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1200V/600A Half Bridge SiC MOSFET Module

PRXS600HF12I5B3

Description

The PRXS600HF12I5B3 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

- 1200V/2.2mΩ
- Low thermal resistance with Si_3N_4 AMB
- 175°C maximum junction temperature
- Low Inductive Design
- Thermistor inside
- Pressfit terminal

Applications

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

Circuit Diagram

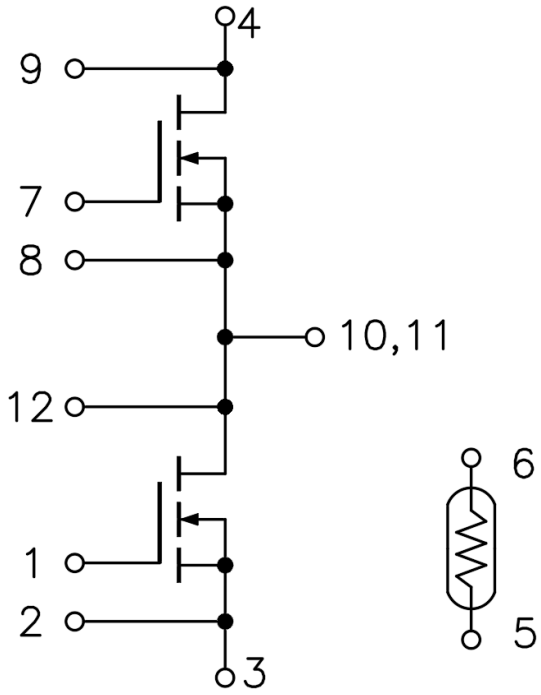

Figure 1. Out drawing & circuit diagram for PRXS600HF12I5B3

PRXS600HF12I5B3
1200V/600A Half Bridge SiC MOSFET Module

Pin Configuration and Marking Information

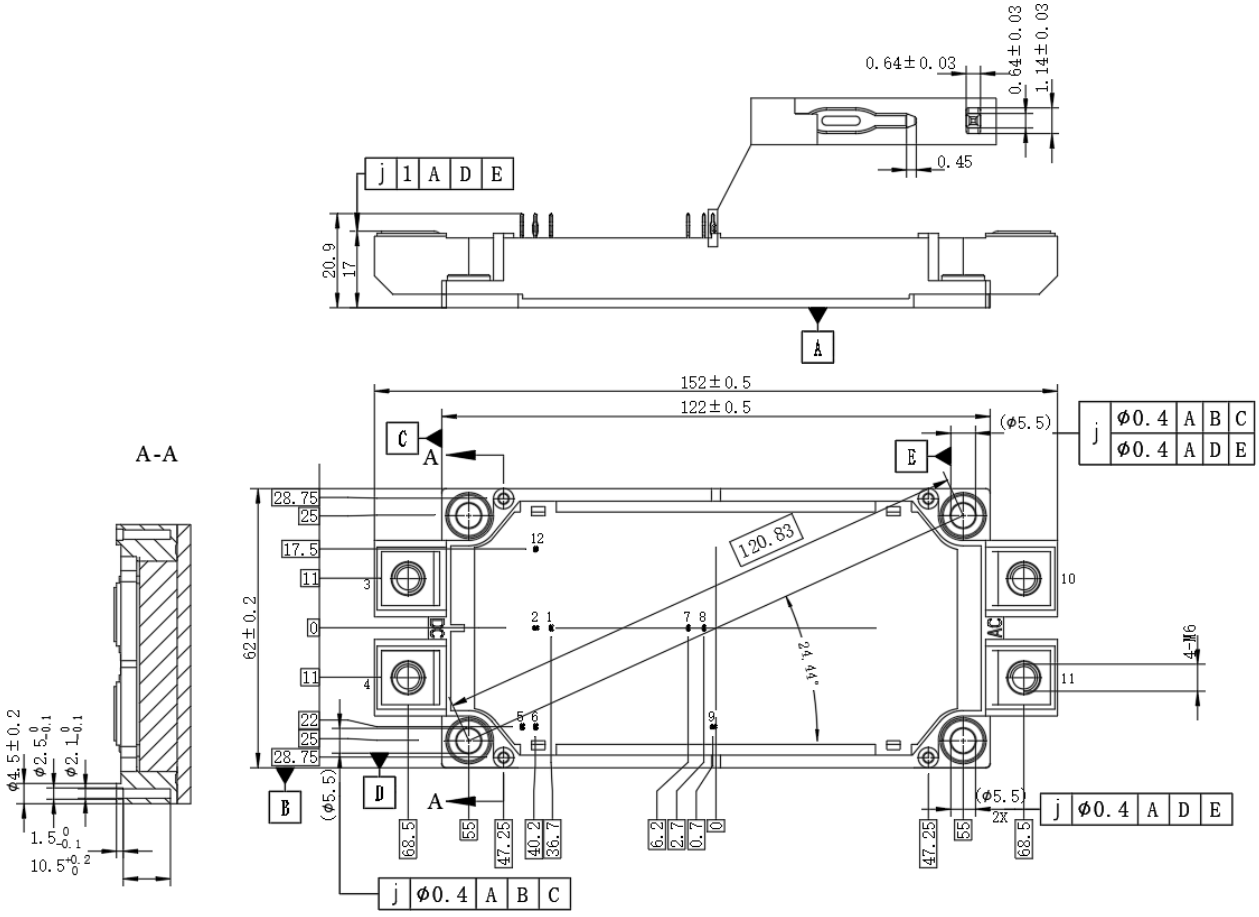

Figure 2. Pin configuration

Module

Parameter	Conditions	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	0.2	mΩ
Mounting torque for module mounting	M5, M6	3 to 6	Nm
Weight	-	350	g

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

Symbol	Parameter	Conditions	Ratings	Unit
V_{DSS}	Drain-Source Voltage	G-S Short	1200	V
V_{GSS}	Gate-Sourse Voltage	D-S Short, AC frequency ≥1Hz, Note1	-11 to 23	V
I_{DS}	DC Continuous Drain Current	T_C =25℃ , V_{GS} =18V	680	A
I_{DS}	DC Continuous Drain Current	T_C =85℃ , V_{GS} =18V	525	A
I_{SD}	Source (Body diode) Current	T_C =25℃, with ON signal	680	A
I_{SD}	Source (Body diode) Current	T_C =85℃, with ON signal	525	A
I_{DSM}	Pulse Drain Current	T_C =85℃, Pulse width =1ms, V_{GS} =18V, Note2	1200	A
P_{tot}	Total Power Dissipation	T_C =25℃	2500	W
T_{jmax}	Max Junction Temperature	-	175	℃
T_{stg}	Storage Temperature	-	-40 to 125	℃

Note1: Recommended Operating Value, -4V/+15V, -5V/+18V
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	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			Unit
				Min.	Typ.	Max	
