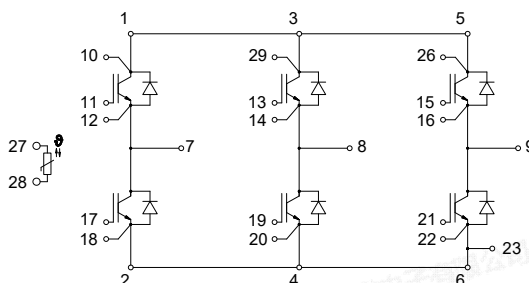


A4 package: 750V 560A IGBT module



等效电路图

Equivalent Circuit Schematic

Features:

- 750V 560A, $V_{CE(sat)} = 1.38V @ 25^{\circ}C$
- 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 560A, $V_{CE(sat)} = 1.38V @ 25^{\circ}C$
- 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	$T_{vj}=25^{\circ}\text{C}$	V_{CES}	750	V
Continuous DC collector current 集电极连续直流电流		$I_{C\text{ nom}}$	560	A
	$T_F=95^{\circ}\text{C}, T_{vj\text{ max}}=175^{\circ}\text{C}$	I_C	/ ⁽¹⁾	A
Repetitive peak collector current 集电极可重复峰值电流	$t_p=1\text{ms}$	I_{CRM}	1120	A
Total power dissipation 功率损耗	$T_F=75^{\circ}\text{C}, T_{vj\text{ max}}=175^{\circ}\text{C}$	P_{tot}	1000 ⁽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

Characteristic Values / 性能参数			min.	typ.	max.		
Collector-emitter saturation voltage 集电极-发射极饱和压降	$I_C=450A, V_{GE}=15V$	$T_{vj}=25^{\circ}C$ $T_{vj}=150^{\circ}C$ $T_{vj}=175^{\circ}C$	V_{CEsat}		1.28 1.33 1.36	V	
	$I_C=560A, V_{GE}=15V$	$T_{vj}=25^{\circ}C$ $T_{vj}=175^{\circ}C$		1.38 1.54	1.8		
Gate threshold voltage 门极阈值电压	$V_{CE}=V_{GE}, I_C=8mA$	$T_{vj}=25^{\circ}C$	V_{GEth}	5.00	6.00	7.00	V
Internal gate resistor 内置门极电阻		$T_{vj}=25^{\circ}C$	R_{Gint}		0.60		Ω
Input capacitance 输入电容	$V_{CE}=25V, V_{GE}=0V, f=100kHz$	$T_{vj}=25^{\circ}C$	C_{ies}		41.8		nF
Output capacitance 输出电容	$V_{CE}=25V, V_{GE}=0V, f=100kHz$	$T_{vj}=25^{\circ}C$	C_{oes}		4.08		nF
Reverse transfer capacitance 反向传输电容	$V_{CE}=25V, V_{GE}=0V, f=100kHz$	$T_{vj}=25^{\circ}C$	C_{res}		0.16		nF
Gate charge 门极电荷	$V_{GE}=-10V\sim+15V, V_{CE}=400V$		Q_G		1.82		μC
Collector-emitter cut-off current 集电极-发射极关断漏电流	$V_{CE}=750V, V_{GE}=0V$	$T_{vj}=25^{\circ}C$	I_{CES}			1.0	mA
Gate-emitter leakage current 门极-发射极漏电流	$V_{CE}=0V, V_{GE}=20V$	$T_{vj}=25^{\circ}C$	I_{GES}			500	nA
Turn-on delay time, inductive load 开通延迟时间, 感性负载	$I_C=450A, V_{CE}=400V$ $V_{GE}=-8V/15V R_{Gon}=3.0\Omega$	$T_{vj}=25^{\circ}C$ $T_{vj}=150^{\circ}C$ $T_{vj}=175^{\circ}C$	t_{don}		73 75 76		ns
Rise time, inductive load 上升时间, 感性负载	$I_C=450A, V_{CE}=400V$ $V_{GE}=-8V/15V R_{Gon}=3.0\Omega$	$T_{vj}=25^{\circ}C$ $T_{vj}=150^{\circ}C$ $T_{vj}=175^{\circ}C$	t_r		50 57 59		ns
Turn-off delay time, inductive load 关断延迟时间, 感性负载	$I_C=450A, V_{CE}=400V$ $V_{GE}=-8V/15V R_{Goff}=14.0\Omega$	$T_{vj}=25^{\circ}C$ $T_{vj}=150^{\circ}C$ $T_{vj}=175^{\circ}C$	t_{doff}		808 865 876		ns
Fall time, inductive load 下降时间, 感性负载	$I_C=450A, V_{CE}=400V$ $V_{GE}=-8V/15V R_{Goff}=14.0\Omega$	$T_{vj}=25^{\circ}C$ $T_{vj}=150^{\circ}C$ $T_{vj}=175^{\circ}C$	t_f		72 145 167		ns
Turn-on energy loss per pulse 开通损耗	$I_C=450A, V_{CE}=400V$ $V_{GE}=-8V/15V R_{Gon}=3.0\Omega,$ $di/dt(T_{vj}=25^{\circ}C)=7200A/us$ $di/dt(T_{vj}=175^{\circ}C)=6100A/us$	$T_{vj}=25^{\circ}C$ $T_{vj}=150^{\circ}C$ $T_{vj}=175^{\circ}C$	E_{on}		17.1 22.1 23.8		mJ

