产品数据手册 Product Datasheet 版本 Ver 22.01

TG650CP17H2-S300

斩波管型 IGBT 模块 Chopper Switch IGBT

关键参数 Key Parameters

V_{CES}		1700	V
$V_{CE(sat)}$	Typ.	1.85	V
I_C	Max.	650	A
$I_{C(RM)}$	Max.	1300	A

典型应用 Typical Applications

- 马达驱动 Motor Drives
- 大功率变流器 High Power Converters
- 风力发电机 Wind Turbines
- 高可靠性逆变器 High Reliability Inverter

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

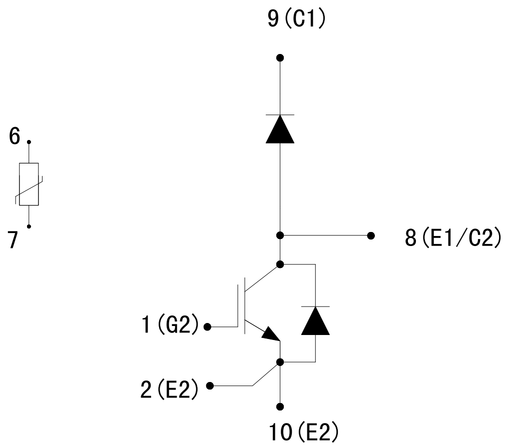


图 1.电路结构

Fig. 1 Circuit configuration

模块外形 Module Appearance

图 2. 模块外形

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	1700	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 = 95 °C	650	A
$I_{C(PK)}$	集电极峰值电流 Peak collector current	t_P=1ms	1300	A
P_{max}	晶体管部分最大损耗 Max. transistor power dissipation	T_{vj} = 150°C, T_C = 25 °C	4.16	kW
I^2t	二极管 I^2t 值 Diode I^2t	V_R =0V, t_P = 10ms, T_{vj} = 150 °C	64	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	33.0	mm
	端子-端子 Terminal to terminal	33.0	mm
绝缘间隙 Clearance	端子-散热器 Terminal to heatsink	19.0	mm
	端子-端子 Terminal to terminal	19.0	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				30	K / kW
$R_{th(J-C)\ Diode}$	二极管结壳热阻 Thermal resistance – Diode				54	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		19.5		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		35		K / kW
$T_{vj\ op}$	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		150	°C
M	安装力矩 Screw torque	安装紧固用 - M5 Mounting – M5	3		6	Nm
		电路互连用– M4 Electrical connections – M4	1.8		2.1	Nm
		电路互连用 – M8 Electrical connections – M8	8		10	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
$\triangle R/R$	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	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			15	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 = 40mA, V_{GE} = V_{CE}	5.70	6.30	6.90	V
$V_{CE\ (sat)}$ (*1)	集电极-发射极饱和电压 Collector-emitter saturation voltage	V_{GE} =15V, I_C = 650A		1.85	2.25	V
		V_{GE} =15V, I_C = 650A, T_{vj} = 125 °C		2.20		V
		V_{GE} =15V, I_C = 650A, T_{vj} = 150 °C		2.30		V
I_F	二极管正向直流电流 Diode forward current	DC		650		A
I_{FRM}	二极管正向重复峰值电流 Diode peak forward current	t_P = 1ms		1300		A
V_F (*1)	二极管正向电压 Diode forward voltage	I_F = 650A, V_{GE} = 0		1.80	2.20	V
		I_F = 650A, V_{GE} = 0, T_{vj} = 125 °C		1.90		V
		I_F = 650A, V_{GE} = 0, T_{vj} = 150 °C		1.90		V
I_{SC}	短路电流 Short circuit current	T_{vj} = 150°C, V_{CC} = 1000V, V_{GE}≤15V, t_p≤10μs, $V_{CE(max)}$ = V_{CES} – $L^{(*2)}$×di/dt, IEC 60747-9		3300		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_M((*2) indicates L is the circuit stray inductance plus L_M).

