中国中车 CRRC

产品数据手册 Product Datasheet 版本 Ver.1908

TG400FF08S2-S3A01

六单元 IGBT 模块 Six-Pack IGBT Module

关键参数 Key Parameters

V_{CES}		750	V
$V_{CE(sat)}$	Typ.	1.70	V
I_C	Max.	400	A
$I_{C(RM)}$	Max.	800	A

典型应用 Typical Applications

- ●电动汽车应用 Automotive applications
- ●混合动力/纯电动车 Hybrid/Electrical vehicles
- ●电机驱动 Motor drives

特点 Features

- ●Cu 基板 Cu pin-fin baseplate
- ●增强型氧化铝衬板 Enhanced Al_2O_3 substrates
- ●750V 额定电压 Blocking Voltage 750V
- ●高电流密度 High current density

电路结构 Circuit Configuration

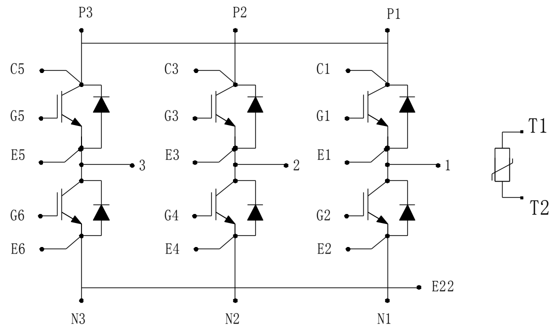


图 1.电路结构

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 Data position	数据内容 Content of data
1—8	模块批次号 Module batch number
9—12	模块序列号 Module serial number

Caution: This device is sensitive to electrostatic discharge. Users should follow ESD handling procedures.

注意：该器件对静电敏感，用户须采取 ESD 防护措施。

最大额定值 Absolute Maximum Ratings

符号 Symbol	参数名称 Parameter	测试条件 Test Conditions	数值 Value	单位 Unit
V_{CES}	集电极-发射极电压 Collector-emitter voltage	V_{GE} = 0V, T_C= 25 °C	750	V
V_{GES}	栅极-发射极电压 Gate-emitter voltage	T_C= 25 °C	± 20	V
I_C	集电极电流 Collector-emitter current	T_F = 65 °C, $T_{vj\,max}$ = 175°C	320	A
	额定电流 Rating current		400	A
$I_{C(PK)}$	集电极峰值电流 Peak collector current	t_P=1ms	800	A
P_{max}	晶体管部分最大损耗 Max. transistor power dissipation	T_F = 25 °C, $T_{vj\,max}$ = 175°C	880	W
I^2t	二极管 I^2t 值 Diode I^2t	V_R =0V, t_P = 10ms, T_{vj} = 150 °C	8500	A^2s
V_{isol}	绝缘电压(模块) Isolation voltage – per module	短接所有端子，端子与基板间施加电压 (Commoned terminals to baseplate), AC RMS,1 min, 50Hz,T_C= 25 °C	2500	V

热和机械数据 Thermal & Mechanical Data

参数 Symbol	说明 Explanation	值 Value	单位 Unit
爬电距离 Creepage distance	端子-散热器 Terminal to heatsink	12	mm
	端子-端子 Terminal to terminal	6.1	mm
绝缘间隙 Clearance	端子-散热器 Terminal to heatsink	12	mm
	端子-端子 Terminal to terminal	6.1	mm
相对漏电起痕指数 CTI (Comparativetrackingindex)		＞200	

热和机械数据 Thermal & Mechanical Data

符号 Symbol	参数名称 Parameter	测试条件 Test Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
$R_{th(J\text{-}F)\ IGBT}$	IGBT 结水热阻 Thermal resistance – IGBT	冷却液：50%乙二醇溶液；△V/△t=10 dm^3/min Cooling Fluid：50% water / 50% enthylenglycol; △V/△t=10 dm^3/min		155	170	K / kW
$R_{th(J\text{-}F)\ Diode}$	二极管结水热阻 Thermal resistance – Diode			230	260	K / kW
△P	冷却液流阻 Pressure drop in cooling circuit	冷却液：50%乙二醇溶液；△V/△t=10 dm^3/min Cooling Fluid：50% water / 50% enthylenglycol; △V/△t=10 dm^3/min; T_F = 25 °C		89		mbar
P	冷却液最大压力 Maximum pressure in cooling circuit				2	bar
$T_{vj\ op}$	工作结温 Operating junction temperature	IGBT 部分（IGBT）	-40		150	°C
		二极管部分(Diode)	-40		150	°C
T_{stg}	存储温度 Storage temperature range		-40		125	°C
M	安装力矩 Screw torque	安装紧固用– M5 Mounting – M5	3		6	Nm
		电路互连用– M6 Electrical connections – M6	3		6	Nm

