HCS02FS120HDA1S

1200V/600A 3 Phase SiC MOSFET Module

Description

The HCS02FS120HDA1S is a 3 Phase SiC MOSFET Power Module. It integrates high performance SiC MOSFET chips for xEV or motor drives application.

Fetures

- Blocking Voltage 1200V
- $R_{DS(on)}$=2.5mΩ (V_{GS}=18V, T_j=25°C)
- 175°C Maximum Junction Temperature
- Si_3N_4 AMB Subtrate
- Direct Cooled Pin Fin Base Plate
- Thermistor Inside
- Press FIT Contact Technology

Application

- xEV Applications
- Motor Drives

Circuit Diagram

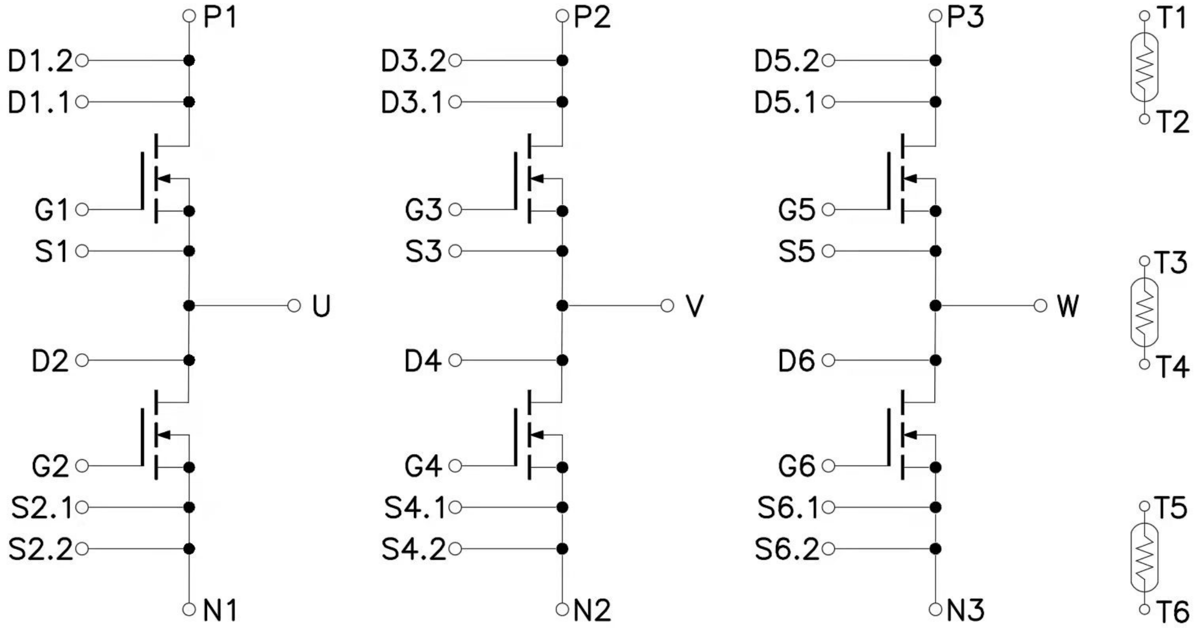

Figure 1. Out Drawing & Circuit Diagram HCS02FS120HDA1S

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Physical Dimensions

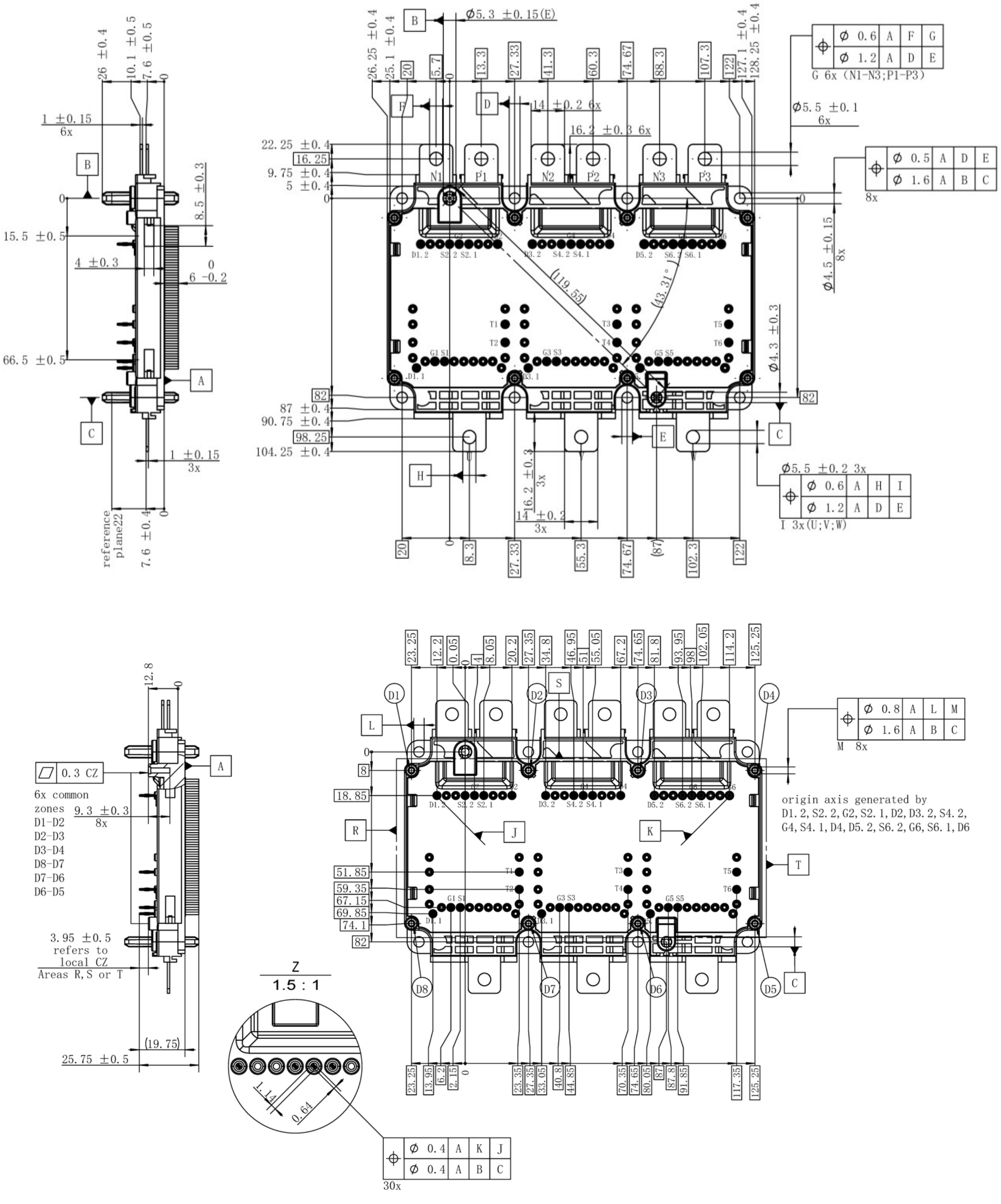

Figure 2. Physical Dimensions

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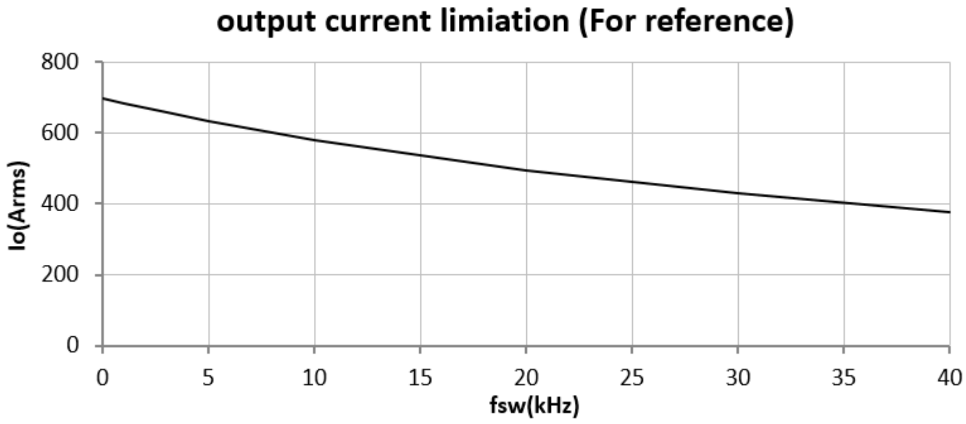
Maximum Ratings (T_j=25℃ Unless Otherwise Specified)

Symbol	Parameter	Conditions	Value	Unit
V_{DSS}	Drain-Source Voltage	G-S Short	1200	V
V_{GSS}	Gate-Source Voltage	D-S Short, AC frequency • 1Hz, Note1	-10V/+23V	V
