中国中车 CRRC

TG600HF12W1-G300

半桥型 IGBT 模块 Half Bridge IGBT

产品数据手册 Product Datasheet 版本 Ver 22.06

关键参数 Key Parameters

V_{CES}		1200	V
$V_{CE(sat)}$	Typ.	1.75	V
I_C	Max.	600	A
$I_{C(RM)}$	Max.	1200	A

典型应用 Typical Applications

- 马达驱动 Motor Drives
- 大功率变流器 High Power Converters
- 风力发电 Wind Turbines
- UPS 系统 UPS Systems

特点 Features

- 铜基板 Cu Baseplate
- 氧化铝衬板 Al_2O_3 Substrates
- 高热循环能力 High Thermal Cycling Capability
- 高功率密度 High Power Density

电路结构 Circuit Configuration

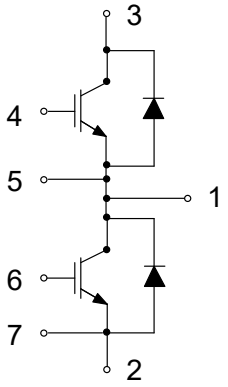


图 1. 电路结构

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

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	1200	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_C = 100 °C, $T_{vj\,max}$=175°C	600	A
$I_{C(PK)}$	集电极峰值电流 Peak collector current	t_P=1ms	1200	A
P_{max}	晶体管部分最大损耗 Max. transistor power dissipation	T_C = 25 °C, $T_{vj\,max}$=175°C	3.09	kW
I^2t	二极管 I^2t 值 Diode I^2t	V_R =0V, t_P = 10ms, T_{vj} = 150 °C	64.8	kA^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 (Connected terminals to base plate), AC RMS,1 min, 50Hz,T_C= 25 °C	4000	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	29.0	mm
	端子-端子 Terminal to terminal	23.0	mm
绝缘间隙 Clearance	端子-散热器 Terminal to heatsink	23.0	mm
	端子-端子 Terminal to terminal	11.0	mm
相对漏电起痕指数 CTI (Comparative Tracking Index)		>400	

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
$R_{th(J-C)\ IGBT}$	IGBT 结壳热阻 Thermal resistance – IGBT				48.5	K / kW
$R_{th(J-C)\ Diode}$	二极管结壳热阻 Thermal resistance – Diode				81.1	K / kW
$R_{th(C-H)\ IGBT}$	接触热阻(IGBT) Thermal resistance – case to heatsink (IGBT)	安装力矩 3.5Nm，导热脂 1W/m·K Mounting torque 3.5Nm, with mounting grease 1W/m·K		22.6		K / kW
$R_{th(C-H)}$ Diode	接触热阻(Diode) Thermal resistance – case to heatsink (Diode)	安装力矩 3.5Nm，导热脂 1W/m·K Mounting torque 3.5Nm, with mounting grease 1W/m·K		25.0		K / kW
$T_{vj\ op}$	工作结温 Operating junction temperature	IGBT 芯片(IGBT)	-40		150	°C
		二极管芯片(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– M6 Mounting – M6	3		6	Nm
		电路互连用 – M6 Electrical connections – M6	2.5		5.0	Nm

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	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_{vj} =125 °C			10	mA
		V_{GE} = 0V, V_{CE} = V_{CES}, T_{vj} =150 °C			20	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 = 20mA, V_{GE} = V_{CE}	5.50	6.10	6.70	V
$V_{CE\ (sat)}$ (*1)	集电极-发射极饱和电压 Collector-emitter saturation voltage	V_{GE} =15V, I_C = 600A		1.75	2.15	V
		V_{GE} =15V, I_C = 600A, T_{vj} = 125 °C		2.10		V
		V_{GE} =15V, I_C = 600A, T_{vj} = 150 °C		2.20		V
I_F	二极管正向直流电流 Diode forward current	DC		600		A
I_{FRM}	二极管正向重复峰值电流 Diode peak forward current	t_P = 1ms		1200		A
V_F (*1)	二极管正向电压 Diode forward voltage	I_F = 600A, V_{GE} = 0V		1.50	1.90	V
		I_F = 600A, V_{GE} = 0V, T_{vj} = 125 °C		1.55		V
		I_F = 600A, V_{GE} = 0V, T_{vj} = 150 °C		1.55		V
I_{SC}	短路电流 Short circuit current	T_{vj} = 150°C, V_{CC} = 800V, V_{GE}≤15V, t_p≤10μs, $V_{CE(max)}$ = V_{CES} – $L^{(*2)}$×di/dt, IEC 60747-9		2800		A

