

HCS540FH120A2C1

1200V/540A Half Bridge SiC MOSFET Module

Description

The HCS540FH120A2C1 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
- $R_{ds(on)} = 2.9m\Omega$
- Low thermal resistance with Si₃N₄ AMB
- 175°C maximum junction temperature
- 62mm half bridge module

Applications

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



Circuit diagram

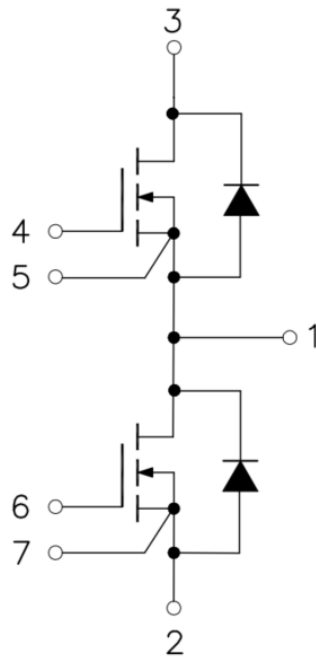


Figure 1. Out drawing & circuit diagram for HCS540FH120A2C1

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Pin Configuration and Marking Information

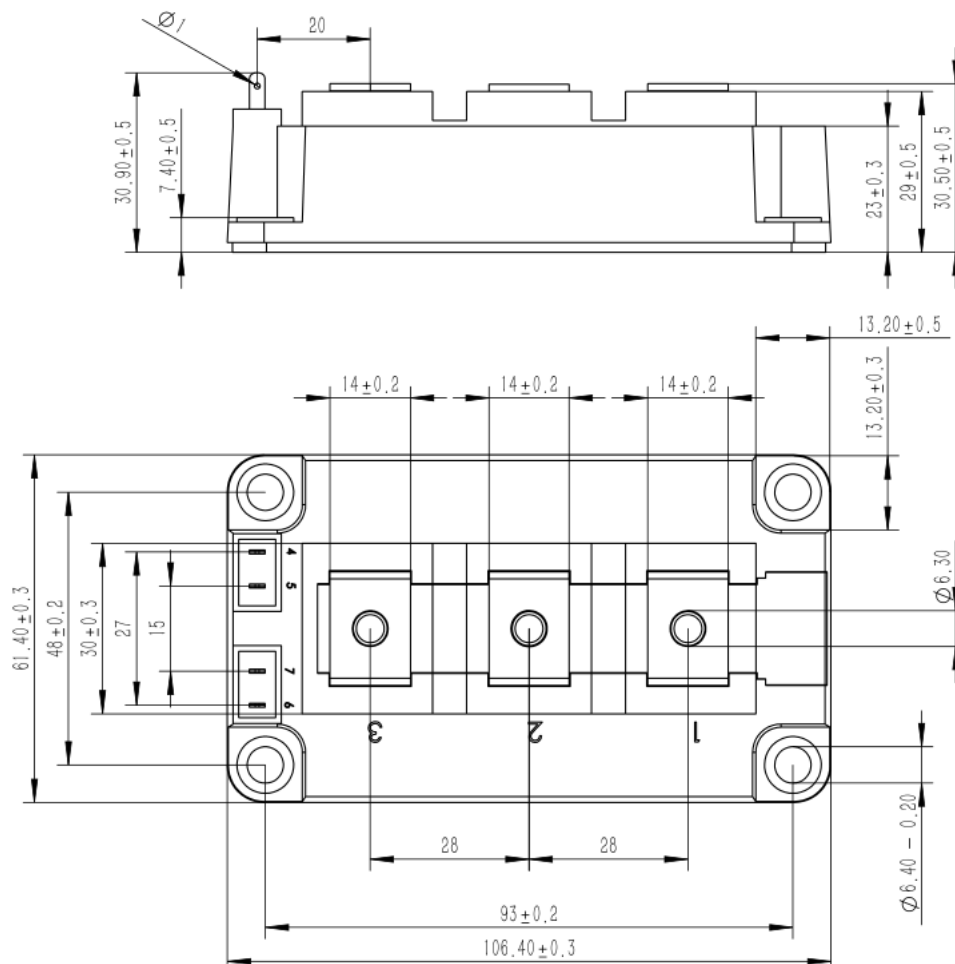


Figure 2. Pin configuration

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

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Maximum Ratings ($T_j=25^{\circ}\text{C}$ unless otherwise specified)

