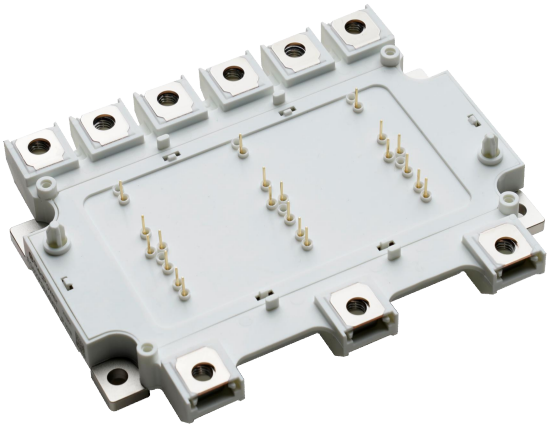
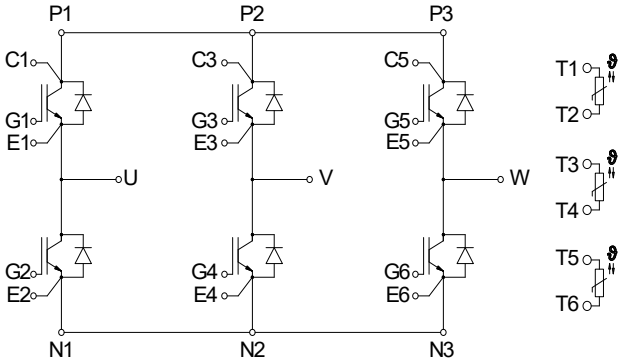
A4 package: 750V 600A IGBT module





等效电路图
Equivalent Circuit Schematic

Features:

- 750V 600A, $V_{CE(sat)}$ =1.35V@25℃
- High RBSOA capability
- Micro pattern trench/FS technology
- Low switching losses
- High SC capability
- Direct Cooled Base Plate with PinFin

产品特性:

- 750V 600A, $V_{CE(sat)}$ = 1.35V@25℃
- 高 RBSOA 能力
- 微沟槽/场终止技术
- 低开关损耗
- 高短路能力
- 直接冷却 PinFin 基板