热敏电阻数据 NTC-Thermistor Data

符号 Symbol	参数名称 Parameter	测试条件 Test Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
R_{25}	额定电阻值 Rated resistance	T_C = 25 °C		5		kΩ
△R/R	R100 偏差 Deviation of R100	T_C = 100 °C, R_{100}=493Ω	-5		5	%
P_{25}	耗散功率 Power dissipation	T_C = 25 °C			20	mW
$B_{25/50}$	B-值 B-value	$R_2 = R_{25}\exp[B_{25/50}(1/T_2 - 1/(298.15\ K))]$		3375		K
$B_{25/80}$	B-值 B-value	$R_2 = R_{25}\exp[B_{25/80}(1/T_2 - 1/(298.15\ K))]$		3411		K
$B_{25/100}$	B-值 B-value	$R_2 = R_{25}\exp[B_{25/100}(1/T_2 - 1/(298.15\ K))]$		3433		K

电特性值 Electrical Characteristics

除非特别声明，否则 T_C= 25 °C　　T_C= 25 °C unless otherwise stated

符号 Symbol	参数名称 Parameter	测试条件 Test Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
I_{CES}	集电极截止电流 Collector cut-off current	V_{GE} = 0V,V_{CE} = V_{CES}			1	mA
		V_{GE} = 0V, V_{CE} = V_{CES}, T_C=125 °C			10	mA
		V_{GE} = 0V, V_{CE} = V_{CES}, T_C=150 °C			15	mA
I_{GES}	栅极漏电流 Gate leakage current	V_{GE} = ±20V, V_{CE} = 0V			0.5	μA
$V_{GE\ (TH)}$	栅极-发射极阈值电压 Gate threshold voltage	I_C = 10mA, V_{GE} = V_{CE}	5.30	5.90	6.50	V
$V_{CE\ (sat)}^{(*1)}$	集电极-发射极饱和电压 Collector-emitter saturation voltage	V_{GE} =15V, I_C = 400A		1.70	2.10	V
		V_{GE} =15V, I_C = 400A,T_{vj} = 125 °C		1.95		V
		V_{GE} =15V, I_C = 400A,T_{vj} = 150 °C		2.00		V
I_F	二极管正向直流电流 Diode forward current	DC		320		A
	二极管额定正向电流 Diode rating forward current			400		A
I_{FRM}	二极管正向重复峰值电流 Diode peak forward current	t_P = 1ms		800		A
$V_F^{(*1)}$	二极管正向电压 Diode forward voltage	I_F = 400A, V_{GE} = 0		1.60	2.00	V
		I_F = 400A, V_{GE} = 0, T_{vj} = 125 °C		1.70		V
		I_F = 400A, V_{GE} = 0, T_{vj} = 150 °C		1.70		V
I_{SC}	短路电流 Short circuit current	T_{vj} = 150°C, V_{CC} = 400V, V_{GE}≤15V, t_p≤6μs, $V_{CE(max)}$ = V_{CES} – $L^{(*2)}$×di/dt, IEC 6074-9		1600		A

电特性值 Electrical Characteristics

除非特别声明，否则 T_C= 25 °C T_C= 25 °C unless otherwise stated

符号 Symbol	参数名称 Parameter	测试条件 Test Conditions	最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
C_{ies}	输入电容 Input capacitance	V_{CE} = 25V, V_{GE} = 0V, f = 100kHz		33		nF
Q_g	栅极电荷 Gate charge	±15V		2.5		μC
C_{res}	反向传输电容 Reverse transfer capacitance	V_{CE} = 25V, V_{GE} = 0V, f = 100kHz		0.5		nF
L_M	模块电感 Module inductance			15		nH
R_{INT}	内阻 Internal transistor resistance			1		mΩ

