DFS540HF12DFA1

1200V/540A Half Bridge SiC MOSFET Module

Description

The DFS540HF12DFA1 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
- $R_{ds(on)}$ =3.5mΩ
- Low thermal resistance with Si_3N_4 AMB
- 175°C maximum junction temperature
- 62mm half bridge module

Applications

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

Circuit diagram

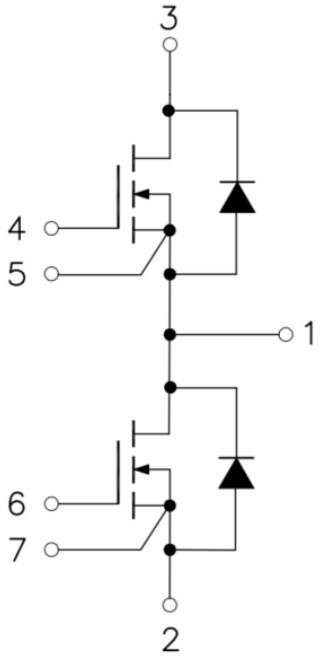

Figure 1. Out drawing & circuit diagram for DFS540HF12DFA1

Pin Configuration and Marking Information

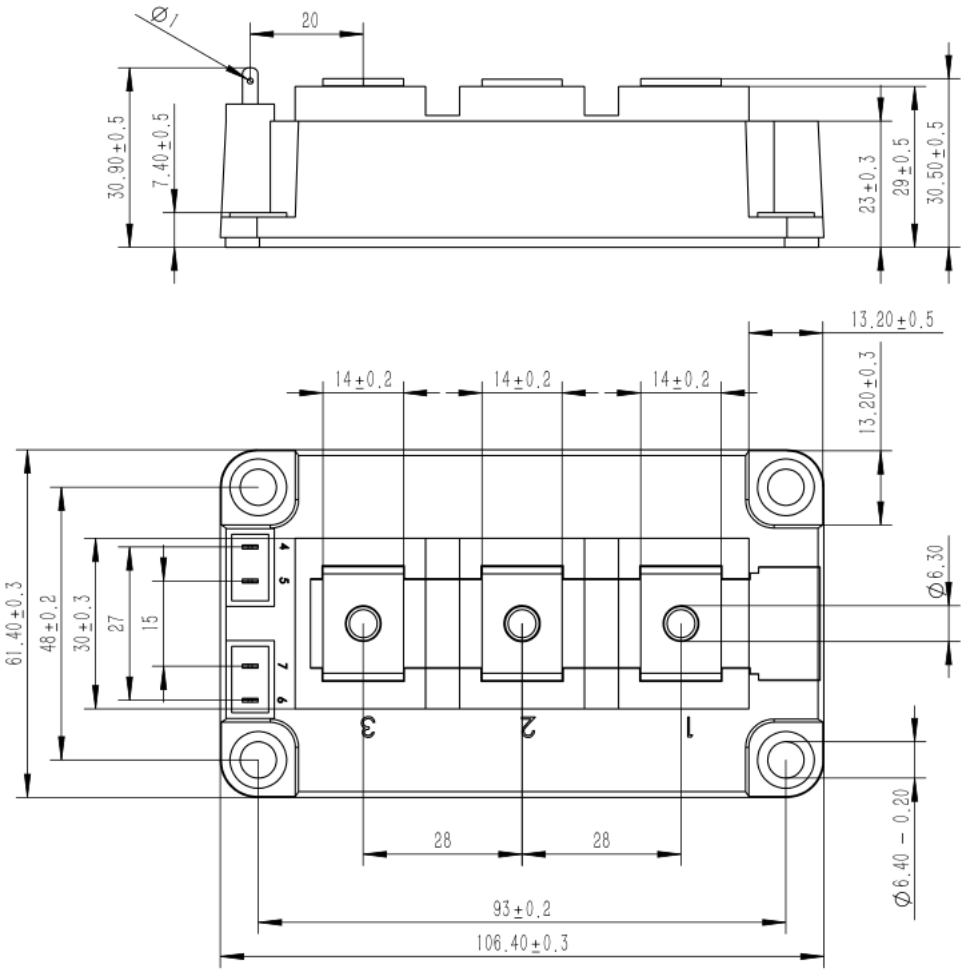

Figure 2. Pin configuration

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 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	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	-8 to 19	V
I_{DS}	DC Continuous Drain Current	T_C =25℃ , V_{GS} =15V	610	A
I_{DS}	DC Continuous Drain Current	T_C =80°C , V_{GS} =15V	480	A
I_{SD}	Source-Drain Current(diode)	T_C =25℃, with ON signal	630	A
I_{SD}	Source-Drain Current(diode)	T_C =80℃, with ON signal	500	A
I_{DSM}	Pulse Drain Current	T_C =25℃, Pulse width =1ms, V_{GS} =18V, Note2	1200	A
P_{tot}	Total Power Dissipation	T_C =25℃	2205	W
T_{jmax}	Max Junction Temperature	-	175	°C
T_{stg}	Storage Temperature	-	-40 to 125	°C

