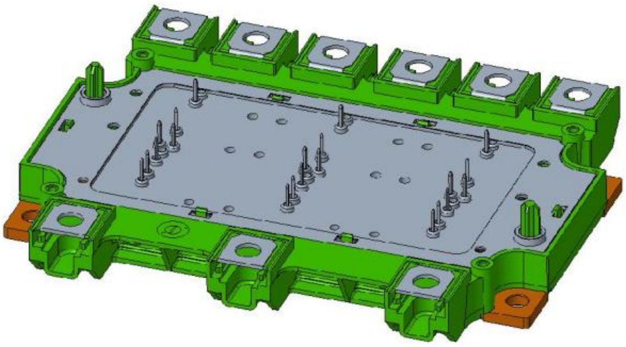
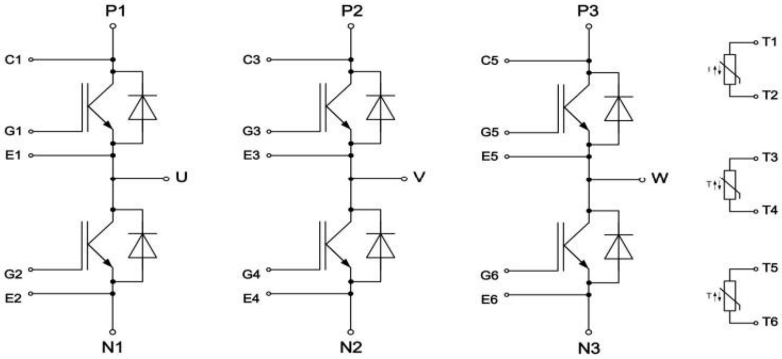
HP1-DC6i IGBT Power Module

V_{CES}= 750V, I_C= 600A, $V_{CE(sat)}$= 1.31V

Features

- Low Switching Losses
- Low V_{CEsat}
- 2.5kV AC 1min Insulation
- Blocking voltage 750V
- Low Qg and Crss
- Low Inductive Design
- High Power Density
- Direct Cooled Base Plate with Ribbon Bonds
- High Creepage and Clearance Distance
- Integrated NTC temperature sensor





Applications

- Hybrid Electrical Vehicles (H)EV
- Commercial Agriculture Vehicles
- Motor Drives

IGBT, Inverter

Maximum Ratings

Parameter	Symbol	Test Condition	Values	Units
Collector-emitter voltage	V_{CES}	T_{vj}=25℃, V_{GE}=0V	750	V
Implemented collector current	I_{CN}		600	A
Continuous DC collector current	$I_{C\ nom}$	T_F=80℃, $T_{vj\ max}$= 175℃	350 1)	A
Repetitive peak collector current	I_{CRM}	t_p= 1ms, T_{vj}=25℃	1200	A
Gate-emitter peak voltage	V_{GES}	T_{vj}=25℃	±30	V
SC data	I_{SC}	V_{GE}≤15V, V_{CC}=400V,tp≤5μs, V_{CEmax}=V_{CES}-L_{sCE}*di/dt ,T_{vj}= 150℃	3750	A
Total power dissipation	P_{tot}	T_F=75℃, $T_{vj\ max}$= 175℃	625 1)	W

1) Verified by characterization / design not by test.

Characteristics Values

Parameter	Symbol	Test Condition	Values			Units
			Min.	Typ.	Max.	
Collector-emitter saturation voltage	$V_{CE\ sat}$	I_C=350A, V_{GE}= 15V, T_{vj}=25℃		1.31	1.55	V
		I_C=350A, V_{GE}= 15V, T_{vj}= 150℃		1.35	1.61	V
		I_C=350A, V_{GE}= 15V, T_{vj}= 175℃		1.37	1.66	V

