

HCS900FC120D3A1

1200V/900A Chopper SiC MOSFET Module

Description

The HCS900FC120D3A1 is a Chopper SiC MOSFET Power Module. It integrates high performance SiC MOSFET and SiC SBD chips designed for the applications such as Motor drives and Renewable energy.



Features

- Blocking voltage: 1200V
- $R_{DS(on)} = 2.1m\Omega$ ($T_j = 25^\circ C, V_{GS} = 18V$)
- Low thermal resistance with Si_3N_4 AMB
- $175^\circ C$ maximum junction temperature
- Thermistor inside
- Low Switching Losses

Applications

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

Circuit diagram

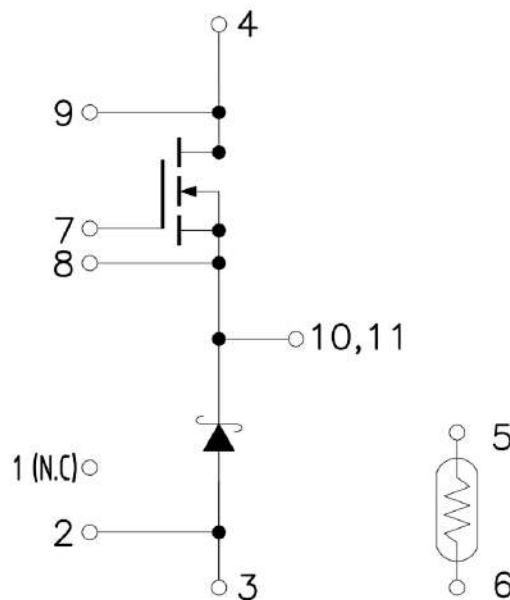


Figure 1. Out drawing & circuit diagram for HCS900FC120D3A1

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Pin Configuration and Marking Information

