DFS04CL12EZC2

1200V/3.9mΩ Chopper SiC MOSFET Module

Description

The DFS04CL12EZC2 is a Chopper SiC MOSFET Power Module. It integrates high performance SiC MOSFET chips designed for the applications such as xEv Application and Renewable energy.

Features

- Blocking voltage:1200V
- $R_{ds(on)}$ =3.9mΩ
- Low Switching Losses
- 175°C maximum junction temperature

Applications

- xEV Applications
- Converter
- Vehicle Fast Chargers
- Renewable

Circuit diagram

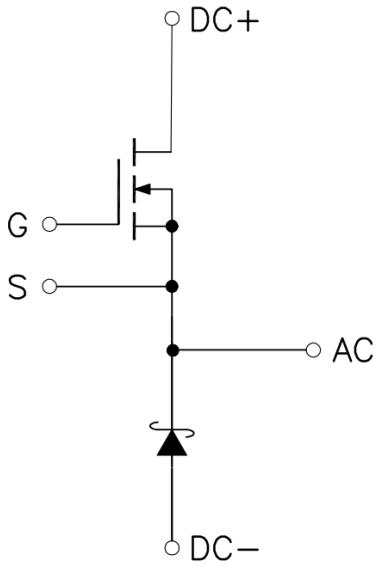
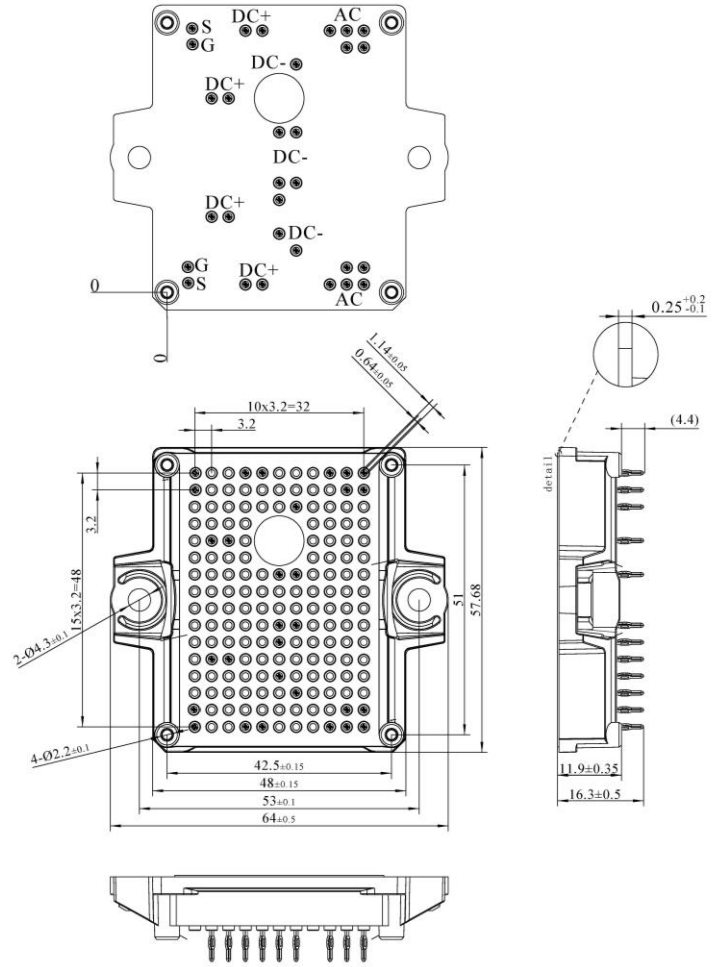


Figure 1. Out drawing & circuit diagram for DFS04CL12EZC2

Physical Dimensions



Pin table			
Pin		X	Y
DC+	1	14.85	1.5
	2	18.05	1.5
	3	8.45	14.3
	4	11.65	14.3
	5	8.45	36.7
	6	11.65	36.7
	7	14.85	49.5
	8	18.05	49.5
DC-	1	24.45	7.9
	2	21.25	11.1
	3	21.25	17.5
	4	21.25	20.7
	5	24.45	20.7
	6	21.25	30.3
	7	24.45	30.3
	8	24.45	43.1
AC	1	30.85	1.5
	2	34.05	1.5
	3	37.25	1.5
	4	34.05	4.7
	5	37.25	4.7
	6	34.05	46.3
	7	37.25	46.3
	8	30.85	49.5
	9	34.05	49.5
	10	37.25	49.5
S2	1	34.05	14.3
	2	34.05	36.7
G2	1	37.25	14.3
	2	37.25	36.7

