BM875B12J34U1

SiC Power Module/碳化硅功率模块

V_{DSS} = 1200V　　I_D = 875A

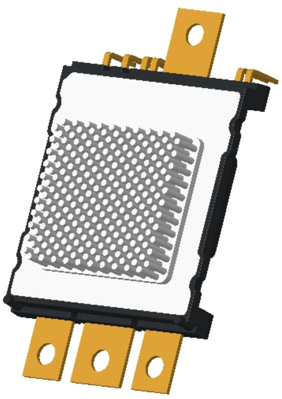
❐ General Description/概述

BYD SiC Power Module BM875B12J34U1 uses latest Double sided Silver sintering technology and provides low switching loss as well as high short circuit capability, which introduce the advanced SiC mosfet chip, it is able to take on a perfect performance in various applications with switching frequencies in the range of 1-30KHz.

比亚迪碳化硅功率模块BM875B12J34U1采用最新双面银烧结工艺，具有高导热、低损耗和高短路能力, 内含先进的碳化硅mosfet芯片,在1-30KHZ频率的应用中表现出优良的性能。

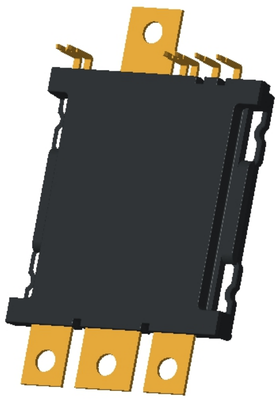
❐ Applications/应用

- Automotive Applications
  汽车级应用
- Hybrid Electrical Vehicles (H)EV
  混动车
- Motor Drives
  电机驱动
- Maximum applied voltage platform: 900V
  最高支持900V电压平台



❐ Features/特性

- The 3rd generation semiconductor material-Silicon Carbide
  第三代半导体材料-碳化硅
- Blocking voltage 1200V
  阻断电压 1200V
- Low $R_{DS(on)}$
  低内阻
- Low Switching Losses
  低开关损耗
- Low Qg and Crss
  低 Qg 和 Crss
- Low Inductive Design, L_s≤10nH
  低电感设计 L_s≤10nH
- $T_{vj\ op}$=175 °C
  最大连续工作结温 175 ºC
- Direct Cooled Cu PinFin Base Plate
  铜直接冷却底板
- High Performance Si_3N_4 Ceramic
  高性能氮化硅陶瓷
- Integrated NTC temperature sensor
  集成化 NTC 温度传感器



❒ Characteristic Values/典型值

Parameter 参数	Symbol 符号	Conditions 工作条件	Temperature 结温	Value 值	Unit 单位
Absolute Maximum Ratings/最大额定值					
Drain-source voltage 漏极—源极间电压	V_{DSS}	V_{GS}<0V	T_{vj}=25℃	1200	V
DC drain current 连续漏极直流电流	I_{DRM}	V_{GS}=18V, T_{cool}=55℃	T_{vj}=175℃	530	A
Pulsed drain current 脉冲漏极电流	I_{Dpulse}	t_P=1ms, D=20%, T_{Cool}=55℃	T_{vj}=175℃	1060	A
Gate-source voltage 栅极-源极间电压	V_{GSS}	—	—	+22/-10	V
Total power dissipation 耗散功率	P_{tot}	—	T_{cool} = 55℃	1228	W
Operating junction temperature 工作结温	T_{vj}	—	—	-40~+175	℃
Storage temperature 存储温度	T_{stg}	—	—	-40~+150	℃

