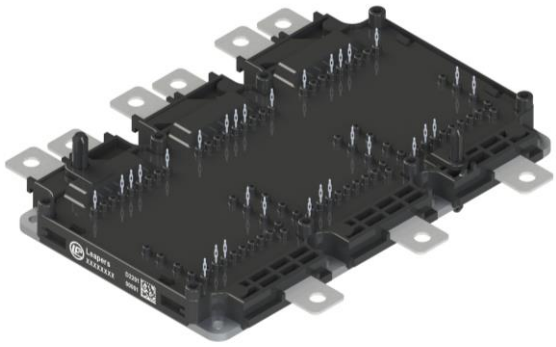
DFS03FB14HDA1S

1400V/600A 3 Phase SiC MOSFET Module

Description

The DFS03FB14HDA1S is a 3 Phase SiC MOSFET Power Module. It integrates high performance SiC MOSFET chips for xEV or motor drives application.



Features

- Blocking voltage 1400V
- $R_{DS(on)}$ =3.2mΩ (T_j =25°C)
- 175°C maximum junction temperature
- Si_3N_4 AMB substrate
- Direct Cooled Pin Fin Base Plate
- Thermistor inside
- Press FIT Contact Technology

Applications

- xEV Applications
- Motor Drives

Circuit diagram

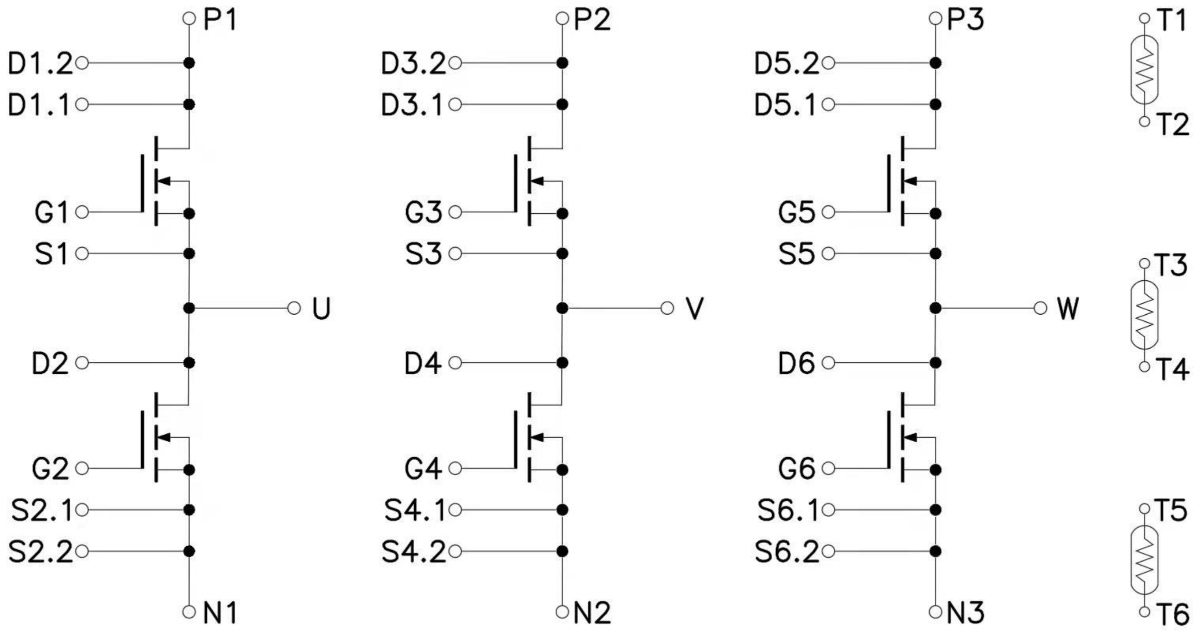


Figure 1. Out drawing & circuit diagram for DFS03FB14HDA1S

Physical Dimensions

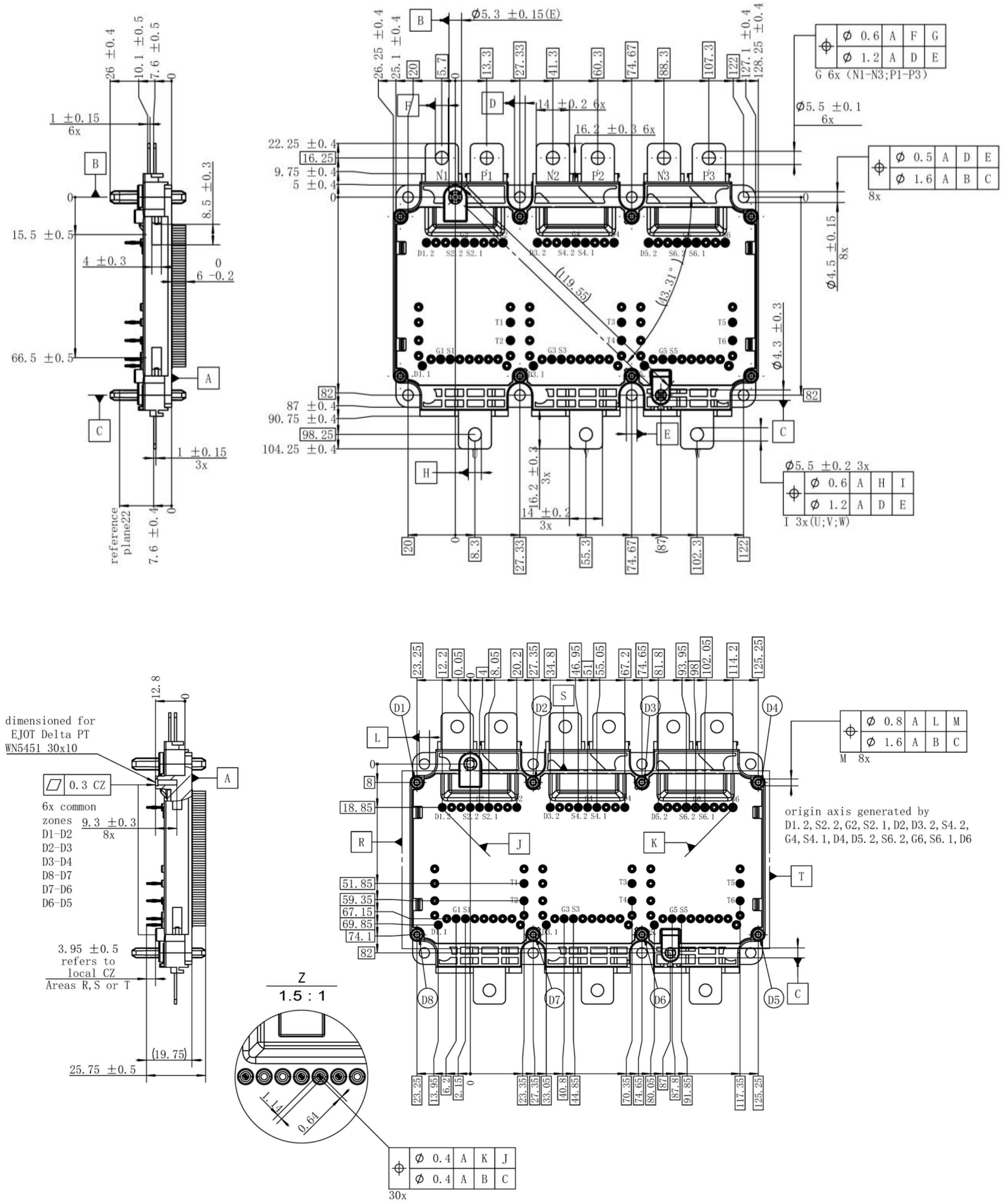


Figure2. Physical Dimensions

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