Figure 2. Physical Dimensions

Module

Parameter	Condition	Value	Unit
Isolation voltage	RMS, f =50Hz, t =1min	3.4	kV
Clearance	Terminal to Terminal	5	mm
	Terminal to Heatsink	10	mm
Creepage distance	Terminal to Terminal	6.3	mm
	Terminal to Heatsink	12.7	mm
Comparative Tracking Index	-	400	-
Weight	-	40	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_{GSS}	Gate-Source Voltage(+)	D-S Short, Note1	22	V
V_{GSS}	Gate-Source Voltage(-)	D-S Short, Note1	-10	V
I_{DS}	DC Continuous Drain Current	T_f =120°C	200	A
I_{DSM}	Pulse Drain Current	Less than 1ms, Note2	400	A
I_F	Forward Current (Diode)	T_f =120°C	200	A
I_{FRM}	Pulse Forward Current (Diode)	Less than 1ms, Note2	400	A
T_j	Max Junction Temperature	-	-40 to 175	°C
T_{stg}	Storage temperature	-	-40 to 125	°C

Note1: Recommended Operating Value, +18V/-4V;+15V/-5V; +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 =400uA		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 =140mA, V_{DS} =V_{GS}, T_j =25°C		1.8	2.7	-	V
		I_D =140mA, V_{DS} =V_{GS}, T_j =175°C		-	2.05	-	V
I_{GSS}	Gate-Source Leakage Current	V_{GS} =20V, V_{DS} =0V, T_j =25°C		-	-	400	nA
$R_{DS(on)}$ (Chip)	Static drain-source On-state resistance	I_D =200A, V_{GS} =15V	T_j =25°C	-	4.7	6.1	mΩ
			T_j =175°C	-	7.1	-	mΩ
		I_D =200A, V_{GS} =18V	T_j =25°C	-	3.9	-	mΩ
			T_j =175°C	-	6.3	-	mΩ
$V_{DS(on)}$ (Chip)	Static drain-source On-state Voltage	I_D =200A, V_{GS} =15V	T_j =25°C	-	0.94	1.02	V
			T_j =175°C	-	1.42	-	V
		I_D =200A, V_{GS} =18V	T_j =25°C	-	0.78	-	V
			T_j =175°C	-	1.26	-	V
C_{iss}	Input Capacitance	V_D =800V, V_{GS} =0V, f =1MHz, V_{AC} =25mV		-	23.2	-	nF
C_{oss}	Output Capacitance			-	0.704	-	nF
C_{rss}	Reverse transfer Capacitance			-	0.056	-	nF
Q_G	Total gate charge	V_{DD}=800V, I_D=200A, V_{GS}=-5/+18V		-	710	-	nC
R_{Gint}	Internal Gate Resistance	f =1Mhz, V_{AC} =25mV		-	0.33	-	Ω
$t_{d(on)}$	Turn-on delay time	V_{DD} =600V, I_D =200A, V_{GS} =-4/+18V, R_G =2.5Ω, Inductive load switching operation	T_j =25°C	-	29	-	ns
			T_j =150°C	-	27	-	
t_r	Rise time		T_j =25°C	-	16	-	ns
			T_j =150°C	-	17	-	
$t_{d(off)}$	Turn-off delay time		T_j =25°C	-	97	-	ns
			T_j =150°C	-	112	-	
t_f	Fall time		T_j =25°C	-	36	-	ns
			T_j =150°C	-	41	-	
E_{on}	Turn-on power dissipation		T_j =25°C	-	3.98	-	mJ
			T_j =150°C	-	4.20	-	
E_{off}	Turn-off power dissipation		T_j =25°C	-	1.58	-	mJ
			T_j =150°C	-	1.77	-	
$R_{th(j-c)}$	FET Thermal Resistance	Junction to Case/MOSFET		-	0.09	-	K/W
$R_{th(c-f)}$	Contact thermal resistance	With thermal conductive grease /MOSFET		-	0.12	-	K/W

Note3: Assumes Thermal Conductivity of grease is 2.8 W/m・K and thickness is 50um.

