

HCG450FH120D3E1E

1200V / 450A D3 (size similar to Econo Dual with Cu Baseplate)

Features

- LOW $V_{CE(SAT)}$
- $V_{CE(SAT)}$ with positive temperature coefficient

Applications

- Inverter for motor drives AC and DC servo drives
- High power converters
- UPS systems



Table 1 Key Performance and Package Parameters

Type	V_{CE}	I_C	$V_{CE(SAT)}$ ($T_{vj} = 25^{\circ}C$, $I_C = 450A$, $V_{GE} = 15V$)	T_{vjmax}	Package
IGBT	1200V	450A	1.50V	175°C	D3

Table 2 Absolute Maximum Ratings ($T_a = 25^{\circ}C$)

Parameter	Symbol	Conditions	Value	Unit
Collector emitter voltage	V_{CE}	$T_{vj} = 25^{\circ}C$	1200	V
Continuous DC collector current	I_{CDC}	$T_C = 90^{\circ}C$	450	A
Repetitive peak collector current	I_{CRM}	$T_p=1ms$	900	A
Continuous DC forward current	I_F		450	A
Repetitive peak forward current	I_{FRM}	$T_p=1ms$	900	A
Gate Emitter Voltage	V_{GE}	$T_{vj} = 25^{\circ}C$	± 20	V
Junction temperature	T_{vj}		-40 to +175	°C
Storage temperature	T_{stg}		-40 to +125	°C
Operating virtual junction temperature	T_{vjop}		-40 to +150	°C

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Table 3 Thermal Resistance

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
IGBT Thermal resistance junction - case	R_{thJC}	Per IGBT	-	0.084	-	°C / W
Diode Thermal resistance junction - case	R_{thJC}	Per diode	-	0.125	-	°C / W

Table 4 Static Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Collector emitter voltage	$V_{(BR)CES}$	$T_{vj} = 25^{\circ}\text{C}$	1200	-	-	V
Collector emitter saturation voltage	V_{CESat} (terminal)	$V_{GE} = 15\text{V}, I_C = 450\text{A}, T_{vj} = 25^{\circ}\text{C}$	-	1.50	-	V
		$V_{GE} = 15\text{V}, I_C = 450\text{A}, T_{vj} = 175^{\circ}\text{C}$	-	1.82	-	
	V_{CESat} (Chip)	$V_{GE} = 15\text{V}, I_C = 450\text{A}, T_{vj} = 25^{\circ}\text{C}$	-	1.40	-	
		$V_{GE} = 15\text{V}, I_C = 450\text{A}, T_{vj} = 175^{\circ}\text{C}$	-	1.70	-	
Diode forward voltage	V_F (terminal)	$V_{GE} = 0\text{V}, I_C = 450\text{A}, T_{vj} = 25^{\circ}\text{C}$	-	1.65	-	V
		$V_{GE} = 0\text{V}, I_C = 450\text{A}, T_{vj} = 175^{\circ}\text{C}$	-	1.78	-	
	V_F (Chip)	$V_{GE} = 0\text{V}, I_C = 450\text{A}, T_{vj} = 25^{\circ}\text{C}$	-	1.60	-	
		$V_{GE} = 0\text{V}, I_C = 450\text{A}, T_{vj} = 175^{\circ}\text{C}$	-	1.70	-	
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 9\text{mA}$	5.00	5.60	6.20	V
Zero gate voltage collector current	I_{CES}	$V_{CE} = 1200\text{V}, V_{GE} = 0\text{V}, T_{vj} = 25^{\circ}\text{C}$	-	-	100	uA
Gate-emitter leakage current	I_{GES}	$V_{GE} = \pm 20, V_{CE} = 0\text{V},$	-100	-	100	nA
Input capacitance	C_{ies}	$V_{GE} = 0\text{V}, V_{CE} = 25\text{V}, f = 100\text{kHz}$	-	65.0	-	nF
Output capacitance	C_{oes}		-	1.81	-	
Reverse transfer capacitance	C_{res}		-	0.39	-	
Gate input resistance	R_G	$f = 1\text{M Hz}$	-	0.80	-	Ω
Gate charge	Q_G	$V_{GE} = -15\text{V to } 15\text{V}, V_{CE} = 600\text{V}$	-	3.17	-	μC

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Table 5 Switching Characteristic, Inductive Load