Symbol	Parameter	Conditions	Ratings	Unit
V_{DS}	Drain-Source Voltage	G-S Short	1200	V
V_{GS}	Gate-Source Voltage	D-S Short, AC frequency $\geq 1\text{Hz}$, Note1	-10 to 22	V
I_{DS}	DC Continuous Drain Current	$T_C=25^{\circ}\text{C}$, $V_{GS}=18\text{V}$	680	A
I_{DS}	DC Continuous Drain Current	$T_C=80^{\circ}\text{C}$, $V_{GS}=18\text{V}$	540	A
I_{SD}	Source-Drain Current(diode)	$T_C=25^{\circ}\text{C}$, with ON signal	700	A
I_{SD}	Source-Drain Current(diode)	$T_C=80^{\circ}\text{C}$, with ON signal	560	A
I_{DSM}	Pulse Drain Current	$T_C=25^{\circ}\text{C}$, Pulse width =1ms, $V_{GS}=18\text{V}$, Note2	1080	A
P_{tot}	Total Power Dissipation	$T_C=25^{\circ}\text{C}$	2140	W
T_{jmax}	Max Junction Temperature	-	175	$^{\circ}\text{C}$
T_{stg}	Storage Temperature	-	-40 to 125	$^{\circ}\text{C}$

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

Note2: Pulse width limited by maximum junction temperature

Diode Electrical characteristics ($T_j=25^{\circ}\text{C}$ 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 =150°C	-	2.65	-	
t _{rr}	Diode Reverse Recovery Time	(Switch side) V _{DD} =600V, I _D =540A	T _j =25°C		27		ns
			T _j =150°C		29		
I _{RM}	Peak reverse recovery Current	V _{GS} =+18V/-4V R _{gon} /R _{goff} =3.3Ω/3.3Ω	T _j =25°C	-	292	-	A
			T _j =150°C	-	331	-	
Q _{rr}	Recovered charge	(FRD side) V _{RR} =600V, I _F =540A	T _j =25°C	-	3.5	-	uC
			T _j =150°C	-	4.5	-	
E _{rr}	Reverse recovered energy	V _{GS} =+18V/-4V Inductive load switching operation	T _j =25°C	-	1.3	-	mJ
			T _j =150°C	-	2.2	-	
R _{th(j-c)}	Thermal Resistance, Junction to Case (Diode)			-	0.065	-	°C/W

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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 =600uA		1200	-	-	V
I _{DSS}	Zero gate voltage drain Current	V _{DS} =1200V, V _{GS} =0V		-	6	-	μA
V _{GS(th)}	Gate-source threshold Voltage	I _D =210mA, V _{DS} =V _{GS}	T _j =25°C	1.8	2.7	-	V
			T _j =175°C	-	2.05	-	V
I _{GSS}	Gate-Source Leakage Current	V _{GS} =20V, V _{DS} =0V	T _j =25°C	-	-	600	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	-	5.0	-	mΩ
		I _D =540A V _{GS} =+18V	T _j =25°C	-	2.9	-	mΩ
			T _j =175°C	-	4.3	-	mΩ
V _{DS(on)} (Chip)	Static drain-source On-state Voltage	I _D =540A V _{GS} =+15V	T _j =25°C	-	1.89	-	V
			T _j =175°C	-	2.70	-	V
		I _D =540A V _{GS} =+18V	T _j =25°C	-	1.57	-	V
			T _j =175°C	-	2.32	-	V
C _{iss}	Input Capacitance	V _D =800V, V _{GS} =0V, f =100kHz, V _{AC} =25mV		-	34890	-	pF
C _{oss}	Output Capacitance			-	1062	-	pF
C _{rss}	Reverse transfer Capacitance			-	86	-	pF
R _{Gint}	Internal gate resistor	f =100kHz, V _{AC} =25mV		-	1.1	-	Ω
Q _g	Total gate charge	V _{DD} =800V, I _D =360A, V _{GS} =+18/-4V		-	1210	-	nC
t _{d(on)}	Turn-on delay time	V _{DD} =600V I _D =540A V _{GS} =+18/-4V R _{gon} /R _{goff} =2.2Ω/2.2Ω Inductive load switching operation	T _j =25°C	-	72	-	ns
			T _j =150°C	-	65	-	
t _r	Rise time		T _j =25°C	-	42	-	ns
			T _j =150°C	-	38	-	
t _{d(off)}	Turn-off delay time		T _j =25°C	-	152	-	ns
			T _j =150°C	-	173	-	
t _f	Fall time		T _j =25°C	-	43	-	ns
			T _j =150°C	-	48	-	
E _{on}	Turn-on power dissipation		T _j =25°C	-	7.5	-	mJ
			T _j =150°C	-	4.9	-	
E _{off}	Turn-off power dissipation		T _j =25°C	-	9.8	-	mJ
			T _j =150°C	-	10.5	-	
R _{th(j-c)}	FET Thermal Resistance	Junction to Case		-	0.07	-	°C /W

