

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

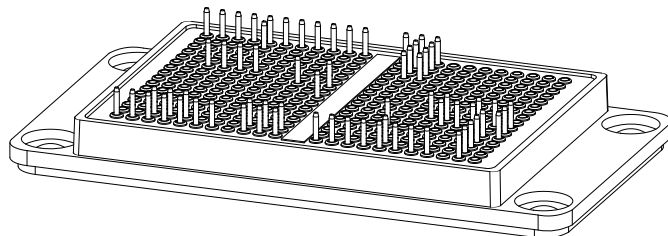


Table 1 Absolute Maximum Ratings (Ta = 25 °C)

Parameter	Symbol	Value	Unit
IGBT (Q1, Q4)			
Collector-Emitter Voltage	V_{CES}	1200	V
Gate-Emitter Voltage	V_{GE}	±25	V
Positive Transient Gate-emitter Voltage (Tpulse = 5 s, D < 0.10)		30	
Continuous Collector Current	I_C	600	A
Pulsed Collector Current	I_{CP}	1200	A
IGBT (Q2, Q3)			
Collector-Emitter Voltage	V_{CES}	700	V
Gate-Emitter Voltage	V_{GE}	±25	V
Positive Transient Gate-emitter Voltage (Tpulse = 5 s, D < 0.10)		30	
Continuous Collector Current	I_C	400	A
Pulsed Collector Current	I_{CP}	800	A
DIODE (D1)			
Peak Repetitive Reverse Voltage	V_{RRM}	1200	V
Continuous Forward Current	I_F	300	A
Repetitive Peak Forward Current	I_{FRM}	600	A
DIODE (D4)			
Peak Repetitive Reverse Voltage	V_{RRM}	1200	V
Continuous Forward Current	I_F	400	A
Repetitive Peak Forward Current	I_{FRM}	800	A
DIODE (D2,D3)			
Peak Repetitive Reverse Voltage	V_{RRM}	700	V
Continuous Forward Current	I_F	100	A
Repetitive Peak Forward Current	I_{FRM}	200	A
DIODE (D5,D6)			
Peak Repetitive Reverse Voltage	V_{RRM}	700	V
Continuous Forward Current	I_F	500	A
Repetitive Peak Forward Current	I_{FRM}	1000	A
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
Junction Temperature	T_j	-40 to +175	°C

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	-	1.82	-	V
		V _{GE} = 15 V, I _C = 600 A	T _j = 150°C	-	2.29	-	
Gate–Emitter Threshold Voltage	V _{GE(TH)}	V _{GE} = V _{CE} , I _C = 9 mA	T _j = 25°C	-	5.50	-	V
Total Gate Charge	Q _g	V _{GE} = -7/+15 V, V _{CE} = 600 V	T _j = 25°C	-	3.17	-	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	T _j = 25°C	1200	-	-	V
Collector–Emitter Cutoff Current	I _{CES}	V _{CE} = 1200 V, V _{GE} = 0 V	T _j = 25°C	-	-	100	μA
Input Capacitance	C _{iss}	V _{GE} = 0 V, V _{CE} = 30 V, f = 100 KHz	T _j = 25°C	-	63.5	-	nF
Output Capacitance	C _{oss}		T _j = 25°C	-	1.83	-	
Reverse Transfer Capacitance	C _{rss}		T _j = 25°C	-	0.20	-	
Turn-on Delay Time(inductive load)	t _{d on}	V _{GE} = -7 V / +15 V, V _{DC+} =400 V, V _{DC-} =400 V, I _C = 330 A, R _{Gon} = 0.5 Ω, R _{Goff} = 0.5 Ω	T _j = 25°C	-	53	-	ns
			T _j = 150°C	-	110	-	
Rise Time (inductive load)	t _r		T _j = 25°C	-	27	-	
			T _j = 150°C	-	35	-	
Turn-off Delay Time(inductive load)	t _{d off}		T _j = 25°C	-	194	-	
			T _j = 150°C	-	205	-	
Fall Time (inductive load)	t _f		T _j = 25°C	-	155	-	mJ
			T _j = 150°C	-	268	-	
Turn-on Switching Loss	E _{on}		T _j = 25°C	-	2.97	-	
			T _j = 150°C	-	6.17	-	
Turn-off Switching Loss	E _{off}		T _j = 25°C	-	12.9	-	
			T _j = 150°C	-	17.7	-	
Thermal Resistance – Chip-to–Case	R _{thJC}	Per IGBT	-	0.063	-	°C/W	

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
DIODE (D5,D6)							
Diode Forward Voltage	V _F	I _F = 500 A	T _j = 25°C	-	1.92	-	V
		I _F = 500 A	T _j = 150°C	-	2.09	-	
Reverse Recovery Time	T _{RR}	V _{GE} = -7 V / +15 V, V _{DC+} =400 V, V _{DC-} =400 V, I _C = 330 A, R _{Gon} = 0.5 Ω, R _{Goff} = 0.5 Ω	T _j = 25°C	-	151	-	ns
	T _j = 150°C		-	210	-		
Reverse Recovery Charge	Q _{RR}		T _j = 25°C	-	15.3	-	μC
			T _j = 150°C	-	29.8	-	
Peak Reverse Recovery Current	I _{RRM}		T _j = 25°C	-	229	-	A
			T _j = 150°C	-	293	-	
Reverse Recovery Energy	E _{REC}		T _j = 25°C	-	5.0	-	mJ
			T _j = 150°C	-	9.9	-	
Thermal Resistance – Chip-to-Case	R _{thJC}	Per diode		-	0.135	-	°C/W
IGBT (Q3)							
Collector-Emitter Saturation Voltage	V _{CE(sat)}	V _{GE} = 15 V, I _C = 400 A	T _j = 25°C	-	1.53	-	V
		V _{GE} = 15 V, I _C = 400 A	T _j = 150°C	-	1.73	-	
Gate-Emitter Threshold Voltage	V _{GE(TH)}	V _{GE} = V _{CE} , I _C = 9 mA	T _j = 25°C	-	5.10	-	V
Total Gate Charge	Q _g	V _{GE} = -7/+15 V, V _{CE} = 600 V	T _j = 25°C	-	3.14	-	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	T _j = 25°C	700	-	-	V
Collector-Emitter Cutoff Current	I _{CES}	V _{CE} = 700 V, V _{GE} = 0 V	T _j = 25°C	-	-	100	μA
Input Capacitance	C _{iss}	V _{GE} = 0 V, V _{CE} = 30 V, f = 100KHz	T _j = 25°C	-	48.3	-	nF
Output Capacitance	C _{oss}		T _j = 25°C	-	0.75	-	
Reverse Transfer Capacitance	C _{rss}		T _j = 25°C	-	0.23	-	
Turn-on Delay Time(inductive load)	t _{d on}	V _{GE} = -7 V / +15 V, V _{DC+} =400 V, V _{DC-} =400 V, I _C = 330 A, R _{Gon} = 0.5 Ω, R _{Goff} = 9.1 Ω	T _j = 25°C	-	42	-	ns
			T _j = 150°C	-	95	-	
Rise Time (inductive load)	t _r		T _j = 25°C	-	27	-	
			T _j = 150°C	-	31	-	
Turn-off Delay Time(inductive load)	t _{d off}		T _j = 25°C	-	886	-	
			T _j = 150°C	-	960	-	

