

HCG600FL110E3F1

1100V / 600A E3 (size similar to Easy 3 with Cu Baseplate)

Features

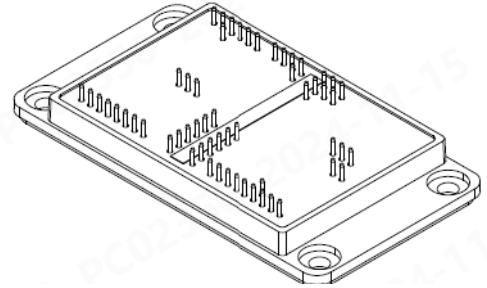
- Neutral Point Clamped Three-Level Inverter Module
- Low Inductive Layout
- Solderable Pins

Benefits

- Higher System Efficiency
- Reduced Cooling Requirements
- Low Conduction Losses Over Temperature

Applications

- Energy Storage System
- Solar Inverters
- Uninterruptable Power Supplies Systems



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Table 1 Absolute Maximum Ratings (Ta = 25 °C)

Parameter	Symbol	Value	Unit
IGBT (Q1, Q4)			
Collector-Emitter Voltage	V_{CES}	1100	V
Gate-Emitter Voltage	V_{GE}	±25	V
Continuous Collector Current	I_C	600	A
Pulsed Collector Current ($t_p=1ms$)	I_{CM}	1200	A
Junction Temperature	T_j	-40 to +175	°C
IGBT (Q2, Q3)			
Collector-Emitter Voltage	V_{CES}	1100	V
Gate-Emitter Voltage	V_{GE}	±25	V
Continuous Collector Current	I_C	600	A
Pulsed Collector Current($t_p=1ms$)	I_{CM}	1200	A
Junction Temperature	T_j	-40 to +175	°C
DIODE (D1, D4)			
Peak Repetitive Reverse Voltage	V_{RRM}	1100	V
Continuous Forward Current	I_F	400	A
Diode Maximum Forward Current($t_p=1ms$)	I_{FM}	800	A
Junction Temperature	T_j	-40 to +175	°C
DIODE (D2,D3,D5,D6)			
Peak Repetitive Reverse Voltage	V_{RRM}	1100	V
Continuous Forward Current	I_F	300	A
Diode Maximum Forward Current($t_p=1ms$)	I_{FM}	600	A
Junction Temperature	T_j	-40 to +175	°C
INSULATION PROPERTIES			
Isolation Test Voltage, t = 1 s, 50 Hz	V_{iso}	4000	V_{RMS}
RECOMMENDED TEMPERATURE			
Storage Temperature	T_{stg}	-40 to +125	°C
Operating Temperature	T_{vjop}	-40 to +150	°C

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Table 2 Characteristics Values

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
IGBT (Q1, Q4)							
Collector–Emitter Saturation Voltage	V _{CE(sat)}	V _{GE} = 15 V, I _C = 600 A	T _J = 25°C	-	1.66	-	V
		V _{GE} = 15 V, I _C = 600 A	T _J = 150°C	-	1.98	-	
Gate–Emitter Threshold Voltage	V _{GE(TH)}	V _{GE} = V _{CE} , I _C = 9 mA	T _J = 25°C	-	4.00	-	V
Total Gate Charge	Q _g	V _{GE} = -7/+15 V, V _{CE} = 600 V	T _J = 25°C	-	2.00	-	μC
Gate-Source Leakage Current	I _{GES}	V _{GE} = ±25 V, V _{CE} = 0 V	T _J = 25°C	-100	-	100	nA
Collector–Emitter Voltage	V _{(BR)CES}	V _{GE} = 0 V, I _C = 250uA	T _J = 25°C	1100	-	-	V
Collector–Emitter Cutoff Current	I _{CES}	V _{CE} = 1100 V, V _{GE} = 0 V	T _J = 25°C	-	-	100	μA
Input Capacitance	C _{ies}	V _{GE} = 0 V, V _{CE} = 30 V, f = 100 KHz	T _J = 25°C	-	28.9	-	nF
Output Capacitance	C _{oes}		T _J = 25°C	-	1.38	-	
Reverse Transfer Capacitance	C _{res}		T _J = 25°C	-	0.192	-	
Turn-on Delay Time(inductive load)	t _{d on}	V _{GE} = -7 V /+15 V, V _{CE} = 675 V, I _C = 330 A, R _{Gon} = 2.0 Ω, R _{Goff} = 16 Ω	T _J = 25°C	-	80	-	ns
			T _J = 150°C	-	80	-	
Rise Time (inductive load)	t _r		T _J = 25°C	-	25	-	
			T _J = 150°C	-	26	-	
Turn-off Delay Time(inductive load)	t _{d off}		T _J = 25°C	-	1550	-	
			T _J = 150°C	-	1600	-	
Fall Time (inductive load)	t _f		T _J = 25°C	-	51	-	
			T _J = 150°C	-	38	-	
Turn-on Switching Loss	E _{on}		T _J = 25°C	-	11.3	-	mJ
			T _J = 150°C	-	21.1	-	
Turn-off Switching Loss	E _{off}		T _J = 25°C	-	13.4	-	
			T _J = 150°C	-	17.8	-	
Thermal Resistance – Chip-to–Case	R _{thJC}	Per IGBT		-	0.086	-	°C/W