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Test Conditions

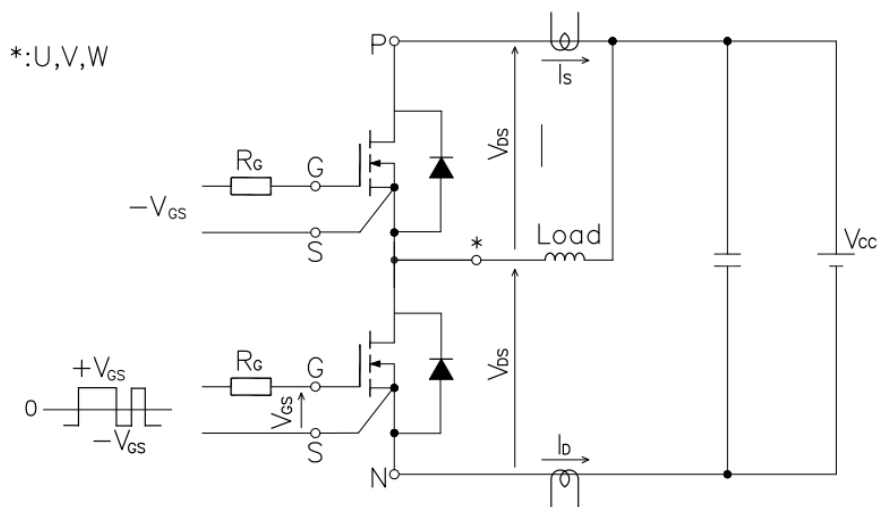


Figure 3. Switching time measure circuit

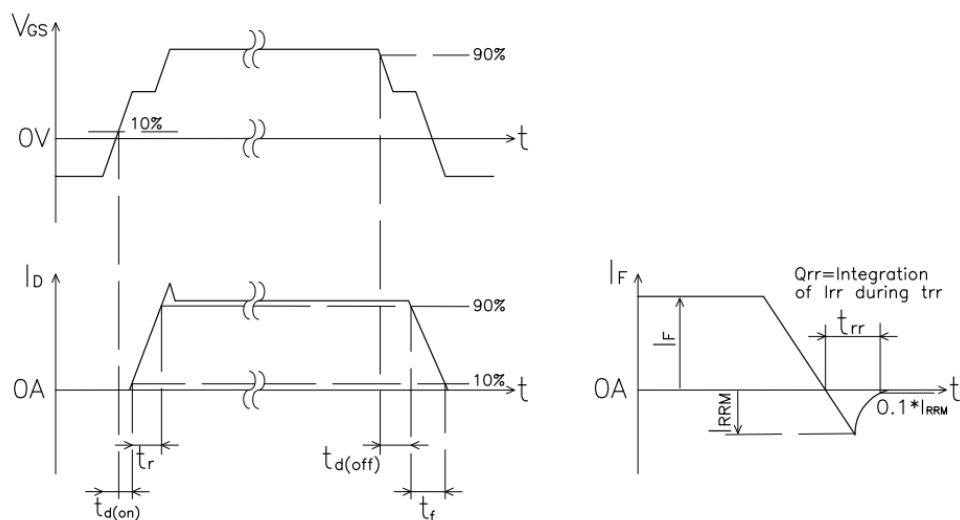


Figure 4. Switching time definition

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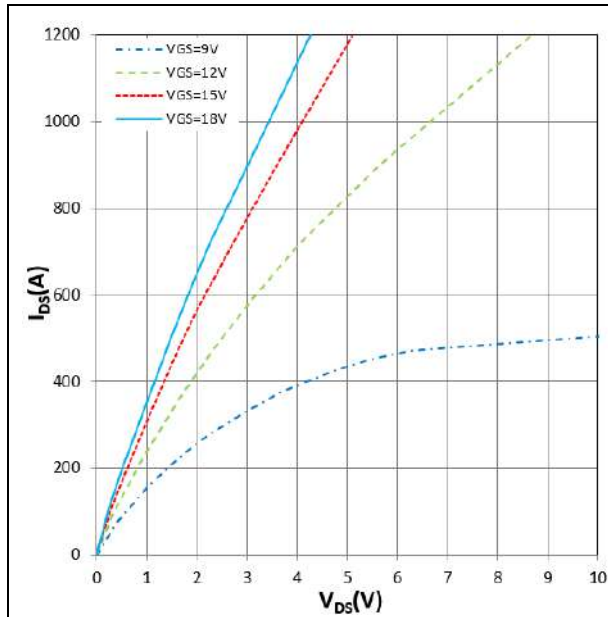