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

Symbol	Item	Condition		Value			Unit
				Min.	Typ.	Max	
I_{RRM}	Reverse Current	V_{RRM} =1200V	-	-	-	200	uA
V_F	Forward Voltage	I_F =200A	T_j =25°C	-	1.45	1.65	V
			T_j =175°C	-	2.05	-	
T_{rr}	Reverse recovery time	V_{RR} =600V, I_F =200A MOSFET side: V_{GS} =+18/-4V R_G =2.5Ω Inductive load switching operation	T_j =25°C	-	25	-	ns
			T_j =150°C	-	28	-	
Q_{rr}	Reverse recovery charge		T_j =25°C	-	1.35	-	uC
			T_j =150°C	-	1.75	-	
E_{rr}	Diode switching power dissipation		T_j =25°C	-	0.71	-	mJ
			T_j =150°C	-	0.98	-	
$R_{th(j-c)}$	SiC SBD Thermal Resistance	Junction to Case		-	0.08	-	K/W
$R_{th(c-f)}$	Contact thermal Resistance	With thermal conductive grease, Note4		-	0.12	-	K/W

Note4: Assumes Thermal Conductivity of grease is 2.8W/m・K and thickness is 50um.

Body Diode Electrical characteristics (T_j =25°C unless otherwise specified, chip: Target)

Symbol	Item	Condition		Value			Unit
				Min.	Typ.	Max	
V_{SD}	Body Diode Forward Voltage	V_{GS} =-5V I_{SD} =200A	T_j =25°C	-	5.17	-	V
			T_j =175°C	-	4.66	-	
T_{rr}	Reverse recovery time	V_{DD} =600V I_D =200A V_{GS} =-4/+18V R_G =2.5Ω Inductive load switching operation	T_j =25°C	-	55	-	ns
			T_j =150°C	-	45	-	
Q_{rr}	Reverse recovery charge		T_j =25°C	-	4.41	-	μC
			T_j =150°C	-	9.02	-	
E_{rr}	Diode switching power dissipation		T_j =25°C	-	0.92	-	mJ
			T_j =150°C	-	1.60	-	

