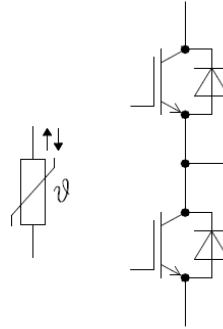


M series package: 1200V 600A IGBT module



等效电路图  
Equivalent Circuit Schematic

### Features:

- 1200V 600A,  $V_{CE(sat)} = 1.65 \text{ V}@25^\circ\text{C}$
- High RBSOA capability
- Trench/FS Technology
- Low reverse-recovery losses
- High SC capability

### 产品特性:

- 1200V 600A,  $V_{CE(sat)} = 1.65\text{V}@25^\circ\text{C}$
- 高 RBSOA 能力
- 沟槽栅/场终止技术
- 低反向恢复损耗
- 高短路能力

### Typical Applications:

- Motor Drives
- Solar Applications
- UPS Systems

### 典型应用:

- 电机驱动
- 光伏应用
- UPS 系统

**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	$T_{vj}=25^{\circ}\text{C}$	$V_{CES}$	1200	V
Continuous DC collector current 集电极连续直流电流		$I_{C\text{ nom}}$	600	A
	$T_C=100^{\circ}\text{C}, T_{vj\text{ max}}=175^{\circ}\text{C}$	$I_C$	620	A
Repetitive Peak collector current 集电极可重复峰值电流	$I_{CRM}=2 \times I_{C\text{ nom}}$	$I_{CRM}$	1200	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.		
Collector-emitter saturation Voltage <sup>1)</sup> 集电极-发射极饱和压降	$I_C=600\text{A}, V_{GE}=15\text{V}$ $I_C=600\text{A}, V_{GE}=15\text{V}$ $I_C=600\text{A}, V_{GE}=15\text{V}$	$T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	$V_{CE\text{ sat}}$	1.65 1.80 1.85	1.95	V	
Gate Threshold Voltage 门极阈值电压	$V_{CE}=10\text{V}, I_C=17.1\text{mA}, T_{vj}=25^{\circ}\text{C}$		$V_{GE\text{ th}}$	5.0	5.6	6.8	V
Gate Charge 门极电荷	$V_{GE}=-15\text{V}/15\text{V}$		$Q_G$	3.90		$\mu\text{C}$	
Internal Gate Resistor 内置门极电阻	$T_{vj}=25^{\circ}\text{C}$		$R_{G\text{ int}}$	1.10		$\Omega$	
Input Capacitance 输入电容	$V_{CE}=25\text{V}, V_{GE}=0\text{V}, f=100\text{KHz}$		$C_{ies}$	51.9		nF	
Reverse Transfer Capacitance 反向传输电容	$V_{CE}=25\text{V}, V_{GE}=0\text{V}, f=100\text{KHz}$		$C_{res}$	1.83		nF	
Collector-emitter Cutoff Current 集电极-发射极关断漏电流	$V_{CE}=1200\text{V}, V_{GE}=0\text{V}, T_{vj}=25^{\circ}\text{C}$		$I_{CES}$		3	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	$I_C=600\text{A}, V_{CE}=600\text{V}$ $V_{GE}=-8\text{V}/15\text{V}$ $R_{Gon}=1.5\Omega$	$T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	$t_{don}$	177 194 192		ns	
Rise Time, Inductive Load 上升时间, 感性负载	$I_C=600\text{A}, V_{CE}=600\text{V}$ $V_{GE}=-8\text{V}/15\text{V}$ $R_{Gon}=1.5\Omega$	$T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	$t_r$	67 72 75		ns	
Turn-off Delay Time, Inductive Load 关断延迟时间, 感性负载	$I_C=600\text{A}, V_{CE}=600\text{V}$ $V_{GE}=-8\text{V}/15\text{V}$ $R_{Goff}=2.4\Omega$	$T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	$t_{doff}$	658 719 742		ns	
Fall Time, Inductive Load 下降时间, 感性负载	$I_C=600\text{A}, V_{CE}=600\text{V}$ $V_{GE}=-8\text{V}/15\text{V}$ $R_{Goff}=2.4\Omega$	$T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	$t_f$	81 114 123		ns	
Turn-on energy loss per pulse 开通损耗	$I_C=600\text{A}, V_{CE}=600\text{V}$ $V_{GE}=-8\text{V}/15\text{V},$ $R_{Gon}=1.5\Omega, L_G=35\text{nH}$	$T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	$E_{on}$	45.2 65.5 74.5		mJ	
Turn-off energy loss per pulse 关断损耗	$I_C=600\text{A}, V_{CE}=600\text{V},$ $V_{GE}=-8\text{V}/15\text{V},$ $R_{Goff}=2.4\Omega, L_G=35\text{nH}$	$T_{vj}=25^{\circ}\text{C}$ $T_{vj}=125^{\circ}\text{C}$ $T_{vj}=150^{\circ}\text{C}$	$E_{off}$	54.7 66.6 70.7		mJ	