Figure 5. I_{DS} vs V_{DS}
 $T_J = 25^\circ\text{C}$

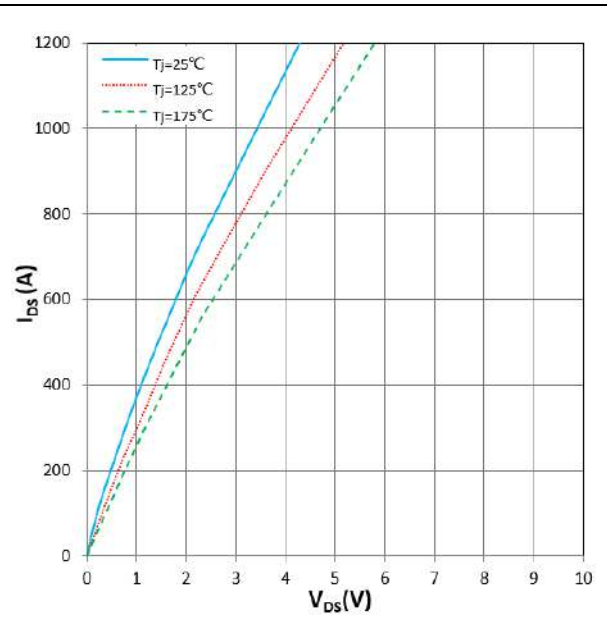


Figure 6. I_{DS} vs V_{DS}
 $V_{GS} = +18\text{V}$

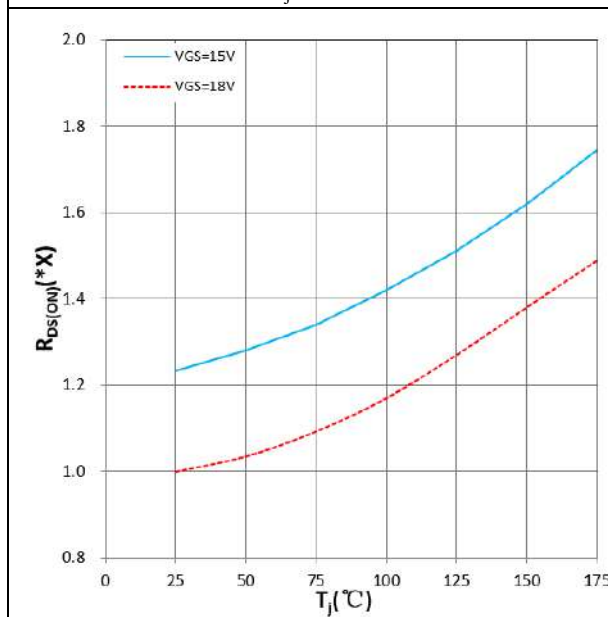


Figure 7. $R_{DS(ON)}$ vs T_J
 $V_{GS} = +15\text{V}/+18\text{V}$, $I_D = 540\text{A}$, $1.0X = 2.9\text{m}\Omega$