Turn-off energy loss per pulse 关断损耗	$I_C=450A, V_{CE}=400V$ $V_{GE} = -8V/15V R_{Goff} = 14.0\Omega$ $dv/dt(T_{vj}=25^\circ C)=7500A/us$ $dv/dt(T_{vj}=175^\circ C)=4400A/us$ $T_{vj}=25^\circ C$ $T_{vj}=150^\circ C$ $T_{vj}=175^\circ C$	E_{off}		21.9 30.2 32.2		mJ
SC data 短路耐量	$V_{CC}=400V, V_{GE} = -8V/15V$ $V_{CEmax}=V_{CES}-L_{sCE} \cdot di/dt$ $t_p \leq 6\mu s$ $t_p \leq 3\mu s$ $T_{vj}=25^\circ C$ $T_{vj}=175^\circ C$	I_{sc}		3200 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; $\Delta V/\Delta T=10.0dm^3/min T_F=65^\circ C$	R_{thJF}		/		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	$^\circ C$

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	$T_{vj}=25^\circ C$	V_{RRM}	750	V
Continuous DC forward current 可连续正向直流电流		I_{Fnom}	560	A
Repetitive peak forward current 可重复正向峰值电流	$I_{FRM}=2 \times I_F$	I_{FRM}	1120 ¹⁾	A

