43	-	
t _r	Rise time			T _j =25°C	-	37	-	ns
				T _j =150°C	-	30	-	
t _{d(off)}	Turn-off delay time			T _j =25°C	-	34	-	ns
				T _j =150°C	-	45	-	
t _f	Fall time			T _j =25°C	-	18	-	ns
				T _j =150°C	-	21	-	
E _{on}	Turn-on power dissipation	T _j =25°C	-	10.6	-	mJ		
		T _j =150°C	-	14.9	-			
E _{off}	Turn-off power dissipation	T _j =25°C	-	2.6	-	mJ		
		T _j =150°C	-	4.4	-			
R _{th(j-c)}	FET Thermal Resistance	Junction to Case		-	0.06	-	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} = 400A	T _j = 25°C	-	4.6	-	V
			T _j = 150°C	-	4.0	-	
T _{rr}	Reverse recovery time	V _{RR} = 800V, I _D = 400A MOSFET side:	T _j = 25°C	-	29	-	ns
			T _j = 150°C	-	34	-	
Q _{rr}	Reverse recovery charge	V _{GS} = +18/-5V R _{G(on)} = R _{G(off)} = 3.3Ω	T _j = 25°C	-	1.5	-	uC
			T _j = 150°C	-	3.8	-	
E _{rr}	Diode switching power dissipation	Inductive load switching operation	T _j = 25°C	-	0.5	-	mJ
			T _j = 150°C	-	1.8	-	

