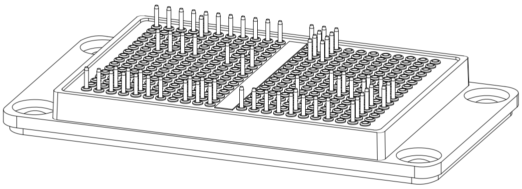
Features

- 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 applications
- Three-level applications
- High-frequency switching application
- Solar applications

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 Positive Transient Gate−emitter Voltage (Tpulse = 5 s, D < 0.10)	V_{GE}	±25 30	V
Continuous Collector Current	I_C	600	A
Pulsed Collector Current	I_{CP}	1200	A
IGBT (Q2, Q3)			
Collector−Emitter Voltage	V_{CES}	750	V
Gate−Emitter Voltage Positive Transient Gate−emitter Voltage (Tpulse = 5 s, D < 0.10)	V_{GE}	±25 30	V
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}	750	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}	750	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	Viso	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	-	1.80	-	V
		V_{GE} = 15 V, I_C = 600 A	T_j= 150°C	-	2.35	-	
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	-	3.49	-	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	-	66.4	-	nF
Output Capacitance	C_{oss}		T_j = 25°C	-	1.77	-	
Reverse Transfer Capacitance	C_{rss}		T_j = 25°C	-	0.19	-	
Turn-on Delay Time(inductive load)	$t_{d\,on}$	V_{GE} = -7 V / +15 V, V_{DC+} =470 V, V_{DC-} =470 V, I_C = 300 A, R_{Gon} = 2.0 Ω, R_{Goff} = 0.5 Ω	T_j = 25°C	-	50	-	ns
			T_j = 150°C	-	100	-	
Rise Time (inductive load)	t_r		T_j = 25°C	-	40	-	
			T_j = 150°C	-	50	-	
Turn-off Delay Time(inductive load)	$t_{d\,off}$		T_j = 25°C	-	150	-	
			T_j = 150°C	-	225	-	
Fall Time (inductive load)	t_f		T_j = 25°C	-	160	-	
			T_j = 150°C	-	230	-	
Turn-on Switching Loss	E_{on}		T_j = 25°C	-	10.92	-	mJ
			T_j = 150°C	-	17.10	-	
Turn-off Switching Loss	E_{off}		T_j = 25°C	-	12.66	-	
			T_j = 150°C	-	19.36	-	
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	-	1.84	-	V
		I_F = 500 A	T_j = 150°C	-	1.98	-	
Reverse Recovery Time	T_{RR}	V_{GE} = -7 V / +15 V, V_{DC+} =470 V, V_{DC-} =470 V, I_C = 300 A, R_{Gon} = 2.0 Ω, R_{Goff} = 0.5 Ω	T_j = 25°C	-	160	-	ns
			T_j = 150°C	-	245	-	
Reverse Recovery Charge	Q_{RR}		T_j = 25°C	-	15.6	-	µC
			T_j = 150°C	-	38.0	-	
Peak Reverse Recovery Current	I_{RRM}		T_j = 25°C	-	250	-	A
			T_j = 150°C	-	315	-	
Reverse Recovery Energy	E_{REC}		T_j = 25°C	-	5.50	-	mJ
			T_j = 150°C	-	10.98	-	
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	-	1.50	-	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	-	4.10	-	V
Total Gate Charge	Q_g	V_{GE} = -7/+15 V, V_{CE} = 600 V	T_j = 25°C	-	0.96	-	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	750	-	-	V
Collector−Emitter Cutoff Current	I_{CES}	V_{CE} = 750 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	-	14	-	nF
Output Capacitance	C_{oss}		T_j = 25°C	-	0.79	-	
Reverse Transfer Capacitance	C_{rss}		T_j = 25°C	-	0.10	-	
Turn-on Delay Time(inductive load)	$t_{d\ on}$	V_{GE} = -7 V / +15 V, V_{DC+} =470 V, V_{DC-} =470 V, I_C = 300 A, R_{Gon} = 10 Ω, R_{Goff} = 36 Ω	T_j = 25°C	-	35	-	ns
			T_j = 150°C	-	68	-	
Rise Time (inductive load)	t_r		T_j = 25°C	-	30	-	
			T_j = 150°C	-	46	-	
Turn-off Delay Time(inductive load)	$t_{d\ off}$		T_j = 25°C	-	980	-	
			T_j = 150°C	-	1550	-	

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Fall Time (inductive load)	t_f	V_{GE} = -7 V / +15 V, V_{DC+} =470 V, V_{DC-} =470 V, I_C = 300 A, R_{Gon} = 10 Ω, R_{Goff} = 36 Ω	T_j = 25°C	-	45	-	ns
			T_j = 150°C	-	53	-	
Turn-on Switching Loss	E_{on}		T_j = 25°C	-	6.50	-	mJ
			T_j = 150°C	-	9.20	-	
Turn-off Switching Loss	E_{off}		T_j = 25°C	-	12.61	-	
			T_j = 150°C	-	15.00	-	
Thermal Resistance − Chip−to−Case	R_{thJC}	Per IGBT		-	0.140	-	°C/W

INVERSE DIODE (D1)

