

## □ General Description

BYD IGBT Power Module BG450BB12L13S6 provides low switching loss as well as high short circuit capability, which introduce the advanced IGBT chip/FWD and improved connection.

## □ 概述

BYD IGBT 功率模块 BG450BB12L13S6 采用高性能的 IGBT 芯片和 FRD 芯片和优化的电气连接，具有低损和高短路耐量。



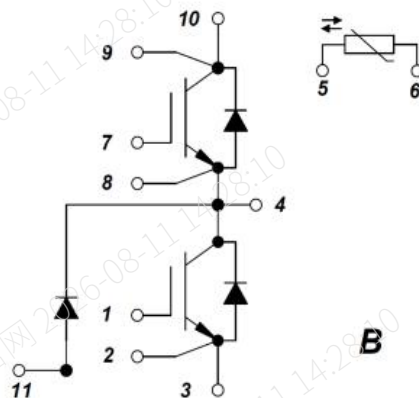
## □ Key Features

- High short circuit withstand capability
- Ultra low conduction and switching loss
- Including ultra fast&soft recovery anti-parallel FWD

$V_{CE}=1200V$ ,  $I_C=450A$

## □ 关键特性

- 高短路耐量
- 低导通和开关损耗
- 反并联超快软恢复续流二极管
- 



## □ Applications

- UPS Systems
- Inverters
- Power Conversion System

## □ 应用

- UPS 系统
- 逆变器
- 储能变流器

## □ IGBT/IGBT

### ● Maximum Rated Values/最大额定值

| 符号<br>Symbol | 参数<br>Parameter                                | 工作条件<br>Conditions                                                                                                | 额定值<br>Ratings | 单位<br>Units   |
|--------------|------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|----------------|---------------|
| $V_{CES}$    | Collector-emitter voltage<br>集电极-发射极电压         | $T_{vj}=25^{\circ}\text{C}$                                                                                       | 1200           | V             |
| $I_C$        | Collector current<br>连续集电极直流电流                 | $T_c=100^{\circ}\text{C}$ , $T_{vj}=175^{\circ}\text{C}$                                                          | 450            | A             |
| $V_{GES}$    | Gate-emitter voltage<br>栅极-发射极峰值电压             | $T_{vj}=25^{\circ}\text{C}$                                                                                       | $\pm 20$       | V             |
| $I_{CRM}$    | Repetitive peak collector current<br>集电极重复峰值电流 | $t_p=1\text{ms}$ , $T_{vj}=25^{\circ}\text{C}$                                                                    | 900            | A             |
| $t_{psc}$    | IGBT short circuit SOA<br>短路安全工作区              | $V_{GE} \leq 15\text{V}$ , $V_{CC}=600\text{V}$<br>$V_{CEM} \leq 1200\text{V}$ , $T_{vj} \leq 25^{\circ}\text{C}$ | 10             | $\mu\text{s}$ |
| $P_{tot}$    | Total power dissipation<br>总耗散功率               | $T_c=25^{\circ}\text{C}$ , $T_{vj}=175^{\circ}\text{C}$                                                           | 2350           | W             |

### ● Characteristics Values/特征值

| 符号<br>Symbol  | 参数<br>Parameter                                        | 工作条件<br>Conditions                                                                       | 额定值 Ratings |      |      | 单位<br>Units   |
|---------------|--------------------------------------------------------|------------------------------------------------------------------------------------------|-------------|------|------|---------------|
|               |                                                        |                                                                                          | Min.        | Typ. | Max. |               |
| $V_{CE\ sat}$ | Collector-Emitter<br>Saturation Voltage<br>集电极-发射极饱和电压 | $I_C=450\text{A}$ , $V_{GE}=15\text{V}$ , $T_{vj}=25^{\circ}\text{C}$                    | -           | 1.7  | 2.2  | V             |
|               |                                                        | $I_C=450\text{A}$ , $V_{GE}=15\text{V}$ , $T_{vj}=125^{\circ}\text{C}$                   |             | 2.1  |      |               |
|               |                                                        | $I_C=450\text{A}$ , $V_{GE}=15\text{V}$ , $T_{vj}=150^{\circ}\text{C}$                   | -           | 2.3  | -    | V             |
| $V_{GEth}$    | Gate threshold voltage<br>栅极阈值电压                       | $V_{CE}=V_{GE}$ , $I_C=12\text{mA}$ , $T_{vj}=25^{\circ}\text{C}$                        | 5.0         | 6.1  | 7.0  | V             |
| $Q_G$         | Gate charge<br>栅极电荷                                    | $V_{GE}=-15\text{V} \dots +15\text{V}$                                                   | -           | 1    | -    | $\mu\text{C}$ |
| $R_{gint}$    | Internal gate resistance<br>内部栅极电阻                     | $T_{vj}=25^{\circ}\text{C}$                                                              | -           | 2    | -    | $\Omega$      |
| $C_{ies}$     | Input capacitance<br>输入电容                              | $T_{vj}=25^{\circ}\text{C}$ , $f=1\text{MHz}$ , $V_{GE}=0\text{V}$ , $V_{CE}=25\text{V}$ | -           | 30   | -    | nF            |
| $C_{res}$     | Reverse capacitance<br>反向传输电容                          |                                                                                          | -           | 0.7  | -    | nF            |
| $I_{CES}$     | Collector-emitter cut-off<br>current<br>集电极-发射极截止电流    | $V_{CE}=1200\text{V}$ , $V_{GE}=0\text{V}$ , $T_{vj}=25^{\circ}\text{C}$                 | -           | -    | 200  | $\mu\text{A}$ |

