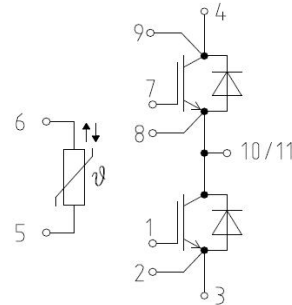


M series package: 1200V900A IGBT module

Datasheet



等效电路图

Equivalent Circuit Schematic

**Features:**

- 1200V 900A,  $V_{CE(sat)} = 1.53 \text{ V}@25^\circ\text{C}$
- MPT Gate Technology
- Low Losses
- High RBSOA capability
- Low reverse-recovery losses

**产品特性:**

- 1200V 900A,  $V_{CE(sat)} = 1.53\text{V}@25^\circ\text{C}$
- 微沟槽栅/场终止技术
- 低损耗
- 高 RBSOA 能力
- 低反向恢复损耗

**Typical Applications:**

- Motor Drives
- Solar Applications
- UPS Systems
- Energy Storage

**典型应用:**

- 电机驱动
- 光伏应用
- UPS 系统
- 储能

# IGBT, Inverter / IGBT, 逆变部分

## Maximum Rated Values / 最大标称参数

|                                                 |                                                                 |                    |          |   |
|-------------------------------------------------|-----------------------------------------------------------------|--------------------|----------|---|
| Collector-Emitter Voltage<br>集电极-发射极电压          | $T_{vj}=25^{\circ}\text{C}$                                     | $V_{CES}$          | 1200     | V |
| Implemented Collector Current<br>集电极电流          |                                                                 | $I_{C\text{ nom}}$ | 900      | A |
| Continuous DC Collector Current<br>集电极连续直流电流    | $T_C=45^{\circ}\text{C}, T_{vj\text{ max}}=175^{\circ}\text{C}$ | $I_C$              | 875      | A |
| Repetitive Peak Collector Current<br>集电极可重复峰值电流 | $t_p=1\text{ms}$                                                | $I_{CRM}$          | 1800     | A |
| Gate-emitter Peak Voltage<br>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><br>集电极-发射极饱和压降 | $I_C=900\text{A}, V_{GE}=15\text{V}$<br>$T_{vj}=25^{\circ}\text{C}$<br>$T_{vj}=125^{\circ}\text{C}$<br>$T_{vj}=175^{\circ}\text{C}$                                                                                                                                               | $V_{CE\text{ sat}}$ | -    | 1.53<br>1.77<br>1.83 | -   | V             |
| Gate Threshold Voltage<br>门极阈值电压                                  | $V_{CE}=V_{GE}, I_C=18\text{mA}, T_{vj}=25^{\circ}\text{C}$                                                                                                                                                                                                                       | $V_{GE\text{ th}}$  | 5.0  | 6.0                  | 7.0 | V             |
| Gate Charge<br>门极电荷                                               | $V_{GE}=-15\text{V}/15\text{V}, V_{CE}=600\text{V}$                                                                                                                                                                                                                               | $Q_G$               | -    | 11.2                 | -   | $\mu\text{C}$ |
| Internal Gate Resistor<br>内置门极电阻                                  | $T_{vj}=25^{\circ}\text{C}$                                                                                                                                                                                                                                                       | $R_{G\text{ int}}$  | -    | 0.2                  | -   | $\Omega$      |
| Input Capacitance<br>输入电容                                         | $f=100\text{kHz}, T_{vj}=25^{\circ}\text{C}, V_{CE}=25\text{V}, V_{GE}=0\text{V}$                                                                                                                                                                                                 | $C_{ies}$           | -    | 199                  | -   | nF            |
| Reverse Transfer Capacitance<br>反向传输电容                            | $f=100\text{kHz}, T_{vj}=25^{\circ}\text{C}, V_{CE}=25\text{V}, V_{GE}=0\text{V}$                                                                                                                                                                                                 | $C_{res}$           | -    | 0.57                 | -   | nF            |