注意： 1.(*1) 表示该参数的测试点为辅助母排端子((*1) indicates it is measured at the auxiliary busbar terminal),

Note: 2.(*2) 表示 L 是电路杂散电感加上 L_{sCE} ((*2) indicates L is the circuit stray inductance plus L_{sCE}).

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	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		90.3		nF
Q_g	栅极电荷 Gate charge	±15V		6.9		μC
C_{res}	反向传输电容 Reverse transfer capacitance	V_{CE} = 25V, V_{GE} = 0V, f = 100kHz		1.0		nF
L_{sCE}	模块电感 Module inductance			20		nH
$R_{CC'+EE'}$	模块引线电阻，端子-芯片 Module lead resistance, terminal-chip			0.4		mΩ
R_{Gint}	内部栅极电阻 Internal gate resistor			1.1		Ω

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 =600A, V_{CE} = 600V, V_{GE} = ±15V, $R_{G(OFF)}$ = 2.2Ω, L_S = 45nH, dv/dt =5300V/μs (T_{vj}= 150 °C).	T_{vj}= 25 °C		700		ns
			T_{vj}= 125 °C		740		
			T_{vj}= 150 °C		760		
t_f	下降时间 Fall time		T_{vj}= 25 °C		120		ns
			T_{vj}= 125 °C		300		
			T_{vj}= 150 °C		310		
E_{OFF}	关断损耗 Turn-off energy loss		T_{vj}= 25 °C		74.0		mJ
			T_{vj}= 125 °C		90.0		
			T_{vj}= 150 °C		94.0		
$t_{d(on)}$	开通延迟时间 Turn-on delay time	I_C =600A, V_{CE} = 600V, V_{GE} = ±15V, $R_{G(ON)}$ = 2.2Ω, L_S = 45nH, di/dt = 7400A/μs (T_{vj}= 150 °C).	T_{vj}= 25 °C		290		ns
			T_{vj}= 125 °C		290		
			T_{vj}= 150 °C		290		
t_r	上升时间 Rise time		T_{vj}= 25 °C		100		ns
			T_{vj}= 125 °C		110		
			T_{vj}= 150 °C		110		
E_{ON}	开通损耗 Turn-on energy loss		T_{vj}= 25 °C		22.0		mJ
			T_{vj}= 125 °C		38.7		
			T_{vj}= 150 °C		47.5		
Q_{rr}	二极管反向恢复电荷 Diode reverse recovery charge	I_F =600A, V_{CE} = 600V, - di_F/dt = 7400A/μs (T_{vj}= 150 °C).	T_{vj}= 25 °C		82.4		μC
			T_{vj}= 125 °C		113.4		
			T_{vj}= 150 °C		134.0		
I_{rr}	二极管反向恢复电流 Diode reverse recovery current		T_{vj}= 25 °C		600		A
			T_{vj}= 125 °C		640		
			T_{vj}= 150 °C		680		
E_{rec}	二极管反向恢复损耗 Diode reverse recovery energy		T_{vj}= 25 °C		48.0		mJ
			T_{vj}= 125 °C		61.0		
			T_{vj}= 150 °C		68.0		