Characteristic Values / 性能参数

			min.	typ.	max.	
Forward voltage ¹⁾ 正向通态压降	$I_F=450A, V_{GE}=0V$ $T_{vj}=25^\circ C$ $T_{vj}=150^\circ C$ $T_{vj}=175^\circ C$	V_F		1.53 1.61 1.62		V
	$I_F=560A, V_{GE}=0V$ $T_{vj}=25^\circ C$ $T_{vj}=175^\circ C$			1.64 1.73	2.2	
Reverse recovery time 反向恢复时间	$I_F=450A, V_R=400V$ $-di_F/dt=6900A/us(T_{vj}=150^\circ C)$ $V_{GE}=-8V$ $T_{vj}=25^\circ C$ $T_{vj}=150^\circ C$ $T_{vj}=175^\circ C$	t_{rr}		115 160 171		ns
Peak reverse recovery current 反向恢复峰值电流	$I_F=450A, V_R=400V$ $-di_F/dt=6900A/us(T_{vj}=150^\circ C)$ $V_{GE}=-8V$ $T_{vj}=25^\circ C$ $T_{vj}=150^\circ C$ $T_{vj}=175^\circ C$	I_{RM}		308 349 355		A
Recovery charge 反向恢复电荷	$I_F=450A, V_R=400V$ $-di_F/dt=6900A/us(T_{vj}=150^\circ C)$ $V_{GE}=-8V$ $T_{vj}=25^\circ C$ $T_{vj}=150^\circ C$ $T_{vj}=175^\circ C$	Q_R		20.6 31.5 34.0		μC
Reverse recovery energy 反向恢复损耗	$I_F=450A, V_R=400V$ $-di_F/dt=6900A/us(T_{vj}=150^\circ C)$ $V_{GE}=-8V$ $T_{vj}=25^\circ C$ $T_{vj}=150^\circ C$ $T_{vj}=175^\circ C$	E_{rec}		4.6 8.1 8.8		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; $\Delta V/\Delta T=10.0dm^3/min T_F=65^\circ C$	R_{thJF}		/		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	$^\circ C$

NTC-Thermistor/ NTC-热敏电阻

Characteristic Values / 性能参数

		min.	typ.	max.	
Rated resistance 标称电阻	$T_{NTC}=25^{\circ}\text{C}$	R_{25}	-	5	$\text{K}\Omega$
Deviation of R100 R100 偏移值	$T_{NTC}=100^{\circ}\text{C}$, $R_{100}=493.3\Omega$	$\Delta R/R$	-5	-	5
Power dissipation 功率耗散	$T_{NTC}=25^{\circ}\text{C}$	P_{25}	-	-	20
B-value B 值	$R_2=R_{25} \exp[B_{25/50}(1/T_2-1/(298.15\text{K}))]$	$B_{25/50}$	-	3375	-
	$R_2=R_{25} \exp[B_{25/80}(1/T_2-1/(298.15\text{K}))]$	$B_{25/80}$	-	3414	-
	$R_2=R_{25} \exp[B_{25/100}(1/T_2-1/(298.15\text{K}))]$	$B_{25/100}$	-	3436	-

Module / 模块

Isolation test voltage 绝缘测试电压	RMS, f=50Hz, t=1min	V_{ISOL}	2.5	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	

		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	$T_C=25^{\circ}\text{C}$, Per Switch	$R_{CC'+EE'}$	-	1.0	$\text{m}\Omega$
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
Terminal connection torque 功率端子连接力矩	Screw M6 / M6 螺丝	M	4.0	-	6.0
Weight 重量		G	-	715	g

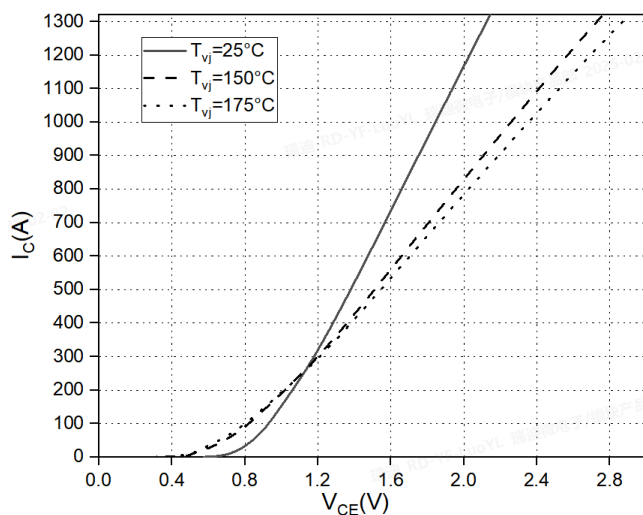
- 1) Verified by characterization/design not by test.
非测试值, 设计计算所得。