I_{DS}	DC Continuous Drain Current	T_f=25°C, V_{GS}=18V	590	A
I_{DS}	DC Continuous Drain Current	T_f=65°C, V_{GS}=18V	505	A
I_{SD}	Source (Body Diode) Current	T_f=25°C,with ON signal	590	A
I_{SD}	Source (Body Diode) Current	T_f=65°C,with ON signal	505	A
I_{DP}	Drain Pulse Current, Peak	Less than 1ms, Note2	1200	A
P_D	Maximum Power Dissipation	Tf=25°C	1667	W
T_j	Junction temperature	-	-40 to 175	°C
T_{stg}	Storage temperature	-	-40 to 125	°C

Note1: Recommended Operating Value: +18V/-5V, +18V/-4V, +15V/-5V, +15V/-4V
Note2: Pulse width limited by maximum junction temperature

Typical Current Output Ability

Condition: SPWM control, V_{cc}=800V,V_{GS}=+18V/-4V, $R_{g(ON)}$=$R_{g(OFF)}$=6.2Ω, T_f=65°C, T_{jmax}=175°C,PF=0.8, Modulation rate=1



Note1: This graph is calculated value for reference based on the limitation of T_{jmax}=175°C. The actual current out ability depends on inverter electrical, thermal and mechanic design. Please confirm it in actual application system.

