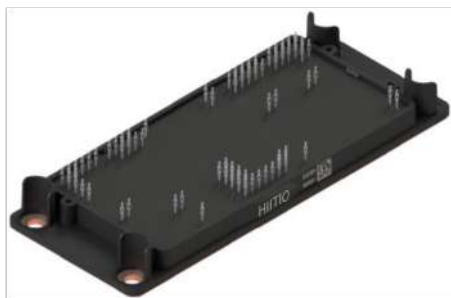


HCH300FA120H5C1

1200V 3-Level Hybrid Power Module

Description

The HCH300FA120H5C1 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 Systems etc.



Features

- Blocking voltage:1200V
- $R_{ds(on)}$:4.3m Ω @ V_{GS} =18V
- Low Switching Losses
- High current density
- Press FIT 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

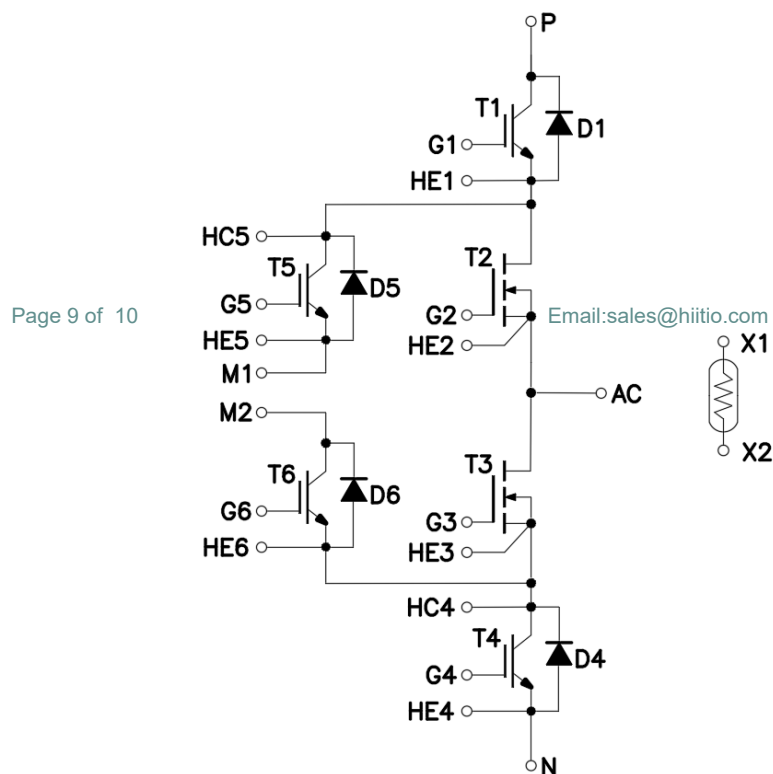


Figure 1. Out drawing & circuit diagram for HCH300FA120H5C1

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1200V 3-Level Hybrid Power Module

Pin Configuration

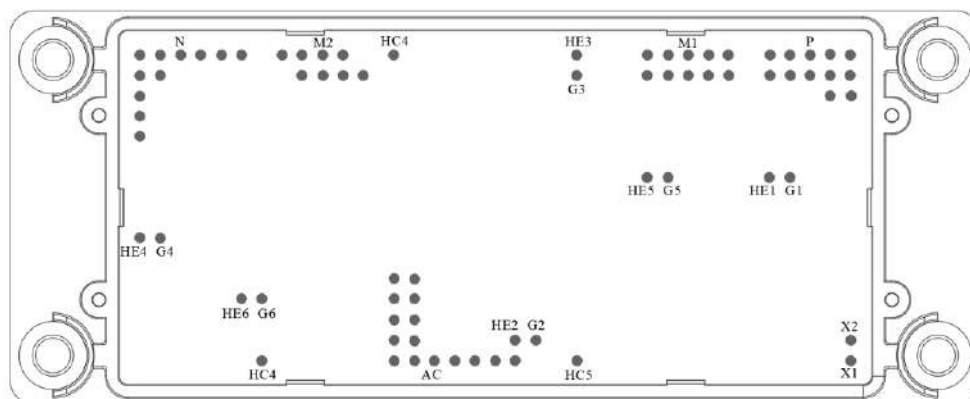


Figure 2. Pin configuration

Module

Parameter	Conditions	Value	Unit
Isolation voltage	Main terminal to base plate, RMS, f =50Hz, t =1 min	3.4	kV
Creepage distance	terminal to heatsink	11.2	mm
	terminal to terminal	6.8	
Clearance	terminal to heatsink	9.4	
	terminal to terminal	5.5	
Comparative tracking index	-	> 400	
Mounting torque for module mounting	Screw M5 baseplate to heatsink	1.3 to 1.5	Nm
Storage temperature	-	-40 to 125	°C
Weight	-	125	g

NTC characteristics

Symbol	Parameter	Condition	Value			Unit
			Min.	Typ.	Max.	
R ₂₅	Resistance	T _C =25°C	-	5	-	kΩ
ΔR/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 (T2/T3: 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	-8 to 22	V
I_{DS}	DC Continuous Drain Current	$T_s=65^{\circ}\text{C}$	275	A
I_{SD}	Source (Body diode) Current	-	275	A
I_{DP}	Drain Pulse Current, Peak	Less than 1ms, Note2	600	A
T_j	junction temperature	-	-40 to 175	$^{\circ}\text{C}$

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

Maximum Ratings (T1/T4/T5/T6: IGBT, $T_j=25^{\circ}\text{C}$ 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_{CDC}	DC Continuous Collector Current	$T_s=65^{\circ}\text{C}$, $T_j=150^{\circ}\text{C}$	310	A
I_{CM}	Pulse Collector Current	$t_p=1\text{ms}$, Note1	800	A
P_{C}	Maximum Power Dissipation	$T_c=25^{\circ}\text{C}$, $T_j=175^{\circ}\text{C}$	1136	W
T_j	junction temperature	-	-40 to 175	$^{\circ}\text{C}$

Note1: Pulse width limited by maximum junction temperature

Maximum Ratings (D1/D4/D5/D6: Diode, $T_j=25^{\circ}\text{C}$ unless otherwise specified)

Symbol	Parameter	Conditions	Ratings	Unit
V_{RRM}	Repetitive peak reverse Voltage	G-E Short	1200	V
I_{F}	Diode forward Current	-	300	A
I_{FRM}	Repetitive peak forward Current	$t_p=1\text{ms}$, Note1	600	A
T_j	junction temperature	-	-40 to 175	$^{\circ}\text{C}$

