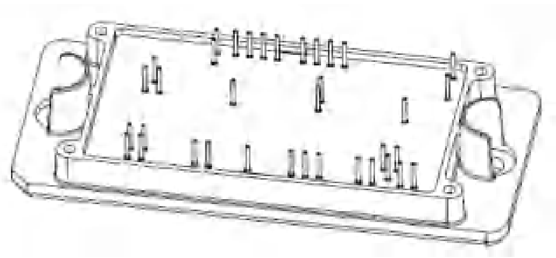
Features

- 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
OUTER IGBT (Q1, Q4)			
Collector−emitter voltage	V_{CES}	650	V
Gate−emitter voltage	V_{GE}	±20	V
Continuous collector current @ T_C = 80°C, T_j = 175°C	I_C	270	A
Pulsed collector current @ T_j = 175°C	I_{CP}	810	A
Junction temperature	T_j	-40 to +175	°C
INNER IGBT (Q2, Q3)			
Collector−emitter voltage	V_{CES}	650	V
Gate−emitter voltage	V_{GE}	±20	V
Continuous collector current @ T_C = 80°C, T_j = 175°C	I_C	270	A
Pulsed collector current @ T_j = 175°C	I_{CP}	810	A
Junction temperature	T_j	-40 to +175	°C
DIODE(D1,D2,D3,D4)			
Peak repetitive reverse voltage	V_{RRM}	650	V
Continuous forward current @ T_C = 80°C, T_j = 175°C	I_F	188	A
Repetitive peak forward current @ T_j = 175°C	I_{FRM}	563	A
I^2t-value@ V_R = 0 V, Tp = 10 ms, T_{vj} = 150°C	I^2t	1800	A^2s
Junction temperature	T_j	-40 to +175	°C
DIODE(D5,D6)			
Peak repetitive reverse voltage	V_{RRM}	650	V
Continuous forward current @ T_C = 80°C, T_j = 175°C	I_F	230	A
Repetitive peak forward current @ T_j = 175°C	I_{FRM}	690	A
I^2t-value@ V_R = 0 V, Tp = 10 ms, T_{vj} = 150°C	I^2t	9800	A^2s
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_{op}	-40 to +150	°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 = 450 A	T_j = 25°C	-	1.6	2.2	V
		V_{GE} = 15 V, I_C = 450 A	T_j = 150°C	-	1.85	-	
Gate−emitter threshold voltage	$V_{GE(TH)}$	V_{GE} = V_{CE}, I_C = 4 mA	T_j = 25°C	3.2	3.8	4.4	V
Total gate charge	Q_g	V_{GE} = ±15 V, V_{CE} = 480 V	T_j = 25°C	-	1.6	-	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	650	-	-	V
Collector−emitter cutoff current	I_{CES}	V_{CE} = 650 V, V_{GE} = 0 V	T_j = 25°C	-	-	100	μA
Input capacitance	C_{iss}	V_{GE} = 0 V, V_{CE} = 20 V, f = 10 KHz	T_j = 25°C	-	24	-	nF
Output capacitance	C_{oss}		T_j = 25°C	-	1.9	-	
Reverse transfer capacitance	C_{rss}		T_j = 25°C	-	0.14	-	
Turn-on delay time (inductive load)	$t_{d\ on}$	V_{GE} = -7 V / +15 V, V_{CE} = 400 V, I_C = 150 A, R_{Gon} = 9.4 Ω, R_{Goff} = 15.7 Ω	T_j = 25°C	-	75	-	ns
			T_j = 150°C	-	58	-	
Rise time (inductive load)	t_r		T_j = 25°C	-	33	-	
			T_j = 150°C	-	38	-	
Turn-off delay time (inductive load)	$t_{d\ off}$		T_j = 25°C	-	757	-	
			T_j = 150°C	-	804	-	
Fall time (inductive load)	t_f		T_j = 25°C	-	44	-	
			T_j = 150°C	-	54	-	
Turn - on switching loss	E_{on}	V_{GE} = -7 V / +15 V, V_{CE} = 400 V, I_C = 150 A, R_{Gon} = 9.4 Ω, R_{Goff} = 15.7 Ω,	T_j = 25°C	-	4.7	-	mJ
			T_j = 150°C	-	6.8	-	
Turn - off switching loss	E_{off}		T_j = 25°C	-	2.6	-	
			T_j = 150°C	-	3.3	-	
IGBT (Q2,Q3)							
Collector−emitter saturation voltage	$V_{CE(sat)}$	V_{GE} = 15 V, I_C = 450 A	T_j = 25°C	-	1.6	2.2	V
		V_{GE} = 15 V, I_C = 450 A	T_j = 150°C	-	1.85	-	