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

Note2: Pulse width limited by maximum junction temperature

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 =400μA		1200	-	-	V
I_{DSS}	Zero gate voltage drain Current	V_{DS} =1200V, V_{GS} =0V		-	4	200	μA
$V_{GS(th)}$	Gate-source threshold Voltage	I_D =108mA, V_{DS} =V_{GS}	T_j =25°C	2.0	2.8	-	V
			T_j =175°C	-	2.1	-	V
I_{GSS}	Gate-Source Leakage Current	V_{GS} =15V, V_{DS} =0V	T_j =25°C	-	-	800	nA
$R_{DS(on)}$ (Chip)	Static drain-source On-state resistance	I_D =540A, V_{GS} =+15V	T_j =25°C	-	3.5	-	mΩ
			T_j =175°C	-	5.8	-	mΩ
$V_{DS(on)}$ (Chip)	Static drain-source On-state Voltage	I_D =540A, V_{GS} =+15V	T_j =25°C	-	1.90	-	V
			T_j =175°C	-	3.15	-	V
C_{iss}	Input Capacitance	V_{DS} =1000V, V_{GS} =0V, f =100kHz, V_{AC} =25mV		-	25540	-	pF
C_{oss}	Output Capacitance			-	1020	-	pF
C_{rss}	Reverse transfer Capacitance			-	68	-	pF
R_{Gint}	Internal gate resistor	f =100kHz, V_{AC} =25mV		-	1.5	-	Ω
Q_g	Total gate charge	V_{DD} =800V, I_D =320A, V_{GS} =+15/-4V		-	1020	-	nC
$t_{d(on)}$	Turn-on delay time	V_{DD} =600V, I_D =540A, V_{GS} =+15/-4V, R_{gon}/R_{goff} =2.2Ω/2.2Ω, Inductive load switching operation	T_j =25°C	-	67	-	ns
			T_j =150°C	-	61	-	
t_r	Rise time		T_j =25°C	-	37	-	ns
			T_j =150°C	-	32	-	
$t_{d(off)}$	Turn-off delay time		T_j =25°C	-	112	-	ns
			T_j =150°C	-	135	-	
t_f	Fall time		T_j =25°C	-	29	-	ns
			T_j =150°C	-	46	-	
E_{on}	Turn-on power dissipation		T_j =25°C	-	8.9	-	mJ
			T_j =150°C	-	7.2	-	
E_{off}	Turn-off power dissipation		T_j =25°C	-	6.5	-	mJ
			T_j =150°C	-	6.9	-	
$R_{th(j-c)}$	FET Thermal Resistance	Junction to Case		-	0.068	-	°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 =540A, V_{GS} =0V	T_j =25°C	-	1.85	-	V
			T_j =175°C	-	3.10	-	
t_{rr}	Diode Reverse Recovery Time	(Switch side) V_{DD} =600V, I_D =540A V_{GS} =+15V/-4V R_{gon}/R_{goff} =2.2Ω/2.2Ω (FRD side) V_{RR}=600V, I_F=540A V_{GS}=+15V/-4V 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	-	285	-	A
			T_j =150°C	-	317	-	
Q_{rr}	Recovered charge		T_j=25°C	-	3.4	-	µC
			T_j =150°C	-	4.6	-	
E_{rr}	Reverse recovered energy		T_j =25°C	-	1.3	-	mJ
			T_j =150°C	-	2.4	-	
$R_{th(j-c)}$	Thermal Resistance, Junction to Case (Diode)			-	0.065	-	°C/W

