HCH300AL120E4C1

1200V 3-Level Hybrid Power Module

Description

The HCH300AL120E4C1 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
- $R_{ds(on)}$:4.3mΩ @ 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

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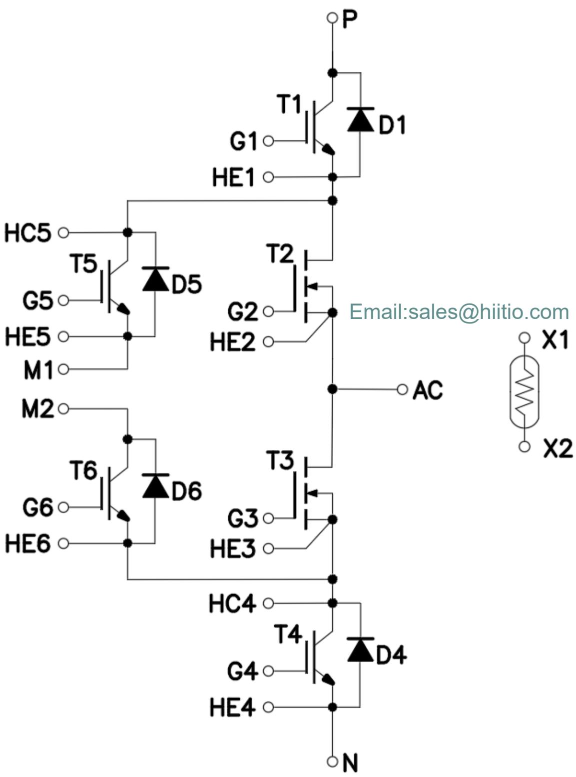

Email:sales@hiitio.com

Figure 1. Out drawing & circuit diagram for HCH300AL120E4C1

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Pin Configuration

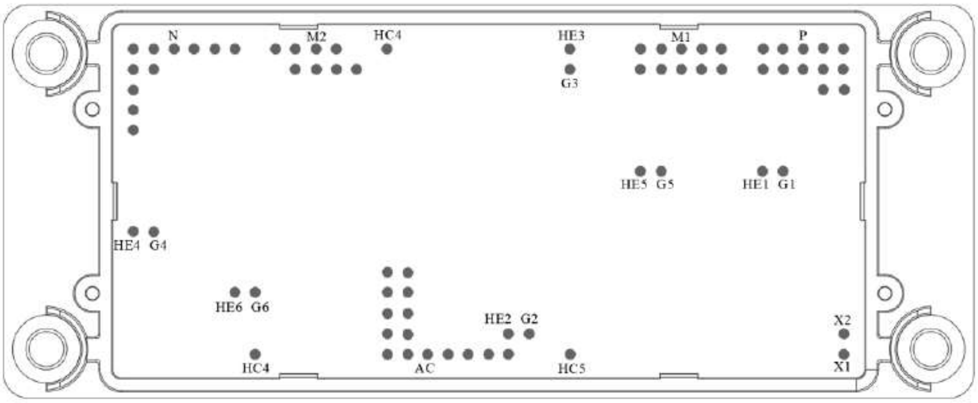

Figure 2. Pin configuration

Module

Parameter	Conditions	Value	Unit
Isolation voltage	Main terminal to base plate, RMS, f =50Hz, t =1min	3.4	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	$R2 = R25 \exp [B_{25/50}(1/T2 - 1/(298,15\ K))]$	-	3375	-	K
$B_{25/80}$	B-value	$R2 = R25 \exp [B_{25/80}(1/T2 - 1/(298,15\ K))]$	-	3411	-	K
$B_{25/100}$	B-value	$R2 = R25 \exp [B_{25/100}(1/T2 - 1/(298,15\ K))]$	-	3433	-	K

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Maximum Ratings (T2/T3: SiC MOSFET, T_j=25°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°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	°C

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

Maximum Ratings (T1/T4/T5/T6: IGBT，T_j=25°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°C, T_j =150°C	310	A
I_{CM}	Pulse Collector Current	t_p =1ms, Note1	800	A
P_C	Maximum Power Dissipation	T_C =25°C, T_j =175°C	1136	W
T_j	junction temperature	-	-40 to 175	°C

Note1: Pulse width limited by maximum junction temperature

Maximum Ratings (D1/D4/D5/D6: Diode，T_j=25°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 =1ms, Note1	600	A
T_j	junction temperature	-	-40 to 175	°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 Min.	Value Typ.	Value Max	Unit
$V_{(BR)DSS}$	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	mΩ
			T_j=175°C	-	8.0	-	mΩ
$V_{DS(on)}$ (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=5.0Ω 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 Min.	Value Typ.	Value Max	Unit
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=5.0⊠ 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 Min.	Value Typ.	Value Max	Unit
$V_{CE(sat)}$ (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°C unless otherwise specified, chip)

Symbol	Item	Condition		Value Min.	Value Typ.	Value Max	Unit
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 2.8W/m·K and thickness is 50um.

