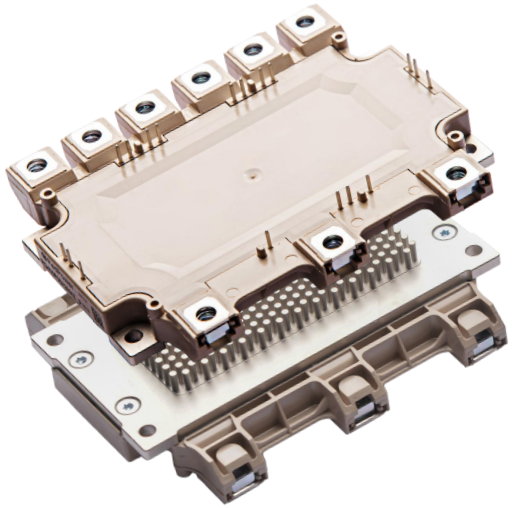
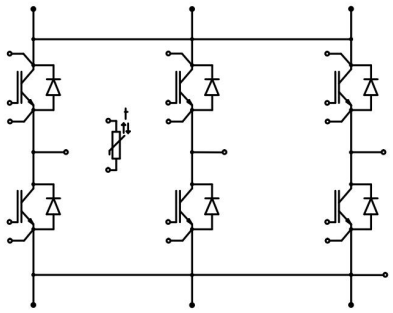
A3 package: 750V 400A IGBT module





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_f=25℃,$T_{vj\ max}$=175℃	I_C	495	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_f=25℃,$T_{vj\ max}$=175℃	P_{tot}	955	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[1)] 集电极-发射极饱和压降	I_C=400A，V_{GE}=15V	T_{vj}=25℃ T_{vj}=125℃ T_{vj}=150℃	V_{CEsat}	-	1.35 1.44 1.47	-	V
Gate threshold voltage 门极阈值电压	V_{CE}=V_{GE}，I_C=4mA		V_{GEth}	5.00	6.00	7.00	V
Gate charge 门极电荷	V_{GE}=-8V/15V，V_{CE}=400V		Q_G	-	2.46	-	μC
Internal gate resistor 内置门极电阻	T_{vj}=25℃		R_{Gint}	-	1.19	-	Ω
Input capacitance 输入电容	V_{CE}=25V，V_{GE}=0V，f=100kHz	T_{vj}=25℃	C_{ies}	-	61.6	-	nF
Reverse transfer capacitance 反向传输电容	V_{CE}=25V，V_{GE}=0V，f=100kHz	T_{vj}=25℃	C_{res}	-	0.20	-	nF
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}	-	-	0.1	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}=1.3Ω	T_{vj}=25℃ T_{vj}=125℃ T_{vj}=150℃	t_{don}	-	158 165 169	-	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}=1.3Ω	T_{vj}=25℃ T_{vj}=125℃ T_{vj}=150℃	t_r	-	49 58 59	-	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}=125℃ T_{vj}=150℃	t_{doff}	-	777 829 852	-	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}=125℃ T_{vj}=150℃	t_f	-	72 85 95	-	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}=1.3Ω di/dt=5367A/μs（T_{vj}=150℃）	T_{vj}=25℃ T_{vj}=125℃ T_{vj}=150℃	E_{on}	-	8.4 11.8 12.0	-	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}=10Ω dv/dt=4802V/μs（T_{vj}=150℃）	T_{vj}=25℃ T_{vj}=125℃ T_{vj}=150℃	E_{off}	-	20.9 25.1 26.4	-	mJ
SC data 短路耐量	V_{CC}=400V, V_{GE}= -8V/15V, V_{CEmax}≤750V	t_P≤8μs，T_{vj}=25℃ t_P≤6μs，T_{vj}=150℃	I_{sc}	- -	3200 2200	- -	A