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		83		nF
Q_g	栅极电荷 Gate charge	±15V		7.7		μC
C_{res}	反向传输电容 Reverse transfer capacitance	V_{CE} = 25V, V_{GE} = 0V, f = 100kHz		1.0		nF
L_M	模块电感 Module inductance			18		nH
$R_{CC'+EE'}$	模块引线电阻，端子-芯片 Module lead resistance, terminal-chip			0.3		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 =650A, V_{CE} = 900V, V_{GE} = ±15V, $R_{G(OFF)}$ = 2.7Ω, L_S = 70nH, dv/dt =4500V/μs (T_{vj}= 150 °C).	T_{vj}= 25 °C		1055		ns
			T_{vj}= 125 °C		1145		
			T_{vj}= 150°C		1170		
t_f	下降时间 Fall time		T_{vj}= 25 °C		360		ns
			T_{vj}= 125 °C		450		
			T_{vj}= 150°C		550		
E_{OFF}	关断损耗 Turn-off energy loss		T_{vj}= 25 °C		155		mJ
			T_{vj}= 125 °C		200		
			T_{vj}= 150°C		210		
$t_{d(on)}$	开通延迟时间 Turn-on delay time	I_C =650A, V_{CE} = 900V, V_{GE} = ±15V, $R_{G(ON)}$ = 1.8Ω, L_S = 70nH, di/dt = 4200A/μs (T_{vj}= 150°C).	T_{vj}= 25 °C		495		ns
			T_{vj}= 125 °C		485		
			T_{vj}= 150°C		480		
t_r	上升时间 Rise time		T_{vj}= 25 °C		170		ns
			T_{vj}= 125 °C		170		
			T_{vj}= 150°C		160		
E_{ON}	开通损耗 Turn-on energy loss		T_{vj}= 25 °C		165		mJ
			T_{vj}= 125 °C		195		
			T_{vj}= 150°C		210		
Q_{rr}	二极管反向恢复电荷 Diode reverse recovery charge	I_F =650A, V_{CE} = 900V, - di_F/dt = 4200A/μs (T_{vj}= 150°C).	T_{vj}= 25 °C		155		μC
			T_{vj}= 125 °C		250		
			T_{vj}= 150°C		280		
I_{rr}	二极管反向恢复电流 Diode reverse recovery current		T_{vj}= 25 °C		610		A
			T_{vj}= 125 °C		700		
			T_{vj}= 150°C		780		
E_{rec}	二极管反向恢复损耗 Diode reverse recovery energy		T_{vj}= 25 °C		100		mJ
			T_{vj}= 125 °C		165		
			T_{vj}= 150°C		190		

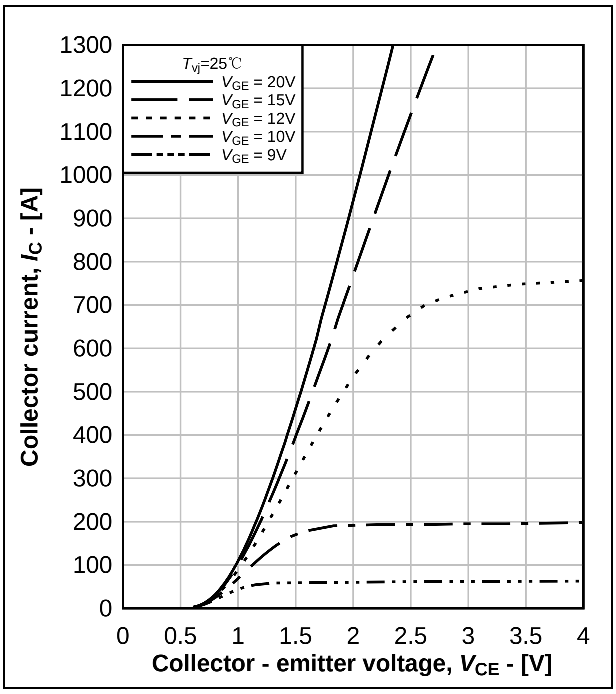


图 3. IGBT 输出特性典型曲线,I_C= f (V_{CE})