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Module

Parameter	Conditions	Value	Unit
Isolation voltage	Main terminal to base plate, f =0Hz, t =1sec	4.2	kV
Material of module baseplate	-	Cu + Ni	-
Creepage distance	terminal to heatsink terminal to terminal	9	mm
Clearance	terminal to heatsink terminal to terminal	4.5	mm
Stray inductance module	T_f =65°C	8	nH
Module lead resistance, terminals – chip	T_f=65°C	0.5	mΩ
Mounting torque for module mounting	Screw M4 baseplate to heatsink	1.8 to 2.2	Nm
Weight	-	780	g

NTC Characteristics

Symbol	Parameter	Conditions	Value			Unit
			Min.	Typ.	Max.	
R25	Resistance	Tc =25°C	-	5	-	kΩ
ΔR/R	Deviation of R_{100}	Tc =100°C, R_{100} =493Ω	-5	-	5	%
P_{25}	Power dissipation	Tc =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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MOSFET Electrical Charateristics (T_j=25°C Unless Otherwise Specified, Chip)

Symbol	Parameter	Conditions		Value			Unit
				Min.	Typ.	Max.	
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	V_{GS}=0V, I_D=6mA		1200	-	-	V
I_{DSS}	Zero gate voltage drain current	V_{DS}=1200V, V_{GS}=0V		-	6	300	μA
$V_{GS(Th)}$	Gate-source threshold voltage	I_D=162mA V_{DS}=V_{GS}	T_j=25°C	2.0	2.8	3.7	V
			T_j=150°C	-	2.1	-	V
			T_j=175°C	-	2	-	V
I_{GSS}	Gate-Source Leakage Current	V_{GS}=18V, V_{DS}=0V		-	6	-1200	nA
		V_{GS}=-4V, V_{DS}=0V		-1200	-6	0	nA
$R_{DS(on)}$ (Chip)	Static drain-source On-state resistance	I_D=600A V_{GS}=18V	T_j=25°C	-	2.5	-	mΩ
			T_j=150°C	-	4.1	-	mΩ
			T_j=175°C	-	4.7	-	mΩ
VDS(on) (Chip)	Static drain-source On-state resistance	I_D=600A V_{GS}=18V	T_j=25°C	-	1.50	-	V
			T_j=150°C	-	2.46	-	V
			T_j=175°C	-	2.82	-	V
C_{iss}	Input capacitance	V_{DS}=1000V V_{GS}=0V f=100kHz		-	25.8	-	nF
C_{oss}	Output capacitance			-	1.28	-	nF
Crss	Reverse transfer capacitance			-	0.11	-	nF
Q_g	Total gate charge	V_{DS}=800VI_D=480AV_{GS}=+18/-4V		-	1332	-	nC
Q_{gs}	Gate to source charge			-	330	-	nC
Q_{gd}	Gate to drain charg			-	528	-	nC
R_{gint}	Internal gate resistance	f=1MHz		-	0.9	-	Ω
$t_{d(on)}$	Turn-on delay tim	V_{DD}=600V I_D=600A V_{GS}=+18/-4V $R_{G(ON)}$=6.2Ω $R_{G(OFF)}$=6.2Ω Inductive load Switching operation	T_j=25°C	-	131	-	ns
			T_j=150°C	-	110	-	
t_r	Rise time		T_j=25°C	-	85	-	ns
			T_j=150°C	-	80	-	
$t_{d(off)}$	Turn-off delay time		T_j=25°C	-	40	-	ns
			T_j=150°C	-	42	-	
t_f	Fall time		T_j=25°C	-	58	-	ns
			T_j=150°C	-	64	-	
E_{on}	Turn-on power dissipation		T_j=25°C	-	22.71	-	mJ
			T_j=150°C	-	31.22	-	
E_{off}	Turn-off power dissipation		T_j=25°C	-	37.06	-	mJ
			T_j=150°C	-	38.31	-	
$R_{th(j-f)}$	FET Thermal Resistance	Junction to cooling fluid ΔV/Δt =10dm³/min, Tf=65°C		-	0.09	-	K/W

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Body Diode Electrical Characteristics (T_j=25°C Unless Otherwise Specified, Chip)