电特性值 Electrical Characteristics

符号 Symbol	参数名称 Parameter	测试条件 Test Conditions		最小值 Min.	典型值 Typ.	最大值 Max.	单位 Unit
$t_{d(off)}$	关断延迟时间 Turn-off delay time	I_C =400A, V_{CE} = 400V, V_{GE} = ±15V, $R_{G(OFF)}$ = 1.8Ω, L_S = 50nH, dv/dt =6700V/us (T_{vj}= 150 °C).	T_{vj}= 25 °C		515		ns
			T_{vj}= 125 °C		550		
			T_{vj}= 150°C		560		
t_f	下降时间 Fall time		T_{vj}= 25 °C		60		ns
			T_{vj}= 125 °C		75		
			T_{vj}= 150°C		85		
E_{OFF}	关断损耗 Turn-off energy loss		T_{vj}= 25 °C		18.0		mJ
			T_{vj}= 125 °C		21.0		
			T_{vj}= 150°C		23.0		
$t_{d(on)}$	开通延迟时间 Turn-on delay time	I_C =400A, V_{CE} = 400V, V_{GE} = ±15V, $R_{G(ON)}$ = 1.8Ω, L_S = 50nH, di/dt = 6100A/us (T_{vj}= 150°C).	T_{vj}= 25 °C		420		ns
			T_{vj}= 125 °C		420		
			T_{vj}= 150°C		420		
t_r	上升时间 Rise time		T_{vj}= 25 °C		65		ns
			T_{vj}= 125 °C		70		
			T_{vj}= 150°C		70		
E_{ON}	开通损耗 Turn-on energy loss		T_{vj}= 25 °C		4.5		mJ
			T_{vj}= 125 °C		5.5		
			T_{vj}= 150°C		6.5		
Q_{rr}	二极管反向恢复电荷 Diode reverse recovery charge	I_F =400A, V_{CE} = 400V, - di_F/dt =6100A/us (T_{vj}= 150°C).	T_{vj}= 25 °C		35		μC
			T_{vj}= 125 °C		55		
			T_{vj}= 150°C		60		
I_{rr}	二极管反向恢复电流 Diode reverse recovery current		T_{vj}= 25 °C		265		A
			T_{vj}= 125 °C		300		
			T_{vj}= 150°C		320		
E_{rec}	二极管反向恢复损耗 Diode reverse recovery energy		T_{vj}= 25 °C		12.5		mJ
			T_{vj}= 125 °C		19.5		
			T_{vj}= 150°C		21.0		

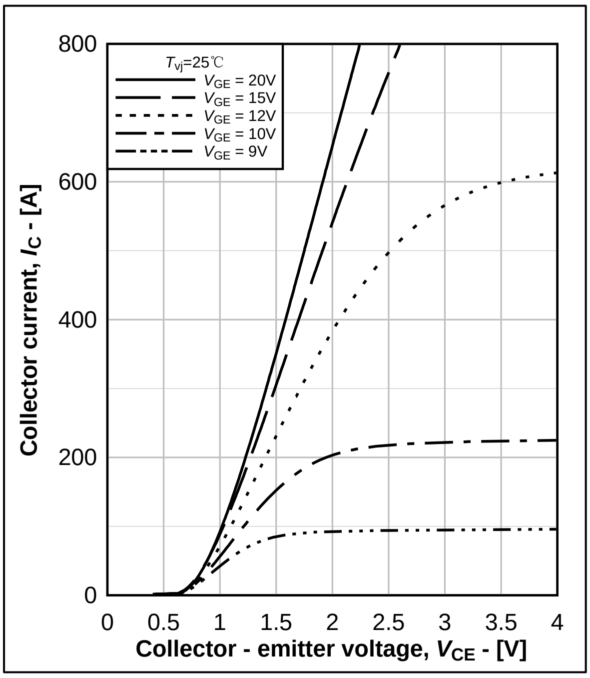


图 3. IGBT 输出特性典型曲线,I_C= f (V_{CE})

Fig.3 Typical IGBT output characteristics, I_C= f (V_{CE})