MOSFET Characteristics MOSFET/特性

Parameter 参数	Symbol 符号	Conditions 工作条件	Temperature 结温	Min. 最小值	Typ. 典型值	Max. 最大值	Unit 单位
Drain-source breakdown voltage 漏极—源极最大阻断电压	$V_{(BR)DSS}$	V_{GS}=0V	T_{vj}=25℃ T_{vj}=175℃	1200	—	—	V
Drain-source on resistance 漏极—源极内阻	$R_{DS(on)}$	V_{GS}=18V, I_D=420A	T_{vj}=25℃	—	2.3	3.2	mΩ
			T_{vj}=175℃	—	4.3	5.2	mΩ
Gate threshold voltage 栅极阈值电压	$V_{GS(th)}$	I_D=60mA, V_{DS}=V_{GS}	T_{vj}=25℃	2	—	5	V
Gate to Source Charge 栅极对源极电量	Q_{GS}	V_{DS}=800V, V_{GS}=-5V/18V, I_D=420A	—	—	287	—	nC
Gate to Drain Charge 栅极对漏极电量	Q_{GD}		—	—	420	—	
Total Gate Charge 总栅极电量	Q_G		—	—	1085	—	
Internal gate resistor 内部栅极电阻	$R_{G(int)}$	—	T_{vj}=25℃	—	1.6	—	Ω

Input capacitance 输入电容	C_{iss}	V_{GS}=0V, V_{DS}=1000V, f=1MHz	—	—	25.2	—	nF
Output capacitance 输出电容	C_{oss}		—	—	1169	—	pF
Reverse transfer capacitance 反向传输电容	C_{rss}		—	—	210	—	pF
Gate-source leakage current 栅极-源极漏电流	I_{GSS}	V_{GS} = 20 V, V_{DS} = 0 V	T_{vj}=25℃	—	—	500	nA
Zero Gate Voltage Drain Current 漏极-源极漏电流	I_{DSS}	V_{DS}=1200V, V_{GS}=0V	T_{vj}=25℃	—	—	50	uA
			T_{vj}=175℃	—	—	175	
Turn-on delay time, inductive load 开通延迟时间	$t_{d(on)}$	V_{DS}=650V I_{DS}=800A, R_{Gon}=2.5Ω, R_{Goff}=3.3Ω , C_{GS}=10nF, V_{GSon}=+18V , V_{GSoff}=-5V , L=20μH, L_{σ}=20nH,	T_{vj}=25℃	—	82.3	—	ns
			T_{vj}=125℃	—	Tbd	—	ns
			T_{vj}=150℃	—	Tbd	—	ns
Rise time, inductive load 上升时间	t_r		T_{vj}=25℃	—	104.6	—	ns
			T_{vj}=125℃	—	Tbd	—	ns
			T_{vj}=150℃	—	Tbd	—	ns
Turn-off delay time, inductive load 关断延迟时间	$t_{d(off)}$		T_{vj}=25℃	—	211.8	—	ns
			T_{vj}=125℃	—	Tbd	—	ns
			T_{vj}=150℃	—	Tbd	—	ns
Fall time, inductive load 下降时间	t_f		T_{vj}=25℃	—	54.9	—	ns
			T_{vj}=125℃	—	Tbd	—	ns
			T_{vj}=150℃	—	Tbd	—	ns
Energy dissipation during turn-on time 开通损耗	E_{on}		T_{vj}=25℃	—	61.11	—	mJ
			T_{vj}=125℃	—	Tbd	—	mJ
			T_{vj}=150℃	—	Tbd	—	mJ
Energy dissipation during turn-off time 关断损耗	E_{off}		T_{vj}=25℃	—	28.75	—	mJ
			T_{vj}=125℃	—	Tbd	—	mJ
			T_{vj}=150℃	—	Tbd	—	mJ
Body Doide/体二极管特性							
Forward voltage 正向电压	V_{SD}	V_{GS}=-5V, I_{SD}=700A	T_{vj}=25	—	5.2	—	V
			T_{vj}=175℃	—	Tbd	—	V
Peak reverse recovery current 反向恢复峰值电流	I_{rrm}	V_{DS}=650V I_{DS}=800A, R_{Gon}=2.5Ω, R_{Goff}=3.3Ω , C_{GS}=10nF, V_{GSon}=+18V , V_{GSoff}=-5V , di/dt=8KA/us	T_{vj}=25℃	—	125	—	A
			T_{vj}=175℃	—	Tbd	—	
Recovered charge 反向恢复电荷	Q_{rr}		T_{vj}=25℃	—	2.7	—	uC
			T_{vj}=175℃	—	Tbd	—	
Reverse recover time 反向恢复时间	T_{rr}		T_{vj}=25℃	—	34	—	ns
			T_{vj}=175℃	—	Tbd	—	
Reverse recovery energy 反向恢复损耗	E_{rec}		T_{vj}=25℃	—	0.16	—	mJ
			T_{vj}=175℃	—	Tbd	—	