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Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
DIODE (D5,D6)							
Diode Forward Voltage	V _F	I _F = 300 A	T _J = 25°C	-	1.91	-	V
		I _F = 300 A	T _J = 150°C	-	2.20	-	
Reverse Recovery Time	T _{RR}	V _{GE} = -7 V / +15 V, V _{CE} = 675 V, I _C = 330 A, R _{Gon} = 2.0 Ω, R _{Goff} = 16 Ω	T _J = 25°C	-	108	-	ns
			T _J = 150°C	-	180	-	
Reverse Recovery Charge	Q _{RR}		T _J = 25°C	-	18.8	-	μC
			T _J = 150°C	-	30.1	-	
Peak Reverse Recovery Current	I _{RRM}		T _J = 25°C	-	360	-	A
			T _J = 150°C	-	410	-	
Reverse Recovery Energy	E _{REC}		T _J = 25°C	-	5.61	-	mJ
			T _J = 150°C	-	9.95	-	
Thermal Resistance – Chip-to-Case	R _{thJC}	Per diode		-	0.182	-	°C/W
IGBT (Q2, Q3)							
Collector-Emitter Saturation Voltage	V _{CE(sat)}	V _{GE} = 15 V, I _C = 600 A	T _J = 25°C	-	1.66	-	V
		V _{GE} = 15 V, I _C = 600 A	T _J = 150°C	-	1.98	-	
Gate-Emitter Threshold Voltage	V _{GE(TH)}	V _{GE} = V _{CE} , I _C = 9 mA	T _J = 25°C	-	4.00	-	V
Total Gate Charge	Q _g	V _{GE} = -7/+15 V, V _{CE} = 600 V	T _J = 25°C	-	2.00	-	μC
Gate-Source Leakage Current	I _{GES}	V _{GE} = ±25 V, V _{CE} = 0 V	T _J = 25°C	-100	-	100	nA
Collector-Emitter Voltage	V _{(BR)CES}	V _{GE} = 0 V, I _C = 250uA	T _J = 25°C	1100	-	-	V
Collector-Emitter Cutoff Current	I _{CES}	V _{CE} = 1100 V, V _{GE} = 0 V	T _J = 25°C	-	-	100	μA
Input Capacitance	C _{ies}	V _{GE} = 0 V, V _{CE} = 30 V, f = 100KHz	T _J = 25°C	-	28.9	-	nF
Output Capacitance	C _{oes}		T _J = 25°C	-	1.38	-	
Reverse Transfer Capacitance	C _{res}		T _J = 25°C	-	0.192	-	
Turn-on Delay Time(inductive load)	t _{d on}	V _{GE} = -7 V / +15 V, V _{CE} = 675 V, I _C = 330 A, R _{Gon} = 2.0 Ω, R _{Goff} = 16 Ω	T _J = 25°C	-	86	-	ns
			T _J = 150°C	-	87	-	
Rise Time (inductive load)	t _r		T _J = 25°C	-	30	-	
			T _J = 150°C	-	31	-	
Turn-off Delay Time(inductive load)	t _{d off}		T _J = 25°C	-	1310	-	
			T _J = 150°C	-	1420	-	

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Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Fall Time (inductive load)	t_f	$V_{GE} = -7\text{ V} / +15\text{ V}$, $V_{CE} = 675\text{ V}$, $I_C = 330\text{ A}$, $R_{Gon} = 2.0\ \Omega$, $R_{Goff} = 16\ \Omega$	$T_J = 25^\circ\text{C}$	-	38	-	ns
			$T_J = 150^\circ\text{C}$	-	38	-	
Turn-on Switching Loss	E_{on}		$T_J = 25^\circ\text{C}$	-	11.2	-	mJ
			$T_J = 150^\circ\text{C}$	-	19.9	-	
Turn-off Switching Loss	E_{off}		$T_J = 25^\circ\text{C}$	-	14.3	-	
			$T_J = 150^\circ\text{C}$	-	18.5	-	
Thermal Resistance – Chip-to-Case	R_{thJC}	Per IGBT		-	0.086	-	$^\circ\text{C/W}$

DIODE (D1, D4)

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Diode Forward Voltage	V _F	I _F = 400 A	T _j = 25°C	-	1.95	-	V
		I _F = 400 A	T _j = 150°C	-	2.23	-	
Reverse Recovery Time	T _{RR}	V _{GE} = -7 V / +15 V, V _{CE} = 675 V, I _C = 330 A, R _{Gon} = 2.0 Ω, R _{Goff} = 16 Ω	T _j = 25°C	-	115	-	ns
			T _j = 150°C	-	200	-	
Reverse Recovery Charge	Q _{RR}		T _j = 25°C	-	20.8	-	μC
			T _j = 150°C	-	34.5	-	
Peak Reverse Recovery Current	I _{RRM}		T _j = 25°C	-	350	-	A
			T _j = 150°C	-	365	-	
Reverse Recovery Energy	E _{REC}		T _j = 25°C	-	6.0	-	mJ
			T _j = 150°C	-	10.1	-	
Thermal Resistance – Chip-to-Case	R _{thJC}	Per diode		-	0.126	-	°C/W