Test Conditions

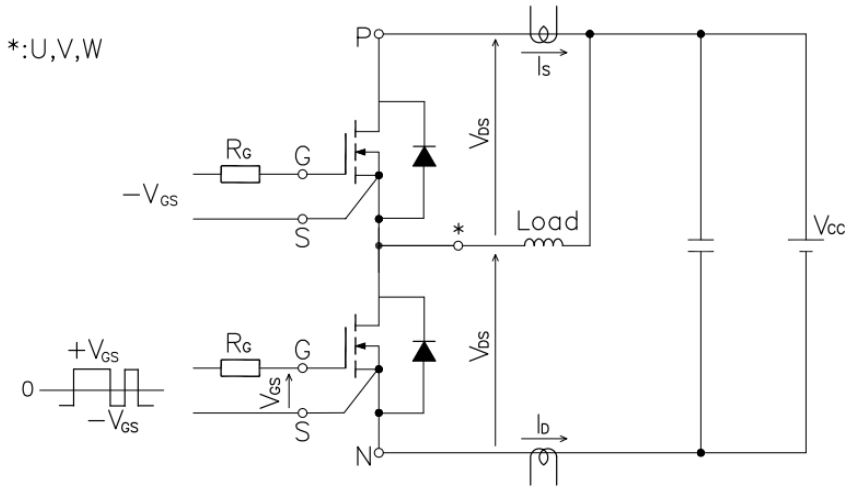

Figure 3. Switching time measure circuit

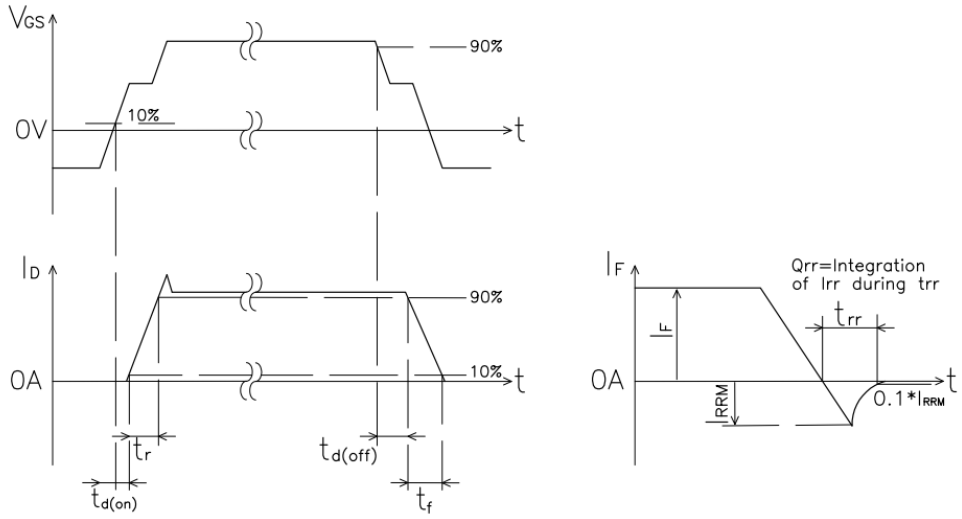

Figure 4. Switching time definition

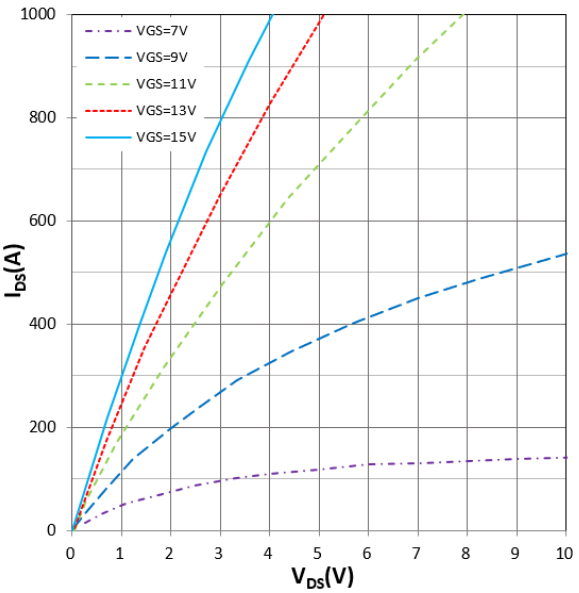

Figure 5. I_{DS} vs V_{DS}
T_j =25°C

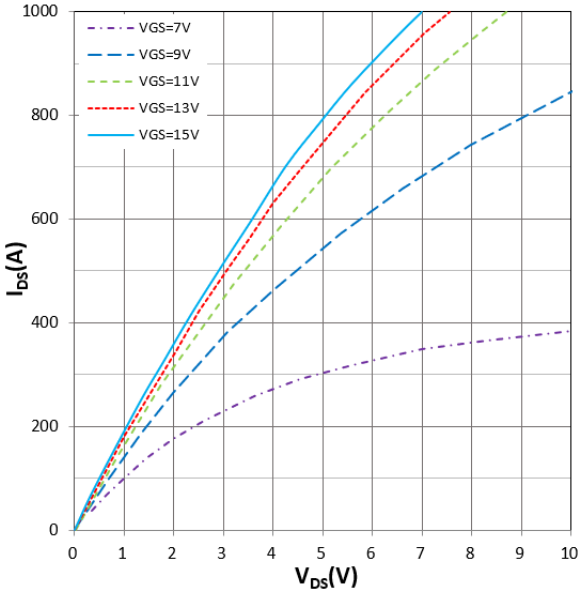

Figure 6. I_{DS} vs V_{DS}