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|              |                                           |                                                                                                       |                       |    |     |     |    |
|--------------|-------------------------------------------|-------------------------------------------------------------------------------------------------------|-----------------------|----|-----|-----|----|
| $I_{GES}$    | Gate-emitter leakage current<br>栅极-发射极漏电流 | $V_{CE}=0V, V_{GE}=40V, T_{vj}=25^{\circ}C$                                                           |                       | -  | -   | 400 | nA |
| $t_{d\ on}$  | Turn-on delay time<br>开通延迟时间              | $I_C = 450\ A,$<br>$V_{CE} = 600\ V,$<br>$V_{GE}=-8V...+15\ V\ ,$<br>$R_G = 2.5\Omega,$<br>$L_s=40nH$ | $T_{vj}=25^{\circ}C$  | -  | 134 | -   | ns |
|              |                                           |                                                                                                       | $T_{vj}=125^{\circ}C$ | -  | 135 | -   | ns |
|              |                                           |                                                                                                       | $T_{vj}=150^{\circ}C$ | -  | 136 | -   | ns |
| $t_r$        | Rise time<br>上升时间                         |                                                                                                       | $T_{vj}=25^{\circ}C$  | -  | 75  | -   | ns |
|              |                                           |                                                                                                       | $T_{vj}=125^{\circ}C$ | -  | 83  | -   | ns |
|              |                                           |                                                                                                       | $T_{vj}=150^{\circ}C$ | -  | 86  | -   | ns |
| $t_{d\ off}$ | Turn-off delay time,<br>关断延迟时间            |                                                                                                       | $T_{vj}=25^{\circ}C$  | -  | 288 | -   | ns |
|              |                                           |                                                                                                       | $T_{vj}=125^{\circ}C$ | -  | 326 | -   | ns |
|              |                                           |                                                                                                       | $T_{vj}=150^{\circ}C$ | -  | 335 | -   | ns |
| $t_f$        | Fall time<br>下降时间                         |                                                                                                       | $T_{vj}=25^{\circ}C$  | -  | 134 | -   | ns |
|              |                                           |                                                                                                       | $T_{vj}=125^{\circ}C$ | -  | 215 | -   | ns |
|              |                                           |                                                                                                       | $T_{vj}=150^{\circ}C$ | -  | 234 | -   | ns |
| $E_{on}$     | Turn-on energy loss<br>开通损耗能量             | $T_{vj}=25^{\circ}C$                                                                                  | -                     | 31 | -   | mJ  |    |
|              |                                           | $T_{vj}=125^{\circ}C$                                                                                 | -                     | 38 | -   | mJ  |    |
|              |                                           | $T_{vj}=150^{\circ}C$                                                                                 | -                     | 40 | -   | mJ  |    |
| $E_{off}$    | Turn-off energy loss<br>关断损耗能量            | $T_{vj}=25^{\circ}C$                                                                                  | -                     | 30 | -   | mJ  |    |
|              |                                           | $T_{vj}=125^{\circ}C$                                                                                 | -                     | 40 | -   | mJ  |    |
|              |                                           | $T_{vj}=150^{\circ}C$                                                                                 | -                     | 42 | -   | mJ  |    |

### □ FRD/二极管

#### ● Maximum Rated Values/最大额定值

| 符号<br>Symbol | 参数<br>Parameter                             | 工作条件<br>Conditions              | 额定值<br>Ratings | 单位<br>Units |
|--------------|---------------------------------------------|---------------------------------|----------------|-------------|
| $V_{RRM}$    | Repetitive peak reverse voltage<br>反向重复峰值电压 | $T_{vj} = 25^{\circ}C$          | 1200           | V           |
| $I_F$        | Forward current of diode<br>连续正向直流电流        | $T_C = 25^{\circ}C$             | 450            | A           |
| $I_{FRM}$    | Repetitive peak forward current<br>正向重复峰值电流 | $t_p=1ms, T_{vj} = 25^{\circ}C$ | 900            | A           |

#### ● Characteristics Values/特征值

| 符号<br>Symbol   | 参数<br>Parameter         | 工作条件<br>Conditions                           |                       | 额定值 Ratings |      |      | 单位<br>Units |
|----------------|-------------------------|----------------------------------------------|-----------------------|-------------|------|------|-------------|
|                |                         |                                              |                       | Min.        | Typ. | Max. |             |
| V <sub>F</sub> | Forward voltage<br>正向电压 | I <sub>F</sub> =450A,<br>V <sub>GE</sub> =0V | T <sub>vj</sub> =25℃  | -           | 2.05 | 2.3  | V           |
|                |                         |                                              | T <sub>vj</sub> =125℃ | -           | 2.2  | -    | V           |
|                |                         |                                              | T <sub>vj</sub> =150℃ | -           | 2.15 | -    | V           |

