

HCS04FC120E2C2

1200V/3.9mΩ Chopper SiC MOSFET Module

Description

The HCS04FC120E2C2 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°C maximum junction temperature

Applications

- xEV Applications
- Converter
- Vehicle Fast Chargers
- Renewable

Circuit diagram

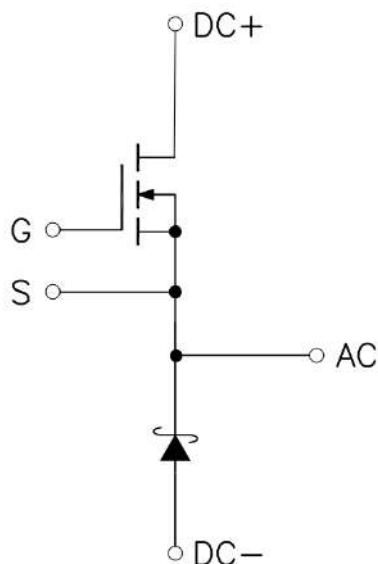
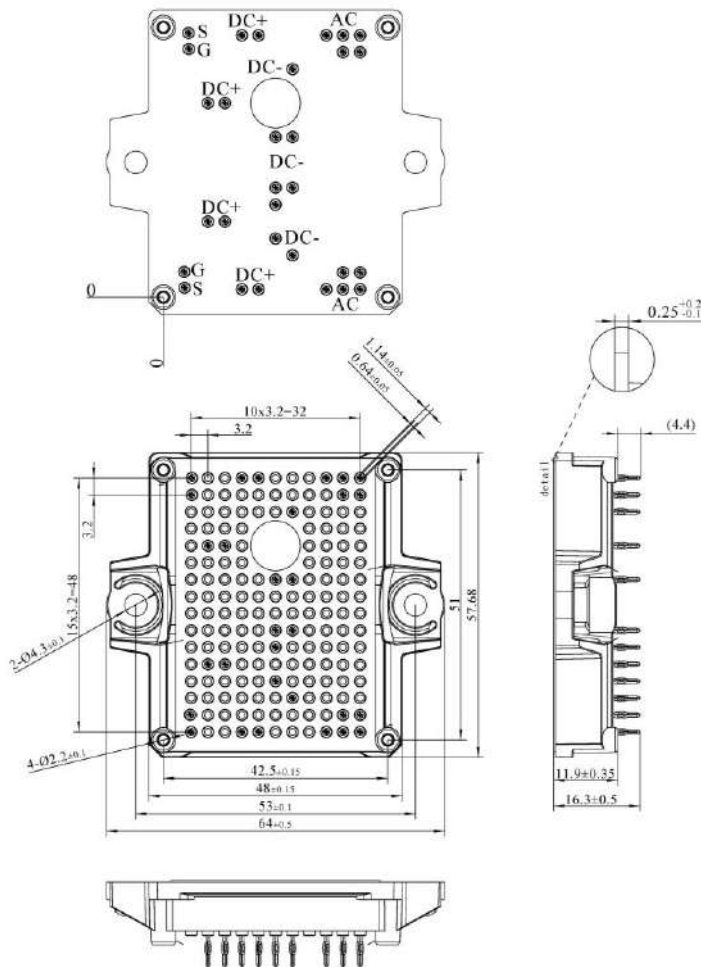


Figure 1. Out drawing & circuit diagram for HCS04FC120E2C2

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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°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

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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 =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			-	0.704	-	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.

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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:	T _j =25°C	-	25	-	ns
			T _j =150°C	-	28	-	
Q _{rr}	Reverse recovery charge	V _{GS} =+18/-4V R _G =2.5Ω	T _j =25°C	-	1.35	-	uC
			T _j =150°C	-	1.75	-	
E _{rr}	Diode switching power dissipation	Inductive load switching operation	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	T _j =25°C	-	55	-	ns
			T _j =150°C	-	45	-	
Q _{rr}	Reverse recovery charge	V _{GS} =-4/+18V R _G =2.5Ω	T _j =25°C	-	4.41	-	μC
			T _j =150°C	-	9.02	-	
E _{rr}	Diode switching power dissipation	Inductive load switching operation	T _j =25°C	-	0.92	-	mJ
			T _j =150°C	-	1.60	-	