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Fall Time (inductive load)	t _f	V _{GE} = -7 V / +15 V, V _{DC+} =400 V, V _{DC-} =400 V, I _C = 330 A, R _{Gon} = 0.5 Ω, R _{Goff} = 9.1 Ω	T _j = 25°C	-	50	-	ns
			T _j = 150°C	-	60	-	
Turn-on Switching Loss	E _{on}		T _j = 25°C	-	1.04	-	mJ
			T _j = 150°C	-	1.96	-	
Turn-off Switching Loss	E _{off}		T _j = 25°C	-	10.2	-	
			T _j = 150°C	-	12.6	-	
Thermal Resistance – Chip-to-Case	R _{thJC}	Per IGBT		-	0.140	-	°C/W

INVERSE DIODE (D1)

Diode Forward Voltage	V _F	I _F = 300 A	T _j = 25°C	-	1.84	-	V
		I _F = 300 A	T _j = 150°C	-	1.90	-	
Reverse Recovery Time	T _{RR}	V _{GE} = -7 V / +15 V, V _{DC+} =400 V, V _{DC-} =400 V, I _C = 330 A, R _{Gon} = 0.5 Ω, R _{Goff} = 9.1 Ω	T _j = 25°C	-	74	-	ns
			T _j = 150°C	-	306	-	
Reverse Recovery Charge	Q _{RR}		T _j = 25°C	-	13.2	-	μC
			T _j = 150°C	-	38.3	-	
Peak Reverse Recovery Current	I _{RRM}		T _j = 25°C	-	328	-	A
			T _j = 150°C	-	418	-	
Reverse Recovery Energy	E _{REC}		T _j = 25°C	-	6.28	-	mJ
			T _j = 150°C	-	15.5	-	
Thermal Resistance – Chip-to-Case	R _{thJC}	Per diode		-	0.119	-	°C/W

IGBT (Q2)

Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_{GE} = 15 \text{ V}$, $I_c = 400 \text{ A}$	$T_j = 25^\circ\text{C}$	-	1.53	-	V
		$V_{GE} = 15 \text{ V}$, $I_c = 400 \text{ A}$	$T_j = 150^\circ\text{C}$	-	1.73	-	
Gate-Emitter Threshold Voltage	$V_{GE(TH)}$	$V_{GE} = V_{CE}$, $I_c = 9 \text{ mA}$	$T_j = 25^\circ\text{C}$	-	5.10	-	V
Total Gate Charge	Q_g	$V_{GE} = -7/+15 \text{ V}$, $V_{CE} = 600 \text{ V}$	$T_j = 25^\circ\text{C}$	-	3.14	-	μC
Gate-Source Leakage Current	I_{GES}	$V_{GE} = \pm 25 \text{ V}$, $V_{CE} = 0 \text{ V}$	$T_j = 25^\circ\text{C}$	-100	-	100	nA
Collector-Emitter Voltage	$V_{(BR)CES}$	$V_{GE} = 0 \text{ V}$	$T_j = 25^\circ\text{C}$	700	-	-	V
Collector-Emitter Cutoff Current	I_{CES}	$V_{CE} = 700 \text{ V}$, $V_{GE} = 0 \text{ V}$	$T_j = 25^\circ\text{C}$	-	-	100	μA
Input Capacitance	C_{iss}	$V_{GE} = 0 \text{ V}$, $V_{CE} = 30 \text{ V}$, $f = 100\text{KHz}$	$T_j = 25^\circ\text{C}$	-	48.3	-	nF
Output Capacitance	C_{oss}		$T_j = 25^\circ\text{C}$	-	0.75	-	
Reverse Transfer Capacitance	C_{rss}		$T_j = 25^\circ\text{C}$	-	0.23	-	

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Turn-on Delay Time(inductive load)	t _{d on}	V _{GE} = -7 V / +15 V , V _{DC+} =400 V , V _{DC-} =400 V , I _C = 330 A , R _{Gon} = 0.5 Ω , R _{Goff} = 9.1 Ω	T _J = 25°C	-	93	-	ns
			T _J = 150°C	-	93	-	
Rise Time (inductive load)	t _r		T _J = 25°C	-	29	-	
			T _J = 150°C	-	32	-	
Turn-off Delay Time(inductive load)	t _{d off}		T _J = 25°C	-	880	-	
			T _J = 150°C	-	950	-	
Fall Time (inductive load)	t _f		T _J = 25°C	-	56	-	ns
			T _J = 150°C	-	61	-	
Turn-on Switching Loss	E _{on}		T _J = 25°C	-	0.68	-	mJ
			T _J = 150°C	-	1.70	-	
Turn-off Switching Loss	E _{off}		T _J = 25°C	-	10.7	-	
			T _J = 150°C	-	13.5	-	
Thermal Resistance – Chip-to-Case	R _{thJC}	Per IGBT		-	0.140	-	°C/W

INVERSE DIODE (D4)