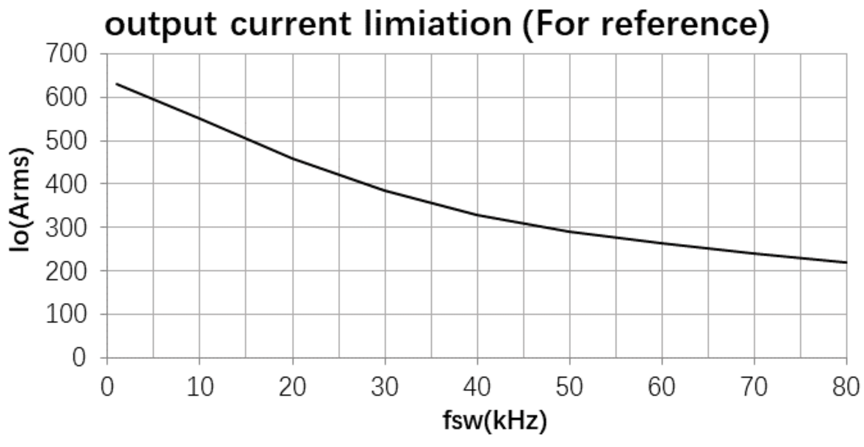
Symbol	Parameter	Condition	Ratings	Unit
V_{DSS}	Drain-Source Voltage	G-S Short	1400	V
$V_{DS\ nom}$	Continuous Operating DC Voltage	Not include surge voltage	1200	V
V_{GSS}	Gate-Source Voltage	D-S Short, AC frequency ⩾1Hz, Note1	-10V/+25V	V
I_{DS}	DC Continuous Drain Current	T_f =25°C, V_{GS} =20V	530	A
I_{DS}	DC Continuous Drain Current	T_f =65°C, V_{GS} =20V	460	A
I_{SD}	Source (Body Diode) Current	T_f =25°C, with ON signal	530	A
I_{SD}	Source (Body Diode) Current	T_f =65°C, with ON signal	460	A
I_{DP}	Drain Pulse Current, Peak	Less than 1ms, Note2	1200	A
P_D	Maximum Power Dissipation	T_f =25°C	1785	W
T_j	Operating Junction temperature	-	-40 to 175	°C
T_{stg}	Storage temperature	-	-40 to 125	°C