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	V_{GS} =0V, I_D =6mA		1200	-	-	V
I_{DSS}	Zero gate voltage drain Current	V_{DS} =1200V, V_{GS} =0V		-	-	60	μA
$V_{GS(th)}$	Gate-source threshold Voltage	I_D =60mA, V_{DS} =V_{GS}	T_j =25°C	2.1	3.2	5.8	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} =18V	T_j =25°C	1.5	2.2	3.1	mΩ
			T_j =175°C	3.5	5.4	7.2	mΩ
$V_{DS(on)}$ (Chip)	Static drain-source On-state Voltage	I_D =600A, V_{GS} =18V	T_j =25°C	9.0	1.32	1.86	V
			T_j =175°C	2.1	3.24	4.32	V
C_{iss}	Input Capacitance	V_D =850V, V_{GS} =0V, f =1MHz		-	24	-	nF
C_{oss}	Output Capacitance			-	1.84	-	nF
C_{rss}	Reverse transfer Capacitance			-	0.132	-	nF
Q_g	Total gate charge	V_{DD} =850V, I_D =600A, V_{GS} =--5/+18V		-	1140	-	nC
$t_{d(on)}$	Turn-on delay time	V_{DD} =600V I_D =600A V_{GS} =+15/-4V $R_{G(on)}$ =5.1Ω $R_{G(off)}$ =3.3Ω Inductive load switching operation	T_j =25°C	-	140	-	ns
			T_j =150°C	-	119	-	
t_r	Rise time		T_j =25°C	-	104	-	ns
			T_j =150°C	-	89	-	
$t_{d(off)}$	Turn-off delay time		T_j =25°C	-	278	-	ns
			T_j =150°C	-	302	-	
t_f	Fall time		T_j =25°C	-	67	-	ns
			T_j =150°C	-	89	-	
E_{on}	Turn-on power dissipation		T_j =25°C	-	29.6	-	mJ
			T_j =150°C	-	24.2	-	
E_{off}	Turn-off power dissipation		T_j =25°C	-	27.2	-	mJ
			T_j =150°C	-	28.9	-	
$R_{th(j-c)}$	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} =-4V I_{SD} =600A	T_j =25°C	3.9	4.9	5.6	V
			T_j =175°C	3.1	4.2	5.2	
T_{rr}	Reverse recovery time	V_{DD} =600V, I_D =400A V_{GS} =-4/+15V $R_{g(on)}$ =5.1Ω $R_{g(off)}$ =3.3Ω Inductive load switching operation	T_j =25°C	-	39	-	ns
			T_j =150°C	-	56	-	
Q_{rr}	Reverse recovery charge		T_j =25°C	-	2.12	-	µC
			T_j =150°C	-	5.48	-	
E_{rr}	Diode switching power dissipation		T_j =25°C	-	0.55	-	mJ
			T_j =150°C	-	1.72	-	

