

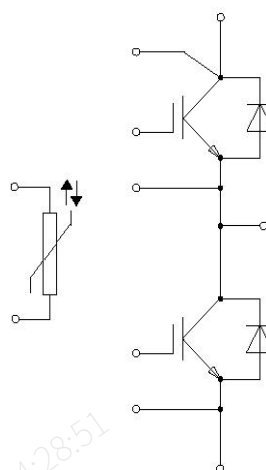
BG600B12ME4R

□ General Description

This IGBT module, which adopts general packaging, can meet Auto-grade standards and is specially developed for new energy motor controller, also can be used for other applications. Compared with other manufacturers, BYD module adopts DBC with additional elements, which has higher strength. DBC can be made thinner, less thermal resistance and better heat dissipation in the case of constant intensity requirements. In order to adapt to the complex automotive application environment at the same time, the module framework adopts PPS material with better performance, higher temperature resistance, not easily deformed, higher corrosion resistance.

□ 概述

这款 IGBT 模块采用了标准封装，可以满足汽车级标准，专为新能源汽车控制器设计，也可用于其他领域。与竞品相比，BYD 模块采用了更高强度、更薄厚度的 DBC，具有更低的热阻，以及更好的热耗散能力。同时为了适应复杂的车用环境，模块外框材料采用了特性更好的 PPS 材料，具有更好的耐热性能，不易变形，耐腐蚀性等优点，可确保模块的高质量及可靠性。



$$V_{CES} = 1200 \text{ V}$$

$$I_{C_nom} = 600 \text{ A} / I_{CRM} = 1200 \text{ A}$$

□ Key Features

- Half-bridge module
- Low V_{CEsat}
- High short circuit withstand capability
- Ultra low conduction and switching loss
- Including ultra fast&soft recovery anti-parallel FRD

□ Applications

- AC motor control
- Inverters
- Solar application
- High power converters
- Motor drives

□ 关键特性

- 半桥模块
- 低 V_{CEsat}
- 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

□ 应用

- 交流马达控制
- 逆变器
- 光伏领域
- 大功率变流器
- 电机传动

BG600B12ME4R

IGBT/IGBT

Maximum Rated Values/最大额定值

Symbol	Items	Conditions	Values	Units
V_{CES}	Collector-emitter voltage 集电极-发射极电压	$T_j = 25^\circ\text{C}$	1200	V
I_C	Continuous DC collector current 连续集电极直流电流	$T_c = 25^\circ\text{C}, T_j = 175^\circ\text{C}$	1200	A
I_{C_nom}		$T_c = 100^\circ\text{C}, T_j = 175^\circ\text{C}$	600	A
V_{GES}	Gate-emitter peak voltage 栅极-发射极峰值电压	$T_j = 25^\circ\text{C}$	± 20	V
I_{CRM}	Repetitive peak collector current 集电极重复峰值电流	Pluse, $t_p = 1\text{ ms}, T_j = 25^\circ\text{C}$	1200	A
P_{tot}	Total power dissipation 总耗散功率(热阻)	$T_c = 25^\circ\text{C}, T_j = 175^\circ\text{C}$	3125	W

Characteristics Values/特征值

Symbol	Items	Conditions		Values			Units
				Min.	Typ.	Max.	
V _{CE sat}	Collector-Emitter Saturation Voltage 集电极-发射极饱和电压	I _C = 600 A, V _{GE} = 15 V	T _j = 25℃	-	1.58	2.2	V
		I _C = 600 A, V _{GE} = 15 V	T _j = 125℃	-	1.71	-	V
		I _C = 600 A, V _{GE} = 15 V	T _j = 150℃	-	1.75	-	V
V _{GEth}	Gate threshold voltage 栅极阈值电压	V _{CE} = V _{GE} , I _C = 24 mA	T _j = 25℃	5.5	-	7.5	V
Q _G	Gate charge 栅极电荷	V _{GE} = -8 V...+15 V	-	-	2.32	-	uC
R _{gint}	Internal gate resistance 内部栅极电阻	-	T _j = 25℃	-	4.0	-	Ω
I _{SC}	SC data 短路数据	V _{GE} = 15 V, V _{CC} = 800 V V _{CEmax} = V _{CES} - L _{sCE} ·di/dt	T _P ≤ 10 μs T _j = 25℃	-	3790	-	A
C _{ies}	Input capacitance 输入电容	f = 1 MHz, V _{GE} = 0 V, V _{CE} = 25 V	T _j = 25℃	-	40	-	nF
C _{res}	Reverse capacitance 反向传输电容			-	0.46	-	nF
I _{CES}	C-E cut-off current 集电极-发射极截止电流	V _{CE} = 1200 V, V _{GE} = 0 V,	T _j = 25℃	-	-	100	uA
I _{GES}	G-E leakage current 栅极-发射极漏电流	V _{CE} = 0 V, V _{GE} = 20 V,	T _j = 25℃	-200	-	200	nA