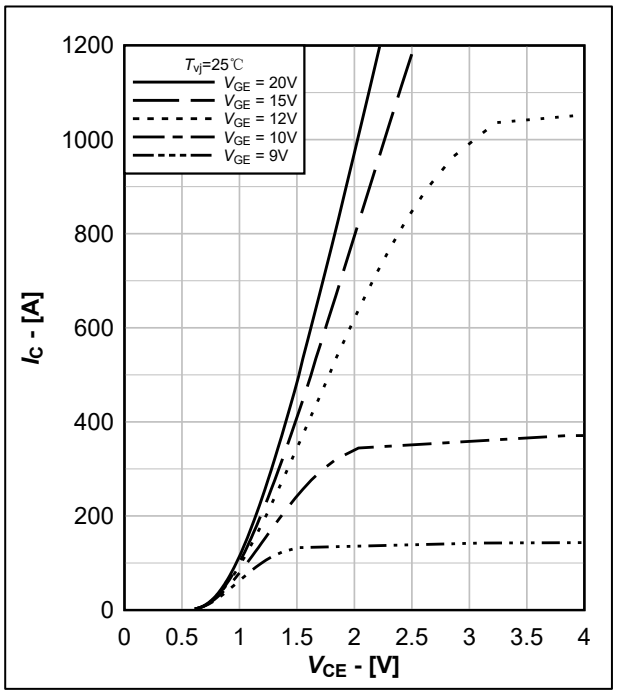


图 3. IGBT 输出特性典型曲线, I_C= f (V_{CE})

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

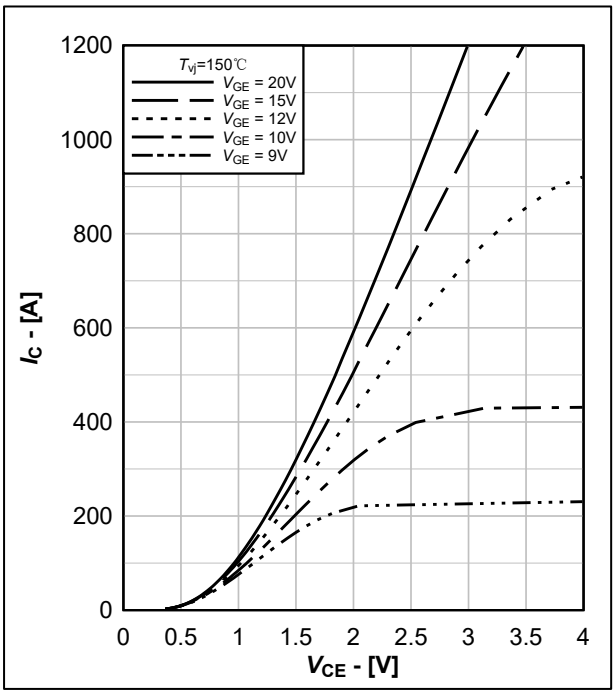


图 4. IGBT 输出特性典型曲线, I_C= f (V_{CE})

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

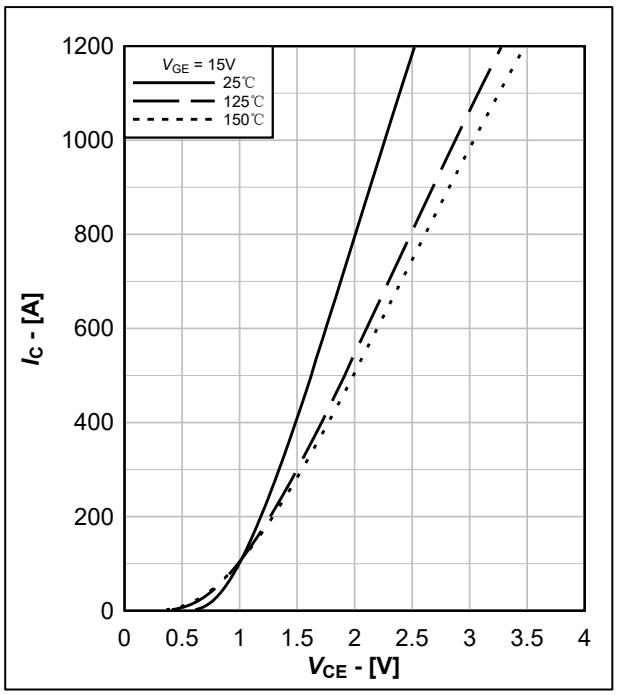


图 5. IGBT 输出特性典型曲线, I_C= f (V_{CE})