Note1: Pulse width limited by maximum junction temperature

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T2/T3: SiC 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		-	-	400	μA
V _{GS(th)}	Gate-source threshold Voltage	I _D =80mA, V _{DS} =V _{GS}		1.9	2.6	3.5	V
I _{GSS}	Gate-Source Leakage Current	V _{GS} =18V, V _{DS} =0V		-	-	400	nA
R _{DS(on)} (Chip)	Static drain-source On-state resistance	I _D =300A V _{GS} =18V	T _j =25°C	-	4.3	7.5	m Ω
			T _j =175°C	-	8.0	-	m Ω
V _{DS(on)} (Chip)	Static drain-source On-state Voltage	I _D =300A V _{GS} =18V	T _j =25°C	-	1.29	2.25	V
			T _j =175°C	-	2.40	-	V
C _{iss}	Input Capacitance	V _D =1000V, V _{GS} =0V f =1MHz		-	18.8	-	nF
C _{oss}	Output Capacitance			-	0.8	-	nF
C _{rss}	Reverse transfer Capacitance			-	0.08	-	nF
Q _G	Total gate charge	V _{DD} =800V, I _D =200A, V _{GS} =0/+18V		-	860	-	nC
R _{Gint}	Internal Gate Resistance	f =1Mhz, V _{AC} =25mV		-	0.15	-	Ω
t _{d(on)}	Turn-on delay time	V _{CC} =600V I _D =300A V _{GS} =+15V/-4V R _g =5.0 Ω Inductive load switching operation	T _j =25°C	-	37	-	ns
			T _j =150°C	-	36	-	
t _r	Rise time		T _j =25°C	-	48	-	ns
			T _j =150°C	-	50	-	
t _{d(off)}	Turn-off delay time		T _j =25°C	-	82	-	ns
			T _j =150°C	-	87	-	
t _f	Fall time		T _j =25°C	-	25	-	ns
			T _j =150°C	-	26	-	
E _{on}	Turn-on power dissipation		T _j =25°C	-	6.75	-	mJ
			T _j =150°C	-	8.74	-	
E _{off}	Turn-off power dissipation		T _j =25°C	-	2.89	-	mJ
			T _j =150°C	-	3.59	-	
R _{th(j-c)}	FET Thermal Resistance	Junction to Case/MOSFET		-	0.082	-	K/W
R _{th(c-s)}	Thermal Resistance, Case to sink (Conductive Grease applied) , Note1			-	0.10	-	K/W

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

T2/T3: Body Diode Electrical characteristics (T_j=25°C unless otherwise specified, chip)

Symbol	Item	Condition		Value			Unit
				Min.	Typ.	Max	
V _{SD}	Body Diode Forward Voltage	V _{GS} =-4V I _{SD} =300A	T _j =25°C	-	5.0	-	V
			T _j =175°C	-	3.9	-	
T _{rr}	Reverse recovery time	V _{CC} =600V I _D =300A V _{GS} =+15/-4V R _g =5.0Ω Inductive load switching operation	T _j =25°C	-	34	-	ns
			T _j =150°C	-	48	-	
Q _{rr}	Reverse recovery charge		T _j =25°C	-	0.69	-	μC
			T _j =150°C	-	2.02	-	
E _{rr}	Diode switching power dissipation		T _j =25°C	-	0.67	-	mJ
			T _j =150°C	-	1.06	-	

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T1/T4/T5/T6: 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 =300A V _{GE} =15V	T _j =25°C	-	1.65	-	V
			T _j =150°C	-	1.85	-	V
			T _j =175°C	-	1.90	-	V
V _{GE(th)}	Gate-Emitter threshold Voltage	I _C =11.4mA, V _{CE} =V _{GE}		5.0	5.6	6.8	V
Q _G	Gate charge	V _{GE} =-15V to +15V		-	2.2	-	uC
R _{Gint}	Internal gate resistor	-	T _j =25°C	-	2.5	-	Ω
C _{ies}	Input Capacitance	V _{CE} =25V, V _{GE} =0V f =1MHz	T _j =25°C	-	26.0	-	nF
C _{res}	Reverse transfer Capacitance			-	0.93	-	nF
I _{CES}	Collector- Emitter Cut off Current	V _{CE} =1200V, V _{GE} =0V	T _j =25°C	-	-	1	mA
I _{GES}	Gate-Emitter Leakage Current	V _{GE} =20V, V _{CE} =0V	T _j =25°C	-	-	0.75	uA
t _{d(on)}	Turn-on delay time	V _{CC} =600V I _C = 300A V _{GE} =+15V/-8V R _g =1.0 Ω Inductive load	T _j =25°C	-	168	-	ns
			T _j =125°C	-	171	-	
			T _j =175°C	-	179	-	
t _r	Rise time		T _j =25°C	-	44	-	ns
			T _j =125°C	-	47	-	
			T _j =175°C	-	48	-	
t _{d(off)}	Turn-off delay time		T _j =25°C	-	392	-	ns
			T _j =125°C	-	421	-	
			T _j =175°C	-	449	-	
t _f	Fall time		T _j =25°C	-	90	-	ns
			T _j =125°C	-	129	-	
			T _j =175°C	-	159	-	
E _{on}	Turn-on power dissipation		T _j =25°C	-	25.1	-	mJ
			T _j =125°C	-	33.2	-	
			T _j =175°C	-	38.7	-	
E _{off}	Turn-off power dissipation	T _j =25°C	-	21.3	-	mJ	
		T _j =125°C	-	29.4	-		
		T _j =175°C	-	35.7	-		
R _{th(j-c)}	Thermal Resistance, Junction to Case (IGBT)			-	0.032	-	K/W
R _{th(c-s)}	Thermal Resistance, Case to sink (Conductive Grease applied) , Note1			-	0.10	-	K/W

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

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D1/D4/D5/D6: Freewheeling 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 =300A, V _{GE} =0V	T _j =25°C	-	1.7	2.1	V
			T _j =175°C	-	1.65	-	
t _{rr}	Reverse recovery time	(Switch side) V _{CC} =600V I _C =300A V _{GE} = +15V/-8V R _g =1.0 Ω (FRD side) V _{rr} =600V I _F =300A V _{GE} = +15V/-8V Inductive load switching operation	T _j =25°C	-	0.30	-	us
			T _j =125°C	-	0.57	-	
			T _j =175°C	-	0.66	-	
I _{RM}	Peak reverse recovery Current		T _j =25°C	-	280	-	A
			T _j =125°C	-	259	-	
			T _j =175°C	-	262	-	
Q _{rr}	Recovered charge		T _j =25°C	-	22.6	-	uC
			T _j =125°C	-	41.7	-	
			T _j =175°C	-	56.5	-	
E _{rr}	Reverse recovered energy		T _j =25°C	-	7.05	-	mJ
		T _j =125°C	-	12.7	-		
		T _j =175°C	-	17.9	-		
R _{th(j-c)}	Thermal Resistance, Junction to Case (Diode)			-	0.083	-	K/W
R _{th(c-s)}	Thermal Resistance, Case to sink (Conductive Grease applied) , Note1			-	0.10	-	K/W