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Diode Forward Voltage	V_F	I_F = 300 A	T_j = 25°C	-	1.81	-	V
		I_F = 300 A	T_j = 150°C	-	1.94	-	
Reverse Recovery Time	T_{RR}	V_{GE} = -7 V / +15 V, V_{DC+} =470 V, V_{DC-} =470 V, I_C = 300 A, R_{Gon} = 10 Ω, R_{Goff} = 36 Ω	T_j = 25°C	-	85	-	ns
			T_j = 150°C	-	343	-	
Reverse Recovery Charge	Q_{RR}		T_j = 25°C	-	14.2	-	μC
			T_j = 150°C	-	39.3	-	
Peak Reverse Recovery Current	I_{RRM}		T_j = 25°C	-	289	-	A
			T_j = 150°C	-	376	-	
Reverse Recovery Energy	E_{REC}		T_j = 25°C	-	6.0	-	mJ
			T_j = 150°C	-	17.0	-	
Thermal Resistance − Chip−to−Case	R_{thJC}	Per diode		-	0.119	-	°C/W

IGBT (Q2)

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Collector−Emitter Saturation Voltage	$V_{CE(sat)}$	V_{GE} = 15 V, I_C = 400 A	T_j = 25°C	-	1.50	-	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	-	4.10	-	V
Total Gate Charge	Q_g	V_{GE} = -7/+15 V, V_{CE} = 600 V	T_j = 25°C	-	0.96	-	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	750	-	-	V
Collector−Emitter Cutoff Current	I_{CES}	V_{CE} = 750 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	-	14	-	nF
Output Capacitance	C_{oss}		T_j = 25°C	-	0.79	-	
Reverse Transfer Capacitance	C_{rss}		T_j = 25°C	-	0.10	-	

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Turn-on Delay Time(inductive load)	$t_{d\ on}$	V_{GE} = -7 V / +15 V, V_{DC+} =470 V, V_{DC-} =470 V, I_C = 300 A, R_{Gon} = 10 Ω, R_{Goff} = 36 Ω	T_j = 25°C	-	100	-	ns
			T_j = 150°C	-	115	-	
Rise Time (inductive load)	t_r		T_j = 25°C	-	89	-	
			T_j = 150°C	-	105	-	
Turn-off Delay Time(inductive load)	$t_{d\ off}$		T_j = 25°C	-	1050	-	
			T_j = 150°C	-	1480	-	
Fall Time (inductive load)	t_f		T_j = 25°C	-	45	-	ns
			T_j = 150°C	-	98	-	
Turn-on Switching Loss	E_{on}		T_j = 25°C	-	4.26	-	mJ
			T_j = 150°C	-	6.55	-	
Turn-off Switching Loss	E_{off}		T_j = 25°C	-	13.2	-	
			T_j = 150°C	-	15.1	-	
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°C	-	1.89	-	V
		I_F = 400 A	T_j = 150°C	-	2.00	-	
Reverse Recovery Time	T_{RR}	V_{GE} = -7 V / +15 V, V_{DC+} =470 V, V_{DC-} =470 V, I_C = 300 A, R_{Gon} = 10 Ω, R_{Goff} = 36 Ω	T_j = 25°C	-	90	-	ns
			T_j = 150°C	-	300	-	
Reverse Recovery Charge	Q_{RR}		T_j = 25°C	-	15.4	-	μC
			T_j = 150°C	-	45.2	-	
Peak Reverse Recovery Current	I_{RRM}		T_j = 25°C	-	280	-	A
			T_j = 150°C	-	360	-	
Reverse Recovery Energy	E_{REC}		T_j = 25°C	-	8.07	-	mJ
			T_j = 150°C	-	22.0	-	
Thermal Resistance − Chip−to−Case	R_{thJC}	Per diode		-	0.102	-	°C/W
INVERSE DIODE (D2,D3)							
Diode Forward Voltage	V_F	I_F = 100 A	T_j = 25°C	-	1.62	-	V
		I_F = 100 A	T_j = 150°C	-	1.68	-	

Table 3 NTC-Thermistor

Parameter	Symbol	Min	Typ.	Max	Unit	Conditions
Rated resistance	R_{25}	-	5	-	kΩ	T_C = 25°C
Deviation of R100	ΔR/R	-5	-	5	%	T_C = 100°C, R_{100} = 493 Ω
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 V (Q1, Q4)

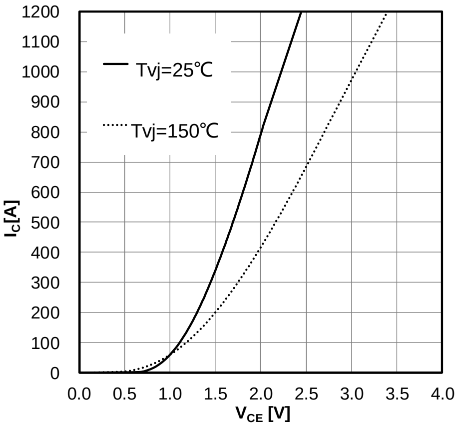


Fig.2 Typical output characteristics IGBT
Tvj = 150°C (Q1, Q4)

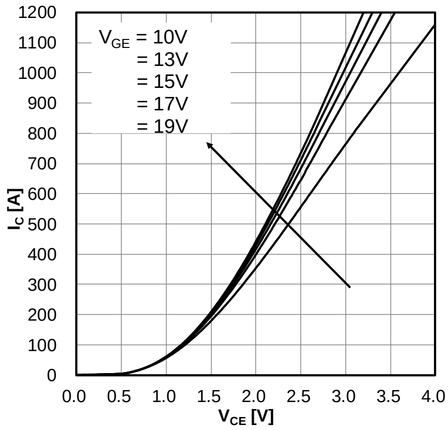


Fig.3 Typical output characteristics IGBT
V_{GE} = 15 V (Q2, Q3)