Thermal resistance, junction to cooling fluid 结-冷却液热阻	Per IGBT, $\Delta V/\Delta t$ = 10.0 dm³/min, T_F=25℃	R_{thJF}	-	0.157	-	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}=125℃ T_{vj}=150℃	V_F	-	1.45 1.42 1.40	-	V
Peak reverse recovery current 反向恢复峰值电流	I_F=400A, V_R=400V, V_{GE}=-8V, -di$_F$/dt=3174A/us(T_{vj}=150℃)	T_{vj}=25℃ T_{vj}=125℃ T_{vj}=150℃	I_{RM}	-	262 300 311	-	A
Recovery charge 反向恢复电荷	I_F=400A, V_R=400V, V_{GE}=-8V, -di$_F$/dt=3174A/us(T_{vj}=150℃)	T_{vj}=25℃ T_{vj}=125℃ T_{vj}=150℃	Q_R	-	20.4 32.6 36.5	-	μC
Reverse recovery energy 反向恢复损耗	I_F=400A, V_R=400V, V_{GE}=-8V, -di$_F$/dt=3174A/us(T_{vj}=150℃)	T_{vj}=25℃ T_{vj}=125℃ T_{vj}=150℃	E_{rec}	-	5.9 9.7 11.3	-	mJ
Thermal resistance, junction to cooling fluid 结-冷却液热阻	Per FRD $\Delta V/\Delta t$ = 10.0 dm³/min, T_F=25℃		R_{thJF}	-	0.24	-	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

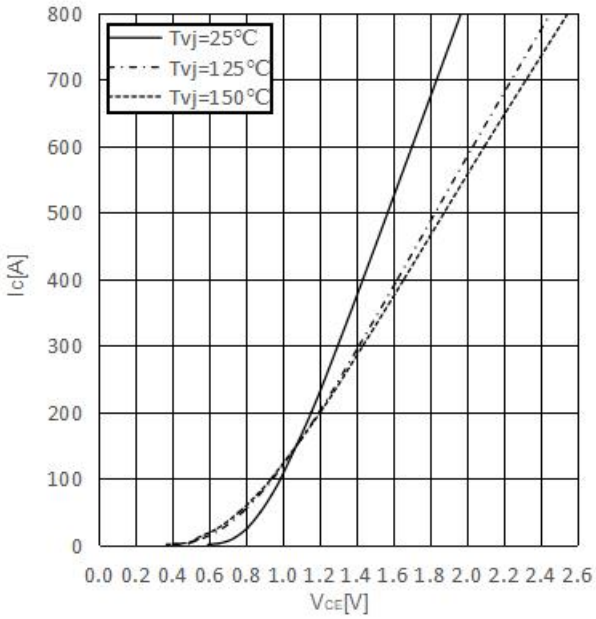
Insulation coordination / 绝缘配合

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				ZTA		
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}	-	13	-	nH
Module lead resistance，terminals-chip 模块引脚电阻，端子-芯片	T=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	4.0	-	6.0	Nm
Weight 重量		G	-	680	-	g

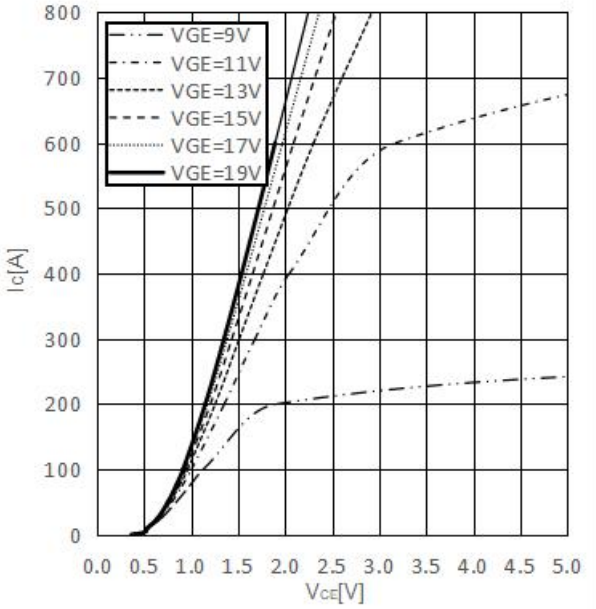
1) Terminal impedance is included.
包含端子阻抗。
2) CTI is about 200.
CTI 约等于 200。

