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1200V/400A Half Bridge SiC MOSFET Module

PRXS400HF12DFQ1

Description

The PRXS400HF12DFQ1 is a Half Bridge SiC MOSFET Power Module. It integrates high performance SiC MOSFET chips and SiC Diode designed for the applications such as Motor drives and Renewable energy

Features

- Blocking voltage: 1200V
- $R_{DS(on)}$ = 4.8mΩ
- Low thermal resistance with Si_3N_4 AMB
- 175°C maximum junction temperature
- 62mm half bridge module
- Low Switching Losses

Applications

- Motor Drives
- Vehicle Fast Chargers
- Renewable energy
- UPS

Circuit Diagram

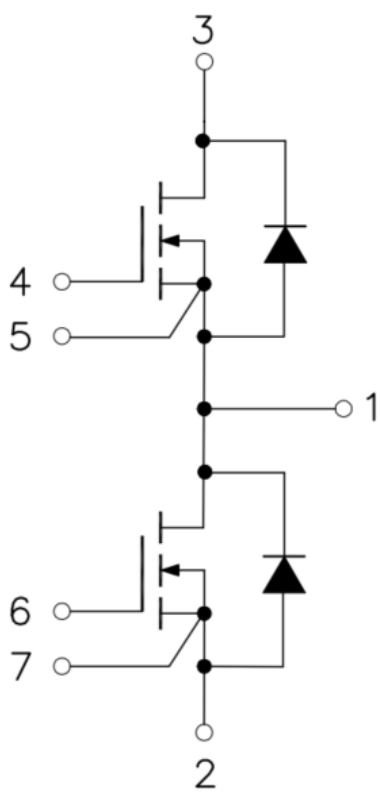

Figure 1. Out drawing & circuit diagram for PRXS400HF12DFQ1

PRXS400HF12DFQ1
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Pin Configuration and Marking Information

