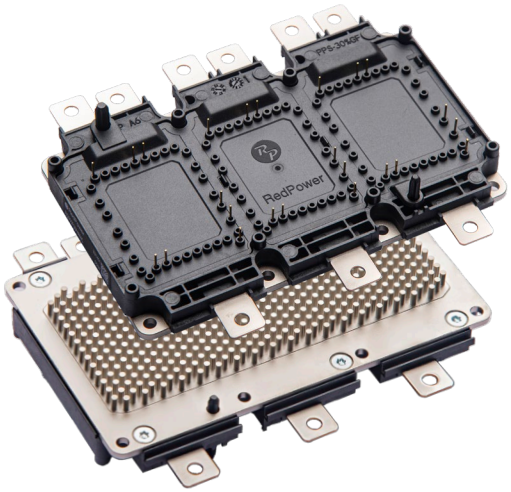
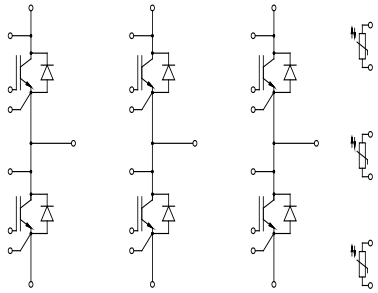
A6 package: 750V 400A IGBT module





等效电路图
Equivalent Circuit Schematic

Features:

- 750V 400A, $V_{CE(sat)}$ =1.35V@25℃
- Direct cooled PinFin Base Plate
- Micro pattern trench/FS Technology
- Low switching losses

产品特性:

- 750V 400A, $V_{CE(sat)}$ = 1.35V@25℃
- PinFin 直接液冷散热底板
- 微沟槽栅/场终止技术
- 低开关损耗

Typical Applications：

- Electric Vehicles
- Motor Drives

典型应用：

- 电动汽车
- 电机驱动

IGBT, Inverter / IGBT，逆变部分

Maximum Rated Values / 最大标称参数

Collector-emitter voltage 集电极-发射极电压	T_{vj}=25℃	V_{CES}	750	V
Implemented collector current 连续集电极电流		$I_{C\ nom}$	400	A
Continuous DC collector current 集电极连续直流电流	T_F=80℃， T_{vjmax}=175℃	I_C	360[1)]	A
Repetitive peak collector current 集电极可重复峰值电流	t_p=1ms	I_{CRM}	800[1)]	A
Gate-emitter peak voltage 门极-发射极峰值电压		V_{GES}	±20	V

Characteristic Values / 性能参数

				min.	typ.	max.	
Collector-emitter saturation voltage 集电极-发射极饱和压降	I_C=400A， V_{GE}=15V	T_{vj}=25℃ T_{vj}=150℃ T_{vj}=175℃	V_{CEsat}		1.35 1.47 1.50	1.60	V
Gate threshold voltage 门极阈值电压	V_{CE}=V_{GE}, I_C=5.0mA,	T_{vj}=25℃ T_{vj}=175℃	V_{GEth}	5.0	6.0 3.8	7.0	V
Internal gate resistor 内置门极电阻		T_{vj}=25℃	R_{Gint}		0.55		Ω
Input capacitance 输入电容	V_{CE}=25V， V_{GE}=0V， f=100kHz， T_{vj}=25℃		C_{ies}		58.4		nF
Reverse transfer capacitance 反向传输电容	V_{CE}=25V， V_{GE}=0V， f=100kHz， T_{vj}=25℃		C_{res}		0.22		nF
Gate charge 门极电荷	V_{GE}=-8V~+15V， V_{CE}=400V		Q_G		2.42		μC
Collector-emitter cutoff current 集电极-发射极关断漏电流	V_{CE}=750V, V_{GE}=0V,	T_{vj}=25℃	I_{CES}			500	uA
Gate-emitter leakage current 门极-发射极漏电流	V_{CE}=0V, V_{GE}=20V,	T_{vj}=25℃	I_{GES}			400	nA
Turn-on delay time, inductive load 开通延迟时间，感性负载	I_C=400A， V_{CE}=400V V_{GE}= -8V/15V R_{Gon}=1.5Ω	T_{vj}=25℃ T_{vj}=150℃ T_{vj}=175℃	t_{don}		100 110 110		ns
Rise time, inductive load 上升时间，感性负载	I_C=400A， V_{CE}=400V V_{GE}= -8V/15V R_{Gon}=1.5Ω	T_{vj}=25℃ T_{vj}=150℃ T_{vj}=175℃	t_r		48 55 56		ns
Turn-off delay time, inductive load 关断延迟时间，感性负载	I_C=400A， V_{CE}=400V V_{GE}= -8V/15V R_{Goff}=10Ω	T_{vj}=25℃ T_{vj}=150℃ T_{vj}=175℃	t_{doff}		755 835 845		ns
Fall time, inductive load 下降时间，感性负载	I_C=400A， V_{CE}=400V V_{GE}= -8V/15V R_{Goff}=10Ω	T_{vj}=25℃ T_{vj}=150℃ T_{vj}=175℃	t_f		70 128 135		ns
Turn-on energy loss per pulse 开通损耗	I_C=400A,V_{CE}=400V,L_s=30nH V_{GE}= -8V/15V,R_{Gon}=1.5Ω di/dt(T_{vj}=25℃)=6700A/us di/dt(T_{vj}=150℃)=5850A/us	T_{vj}=25℃ T_{vj}=150℃ T_{vj}=175℃	E_{on}		6.0 9.7 10.3		mJ
Turn-off energy loss per pulse 关断损耗	I_C=400A,V_{CE}=400V,L_s=30nH V_{GE}=-8V/15V,R_{Goff}=10Ω dv/dt(T_{vj}=25℃)=6350V/us dv/dt(T_{vj}=150℃)=4550V/us	T_{vj}=25℃ T_{vj}=150℃ T_{vj}=175℃	E_{off}		21.0 26.8 28.2		mJ