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

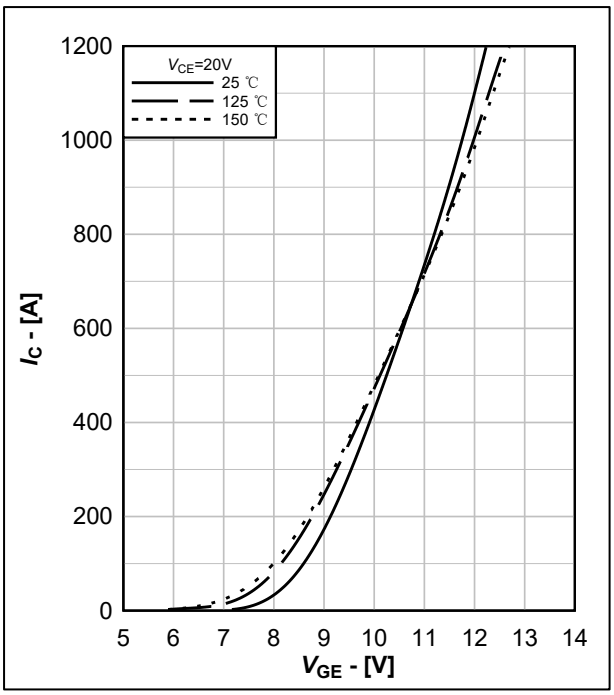


图 6. IGBT 传输特性典型曲线, I_C= f (V_{GE})

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

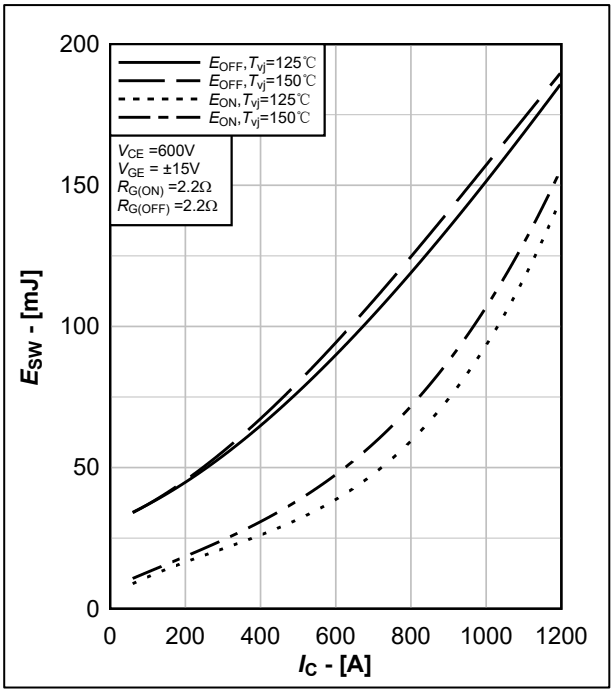


图 7. IGBT 开关损耗典型曲线, E_{on}= f (I_C), E_{off}= f (I_C)

Fig.7 Typical IGBT switching energy, E_{on}= f (I_C), E_{off}= f (I_C)

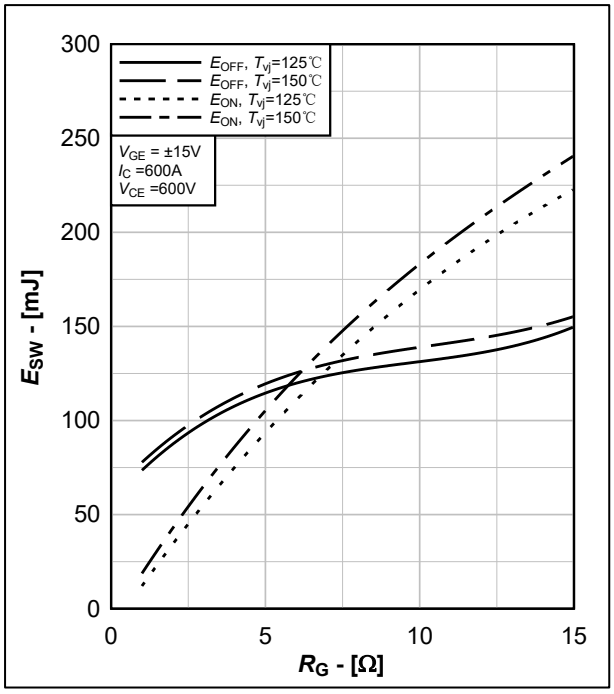


图 8. IGBT 开关损耗典型曲线, E_{on}= f (R_G), E_{off}= f (R_G)

