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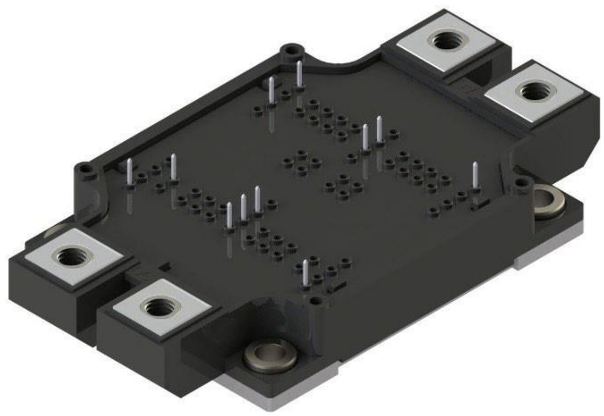
1700V/400A Half Bridge SiC MOSFET Module

PRXS400HF17I3C2



Description

The PRXS400HF17I3C2 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 1700V
- □ $R_{DS(on)}$ = 5.2mΩ @T_j = 25°C, V_{GS} = 15V
- □ Low thermal resistance with Si_3N_4 AMB
- □ 175°C maximum junction temperature
- □ Low Inductive Design
- □ Thermistor inside
- □ Pressfit terminal
- □ Copper base size: 79mmx62mm

Applications

- □ Motor Drives
- □ Servo Drives
- □ UPS Systems
- □ Smart-Grid/Grid-Tied Distributed Generation

Circuit Diagram

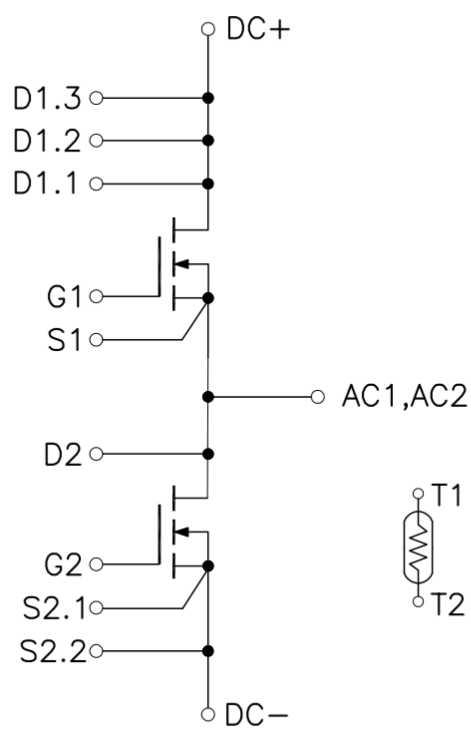
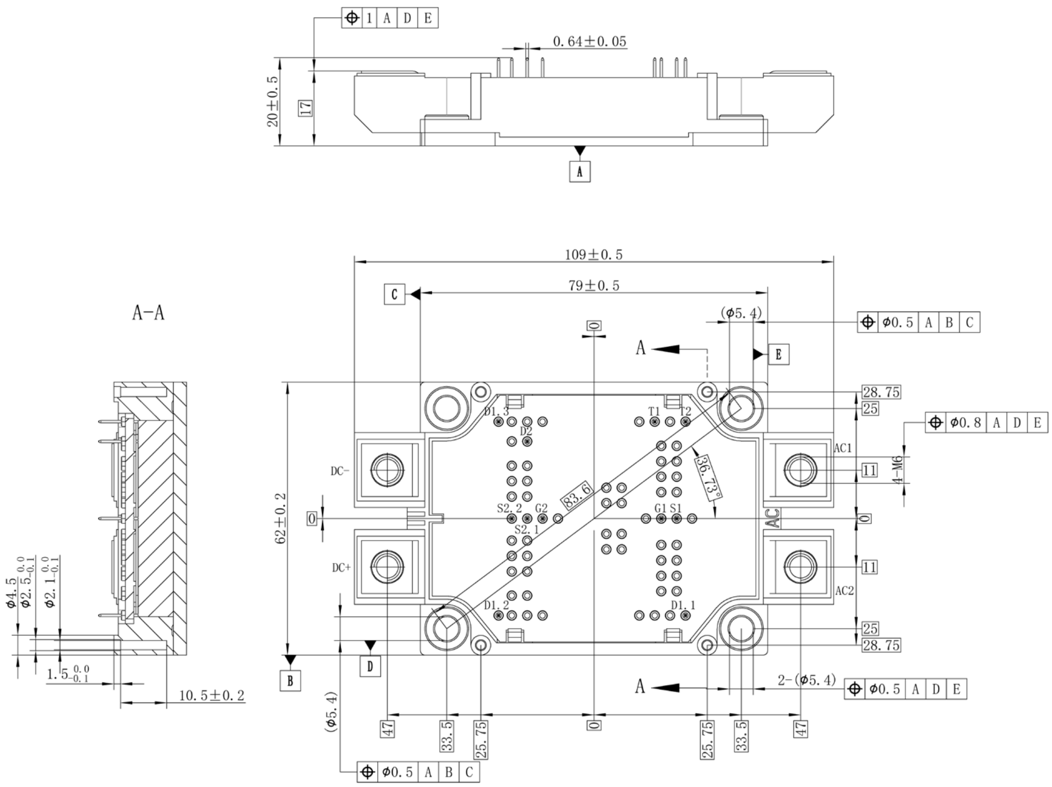