Test Conditions

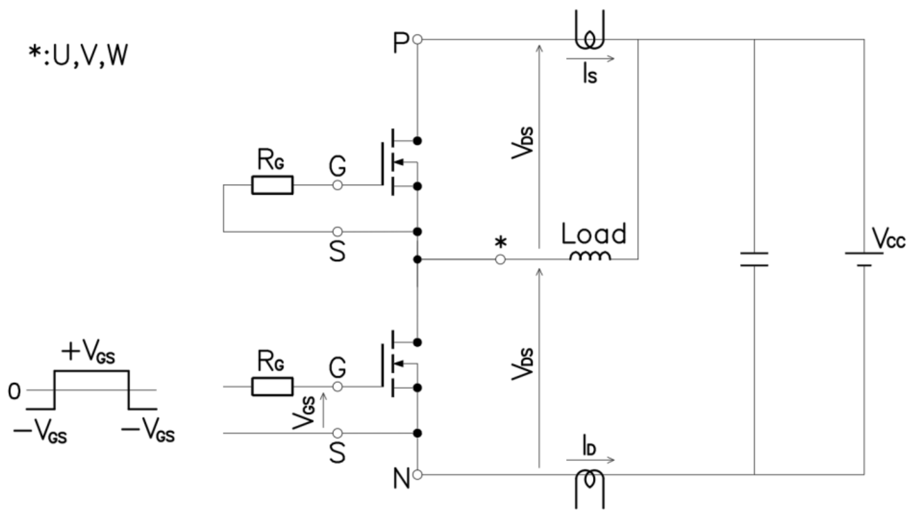

Figure 3. Switching time measure circuit

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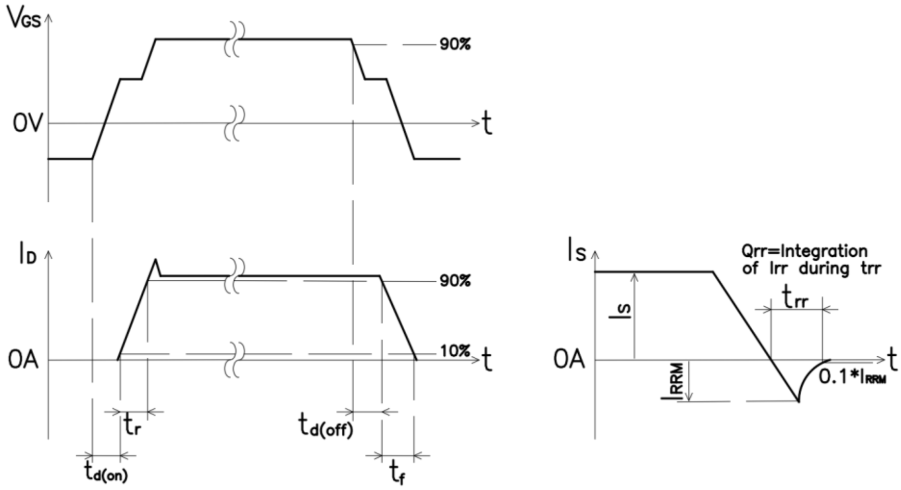

Figure 4. Switching time definition

SiC Mosfet: T2, T3	
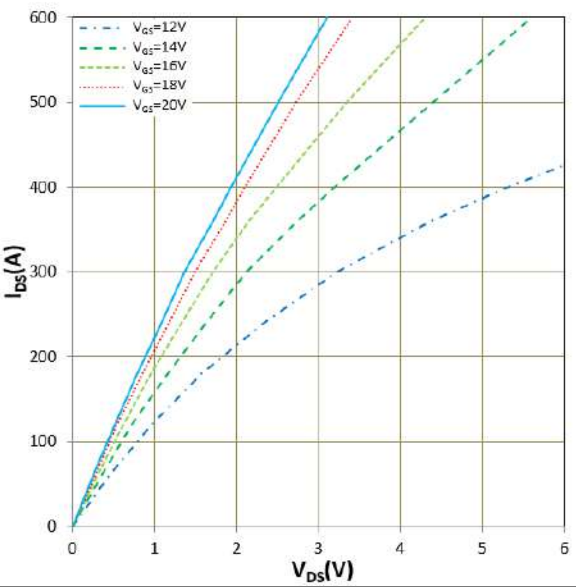	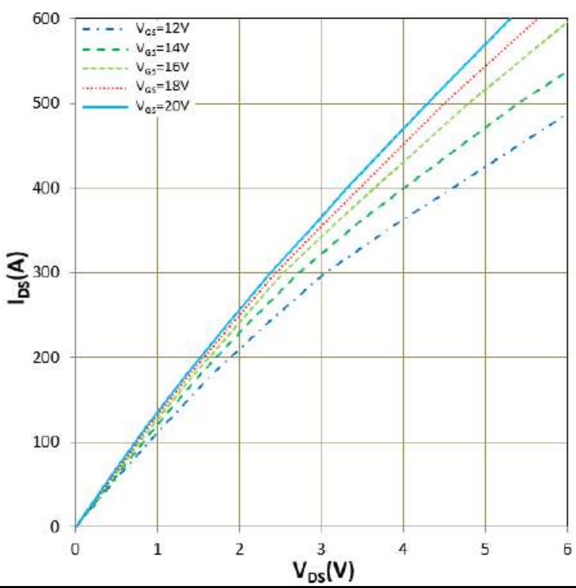
Figure 5. I_{DS} vs V_{DS} T_j=25°C	Figure 6. I_{DS} vs V_{DS} T_j=175°C

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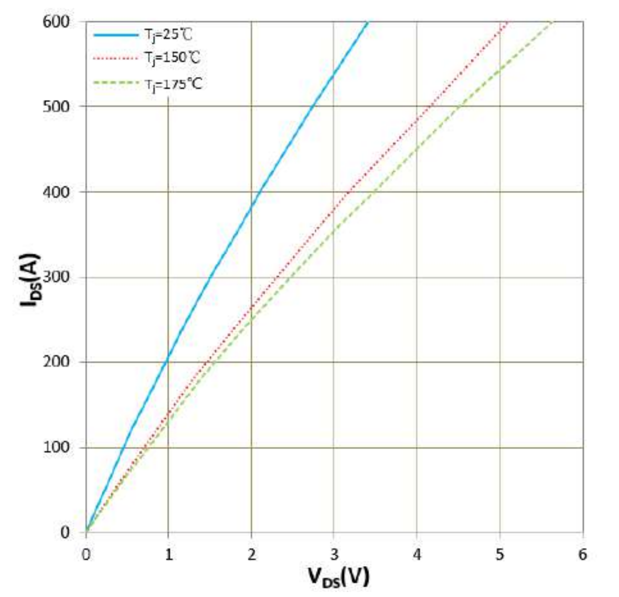

