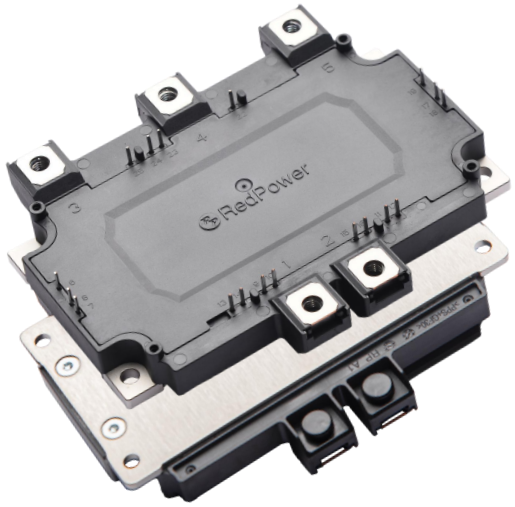
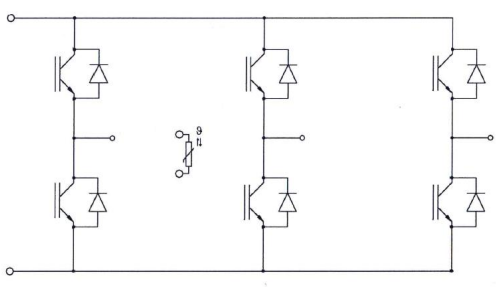
A1 package: 750V 400A IGBT module





等效电路图
Equivalent Circuit Schematic

Features:

- 750V 400A, $V_{CE(sat)}$ =1.35V@25℃
- High RBSOA capability
- Micro pattern trench/FS technology
- Low switching losses
- High SC capability

产品特性:

- 750V 400A, $V_{CE(sat)}$ = 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

Typical Applications：

- Automotive Applications
- Motor Drives

典型应用：

- 汽车应用
- 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
Continuous DC collector current 集电极连续直流电流		$I_{C\ nom}$	400	A
	T_C=65℃,$T_{vj\ max}$=175℃	I_C	460	A
Repetitive peak collector current 集电极可重复峰值电流	t_p=1ms	I_{CRM}	800	A
Total power dissipation 功率损耗	T_C=25℃,$T_{vj\ max}$=175℃	P_{tot}	1200	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=400A，V_{GE}=15V I_C=400A，V_{GE}=15V	T_{vj}=25℃ T_{vj}=150℃	V_{CEsat}	-	1.35 1.47	1.70	V
Gate threshold voltage 门极阈值电压	V_{CE}=V_{GE}，I_C=6.4mA	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}	-	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}=±15V		Q_G	-	2.42	-	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=400A,V_{CE}=400V V_{GE}= -8V/15V R_{Gon}=2.4Ω	T_{vj}=25℃ T_{vj}=125℃ T_{vj}=150℃	t_{don}	-	158 165 171	-	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}=2.4Ω	T_{vj}=25℃ T_{vj}=125℃ T_{vj}=150℃	t_r	-	63 71 72	-	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}=7.5Ω	T_{vj}=25℃ T_{vj}=125℃ T_{vj}=150℃	t_{doff}	-	729 786 813	-	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}=7.5Ω	T_{vj}=25℃ T_{vj}=125℃ T_{vj}=150℃	t_f	-	62 121 136	-	ns
Turn-on energy loss per pulse 开通损耗	I_C=400A，V_{CE}=400V，L_σ=30nH V_{GE}= -8V/15V R_{Gon}=2.4Ω,	T_{vj}=25℃ T_{vj}=125℃ T_{vj}=150℃	E_{on}	-	10.9 13.8 15.0	-	mJ
Turn-off energy loss per pulse 关断损耗	I_C=400A,V_{CE}=400V L_σ=30nH V_{GE}= -8V/15V R_{Goff}=7.5Ω	T_{vj}=25℃ T_{vj}=125℃ T_{vj}=150℃	E_{off}	-	20.0 25.3 26.5	-	mJ
SC data 短路耐量	V_{CC}=400V，V_{GE}= -8V/15V, V_{CEmax}=V_{CES}-L_{sCE}·di/dt	T_{vj}=150℃	t_{psc}	6	-	-	μs
Thermal resistance, junction to case 结-壳热阻	Per IGBT/单个 IGBT		R_{thJC}	-	0.12	-	K/W