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|           |                                           |                                                                       |                              |   |      |   |               |
|-----------|-------------------------------------------|-----------------------------------------------------------------------|------------------------------|---|------|---|---------------|
| $I_{RM}$  | Peak reverse recovery current<br>反向恢复峰值电流 | $I_F=450\text{ A},$<br>$V_R = 600\text{ V},$<br>$V_{GE}=-8V\dots+15V$ | $T_{vj}=25^{\circ}\text{C}$  | - | 200  | - | A             |
|           |                                           |                                                                       | $T_{vj}=125^{\circ}\text{C}$ |   | 250  |   | A             |
|           |                                           |                                                                       | $T_{vj}=150^{\circ}\text{C}$ |   | 275  |   | A             |
| $Q_r$     | Recovered charge<br>恢复电荷                  |                                                                       | $T_{vj}=25^{\circ}\text{C}$  | - | 30   | - | $\mu\text{C}$ |
|           |                                           |                                                                       | $T_{vj}=125^{\circ}\text{C}$ |   | 51   |   | $\mu\text{C}$ |
|           |                                           |                                                                       | $T_{vj}=150^{\circ}\text{C}$ |   | 60   |   | $\mu\text{C}$ |
| $E_{rec}$ | Reverse recovery energy<br>反向恢复损耗         |                                                                       | $T_{vj}=25^{\circ}\text{C}$  | - | 12.7 | - | mJ            |
|           |                                           |                                                                       | $T_{vj}=125^{\circ}\text{C}$ |   | 23   |   | mJ            |
|           |                                           |                                                                       | $T_{vj}=150^{\circ}\text{C}$ |   | 25.7 |   | mJ            |

### □ NTC-Thermistor/负温度系数热敏电阻

| Parameter                    | Symbol       | Conditions                                             | Values |      |      | Units      |
|------------------------------|--------------|--------------------------------------------------------|--------|------|------|------------|
|                              |              |                                                        | Min.   | Typ. | Max. |            |
| Rated resistance<br>额定电阻值    | $R_{25}$     | $T_C=25^\circ\text{C}$                                 | -      | 5.0  | -    | k $\Omega$ |
| Deviation of R100<br>R100 偏差 | $\Delta R/R$ | $T_C=100^\circ\text{C}, R_{100}=493\Omega$             | -5     | -    | 5    | %          |
| Power dissipation<br>耗散功率    | $P_{25}$     | $T_C=25^\circ\text{C}$                                 | -      | -    | 20   | mW         |
| B-value/B-值                  | $B_{25/50}$  | $R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298.15\text{K}))]$  | -      | 3375 | -    | K          |
| B-value/ B-值                 | $B_{25/80}$  | $R_2=R_{25}\exp[B_{25/80}(1/T_2-1/(298.15\text{K}))]$  | -      | 3411 | -    | K          |
| B-value/ B-值                 | $B_{25/100}$ | $R_2=R_{25}\exp[B_{25/100}(1/T_2-1/(298.15\text{K}))]$ | -      | 3433 | -    | K          |

## □ Module/模块

| 符号<br>Symbol     | 参数<br>Parameter                                       | 工作条件<br>Conditions                     | 额定值 Ratings             |      |       | 单位<br>Units |
|------------------|-------------------------------------------------------|----------------------------------------|-------------------------|------|-------|-------------|
|                  |                                                       |                                        | Min.                    | Typ. | Max.  |             |
| $T_{vjmax}$      | Maximum junction temperature<br>最大结温                  | -                                      | -                       | -    | 175   | ℃           |
| $T_{vjop}$       | Temperature under switching conditions<br>工作结温        | -                                      | -40                     | -    | 175   | ℃           |
| $T_{stg}$        | Storage temperature<br>储存温度                           | -                                      | -40                     | -    | 125   | ℃           |
| $R_{thjc}$ IGBT  | IGBT, thermal resistance, junction to case<br>结-外壳热阻  | per IGBT<br>单个 IGBT                    | -                       | -    | 0.069 | K/W         |
| $R_{thjc}$ Diode | Diode, thermal resistance, junction to case<br>结-外壳热阻 | per diode<br>单个二极管                     | -                       | -    | 0.1   | K/W         |
| $V_{isol}$       | Isolation test voltage<br>绝缘测试电压                      | $f = 50\text{Hz}$ , $t = 1\text{min.}$ | 4                       | -    | -     | KV          |
| G                | Weight<br>重量                                          | -                                      | -                       | 339  | -     | g           |
| -                | Cree page distance<br>爬电距离                            | Terminal to terminal<br>端子到端子          | -                       | 17   | -     | mm          |
| -                |                                                       | Terminal to base<br>端子到底板              | -                       | 17   | -     |             |
| -                | Clearance distance in air<br>空气间隙                     | Terminal to terminal<br>端子到端子          | -                       | 10.0 | -     |             |
| -                |                                                       | Terminal to base<br>端子到底板              | -                       | 12.5 | -     |             |
| $M_1$            | Mounting torque for module mounting<br>模块的安装扭矩        | Screw M5<br>M5 螺栓                      | 3                       | -    | 6     | N.m         |
| $M_2$            | Terminal connection torque<br>端子的连接扭矩                 | Screw M6<br>M6 螺栓                      | 3                       | -    | 6     | N.m         |
| -                | Internal isolation<br>内部绝缘                            | ceramics<br>陶瓷                         | $\text{Al}_2\text{O}_3$ |      |       |             |
| -                | Material of module baseplate<br>模块基板材料                | -                                      | Cu                      |      |       |             |
| L x W x H        | Dimensions<br>尺寸                                      | -                                      | 152.1×62×21             |      |       | mm          |

$T_{vjop} > 150^\circ\text{C}$  is only allowed for operation at overload conditions.

