

## □ General Description

BYD IGBT Power Module BG600B12LY4-I 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 BG600B12LY4-I 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

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

## □ 关键特性

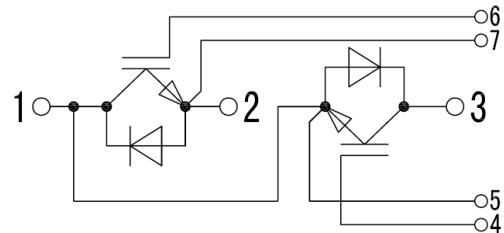
- 半桥模块
- 高短路耐量
- 低导通和开关损耗
- 并联超快软恢复续流二极管

## □ Applications

- Induction heating
- Inverters
- Servo
- UPS (Uninterruptible Power Supplies)



$$V_{CE}=1200V, I_C=600A$$



## □ 应用

- 感应加热
- 逆变器
- 伺服系统
- 不间断电源



□ IGBT/IGBT

● Maximum Rated Values/最大额定值

符号 Symbol	参数 Parameter	工作条件 Conditions	额定值 Ratings	单位 Units
$V_{CES}$	Collector-emitter voltage 集电极-发射极电压	$T_{vj}=25^{\circ}C$	1200	V
$I_{C\ nom}$	Continuous DC collector current 连续集电极直流电流	$T_c=80^{\circ}C, T_{vj}=175^{\circ}C$	600	A
$V_{GES}$	Gate-emitter voltage 栅极-发射极电压	$T_{vj}=25^{\circ}C$	$\pm 20$	V
$I_{CRM}$	Repetitive peak collector current 集电极重复峰值电流	$t_p=1\ ms, T_{vj}=25^{\circ}C$	1200	A
$t_{psc}$	IGBT short circuit SOA 短路安全工作区	$V_{GE} \leq 15V, V_{CC}=600V$ $V_{CEM} \leq 1200V, T_{vj} \leq 25^{\circ}C$	10	us
$P_{tot}$	Total power dissipation 总耗散功率	$T_c=25^{\circ}C, T_{vj}=175^{\circ}C$	1430	W

● Characteristics Values/特征值

符号 Symbol	参数 Parameter	工作条件 Conditions	额定值 Ratings			单位 Units
			Min.	Typ.	Max.	
$V_{CE\ sat}$	Collector-Emitter Saturation Voltage 集电极-发射极饱和电压	$I_C=600A, V_{GE}=15V, T_{vj}=25^{\circ}C$	-	1.95		V
		$I_C=600A, V_{GE}=15V, T_{vj}=150^{\circ}C$	-	2.3	-	V
$V_{GEth}$	Gate threshold voltage 栅极阈值电压	$V_{CE}=V_{GE}, I_C=8mA, T_{vj}=25^{\circ}C$	5.0	6.0	7.0	V
$Q_G$	Gate charge 栅极电荷	$V_{GE}=-7.5V \dots +15V$	-	0.69	-	uC
$R_{gint}$	Internal gate resistance 内部栅极电阻	$T_{vj}=25^{\circ}C$	-	1.33	-	$\Omega$
$C_{ies}$	Input capacitance 输入电容	$T_{vj}=25^{\circ}C, f=1MHz, V_{GE}=0V, V_{CE}=25V$	-	26.4	-	nF
$C_{res}$	Reverse transfer capacitance 反向传输电容		-	2.16	-	nF
$I_{CES}$	Collector-emitter cut-off current 集电极-发射极截止电流	$V_{CE}=1200V, V_{GE}=0V, T_{vj}=25^{\circ}C$	-	-	600	uA