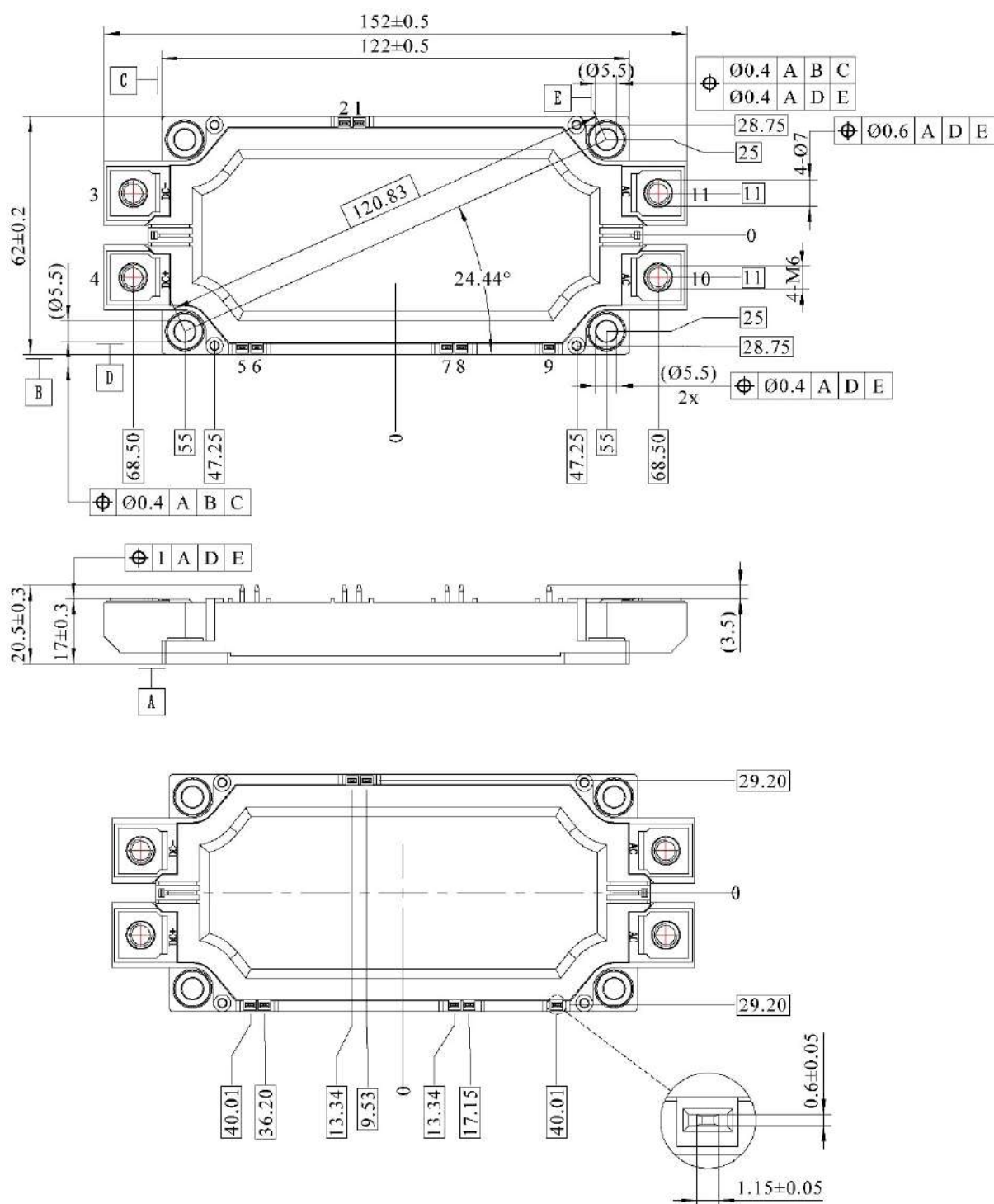


Figure 2. Pin configuration

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Module

Parameter	Condition	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	0.5	mΩ
Mounting torque for module mounting	M5, M6	3 to 6	Nm
Weight	-	340	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, AC frequency ≥1Hz, Note1	-10 to 25	V
I _{DS}	DC Continuous Drain Current	T _C =25°C, V _{GS} =+18V	930	A
I _{DS}	DC Continuous Drain Current	T _C =80°C, V _{GS} =+18V	745	A
I _{DSM}	Pulse Drain Current	T _C =25°C, Pulse width =1ms, V _{GS} =+18V, Note2	1800	A
I _F	Forward Current (Diode)	-	900	A
I _{FRM}	Pulse Forward Current (Diode)	Less than 1ms, Note2	1800	A
P _{tot}	Total Power Dissipation	T _C =25°C	3330	W
T _{jmax}	Max Junction Temperature	-	175	°C
T _{stg}	Storage Temperature	-	-40 to 125	°C

Note1: Recommended Operating Value, +18V/-5V ,+18V/-4V, +15V/-4V

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 R ₁₀₀	T _C =100°C, R ₁₀₀ =493Ω	-5	-	5	%
P ₂₅	Power dissipation	T _C =25°C	-	-	20	mW
B _{25/50}	B-value	R ₂ =R ₂₅ exp [B _{25/50} (1/T ₂ - 1/(298,15 K))]	-	3375	-	K
B _{25/80}	B-value	R ₂ =R ₂₅ exp [B _{25/80} (1/T ₂ - 1/(298,15 K))]	-	3411	-	K
B _{25/100}	B-value	R ₂ =R ₂₅ exp [B _{25/100} (1/T ₂ - 1/(298,15 K))]	-	3433	-	K