Test Conditions

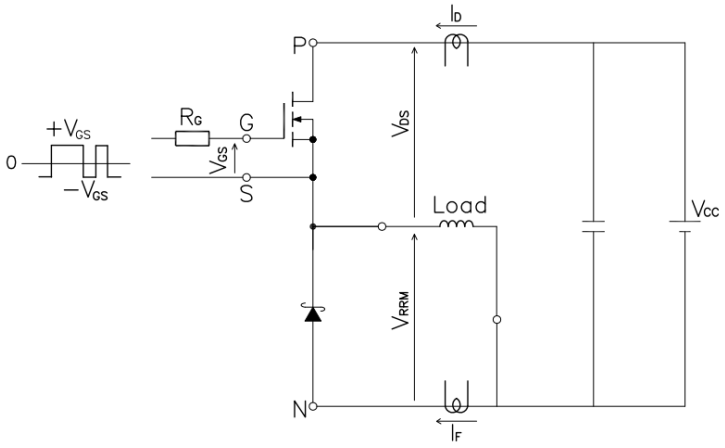


Figure 3. Switching time measure circuit

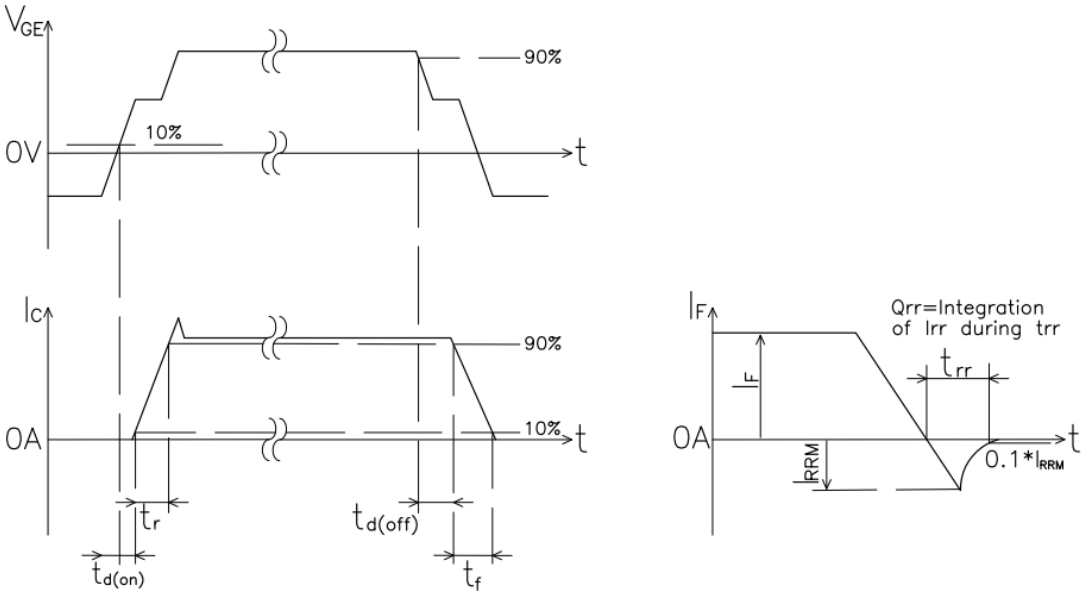


Figure 4. Switching time definition

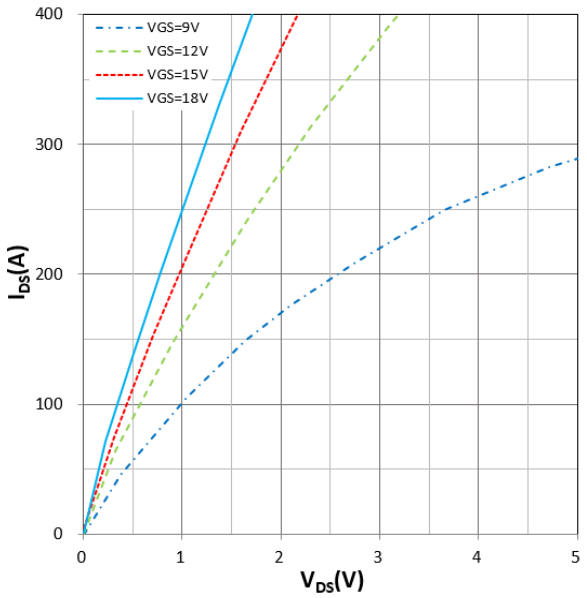


Figure 5. I_{DS} vs V_{DS}
T_j =25°C, V_{GS} parameter