Figure 7. I_{DS} vs V_{DS}
V_{GS} =18V

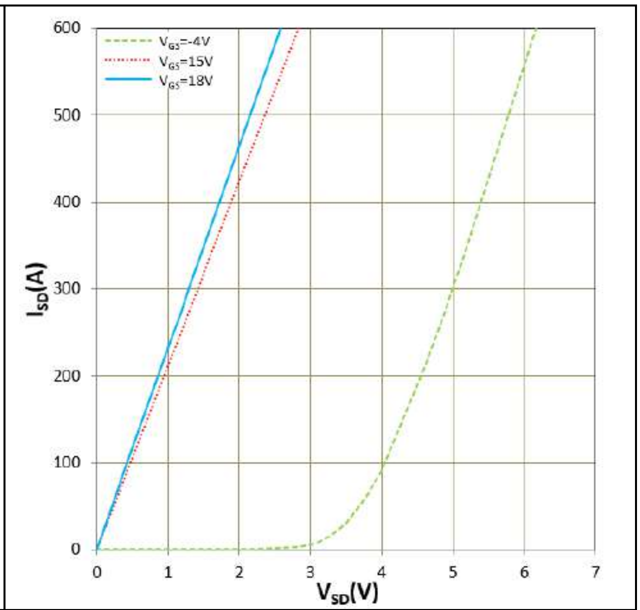

Figure 8. I_{SD} vs V_{SD} (V_F)
T_j =25°C

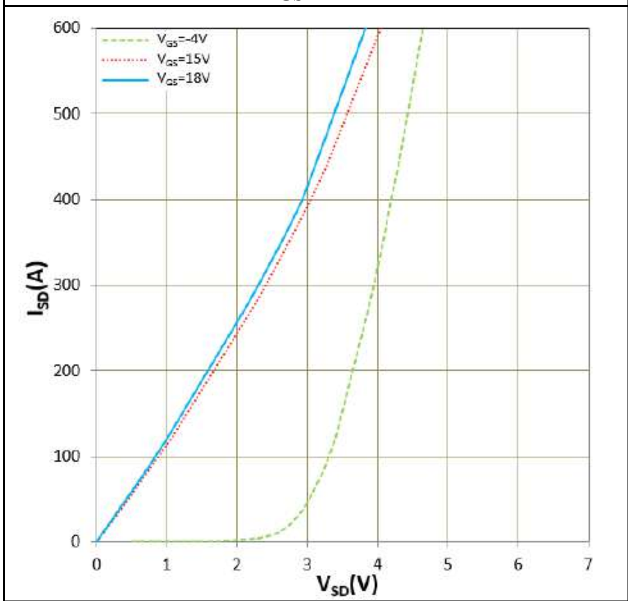

Figure 9. I_{SD} vs V_{SD} (V_F)
T_j =150°C

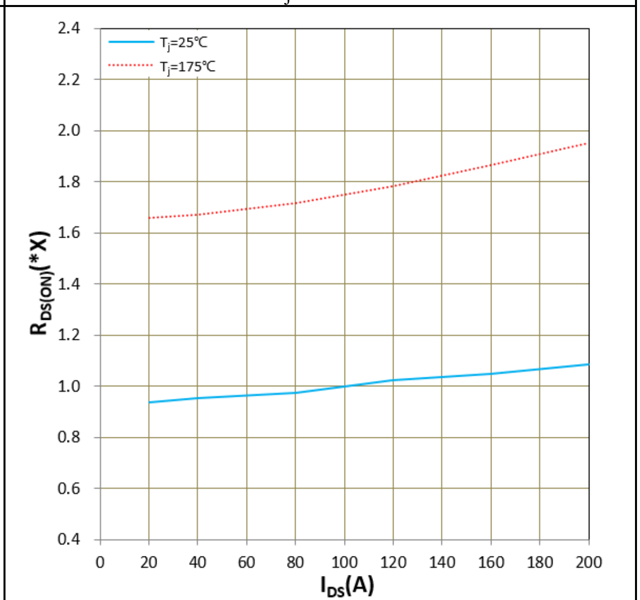

Figure 10. $R_{DS(ON)}$ vs I_{DS}
1.0x =4.3mΩ, V_{GS} =18V

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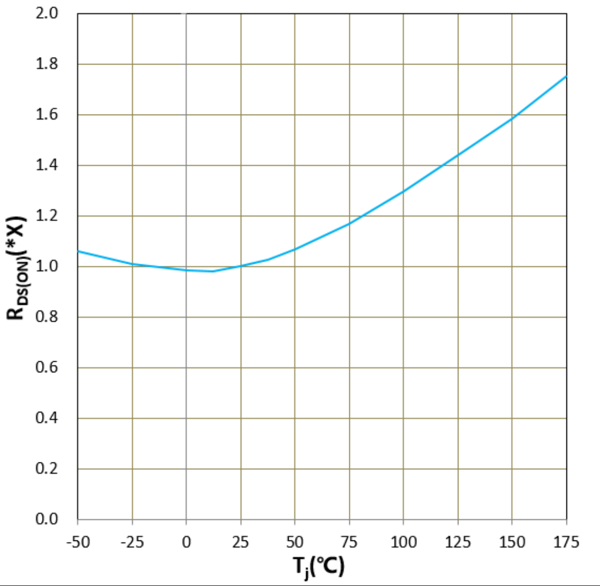