| Collector-Emitter Cutoff Current<br>集电极-发射极关断漏电流                  | $V_{CE}=1200\text{V}, V_{GE}=0\text{V}, T_{vj}=25^{\circ}\text{C}$                                                                                                                                                                                                                | $I_{CES}$           | -    | -                    | 0.1 | mA            |
| Gate-Emitter Leakage Current<br>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<br>开通延迟时间, 感性负载                | $I_C=900\text{A}, V_{CE}=600\text{V}$<br>$V_{GE}=-8\text{V}/15\text{V}$<br>$R_{Gon}=1\Omega$<br>$T_{vj}=25^{\circ}\text{C}$<br>$T_{vj}=125^{\circ}\text{C}$<br>$T_{vj}=175^{\circ}\text{C}$                                                                                       | $t_{don}$           | -    | 201<br>268<br>273    | -   | ns            |
| Rise Time, Inductive Load<br>上升时间, 感性负载                           | $I_C=900\text{A}, V_{CE}=600\text{V}$<br>$V_{GE}=-8\text{V}/15\text{V}$<br>$R_{Gon}=1\Omega$<br>$T_{vj}=25^{\circ}\text{C}$<br>$T_{vj}=125^{\circ}\text{C}$<br>$T_{vj}=175^{\circ}\text{C}$                                                                                       | $t_r$               | -    | 95<br>110<br>117     | -   | ns            |
| Turn-off Delay Time, Inductive Load<br>关断延迟时间, 感性负载               | $I_C=900\text{A}, V_{CE}=600\text{V}$<br>$V_{GE}=-8\text{V}/15\text{V}$<br>$R_{Goff}=3\Omega$<br>$T_{vj}=25^{\circ}\text{C}$<br>$T_{vj}=125^{\circ}\text{C}$<br>$T_{vj}=175^{\circ}\text{C}$                                                                                      | $t_{doff}$          | -    | 950<br>988<br>1018   | -   | ns            |
| Fall Time, Inductive Load<br>下降时间, 感性负载                           | $I_C=900\text{A}, V_{CE}=600\text{V}$<br>$V_{GE}=-8\text{V}/15\text{V}, R_{Goff}=3\Omega$<br>$T_{vj}=25^{\circ}\text{C}$<br>$T_{vj}=125^{\circ}\text{C}$<br>$T_{vj}=175^{\circ}\text{C}$                                                                                          | $t_f$               | -    | 92<br>139<br>184     | -   | ns            |
| Turn-on Energy Loss Per Pulse<br>开通损耗                             | $I_C=900\text{A}, V_{CE}=600\text{V}, L_{\sigma}=30\text{nH}$<br>$di/dt=6131\text{A}/\mu\text{s} (T_{vj}=175^{\circ}\text{C})$<br>$V_{GE}=-8\text{V}/15\text{V}, R_{Gon}=1\Omega$<br>$T_{vj}=25^{\circ}\text{C}$<br>$T_{vj}=125^{\circ}\text{C}$<br>$T_{vj}=175^{\circ}\text{C}$  | $E_{on}$            | -    | 91<br>121<br>139     | -   | mJ            |
| Turn-off Energy Loss Per Pulse<br>关断损耗                            | $I_C=900\text{A}, V_{CE}=600\text{V}, L_{\sigma}=30\text{nH}$<br>$du/dt=4762\text{V}/\mu\text{s} (T_{vj}=175^{\circ}\text{C})$<br>$V_{GE}=-8\text{V}/15\text{V}, R_{Goff}=3\Omega$<br>$T_{vj}=25^{\circ}\text{C}$<br>$T_{vj}=125^{\circ}\text{C}$<br>$T_{vj}=175^{\circ}\text{C}$ | $E_{off}$           | -    | 88<br>117<br>131     | -   | mJ            |
| SC Data<br>短路耐量                                                   | $V_{GE}=-8\text{V}/15\text{V}$<br>$V_{CC}=600\text{V}$<br>$t_p \leq 8\mu\text{s}, T_{vj}=150^{\circ}\text{C}$<br>$t_p \leq 6\mu\text{s}, T_{vj}=175^{\circ}\text{C}$                                                                                                              | $I_{sc}$            | -    | 3200<br>3100         | -   | A             |

|                                                  |                                                        |              |     |       |     |     |
|--------------------------------------------------|--------------------------------------------------------|--------------|-----|-------|-----|-----|
| Thermal Resistance, Junction to Case<br>结-外壳热阻   | Per IGBT/单个 IGBT                                       | $R_{thJC}$   | -   | 0.037 | -   | K/W |
| Thermal Resistance, Case to Heatsink<br>外壳-散热器热阻 | Per IGBT/单个 IGBT<br>$\lambda_{grease} = 1W(m \cdot K)$ | $R_{thCH}$   | -   | 0.037 | -   | K/W |
| Temperature under Switching Conditions<br>工作温度   |                                                        | $T_{vj\ op}$ | -40 | -     | 175 | °C  |

