

HCH10FA120E2C1

1200V 3-Level Hybrid Power Module

Description

The HCH10FA120E2C1 is a 3-level Power Module. It integrates 1200V SiC MOSFET chips and 1200V IGBT chips designed for the applications such as Solar Inverter, High frequency switching, Energy storage System etc.



Features

- Blocking voltage: 1200V
- $R_{ds(on)}$: $9.5m\Omega$ ($V_{GS} = 15V$)/ $8.3m\Omega$ ($V_{GS} = 18V$)
- Low Switching Losses
- High current density
- PressFIT Contact Technology
- 175°C maximum junction temperature
- Thermistor inside

Applications

- Solar inverter Systems
- Three-level applications
- Energy Storage Systems
- High Frequency Switching application

Circuit diagram

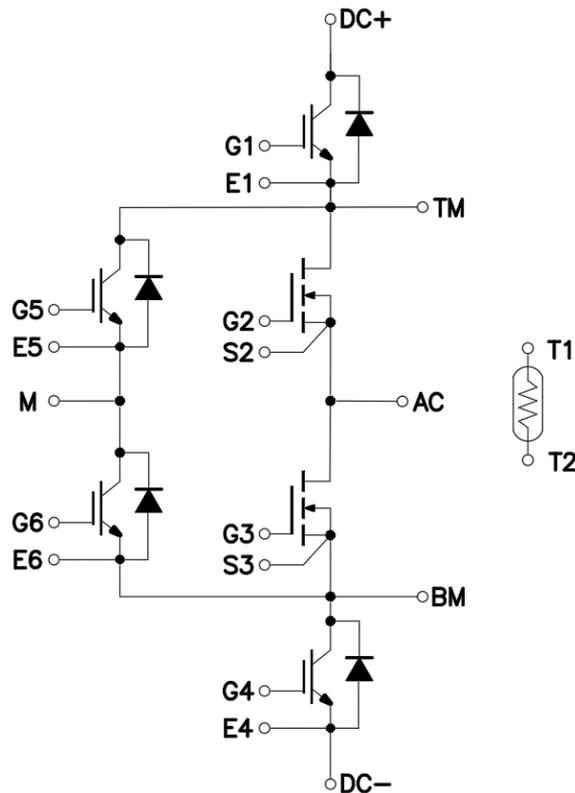


Figure 1. Out drawing & circuit diagram for HCH10FA120E2C1

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Pin Configuration

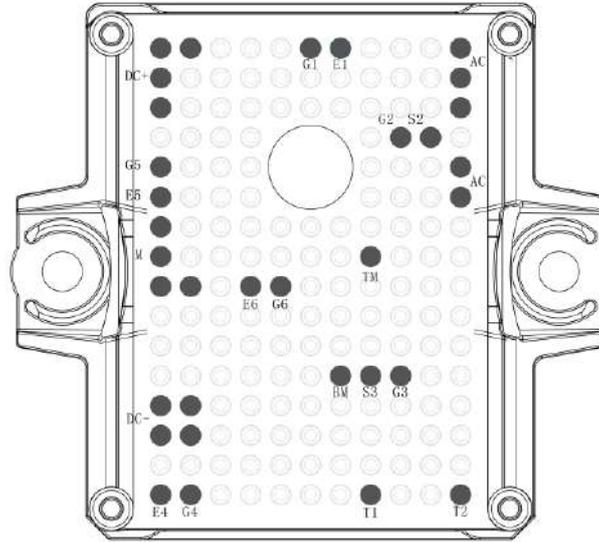


Figure 2. Pin configuration

Module

Parameter	Conditions	Value	Unit
Isolation voltage	Main terminal to base plate, RMS, f=50Hz, t=1min	3.0	kV
Creepage distance	terminal to heatsink	11.5	mm
	terminal to terminal	6.3	
Clearance	terminal to heatsink	10.0	mm
	terminal to terminal	5.0	
Comparative tracking index	-	> 400	
Mounting torque for module mounting	Screw M4 baseplate to heatsink	1.8 to 2.2	Nm
Storage temperature	-	-40 to 125	°C
Weight	-	40	g

NTC characteristics

Symbol	Parameter	Condition	Value			Unit
			Min.	Typ.	Max.	
R ₂₅	Resistance	T _C =25°C	-	5	-	kΩ
R/R	Deviation of R100	T _C =100°C, R ₁₀₀ =493 Ω	-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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Maximum Ratings (SiC MOSFET, $T_j=25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Conditions	Ratings	Unit
V_{DSS}	Drain-Source Voltage	G-S Short	1200	V
V_{GSS}	G-S Voltage	D-S Short, Note1	-10 to 22	V
I_{DS}	DC Continuous Drain Current	$T_C=125^\circ\text{C}$	100	A
I_{SD}	Source (Body diode) Current	$T_C=125^\circ\text{C}$	32	A
I_{DP}	Drain Pulse Current, Peak	Less than 1ms, Note2	200	A
T_j	junction temperature	-	-40 to 175	$^\circ\text{C}$

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

Note2: Pulse width limited by maximum junction temperature

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

Symbol	Parameter	Conditions	Ratings	Unit
V_{CES}	Collector-Emitter Voltage	G-E Short	1200	V
V_{GES}	Gate-Emitter Voltage	C-E Short	± 20	V
I_{CN}	DC Continuous Collector Current	$T_C=135^\circ\text{C}$	100	A
I_{CM}	Pulse Collector Current	$t_p=1\text{ms}$, Note1	200	A
I_F	Diode forward Current	$T_C=100^\circ\text{C}$	100	A
I_{FRM}	Repetitive peak forward Current	$t_p=1\text{ms}$, Note1	200	A
T_j	junction temperature	-	-40 to 175	$^\circ\text{C}$
T_{stg}	Storage temperature	-	-40 to 125	$^\circ\text{C}$