Diode Forward Voltage	V_F	$I_F = 400\ A$	$T_j = 25^\circ C$	-	1.97	-	V
		$I_F = 400\ A$	$T_j = 150^\circ C$	-	2.08	-	
Reverse Recovery Time	T_{RR}	$V_{GE} = -7\ V / +15\ V,$ $V_{DC+} = 400\ V,$ $V_{DC-} = 400\ V,$ $I_c = 330\ A,$ $R_{Gon} = 0.5\ \Omega,$ $R_{Goff} = 9.1\ \Omega$	$T_j = 25^\circ C$	-	85	-	ns
			$T_j = 150^\circ C$	-	315	-	
Reverse Recovery Charge	Q_{RR}		$T_j = 25^\circ C$	-	15.7	-	μC
			$T_j = 150^\circ C$	-	45.5	-	
Peak Reverse Recovery Current	I_{RRM}		$T_j = 25^\circ C$	-	328	-	A
			$T_j = 150^\circ C$	-	450	-	
Reverse Recovery Energy	E_{REC}		$T_j = 25^\circ C$	-	7.51	-	mJ
			$T_j = 150^\circ C$	-	19.0	-	
Thermal Resistance – Chip-to-Case	R_{thJC}	Per diode	-	0.102	-	-	$^\circ C/W$

INVERSE DIODE (D2,D3)

Diode Forward Voltage	V_F	$I_F = 200\ A$	$T_j = 25^\circ C$	-	2.10	-	V
		$I_F = 200\ A$	$T_j = 150^\circ C$	-	2.30	-	

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		
Flatness of base plate					0.3	mm

Typical Characteristics

Fig.1 Typical output characteristics IGBT
 $V_{GE} = 15\text{ V}$ (Q1, Q4)

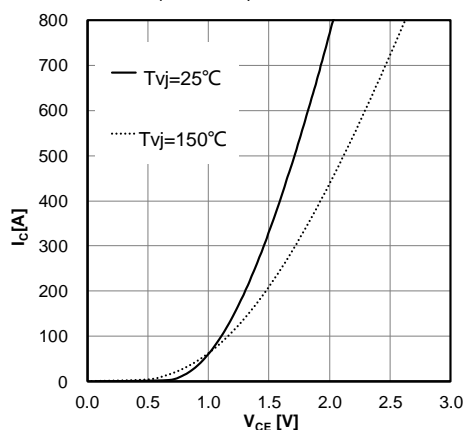


Fig.2 Typical output characteristics IGBT
 $T_{vj} = 150^\circ\text{C}$ (Q1, Q4)

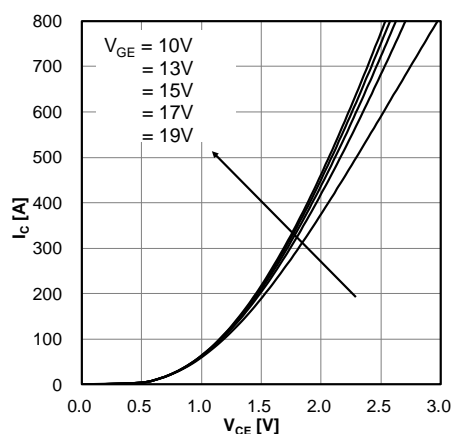


Fig.3 Typical output characteristics IGBT
 $V_{GE} = 15\text{ V}$ (Q2, Q3)

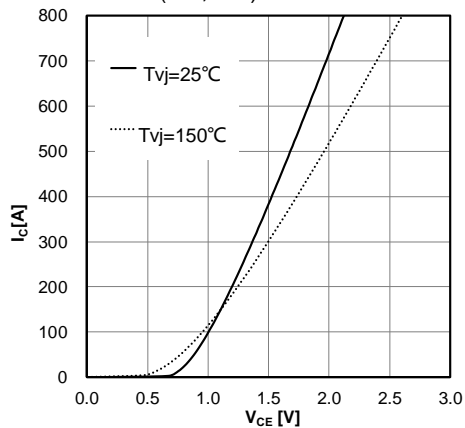


Fig.4 Typical output characteristics IGBT
 $T_{vj} = 150^\circ\text{C}$ (Q2, Q3)

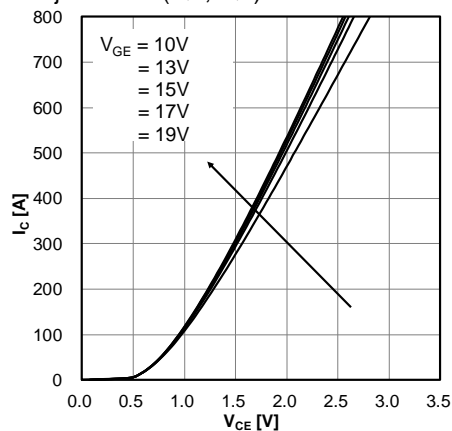


Fig.5 Typical Output Characteristic, IGBT
 $I_c = f(V_{GE})$
 $V_{CE} = 20\text{ V}$ (Q1, Q4)

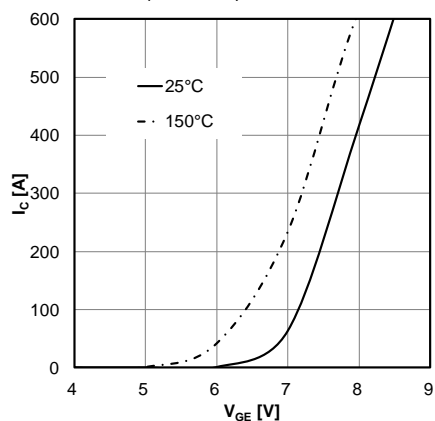
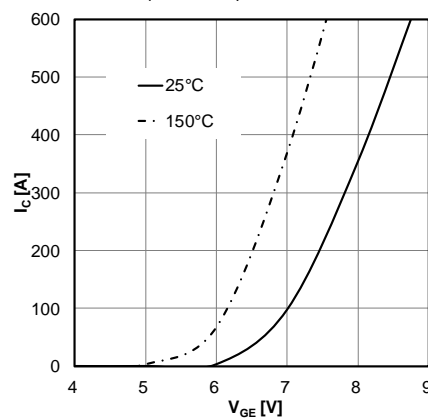


Fig.6 Typical Output Characteristic, IGBT
 $I_c = f(V_{GE})$
 $V_{CE} = 20\text{ V}$ (Q2, Q3)



Typical Characteristics

Fig.7 Diode forward characteristics (D1)