$T_{vjop} > 150^\circ\text{C}$  只允许在过载条件下进行。

**Note:** The typical reference values in the above parameters are based on laboratory test data under encapsulation conditions and are not to be used as a basis for production test acceptance.

**注：**以上参数中的典型参考值基于封装条件下实验室测试数据得出，不作为生产测试验收依据。

## □ Characteristics Diagrams/特性曲线

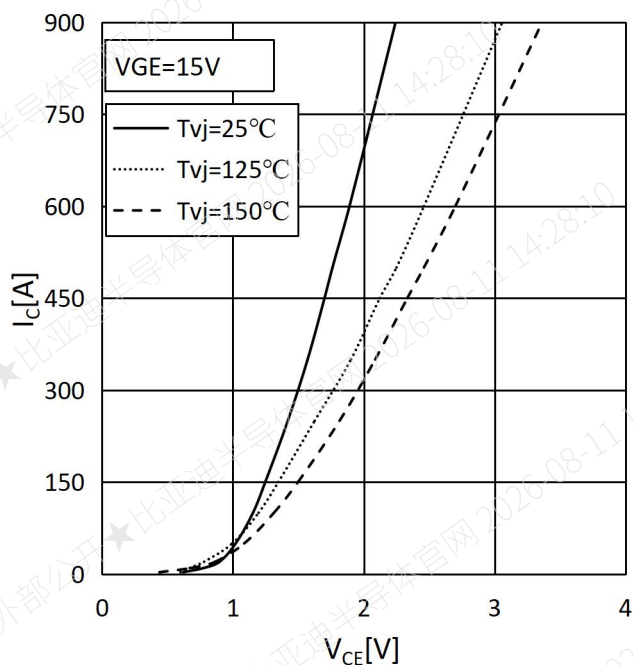