Note1: Pulse width limited by maximum junction temperature

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

Symbol	Item	Condition	Value			Unit	
			Min.	Typ.	Max		
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	$V_{GS}=0\text{V}$, $I_D=200\mu\text{A}$	1200	-	-	V	
I_{DSS}	Zero gate voltage drain Current	$V_{DS}=1200\text{V}$, $V_{GS}=0\text{V}$	-	2	-	μA	
$V_{GS(th)}$	Gate-source threshold Voltage	$I_D=70\text{mA}$, $V_{DS}=V_{GS}$, $T_j=25^\circ\text{C}$	1.8	2.7	-	V	
		$I_D=70\text{mA}$, $V_{DS}=V_{GS}$, $T_j=175^\circ\text{C}$	-	2.05	-	V	
I_{GSS}	Gate-Source Leakage Current	$V_{GS}=20\text{V}$, $V_{DS}=0\text{V}$, $T_j=25^\circ\text{C}$	-	200	-	nA	
$R_{DS(on)}$ (Chip)	Static drain-source On-state resistance	$I_D=100\text{A}$ $V_{GS}=15\text{V}$	$T_j=25^\circ\text{C}$	-	9.5	-	$\text{m}\Omega$
			$T_j=175^\circ\text{C}$	-	14.3	-	$\text{m}\Omega$
		$I_D=100\text{A}$ $V_{GS}=+18\text{V}$	$T_j=25^\circ\text{C}$	-	8.3	12.5	$\text{m}\Omega$
			$T_j=175^\circ\text{C}$	-	12.6	-	$\text{m}\Omega$
$V_{DS(on)}$ (Chip)	Static drain-source On-state Voltage	$I_D=100\text{A}$ $V_{GS}=15\text{V}$	$T_j=25^\circ\text{C}$	-	0.95	-	V
			$T_j=175^\circ\text{C}$	-	1.43	-	V
		$I_D=100\text{A}$ $V_{GS}=+18\text{V}$	$T_j=25^\circ\text{C}$	-	0.83	1.25	V
			$T_j=175^\circ\text{C}$	-	1.26	-	V
C_{iss}	Input Capacitance	$V_D=800\text{V}$, $V_{GS}=0\text{V}$ $f=1\text{MHz}$, $V_{AC}=25\text{mV}$	-	11.6	-	nF	
C_{oss}	Output Capacitance		-	0.	-	nF	
C_{rss}	Reverse transfer Capacitance		-	3520.	-	nF	

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Q _G	Total gate charge	V _{DD} =800V, I _D =120A, V _{GS} =-5/+15V	-	360	-	nC	
R _{Gint}	Internal Gate Resistance	f=1Mhz, V _{AC} =25mV	-	0.65	-	Ω	
t _{d(on)}	Turn-on delay time	V _{DD} =600V I _D =100A V _{GS} =+15V/-4V R _g =5.1 Ω Inductive load switching operation	T _j =25°C	-	43	-	ns
			T _j =150°C	-	40	-	
t _r	Rise time		T _j =25°C	-	23	-	ns
			T _j =150°C	-	19	-	
t _{d(off)}	Turn-off delay time		T _j =25°C	-	112	-	ns
			T _j =150°C	-	120	-	
t _f	Fall time		T _j =25°C	-	15	-	ns
			T _j =150°C	-	40	-	
E _{on}	Turn-on power dissipation		T _j =25°C	-	2.	-	mJ
			T _j =150°C	-	222.	-	
E _{off}	Turn-off power dissipation		T _j =25°C	-	311.	-	mJ
			T _j =150°C	-	501.	-	
R _{th(j-c)}	FET Thermal Resistance	Junction to Case/MOSFET	-	590	-	K/W	
R _{th(c-s)}	Thermal Resistance, Case to sink (Conductive Grease applied), Note1		-	.320	-	K/W	

Note1: Assumes Thermal Conductivity of grease is 2.8W/m·K and thickness is 50um. .12

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} = 100A	T _j = 25°C	-	5.1	-	V
			T _j = 175°C	-	4.6	-	
T _{rr}	Reverse recovery time	V _{DD} = 600V I _D = 100A V _{GS} = +15/-4V	T _j = 25°C	-	26	-	ns
			T _j = 150°C	-	50	-	
Q _{rr}	Reverse recovery charge	R _g = 5.1 Ω Inductive load switching operation	T _j = 25°C	-	0.	-	μC
			T _j = 150°C	-	753.	-	
E _{rr}	Diode switching power dissipation		T _j = 25°C	-	200.	-	mJ
			T _j = 150°C	-	120.	-	

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

Symbol	Item	Condition	Value			Unit	
			Min.	Typ.	Max		
V _{CE(sat)} (Chip)	Collector-Emitter Saturation Voltage	I _C = 100A V _{GE} = 15V	T _j = 25°C	-	1.56	-	V
			T _j = 175°C	-	1.81	-	V
V _{GE(th)}	Gate-Emitter threshold Voltage	I _C = 2.6mA, V _{CE} = 10V	-	5.9	-	V	
Q _G	Gate charge	V _{GE} = -15V to +15V	-	2.0	-	uC	
R _{Gint}	Internal gate resistor	-	T _j = 25°C	-	13	-	Ω
C _{ies}	Input Capacitance	V _{CE} = 25V, V _{GE} = 0V f = 1MHz	T _j = 25°C	-	3.56	-	nF
C _{res}	Reverse transfer Capacitance			-	0.04	-	nF
I _{CES}	Collector- Emitter Cut off Current	V _{CE} = 1200V, V _{GE} = 0V	T _j = 25°C	-	-	0.01	mA
I _{GES}	Gate-Emitter Leakage Current	V _{GE} = 20V, V _{CE} = 0V	T _j = 25°C	-	-	0.1	uA

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$t_{d(on)}$	Turn-on delay time	$V_{CC}=600V$ $I_C=100A$ $V_{GE}=+15V/-15V$ $R_g=1.5\Omega$ Inductive load	$T_j=25^\circ C$	-	100	-	ns
			$T_j=125^\circ C$	-	108	-	
			$T_j=175^\circ C$	-	114	-	
t_r	Rise time		$T_j=25^\circ C$	-	31	-	ns
			$T_j=125^\circ C$	-	34	-	
			$T_j=175^\circ C$	-	37	-	
$t_{d(off)}$	Turn-off delay time		$T_j=25^\circ C$	-	228	-	ns
			$T_j=125^\circ C$	-	299	-	
			$T_j=175^\circ C$	-	342	-	
t_f	Fall time		$T_j=25^\circ C$	-	210	-	ns
			$T_j=125^\circ C$	-	308	-	
			$T_j=175^\circ C$	-	384	-	
E_{on}	Turn-on power dissipation	$T_j=25^\circ C$	-	1.	-	mJ	
		$T_j=125^\circ C$	-	241.	-		
		$T_j=175^\circ C$	-	802.	-		
E_{off}	Turn-off power dissipation	$T_j=25^\circ C$	-	01	-	mJ	
		$T_j=125^\circ C$	-	6.7	-		
		$T_j=175^\circ C$	-	12.	-		
$R_{th(j-c)}$	Thermal Resistance, Junction to Case (IGBT)		-	215.	-	K/W	
$R_{th(c-s)}$	Thermal Resistance, Case to sink (Conductive Grease applied), Note1		-	10.	-	K/W	

 Note1: Assumes Thermal Conductivity of grease is $2.8W/m\cdot K$ and thickness is 50um. 160.