Test Conditions

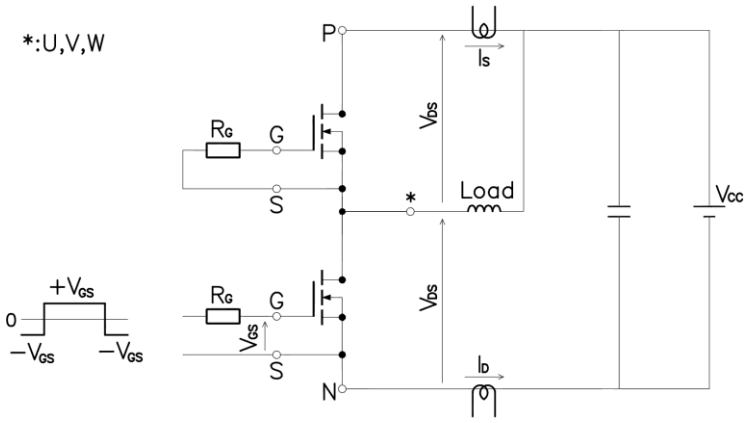

Figure 3. Switching time measure circuit

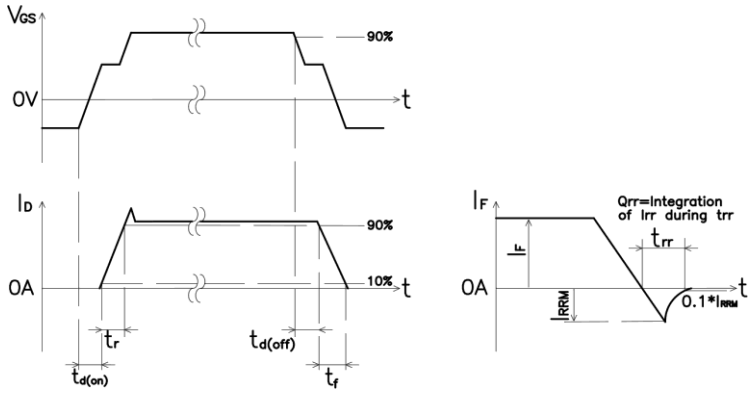

Figure 4. Switching time definition

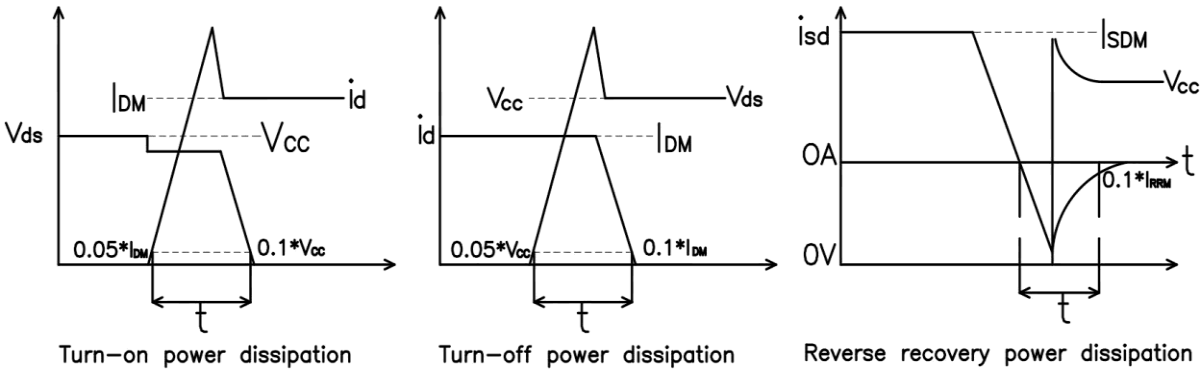

Figure 5. Switching power dissipation definition