T_j =175°C

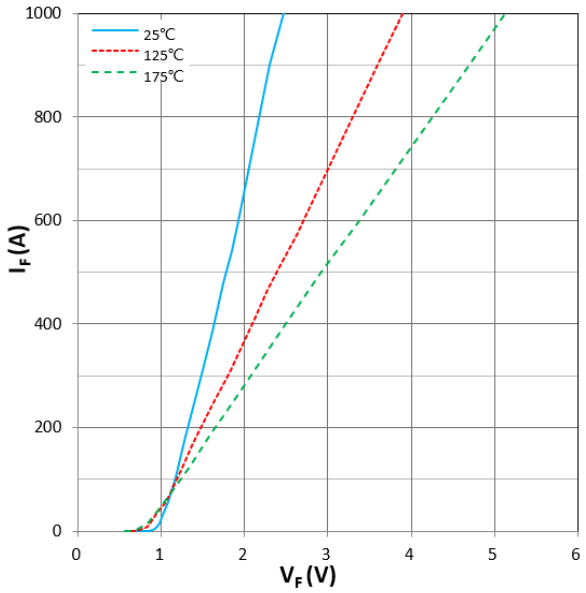

Figure 7. I_F vs V_F
V_{GS} =0V

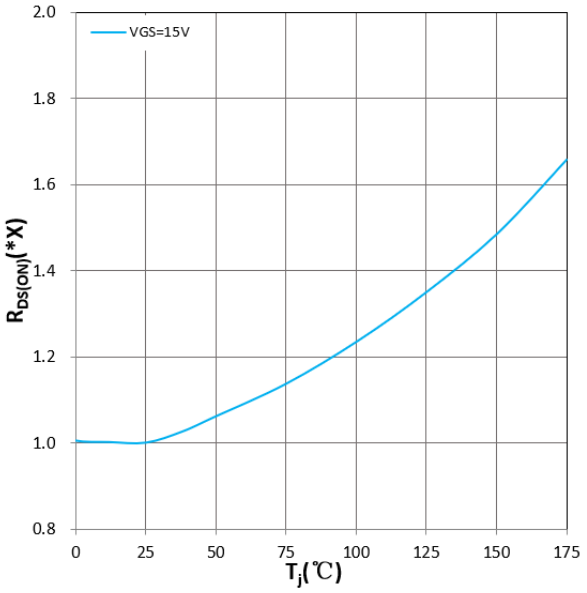

Figure 8. $R_{DS(ON)}$ vs T_j
V_{GS} =+15V, I_D =540A, 1.0X =3.5mΩ

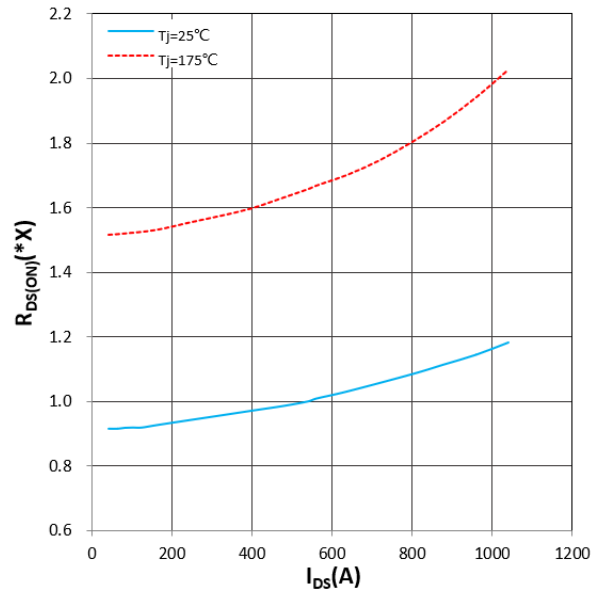

Figure 9. $R_{DS(ON)}$ vs I_{DS}
V_{GS} =+15V, 1.0X =3.5mΩ

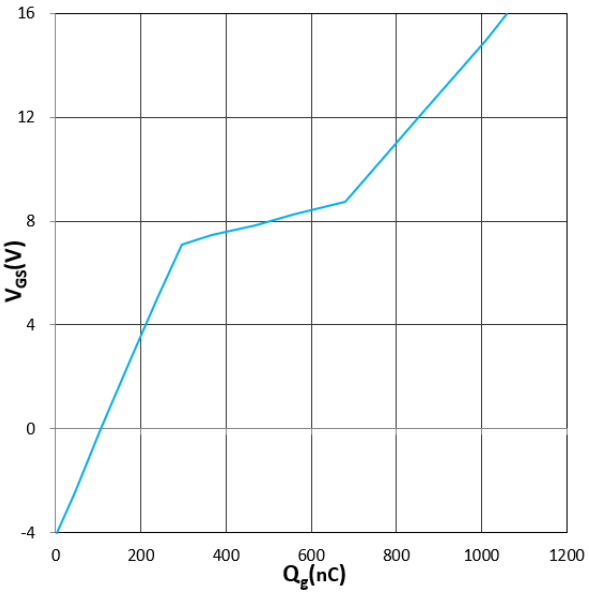

