



产品数据手册 Product Datasheet 版本 Ver 21.10

TIM1000NSM33-PSA011

单管型 IGBT 模块 Single Switch IGBT

| 关键参数          |      | Key Parameters |   |
|---------------|------|----------------|---|
| $V_{CES}$     |      | 3300           | V |
| $V_{CE(sat)}$ | Typ. | 2.40           | V |
| $I_c$         | Max. | 1000           | A |
| $I_{C(RM)}$   | Max. | 2000           | A |

| 典型应用      |  | Typical Applications      |  |
|-----------|--|---------------------------|--|
| ● 牵引传动    |  | Traction Drives           |  |
| ● 电机控制    |  | Motor Controllers         |  |
| ● 智能电网    |  | Smart Grid                |  |
| ● 高可靠性逆变器 |  | High Reliability Inverter |  |

| 特点            |  | Features                        |  |
|---------------|--|---------------------------------|--|
| ● AISiC 基板    |  | AISiC Baseplate                 |  |
| ● AlN 衬板      |  | AlN Substrates                  |  |
| ● 高热循环能力      |  | High Thermal Cycling Capability |  |
| ● 10μs 短路承受能力 |  | 10μs Short Circuit Withstand    |  |
| ● 低开关损耗型器件    |  | Low Switching Loss Device       |  |
| ● 高电流密度       |  | High Current Density            |  |

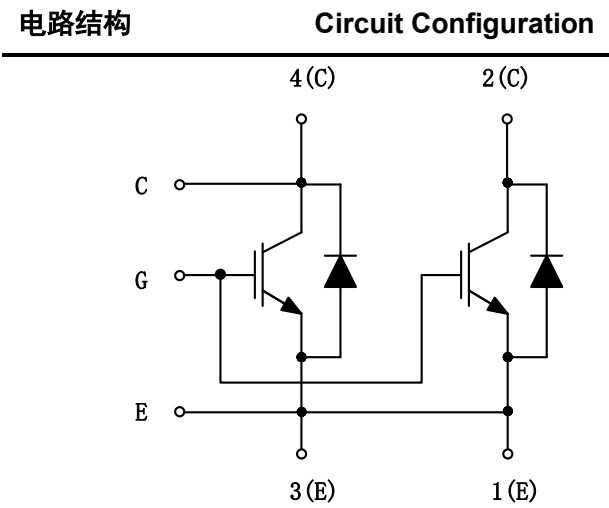


图 1. 电路结构

Fig. 1 Circuit configuration

| 模块外形 | Module Appearance |
|------|-------------------|
|------|-------------------|



图 2. 模块外形

Fig. 2 Module appearance

| 模块标签说明 |               | Module Label Code Instruction |  |
|--------|---------------|-------------------------------|--|
|        | 数据位置          | 数据内容                          |  |
|        | Data position | Content of data               |  |
|        | 1--8          | 模块批次号                         |  |
|        |               | Module batch number           |  |
|        | 9--12         | 模块序列号                         |  |
|        |               | Module serial number          |  |

**最大额定值**
**Absolute Maximum Ratings**

| 符号<br>Symbol | 参数名称<br>Parameter                              | 测试条件<br>Test Conditions                                                                                              | 数值<br>Value | 单位<br>Unit            |
|--------------|------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|-------------|-----------------------|
| $V_{CES}$    | 集电极-发射极电压<br>Collector-emitter voltage         | $V_{GE} = 0V, T_C = 25\text{ }^{\circ}\text{C}$                                                                      | 3300        | V                     |
| $V_{GES}$    | 栅极-发射极电压<br>Gate-emitter voltage               | $T_C = 25\text{ }^{\circ}\text{C}$                                                                                   | $\pm 20$    | V                     |
| $I_C$        | 集电极电流<br>Collector-emitter current             | $T_C = 95\text{ }^{\circ}\text{C}$                                                                                   | 1000        | A                     |
| $I_{C(PK)}$  | 集电极峰值电流<br>Peak collector current              | $t_P = 1\text{ms}$                                                                                                   | 2000        | A                     |
| $P_{max}$    | 晶体管部分最大损耗<br>Max. transistor power dissipation | $T_{vj} = 150\text{ }^{\circ}\text{C}, T_C = 25\text{ }^{\circ}\text{C}$                                             | 10.4        | kW                    |
| $t_t$        | 二极管 $t_t$ 值<br>Diode $t_t$                     | $V_R = 0V, t_P = 10\text{ms}, T_{vj} = 150\text{ }^{\circ}\text{C}$                                                  | 320         | $\text{kA}^2\text{s}$ |
| $V_{isol}$   | 绝缘电压(模块)<br>Isolation voltage – per module     | 短接所有端子，端子与基板间施加电压<br>(Connected terminals to base plate),<br>AC RMS, 1 min, 50Hz, $T_C = 25\text{ }^{\circ}\text{C}$ | 6000        | V                     |
| $Q_{PD}$     | 局部放电电荷 (模块)<br>Partial Discharge – per module  | IEC1287. $V_1 = 3500V, V_2 = 2600V,$<br>50Hz RMS, $T_C = 25\text{ }^{\circ}\text{C}$                                 | 10          | pC                    |