Figure 11. $R_{DS(ON)}$ vs T_j
1.0x =4.3m[illegible]$_{DS}$=300A

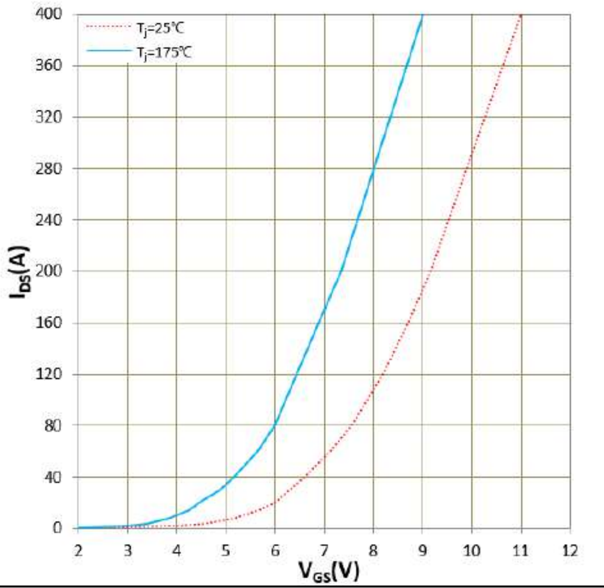

Figure 12. I_{DS} vs V_{GS}
V_{DS} =10V

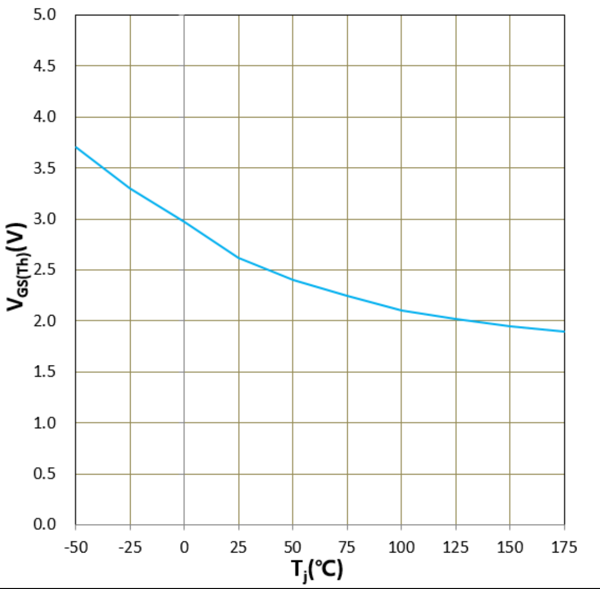

Figure 13. $V_{GS(Th)}$ vs T_j
V_{DS} =10V[illegible]s =80mA

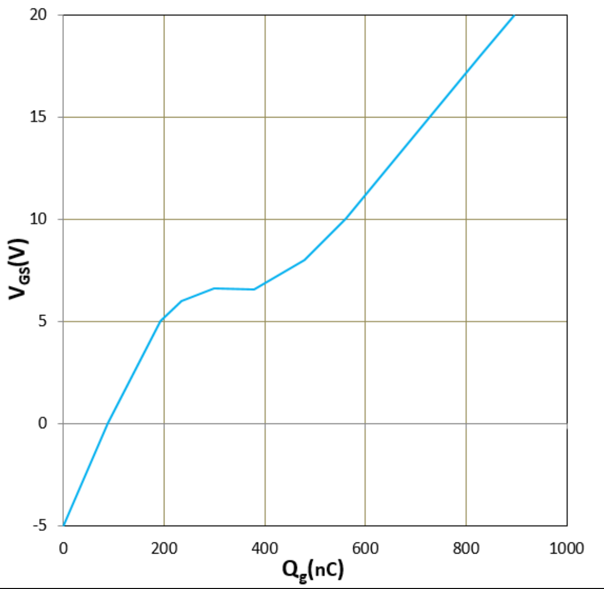

Figure 14. Gate charge
[illegible]s =200A, I_{GS} =0.4mA, V_{DS} =400V

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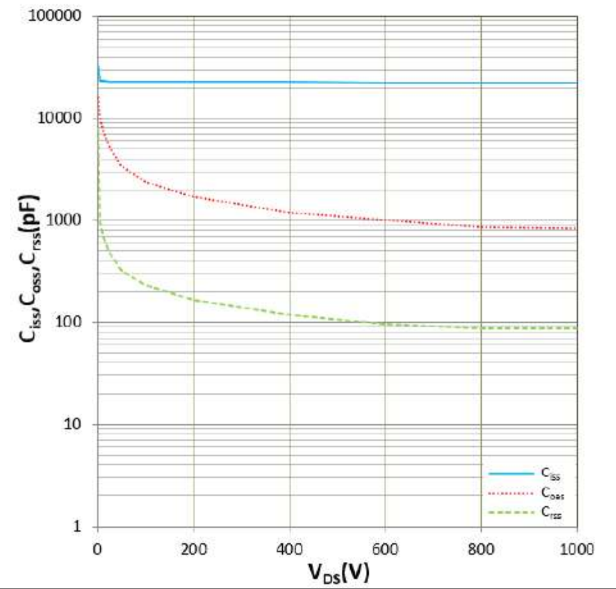

Figure 15. C_{iss}, C_{oss}, C_{rss} vs V_{CE}
V_{AC}=25mV, f=1MHz

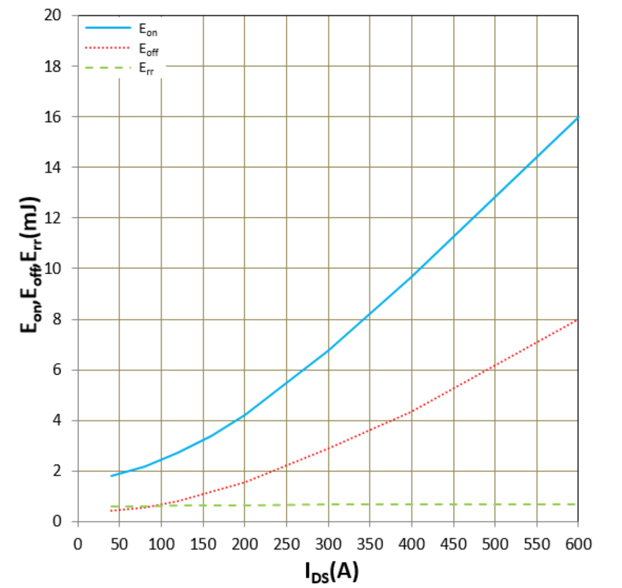

Figure 16. E_{on}, E_{off}, E_{rr} vs I_{DS}
T_j=25°C, V_{CC}=600V, V_{GE}=+15/-4V
R_{GON}/R_{GOFF}=5.0Ω, Inductive Load

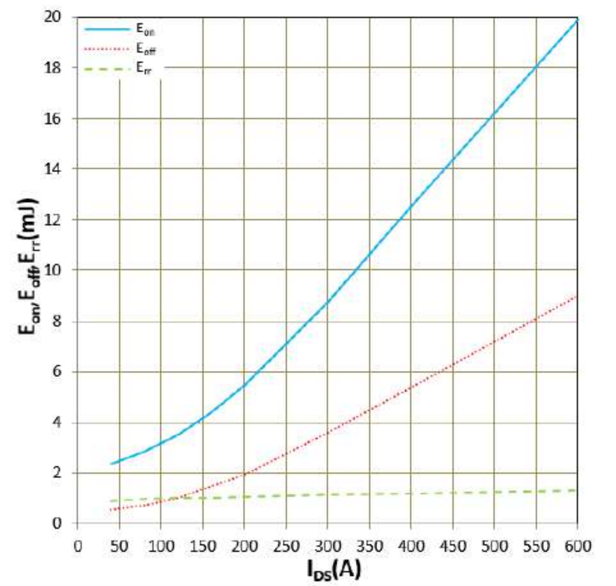

Figure 17. E_{on}, E_{off}, E_{rr} vs I_{DS}
T_j=150°C, V_{CC}=600V, V_{GE}=+15/-4V
R_{GON}/R_{GOFF}=5.0Ω, Inductive Load