Circuit Diagram / 曲线图

Output characteristic IGBT, Inverter (typical), Inclusive $R_{CC'+EE'}$

IGBT 输出特性, 逆变 (典型值), 包含 $R_{CC'+EE'}$

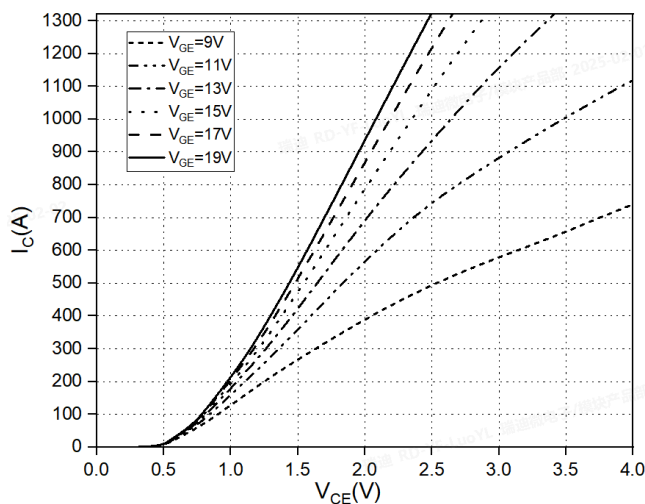
$I_C = f(V_{CE}), V_{GE} = 15V$



Output characteristic IGBT, Inverter (typical), Inclusive $R_{CC'+EE'}$

IGBT 输出特性, 逆变 ($T_J = 150^\circ C$), 包含 $R_{CC'+EE'}$

$I_C = f(V_{CE}), T_{vj} = 175^\circ C$



Transfer characteristic IGBT, Inverter (typical), Inclusive $R_{CC'+EE'}$

IGBT 传输特性, 逆变 (典型值), 包含 $R_{CC'+EE'}$

$I_C = f(V_{GE}), V_{CE} = 20V$

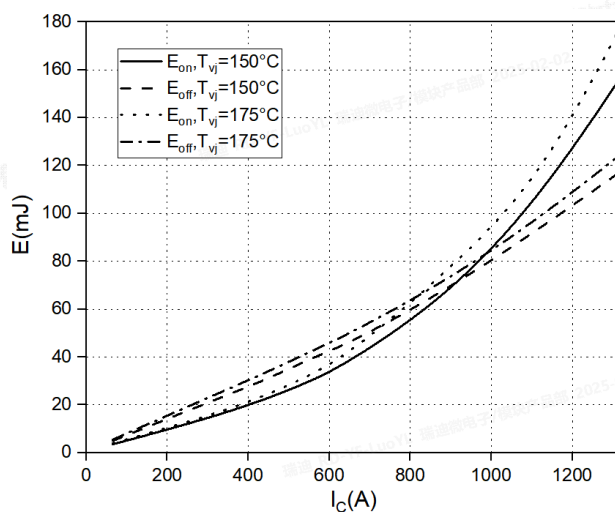
TBD

Switching losses IGBT, Inverter (typical), Inclusive $R_{CC'+EE'}$

IGBT 开关损耗, 逆变 (典型值), 包含 $R_{CC'+EE'}$

$E = f(I_C), V_{GE} = +15V/-8V,$

$R_{Gon} = 3\Omega, R_{Goff} = 14.0\Omega, V_{CE} = 400V$



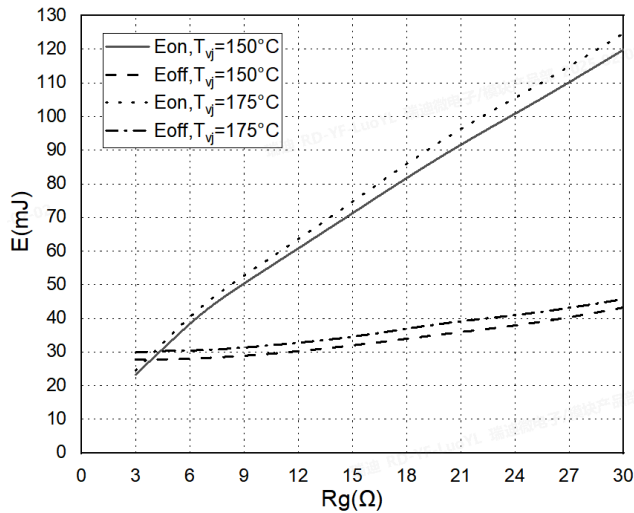
Switching losses IGBT, Inverter (typical),