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

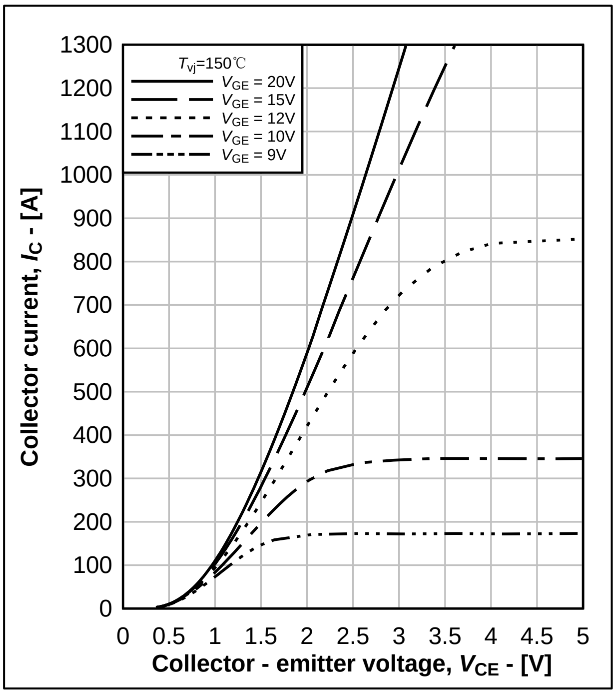


图 4. IGBT 输出特性典型曲线,I_C= f (V_{CE})

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

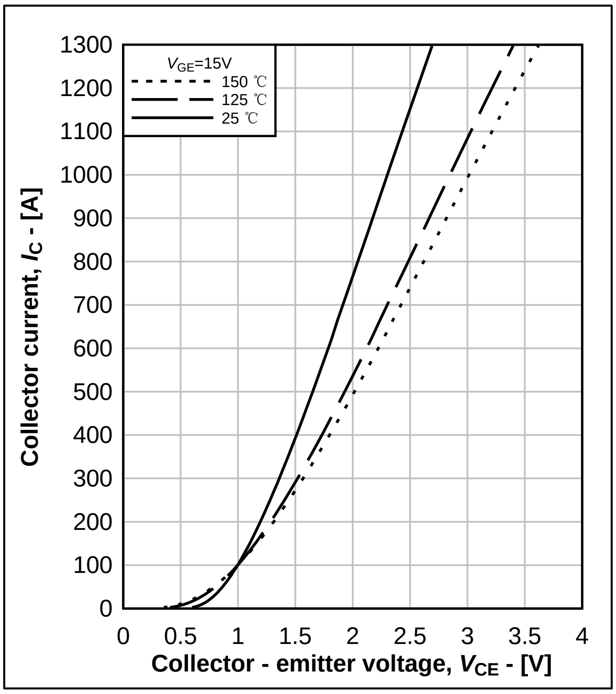


图 5. IGBT 输出特性典型曲线,I_C= f (V_{CE})