Fig.8 Typical IGBT switching energy, E_{on}= f(R_G), E_{off}= f (R_G)

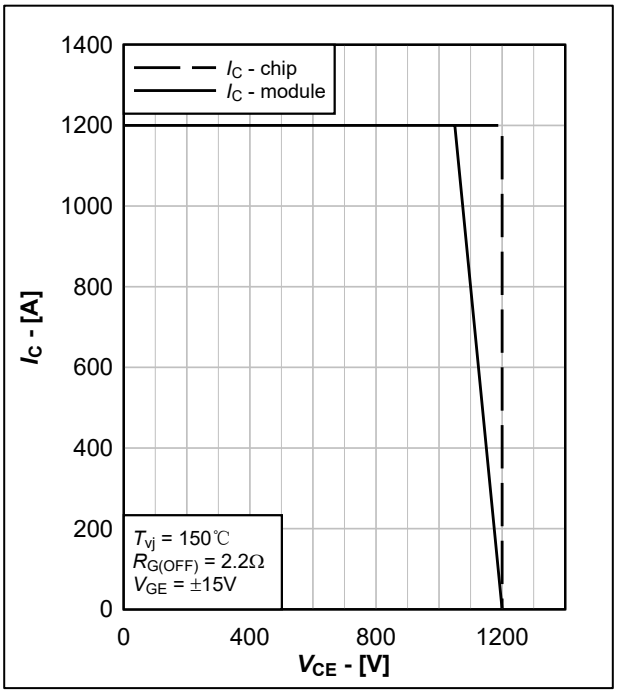


图 9. IGBT 反偏安全工作区, I_C = f (V_{CE})

Fig.9 Reverse bias safe operating area of IGBT, I_C = f (V_{CE})

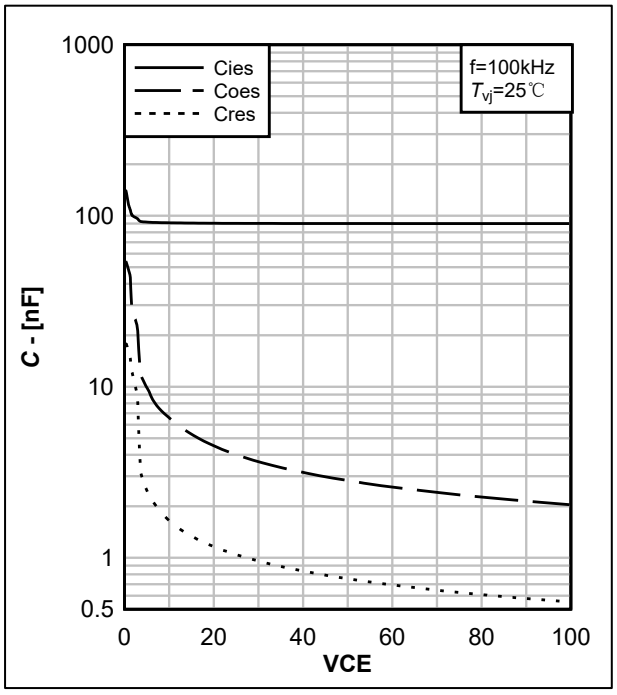


图 10. 电容特性典型曲线, C= f (V_{CE})

Fig.10 Typical capacity characteristic, C= f (V_{CE})