Note1: Recommended Operating Value, +20V/-5V ,+18V/-4V, +15V/-4V

Note2: Pulse width limited by maximum junction temperature

Typical current output ability

Condition: SPWM control, V_{DD} =800V, $R_{G(on)}$ =$R_{G(off)}$ =5.0Ω, T_f =65°C, T_{jmax} =175°C, PF =0.8, Modulation rate =1



Note1: This graph is calculated value for reference based on the limitation of T_{jmax} =175°C. The actual current out ability depends on inverter electrical, thermal and mechanic design. Please confirm it in actual application system.

Module

Parameter	Condition	Value	Unit
Isolation voltage	Main terminal to base plate, f =0Hz, t =1sec	4.0	kV
Material of module baseplate	-	Cu + Ni	-
Creepage distance	terminal to heatsink terminal to terminal	9	mm
Clearance	terminal to heatsink terminal to terminal	4.5	mm
Stray inductance module	T_f =65°C	8	nH
Module lead resistance, terminals – chip	T_f =65°C	0.2	mΩ
Mounting torque for module mounting	Screw M4 baseplate to heatsink	1.8 to 2.2	Nm
Weight	-	798	g

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	R2 =R25 exp [$B_{25/50}$(1/T2 - 1/(298,15 K))]	-	3375	-	K
$B_{25/80}$	B-value	R2 =R25 exp [$B_{25/80}$(1/T2 - 1/(298,15 K))]	-	3411	-	K
$B_{25/100}$	B-value	R2 =R25 exp [$B_{25/100}$(1/T2 - 1/(298,15 K))]	-	3433	-	K

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

Symbol	Item	Condition		Value Min.	Value Typ.	Value Max	Unit
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	V_{GS} =0V, I_D =600μA		1400	-	-	V
I_{DSS}	Zero gate voltage drain current	V_{DS} =1400V, V_{GS} =0V		-	60	-	μA
$V_{GS(th)}$	Gate-source threshold Voltage	I_D =120mA, V_{DS} =V_{GS}	T_j =25°C	1.9	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		-	-	1200	nA
$R_{DS(on)}$ (Chip)	Static drain-source On-state resistance	I_D =600A, V_{GS} =20V	T_j =25°C	-	3.2	-	mΩ
			T_j =175°C	-	6.2	-	mΩ
		I_D =600A, V_{GS} =18V	T_j =25°C	-	3.5	-	mΩ
			T_j =175°C	-	6.5	-	mΩ
$V_{DS(on)}$ (Chip)	Static drain-source On-state voltage	I_D =600A, V_{GS} =20V	T_j =25°C	-	1.9	-	V
			T_j =175°C	-	3.7	-	V
		I_D =600A, V_{GS} =18V	T_j =25°C	-	2.1	-	V
			T_j =175°C	-	3.9	-	V
C_{iss}	Input capacitance	V_D =1000V, V_{GS} =0V, f =100kHz		-	28.62	-	nF
C_{oss}	Output capacitance			-	1.30	-	nF
C_{rss}	Reverse transfer capacitance			-	0.10	-	nF
Q_G	Total gate charge	V_{DD} =800V, I_D =300A, V_{GS} =+20/-5V		-	1620	-	nC
Q_{GS}	Gate to source charge			-	372	-	nC
Q_{GD}	Gate to drain charge			-	468	-	nC
R_{Gint}	Internal Gate Resistance	T_j =25°C		-	1.5	-	Ω
$t_{d(on)}$	Turn-on delay time	V_{DD} =800V, I_D =600A, V_{GS} =+18/-4V, $R_{G(on)}$ =3.3Ω, $R_{G(off)}$ =3.3Ω, Inductive load switching operation	T_j =25°C	-	71	-	ns
			T_j =150°C	-	63	-	ns
t_r	Rise time		T_j =25°C	-	59	-	ns
			T_j =150°C	-	48	-	ns
$t_{d(off)}$	Turn-off delay time		T_j =25°C	-	48	-	ns
			T_j =150°C	-	63	-	ns
t_f	Fall time		T_j =25°C	-	30	-	ns
			T_j =150°C	-	41	-	ns
E_{on}	Turn-on power dissipation		T_j =25°C	-	16.2	-	mJ
			T_j =150°C	-	22.9	-	mJ
E_{off}	Turn-off power dissipation		T_j =25°C	-	4.4	-	mJ
			T_j =150°C	-	7.1	-	mJ
$R_{th(j-f)}$	FET Thermal Resistance	Junction to cooling fluid $\Delta V/\Delta t$ =10dm³/min, T_f =65°C		-	0.084	-	K/W