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

Test Conditions

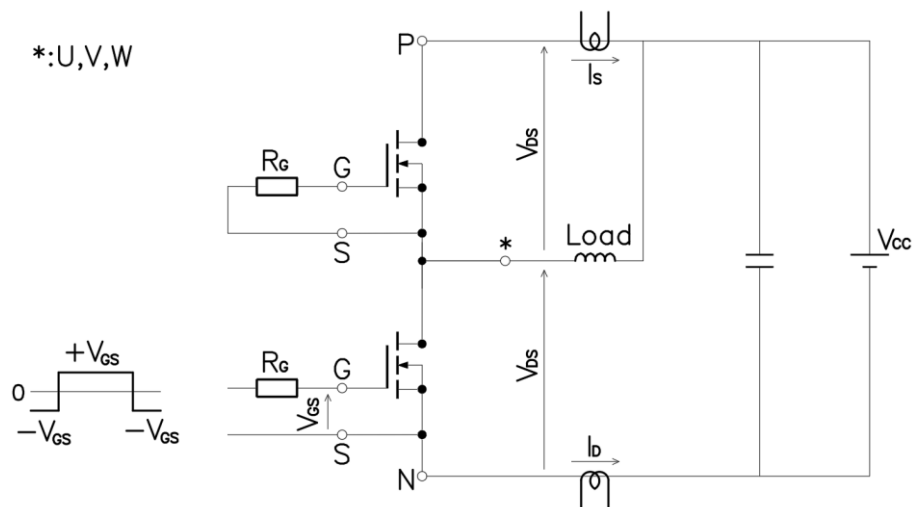


Figure 3. Switching time measure circuit

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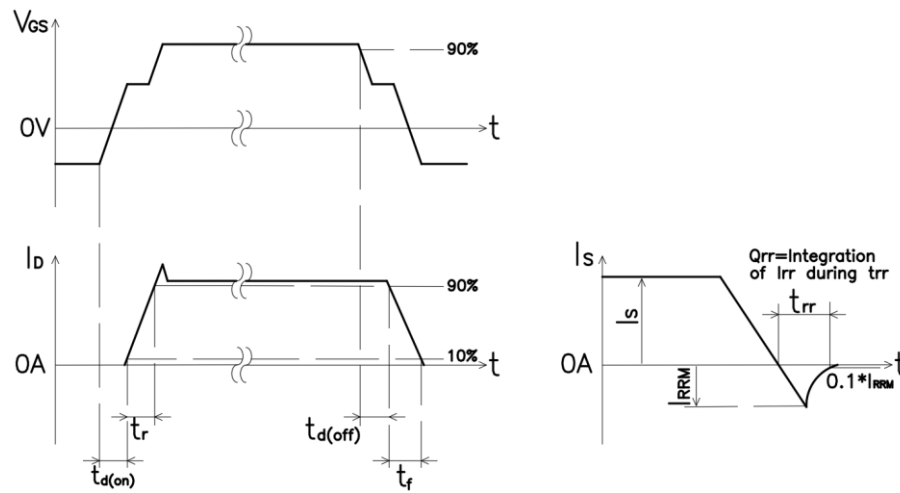


Figure 4. Switching time definition

SiC Mosfet: T2, T3

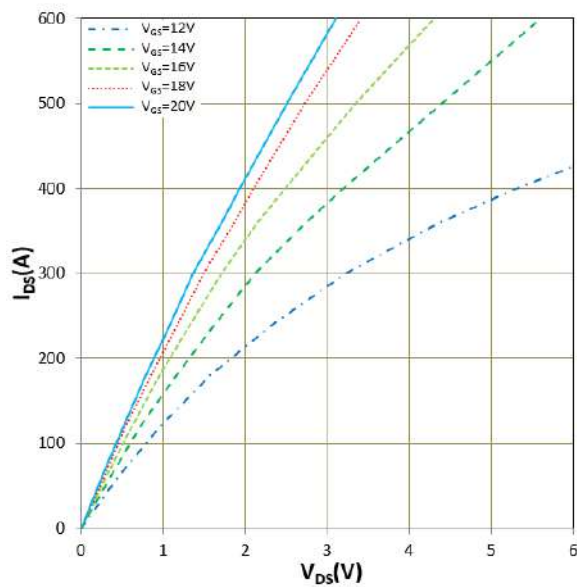


Figure 5. I_{DS} vs V_{DS}
 $T_j=25^{\circ}\text{C}$

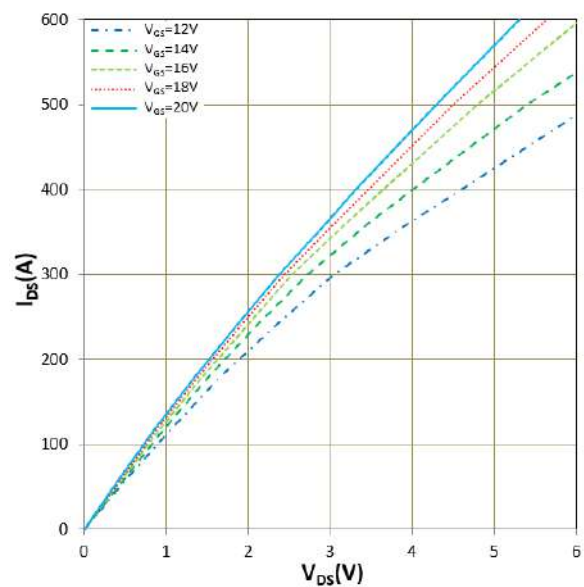


Figure 6. I_{DS} vs V_{DS}
 $T_j=175^{\circ}\text{C}$

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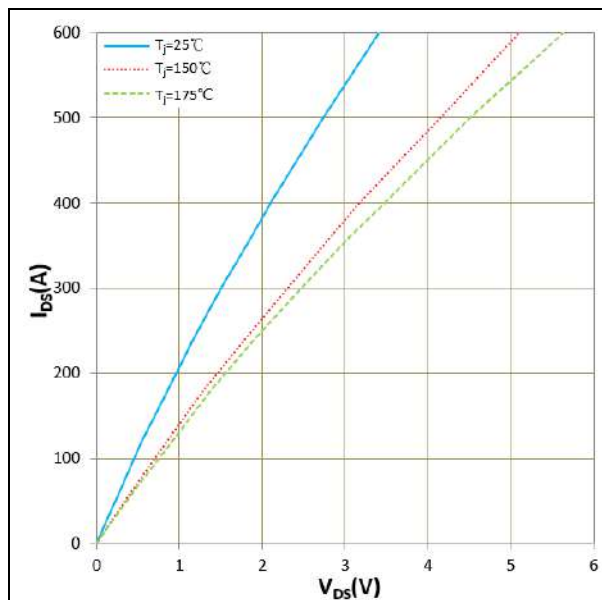