DIODE (D2,D3)

Diode Forward Voltage	V _F	I _F = 300 A	T _J = 25°C	-	1.91	-	V
		I _F = 300 A	T _J = 150°C	-	2.20	-	
Thermal Resistance – Chip-to-Case	R _{thJC}	Per diode		-	0.182	-	°C/W

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Table 3 NTC-Thermistor

Parameter	Symbol	Min	Typ.	Max	Unit	Conditions
Rated resistance	R_{25}	-	5	-	k Ω	$T_C = 25^{\circ}\text{C}$
Deviation of R100	$\Delta R/R$	-5	-	5	%	$T_C = 100^{\circ}\text{C}$, $R_{100} = 493 \Omega$
B-value	$B_{25/50}$	-	3375	-	K	$R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298,15K))]$

Table 4 Module Characteristics

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Mounting Torque Screw:M5	M		3.0	-	5.0	N.m
Creepage Distance		terminal to heatsink		16.2		
Clearance		terminal to heatsink		15.2		
CTI				≥ 600		

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Typical Characteristics

Fig.1 Typical output characteristics IGBT

$I_C = f(V_{CE})$

$V_{GE} = 15V$ (Q1, Q2, Q3, Q4)

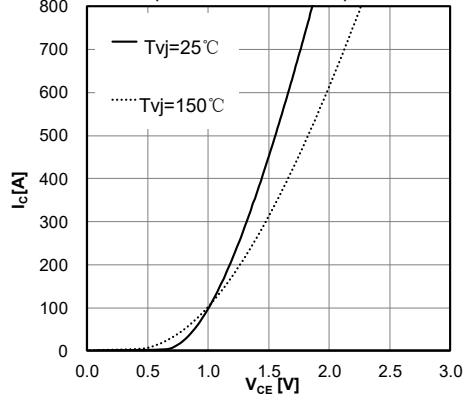


Fig.2 Typical output characteristics IGBT

$T_{vj} = 150^\circ C$ (Q1, Q2, Q3, Q4)

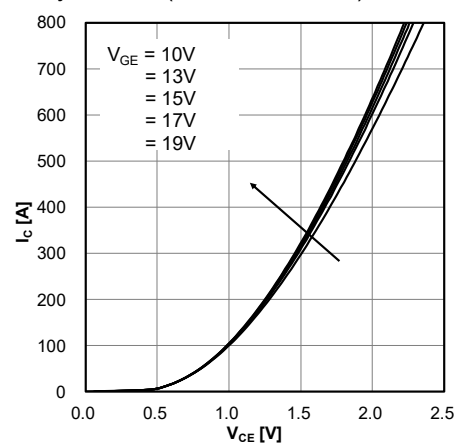


Fig.3 Typical Output Characteristic, IGBT, Inverter

$I_C = f(V_{GE})$ (Q1, Q2, Q3, Q4)

$V_{CE} = 20V$

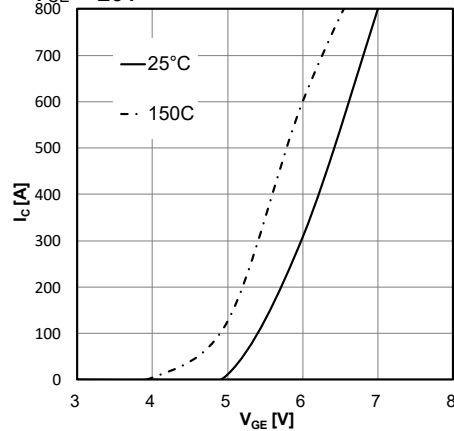


Fig.4 Diode forward characteristics (D1, D4)

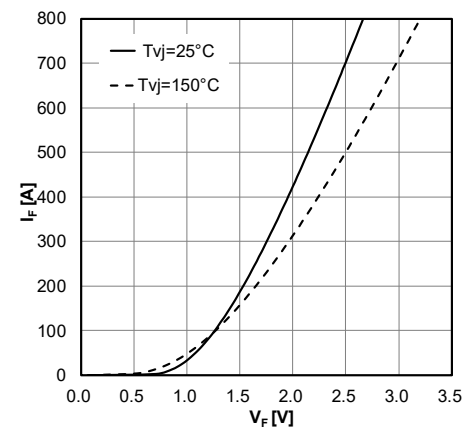


Fig.5 Capacity characteristic

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

(Q1, Q2, Q3, Q4)

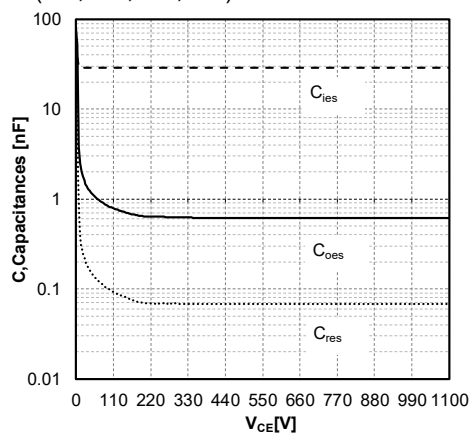
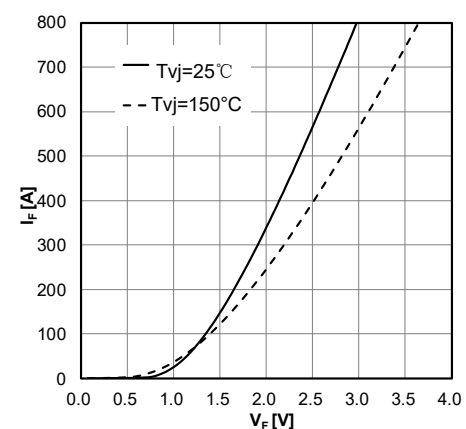