BG600B12ME4R

Symbol	Items	Conditions		Values			Units
				Min.	Typ.	Max.	
$t_{d\ on}$	Turn-on delay time 开通延迟时间	$I_C = 600\ A,$ $V_{CE} = 600\ V$ $V_{GE} = -7\ V...+15\ V$ $R_{Gon} = 3.3\Omega,$ $L_s = 30\ nH$	$T_j = 25^{\circ}C$	-	156	-	ns
			$T_j = 125^{\circ}C$	-	153	-	ns
			$T_j = 150^{\circ}C$	-	153	-	ns
t_r	Rise time 上升时间		$T_j = 25^{\circ}C$	-	87	-	ns
			$T_j = 125^{\circ}C$	-	94	-	ns
			$T_j = 150^{\circ}C$	-	94	-	ns
E_{on}	Turn-on energy loss 开通损耗能量		$T_j = 25^{\circ}C$	-	65	-	mJ
			$T_j = 125^{\circ}C$	-	87	-	mJ
			$T_j = 150^{\circ}C$	-	85	-	mJ
$t_{d\ off}$	Turn-off delay time, 关断延迟时间	$I_C = 600\ A,$ $V_{CE} = 600\ V$ $V_{GE} = -7\ V...+15\ V$ $R_{Goff} = 11\Omega,$ $L_s = 30\ nH$	$T_j = 25^{\circ}C$	-	1141	-	ns
			$T_j = 125^{\circ}C$	-	1244	-	ns
			$T_j = 150^{\circ}C$	-	1302	-	ns
t_f	Fall time 下降时间		$T_j = 25^{\circ}C$	-	108	-	ns
			$T_j = 125^{\circ}C$	-	211	-	ns
			$T_j = 150^{\circ}C$	-	253	-	ns
E_{off}	Turn-off energy loss 关断损耗能量		$T_j = 25^{\circ}C$	-	80	-	mJ
			$T_j = 125^{\circ}C$	-	100	-	mJ
			$T_j = 150^{\circ}C$	-	98	-	mJ

□ FRD/二极管

● Maximum Rated Values/最大额定值

Symbol	Items	Conditions	Values	Units
V_{RRM}	Repetitive peak reverse voltage 反向重复峰值电压	$T_j = 25^\circ C$	1200	V
I_F	Forward current of diode 连续正向直流电流	$T_j = 25^\circ C$	600	A
I_{FRM}	Repetitive peak forward current 正向重复峰值电流	Pluse, $t_p = 1ms$, $T_j = 25^\circ C$	1200	A
I^2t	I^2t – value I^2t -值	$t_p = 10\ ms$, $T_{vj} = 125^\circ C$	54450	A^2s
		$t_p = 10\ ms$, $T_{vj} = 150^\circ C$	28800	A^2s

● Characteristics Values/特征值

Symbol	Items	Conditions	Values			Units
			Min.	Typ.	Max.	
V_F	Forward voltage 正向电压	$I_F = 600\ A$, $V_{GE} = 0\ V$	$T_j = 25^\circ C$	-	2.10	V
			$T_j = 125^\circ C$	-	2.12	V
			$T_j = 150^\circ C$	-	2.15	V

BG600B12ME4R

Symbol	Items	Conditions		Values			Units
				Min.	Typ.	Max.	
I_{RM}	Peak reverse recovery current 反向恢复峰值电流	$I_F = 600\text{ A},$ $V_R = 600\text{ V},$ $di/dt = 4834\text{ A/us},$ $V_{GE} = -7\text{ V}...+15\text{ V},$ $L_s = 30\text{ nH}$	$T_j = 25^{\circ}\text{C}$	-	350	-	A
			$T_j = 125^{\circ}\text{C}$	-	451	-	A
			$T_j = 150^{\circ}\text{C}$	-	484	-	A
Q_r	Recovered charge 恢复电荷		$T_j = 25^{\circ}\text{C}$	-	53	-	uC
			$T_j = 125^{\circ}\text{C}$	-	116	-	uC
			$T_j = 150^{\circ}\text{C}$	-	128	-	uC
E_{rec}	Reverse recovery energy 反向恢复损耗		$T_j = 25^{\circ}\text{C}$	-	17	-	mJ
			$T_j = 125^{\circ}\text{C}$	-	42	-	mJ
			$T_j = 150^{\circ}\text{C}$	-	47	-	mJ

□ Module/模块

Symbol	Items	Conditions	Values			Units
			Min.	Typ.	Max.	
T_{jmax}	Maximum junction temperature 最大结温	-	-	-	175	$^{\circ}\text{C}$
T_{jop}	Temperature under switching conditions 工作结温	-	-40	-	150	$^{\circ}\text{C}$
T_{stg}	Storage temperature 储存温度	-	-40	-	125	$^{\circ}\text{C}$
$R_{thjc\text{ IGBT}}$	Junction-to-Case 结-壳热阻	per IGBT 每个 IGBT	-	-	0.053	K/W
$R_{thjc\text{ Diode}}$	Junction-to-Case 结-壳热阻	per diode 每个二极管	-	-	0.051	K/W
L_{sCE}	Stray inductance, module 杂散电感, 模块	-	-	22.28	-	nH
$R_{CC'+EE'}$	Module lead resistance, terminals - chip 模块引线电阻, 端子-芯片	$T_j = 25^{\circ}\text{C}$, per switch	-	1.2	-	m Ω
V_{isol}	Isolation test voltage 绝缘测试电压	RMS, $f = 50\text{ Hz}$, $t = 1\text{ min.}$	3.8	-	-	KV
ds	Creepage distance 爬电距离	Terminal to terminal 端子到端子	-	13	-	mm
		Terminal to base 端子到底板	-	15	-	
ds	Clearance 电气间隙	Terminal to terminal 端子到端子	-	10	-	
		Terminal to base 端子到底板	-	12.5	-	

BG600B12ME4R

Symbol	Items	Conditions	Values			Units
			Min.	Typ.	Max.	
M ₁	Mounting torque for modul mounting 模块的安装扭矩	Screw M5 M5 螺栓	3	-	6	N.m
M ₂	Terminal connection torque 端子的连接扭矩	Screw M6 M6 螺栓	3	-	6	N.m
-	Internal isolation 内部绝缘	ceramics 陶瓷	Al ₂ O ₃			
-	Material of module baseplate 模块基板材料	-	Cu			
L x W x H	Dimensions 尺寸	-	152.1×62×20.8			mm
m	Weight 重量	-	345			g
CTI	Comparative tracking index 相对电痕指数	-	>200			