Symbol	Parameter	Conditions		Value			Unit
				Min.	Typ.	Max.	
V_{SD}	Body Diode Forward Voltage	V_{GS}=-4V I_{SD}=600A	T_j=25°C	-	4.8	-	V
			T_j=175°C	-	4.2	-	
T_{rr}	Reverse Recovery Time	V_{DD}=600V I_D=600A V_{GS}=+18/-4V $R_{G(ON)}$=$R_{G(OFF)}$=6.2Ω Inductive loads Switching operation	T_j=25°C	-	32	-	ns
			T_j=150°C	-	47	-	
Q_{rr}	Reverse Recovery Charge		T_j=25°C	-	2.51	-	μC
			T_j=150°C	-	7.26	-	
E_{rr}	Diode Switching Power Dissipation		T_j=25°C	-	0.57	-	mJ
			T_j=150°C	-	1.51	-	

Test Conditions

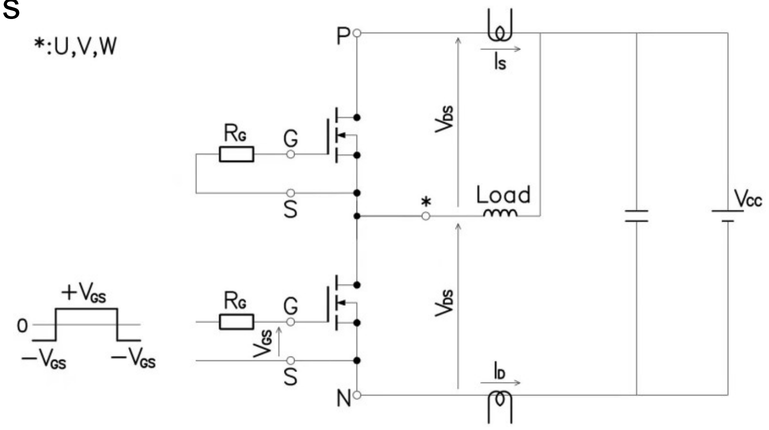

Figure 3. Switching Time Measure Circuit

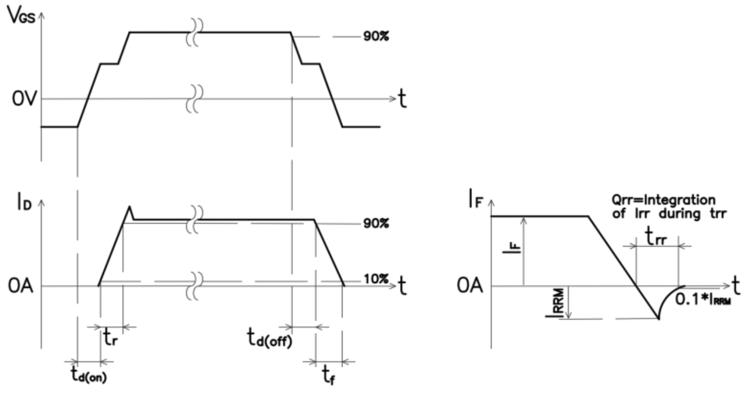

Figure 4. Switching Time Definition

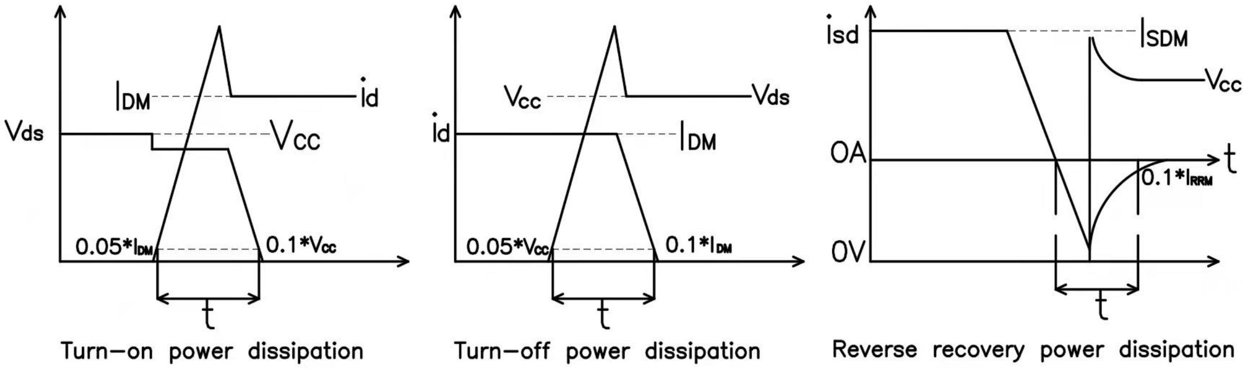

Figure 4. Switching Power Dissipation Definition

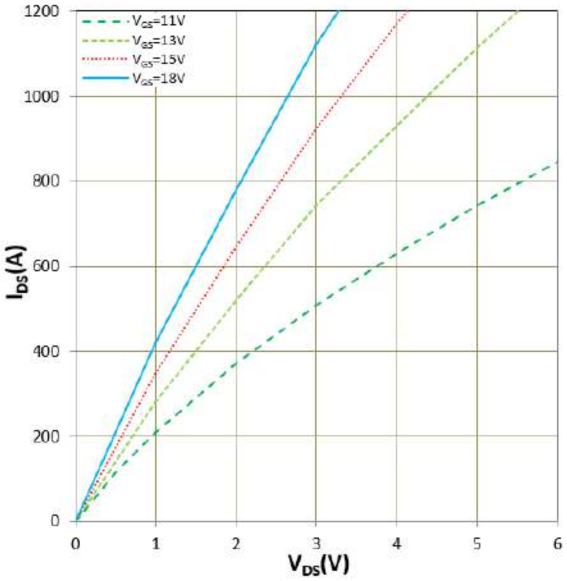

Figure 6. I_{DS}VS V_{DS}
T_j=25°C, V_{GS} Parameter

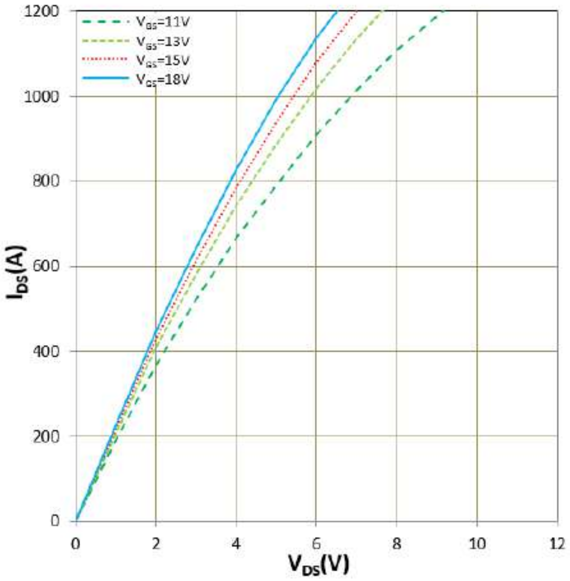

Figure 7. I_{DS}VS V_{DS}
T_j=175°C, V_{GS} Parameter

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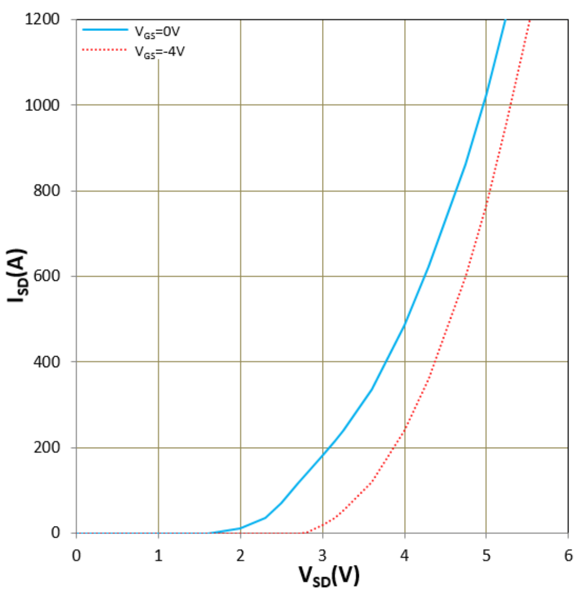