**热和机械数据**
**Thermal & Mechanical Data**

| 参数<br>Symbol                                 | 说明<br>Explanation             | 值<br>Value | 单位<br>Unit |
|----------------------------------------------|-------------------------------|------------|------------|
| 爬电距离<br>Creepage distance                    | 端子-端子<br>Terminal to terminal | 33.0       | mm         |
| 绝缘间隙<br>Clearance                            | 端子-端子<br>Terminal to terminal | 20.0       | mm         |
| 相对漏电起痕指数<br>CTI (Comparative Tracking Index) |                               | >600       |            |



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## 热和机械数据

## Thermal &amp; Mechanical Data

| 符号<br>Symbol        | 参数名称<br>Parameter                                                 | 测试条件<br>Test Conditions                                                     | 最小值<br>Min. | 典型值<br>Typ. | 最大值<br>Max. | 单位<br>Unit |
|---------------------|-------------------------------------------------------------------|-----------------------------------------------------------------------------|-------------|-------------|-------------|------------|
| $R_{th(J-C)} IGBT$  | IGBT 结壳热阻<br>Thermal resistance – IGBT                            | 结壳恒定功耗<br>Continuous dissipation-junction<br>to case                        |             |             | 12          | K / kW     |
| $R_{th(J-C)} Diode$ | 二极管结壳热阻<br>Thermal resistance – Diode                             | 结壳恒定功耗<br>Continuous dissipation-junction<br>to case                        |             |             | 24          | K / kW     |
| $R_{th(C-H)} IGBT$  | 接触热阻(模块)<br>Thermal resistance –<br>case to heatsink (per module) | 安装力矩 5Nm, 导热脂 1W/m·K<br>Mounting torque 5Nm,<br>with mounting grease 1W/m·K |             | 8           |             | K / kW     |
| $T_{vj}$            | 结温<br>Junction temperature                                        | IGBT 部分 ( IGBT )                                                            | -40         |             | 150         | °C         |
|                     |                                                                   | 二极管部分( Diode )                                                              | -40         |             | 150         | °C         |
| $T_{stg}$           | 存储温度<br>Storage temperature range                                 |                                                                             | -40         |             | 125         | °C         |
| $M$                 | 安装力矩<br>Screw torque                                              | 安装紧固用– M6<br>Mounting – M6                                                  |             |             | 5           | Nm         |
|                     |                                                                   | 电路互连用– M4<br>Electrical connections – M4                                    |             |             | 2           | Nm         |
|                     |                                                                   | 电路互连用– M8<br>Electrical connections – M8                                    |             |             | 10          | Nm         |

**电特性值**
**Electrical Characteristics**

除非特别声明, 否则  $T_C = 25\text{ }^{\circ}\text{C}$ 
 $T_C = 25\text{ }^{\circ}\text{C}$  unless otherwise stated

