

HCS04FC120E2C3

1200V/3.9mΩ Chopper SiC MOSFET Module

Description

The HCS04FC120E2C3 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
- $R_{ds(on)}=3.9m\Omega$
- Low Switching Losses
- 175℃ maximum junction temperature

Applications

- xEV Applications
- Converter
- Vehicle Fast Chargers
- Renewable

Circuit diagram

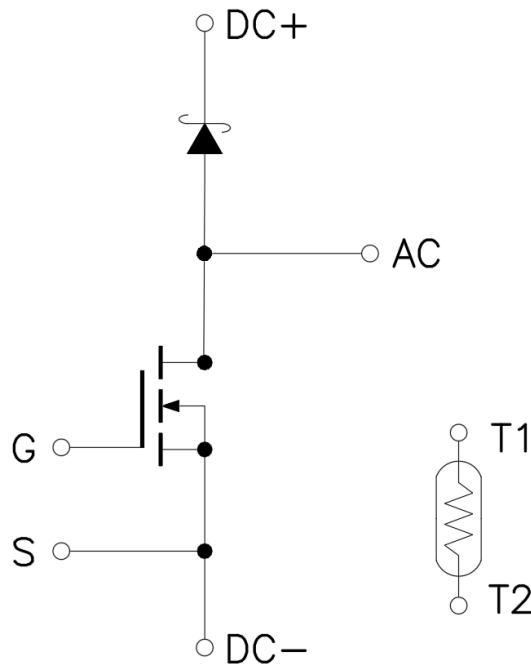
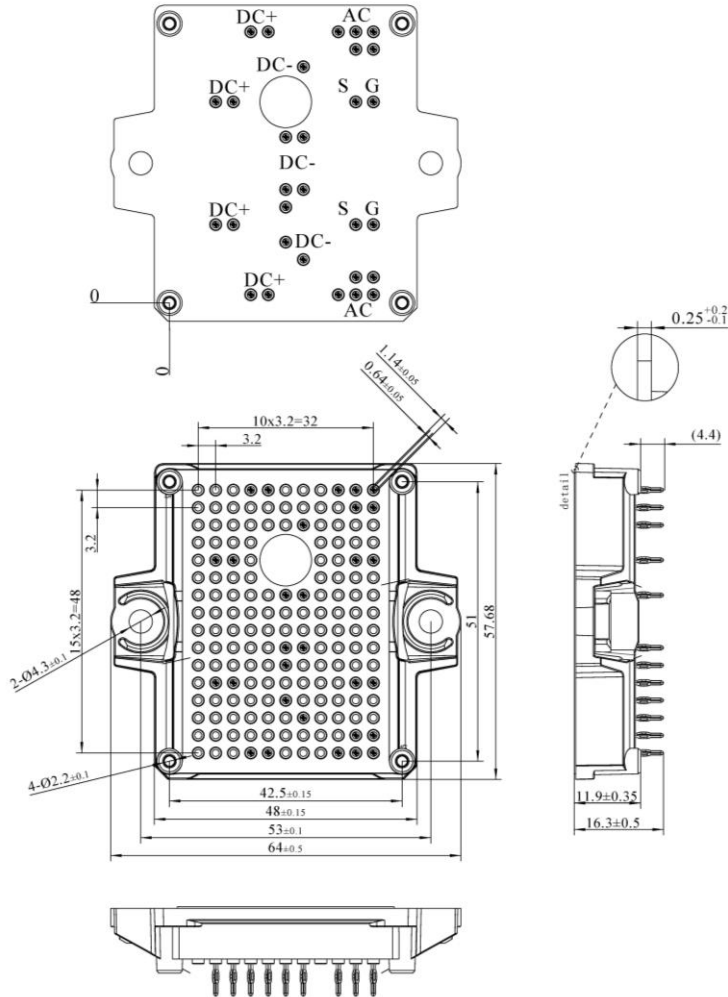


Figure 1. Out drawing & circuit diagramfor HCS04FC120E2C3

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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

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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• 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