DC reverse drain current 直流反向电流	I_{DR}	V_{GS}=-5V, T_{cool}=55℃	T_{vj}=175℃	—	240	—	A
Peak reverse drain current 最大反向电流	I_{DRM}	V_{GS}=-5V, t_{pulse}=1ms	—	—	480	—	A
Thermal Resistance/热阻							
Thermal resistance junction to coolant 结-冷却液热阻	$R_{th(j-f)}$	△v /△t=8L/min, T_{cool}=55℃, 50%乙二醇,50%水		—	0.0977	—	K/W
Module Characteristics/模块特性							
Dimensions 尺寸	L x W x H	Typical , see outline drawing 标准外观图		74×70×19.8			mm
Isolation voltage 绝缘耐压	V_{isol}	t=1min,f=50Hz		3.8			kV
Internal isolation 绝缘层材料	—	Basic insulation 基本绝缘		Si_3N_4			
Clearance distance in air 空气间隙	d_a	according to/ 请参考 IEC 60664-1 & EN 50124-1	Term. to base:	—	9.6	—	mm
			Term. to term:	—	4.5	—	mm
Surface creepage distance 爬电距离	d_s	according to/ 请参考 IEC 60664-1 &EN 50124-1	Term. to base:	—	9.6	—	mm
			Term. to term:	—	7.5	—	mm
Mass 重量	m	—	—	—	280	—	g
Pressure drop in cooling circuit 在冷却液中的压差	△P	△v /△t=12L/min, T_{cool}=25℃, 50%乙二醇,50%水		—	10	—	kPa
Maximum pressure in cooling circuit 冷却循环中的最大压力	P	—		—	250	—	kPa
Stray inductance module 杂散电感	L_{sds}	—		—	—	10	nH
Comparative tracking index 相对漏电指数	CTI	—		—	600	—	V
Mounting torque 安装扭矩	M	Screw M4-mounting according to valid application note 参考规格书使用 M4 螺丝安装		1.8	2.0	2.2	N.m

NTC-Thermistor Characteristic Values/热敏电阻特性						
Rated resistance 额定阻值	R_{25}	T_C=25℃	—	5.0	—	kΩ
Deviation of R100 R100 偏差	△R/R	T_C=100℃, R_{100}=493Ω	-5	—	5	%
Power dissipation 耗散功率	P_{25}	T_C=25℃	—	—	20.0	mW
B-Value B-值	$B_{25/50}$	$R_2=R_{25}exp[B_{25/50}(1/T_2-1/(298.15K))]$	—	3375	—	K
B-value B-值	$B_{25/80}$	$R_2=R_{25}exp[B_{25/80}(1/T_2-1/(298.15K))]$	—	3411	—	K
B-value B-值	$B_{25/100}$	$R_2=R_{25}exp[B_{25/100}(1/T_2-1/(298.15K))]$	—	3433	—	K

Thermal and mechanical properties according to IEC 60747–15.

Specification according to the valid application note.