Figure 7. I_{DS} vs V_{DS}
 $V_{GS} = 18\text{V}$

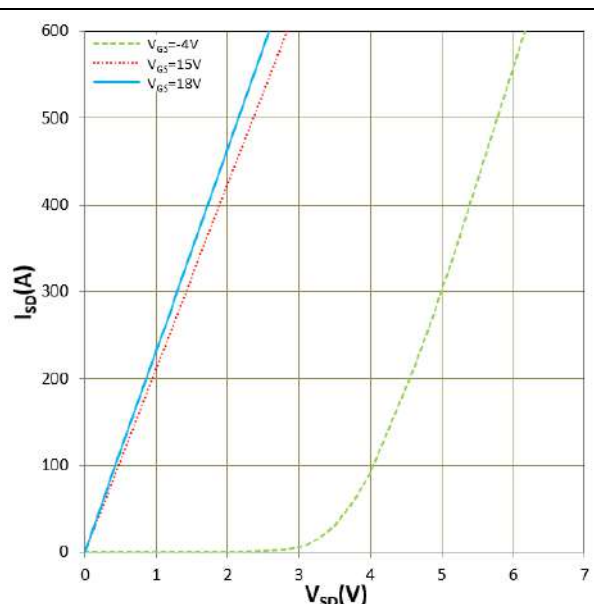


Figure 8. I_{SD} vs V_{SD} (V_F)
 $T_J = 25^\circ\text{C}$

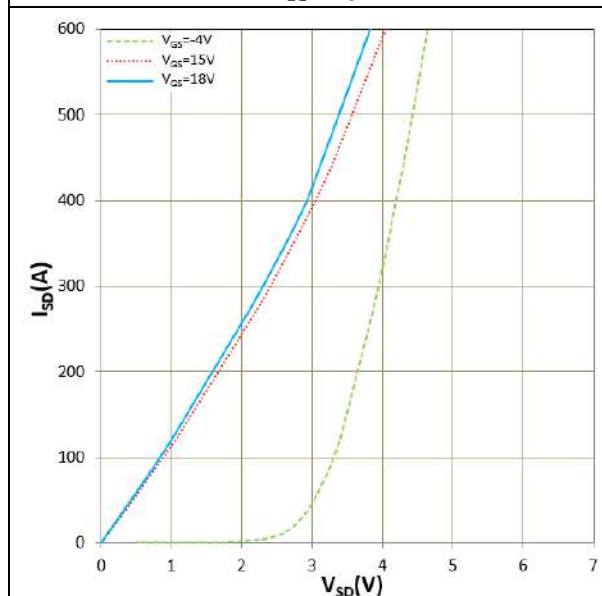


Figure 9. I_{SD} vs V_{SD} (V_F)
 $T_J = 150^\circ\text{C}$

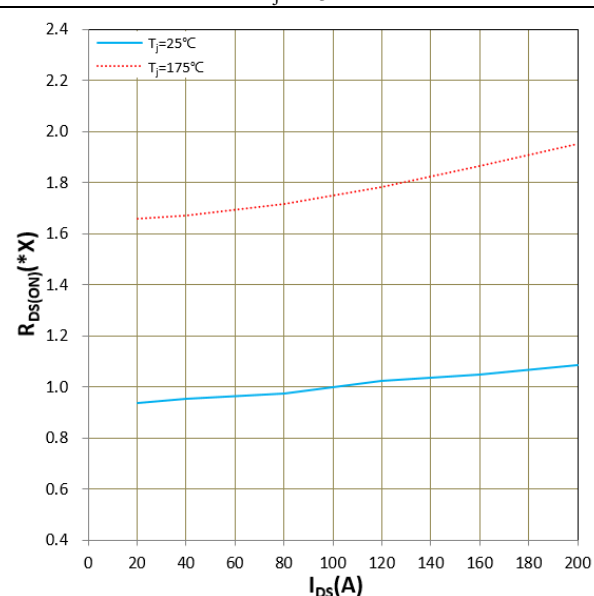


Figure 10. $R_{DS(ON)}$ vs I_{DS}
 $1.0 \times = 4.3\text{m}\Omega$ $V_{GS} = 18\text{V}$

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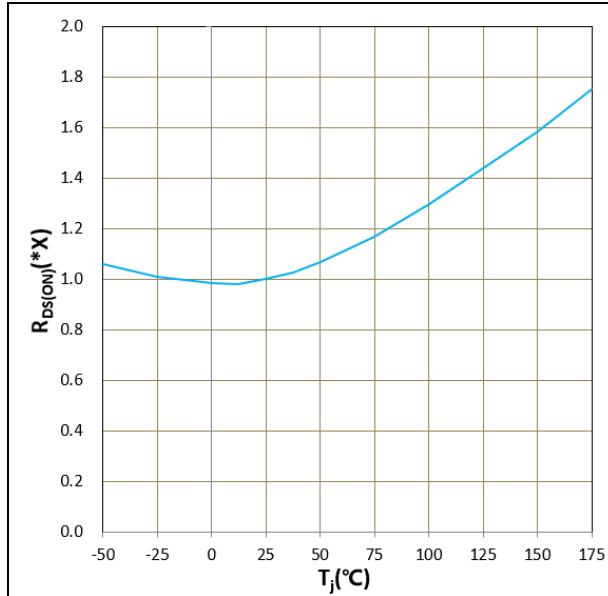