Temperature under switching conditions 工作温度	t_{op} continuous	$T_{vj\ op}$	-40	-	150	℃

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}	400		A
Repetitive peak forward current 可重复正向峰值电流	I_{FRM}=2×I_F	I_{FRM}	800		A

Characteristic Values / 性能参数

			min.	typ.	max.	
Forward voltage[1)] 正向通态压降	I_F=400A，V_{GE}=0V	T_{vj}=25℃ T_{vj}=150℃	V_F	-	1.40 1.33	-	V
Peak reverse recovery current 反向恢复峰值电流	I_F=400A, V_R=400V -di$_F$/dt=5500A/us(T_{vj}=150℃) V_{GE}=-8V	T_{vj}=25℃ T_{vj}=125℃ T_{vj}=150℃	I_{RM}	-	216 248 260	-	A
Recovery charge 反向恢复电荷	I_F=400A, V_R=400V -di$_F$/dt=5500A/us(T_{vj}=150℃) V_{GE}=-8V	T_{vj}=25℃ T_{vj}=125℃ T_{vj}=150℃	Q_R	-	17.1 28.0 33.0	-	μC
Reverse recovery energy 反向恢复损耗	I_F=400A, V_R=400V -di$_F$/dt=5500A/us(T_{vj}=150℃) V_{GE}=-8V	T_{vj}=25℃ T_{vj}=125℃ T_{vj}=150℃	E_{rec}	-	4.6 7.9 9.6	-	mJ
Thermal resistance, junction to case 结-壳热阻	Per FRD/单个 FRD		R_{thJC}	-	0.20	-	K/W
Temperature under switching conditions 工作温度	t_{op} continuous		$T_{vj\ op}$	-40	-	150	℃

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

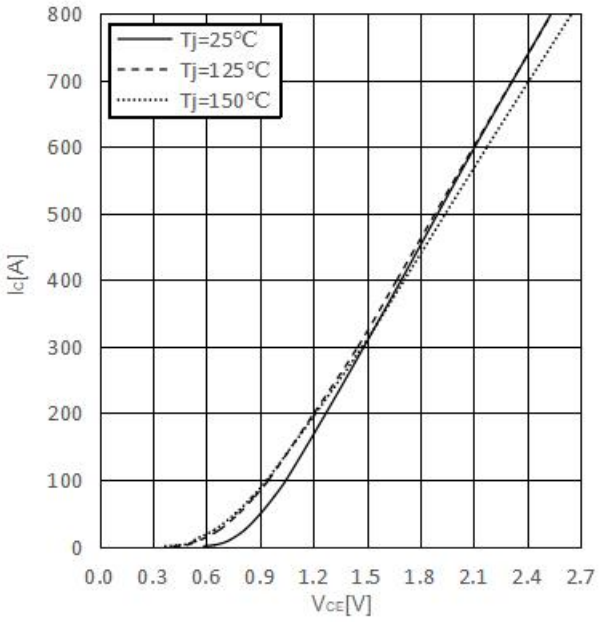
Module / 模块

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		
Internal isolation 内部绝缘				Al_2O_3/ZrO_2		
Creepage distance 爬电距离	Terminal to heatsink Terminal to terminal			12.0 6.1		mm
Clearance 电气间隙	Terminal to heatsink Terminal to terminal			12.0 6.1		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}	-	20	-	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	3.0	-	6.0	Nm
Terminal connection torque 功率端子连接力矩	Screw M6 / M6 螺丝	M	3.0	-	6.0	Nm
Weight 重量		G	-	470	-	g