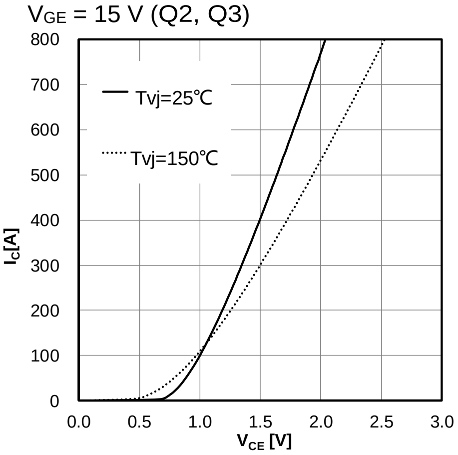


Fig.4 Typical output characteristics IGBT
Tvj = 150°C (Q2, Q3)

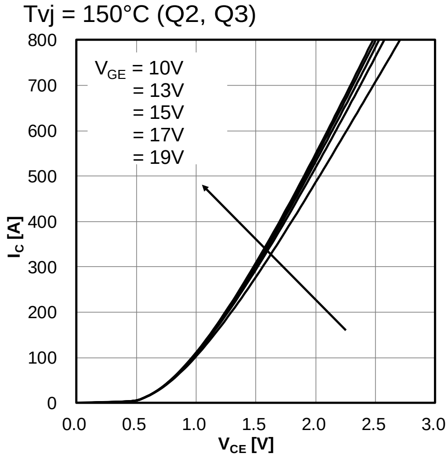


Fig.5 Typical Output Characteristic, IGBT
$I_C = f(V_{GE})$
V_{CE} = 20V (Q1, Q4)

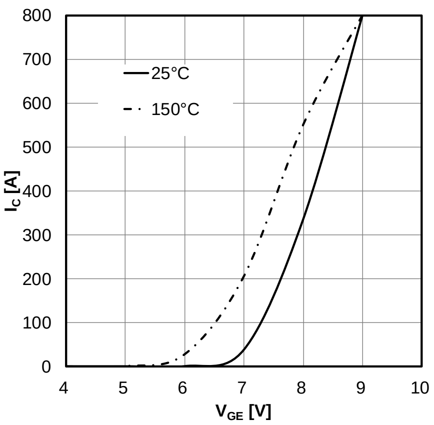
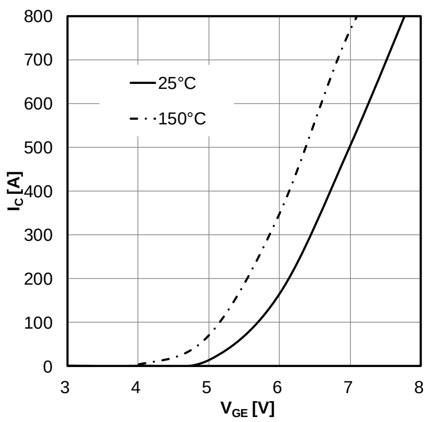


Fig.6 Typical Output Characteristic, IGBT
$I_C = f(V_{GE})$
V_{CE} = 20V (Q2, Q3)



Typical Characteristics

Fig.7 Diode forward characteristics (D1)

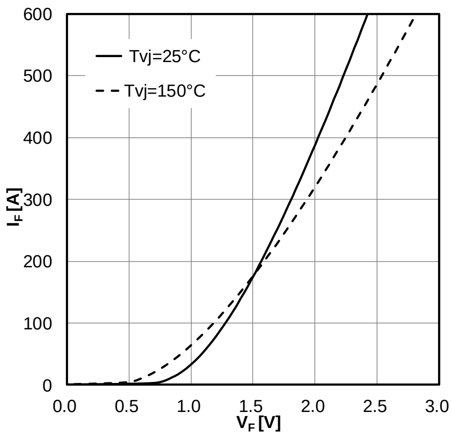


Fig.8 Diode forward characteristics (D2, D3)

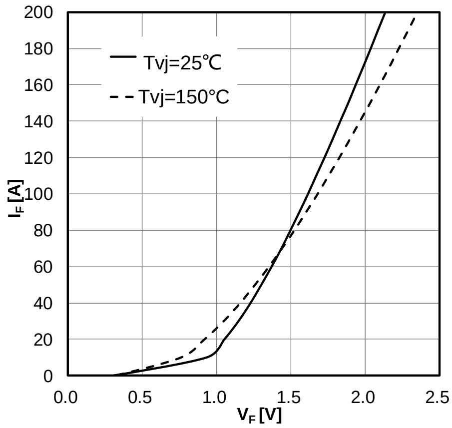


Fig.9 Diode forward characteristics (D4)

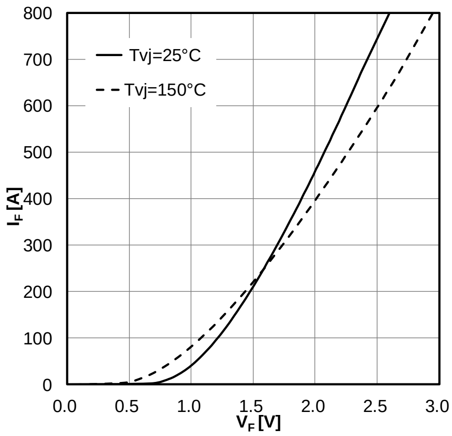


Fig.10 Diode forward characteristics (D5, D6)