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	T_j =25°C	-	5.8	-	V
		I_{SD} =600A	T_j =175°C	-	5.2	-	
T_{rr}	Reverse recovery time	V_{RR} =800V, I_D =600A	T_j =25°C	-	44	-	ns
		MOSFET side:	T_j =150°C	-	51	-	
Q_{rr}	Reverse recovery charge	V_{GS} =+18/-4V	T_j =25°C	-	3.4	-	µC
		$R_{G(on)}$ = $R_{G(off)}$ =3.3Ω	T_j =150°C	-	7.3	-	
E_{rr}	Diode switching power dissipation	Inductive load	T_j =25°C	-	0.9	-	mJ
		switching operation	T_j =150°C	-	2.8	-	

Test Conditions

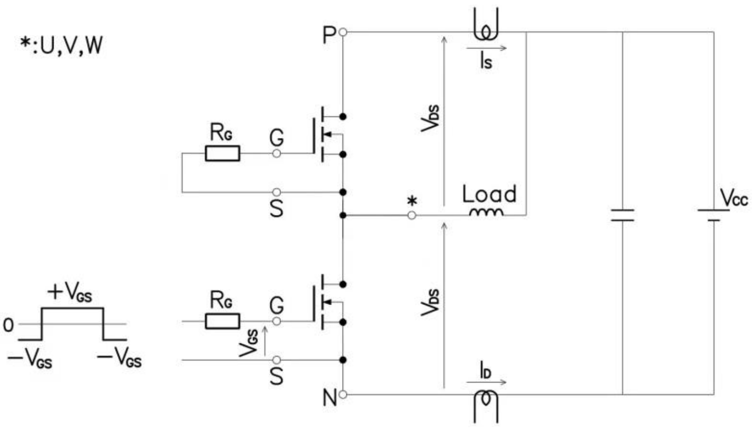


Figure 3. Switching time measure circuit

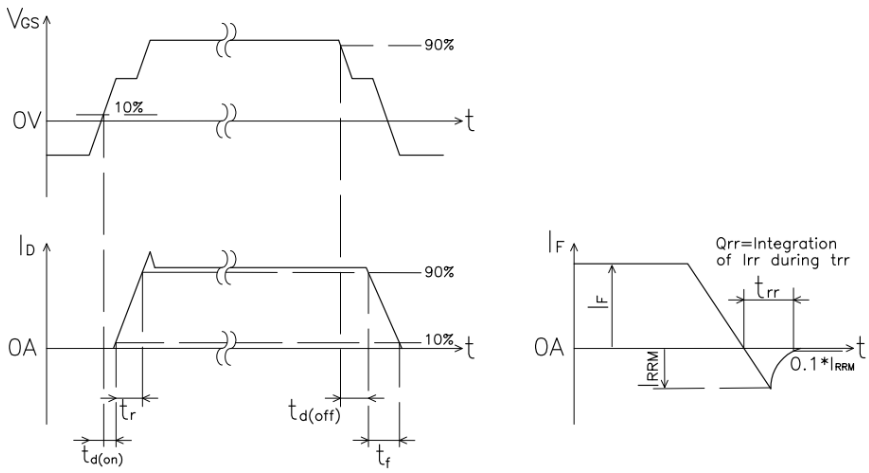


Figure 4. Switching time definition

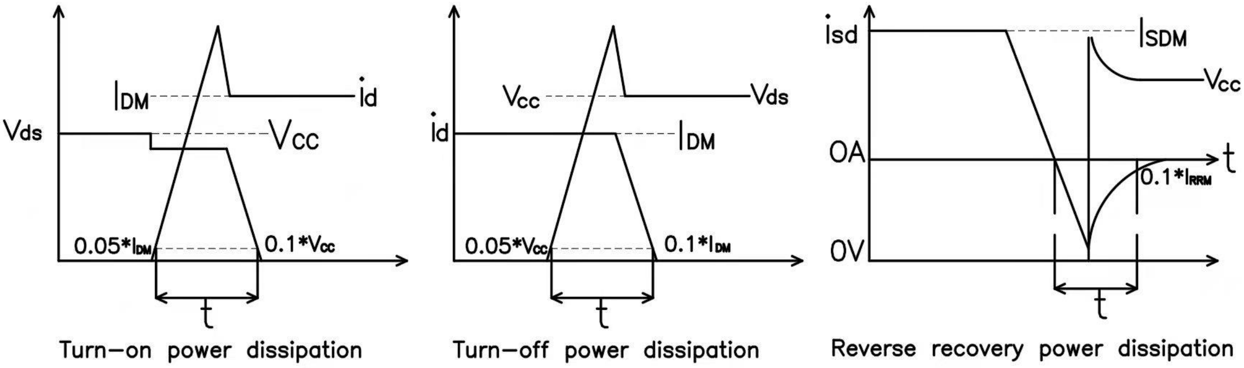
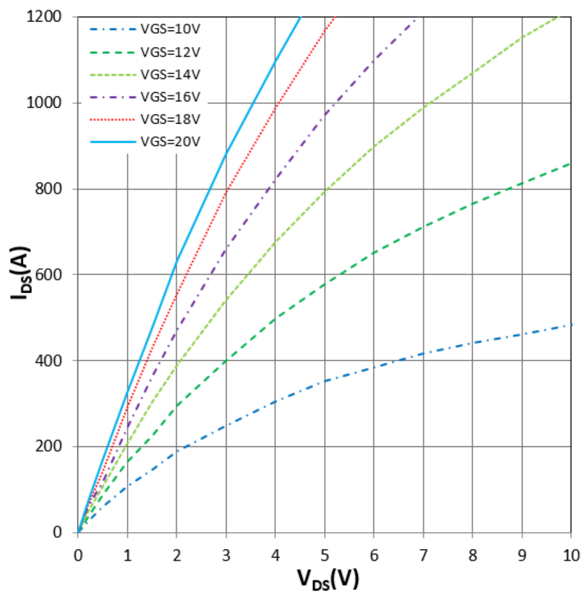


Figure 5. Switching power dissipation definition



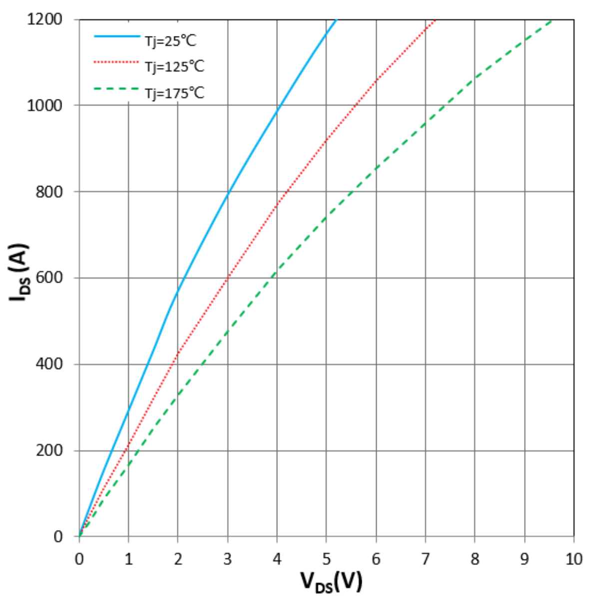


Figure 6. I_{DS} vs V_{DS} T_j =25℃, V_{GS} parameter	Figure 7. I_{DS} vs V_{DS} V_{GS} =18V, T_j parameter

