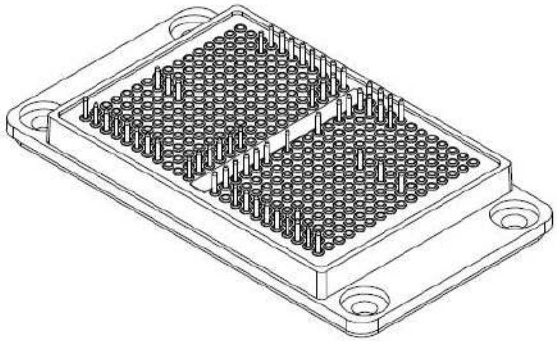
HCG600FL100E3T1

1000V / 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

- Solar Inverters
- Uninterruptable Power Supplies Systems

HCG600FL100E3T1
1000V / 600A E3 (size similar to Easy 3 with Cu Baseplate)

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

Parameter	Symbol	Value	Unit
IGBT (Q1, Q4)			
Collector−Emitter Voltage	V_{CES}	1000	V
Gate−Emitter Voltage	V_{GE}	±23	V
Continuous Collector Current @ Tc = 75°C, T_j = 150°C	I_C	350	A
Pulsed Collector Current @ T_j = 150°C	I_{CP}	700	A
Junction Temperature	T_j	-40 to +175	°C
IGBT (Q2, Q3)			
Collector−Emitter Voltage	V_{CES}	1000	V
Gate−Emitter Voltage	V_{GE}	±23	V
Continuous Collector Current @ Tc = 75°C, T_j = 150°C	I_C	350	A
Pulsed Collector Current @ T_j = 150°C	I_{CP}	700	A
Junction Temperature	T_j	-40 to +175	°C
DIODE (D1,D2,D3,D4)			
Peak Repetitive Reverse Voltage	V_{RRM}	1000	V
Continuous Forward Current @ Tc = 75°C, T_j = 150°C	I_F	131	A
Repetitive Peak Forward Current @ T_j = 150°C	I_{FRM}	262	A
I^2t-value@ V_R = 0 V, Tp = 10 ms, T_{vj} = 150°C	I^2t	4050	A^2s
Junction Temperature	T_j	-40 to +175	°C
DIODE (D5,D6)			
Peak Repetitive Reverse Voltage	V_{RRM}	1000	V
Continuous Forward Current @ Tc = 75°C, Tj = 150°C	I_F	110	A
Repetitive Peak Forward Current @ Tj = 150°C	I_{FRM}	220	A
I^2t-value@ V_R = 0 V, Tp = 10 ms, T_{vj} = 150°C	I^2t	4050	A^2s
Junction Temperature	T_j	-40 to +175	°C
INSULATION PROPERTIES			
Isolation Test Voltage, t = 1 s, 50 Hz	Viso	4000	V_{RMS}
RECOMMENDED TEMPERATURE			
Storage Temperature	T_{stg}	-40 to +125	°C
Operating Temperature	T_{vjop}	-40 to +150	°C

HCG600FL100E3T1

1000V / 600A E3 (size similar to Easy 3 with Cu Baseplate)

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	-	1.56	-	V
		V_{GE} = 15 V, I_C = 600 A	T_j= 150°C	-	1.88	-	
Gate−Emitter Threshold Voltage	$V_{GE(TH)}$	V_{GE} = V_{CE}, I_C = 9 mA	T_j = 25°C	-	3.87	-	V
Total Gate Charge	Q_g	V_{GE} = ±15 V, V_{CE} = 600 V	T_j = 25°C	-	1.93	-	μC
Gate-Source Leakage Current	I_{GES}	V_{GE} = 20 V, V_{CE} = 0 V	T_j = 25°C	-	-	1	μA
Collector−Emitter Voltage	$V_{(BR)CES}$	V_{GE} = 0 V	T_j = 25°C	1000	-	-	V
Collector−Emitter Cutoff Current	I_{CES}	V_{CE} = 1000 V, V_{GE} = 0 V	T_j = 25°C	-	-	100	μA
Input Capacitance	C_{iss}	V_{GE} = 0 V, V_{CE} = 20 V, f = 100 KHz	T_j = 25°C	-	28.7	-	nF
Output Capacitance	C_{oss}		T_j = 25°C	-	1.70	-	
Reverse Transfer Capacitance	C_{rss}		T_j = 25°C	-	0.27	-	
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} = 0.5 Ω, R_{Goff} = 5.1 Ω	T_j = 25°C	-	100	-	ns
			T_j = 150°C	-	105	-	
Rise Time (inductive load)	t_r		T_j = 25°C	-	20	-	
			T_j = 150°C	-	25	-	
Turn-off Delay Time(inductive load)	$t_{d\ off}$		T_j = 25°C	-	1100	-	
			T_j = 150°C	-	1200	-	
Fall Time (inductive load)	t_f		T_j = 25°C	-	30	-	
			T_j = 150°C	-	35	-	
Turn-on Switching Loss	E_{on}		T_j = 25°C	-	10.7	-	mJ
			T_j = 150°C	-	16.66	-	
Turn-off Switching Loss	E_{off}		T_j = 25°C	-	8.5	-	
			T_j = 150°C	-	14.01	-	
Thermal Resistance − Chip−to−Case	R_{thJC}	Thermal grease, λ = 2.8 W/mK		-	0.099	-	°C/W