Figure 1. Out drawing & circuit diagram for PRXS400HF17I3C2
Note: Please use **S2.1** for the low side drive signal and do not connect it to **S2.2** which is power terminal

Pin Configuration and Marking Information



Pin table		
Pin	X	Y
D1.2	-21.7	-22
D1.1	20.8	-22
S2.2	-18.7	0
S2.1	-15.2	0
G2	-11.7	0
G1	15.3	0
S1	18.8	0
D2	-15.2	17.5
D1.3	-21.7	22
T1	13.8	22
T2	20.8	22

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 10	mm
Clearance	terminal to heatsink terminal to terminal	12.5 10	mm
CTI	-	600	-
Module lead resistance, terminals–chip	T_C =25°C	0.5	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	1700	V
V_{GSS}	Gate-Source Voltage (+)	D-S Short	20	V
V_{GSS}	Gate-Source Voltage (-)	D-S Short	-10	V
$V_{GSSSurge}$	G-S Voltage(t_{surge} <300nsec)	D-S Short, Note1	-10 to 20	V
I_{DS}	DC Continuous Drain Current	T_f =25°C, V_{GS} =15V	420	A
I_{DS}	DC Continuous Drain Current	T_f =80°C, V_{GS} =15V	330	A
I_{SD}	Source (Body diode) Current	T_f =25°C, with ON signal	420	A
I_{SD}	Source (Body diode) Current	T_f =80°C, with ON signal	330	A
I_{DSM}	Pulse Forward Current	T_C =25°C, Pulse width =1ms, V_{GS} =15V, Note2	800	A
P_{tot}	Total Power Dissipation	T_C =25°C	2585	W
T_{jmax}	Max Junction Temperature	-	175	°C
T_{jop}	Operating junction Temperature	-	-40 to 150	°C
T_{stg}	Storage Temperature	-	-40 to 125	°C