Inclusive $R_{CC} + EE'$

IGBT 开关损耗, 逆变 (典型值), 包含 $R_{CC} + EE'$

$E_{on} = f(R_G)$, $E_{off} = f(R_G)$,

$V_{GE} = +15V/-8V$, $I_C = 450A$, $V_{CE} = 400V$



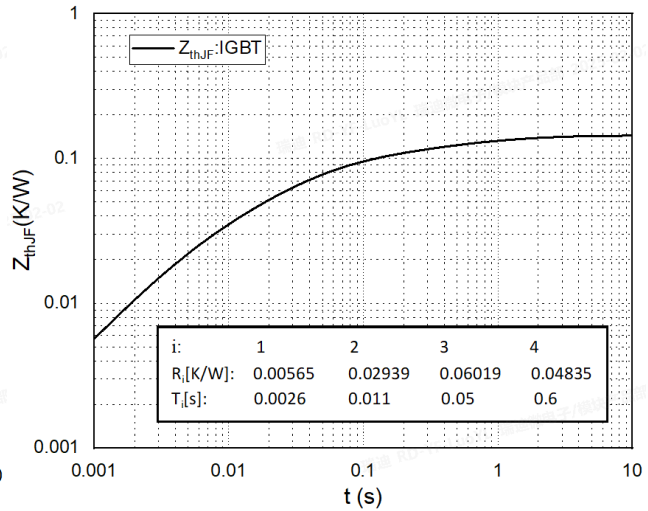
Transient thermal impedance IGBT, Inverter

IGBT 瞬态热阻, 逆变

$Z_{thJF} = f(t)$

Cooling fluid = 50% water/50% ethylene glycol;

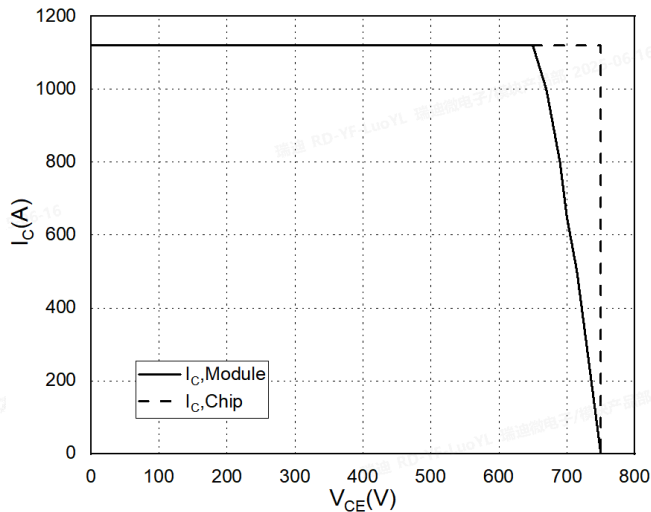
$\Delta V/\Delta T = 10.0 dm^3/min$; $T_F = 65^\circ C$



Reverse bias safe operating area IGBT, Inverter (RBSOA)

IGBT 反向安全区, 逆变 (RBSOA)

$I_C = f(V_{CE})$, $V_{GE} = +15V/-8V$, $R_{Goff} = 14.0 \Omega$, $T_{vj} = 175^\circ C$