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Gate−emitter threshold voltage	$V_{GE(TH)}$	$V_{GE} = V_{CE}$, $I_C = 4$ mA	$T_j = 25°C$	3.2	3.8	4.4	V
Total gate charge	Q_g	$V_{GE} = \pm15$ V, $V_{CE} = 480$ V	$T_j = 25°C$	-	1.6	-	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	$T_j = 25°C$	650	-	-	V
Collector−emitter cutoff current	I_{CES}	$V_{CE} = 650$ V, $V_{GE} = 0$ V	$T_j = 25°C$	-	-	100	μA
Input capacitance	C_{iss}	$V_{GE} = 0$ V, $V_{CE} = 20$ V, f = 10 KHz	$T_j = 25°C$	-	24	-	nF
Output capacitance	C_{oss}		$T_j = 25°C$	-	1.9	-	
Reverse transfer capacitance	C_{rss}		$T_j = 25°C$	-	0.14	-	
Turn-on delay time (inductive load)	$t_{d\ on}$	$V_{GE} = -7$ V / +15 V, $V_{CE} = 400$ V, $I_C = 150$ A, $R_{Gon} = 4.3$ Ω, $R_{Goff} = 32$ Ω	$T_j = 25°C$	-	35	-	ns
			$T_j = 150°C$	-	26	-	
Rise time (inductive load)	t_r		$T_j = 25°C$	-	25	-	
			$T_j = 150°C$	-	30	-	
Turn-off delay time (inductive load)	$t_{d\ off}$		$T_j = 25°C$	-	1100	-	
			$T_j = 150°C$	-	1300	-	
Fall time (inductive load)	t_f		$T_j = 25°C$	-	27	-	
			$T_j = 150°C$	-	33	-	
Turn - on switching loss	E_{on}	$V_{GE} = -7$ V / +15 V, $V_{CE} = 400$ V, $I_C = 150$ A, $R_{Gon} = 4.3$ Ω, $R_{Goff} = 32$ Ω	$T_j = 25°C$	-	1.62	-	mJ
			$T_j = 150°C$	-	2.56	-	
Turn - off switching loss	E_{off}		$T_j = 25°C$	-	5.62	-	
			$T_j = 150°C$	-	6.63	-	

NEUTRAL POINT DIODE (D5, D6)

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Diode forward voltage	V_F	$I_F = 450$ A	$T_j = 25°C$	-	1.65	2.05	V
		$I_F = 450$ A	$T_j = 150°C$	-	1.75	-	
Reverse recovery time	T_{RR}	$V_{GE} = -7$ V / +15 V, $V_{CE} = 400$ V, $I_C = 150$ A, $R_{Gon} = 9.4$ Ω, $R_{Goff} = 15.7$ Ω	$T_j = 25°C$	-	173	-	ns
			$T_j = 150°C$	-	215	-	
Reverse recovery charge	Q_{RR}		$T_j = 25°C$	-	8.68	-	μC
			$T_j = 150°C$	-	20.4	-	
Peak reverse recovery current	I_{RRM}		$T_j = 25°C$	-	120	-	A
			$T_j = 150°C$	-	184	-	
Reverse recovery energy	E_{RR}		$T_j = 25°C$	-	2.02	-	mJ
			$T_j = 150°C$	-	4.02	-	

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
INVERSE DIODE (D1,D2,D3,D4)							
Diode forward voltage	V_F	I_F = 100 A	T_j = 25°C	-	1.23	1.65	V
		I_F = 100 A	T_j = 150°C	-	1.18	-	
		I_F = 200 A	T_j = 25°C		1.58	-	
		I_F = 200 A	T_j = 150°C		1.64		
Reverse recovery time	T_{RR}	V_{GE} = -7 V / +15 V, V_{CE} = 400 V, I_C = 150 A, R_{Gon} = 4.3 Ω, R_{Goff} = 32 Ω	T_j = 25°C	-	342	-	ns
			T_j = 150°C	-	432	-	
Reverse recovery charge	Q_{RR}		T_j = 25°C	-	2.58	-	μC
			T_j = 150°C	-	3.99	-	
Peak reverse recovery current	I_{RRM}		T_j = 25°C	-	43.3	-	A
			T_j = 150°C	-	48.1	-	
Reverse recovery energy	E_{RR}		T_j = 25°C	-	2.52	-	mJ
			T_j = 150°C	-	4.02	-	