Figure 11. $R_{DS(ON)}$ vs T_j
 $1.0x = 4.3m\Omega \times 300A$

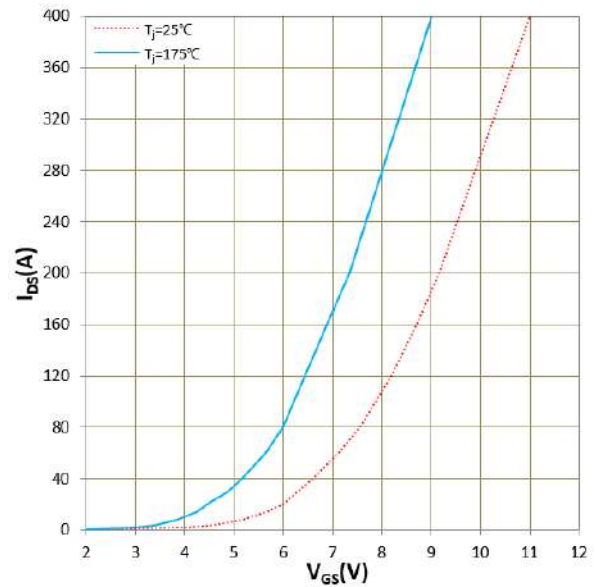


Figure 12. I_{DS} vs V_{GS}
 $V_{DS} = 10V$

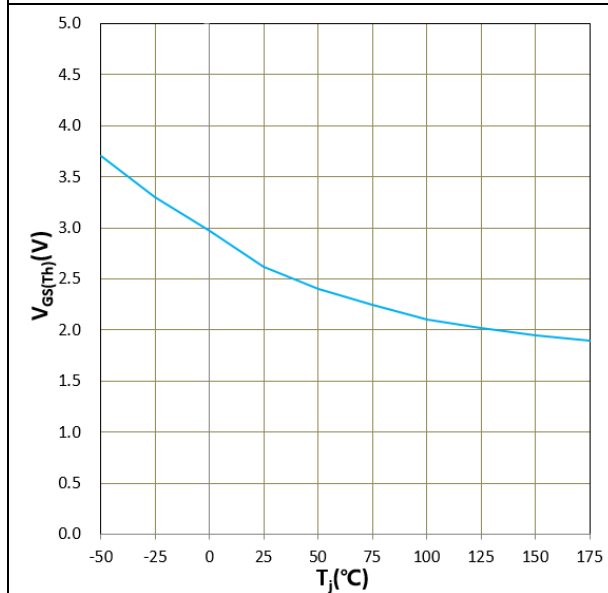


Figure 13. $V_{GS(Th)}$ vs T_j
 $V_{DS} = 10V, I_{GS} = 80mA$

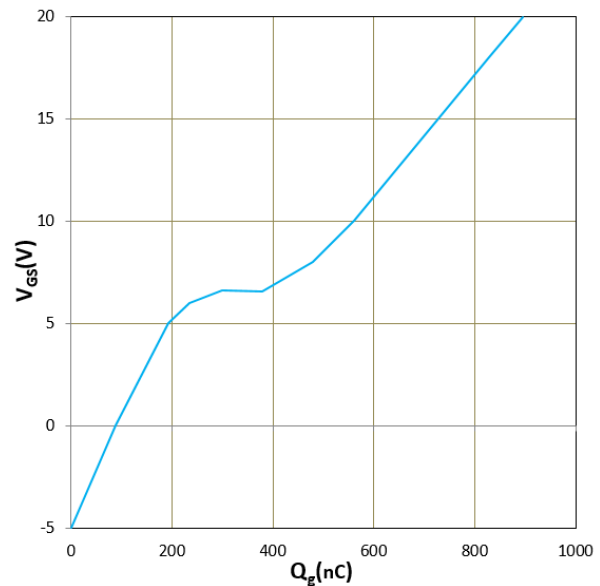


Figure 14. Gate charge
 $I_{DS} = 200A, I_{GS} = 0.4mA, V_{DS} = 400V$

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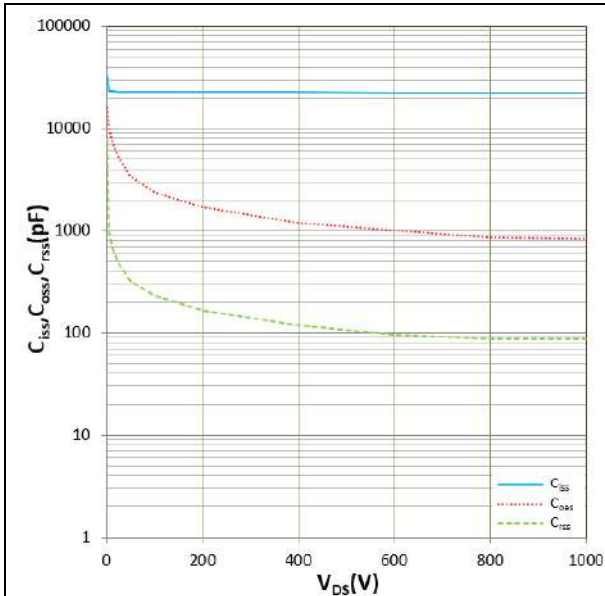


Figure 15. C_{iss} , C_{oss} , C_{rss} vs V_{CE}
 $V_{AC}=25mV$, $f=1MHz$

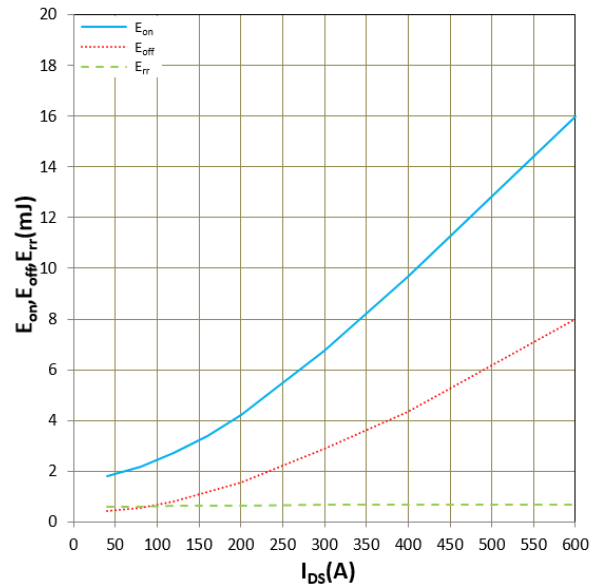


Figure 16. E_{on} , E_{off} , E_{rr} vs I_{DS}
 $T_j=25^{\circ}C$, $V_{CC}=600V$, $V_{GE}=+15/-4V$
 $R_{GON}/R_{GOFF}=5.0\Omega$, Inductive Load

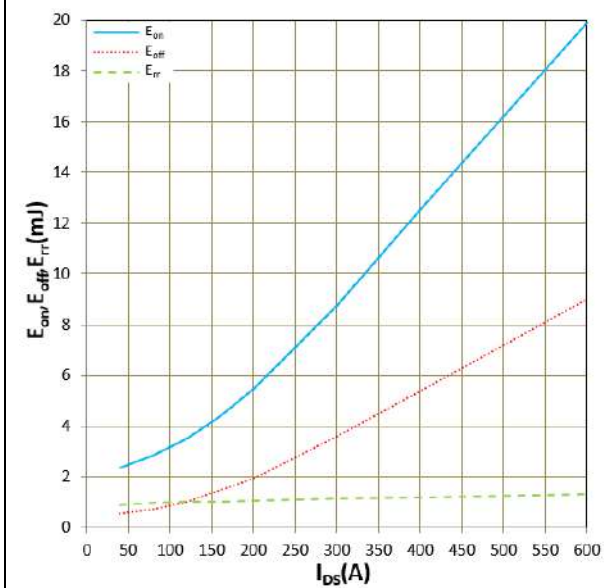


Figure 17. E_{on} , E_{off} , E_{rr} vs I_{DS}
 $T_j=150^{\circ}C$, $V_{CC}=600V$, $V_{GE}=+15/-4V$
 $R_{GON}/R_{GOFF}=5.0\Omega$, Inductive Load

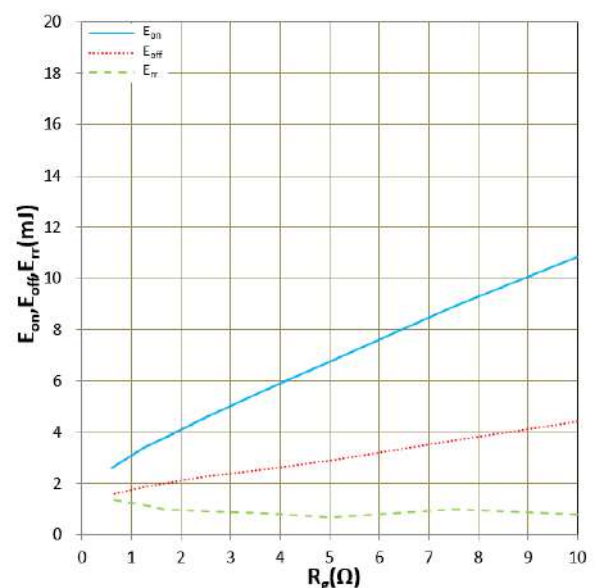


Figure 18. E_{on} , E_{off} , E_{rr} vs R_g
 $T_j=25^{\circ}C$, $V_{CC}=600V$, $V_{GE}=+15/-4V$,
 $I_D=300A$, Inductive Load