Test Conditions

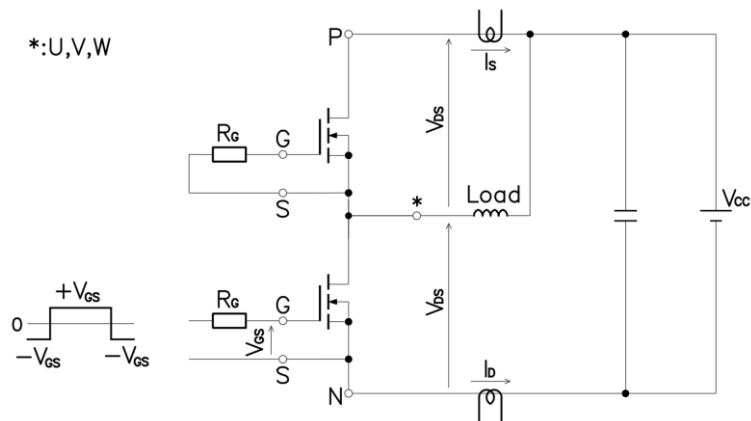


Figure 3. Switching time measure circuit

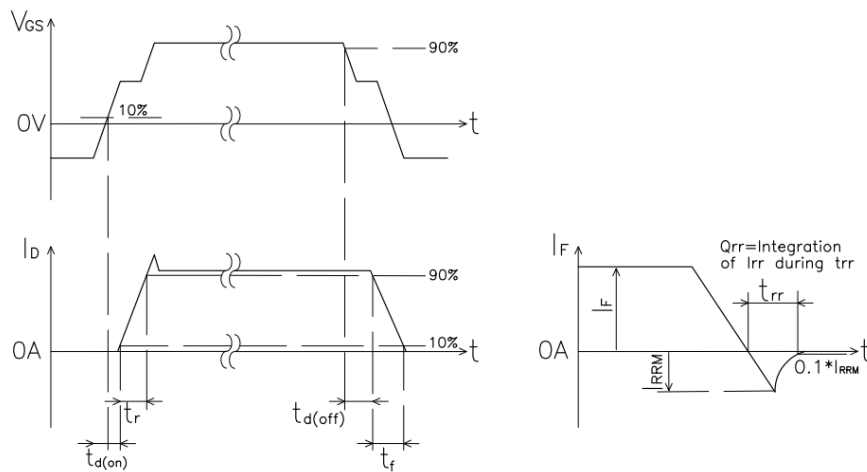


Figure 4. Switching time definition

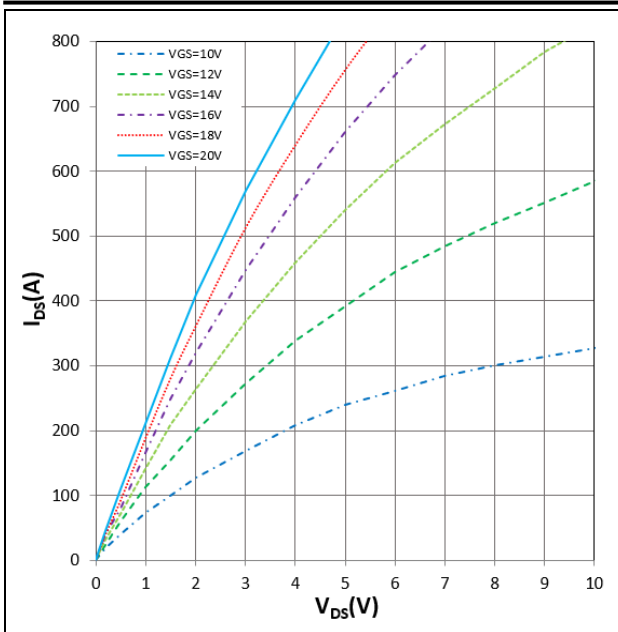


Figure 5. I_{DS} vs V_{DS}
 $T_j = 25^\circ\text{C}$, V_{GS} parameter

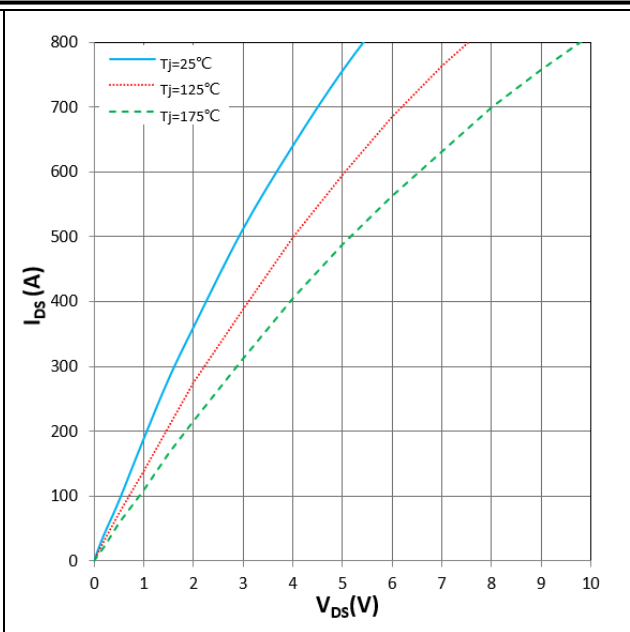


Figure 6. I_{DS} vs V_{DS}
 $V_{GS} = 18\text{V}$, T_j parameter

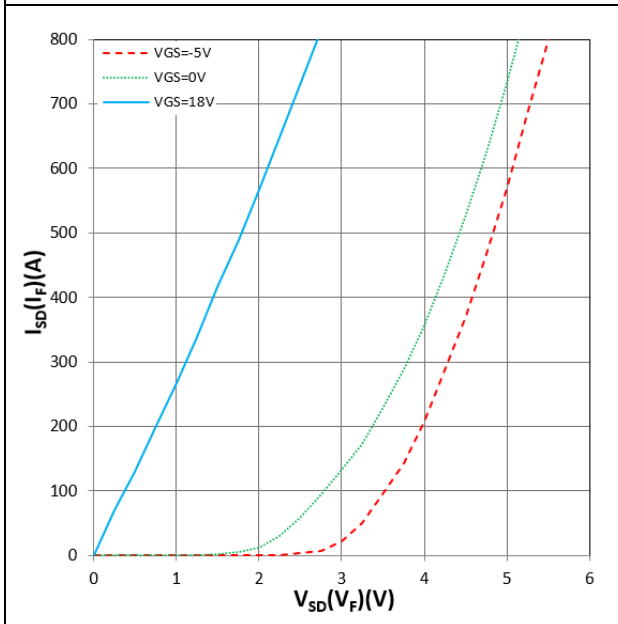


Figure 7. $I_{SD}(I_F)$ vs $V_{SD}(V_F)$
 $T_j = 25^\circ\text{C}$, V_{GS} parameter