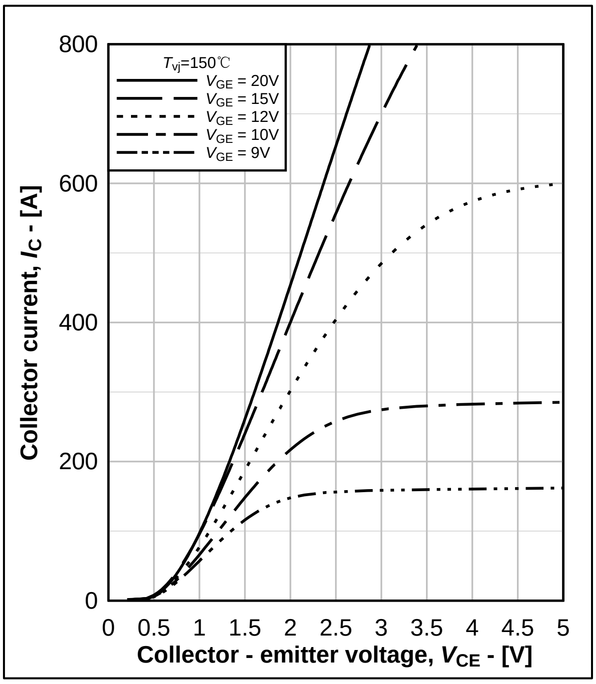


图 4. IGBT 输出特性典型曲线,I_C= f (V_{CE})

Fig.4 Typical IGBT output characteristics, I_C= f (V_{CE})

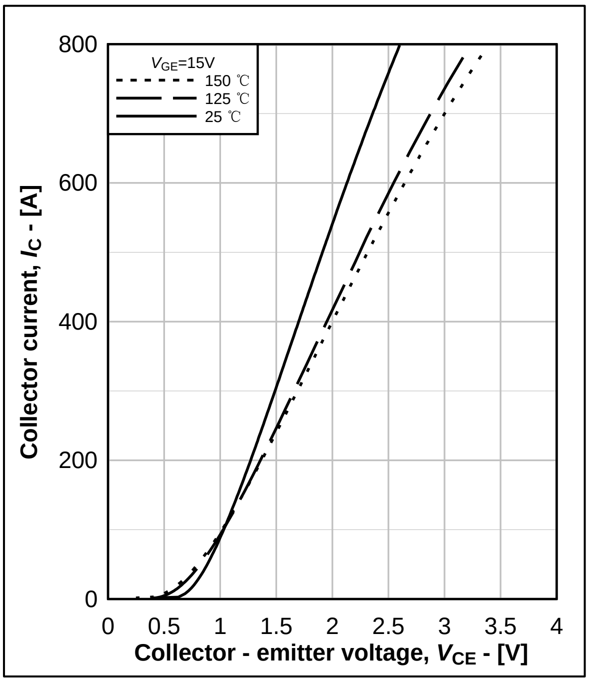


图 5. IGBT 输出特性典型曲线,I_C= f (V_{CE})

Fig.5 Typical IGBT output characteristics, I_C= f (V_{CE})

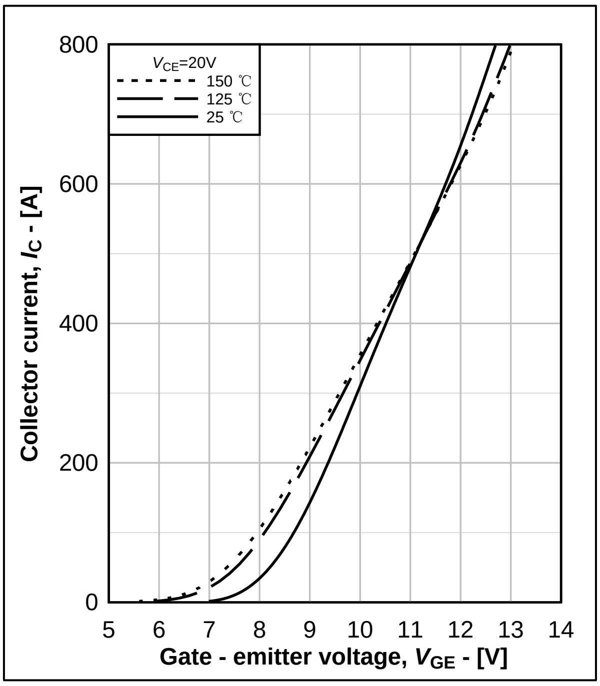


图 6. IGBT 传输特性典型曲线,I_C= f (V_{GE})