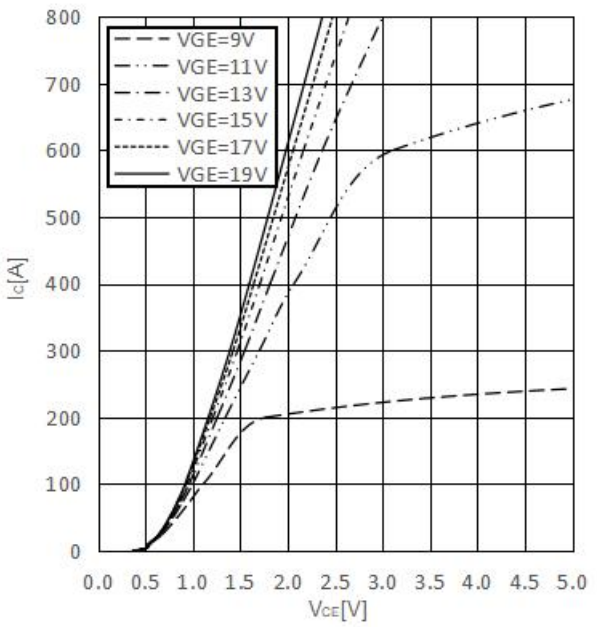
1) Terminal impedance is not included.
不包含端子阻抗。
2) CTI is about 200.
CTI 约等于 200。

Circuit Diagram / 曲线图

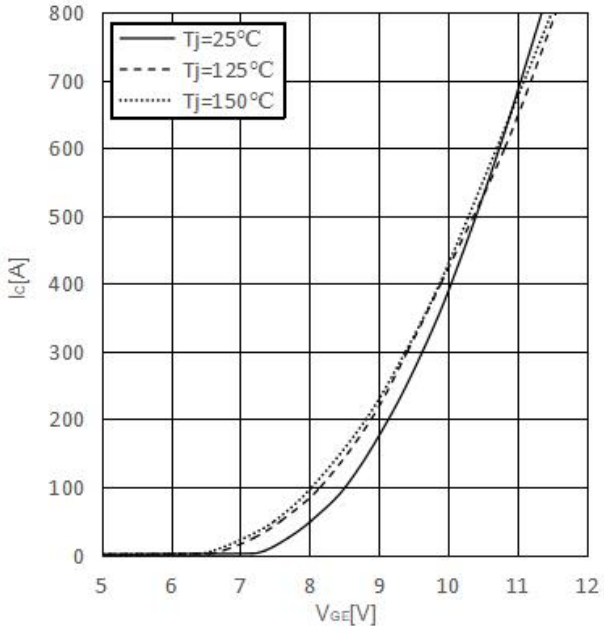
Output chanracteristic IGBT,Inverter(typical), Inclusive $R_{CC'+EE'}$
IGBT 输出特性，逆变（典型值），包含 $R_{CC'+EE'}$
$I_C=f(V_{CE}),V_{GE}=15V$



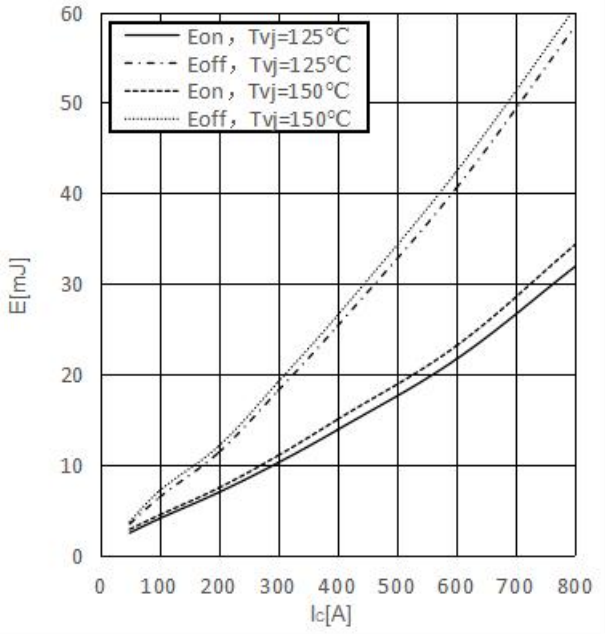
Output characteristic IGBT,Inverter(typical), Inclusive $R_{CC'+EE'}$
IGBT 输出特性，逆变（典型值），包含 $R_{CC'+EE'}$
$I_C=f(V_{CE}),T_j=150℃$