Circuit Diagram / 曲线图

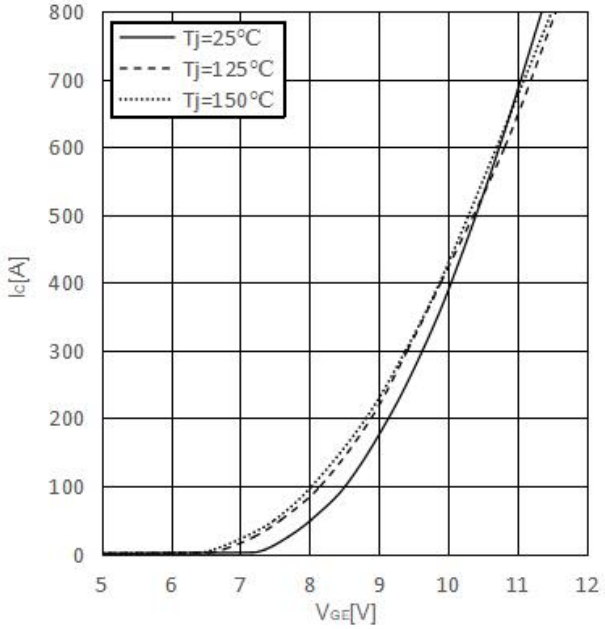
Output chanracteristic IGBT,Inverter(typical), Inclusive $R_{CC'+EE'}$
IGBT 输出特性，逆变（典型值），包含 $R_{CC'+EE'}$
$I_C=f(V_{CE}),V_{GE}=15V$



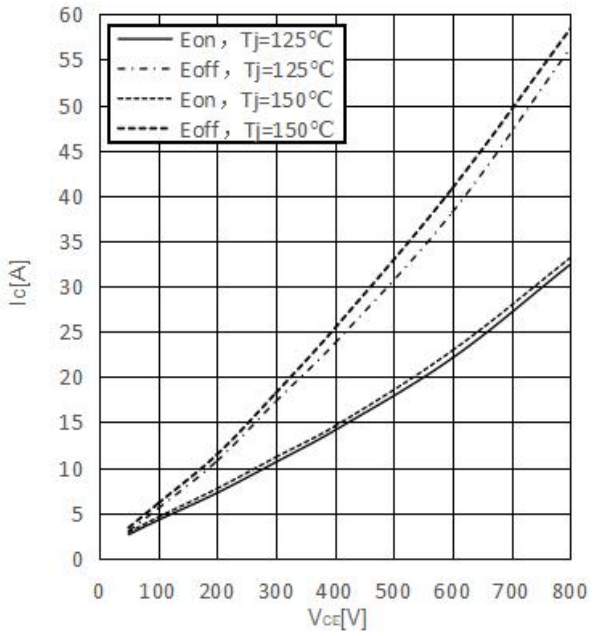
Output characteristic IGBT,Inverter(typical), Inclusive $R_{CC'+EE'}$
IGBT 输出特性，逆变（典型值），包含 $R_{CC'+EE'}$
$I_C=f(V_{CE}),T_{vj}=150℃$



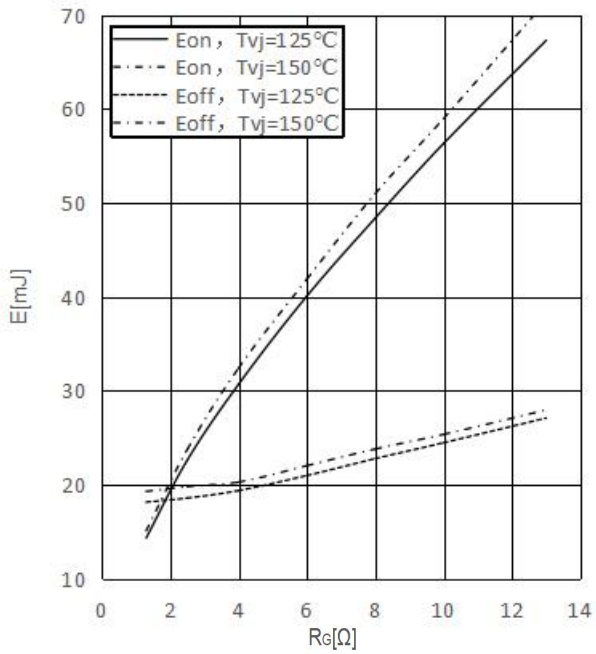
Transfer characteristic IGBT,Inverter(typical), Inclusive $R_{CC'+EE'}$
IGBT 传输特性，逆变（典型值），包含 $R_{CC'+EE'}$
$I_C=f(V_{GE}),V_{CE}=20V$