## BG600B12LY4-I

$I_{GES}$	Gate-emitter leakage current 栅极-发射极漏电流	$V_{CE}=0V, V_{GE}=20V, T_{vj}=25^{\circ}C$	-	-	600	nA	
$t_{d\ on}$	Turn-on delay time 开通延迟时间	$I_C = 600A,$ $V_{CE} = 600 V,$ $V_{GE} =$ $-7.5V \dots +15 V,$ $R_{Gon} = R_{Goff} =$ $3.3\Omega,$ $L_s = 37nH$	$T_{vj}=25^{\circ}C$	-	205	-	ns
			$T_{vj}=150^{\circ}C$	-	211	-	ns
$t_r$	Rise time 上升时间		$T_{vj}=25^{\circ}C$	-	179	-	ns
			$T_{vj}=150^{\circ}C$	-	192	-	ns
$t_{d\ off}$	Turn-off delay time, 关断延迟时间		$T_{vj}=25^{\circ}C$	-	556	-	ns
			$T_{vj}=150^{\circ}C$	-	621	-	ns
$t_f$	Fall time 下降时间		$T_{vj}=25^{\circ}C$	-	71	-	ns
			$T_{vj}=150^{\circ}C$	-	211	-	ns
$E_{on}$	Turn-on energy loss 开通损耗能量		$T_{vj}=25^{\circ}C$	-	79	-	mJ
			$T_{vj}=150^{\circ}C$	-	100	-	mJ
$E_{off}$	Turn-off energy loss 关断损耗能量	$T_{vj}=25^{\circ}C$	-	67	-	mJ	
		$T_{vj}=150^{\circ}C$	-	81	-	mJ	

### □ FRD/二极管

#### ● Maximum Rated Values/最大额定值

符号 Symbol	参数 Parameter	工作条件 Conditions	额定值 Ratings	单位 Units
$V_{RRM}$	Repetitive peak reverse voltage 反向重复峰值电压	$T_{vj} = 25^{\circ}C$	1200	V
$I_F$	Forward current of diode 连续正向直流电流	$T_C = 25^{\circ}C$	600	A
$I_{FRM}$	Repetitive peak forward current 正向重复峰值电流	$T_C = 25^{\circ}C, T_{vj} = 175^{\circ}C$	1200	A

#### ● Characteristics Values/特征值

符号 Symbol	参数 Parameter	工作条件 Conditions	额定值 Ratings			单位 Units	
			Min.	Typ.	Max.		
$V_F$	Forward voltage 正向电压	$I_F=600A,$ $V_{GE}=0V$	$T_{vj}=25^{\circ}C$	-	2.0	-	V
			$T_{vj}=150^{\circ}C$	-	2.1	-	V
$I_{RM}$	Peak reverse recovery current 反向恢复峰值电流	$I_F=600 A,$ $V_R = 600 V,$ $V_{GE} =$	$T_{vj}=25^{\circ}C$	-	161	-	A
			$T_{vj}=150^{\circ}C$	-	212	-	A
$Q_r$	Recovered charge 恢复电荷	$-7.5V \dots +15V,$ $R_{Gon}=3.3\Omega,$ $L_s=37nH$	$T_{vj}=25^{\circ}C$	-	36	-	uC
			$T_{vj}=150^{\circ}C$	-	73	-	uC
$E_{rec}$	Reverse recovery energy 反向恢复损耗		$T_{vj}=25^{\circ}C$	-	14	-	mJ
			$T_{vj}=150^{\circ}C$	-	31	-	mJ