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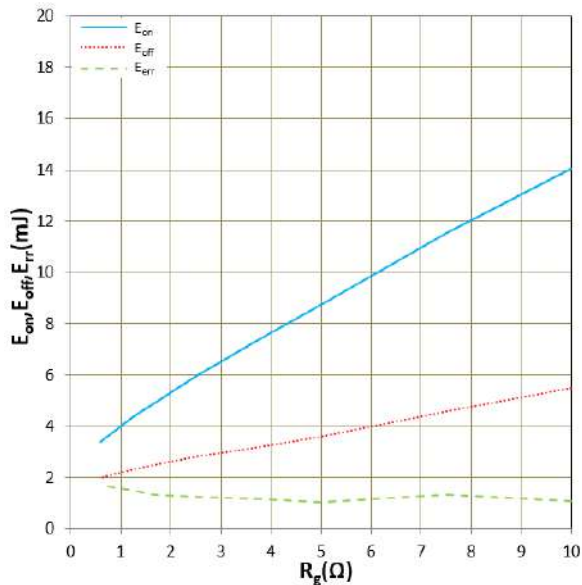


Figure 19. E_{on} , E_{off} , E_{rr} vs R_g
 $T_j=150^{\circ}\text{C}$, $V_{CC}=600\text{V}$, $V_{GE}=+15/-4\text{V}$,
 $I_D=300\text{A}$, Inductive Load

IGBT: T1, T4, T5, T6 + Diode: D1, D4, D5, D6

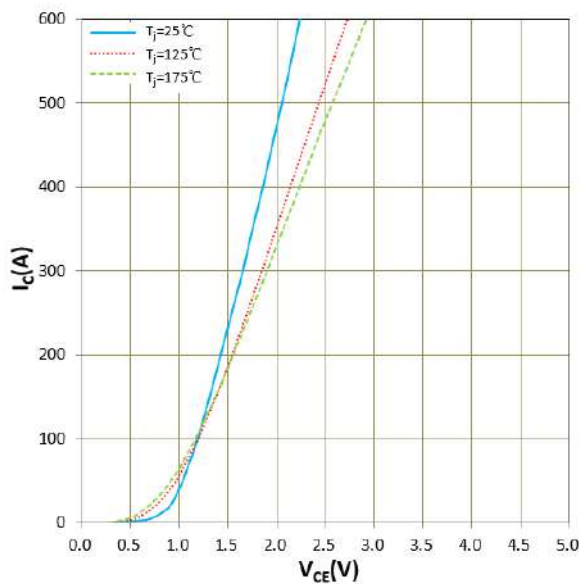


Figure 20. I_c vs V_{CE}
 $V_{GE}=15\text{V}$

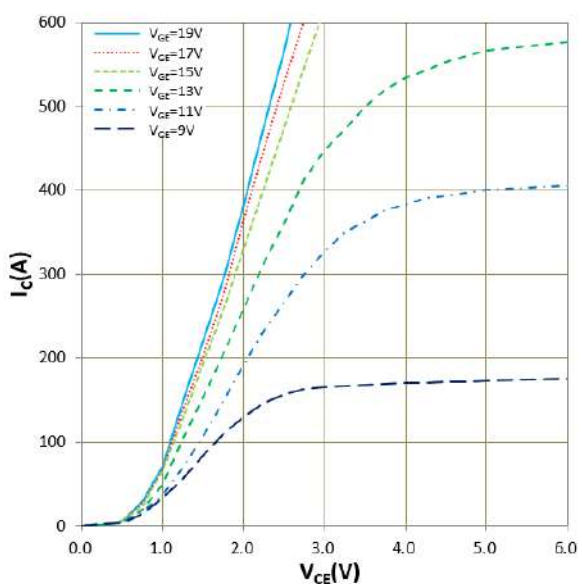


Figure 21. I_c vs V_{CE}
 $T_j=175^{\circ}\text{C}$

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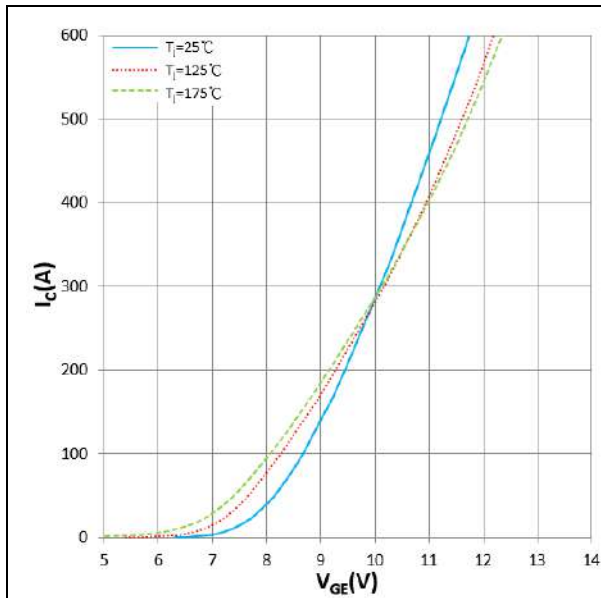


Figure 22. I_c vs V_{GE}
 $V_{CE}=20\text{V}$

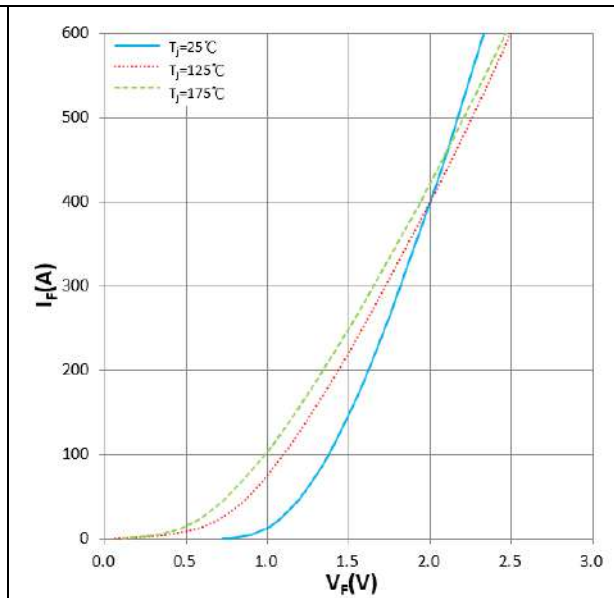


Figure 23. I_F vs V_F

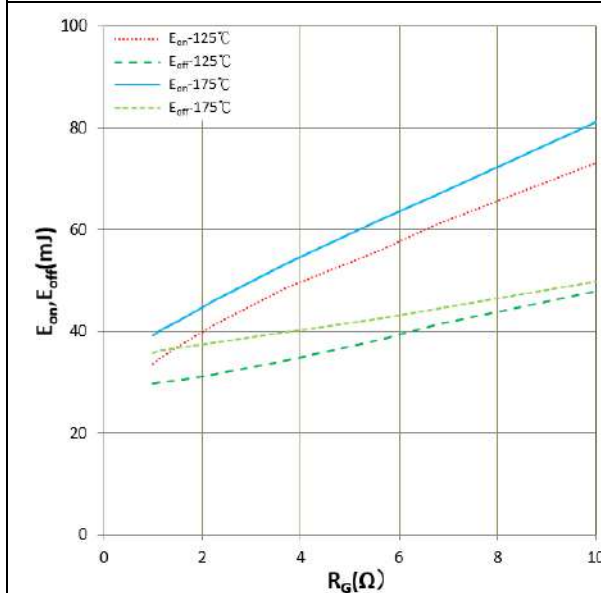


Figure 24. E_{on} , E_{off} vs R_G (Typ)
 $V_{CC}=600\text{V}$, $V_{GE}=+15\text{V}/-8\text{V}$, $I_c=300\text{A}$
Inductive Load

