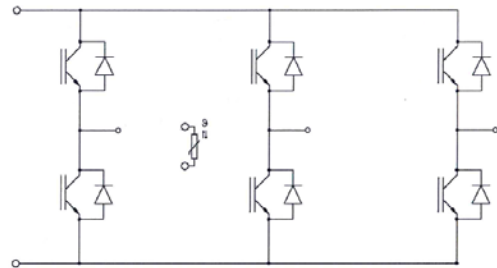


A1 package: 750V 400A IGBT module



等效电路图

Equivalent Circuit Schematic

**Features:**

- 750V 400A,  $V_{CE(sat)} = 1.70V @ 25^{\circ}C$
- High RBSOA capability
- Trench/FS Technology
- Low switching losses
- High SC capability

**产品特性:**

- 750V 400A,  $V_{CE(sat)} = 1.70V @ 25^{\circ}C$
- 高 RBSOA 能力
- 沟槽栅/场终止技术
- 低开关损耗
- 高短路能力

**Typical Applications:**

- E-Mobility

**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	$T_{vj}=25^{\circ}\text{C}$	$V_{CES}$	750	V
Continuous DC collector current 集电极连续直流电流		$I_{C\text{ nom}}$	400	A
	$T_C=65^{\circ}\text{C}, T_{vj\text{ max}}=175^{\circ}\text{C}$	$I_C$	430	A
Repetitive Peak collector current 集电极可重复峰值电流	$I_{CRM}=2 \times I_{C\text{ nom}}$	$I_{CRM}$	800	A
Gate-emitter peak voltage 门极-发射极峰值电压		$V_{GES}$	$\pm 20$	V

**Characteristic Values / 性能参数**

min. typ. max.

			min.	typ.	max.		
Collector-emitter saturation Voltage <sup>1)</sup> 集电极-发射极饱和压降	$I_C=400\text{A}, V_{GE}=15\text{V}$ $I_C=400\text{A}, V_{GE}=15\text{V}$ $I_C=400\text{A}, V_{GE}=15\text{V}$	$T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	$V_{CE\text{ sat}}$	-	1.70 1.95 2.00	2.10	V
Gate Threshold Voltage 门极阈值电压	$V_{CE}=10\text{V}, I_C=5\text{mA}, T_{vj}=25^{\circ}\text{C}$		$V_{GE\text{ th}}$	5.50	5.90	6.50	V
Internal Gate Resistor 内置门极电阻	$T_{vj}=25^{\circ}\text{C}$		$R_{G\text{ int}}$	-	1	-	$\Omega$
Input Capacitance 输入电容	$V_{CE}=25\text{V}, V_{GE}=0\text{V}, f=100\text{kHz}$		$C_{ies}$	-	33	-	nF
Reverse Transfer Capacitance 反向传输电容	$V_{CE}=25\text{V}, V_{GE}=0\text{V}, f=100\text{kHz}$		$C_{res}$	-	0.50	-	nF
Gate Charge 门极电荷	$V_{GE}=-15\text{V}/15\text{V}$		$Q_G$	-	2.50	-	$\mu\text{C}$
Collector-emitter Cutoff Current 集电极-发射极关断漏电流	$V_{CE}=650\text{V}, V_{GE}=0\text{V}, T_{vj}=25^{\circ}\text{C}$		$I_{CES}$	-	-	1	mA
Gate-emitter Leakage Current 门极-发射极漏电流	$V_{CE}=0\text{V}, V_{GE}=20\text{V}, T_{vj}=25^{\circ}\text{C}$		$I_{GES}$	-	-	500	nA
Turn-on Delay Time, Inductive Load 开通延迟时间, 感性负载	$I_C=400\text{A}, V_{CE}=400\text{V}$ $V_{GE}=-8\text{V}/15\text{V}$ $R_{Gon}=3.3\Omega$	$T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	$t_{don}$	-	172 172 165	-	ns
Rise Time, Inductive Load 上升时间, 感性负载	$I_C=400\text{A}, V_{CE}=400\text{V}$ $V_{GE}=-8\text{V}/15\text{V}$ $R_{Gon}=3.3\Omega$	$T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	$t_r$	-	70 73 74	-	ns
Turn-off Delay Time, Inductive Load 关断延迟时间, 感性负载	$I_C=400\text{A}, V_{CE}=300\text{V}$ $V_{GE}=-8\text{V}/15\text{V}$ $R_{Goff}=12\Omega$	$T_{vj}=25^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	$t_{doff}$	-	180 1100 1067	-	ns
Fall Time, Inductive Load 下降时间, 感性负载	$I_C=400\text{A}, V_{CE}=300\text{V}$ $V_{GE}=-8\text{V}/15\text{V}$ $R_{Goff}=12\Omega$	$T_{vj}=25^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	$t_f$	-	68 84 87	-	ns
Turn-on energy loss per pulse 开通损耗	$I_C=400\text{A}, V_{CE}=300\text{V}$ $V_{GE}=-8\text{V}/15\text{V}$ $R_{Gon}=3.3\Omega, L_G=35\text{nH}$	$T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	$E_{on}$	-	8.4 10.1 11.9	-	mJ
Turn-off energy loss per pulse 关断损耗	$I_C=400\text{A}, V_{CE}=300\text{V},$ $V_{GE}=-8\text{V}/15\text{V}, L_G=35\text{nH}$ $V_{GE}=-8\text{V}/15\text{V}, R_{Goff}=12\Omega$	$T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	$E_{off}$	-	24.9 29.0 31.7	-	mJ