SC Data 短路耐量	$V_{CE}=600V$ , $V_{GE}=15V/-8V$ , $T_{vj}=150^{\circ}C$	$t_{psc}$	10			$\mu s$
Thermal Resistance, Junction to Case 结-壳热阻	Per IGBT/单个 IGBT	$R_{thJC}$		0.050		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	$T_{vj}=25^{\circ}C$	$V_{RRM}$	1200	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	$I_{FRM}=2 \times I_F$	$I_{FRM}$	1200	A

### Characteristic Values / 性能参数

			min.	typ.	max.	
Forward Voltage <sup>1)</sup> 正向通态压降	$I_F=600A$ , $V_{GE}=0V$ $I_F=600A$ , $V_{GE}=0V$ $I_F=600A$ , $V_{GE}=0V$	$T_{vj}=25^{\circ}C$ $T_{vj}=125^{\circ}C$ $T_{vj}=150^{\circ}C$	$V_F$	1.80 1.80 1.80	2.40	V
Peak Reverse Recovery Current 反向恢复峰值电流	$I_F=600A$ , $V_R=600V$ $-di_F/dt=5000A/\mu s(T_{vj}=150^{\circ}C)$ $V_{GE}=-8V$	$T_{vj}=25^{\circ}C$ $T_{vj}=125^{\circ}C$ $T_{vj}=150^{\circ}C$	$I_{RM}$	264 296 304		A
Recovery Charge 反向恢复电荷	$I_F=600A$ , $V_R=600V$ $-di_F/dt=5000A/\mu s(T_{vj}=150^{\circ}C)$ $V_{GE}=-8V$	$T_{vj}=25^{\circ}C$ $T_{vj}=125^{\circ}C$ $T_{vj}=150^{\circ}C$	$Q_R$	19.1 35.8 64.0		$\mu C$
Reverse Recovery Energy 反向恢复损耗	$I_F=600A$ , $V_R=600V$ $-di_F/dt=5000A/\mu s(T_{vj}=150^{\circ}C)$ $V_{GE}=-8V$	$T_{vj}=25^{\circ}C$ $T_{vj}=125^{\circ}C$ $T_{vj}=150^{\circ}C$	$E_{rec}$	11.7 20.7 25.4		mJ
Thermal Resistance, Junction to Case 结-壳热阻	Per FRD/单个 FRD		$R_{thJC}$	0.073		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 偏移值	$T_{NTC}=100^{\circ}C, R_{100}=465\Omega$	$\Delta R/R$	-7.3			7.3	%
Power Dissipation 功率耗散	$T_{NTC}=25^{\circ}C$	$P_{25}$				10	mW
B-Value B 值	$R_2=R_{25} \exp[B_{25/50}(1/T_2-1/(298.15K))]$	$B_{25/50}$		3380			K
	$R_2=R_{25} \exp[B_{25/80}(1/T_2-1/(298.15K))]$	$B_{25/80}$		3470			K
	$R_2=R_{25} \exp[B_{25/100}(1/T_2-1/(298.15K))]$	$B_{25/100}$		3520			K