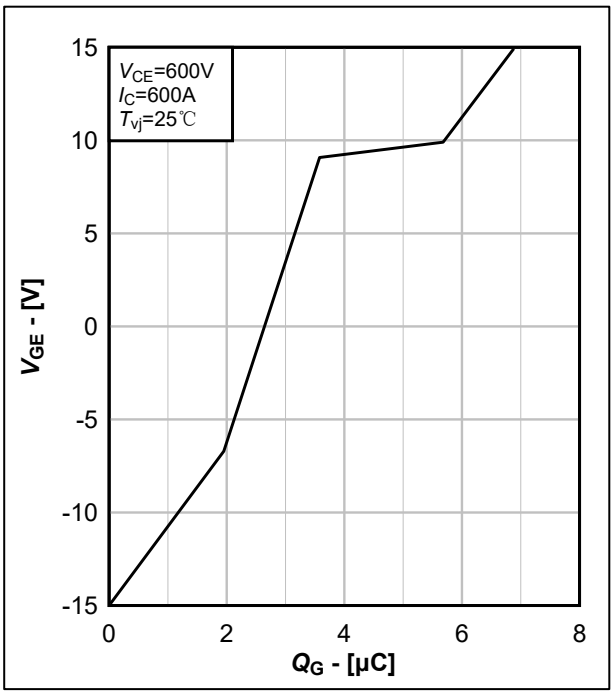


图 11. 栅极电荷特性典型曲线, V_{GE} = f (Q_G)

Fig.11 Typical gate charge characteristic, V_{GE}= f (Q_G)

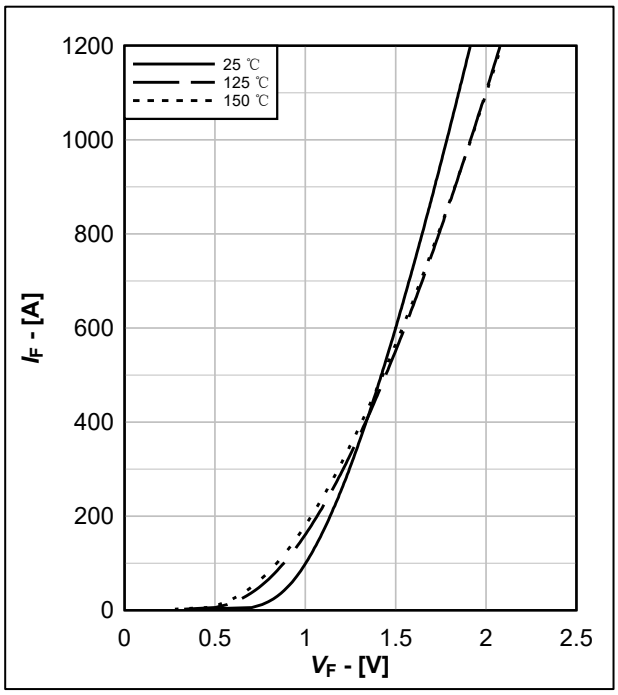


图 12. FRD 输出特性典型曲线, I_F = f (V_F)

Fig.12 Typical FRD output characteristic, I_F = f (V_F)

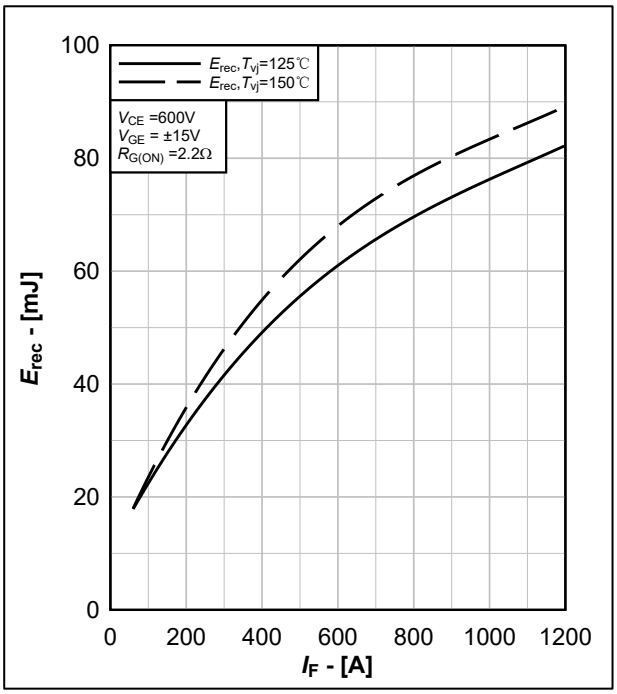


图 13. FRD 反向恢复损耗典型曲线, E_{rec}=f(I_F)