Typical Applications：

- Automotive Applications
- Motor Drives
- Inverters

典型应用：

- 汽车应用
- 电机驱动
- 逆变器

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
Continuous DC collector current 集电极连续直流电流		$I_{C\ nom}$	600	A
	T_C=65℃,$T_{vj\ max}$=175℃	I_C	695[1)]	A
Repetitive peak collector current 集电极可重复峰值电流	t_p=1ms	I_{CRM}	1200	A
Total power dissipation 功率损耗	T_C=75℃,$T_{vj\ max}$=175℃	P_{tot}	934[1)]	W
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=450A, V_{GE}=15V	T_{vj}=25℃ T_{vj}=150℃ T_{vj}=175℃	V_{CEsat}		1.28 1.38 1.40		V
	I_C=600A, V_{GE}=15V	T_{vj}=25℃ T_{vj}=175℃			1.40 1.60	1.90	
Gate threshold voltage 门极阈值电压	V_{CE}=V_{GE}, I_C=8mA	T_{vj}=25℃	V_{GEth}	5.00	6.00	7.00	V
Internal gate resistor 内置门极电阻		T_{vj}=25℃	R_{Gint}		1.45		Ω
Input capacitance 输入电容	V_{CE}=50V, V_{GE}=0V, f=100kHz	T_{vj}=25℃	C_{ies}		70.55		nF
Output capacitance 输出电容	V_{CE}=50V, V_{GE}=0V, f=100kHz	T_{vj}=25℃	C_{oes}		2.42		nF
Reverse transfer capacitance 反向传输电容	V_{CE}=50V, V_{GE}=0V, f=100kHz	T_{vj}=25℃	C_{res}		0.16		nF
Gate charge 门极电荷	V_{GE}=-10V~+15V, V_{CE}=400V, I_C=600A	T_{vj}=25℃	Q_G		3.03		μC
Collector-emitter cut-off current 集电极-发射极关断漏电流	V_{CE}=750V,V_{GE}=0V	T_{vj}=25℃	I_{CES}			1.0	mA
Gate-emitter leakage current 门极-发射极漏电流	V_{CE}=0V,V_{GE}=20V	T_{vj}=25℃	I_{GES}			500	nA
Turn-on delay time, inductive load 开通延迟时间，感性负载	I_C=600A,V_{CE}=400V V_{GE}= -8V/15V R_{Gon}=2.0Ω	T_{vj}=25℃ T_{vj}=150℃ T_{vj}=175℃	t_{don}		157 187 190		ns
Rise time, inductive load 上升时间，感性负载	I_C=600A,V_{CE}=400V V_{GE}= -8V/15V R_{Gon}=2.0Ω	T_{vj}=25℃ T_{vj}=150℃ T_{vj}=175℃	t_r		79 100 105		ns
Turn-off delay time, inductive load 关断延迟时间，感性负载	I_C=600A, V_{CE}=400V V_{GE}= -8V/15V R_{Goff}=12Ω	T_{vj}=25℃ T_{vj}=150℃ T_{vj}=175℃	t_{doff}		969 1053 1067		ns
Fall time, inductive load 下降时间，感性负载	I_C=600A, V_{CE}=400V V_{GE}= -8V/15V R_{Goff}=12Ω	T_{vj}=25℃ T_{vj}=150℃ T_{vj}=175℃	t_f		89 90 90		ns
Turn-on energy loss per pulse 开通损耗	I_C=600A, V_{CE}=400V V_{GE}= -8V/15V R_{Gon}=2.0Ω, di/dt(T_{vj}=25℃)=5929A/us di/dt(T_{vj}=175℃)=4468A/us	T_{vj}=25℃ T_{vj}=150℃ T_{vj}=175℃	E_{on}		23.5 30.4 33.0		mJ

Turn-off energy loss per pulse 关断损耗	I_C=600A,V_{CE}=400V V_{GE}= -8V/15V R_{Goff}=12Ω dv/dt(T_{vj}=25℃)=6349A/us dv/dt(T_{vj}=175℃)=3968A/us	T_{vj}=25℃ T_{vj}=150℃ T_{vj}=175℃	E_{off}		42.0 44.8 45.9		mJ
SC data 短路耐量	V_{CC}=400V，V_{GE}= -8V/15V t_p≤6μs V_{CEmax}=V_{CES}-L_{sCE}·di/dt t_p≤6μs	T_{vj}=25℃ T_{vj}=175℃	I_{sc}		2900 2300		A
Thermal resistance, junction to cooling fluid 结-冷却液热阻	Per IGBT/单个 IGBT Cooling fluid = 50%water/50% ethylene glycol; ΔV/ΔT=10.0dm³/min T_F=65℃		R_{thJF}		0.107		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
Continuous DC forward current 可连续正向直流电流		I_{Fnom}	600	A
Repetitive peak forward current 可重复正向峰值电流	I_{FRM}=2×I_F	I_{FRM}	1200[1)]	A