**Module / 模块**

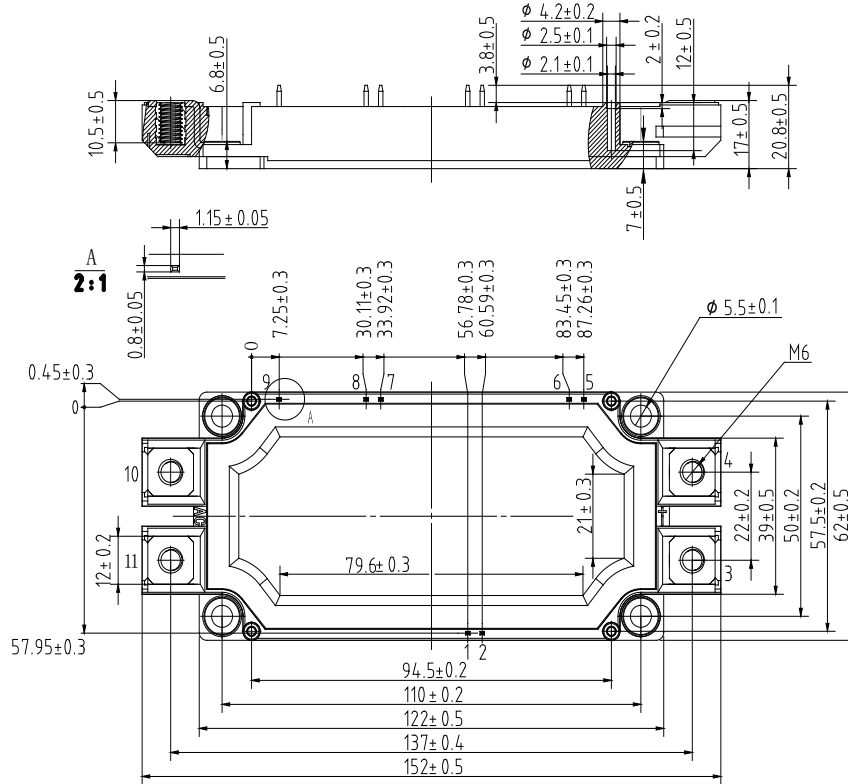
Isolation Test Voltage 绝缘测试电压	RMS, f=50Hz, t=1min	$V_{ISOL}$		2.5			KV
Material of Module Baseplate 模块底板材料				Cu			
Internal Isolation 内部绝缘				$Al_2O_3$			
Creepage Distance 爬电距离	Terminal to heatsink			14.5			mm
	Terminal to terminal			13			
Clearance 电气间隙	Terminal to heatsink			12.5			mm
	Terminal to terminal			10			
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		$L_{sCE}$		20			nH
Module Lead Resistance, Terminals-Chip 模块引脚电阻, 端子-芯片	$T_C=25^{\circ}C, \text{ Per Switch}$	$R_{CC+EE}$		0.83			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
Weight 重量		G		345			g

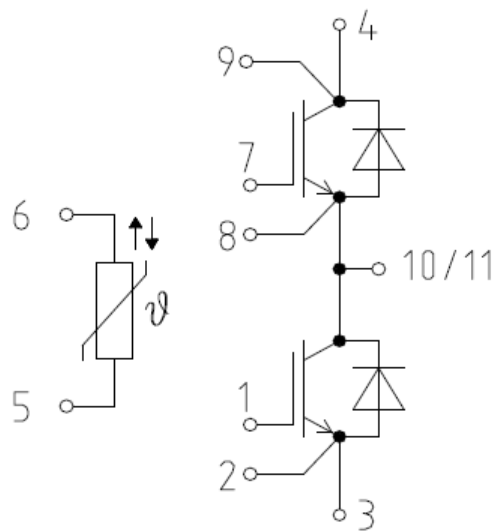
- 1) Terminal impedance is not included.  
不包含端子阻抗。
- 2) CTI is about 200.  
CTI 约等于 200。