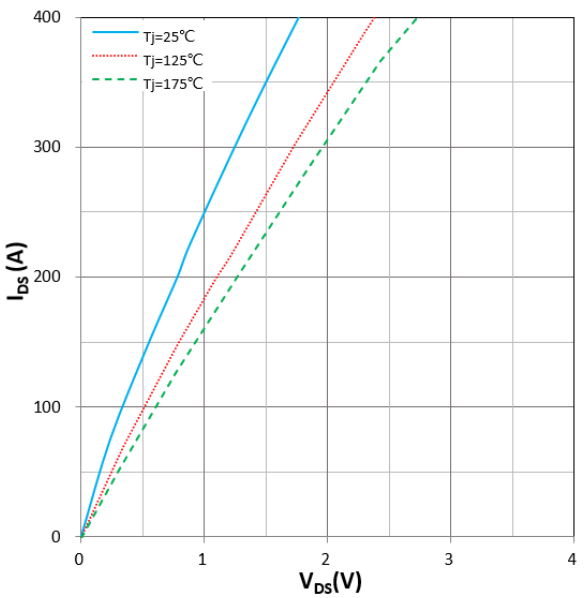


Figure 6. I_{DS} vs V_{DS}
V_{GS} =+18V

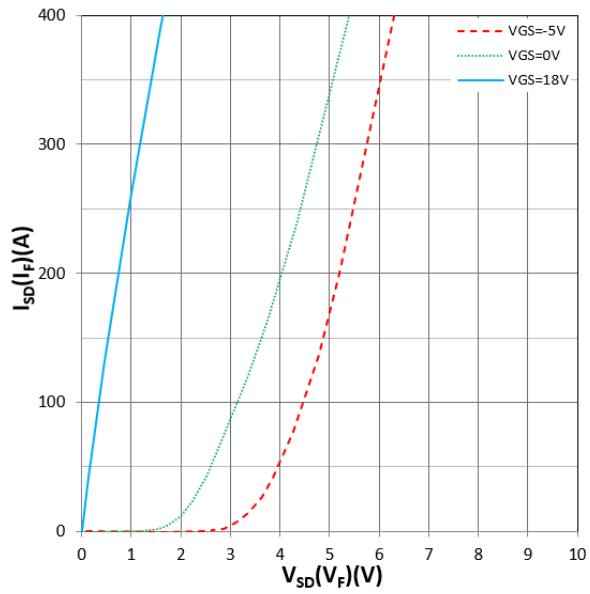


Figure 7. I_{SD} vs V_{SD} (Body Diode)
T_j =25°C, V_{GS} parameter

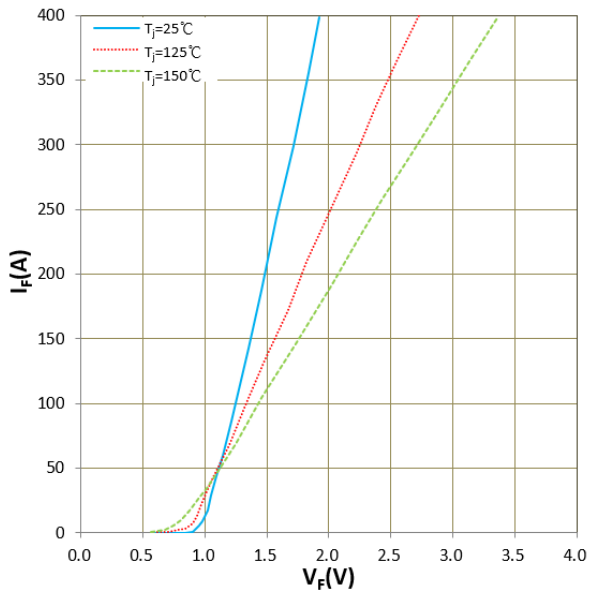


Figure8. I_F vs V_F (SiC SBD)