HCG600FL100E3T1

1000V / 600A E3 (size similar to Easy 3 with Cu Baseplate)

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
DIODE (D5,D6)							
Diode Forward Voltage	V_F	I_F = 300 A	T_j = 25°C	-	2.26	-	V
		I_F = 300 A	T_j = 150°C	-	2.25	-	
Reverse Recovery Time	T_{RR}	V_{GE} = -7 V / +15 V, V_{CE} = 675 V, I_C = 330 A, R_{Gon} = 0.5 Ω, R_{Goff} = 5.1 Ω	T_j = 25°C	-	95	-	ns
			T_j = 150°C	-	200	-	
Reverse Recovery Charge	Q_{RR}		T_j = 25°C	-	14.5	-	µC
			T_j = 150°C	-	35.3	-	
Peak Reverse Recovery Current	I_{RRM}		T_j = 25°C	-	300	-	A
			T_j = 150°C	-	450	-	
Reverse Recovery Energy	E_{REC}		T_j = 25°C	-	5.25	-	mJ
			T_j = 150°C	-	11.75	-	
Thermal Resistance – Chip–to–Case	R_{thJC}	Thermal grease ,λ = 2.8 W/mK		-	0.243	-	°C/W
IGBT (Q2, Q3)							
Collector−Emitter Saturation Voltage	$V_{CE(sat)}$	V_{GE} = 15 V, I_C = 600 A	T_j = 25°C	-	1.56	-	V
		V_{GE} = 15 V, I_C = 600 A	T_j = 150°C	-	1.88	-	
Gate−Emitter Threshold Voltage	$V_{GE(TH)}$	V_{GE} = V_{CE}, I_C = 9 mA	T_j = 25°C	-	3.87	-	V
Total Gate Charge	Q_g	V_{GE} = ±15 V, V_{CE} = 600 V	T_j = 25°C	-	1.93	-	µC
Gate-Source Leakage Current	I_{GES}	V_{GE} = 20 V, V_{CE} = 0 V	T_j = 25°C	-	-	100	nA
Collector−Emitter Voltage	$V_{(BR)CES}$	V_{GE} = 0 V	T_j = 25°C	1000	-	-	V
Collector−Emitter Cutoff Current	I_{CES}	V_{CE} = 1000 V, V_{GE} = 0 V	T_j = 25°C	-	-	100	µA
Input Capacitance	C_{iss}	V_{GE} = 0 V, V_{CE} = 20 V, f = 100KHz	T_j = 25°C	-	28.7	-	nF
Output Capacitance	C_{oss}		T_j = 25°C	-	1.70	-	
Reverse Transfer Capacitance	C_{rss}		T_j = 25°C	-	0.27	-	
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} = 0.51 Ω, R_{Goff} = 5.1 Ω	T_j = 25°C	-	90	-	ns
			T_j = 150°C	-	100	-	
Rise Time (inductive load)	t_r		T_j = 25°C	-	25	-	
			T_j = 150°C	-	30	-	
Turn-off Delay Time(inductive load)	$t_{d\ off}$		T_j = 25°C	-	1120	-	
			T_j = 150°C	-	1250	-	

HCG600FL100E3T1

1000V / 600A E3 (size similar to Easy 3 with Cu Baseplate)

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Fall Time (inductive load)	t_f	V_{GE} = -7 V / +15 V, V_{CE} = 675 V, I_C = 330 A, R_{Gon} = 0.51 Ω, R_{Goff} = 5.1 Ω	T_j = 25°C	-	28	-	ns
			T_j = 150°C	-	37	-	
Turn-on Switching Loss	E_{on}		T_j = 25°C	-	9.35	-	mJ
			T_j = 150°C	-	14.64	-	
Turn-off Switching Loss	E_{off}		T_j = 25°C	-	8.37	-	
			T_j = 150°C	-	14.75	-	
Thermal Resistance – Chip–to–Case	R_{thJC}	Thermal grease ,λ = 2.8 W/mK		-	0.099	-	°C/W

INVERSE DIODE (D1,D2,D3,D4)