## Diode, Inverter / 二极管，逆变部分

### Maximum Rated Values / 最大标称参数

|                                              |                      |            |      |   |
|----------------------------------------------|----------------------|------------|------|---|
| Repetitive Peak Reverse Voltage<br>可重复反向峰值电压 | $T_{vj}=25^{\circ}C$ | $V_{RRM}$  | 1200 | V |
| Continuous DC Forward Current<br>可连续正向直流电流   |                      | $I_{Fnom}$ | 900  | A |
| Repetitive Peak Forward Current<br>可重复正向峰值电流 | $t_p=1ms$            | $I_{FRM}$  | 1800 | A |

### Characteristic Values / 性能参数

|                                                  |                                                                                                                                                            |              | min. | typ.                 | max |         |
|--------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|------|----------------------|-----|---------|
| Forward Voltage <sup>1)</sup><br>正向通态压降          | $I_F=900A, V_{GE}=0V$<br>$T_{vj}=25^{\circ}C$<br>$T_{vj}=150^{\circ}C$<br>$T_{vj}=175^{\circ}C$                                                            | $V_F$        | -    | 1.85<br>2.05<br>2.05 | -   | V       |
| Peak Reverse Recovery Current<br>反向恢复峰值电流        | $I_F=900A, V_R=600V$<br>$-di_F/dt=5556A/us(T_{vj}=175^{\circ}C)$<br>$V_{GE}=-8V$<br>$T_{vj}=25^{\circ}C$<br>$T_{vj}=125^{\circ}C$<br>$T_{vj}=175^{\circ}C$ | $I_{RM}$     | -    | 420<br>444<br>476    | -   | A       |
| Recovery Charge<br>反向恢复电荷                        | $I_F=900A, V_R=600V$<br>$-di_F/dt=5556A/us(T_{vj}=175^{\circ}C)$<br>$V_{GE}=-8V$<br>$T_{vj}=25^{\circ}C$<br>$T_{vj}=125^{\circ}C$<br>$T_{vj}=175^{\circ}C$ | $Q_R$        | -    | 34<br>55<br>71       | -   | $\mu C$ |
| Reverse Recovery Energy<br>反向恢复损耗                | $I_F=900A, V_R=600V$<br>$-di_F/dt=5556A/us(T_{vj}=175^{\circ}C)$<br>$V_{GE}=-8V$<br>$T_{vj}=25^{\circ}C$<br>$T_{vj}=125^{\circ}C$<br>$T_{vj}=175^{\circ}C$ | $E_{rec}$    | -    | 7<br>25<br>29        | -   | mJ      |
| Thermal Resistance, Junction to Case<br>结-外壳热阻   | Per FRD/单个 FRD                                                                                                                                             | $R_{thJC}$   | -    | 0.063                | -   | K/W     |
| Thermal Resistance, Case to Heatsink<br>外壳-散热器热阻 | Per FRD/单个 FRD<br>$\lambda_{grease} = 1W(m \cdot K)$                                                                                                       | $R_{thJH}$   | -    | 0.048                | -   | K/W     |
| Temperature under Switching Conditions<br>工作温度   |                                                                                                                                                            | $T_{vj\ op}$ | -40  | -                    | 175 | °C      |

## NTC-Thermistor/ NTC-热敏电阻

### Characteristic Values / 性能参数

|                               |                                                     |              | min. | typ. | max |            |
|-------------------------------|-----------------------------------------------------|--------------|------|------|-----|------------|
| Rated Resistance<br>标称电阻      | $T_{NTC}=25^{\circ}\text{C}$                        | $R_{25}$     | -    | 5    | -   | K $\Omega$ |
| Deviation of R100<br>R100 偏移值 | $T_{NTC}=100^{\circ}\text{C}$ , $R_{100}=465\Omega$ | $\Delta R/R$ | -7.3 | -    | 7.3 | %          |
| Power Dissipation<br>功率耗散     | $T_{NTC}=25^{\circ}\text{C}$                        | $P_{25}$     | -    | -    | 10  | mW         |
| B-Value<br>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<br>绝缘测试电压       | RMS, f=50Hz, t=1min                          | $V_{ISOL}$ | 3                 | kV |
| Material of Module Baseplate<br>模块底板材料 |                                              |            | Cu                |    |
| Internal Isolation<br>内部绝缘             |                                              |            | ZTA               |    |
| Creepage Distance<br>爬电距离              | Terminal to heatsink<br>Terminal to terminal |            | 15.0<br>13.0      | mm |
| Clearance<br>电气间隙                      | Terminal to heatsink<br>Terminal to terminal |            | 12.5<br>10.0      | mm |
| Comparative Tracking Index<br>相对漏电起痕指数 |                                              | CTI        | 200 <sup>2)</sup> |    |