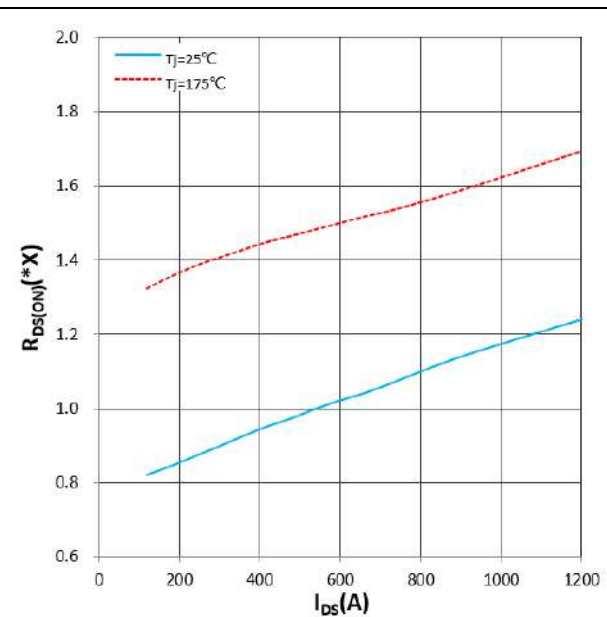


Figure 8. $R_{DS(ON)}$ vs I_{DS}
 $V_{GS} = +15\text{V}$, $1.0X = 2.9\text{m}\Omega$

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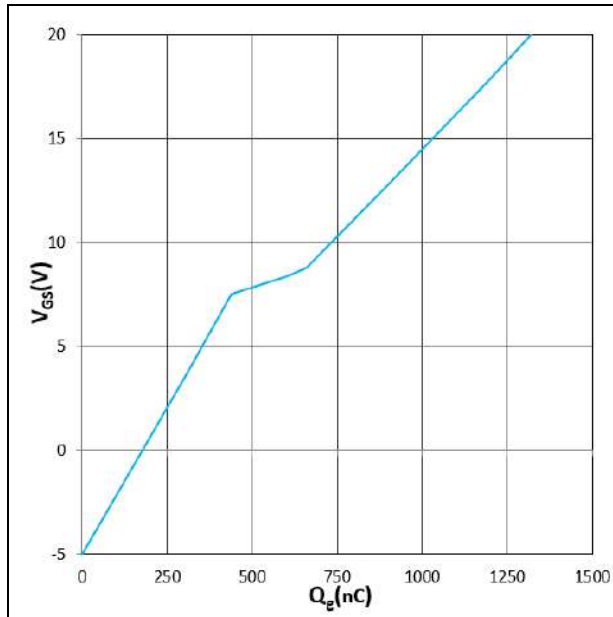