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Freewheeling Diode Electrical characteristics ($T_j=25^\circ C$ unless otherwise specified, chip)

Symbol	Item	Condition	Value			Unit	
			Min.	Typ.	Max		
V_F	Diode Forward Voltage	$I_F=100A, V_{GE}=0V$	$T_j=25^\circ C$	-	1.9	-	V
			$T_j=175^\circ C$	-	1.75	-	
t_{rr}	Reverse recovery time	(Switch side) $V_{CC}=600V$ $I_C=100A$ $V_{GE}=+15V/-15V$ $R_g=1.5\Omega$ (FRD side) $V_{rr}=600V$ $I_F=100A$ $V_{GE}=+15V/-15V$ Inductive load switching operation	$T_j=25^\circ C$	-	0.36	-	us
			$T_j=125^\circ C$	-	0.53	-	
			$T_j=175^\circ C$	-	0.71	-	
I_{RM}	Peak reverse recovery Current		$T_j=25^\circ C$	-	103	-	A
			$T_j=175^\circ C$	-	154	-	
Q_{rr}	Recovered charge		$T_j=25^\circ C$	-	9.32	-	uC
			$T_j=125^\circ C$	-	16.7	-	
			$T_j=175^\circ C$	-	27.2	-	
E_{rr}	Reverse recovered energy		$T_j=25^\circ C$	-	3.74	-	mJ
		$T_j=125^\circ C$	-	6.90	-		
		$T_j=175^\circ C$	-	8.77	-		
$R_{th(j-c)}$	Thermal Resistance, Junction to Case (Diode)		-	0.28	-	K/W	
$R_{th(c-s)}$	Thermal Resistance, Case to sink (Conductive Grease applied), Note1		-	0.12	-	K/W	

 Note1: Assumes Thermal Conductivity of grease is $2.8W/m\cdot K$ and thickness is 50um.

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Test Conditions

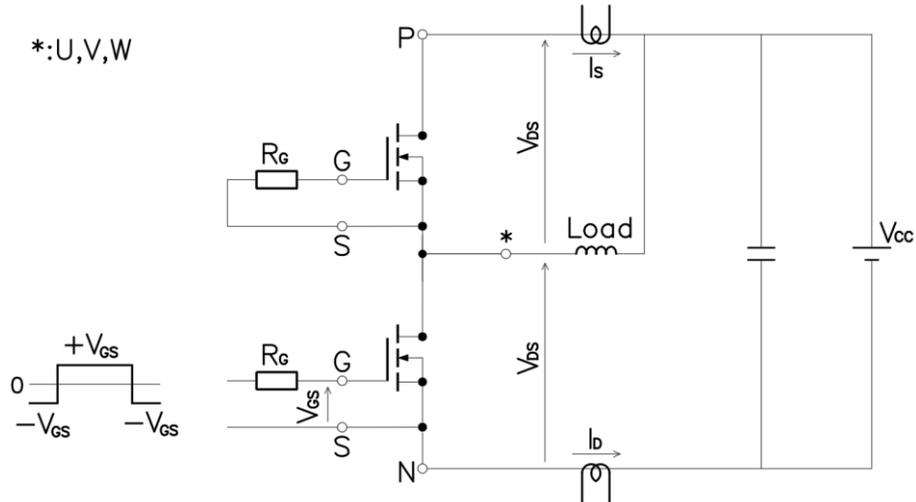


Figure 3. Switching time measure circuit

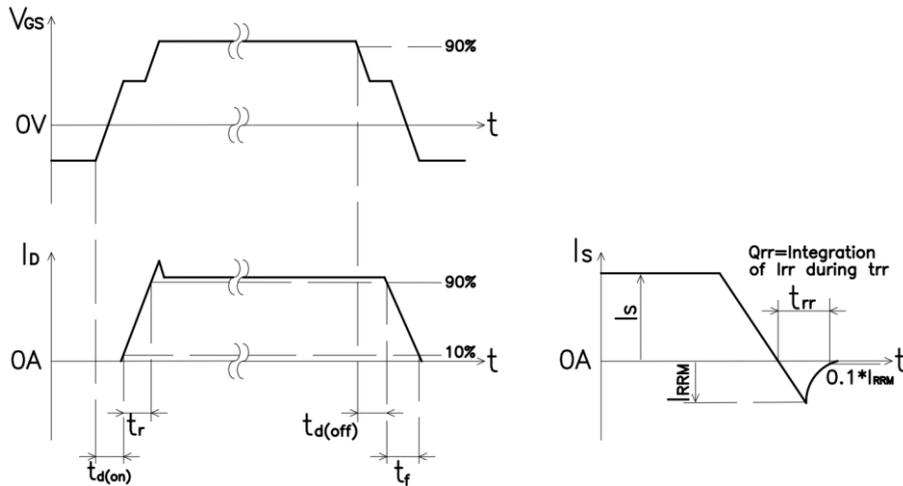


Figure 4. Switching time definition

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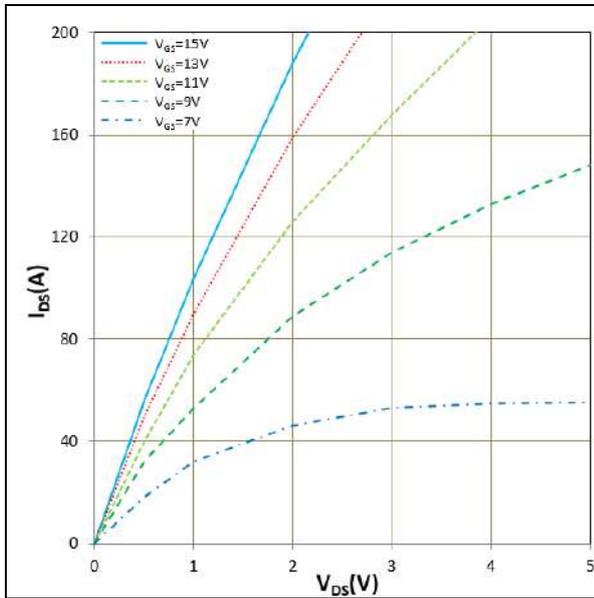


Figure 5. I_{DS} vs V_{DS} , SiC MOSFET
 $T_j = 25^\circ\text{C}$, V_{GS} parameter