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Diode Forward Voltage	V_F	I_F = 300 A	T_j = 25°C	-	2.27	-	V
		I_F = 300 A	T_j = 150°C	-	2.36	-	
Reverse Recovery Time	T_{RR}	V_{GE} = -7 V / +15 V, V_{CE} = 675 V, I_C = 330 A, R_{Gon} = 0.51 Ω, R_{Goff} = 5.1 Ω	T_j = 25°C	-	100	-	ns
			T_j = 150°C	-	200	-	
Reverse Recovery Charge	Q_{RR}		T_j = 25°C	-	15	-	μC
			T_j = 150°C	-	36	-	
Peak Reverse Recovery Current	I_{RRM}		T_j = 25°C	-	280	-	A
			T_j = 150°C	-	350	-	
Reverse Recovery Energy	E_{REC}		T_j = 25°C	-	5.27	-	mJ
			T_j = 150°C	-	11.01	-	
Thermal Resistance – Chip–to–Case	R_{thJC}	Thermal grease ,λ = 2.8 W/mK		-	0.243	-	°C/W

HCG600FL100E3T1

1000V / 600A E3 (size similar to Easy 3 with Cu Baseplate)

Table 3 NTC-Thermistor

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Rated Resistance	R_{25}	T_C = 25°C	-	22	-	kΩ
Deviation of R100	△R/R	T_C = 100°C, R_{100} = 1486 Ω	-5	-	5	%
Power Dissipation	P25	TNTC = 25°C	-	-	20	mW
B-value	$B_{25/50}$	B (25/50), tolerance ±3%	-	3950	-	K
B-value	$B_{25/100}$	B (25/100), tolerance ±3%	-	3998	-	K

Table 4 Module Characteristics

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Stray Inductance	L_{CE}		-	15	-	nH
Mounting Torque Screw:M5	M		3.0	-	5.0	N.m
Creepage Distance		terminal to heatsink		11.5		
Clearance		terminal to heatsink		9.4		
CTI				≥600		
Flatness of base plate					0.3	mm
Weight				250		g

HCG600FL100E3T1

1000V / 600A E3 (size similar to Easy 3 with Cu Baseplate)

Typical Characteristics

Fig.1 Typical output characteristics IGBT
I_C= f (V_{CE})
V_{GE} = 15V (Q1, Q2, Q3, Q4)

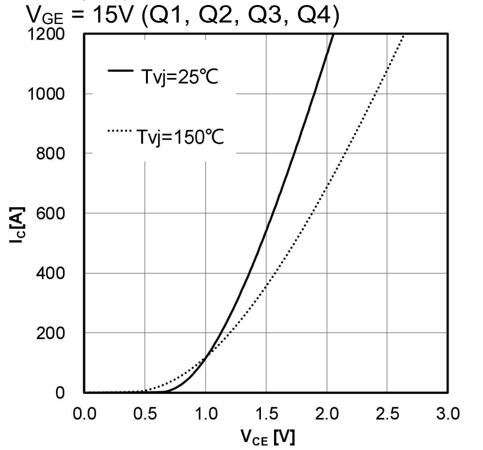


Fig.2 Typical output characteristics IGBT
Tvj = 150°C (Q1, Q2, Q3, Q4)

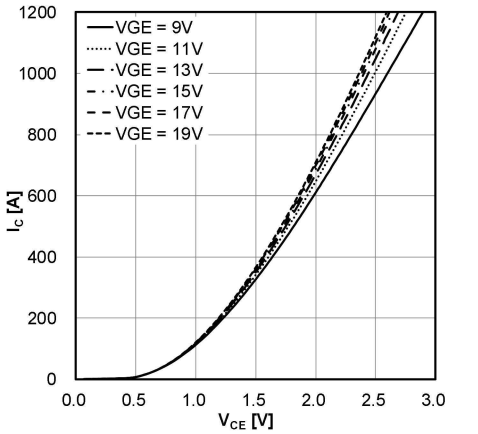


Fig.3 Body diode characteristics (D1, D2, D3, D4)

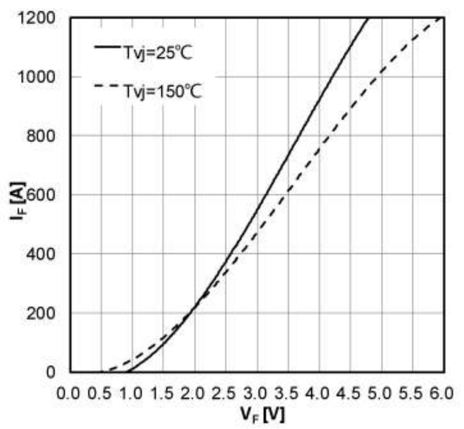


Fig.4 Transient thermal impedance (Q1, Q2, Q3, Q4)

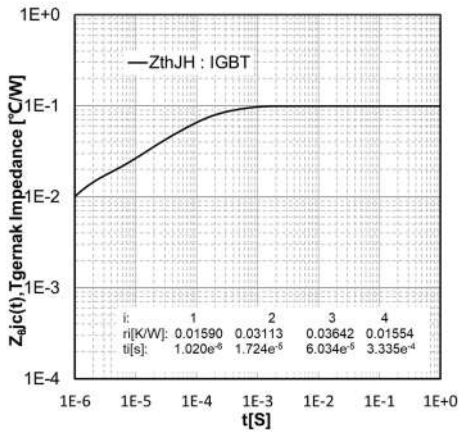


Fig.5 Capacity characteristic
C = f (V_{CE}), V_{GE} = 0 V, Tvj = 25°C, f = 100 KHz
(Q1, Q2, Q3, Q4)