Note1: Recommended Operating Value, -4V/+15V, -5V/+15V
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 Min.	Value Typ.	Value Max	Unit
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	V_{GS}=0V, I_D=160uA		1700	-	-	V
I_{DSS}	Zero gate voltage drain Current	V_{DS}=1700V, V_{GS}=0V		-	4	160	μA
$V_{GS(th)}$	Gate-source threshold Voltage	I_D=240mA, V_{DS}=V_{GS}	T_j=25°C	1.8	2.70	-	V
			T_j=175°C	-	1.90	-	V
I_{GSS}	Gate-Source Leakage Current	V_{GS}=15V, V_{DS}=0V, T_j=25°C		-	-	1000	nA
$R_{DS(on)}$ (Chip)	Static drain-source On-state resistance	I_D=400A, V_{GS}=15V	T_j=25°C	-	5.2	7.5	mΩ
			T_j=175°C	-	11.6	-	mΩ
$V_{DS(on)}$ (Chip)	Static drain-source On-state Voltage	I_D=400A, V_{GS}=15V	T_j=25°C	-	2.08	3.0	V
			T_j=175°C	-	4.64	-	V
C_{iss}	Input Capacitance	V_D=1000V, V_{GS}=0V, f =1MHz, V_{AC}=25mV		-	30.5	-	nF
C_{oss}	Output Capacitance			-	0.82	-	nF
C_{rss}	Reverse transfer Capacitance			-	0.15	-	nF
Q_G	Total gate charge	V_{DD}=1000V, I_D=300A, V_{GS}=-5/+15V		-	1022	-	nC
R_{Gint}	Internal Gate Resistance	T_j=25°C		-	0.48	-	Ω
$t_{d(on)}$	Turn-on delay time	V_{DD}=900V, I_D=400A, V_{GS}=+15/-4V, $R_{G(on)}$=6.8Ω, $R_{G(off)}$=6.8Ω, Inductive load switching operation	T_j=25°C	-	165	-	ns
			T_j=150°C	-	129	-	
t_r	Rise time		T_j=25°C	-	123	-	ns
			T_j=150°C	-	93	-	
$t_{d(off)}$	Turn-off delay time		T_j=25°C	-	515	-	ns
			T_j=150°C	-	646	-	
t_f	Fall time		T_j=25°C	-	80	-	ns
			T_j=150°C	-	102	-	
E_{on}	Turn-on power dissipation		T_j=25°C	-	48.4	-	mJ
			T_j=150°C	-	40.7	-	
E_{off}	Turn-off power dissipation		T_j=25°C	-	46.1	-	mJ
			T_j=150°C	-	49.6	-	
$R_{th(j-c)}$	FET Thermal Resistance	Junction to Case		-	0.058	-	K/W
$R_{th(c-f)}$	Contact thermal Resistance	With thermal conductive grease, Note4		-	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 Min.	Value Typ.	Value Max	Unit
V_{SD}	Body Diode Forward Voltage	V_{GS} = -4V	T_j =25°C	-	5.5	-	V
		I_{SD} =400A	T_j =150°C	-	5.2	-	
T_{rr}	Reverse recovery time	V_{RR} =900V, I_D =400A	T_j =25°C	-	46	-	ns
		MOSFET side:	T_j =150°C	-	147	-	
Q_{rr}	Reverse recovery charge	V_{GS} =+15/-4V	T_j =25°C	-	2.2	-	uC
		$R_{G(on)}$ = $R_{G(off)}$ = 6.8Ω	T_j =150°C	-	11.1	-	
E_{rr}	Diode switching power dissipation	Inductive load	T_j =25°C	-	0.5	-	mJ
		switching operation	T_j =150°C	-	4.6	-	