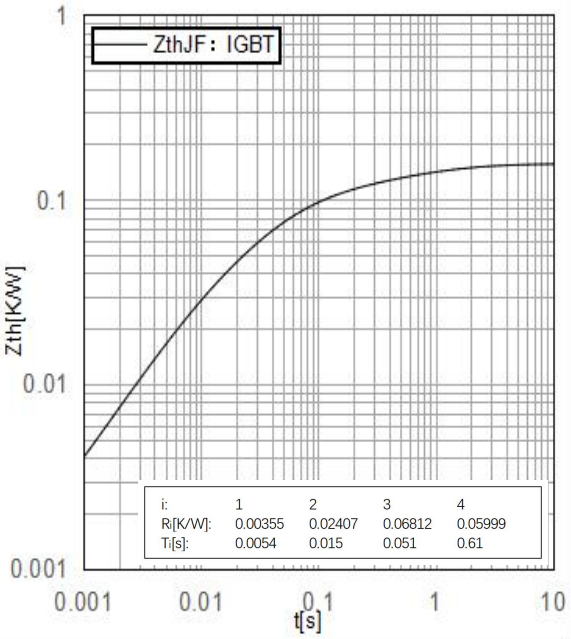
Switching losses IGBT,Inverter(typical), Inclusive $R_{CC'+EE'}$
IGBT 开关损耗，逆变（典型值），包含 $R_{CC'+EE'}$
$E=f(I_C)$，$V_{GE}=+15V/-8V$，
$R_{Gon}=1.3Ω$，$R_{Goff}=10Ω$，$V_{CE}=400V$



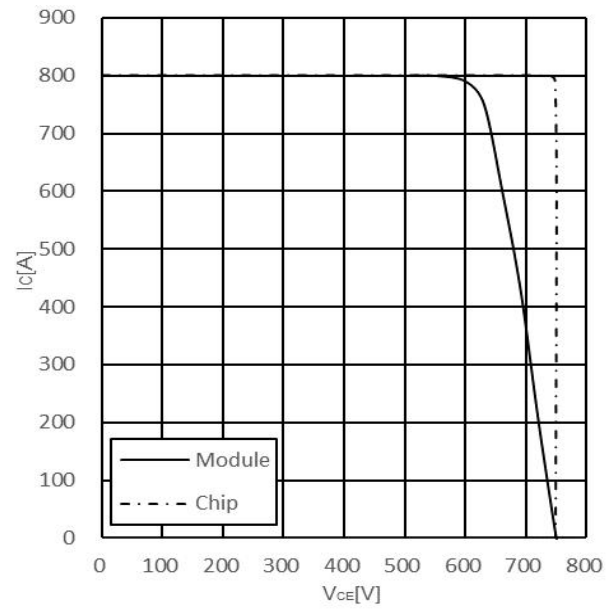
Switching losses IGBT,Inverter(typical), Inclusive $R_{CC'+EE'}$
IGBT 开关损耗，逆变（典型值），包含 $R_{CC'+EE'}$
$E=f(R_G)$，V_{GE}=+15V/-8V，I_C=400A，V_{CE}=400V