Fig.1 Output Characteristics

图 1 输出特性

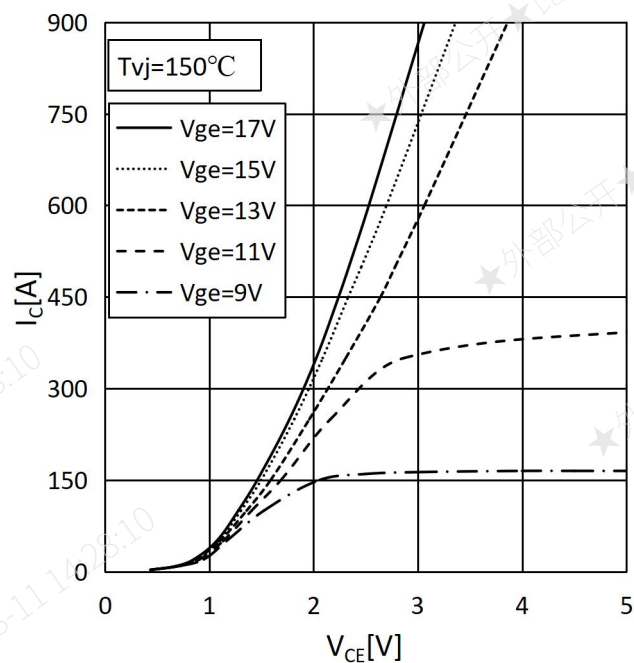


Fig.2: Output characteristics

图 2: 输出特性

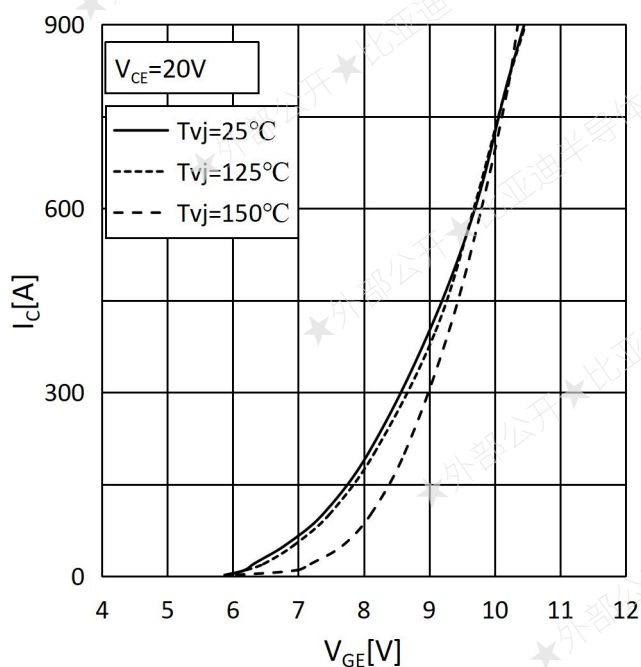


Fig.3: Transfer Characteristics

图 3: 传输特性

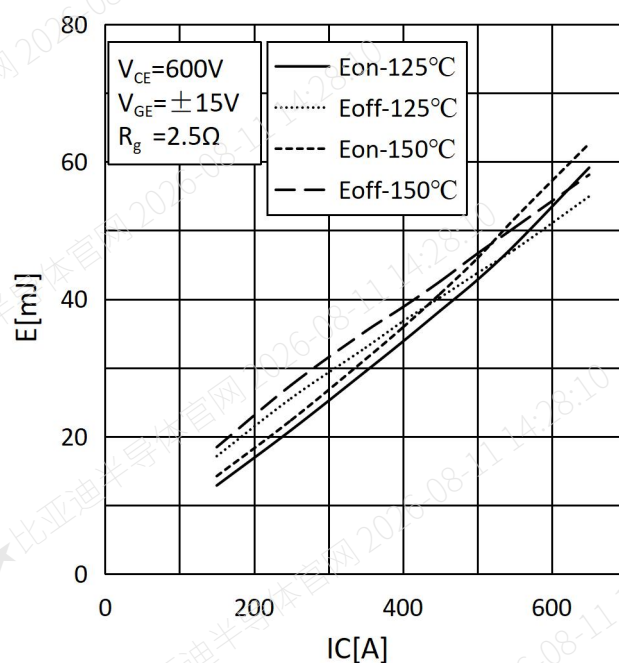


Fig.4 Switching Loss vs. Collector Current

图 4 开关损耗和集电极电流

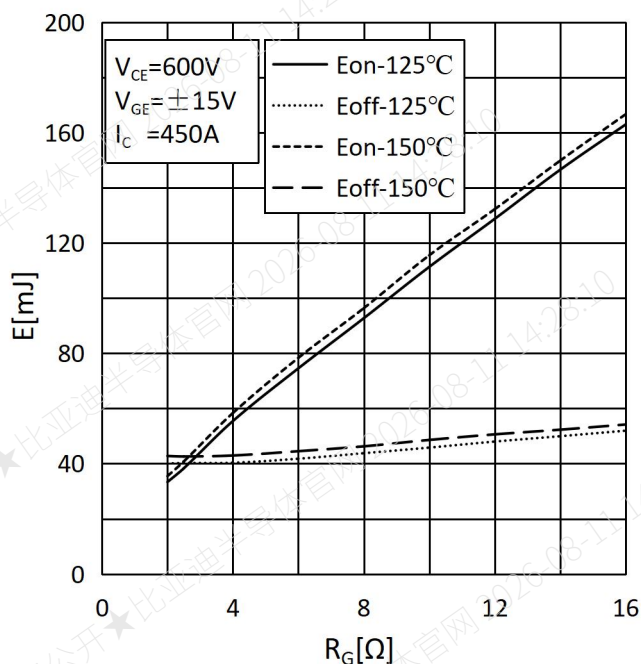


