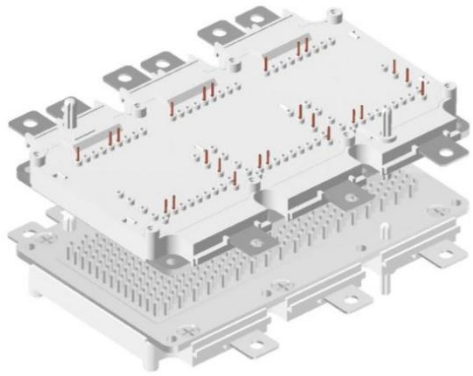
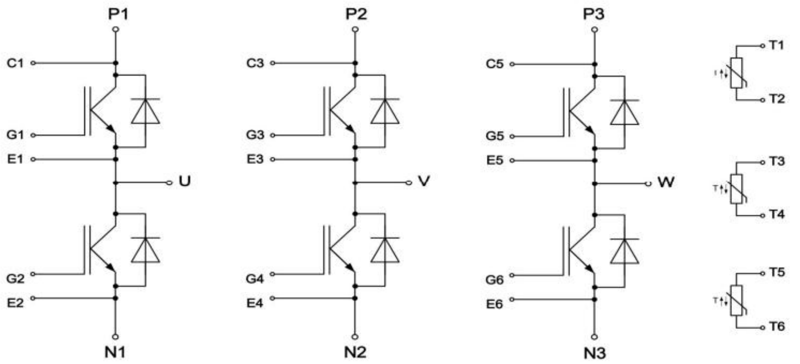
HPD IGBT Power Module

V_{CES}=750V, I_C=820A, $V_{CE(sat)}$=1.40V



Features

- 750V Trench and Field Stop technology
- High short circuit capability
- High Power Density
- Low conduction and switching losses
- Vcesat positive temperature coefficient
- Fast & soft recovery anti-parallel FRD
- Integrated NTC temperature sensor



Applications

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

IGBT, Inverter
Maximum Ratings

Parameter	Symbol	Test Condition	Value	Unit
Collector-emitter voltage	V_{CES}	T_{vj}=25℃, V_{GE}=0V	750	V
Implemented collector current	I_{CN}		820	A
Continuous DC collector current	$I_{C\ nom}$	T_F=70℃, $T_{vj\ max}$=175℃	450[1)]	A
Repetitive peak collector current	I_{CRM}	t_P=1ms, T_{vj}=25℃	1640	A
Gate-emitter peak voltage	V_{GES}	T_{vj}=25℃	±30	V
SC data	I_{SC}	V_{GE}≤15V, V_{CC}=400V, V_{CEmax}=V_{CES}-L_{sCE}*di/dt, t_P≤5μs, T_{vj}=150℃	4000	A
Total power dissipation	P_{tot}	T_F=85℃, $T_{vj\ max}$=175℃	692[1)]	W

Characteristics Values

Parameter	Symbol	Test Condition	Value			Unit
			min.	typ.	max.	
Collector-emitter saturation voltage	V_{CEsat}	I_C=450A, V_{GE}=15V, T_{vj}=25℃		1.40	1.60	V
		I_C=450A, V_{GE}=15V, T_{vj}=150℃		1.50		
		I_C=450A, V_{GE}=15V, T_{vj}=175℃		1.51		
		I_C=800A, V_{GE}=15V, T_{vj}=25℃		1.79		
		I_C=800A, V_{GE}=15V, T_{vj}=175℃		2.0		

Gate-emitter threshold voltage	V_{GEth}	$V_{CE}=V_{GE}$, I_C=10mA	T_{vj}=25℃	5.0	5.8	6.5	V
			T_{vj}=175℃		4.0		
Gate charge	Q_G	V_{GE}=-8V...+15V, V_{CE} = 400V			4.3		μC
Integrated gate resistor	R_{Gint}	T_{vj}=25℃			1		Ω
Input capacitance	C_{ies}	T_{vj}=25℃, f=100KHz, V_{GE}=0V, V_{CE}=25V			38		nF
Output capacitance	C_{oes}	T_{vj}=25℃, f=100KHz, V_{GE}=0V, V_{CE}=25V			1.82		
Reverse transfer capacitance	C_{res}	T_{vj}=25℃, f=100KHz, V_{GE}=0V, V_{CE}=25V			0.23		
Collector-emitter cut-off current	I_{CES}	V_{CE}=750V, V_{GE}=0V	T_{vj}=25℃			1	mA
			T_{vj}=175℃		4		
Gate-emitter leakage current	I_{GES}	V_{CE}=0V, V_{GE}=20V, T_{vj}=25℃				400	nA
Turn-on delay time, inductive load	$t_{d\ on}$	I_C=450A, V_{CE}=400V, V_{GE}=-8V/+15V, R_{Gon}=5Ω, R_{Goff}=5Ω	T_{vj}=25℃		248		ns
			T_{vj}=150℃		255		
			T_{vj}=175℃		265		
Rise time, inductive load	t_r		T_{vj}=25℃		88		
			T_{vj}=150℃		101		
			T_{vj}=175℃		105		
Turn-off delay time, inductive load	$t_{d\ off}$		T_{vj}=25℃		509		
			T_{vj}=150℃		662		
			T_{vj}=175℃		670		
Fall time, inductive load	t_f		T_{vj}=25℃		111		
			T_{vj}=150℃		122		
			T_{vj}=175℃		130		
Turn-on energy loss per pulse	E_{on}	I_C=450A, V_{CE}=400V, V_{GE}=-8V/+15V, R_{Gon}=5Ω, L_s=20nH, di/dt($T_{vj25℃}$)=4300A/μs,	T_{vj}=25℃		16.5		mJ
			T_{vj}=150℃		20.5		
			T_{vj}=175℃		21.9		
Turn-off energy loss per pulse	E_{off}	I_C=450A, V_{CE}=400V, V_{GE}=-8V/+15V, R_{Goff}=5Ω, L_s=20nH, dv/dt(T_{vj}25℃)=7100V/μs	T_{vj}=25℃		22.2		
			T_{vj}=150℃		27.5		
			T_{vj}=175℃		28.7		
IGBT, thermal resistance, junction to cooling fluid	R_{thjF} IGBT	per IGBT, ΔV/ Δt=10dm³/min, T_F=75℃			0.11	0.13	K/W
Temperature under switching conditions	$T_{vj\ op}$	top continuous for 10s within a period of 30s, occurence maximum 3000 times over lifetime		-40 150		150[2)] 175	℃