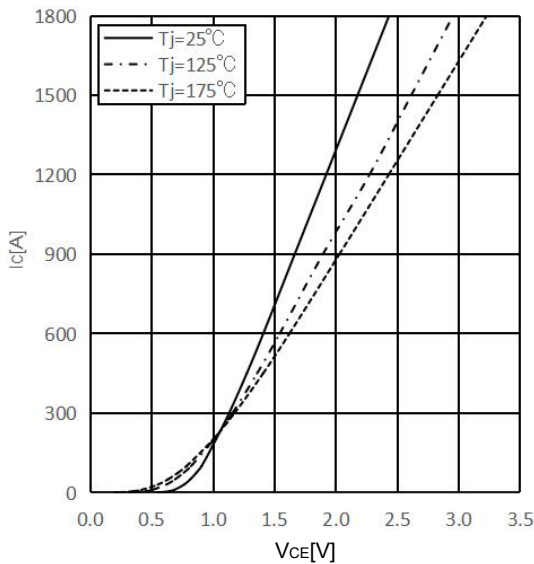
|                                                            |                                       |               | min. | typ. | max. |                    |
|------------------------------------------------------------|---------------------------------------|---------------|------|------|------|--------------------|
| Stray Inductance Module<br>模块杂散电感                          |                                       | $L_{sCE}$     | -    | 20   | -    | nH                 |
| Module Lead Resistance,<br>Terminals-Chip<br>模块引脚电阻, 端子-芯片 | $T_C=25^{\circ}\text{C}$ , Per Switch | $R_{CC'+EE'}$ | -    | 0.8  | -    | m $\Omega$         |
| Storage Temperature<br>贮存温度                                |                                       | $T_{stg}$     | -40  | -    | 125  | $^{\circ}\text{C}$ |
| Mounting Torque for Module Mounting<br>模块安装力矩              | Screw M5 / M5 螺丝                      | M             | 3.0  | -    | 6.0  | Nm                 |
| Power Terminal Installation Torque<br>功率端子安装扭矩             | Screw M6 / M6 螺丝                      | M             | 3.0  | -    | 6.0  | Nm                 |
| Weight<br>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。

## Circuit Diagram / 曲线图

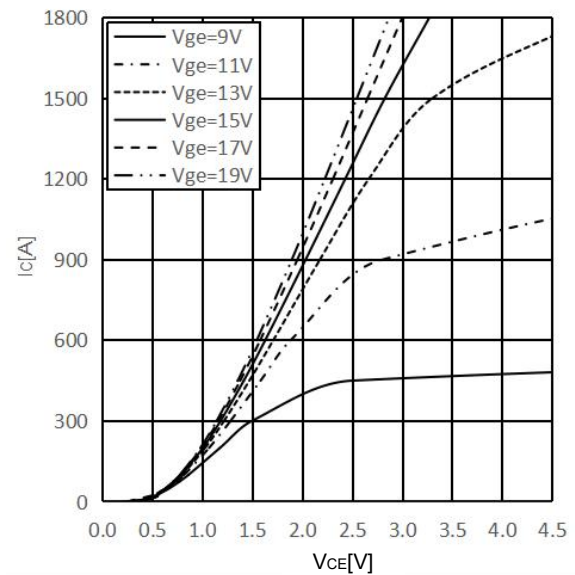
### Output characteristic IGBT, Inverter (typical), Inclusive $R_{CC'+EE'}$

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



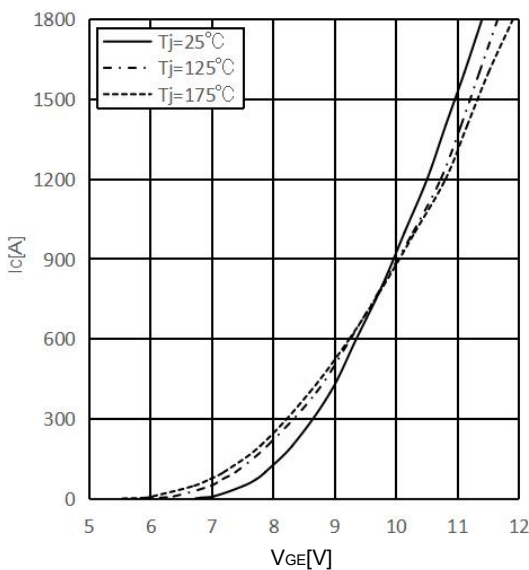
### Output characteristic IGBT, Inverter (typical), Inclusive $R_{CC'+EE'}$