Characteristic Values / 性能参数

				min.	typ.	max.	
Forward voltage[1)] 正向通态压降	I_F=450A，V_{GE}=0V	T_{vj}=25℃ T_{vj}=150℃ T_{vj}=175℃	V_F		1.45 1.40 1.35		V
	I_F=600A，V_{GE}=0V	T_{vj}=25℃ T_{vj}=175℃			1.57 1.44	2.1	
Reverse recovery time 反向恢复时间	I_F=600A, V_R=400V -di$_F$/dt=7143A/us(T_{vj}=150℃) V_{GE}=-8V	Tvj=25℃ Tvj=150℃ T_{vj}=175℃	t_{rr}		137 171 182		ns
Peak reverse recovery current 反向恢复峰值电流	I_F=600A, V_R=400V -di$_F$/dt=7143A/us(T_{vj}=150℃) V_{GE}=-8V	Tvj=25℃ Tvj=150℃ T_{vj}=175℃	I_{RM}		332 388 396		A
Recovery charge 反向恢复电荷	I_F=600A, V_R=400V -di$_F$/dt=7143A/us(T_{vj}=150℃) V_{GE}=-8V	T_{vj}=25℃ T_{vj}=150℃ T_{vj}=175℃	Q_R		26.4 37.5 41.1		μC
Reverse recovery energy 反向恢复损耗	I_F=600A, V_R=400V -di$_F$/dt=7143A/us(T_{vj}=150℃) V_{GE}=-8V	T_{vj}=25℃ T_{vj}=150℃ T_{vj}=175℃	E_{rec}		4.4 9.9 12.1		mJ
Thermal resistance, junction to cooling fluid 结-冷却液热阻	Per FRD/单个 FRD Cooling fluid = 50%water/50% ethylene glycol; ΔV/ΔT=10.0dm³/min T_F=65℃		R_{thJF}		0.150		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	℃

NTC-Thermistor/ NTC-热敏电阻

Characteristic Values / 性能参数

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

Module / 模块

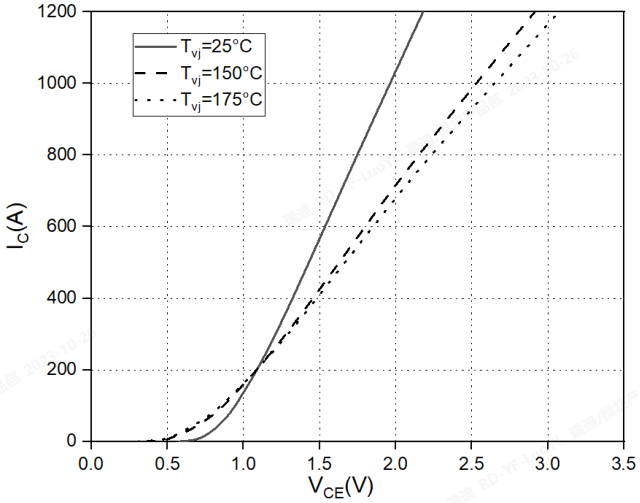
Isolation test voltage 绝缘测试电压	RMS, f=50Hz, t=1min	V_{ISOL}	3	KV
Material of module baseplate 模块底板材料			Cu+Ni	
Internal isolation 内部绝缘			Si_3N_4	
Creepage distance 爬电距离	Terminal to heatsink Terminal to terminal		18.2 8.2	mm
Clearance 电气间隙	Terminal to heatsink Terminal to terminal		18.2 5.9	mm
Comparative 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}	-	15	-	nH
Module lead resistance，terminals-chip 模块引脚电阻，端子-芯片	T_C=25℃，Per Switch	$R_{CC'+EE'}$	-	1.0	-	mΩ
Storage temperature 贮存温度		T_{stg}	-40	-	125	℃
Mounting torque for module mounting 模块安装力矩	Screw M5 / M5 螺丝 Baseplate to heatsink	M	4.0	-	6.0	Nm
Terminal connection torque 功率端子连接力矩	Screw M6 / M6 螺丝	M	4.0	-	6.0	Nm
Weight 重量		G	-	715	-	g