1）Verified by characterization / design not by test.
2）For Tvjop >150℃: Baseplate temperature has to be limited to 125℃.

Diode, Inverter

Maximum Ratings

Parameter	Symbol	Test Condition	Value	Unit
Repetitive peak reverse voltage	V_{RRM}	Tvj=25℃	750	V
Implemented forward current	I_{FN}		820	A
Continuous DC forward current	I_F		450[1)]	A
Repetitive peak forward current	I_{FRM}	t_P=1ms	1640	A
I^2t-value	I^2t	V_R=0V, t_P=10ms, T_{vj}=150℃	18000	A^2s
		V_R=0V, t_P=10ms, T_{vj}=175℃	15500	A^2s

Characteristics Values

Parameter	Symbol	Test Condition		Value			Unit
				min.	typ.	max.	
Forward voltage	V_F	I_F=450A, V_{GE}=0V	T_{vj}=25℃		1.3	1.6	V
		I_F=450A, V_{GE}=0V	T_{vj}=150℃		1.28		V
		I_F=450A, V_{GE}=0V	T_{vj}=175℃		1.27		V
		I_F=800A, V_{GE}=0V	T_{vj}=25℃		1.56		V
		I_F=800A, V_{GE}=0V	T_{vj}=175℃		1.58		V
Peak reverse recovery current	I_{RM}	I_F=450A, V_R=400V, V_{GE}=-8V, -diF/dt=5000A/μs (T_{vj}=25℃)	T_{vj}=25℃		195		A
			T_{vj}=150℃		300		A
			T_{vj}=175℃		320		A
Recovered charge	Q_r		T_{vj}=25℃		12.17		μC
			T_{vj}=150℃		29.5		μC
			T_{vj}=175℃		37.2		μC
Reverse recovery energy	E_{rec}		T_{vj}=25℃		3.7		mJ
			T_{vj}=150℃		6.8		mJ
			T_{vj}=175℃		7.4		mJ
Diode, thermal resistance, junction to cooling fluid	R_{thjF} Diode	per diode, ΔV/Δt=10dm³/min, T_F=75℃			0.17	0.19	K/W
Temperature under switching conditions	$T_{vj\ op}$	top continuous for 10s within a period of 30s, occurence maximum 3000times over lifetime		-40 150		150[2)] 175	℃

1）Verified by characterization / design not by test.
2）For Tvjop >150℃: Baseplate temperature has to be limited to 125℃.

NTC-Thermistor

Parameter	Symbol	Test Condition	Value			Unit
			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℃			20	mW
B-value	$B_{25/50}$	$R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298.15K))]$		3375		K

B-value	$B_{25/80}$	$R_2=R_{25}$ exp[$B_{25/80}$(1/T_2-1/(298.15K))]		3411		K
B-value	$B_{25/100}$	$R_2=R_{25}$ exp [$B_{25/100}$(1/T2-1/(298.15K))]		3433		K

Specification according to the valid application note.

Characteristics Values(Module)

Parameter	Symbol	Test Condition	Value			Unit
			min.	typ.	max.	
Storage temperature	T_{stg}		-40		150	℃
Stray inductance module	L_{sCE}			7		nH
Module lead resistance, terminals - chip	$R_{CC'+EE}$	T_{vj}=25℃, per switch		0.9		mΩ
Isolation test voltage	V_{isol}	AC, RMS, f=50Hz, t=1min		3.5		kV
Maximum RMS module terminal current	I_{tRMS}	T_F=75℃ , T_{Ct}=105℃		500		A
Creepage distance	d_{Creep}	Terminal to terminal		9.0		mm
		Terminal to heat sink		9.0		mm
Clearance distance in air	d_{Clear}	Terminal to terminal		4.5		mm
		Terminal to heat sink		4.5		mm
Comparative tracking index	CTI		>200			
Mounting torque for module mounting	M1	Screw M4 base plate to heat sink	1.8	2.0	2.2	N·m
	M2	Screw M4 EJOT Delta PCB to frame	0.45	0.50	0.55	N·m
Terminal connection torque	M3	Screw M5	3		6	N·m
Material of module base plate	-		Cu+Ni1)			-
Internal isolation	-	Basic insulation (class1, IEC61140)	$Al_2O_3$2)			-
Pressure drop in cooling circuit	Δp	ΔV/Δt =10.0 dm³/min; TF=75℃		64		mbar
Maximum pressure in cooling circuit	p	T_base plate < 40℃ T_base plat > 40℃ (relative pressure)			2.5 2.0	bar
Dimensions	LxWxH		154.5x126.5x32			mm
Weight	G		720			g

1） Ni-plated Cu baseplate.
2） Improved Al2O3 ceramic.