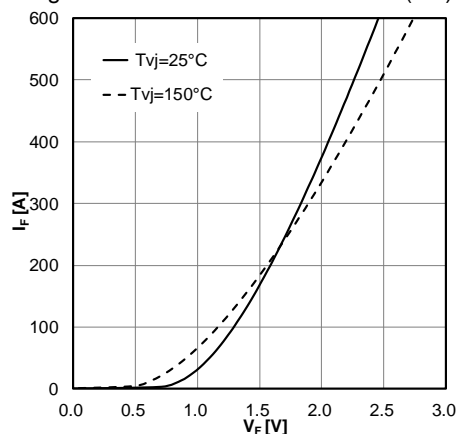


Fig.8 Diode forward characteristics (D2, D3)

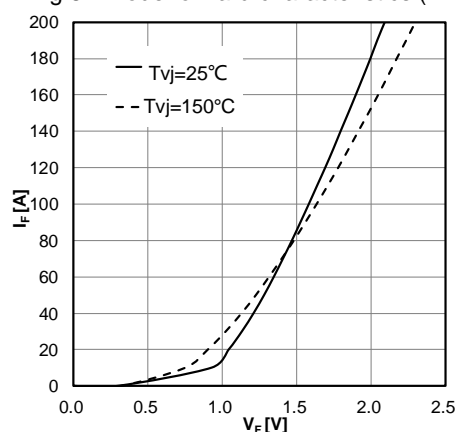


Fig.9 Diode forward characteristics (D4)

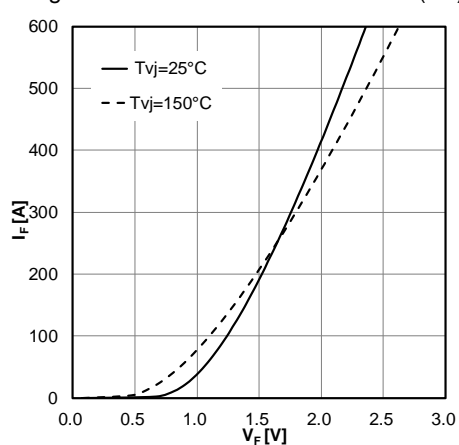


Fig.10 Diode forward characteristics (D5, D6)

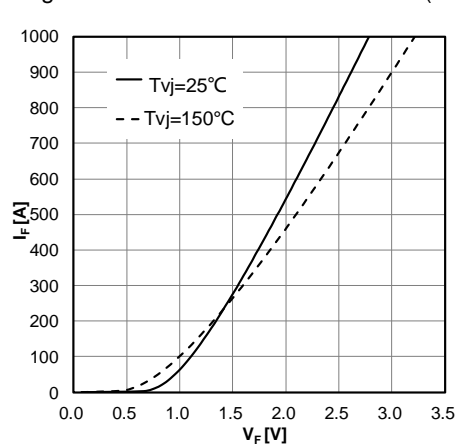


Fig.11 Capacity characteristic
 $C = f(V_{CE})$, $V_{GE} = 0\text{ V}$, $T_{vj} = 25^{\circ}\text{C}$, $f = 100\text{KHz}$
(Q1, Q4)

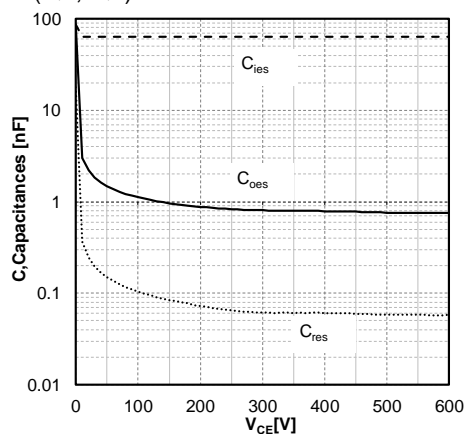
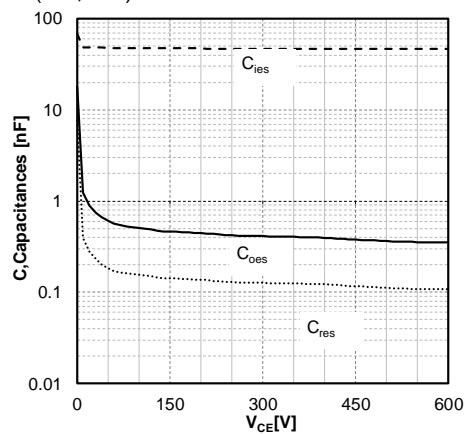


Fig.12 Capacity characteristic
 $C = f(V_{CE})$, $V_{GE} = 0\text{ V}$, $T_{vj} = 25^{\circ}\text{C}$, $f = 100\text{KHz}$
(Q2, Q3)



Typical Characteristics

Q1 || D5 or Q4 || D6

Fig.13 Switching losses IGBT, (typical)

$E_{on} = f(I_c)$, $E_{off} = f(I_c)$,
 $V_{GE} = +15\text{ V} / -7\text{ V}$, $R_{Gon} = 0.5\ \Omega$, $R_{Goff} = 0.5\ \Omega$,
 $V_{DC+} = 400\text{ V}$, $V_{DC-} = 400\text{ V}$

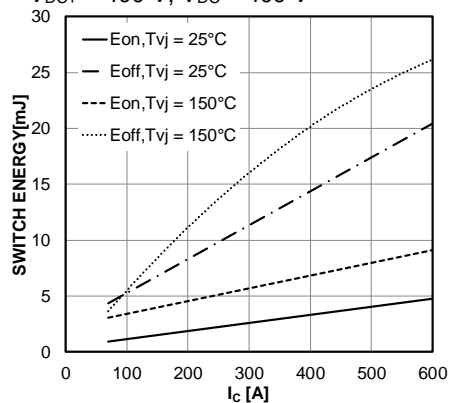


Fig.14 Switching losses Diode, (typical)

$E_{REC} = f(I_F)$,
 $V_{GE} = +15\text{ V} / -7\text{ V}$, $R_{Gon} = 0.5\ \Omega$, $R_{Goff} = 0.5\ \Omega$,
 $V_{DC+} = 400\text{ V}$, $V_{DC-} = 400\text{ V}$

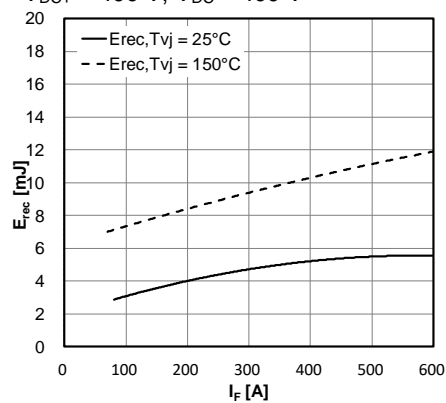


Fig.15 Switching losses IGBT, (typical)