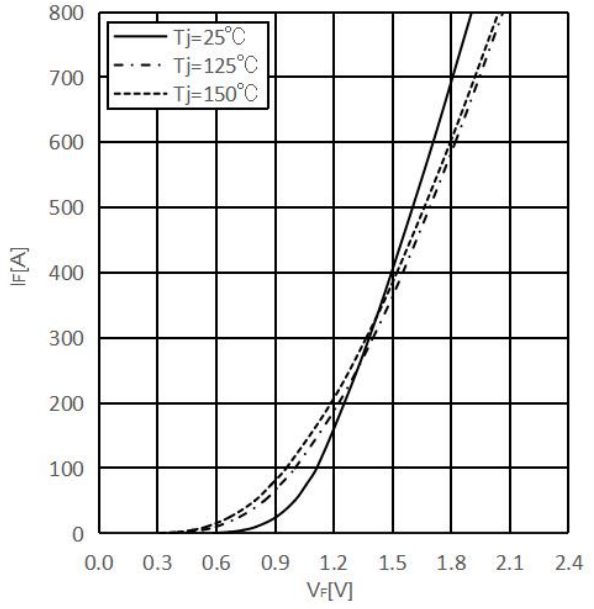
Transient thermal impedance IGBT, Inverter
IGBT 瞬态热阻，逆变
$Z_{thJF}=f(t)$
$\Delta V/\Delta t$ = 10.0 dm³/min，T_F=25℃，pure water



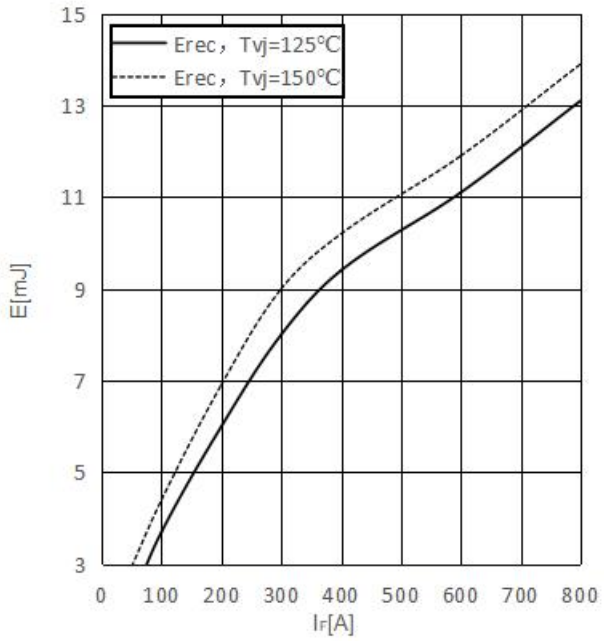
Reverse bias safe operating area IGBT, Inverter(RBSOA)
IGBT 反向安全工作区，逆变(RBSOA)
$I_C=f(V_{CE})$,V_{GE}=+15V/-8V, R_{Goff} = 10Ω, Tj = 150°C



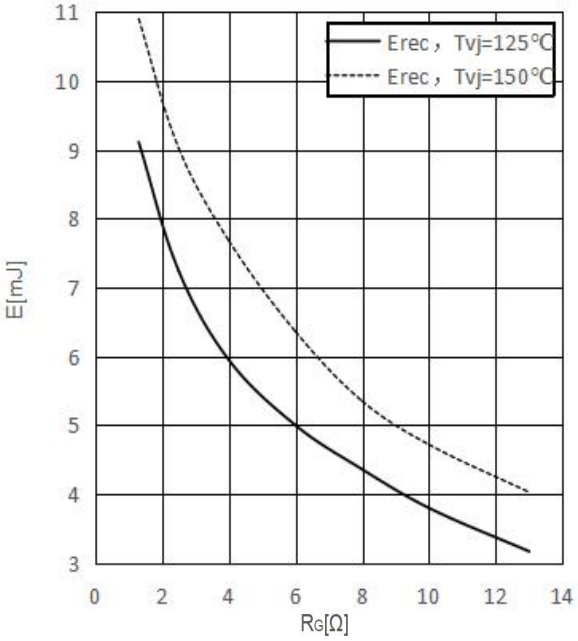
Forward characteristic FRD, Inverter(typical)，Inclusiver $R_{CC'+EE'}$
FRD 正向特性，逆变（典型值）,包含 $R_{CC'+EE'}$
$I_F=f(V_F)$