[1)] 非测试值，设计计算所得

SC data 短路耐量	V_{GE}=15V/-8V, tp≤6us,T_{vj}=25℃ V_{cc}=400V, tp≤3us,T_{vj}=175℃ V_{CEmax}≤750V	I_{sc}		3000 2300		A
Thermal resistance, junction to cooling fluid 结-冷却液热阻	Per IGBT, ΔV/Δt=10dm³/min T_F=25℃	R_{thJF}		0.165		K/W
Temperature under switching conditions 工作温度	t_{op} continuous for 10s within a period of 30s, occurrence maximum 3000 times over lifetime	$T_{vj\ op}$	-40 150		150 175	℃

Diode, Inverter / 二极管，逆变部分

Maximum Rated Values / 最大标称参数

Repetitive peak reverse voltage 可重复反向峰值电压	T_{vj}=25℃	V_{RRM}	750	V
Implemented forward current 连续正向电流		$I_{F\ nom}$	400	A
Repetitive peak forward current 可重复正向峰值电流	t_p=1ms	I_{FRM}	800[1)]	A

Characteristic Values / 性能参数

			min.	typ.	max.	
Forward voltage 正向通态压降	I_F=400A, V_{GE}=0V	T_{vj}=25℃ T_{vj}=150℃ T_{vj}=175℃	V_F		1.42 1.33 1.27	1.85	V
Peak reverse recoverycurrent 反向恢复峰值电流	I_F=400A, V_R=400V -di_F/dt=6450A/us(T_{vj}=150℃) V_{GE}=-8V	T_{vj}=25℃ T_{vj}=150℃ T_{vj}=175℃	I_{RM}		310 395 415		A
Recovery charge 反向恢复电荷	I_F=400A, V_R=400V -di_F/dt=6450A/us(T_{vj}=150℃) V_{GE}=-8V	T_{vj}=25℃ T_{vj}=150℃ T_{vj}=175℃	Q_r		19.0 33.6 37.8		μC
Reverse recovery energy 反向恢复损耗	I_F=400A, V_R=400V -di_F/dt=6450A/us(T_{vj}=150℃) V_{GE}=-8V	T_{vj}=25℃ T_{vj}=150℃ T_{vj}=175℃	E_{rec}		6.2 12 13.8		mJ
Thermal resistance, junction to cooling fluid 结-冷却液热阻	Per FRD, ΔV/Δt=10dm³/min T_F=25℃		R_{thJF}		0.213		K/W
Temperature under switching conditions 工作温度	t_{op} continuous for 10s within a period of 30s, occurrence maximum 3000 times over lifetime		$T_{vj\ op}$	-40 150		150 175	℃

