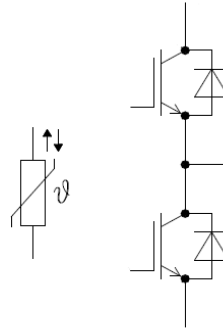


M series package: 1200V 450A IGBT module

Datasheet



等效电路图

Equivalent Circuit Schematic

**Features:**

- 1200V 450A,  $V_{CE(sat)} = 1.5\text{ V}@25^\circ\text{C}$
- MPT Gate Technology
- Low Losses
- High RBSOA capability
- Low reverse-recovery losses

**产品特性:**

- 1200V 450A,  $V_{CE(sat)} = 1.5\text{V}@25^\circ\text{C}$
- 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 |
| Continuous DC collector current<br>集电极连续直流电流    | $T_C=25^{\circ}\text{C}, T_{vjmax}\leq 175^{\circ}\text{C}$  | $I_{C\ nom}$ | 450      | A |
|   | $T_C=100^{\circ}\text{C}, T_{vjmax}\leq 175^{\circ}\text{C}$ | $I_C$        | 540      | A |
| Repetitive Peak collector current<br>集电极可重复峰值电流 | $t_p=1\text{ms}$   | $I_{CRM}$    | 900      | 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 | $I_C=450\text{A}, V_{GE}=15\text{V}$<br>$I_C=450\text{A}, V_{GE}=15\text{V}$<br>$T_{vj}=25^{\circ}\text{C}$<br>$T_{vj}=150^{\circ}\text{C}$<br>$T_{vj}=175^{\circ}\text{C}$   | $V_{CEsat}$ | 1.4  | 1.50<br>1.76<br>1.84         | 1.70 | V             |
| Gate Threshold Voltage<br>门极阈值电压                                  | $V_{CE}=V_{GE}, I_C=24\text{mA}, T_{vj}=25^{\circ}\text{C}$   | $V_{GEth}$  | 5.0  | 6.0                          | 7.0  | V             |
| Gate Charge<br>门极电荷   | $V_{GE}=15\text{V}/-8\text{V}, V_{CE}=600\text{V}$  | $Q_G$       | -    | 4.5                          | -    | $\mu\text{C}$ |
| Internal Gate Resistor<br>内置门极电阻                                  | $T_{vj}=25^{\circ}\text{C}$   | $R_{Gint}$  | -    | 0.43                         | -    | $\Omega$      |
| Input Capacitance<br>输入电容   | $V_{CE}=25\text{V}, V_{GE}=0\text{V}, T_{vj}=25^{\circ}\text{C}, f=100\text{KHz}$   | $C_{ies}$   | -    | TBD                          | -    | nF            |
| Reverse Transfer Capacitance<br>反向传输电容                            | $V_{CE}=25\text{V}, V_{GE}=0\text{V}, T_{vj}=25^{\circ}\text{C}, f=100\text{KHz}$   | $C_{res}$   | -    | TBD                          | -    | nF            |
| Collector-emitter Cutoff Current<br>集电极-发射极关断漏电流                  | $V_{CE}=1200\text{V}, V_{GE}=0\text{V}, T_{vj}=25^{\circ}\text{C}$  | $I_{CES}$   | -    | -                            | 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,<br>Inductive Load<br>开通延迟时间, 感性负载             | $I_C=450\text{A}, V_{CE}=600\text{V}$<br>$V_{GE}=15\text{V}/-8\text{V}$<br>$R_{Gon}=0.5\Omega$<br>$T_{vj}=25^{\circ}\text{C}$<br>$T_{vj}=125^{\circ}\text{C}$<br>$T_{vj}=150^{\circ}\text{C}$<br>$T_{vj}=175^{\circ}\text{C}$   | $t_{don}$   | -    | 186<br>192<br>195<br>217     | -    | ns            |
| Rise Time, Inductive Load<br>上升时间, 感性负载                           | $I_C=450\text{A}, V_{CE}=600\text{V}$<br>$V_{GE}=15\text{V}/-8\text{V}$<br>$R_{Gon}=0.5\Omega$<br>$T_{vj}=25^{\circ}\text{C}$<br>$T_{vj}=125^{\circ}\text{C}$<br>$T_{vj}=150^{\circ}\text{C}$<br>$T_{vj}=175^{\circ}\text{C}$   | $t_r$       | -    | 54<br>64<br>67<br>85         | -    | ns            |
| Turn-off Delay Time,<br>Inductive Load<br>关断延迟时间, 感性负载            | $I_C=450\text{A}, V_{CE}=600\text{V}$<br>$V_{GE}=15\text{V}/-8\text{V}$<br>$R_{Goff}=1\Omega$<br>$T_{vj}=25^{\circ}\text{C}$<br>$T_{vj}=125^{\circ}\text{C}$<br>$T_{vj}=150^{\circ}\text{C}$<br>$T_{vj}=175^{\circ}\text{C}$  | $t_{doff}$  | -    | 435<br>485<br>492<br>553     | -    | ns            |
| Fall Time, Inductive Load<br>下降时间, 感性负载                           | $I_C=450\text{A}, V_{CE}=600\text{V}$<br>$V_{GE}=15\text{V}/-8\text{V}$<br>$R_{Goff}=1\Omega$<br>$T_{vj}=25^{\circ}\text{C}$<br>$T_{vj}=125^{\circ}\text{C}$<br>$T_{vj}=150^{\circ}\text{C}$<br>$T_{vj}=175^{\circ}\text{C}$  | $t_f$       | -    | 123<br>191<br>203<br>210     | -    | ns            |
| Turn-on energy loss per pulse<br>开通损耗                             | $I_C=450\text{A}, V_{CE}=600\text{V}$<br>$V_{GE}=15\text{V}/-8\text{V}$<br>$R_{Gon}=0.5\Omega, L_{\sigma}=35\text{nH}$<br>$di/dt=4200(T_{vj}=175^{\circ}\text{C})$<br>$T_{vj}=25^{\circ}\text{C}$<br>$T_{vj}=125^{\circ}\text{C}$<br>$T_{vj}=150^{\circ}\text{C}$<br>$T_{vj}=175^{\circ}\text{C}$ | $E_{on}$    | -    | 18.4<br>27.5<br>31.2<br>35.0 | -    | mJ            |
| Turn-off energy loss per pulse                                    | $I_C=450\text{A}, V_{CE}=600\text{V}, T_{vj}=25^{\circ}\text{C}$  | $E_{off}$   | -    | 33.4                         | -    | mJ            |