Gate-emitter threshold voltage	V_{GEth}	V_{CE}=V_{GE}, I_C=6.4mA	T_{vj}=25℃	5.9	6.1	6.3	V
			T_{vj}=175℃		3.9		
Gate charge	Q_G	V_{GE}=-8V...+15V			3.5		μC
Integrated gate resistor	R_G	Tvj=25℃			1		Ω
Input capacitance	C_{ies}	T_{vj}=25℃,f=1MHz,V_{GE}=0V,V_{CE}=50V			28		nF
Output capacitance	C_{oes}	T_{vj}=25℃,f=1MHz,V_{GE}=0V,V_{CE}=50V			0.65		nF
Reverse transfer capacitance	C_{res}	T_{vj}=25℃,f=1MHz,V_{GE}=0V,V_{CE}=50V			0.18		nF
Collector-emitter cut-off current	I_{CES}	V_{CE}=750V, V_{GE}=0V	T_{vj}=25℃			0.85	mA
			T_{vj}=175℃		4		
Gate-emitter leakage current	I_{GES}	V_{CE}=0V, V_{GE}=20V, T_{vj}=25℃				380	nA
Turn-on delay time,inductive load	t_{don}	I_C=350A, V_{CE}=400V, V_{GE}=-8V/+15V, R_{Gon}=R_{Goff}=5Ω	T_{vj}=25℃		315		ns
			T_{vj}=150℃		330		ns
			T_{vj}=175℃		340		ns
Rise time, inductive load	t_r		T_{vj}=25℃		75		ns
			T_{vj}=150℃		90		ns
			T_{vj}=175℃		95		ns
Turn-off delay time,inductive load	$T_{d(off)}$		T_{vj}=25℃		785		ns
			T_{vj}=150℃		885		ns
			T_{vj}=175℃		935		ns
Fall time, inductive load	t_f		T_{vj}=25℃		75		ns
			T_{vj}=150℃		75		ns
			T_{vj}=175℃		80		ns
Turn-on energy loss perpulse	E_{on}	I_C=350A, V_{CE}=400V, V_{GE}=-8V/+15V, R_{Gon}=R_{Goff}=5Ω, L_s=25nH, di/dt=6800A/μs($T_{vj25℃}$) di/dt=3500A/μs($T_{vj\ 150℃}$), dv/dt=3850V/μs($T_{vj25℃}$), dv/dt=3300V/μs($T_{vj\ 150℃}$)	T_{vj}=25℃		8.2		mJ
			T_{vj}=150℃		16		mJ
			T_{vj}=175℃		17.5		mJ
Turn-off energy loss perpulse	E_{off}		T_{vj}=25℃		16.5		mJ
			T_{vj}=150℃		25.4		mJ
			T_{vj}=175℃		26.6		mJ
Thermal resistance, junctionto cooling fluid	R_{thJF}	Per IGBT, ΔV/ Δt=10dm³/min, T_F =75℃			0.16		K/W

Diode, Inverter

Maximum Ratings

Parameter	Symbol	Test Condition	Values	Units
Repetitive peak reverse voltage	V_{RRM}	T_{vj}=25℃	750	V
Implemented forward current	I_{FN}		600	A

Continuous forward current	I_F		350[1]	A
Maximum repetitive forward current	I_{FRM}	t_p=1ms	1200	A
I^2t-value	I^2t	V_R=0V, tp=10ms, T_{vj}=150℃	14500	A^2s
		V_R=0V, tp=10ms, T_{vj}=175℃	12500	

Characteristics Values

Parameter	Symbol	Test Condition		Values			Units
				Min.	Typ.	Max.	
Forward voltage	V_F	I_F=350A, V_{GE}=0V	T_{vj}=25℃		1.47		V
			T_{vj}=150℃		1.37		V
			T_{vj}=175℃		1.33		V
Peak reverse recovery current	I_{RM}	I_F=350A, V_R=400V, V_{GE}=-8V diF/dt=3950A/µs (T_{vj} 150℃)	T_{vj}=25℃		207		A
			T_{vj}=150℃		317		A
			T_{vj}=175℃		337		A
Recovered charge	Q_r		T_{vj}=25℃		24.3		µC
			T_{vj}=150℃		47.9		µC
			T_{vj}=175℃		55.8		µC
Reverse recovery energy	E_{rec}		T_{vj}=25℃		2.1		mJ
			T_{vj}=150℃		5.5		mJ
			T_{vj}=175℃		7.2		mJ
Thermal resistance, junction to cooling fluid	R_{thJF}	Per diode,ΔV/Δt=10dm³/min, T_F =75℃				0.25	K/W

NTC Thermistor
Characteristics Values

Parameter	Symbol	Test Condition	Values			Units
			Min.	Typ.	Max.	
Rated resistance	R_{25}	T_C=25℃		5.0		KΩ
Deviation of R100	△R/R	T_C=100℃, R_{100}=493Ω	-3		3	%
Power dissipation	P_{25}	T_C=25℃			60	mW
B-value	$B_{25/50}$	$R_2=R_{25}\exp[B_{25/50}(1/T2-1/(298.15K))]$		3375		K
B-value	$B_{25/80}$	$R_2=R_{25}\exp[B_{25/80}(1/T2-1/(298.15K))]$		3411		K
B-value	$B_{25/100}$	$R_2=R_{25}\exp[B_{25/100}(1/T2-1/(298.15K))]$		3433		K

Characteristics Values(Module)

Parameter	Symbol	Test Condition	Values			Units
			Min.	Typ.	Max.	
Maximum junction temperature	$T_{vj\,max}$				175	℃