Test Conditions

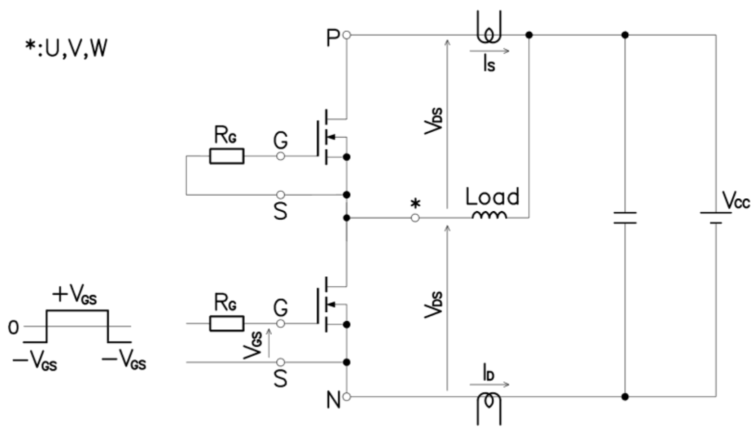


Figure 3. Switching time measure circuit

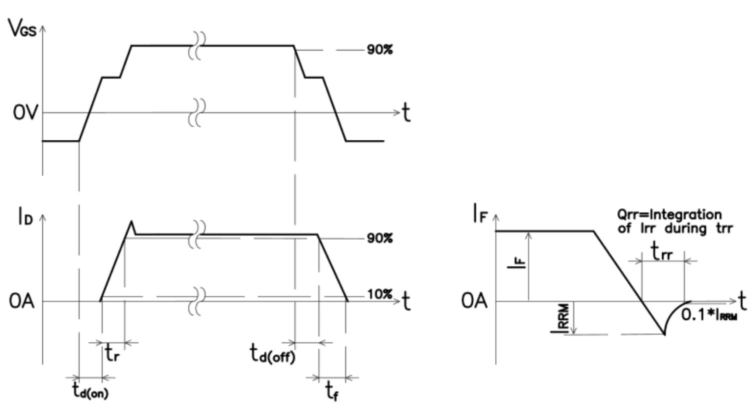


Figure 4. Switching time definition

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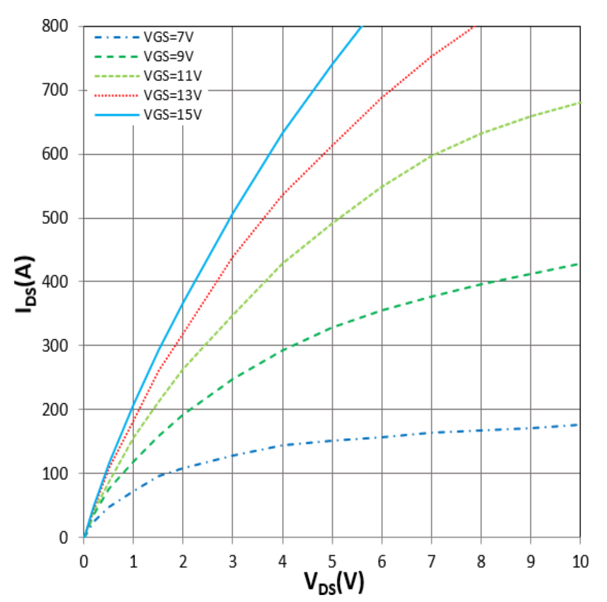