Figure 10. V_{GS} vs Q_g
V_{DS} =800V, I_D =320A, T_j =25°C

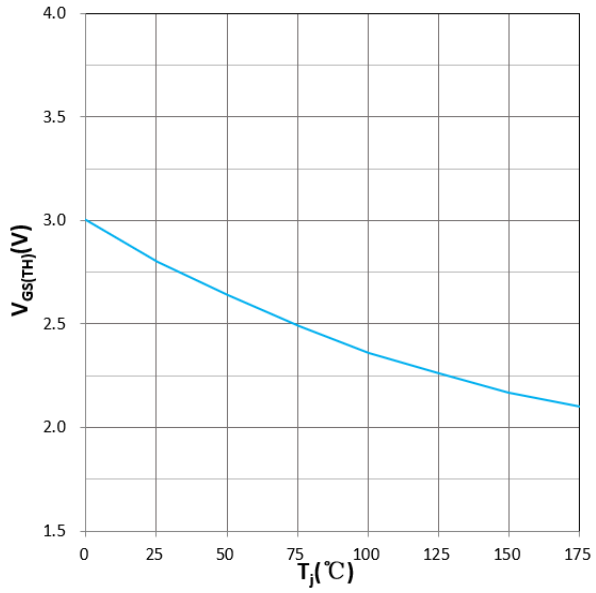

Figure 11. $V_{GS(TH)}$ vs T_j
V_{GS} =V_{DS}, I_D =108mA

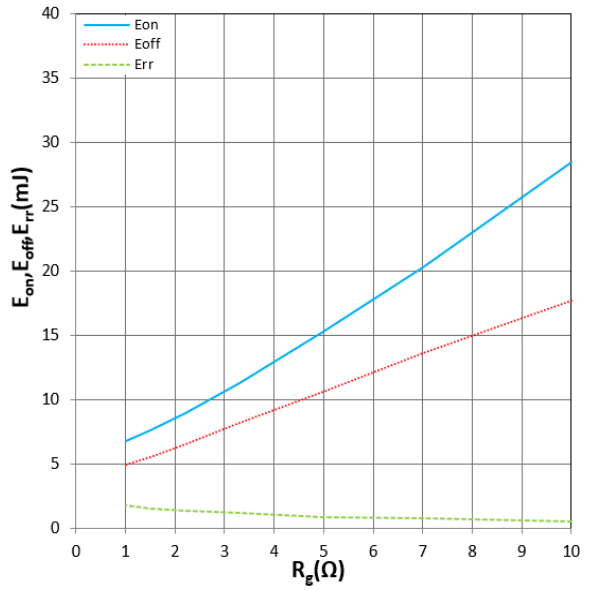

Figure 12. E_{on}, E_{off}, E_{rr} vs R_g
T_j =25°C, V_{DD} =600V, V_{GS} =+15V/-4V, I_D =540A
Inductive Load