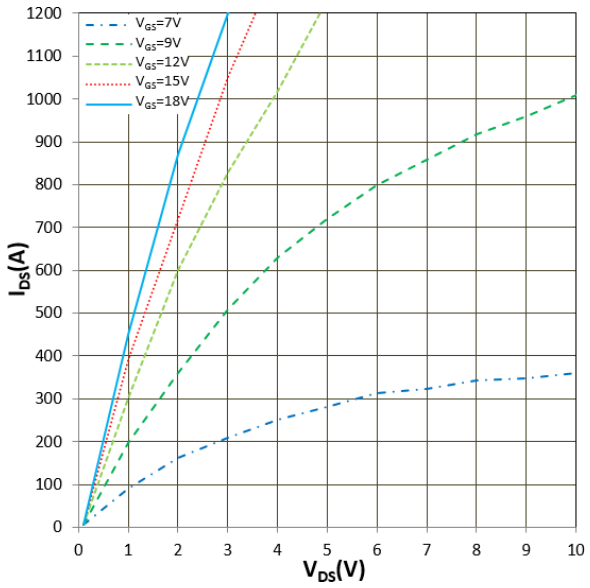

Figure 6. I_{DS} vs V_{DS}
T_j =25°C

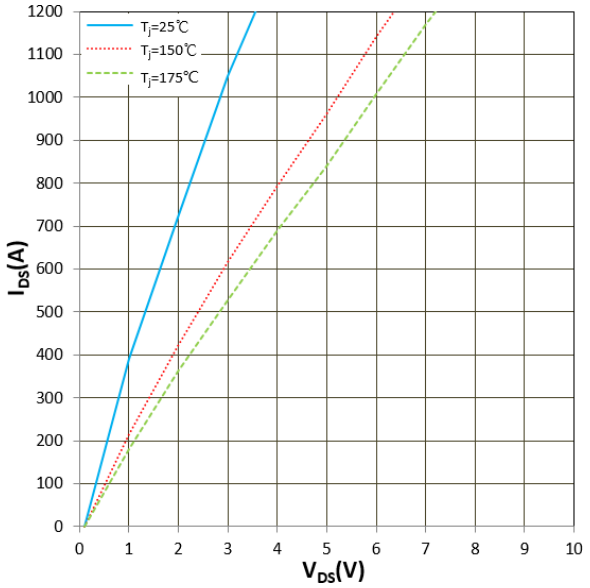

Figure 7. I_{DS} vs V_{DS}
V_{GS} =15V

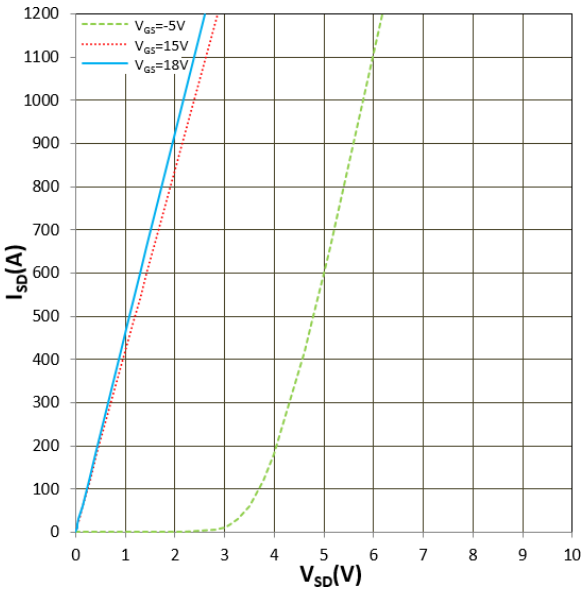

Figure 8. I_{SD} vs V_{SD}
T_j =25°C

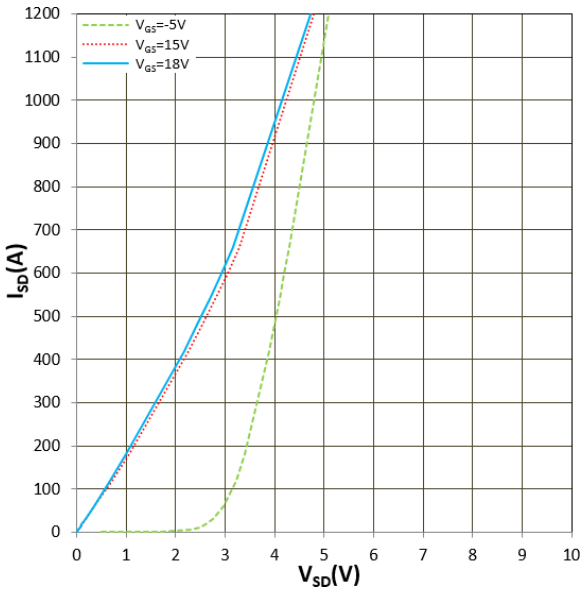

Figure 9. I_{SD} vs V_{SD}