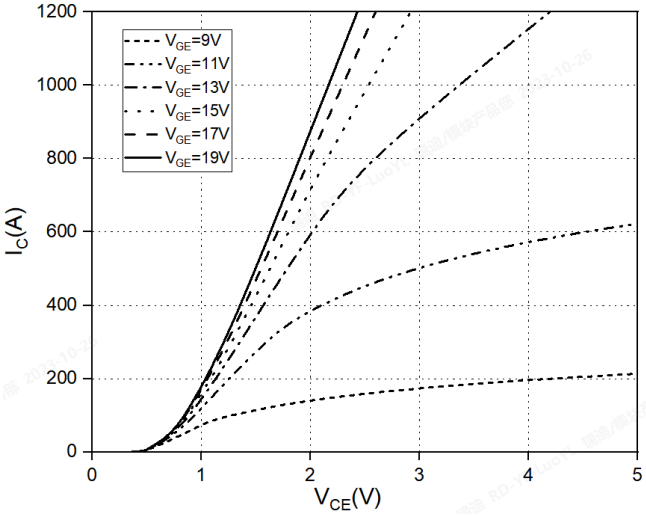
1) Verified by characterization/design not by test.
非测试值，设计计算所得。
2) CTI is about 200.
CTI 约等于 200。

Circuit Diagram / 曲线图

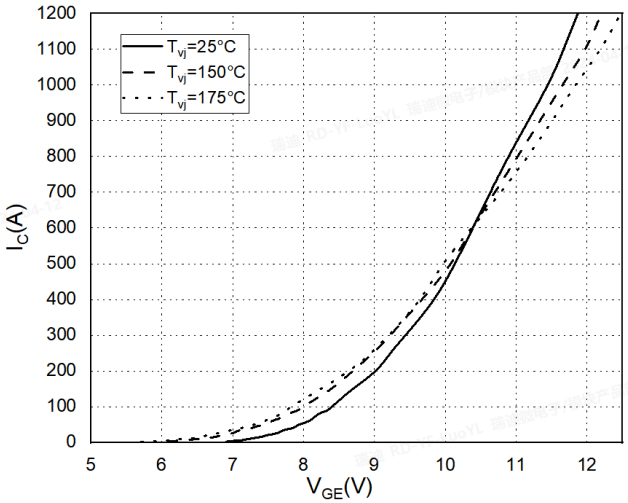
Output chanracteristic IGBT,Inverter(typical), Inclusive $R_{CC'+EE'}$
IGBT 输出特性，逆变（典型值），包含 $R_{CC'+EE'}$
$I_C=f(V_{CE}),V_{GE}=15V$



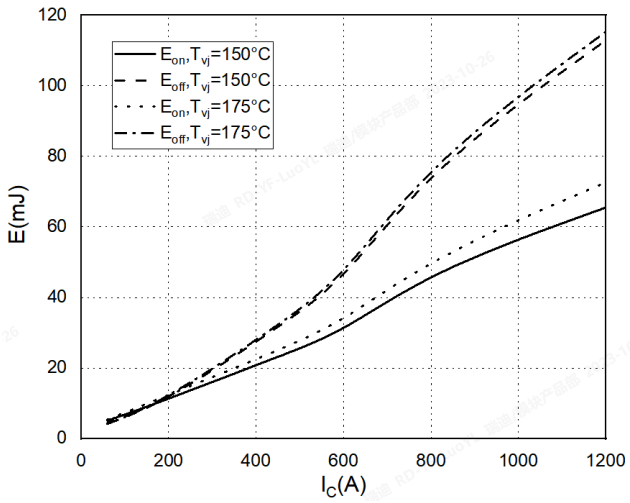
Output characteristic IGBT,Inverter(typical), Inclusive $R_{CC'+EE'}$
IGBT 输出特性，逆变（典型值），包含 $R_{CC'+EE'}$
$I_C=f(V_{CE}),T_{vj}=175℃$