□ **Module/模块**

符号 Symbol	参数 Parameter	工作条件 Conditions	额定值 Ratings			单位 Units
			Min.	Typ.	Max.	
T <sub>vjmax</sub>	Maximum junction temperature 最大结温	-	-	-	175	°C
T <sub>vjop</sub>	Temperature under switching conditions 工作结温	-	-40	-	150	°C
T <sub>stg</sub>	Storage temperature 储存温度	-	-40	-	150	°C
R <sub>thjc IGBT</sub>	IGBT, thermal resistance, junction to case 结-外壳热阻	per IGBT 单个 IGBT	-	0.045		K/W
R <sub>thjc Diode</sub>	Diode, thermal resistance, junction to case 结-外壳热阻	per diode 单个二极管	-	0.117		K/W
V <sub>isol</sub>	Isolation test voltage 绝缘测试电压	f = 50Hz, t = 1min.	2.5	-	-	KV
G	Weight 重量	-	-	320	-	g
-	Cree page distance 爬电距离	Terminal to terminal 端子到端子	-	14	-	mm
-		Terminal to base 端子到底板	-	24	-	
-	Clearance distance in air 空气间隙	Terminal to terminal 端子到端子	-	6.0	-	
-		Terminal to base 端子到底板	-	28.3	-	
M <sub>1</sub>	Mounting torque for module mounting 模块的安装扭矩	Screw M6 M6 螺栓	3.0	-	6.0	Nm
M <sub>2</sub>	Terminal connection torque 端子的连接扭矩	Screw M6 M6 螺栓	2.5	-	5.0	Nm
-	Internal isolation 内部绝缘	ceramics 陶瓷	Al <sub>2</sub> O <sub>3</sub>			-
-	Material of module baseplate 模块基板材料	-	Cu			-
L x W x H	Dimensions 尺寸	-	106.4 x 61.4 x 30.9			mm