Table 3 Thermal Resistance

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Thermal resistance − chip−to−heatsink (D1,D2,D3,D4)	R_{thJH}	Thermal grease ,λ = 2.8 W/mK	-	0.41	-	°C /W
Thermal resistance − chip−to−case (D1,D2,D3,D4)	R_{thJC}		-	0.32	-	°C /W
Thermal resistance − chip−to−heatsink (Q2,Q3)	R_{thJH}	Thermal grease ,λ = 2.8 W/mK	-	0.28	-	°C /W
Thermal resistance − chip−to−case (Q2,Q3)	R_{thJC}		-	0.18	-	°C /W
Thermal resistance − chip−to−heatsink (D5, D6)	R_{thJH}	Thermal grease ,λ = 2.8 W/mK	-	0.29	-	°C /W
Thermal resistance − chip−to−case (D5, D6)	R_{thJC}		-	0.19	-	°C /W
Thermal resistance − chip−to−heatsink(Q1, Q4)	R_{thJH}	Thermal grease ,λ = 2.8 W/mK	-	0.24	-	°C /W
Thermal resistance − chip−to−case (Q1, Q4)	R_{thJC}		-	0.16	-	°C /W

Table 4 NTC-Thermistor

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

Table 5 Module

Parameter	Symbol	Min	Typ.	Max	Unit	Conditions
Stray Inductance	L_{CE}	-	17	-	nH	
Mounting Torque Screw:M5	M	3.0	-	5.0	N.m	
Creepage distance	d_{Creep}		12.7		mm	terminal to heatsink
Clearance	d_{Clear}		12.7		mm	terminal to heatsink
CTI			≥600			
RTI			130		°C	
Flatness of base plate				0.3	mm	
Weight			176.5		g	

Typical Characteristics

IGBT Q1, Q2, Q3, Q4 and DIODE D1, D2, D3, D4

Fig.1 Typical output characteristics IGBT
Tvj = 25°C

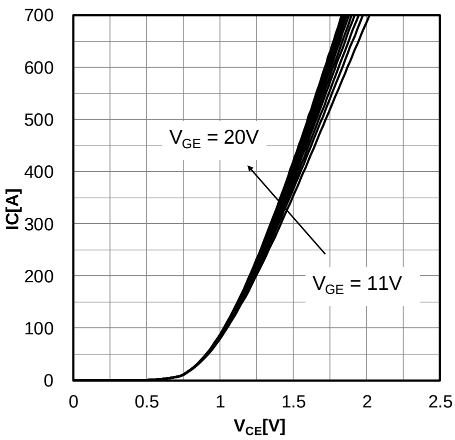


Fig.2 Typical output characteristics IGBT
Tvj = 150°C

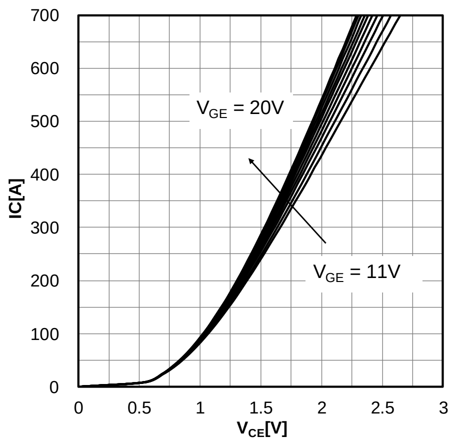


Fig.3 Body diode characteristics

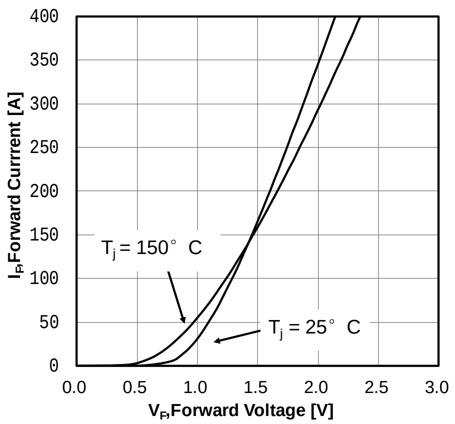


Fig.4 Transient thermal impedance(Q1, Q4)