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

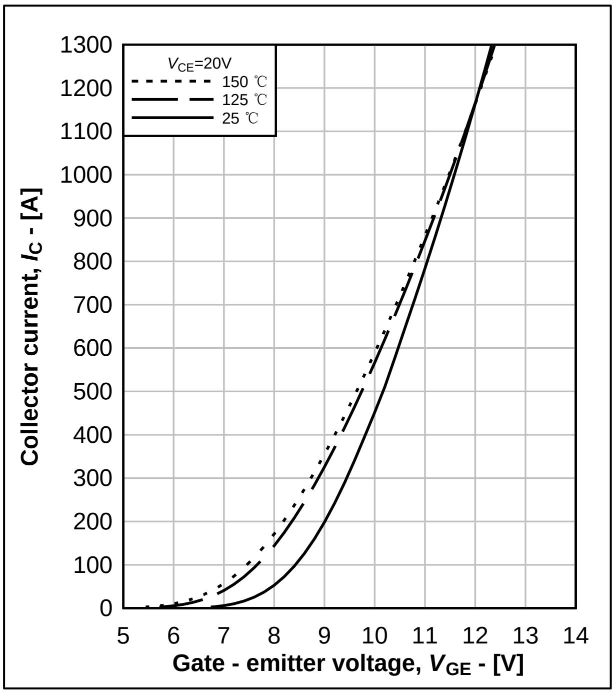


图 6. IGBT 传输特性典型曲线,I_C= f (V_{GE})

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

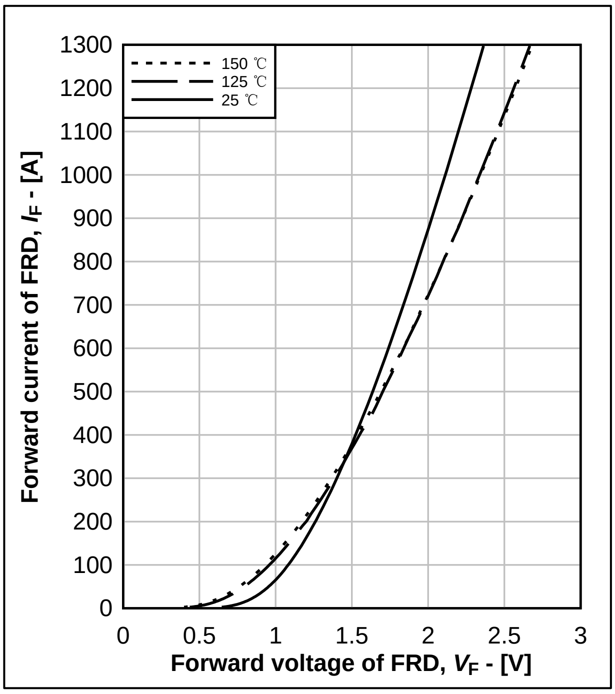


图 7. FRD 输出特性典型曲线,I_F = f (V_F)

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

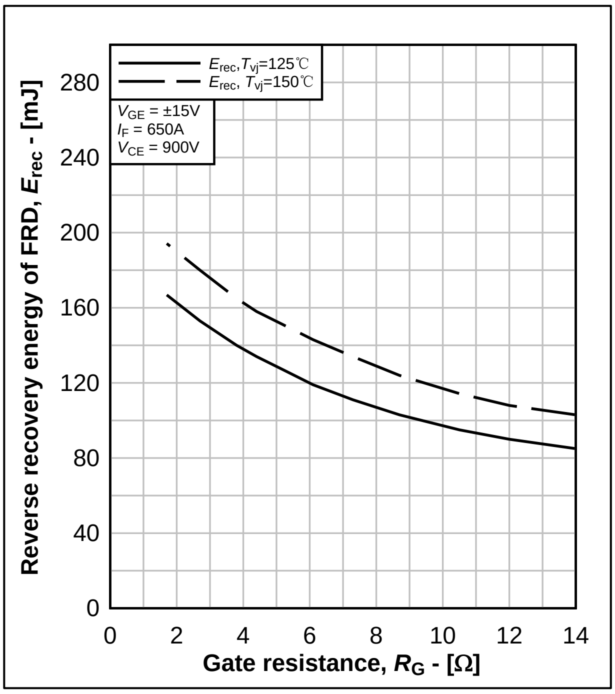


图 8. FRD 反向恢复能耗典型曲线,E_{rec}=f(R_G)