$E_{on} = f(R_G)$, $E_{off} = f(R_G)$,
 $V_{GE} = +15\text{ V} / -7\text{ V}$, $I_c = 330\text{ A}$,
 $V_{DC+} = 400\text{ V}$, $V_{DC-} = 400\text{ V}$

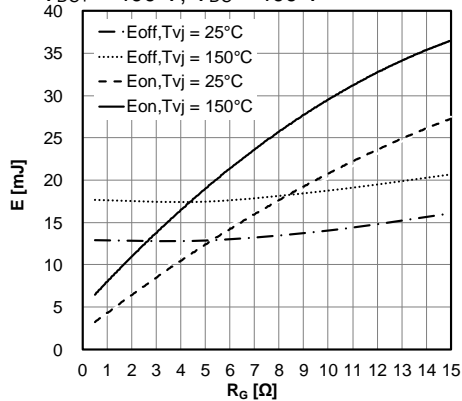
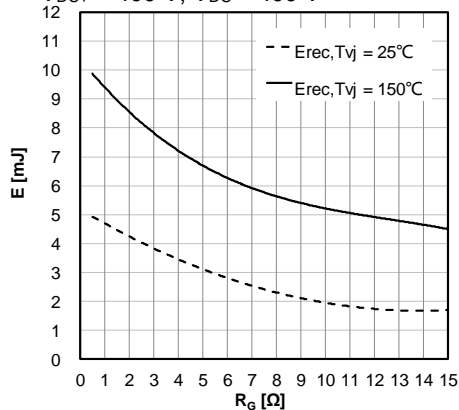


Fig.16 Switching losses Diode, (typical)

$E_{REC} = f(R_G)$,
 $V_{GE} = +15\text{ V} / -7\text{ V}$, $I_F = 330\text{ A}$,
 $V_{DC+} = 400\text{ V}$, $V_{DC-} = 400\text{ V}$



Q3 || D1

Fig.17 Switching losses IGBT, (typical)

$E_{on} = f(I_c)$,
 $V_{GE} = +15\text{ V} / -7\text{ V}$, $R_{Gon} = 0.5\ \Omega$, $R_{Goff} = 9.1\ \Omega$,
 $V_{DC+} = 400\text{ V}$, $V_{DC-} = 400\text{ V}$

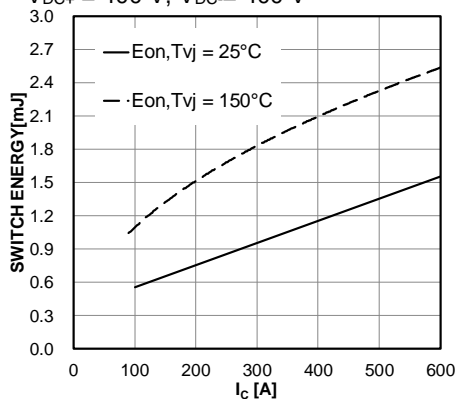
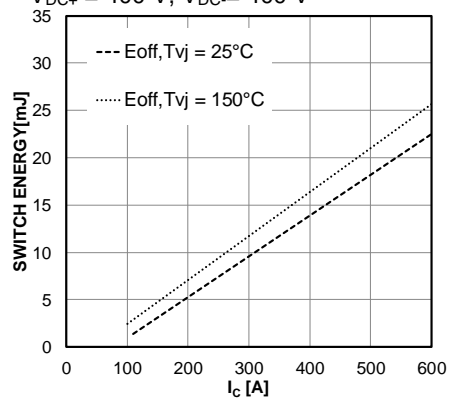


Fig.18 Switching losses IGBT, (typical)

$E_{off} = f(I_c)$,
 $V_{GE} = +15\text{ V} / -7\text{ V}$, $R_{Gon} = 0.5\ \Omega$, $R_{Goff} = 9.1\ \Omega$,
 $V_{DC+} = 400\text{ V}$, $V_{DC-} = 400\text{ V}$



Typical Characteristics

Fig.19 Switching losses Diode, (typical)

$E_{REC} = f(I_C)$,
 $V_{GE} = +15\text{ V} / -7\text{ V}$, $R_{Gon} = 0.5\ \Omega$, $R_{Goff} = 9.1\ \Omega$,
 $V_{DC+} = 400\text{ V}$, $V_{DC-} = 400\text{ V}$

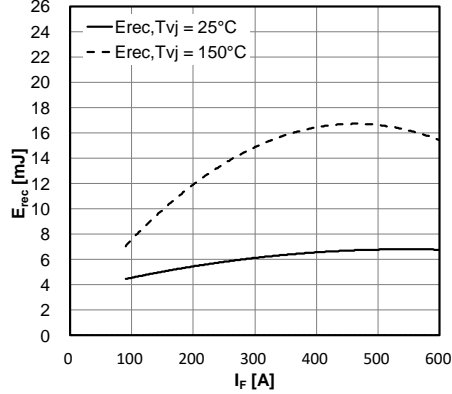


Fig.20 Switching losses IGBT, (typical)

$E_{on} = f(R_G)$,
 $V_{GE} = +15\text{ V} / -7\text{ V}$, $I_C = 330\text{ A}$,
 $V_{DC+} = 400\text{ V}$, $V_{DC-} = 400\text{ V}$

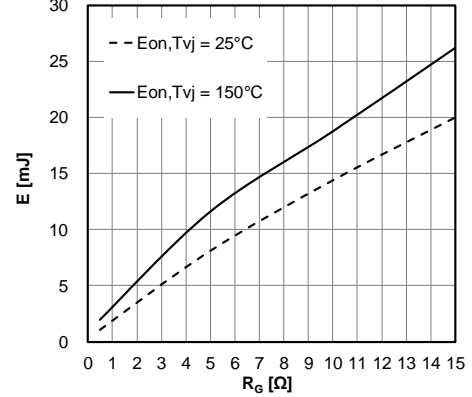


Fig.21 Switching losses IGBT, (typical)

$E_{off} = f(R_G)$,
 $V_{GE} = +15\text{ V} / -7\text{ V}$, $I_C = 330\text{ A}$,
 $V_{DC+} = 400\text{ V}$, $V_{DC-} = 400\text{ V}$