Temperature under switching conditions	$T_{vj\ op}$		-40		175	℃
Storage temperature	T_{stg}		-40		150	℃
Stray inductance module	L_{sCE}			21		nH
Module lead resistance, terminals-chip	$R_{CC'+EE'}$	T_{vj}=25℃, per switch		0.9		mΩ
Isolation test voltage	V_{isol}	R_{MS}, f=50Hz, t= 1min		2.5		kV
Creepage distance	ds	Terminal to heat sink		18.2		mm
		Terminal to terminal		8.2		mm
Clearance distance in air	da	Terminal to heat sink		18.2		mm
		Terminal to terminal		5.9		mm
Comparative tracking index	CTI		>200			
Mounting torque for module mounting	M1	Screw M_5 base plate to heat sink	1.8	2.0	2.2	N.m
	M2	Screw M_3 EJOT Delta PCB to frame	0.45	0.50	0.55	
Mounting torque for module mounting	M3	Screw M_6	3		6	
Internal isolation	-	Basic insulation	Al_2O_3			-
Material of module base plate	-		Cu+Ni			-
Dimensions	LxWxH		140x112.6x23.15			mm
Weight	G		610			g

Typical Characteristics

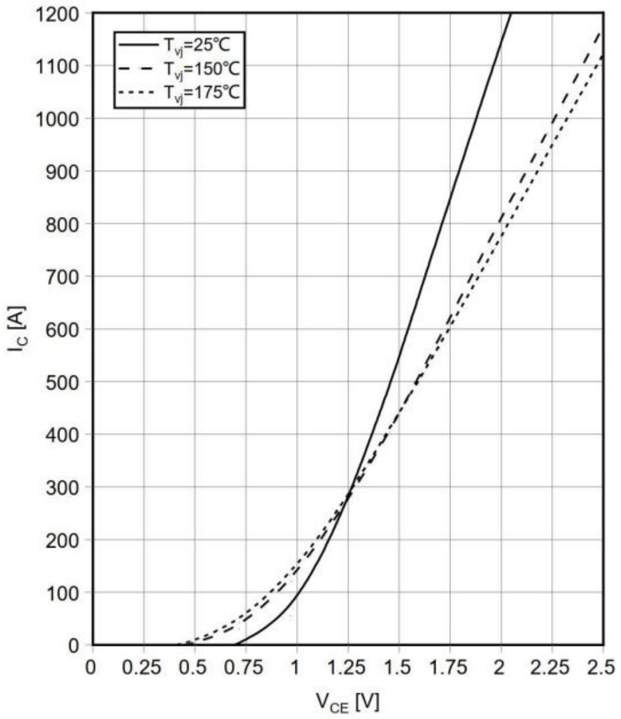


Fig 1.Output characteristic IGBT, Inverter(typical)
$I_C=f(V_{CE})$, V_{GE}=15V

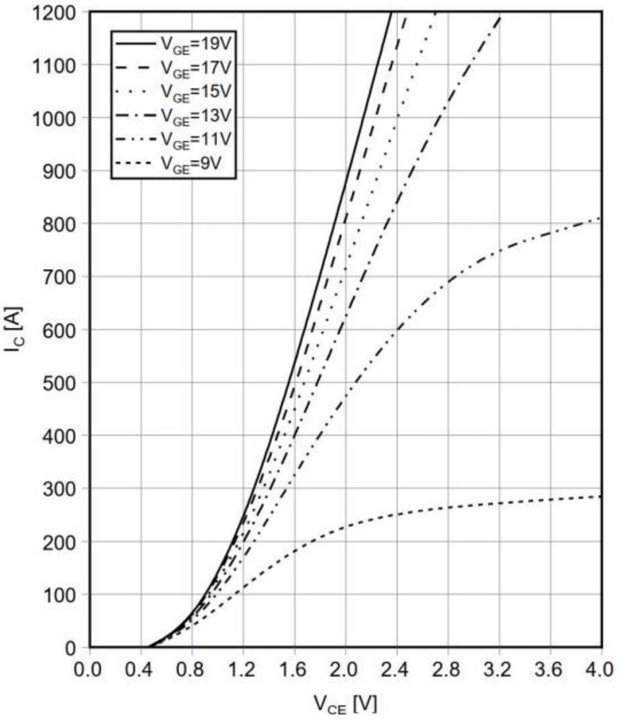


Fig 2.Output characteristic IGBT, Inverter(typical)
$I_C=f(V_{CE})$, T_{vj}=150℃

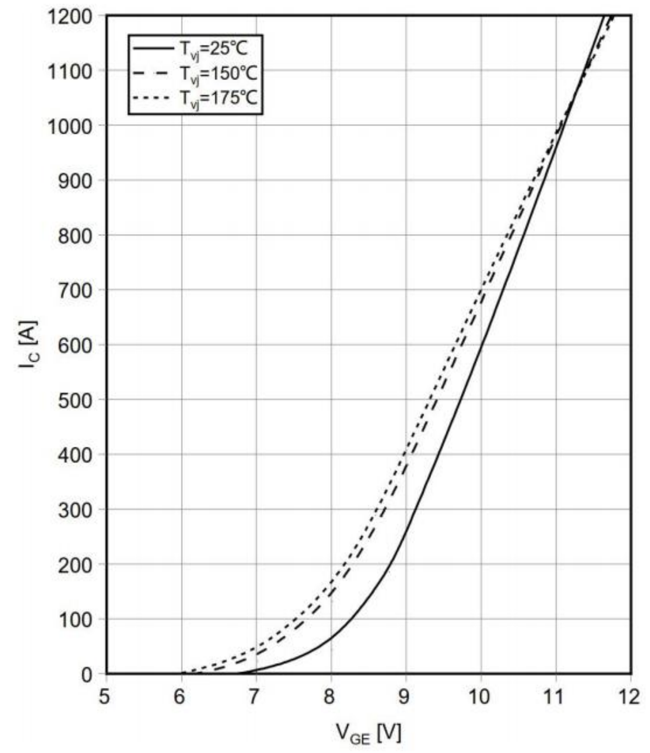


Fig 3.Transfer characteristic IGBT, Inverter(typical)
$I_C=f(V_{GE})$, V_{CE}=20V

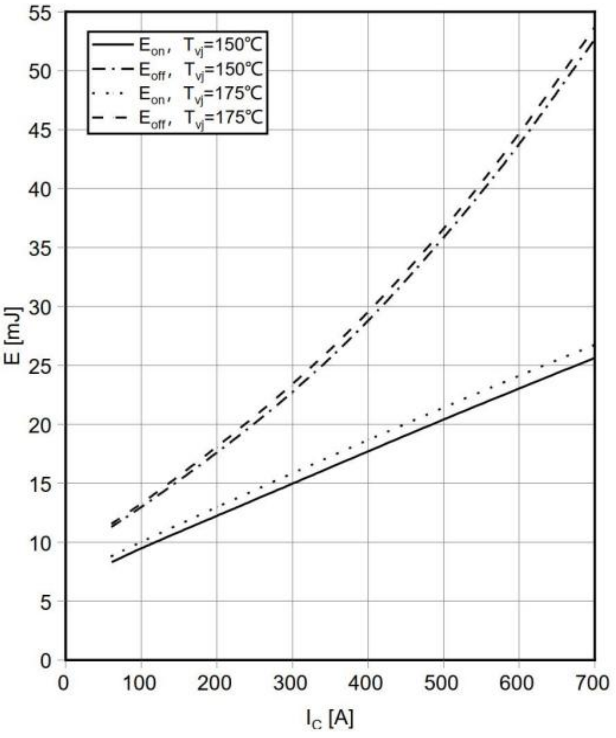


Fig 4.Switching losses IGBT, Inverter(typical)
$E_{on}=f(I_C)$, $E_{off}=f(I_C)$, V_{GE}=-8/+15V, $R_{Gon}=R_{Goff}=5\Omega$,
V_{CE}=400V