Fig.6 Typical IGBT transfer characteristics, I_C= f (V_{GE})

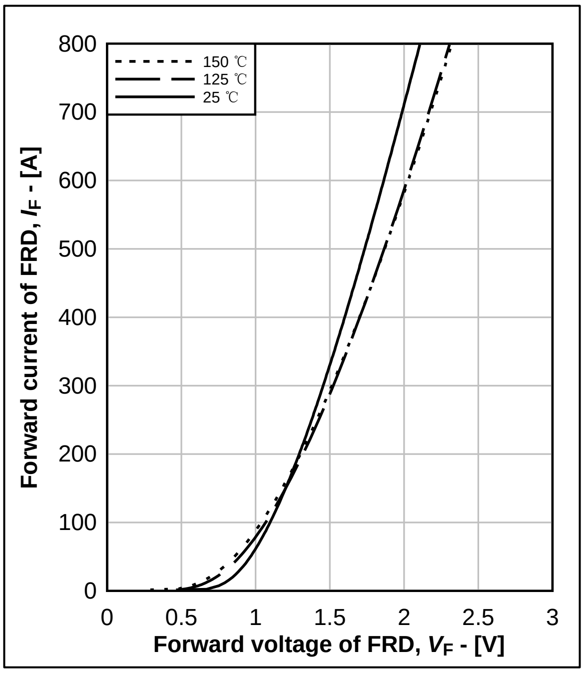


图 7. FRD 输出特性典型曲, I_F = f (V_F)

Fig.7 Typical FRD output characteristics, I_F = f (V_F)

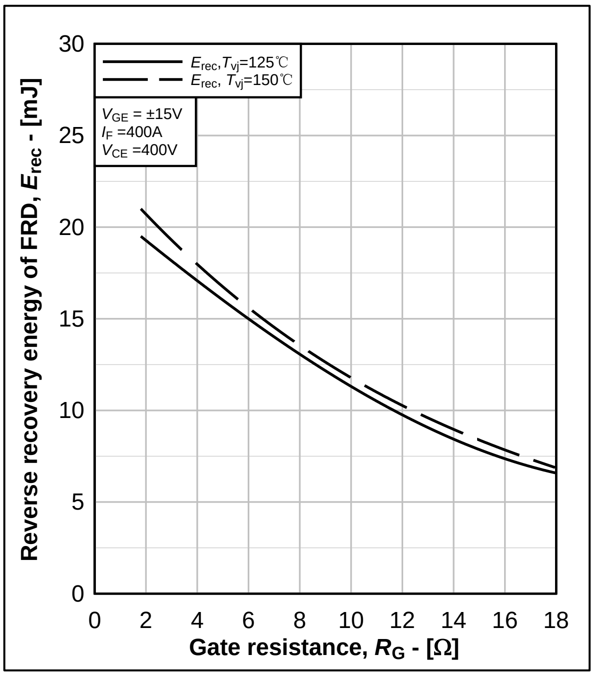


图 8. FRD 反向恢复能耗典型曲线, E_{rec}=f(R_G)

Fig.8 Typical FRD E_{rec}, E_{rec}=f(R_G)