**Package Dimension / 封装尺寸**

**Dimensions in Millimeters / 毫米为单位**



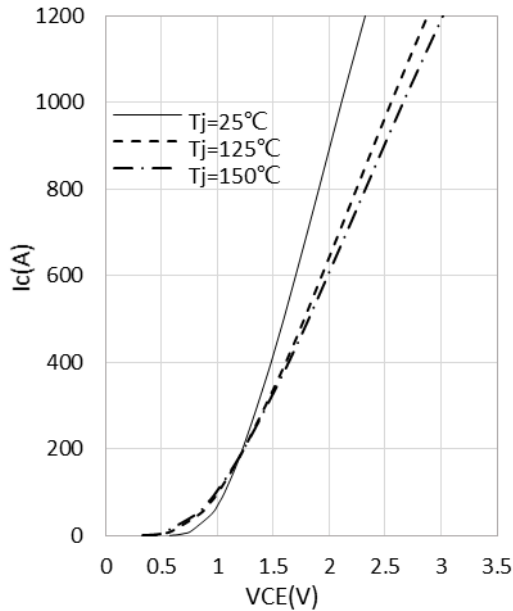
**Internal Circuit / 内部电路**



**Circuit Diagram / 曲线图**

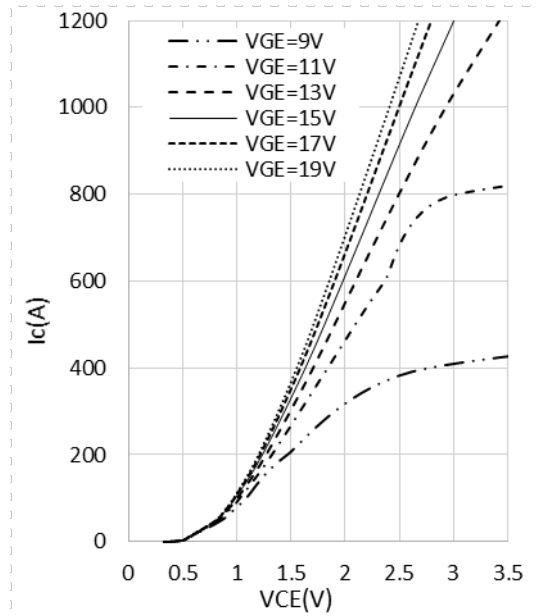
Output characteristic IGBT, Inverter (typical),  
Inclusive  $R_{OC+R_{\theta J}}$ .

IGBT 输出特性, 逆变 (典型值), 包含  $R_{OC+R_{\theta J}}$ .  
 $I_C=f(V_{CE}), V_{GE}=15V$



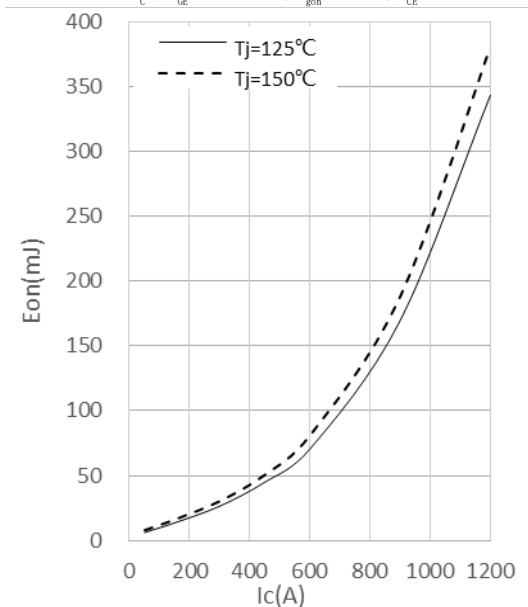
Output characteristic IGBT, Inverter (typical) ( $T_j=150^\circ\text{C}$ ),  
Inclusive  $R_{OC+R_{\theta J}}$ .