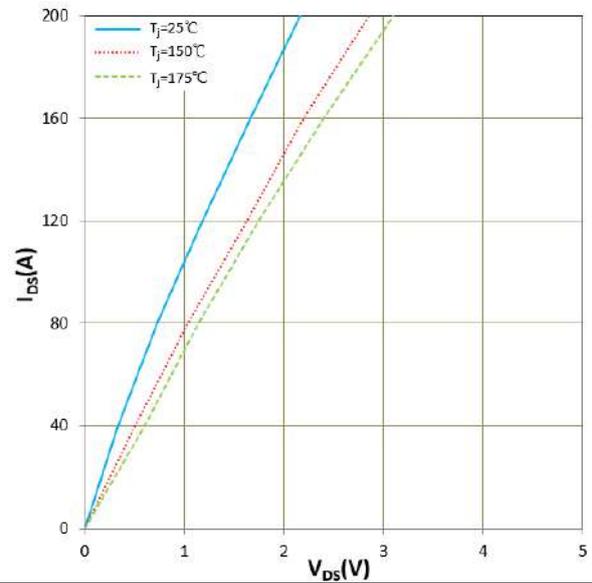


Figure 6. I_{DS} vs V_{DS} , SiC MOSFET
 $V_{GS} = +15\text{V}$

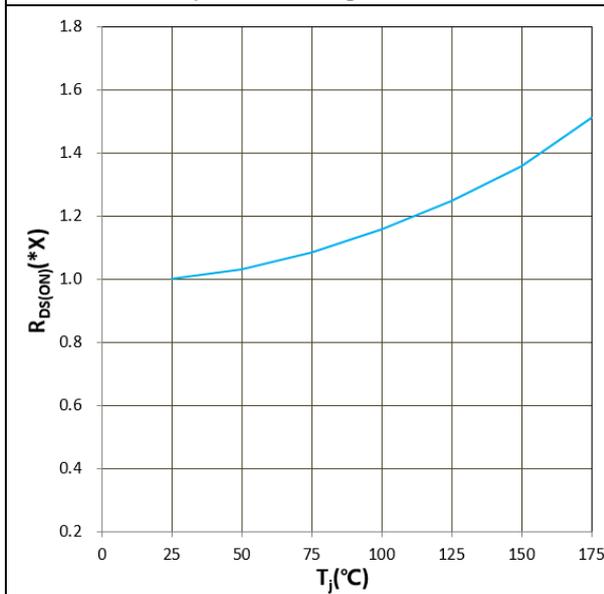


Figure 7. $R_{DS(ON)}$ vs T_j , SiC MOSFET
 $V_{GS} = +15\text{V}$, $I_D = 100\text{A}$, $1.0X = 9.5\text{m}\Omega$

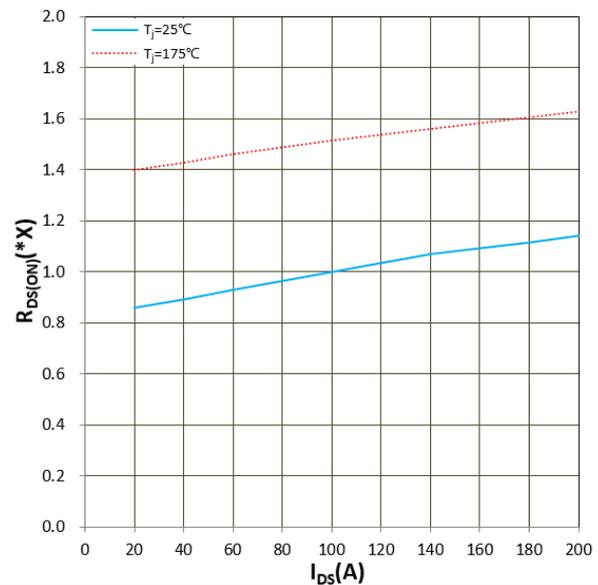


Figure 8. $R_{DS(ON)}$ vs I_{DS} , SiC MOSFET
 $V_{GS} = +15\text{V}$, $1.0X = 9.5\text{m}\Omega$

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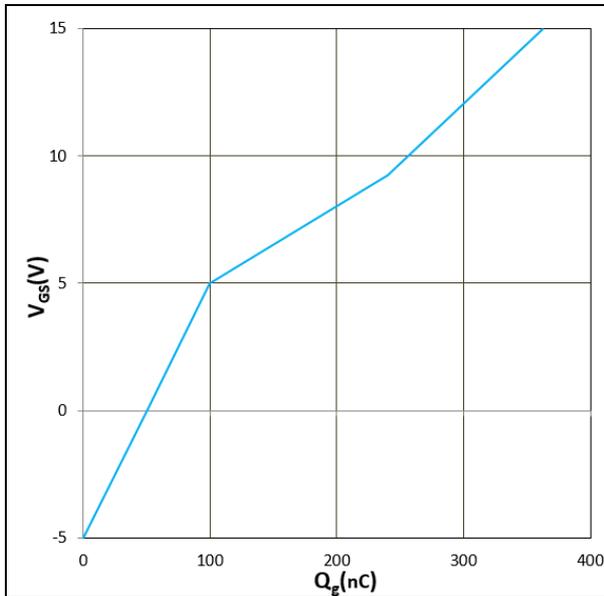


Figure 9. V_{GS} vs Q_g , SiC MOSFET
 $V_{DS}=800V, I_D=120A, T_j=25^\circ C$

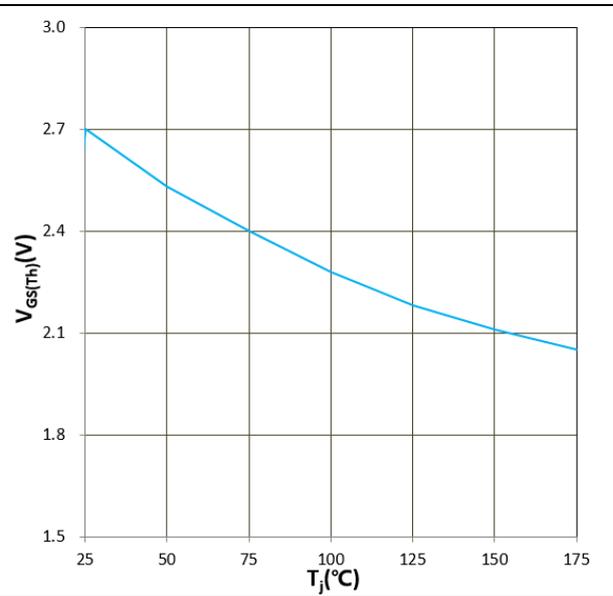


Figure 10. $V_{GS(TH)}$ vs T_j , SiC MOSFET
 $V_{GS}=V_{DS}, I_D=70mA$

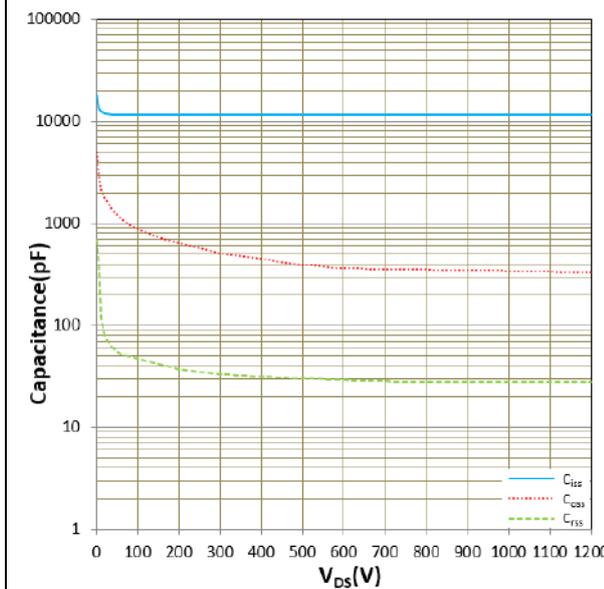


Figure 11. $C_{iss}, C_{oss}, C_{rss}$ vs V_{DS} , SiC MOSFET
 $T_j=25^\circ C, V_{GS}=0V, f=1MHz$