Fig.5: Switching Loss vs. Gate Resistor

图 5: 开关损耗与门极电阻关系

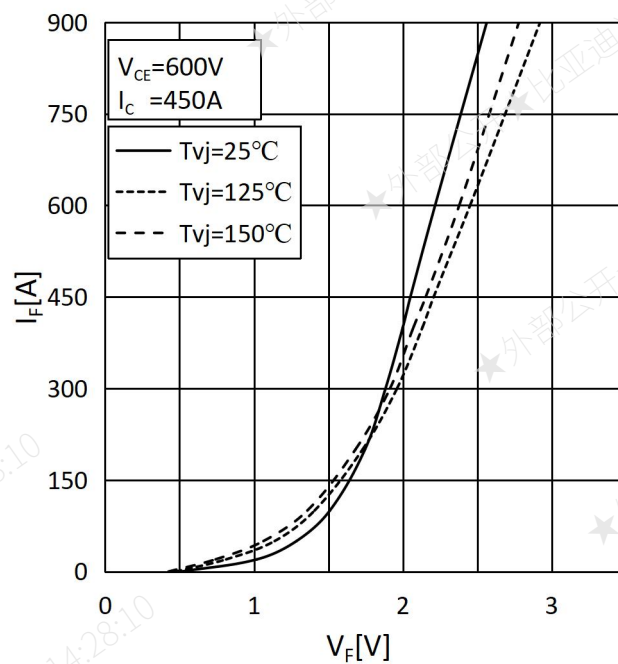


Fig.6: Forward characteristic

图 6: 正向特性

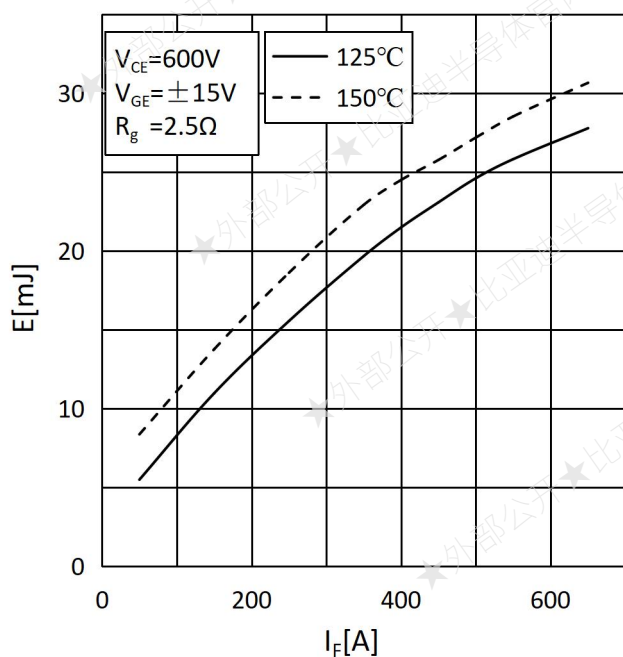


Fig.7: Reverse recovery Energy

图 7: 反向恢复损耗

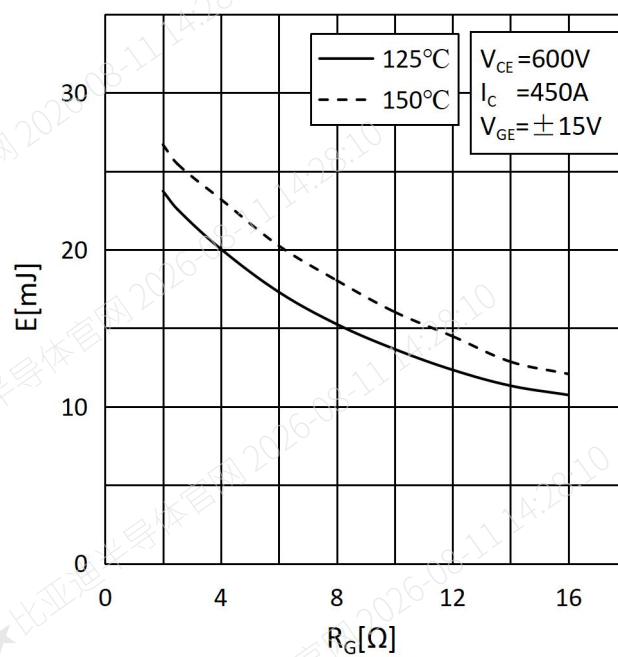


Fig.8: Reverse recovery Energy vs. Gate Resistor

图 8: 反向恢复损耗与门极电阻关系

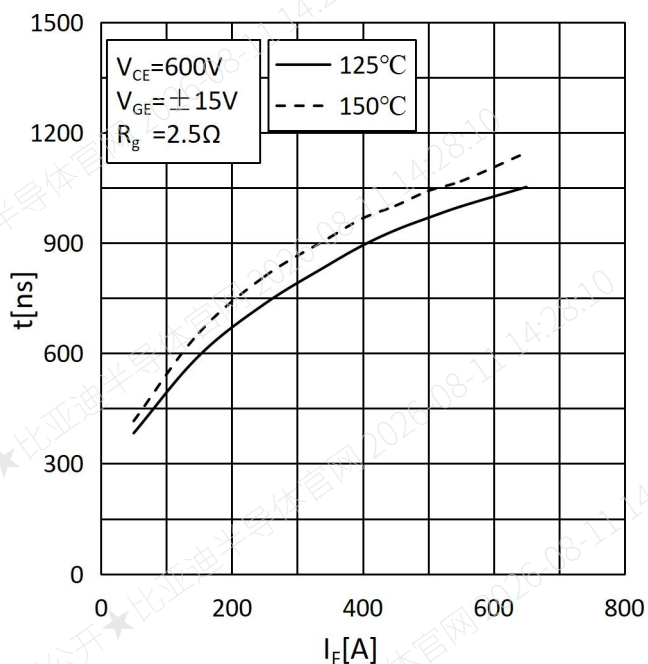