Fig.6 Diode forward characteristics (D2, D3, D5, D6)



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Typical Characteristics

Q1 || D5 or Q4 || D6

Fig.7 Switching losses IGBT, Inverter (typical)
 $E_{on} = f(I_C)$, $E_{off} = f(I_C)$,
 $V_{GE} = +15\text{ V} / -7\text{ V}$, $R_{Gon} = 2\ \Omega$, $R_{Goff} = 16\ \Omega$,
 $V_{CE} = 675\text{ V}$

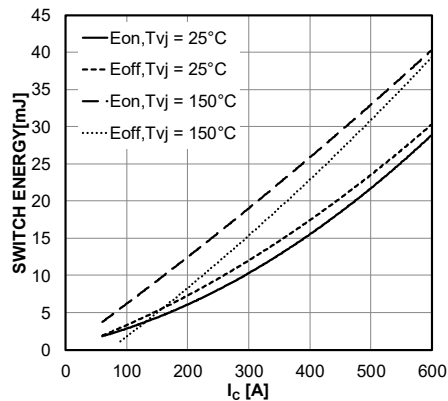


Fig.8 Switching losses IGBT, Inverter (typical)
 $E_{on} = f(R_G)$,
 $V_{GE} = +15\text{ V} / -7\text{ V}$, $I_C = 330\text{ A}$, $V_{CE} = 675\text{ V}$

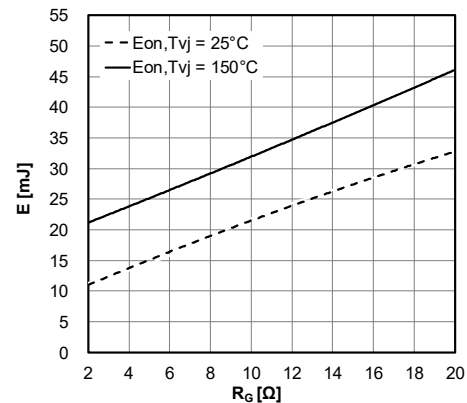


Fig.9 Switching losses IGBT, Inverter (typical)
 $E_{off} = f(R_G)$,
 $V_{GE} = +15\text{ V} / -7\text{ V}$, $I_C = 330\text{ A}$, $V_{CE} = 675\text{ V}$

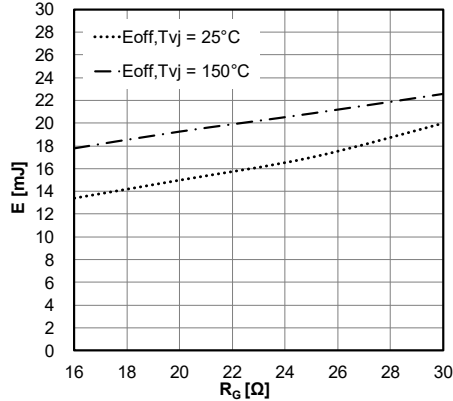


Fig.10 Switching losses IGBT, Inverter (typical)
 $E_{rec} = f(R_G)$,
 $V_{GE} = +15\text{ V} / -7\text{ V}$, $I_C = 330\text{ A}$, $V_{CE} = 675\text{ V}$

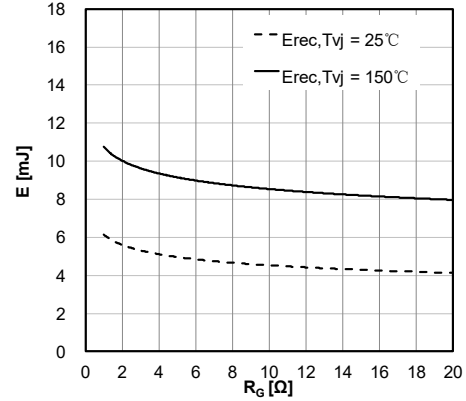
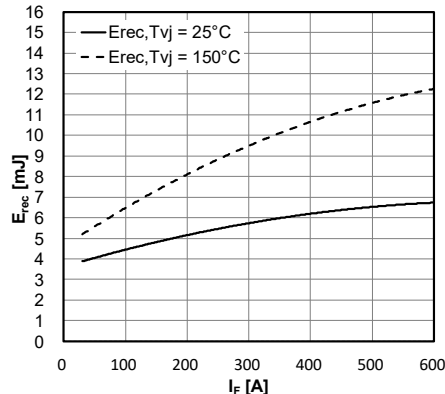