□ NTC-Thermistor/负温度系数热敏电阻

Symbol	Items	Conditions	Values			Units
			Min.	Typ.	Max.	
R ₂₅	Rated resistance 额定电阻值	T _C = 25℃	-	5.0	-	KΩ
ΔR/R	Deviation of R100 R100 偏差	T _C = 100℃, R ₁₀₀ = 493 Ω	-5	-	5	%
P ₂₅	Power dissipation 耗散功率	T _C = 25℃	-	-	20	mW
B _{25/50}	B-value/B-值	$R_2 = R_{25} \exp[B_{25/50}(1/T_2 - 1/(298.15K))]$	-	3375	-	K
B _{25/80}	B-value/ B-值	$R_2 = R_{25} \exp[B_{25/80}(1/T_2 - 1/(298.15K))]$	-	3411	-	K
B _{25/100}	B-value/ B-值	$R_2 = R_{25} \exp[B_{25/100}(1/T_2 - 1/(298.15K))]$	-	3433	-	K

BG600B12ME4R

□ Characteristics Diagrams/特性曲线

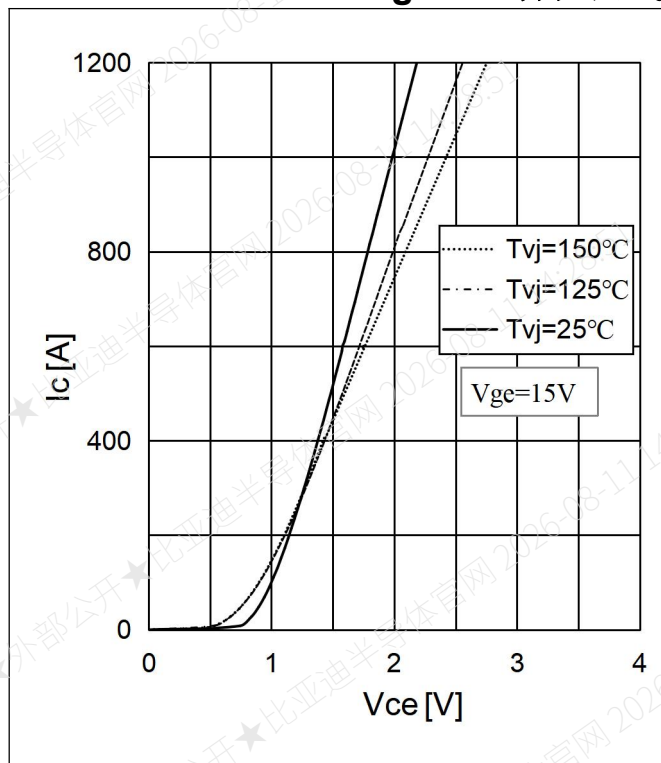


Fig.1: Output Characteristics
图 1: 输出特性

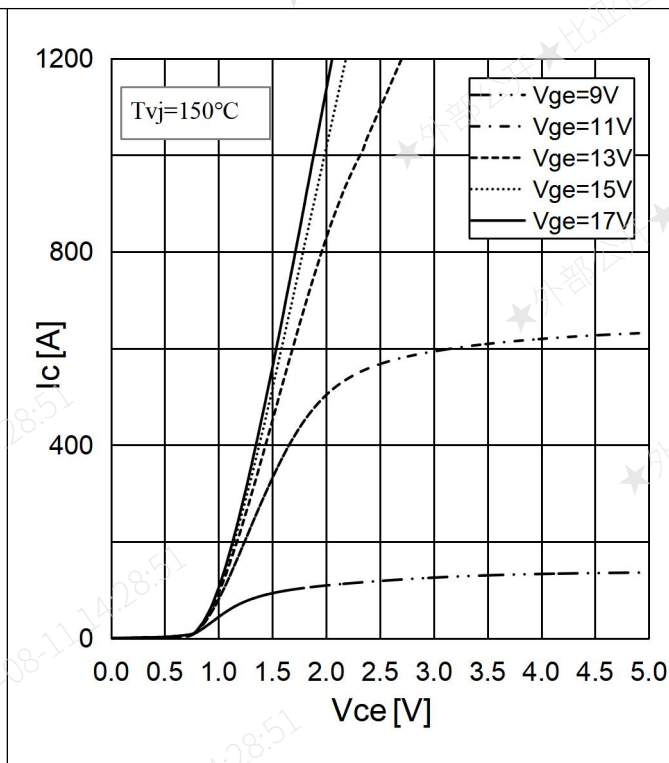


Fig.2: Output Characteristics
图 2: 输出特性

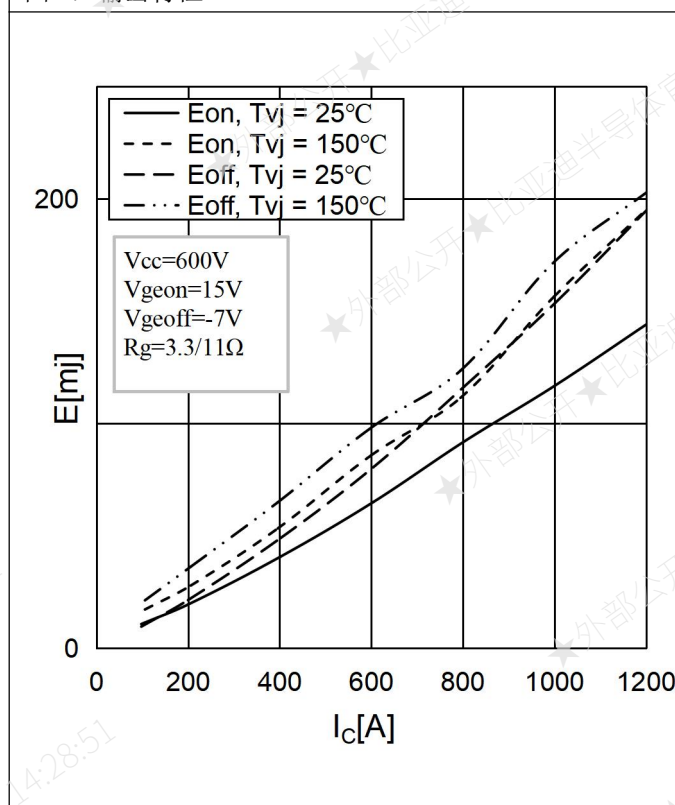


Fig.3: Switching Loss vs. Collector Current
图 3: 开关损耗与集电极电流关系

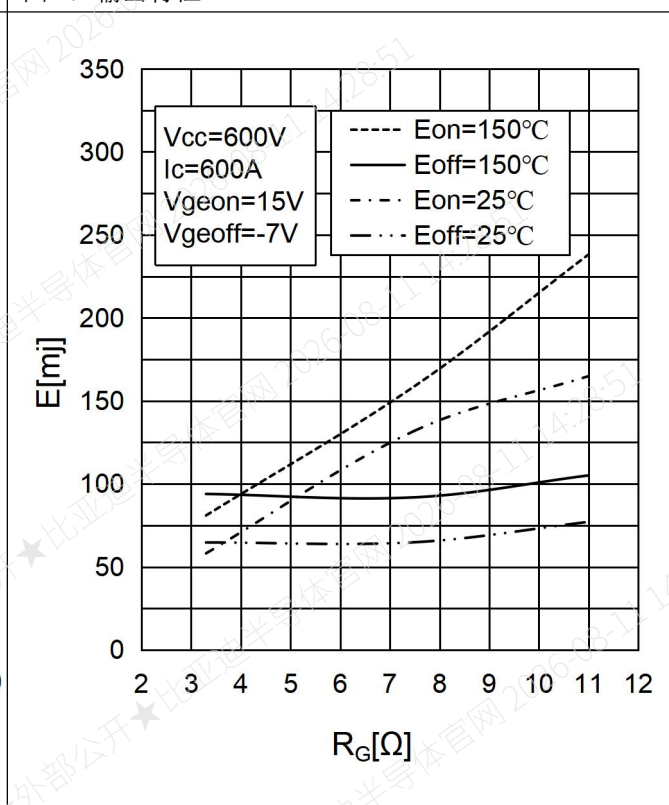


Fig.4: Switching Loss vs. Gate Resistor
图 4: 开关损耗与门极电阻关系

BG600B12ME4R

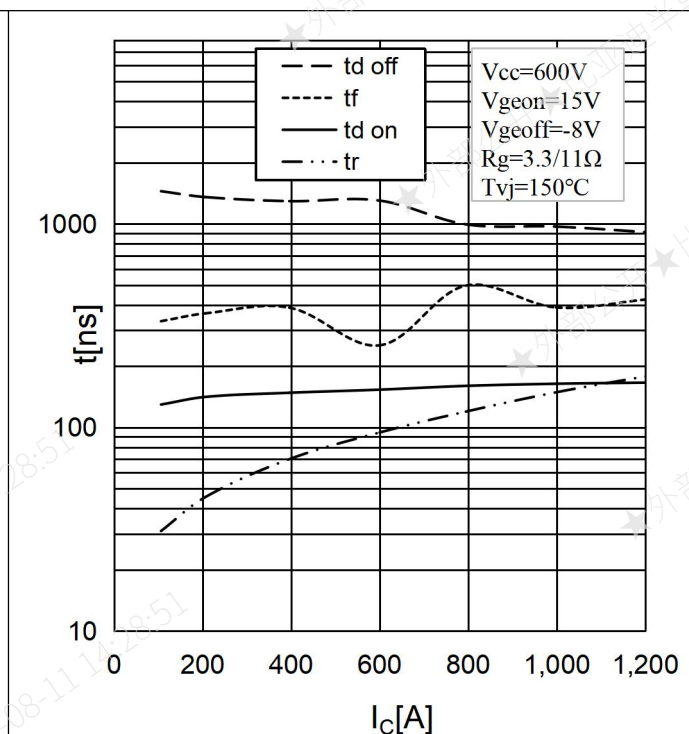
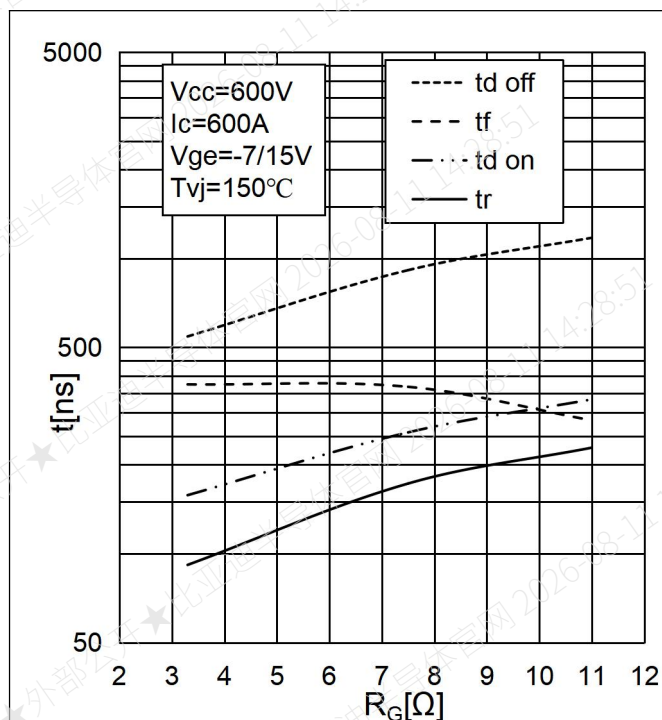