Fig.9: Reverse Recovery Times vs. IF

图 9: 反向恢复时间与正向电流关系

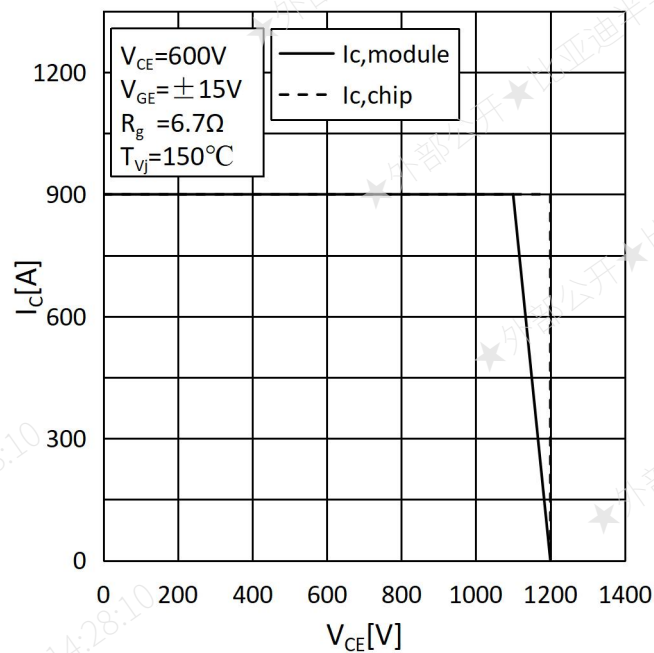


Fig.10: Reverse Bias Safe Operating Area

图 10: 反偏安全工作区

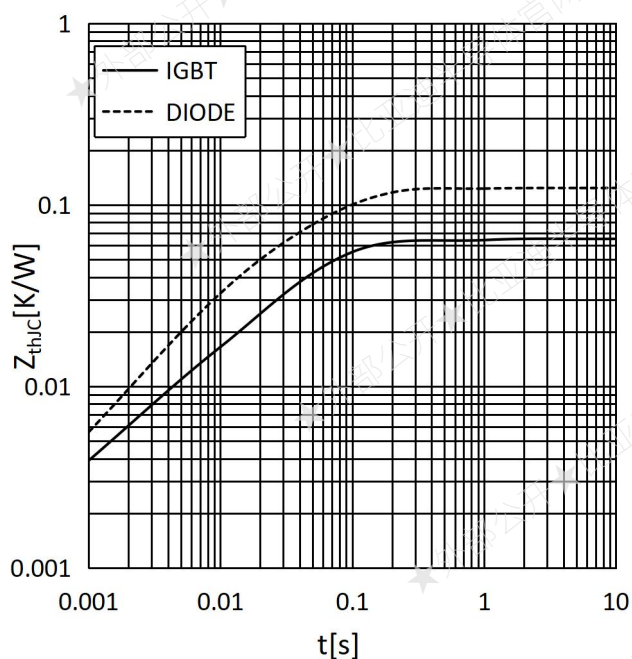


Fig.11: Typ. transient thermal impedance ZthJC

图 11: 典型的瞬态热阻抗 ZthJC

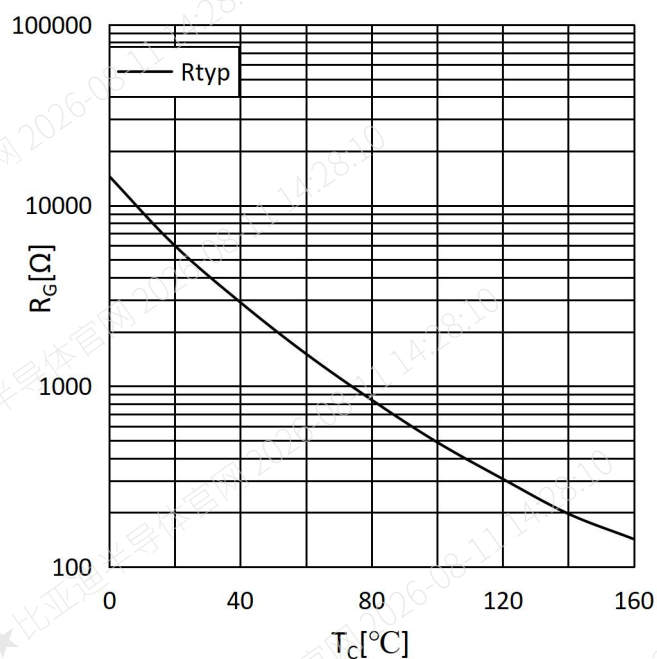
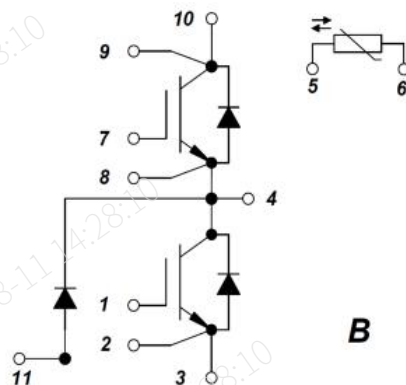