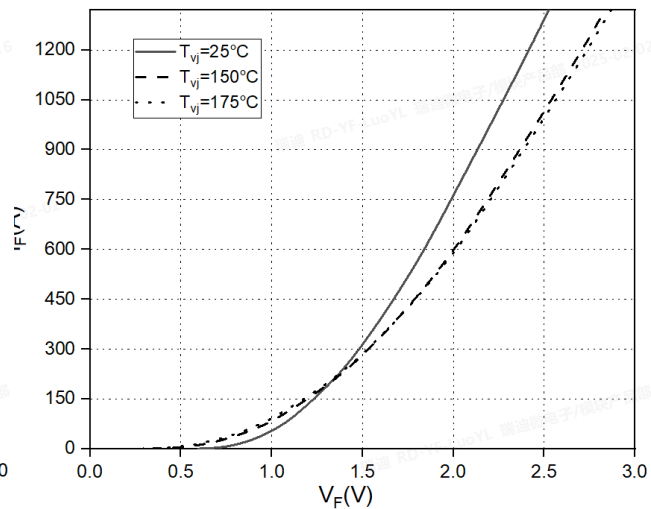


Forward characteristic FRD, Inverter (typical),

Inclusive $R_{CC} + EE'$

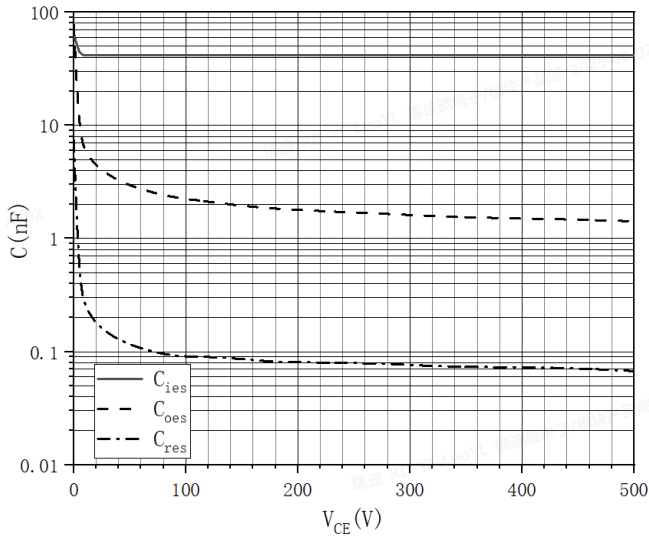
FRD 正向特性, 逆变 (典型值), 包含 $R_{CC} + EE'$

$I_F = f(V_F)$



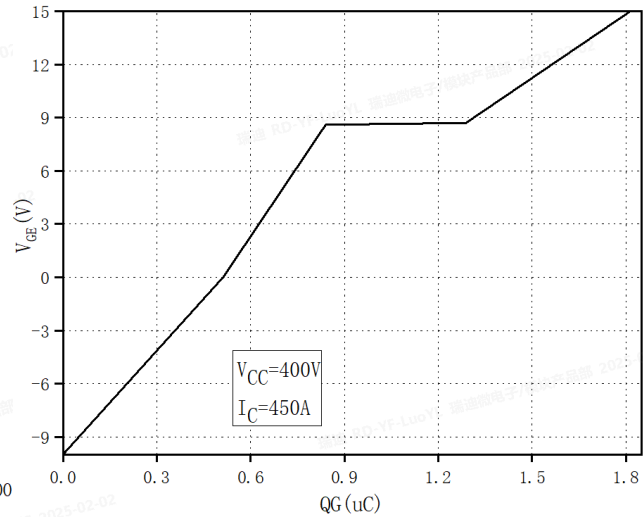
Capacity characteristic IGBT, Inverter (typical)
 $C=f(V_{CE})$,
 电容特性 IGBT, 逆变器(典型值)