[1)] 非测试值，设计计算所得

NTC-Thermistor/ NTC-热敏电阻

Characteristic Values / 性能参数

			min.	typ.	max.	
Rated resistance 标称电阻	T_C=25℃	R_{25}		5.00		KΩ
Deviation of R100 R100 偏移值	T_C=100℃，R_{100}=493.3Ω	△R/R	-5		5	%
Power dissipation 功率耗散	T_C=25℃	P_{25}			20	mW
B-value B 值	$R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298.15K))]$	$B_{25/50}$		3375		K
B-value B 值	$R_2=R_{25}\exp[B_{25/80}(1/T_2-1/(298.15K))]$	$B_{25/80}$		3414		K
B-value B 值	$R_2=R_{25}\exp[B_{25/100}(1/T_2-1/(298.15K))]$	$B_{25/100}$		3436		K

Module / 模块

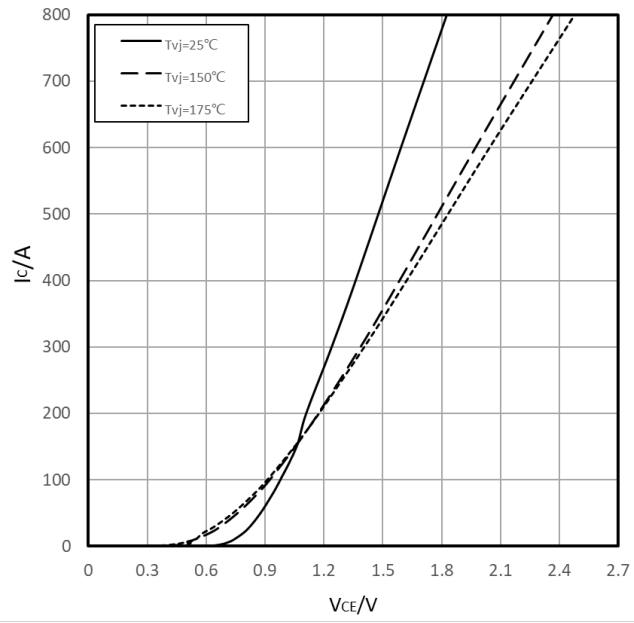
Isolation test voltage 绝缘测试电压	RMS, f=50Hz, t=1min	V_{ISOL}	3.0	KV
Material of module baseplate 模块底板材料			Cu+Ni[1)]	
Internal isolation 内部绝缘			ZTA	
Creepage distance 爬电距离	Terminal to heatsink Terminal to terminal	d_{Creep}	9.0 9.0	mm
Clearance 电气间隙	Terminal to heatsink Terminal to terminal	d_{Clear}	4.5 4.5	mm
Comparative tracking index 相对漏电起痕指数		CTI	200[2)]	

			min.	typ.	max.	
Stray inductance module 模块杂散电感		L_{sCE}		10		nH
Module lead resistance, terminals-chip 模块引脚电阻，端子-芯片	T_C=25℃，Per switch	$R_{CC'+EE'}$		0.85		mΩ
Storage temperature 贮存温度		T_{stg}	-40		125	℃
Mounting torque for module mounting 模块安装力矩	Baseplate to heatsink，Screw M4	M	1.8		2.2	Nm
	Terminal connection，Screw M5		3.6		4.4	
	PCB to frame		0.5		0.6	
Weight 重量		G		715		g