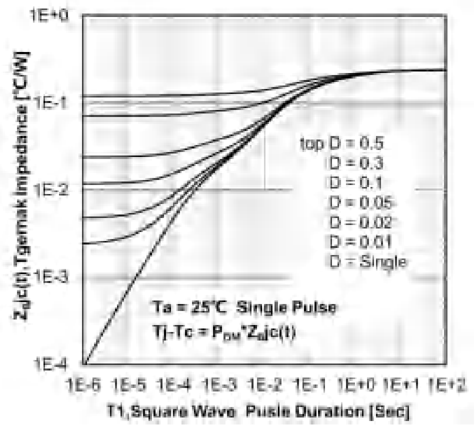


Fig.4 Transient thermal impedance (Q2, Q3)

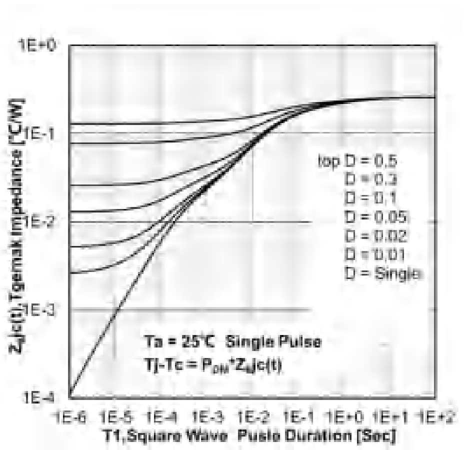
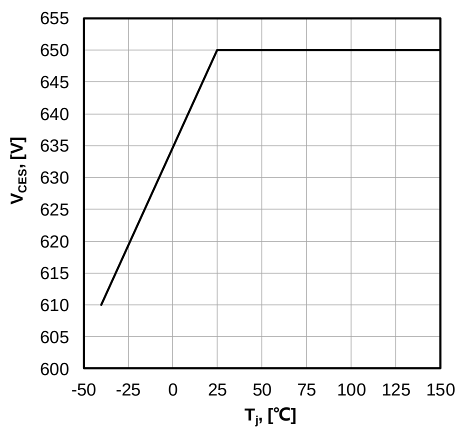


Fig.6 Maximum allowed collector-emitter voltage
(Q1, Q2, Q3, Q4)



Typical Characteristics

DIODE D5, D6

Fig.7 Diode forward characteristics

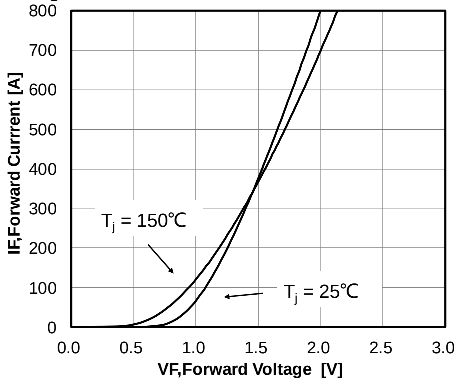


Fig.8 Transient thermal impedance (D5, D6)

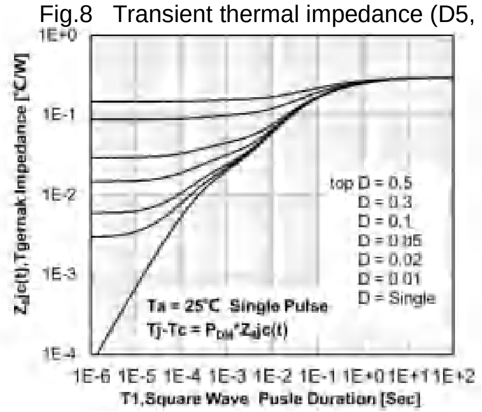


Fig.9 Maximum allowed collector-emitter voltage (D5, D6)