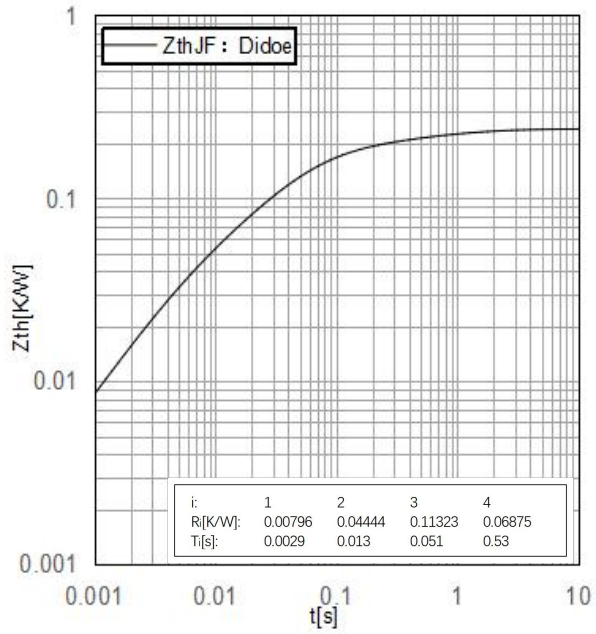
Swiching Losses FRD, Inverter (typical), Inclusive $R_{CC'+EE'}$
FRD 开关损耗，逆变（典型值）,包含 $R_{CC'+EE'}$
$E_{rec}=f(I_F)$,$R_{Gon}=1.3\Omega$,$V_{CE}=400V$



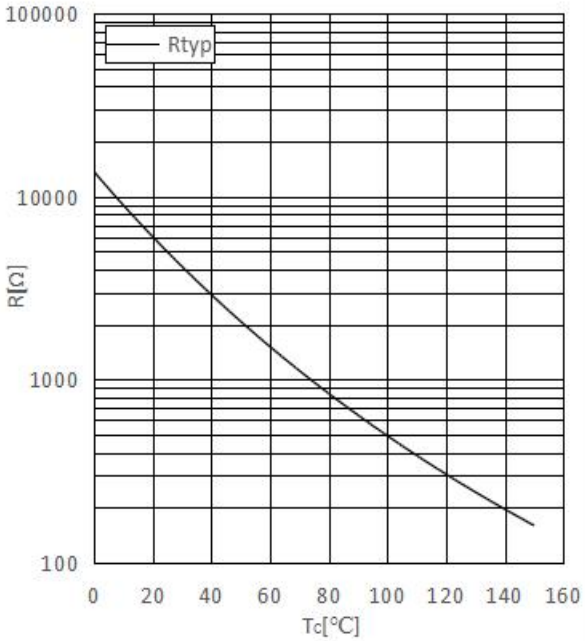
Output characteristic Erec, Inverter(typical), Inclusive $R_{CC'+EE'}$
FRD 输出特性，逆变（典型值）,包含 $R_{CC'+EE'}$
$E_{rec}=f(R_g)$



Transient thermal impedance FRD, Inverter
FRD 瞬态热阻，逆变
$Z_{thJF}=f(t)$
$\Delta V/\Delta t$ = 10.0 dm³/min， T_F=25℃， pure water