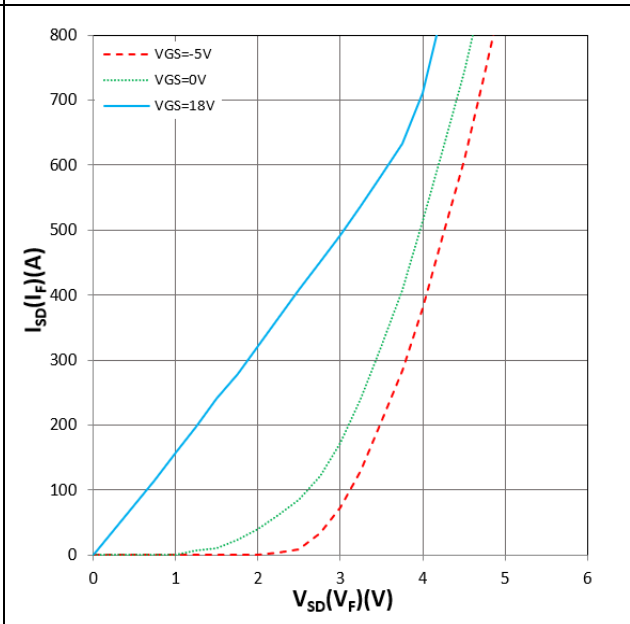


Figure 8. $I_{SD}(I_F)$ vs $V_{SD}(V_F)$
 $T_j = 175^\circ\text{C}$, V_{GS} parameter

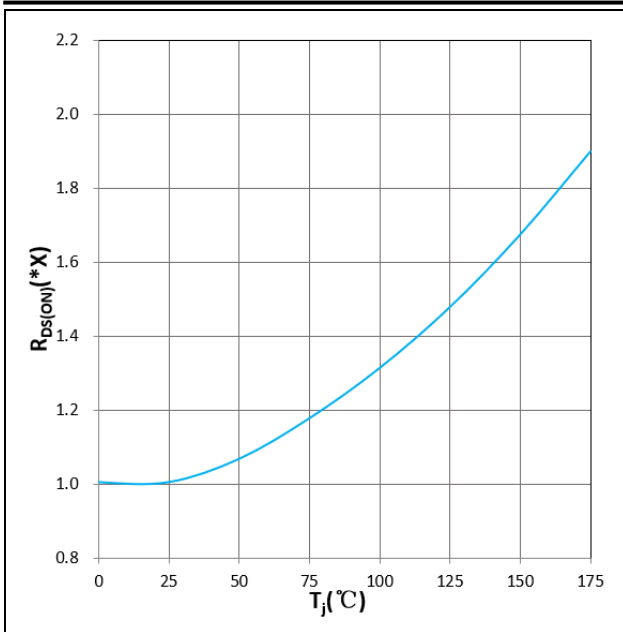


Figure 9. $R_{DS(ON)}$ vs T_j
 $V_{GS}=+20V, I_D=400A, 1.0X=4.8m\Omega$

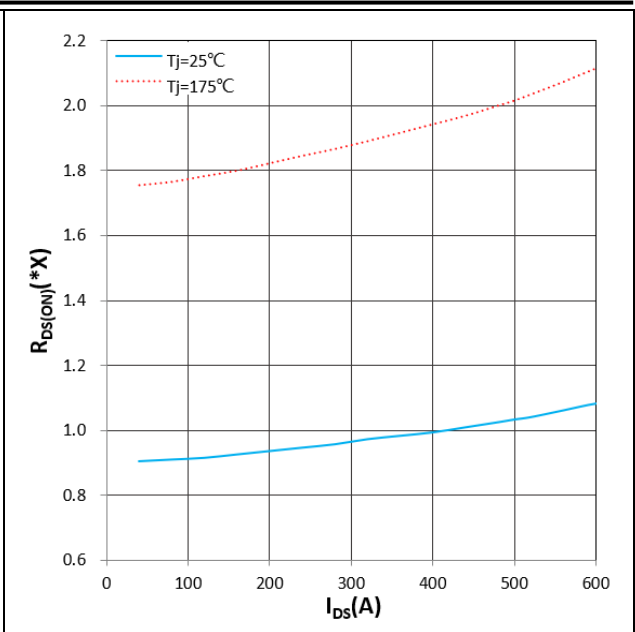


Figure 10. $R_{DS(ON)}$ vs I_{DS}
 $T_j=25^\circ C/175^\circ C, V_{GS}=+20V, 1.0X=4.8m\Omega$