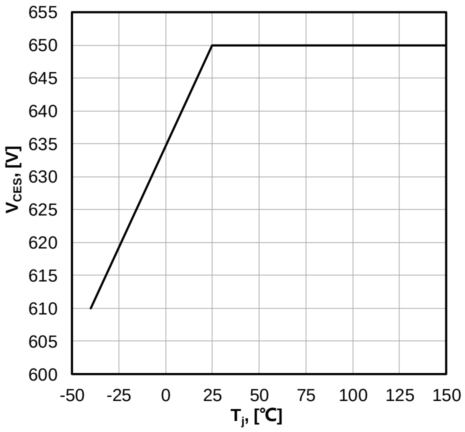
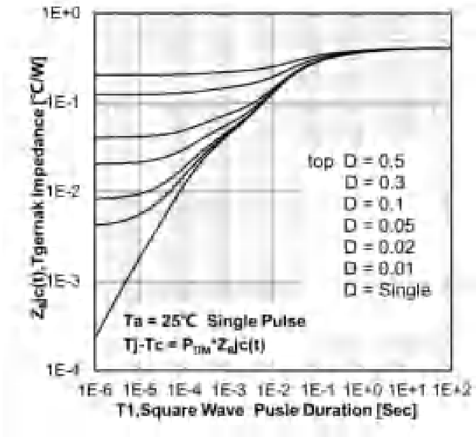


Fig.10 Transient thermal impedance (D1, D2, D3, D4)



Typical Characteristics

IGBT Q1, Q4 and DIODE D5, D6

Fig.11 Switching losses IGBT,Inverter (typical)
E_{on} = f (I_C), E_{off} = f (I_C),
V_{GE} = +15 V / -7 V, R_{Gon} = 9.4 Ω, R_{Goff} = 16.7 Ω,
V_{CE} = 400 V

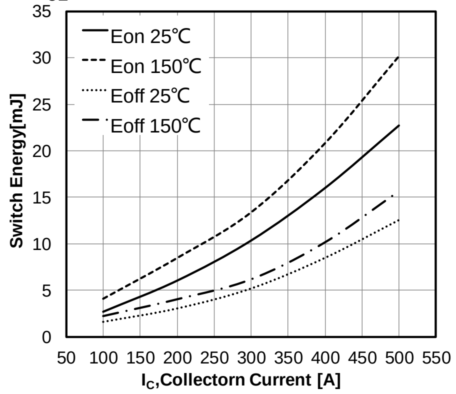
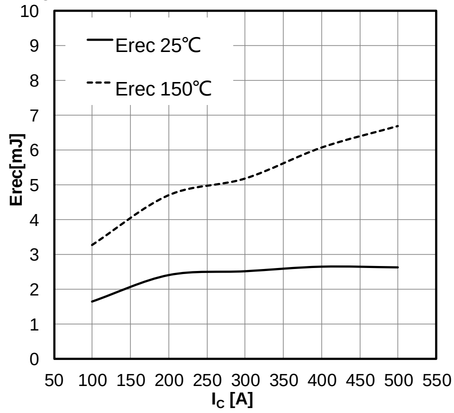


Fig.12 Switching losses IGBT,Inverter (typical)
E_{rec} = f (I_C),
V_{GE} = +15 V / -7 V, R_{Gon} = 9.4 Ω, R_{Goff} = 16.7 Ω,
V_{CE} = 400 V



IGBT Q2, Q3 and DIODE D1, D4

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} = 4.3 Ω, R_{Goff} = 32 Ω,
V_{CE} = 400 V

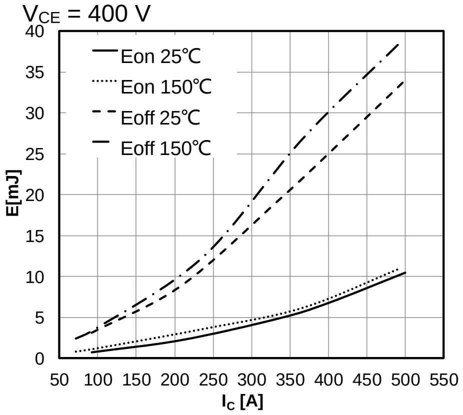


Fig.14 Switching losses IGBT, Inverter (typical)
E_{rec} = f (I_C),
V_{GE} = +15 V / -7 V, R_{Gon} = 4.3 Ω, R_{Goff} = 32 Ω,
V_{CE} = 400 V

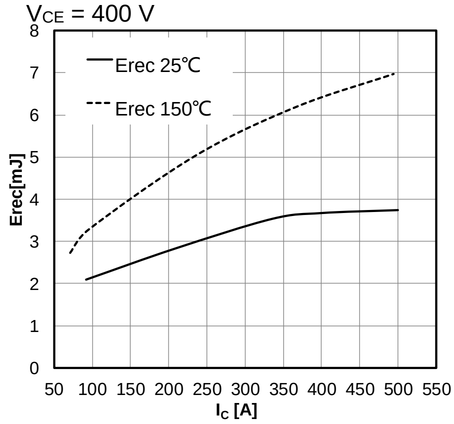


Fig.15 NTC-Thermistor-temperature characteristic (typical)