Typical Characteristics

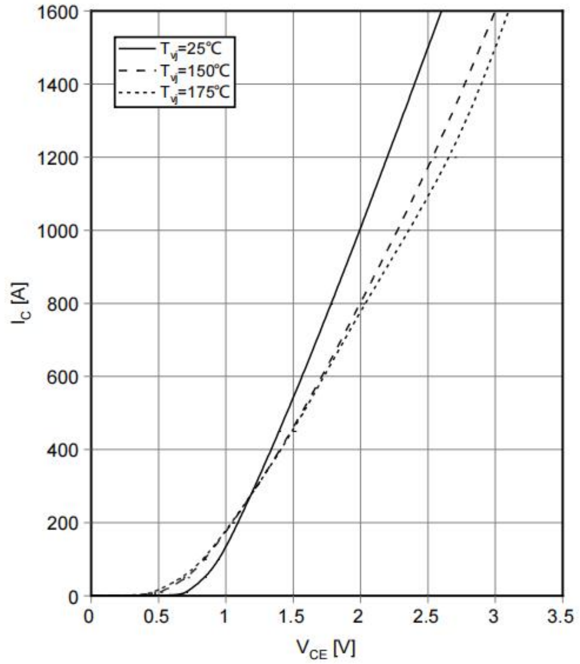


Fig 1. Output characteristic IGBT, Inverter(typical)
$I_C=f(V_{CE})$, $V_{GE}=15V$

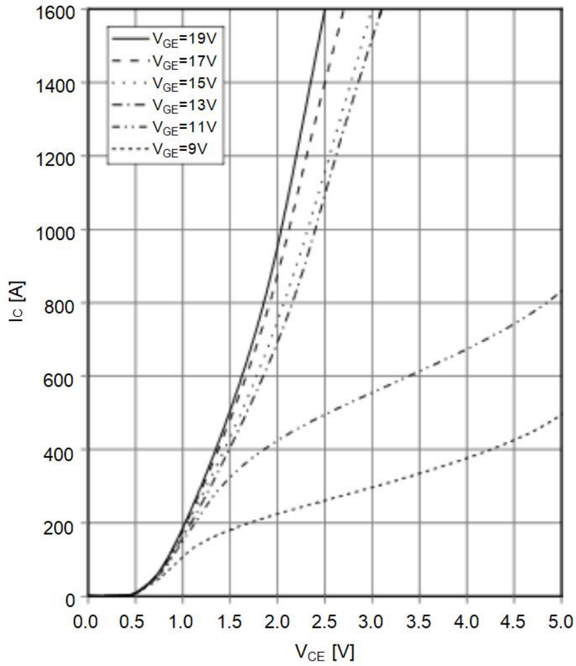


Fig 2. Output characteristic IGBT, Inverter(typical)
$I_C=f(V_{CE})$, $T_{vj}=150$℃

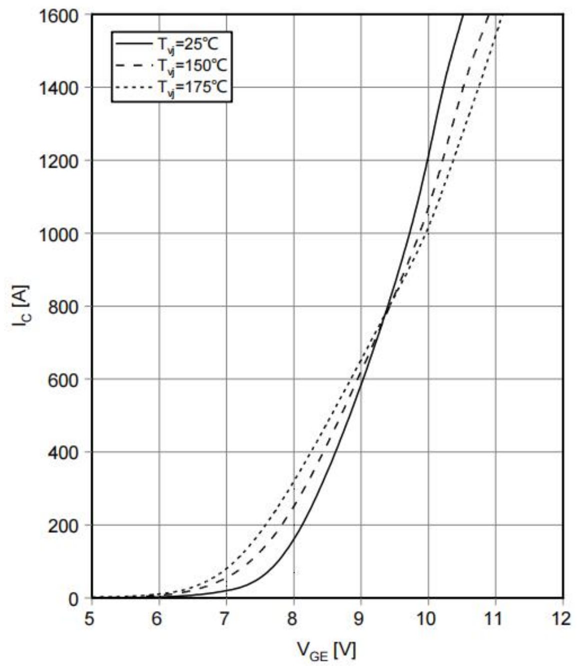


Fig 3. Transfer characteristic IGBT, Inverter(typical)
$I_C=f(V_{GE})$, $V_{CE}=20V$

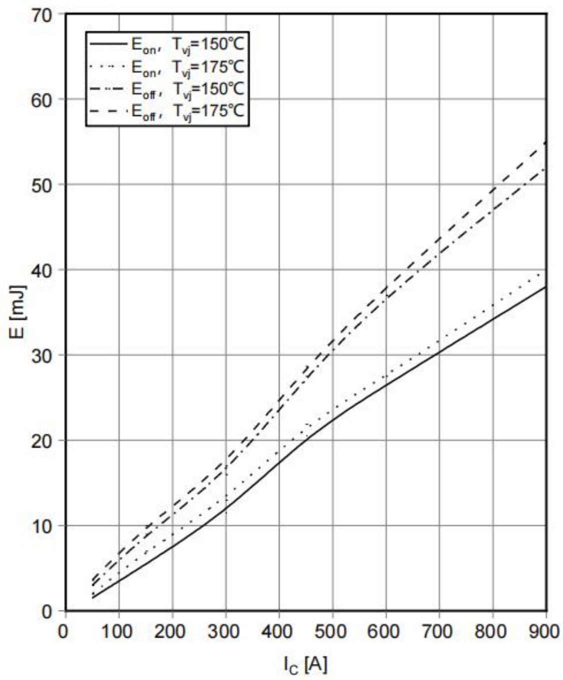


Fig 4. Switching losses IGBT, Inverter(typical)
$E_{on}=f(I_C)$,$E_{off}=f(I_C)$,$V_{GE}=-8V/+15V$,$R_{Gon}=R_{Goff}=5\Omega$, $V_{CE}=400V$