Fig.5: Switching Times vs. Gate Resistor
图 5: 开关时间与门极电阻关系

Fig.6: Switching Times vs. I_c
图 6: 开关时间与集电极电流关系

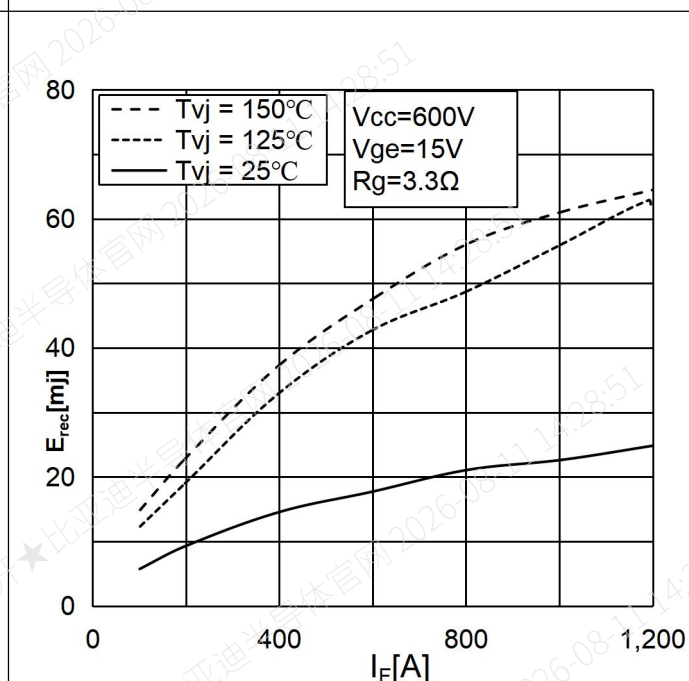
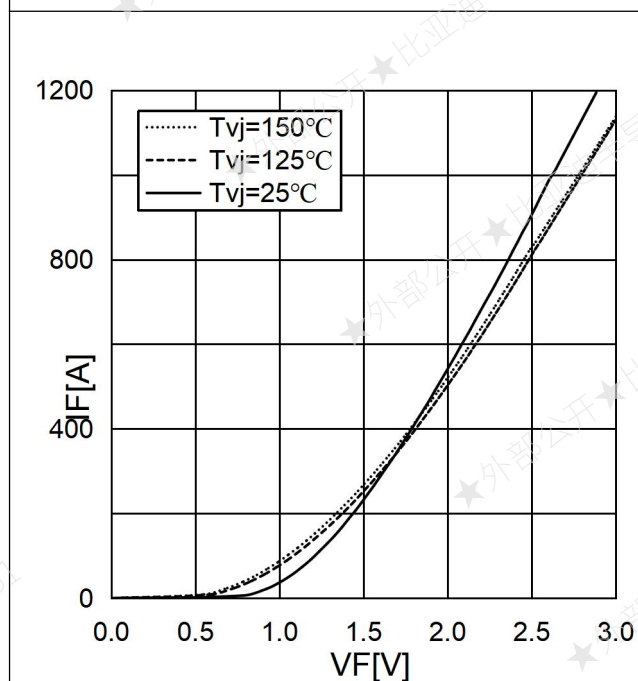