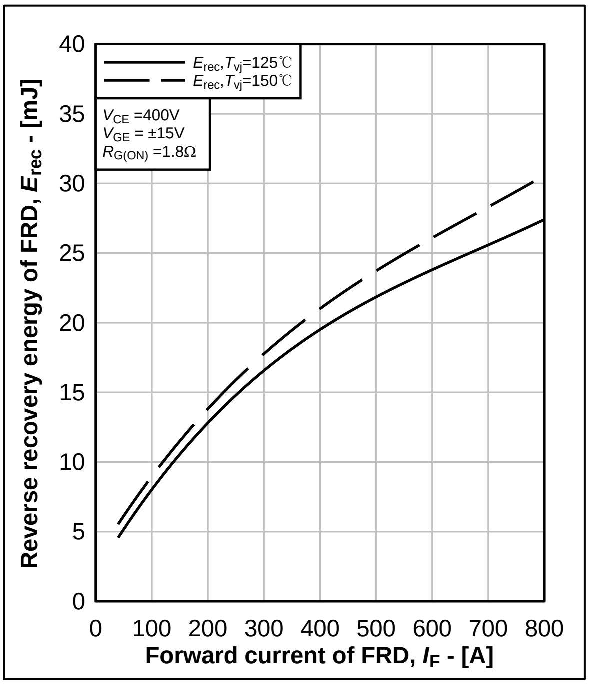


图 9. FRD 反向恢复能耗典型曲线, E_{rec}=f(I_F)

Fig.9 Typical FRD E_{rec}, E_{rec}=f(I_F)

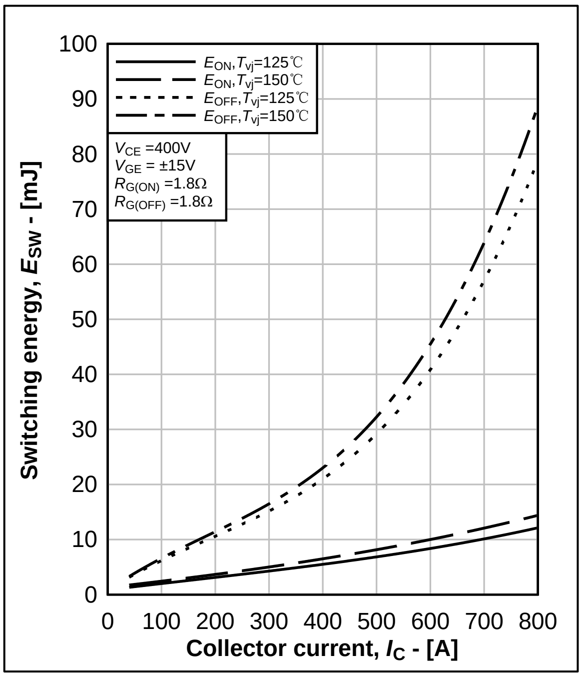


图 10. IGBT 开关能耗典型曲线, E_{on}= f (I_C), E_{off}= f (I_C)

Fig.10 Typical IGBT switching energy, E_{on}= f (I_C), E_{off}= f (I_C)

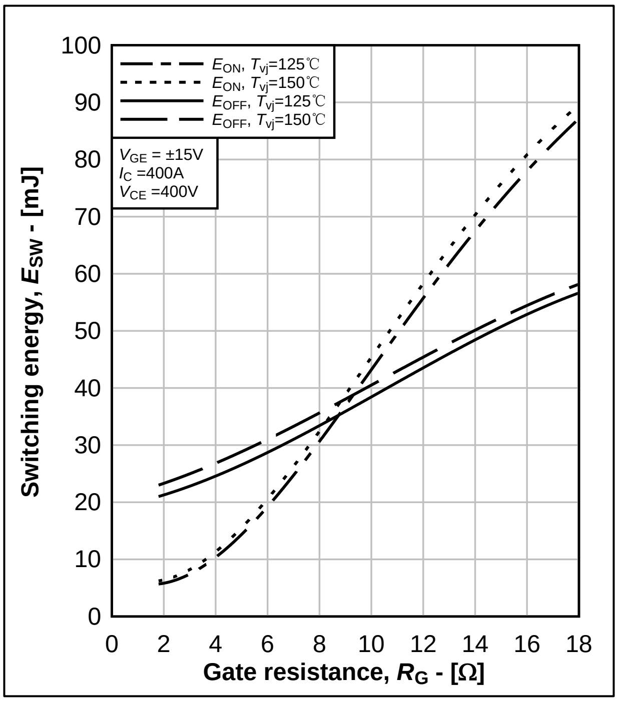


图 11. IGBT 开关能耗典型曲线,E_{on}= f (R_G), E_{off}= f (R_G)

Fig.11 Typical IGBT switching energy,

E_{on}= f(R_G), E_{off}= f (R_G)