IGBT 输出特性, 逆变 (典型值), 包含  $R_{CC'+EE'}$   
 $I_C = f(V_{CE}), T_J = 175^\circ C$



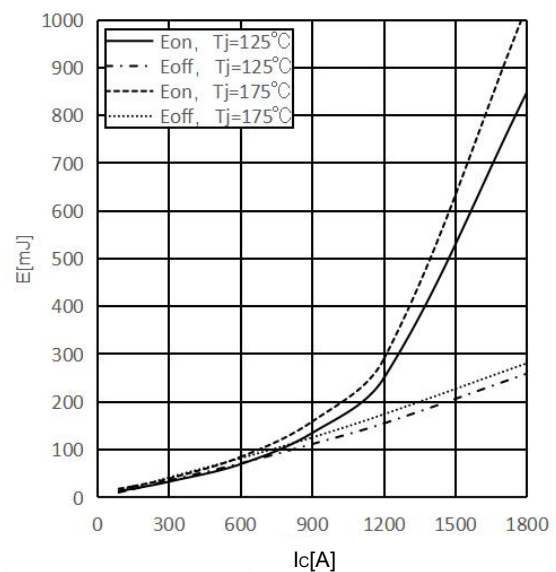
### Transfer characteristic IGBT, Inverter (typical), Inclusive $R_{CC'+EE'}$

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



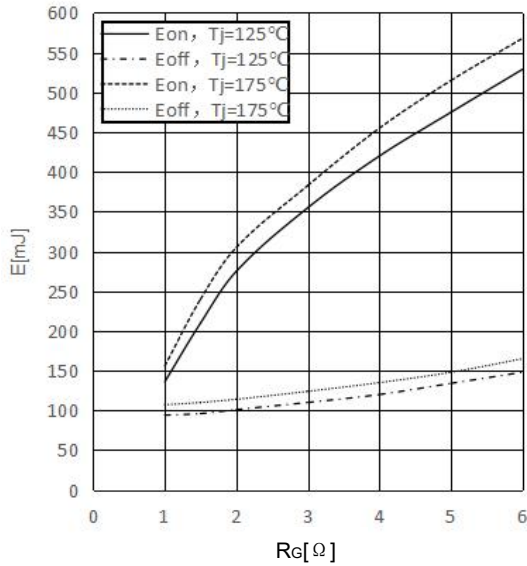
### Switching losses IGBT, Inverter (typical), Inclusive $R_{CC'+EE'}$

IGBT 开关损耗, 逆变 (典型值), 包含  $R_{CC'+EE'}$   
 $E = f(I_C), V_{GE} = +15V/-8V$ ,  
 $R_{Gon} = 1\Omega, R_{Goff} = 3\Omega, V_{CE} = 600V$



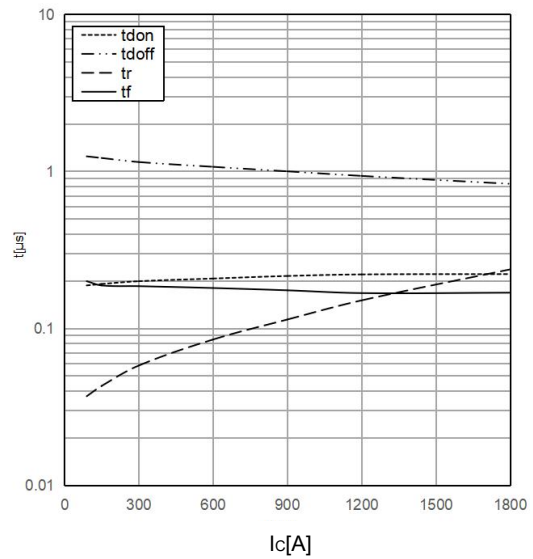
### Switching losses IGBT, Inverter (typical), Inclusive $R_{CC} + E_E$

IGBT 开关损耗, 逆变 (典型值), 包含  $R_{CC} + E_E$   
 $E = f(R_G)$ ,  $V_{GE} = +15V/-8V$ ,  $I_C = 900A$ ,  $V_{CE} = 600V$



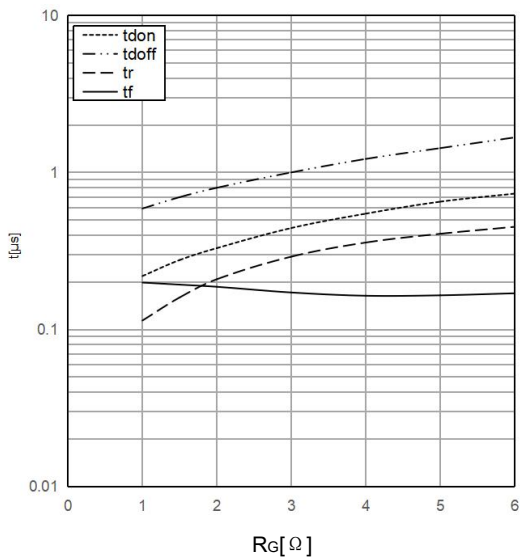
### Switching times IGBT, Inverter (typical)