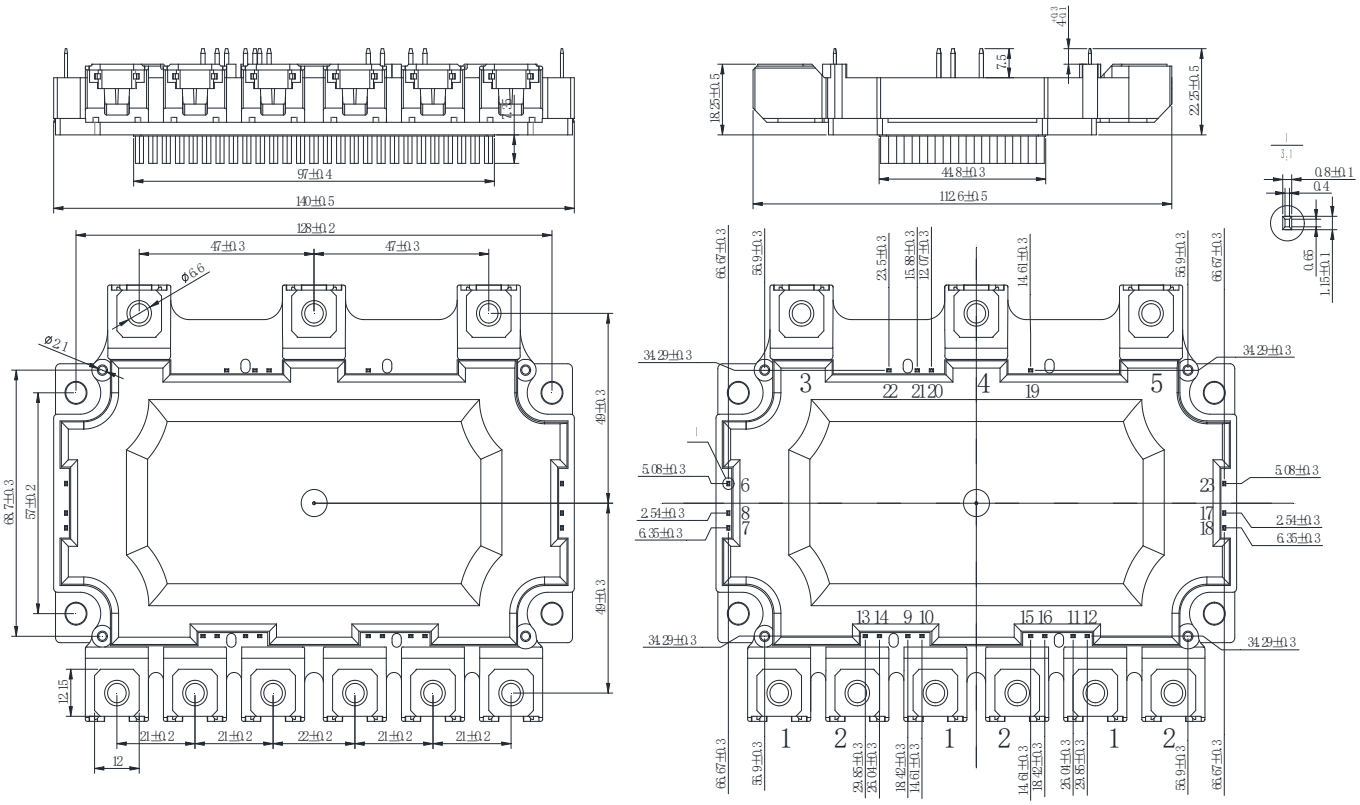
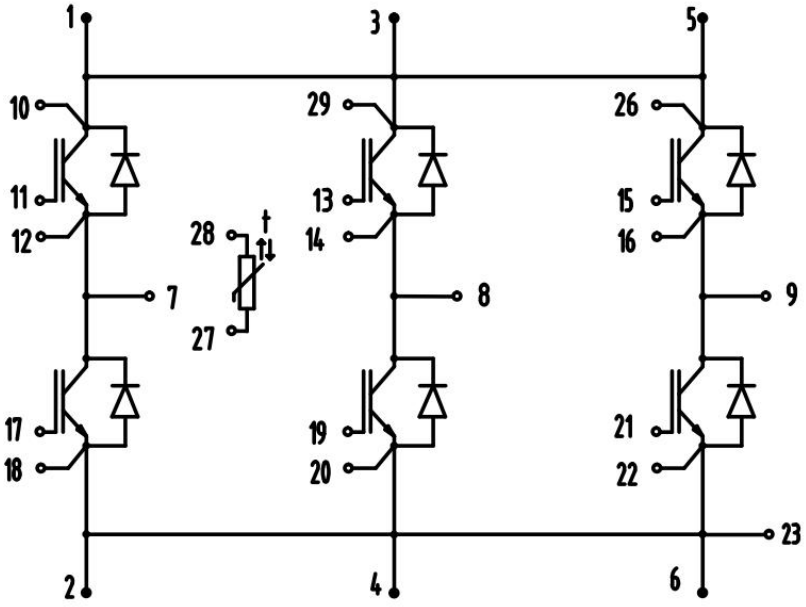


NTC Thermistor temperature characteristic (typical)
NTC 热敏电阻
R=f（T）



Package Dimension / 封装尺寸

Dimensions in Millimeters / 毫米为单位



Internal Circuit / 内部电路