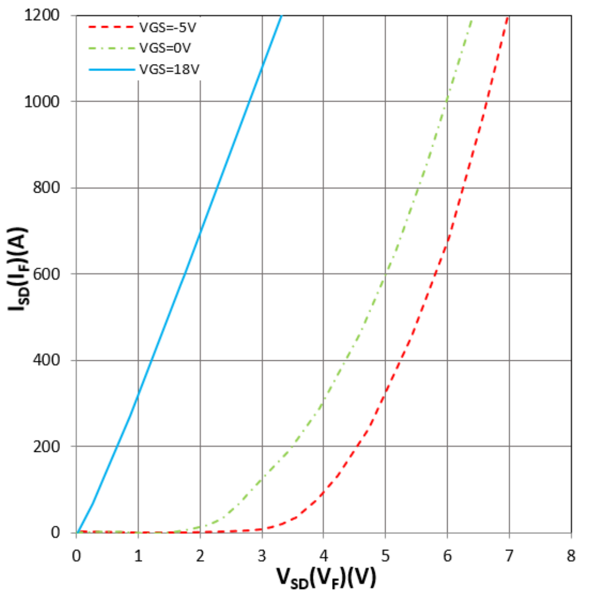


Figure 8. I_{SD} vs V_{SD}

T_j =25℃, V_{GS} parameter

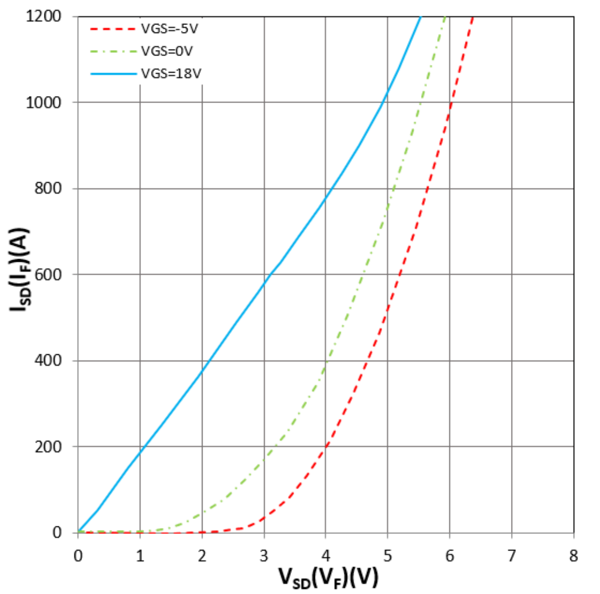


Figure 9. I_{SD} vs V_{SD}

T_j =175℃, V_{GS} parameter

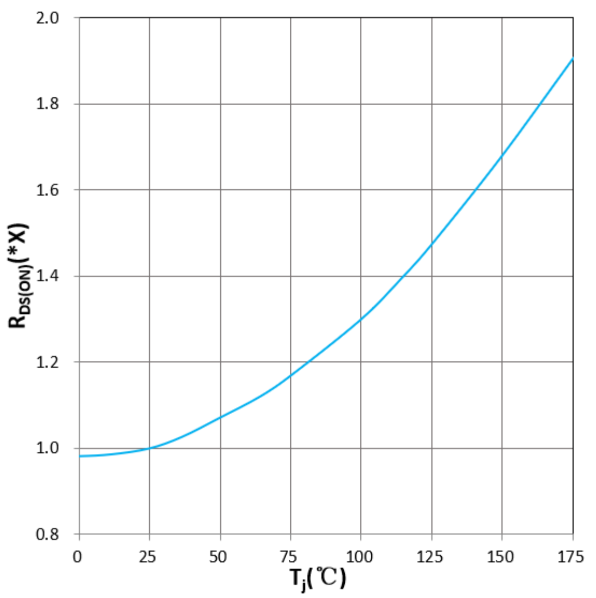


Figure 10. $R_{DS(ON)}$ vs T_j

V_{GS} =+20V, I_D =600A, 1.0X =3.2mΩ

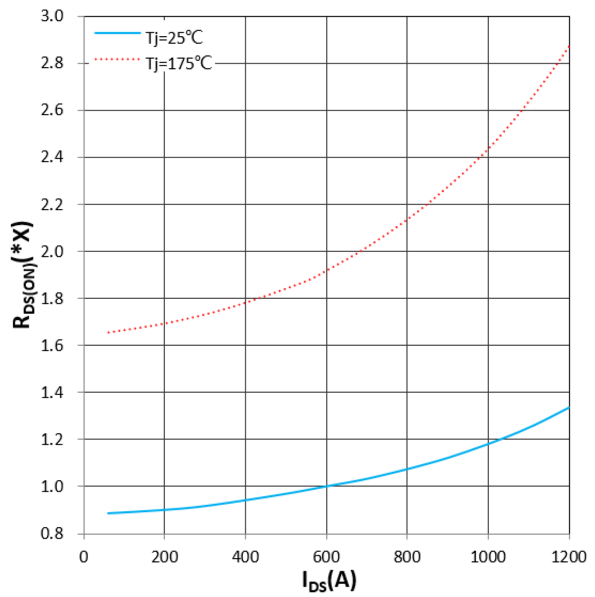


Figure 11. $R_{DS(ON)}$ vs I_{DS}

T_j =25℃/175℃,V_{GS} =+20V, 1.0X =3.2mΩ

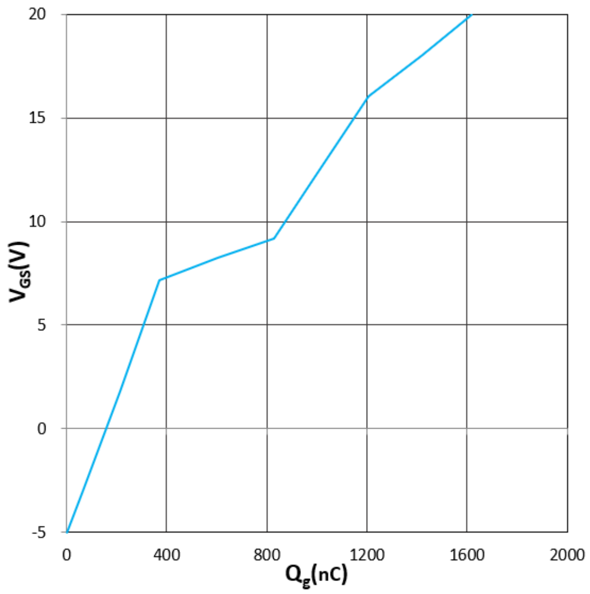