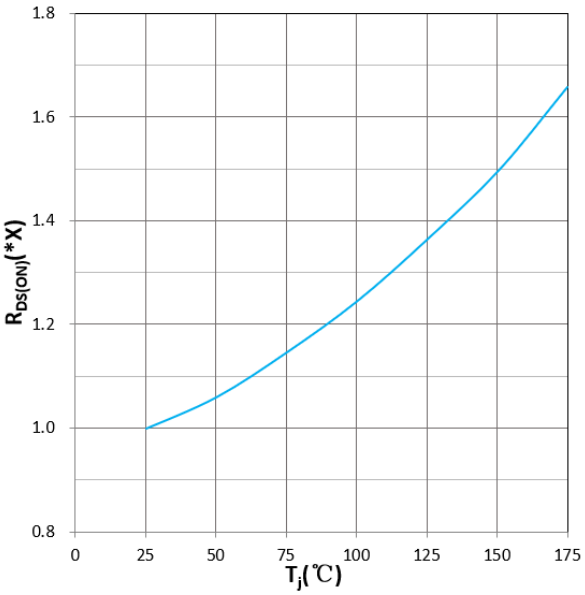


Figure 9. $R_{DS(ON)}$ vs T_j
V_{GS} =+18V, I_D =200A, 1.0X =3.9mΩ

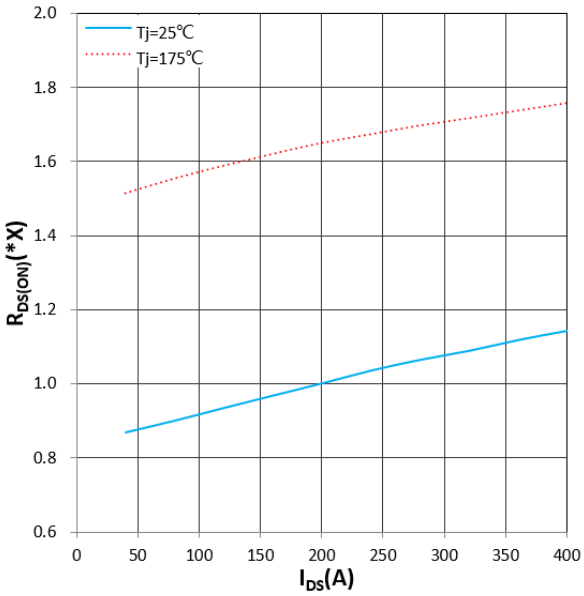


Figure 10. $R_{DS(ON)}$ vs I_{DS}
V_{GS} =+18V, 1.0X =3.9mΩ

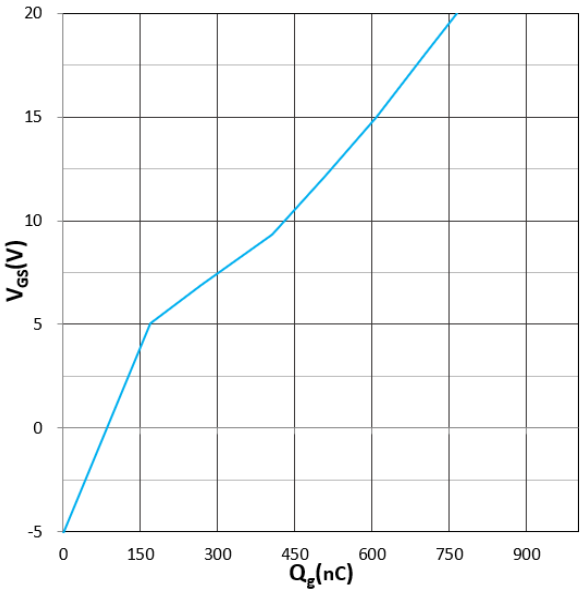


Figure 11. V_{GS} vs Q_g
V_{DS} =800V, I_D =200A , T_j =25°C

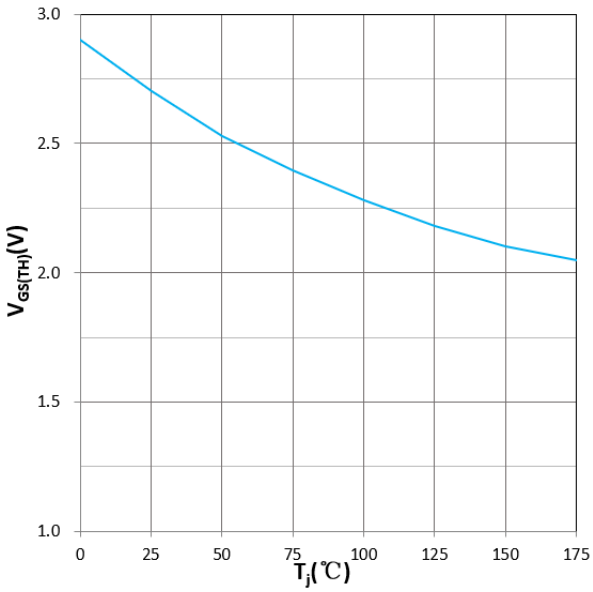


Figure 12. $V_{GS(TH)}$ vs T_j
V_{GS} =V_{DS}, I_D =140mA

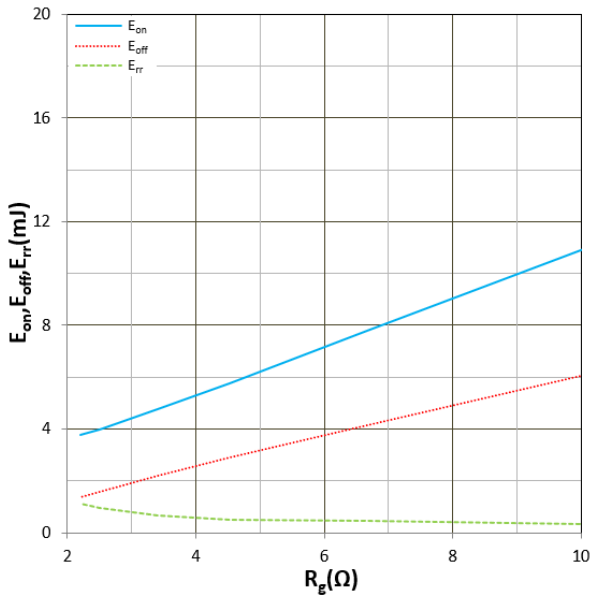


Figure 13. E_{on}, E_{off}, E_{rr} vs R_G
T_j =25°C, V_{DD} =600V, I_D =200A, V_{GS} =-4V/+18V
Inductive Load