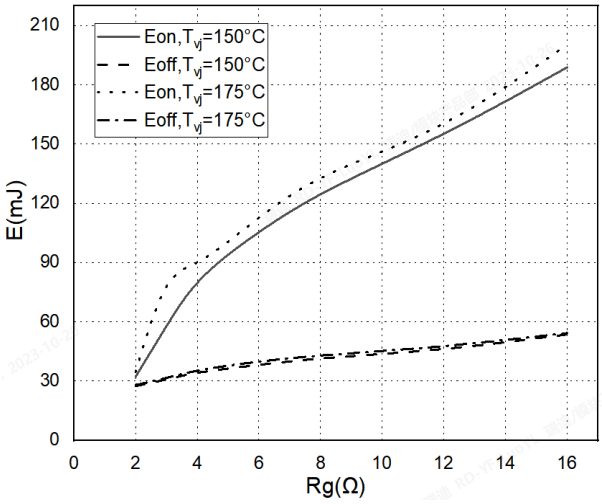
Transfer characteristic IGBT,Inverter(typical), Inclusive $R_{CC'+EE'}$
IGBT 传输特性，逆变（典型值），包含 $R_{CC'+EE'}$
$I_C=f(V_{GE}),V_{CE}=20V$



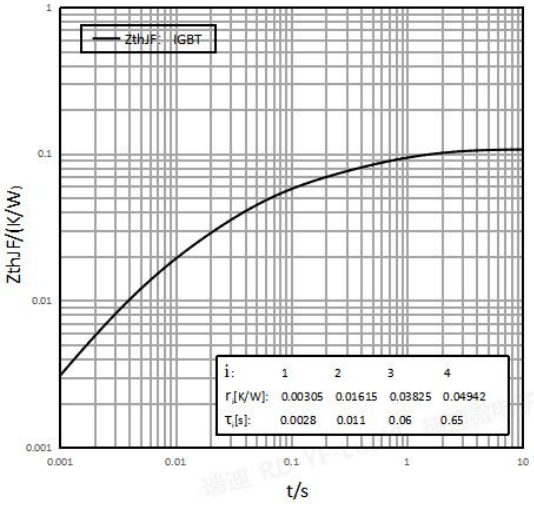
Switching losses IGBT,Inverter(typical), Inclusive $R_{CC'+EE'}$
IGBT 开关损耗，逆变（典型值），包含 $R_{CC'+EE'}$
$E=f(I_C)$，V_{GE}=+15V/-8V，
$R_{Gon}=2\Omega$，$R_{Goff}=12\Omega$，$V_{CE}=400V$



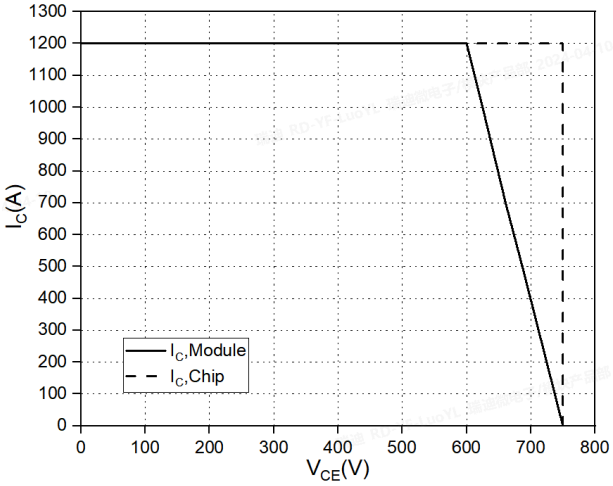
Switching losses IGBT,Inverter(typical), Inclusive $R_{CC'+EE'}$
IGBT 开关损耗，逆变（典型值），包含 $R_{CC'+EE'}$
$E_{on}=f(R_G)$，$E_{off}=f(R_G)$),
V_{GE}=+15V/-8V，I_C=600A，V_{CE}=400V