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MOSFET Electrical characteristics (T_j=25• 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	T _j =25°C=	-	4.7	6.1	mΩ
		V _{GS} =15V	T _j 175°C=	-	7.1	-	mΩ
		I _D =200A	T _j 25°C=	-	3.9	-	mΩ
		V _{GS} =18V	T _j 175°C=	-	6.3	-	mΩ
V _{DS(on)} (Chip)	Static drain-source On-state Voltage	I _D =200A	T _j 25°C=	-	0.94	1.02	V
		V _{GS} =15V	T _j 175°C=	-	1.42	-	V
		I _D =200A	T _j 25°C=	-	0.78	-	V
		V _{GS} =18V	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.	-	nF
C _{rss}	Reverse transfer Capacitance			-	7040.	-	nF
Q _G	Total gate charge	V _{DD} =800V, I _D =200A, V _{GS} =-5/+18V		-	056	-	nC
R _{Gint}	Internal Gate Resistance	f =1Mhz, V _{AC} =25mV		-	710	-	Ω
t _{d(on)}	Turn-on delay time	V _{DD} =600V I _D =200A V _{GS} =-4/+18V R _G =2.5 Ω Inductive load switching operation	T _j =25°C	-	0.33	-	ns
			T _j =150°C	-	29	-	
t _r	Rise time		T _j =25°C	-	27	-	ns
			T _j =150°C	-	16	-	
t _{d(off)}	Turn-off delay time		T _j =25°C	-	17	-	ns
			T _j =150°C	-	97	-	
t _f	Fall time		T _j =25°C	-	112	-	ns
			T _j =150°C	-	36	-	
E _{on}	Turn-on power dissipation		T _j =25°C	-	41	-	mJ
			T _j =150°C	-	3.98	-	
E _{off}	Turn-off power dissipation		T _j =25°C	-	4.20	-	mJ
			T _j =150°C	-	1.58	-	
R _{th(j-c)}	FET Thermal Resistance	Junction to Case/MOSFET		-	1.77	-	K/W
R _{th(c-f)}	Contact thermal resistance	With thermal conductive grease /MOSFET		-	0.09 0.12	-	K/W

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

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SiC SBDElectrical characteristics ($T_j=25^\circ\text{C}$ 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	$I_F=200A$	$T_j=25^\circ\text{C}$	-	1.45	1.65	V
			$T_j=175^\circ\text{C}$	-	2.05	-	
T_{rr}	Reverse recovery time	$V_{RR}=600V, I_F=200A$ MOSFET side:	$T_j=25^\circ\text{C}$	-	25	-	ns
			$T_j=150^\circ\text{C}$	-	28	-	
Q_{rr}	Reverse recovery charge	$V_{GS}=+18/-4V$ $R_G=2.5\Omega$	$T_j=25^\circ\text{C}$	-	1.35	-	uC
			$T_j=150^\circ\text{C}$	-	1.75	-	
E_{rr}	Diode switching power dissipation	Inductive load switching operation	$T_j=25^\circ\text{C}$	-	0.71	-	mJ
			$T_j=150^\circ\text{C}$	-	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 $2.8W/m \cdot K$ and thickness is 50um.

Body Diode Electrical characteristics ($T_j=25^\circ\text{C}$ unless otherwise specified, chip:Target)