|  |   |   |             |     |                      |     |            |
|--|---|---|-------------|-----|----------------------|-----|------------|
| 关断损耗   | $V_{GE}=15V/-8V$ ,<br>$R_{Goff}=1\Omega$ , $L_G=35nH$<br>$dv/dt=6300(T_{vj}=175^\circ C)$ | $T_{vj}=125^\circ C$<br>$T_{vj}=150^\circ C$<br>$T_{vj}=175^\circ C$  |             |     | 46.4<br>50.4<br>56.9 |     |            |
| SC Data<br>短路耐量                                | $V_{GE}=600V$ ,<br>$V_{GE}=15V/-8V$   | $T_p=10\mu s$ , $T_{vj}=25^\circ C$<br>$T_p=10\mu s$ , $T_{vj}=150^\circ C$<br>$T_p=10\mu s$ , $T_{vj}=175^\circ C$ | $I_{sc}$    | -   | 2700<br>2100<br>2000 | -   | A          |
| Thermal Resistance, Junction to Case<br>结-壳热阻  | Per IGBT  |   | $R_{thJC}$  | -   | 0.064                | -   | K/W        |
| Temperature under switching conditions<br>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<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   |                     | $I_{Fnom}$ | 450  | A |
| Repetitive Peak Forward Current<br>可重复正向峰值电流 | $t_p=1ms$           | $I_{FRM}$  | 900  | A |