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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 =800μA		1200	-	-	V
I _{DSS}	Zero gate voltage drain Current	V _{DS} =1200V, V _{GS} =0V		-	10	-	μA
V _{GS(th)}	Gate-source threshold Voltage	I _D =160mA	T _J =25°C	1.9	2.5	4.0	V
		V _{DS} =V _{GS}	T _J =175°C	-	1.6	-	V
I _{GSS}	Gate-Source Leakage Current	V _{GS} =18V, V _{DS} =0V, T _J =25°C		-	20	2000	nA
R _{DS(on)} (Chip)	Static drain-source	I _D =900A	T _J =25°C	-	2.1	-	mΩ
	On-state resistance	V _{GS} =18V	T _J =175°C	-	3.8	-	mΩ
V _{DS(on)} (Chip)	Static drain-source	I _D =900A	T _J =25°C	-	1.89	-	V
	On-state Voltage	V _{GS} =18V	T _J =175°C	-	3.42	-	V
C _{iss}	Input Capacitance	V _D =1000V, V _{GS} =0V f =100kHz, V _{AC} =25mV		-	38.2	-	nF
C _{oss}	Output Capacitance			-	1.74	-	nF
C _{rss}	Reverse transfer Capacitance			-	0.14	-	nF
Q _G	Total gate charge	V _{DD} =800V, I _D =400A, V _{GS} =+20/-5V		-	1895	-	nC
R _{Gint}	Internal Gate Resistance	T _J =25°C		-	0.9	-	Ω
t _{d(on)}	Turn-on delay time	V _{DD} =600V I _D =900A V _{GS} =+18/-4V R _{g(on)} =1.5Ω R _{g(off)} =1.5Ω Inductive load switching operation	T _J =25°C	-	51	-	ns
			T _J =150°C	-	42	-	
t _r	Rise time		T _J =25°C	-	41	-	ns
			T _J =150°C	-	39	-	
t _{d(off)}	Turn-off delay time		T _J =25°C	-	35	-	ns
			T _J =150°C	-	47	-	
t _f	Fall time		T _J =25°C	-	23	-	ns
			T _J =150°C	-	29	-	
E _{on}	Turn-on power dissipation		T _J =25°C	-	22.5	-	mJ
			T _J =150°C	-	31.6	-	
E _{off}	Turn-off power dissipation		T _J =25°C	-	6.6	-	mJ
			T _J =150°C	-	10.9	-	
R _{th(j-c)}	FET Thermal Resistance	Junction to Case		-	0.045	-	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 50μm.

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SiC SBD Electrical characteristics ($T_j=25^{\circ}\text{C}$ unless otherwise specified, chip)

Symbol	Item	Condition		Value			Unit
				Min.	Typ.	Max	
V _{DC}	DC blocking Voltage	T _j =25°C		1200	-	-	V
V _{BR}	Breakdown Voltage	I _R =16mA, T _j =25°C		1200	-	-	V
V _F	Diode forward Voltage	I _F =900A	T _j =25°C	-	2.00	2.20	V
			T _j =125°C	-	2.90	-	
			T _j =175°C	-	3.70	-	
I _R	Reverse Current	V _R =1200V	T _j =25°C	-	48	800	μA
			T _j =125°C	-	392	-	
			T _j =175°C	-	1544	-	
Q _C	Total capacitive charge	V _R =800V	T _j =25°C	-	2152	-	nC
C	Total capacitance	V _R =800V	f =1MHz		1448		pF
R _{th(j-c)}	SiC SBD Thermal Resistance	Junction to Case		-	0.054	-	K/W
R _{th(c-f)}	Contact thermal Resistance	With thermal conductive grease, Note1		-	0.020	-	K/W