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Test Conditions

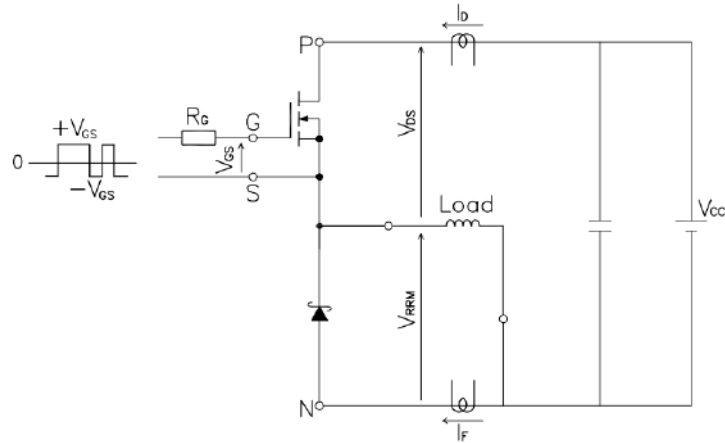


Figure 3. Switching time measure circuit

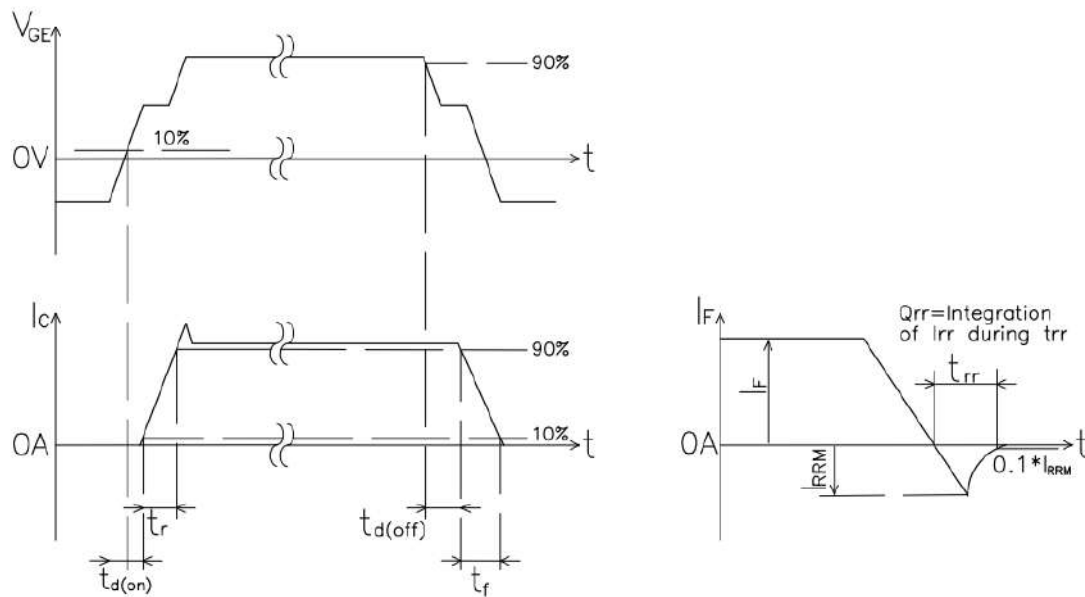


Figure 4. Switching time definition

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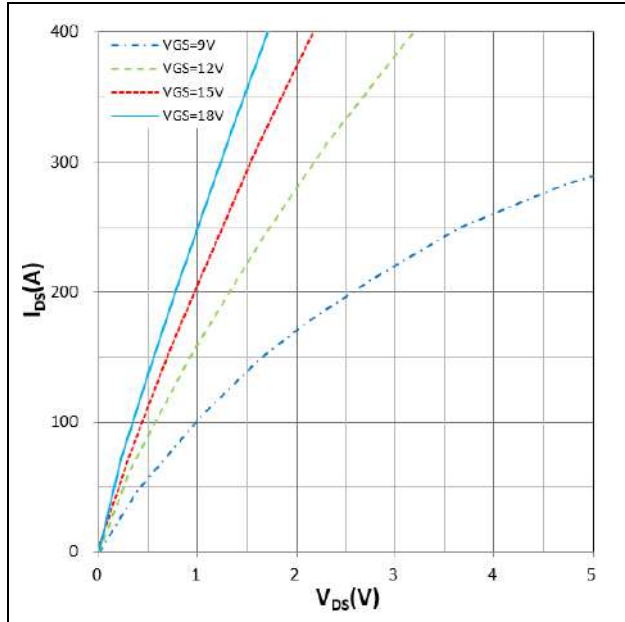