### Characteristic Values / 性能参数

|  |   |   | min.        | typ.                              | max.  |            |
|--|---|---|-------------|-----------------------------------|-------|------------|
| Forward Voltage <sup>1)</sup><br>正向通态压降        | $I_F=450A$ , $V_{GE}=0V$<br>$I_F=450A$ , $V_{GE}=0V$                                  | $T_{vj}=25^\circ C$<br>$T_{vj}=150^\circ C$<br>$T_{vj}=175^\circ C$                         | $V_F$       | 1.5<br>1.95<br>1.92<br>1.82       | 2.40  | V          |
| Peak Reverse Recovery Current<br>反向恢复峰值电流      | $I_F=450A$ , $V_R=600V$<br>$-di_F/dt=4200A/\mu s(T_{vj}=175^\circ C)$<br>$V_{GE}=-8V$ | $T_{vj}=25^\circ C$<br>$T_{vj}=125^\circ C$<br>$T_{vj}=150^\circ C$<br>$T_{vj}=175^\circ C$ | $I_{RM}$    | -<br>302<br>358<br>374<br>390     | -     | A          |
| Recovery Charge<br>反向恢复电荷                      | $I_F=450A$ , $V_R=600V$<br>$-di_F/dt=4200A/\mu s(T_{vj}=175^\circ C)$<br>$V_{GE}=-8V$ | $T_{vj}=25^\circ C$<br>$T_{vj}=125^\circ C$<br>$T_{vj}=150^\circ C$<br>$T_{vj}=175^\circ C$ | $Q_R$       | -<br>21.3<br>42.1<br>50.0<br>56.0 | -     | $\mu C$    |
| Reverse Recovery Energy<br>反向恢复损耗              | $I_F=450A$ , $V_R=600V$<br>$-di_F/dt=4200A/\mu s(T_{vj}=175^\circ C)$<br>$V_{GE}=-8V$ | $T_{vj}=25^\circ C$<br>$T_{vj}=125^\circ C$<br>$T_{vj}=150^\circ C$<br>$T_{vj}=175^\circ C$ | $E_{rec}$   | -<br>11.3<br>22.5<br>27.7<br>33.0 | -     | mJ         |
| Thermal Resistance, Junction to Case<br>结-壳热阻  | Per FRD   |   | $R_{thJC}$  | -                                 | 0.092 | K/W        |
| Temperature under switching conditions<br>工作温度 |   |   | $T_{vj op}$ | -40                               | -     | $^\circ C$ |

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

|                               |   | min.         |      | typ. |     | max.      |  |
|-------------------------------|---|--------------|------|------|-----|-----------|--|
| Rated Resistance<br>标称电阻      | $T_{NTC}=25^{\circ}C$                             | $R_{25}$     | -    | 5    | -   | $K\Omega$ |  |
| Deviation of R100<br>R100 偏移值 | $T_{NTC}=100^{\circ}C, R_{100}=465\Omega$         | $\Delta R/R$ | -7.3 | -    | 7.3 | %         |  |
| Power Dissipation<br>功率耗散     | $T_{NTC}=25^{\circ}C$                             | $P_{25}$     | -    | -    | 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**

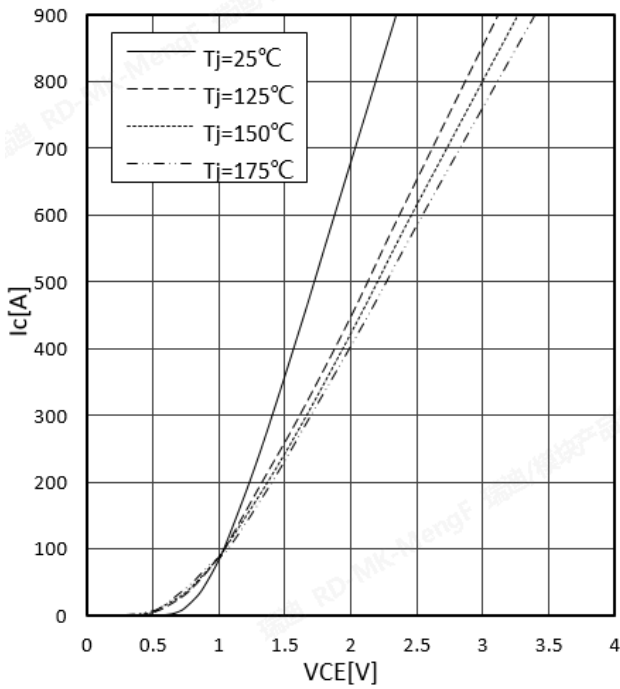
|  |                      |            |  |                   |  |    |
|--|----------------------|------------|--|-------------------|--|----|
| Isolation Test Voltage<br>绝缘测试电压       | RMS, f=50Hz, t=1min  | $V_{ISOL}$ |  | 3                 |  | KV |
| Material of Module Baseplate<br>模块底板材料 |                      | -          |  | Cu                |  | -  |
| Internal Isolation<br>内部绝缘             |                      | -          |  | ZTA               |  | -  |
| Creepage Distance<br>爬电距离              | Terminal to heatsink | -          |  | 14.5              |  | mm |
|  | Terminal to terminal | -          |  | 13                |  |    |
| Clearance<br>电气间隙                      | Terminal to heatsink | -          |  | 12.5              |  | mm |
|  | Terminal to terminal | -          |  | 10                |  |    |
| 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 | $T_c=25^{\circ}C, \text{ Per Switch}$ | $R_{CC+EE}$ | -   | 0.8  | -   | m $\Omega$  |  |
| Storage Temperature<br>贮存温度                                |                                       | $T_{stg}$   | -40 | -    | 125 | $^{\circ}C$ |  |
| Mounting Torque for Module<br>Mounting<br>模块安装力矩           | Screw M5 / M5 螺丝                      | M           | 3.0 | -    | 6.0 | Nm          |  |
| Power terminal installation<br>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           |  |