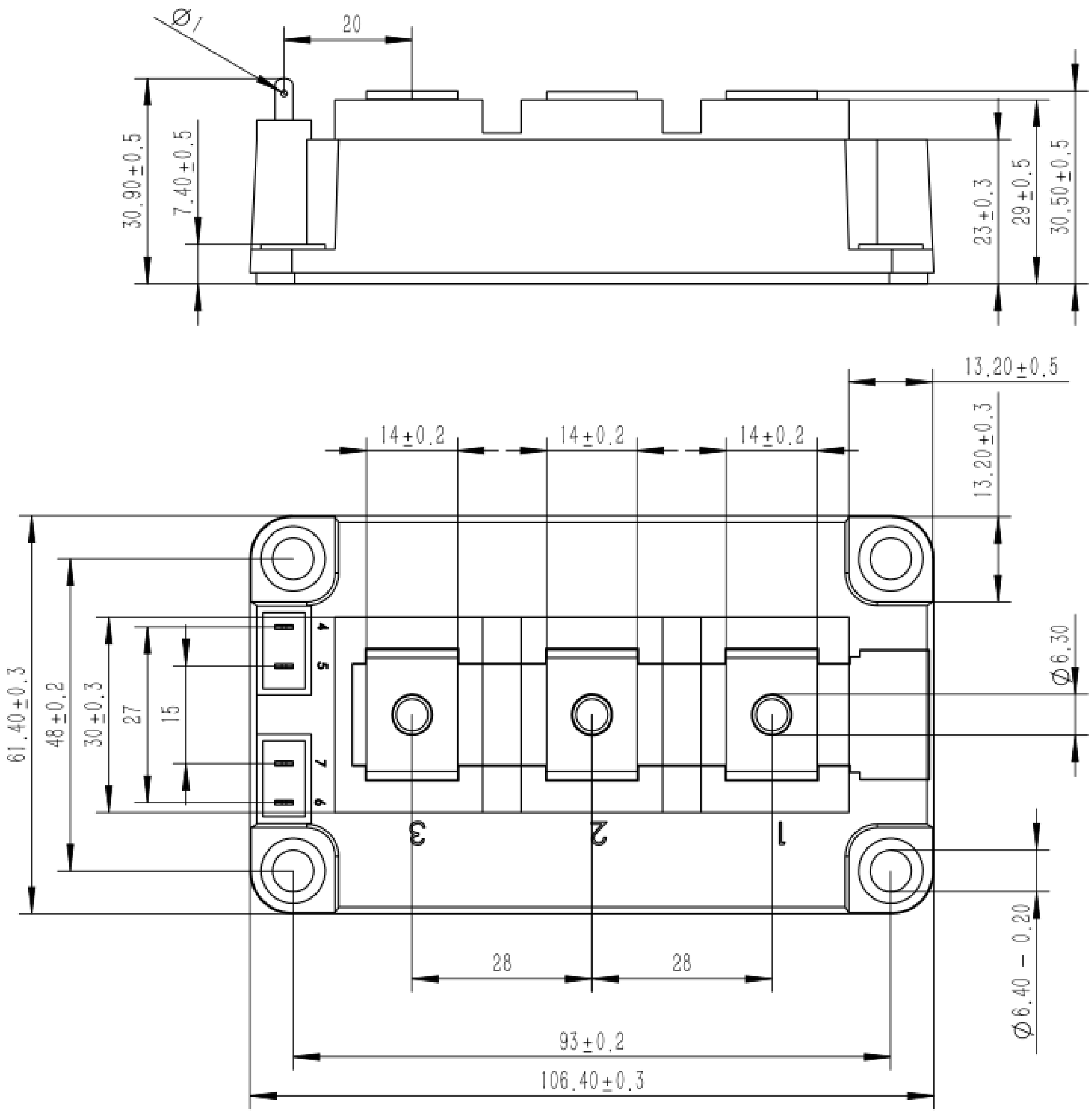

Figure 2. Pin configuration

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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	-	>400	-
Module lead resistance, terminals – chip	T_C =25°C	0.6	mΩ
Mounting torque for module mounting	M6	4 to 6	Nm
Weight	-	320	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
$V_{DS\ nom}$	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 =25°C, V_{GS} =20V	460	A
I_{DS}	DC Continuous Drain Current	T_C =80°C, V_{GS} =20V	370	A
I_{DP}	Drain Pulse Current, Peak	T_C =25°C, Less than 1ms, Note2	800	A
I_F	Forward Current	T_C =25°C, with ON signal	450	A
I_F	Forward Current	T_C =80°C, with ON signal	350	A
I_{FRM}	Pulse Forward Current	T_C =25°C, Less than 1ms, Note2	800	A
P_{tot}	Total Power Dissipation	T_C =25°C	2142	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

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MOSFET Electrical characteristics (Tj =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=4mA		1200	-	-	V
I_{DSS}	Zero gate voltage drain Current	V_{DS}=1200V, 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=800V, V_{GS}=0V, f =100kHz, 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		-	1.5	-	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	-	46	-	ns
			T_j=150°C	-	43	-	
t_r	Rise time		T_j=25°C	-	36	-	ns
			T_j=150°C	-	32	-	
$t_{d(off)}$	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	-	7.5	-	mJ
			T_j=150°C	-	10.4	-	
E_{off}	Turn-off power dissipation		T_j=25°C	-	2.5	-	mJ
			T_j=150°C	-	4.4	-	
$R_{th(j-c)}$	FET Thermal Resistance	Junction to Case		-	0.07	-	°C /W

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

Symbol	Item	Condition		Value			Unit
				Min.	Typ.	Max	
V_F	Diode Forward Voltage	I_F =400A, V_{GS} =-4V	T_j =25°C	-	1.90	-	V
			T_j =175°C	-	3.35	-	
t_{rr}	Diode Reverse Recovery Time	V_{RR} =600V, I_D =400A MOSFET side: V_{GS} =+18/-5V $R_{G(on)}$ = $R_{G(off)}$ =3.3Ω Inductive load switching operation	T_j =25°C	-	27	-	ns
			T_j =150°C	-	29	-	
I_{RM}	Peak reverse recovery Current		T_j =25°C	-	156	-	A
			T_j =150°C	-	189	-	
Q_{rr}	Recovered charge		T_j=25°C	-	2.5	-	µC
			T_j =150°C	-	3.4	-	
E_{rr}	Reverse recovered energy		T_j =25°C	-	0.5	-	mJ
			T_j =150°C	-	1.7	-	
$R_{th(j-c)}$	Thermal Resistance, Junction to Case (Diode)			-	0.09	-	°C/W