SC Data 短路耐量	$V_{CE}=300V$ , $V_{GE}=15V/-8V$ , $T_{vj}=150^{\circ}C$	$t_{psc}$	6	-	-	$\mu s$
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		$T_{vj op}$	-40	-	150	$^{\circ}C$

## 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		$I_{Fnom}$	400	A
Repetitive Peak Forward Current 可重复正向峰值电流	$I_{FRM}=2 \times I_F$	$I_{FRM}$	800	A

### Characteristic Values / 性能参数

min. typ. max.

Forward Voltage <sup>1)</sup> 正向通态压降	$I_F=400A$ , $V_{GE}=0V$ $T_{vj}=25^{\circ}C$ $I_F=400A$ , $V_{GE}=0V$ $T_{vj}=125^{\circ}C$ $I_F=400A$ , $V_{GE}=0V$ $T_{vj}=150^{\circ}C$	$V_F$	-	1.65 1.70 1.70	2.0	V
Peak Reverse Recovery Current 反向恢复峰值电流	$I_F=400A$ , $V_R=300V$ $T_{vj}=25^{\circ}C$ $-di_F/dt=6700A/\mu s$ ( $T_{vj}=150^{\circ}C$ ) $T_{vj}=125^{\circ}C$ $V_{GE}=-8V$ $T_{vj}=150^{\circ}C$	$I_{RM}$	-	244 276 288	-	A
Recovery Charge 反向恢复电荷	$I_F=400A$ , $V_R=300V$ $T_{vj}=25^{\circ}C$ $-di_F/dt=6700A/\mu s$ ( $T_{vj}=150^{\circ}C$ ) $T_{vj}=125^{\circ}C$ $V_{GE}=-8V$ $T_{vj}=150^{\circ}C$	$Q_R$	-	22.1 34.6 40.6	-	$\mu C$
Reverse Recovery Energy 反向恢复损耗	$I_F=400A$ , $V_R=300V$ $T_{vj}=25^{\circ}C$ $-di_F/dt=6700A/\mu s$ ( $T_{vj}=150^{\circ}C$ ) $T_{vj}=125^{\circ}C$ $V_{GE}=-8V$ $T_{vj}=150^{\circ}C$	$E_{rec}$	-	8.2 8.5 15.0	-	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		$T_{vj op}$	-40	-	150	$^{\circ}C$