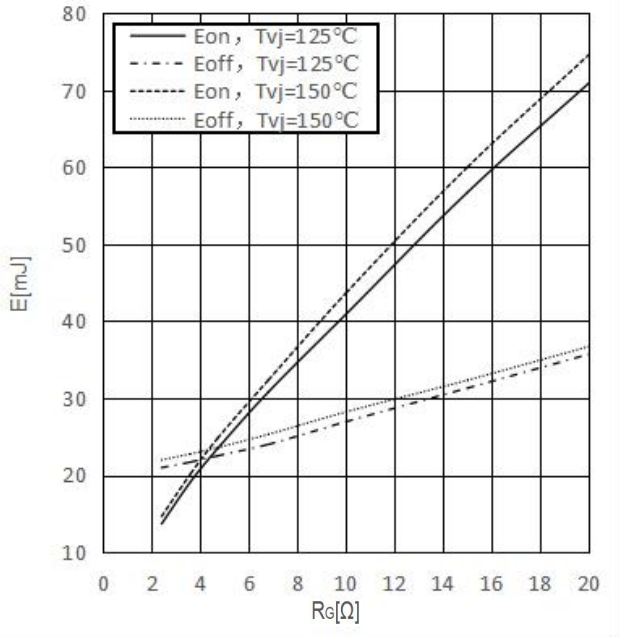
Transfer characteristic IGBT,Inverter(typical), Inclusive $R_{CC'+EE'}$
IGBT 传输特性，逆变（典型值），包含 $R_{CC'+EE'}$
$I_C=f(V_{GE}),V_{CE}=20V$



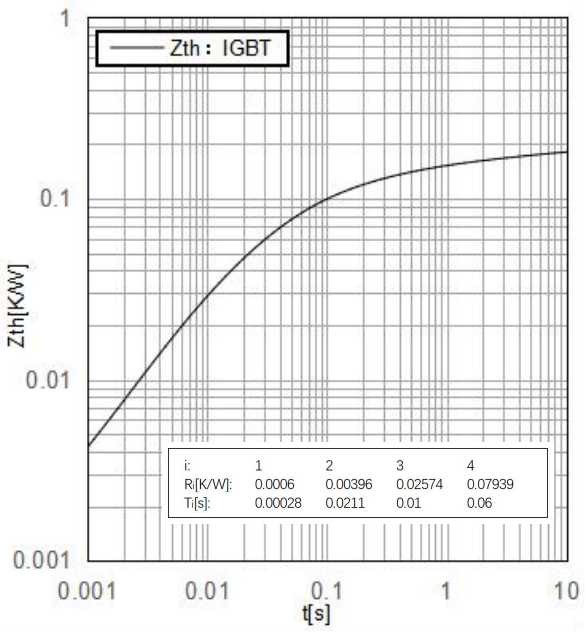
Switching losses IGBT,Inverter(typical), Inclusive $R_{CC'+EE'}$
IGBT 开关损耗，逆变（典型值），包含 $R_{CC'+EE'}$
$E=f(I_C)$，$V_{GE}=+15V/-8V$，
$R_{Gon}=2.4Ω$，$R_{Goff}=7.5Ω$，$V_{CE}=400V$