Figure 5. I_{DS} vs V_{DS}
T_j =25°C, V_{GS} parameter

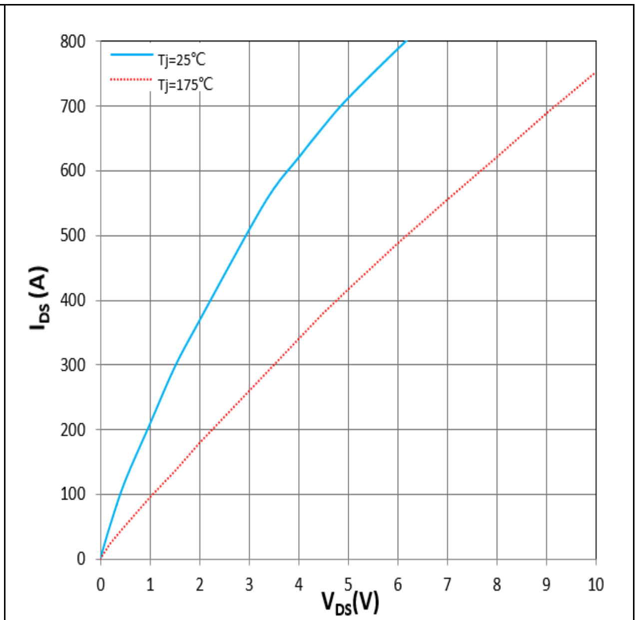

Figure 6. I_{DS} vs V_{DS}
V_{GS} =15V, T_j parameter

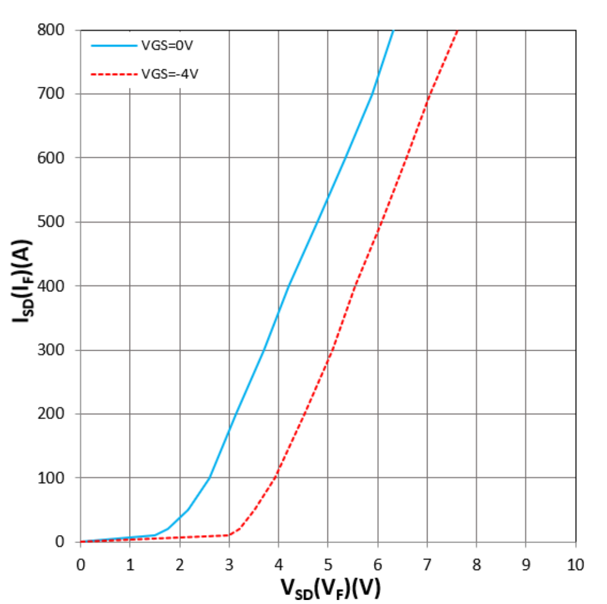

Figure 7. $I_{SD}(I_F)$ vs $V_{SD}(V_F)$
T_j =25°C, V_{GS} parameter

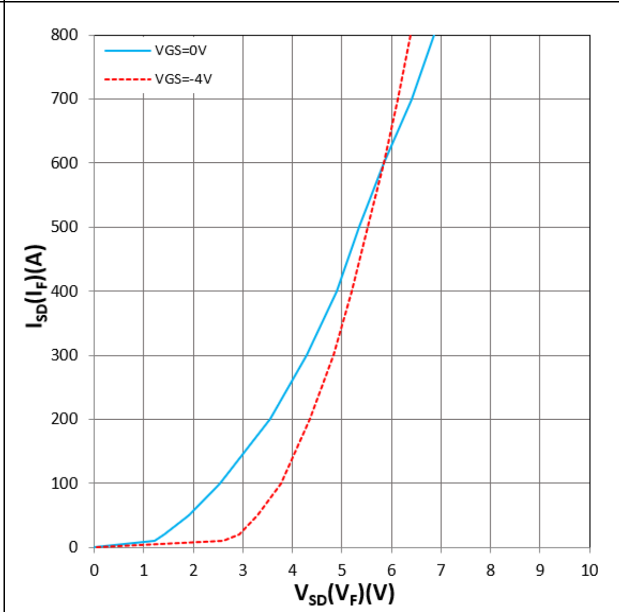

Figure8. $I_{SD}(I_F)$ vs $V_{SD}(V_F)$
T_j =175°C, V_{GS} parameter

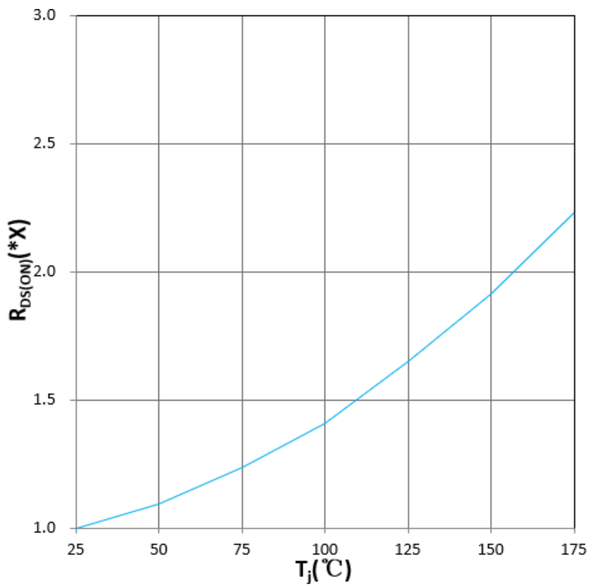

Figure 9. $R_{DS(ON)}$ vs T_j