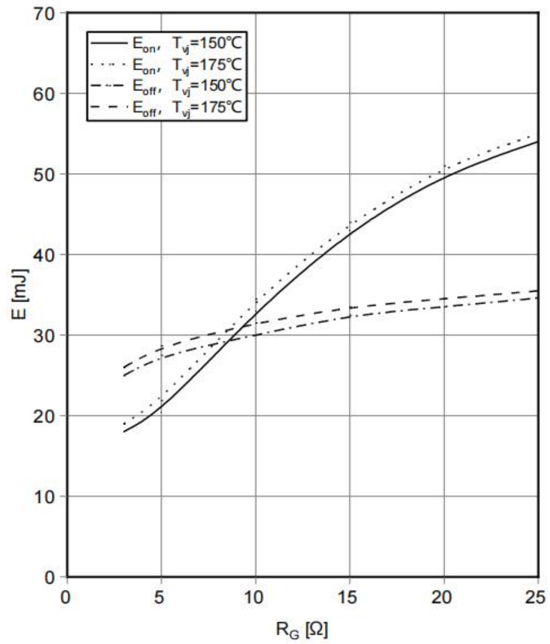


Fig 5. Switching losses IGBT, Inverter(typical) $E_{on}=f(R_G)$, $E_{off}=f(RG)$ V_{GE}=-8V/+15V, I_C=450A, V_{CE}=400V

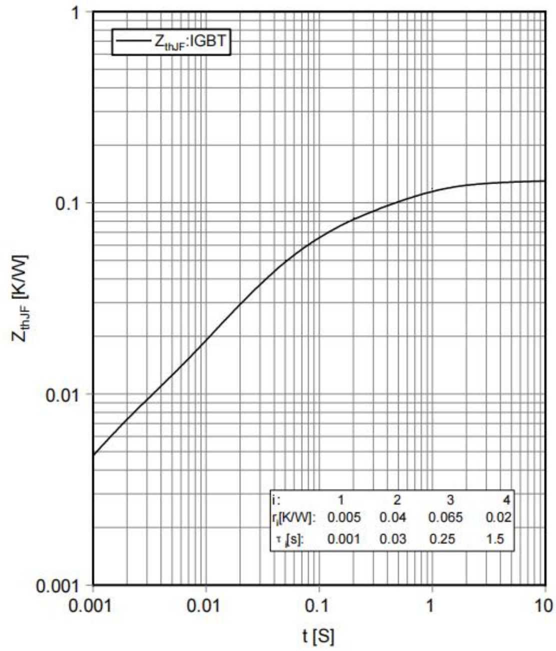


Fig 6. Transient thermal impedance IGBT, Inverter $Z_{thJF}=f(t)$

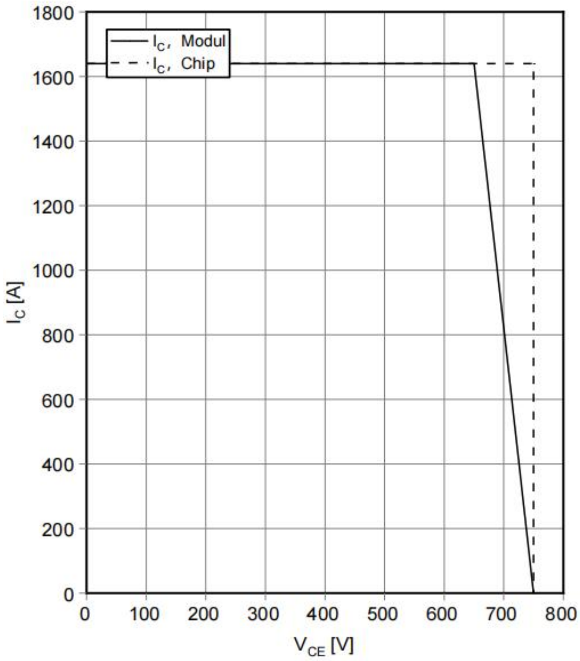


Fig 7. Reverse bias safe operating area IGBT, Inverter(RBSOA)
$I_C=f(V_{CE})$ ， V_{GE}=+15V/-8V, R_{Goff}=5Ω, T_{vj}=175℃

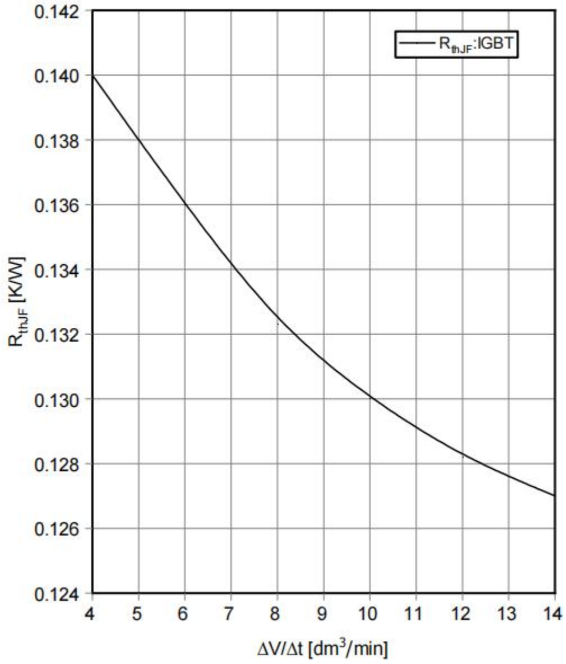


Fig 8. Thermal impedance IGBT, Inverter
$R_{thJF}=f(\Delta V/\Delta t)$,Tf=75℃;50% water/50% ethylene glycol