热和机械特性请参考 IEC 60747–15。

规格书根据实际应用撰写。

❐ Characterization Curves/特性曲线

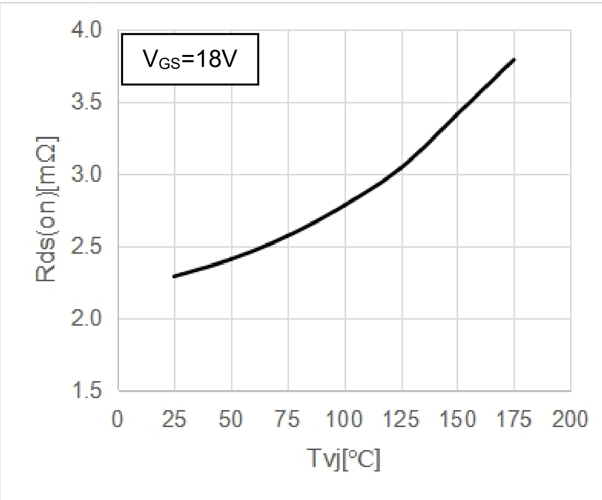


Fig.1 Drain-source On Resistance vs.Junction Temperature

图1：内阻和结温的关系

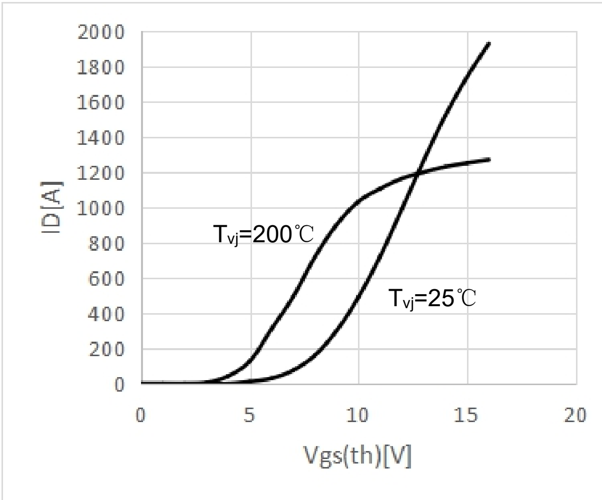


Fig.2 Transfer Characteristic MOSFET (typical)