Test Conditions

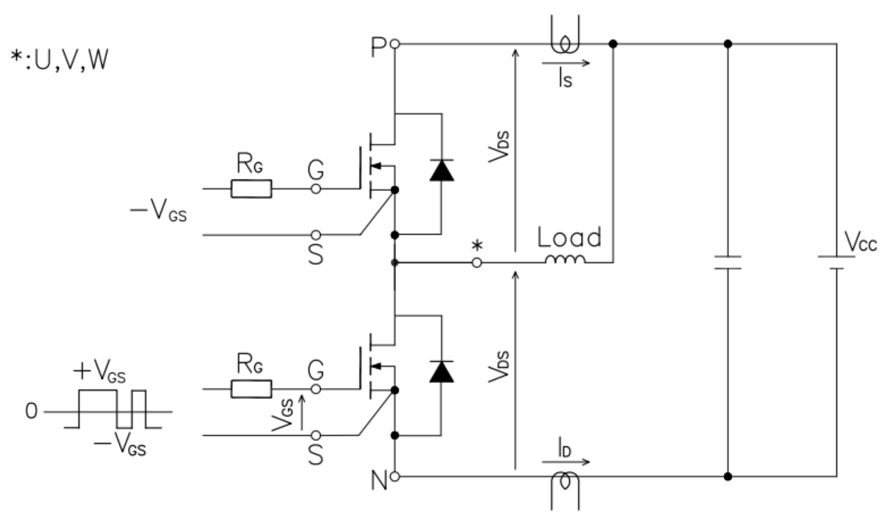

Figure 3. Switching time measure circuit

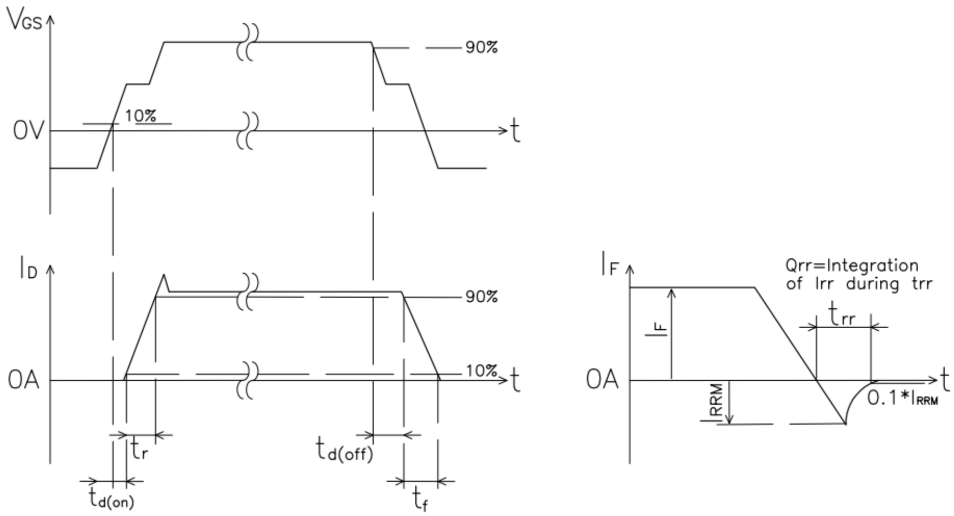

Figure 4. Switching time definition

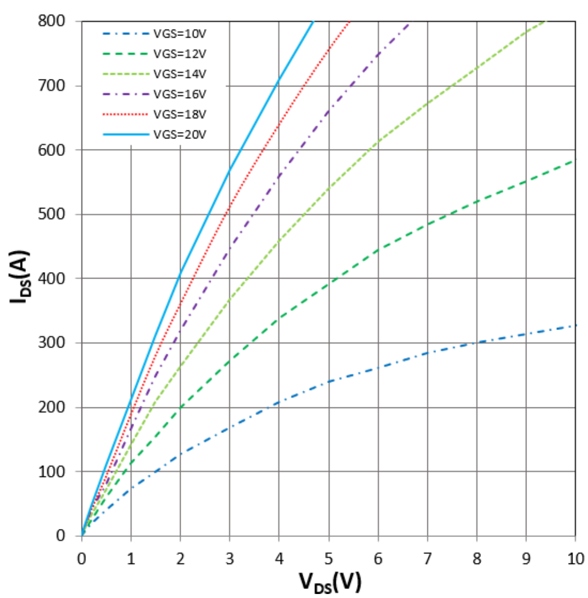

Figure 5. I_{DS} vs V_{DS}
T_j =25°C, V_{GS} parameter

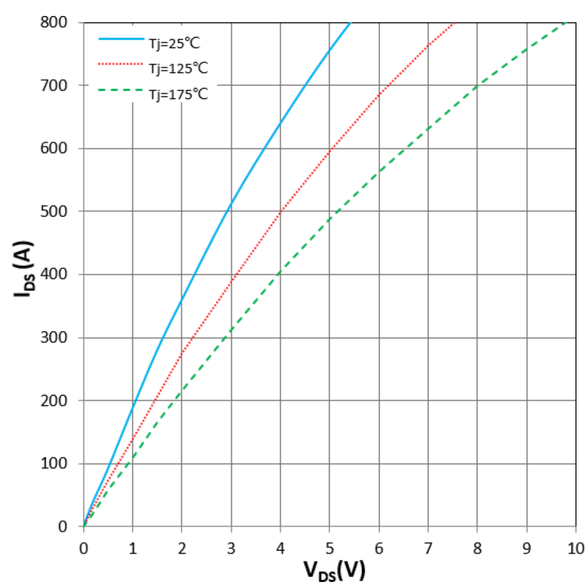

Figure 6. I_{DS} vs V_{DS}
V_{GS} =18V, T_j parameter