Figure 9. V_{GS} vs Q_g
 $V_{DS}=800V$, $I_D=360A$, $T_j=25^{\circ}C$

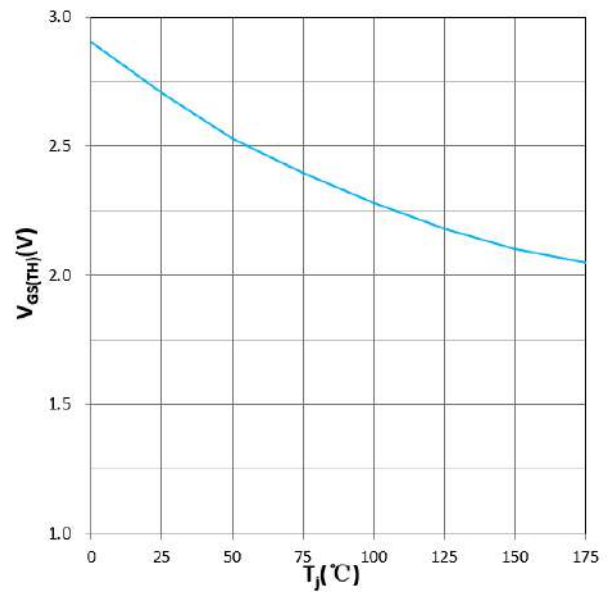


Figure 10. $V_{GS(TH)}$ vs T_j
 $V_{GS}=V_{DS}$, $I_D=210mA$

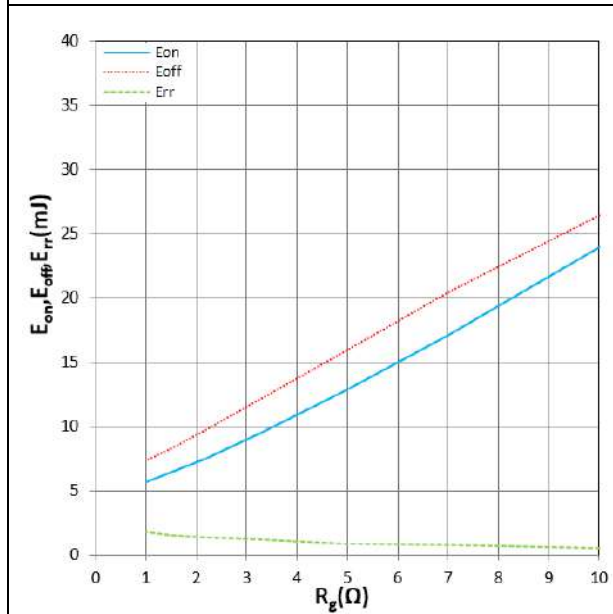


Figure 11. E_{on} , E_{off} , E_{rr} vs R_g
 $T_j=25^{\circ}C$, $V_{DD}=600V$, $V_{GS}=+18V/-4V$, $I_D=540A$
Inductive Load

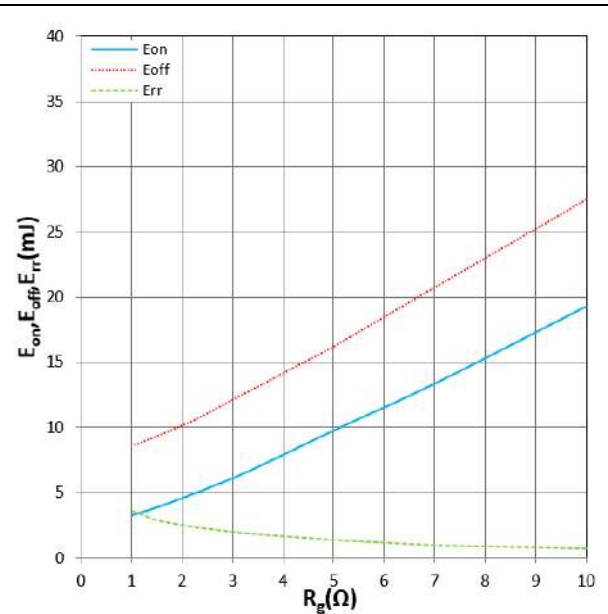


Figure 12. E_{on} , E_{off} , E_{rr} vs R_g
 $T_j=150^{\circ}C$, $V_{DD}=600V$, $V_{GS}=+18V/-4V$, $I_D=540A$
Inductive Load