Fig.11 Switching losses IGBT, (typical)
 $E_{rec} = f(I_F)$,
 $V_{GE} = +15\text{ V} / -7\text{ V}$, $R_{Gon} = 2\ \Omega$, $V_{CE} = 675\text{ V}$



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Typical Characteristics

Q2||D3+D4 or Q3||D1+D2

Fig.12 Switching losses IGBT, Inverter (typical)

$E_{on} = f(I_c)$, $E_{off} = f(I_c)$,
 $V_{GE} = +15\text{ V} / -7\text{ V}$, $R_{Gon} = 2\ \Omega$, $R_{Goff} = 16\ \Omega$,
 $V_{CE} = 675\text{ V}$

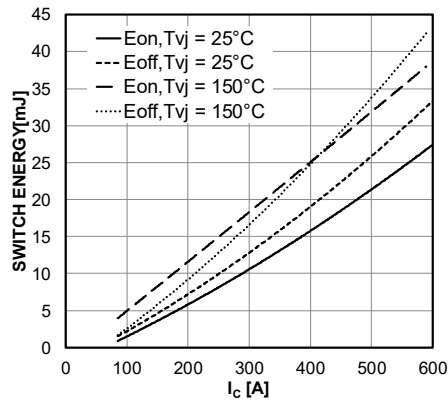


Fig.13 Switching losses IGBT, Inverter (typical)

$E_{on} = f(R_G)$,
 $V_{GE} = +15\text{ V} / -7\text{ V}$, $I_c = 330\text{ A}$, $V_{CE} = 675\text{ V}$

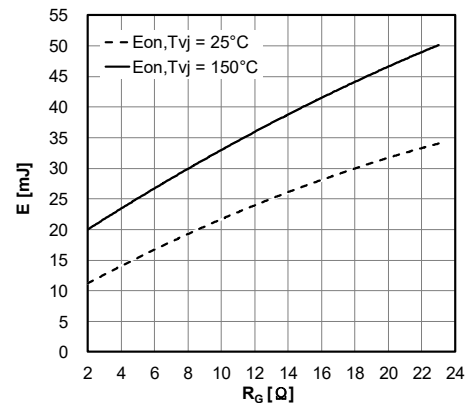


Fig.14 Switching losses IGBT, Inverter (typical)

$E_{off} = f(R_G)$,
 $V_{GE} = +15\text{ V} / -7\text{ V}$, $I_c = 330\text{ A}$, $V_{CE} = 675\text{ V}$

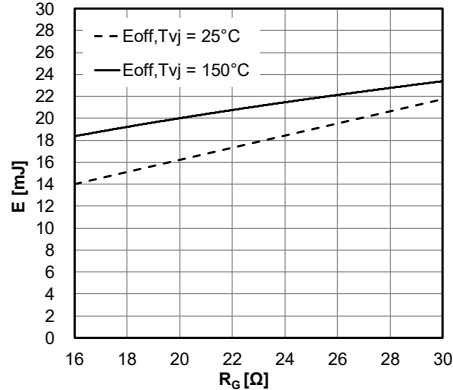


Fig.15 Switching losses IGBT, Inverter (typical)

$E_{rec} = f(R_G)$,
 $V_{GE} = +15\text{ V} / -7\text{ V}$, $I_c = 330\text{ A}$, $V_{CE} = 675\text{ V}$

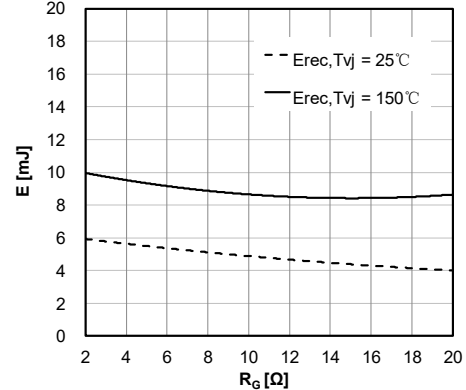


Fig.16 Switching losses IGBT, (typical)

$E_{rec} = f(I_F)$,
 $V_{GE} = +15\text{ V} / -7\text{ V}$, $R_{Gon} = 2.0\ \Omega$, $V_{CE} = 675\text{ V}$

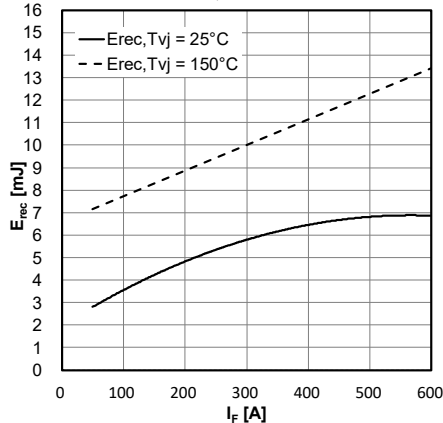
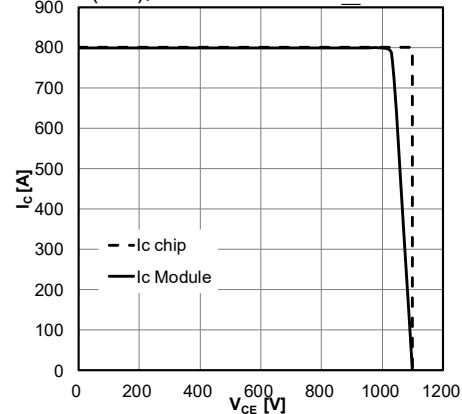