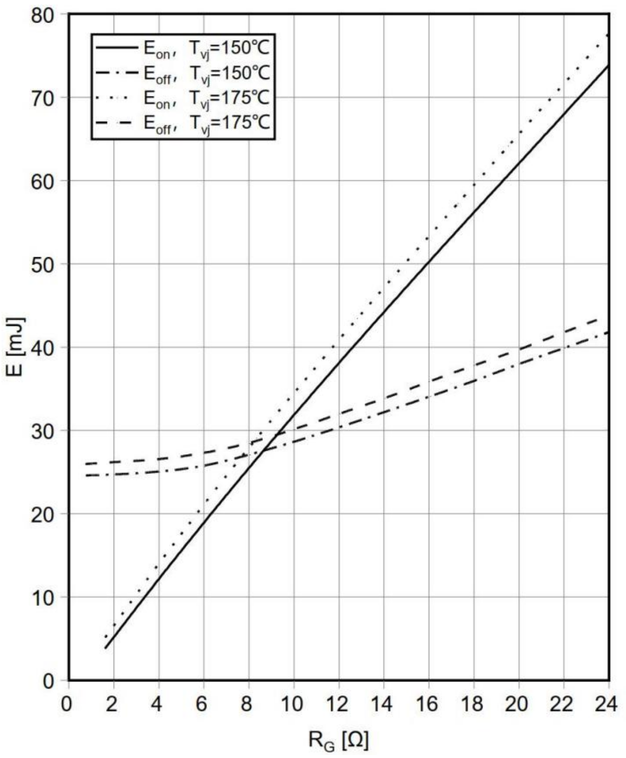
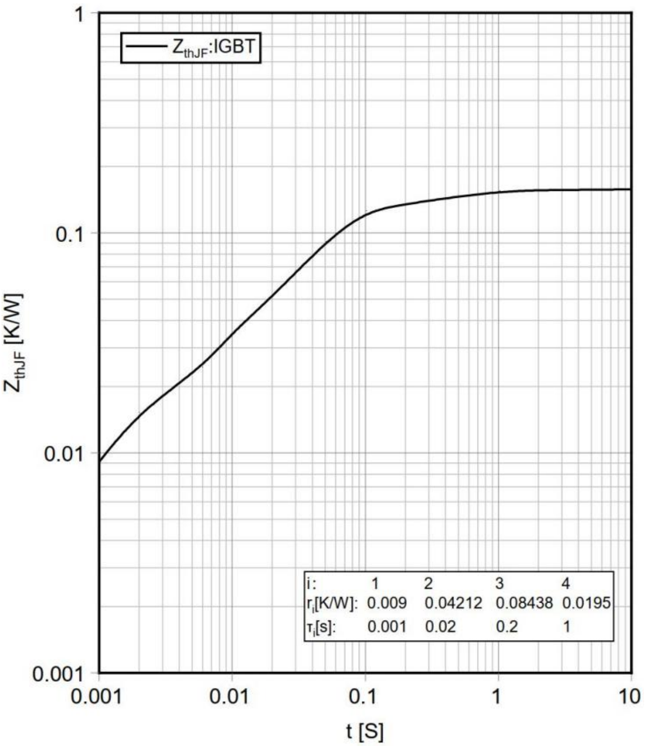


Fig 5.Switching losses IGBT, Inverter(typical)
$E_{on}=f(R_G)$, $E_{off}=f(R_G)$, V_{GE}=-8/+15V, I_C=350A,
V_{CE}=400V



i:	1	2	3	4
r_i[K/W]:	0.009	0.04212	0.08438	0.0195
τ_i[s]:	0.001	0.02	0.2	1

Fig 6.Transient thermal impedance IGBT, Inverter
$Z_{thJF}=f(t)$

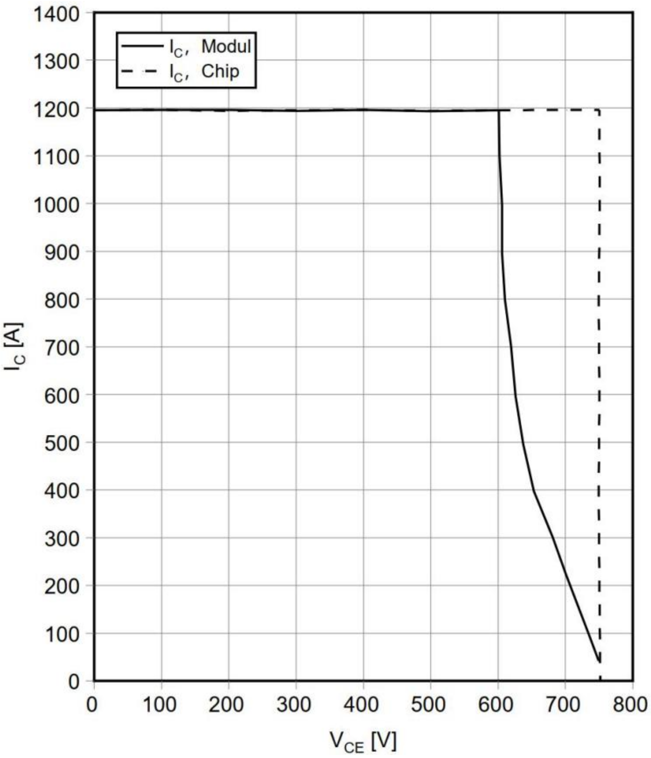


Fig 7.Reverse bias safe operating area IGBT, Inverter(R_{BSOA}) $I_C=f(V_{CE})$, V_{GE}=-8V/+15V, R_{Goff}=5Ω, T_{vj}=175℃