IGBT 开关时间, 逆变 (典型值)  
 $t_{don} = f(I_C)$ ,  $t_r = f(I_C)$ ,  $V_{GE} = +15V/-8V$ ,  
 $R_{Gon} = 1\Omega$ ,  $R_{Goff} = 3\Omega$ ,  $V_{CE} = 600V$



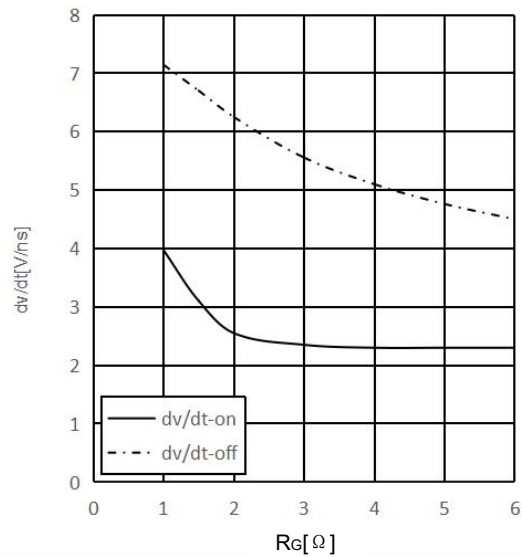
### Switching times IGBT, Inverter (typical)

IGBT 开关时间, 逆变 (典型值)  
 $t_{don} = f(R_G)$ ,  $t_r = f(R_G)$ ,  $V_{GE} = +15V/-8V$ ,  
 $I_C = 900A$ ,  $V_{CE} = 600V$

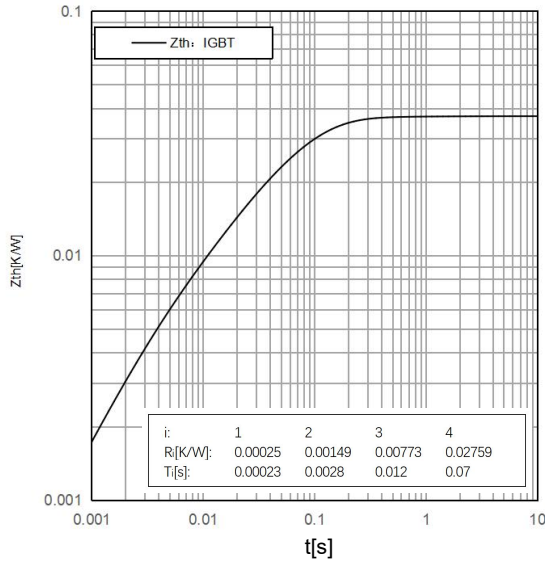


### IGBT, Inverter (typical)

IGBT 开关时间, 逆变 (典型值)  
 $dv/dt = f(R_G)$ ,  $V_{GE} = +15V/-8V$ ,  
 $I_C = 900A$ ,  $V_{CE} = 600V$ ,  $T_j = 125^\circ C$



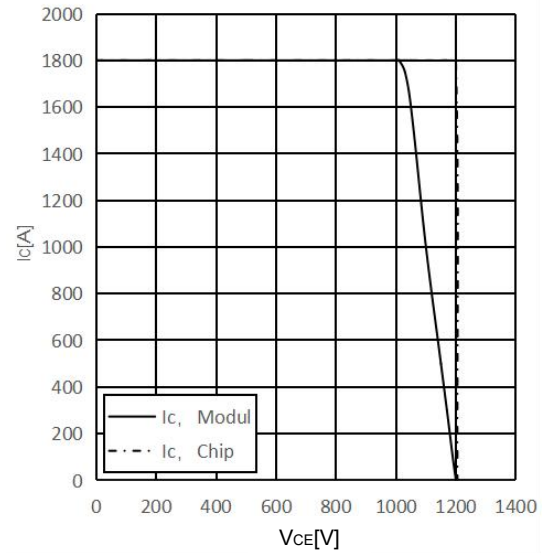
**Transient thermal impedance IGBT, Inverter**  
IGBT 瞬态热阻, 逆变  
 $Z_{thJC}=f(t)$



**Reverse bias safe operating area IGBT, Inverter(RBSOA)**

IGBT 反向安全工作区, 逆变 (RBSOA)