| 符号<br>Symbol         | 参数名称<br>Parameter                                   | 条件<br>Test Conditions                                                                                                                                                    | 最小值<br>Min. | 典型值<br>Typ. | 最大值<br>Max. | 单位<br>Unit    |
|----------------------|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------------|-------------|---------------|
| $I_{CES}$            | 集电极截止电流<br>Collector cut-off current                | $V_{GE} = 0V, V_{CE} = V_{CES}$                                                                                                                                          |             |             | 1           | mA            |
|                      |                                                     | $V_{GE} = 0V, V_{CE} = V_{CES}, T_{vj} = 125\text{ }^{\circ}\text{C}$                                                                                                    |             |             | 60          | mA            |
|                      |                                                     | $V_{GE} = 0V, V_{CE} = V_{CES}, T_{vj} = 150\text{ }^{\circ}\text{C}$                                                                                                    |             |             | 100         | mA            |
| $I_{GES}$            | 栅极漏电流<br>Gate leakage current                       | $V_{GE} = \pm 20V, V_{CE} = 0V$                                                                                                                                          |             |             | 1           | $\mu\text{A}$ |
| $V_{GE(TH)}$         | 栅极-发射极阈值电压<br>Gate threshold voltage                | $I_C = 80\text{mA}, V_{GE} = V_{CE}$                                                                                                                                     | 5.50        | 6.10        | 7.00        | V             |
| $V_{CE(sat)}^{(*1)}$ | 集电极-发射极饱和电压<br>Collector-emitter saturation voltage | $V_{GE} = 15V, I_C = 1000A$                                                                                                                                              |             | 2.40        | 2.90        | V             |
|                      |                                                     | $V_{GE} = 15V, I_C = 1000A, T_{vj} = 125\text{ }^{\circ}\text{C}$                                                                                                        |             | 2.95        | 3.40        | V             |
|                      |                                                     | $V_{GE} = 15V, I_C = 1000A, T_{vj} = 150\text{ }^{\circ}\text{C}$                                                                                                        |             | 3.10        | 3.60        | V             |
| $I_F$                | 二极管正向直流电流<br>Diode forward current                  | DC                                                                                                                                                                       |             | 1000        |             | A             |
| $I_{FRM}$            | 二极管正向重复峰值电流<br>Diode peak forward current           | $t_p = 1\text{ms}$                                                                                                                                                       |             | 2000        |             | A             |
| $V_F^{(*1)}$         | 二极管正向电压<br>Diode forward voltage                    | $I_F = 1000A, V_{GE} = 0$                                                                                                                                                |             | 2.10        | 2.60        | V             |
|                      |                                                     | $I_F = 1000A, V_{GE} = 0, T_{vj} = 125\text{ }^{\circ}\text{C}$                                                                                                          |             | 2.25        | 2.70        | V             |
|                      |                                                     | $I_F = 1000A, V_{GE} = 0, T_{vj} = 150\text{ }^{\circ}\text{C}$                                                                                                          |             | 2.25        | 2.70        | V             |
| $I_{SC}$             | 短路电流<br>Short circuit current                       | $T_{vj} = 150\text{ }^{\circ}\text{C}, V_{CC} = 2500V,$<br>$V_{GE} \leq 15V, t_p \leq 10\mu\text{s},$<br>$V_{CE(max)} = V_{CES} - L^{(*2)} \times di/dt,$<br>IEC 60747-9 |             | 3900        |             | A             |