$V_{CE}=25V$, $V_{GE}=0V$, $f=100kHz$, $T_{vj}=25^{\circ}C$



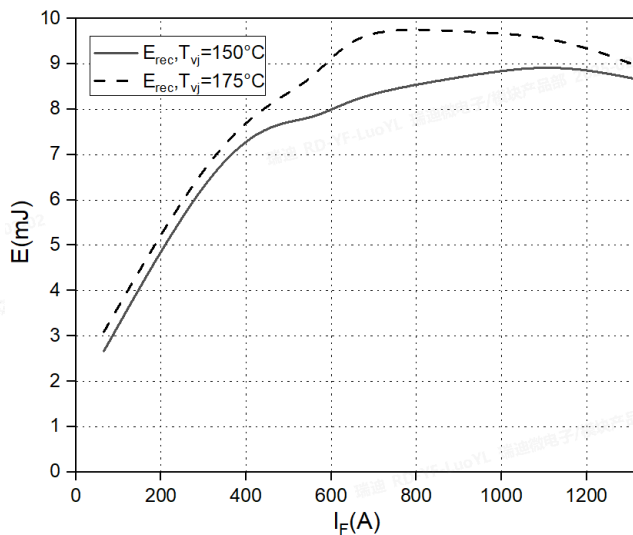
Gate charge characteristic IGBT, Inverter (typical)
 $V_{GE}=f(Q_G)$,
 栅极电荷特性 IGBT, 逆变器(典型值)

$V_{GE}=-10V \sim +15V$, $V_{CE}=400V$, $I_C=450A$, $T_{vj}=25^{\circ}C$



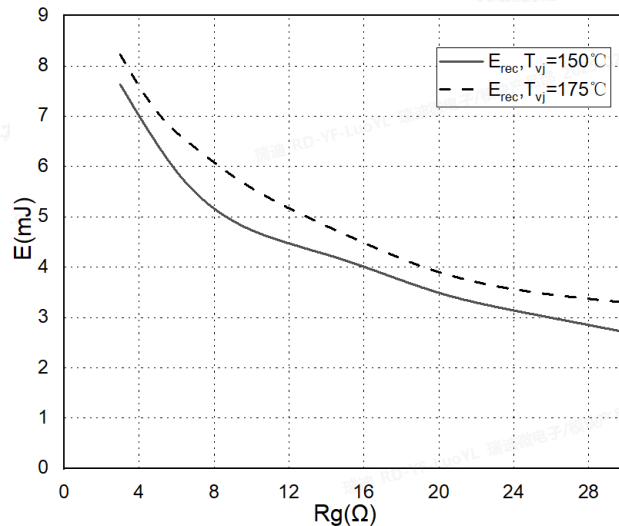
Switching losses FRD, Inverter (typical), Inclusive $R_{CC}+EE$
 FRD 开关损耗, 逆变 (典型值), 包含 $R_{CC}+EE$

$E_{rec}=f(I_F)$, $R_{Gon}=3\Omega$, $V_{CE}=400V$



Switching losses FRD, Inverter (typical), Inclusive $R_{CC}+EE$
 FRD 开关损耗, 逆变 (典型值), 包含 $R_{CC}+EE$

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



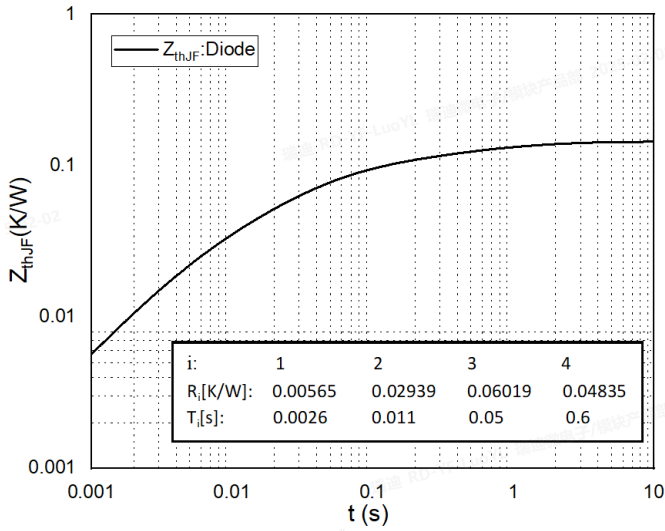
Transient thermal impedance FRD, Inerter