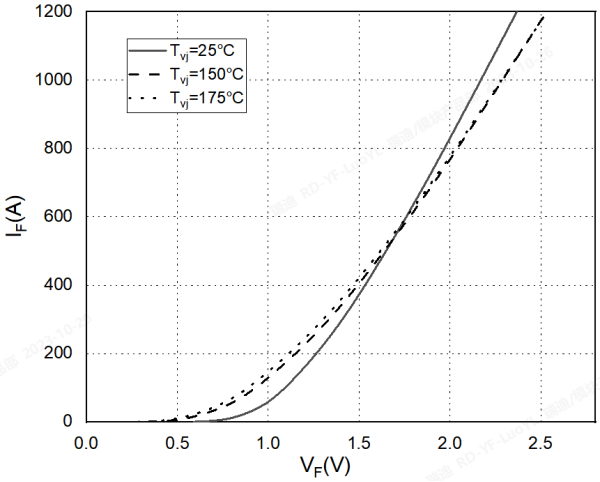
Transient thermal impedance IGBT, Inerter
IGBT 瞬态热阻，逆变
$Z_{thJC}=f(t)$
Cooling fluid = 50%water/50% ethylene glycol;
$\Delta V/\Delta T=10.0dm^3/min;T_F=65℃$



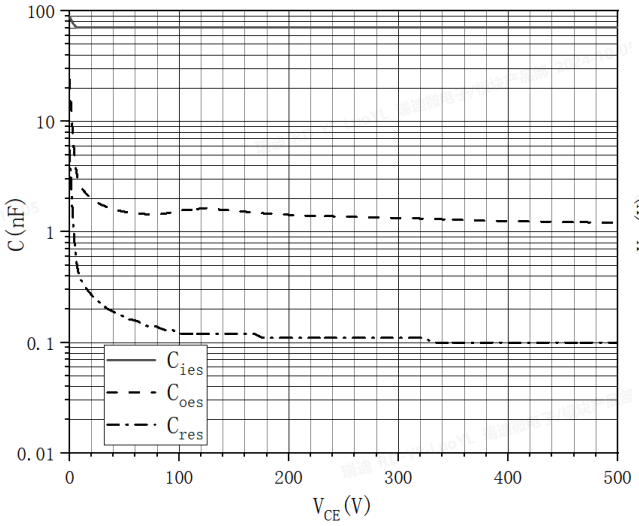
Reverse bias safe operating area IGBT, Inverter(RBSOA)
IGBT 反向安全工作区，逆变(RBSOA)
$I_C=f(V_{CE})$,V_{GE}=+15V/-8V, R_{Goff} = 12Ω, Tvj = 175°C



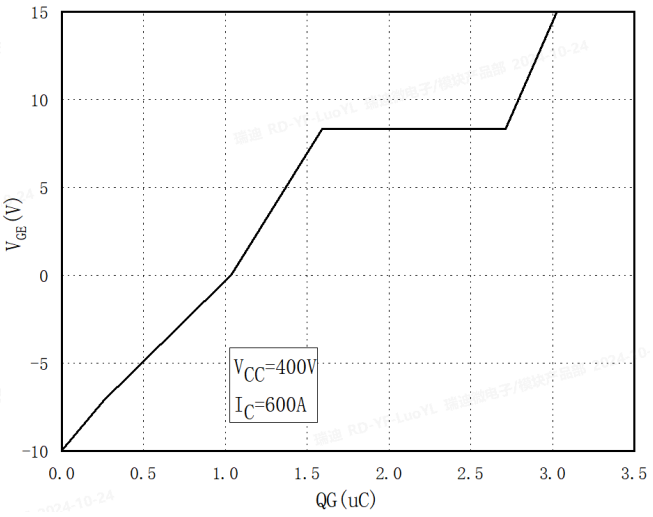
Forward characteristic FRD, Inverter(typical), Inclusive $R_{CC'+EE'}$
FRD 正向特性，逆变（典型值）,包含 $R_{CC'+EE'}$
$I_F=f(V_F)$