Fig.13 Typical FRD switching loss E_{rec}, E_{rec}=f(I_F)

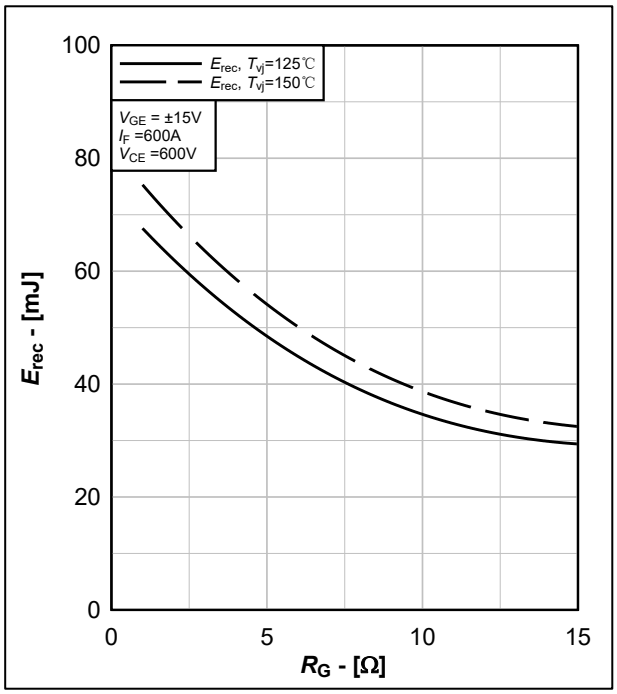


图 14. FRD 反向恢复损耗典型曲线, E_{rec}=f(R_G)

Fig.14 Typical FRD switching loss E_{rec}, E_{rec}=f(R_G)

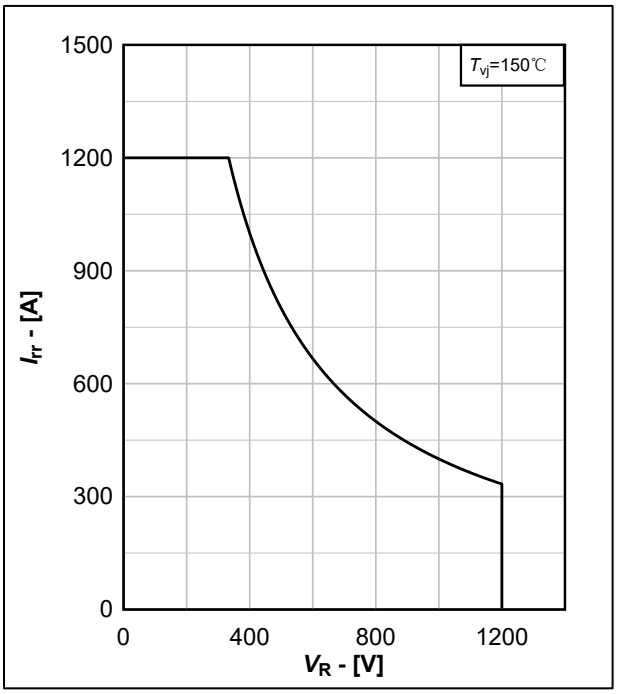


图 15. FRD 反偏安全工作区, I_{rr} = f (V_R)

Fig.15 Reverse bias safe operating area of FRD, I_{rr} = f (V_R)