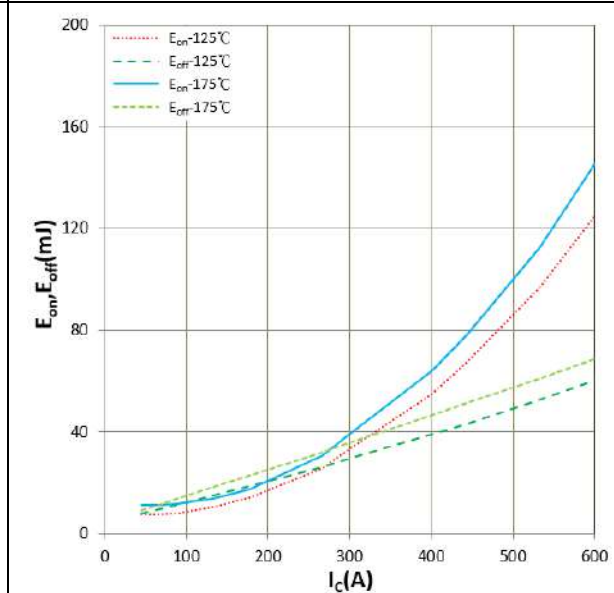


Figure 25. E_{on} , E_{off} vs I_c (Typ)
 $V_{CC}=600\text{V}$, $V_{GE}=+15\text{V}/-8\text{V}$, $R_G=1.0\Omega$
Inductive Load

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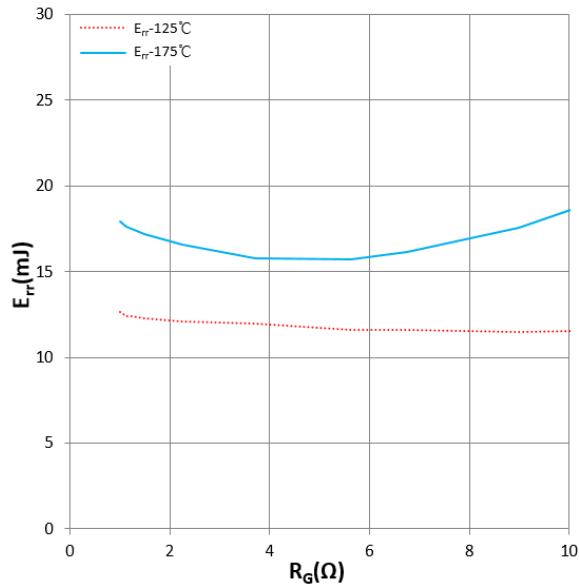


Figure 26. E_T vs R_G (Typ)
 $V_{CC}=600V$, $V_{GE}=+15V/-8V$, $I_F=300A$
 Inductive Load

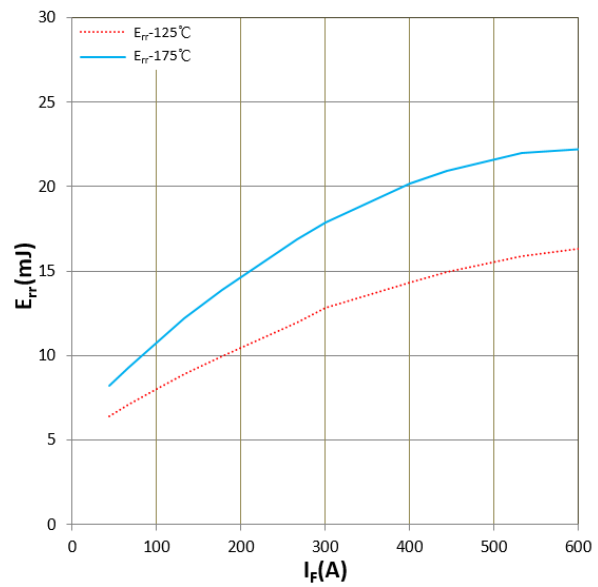


Figure 27. E_T vs I_F (Typ)
 $V_{CC}=600V$, $V_{GE}=+15V/-8V$, $R_G=1.0\Omega$
 Inductive Load

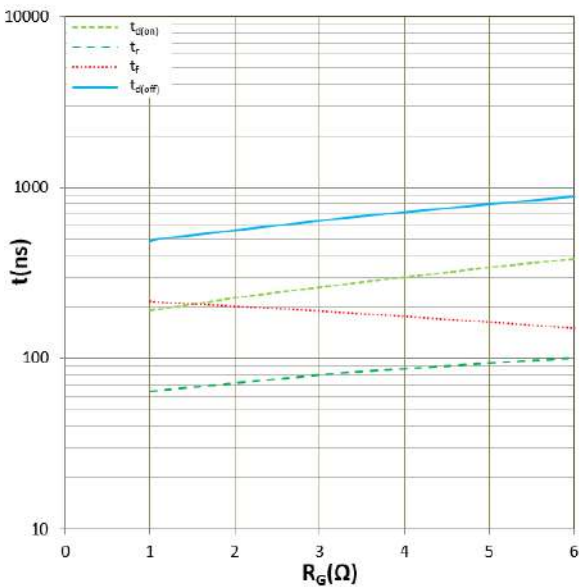


Figure 28. Switching time vs R_G (Typ)
 $V_{CC}=600V$, $V_{GE}=+15V/-8V$, $I_C=300A$
 $T_J=175^\circ C$, Inductive Load

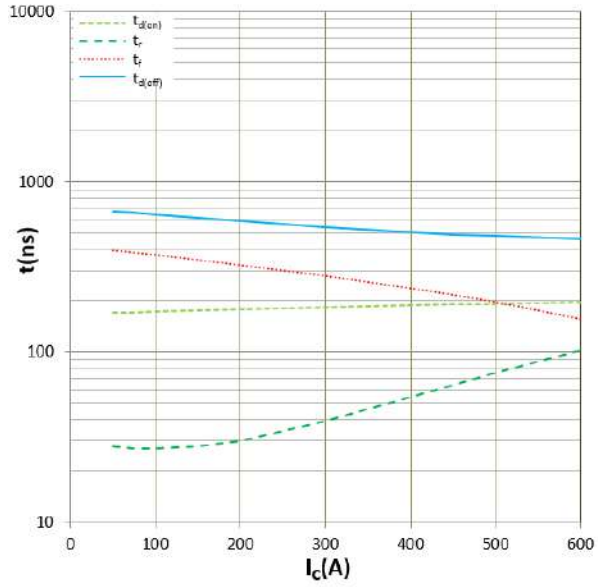


Figure 29. Switching time vs I_C (Typ)
 $V_{CC}=600V$, $V_{GE}=+15V/-8V$, $R_G=1.0\Omega$
 $T_J=175^\circ C$, Inductive Load