Figure 5. I_{DS} vs V_{DS}
 $T_J = 25^\circ\text{C}$, V_{GS} parameter

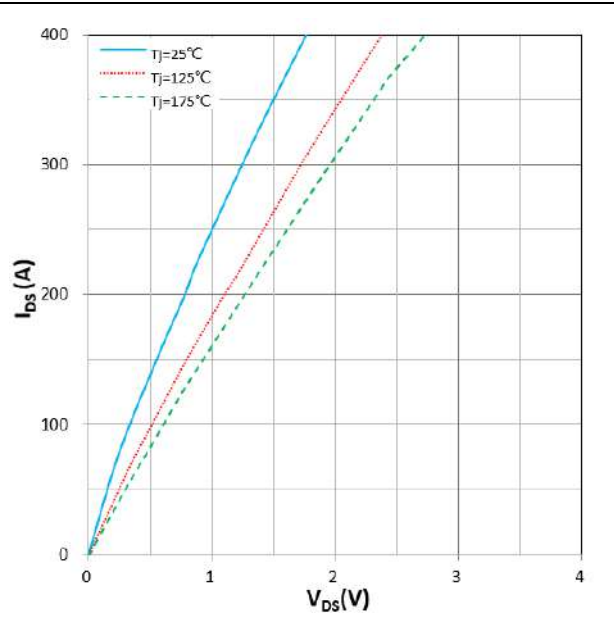


Figure 6. I_{DS} vs V_{DS}
 $V_{GS} = +18\text{V}$

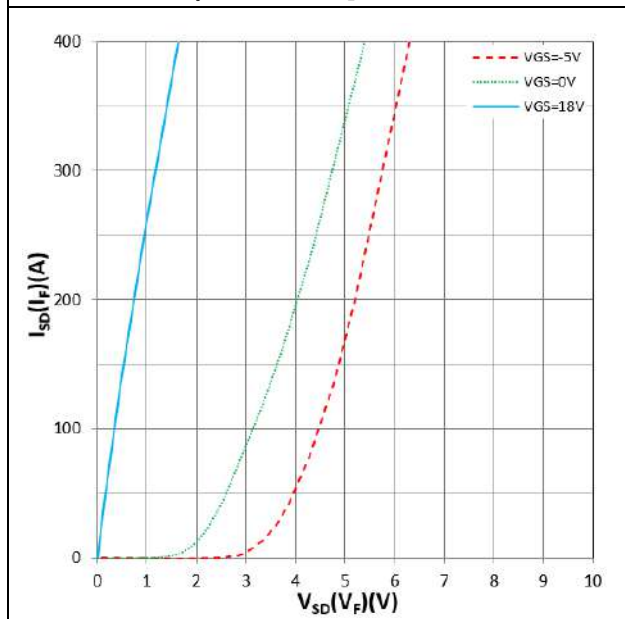


Figure 7. I_{SD} vs V_{SD} (Body Diode)
 $T_J = 25^\circ\text{C}$, V_{GS} parameter