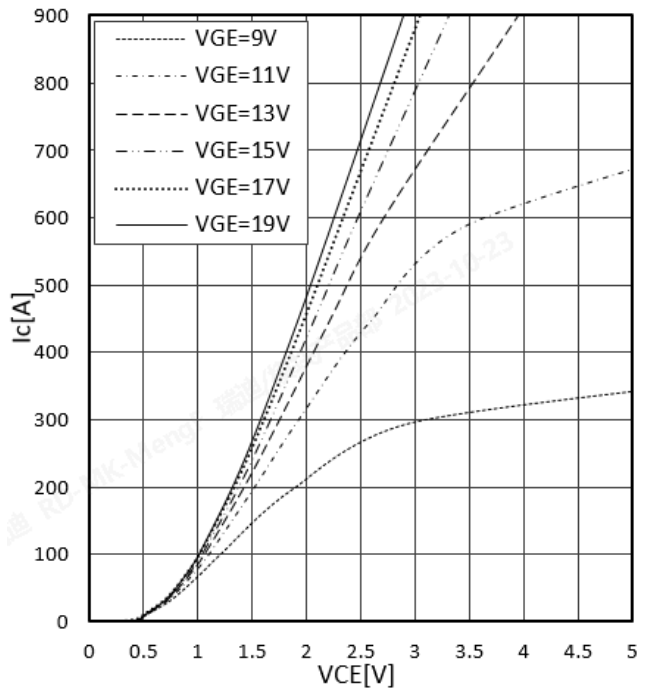
- 1) Terminal impedance is not included.  
不包含端子阻抗。
- 2) CTI is about 200.  
CTI 约等于 200。

Circuit Diagram / 曲线图

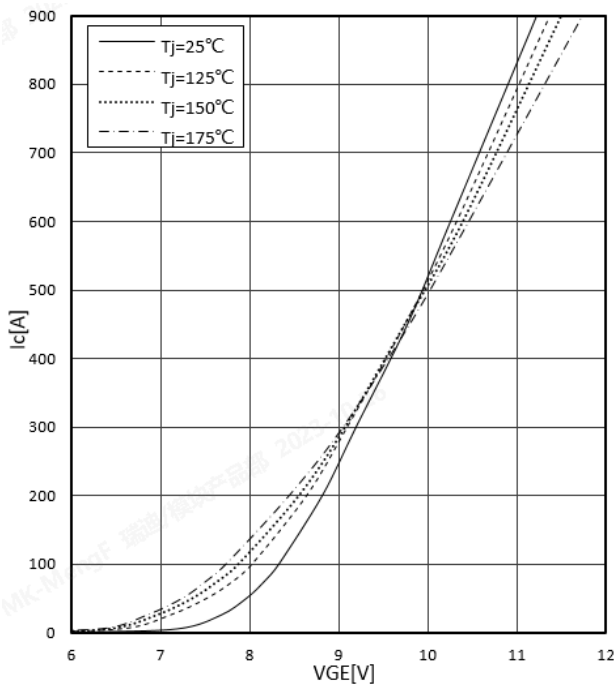
Output characteristic IGBT, Inverter (typical),  
输出特性 IGBT, 逆变器 (典型值)  
 $I_c = f(V_{CE}), V_{GE} = 15V$