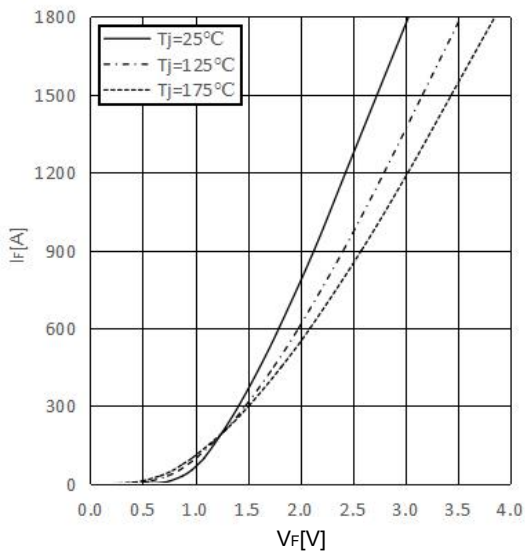
$I_C=f(V_{CE}), V_{GE}=+15V/-8V, R_{Goff}=3\Omega, T_j=175^\circ\text{C}$



**Forward characteristic FRD, Inverter(typical), Inclusive  $R_{CC}+EE$**

FRD 正向特性, 逆变 (典型值), 包含  $R_{CC}+EE$

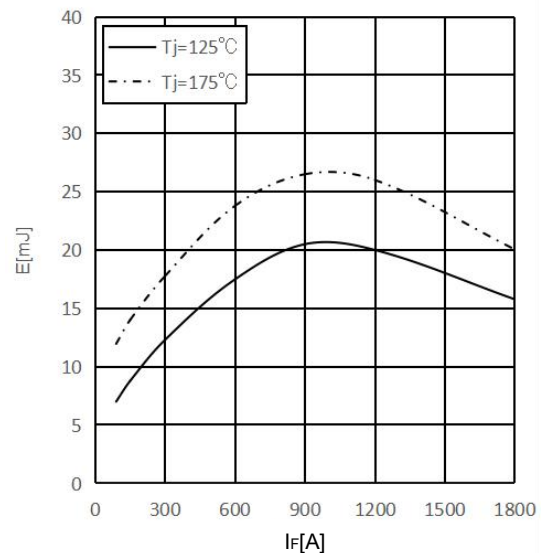
$I_F=f(V_F)$



**Switching Losses FRD, Inverter (typical), Inclusive  $R_{CC}+EE$**

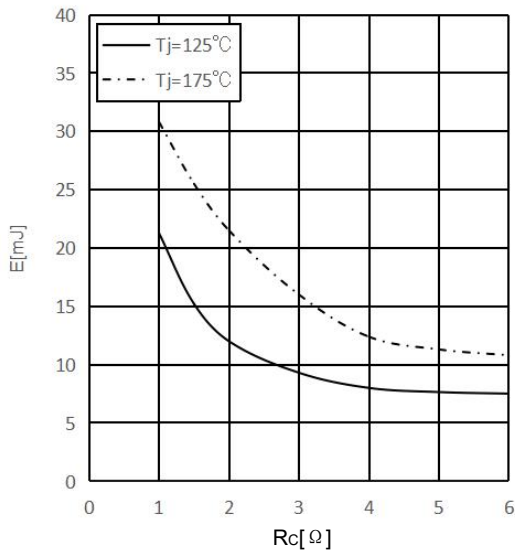
FRD 开关损耗, 逆变 (典型值), 包含  $R_{CC}+EE$

$E_{rec}=f(I_F), R_{Gon}=1\Omega, V_{CE}=400V$



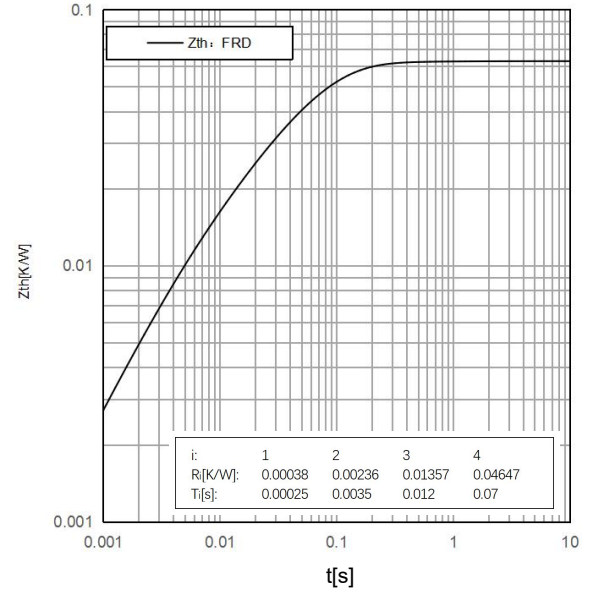
**Switching Losses FRD, Inverter(typical),  
Inclusive  $R_{CC}+EE'$**