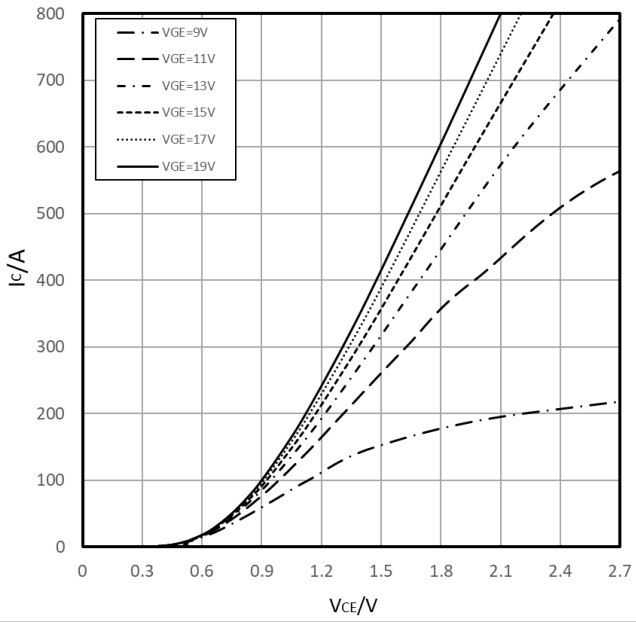
1) 铜底板表面镀镍
2) CTI 约为 200

Circuit Diagram / 曲线图

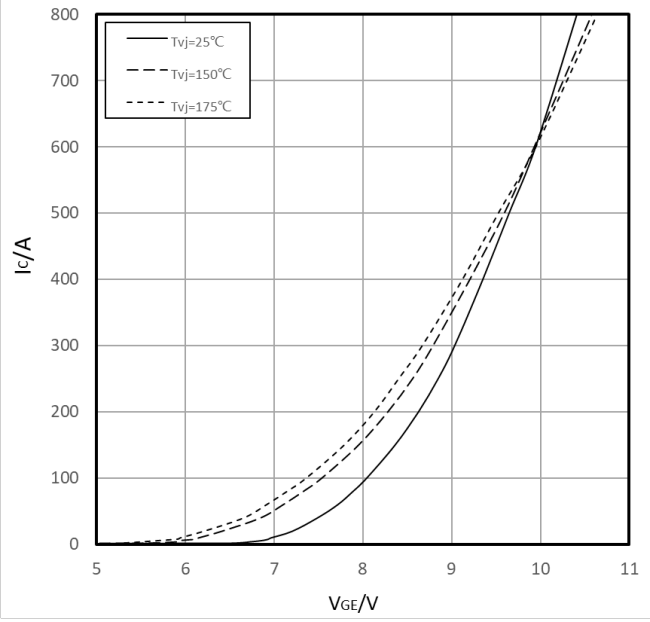
Output characteristic , Inverter IGBT (typical)
输出特性，逆变IGBT (典型)
$I_C=f(V_{CE})$, $V_{GE}=15V$ (Inclusive $R_{CC'+EE'}$)



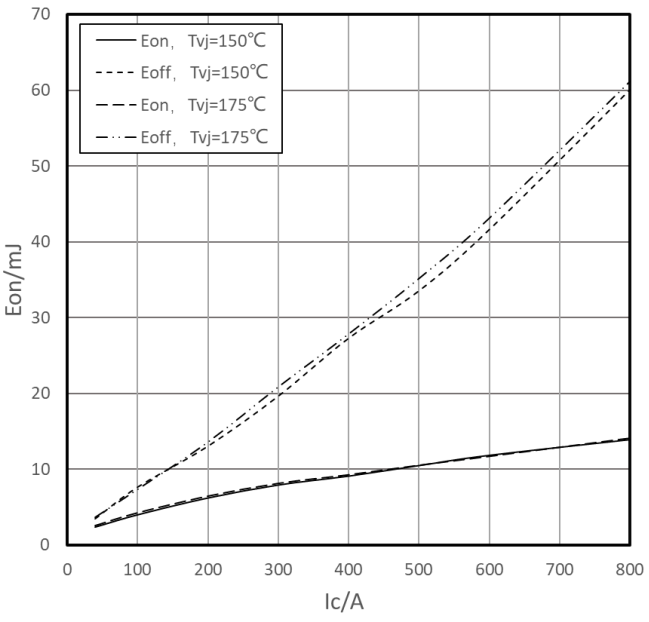
Output characteristic , Inverter IGBT (typical)
输出特性，逆变IGBT (典型)
$I_C=f(V_{CE})$, $T_{vj}=150℃$



Transfer characteristic , Inverter IGBT (typical)
传输特性，逆变IGBT (典型)
$I_C=f(V_{GE})$, $V_{CE}=20V$