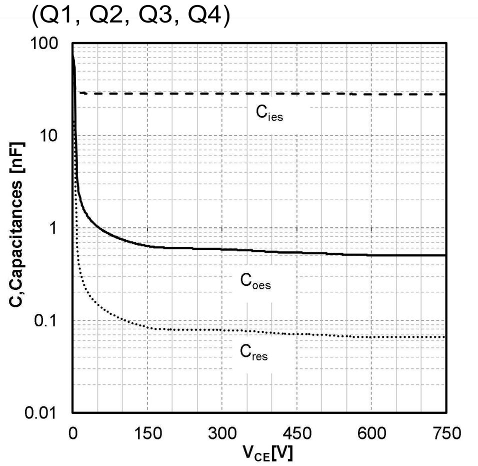
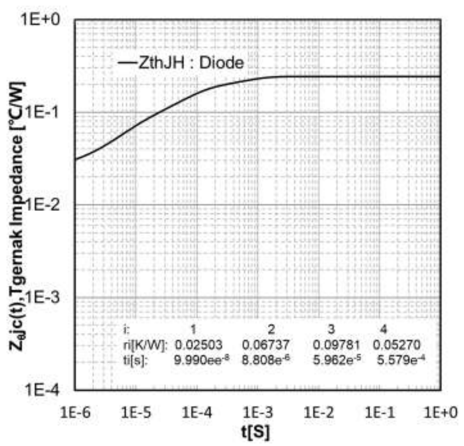


Fig.6 Transient thermal impedance (D1, D2, D3, D4)



HCG600FL100E3T1

1000V / 600A E3 (size similar to Easy 3 with Cu Baseplate)

Typical Characteristics

Fig.7 Diode forward characteristics (D5, D6)

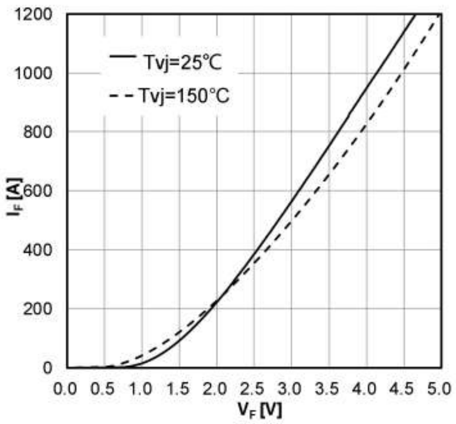
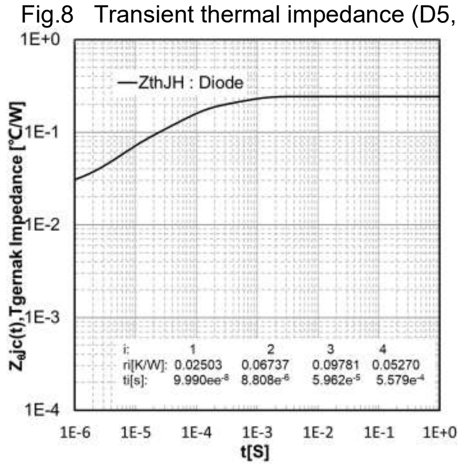


Fig.8 Transient thermal impedance (D5, D6)



Q1 || D5 or Q4 || D6

Fig.9 Switching losses IGBT, Inverter (typical)
E_{on} = f (I_C), E_{off} = f (I_C),
V_{GE} = +15 V / -7 V, R_{Gon} = 0.5 Ω, R_{Goff} = 5.1 Ω,
V_{CE} = 675 V

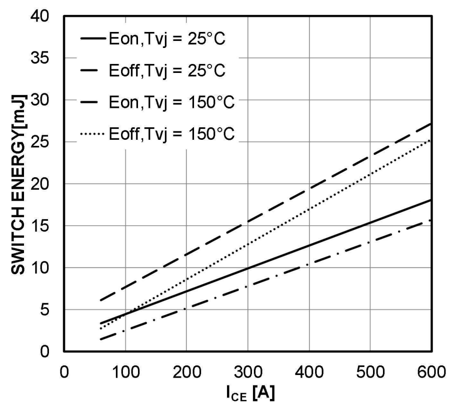


Fig.10 Switching losses IGBT, Inverter (typical)
E_{on} = f (R_G),
V_{GE} = +15 V / -7 V, I_C = 330 A, V_{CE} = 675 V