FRD 瞬态热阻, 逆变

$Z_{thJF}=f(t)$

Cooling fluid = 50%water/50% ethylene glycol;

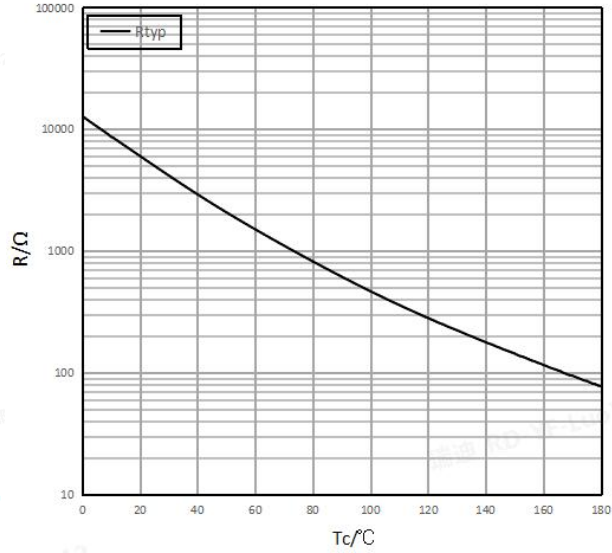
$\Delta V/\Delta T=10.0\text{dm}^3/\text{min}; T_F=65^\circ\text{C}$



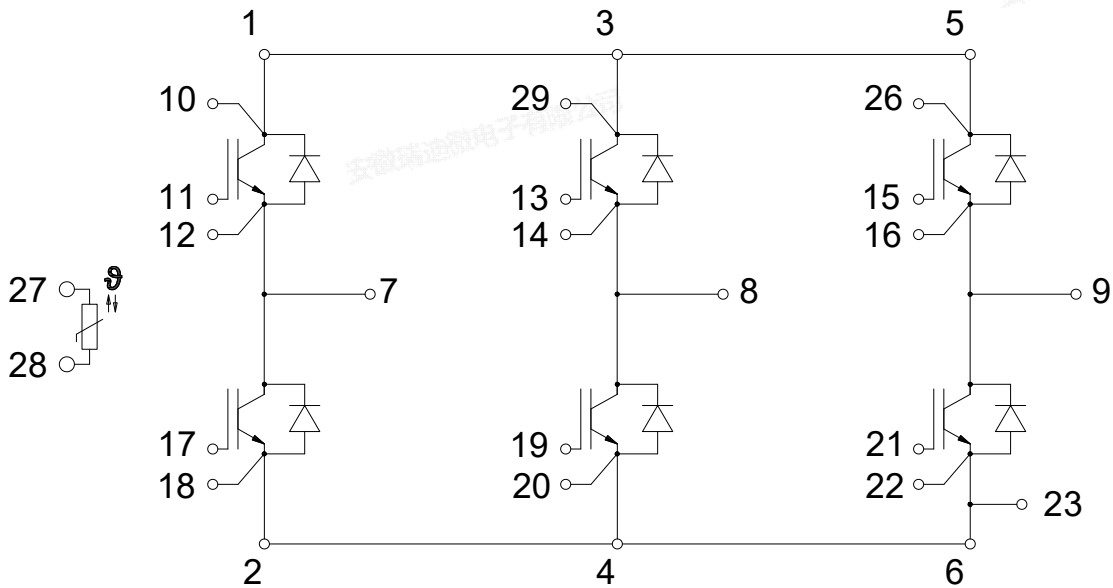
NTC Thermistor temperature characteristic (typical)

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