**注意:** 1.(\*)1 表示该参数的测试点为辅助母排端子( (\*1) indicates it is measured at the auxiliary busbar terminal),

**Note:** 2.(\*)2 表示  $L$  是电路杂散电感加上  $L_M$ ( (\*2) indicates  $L$  is the circuit stray inductance plus  $L_M$ ).



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## 电特性值

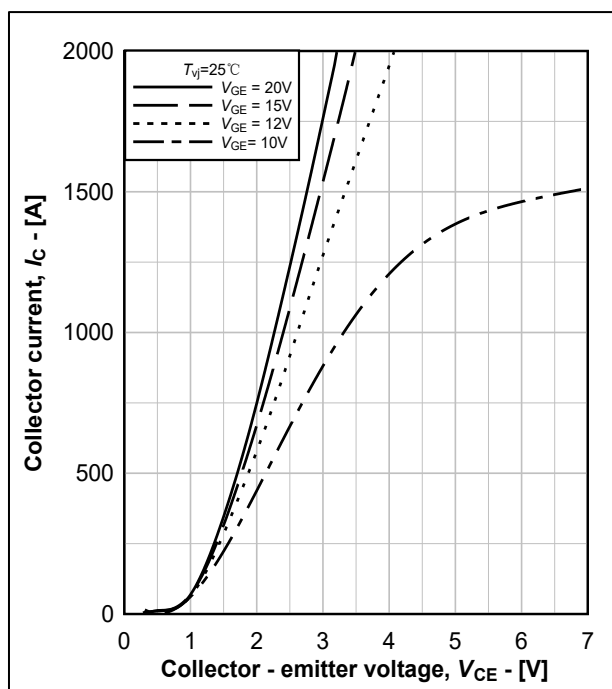
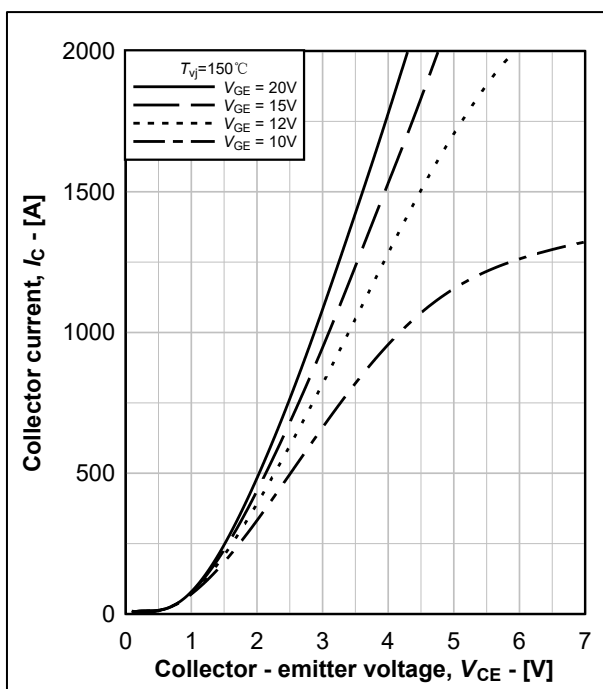
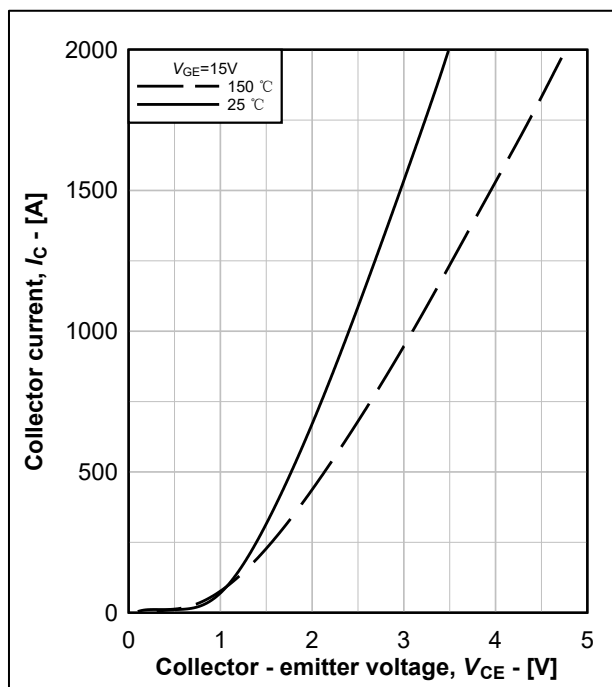
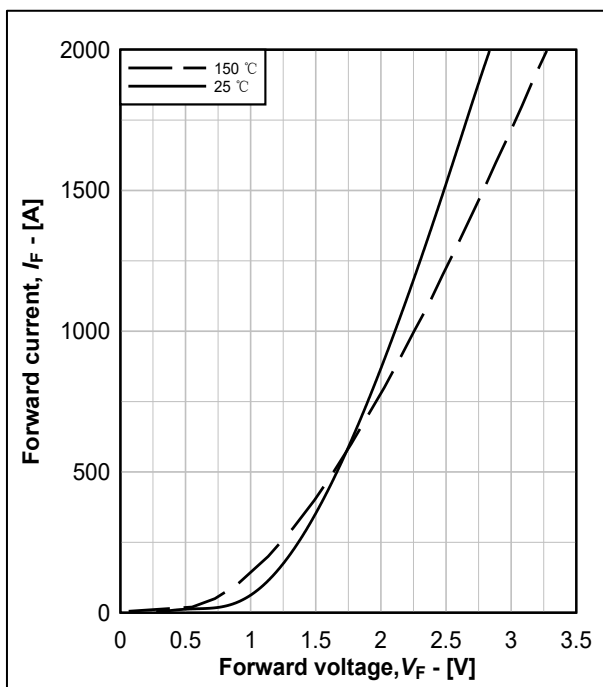
## Electrical Characteristics

除非特别声明, 否则  $T_C = 25\text{ }^{\circ}\text{C}$  $T_C = 25\text{ }^{\circ}\text{C}$  unless otherwise stated

| 符号<br>Symbol | 参数名称<br>Parameter                      | 条件<br>Test Conditions                 | 最小值<br>Min. | 典型值<br>Typ. | 最大值<br>Max. | 单位<br>Unit  |
|--------------|----------------------------------------|---------------------------------------|-------------|-------------|-------------|-------------|
| $C_{ies}$    | 输入电容<br>Input capacitance              | $V_{CE} = 25V, V_{GE} = 0V, f = 1MHz$ |             | 170         |             | nF          |
| $Q_g$        | 栅极电荷<br>Gate charge                    | $\pm 15V$                             |             | 17          |             | $\mu C$     |
| $C_{res}$    | 反向传输电容<br>Reverse transfer capacitance | $V_{CE} = 25V, V_{GE} = 0V, f = 1MHz$ |             | 4           |             | nF          |
| $L_M$        | 模块电感<br>Module inductance              |                                       |             | 15          |             | nH          |
| $R_{INT}$    | 内阻<br>Internal transistor resistance   |                                       |             | 165         |             | $\mu\Omega$ |