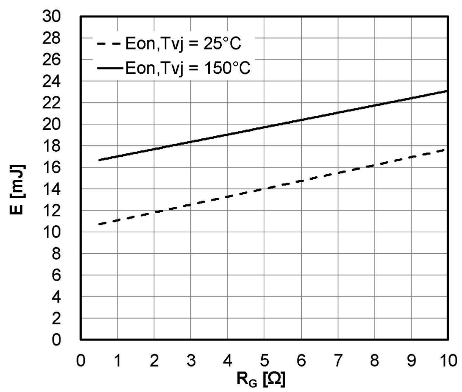


Fig.11 Switching losses IGBT, Inverter (typical)
E_{off} = f (R_G),
V_{GE} = +15 V / -7 V, I_C = 330 A, V_{CE} = 675 V

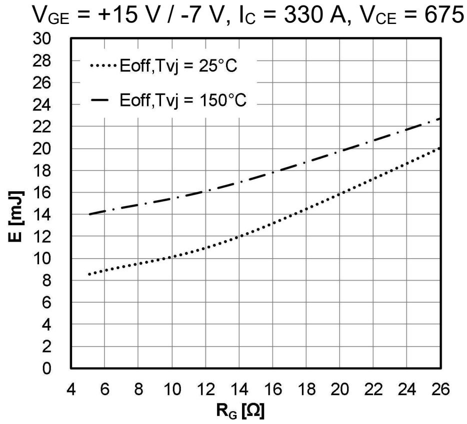
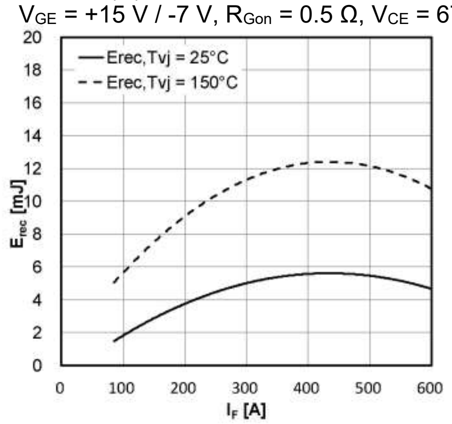


Fig.12 Switching losses IGBT, Inverter (typical)
E_{REC} = f (I_C),
V_{GE} = +15 V / -7 V, R_{Gon} = 0.5 Ω, V_{CE} = 675 V



HCG600FL100E3T1

1000V / 600A E3 (size similar to Easy 3 with Cu Baseplate)

Typical Characteristics

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

Fig.13 Switching losses IGBT, Inverter (typical)
E_{on} = f (I_C), E_{off} = f (I_C),
V_{GE} = +15 V / -7 V, R_{Gon} = 0.51 Ω, R_{Goff} = 5.1 Ω,
V_{CE} = 675 V

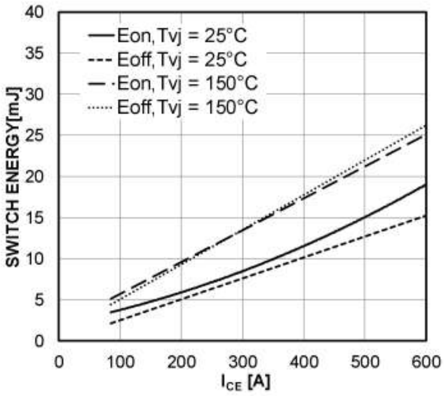


Fig.14 Switching losses IGBT, Inverter (typical)
E_{on} = f (R_G),
V_{GE} = +15 V / -7 V, I_C = 330 A, V_{CE} = 675 V

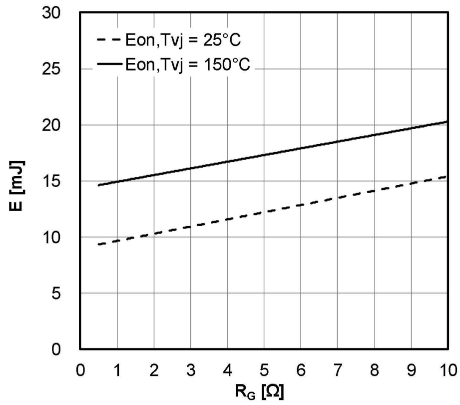


Fig.15 Switching losses IGBT,Inverter (typical)
E_{off} = f (R_G),
V_{GE} = +15 V / -7 V, I_C = 330 A, V_{CE} = 675 V

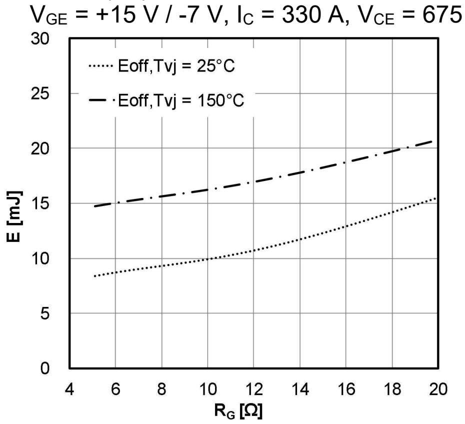


Fig.16 Switching losses IGBT, Inverter (typical)
E_{REC} = f (I_C),
V_{GE} = +15 V / -7 V, R_{Gon} = 0.5 Ω, V_{CE} = 675 V