T_j =150°C,

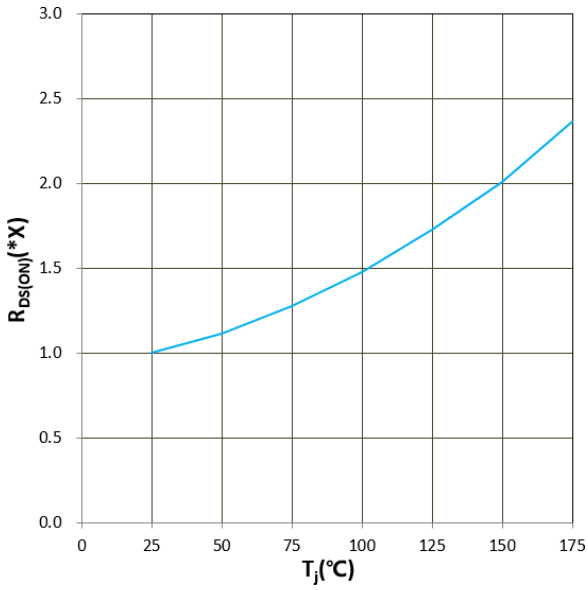

Figure 10. $R_{DS(ON)}$ vs T_j
V_{GS} =+18V, I_D =600A, 1.0X =2.2mΩ

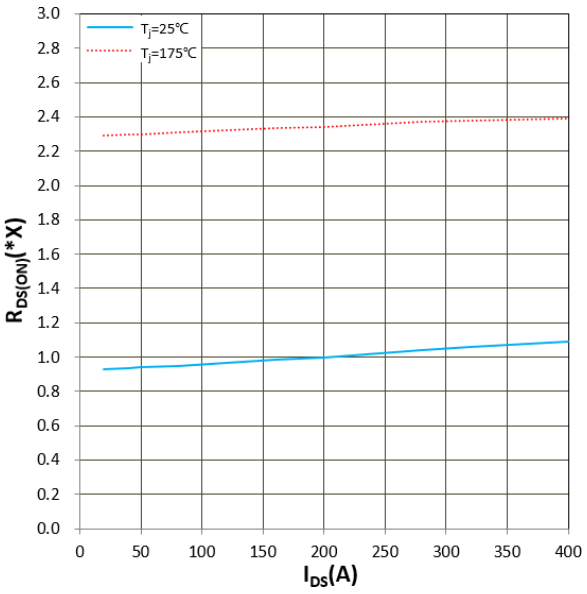

Figure 11. $R_{DS(ON)}$ vs I_{DS}
V_{GS} =+18V, I_D =600A, 1.0X =2.2mΩ

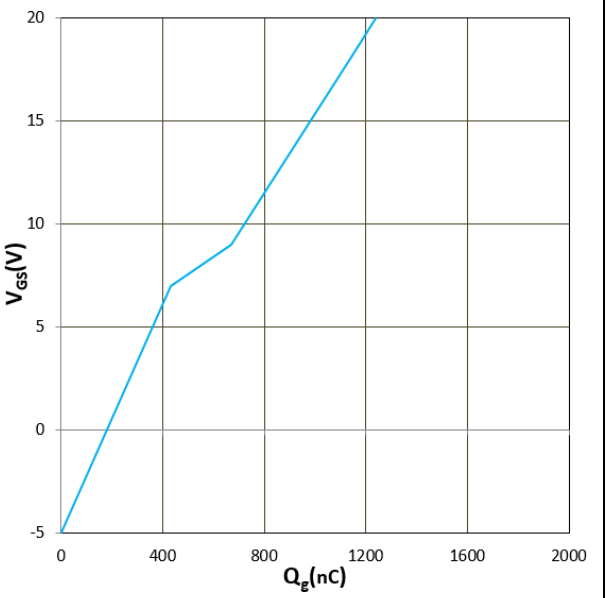