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

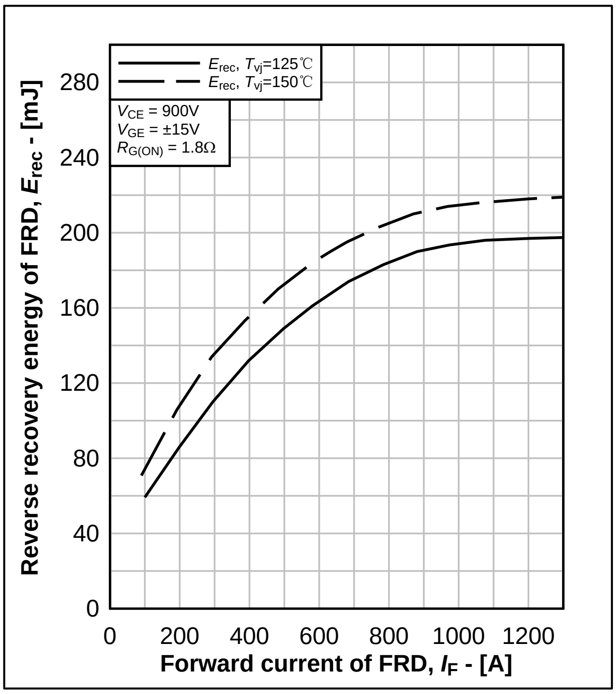


图 9. FRD 反向恢复能耗典型曲线,E_{rec}=f(I_F)

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

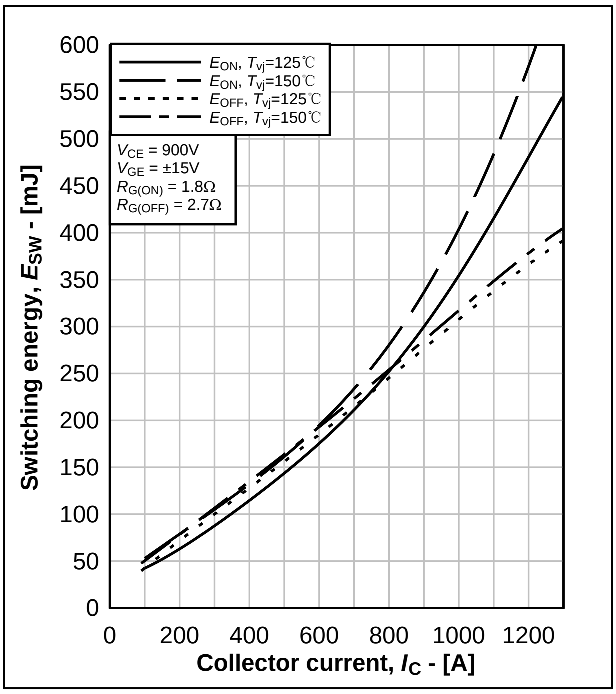


图 10. IGBT 开关能耗典型曲线,E_{on}= f (I_C), E_{off}= f (I_C)

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

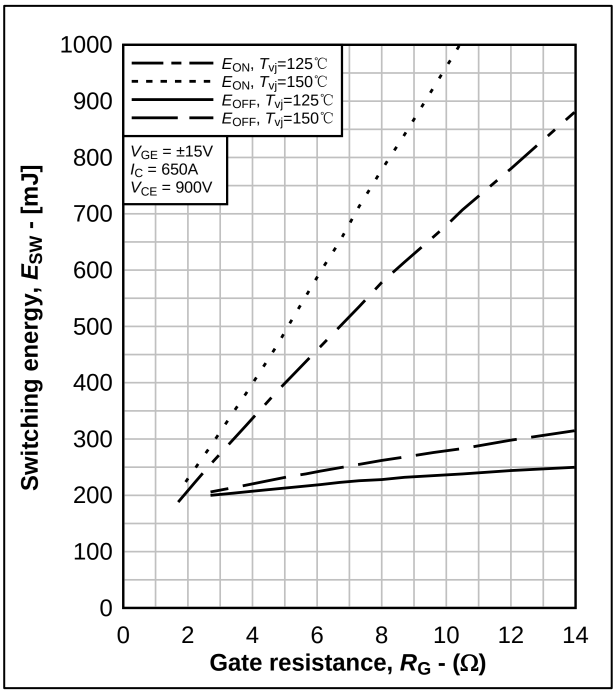


图 11. IGBT 开关能耗典型曲线,E_{on}= f (R_G), E_{off}= f (R_G)