图2：MOSFET转移特性

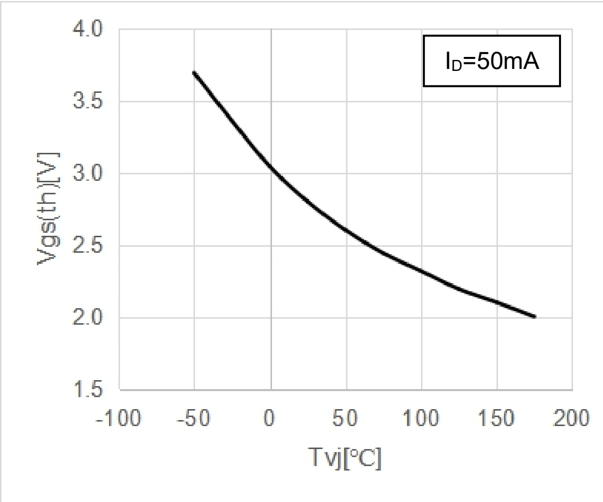


Fig.3 Gate Threshold Voltage vs.Junction Temperature

图3：栅极阈值电压和结温的关系

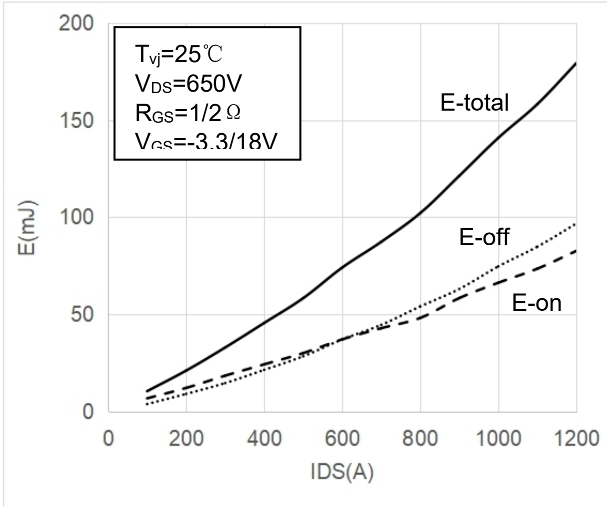


Fig.4 Switching Loss vs. Drain Current

图4：开关损耗和漏极电流关系

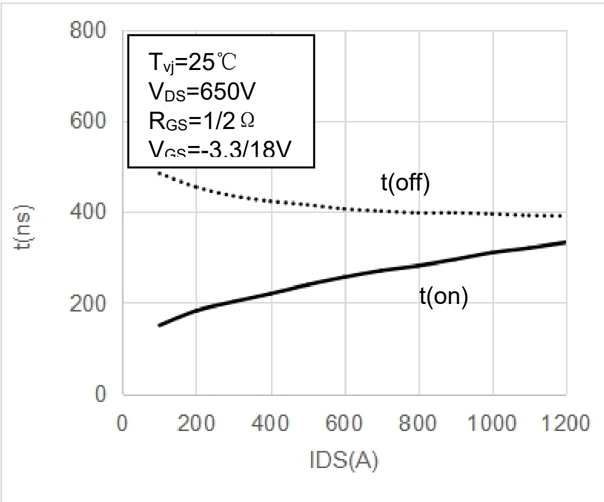


Fig.5 Switching Time vs. Drain Current

图5：开关时间和漏极电流关系

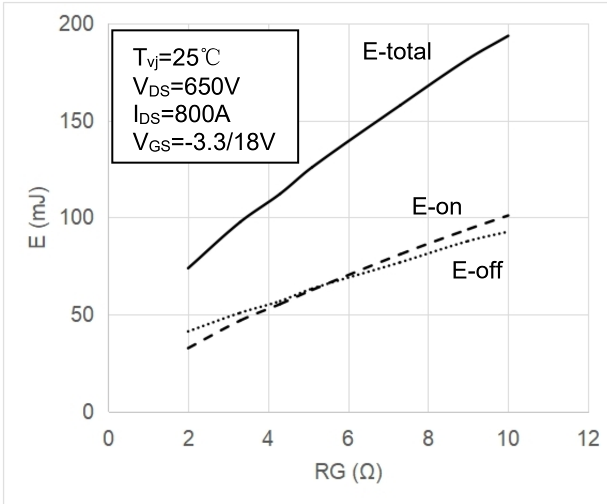