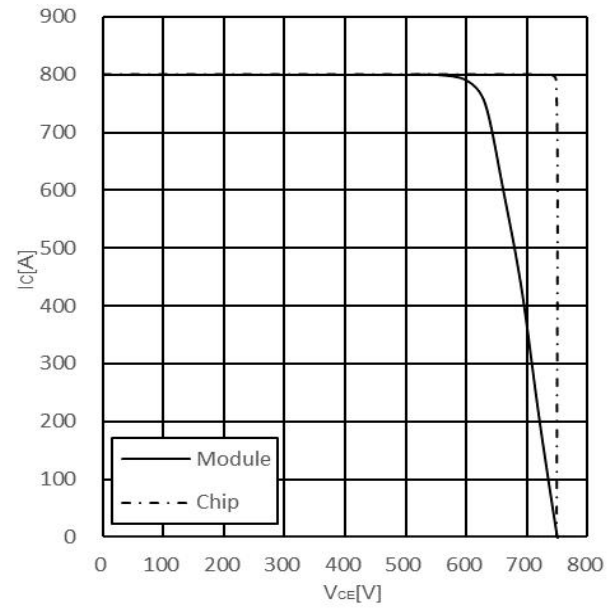
Switching losses IGBT,Inverter(typical), Inclusive $R_{CC'+EE'}$
IGBT 开关损耗，逆变（典型值），包含 $R_{CC'+EE'}$
$E=f(R_G)$，V_{GE}=+15V/-8V，I_C=400A，V_{CE}=400V



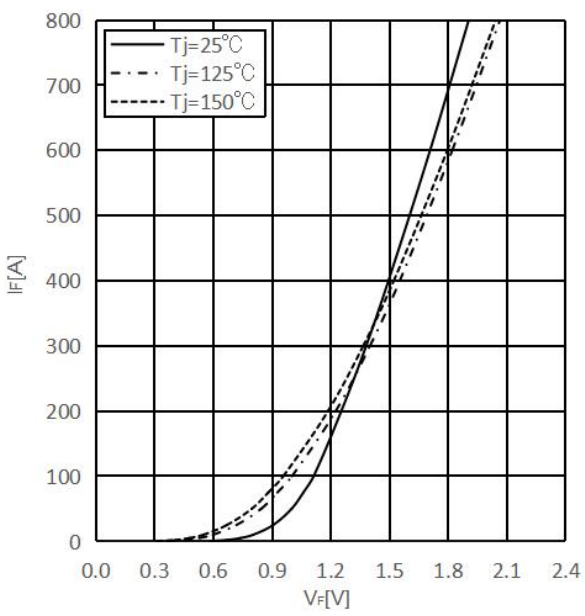
Transient thermal impedance IGBT, Inverter
IGBT 瞬态热阻，逆变
$Z_{thJC}=f(t)$



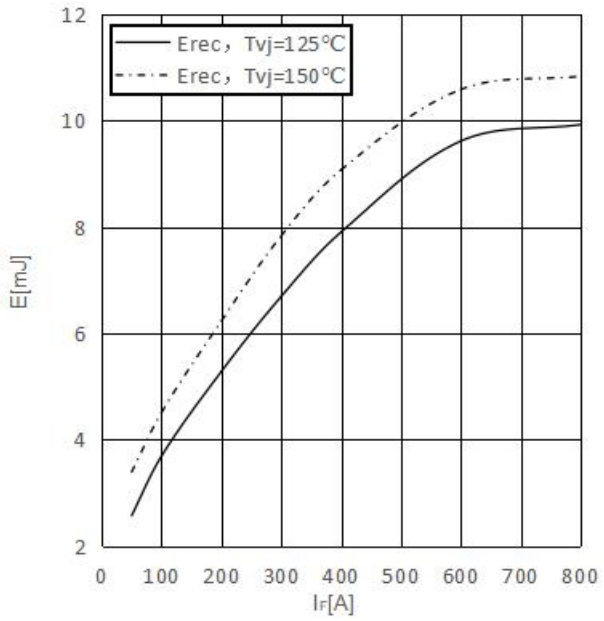
Reverse bias safe operating area IGBT, Inverter(RBSOA)
IGBT 反向安全工作区，逆变(RBSOA)
$I_C=f(V_{CE})$,V_{GE}=+15V/-8V, R_{Goff} = 7.5Ω, Tj = 150°C