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Turn-on delay time	t_{don}	$T_{vj} = 25^{\circ}\text{C}$, $V_{CC} = 600\text{V}$, $I_C = 450\text{A}$, $V_{GE} = -15/15\text{V}$, $R_{G(on)}=0.6\Omega, R_{G(off)}= 0.6\Omega$	-	290	-	ns
Rise time	t_r		-	75	-	
Turn-off delay time	t_{doff}		-	400	-	
Fall time	t_f		-	120	-	
Turn-on energy	E_{on}	$T_{vj} = 175^{\circ}\text{C}$, $V_{CC} = 600\text{V}$, $I_C = 450\text{A}$, $V_{GE} = -15/15\text{V}$, $R_{G(on)}= 0.6\Omega, R_{G(off)}= 0.6\Omega$	-	22.6	-	mJ
Turn-off energy	E_{off}		-	38.7	-	
Total switching energy	E_{ts}		-	61.3	-	
Turn-on delay time	t_{don}		-	305	-	ns
Rise time	t_r		-	85	-	
Turn-off delay time	t_{doff}		-	490	-	
Fall time	t_f		-	240	-	
Turn-on energy	E_{on}	$T_{vj} = 175^{\circ}\text{C}$, $V_{CC} = 800\text{V}$, $V_{GE} = 15\text{V}$, $V_{CEmax} = V_{CES} - L_{sCE} * di/dt$ $T_P \leq 6 \text{ us}$	-	44.0	-	mJ
Turn-off energy	E_{off}		-	55.6	-	
Total switching energy	E_{ts}		-	99.6	-	
Short circuit current	I_{SC}		-	1400	-	A

Table 6 Diode Recovery Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Reverse recovery time	T_{rr}	$T_{vj} = 25^{\circ}\text{C}$, $V_{CC} = 600\text{V}$, $I_C = 450\text{A}$, $V_{GE} = -15/15\text{V}$, $R_{G(on)} = 0.6\Omega$, $R_{G(off)} = 0.6\Omega$	-	180	-	ns
Peak reverse recovery current	I_{rrm}		-	34.1	-	A
Reverse recovery charge	Q_{rr}		-	370	-	μC
Reverse recovery energy	E_{rec}		-	12.8	-	mJ
Reverse recovery time	T_{rr}	$T_{vj} = 175^{\circ}\text{C}$, $V_{CC} = 600\text{V}$, $I_C = 450\text{A}$, $V_{GE} = -15/15\text{V}$, $R_{G(on)} = 0.6\Omega$, $R_{G(off)} = 0.6\Omega$	-	370	-	ns
Peak reverse recovery current	I_{rrm}		-	395	-	A
Reverse recovery charge	Q_{rr}		-	62	-	μC
Reverse recovery energy	E_{rec}		-	23.5	-	mJ

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Table 7 Module characteristics

Parameter	Symbol	Conditions	Value	Typ
Isolation test voltage	V_{ISOL}	RMS, $f = 50\text{ Hz}$, $t = 1\text{ min}$	3.4	kV
Material of module baseplate			Cu+Ni	
Internal isolation		Basic insulation	Al_2O_3	
Mounting torque of screws to heat sink	M	M5	3.0-6.0	N·m
Mounting torque of screws to terminals	M	M6	3.0-6.0	N·m
Creepage distance	d_{Creep}	terminal to heatsink	15.0	mm
Creepage distance	d_{Creep}	terminal to terminal	13.0	mm
Clearance	d_{Clear}	terminal to heatsink	12.5	mm
Clearance	d_{Clear}	terminal to terminal	10.0	mm
Comperative tracking index	CTI		>200	

Table 8 NTC-Thermistor

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Rated resistance	R25	TC = 25°C	-	5	-	kΩ
Deviation of R100	$\Delta R/R$	TC = 100°C, R100 = 493 Ω	-5	-	5	%
B-value	B25/50	$R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298,15K))]$	-	3375	-	K

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Characteristics Diagrams

Fig.1 Typical Output Characteristic, IGBT, Inverter
 $I_C = f(V_{CE})$ / (terminal)