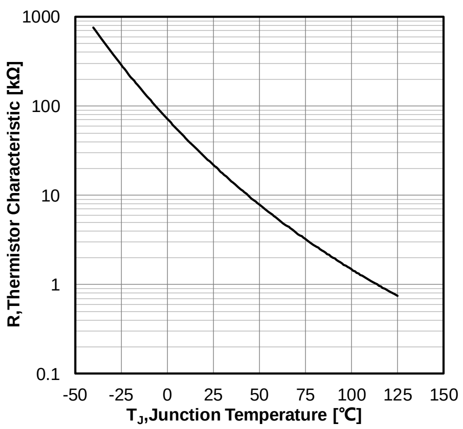
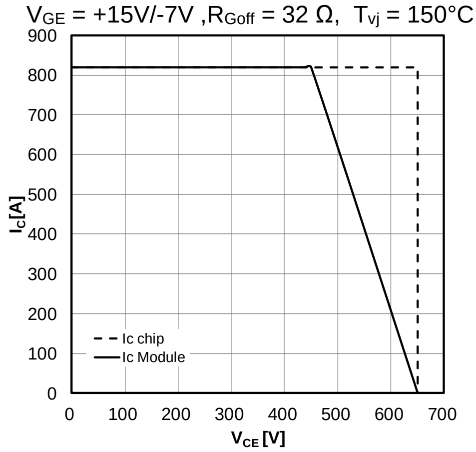
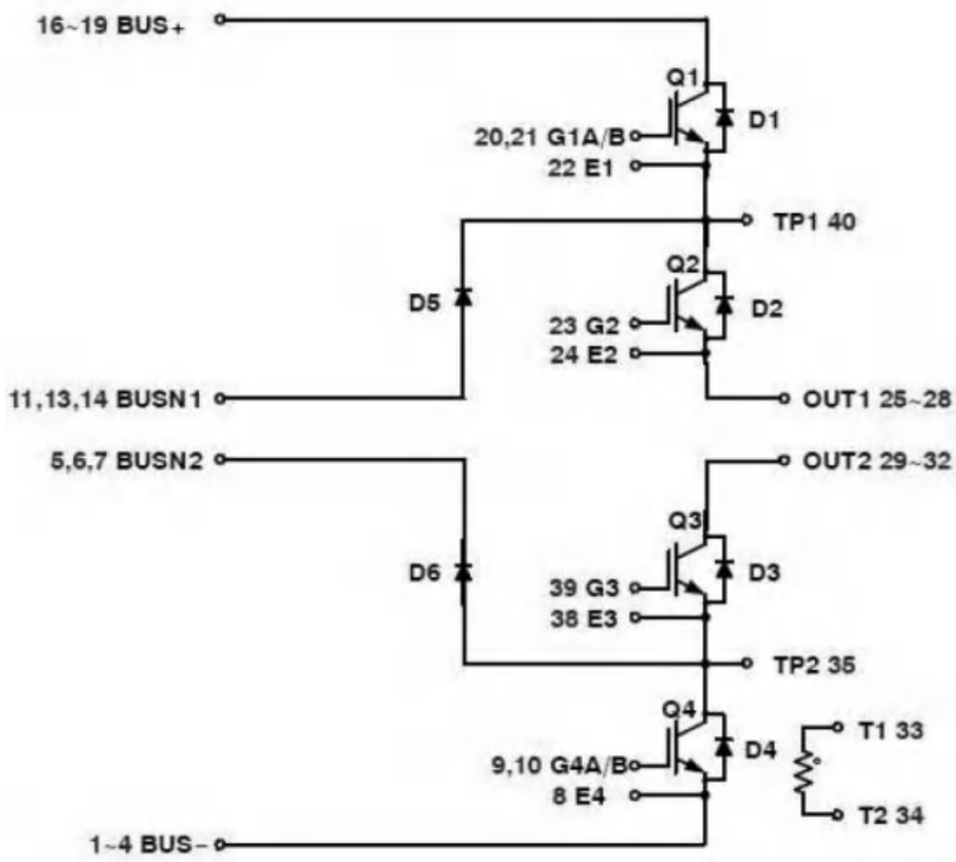