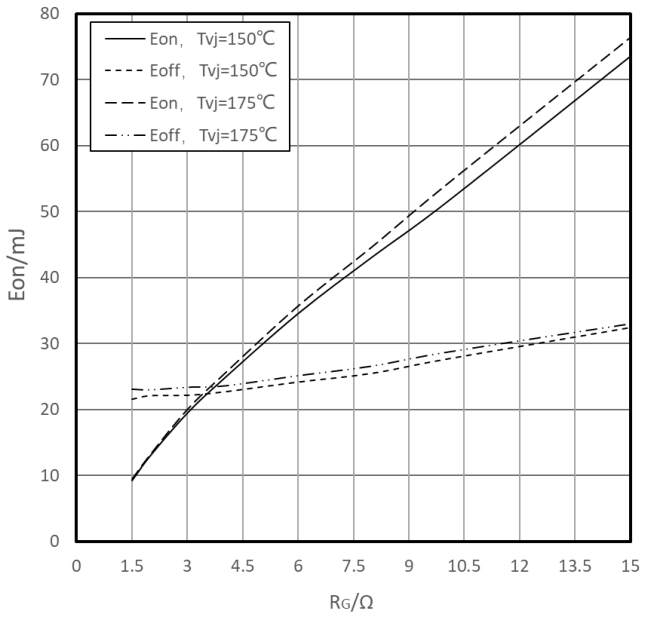


Switching losses , Inverter IGBT (typical)
开关损耗，逆变IGBT (典型)
$E_{on}=f(I_C)$, $E_{off}=f(I_C)$
$V_{GE}=+15V/-8V$, $R_{gon}=1.5Ω$, $R_{goff}=10Ω$, $V_{CE}=400V$



Switching losses , Inverter IGBT (typical)
开关损耗，逆变IGBT (典型)

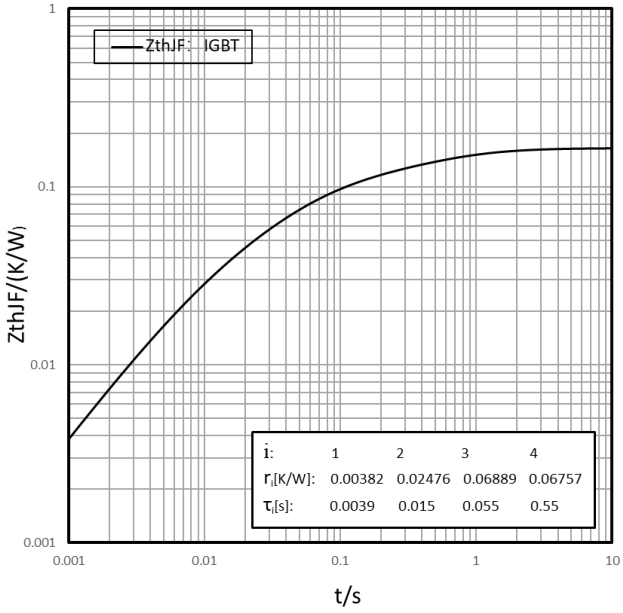
$E_{on}=f(R_g)$, $E_{off}=f(R_g)$
V_{GE}=+15V/-8V , I_C=400A , V_{CE}=400V