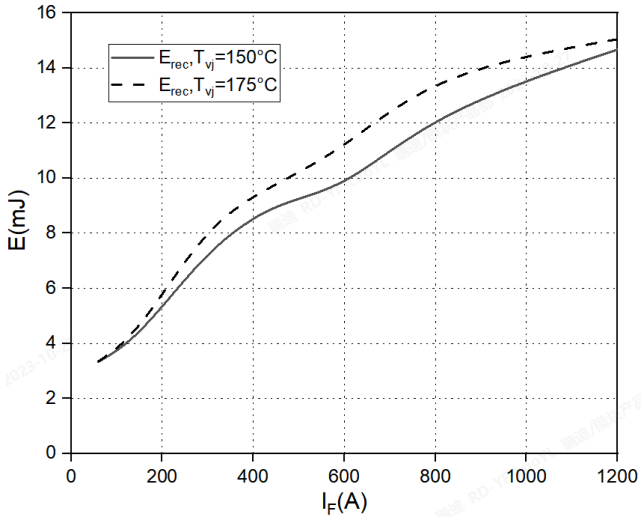
Capacity characteristic IGBT, Inverter
(typical)C=f(V_{CE}),
电容特性 IGBT，逆变器(典型值)
V_{CE}=50V，V_{GE}=0V，f=100kHz,T_{vj}=25℃



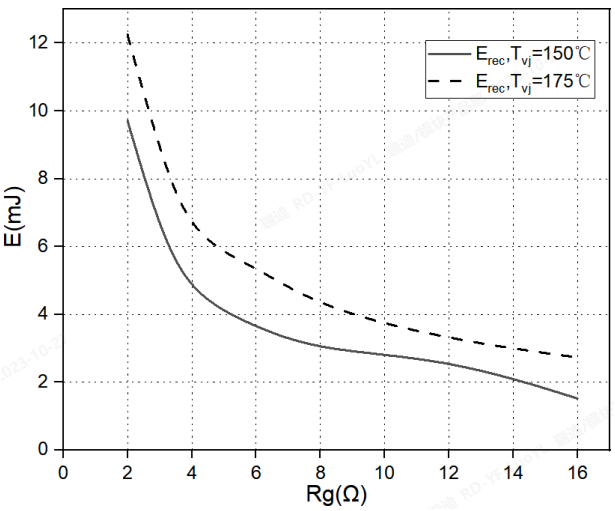
Gate charge characteristic IGBT, Inverter
(typical)V_{GE}=f(Q_G),
栅极电荷特性 IGBT，逆变器(典型值)
V_{GE}=-10V~+15V，V_{CE}=400V，I_C=600A，T_{vj}=25℃



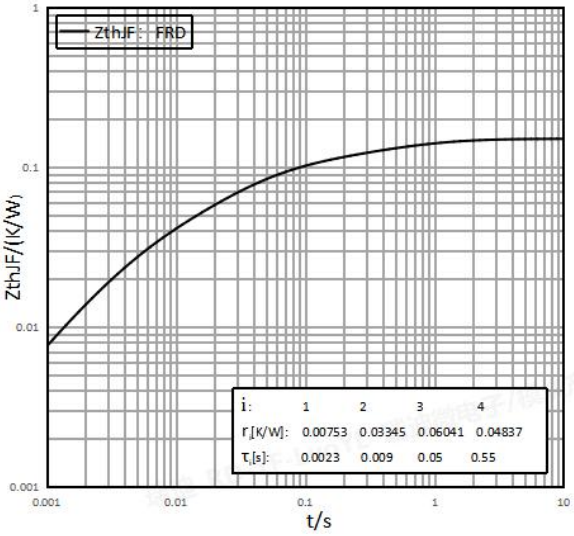
Swiching losses FRD, Inverter (typical),
Inclusive $R_{CC'+EE'}$
FRD 开关损耗，逆变（典型值）,包含 $R_{CC'+EE'}$
E_{rec}=f(I_F),R_{Gon}=2Ω,V_{CE}=400V