V_{GS} =+15V, I_D =400A, 1.0X =5.2mΩ

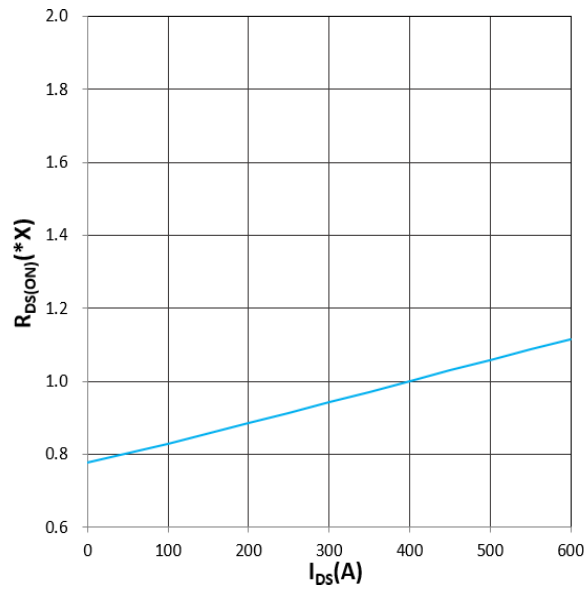

Figure 10. $R_{DS(ON)}$ vs I_{DS}
T_j =25℃, V_{GS} =+15V, 1.0X =5.2mΩ

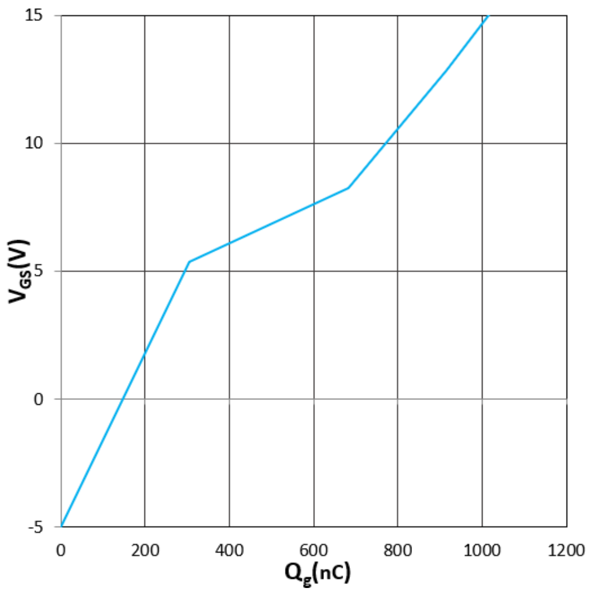

Figure 11. V_{GS} vs Q_g
T_j =25℃, V_{DS} =1000V, I_D =300A

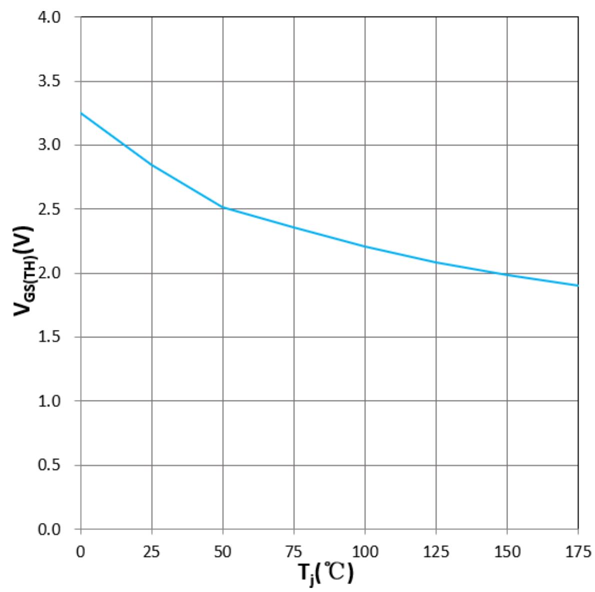

Figure 12. $V_{GS(TH)}$ vs T_j
V_{GS} =V_{DS} , I_D =240mA

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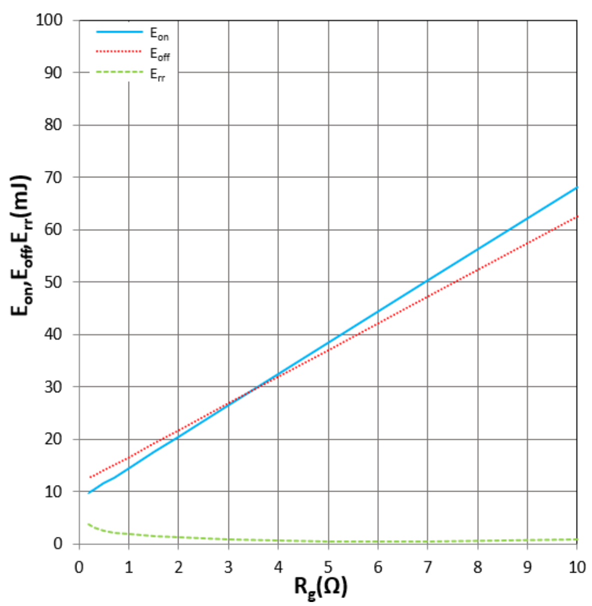