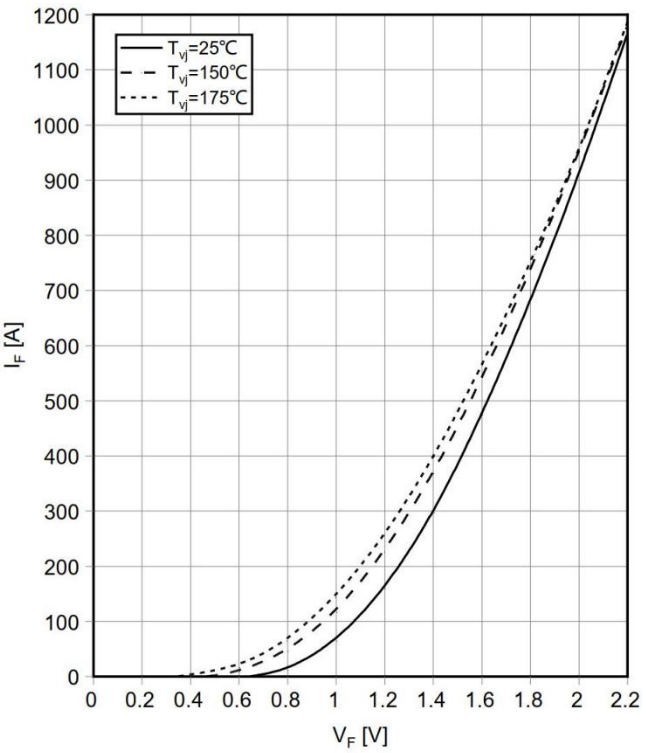


Fig 8.Forward characteristic of Diode, Inverter(typical) $I_F=f(V_F)$

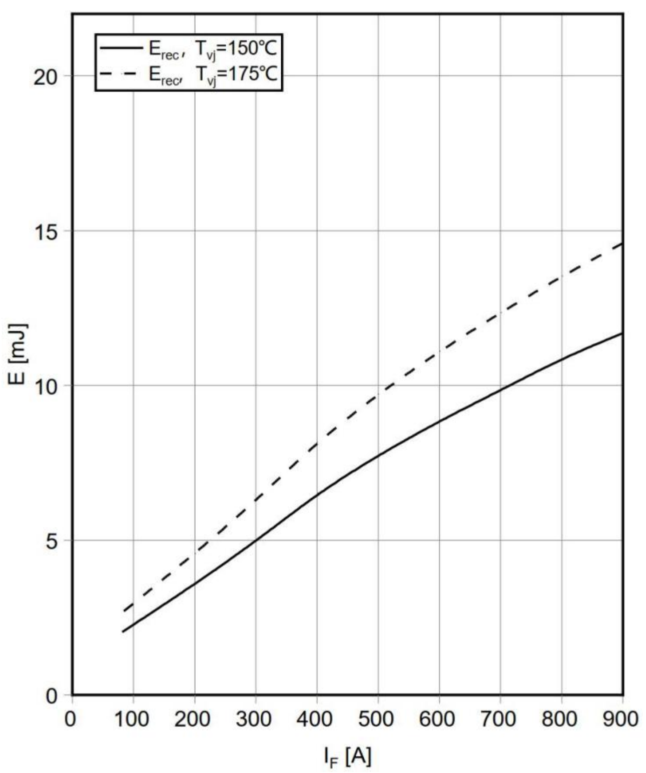


Fig 9.Switching losses Diode, Inverter(typical) $E_{rec}=f(I_F)$, R_{Gon}=5Ω, V_{CE}=400V

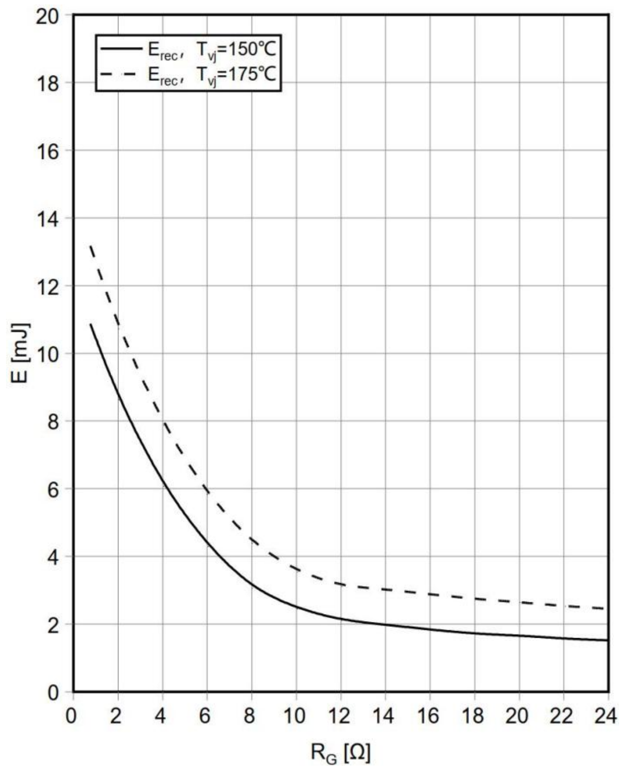
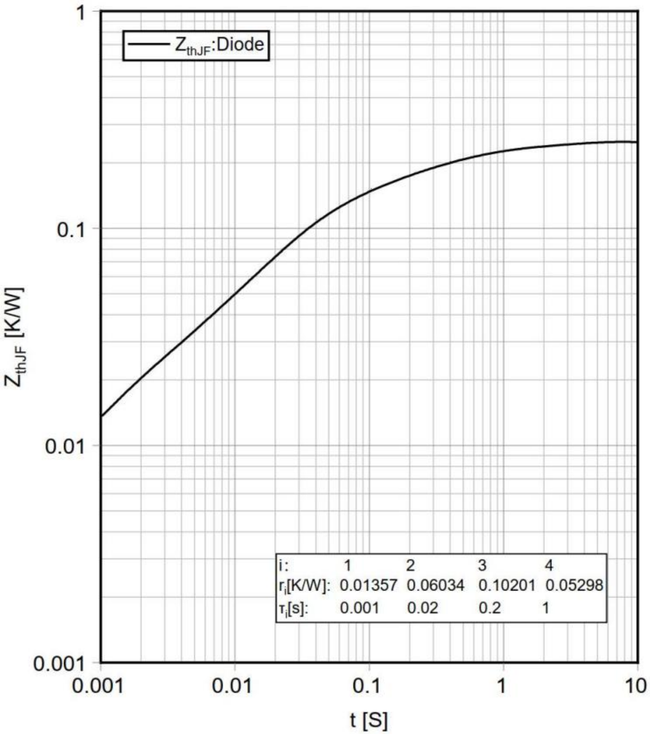