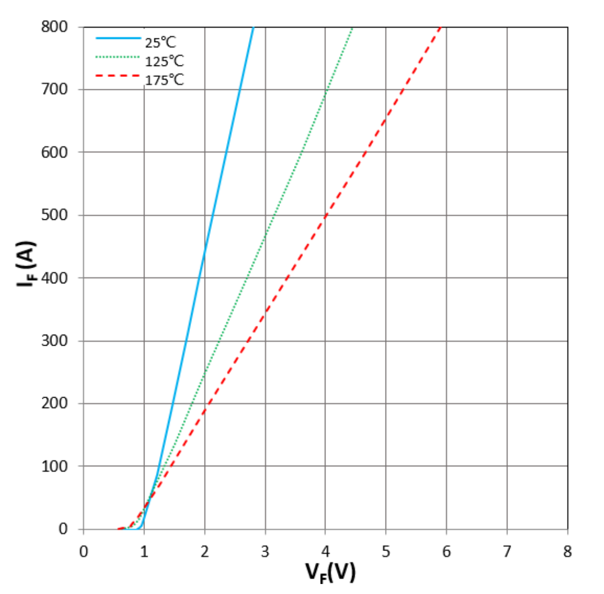

Figure 7. I_F vs V_F
V_{GS} =0V

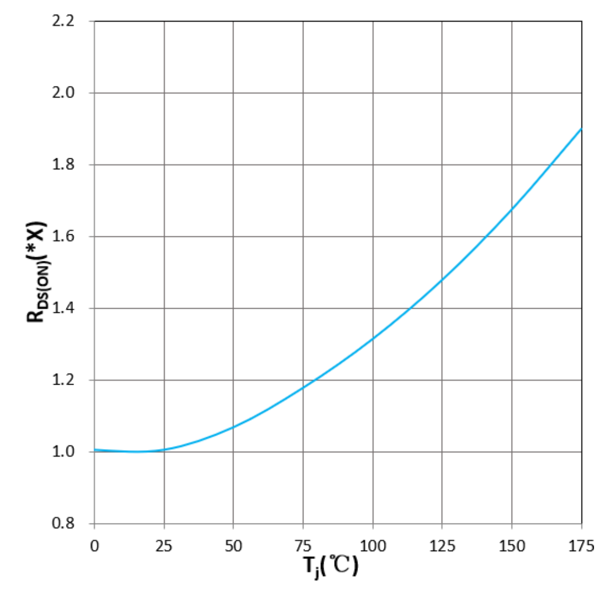

Figure 8. $R_{DS(ON)}$ vs T_j
V_{GS} =+20V, I_D =400A, 1.0X =4.8mΩ

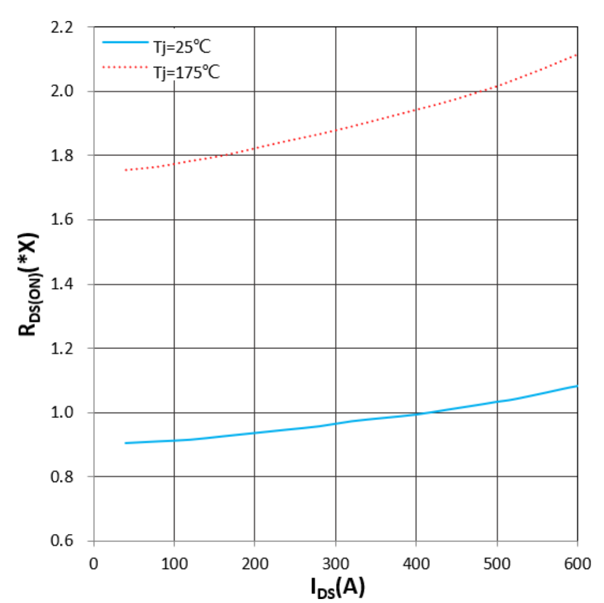

Figure 9. $R_{DS(ON)}$ vs I_{DS}
T_j =25℃/175°C, V_{GS} =+20V, 1.0X =4.8mΩ

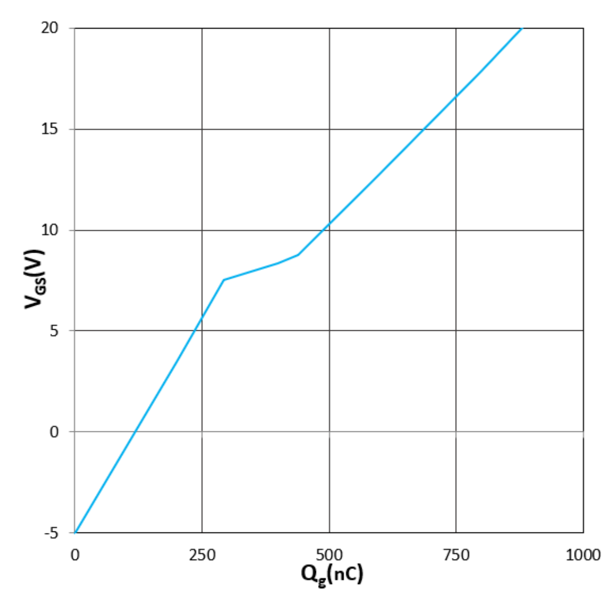