Figure 12. V_{GS} vs Q_g
T_j =25℃, V_{DS} =800V, I_D =300A

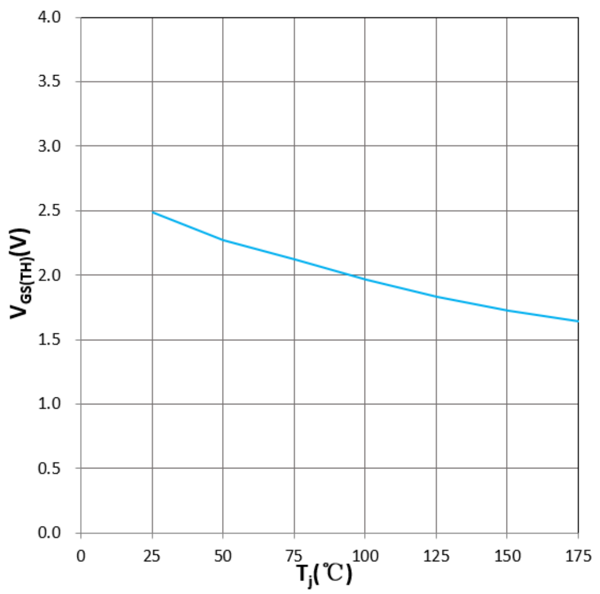


Figure 13. $V_{GS(TH)}$ vs T_j
V_{GS} =V_{DS} , I_D =120mA

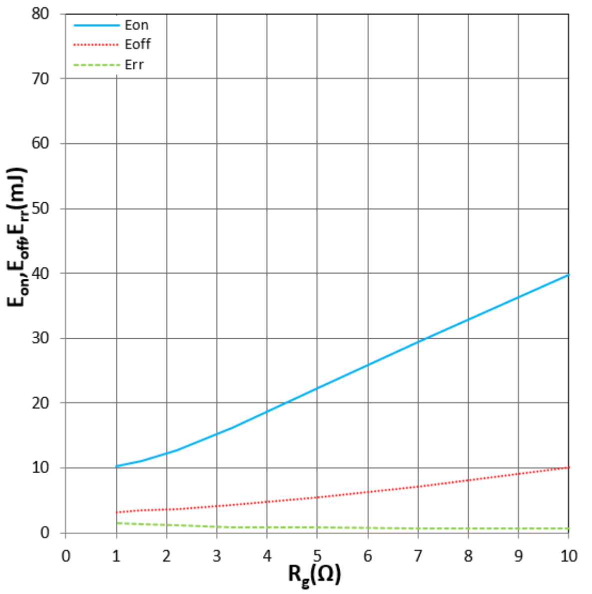


Figure 14. E_{on}, E_{off}, E_{rr} vs R_g
T_j =25°C, V_{DD} =800V, V_{GS} =+18V/-4V, I_D =600A
Inductive Load

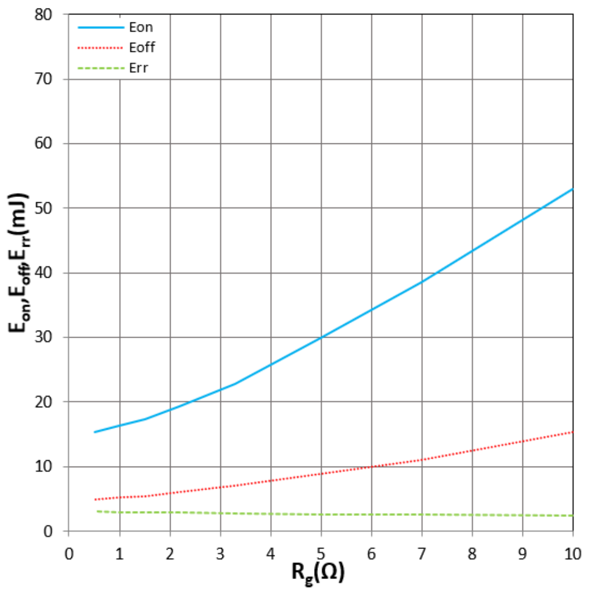


Figure 15. E_{on}, E_{off} , E_{rr} vs R_g
T_j =150°C, V_{DD}=800V, V_{GS} =+18V/-4V, I_D =600A
Inductive Load