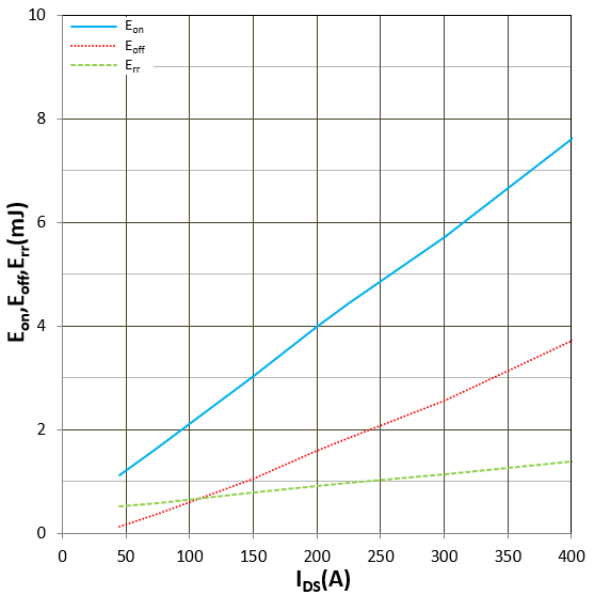


Figure 14. E_{on}, E_{off}, E_{rr} vs I_{DS}
T_j =25°C, V_{DD} =600V, R_G =2.5Ω, V_{GS} =-4V/+18V
Inductive Load

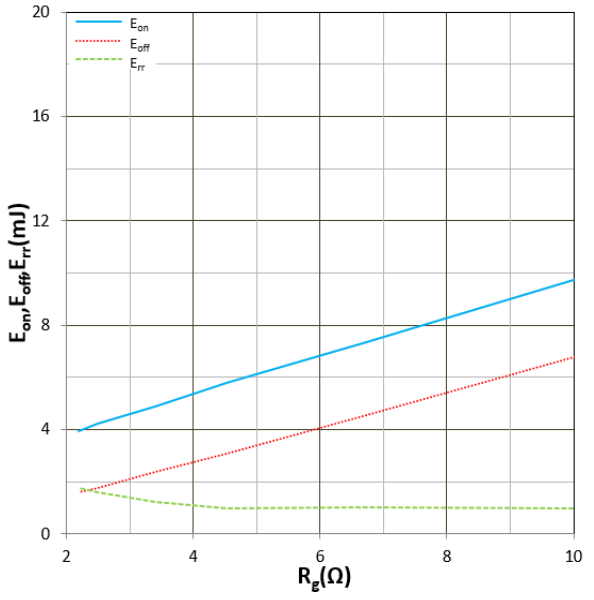


Figure 15. E_{on}, E_{off}, E_{rr} vs R_G
T_j =150°C, V_{DD} =600V, I_D =200A , V_{GS} =-4V/+18V
Inductive Load

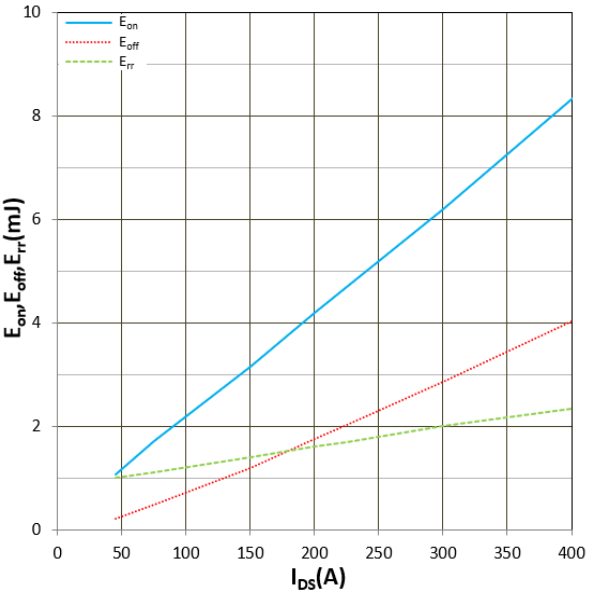


Figure 16. E_{on}, E_{off}, E_{rr} vs I_{DS}
T_j =150°C, V_{DD} =600V, R_G =2.5Ω, V_{GS} =-4V/+18V
Inductive Load

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