Figure 10. V_{GS} vs Q_g
T_j =25°C, V_{DS} =800V, I_D =200A

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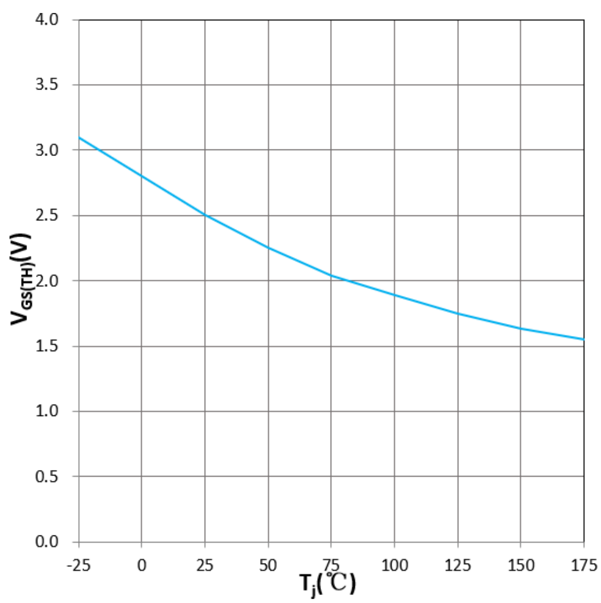

Figure 11. $V_{GS(TH)}$ vs T_j
$V_{GS} = V_{DS}$, I_D =80mA

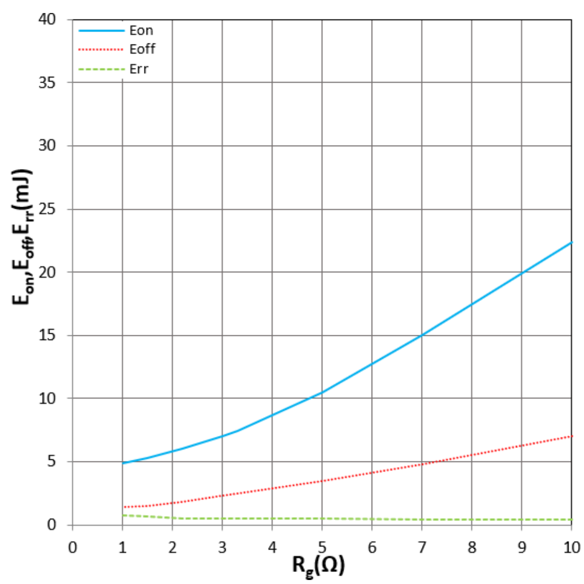

Figure 12. E_{on}, E_{off}, E_{rr} vs R_g
T_j =25°C, V_{DD} =600V, V_{GS} =+18V/-5V, I_D =400A
Inductive Load