Transient thermal inpedance IGBT, Inverter
瞬态热阻，逆变IGBT

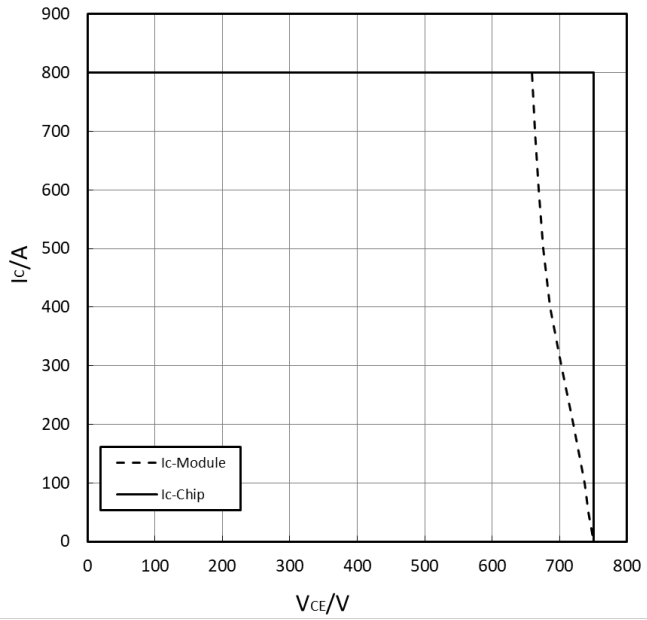
$Z_{thJF}=f(t)$

$\Delta V/\Delta t$=10dm³/min ; Tf=25℃ ; 100% water



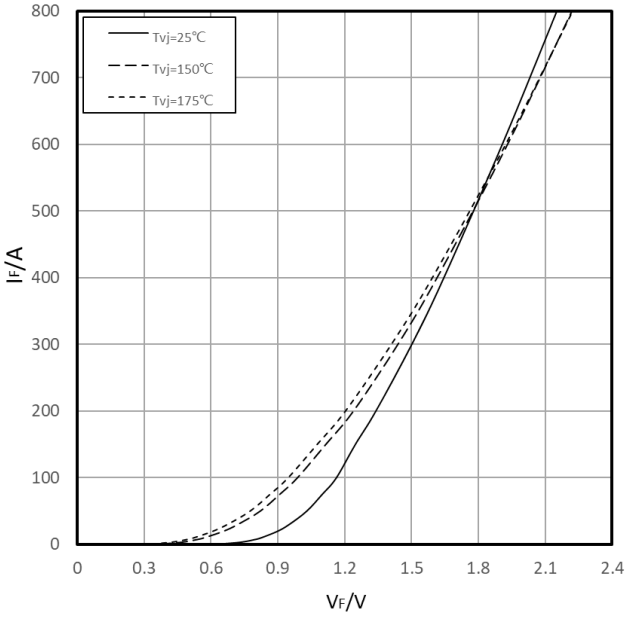
Reverse bias safe operating area , Inverter IGBT (RBSOA)
反偏安全工作区，逆变IGBT (RBSOA)

$I_c=f(V_{CE})$, V_{GE}=+15V/-8V , R_{goff}=10Ω , T_{vj}=175℃

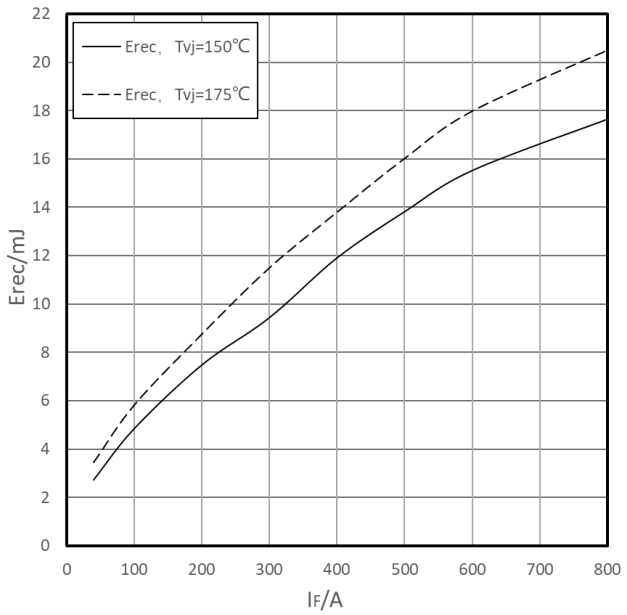


Forward characteristic , Inverter FRD (typical)
正向偏压特性，逆变FRD (典型)

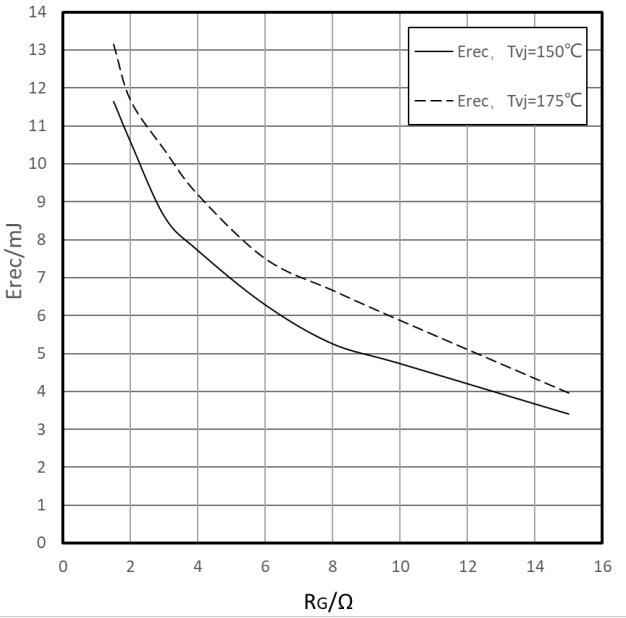
$I_F=f(V_F)$ (Inclusive $R_{CC'+EE'}$)