□ Characteristics Diagrams/特性曲线

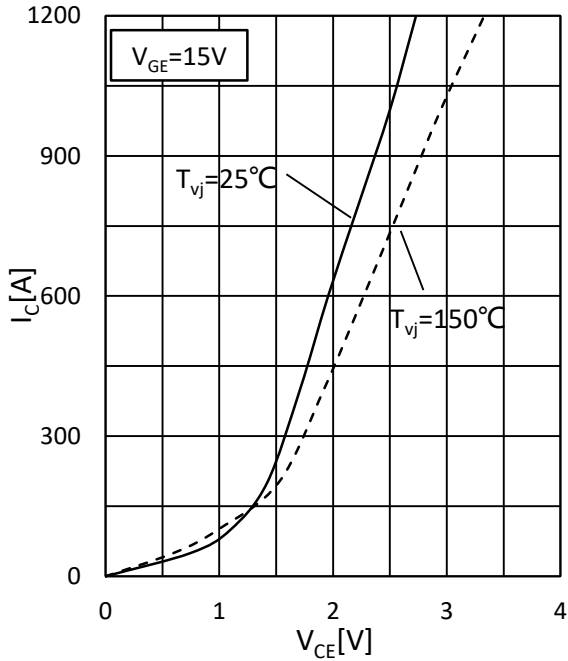


图 1 开通状态特性

Fig.1 Typ. On-state Characteristics

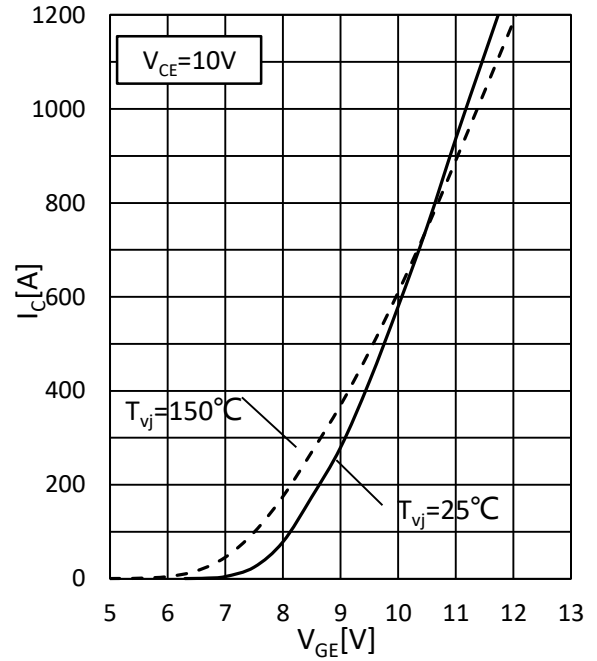


图 2 传输特性

Fig.2 Typ. Transfer Characteristics

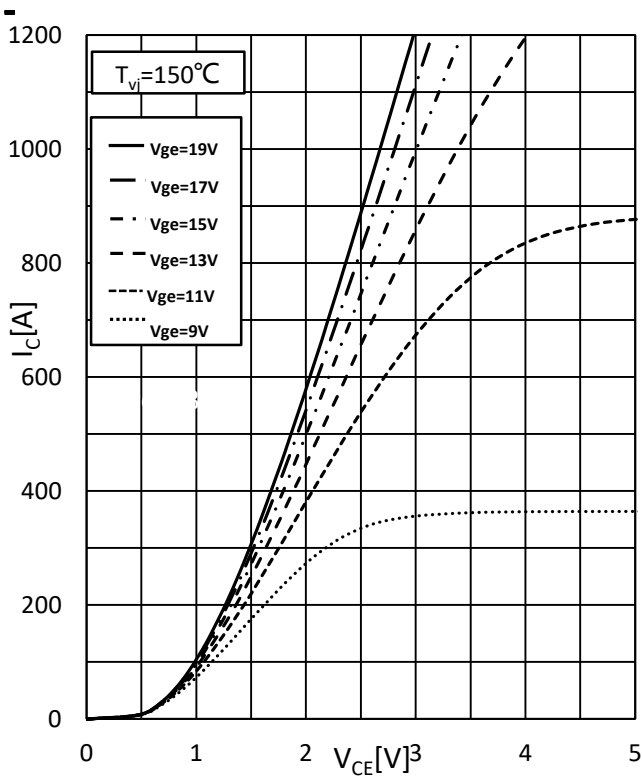


图 3 输出特性