Figure 8. I_{SD} VS V_{SD}
T_j=25°C, V_{GS} Parameter

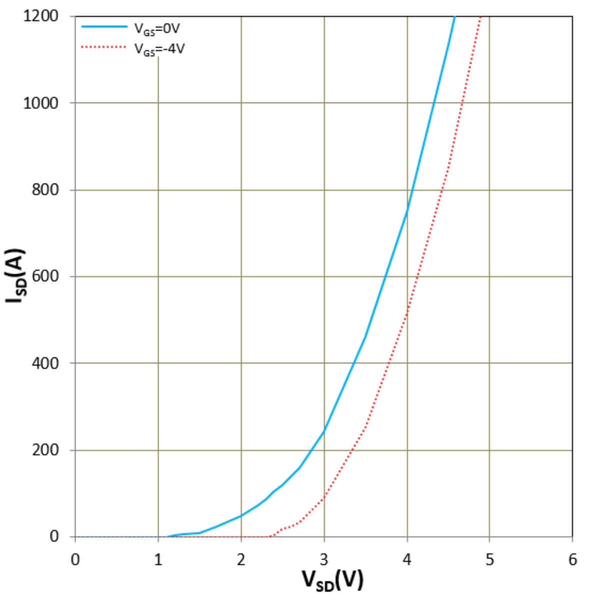

Figure 9. I_{SD} VS V_{SD}
T_j=175°C, V_{GS} Parameter

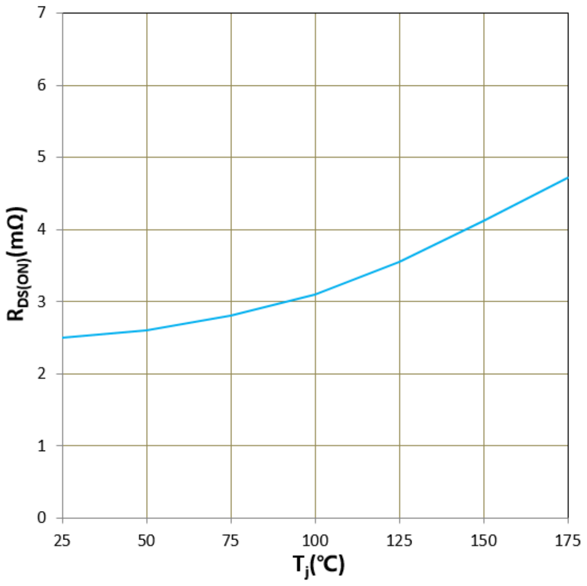

Figure 10. $R_{DS(ON)}$ VS T_j
V_{GS}=+18V, I_D=600A

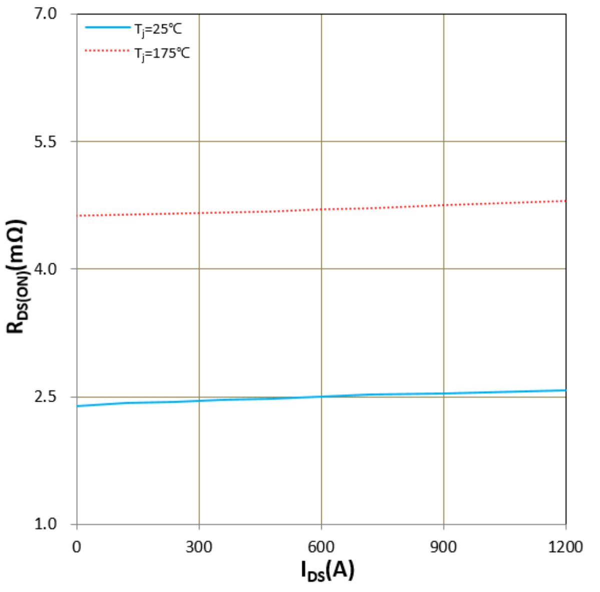

Figure 11. $R_{DS(ON)}$ VS I_{DS}
V_{GS}=+18V

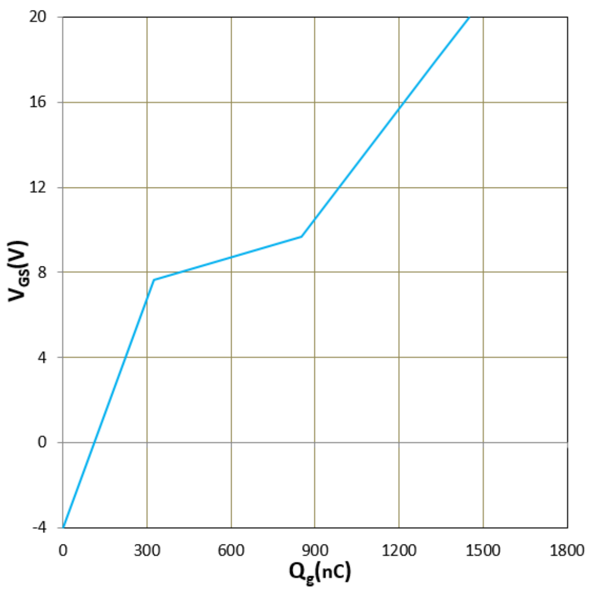

Figure 12. V_{GS} VS Q_g
T_j=25°C, I_D=480A, V_{DS}=800V

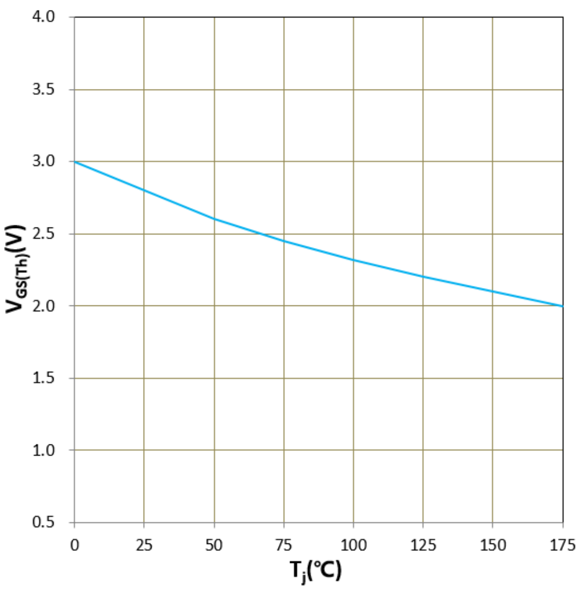