HCH300FA120H5C1

1200V 3-Level Hybrid Power Module

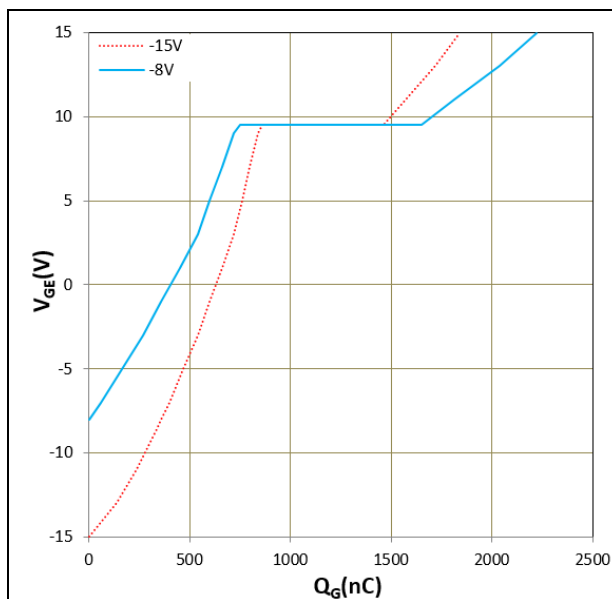


Figure 30. Gate charge

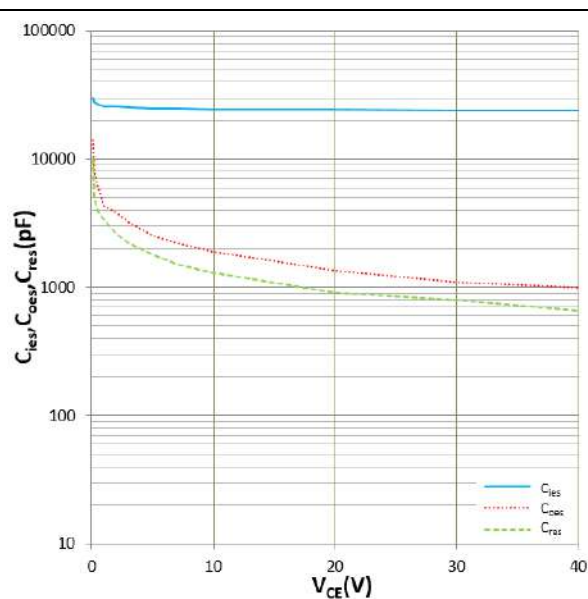
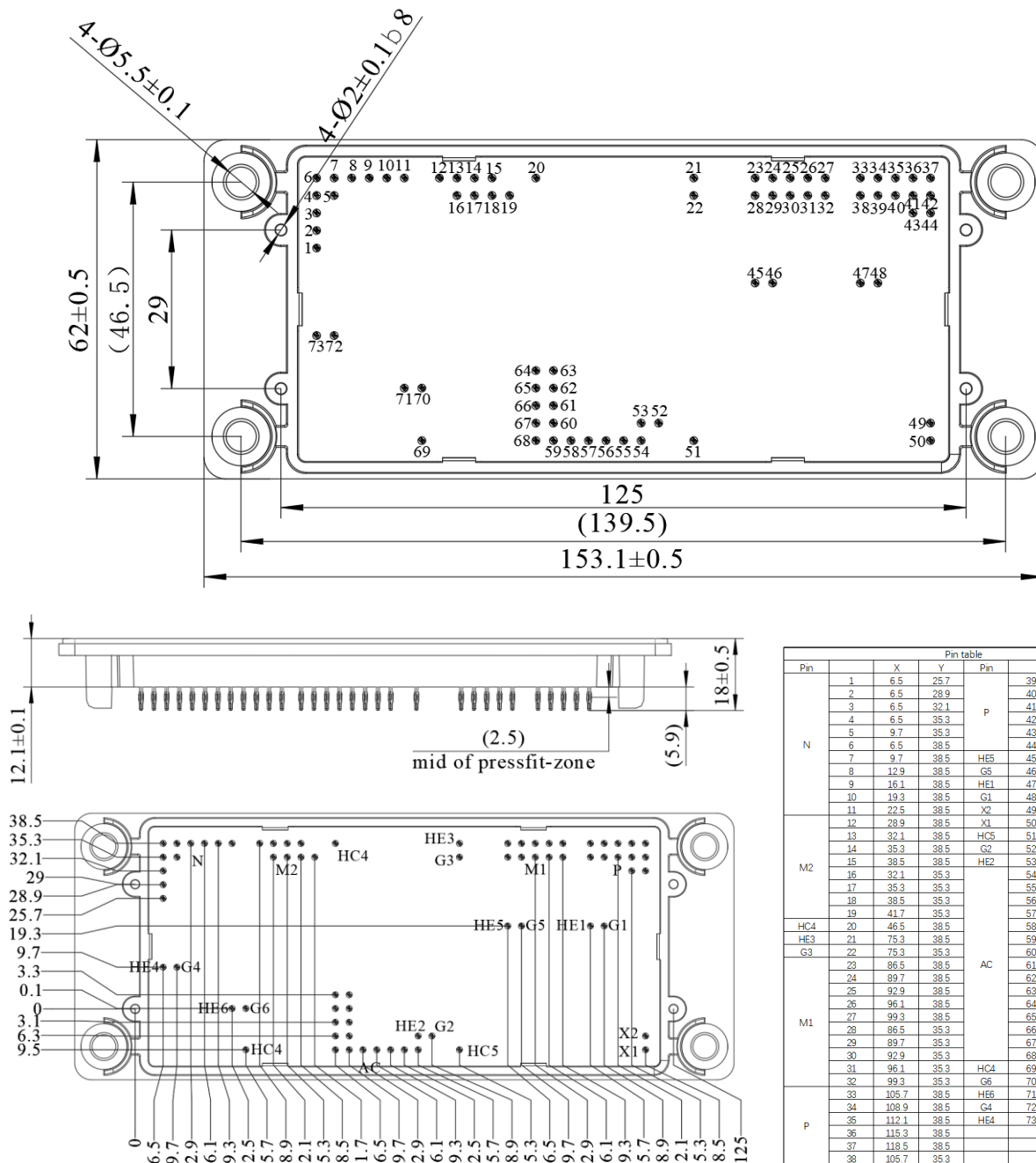


Figure 31. C_{ies} , C_{oes} , C_{res} vs V_{CE}
 $T_j = 25^{\circ}C$, $f = 100KHz$

HCH300FA120H5C1

1200V 3-Level Hybrid Power Module

Package dimensions



HCH300FA120H5C1

1200V 3-Level Hybrid Power Module

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