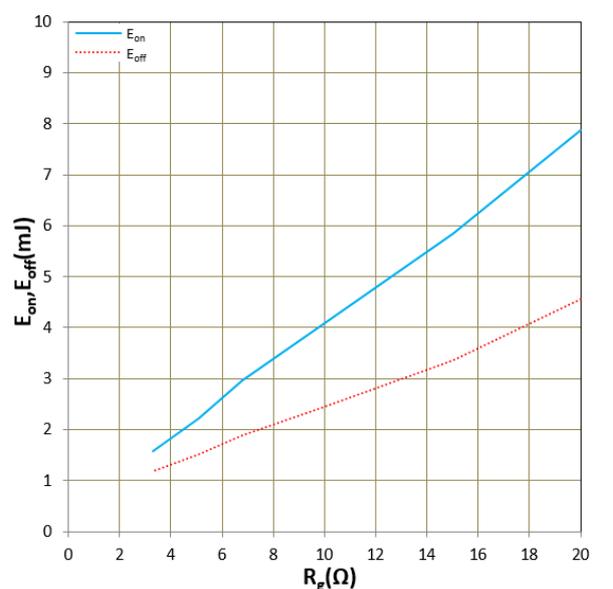


Figure 12. E_{on}, E_{off} vs R_g , SiC MOSFET
 $T_j=25^\circ C, V_{CC}=600V, I_D=100A, V_{GS}=+15V/-4V$

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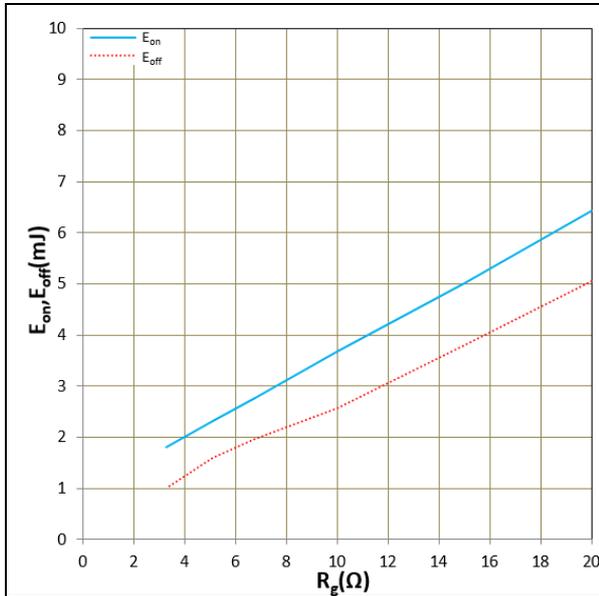


Figure 13. E_{on} , E_{off} vs R_g , SiC MOSFET
 $T_j = 150^\circ\text{C}$, $V_{CC} = 600\text{V}$, $I_D = 100\text{A}$, $V_{GS} = +15\text{V}/-4\text{V}$

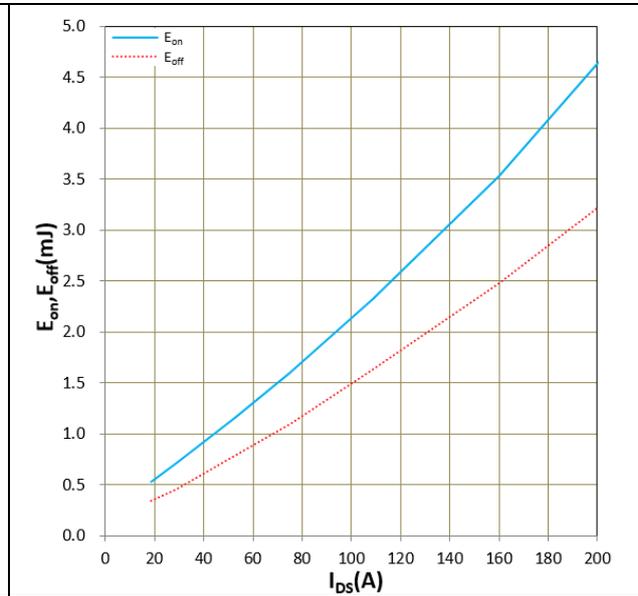


Figure 14. E_{on} , E_{off} vs I_{DS} , SiC MOSFET
 $T_j = 25^\circ\text{C}$, $V_{CC} = 600\text{V}$, $R_g = 5.1\ \mu\text{s}$, $V_{GS} = +15\text{V}/-4\text{V}$

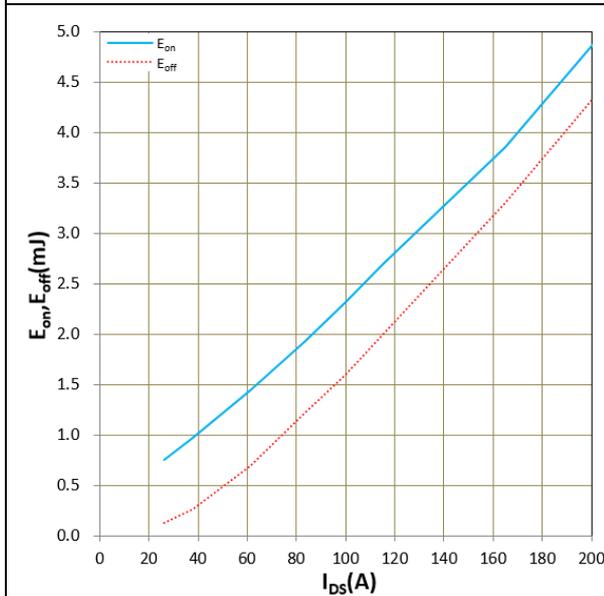


Figure 15. E_{on} , E_{off} vs I_{DS} , SiC MOSFET
 $T_j = 150^\circ\text{C}$, $V_{CC} = 600\text{V}$, $R_g = 5.1\ \mu\text{s}$, $V_{GS} = +15\text{V}/-4\text{V}$