Fig.3 Typ. Output Characteristics

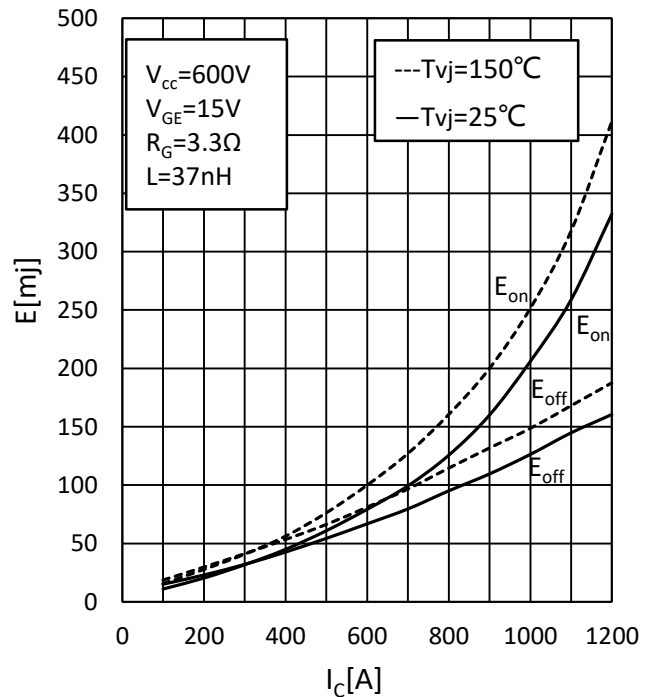


图 4 开关损耗和集电极电流

Fig.4 Switching Loss vs. Collector Current

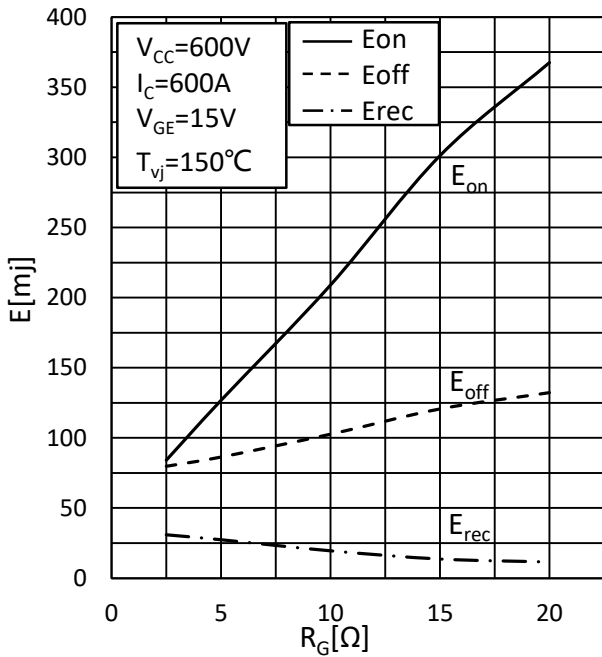


图 5 开关损耗和门极电阻

Fig.5 Switching Loss vs. Gate Resistor

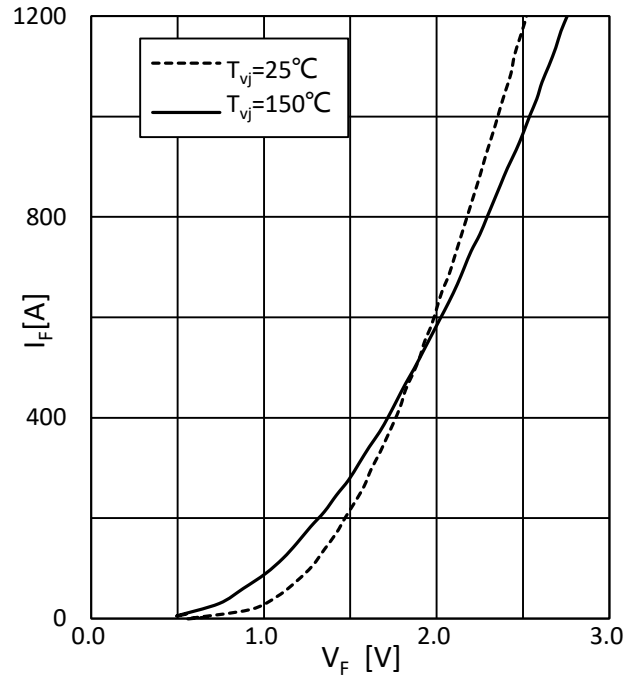