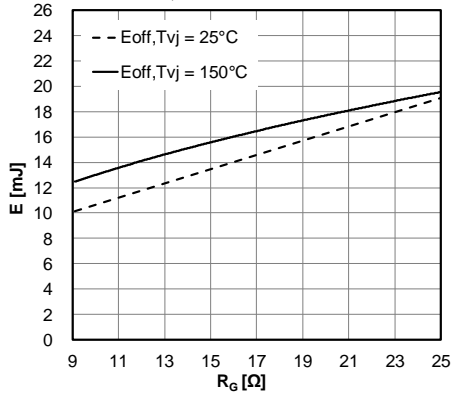
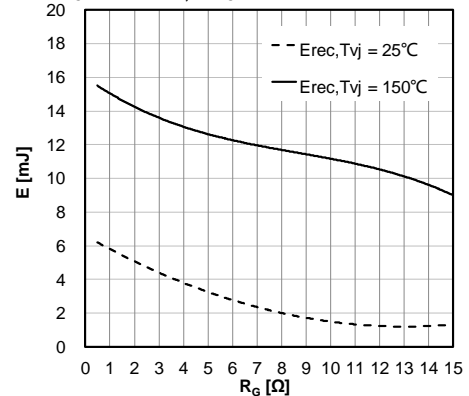


Fig.22 Switching losses Diode, (typical)

$E_{REC} = f(R_G)$,
 $V_{GE} = +15\text{ V} / -7\text{ V}$, $I_F = 330\text{ A}$,
 $V_{DC+} = 400\text{ V}$, $V_{DC-} = 400\text{ V}$



Q2 || D4

Fig.23 Switching losses IGBT, (typical)

$E_{on} = f(I_C)$,
 $V_{GE} = +15\text{ V} / -7\text{ V}$, $R_{Gon} = 0.5\ \Omega$, $R_{Goff} = 9.1\ \Omega$,
 $V_{DC+} = 400\text{ V}$, $V_{DC-} = 400\text{ V}$

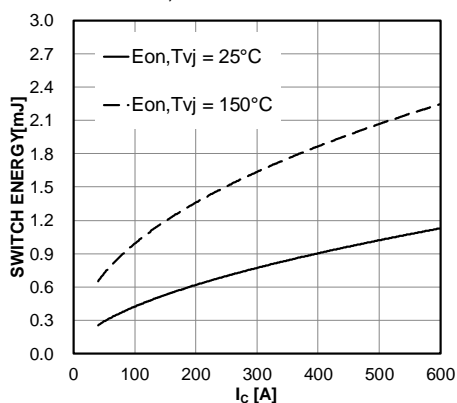
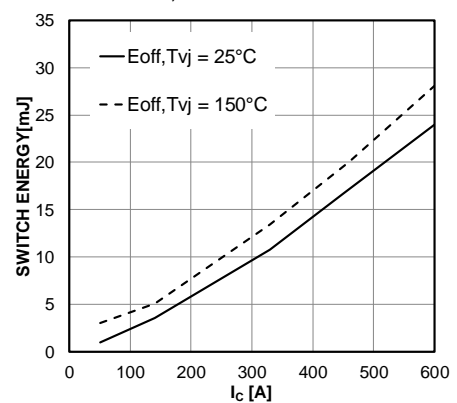


Fig.24 Switching losses IGBT, (typical)

$E_{off} = f(I_C)$,
 $V_{GE} = +15\text{ V} / -7\text{ V}$, $R_{Gon} = 0.5\ \Omega$, $R_{Goff} = 9.1\ \Omega$,
 $V_{DC+} = 400\text{ V}$, $V_{DC-} = 400\text{ V}$



Typical Characteristics

Fig.25 Switching losses Diode, (typical)

$E_{REC} = f(I_F)$,
 $V_{GE} = +15\text{ V} / -7\text{ V}$, $R_{Gon} = 0.5\ \Omega$, $R_{Goff} = 9.1\ \Omega$,
 $V_{DC+} = 400\text{ V}$, $V_{DC-} = 400\text{ V}$

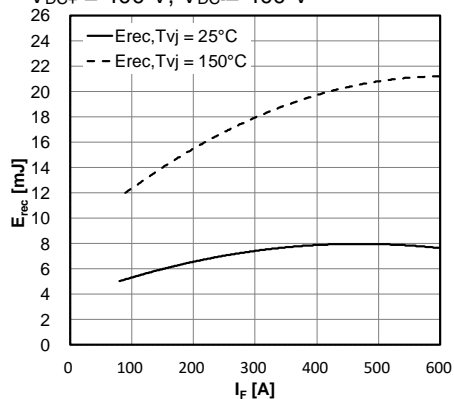


Fig.26 Switching losses IGBT, (typical)

$E_{off} = f(R_G)$,
 $V_{GE} = +15\text{ V} / -7\text{ V}$, $I_C = 330\text{ A}$,
 $V_{DC+} = 400\text{ V}$, $V_{DC-} = 400\text{ V}$

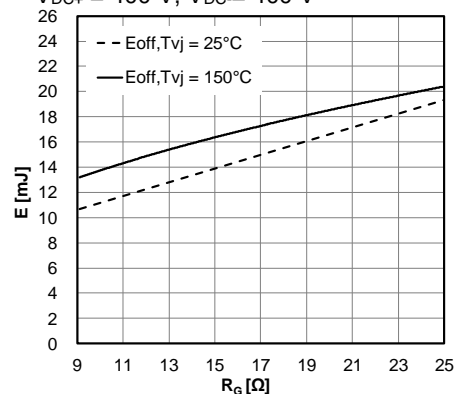


Fig.27 Switching losses IGBT, (typical)

$E_{on} = f(R_G)$,
 $V_{GE} = +15\text{ V} / -7\text{ V}$, $I_C = 330\text{ A}$,
 $V_{DC+} = 400\text{ V}$, $V_{DC-} = 400\text{ V}$