**电特性值**
**Electrical Characteristics**

| 符号<br>Symbol | 参数名称<br>Parameter                           | 测试条件<br>Test Conditions                                                                                                                                      |                        | 最小值<br>Min. | 典型值<br>Typ. | 最大值<br>Max. | 单位<br>Unit |
|--------------|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-------------|-------------|-------------|------------|
| $t_{d(off)}$ | 关断延迟时间<br>Turn-off delay time               | $I_C = 1000A,$<br>$V_{CE} = 1800V,$<br>$V_{GE} = \pm 15V,$<br>$R_{G(OFF)} = 2.2\Omega$<br>$C_{GE} = 220nF,$<br>$L_S = 150nH,$<br>( $T_{vj} = 150^\circ C$ ). | $T_{vj} = 25^\circ C$  |             | 1800        |             | ns         |
|              |                                             |                                                                                                                                                              | $T_{vj} = 125^\circ C$ |             | 1940        |             |            |
|              |                                             |                                                                                                                                                              | $T_{vj} = 150^\circ C$ |             | 1950        |             |            |
| $t_f$        | 下降时间<br>Fall time                           |                                                                                                                                                              | $T_{vj} = 25^\circ C$  |             | 530         |             | ns         |
|              |                                             |                                                                                                                                                              | $T_{vj} = 125^\circ C$ |             | 580         |             |            |
|              |                                             |                                                                                                                                                              | $T_{vj} = 150^\circ C$ |             | 600         |             |            |
| $E_{OFF}$    | 关断损耗<br>Turn-off energy loss                |                                                                                                                                                              | $T_{vj} = 25^\circ C$  |             | 1600        |             | mJ         |
|              |                                             |                                                                                                                                                              | $T_{vj} = 125^\circ C$ |             | 1950        |             |            |
|              |                                             |                                                                                                                                                              | $T_{vj} = 150^\circ C$ |             | 2100        |             |            |
| $t_{d(on)}$  | 开通延迟时间<br>Turn-on delay time                | $T_{vj} = 25^\circ C$                                                                                                                                        |                        | 680         |             | ns          |            |
|              |                                             | $T_{vj} = 125^\circ C$                                                                                                                                       |                        | 660         |             |             |            |
|              |                                             | $T_{vj} = 150^\circ C$                                                                                                                                       |                        | 650         |             |             |            |
| $t_r$        | 上升时间<br>Rise time                           | $T_{vj} = 25^\circ C$                                                                                                                                        |                        | 320         |             | ns          |            |
|              |                                             | $T_{vj} = 125^\circ C$                                                                                                                                       |                        | 340         |             |             |            |
|              |                                             | $T_{vj} = 150^\circ C$                                                                                                                                       |                        | 340         |             |             |            |
| $E_{ON}$     | 开通损耗<br>Turn-on energy loss                 | $T_{vj} = 25^\circ C$                                                                                                                                        |                        | 1240        |             | mJ          |            |
|              |                                             | $T_{vj} = 125^\circ C$                                                                                                                                       |                        | 1600        |             |             |            |
|              |                                             | $T_{vj} = 150^\circ C$                                                                                                                                       |                        | 1750        |             |             |            |
| $Q_{rr}$     | 二极管反向恢复电荷<br>Diode reverse recovery charge  | $T_{vj} = 25^\circ C$                                                                                                                                        |                        | 780         |             | $\mu C$     |            |
|              |                                             | $T_{vj} = 125^\circ C$                                                                                                                                       |                        | 1200        |             |             |            |
|              |                                             | $T_{vj} = 150^\circ C$                                                                                                                                       |                        | 1420        |             |             |            |
| $I_{rr}$     | 二极管反向恢复电流<br>Diode reverse recovery current | $T_{vj} = 25^\circ C$                                                                                                                                        |                        | 810         |             | A           |            |
|              |                                             | $T_{vj} = 125^\circ C$                                                                                                                                       |                        | 930         |             |             |            |
|              |                                             | $T_{vj} = 150^\circ C$                                                                                                                                       |                        | 970         |             |             |            |
| $E_{rec}$    | 二极管反向恢复损耗<br>Diode reverse recovery energy  | $T_{vj} = 25^\circ C$                                                                                                                                        |                        | 980         |             | mJ          |            |
|              |                                             | $T_{vj} = 125^\circ C$                                                                                                                                       |                        | 1520        |             |             |            |
|              |                                             | $T_{vj} = 150^\circ C$                                                                                                                                       |                        | 1920        |             |             |            |

图 3. IGBT 输出特性典型曲线,  $I_C = f(V_{CE})$ Fig.3 Typical IGBT output characteristics,  $I_C = f(V_{CE})$ 图 4. IGBT 输出特性典型曲线,  $I_C = f(V_{CE})$ Fig.4 Typical IGBT output characteristics,  $I_C = f(V_{CE})$ 图 5. IGBT 输出特性典型曲线,  $I_C = f(V_{CE})$ Fig.5 Typical IGBT output characteristics,  $I_C = f(V_{CE})$ 图 6. FRD 输出特性典型曲线,  $I_F = f(V_F)$ Fig.6 Typical FRD output characteristics,  $I_F = f(V_F)$