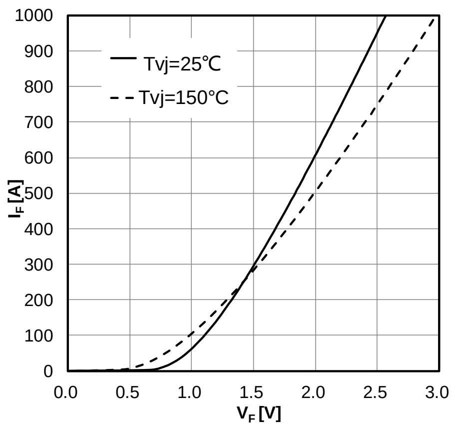


Fig.11 Capacity characteristic
C = f (V_{CE}), V_{GE} = 0 V, Tvj = 25°C, f = 100 KHz
(Q1, Q4)

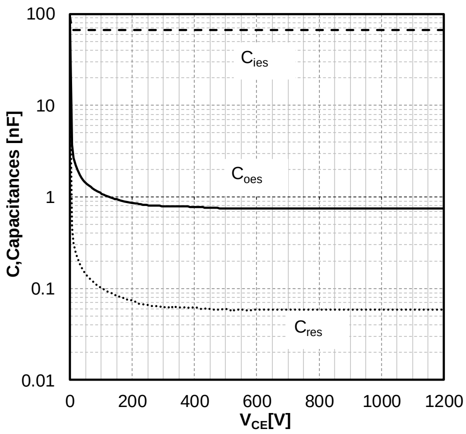
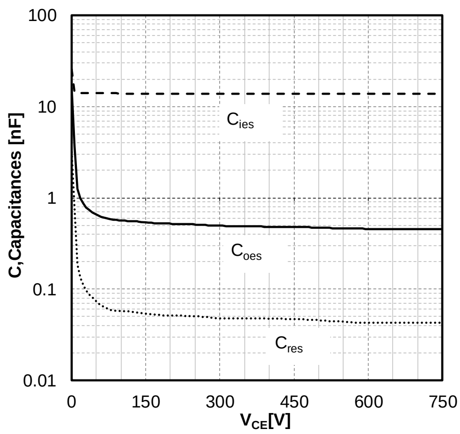


Fig.12 Capacity characteristic
C = f (V_{CE}), V_{GE} = 0 V, Tvj = 25°C, f = 100 KHz
(Q2, Q3)



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 V / -7 V, R_{Gon} = 2.0 Ω, R_{Goff} = 0.5 Ω,
V_{DC+} = 470 V, V_{DC-}= 470 V

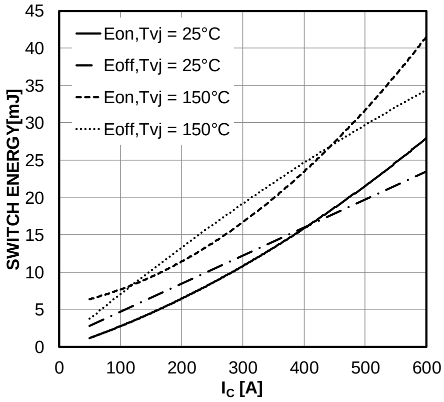


Fig.14 Switching losses Diode, (typical)
E_{REC} = f (I_F),
V_{GE} = +15 V / -7 V, R_{Gon} = 2.0 Ω, R_{Goff} = 0.5 Ω,
V_{DC+} = 470 V, V_{DC-}= 470 V

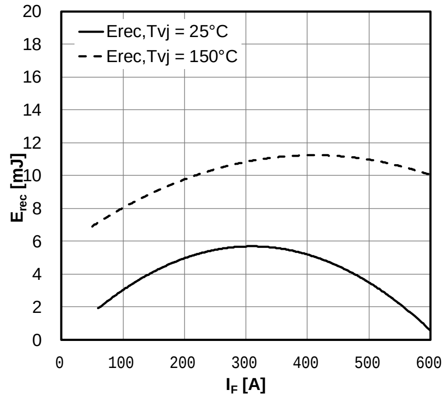


Fig.15 Switching losses IGBT, (typical)
E_{on} = f (R_G), E_{off} = f (R_G),
V_{GE} = +15 V / -7 V, I_C = 300 A,
V_{DC+} = 470 V, V_{DC-}= 470 V

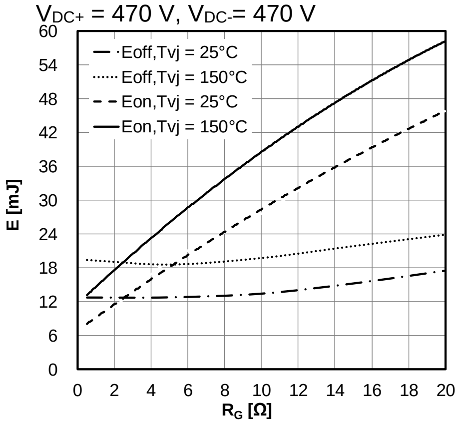
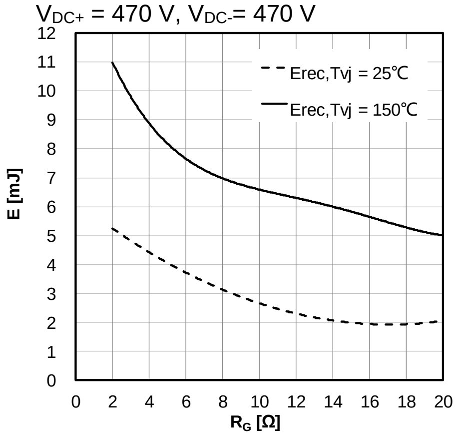