Fig.7: Forward characteristic
图 7: 正向特性

Fig.8: Reverse recovery Energy
图 8: 反向恢复损耗

BG600B12ME4R

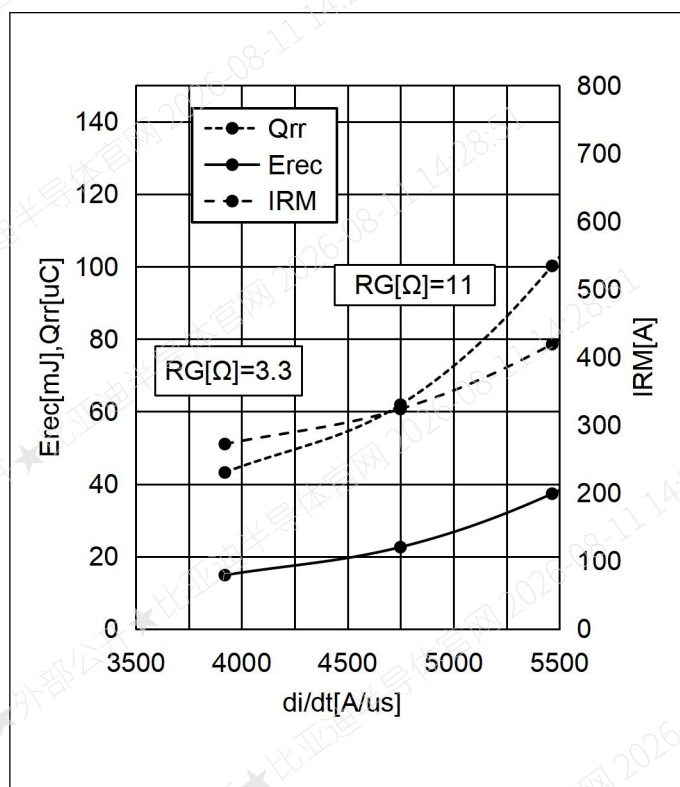


Fig.9: Reverse recovery characteristics vs. di/dt
图 9: 反向恢复特性

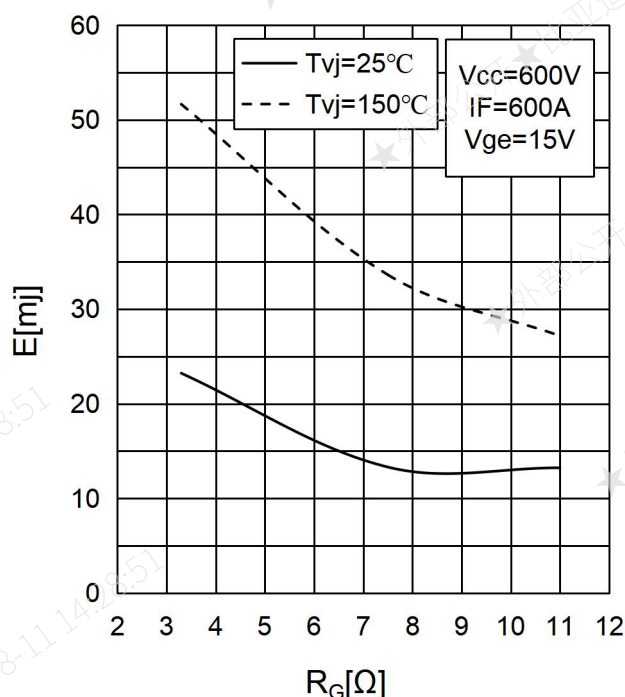


Fig.10: Reverse recovery Energy vs. Gate Resistor
图 10: 反向恢复损耗与门极电阻关系

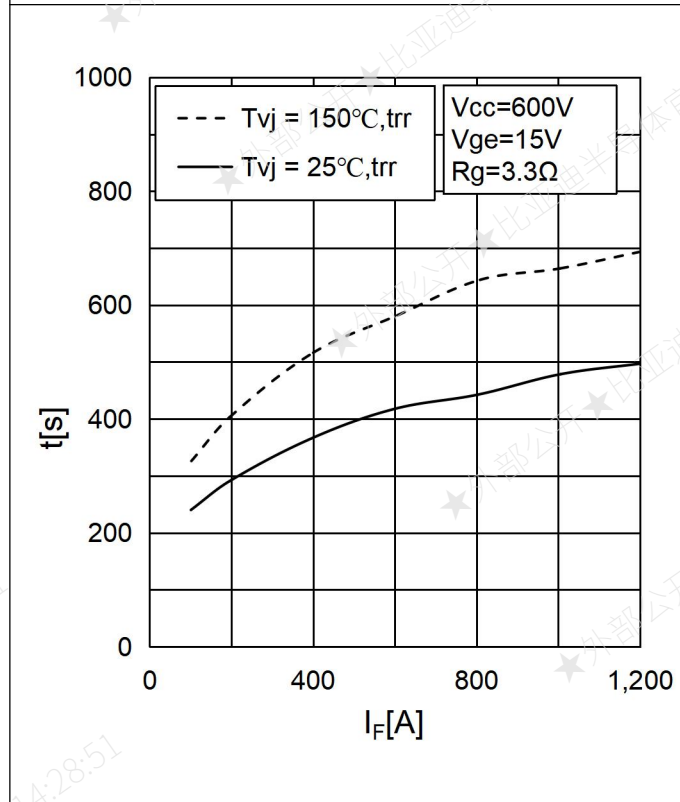


Fig.11: Reverse Recovery Times vs. IF
图 11: 反向恢复时间与正向电流关系