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



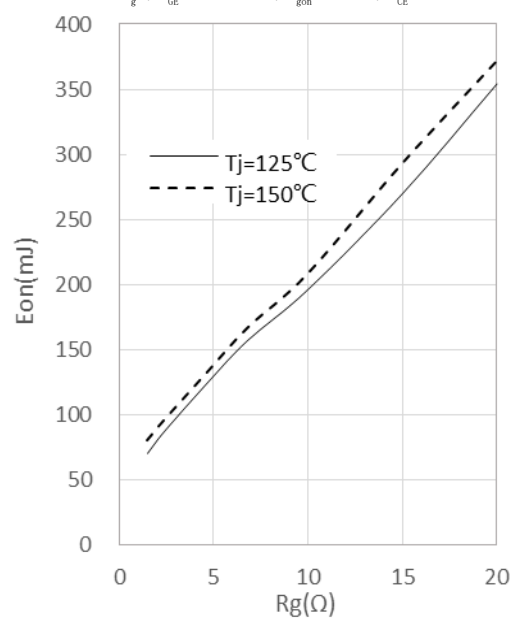
Turn-on loss IGBT, Inverter (Typical)  
IGBT 开通损耗, 逆变 (典型值)

$E_{on}=F(I_C), V_{GE}=+15V/-8V, R_{\theta J}=1.5\Omega, V_{CE}=600V$



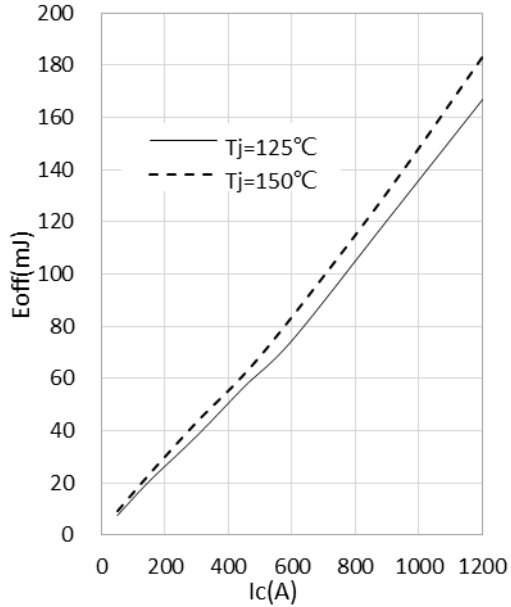
Turn-on loss IGBT, Inverter (Typical)  
IGBT 开通损耗, 逆变 (典型值)

$E_{on}=F(R_g), V_{GE}=+15V/-8V, R_{\theta J}=1.5\Omega, V_{CE}=600V$



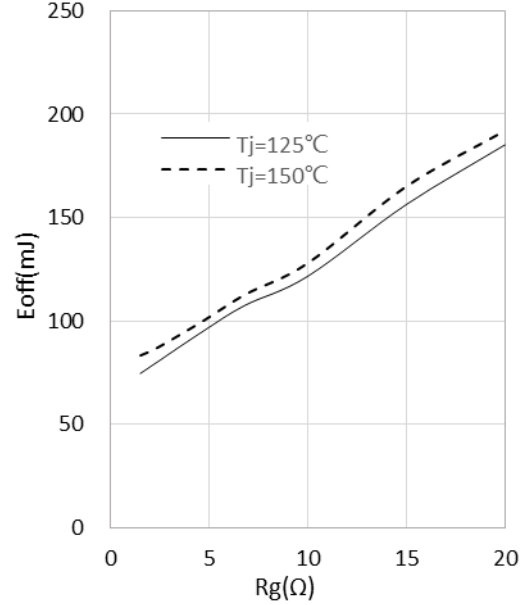
Turn-off loss IGBT, Inverter (Typical)  
IGBT 关断损耗, 逆变 (典型值)