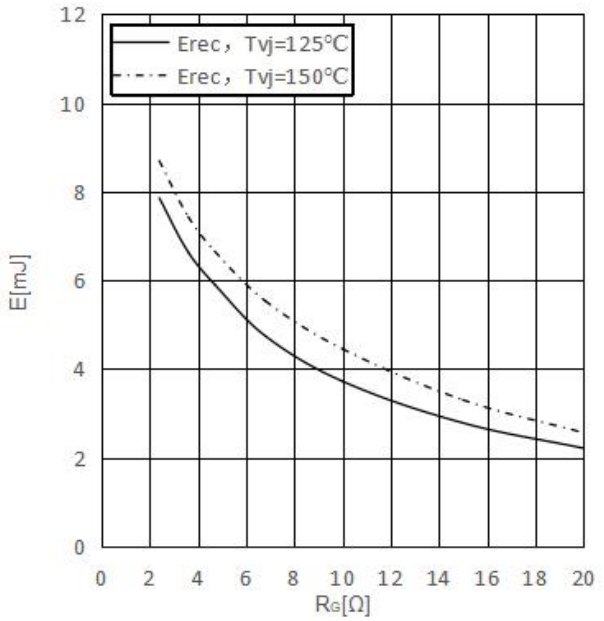
Forward characteristic FRD, Inverter(typical)，Inclusiver $R_{CC'+EE'}$
FRD 正向特性，逆变（典型值）,包含 $R_{CC'+EE'}$
$I_F=f(V_F)$



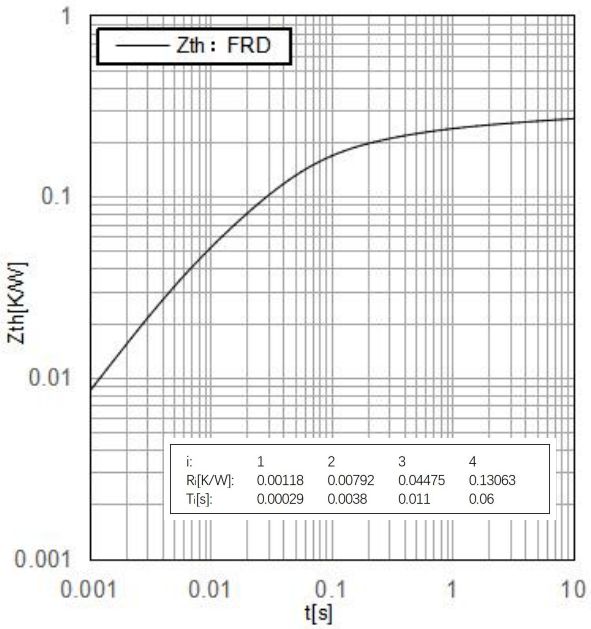
Swiching Losses FRD, Inverter (typical), Inclusive $R_{CC'+EE'}$
FRD 开关损耗，逆变（典型值）,包含 $R_{CC'+EE'}$
$E_{rec}=f(I_F)$,$R_{Gon}=2.4\Omega$,$V_{CE}=400V$



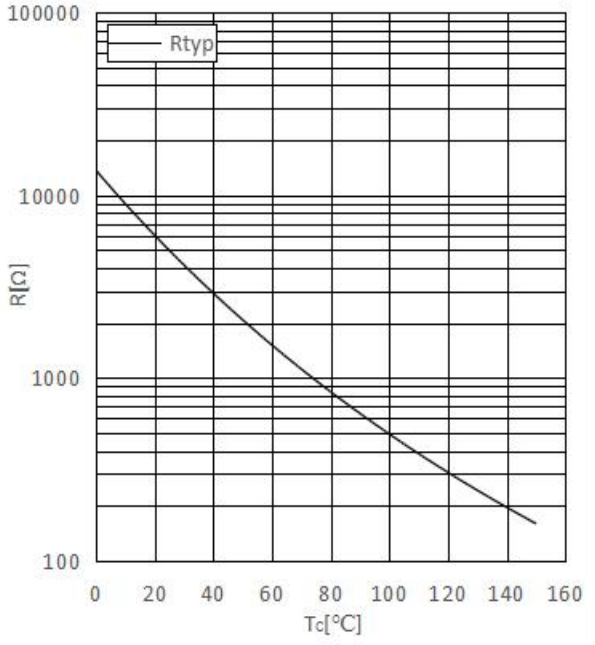
Output characteristic Erec, Inverter(typical), Inclusive $R_{CC'+EE'}$
FRD 输出特性，逆变（典型值）,包含 $R_{CC'+EE'}$
$E_{rec}=f(R_g)$