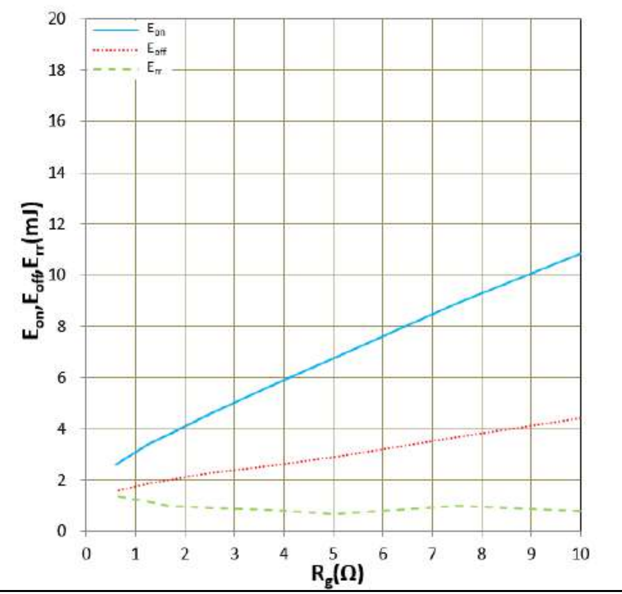

Figure 18. E_{on}, E_{off}, E_{rr} vs R_g
T_j=25°C, V_{CC}=600V, V_{GE}=+15/-4V,
I_D=300A, Inductive Load

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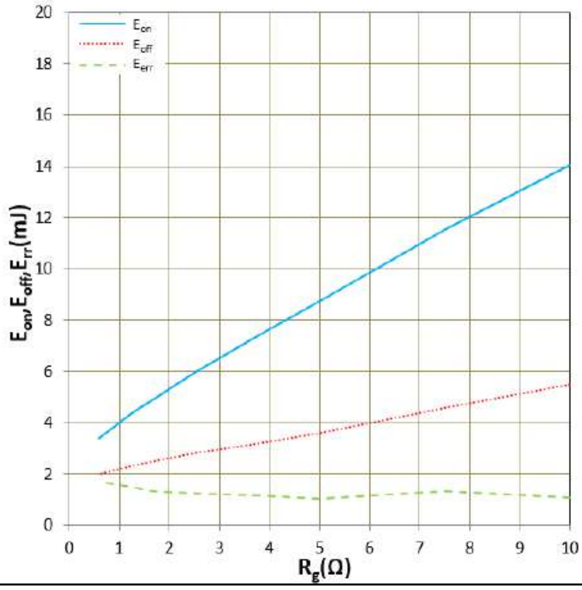

Figure 19. E_{on}, E_{off}, E_{rr} vs R_g
T_j=150°C, V_{CC}=600V, V_{GE}=+15/-4V,
I_D=300A, Inductive Load

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

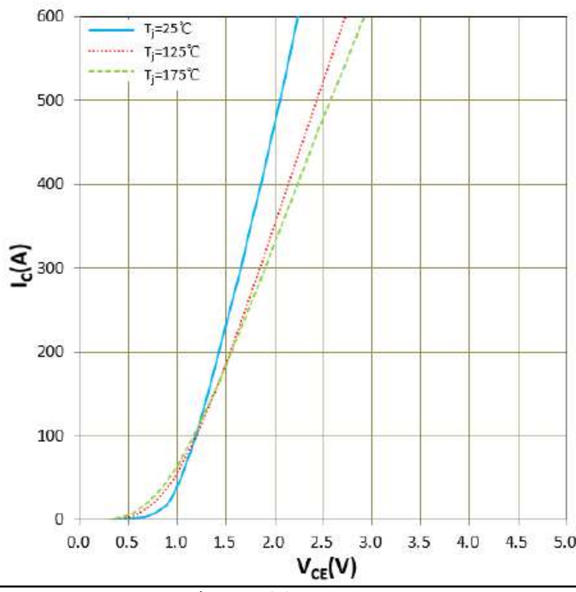

Figure 20. Ic vs V_{CE}
V_{GE}=15V

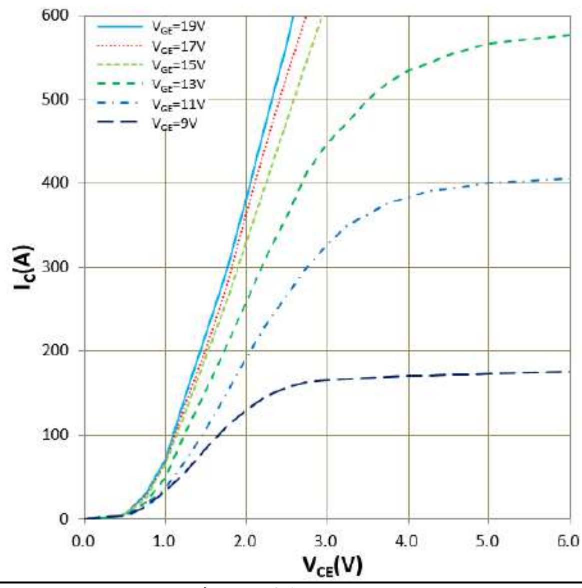

Figure 21. Ic vs V_{CE}
T_j=175°C

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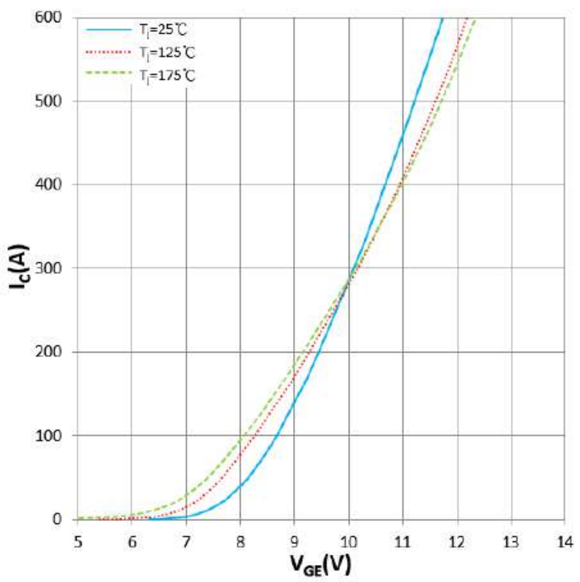