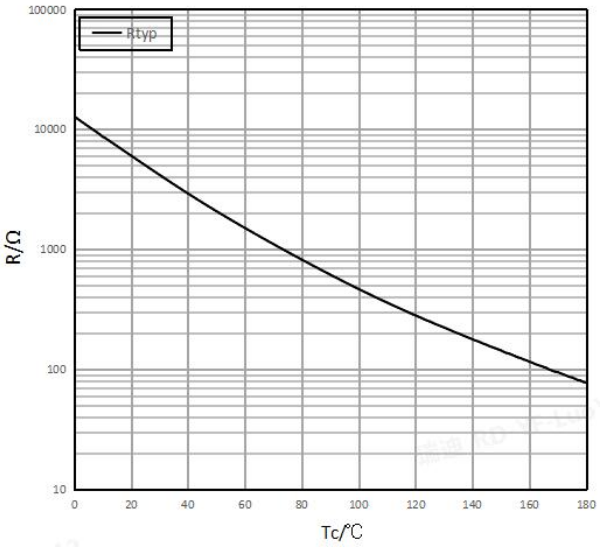
Swiching losses FRD, Inverter (typical),
Inclusive $R_{CC'+EE'}$
FRD 开关损耗，逆变（典型值）,包含 $R_{CC'+EE'}$
E_{rec}=f(R_G),I_F=600A,V_{CE}=400V



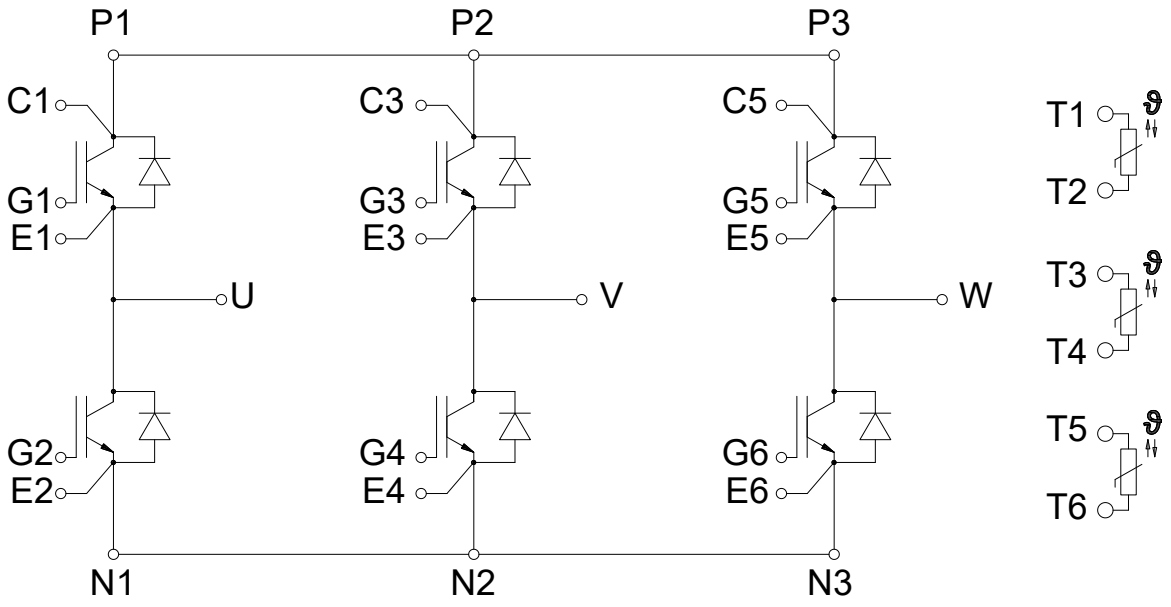
Transient thermal impedance FRD, Inerter
FRD 瞬态热阻，逆变
$Z_{thJC}=f(t)$
Cooling fluid = 50%water/50% ethylene glycol;
$\Delta V/\Delta T=10.0dm^3/min;T_F=65℃$



NTC Thermistor temperature characteristic (typical)
NTC 热敏电阻
R=f（T）



Internal Circuit / 内部电路



Package Dimension / 封装尺寸

Dimensions in Millimeters / 毫米为单位