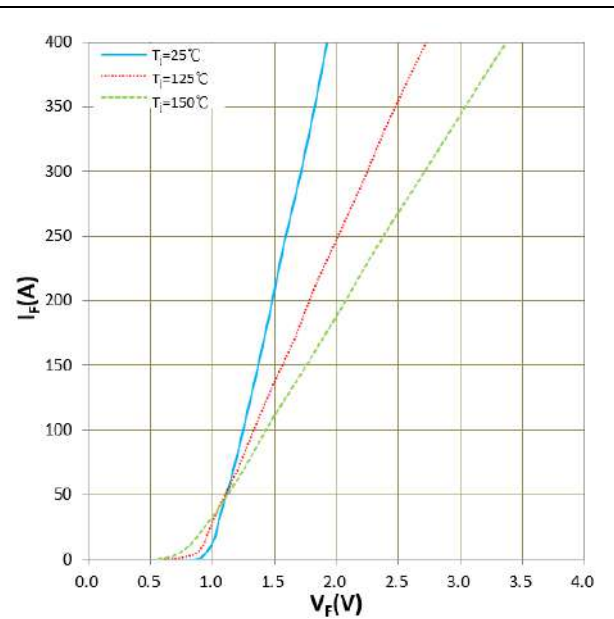


Figure 8. I_F vs V_F (SiC SBD)

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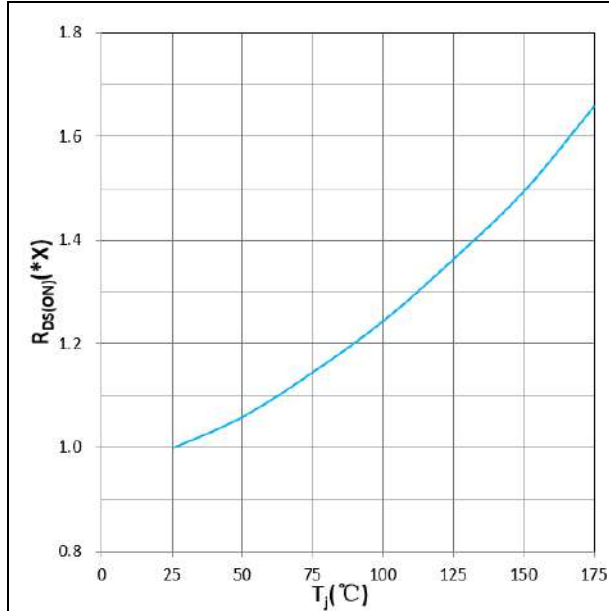


Figure 9. $R_{DS(ON)}$ vs T_J
 $V_{GS} = +18V$, $I_D = 200A$, $1.0X = 3.9m\Omega$