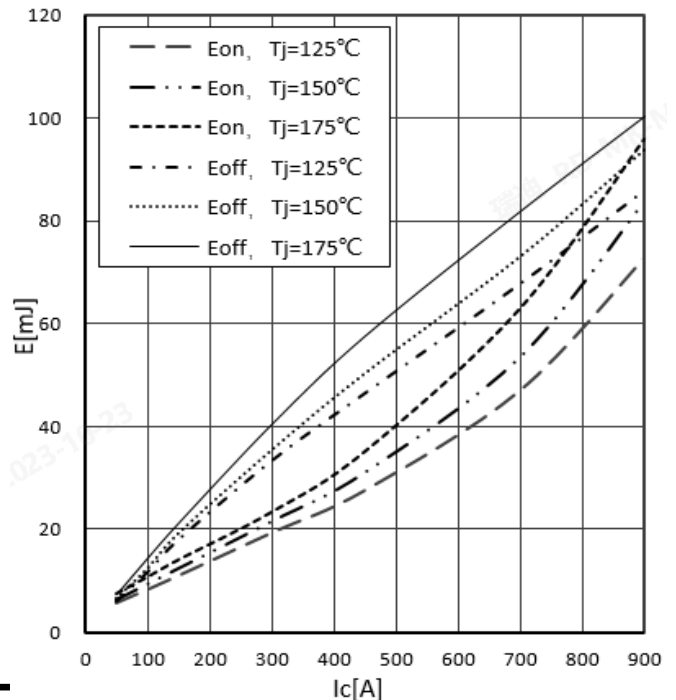
Output characteristic IGBT, Inverter (typical)  
输出特性 IGBT, 逆变器 (典型值)  
 $I_c = f(V_{CE}), T_{vj} = 175^\circ C$



Transfer characteristic IGBT, Inverter (typical)  
传输特性 IGBT, 逆变器 (典型值)  
 $I_c = f(V_{GE}), V_{CE} = 20V$



Switching losses IGBT, Inverter (Typical)  
开关损耗 IGBT, 逆变器 (典型值)  
 $E_{on} = f(I_c), E_{off} = f(I_c)$   
 $V_{GE} = +15V / -8V, R_{Gon} = 0.5 \Omega, R_{Goff} = 3 \Omega, V_{CC} = 600V$

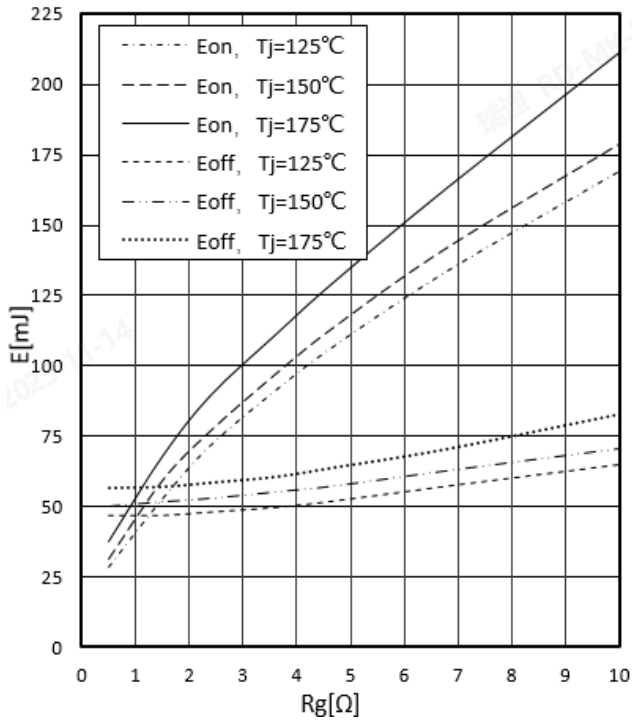


**Switching losses IGBT, Inverter (Typical)**

开关损耗 IGBT, 逆变器 (典型值)

$E_{on}=f(R_G), E_{off}=f(R_G)$ ,

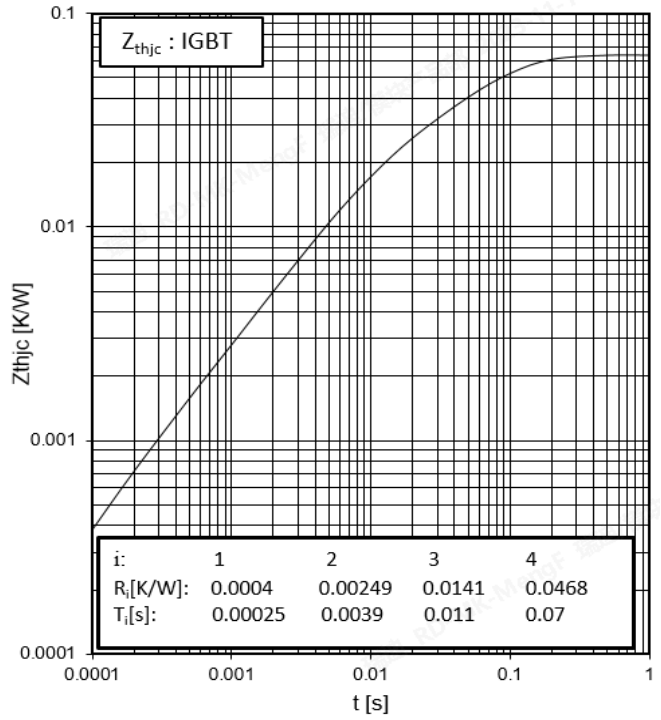
$V_{GE}=+15V/-8V, I_c=450A, V_{CE}=600V$