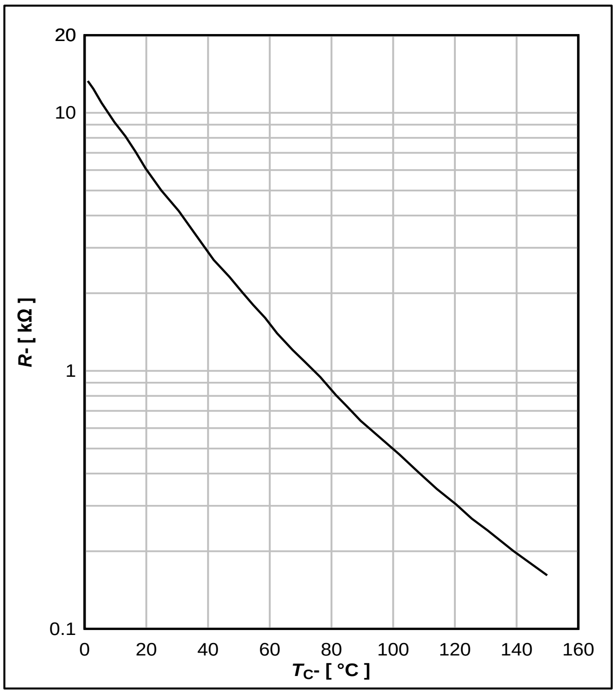


图 12. 热敏电阻典型特性曲线,R= f (T_C)

Fig.12Typical NTC thermistor characteristic, R= f(T_C)

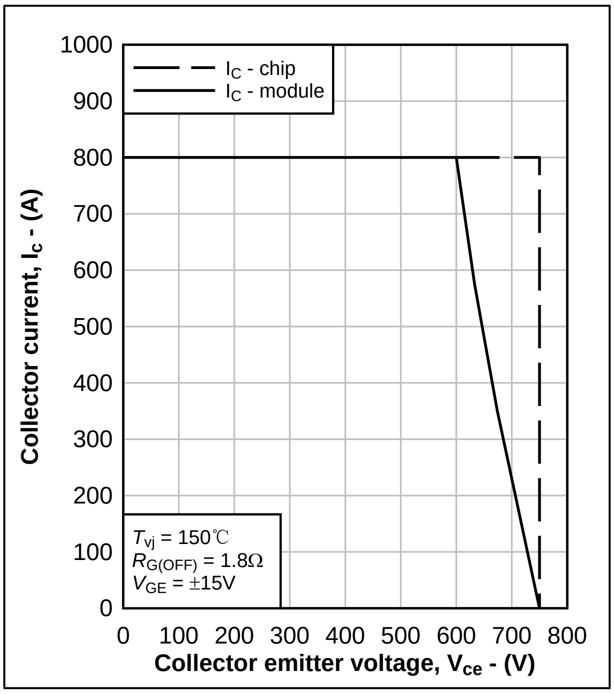


图 13. IGBT 反偏安全工作区,I_C = f (V_{CE})

Fig.13 Reverse bias safe operating area of IGBT,

I_C = f (V_{CE})