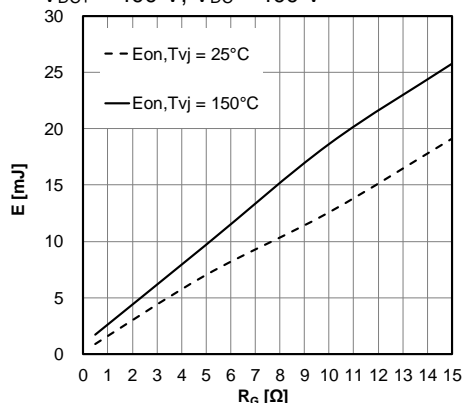


Fig.28 Switching losses Diode, (typical)

$E_{REC} = f(R_G)$,
 $V_{GE} = +15\text{ V} / -7\text{ V}$, $I_F = 330\text{ A}$,
 $V_{DC+} = 400\text{ V}$, $V_{DC-} = 400\text{ V}$

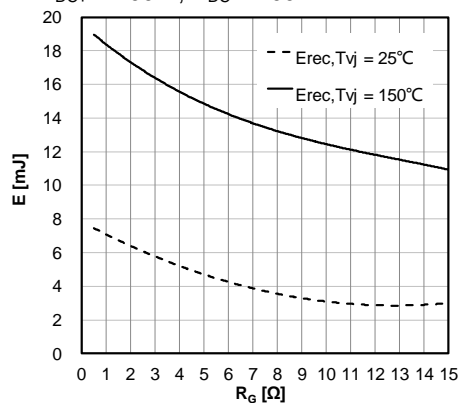


Fig.29 Transient thermal impedance IGBT,
 $Z_{thJC} = f(t)$ (Q1, Q4)

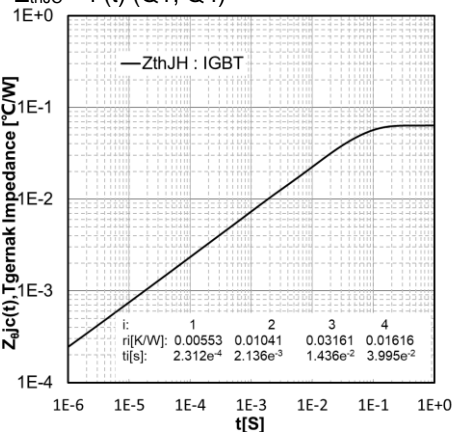
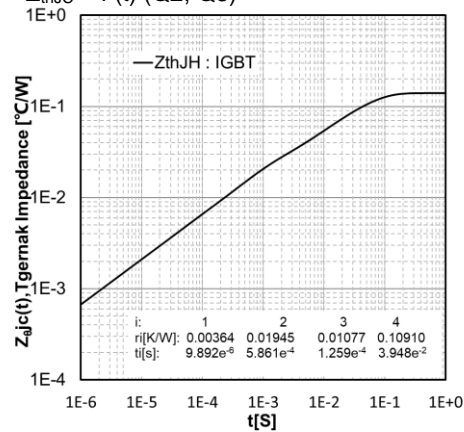


Fig.30 Transient thermal impedance IGBT,
 $Z_{thJC} = f(t)$ (Q2, Q3)



Typical Characteristics

Fig.31 Transient thermal impedance Diode,
 $Z_{thJC} = f(t)$ (D1)

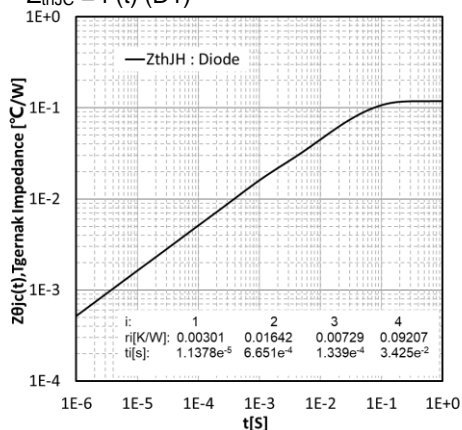


Fig.32 Transient thermal impedance Diode,
 $Z_{thJC} = f(t)$ (D4)

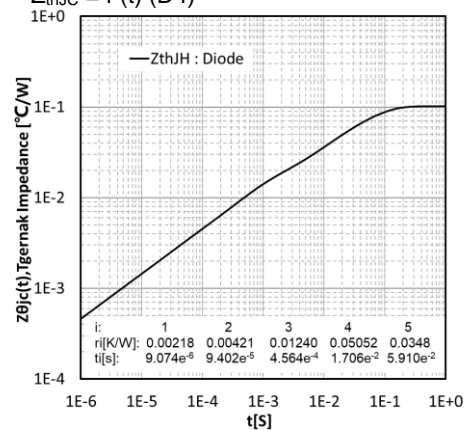


Fig.33 Transient thermal impedance Diode,
 $Z_{thJC} = f(t)$ (D5, D6)

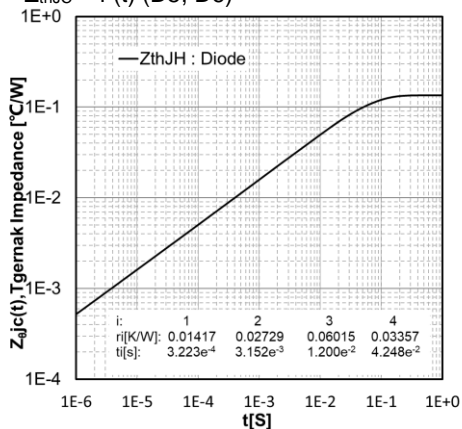
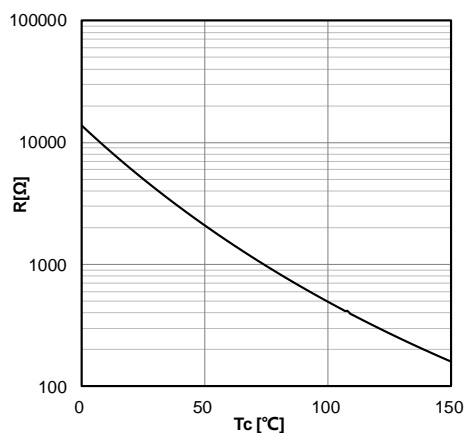
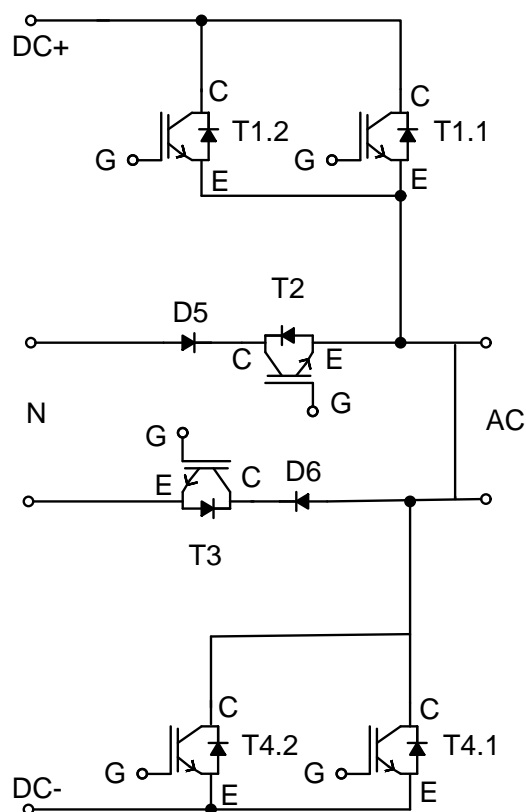