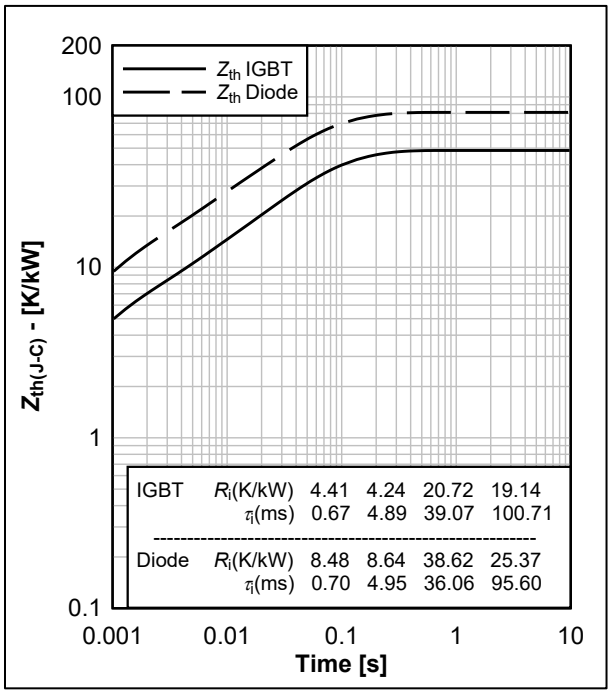
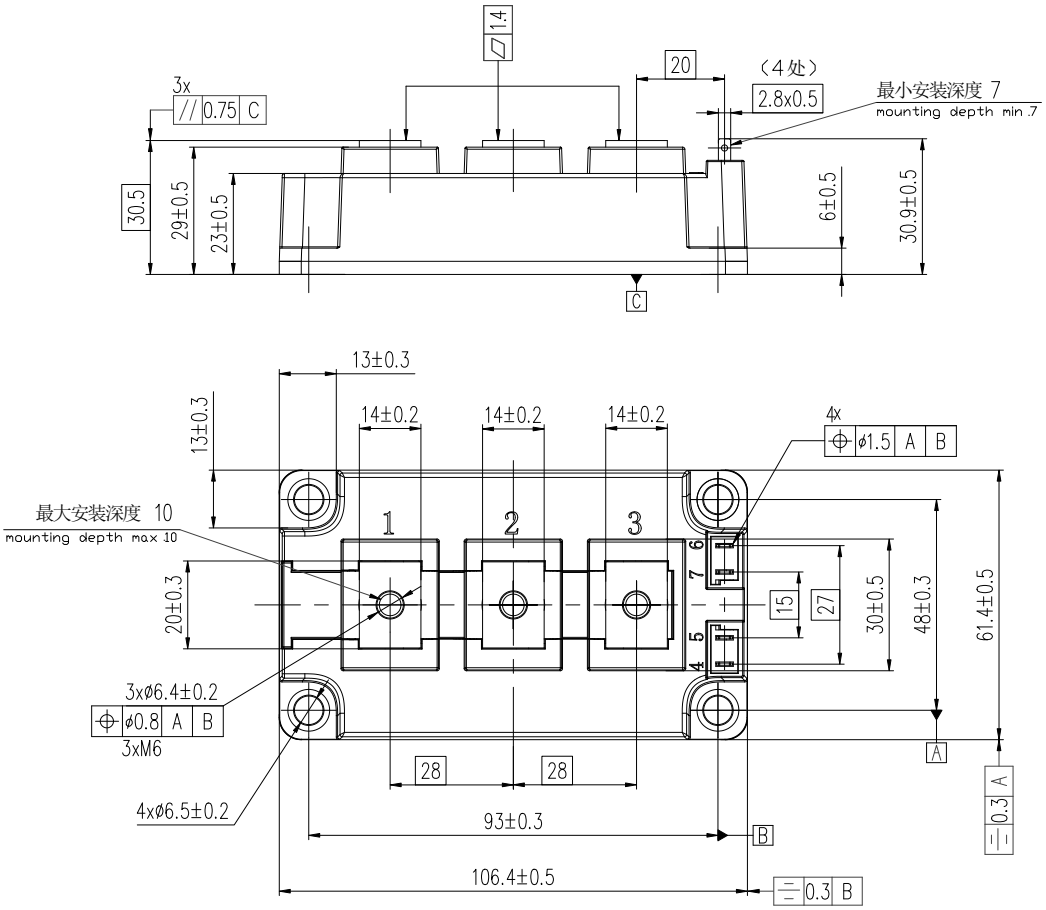


图 16. 瞬态热阻抗曲线, $Z_{th(J-C)}$ = f (t_p)

Fig.16 Transient thermal impedance, $Z_{th(J-C)}$ = f (t_p)



重量 Weight：335g　　模块外观类型 Module outline code：W1

图 17.　模块外观尺寸

Fig. 17　Module outlines

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