**NTC-Thermistor/ NTC-热敏电阻**
**Characteristic Values / 性能参数**

		min.		typ.		max.	
Rated Resistance 标称电阻	$T_{NTC}=25^{\circ}C$	$R_{25}$	-	5	-	-	K $\Omega$
Deviation of R100 R100 偏差值	$T_{NTC}=100^{\circ}C, R_{100}=493.3\Omega$	$\Delta R/R$	-5	-	5	-	%
Power Dissipation 功率耗散	$T_{NTC}=25^{\circ}C$	$P_{25}$	-	-	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**

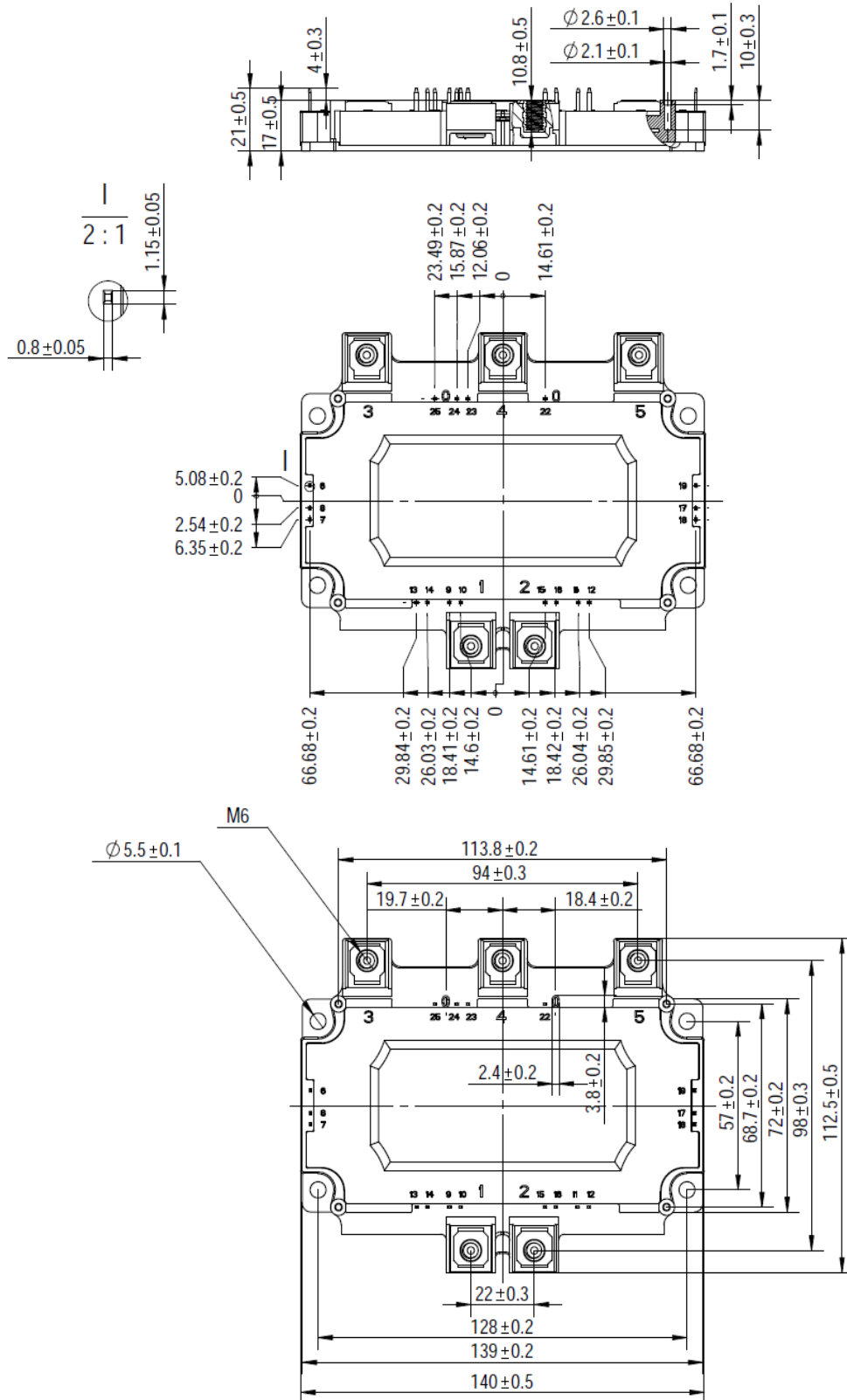
Isolation Test Voltage 绝缘测试电压	RMS, f=50Hz, t=3s	$V_{ISOL}$	3.0		KV	
Material of Module Baseplate 模块底板材料			Cu			
Internal Isolation 内部绝缘			Al <sub>2</sub> O <sub>3</sub>			
Creepage Distance 爬电距离	Terminal to heatsink		12.0		mm	
	Terminal to terminal		6.1			
Clearance 电气间隙	Terminal to heatsink		12.0		mm	
	Terminal to terminal		6.1			
Comparative Tracking Index 相对漏电起痕指数		CTI	200 <sup>2)</sup>			