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

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Test Conditions

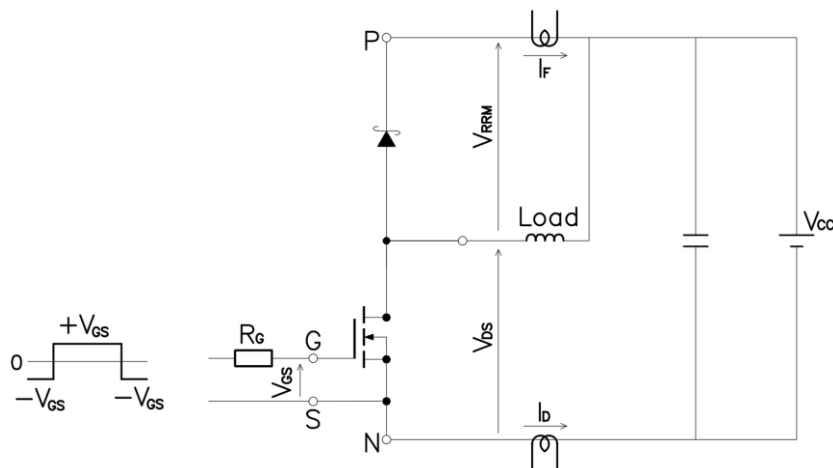


Figure 3. Switching time measure circuit

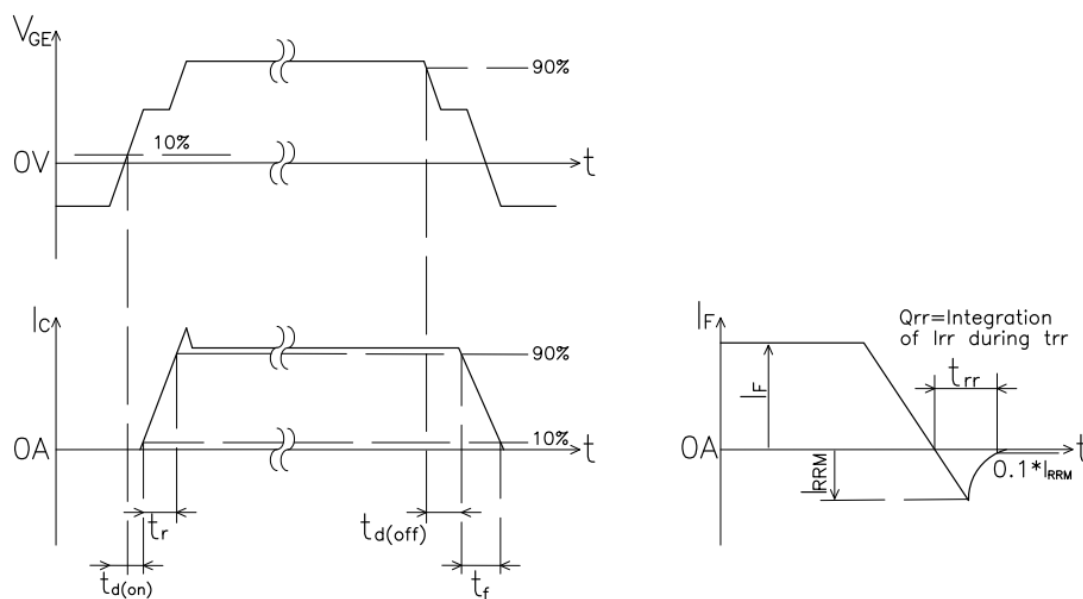


Figure 4. Switching time definition

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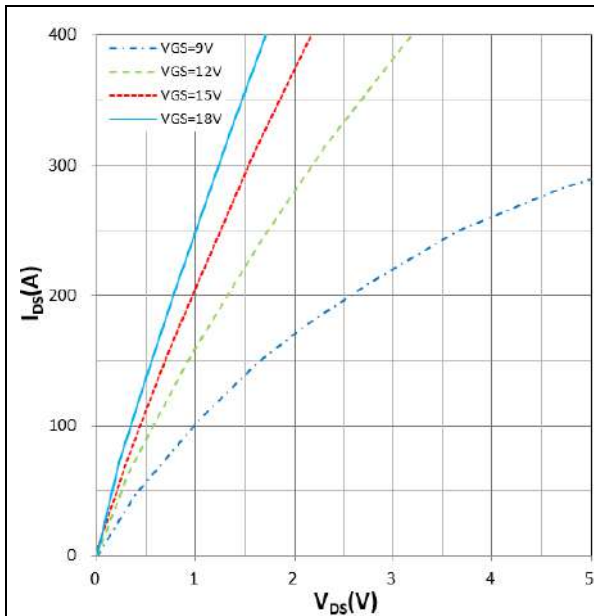