$V_{GE} = 15V$

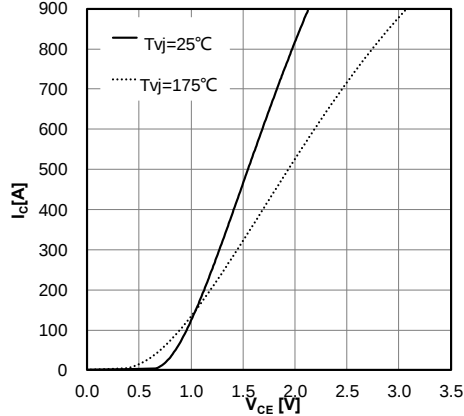


Fig.2 Typical Output Characteristic, IGBT, Inverter
 $I_C = f(V_{CE})$ / (terminal)

$T_{vj} = 175^{\circ}C$

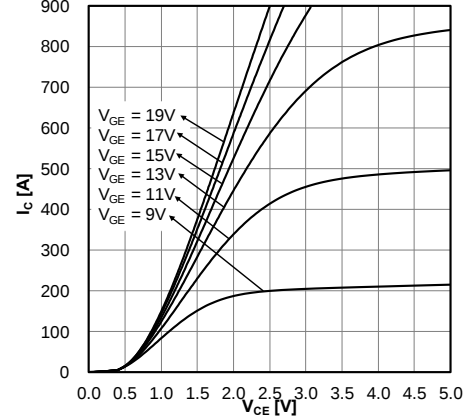


Fig.3 Typical Output Characteristic, IGBT, Inverter
 $I_C = f(V_{GE})$

$V_{CE} = 20V$

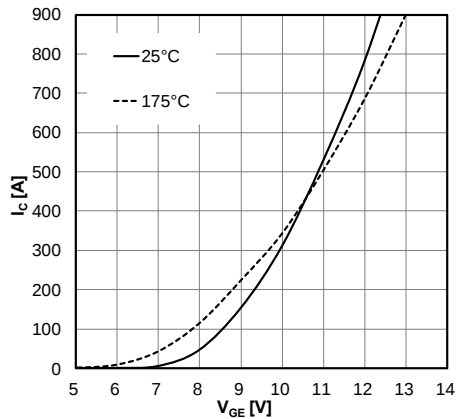


Fig.4 Switching losses, IGBT, Inverter
 $E = f(I_C)$

$R_{Goff} = 0.6\Omega$, $R_{Gon} = 0.6\Omega$, $V_{CE} = 600V$, $V_{GE} = \pm 15V$

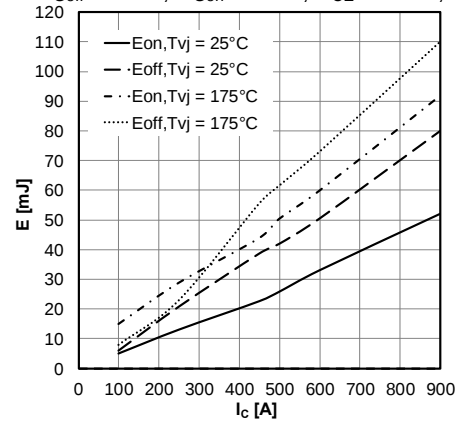


Fig.5 Switching losses, IGBT, Inverter
 $E = f(R_G)$

$I_C = 450A$, $V_{CE} = 600V$, $V_{GE} = \pm 15V$

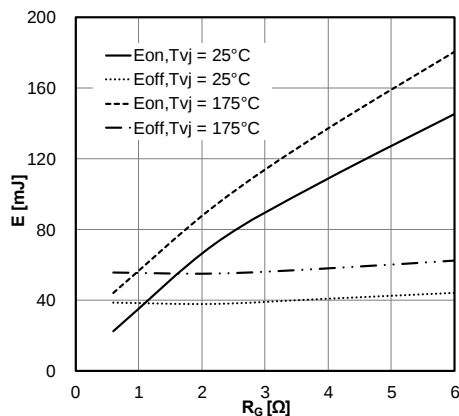
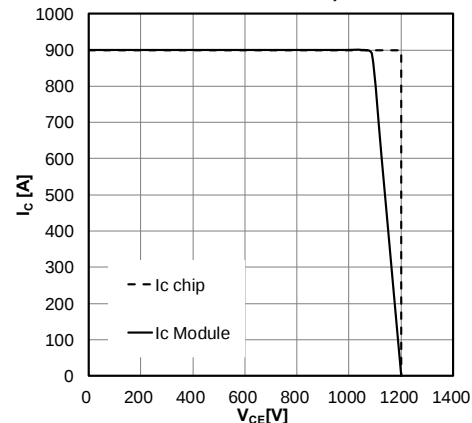