Fig.16 Switching losses Diode, (typical)
E_{REC} = f (R_G),
V_{GE} = +15 V / -7 V, I_F = 300 A,
V_{DC+} = 470 V, V_{DC-}= 470 V



Q3 || D1

Fig.17 Switching losses IGBT, (typical)
E_{on} = f (I_C),
V_{GE} = +15 V / -7 V, R_{Gon} = 10 Ω, R_{Goff} = 36 Ω,
V_{DC+} = 470 V, V_{DC-}= 470 V

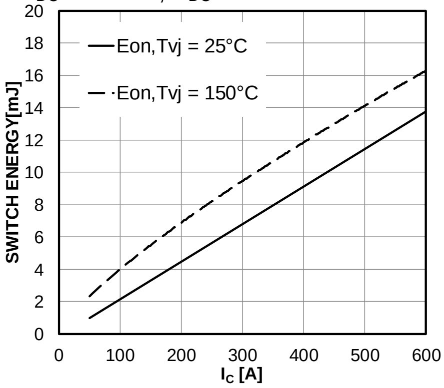
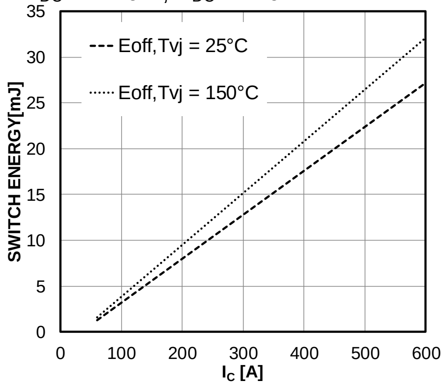


Fig.18 Switching losses IGBT, (typical)
E_{off} = f (I_C),
V_{GE} = +15 V / -7 V, R_{Gon} = 10 Ω, R_{Goff} = 36 Ω,
V_{DC+} = 470 V, V_{DC-}= 470 V



Typical Characteristics

Fig.19 Switching losses Diode, (typical)
$E_{REC} = f(I_F)$,
V_{GE} = +15 V / -7 V, R_{Gon} = 10 Ω, R_{Goff} = 36 Ω,
V_{DC+} = 470 V, V_{DC-}= 470 V

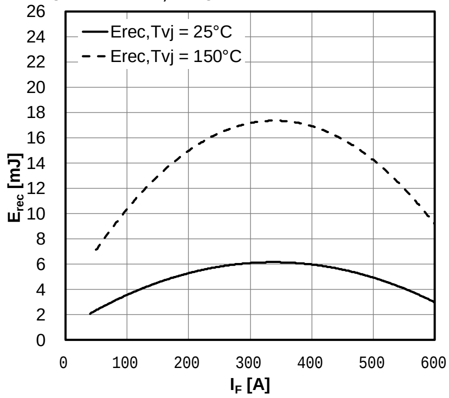


Fig.20 Switching losses IGBT, (typical)
$E_{on} = f(R_G)$,
V_{GE} = +15 V / -7 V, I_C = 300 A,
V_{DC+} = 470 V, V_{DC-}= 470 V

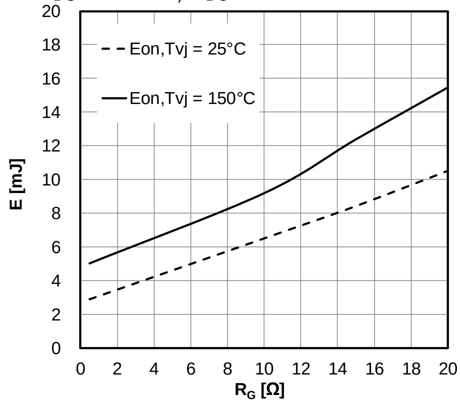


Fig.21 Switching losses IGBT, (typical)
$E_{off} = f(R_G)$,
V_{GE} = +15 V / -7 V, I_C = 300 A,
V_{DC+} = 470 V, V_{DC-}= 470 V

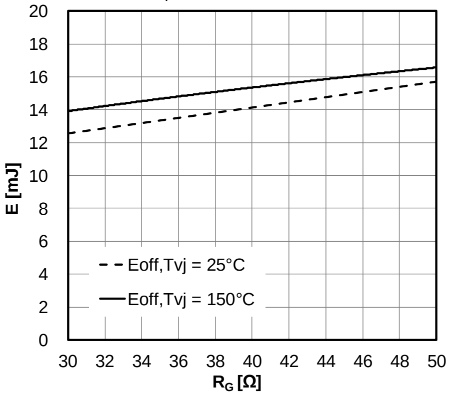
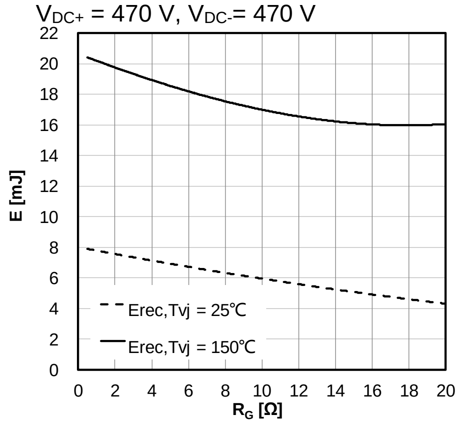