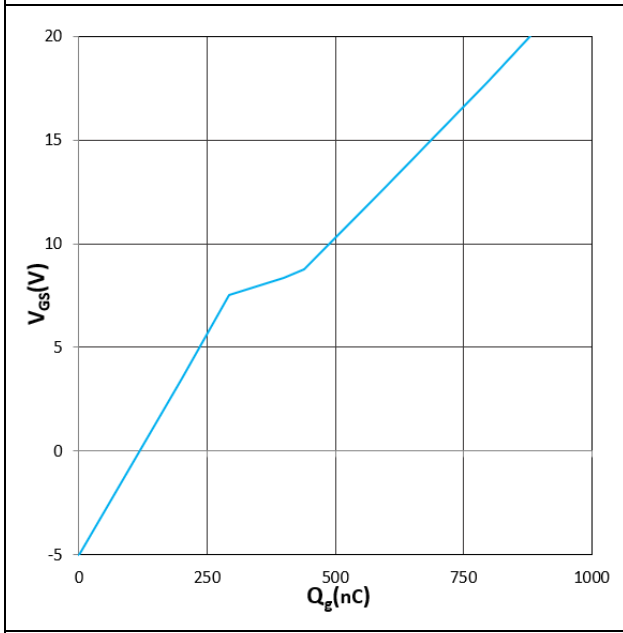


Figure 11. V_{GS} vs Q_g
 $T_j=25^\circ C, V_{DS}=800V, I_D=200A$

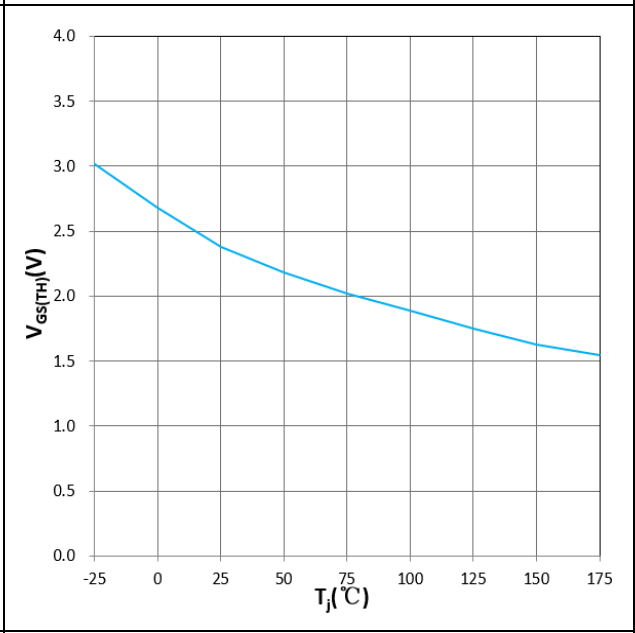


Figure 12. $V_{GS(TH)}$ vs T_j
 $V_{GS}=V_{DS}, I_D=80mA$

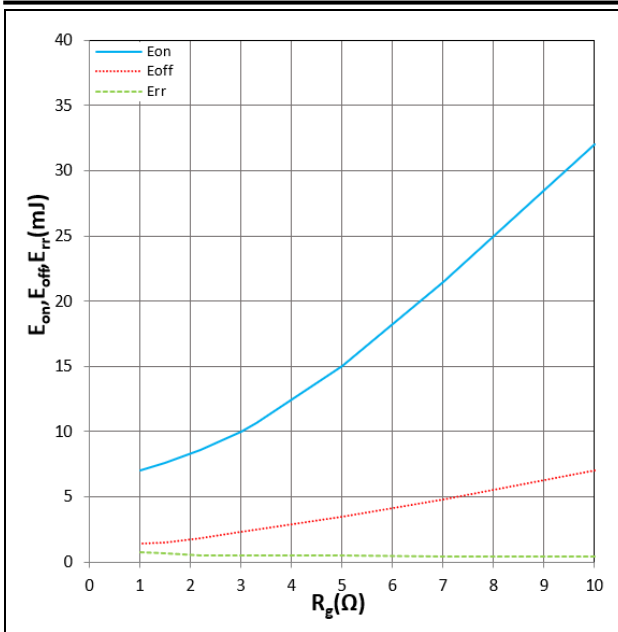


Figure 13. E_{on} , E_{off} , E_{rr} vs R_g
 $T_j=25^\circ\text{C}$, $V_{DD}=600\text{V}$, $V_{GS}=+18\text{V}/-5\text{V}$, $I_D=400\text{A}$
 Inductive Load