Fig.17 Reverse bias safe operating area IGBT, Inverter (RBSOA)

$I_c = f(V_{CE})$,



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Typical Characteristics

Fig.18 NTC-Thermistor-temperature characteristic (typical)

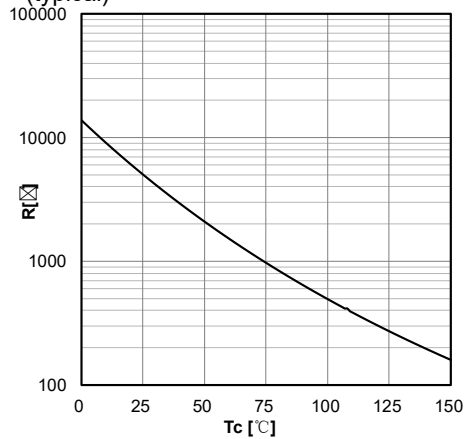


Fig.19 Transient thermal impedance (Q1, Q2, Q3, Q4)

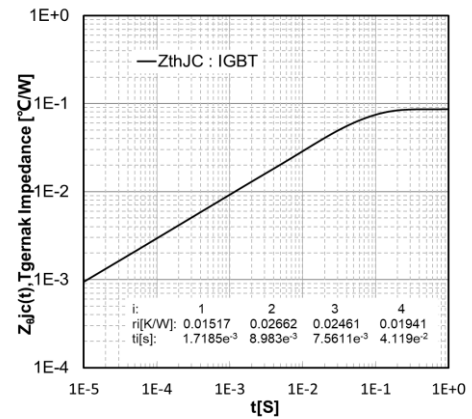


Fig.20 Transient thermal impedance (D2, D3, D5, D6)

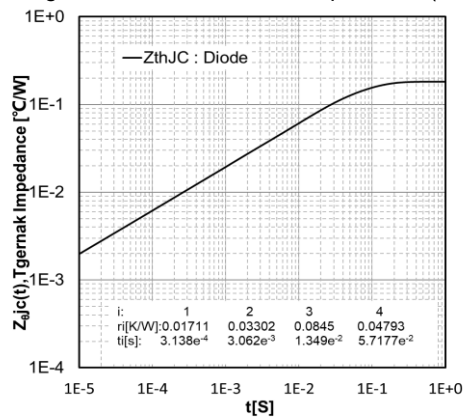
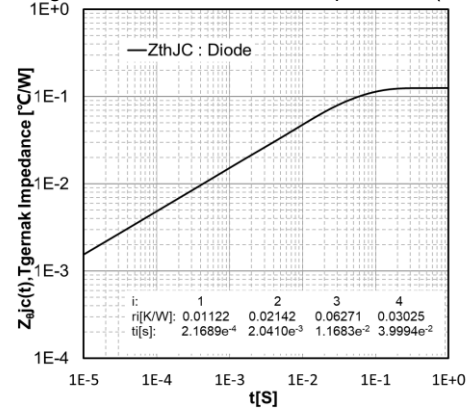


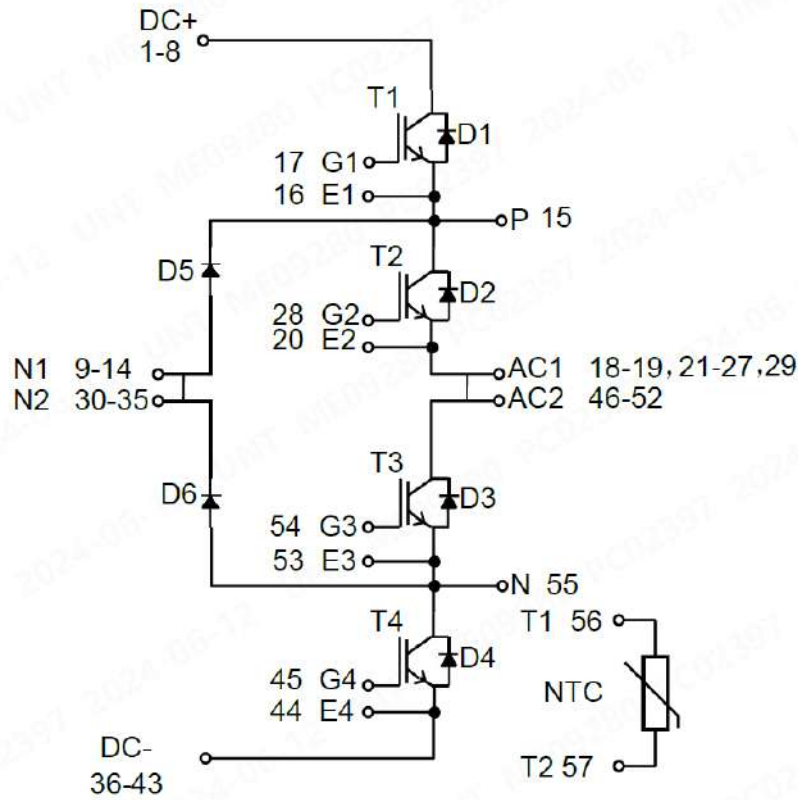
Fig.21 Transient thermal impedance (D1, D4)