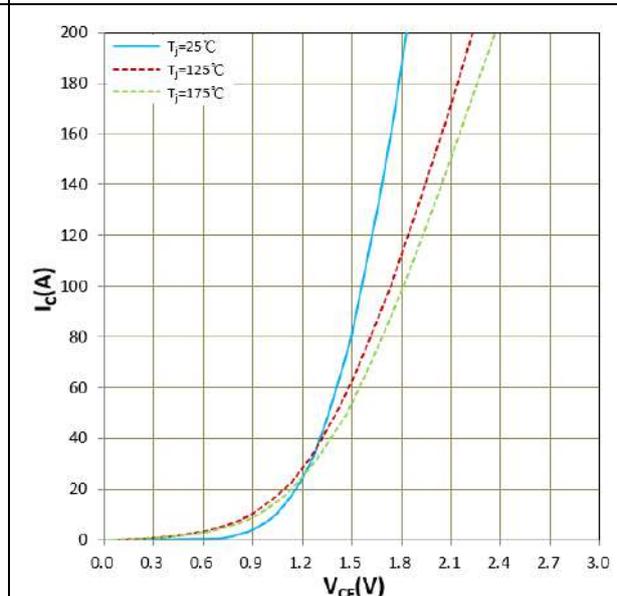


Figure 16. I_c vs V_{GE} , IGBT
 $V_{GE} = 15\text{V}$

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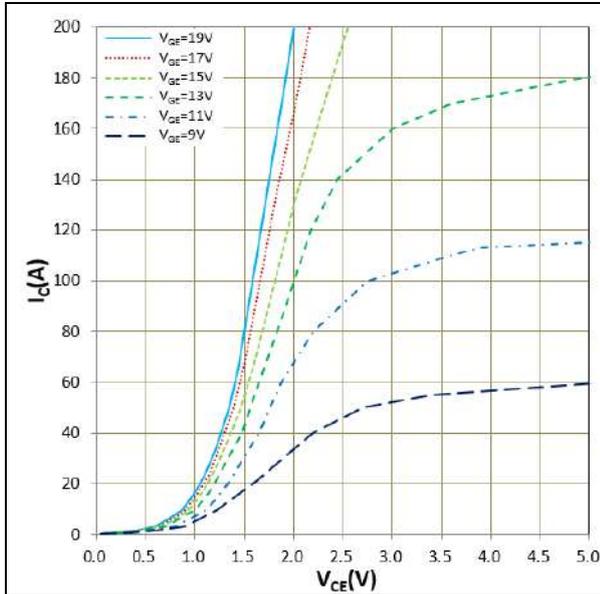


Figure 17. I_c vs V_{CE} , IGBT
 $T_j=175^\circ\text{C}$

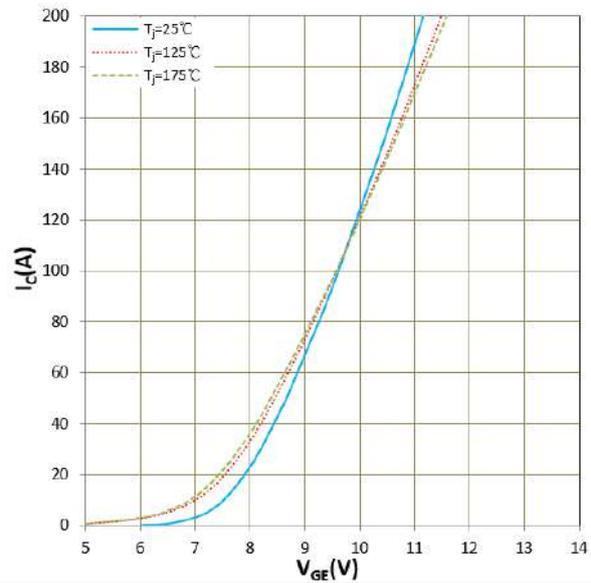


Figure 18. I_c vs V_{GE} , IGBT
 $V_{CE}=20\text{V}$

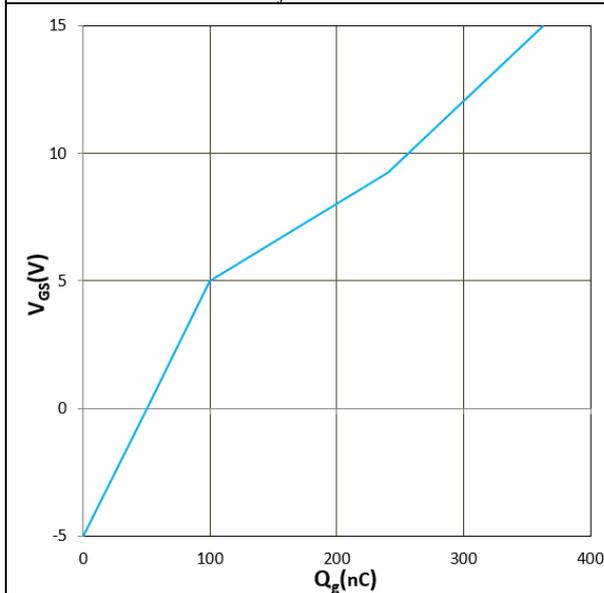


Figure 19. V_{GE} vs Q_g , IGBT
 $V_{CC}=600\text{V}$, $I_D=100\text{A}$, $T_j=25^\circ\text{C}$

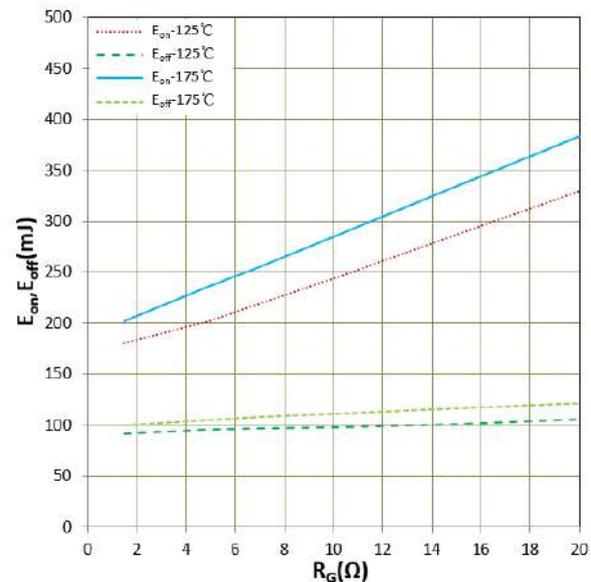


Figure 20. E_{on} , E_{off} vs I_c , IGBT
 $V_{CC}=600\text{V}$, $V_{GE}=\pm 15\text{V}$, $R_g=1.5\Omega$