Fig.11 Typical IGBT switching energy,E_{on}= f(R_G), E_{off}= f (R_G)

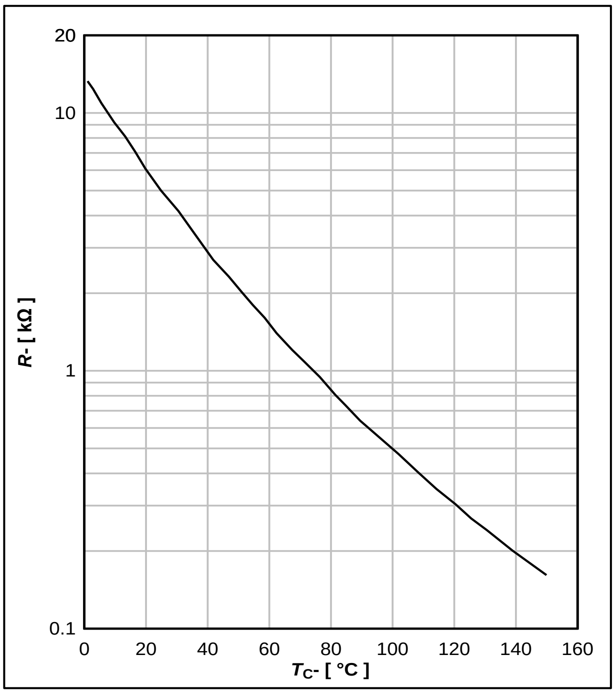


图 12. 热敏电阻典型特性曲线,R= f (T_C)

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

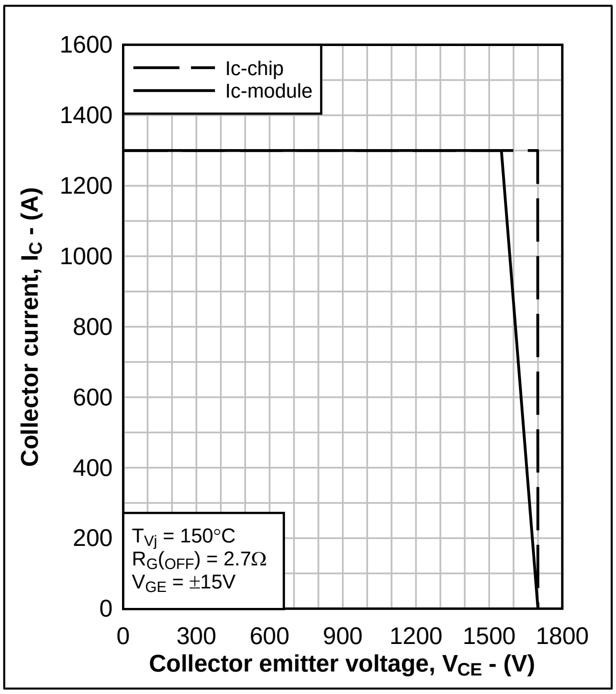


图 13. IGBT 反偏安全工作区,I_C = f (V_{CE})

Fig.13 Reverse bias safe operating area of IGBT,I_C = f (V_{CE})