		min.		typ.		max.	
Stray Inductance Module 模块杂散电感		$L_{sCE}$	-	30	-	-	nH
Module Lead Resistance, Terminals-Chip 模块引脚电阻, 端子-芯片	$T_C=25^{\circ}C, \text{ Per Switch}$	$R_{CC+EE}$	-	0.76	-	-	m $\Omega$
Storage Temperature 贮存温度		$T_{stg}$	-40	-	125	-	$^{\circ}C$
Mounting Torque for Module Mounting 模块安装力矩	Screw M5 / M5 螺丝	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	-	460	-	-	G

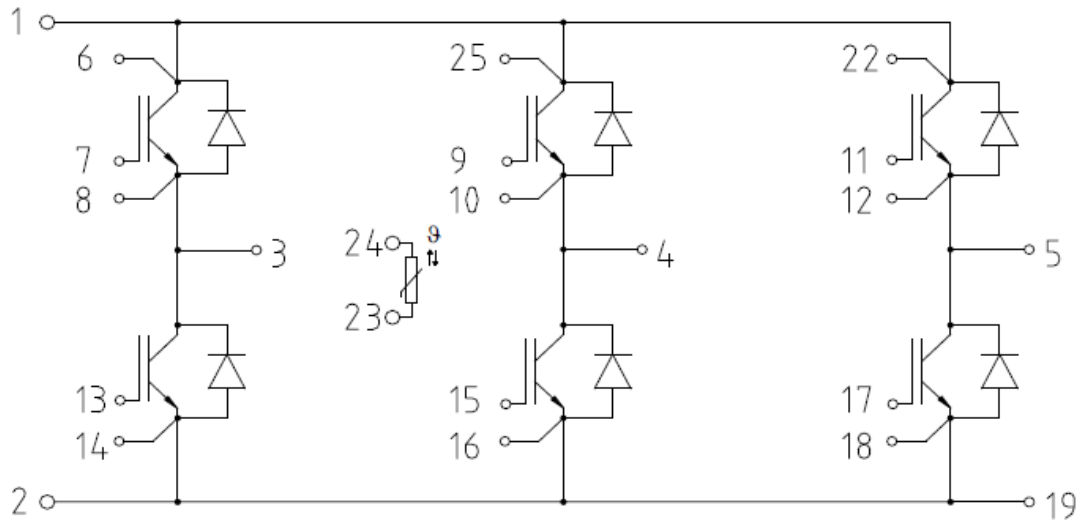
- 1) Terminal impedance is included.  
包含端子阻抗。
- 2) CTI is about 200.  
CTI 约等于 200。