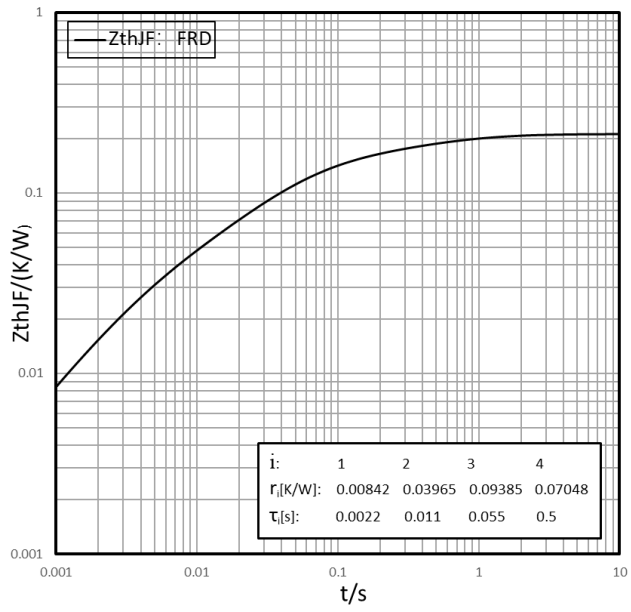
Switching losses , Inverter IGBT (typical)
开关损耗，逆变FRD (典型)
$E_{rec}=f(I_F)$, $R_{gon}=1.5\Omega$, $V_{CE}=400V$



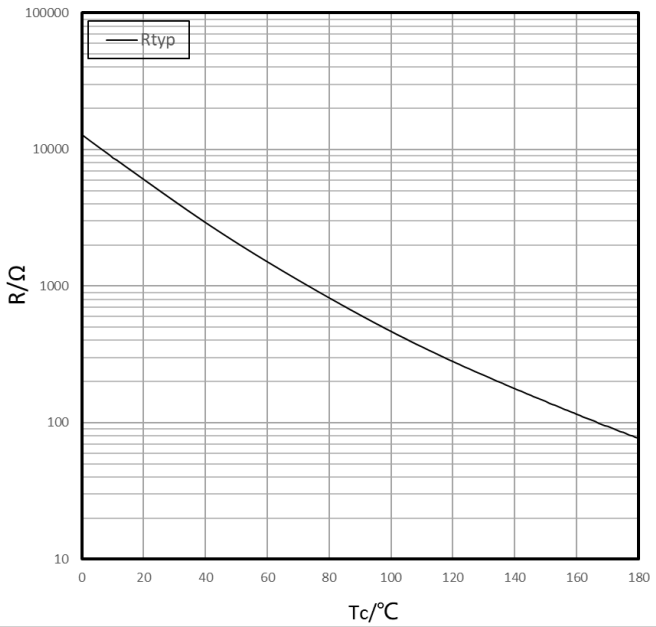
Switching losses , Inverter FRD (typical)
开关损耗，逆变FRD (典型)
$E_{rec}=f(R_G)$, $I_F=400A$, $V_{CE}=400V$



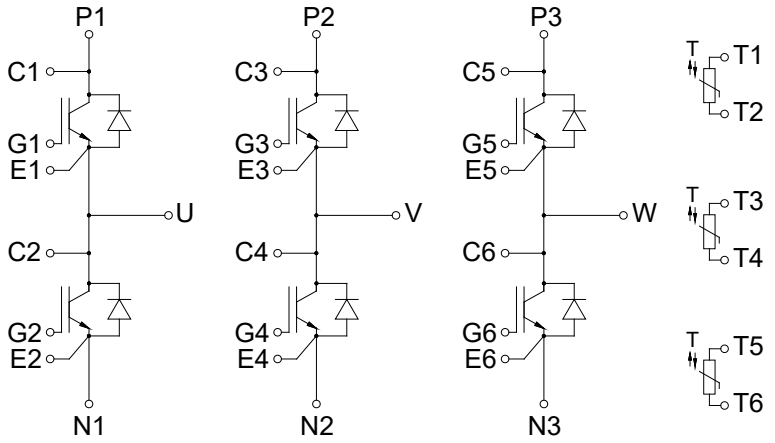
Transient thermal inpedance FRD, Inverter
瞬态热阻，逆变FRD
$Z_{thJF}=f(t)$
$\Delta V/\Delta t=10dm^3/min$; Tf=25℃ ; 100% water