**Transient thermal impedance IGBT, Inverter**

瞬态热阻 IGBT, 逆变器

$Z_{thJC}=f(t)$

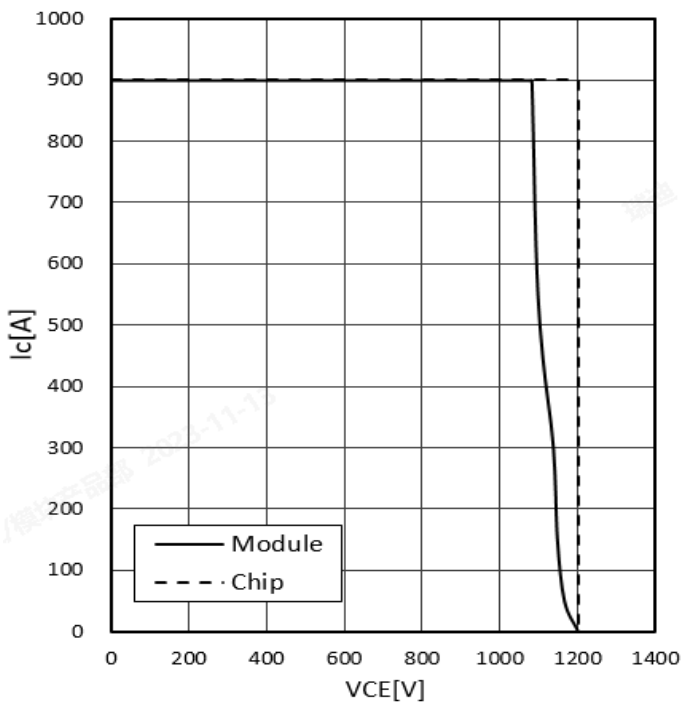


**Reverse bias safe operating area IGBT, Inverter (RBSOA)**

反向安全工作区 IGBT, 逆变器 (RBSOA)

$I_c=f(V_{CE})$

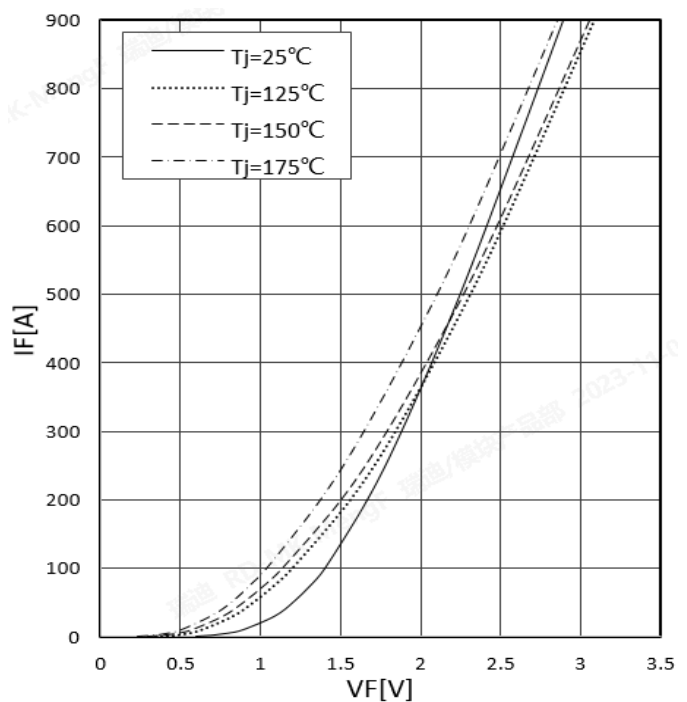
$V_{GE}=+15V/-8V, R_{Goff}=1 \Omega, T_{vj}=175^\circ C$