图 6 二极管输出特性

Fig.6 FWD Forward Characteristics

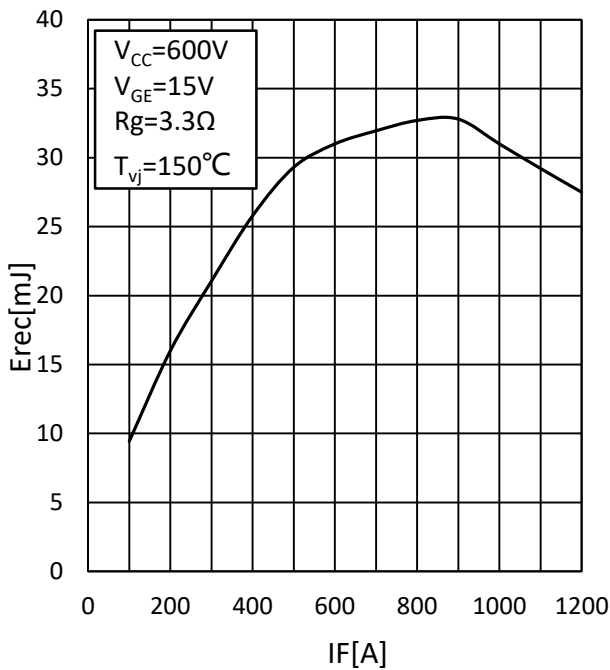


图 7 开关损耗二极管-逆变器

Fig.7 Typ. Switching Losses Diode-Inverter

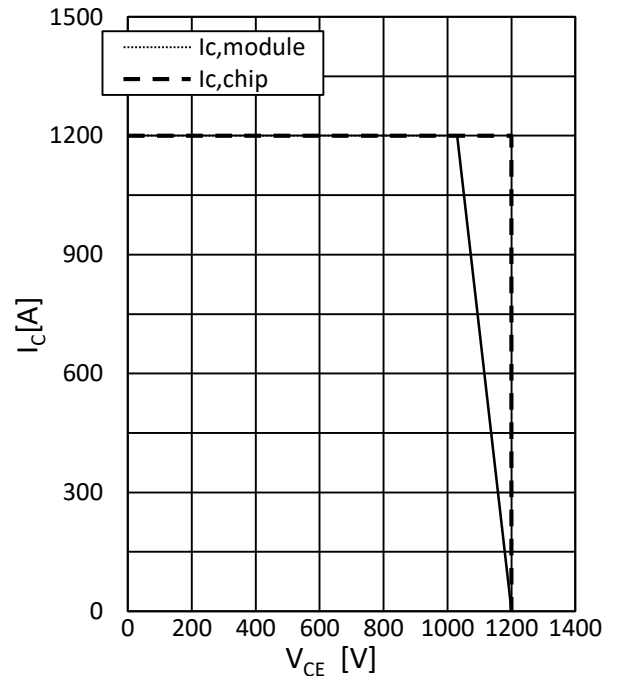


图 8 反偏安全工作区

Fig.8 Reverse Bias Safe Operating Area (RBSOA)