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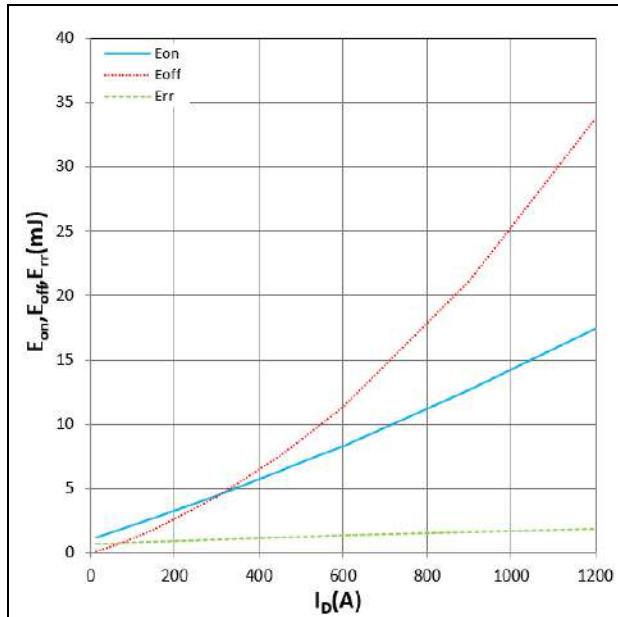


Figure 13. E_{on} , E_{off} , E_{rr} vs I_{DS}
 $T_j = 25^\circ\text{C}$, $V_{DD} = 600\text{V}$, $V_{GS} = +18\text{V}/-4\text{V}$
 $R_{gon}/R_{goff} = 2.2\Omega/2.2\Omega$, Inductive Load

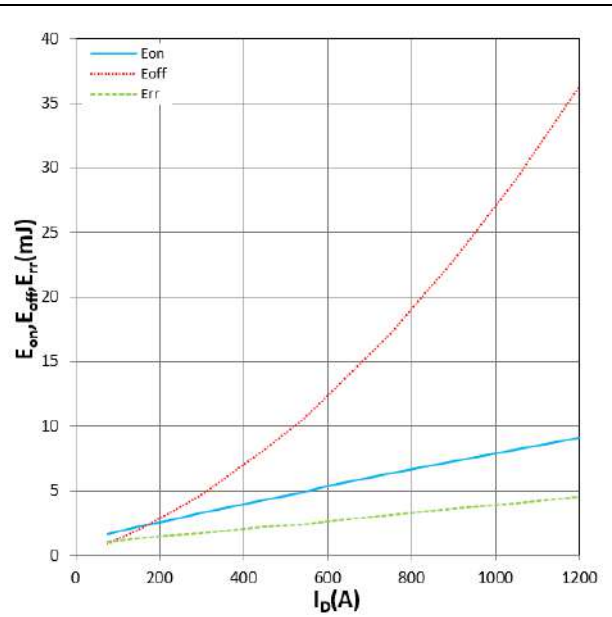


Figure 14. E_{on} , E_{off} , E_{rr} vs I_{DS}
 $T_j = 150^\circ\text{C}$, $V_{DD} = 600\text{V}$, $V_{GS} = +18\text{V}/-4\text{V}$
 $R_{gon}/R_{goff} = 2.2\Omega/2.2\Omega$, Inductive Load

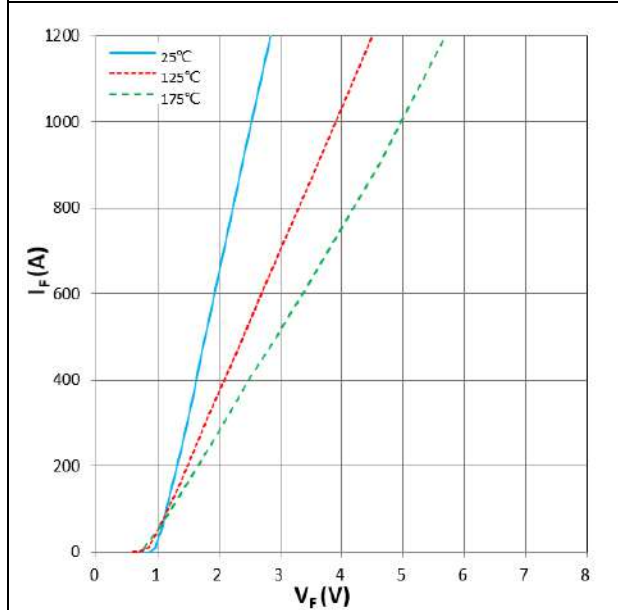


Figure 15. I_F vs V_F
 $V_{GS} = 0\text{V}$

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Revision History

Document Version	Description of Changes
RevX.0.1	Released

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