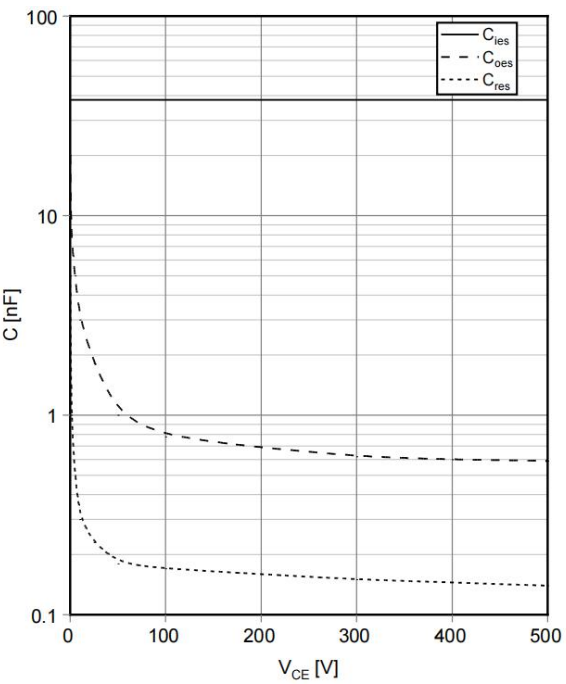


Fig 9. Capacity characteristic IGBT, Inverter(typical)
C=f(V_{CE}), V_{GE}=0V, T_{vj}= 25℃, f=100KHz

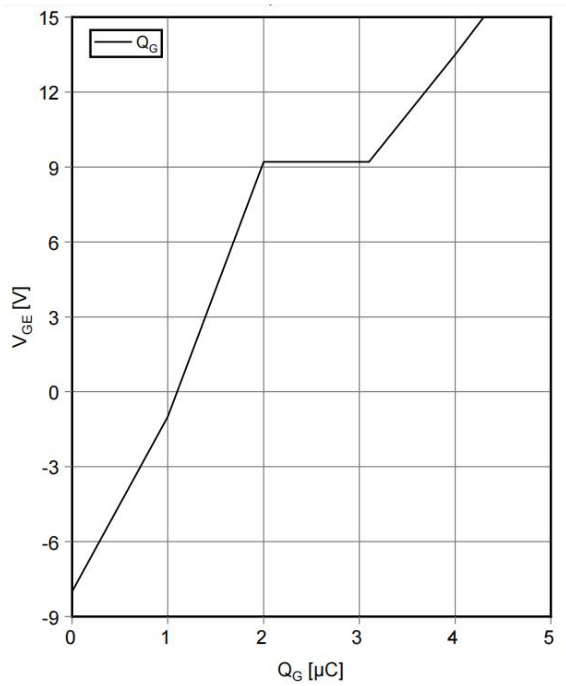


Fig 10. Gate charge characteristic IGBT, Inverter(typical)
V_{GE}= f(Q_G),V_{CE}=400V, I_C= 450A, T_{vj} = 25℃

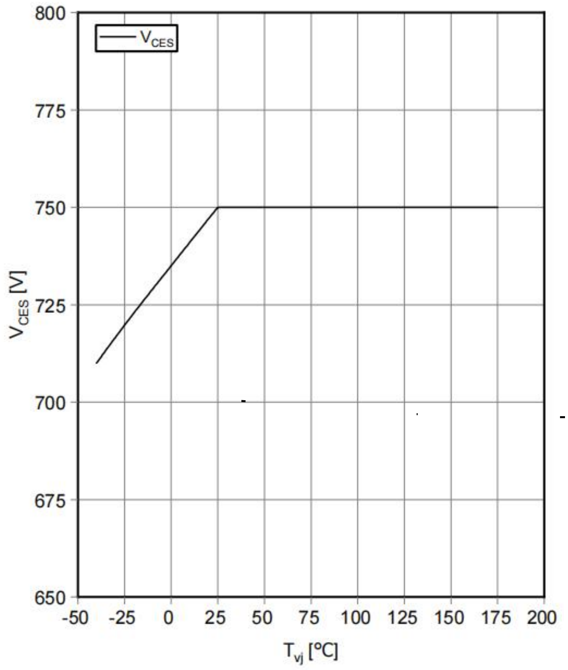


Fig 11. Maximum allowed collector-emitter voltage
V_{CES} = f(T_{vj}), verified by characterization/design not by test,
I_{CES} =1mA for T_{vj} ≤ 25℃; I_{CES} = 30 mA for T_{vj} > 25℃

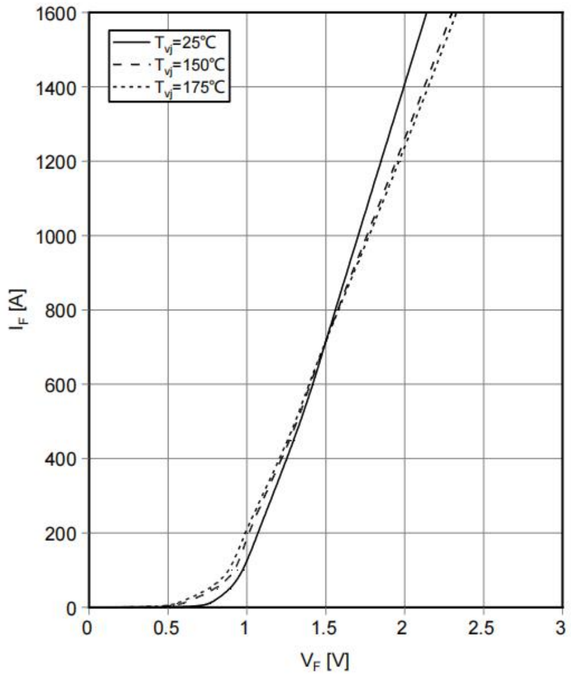


Fig 12.Forward characteristic of FRD, Inverter(typical)
I_F=f(V_F)