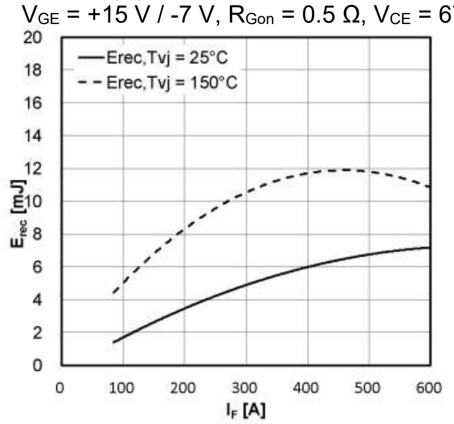


Fig.17 NTC-Thermistor-temperature characteristic (typical)

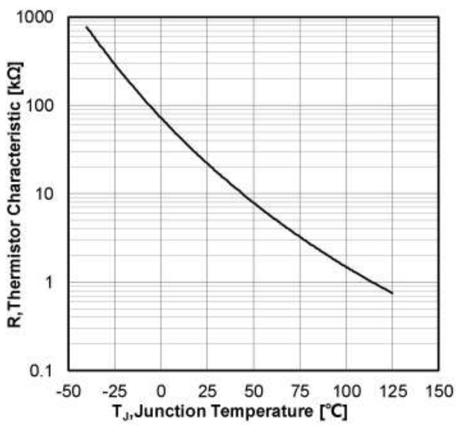
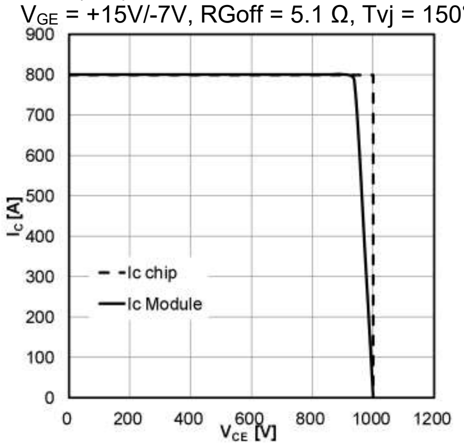


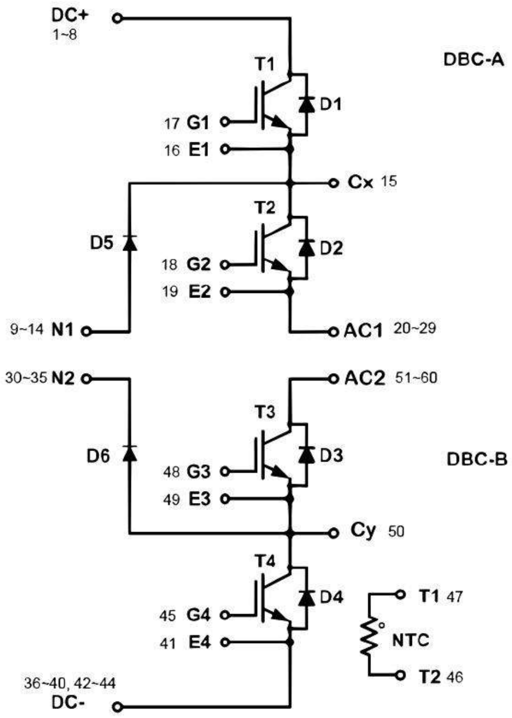
Fig.18 Reverse bias safe operating area IGBT, Inverter (RBSOA)
I_c = f (V_{CE}),
V_{GE} = +15V/-7V, RGoff = 5.1 Ω, Tvj = 150°C