Test Conditions

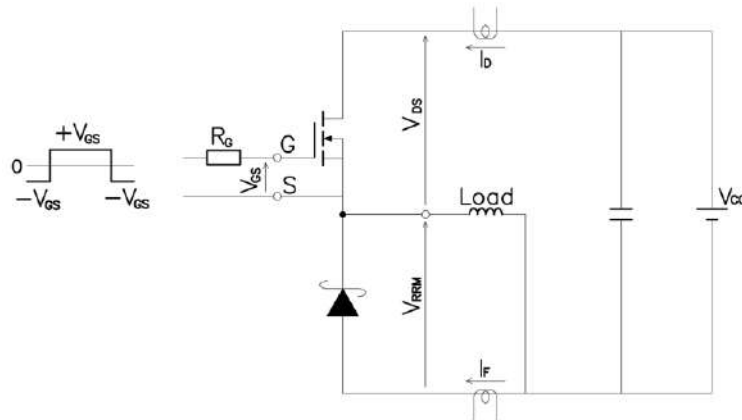


Figure 3. Switching time measure circuit

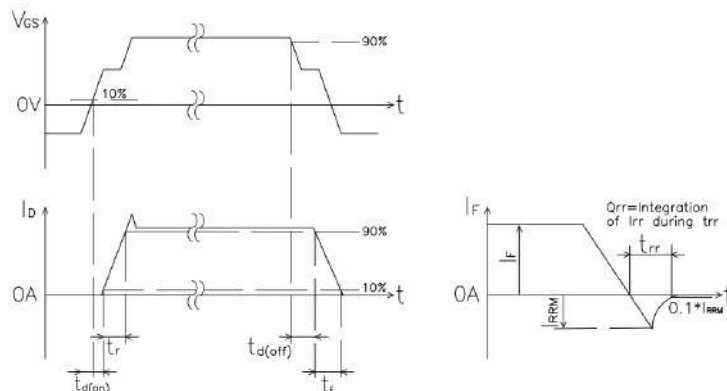


Figure 4. Switching time definition

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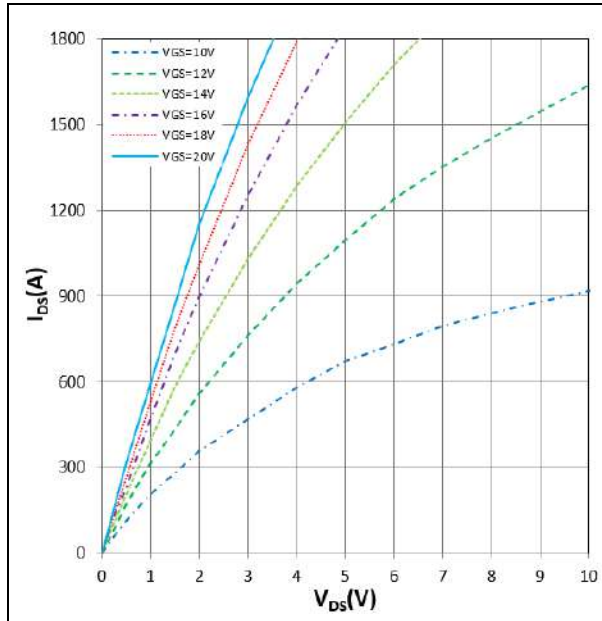