Figure 12. V_{GS} vs Q_g
T_j =25℃, I_{GS} =6mA

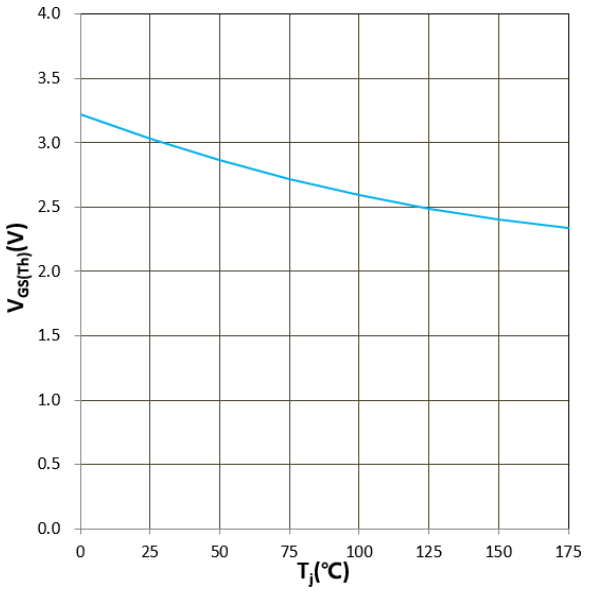

Figure 13. $V_{GS(TH)}$ vs T_j
V_{GS} =V_{DS}, I_D =60mA

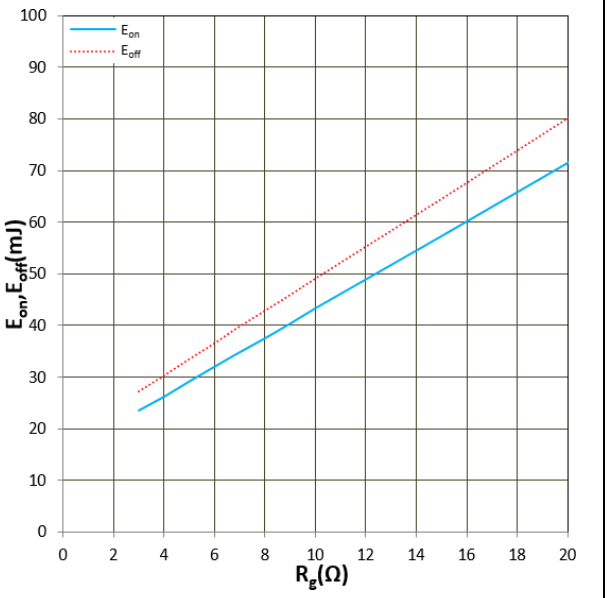

Figure 14. E_{on}, E_{off} vs R_g
T_j =25°C, V_{CC} =600V, V_{GS} =+15V/-4V, I_D =600A
Inductive Load