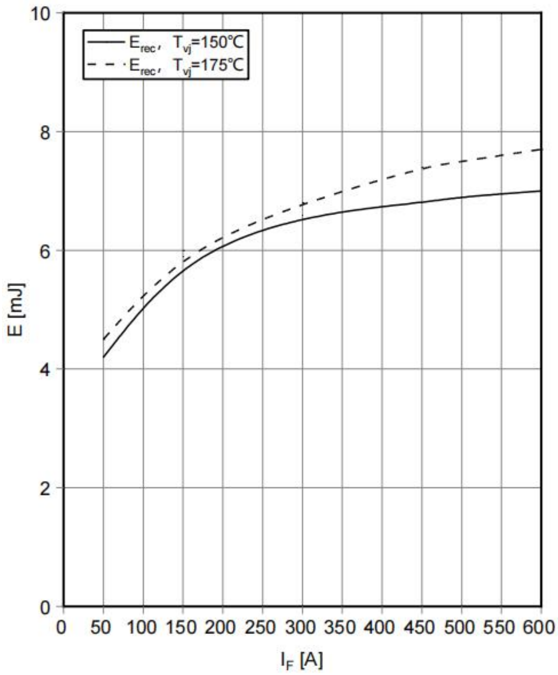


Fig 13. Switching losses FRD, Inverter(typical)

$E_{rec}=f(I_F)$，$R_{Gon}=5\Omega, V_{CE}=400V$

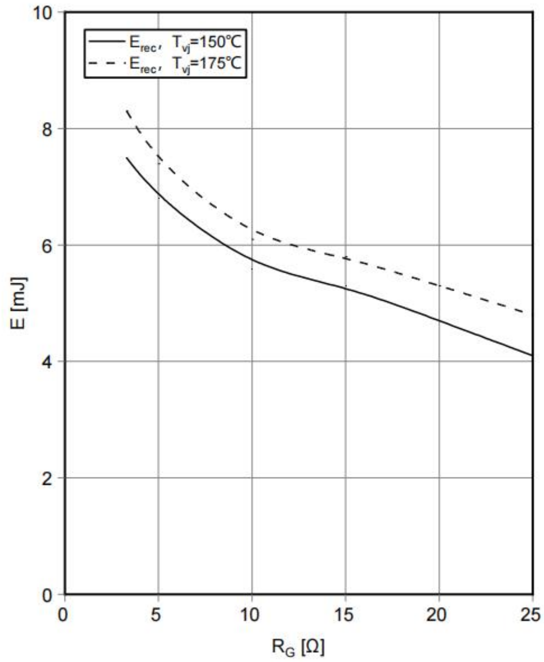


Fig 14. Switching losses FRD, Inverter(typical)