Figure 5. I_{DS} vs V_{DS}
 $T_j = 25^\circ\text{C}$, V_{GS} parameter

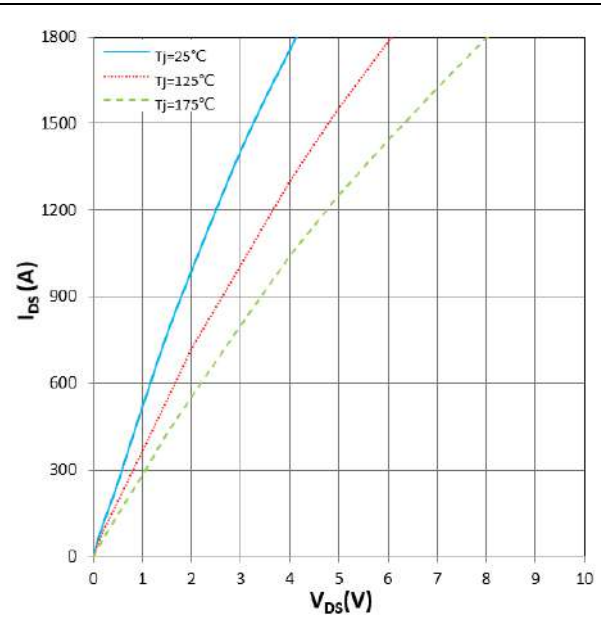


Figure 6. I_{DS} vs V_{DS}
 $V_{GS} = 18\text{V}$, T_j parameter

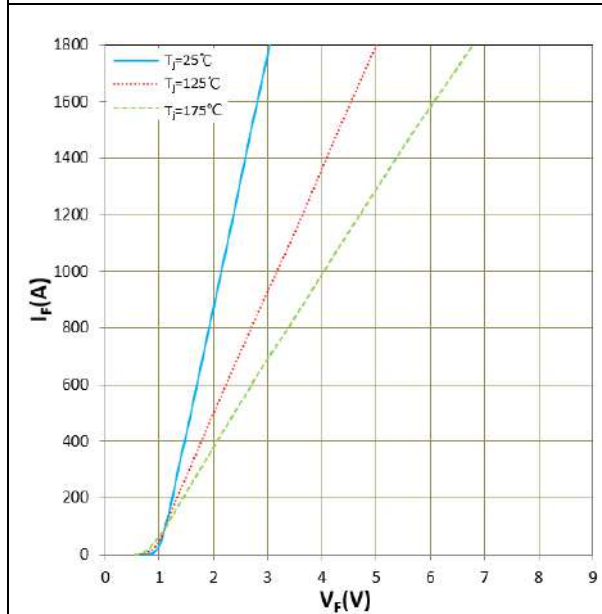


Figure 7. I_F vs V_F
 T_j parameter

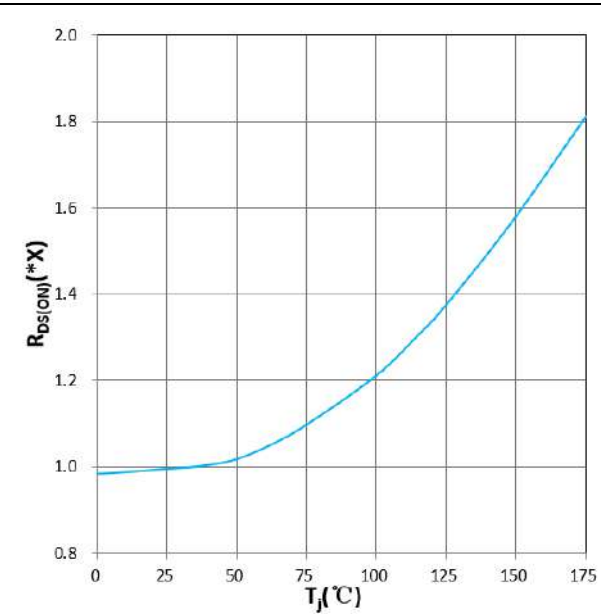


Figure 8. $R_{DS(ON)}$ vs T_j
 $V_{GS} = +18\text{V}$, $I_D = 900\text{A}$, $1.0X = 2.1\text{m}\Omega$

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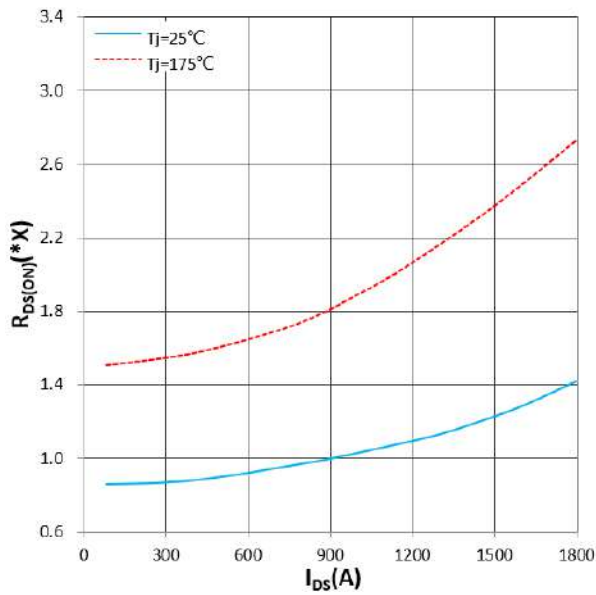


Figure 9. $R_{DS(ON)}$ vs I_{DS}
 $V_{GS} = +18\text{V}$, $1.0X = 2.1\text{m}\Omega$