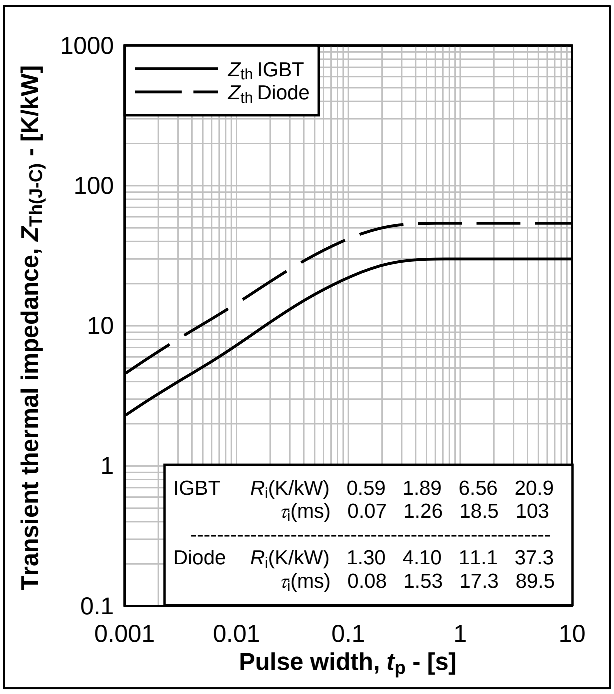
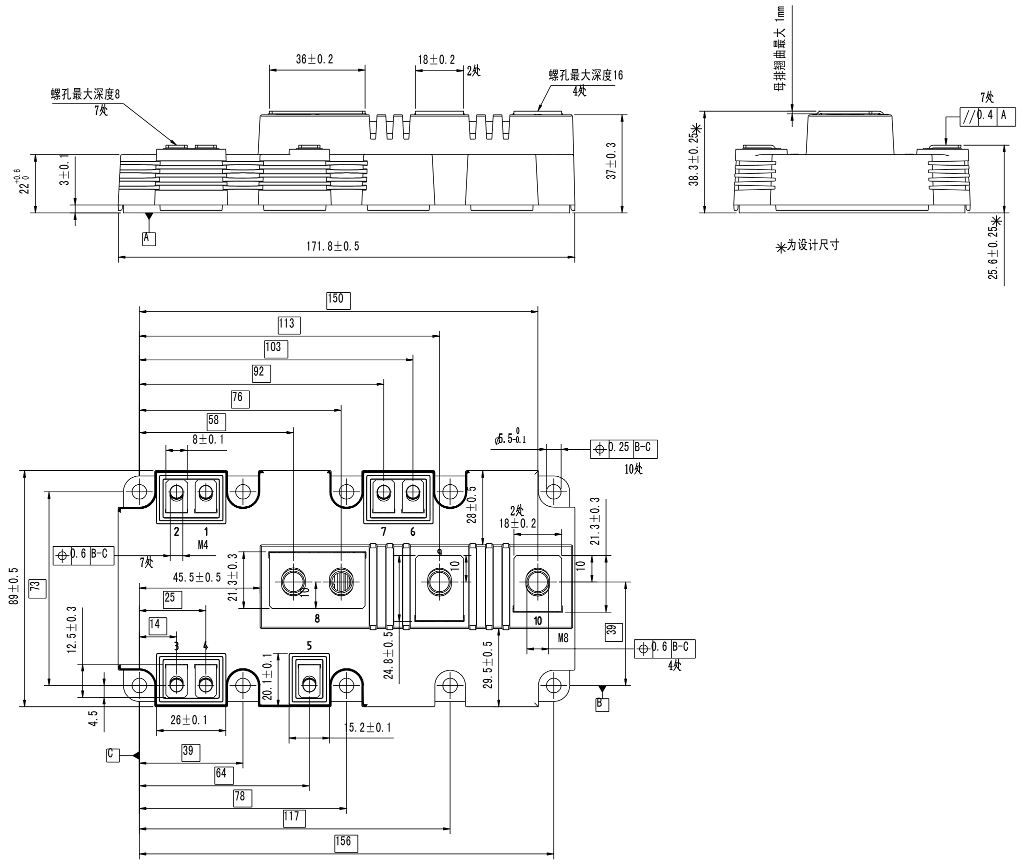


图 14. 瞬态热阻抗曲线,$Z_{Th(J-C)}$ = f (t_p)

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



重量 Weight：900g　　模块外观类型 Module outline code：H2

图 15.　模块外观尺寸

Fig. 15　Module outlines

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