**Forward characteristic of Diode, Inverter (typical)**

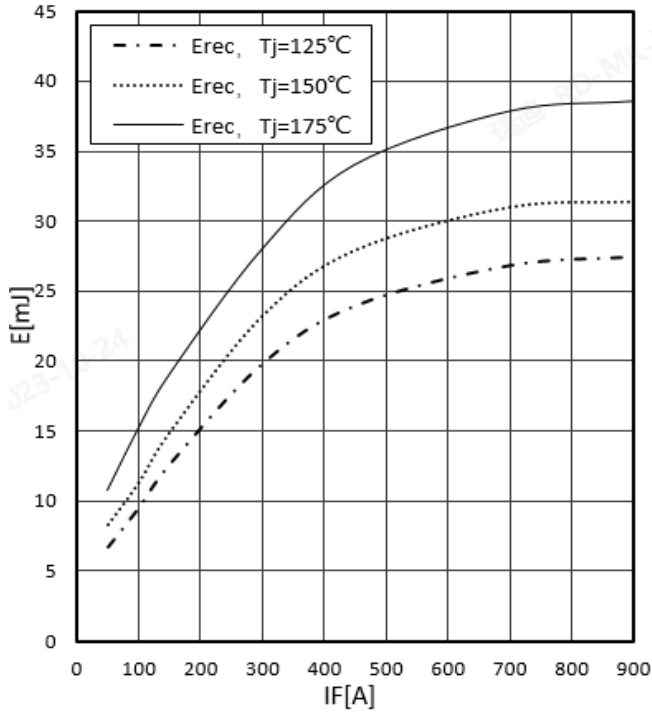
正向偏压特性 二极管, 逆变器 (典型值)

$I_F=f(V_F)$



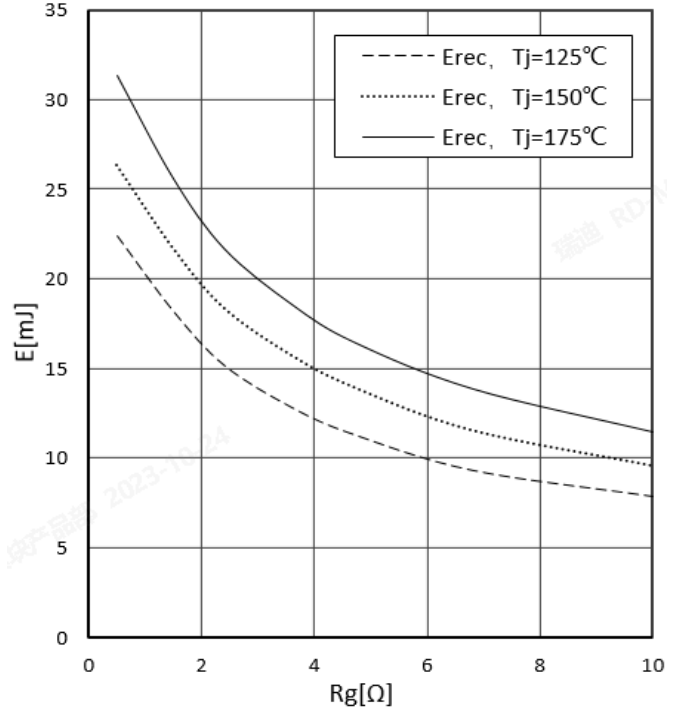
Switching losses Diode, Inverter (typical)  
开关损耗 二极管, 逆变器 (典型值)

$E_{rec}=f(I_F)$ ,  
 $R_{gon}=0.5\ \Omega, V_{CE}=600V$



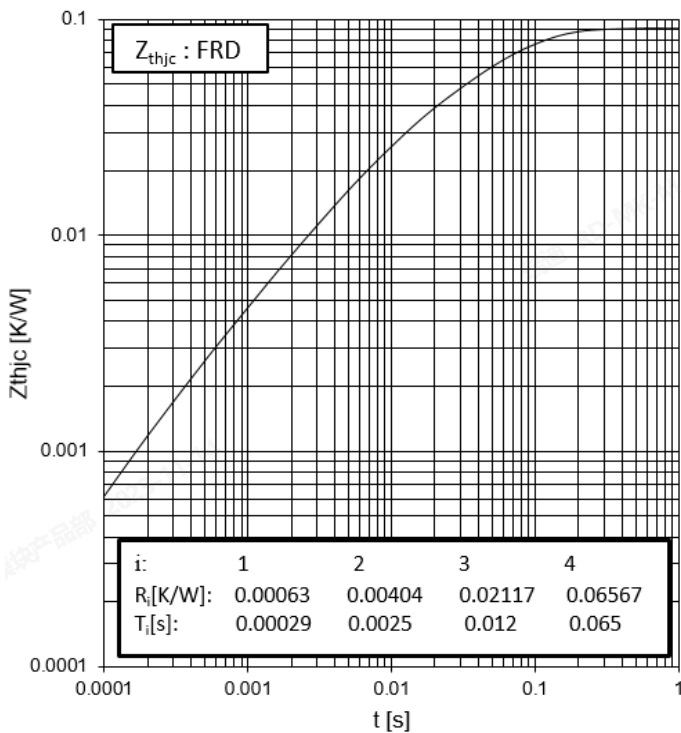
Switching losses Diode, Inverter (typical)  
开关损耗 二极管, 逆变器 (典型值)