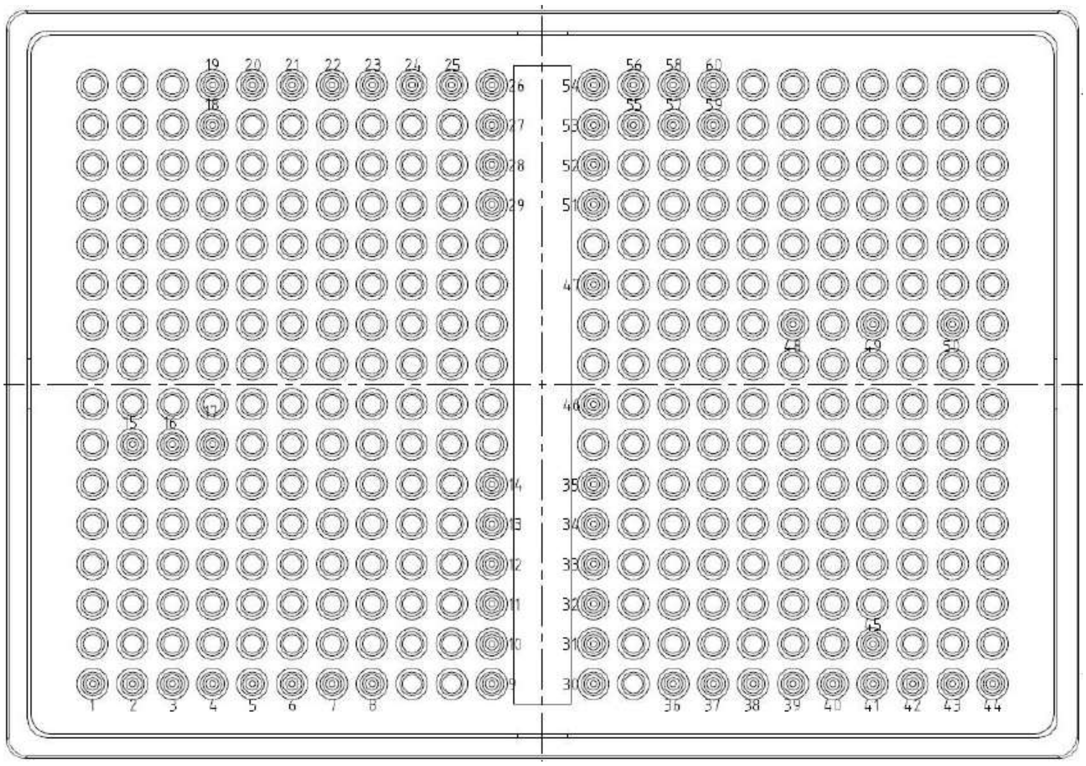
HCG600FL100E3T1

1000V / 600A E3 (size similar to Easy 3 with Cu Baseplate)