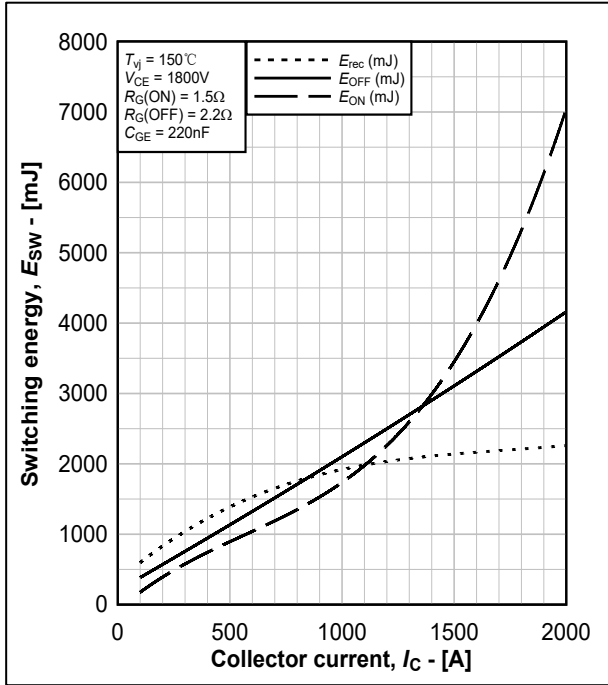

图 7. 开关能耗与集电极电流关系曲线,  $E_{sw} = f(I_c)$ 

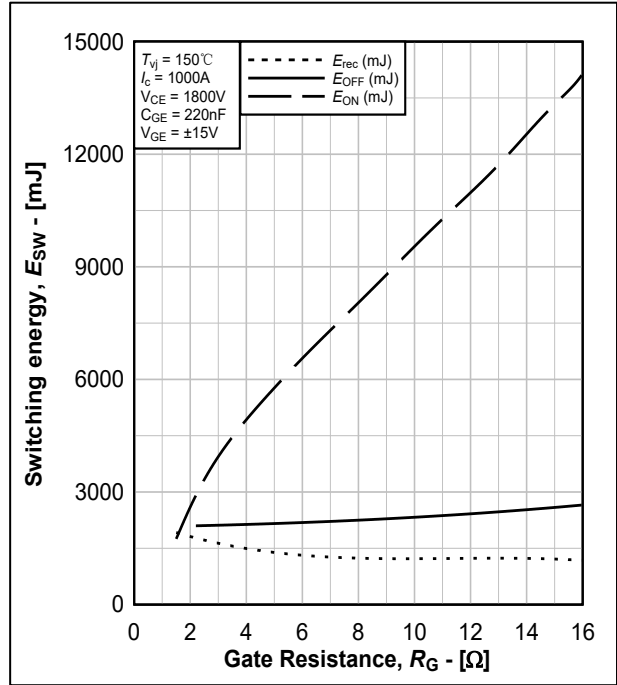
Fig.7 Typical Switching energy,  $E_{sw} = f(I_c)$ 

图 8. 开关能耗与栅极电阻关系曲线,  $E_{sw} = f(R_g)$ 

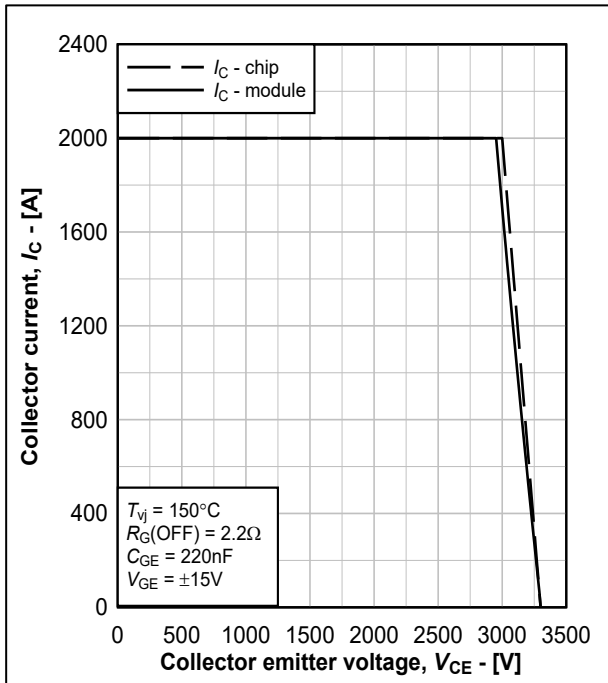
Fig.8 Typical Switching energy,  $E_{sw} = f(R_g)$ 