Package Dimension / 封装尺寸

Dimensions in Millimeters / 毫米为单位



**Internal Circuit / 内部电路**

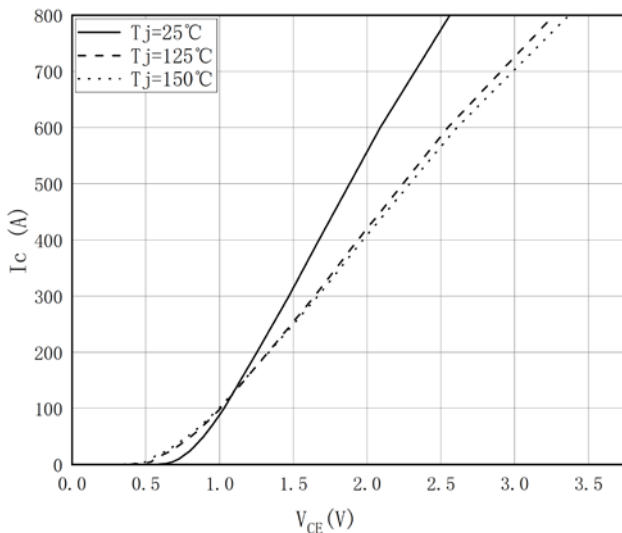


**Circuit Diagram / 曲线图**

Output characteristic IGBT, Inverter (typical), Inclusive  $R_{OC+BE}$

IGBT 输出特性, 逆变 (典型值), 包含  $R_{OC+BE}$

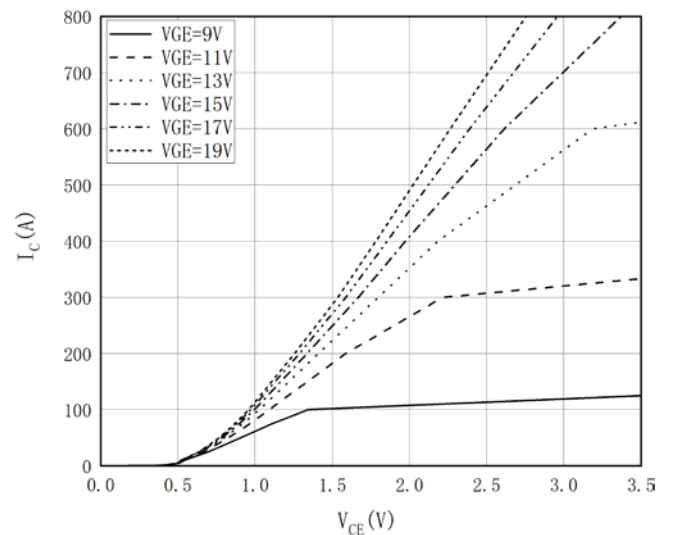
$I_c = f(V_{CE}), V_{GE} = 15V$



Output characteristic IGBT, Inverter (typical)

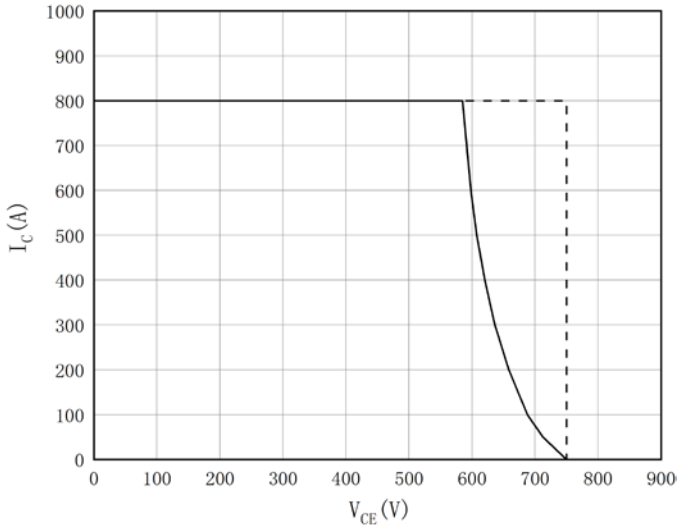
( $T_j = 150^\circ C$ ), Inclusive  $R_{OC+BE}$