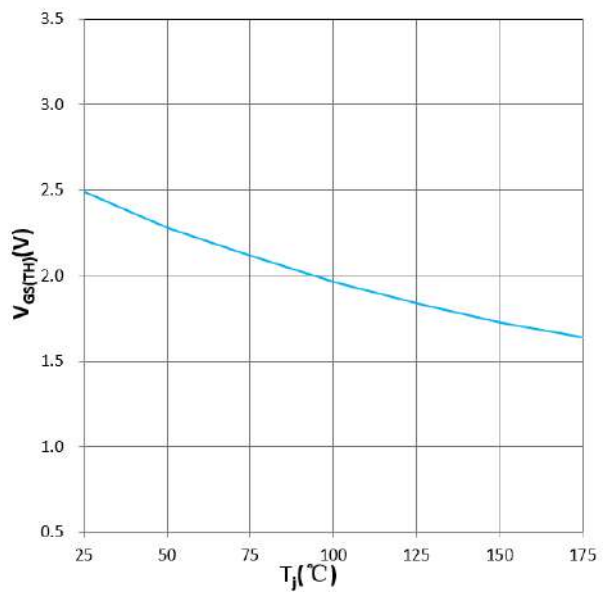


Figure 10. $V_{GS(TH)}$ vs T_J
 $V_{GS} = V_{DS}$, $I_D = 160\text{mA}$

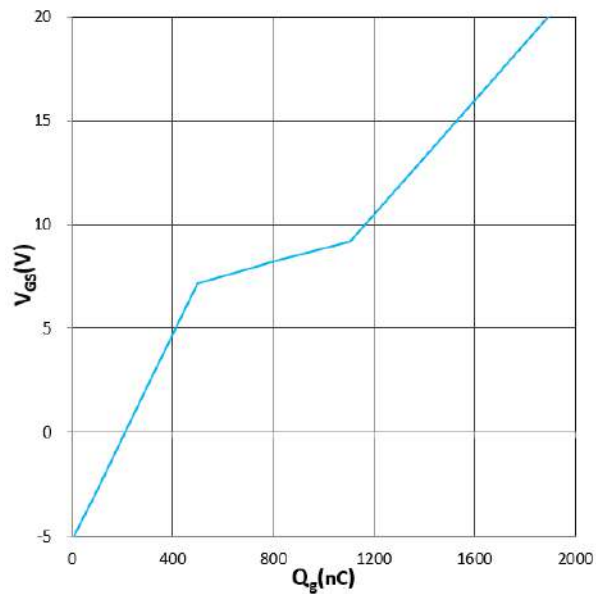


Figure 11. V_{GS} vs Q_g
 $T_J = 25^\circ\text{C}$, $V_{DS} = 800\text{V}$, $I_D = 400\text{A}$