图 9. IGBT 反偏安全工作区,  $I_c = f(V_{ce})$ 

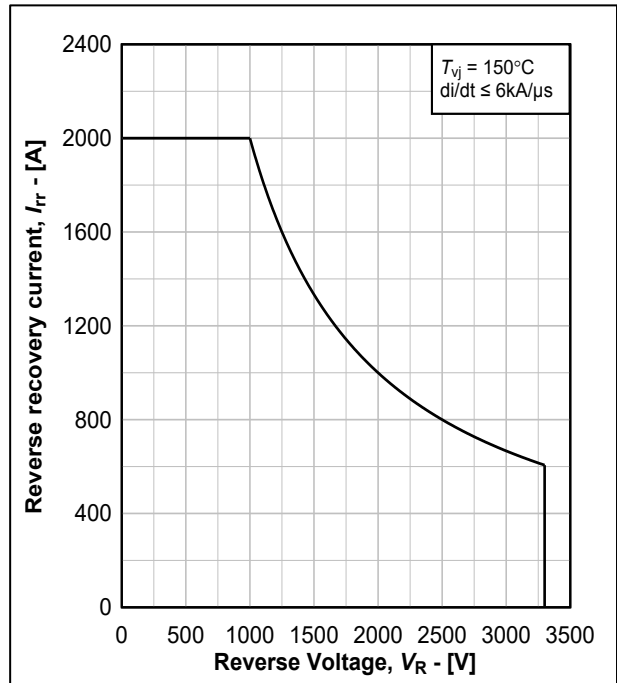
Fig.9 Reverse bias safe operating area of IGBT,  $I_c = f(V_{ce})$ 

图 10. FRD 反偏安全工作区,  $I_{rr} = f(V_r)$ 

Fig.10 Reverse bias safe operating area of FRD,  $I_{rr} = f(V_r)$



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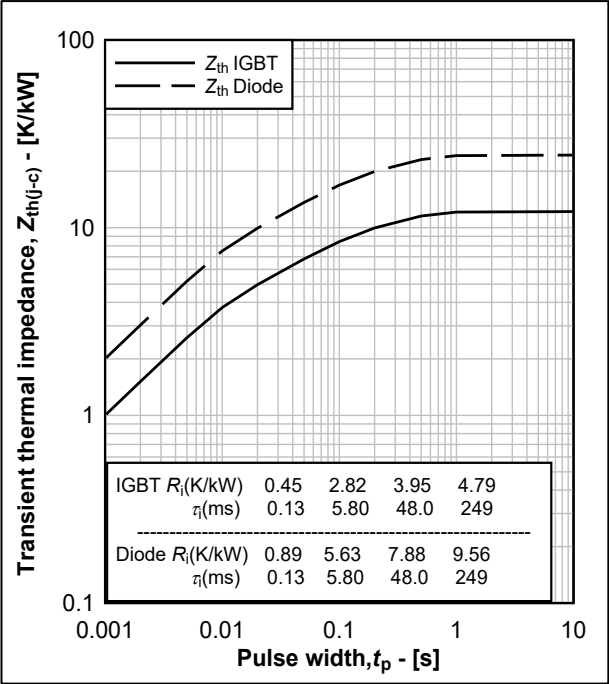
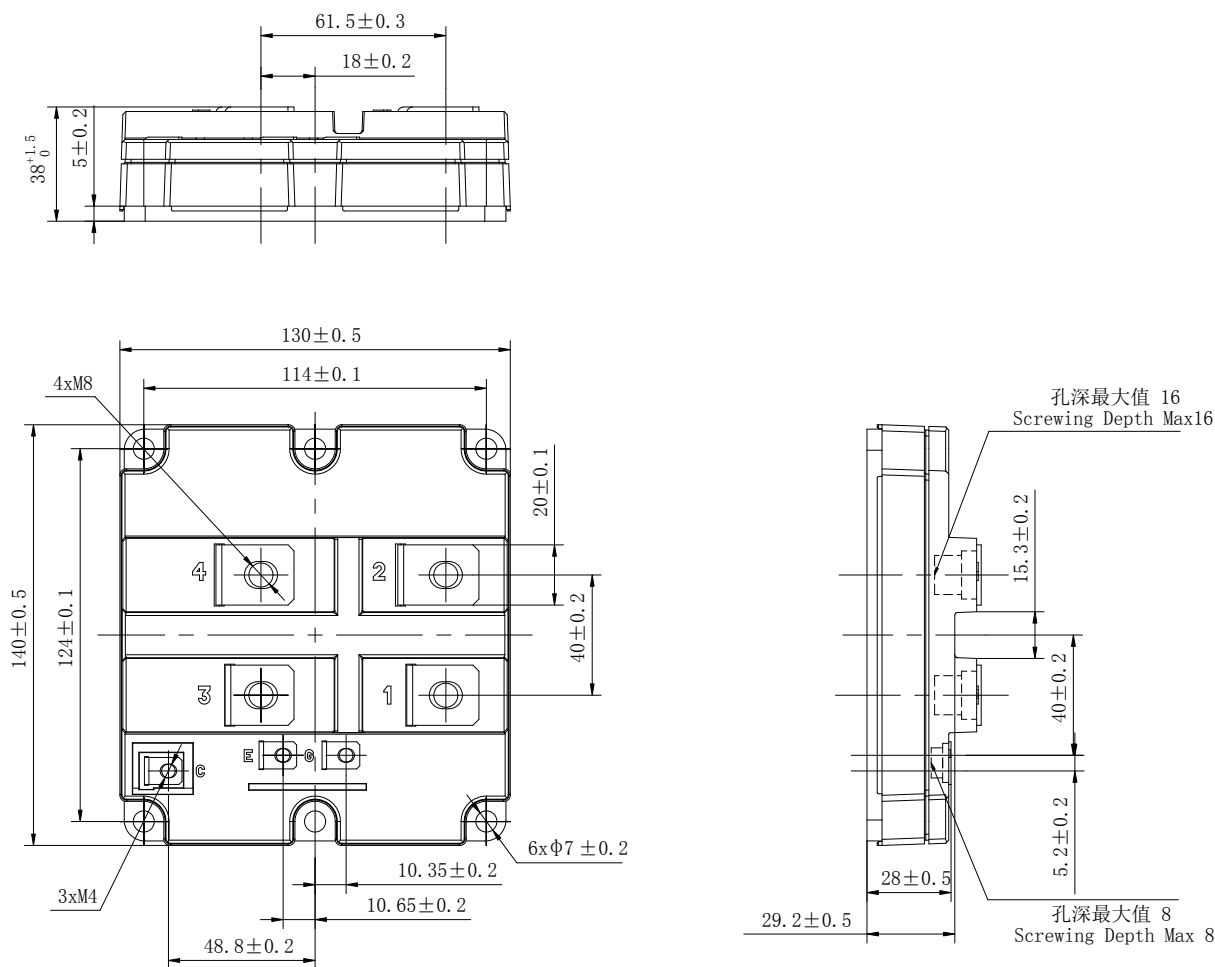