Figure 22. I_C vs V_{GE}
V_{CE} =20V

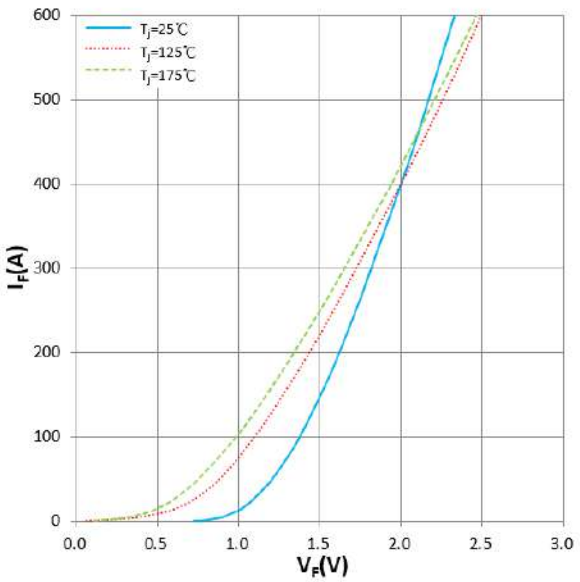

Figure 23. I_F vs V_F

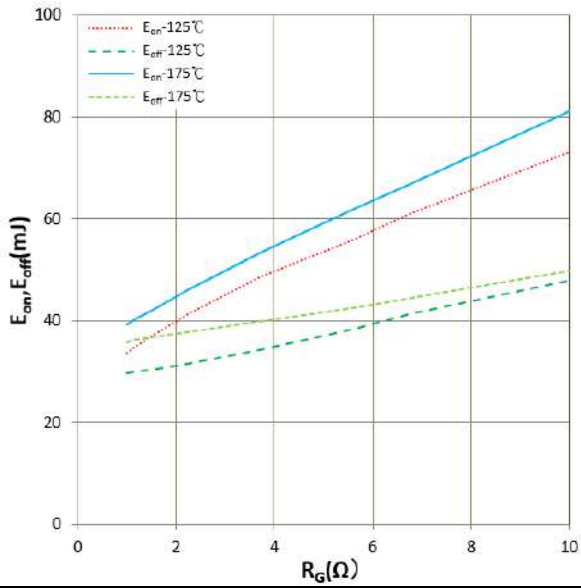

Figure 24. E_{on}, E_{off} vs R_G(Typ)
V_{CC} =600V, V_{GE} =+15V/-8V, I_C =300A
Inductive Load

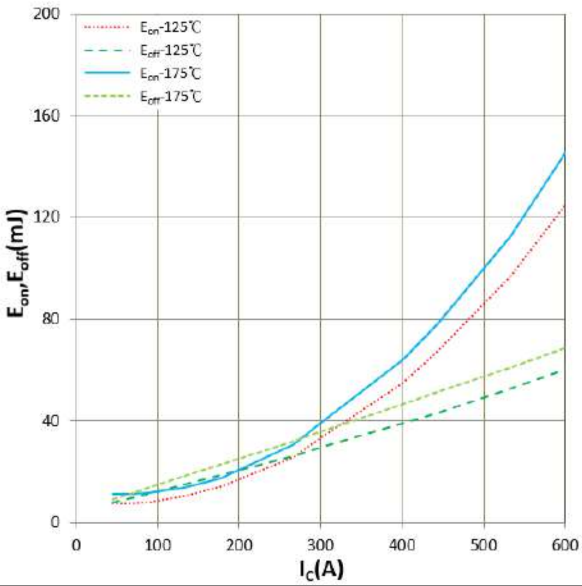

Figure 25. E_{on}, E_{off} vs I_C(Typ)
V_{CC} =600V, V_{GE} =+15V/-8V, R_G =1.0Ω
Inductive Load

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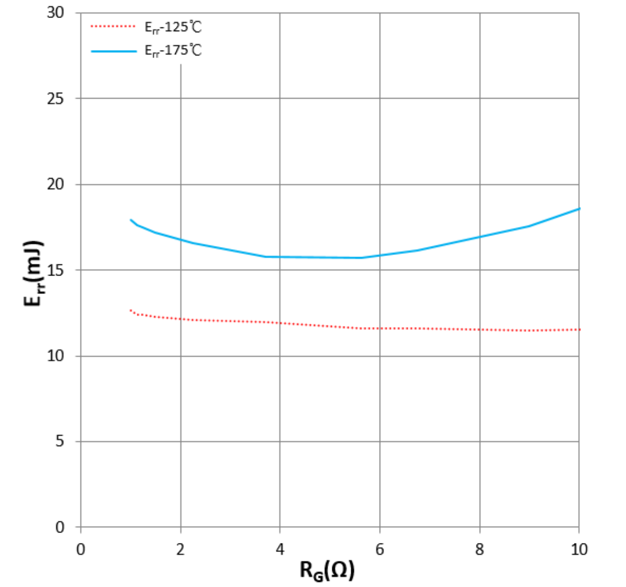


Figure 26. E_{rr} vs R_G(Typ)
V_{CC}=600V, V_{GE}=+15V/-8V, I_F=300A
Inductive Load

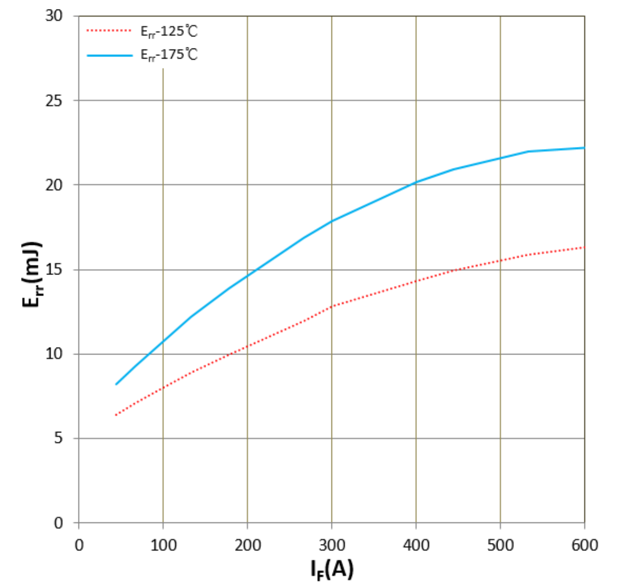


Figure 27. E_{rr} vs I_F(Typ)
V_{CC}=600V, V_{GE}=+15V/-8V, R_G=1.0Ω
Inductive Load