Circuit Diagram



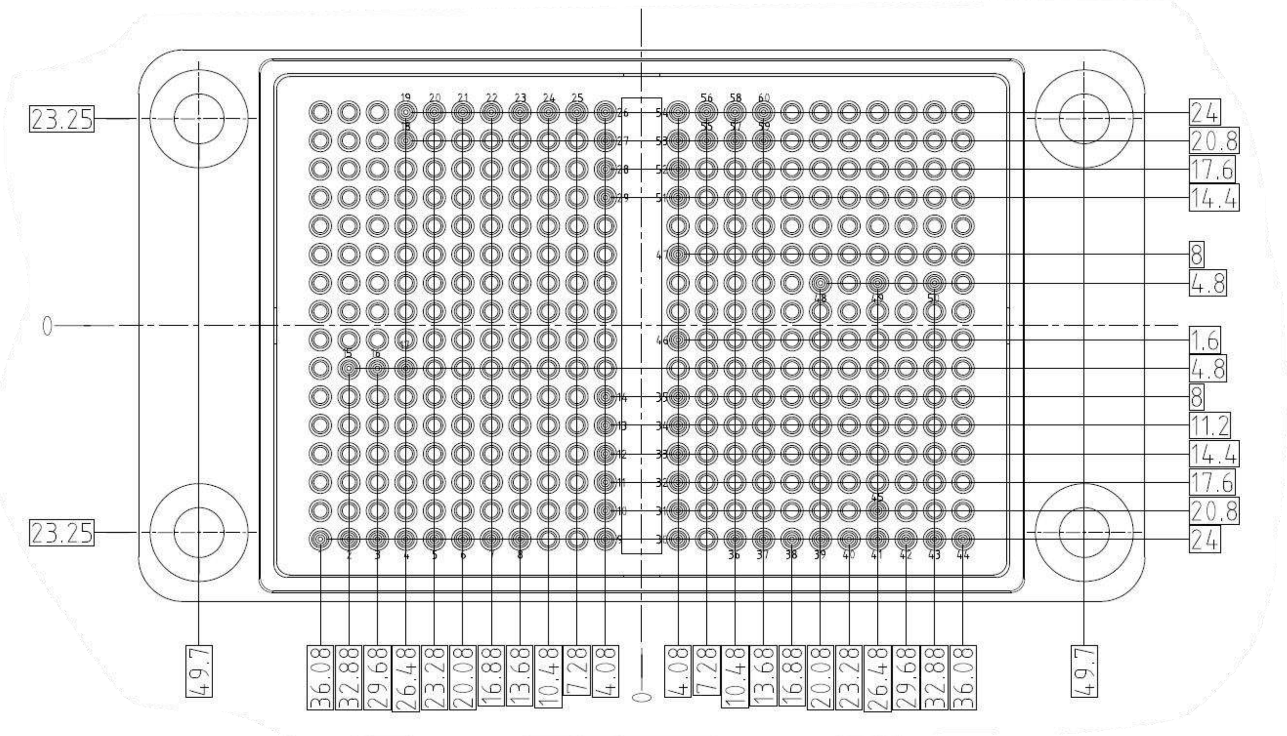
Pin Connections

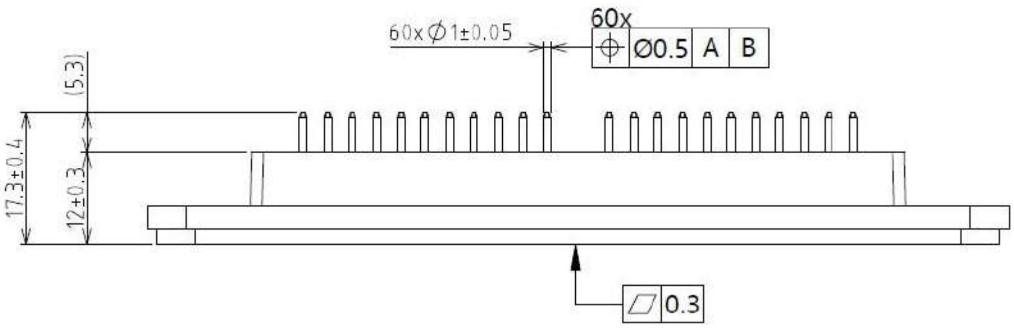


HCG600FL100E3T1

1000V / 600A E3 (size similar to Easy 3 with Cu Baseplate)

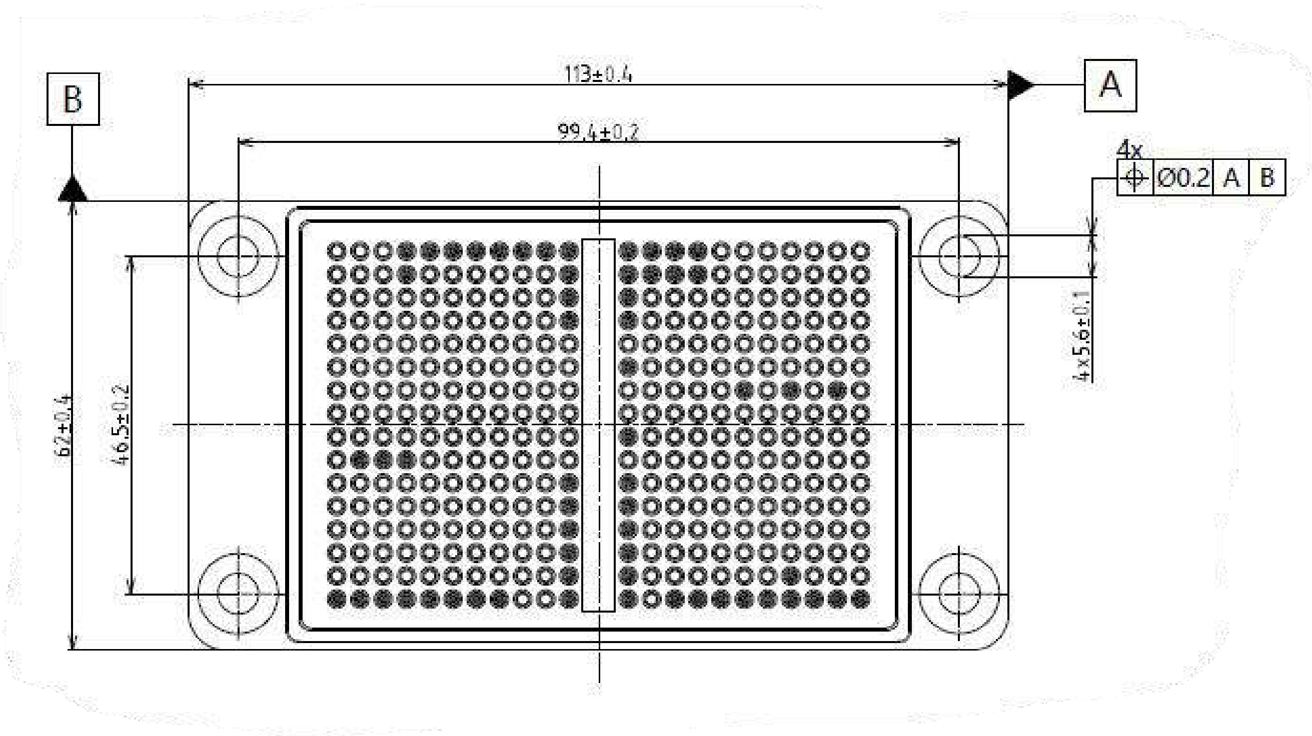
Package Outlines





HCG600FL100E3T1
1000V / 600A E3 (size similar to Easy 3 with Cu Baseplate)

Package Outlines



Revision History

Document Version	Description of Changes
RevX.0.1	Released

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Changes to this product data sheet are reserved.

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