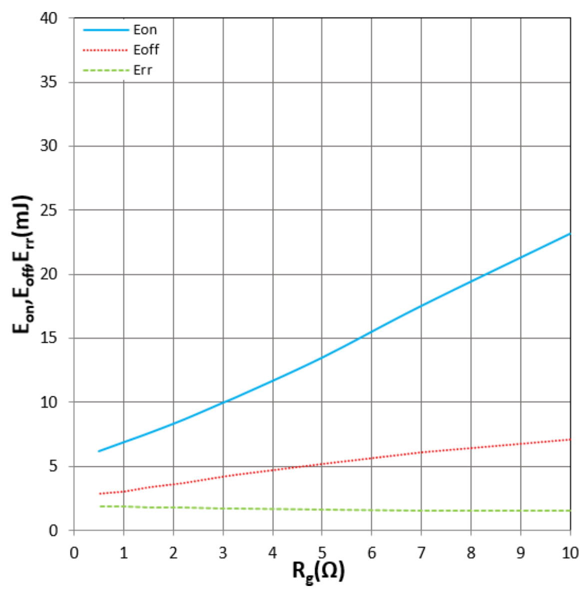

Figure 13. E_{on}, E_{off} , E_{rr} vs R_g
T_j =150°C, V_{DD}=600V, V_{GS} =+18V/-5V, I_D =400A
Inductive Load

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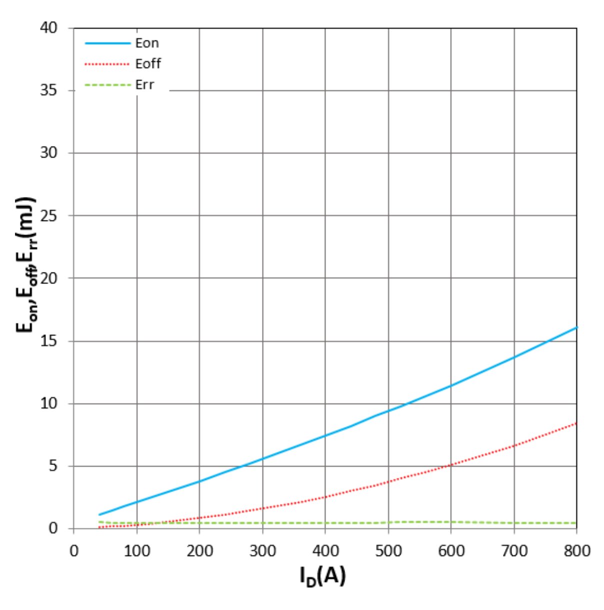

Figure 14. E_{on}, E_{off}, E_{rr} vs I_D
T_j =25°C, V_{DD} =600V, V_{GS} =+18V/-5V, R_g =3.3Ω
Inductive Load

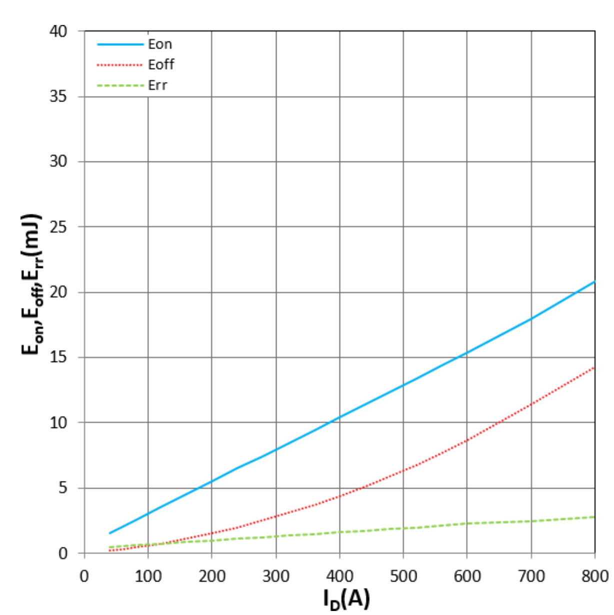

Figure 15. E_{on}, E_{off}, E_{rr} vs I_D
T_j =150°C, V_{DD} =600V, V_{GS} =+18V/-5V, R_g =3.3Ω
Inductive Load