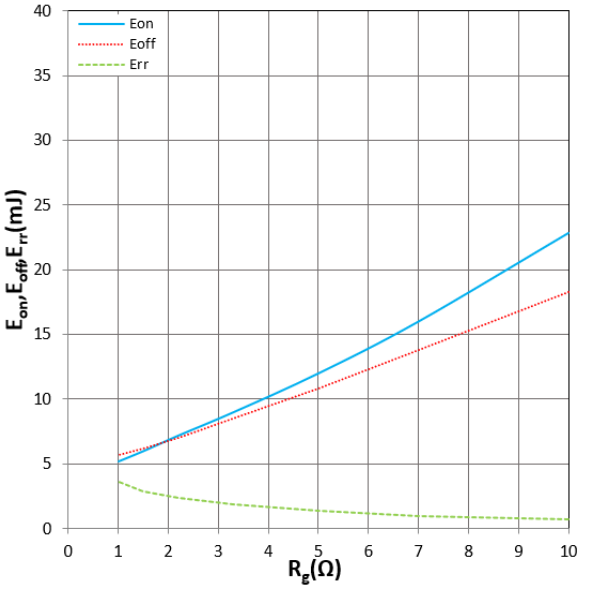

Figure 13. E_{on}, E_{off}, E_{rr} vs R_g
T_j =150°C, V_{DD} =600V, V_{GS} =+15V/-4V, I_D =540A
Inductive Load

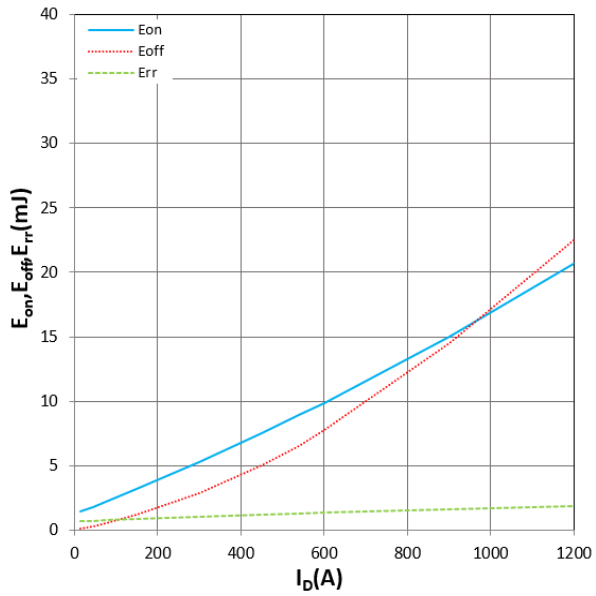

Figure 14. E_{on}, E_{off}, E_{rr} vs I_{DS}
T_j =25°C, V_{DD} =600V, V_{GS} =+15V/-4V
R_{gon}/R_{goff} =2.2Ω/2.2Ω, Inductive Load

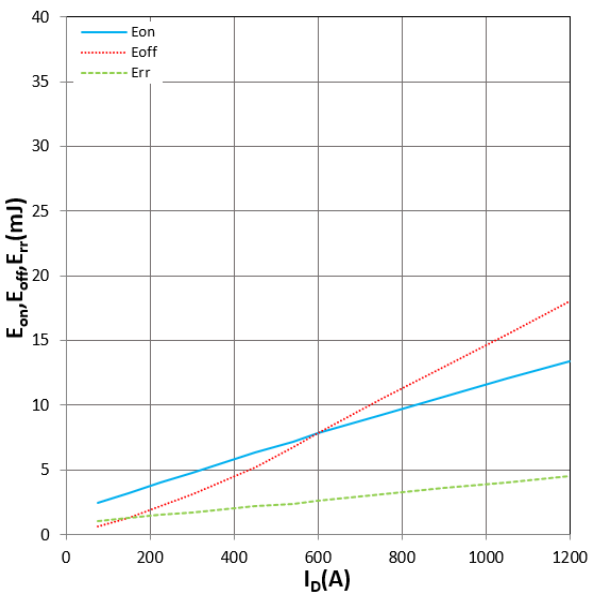

Figure 15. E_{on}, E_{off}, E_{rr} vs I_{DS}
T_j =150°C, V_{DD} =600V, V_{GS} =+15V/-4V
R_{gon}/R_{goff} =2.2Ω/2.2Ω, Inductive Load

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