Transient thermal impedance FRD, Inverter
FRD 瞬态热阻，逆变
$Z_{thJC}=f(t)$

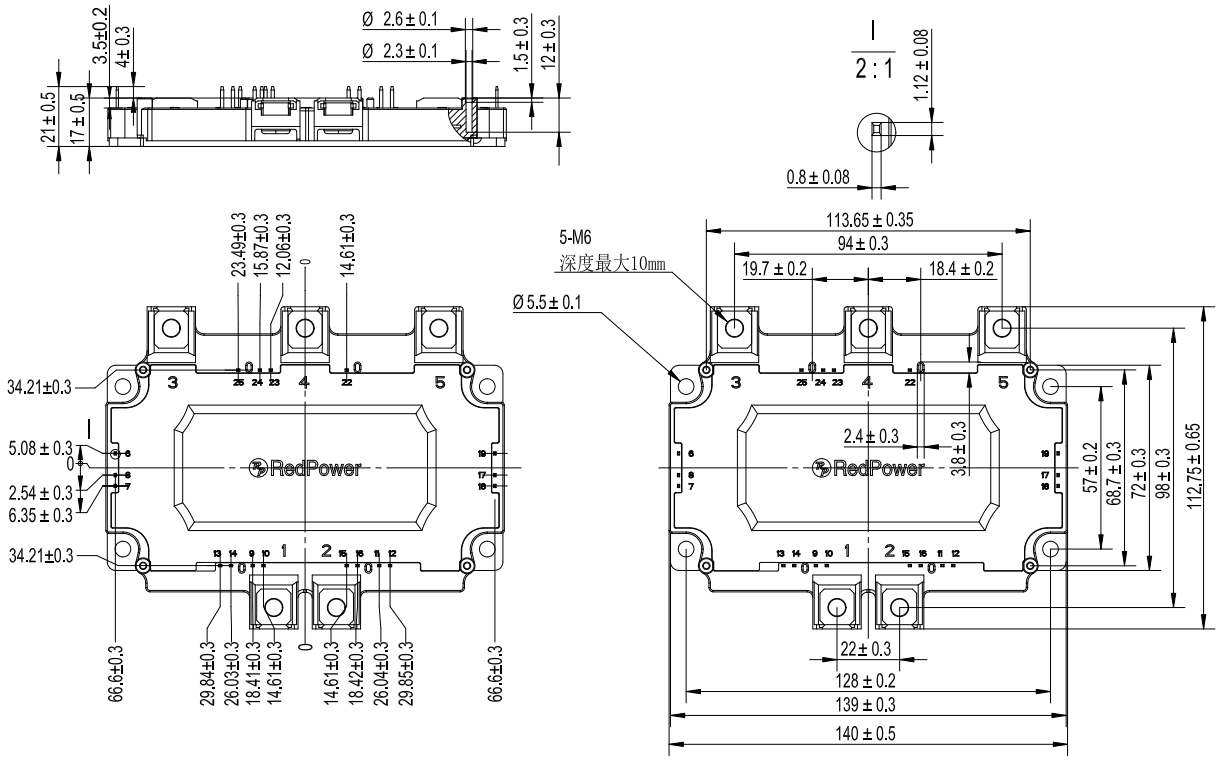


NTC Thermistor temperature characteristic (typical)
NTC 热敏电阻
R=f（T）



Package Dimension / 封装尺寸

Dimensions in Millimeters / 毫米为单位



Internal Circuit / 内部电路