Fig.12: Typ. NTC-Temperature Characteristics

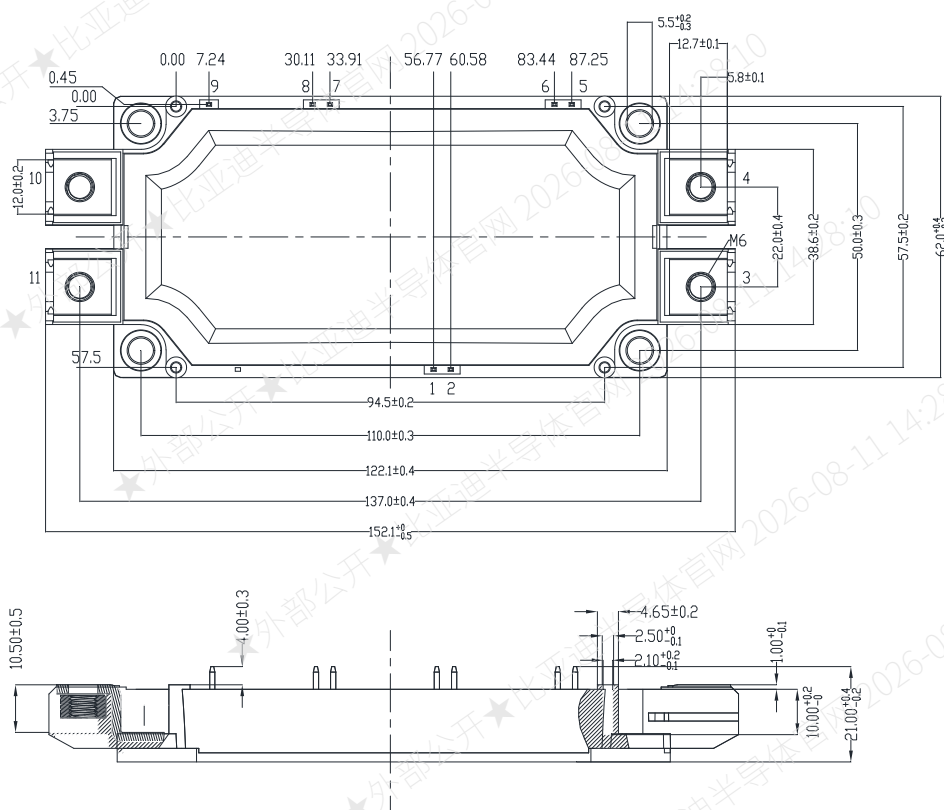
图 12: 典型的 NTC 电阻-温度特性



● Circuit Diagram/接线图



□ Package outlines/封装尺寸



## DISCLAIMER 免责声明

- Applications: This product is suitable for industrial electrical applications (including but not limited to: industrial motor drives, frequency converters, UPS, photovoltaic inverters, energy storage converters, industrial welding equipment, power quality devices (SVG, APF), etc.)

使用范围：本产品适用于工业级电气应用（包括但不限于：工业电机驱动、变频器、不间断电源（UPS）、光伏逆变器、储能变流器、工业焊接设备、电能质量设备（如 SVG、APF）等）

- Warranty Period: Unless otherwise agreed in the COOPERATION AGREEMENT Or Other WRITTEN DOCUMENTS, The warranty period for the product described in this specification is 12 months from the date of shipment.

质保期：除双方在合作协议或其他书面文件中另行约定外，本规格书所述产品质保期自出货起 12 个月。

- Special Instructions:

特别说明：

- Correct and Safety Use of Power Module: Unsuitable operation (such as electrical, mechanical stress and so on) may lead to damage of power modules. Please pay attention to the following descriptions and use this product according to the guidance.

功率模块安全正确的使用方法：不当的操作（如电应力、机械应力等）可能导致模块损毁。请注意以下介绍，并根据指导来使用本产品。

- During Transit: Tossing or dropping of a carton may damage devices inside. Devices exposed to moisture may result in failure. Special care should be taken during rainy or snowy weather to implement protective measures preventing the device from getting wet.

运输过程中：包装箱颠簸或坠落可能导致内部器件损毁；器件遇水受潮将导致故障失效。在雨雪天气尤其要注意保护器件防止淋湿。

- Storage: The temperature and humidity of the storage place should be  $20\pm 5^{\circ}\text{C}$  and 30% ~ 60%RH respectively. The performance and reliability of devices may be jeopardized if devices are stored in an environment far above or below the range indicated above.

贮存：贮存地点温度与湿度应分别控制在  $20\pm 5^{\circ}\text{C}$  和 30%~60%RH。如果贮存环境远高于或低于指示的变化范围，将危害器件的性能与可靠性。

- Prolonged Storage: When storing devices more than one year, dehumidifying measures should be provided for the storage place. When using devices after a long period of storage, please inspect them to ensure there are no scratches, dust, rust, or other defects on the surface.

长期贮存：当存储器件时间超过一年，贮存地点应当采取去湿措施。器件经过长期存放使用时，检查器件确保外观没有刮伤，灰尘，锈迹等。

- Operating Environment: Devices should not be exposed to water, organic solvents, corrosive gases, explosive gases, fine particles, or corrosive agents, since any of those can lead to a serious accident.

应用环境：器件不应当暴露在水，有机溶剂，腐蚀性气体、易燃易爆性气体，微尘，腐蚀性药剂中，上述

任何一种情况都会导致严重事故。

- **Anti-electrostatic Measures:** Following precautions should be taken for gated devices to prevent static buildup which could damage the devices:

防静电措施：带栅极器件应采取以下预警来防止可以损毁器件的静电生成：

1. Static electricity of human bodies and cartons and/or excessive voltage applied across the gate to emitter may damage and rupture devices. Sense-emitter and temperature-sensor are also vulnerable to excessive voltage. The basis of anti-electrostatic is suppression of build-up and quick dissipation of the charged electricity.

门极与发射极间产生的人体静电、包装箱静电和过电压将损毁或击穿器件。采样发射极和温度传感器同样容易受到过压损毁。防静电底板可以抑制电荷生成并快速耗散。

2. Containers that are susceptible to static electricity should not be used for transit or for storage.

不要用易受静电影响的容器运输或贮存器件。

3. Signal terminals to emitter should be always shorted with a carbon cloth or the like until right before a module is used. Never touch the signal terminals with bare hands.

发射极信号端子应一直用碳纤维布或类似物短接直到模块使用前。任何情况下不要徒手碰触信号端子。

4. During the installation process, it is necessary to always maintain the equipment and the operator's body in contact with the ground after removing carbon fiber cloth or similar materials. It is advisable to cover the workstation and its surrounding floor with conductive mats and ground them.

安装过程中始终保持设备和操作人员的身体接触地面（移除碳纤维布或类似物后）。用导电垫覆盖工作地点及周围地板并使其接地。

5. Use soldering irons with grounded tips.

使用接地的烙铁头。

- Our Company is committed to enhancing product quality and stability. This specification serves solely to delineate technical product details.

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