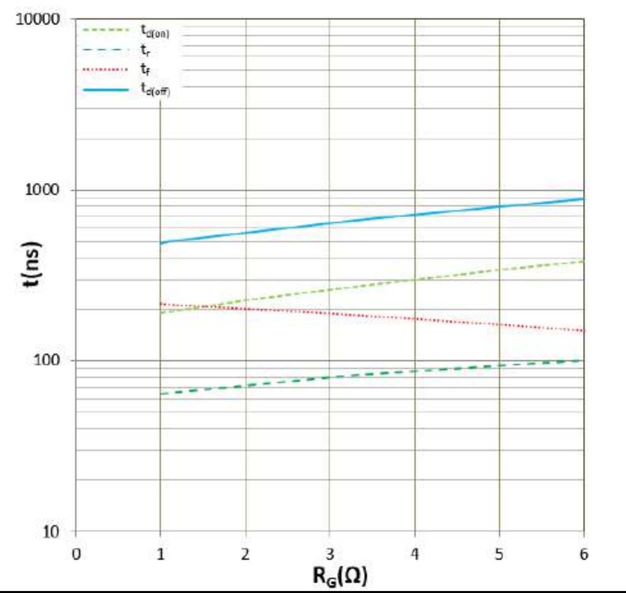


Figure 28. Switching time vs R_G(Typ)
V_{CC}=600V, V_{GE}=+15V/-8V, I_C=300A
T_j=175°C, Inductive Load

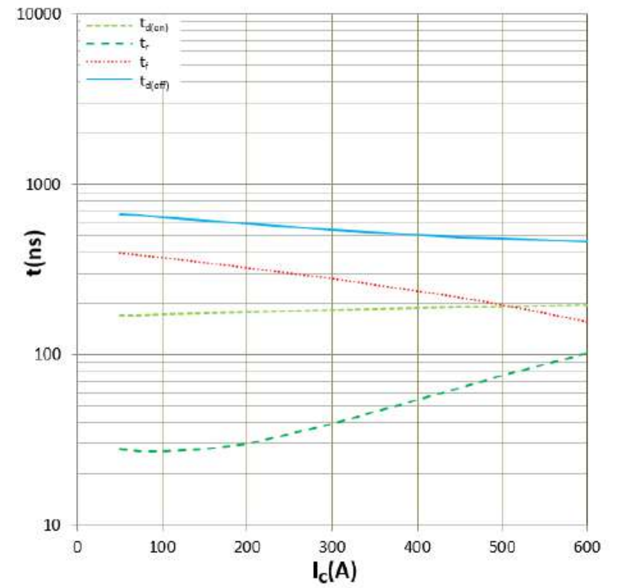
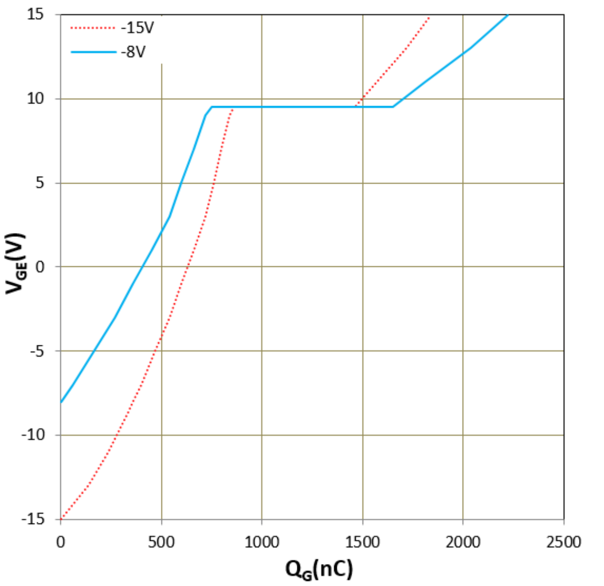
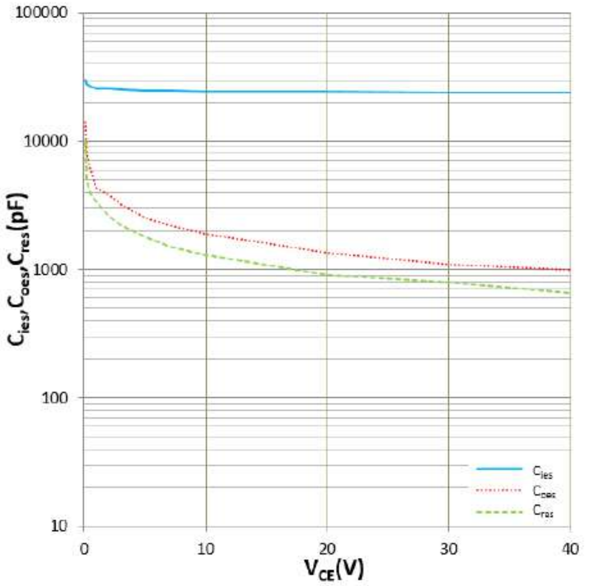


Figure 29. Switching time vs Ic(Typ)
V_{CC}=600V, V_{GE}=+15V/-8V, R_G=1.0Ω
T_j=175°C, Inductive Load

HCH300AL120E4C1

1200V 3-Level Hybrid Power Module

<table>
<tr><td></td><td></td></tr>
<tr><td>Figure 30. Gate charge</td><td>Figure 31. C_{ies}, C_{oes}, C_{res} vs V_{CE}
T_j=25°C, f =100KHz</td></tr>
</table>