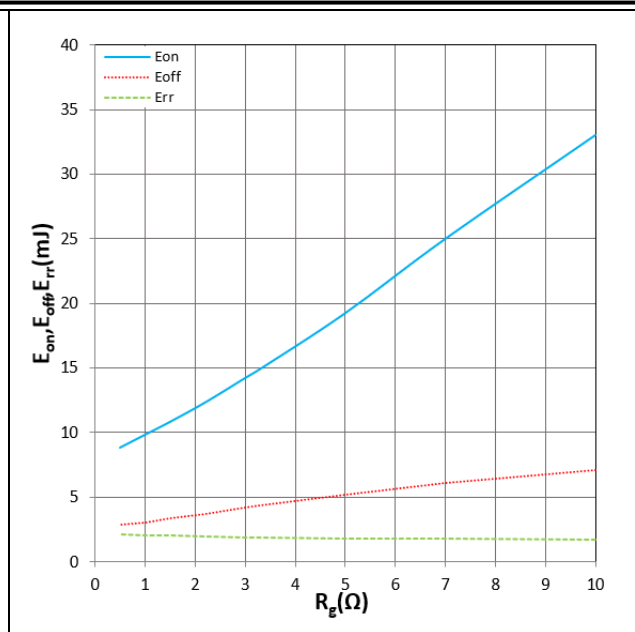


Figure 14. E_{on} , E_{off} , E_{rr} vs R_g
 $T_j=150^\circ\text{C}$, $V_{DD}=600\text{V}$, $V_{GS}=+18\text{V}/-5\text{V}$, $I_D=400\text{A}$
 Inductive Load

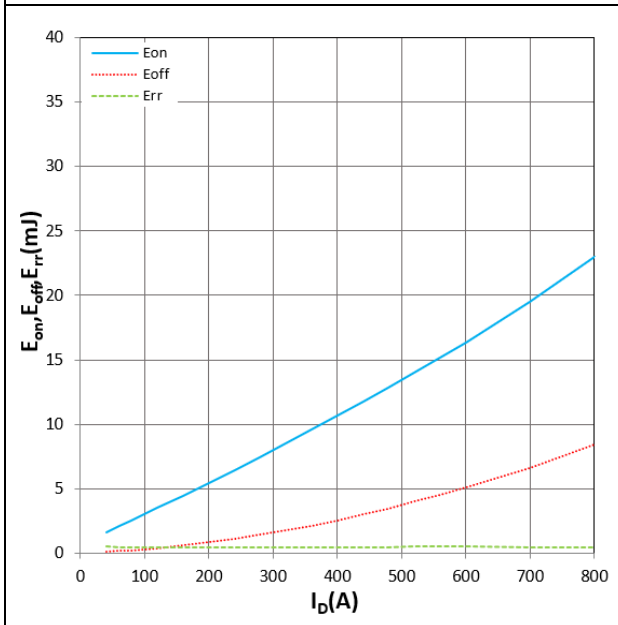


Figure 15. E_{on} , E_{off} , E_{rr} vs I_D
 $T_j=25^\circ\text{C}$, $V_{DD}=600\text{V}$, $V_{GS}=+18\text{V}/-5\text{V}$, $R_g=3.3\Omega$
 Inductive Load

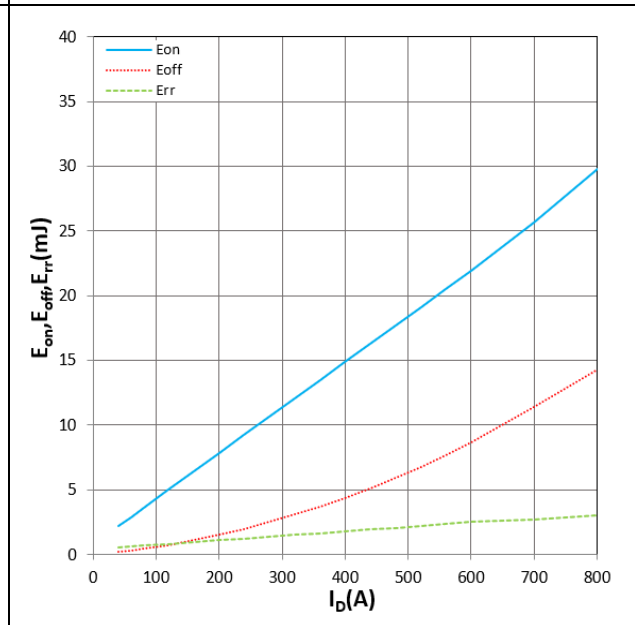


Figure 16. E_{on} , E_{off} , E_{rr} vs I_D
 $T_j=150^\circ\text{C}$, $V_{DD}=600\text{V}$, $V_{GS}=+18\text{V}/-5\text{V}$, $R_g=3.3\Omega$
 Inductive Load

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