图 11 瞬态热阻抗曲线,  $Z_{th(j-c)} = f(t_p)$

Fig.11 Transient thermal impedance,  $Z_{th(j-c)} = f(t_p)$



重量 Weight: 900g 模块外观类型 Module outline code: N

图 12. 模块外观尺寸

Fig. 12 Module outlines

株洲中车时代半导体有限公司

ZHUZHOU CRRC TIMES SEMICONDUCTOR CO., LTD

|      |           |                                         |                                                                                   |
|------|-----------|-----------------------------------------|-----------------------------------------------------------------------------------|
| 地 址  | Address   | 湖南省株洲市石峰区田心工业园                          | Tianxin Industrial Park, Shifeng District,<br>ZhuZhou City, Hunan Province, China |
| 邮 编  | Zipcode   | 412001                                  |                                                                                   |
| 电 话  | Telephone | +86 (0)731-28498268, 28498238, 28493472 |                                                                                   |
| 传 真  | Fax       | +86 (0)731-28498851, 28498494           |                                                                                   |
| 电子邮箱 | Email     | sbu@crzczic.cc                          |                                                                                   |
| 网 址  | Web Site  | http://www.sbu.crzczic.cc               |                                                                                   |



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(1) The product information in this datasheet are intended for use by technical personnel. Due to the diversity of product applications, the information contained in this document can only be used as a general guide, the application applicability cannot be guaranteed in some special applications. It is recommended that users do the assessment of the application applicability before applied. If users need additional product information and help, please contact our sales or technical support.

(2) Some product data in the datasheet of this product are the typical values, the actual factory testing data may deviate slightly from typical values, but our company guarantees that these deviations will not affect the normal use of the product. If the product information changes, our company will promptly amend the datasheet, please keeps your attention to product information changing in our company website.

(3) If there are special requirements for the product, or apply it in special industries (such as aerospace, medical, life support, etc.), we strongly recommend that to perform joint application risk and quality assessments, get the quality agreements.

(4) During the application, if the working conditions are beyond the limitation of temperature, voltage, current or safe operating area of the product defined in the product datasheet, our company cannot guarantee the reliability of the product.

(5) When the products are in use, it is strictly prohibited to touch. After power off, to ensure that there is no residual charge and the products have been cooled before they can be touched. And all operations must be under ESD protection measures.

(6) We annotate datasheet in the top right hand corner of the front page, to indicate product status. The annotation “Preliminary” indicates the product design is complete and final characterization for volume production is in progress, the product information in the datasheet is currently can be referenced, but some details may change in the future. There is no annotation indicates the product is capable to produce in batch quantity.