Fig 10.Switching losses Diode, Inverter(typical) $E_{rec}=f(I_F)$, I_F=350A, V_{CE}=400V



i:	1	2	3	4
r_i[K/W]:	0.01357	0.06034	0.10201	0.05298
τ_i[s]:	0.001	0.02	0.2	1

Fig 11.Transient thermal impedance Diode,Inverter
Z_{thJF}=f(t)

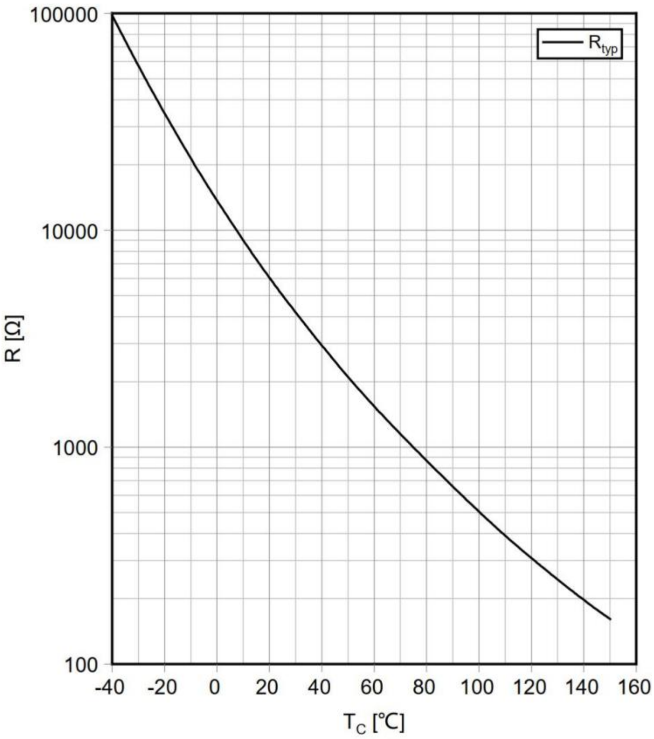