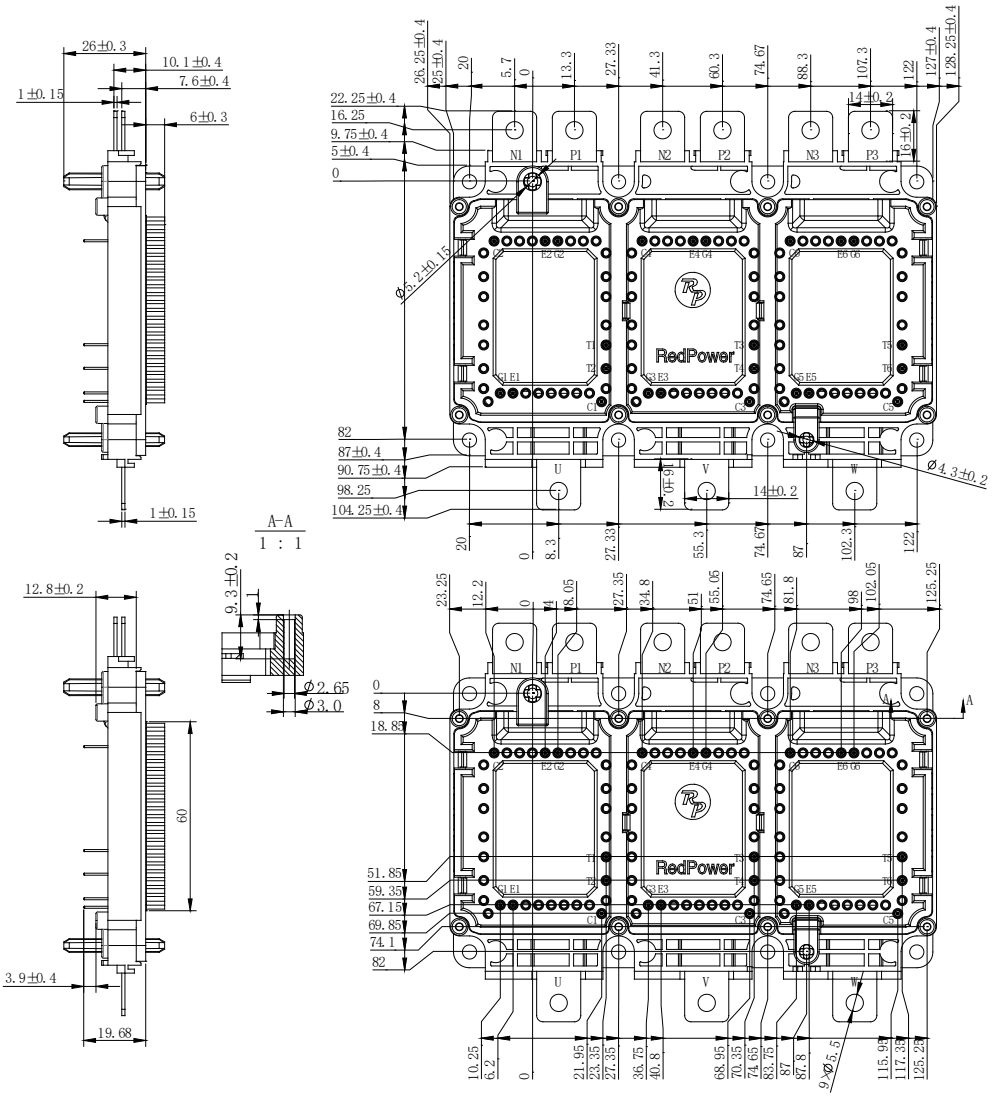


NTC-Thermistor-temperature characteristic
负温度系数热敏电阻 温度特性
R=f(T)



Internal Circuit / 内部电路



Package Dimension / 封装尺寸

Dimensions in Millimeters / 毫米为单位