$E_{rec}=f(R_g)$ ,  
 $I_F=450A, V_{CE}=600V$



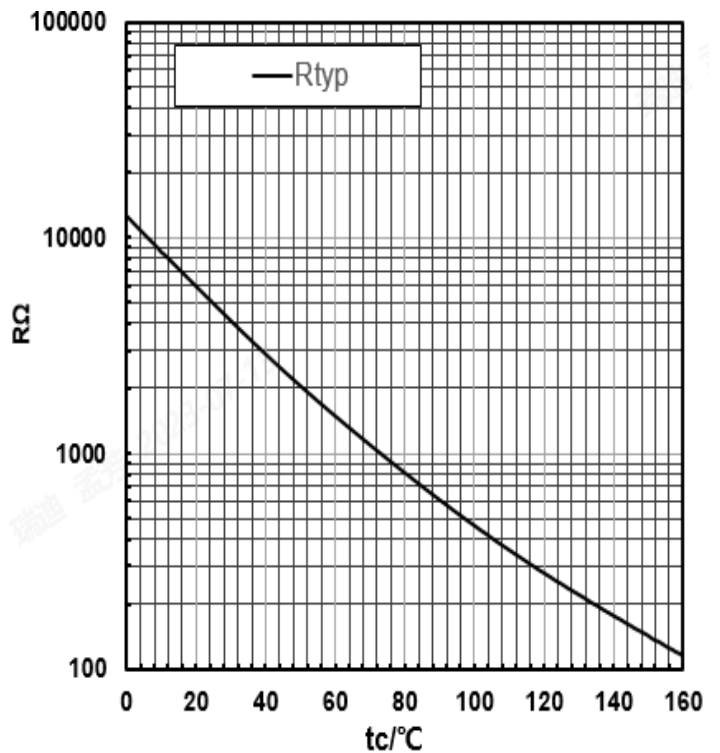
Transient thermal impedance Diode, Inverter  
瞬态热阻抗 二极管, 逆变器

$Z_{thjc}=f(t)$

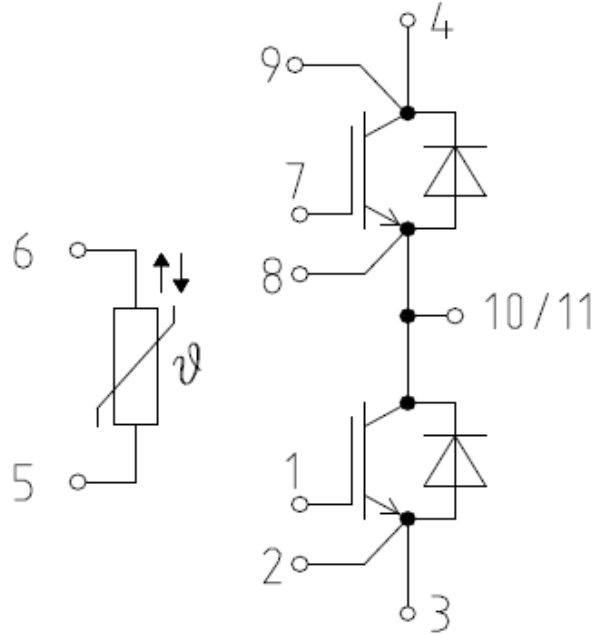


NTC-Thermistor-temperature characteristic (typical)  
负温度系数热敏电阻 温度特性

$R=f(T)$



Circuit diagram/ 接线图



Package outlines / 封装尺寸

Dimensions in Millimeters / 毫米为单位