IGBT 输出特性, 逆变 ( $T_j = 150^\circ C$ ), 包含  $R_{OC+BE}$



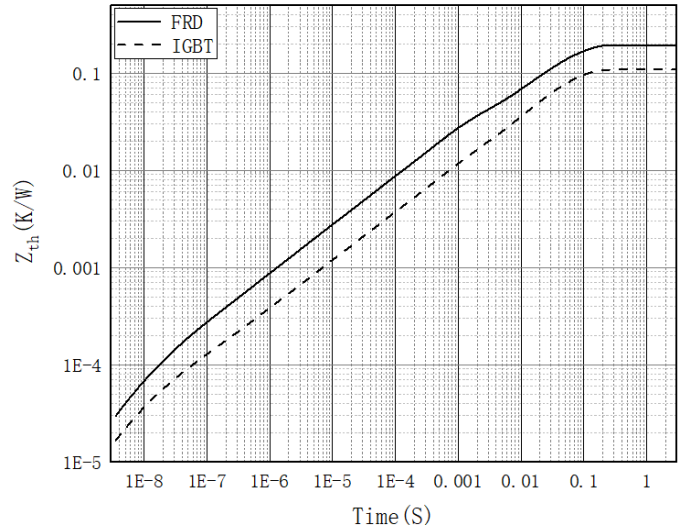
**Reverse bias safe operating area IGBT, Inverter(RBSOA)**  
IGBT 反向安全工作区, 逆变(RBSOA)

$I_C=f(V_{CE}), V_{GE}=+15V/-8V, R_{goff}=12\Omega, T_{vj}=150^\circ C$



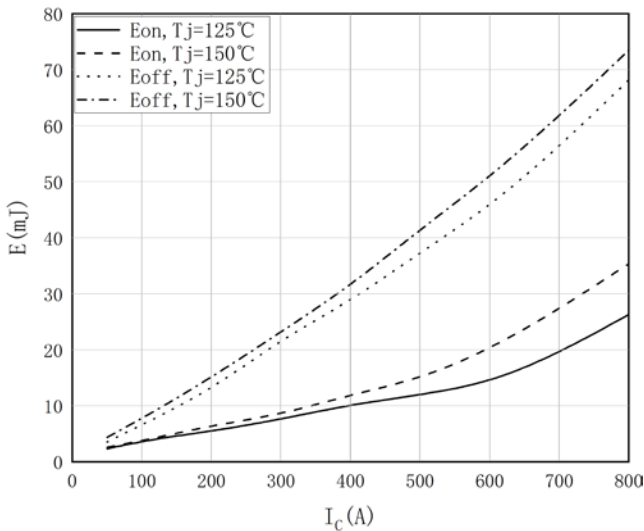
**Transient thermal impedance, Inverter**  
瞬态热阻, 逆变

$Z_{thJC}=f(t)$



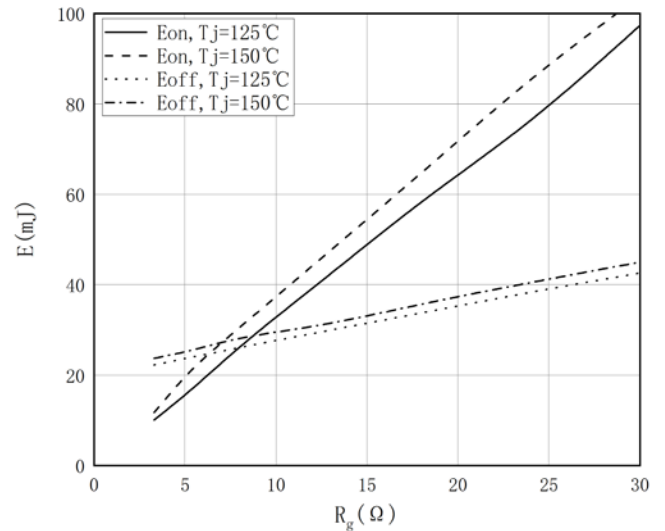
**Turn-on/off loss IGBT, Inverter(Typical)**  
IGBT 开通/关断损耗, 逆变 (典型值)

$E_{on}=f(I_C), E_{off}=f(I_C) V_{GE}=+15V/-8V, R_{gon}=1.5\Omega, R_{goff}=12\Omega, V_{CE}=400V$