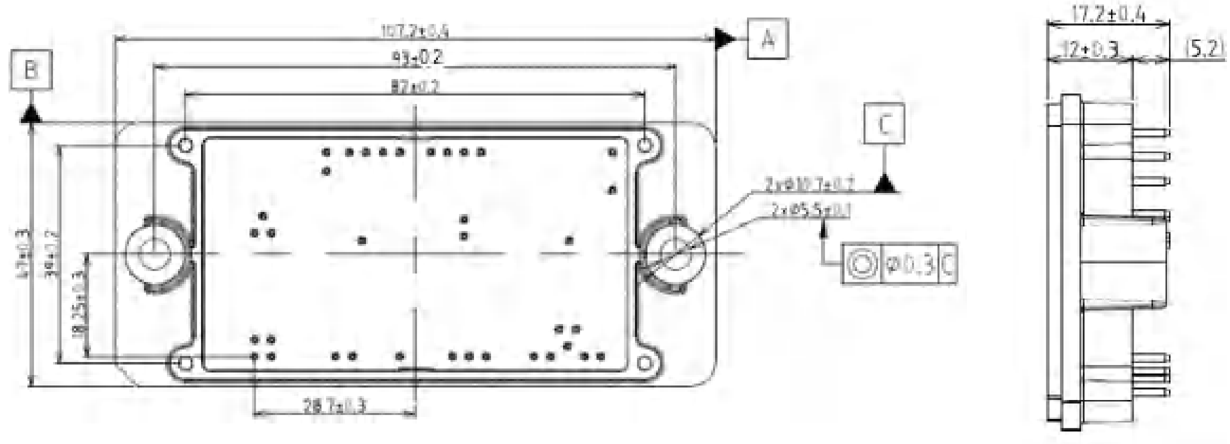
Fig.16 Reverse bias safe operating area IGBT,Inverter(RBSOA)
I_c = f (V_{CE}),
V_{GE} = +15V/-7V ,R_{Goff} = 32 Ω, T_{vj} = 150°C

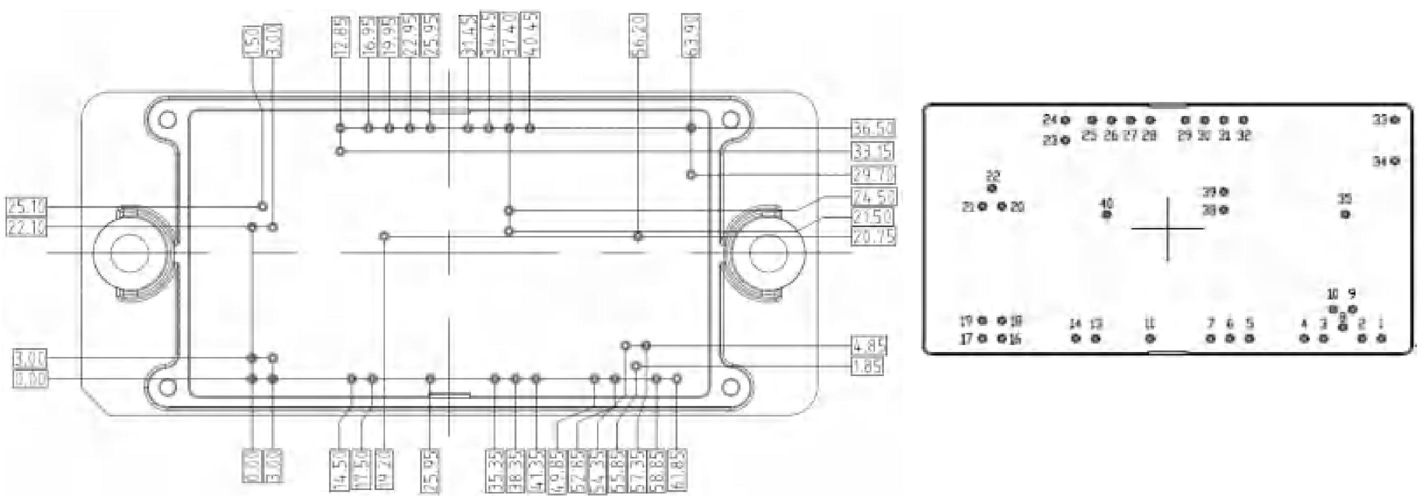


Circuit Diagram



Package Outlines





Package Outlines (continued)