Fig.6 Switching Loss vs. Gate Resistor

图6：开关损耗和栅极电阻关系

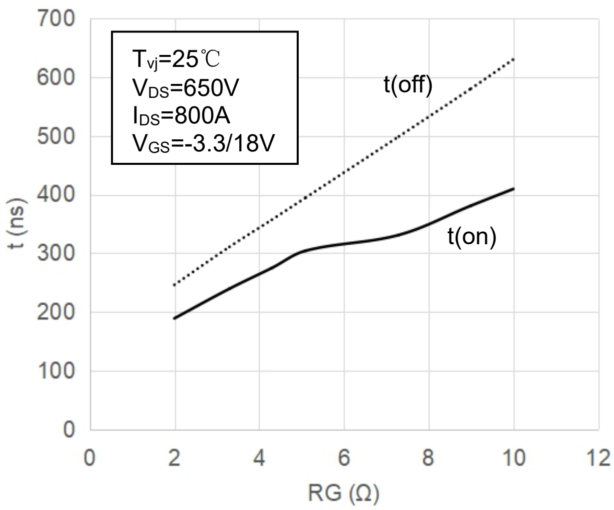


Fig.7 Switching Time vs. Gate Resistor

图7：开关时间和栅极电阻关系

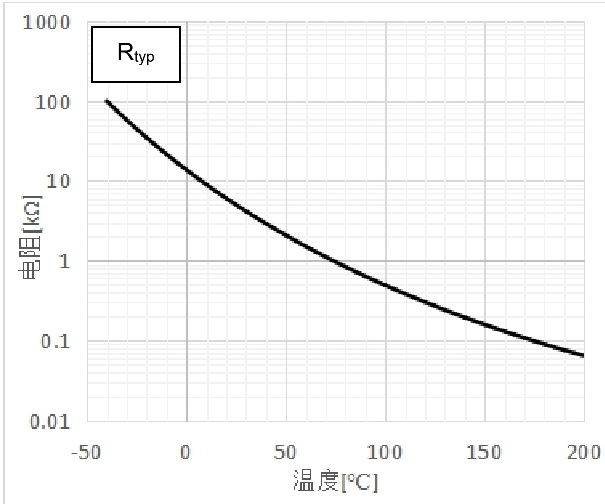


Fig.8 Typ. NTC-Temperature Characteristics

图8：典型NTC热特性

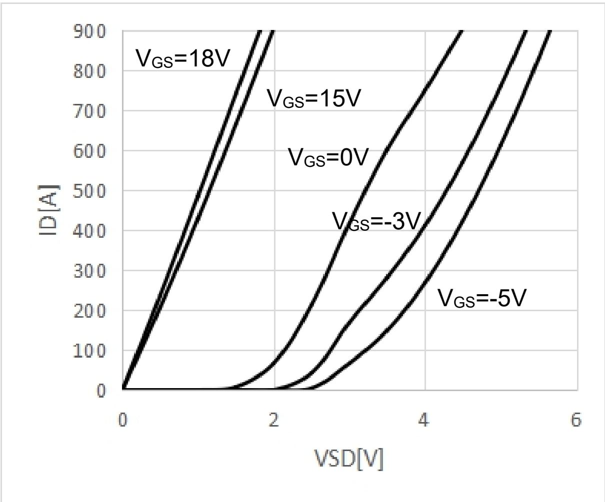


Fig 9 Body Diode Forward Current vs. Forward Voltage

T_{vj}=25℃

图9：体二极管正向电流和正向压降的关系，结温25℃