Fig.22 Switching losses Diode, (typical)
$E_{REC} = f(R_G)$,
V_{GE} = +15 V / -7 V, I_F = 300 A,
V_{DC+} = 470 V, V_{DC-}= 470 V



Q2 || D4

Fig.23 Switching losses IGBT, (typical)
$E_{on} = f(I_C)$,
V_{GE} = +15 V / -7 V, R_{Gon} = 10 Ω, R_{Goff} = 36 Ω,
V_{DC+} = 470 V, V_{DC-}= 470 V

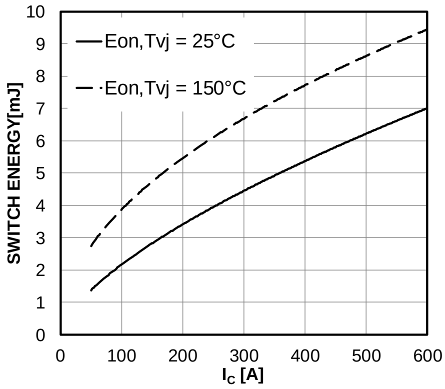
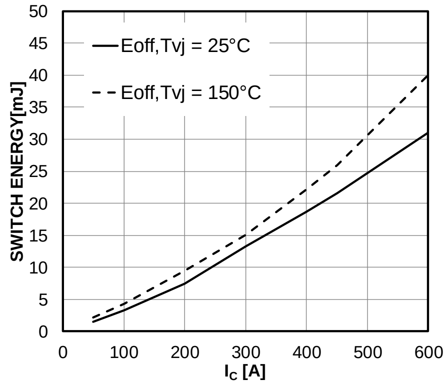


Fig.24 Switching losses IGBT, (typical)
$E_{off} = f(I_C)$,
V_{GE} = +15 V / -7 V, R_{Gon} = 10 Ω, R_{Goff} = 36 Ω,
V_{DC+} = 470 V, V_{DC-}= 470 V



Typical Characteristics

Fig.25 Switching lossses Diode, (typical)
E_{REC} = f (I_F),
V_{GE} = +15 V / -7 V, R_{Gon} = 10 Ω, R_{Goff} = 36 Ω,
V_{DC+} = 470 V, V_{DC-}= 470 V

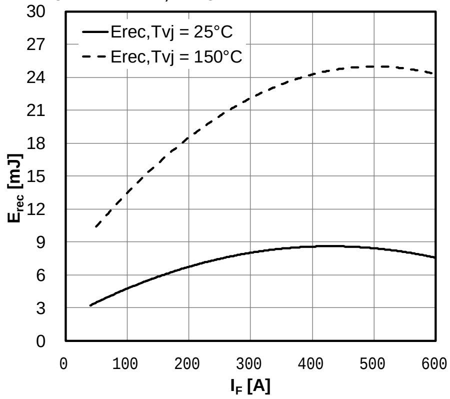


Fig.26 Switching lossses IGBT, (typical)
E_{off} = f (R_G),
V_{GE} = +15 V / -7 V, I_C = 300 A,
V_{DC+} = 470 V, V_{DC-}= 470 V

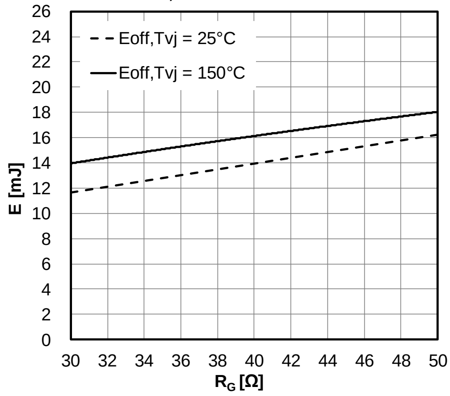


Fig.27 Switching losses IGBT, (typical)
E_{on} = f (R_G),
V_{GE} = +15 V / -7 V, I_C = 300 A,
V_{DC+} = 470 V, V_{DC-}= 470 V

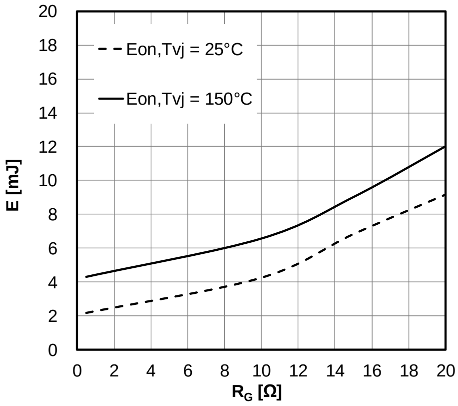


Fig.28 Switching losses Diode, (typical)
E_{REC} = f (R_G),
V_{GE} = +15 V / -7 V, I_F = 300 A,
V_{DC+} = 470 V, V_{DC-}= 470 V