Fig.6 Reverse bias safe operating area (RBSOA), IGBT, Inverter

$I_C = f(V_{CE})$

$R_{Goff} = 0.6\Omega$, $V_{GE} = \pm 15V$, $T_{vj} = 175^{\circ}C$



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Characteristics Diagrams

Fig.7 Capacity characteristic, IGBT, Inverter

$$C = f(V_{CE})$$

$f = 100\text{KHz}$, $V_{GE} = 0\text{V}$, $T_{vj} = 25^\circ\text{C}$

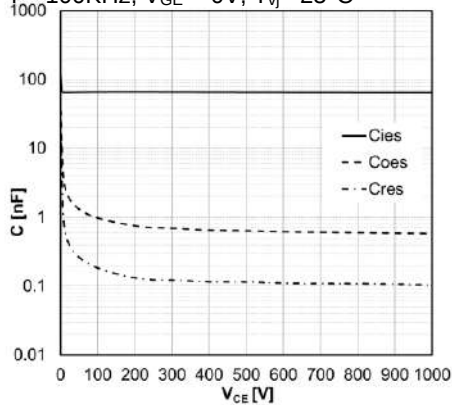


Fig.8 Transient thermal impedance IGBT, Inverter
 $Z_{thJC} = f(t)$

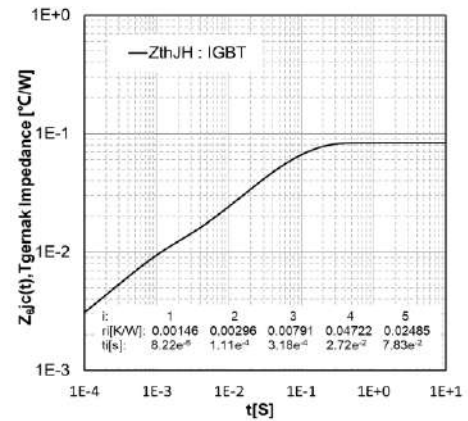


Fig.9 Forward characteristic, Diode, Inverter
 $I_F = f(V_F)$ / (terminal)

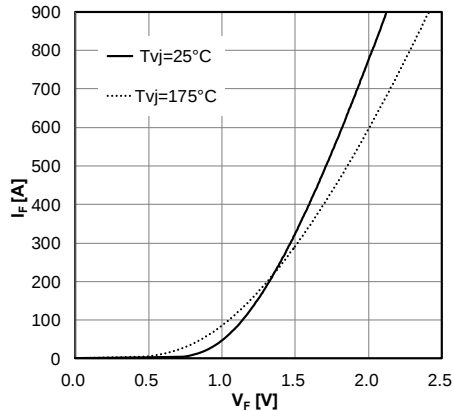


Fig.10 Switching losses, Diode, Inverter
 $E_{rec} = f(I_F)$

$V_{CE} = 600\text{V}$, $R_{Goff} = 0.6\Omega$, $R_{Gon} = 0.6\Omega$, $V_{GE} = \pm 15\text{V}$