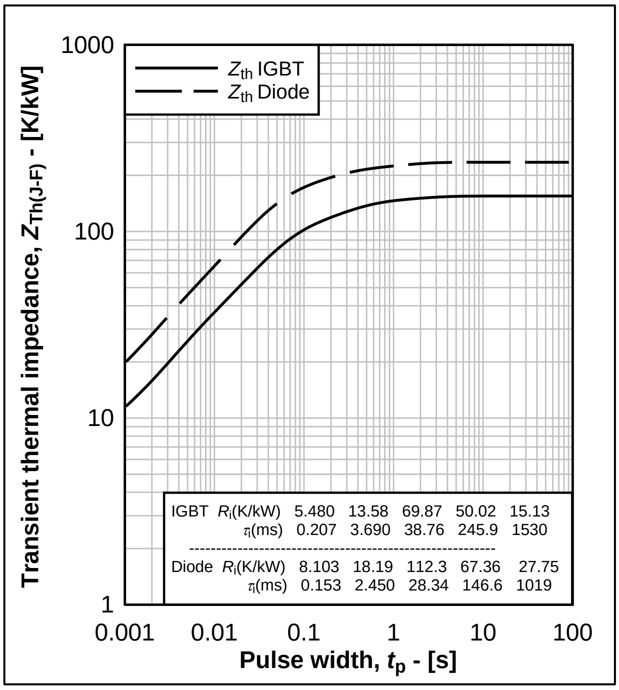
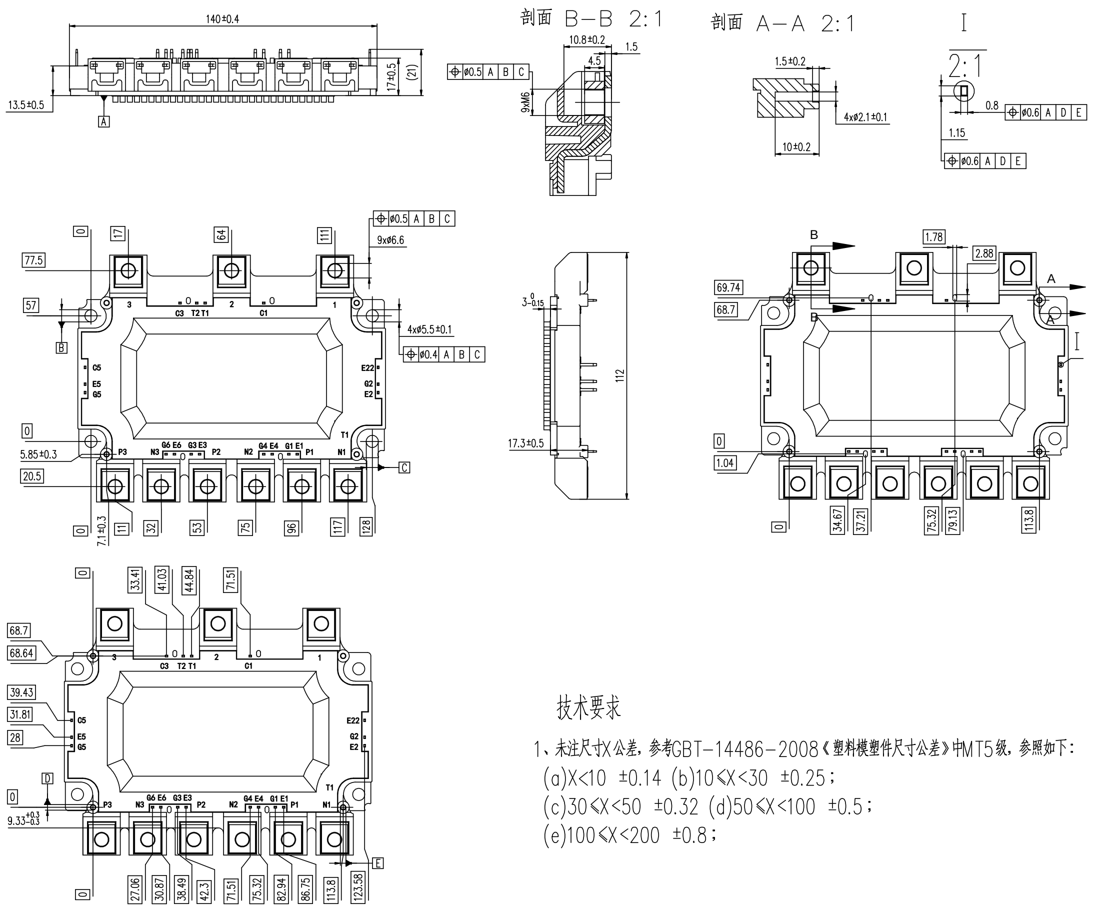


图 14. 瞬态热阻抗曲线,$Z_{Th(J-F)}$ = f (t_p)

Fig.14 Transient thermal impedance,$Z_{Th(J-F)}$ = f (t_p)



重量 Weight：565g 模块外观类型 Module outline code：S2

图 15. 模块外观尺寸

Fig. 15 Module outlines

株洲中车时代半导体有限公司

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Caution: This device is sensitive to electrostatic discharge. Users should follow ESD handling procedures.
注意：该器件对静电敏感，用户须采取 ESD 防护措施。

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(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.