**Turn-on/off loss IGBT, Inverter(Typical)**  
IGBT 开通/关断损耗, 逆变 (典型值)

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

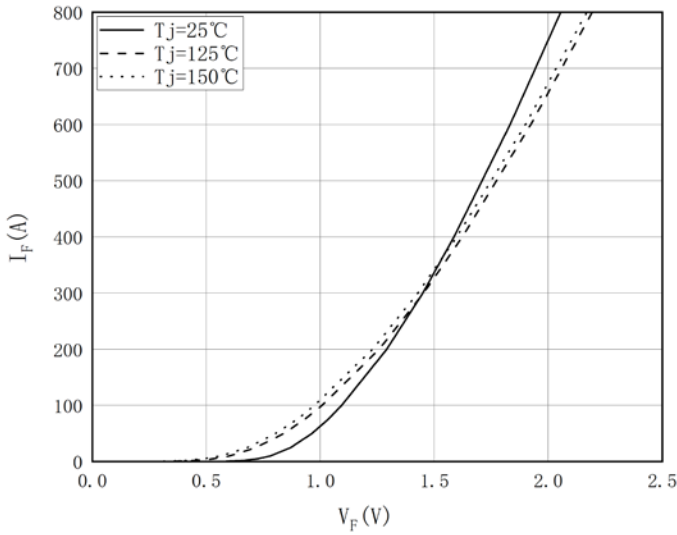


Output characteristic FRD, Inverter (typical)

Inclusiver  $R_{cc'} + R_B'$

FRD 输出特性, 逆变 (典型值), 包含  $R_{cc'} + R_B'$

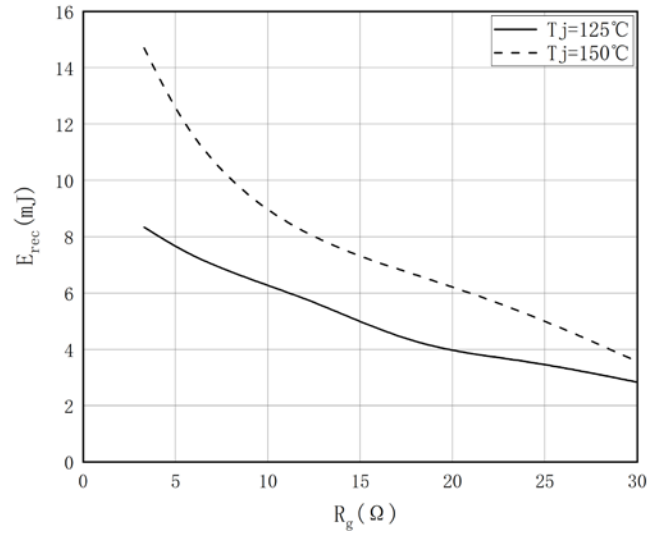
$I_F = f(V_F)$



Output characteristic  $E_{rec}$ , Inverter (typical)

FRD 输出特性, 逆变 (典型值), 包含  $R_{cc'} + R_B'$

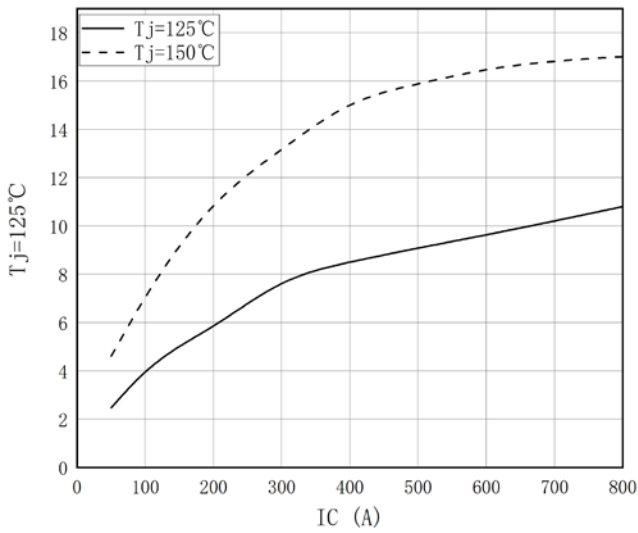
$E_{rec} = f(R_g)$



Switching Loss FRD, Inverter (typical)

FRD 开关损耗, 逆变 (典型值)

$E_{rec} = f(I_F), R_{gon} = 3.3 \Omega, V_{CE} = 400V$



NTC Thermistor

NTC 热敏电阻

$R = f(T)$