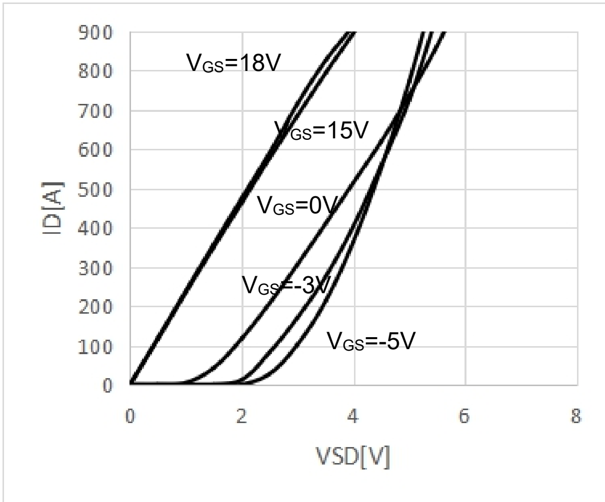


Fig 10 Body Diode Forward Current vs. Forward Voltage

T_{vj}=200℃

图10：体二极管正向电流和正向压降关系，结温200℃

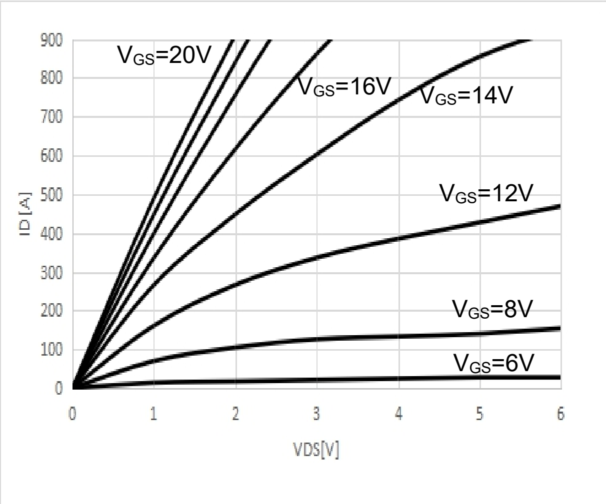


Fig 11 Forward Current vs. Forward Voltage T_{vj}=25℃

图11：正向电流和正向压降关系，结温25℃

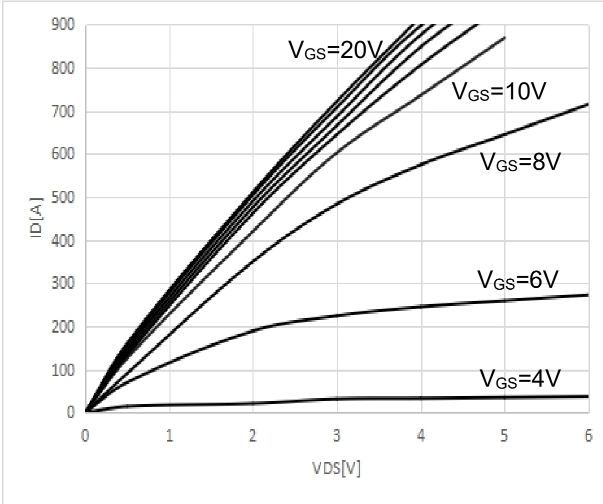
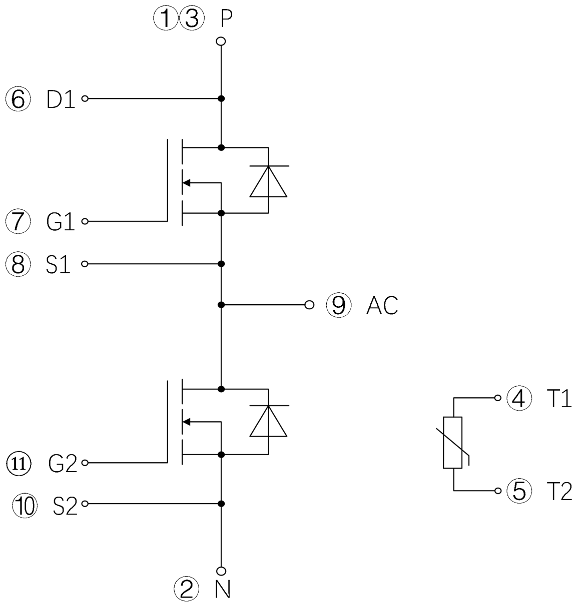
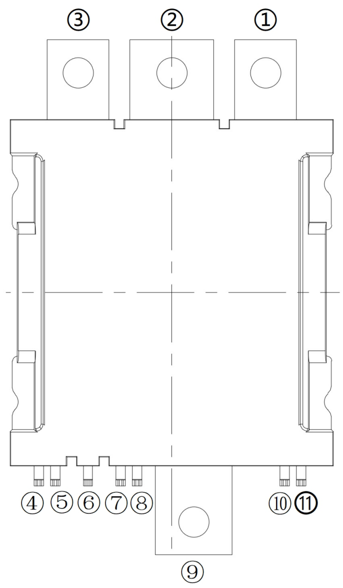