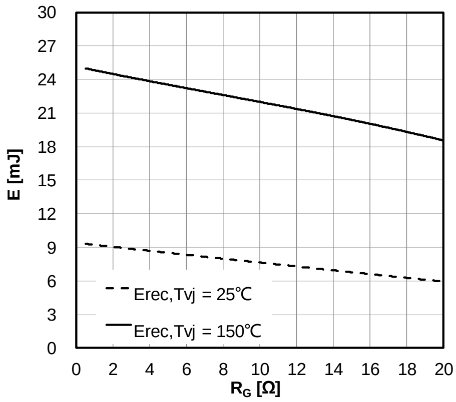


Fig.29 Transient thermal impedance IGBT,
Z_{thJC} = f (t) (Q1, Q4)

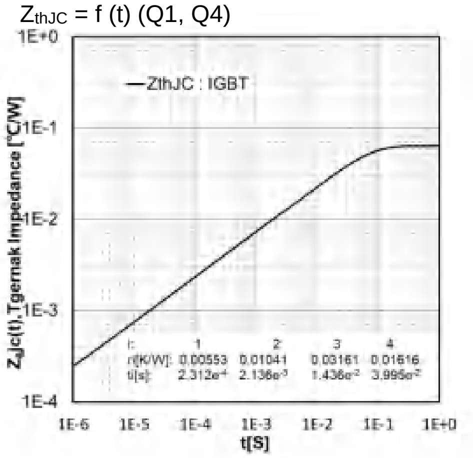
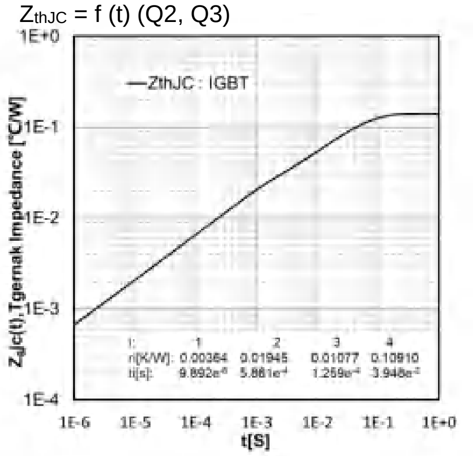


Fig.30 Transient thermal impedance IGBT,
Z_{thJC} = f (t) (Q2, Q3)



Typical Characteristics

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

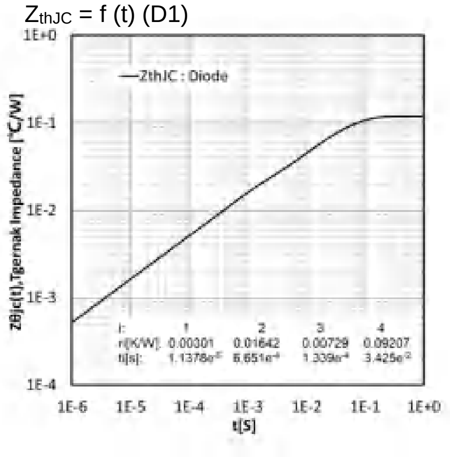


Fig.32 Transient thermal impedance Diode, Z_{thJC} = f (t) (D4)

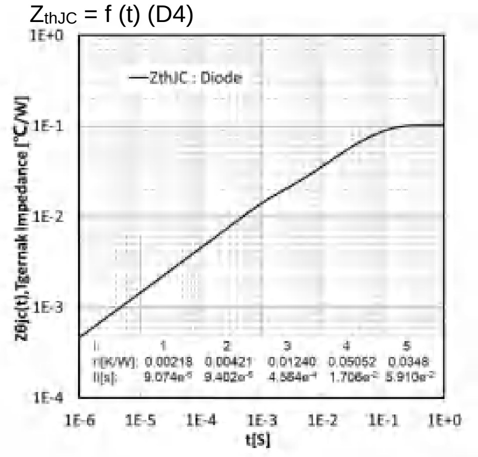


Fig.33 Transient thermal impedance Diode, Z_{thJC} = f (t) (D5, D6)

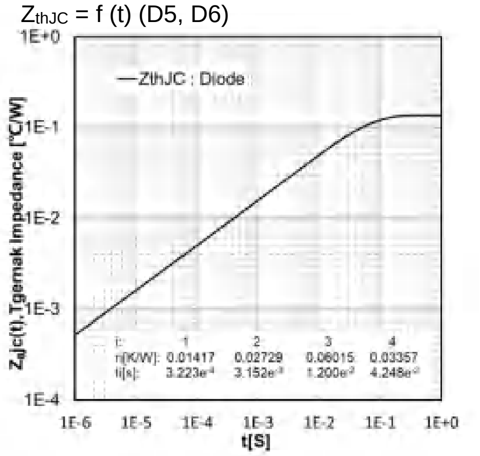
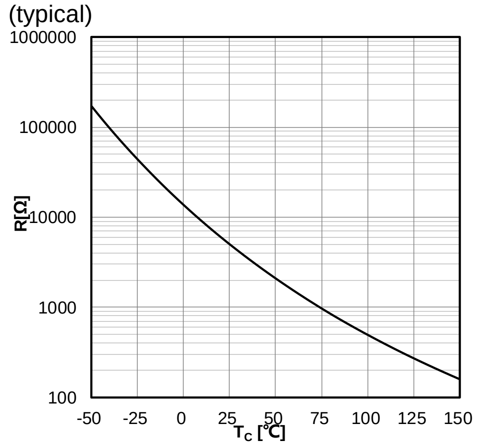
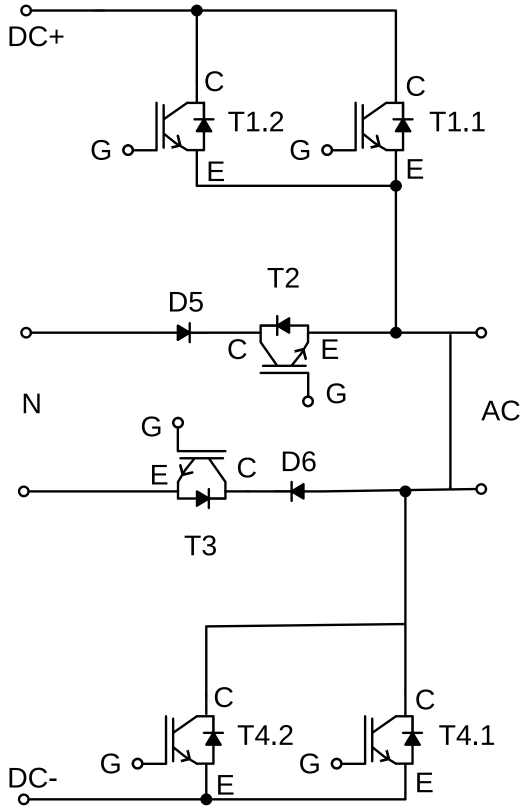