Figure 5. I_{DS} vs V_{DS}
 $T_j = 25^\circ\text{C}$, V_{GS} parameter

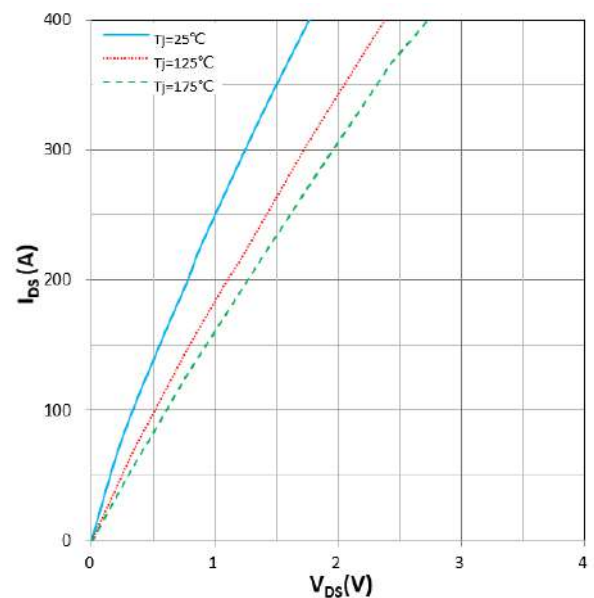


Figure 6. I_{DS} vs V_{DS}
 $V_{GS} = +18\text{V}$

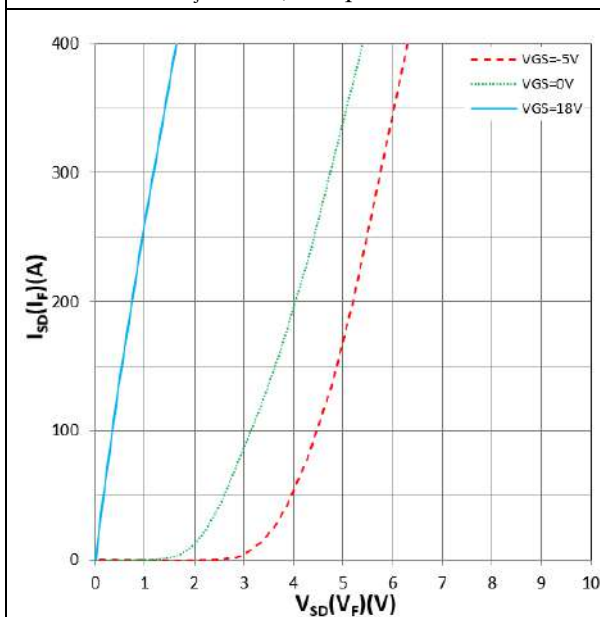


Figure 7. I_{SD} vs V_{SD} (Body Diode)
 $T_j = 25^\circ\text{C}$, V_{GS} parameter

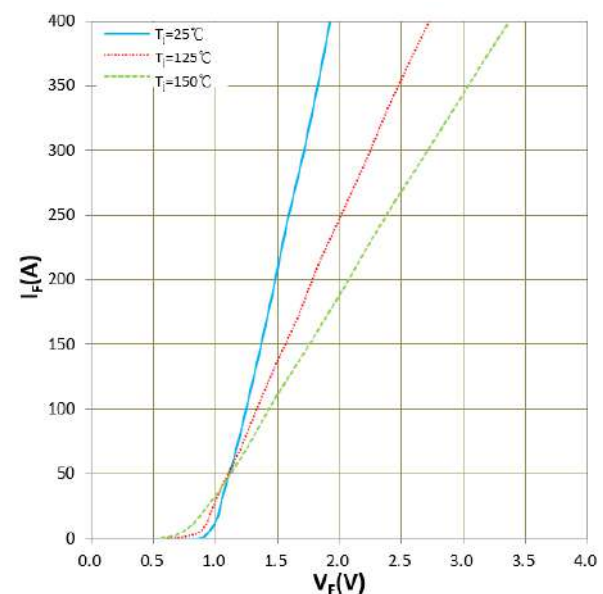


Figure 8. I_F vs V_F (SiC SBD)