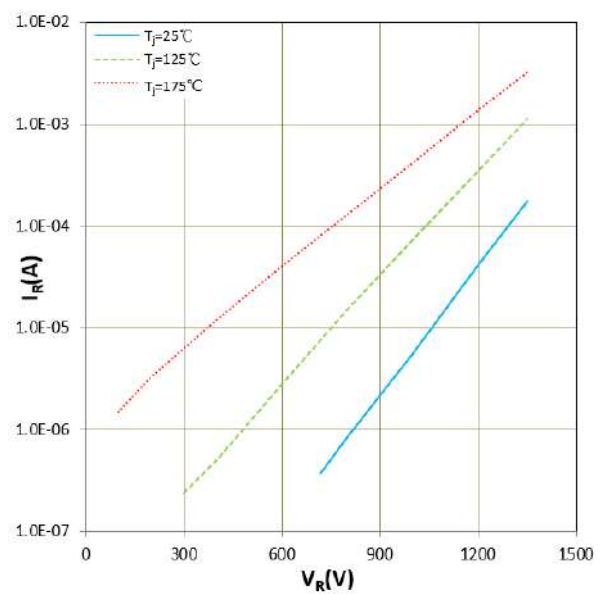


Figure 12. I_R vs V_R
 T_J parameter

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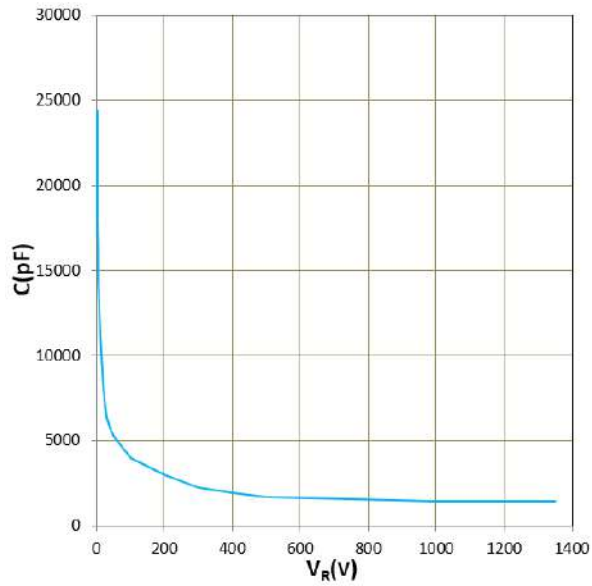


Figure 13. C vs V_R

$T_j = 25^\circ\text{C}$

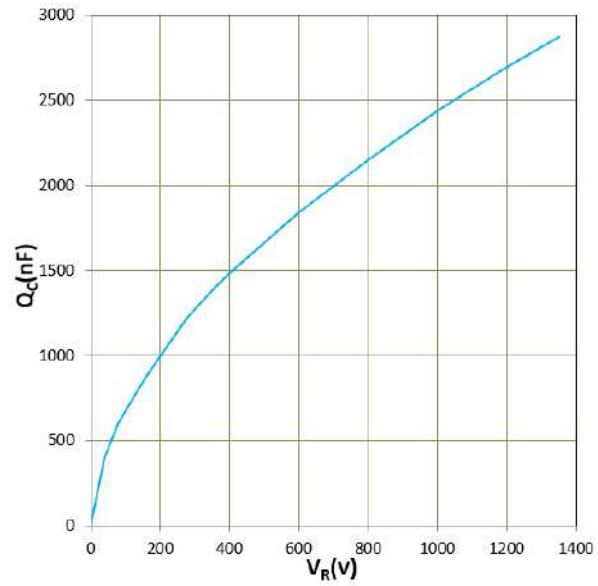


Figure 14. Q_C vs V_R

$T_j = 25^\circ\text{C}$

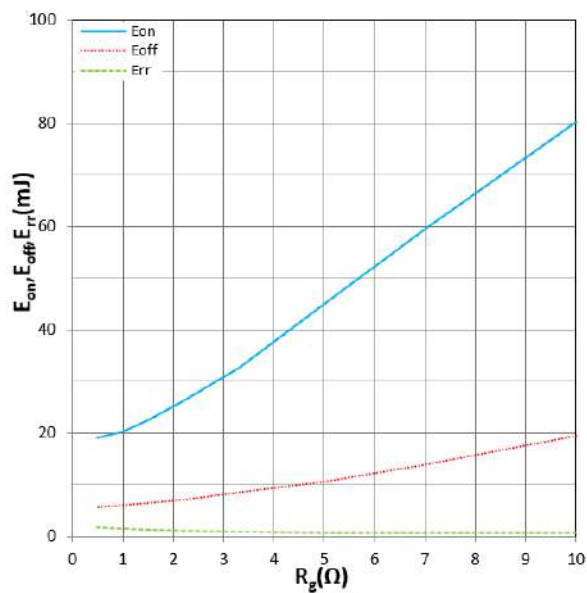


Figure 15. E_{on} , E_{off} , E_{rr} vs R_g

$T_j = 25^\circ\text{C}$, $V_{DD} = 600\text{V}$, $V_{GS} = +18\text{V}/-4\text{V}$, $I_D = 900\text{A}$