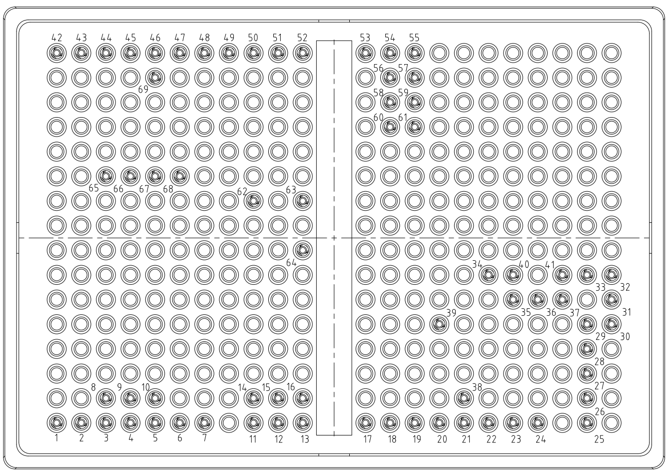
Fig.34 NTC-Thermistor-temperature characteristic (typical)



Circuit Diagram



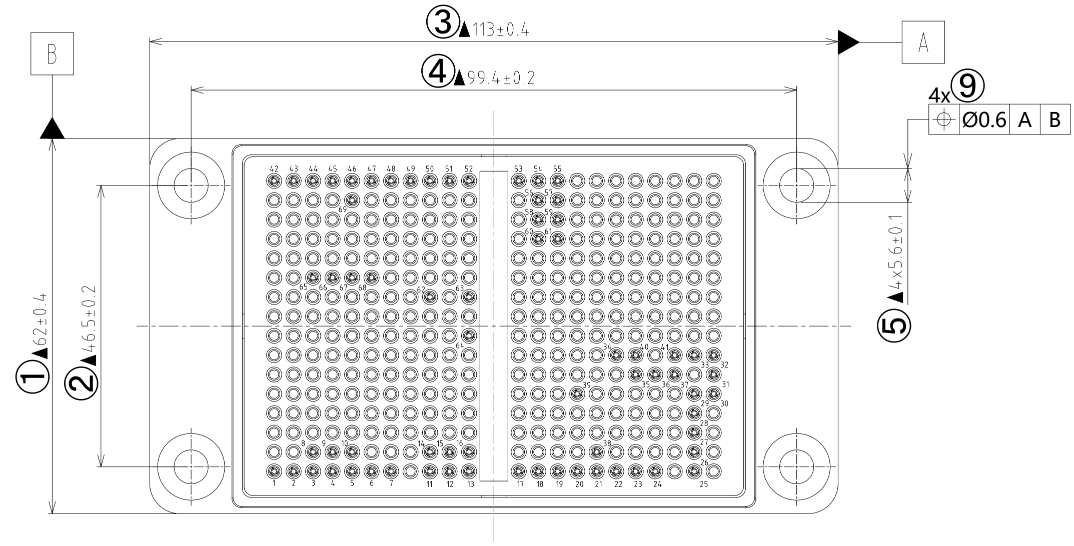
Pin Connections

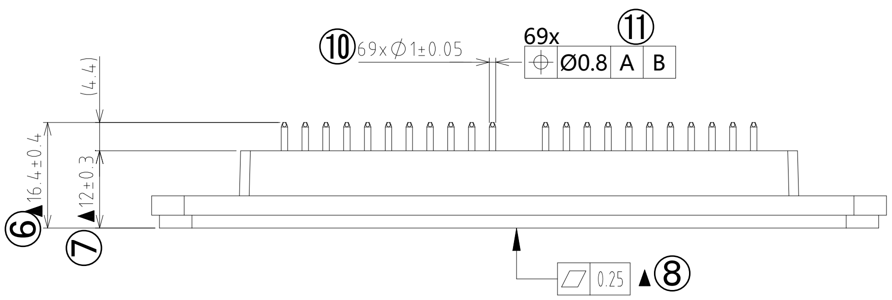


PIN 脚定义:

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