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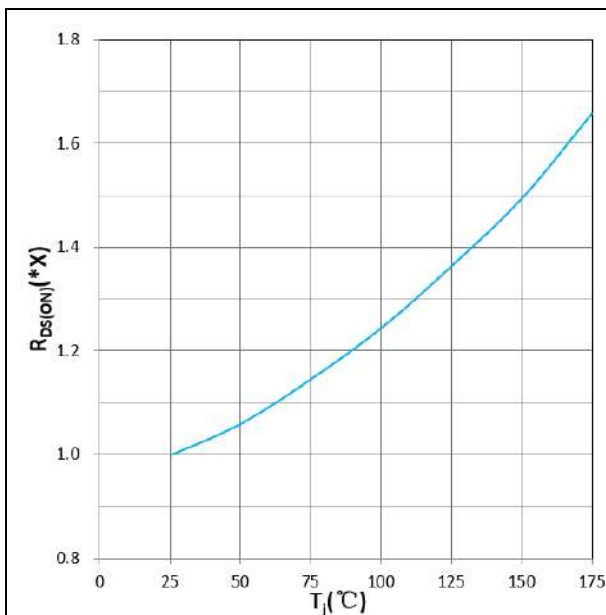


Figure 9. $R_{DS(ON)}$ vs T_J
 $V_{GS}=+18V$, $I_D=200A$, $1.0X=3.9m\Omega$

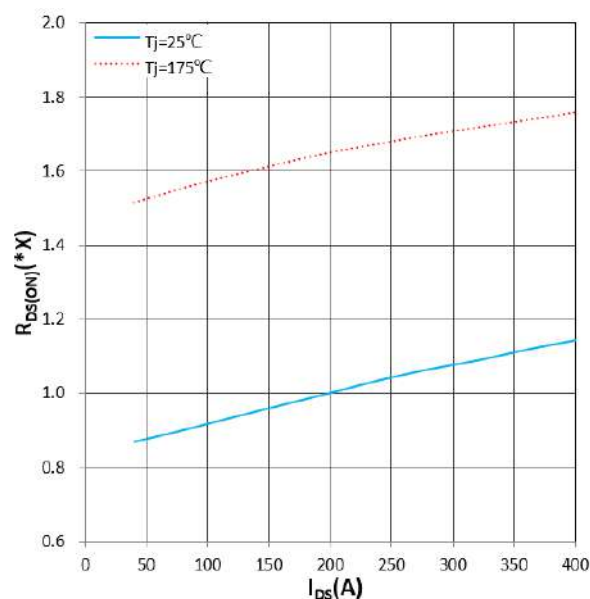


Figure 10. $R_{DS(ON)}$ vs I_{DS}
 $V_{GS}=+18V$, $1.0X=3.9m\Omega$

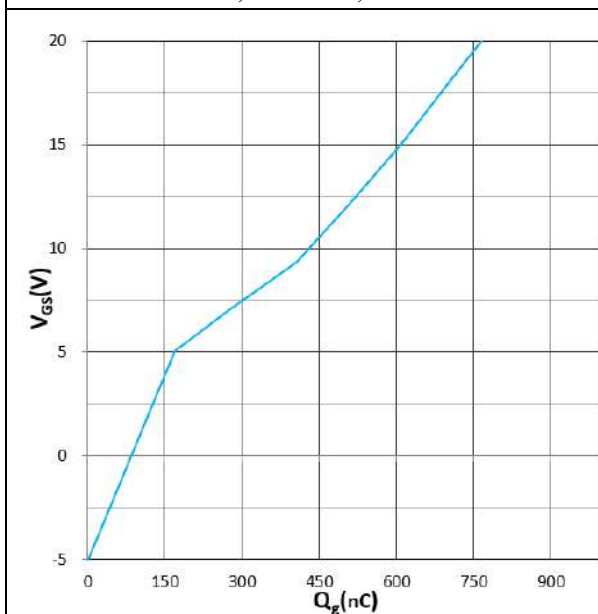


Figure 11. V_{GS} vs Q_g
 $V_{DS}=800V$, $I_D=200A$, $T_J=25^\circ C$