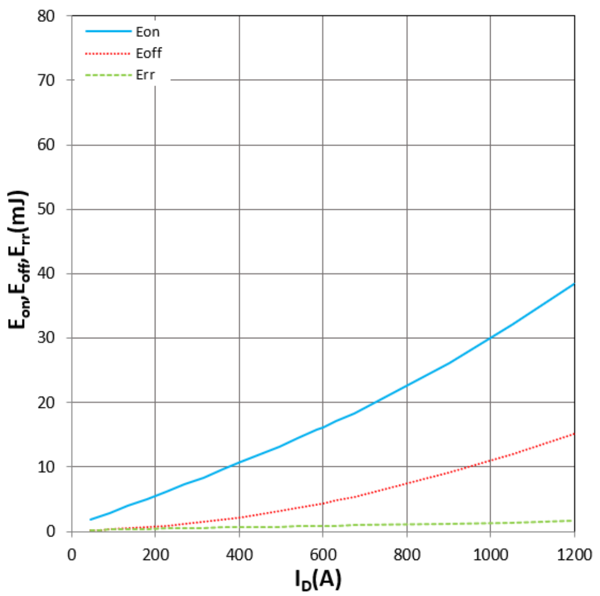


Figure 16. E_{on}, E_{off}, E_{rr} vs I_D

T_j =25°C, V_{DD} =800V, V_{GS} =+18V/-4V, R_g =3.3Ω

Inductive Load

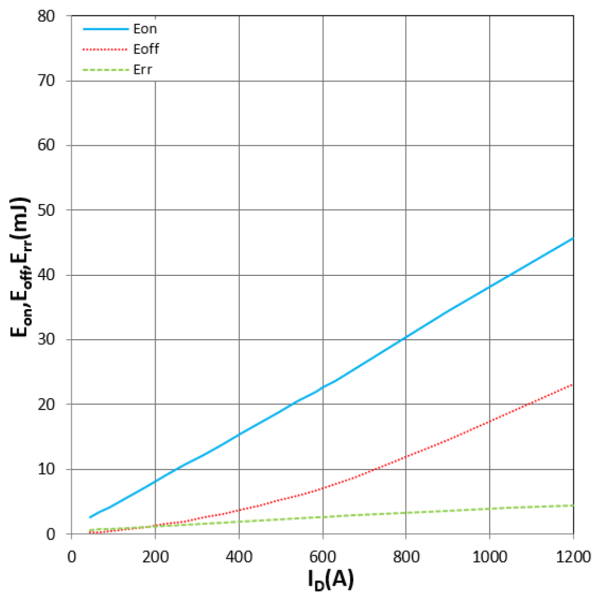


Figure 17. E_{on}, E_{off}, E_{rr} vs I_D

T_j =150°C, V_{DD} =800V, V_{GS} =+18V/-4V, R_g =3.3Ω

Inductive Load

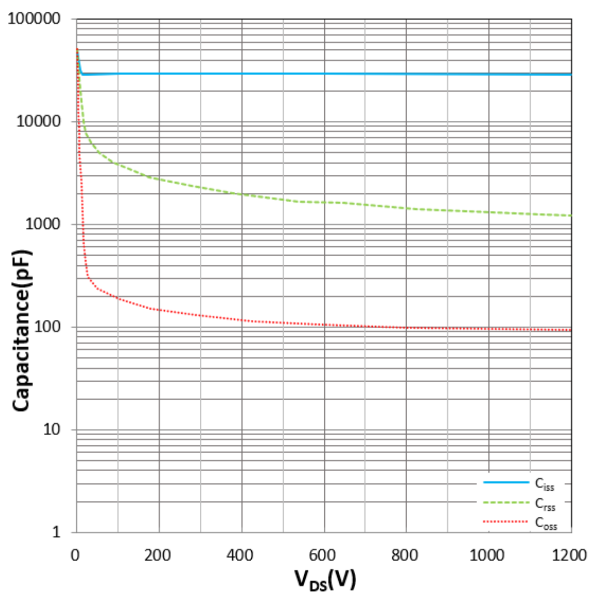


Figure 18. C_{iss},C_{oss},C_{rss} vs V_{DS}

V_{GS} =0V, f =100kHz

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