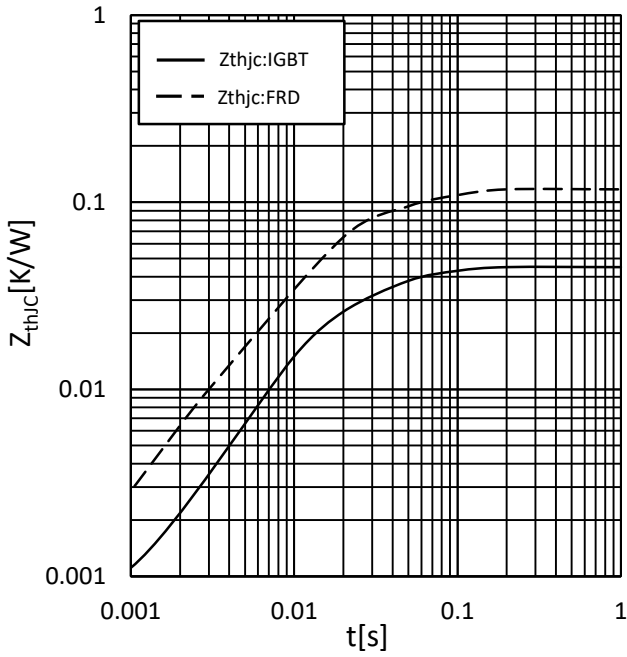


图 9 瞬态热阻

Fig.9 Typ. Transient Thermal Impedance

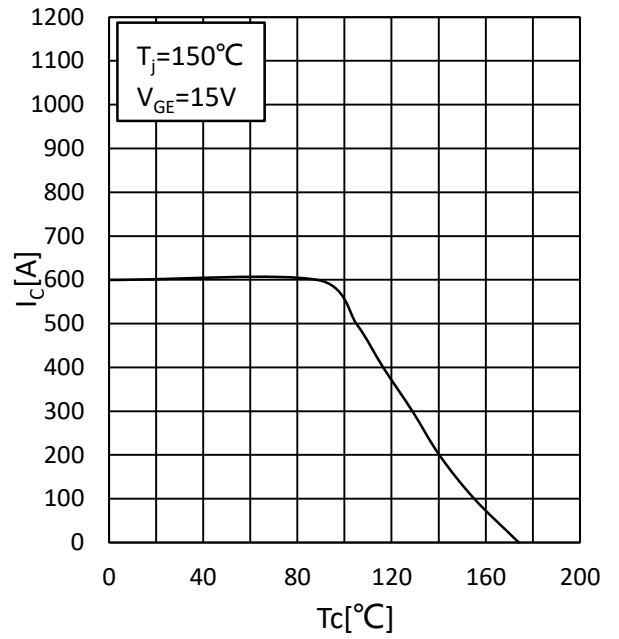
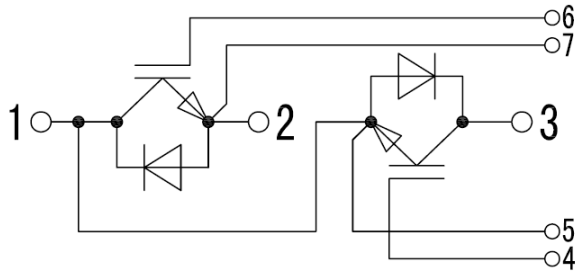


图 10 额定电流和温度

Fig. 10 Rate Current vs. Temperature (Tc)