Figure 13. E_{on}, E_{off}, E_{rr} vs R_g

T_j =25°C, V_{CC} =900V, V_{GS} =+15V/-4V, I_D =400A

Inductive Load

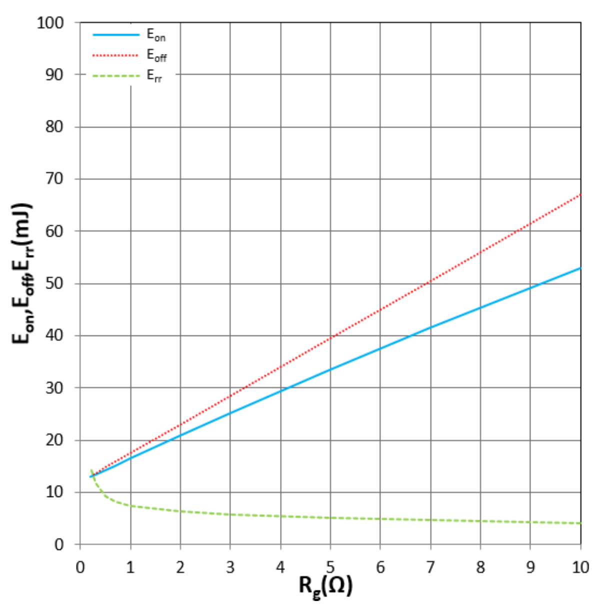

Figure 14. E_{on}, E_{off} , E_{rr} vs R_g

T_j =150°C, V_{CC} =900V, V_{GS} =+15V/-4V, I_D =400A

Inductive Load

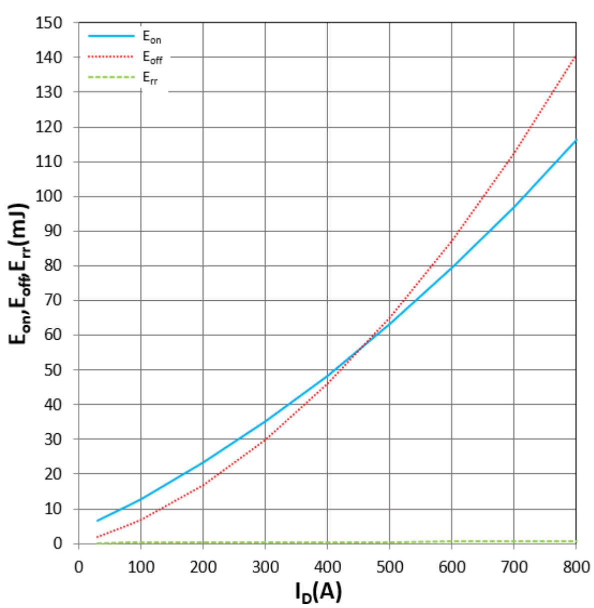

Figure 15. E_{on}, E_{off}, E_{rr} vs I_D

T_j =25°C, V_{CC} =900V, V_{GS} =+15V/-4V, R_g =6.8Ω

Inductive Load

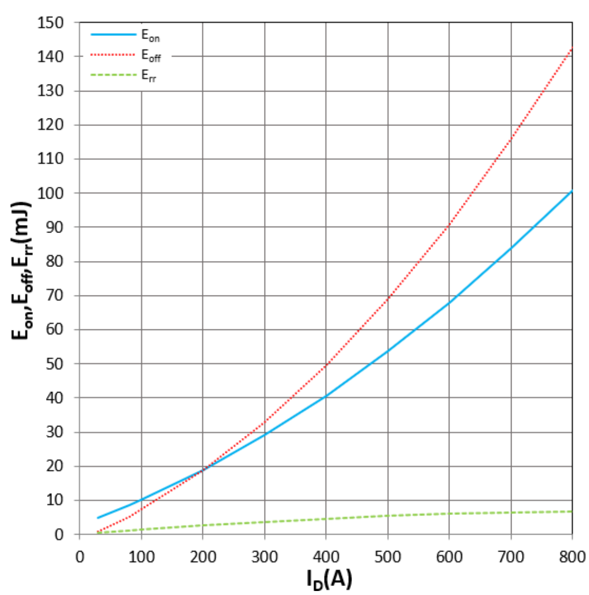

Figure 16. E_{on}, E_{off}, E_{rr} vs I_D

T_j =150°C, V_{CC} =900V, V_{GS} =+15V/-4V, R_g =6.8Ω

Inductive Load