Figure 13. $V_{GS(Th)}$ VS T_j
V_{GS}=V_{DS}, I_D=162mA

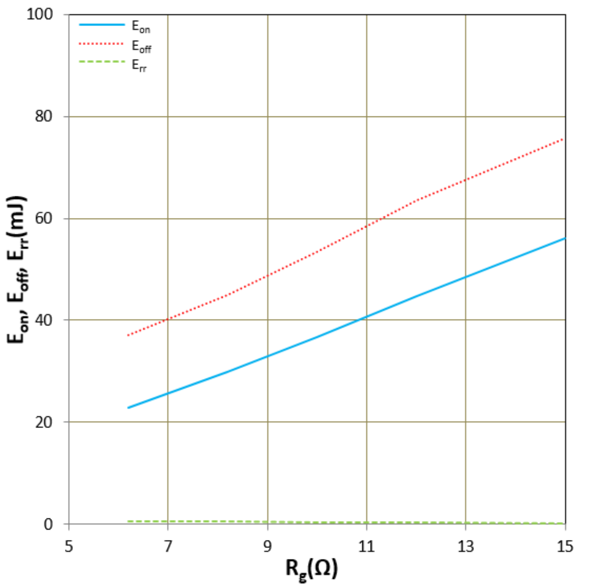

Figure 14. E_{on}, E_{off}, E_{rr} VS R_g
T_j=25°C, V_{DD}=600V, I_D=600A, V_{GS}=+18V/-4V
Inductive Load

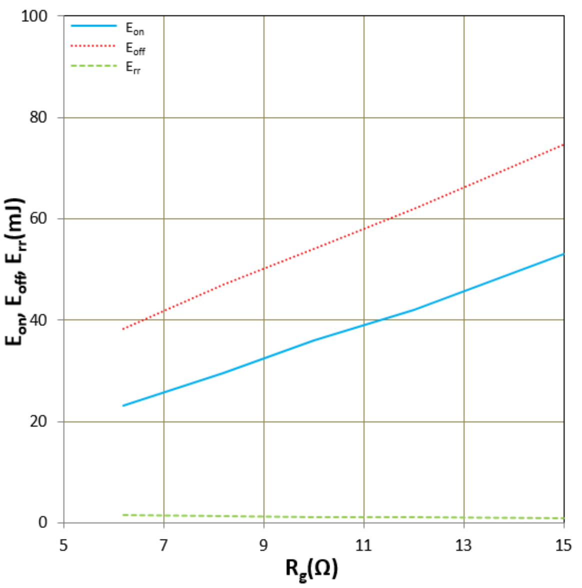

Figure 15. E_{on}, E_{off}, E_{rr} VS R_g
T_j=150°C, V_{DD}=600V, I_D=600A, V_{GS}=+18V/-4V
Inductive Load

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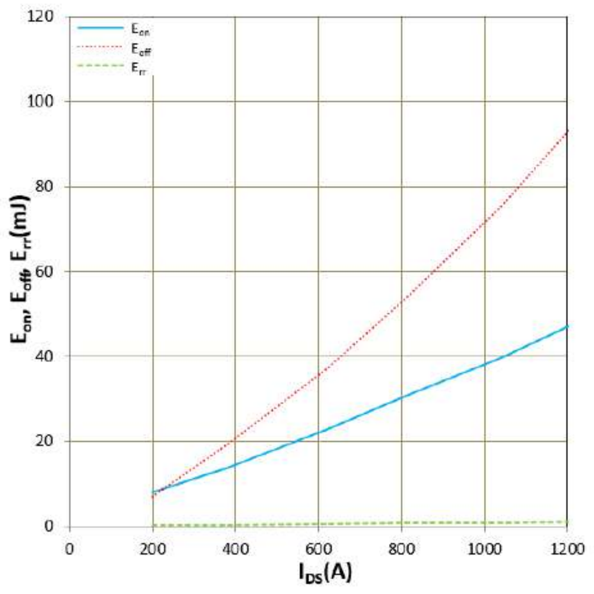