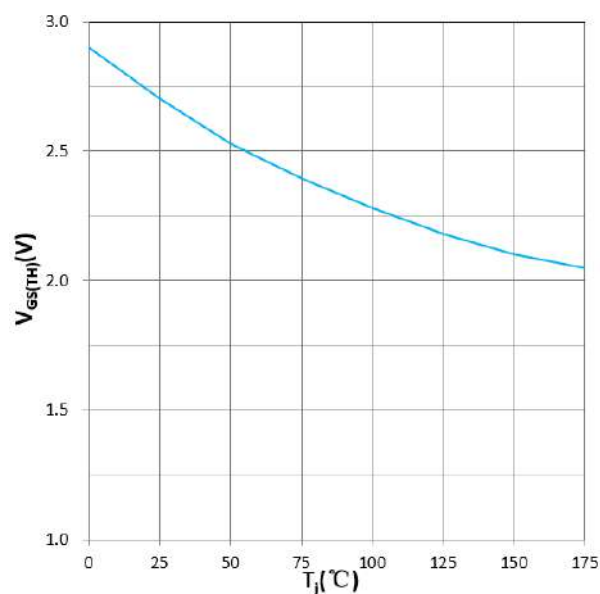


Figure 12. $V_{GS(TH)}$ vs T_J
 $V_{GS}=V_{DS}$, $I_D=140mA$

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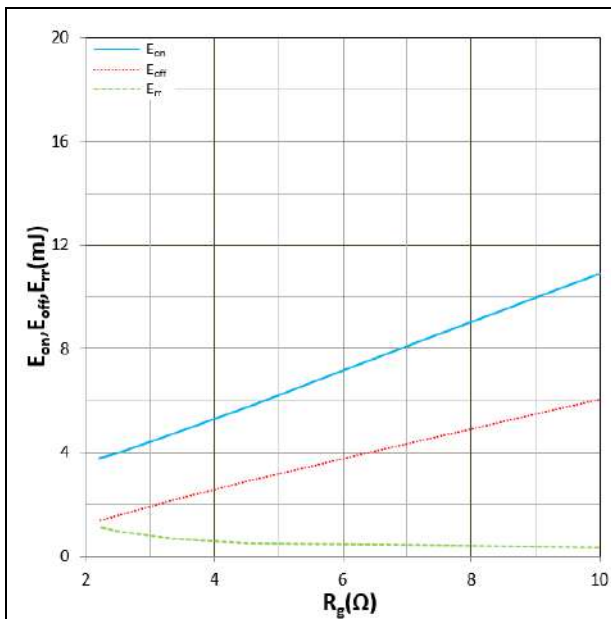


Figure 13. E_{on} , E_{off} , E_{rr} vs R_g
 $T_j = 25^\circ\text{C}$, $V_{DD} = 600\text{V}$, $I_D = 200\text{A}$, $V_{GS} = -4\text{V}/+18\text{V}$
 Inductive Load