Inductive Load

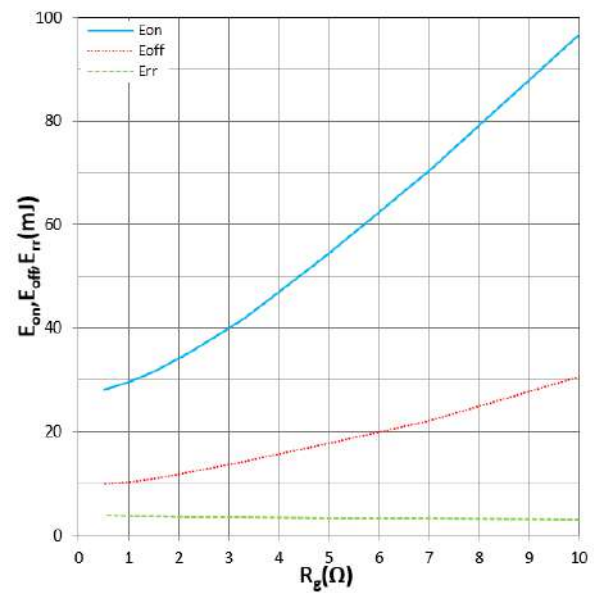


Figure 16. E_{on} , E_{off} , E_{rr} vs R_g

$T_j = 150^\circ\text{C}$, $V_{DD} = 600\text{V}$, $V_{GS} = +18\text{V}/-4\text{V}$, $I_D = 900\text{A}$

Inductive Load

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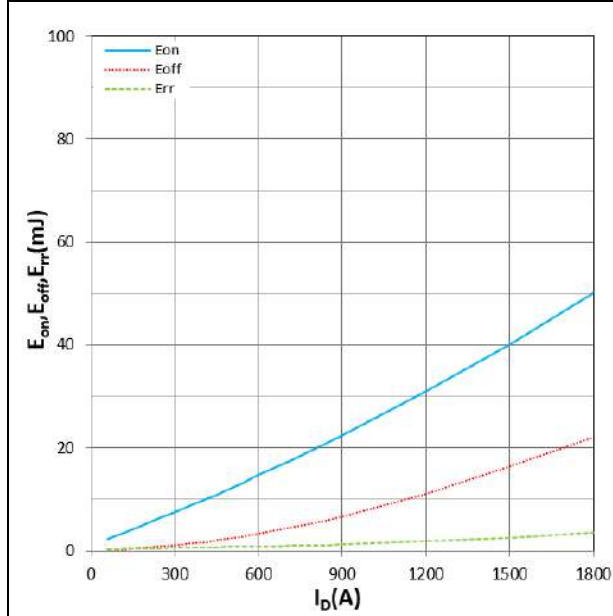


Figure 17. E_{on} , E_{off} , E_{rr} vs I_D
 $T_j=25^{\circ}\text{C}$, $V_{DD}=600\text{V}$, $V_{GS}=+18\text{V}/-4\text{V}$, $R_g=1.5\Omega$
Inductive Load

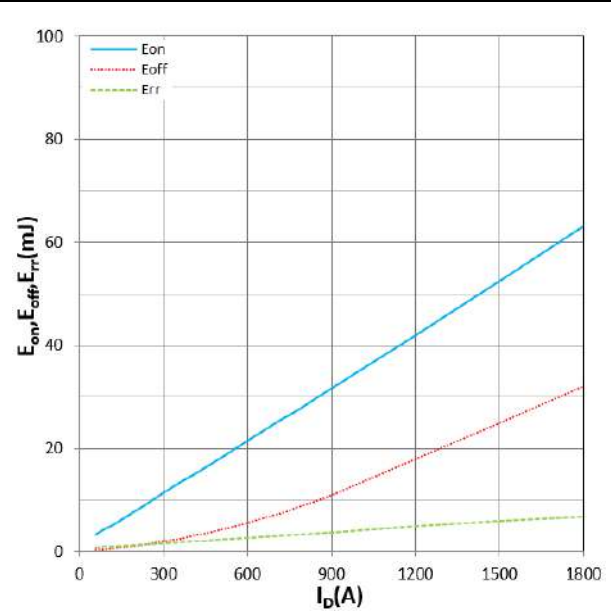


Figure 18. E_{on} , E_{off} , E_{rr} vs I_D
 $T_j=150^{\circ}\text{C}$, $V_{DD}=600\text{V}$, $V_{GS}=+18\text{V}/-4\text{V}$, $R_g=1.5\Omega$
Inductive Load

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