$E_{off} = f(I_c), V_{GE} = +15V / -8V, R_{goff} = 1.5 \Omega, V_{CE} = 600V$



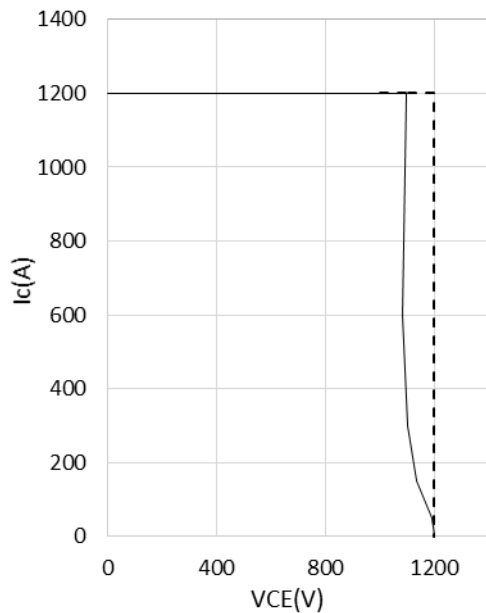
Turn-off loss IGBT, Inverter (Typical)  
IGBT 关断损耗, 逆变 (典型值)

$E_{off} = f(R_g), V_{GE} = +15V / -8V, R_{goff} = 1.5 \Omega, V_{CE} = 600V$



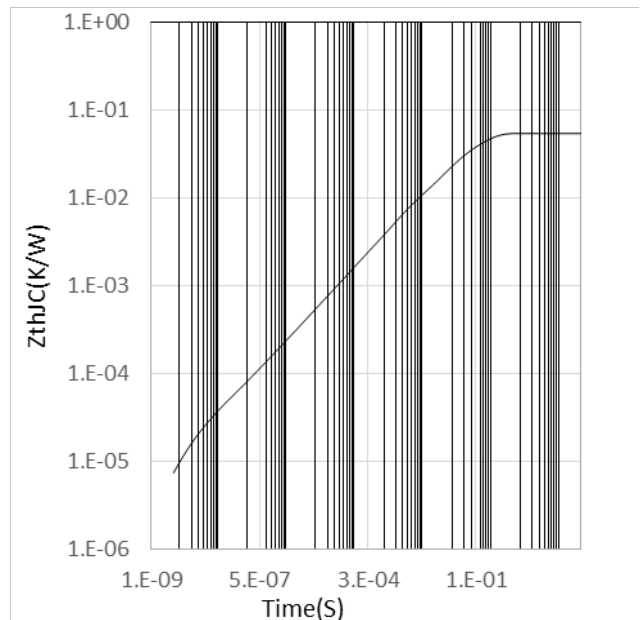
Reverse bias safe operating area IGBT, Inverter (RBSOA)  
IGBT 反向安全工作区, 逆变 (RBSOA)

$I_c = f(V_{CE}), V_{GE} = +15V / -8V, R_{goff} = 1.5 \Omega, T_{vj} = 150^\circ C$