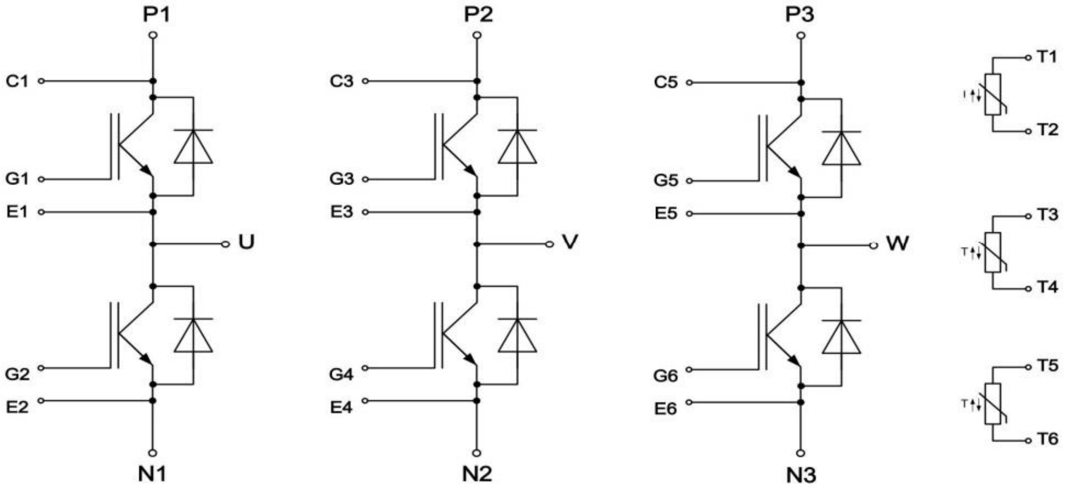
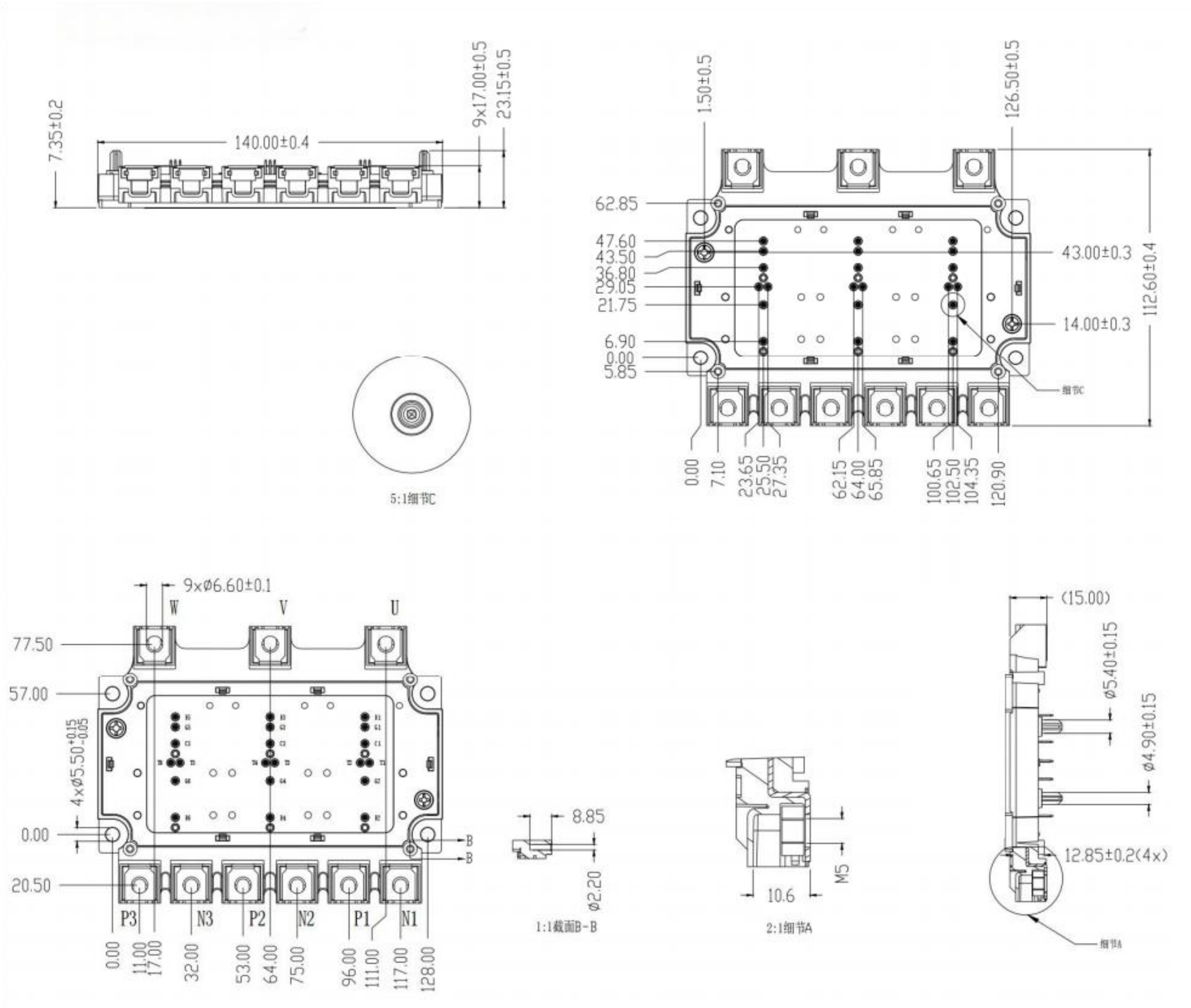


Fig 12.NTC Thermistor temperature
characteristic(typical)， R=f(τ)

Circuit Diagram



Package Outlines(Unit： mm)



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