$E_{rec}=f(R_G), I_F=450A, V_{CE}=400V$

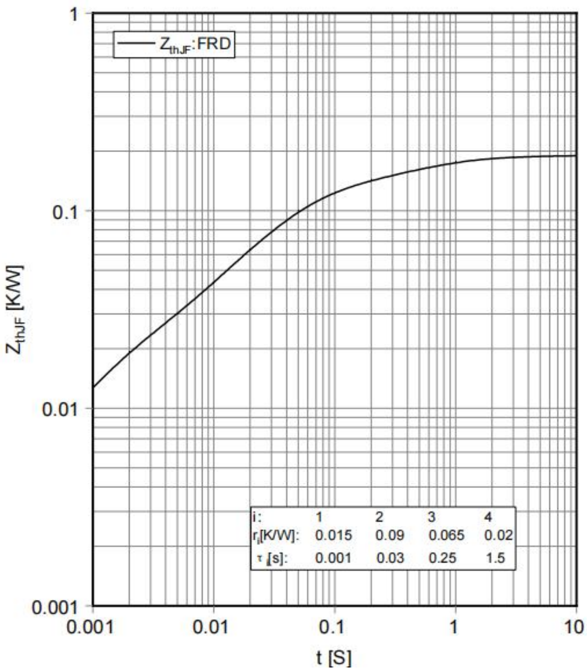


Fig 15. Transient thermal impedance FRD, Inverter

$Z_{thJF}=f(t)$

$\Delta V/\Delta t=10dm^3/min$; $T_F=75℃$; 50% water/50% ethylene glycol

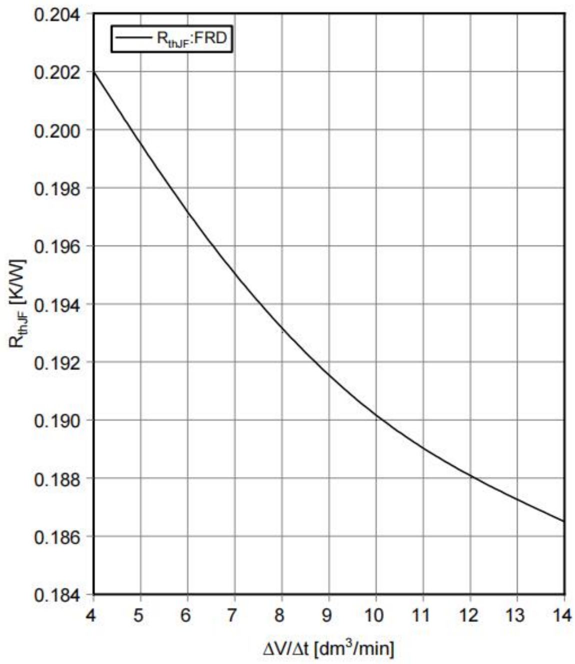


Fig 16. Thermal impedance FRD, Inverter

$R_{thJF}=f(\Delta V/\Delta t)$，Tf=75℃; 50% water / 50% ethylene glycol

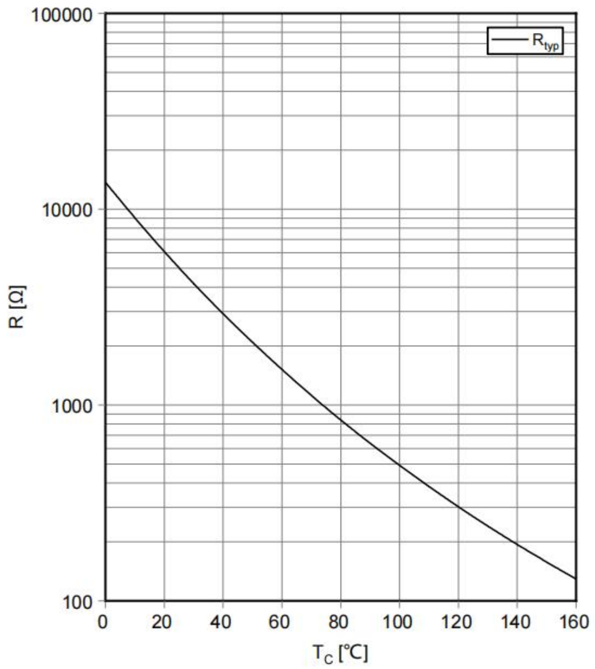


Fig 17.NTC Thermistor temperature, characteristic(typical）
R=f(T)

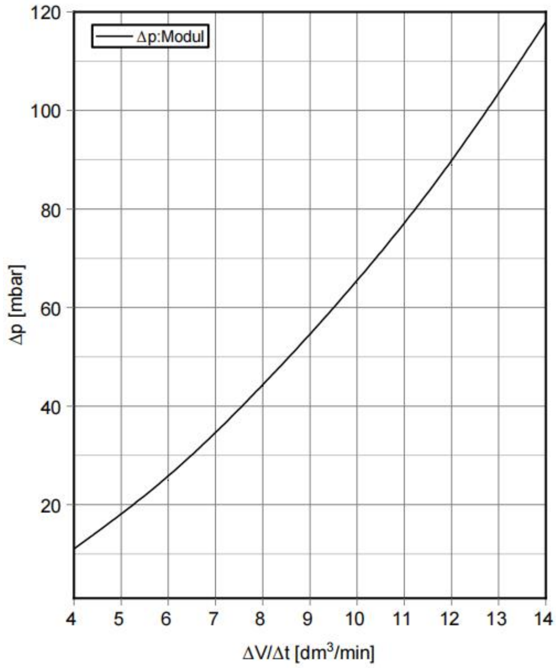
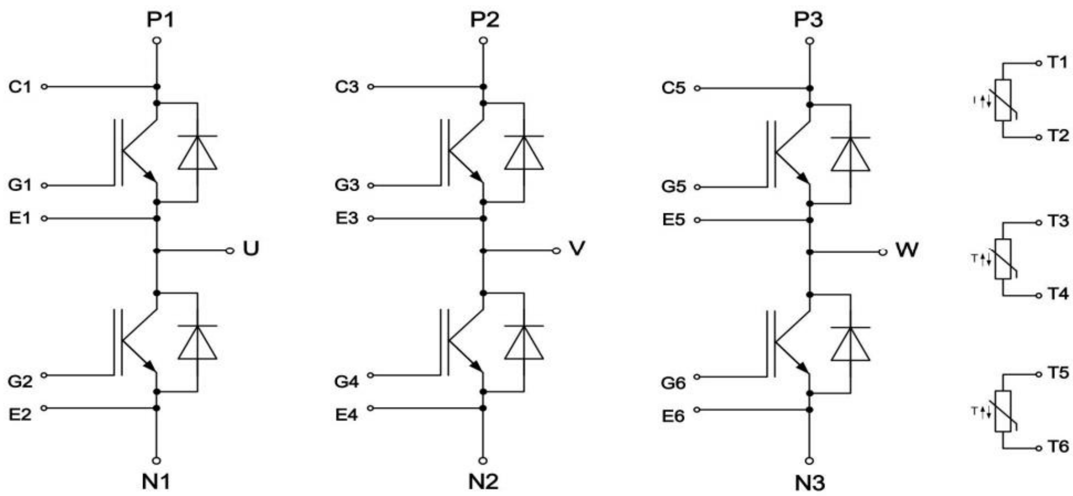
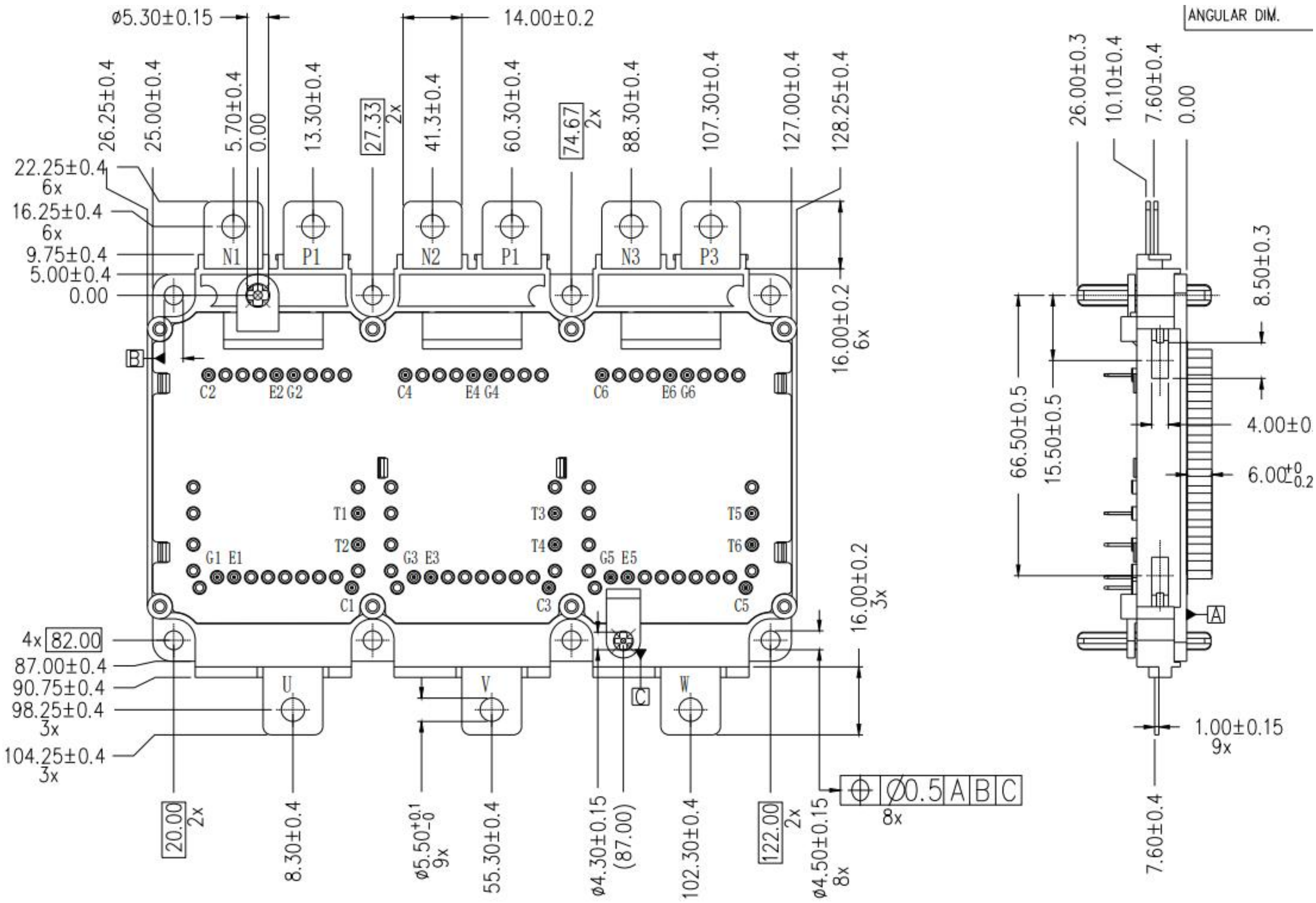