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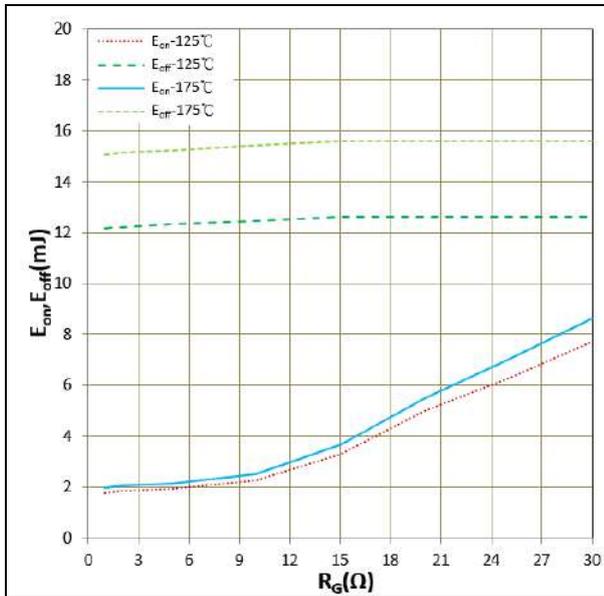


Figure 21. E_{on} , E_{off} vs R_g , IGBT
 $V_{CC}=600V$, $V_{GE}=\pm 15V$, $I_C=100A$

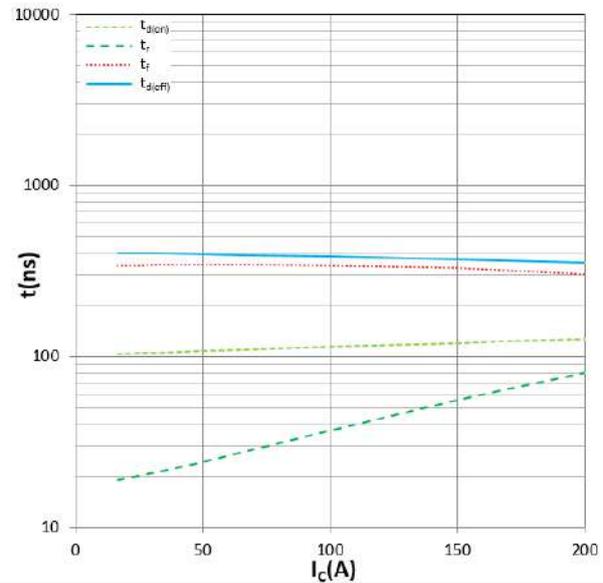


Figure 22. Switching time vs I_C , IGBT
 $V_{CC}=600V$, $V_{GE}=\pm 15V$, $R_g=1.5\Omega$, $T_j=175^\circ C$

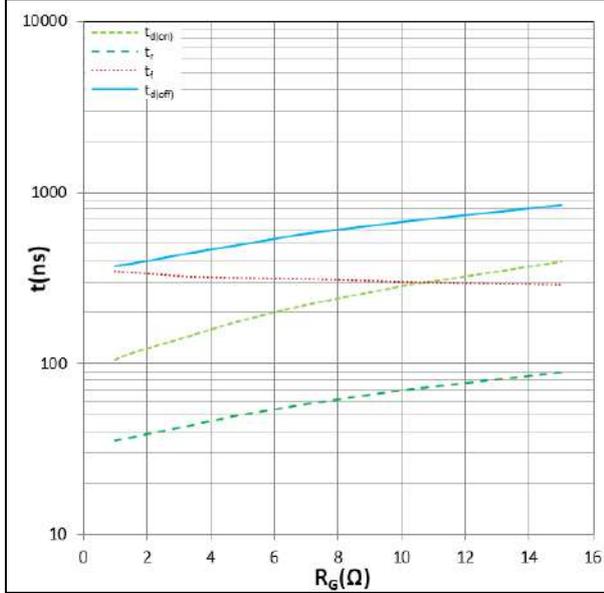


Figure 23. Switching time vs R_g , IGBT
 $V_{CC}=600V$, $V_{GE}=\pm 15V$, $I_C=100A$, $T_j=175^\circ C$

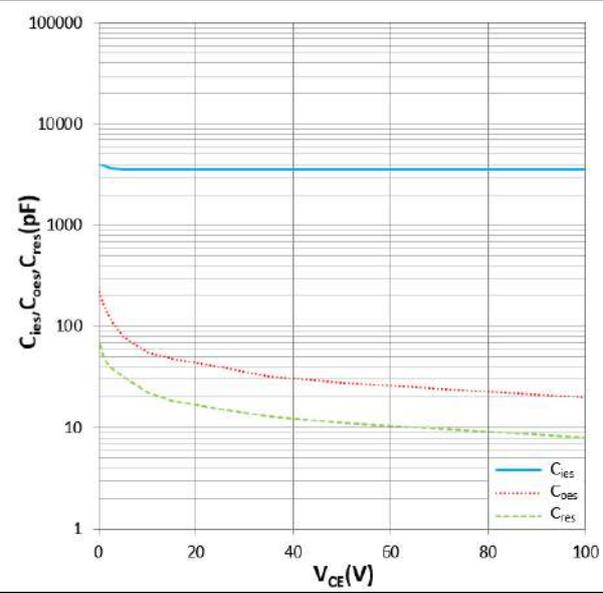
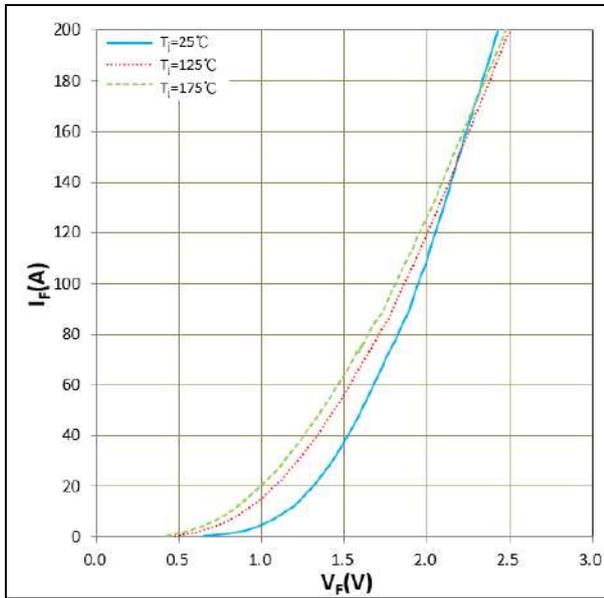
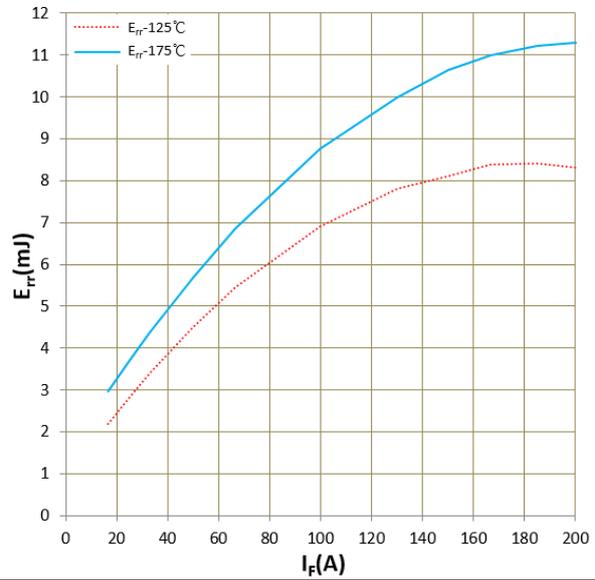
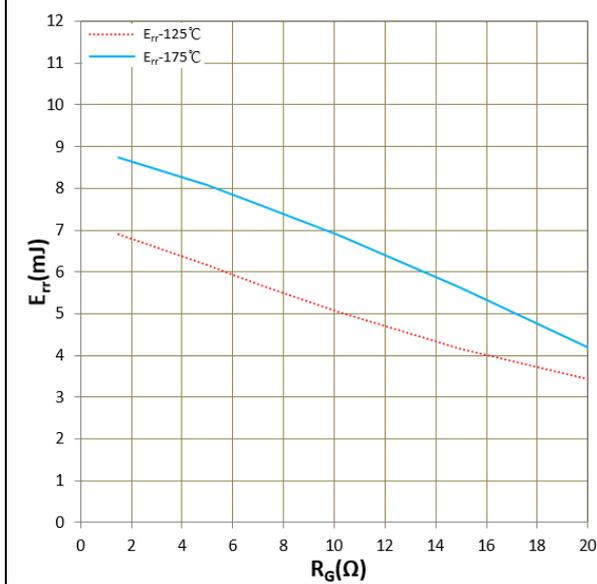