FRD 开关损耗, 逆变 (典型值), 包含  $R_{CC}+EE'$   
 $E_{rec}=f(R_g)$



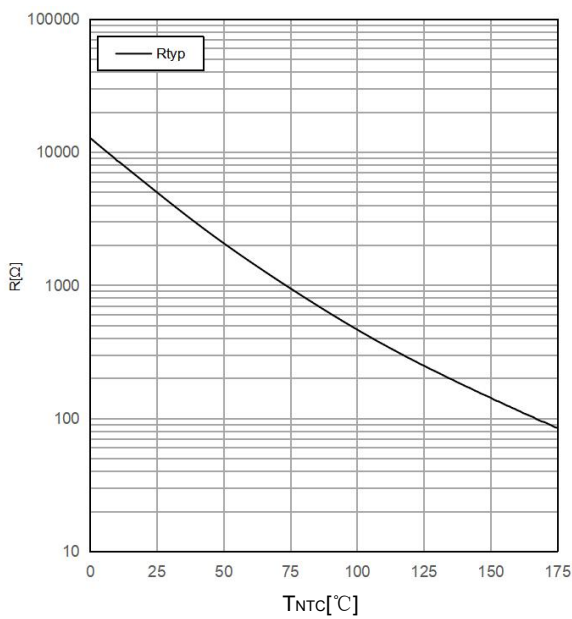
**Transient thermal impedance FRD, Inverter  
FRD 瞬态热阻, 逆变**

$Z_{thJC}=f(t)$



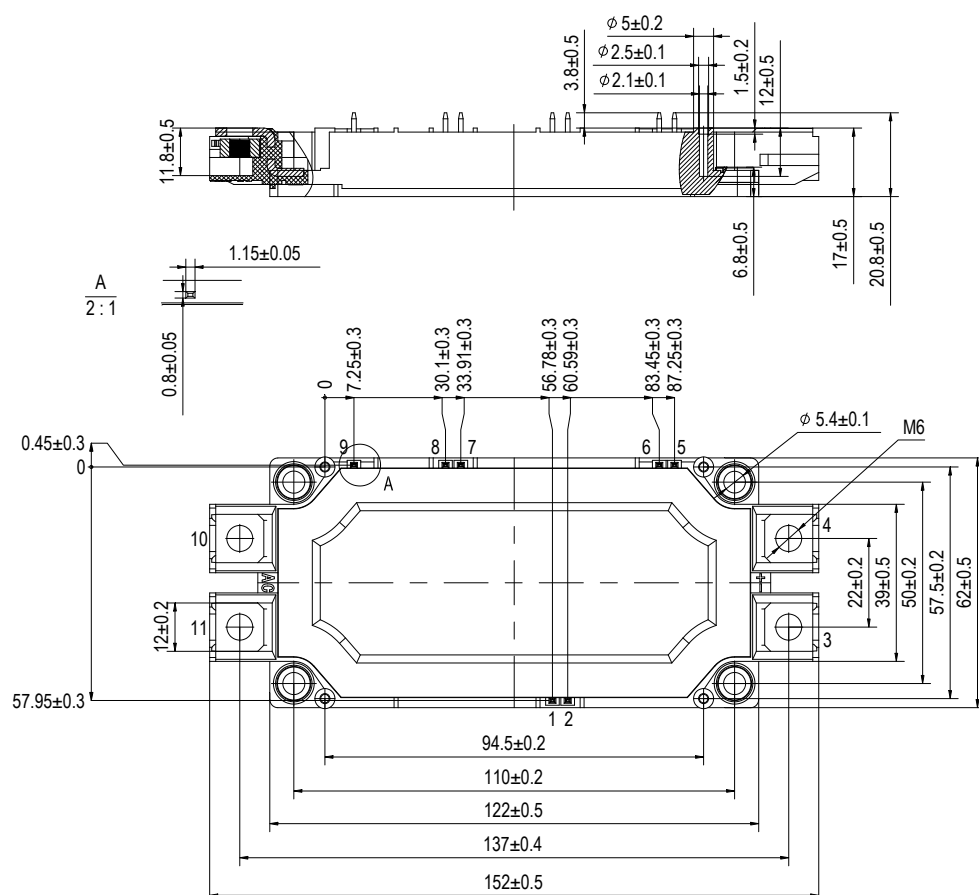
**NTC Thermistor temperature characteristic  
(typical)**

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