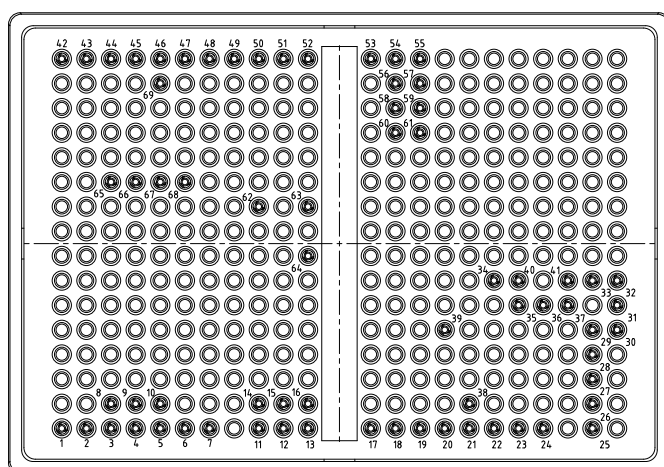
Fig.34 NTC-Thermistor-temperature characteristic
(typical)



Circuit Diagram



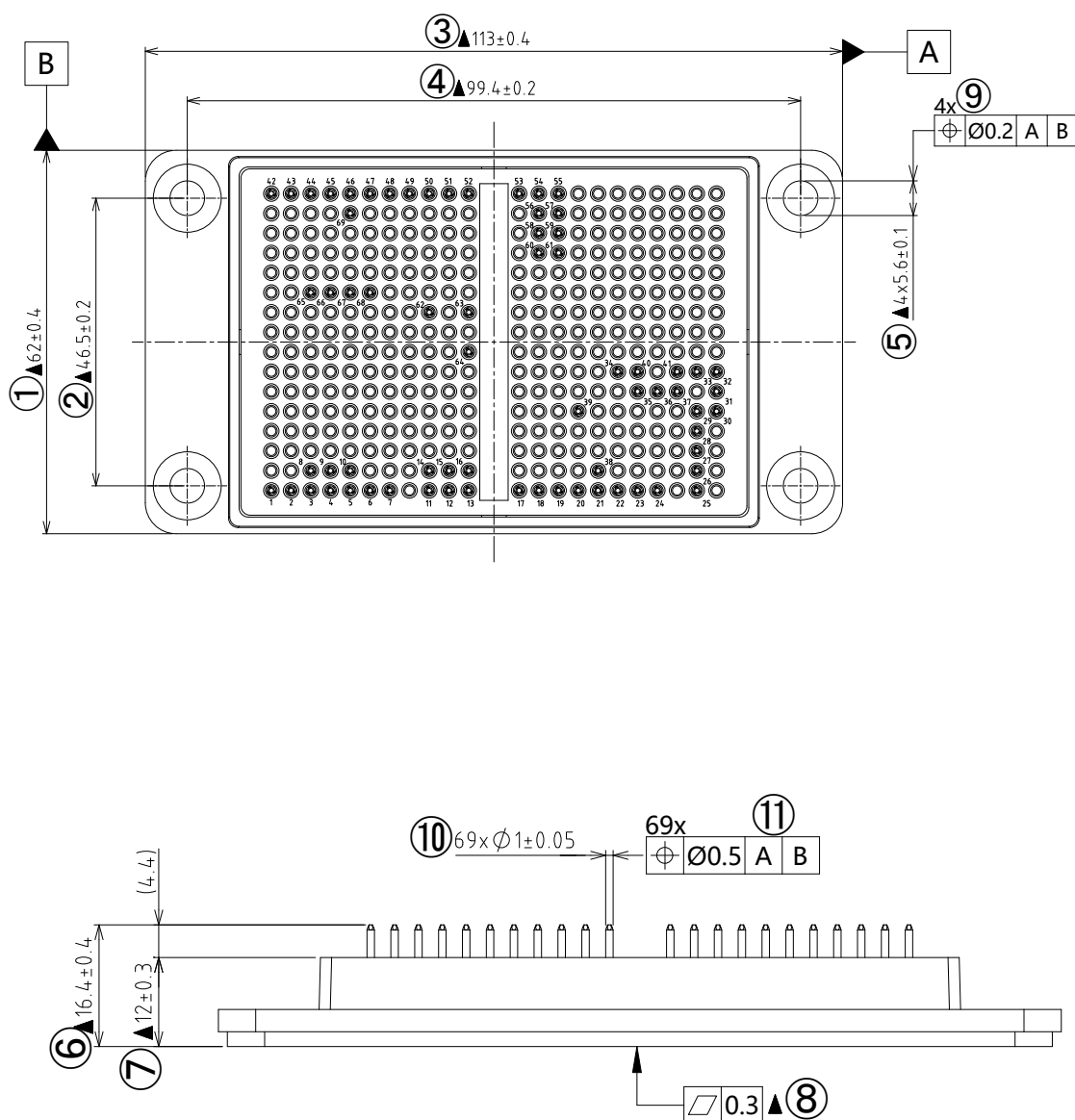
Pin Connections



PIN 脚定义:

1~10	DC+
11~24	N
25~37	DC-
38	G3
39	C3
40	G4.2
41	G4.1
42~61	AC
62	C2
63	T1
64	T2
65	E1.2
66	G1.2
67	G1.1
68	E1.1
69	G2

Package Outlines



Package Outlines