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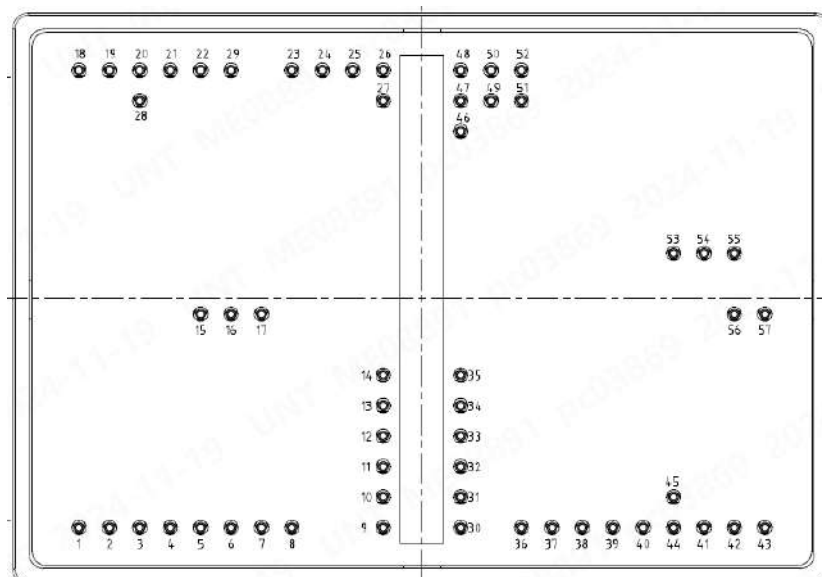
1100V / 600A E3 (size similar to Easy 3 with Cu Baseplate)

Circuit Diagram



1. Suggest that AC1 and AC2, N1 and N2 be electrically connected on the PCB.

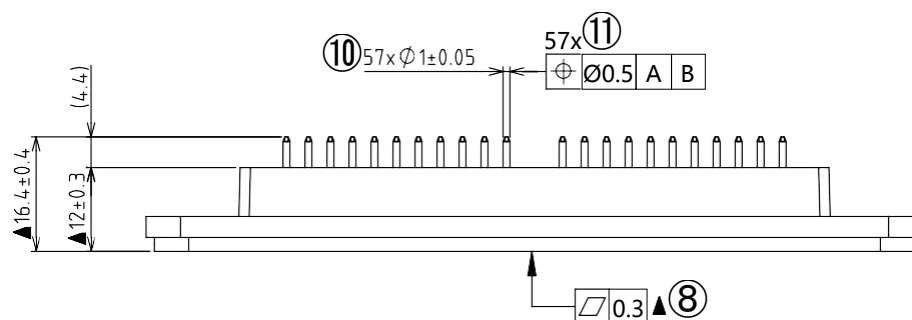
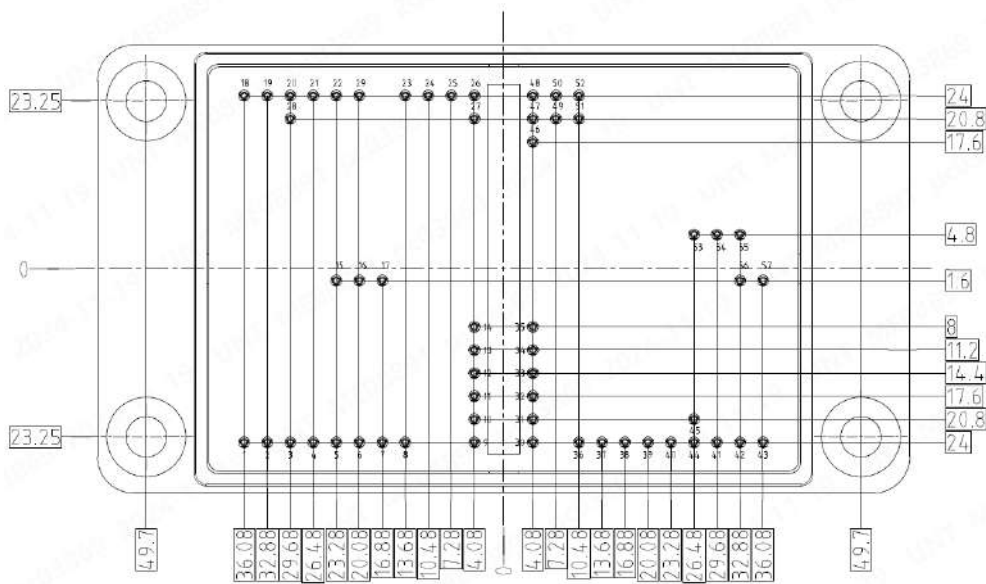
Pin Connections