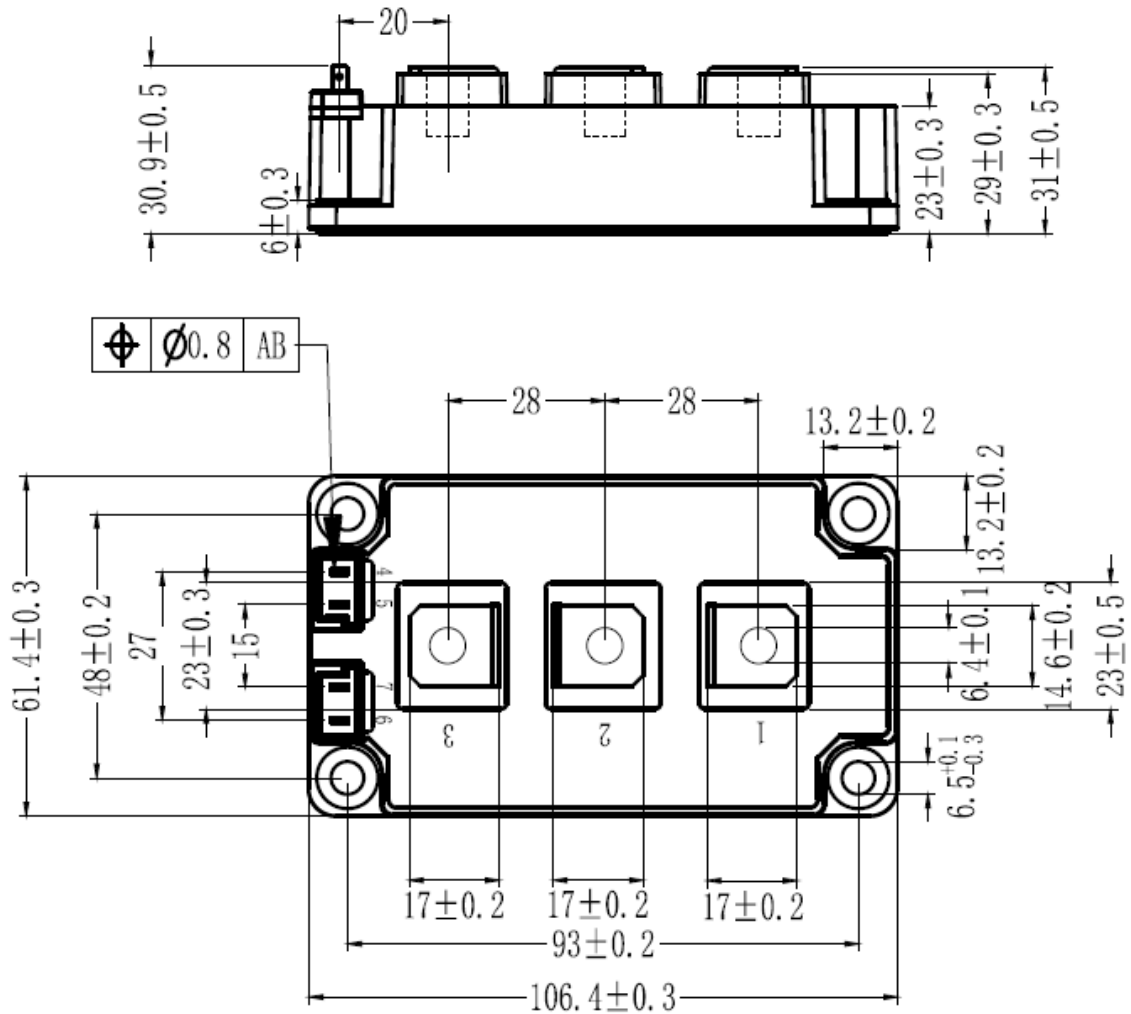


● Circuit Diagram/接线图



- |                     |              |
|---------------------|--------------|
| (1)AC Output        | (7)交流输出端     |
| (2)N-Negative Power | (2) N-负电极    |
| (3)P-Positive Power | (3) P-正电极    |
| (4)GH-Gate High     | (4) GH-上桥门极  |
| (5)EH-Emitter High  | (5) EH-上桥发射极 |
| (6)GL-Gate Low      | (6) GL-下桥门极  |
| (7)EL-Emitter Low   | (7) EL-下桥发射极 |

□ Package outlines/封装尺寸







## ☐ Attention

### **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 BYD's IGBT modules according to the guidance.

### **During Transit:**

- Tossing or dropping of a carton may damage devices inside.
- If a device gets wet with water, malfunctioning and failure may result. Special care should be taken during rain or snow to prevent the devices from getting wet.

### **Storage:**

- The temperature and humidity of the storage place should be 5~35°C and 45~75% 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.

### **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, make sure to check the exterior of the devices is free from scratches, dirt, rust, and so on.

### **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.

### **Anti-electrostatic Measures:**

- Following precautions should be taken for gated devices to prevent static buildup which could damage the devices.

#### (1) Precautions against the device rupture caused by static electricity

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.

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

\* 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.

\* Always ground the equipment and your body during installation (after removing a carbon cloth or the like. It is advisable to cover the workstation and its surrounding floor with conductive mats and ground them.

- \* Use soldering irons with grounded tips.

BYD Semiconductor Co., Ltd. (short for BYD) exerts the greatest possible effort to ensure high quality and reliability. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing BYD products, to comply with the standards of safety in making a safe design for the entire system, including redundancy, fire-prevention measures, and malfunction prevention, to prevent any accidents, fires, or community damage that may ensue. In developing your designs, please ensure that BYD products are used within specified operating ranges as set forth in the most recent BYD products specifications.



## □ 警示

### 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，并根据指导来使用使用比亚迪IGBT模块。

### 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。

### 贮存:

- 贮存地点温度与湿度应分别控制在5~35°C和45~75%。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。

### 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。

### 应用环境:

- 器件不当暴露在水，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。**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) 预防措施可以防止静电击穿器件。

- \* 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。
- \* 不要用易受静电影响的容器运输或贮存器件。
- \* 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。
- \* 安装过程中始终保持设备和你的身体接地(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。
- \* 使用接地的烙铁头。

比亚迪半导体股份有限公司(简称BYD)致力于产品的高性能和高可靠性。然而，半导体器件一般会因为其固有的对电荷敏感性和易受物理应力损坏的特点，而发生故障和失效。当用户购买BYD的产品时，用户有责任按照安全标准来为整个系统做出安全的设计来防止任何事故，火灾或继而引起的危害公共安全，包括设计的冗余，防火措施，故障预防。在开发设计时，确保BYD的产品在额定范围内使用并参考最新的BYD产品规格书。