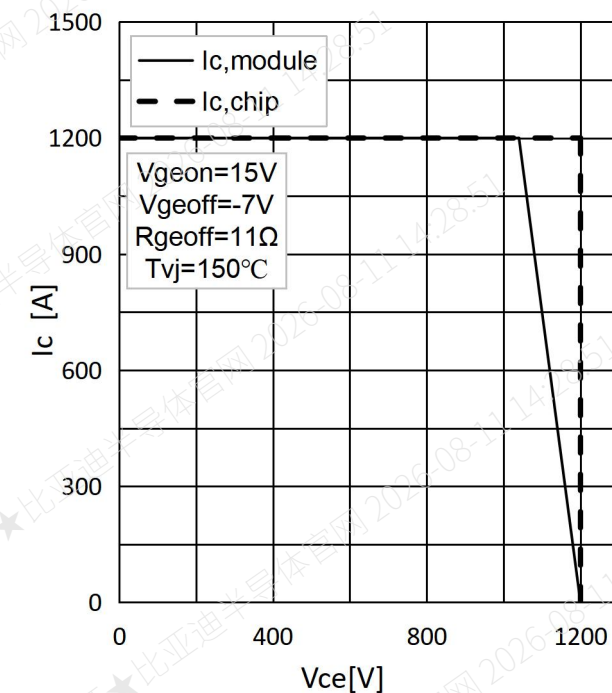


Fig.12: Reverse Bias Safe Operating Area
图 12: 反偏安全工作区

BG600B12ME4R

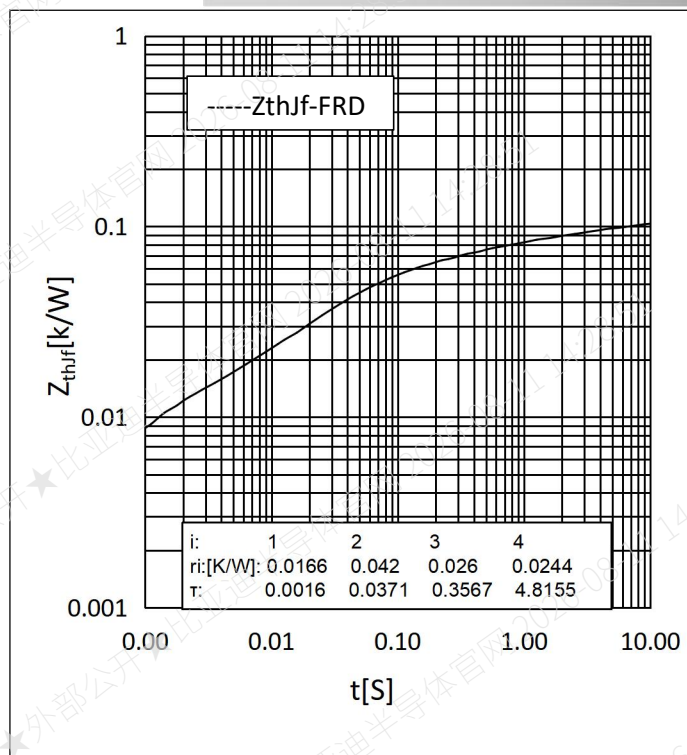


Fig.13: Typ. transient thermal impedance
图 13: 典型的瞬态热阻抗 Z_{thJf}

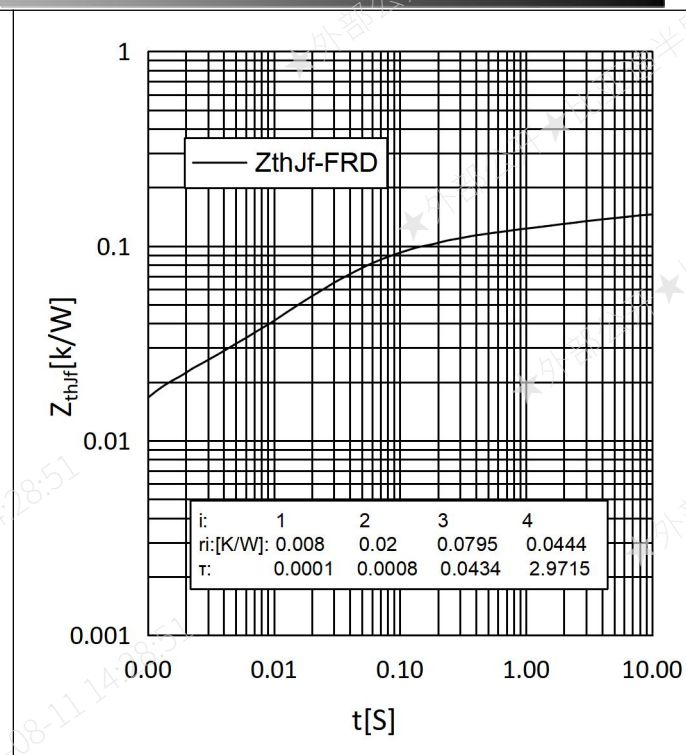


Fig.14: Typ. transient thermal impedance
图 14: 典型的瞬态热阻抗 Z_{thJf}

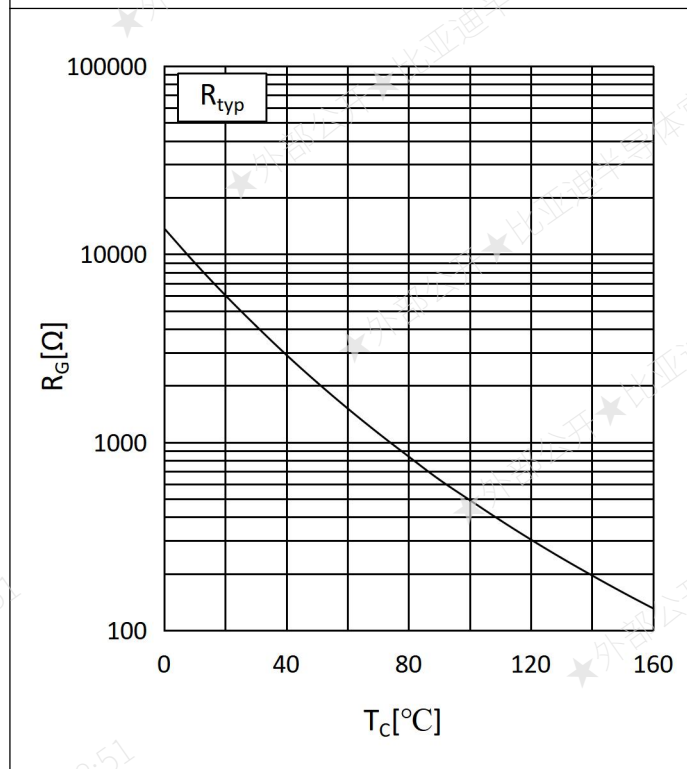
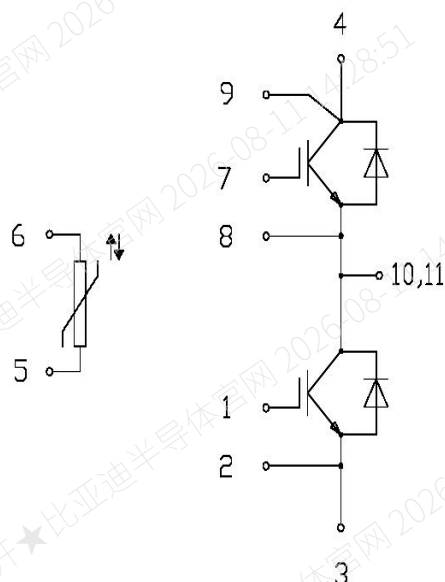