Figure 24. C_{ies} , C_{oss} , C_{res} vs V_{CE} , IGBT
 $T_j=25^\circ C$, $V_{GE}=0V$, $f=1MHz$

HCH10FA120E2C1

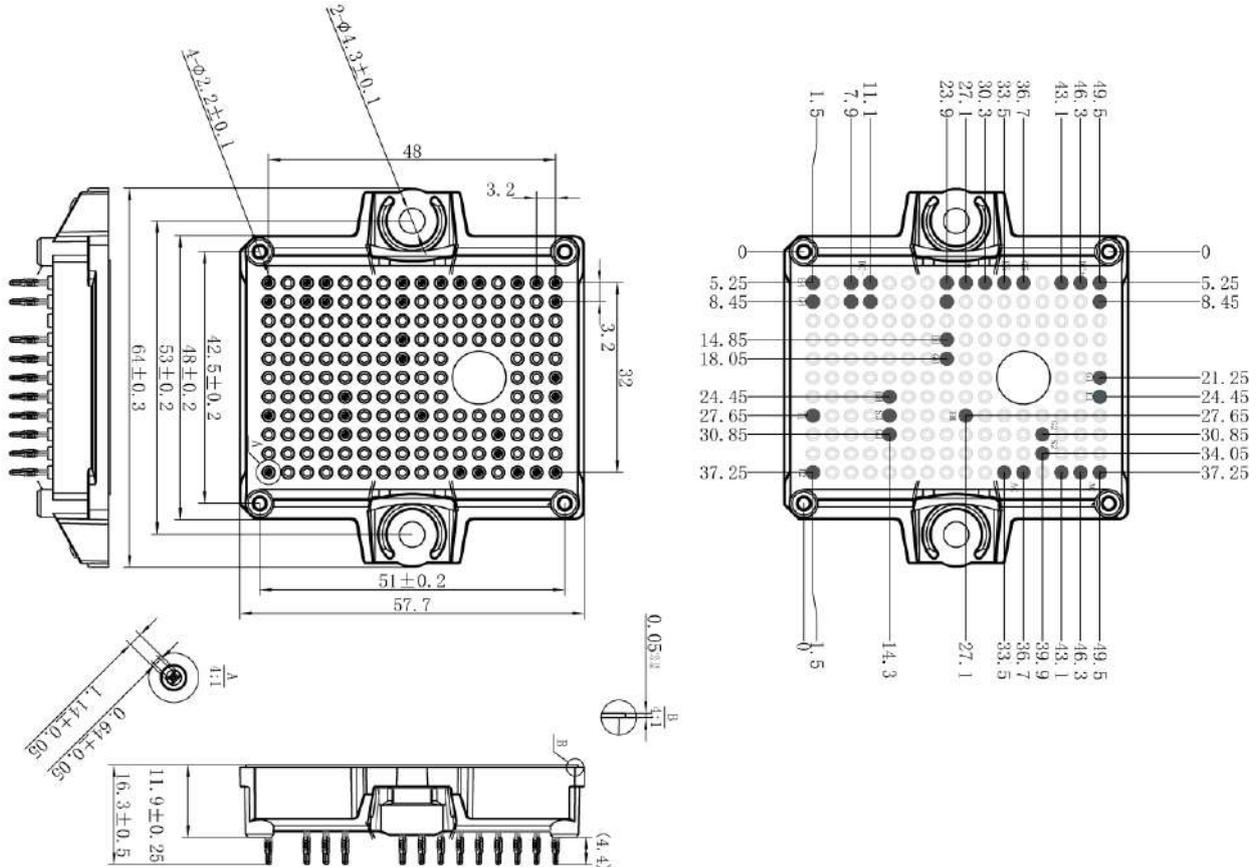
1200V 3-Level Hybrid Power Module


 Figure 25. I_F vs V_F , Freewheeling Diode

 Figure 26. E_{rr} vs I_F , Freewheeling Diode
 $V_{CC}=600V, R_g=1.5\Omega$

 Figure 27. E_{rr} vs R_g , Freewheeling Diode
 $V_{CC}=600V, I_C=100A$

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1200V 3-Level Hybrid Power Module

Package dimensions



IMPORTANT NOTICE

This product data sheet describes the characteristics of this product for which a warranty is granted. Any such warranty is granted exclusively under the terms and conditions of the supply agreement. There will be no guarantee or of any kind for the product and its characteristics.

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.

Please contact the sales staff (sales@hiitio.com) for further information on the product, technology, delivery terms, conditions and prices.

Revision History

Document Version	Description of Changes
RevX.0.1	Released

Zhejiang HIITIO New Energy Co., Ltd

ADD : NO.1125 Zhixing Road,Qiaonan District, Xiaoshan Economic and
Technological Development Zone, Hangzhou, Zhejiang

TEL :400-667-9977