Fig 12 Forward Current vs. Forward Voltage T_{vj}=200℃

图12：正向电流和正向压降关系，结温200℃

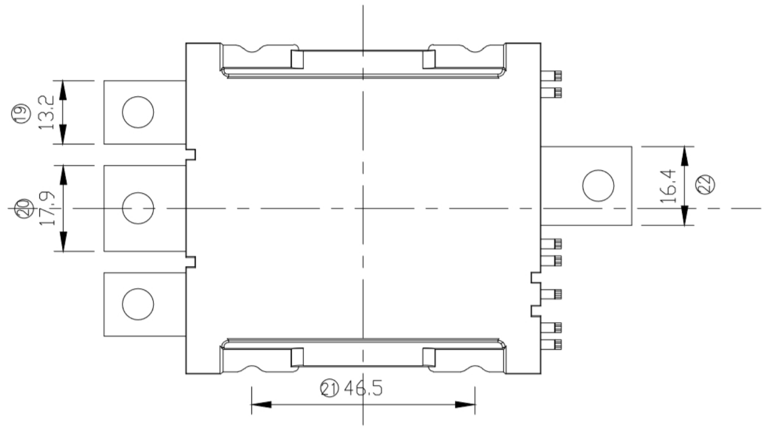
❐ Circuit Diagram/电路图

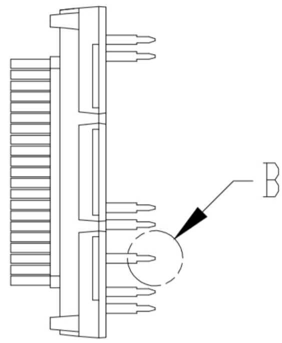


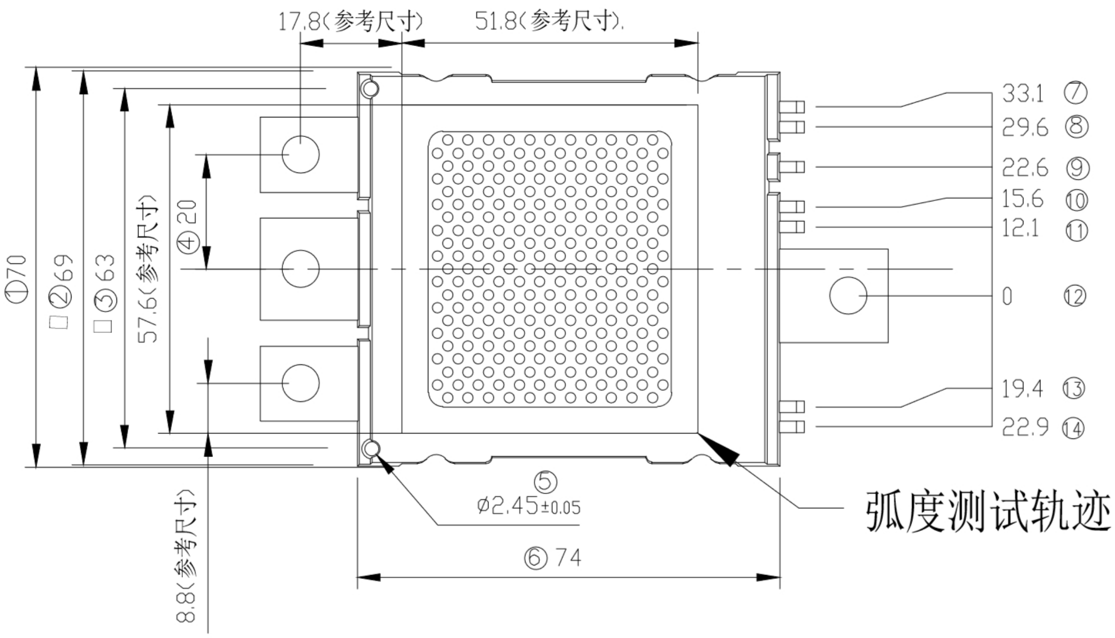


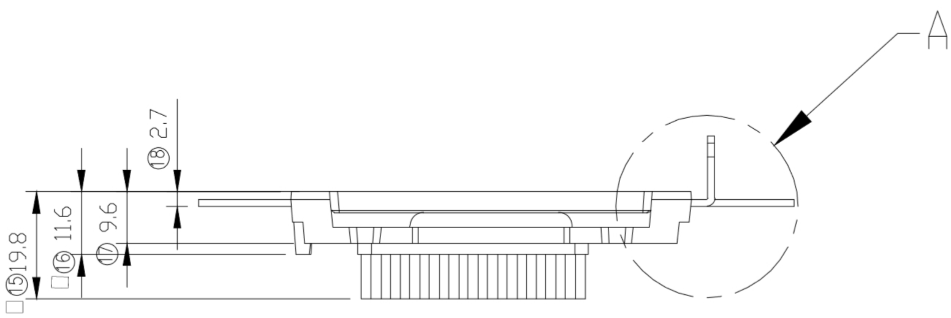
注：图中二极管为 MOSFET 体二极管。

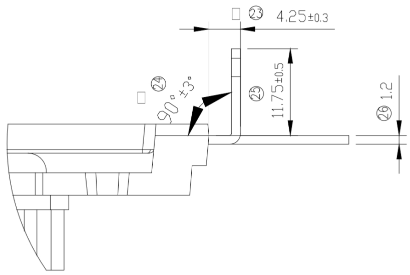
❒ Package Outlines/封装轮廓图



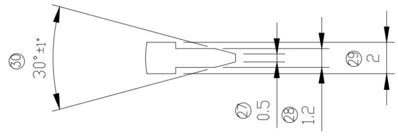








Detail A Proportion 2:1



Detail B Proportion 2:1

❒ Attached (recommended torque and screw)/安装（推荐扭矩和螺丝）:

Recommend Mounting Torque(M4): 1.8-2.2 N·m

推荐安装扭矩(M4)扭矩:1.8-2.2 N·m

❒ 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.
- 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.

❐ 注意：

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%湿度。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。

防静电措施：

- 带栅极器件应采取以下预防措施来防止可以损毁器件的静电生成。
- 预防措施可以防止静电击穿器件：
- 栅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。
- 不要使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。

❒ RESTRICTIONS ON PRODUCT USE

BYD Semiconductor Co., Ltd. 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.

❒ 产品使用须知

比亚迪半导体有限公司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的隐患，包括设计的裕量，防火措施，故障预防等。请改善您的设计，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。