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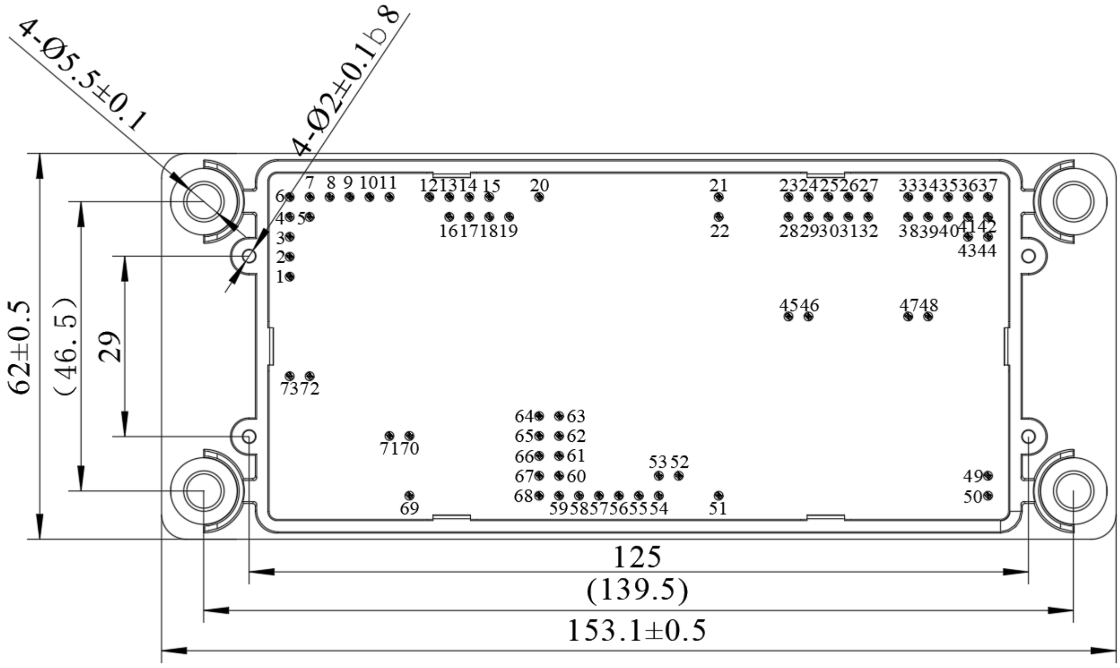
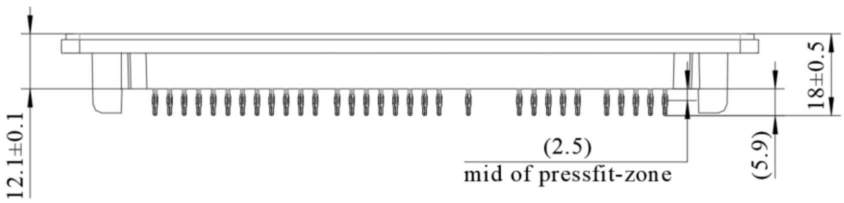
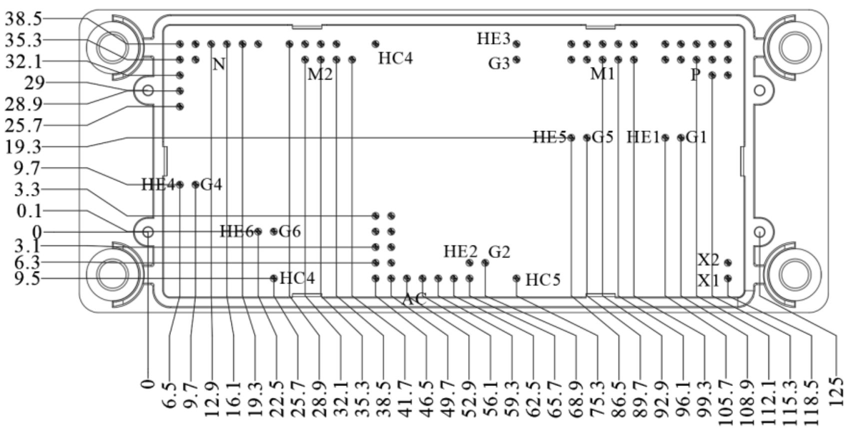
1200V 3-Level Hybrid Power Module

Package dimensions







Pin table							
Pin		X	Y	Pin		X	Y
N	1	6.5	25.7	P	39	108.9	35.3
	2	6.5	28.9		40	112.1	35.3
	3	6.5	32.1		41	115.3	35.3
	4	6.5	35.3		42	118.5	35.3
	5	9.7	35.3		43	115.3	32.1
	6	6.5	38.5		44	118.5	32.1
	7	9.7	38.5	HE5	45	86.5	19.3
	8	12.9	38.5	G5	46	89.7	19.3
	9	16.1	38.5	HE1	47	105.7	19.3
	10	19.3	38.5	G1	48	108.9	19.3
	11	22.5	38.5	X2	49	118.5	-6.3
M2	12	28.9	38.5	X1	50	118.5	-9.5
	13	32.1	38.5	HC5	51	75.3	-9.5
	14	35.3	38.5	G2	52	68.9	-6.3
	15	38.5	38.5	HE2	53	65.7	-6.3
	16	32.1	35.3	AC	54	65.7	-9.5
	17	35.3	35.3		55	62.5	-9.5
	18	38.5	35.3		56	59.3	-9.5
	19	41.7	35.3		57	56.1	-9.5
HC4	20	46.5	38.5		58	52.9	-9.5
HE3	21	75.3	38.5		59	49.7	-9.5
G3	22	75.3	35.3		60	49.7	-6.3
M1	23	86.5	38.5		61	49.7	-3.1
	24	89.7	38.5		62	49.7	0.1
	25	92.9	38.5		63	49.7	3.3
	26	96.1	38.5		64	46.5	3.3
	27	99.3	38.5		65	46.5	0.1
	28	86.5	35.3		66	46.5	-3.1
	29	89.7	35.3		67	46.5	-6.3
	30	92.9	35.3		68	46.5	-9.5
	31	96.1	35.3	HC4	69	25.7	-9.5
	32	99.3	35.3	G6	70	25.7	0.1
P	33	105.7	38.5	HE6	71	22.5	0.1
	34	108.9	38.5	G4	72	9.7	9.7
	35	112.1	38.5	HE4	73	6.5	9.7
	36	115.3	38.5				
	37	118.5	38.5				
	38	105.7	35.3				

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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.

Instruction note

Naming rules for power module product models（Industrial module）

Product Model

HC	G	100	FF	120	E3	A

Hecheng Code

Module type G : IGBT module
D : FRD module
S : SiC module
H : Si/SiC hybrid

Current level (A) 50~900

Topology structure FZ : A switch unit FF : Half bridge
FS : Three phase F4 : H Bridge
F3L : Three level DF : Boost Circuit
FD : Braking Circuit
FP : Rectification+Inverter+Control move
AL : ANPC CL : Chopper

Voltage level (x10)（V） 650~2200

Packaging form+features（A...Z） A1: 34 mm A2: 62 mm
D0: Flow0 D1: Flow1 D2: Flow2
E1: Easy 1B E2: Easy 2B
E3: Econo Dual E4 : E4 E5 : ED3S
E6 : EconoPIM2 E7 : EconoPIM3
E9 : ED3H
F0 : F0

Feature :A: Special Code Nil: Standard

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