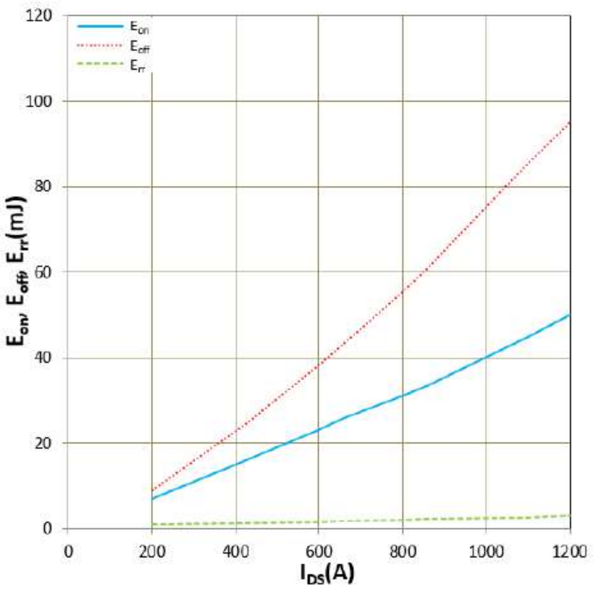
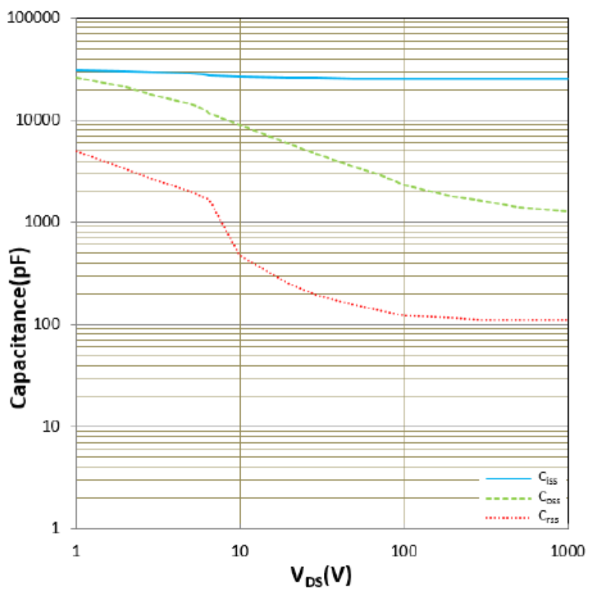
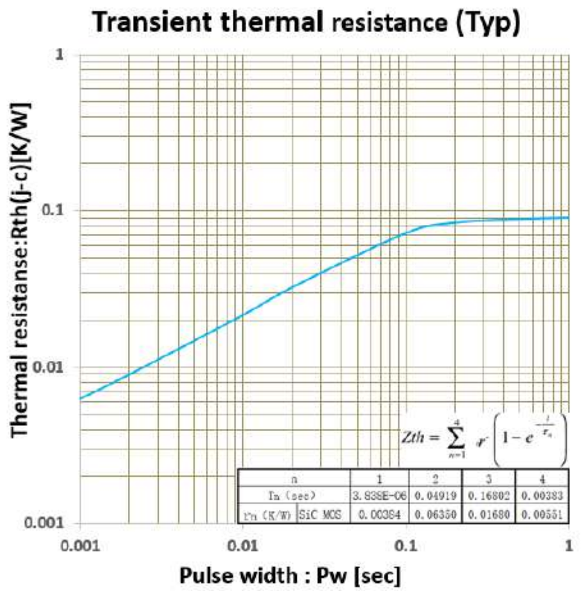


Figure 16. E_{on}, E_{off}, E_{rr} VS I_{DS}
T_j=25°C, V_{DD}=600V, R_G=6.2Ω, V_{GS}=+18V/-4V
Inductive Load

Figure 17. E_{on}, E_{off}, E_{rr} VS I_{DS}
T_j=150°C, V_{DD}=600V, R_G=6.2Ω, V_{GS}=+18V/-4V
Inductive Load





$$Zth = \sum_{n=1}^{4} r\left(1 - e^{-\frac{t}{\tau_n}}\right)$$

n		1	2	3	4
Tn (sec)		3.838E-06	0.04919	0.16802	0.00383
rn (K/W)	SiC MOS	0.00384	0.06350	0.01680	0.00551

Figure 18. C_{iss}, C_{oss}, C_{rss} VS V_{DS}
T_j=25°C, f=100kHz

Figure 19. Transient Themal Impedance

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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	02	FF	120	E3	A

Hecheng Code

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

On-state resistance (mΩ) 01~80

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	
B1: Easy 1B	B1A	B1B…
B2: Easy 2B…	B3: Easy 3B…	
D1: Flow0	D2: Flow1	D3: Flow2
E0 : E0	E1: Econo 2…	E2: E2
E3: ED3	E4 : E4	E5 : ED3S
E6 : EPM2	E7 : EPM3	E8 : EconoPIM3
E9 : ED3H	F0 : F0	P2 : EPM2

Feature :A: Special Code Nil: Standard

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