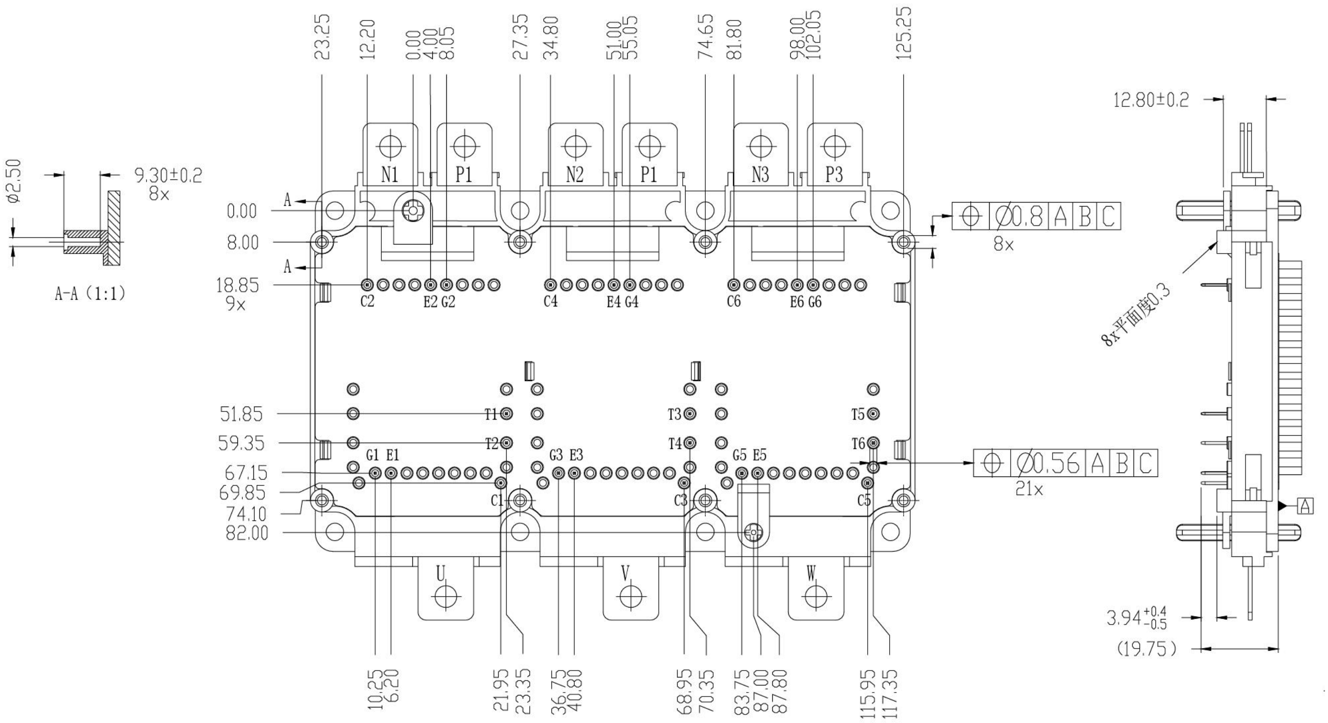
Fig 18. Pressure drop in cooling circuit
$\Delta p = f(\Delta V/\Delta t)$,T_F=75℃; 50% water / 50% ethylene glycol

Circuit Diagram



Package Outlines(Unit：mm)





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