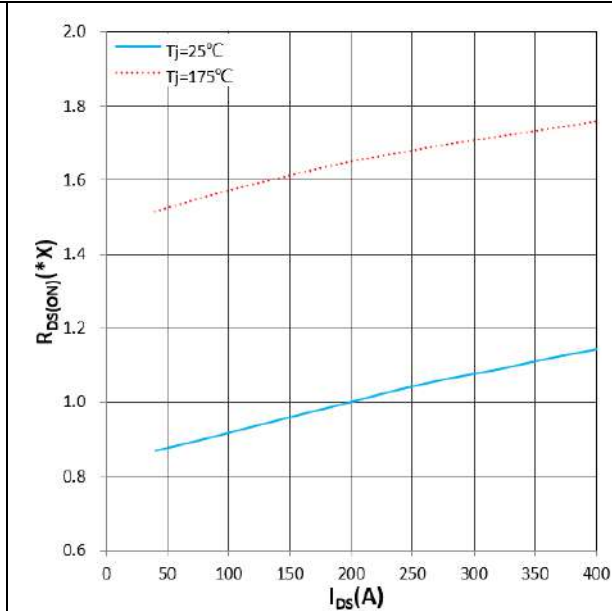


Figure 10. $R_{DS(ON)}$ vs I_{DS}
 $V_{GS} = +18V$, $1.0X = 3.9m\Omega$

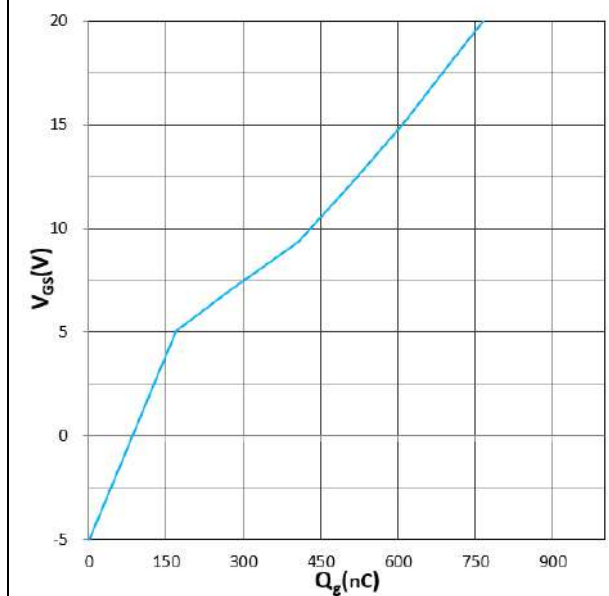


Figure 11. V_{GS} vs Q_g
 $V_{DS} = 800V$, $I_D = 200A$, $T_J = 25^\circ C$

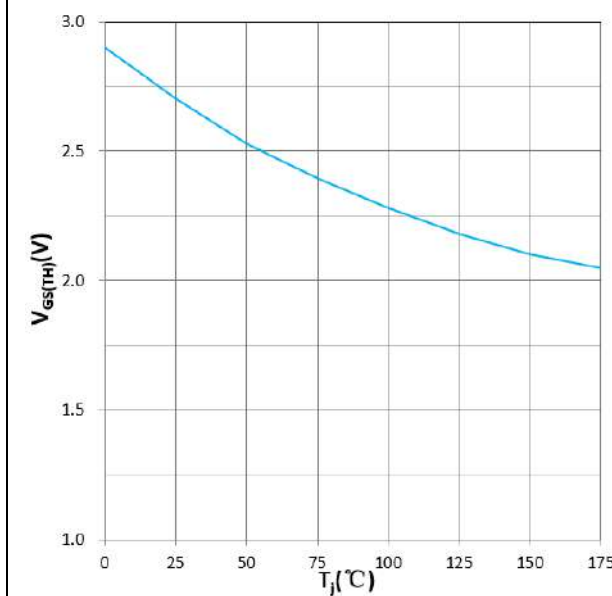


Figure 12. $V_{GS(TH)}$ vs T_J
 $V_{GS} = V_{DS}$, $I_D = 140mA$

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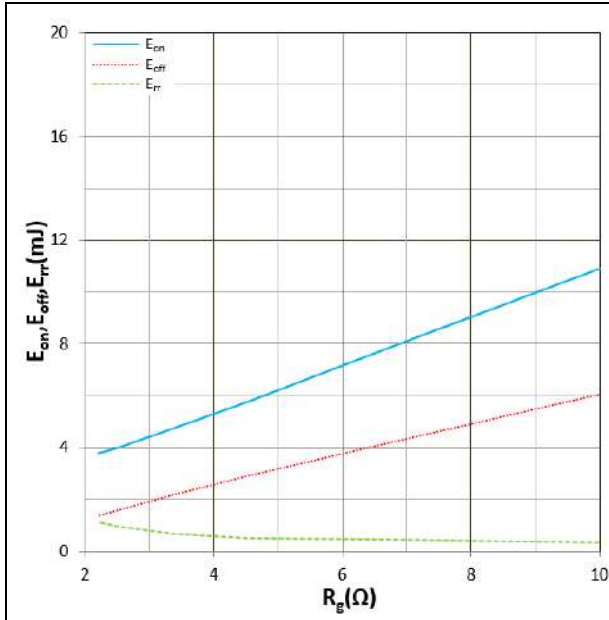


Figure 13. E_{on} , E_{off} , E_{rr} vs R_g

$T_j = 25^\circ\text{C}$, $V_{DD} = 600\text{V}$, $I_D = 200\text{A}$, $V_{GS} = -4\text{V}/+18\text{V}$
Inductive Load