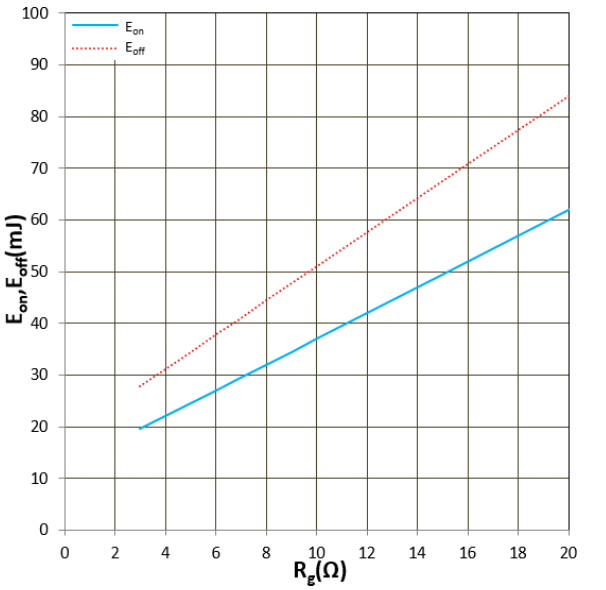

Figure 15. E_{on}, E_{off} vs R_g
T_j =150°C, V_{CC} =600V, V_{GS} =+15V/-4V, I_D =600A
Inductive Load

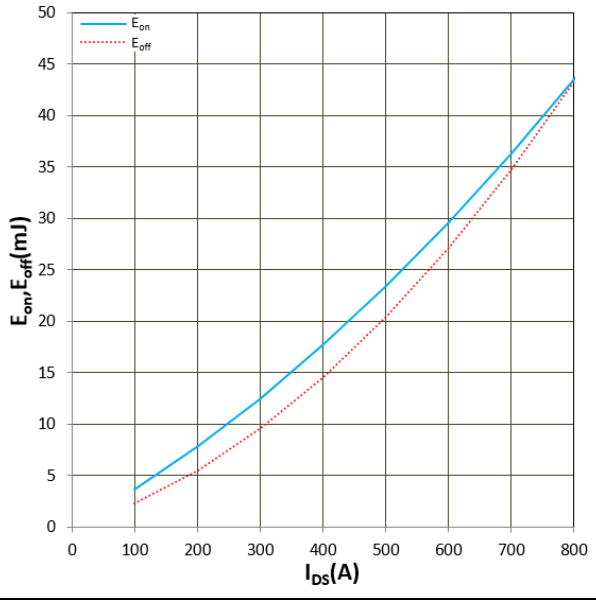

Figure 16. E_{on}, E_{off} vs I_{DS}
T_j =25°C, V_{CC} =600V, V_{GS} =+15V/-4V
$R_{g(on)}$ =5.1Ω, $R_{g(off)}$ =3.3Ω, Inductive Load

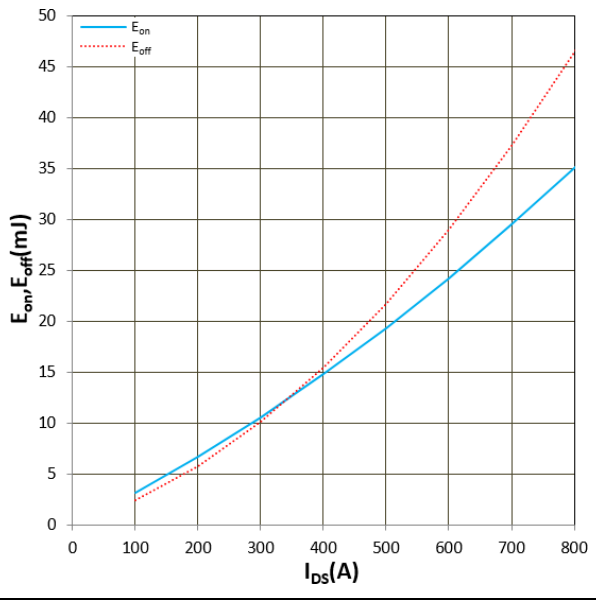

Figure 17. E_{on}, E_{off} vs I_{DS}
T_j =150°C, V_{CC} =600V, V_{GS} =+15V/-4V
$R_{g(on)}$ =5.1Ω, $R_{g(off)}$ =3.3Ω, Inductive Load