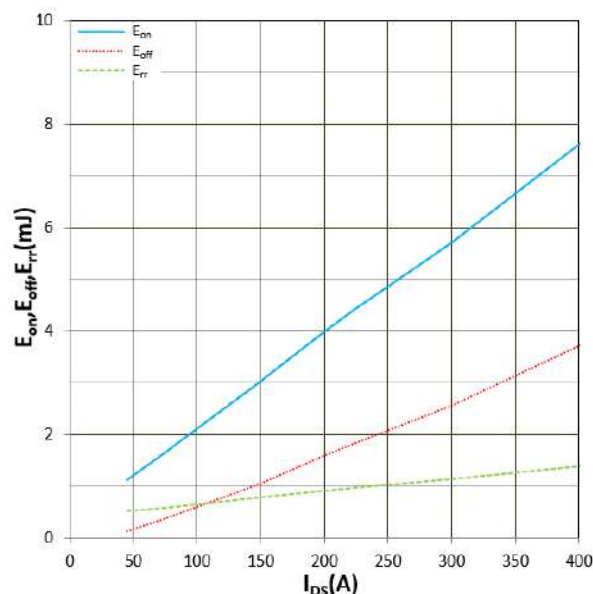


Figure 14. E_{on} , E_{off} , E_{rr} vs I_{DS}
 $T_j = 25^\circ\text{C}$, $V_{DD} = 600\text{V}$, $R_g = 2.5\Omega$, $V_{GS} = -4\text{V}/+18\text{V}$
 Inductive Load

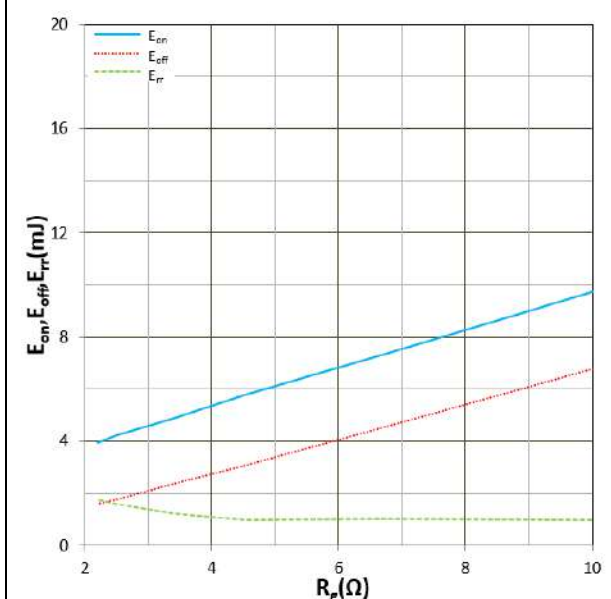


Figure 15. E_{on} , E_{off} , E_{rr} vs R_g
 $T_j = 150^\circ\text{C}$, $V_{DD} = 600\text{V}$, $I_D = 200\text{A}$, $V_{GS} = -4\text{V}/+18\text{V}$
 Inductive Load

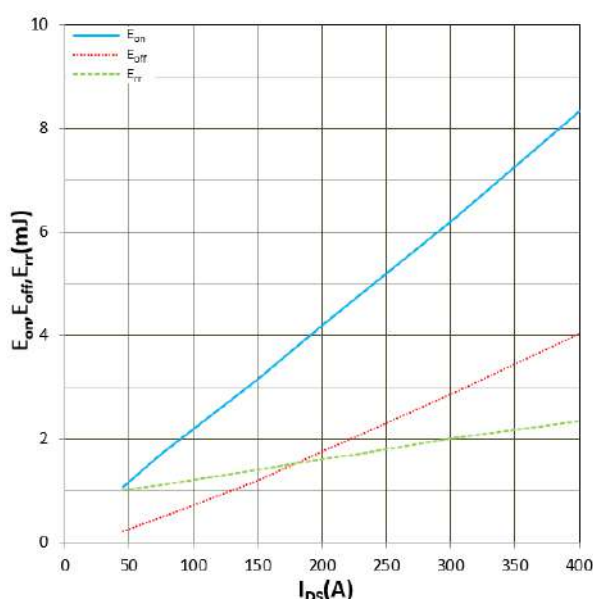


Figure 16. E_{on} , E_{off} , E_{rr} vs I_{DS}
 $T_j = 150^\circ\text{C}$, $V_{DD} = 600\text{V}$, $R_g = 2.5\Omega$, $V_{GS} = -4\text{V}/+18\text{V}$
 Inductive Load

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The data contained in this document is exclusively intended for technically trained staff. You and your technical departments will have to evaluate the product's suitability for the intended application and the completeness of the product data concerning such application.

Due to technical requirements, our product may contain dangerous substances. For information on the types in question, please contact the sales staff responsible for you.

Changes to this product data sheet are reserved.

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Revision History

Document Version	Description of Changes
RevX.0.1	Released

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