Fig.15:Typ. NTC-Temperature Characteristics
图 15: 典型的 NTC 电阻-温度特性

BG600B12ME4R

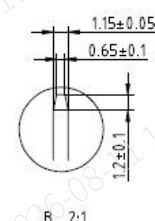
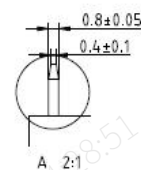
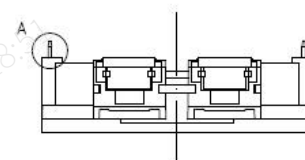
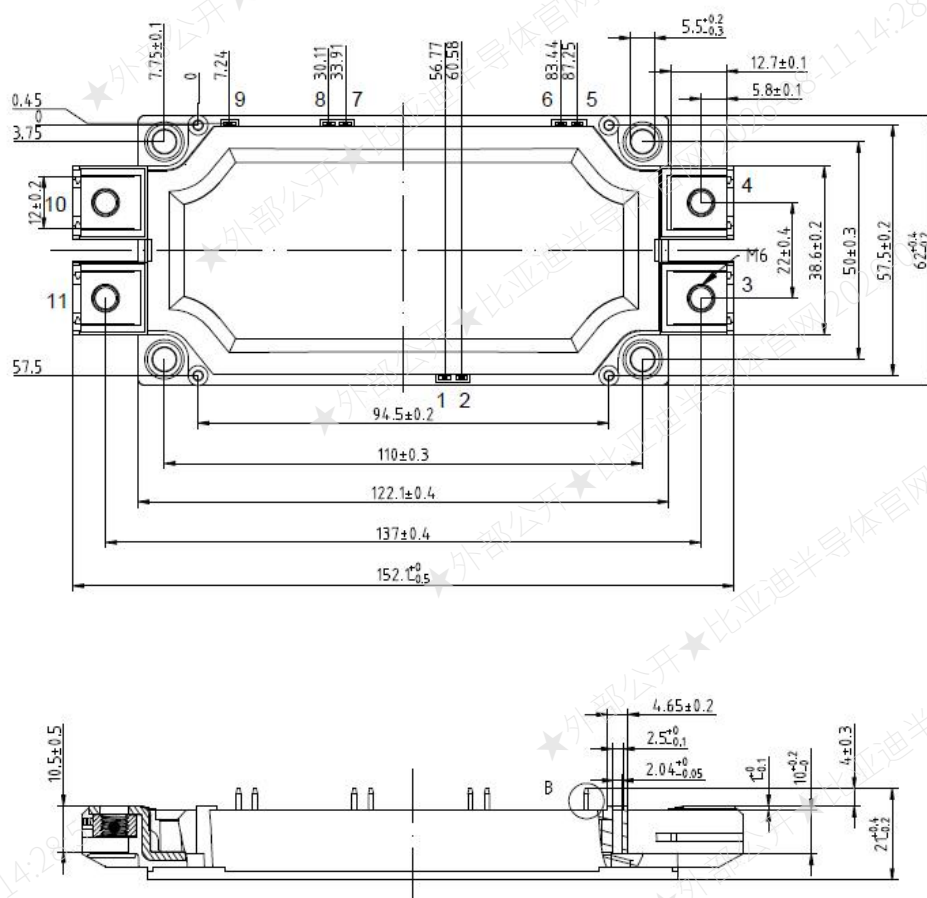
□ Circuit Diagram/接线图



- (1)GL-Gate Low
- (2)EL-Emitter Low
- (3)N-Negative Power
- (4)P-Positive Power
- (5)T1-NTC
- (6)T2-NTC
- (7)GH-Gate High
- (8)EH-Emitter High
- (9)CH-Collector High
- (10)/(11) AC Output

- (1) GL-下桥门极
- (2) EL-下桥发射极
- (3) N-负电极
- (4) P-正电极
- (5) T1-热敏电阻
- (6) T2-热敏电阻
- (7) GH-上桥门极
- (8) EH-上桥发射极
- (9) CH-上桥集电极
- (10)/(11)交流输出端

□ Package outlines/封装尺寸



BG600B12ME4R**□ Attention/警示****Correct and Safety Use of Power Module:**

功率模块安全正确的使用方法:

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.

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。

During Transit:**运输过程:**

- Tossing or dropping of a carton may damage devices inside.

包装箱颠簸或坠落可能导致内部器件损毁。

- 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.

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:**存储:**

- 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.

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。

Prolonged Storage:**长期存储:**

- 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.

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:**应用环境:**

- 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.

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。

- Silicone modules are not suitable for flip-chip applications.

硅胶模块，不适合用于倒装。

BG600B12ME4R**Anti-electrostatic Measures:****防静电措施:**

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

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。

- Precautions against the device rupture caused by static electricity.

预防措施可以防止静电击穿器件。

- 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。

- 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。

- 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。

- 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触地面。

- Use soldering irons with grounded tips.

使用接地的烙铁头。

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- **Warranty Period:** Unless otherwise agreed in the COOPERATION AGREEMENT or other WRITTEN DOCUMENTS, the Warranty Period for products specified in this specification shall be 12 months from the date of shipment.

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