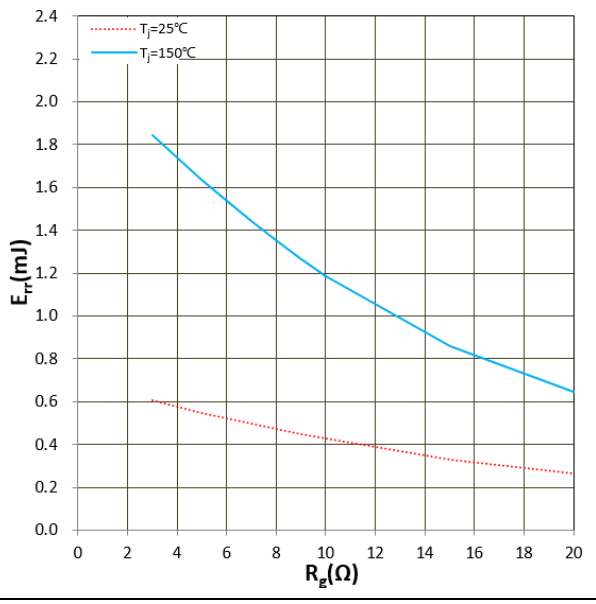

Figure 18. E_{rr} vs R_G
V_{DD} =600V, I_F =600A, V_{GS} =+15V/-4V
Inductive Load

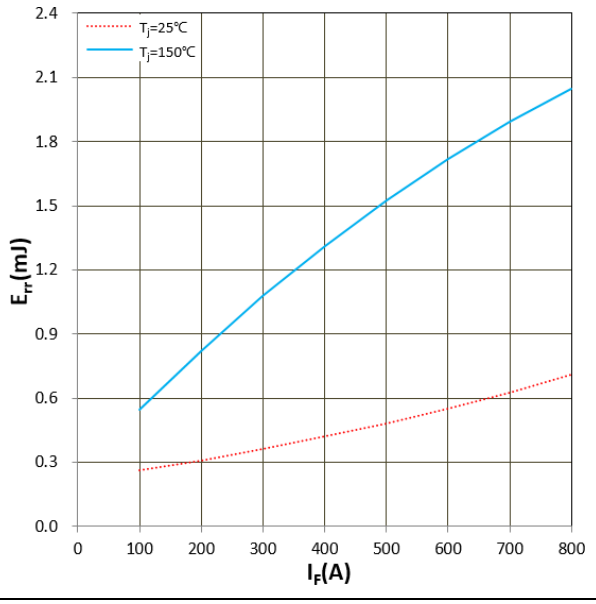

Figure 19. E_{rr} vs I_F
V_{DD} =600V, $R_{g(on)}$ =5.1Ω, $R_{g(off)}$ =3.3Ω
V_{GS} =+15V/-4V, Inductive Load

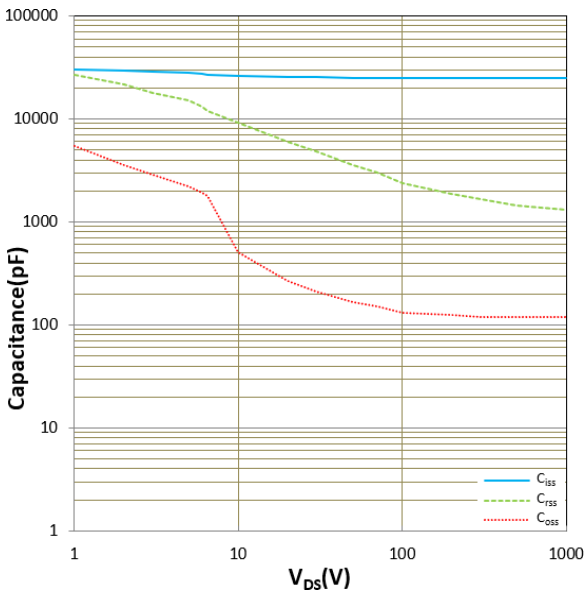

Figure 20. C_{ies},C_{oss},C_{rss} vs V_{DS}
T_j =25°C