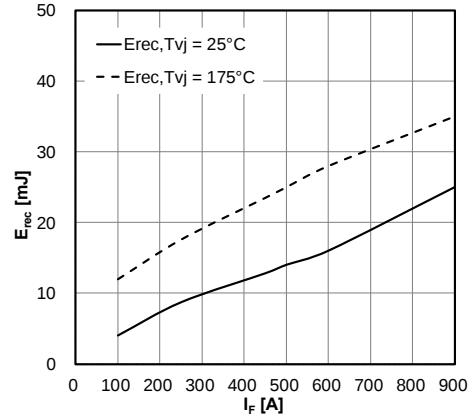


Fig.11 Switching losses, Diode, Inverter
 $E_{rec} = f(R_G)$

$V_{CE} = 600\text{V}$, $I_F = 450\text{A}$

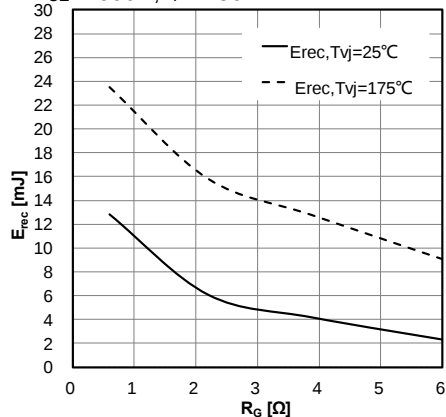
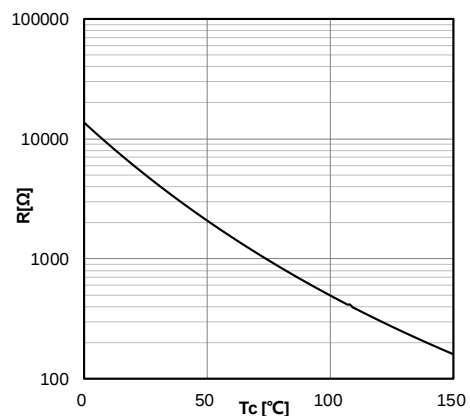


Fig.12 Temperature characteristic, NTC - Thermistor



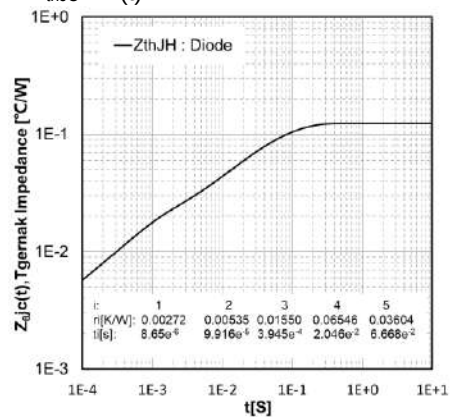
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Characteristics Diagrams

Fig.13 Transient thermal impedance Diode, Inverter

$Z_{thJC} = f(t)$

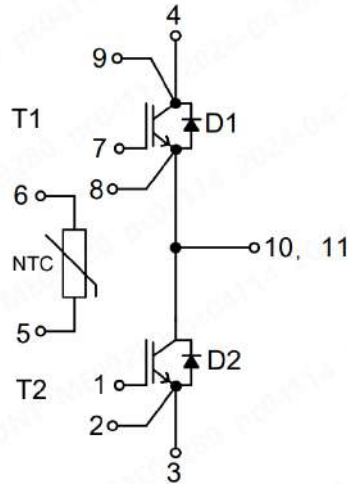


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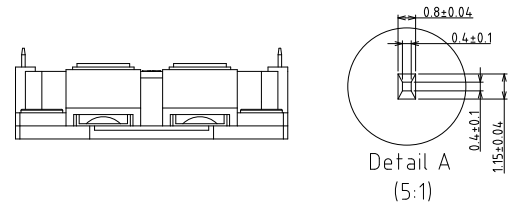
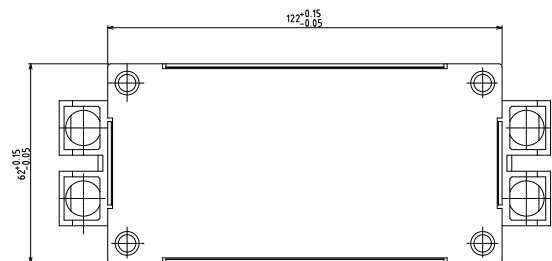
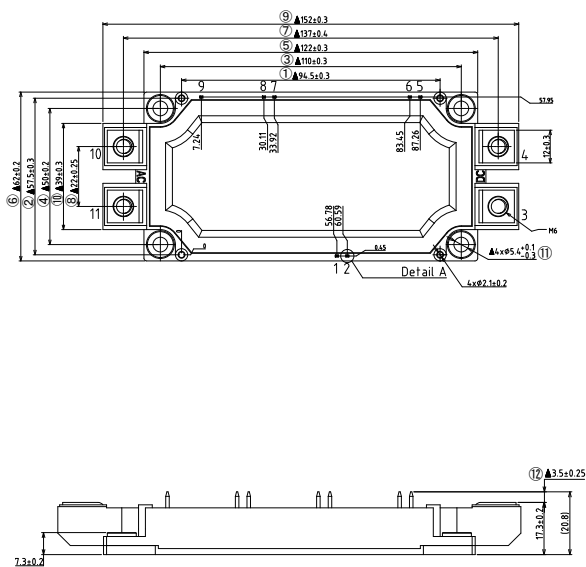
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Package Information

Circuit Diagram



Package Outlines



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



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