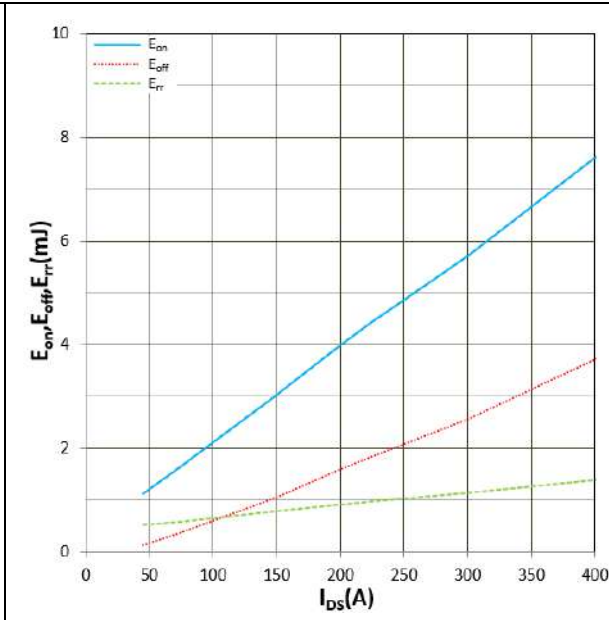


Figure 14. E_{on} , E_{off} , E_{rr} vs I_{DS}

$T_j = 25^\circ\text{C}$, $V_{DD} = 600\text{V}$, $R_g = 2.5\Omega$, $V_{GS} = -4\text{V}/+18\text{V}$
Inductive Load

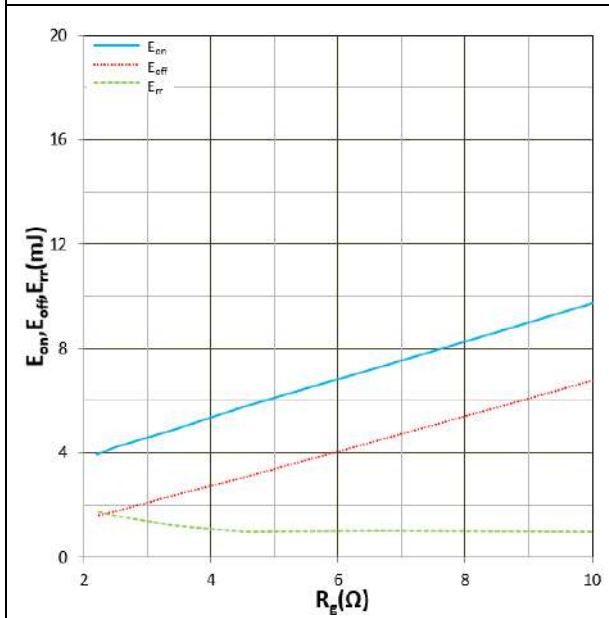


Figure 15. E_{on} , E_{off} , E_{rr} vs R_g

$T_j = 150^\circ\text{C}$, $V_{DD} = 600\text{V}$, $I_D = 200\text{A}$, $V_{GS} = -4\text{V}/+18\text{V}$
Inductive Load

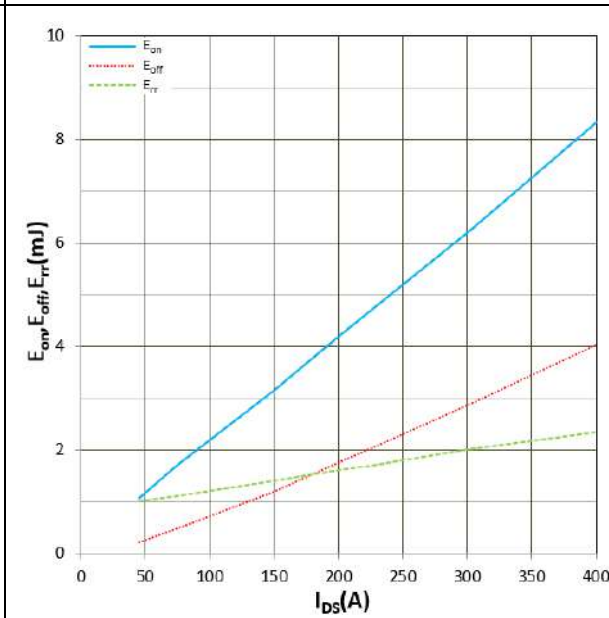


Figure 16. E_{on} , E_{off} , E_{rr} vs I_{DS}

$T_j = 150^\circ\text{C}$, $V_{DD} = 600\text{V}$, $R_g = 2.5\Omega$, $V_{GS} = -4\text{V}/+18\text{V}$
Inductive Load

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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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