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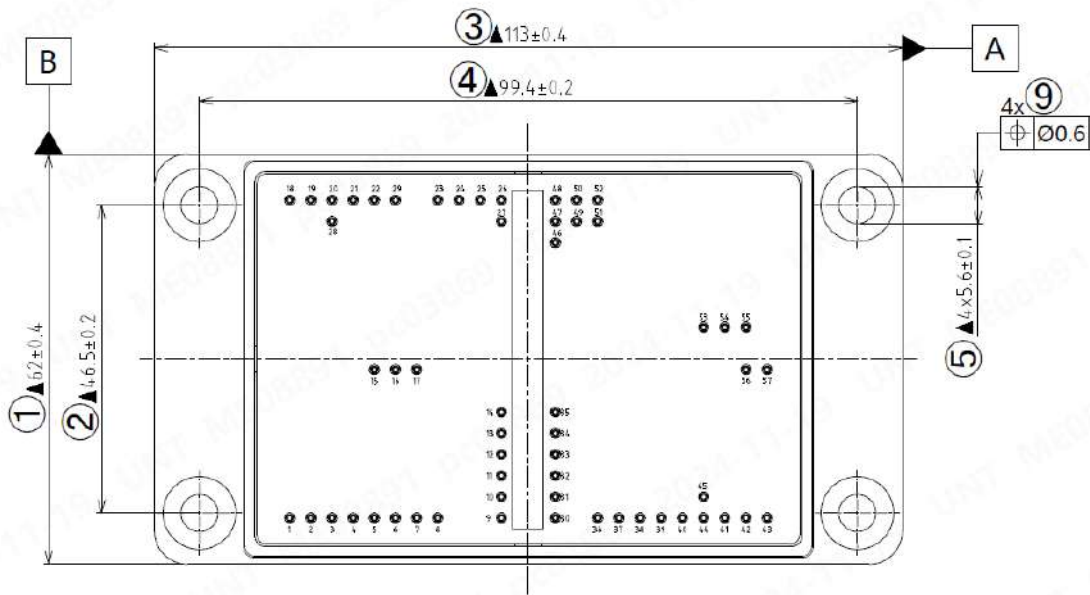
1100V / 600A E3 (size similar to Easy 3 with Cu Baseplate)

Package Outlines

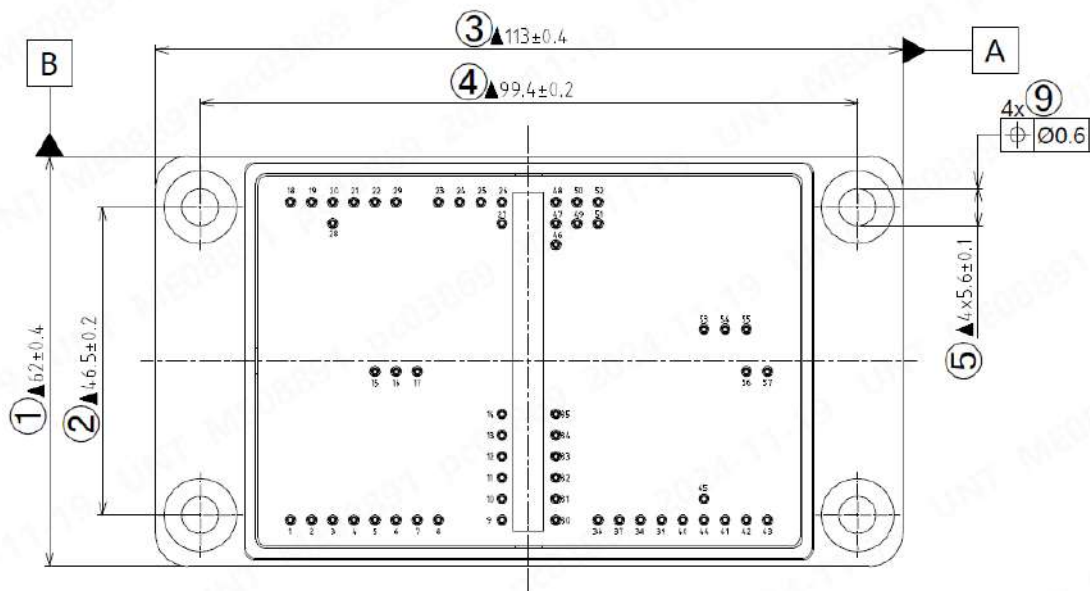


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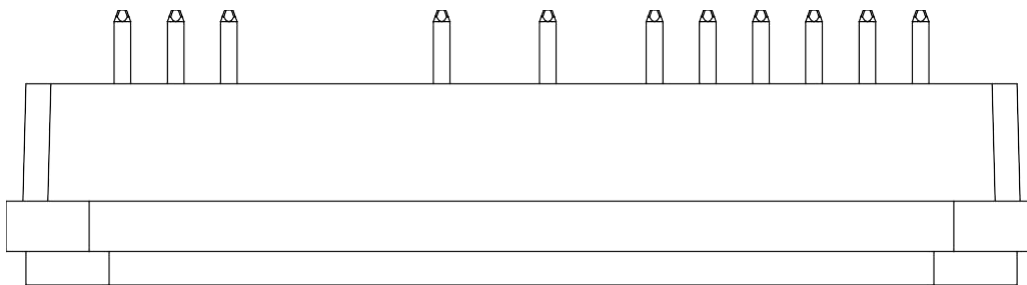


Package Outlines



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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