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

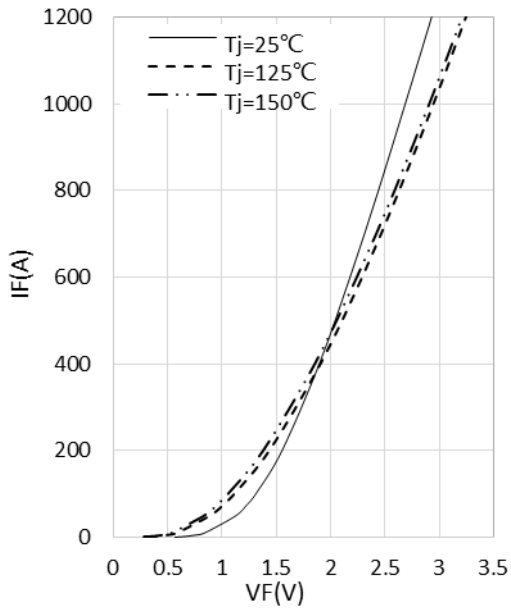
$Z_{thJC} = f(t)$



Output characteristic FRD, Inverter (typical)  
Inclusive  $R_{CC} + R_{BB}$

FRD 输出特性, 逆变 (典型值), 包含  $R_{CC} + R_{BB}$

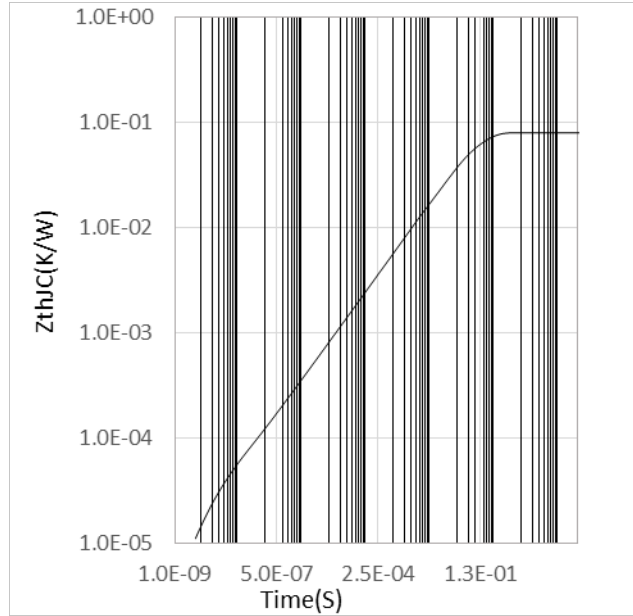
$I_F = f(V_F)$



Transient thermal impedance FRD, Inverter

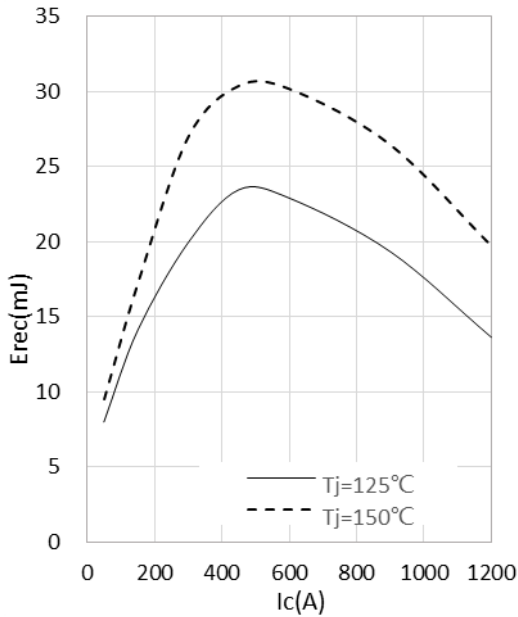
FRD 瞬态热阻, 逆变

$Z_{thJC} = f(t)$



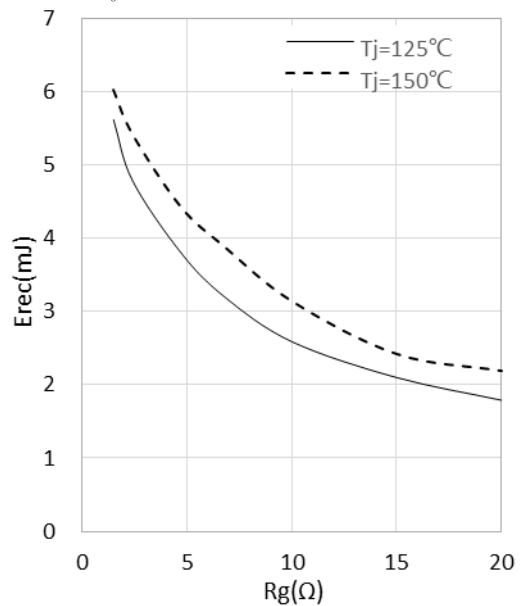
Switching Loss FRD, Inverter (typical)  
FRD 开关损耗, 逆变 (典型值)

$E_{rec} = f(I_F), R_{gon} = 1.5 \Omega, V_{CE} = 600V$



Switching Loss FRD, Inverter (typical)  
FRD 开关损耗, 逆变 (典型值)

$E_{rec} = f(R_g), I_F = 600A, V_{CE} = 600V$





NTC Thermistor  
NTC 热敏电阻  
 $R=f(T)$

