中国中车 CRRC

产品数据手册 Product Datasheet 版本 Ver.1803

TIM250PHM33-PSA011

半桥型 IGBT 模块 Half Bridge IGBT

关键参数 Key Parameters

V_{CES}		3300	V
$V_{CE(sat)}$	Typ.	2.5	V
I_C	Max.	250	A
$I_{C(RM)}$	Max.	500	A

典型应用 Typical Applications

- 牵引辅变 Traction Auxiliaries
- 电机控制 Motor Controllers
- 斩波 Choppers
- 高可靠性逆变器 High Reliability Inverter

特点 Features

- AlSiC 基板 AlSiC Baseplate
- AlN 衬板 AlN Substrates
- 高热循环能力 High Thermal Cycling Capability
- 10μs 短路承受能力 10μs Short Circuit Withstand

电路结构 Circuit Configuration

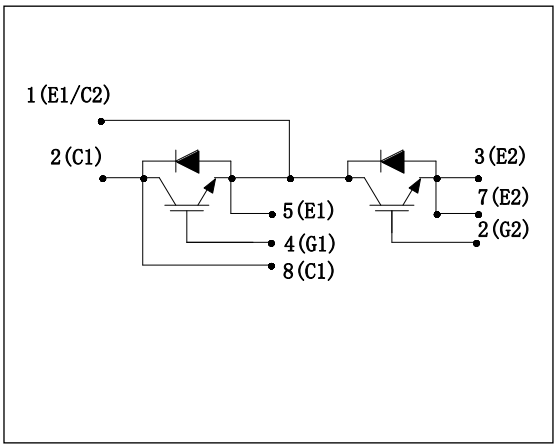


图 1.电路结构

Fig. 1 Circuit configuration

模块外形 Module Appearance

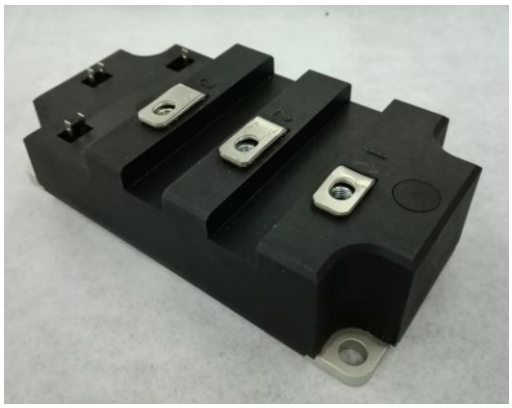


图 2. 模块外形

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--4	模块生产年周 Production year and week
5--12	模块批次号 Module batch number
13--16	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	3300	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	250	A
$I_{C(PK)}$	集电极峰值电流 Peak collector current	t_P=1ms	500	A
P_{max}	晶体管部分最大损耗 Max. transistor power dissipation	T_{vj} = 150°C, T_C = 25 °C	2.6	kW
I^2t	二极管 I^2t 值 Diode I^2t	V_R =0V, t_P = 10ms, T_{vj} = 150 °C	20	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 (Commoned terminals to baseplate), AC RMS,1 min, 50Hz,T_C= 25 °C	6	kV
Q_{PD}	局部放电电荷(模块) Partial discharge – per module	IEC1287.V_1=6900V,V_2=5100V,50Hz RMS	10	pC

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	20.0	mm
	端子-端子 Terminal to terminal	20.0	mm
相对漏电起痕指数 CTI (Comparative Tracking Index)		>600	

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.	最大值 Max.	单位 Unit
$R_{th(J-C)\ IGBT}$	IGBT 结壳热阻 Thermal resistance – IGBT			48	K / kW
$R_{th(J-C)\ Diode}$	二极管结壳热阻 Thermal resistance – Diode			80	K / kW
$R_{th(C-H)\ IGBT}$	接触热阻(IGBT) Thermal resistance – case to heatsink (IGBT)	安装力矩 5Nm，导热脂 1W/m·°C Mounting torque 5Nm, with mounting grease 1W/m·°C		18	K / kW
$R_{th(C-H)\ Diode}$	接触热阻(Diode) Thermal resistance – case to heatsink (Diode)	安装力矩 5Nm，导热脂 1W/m·°C Mounting torque 5Nm, with mounting grease 1W/m·°C		36	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 – M6 Mounting – M6		5	Nm
		电路互连用 – M5 Electrical connections – M5		4	Nm

电特性值 Electrical Characteristics

除非特别声明，否则 T_C= 25 °CT_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_C=125 °C			15	mA
		V_{GE} = 0V, V_{CE} = V_{CES}, T_C=150 °C			25	mA
I_{GES}	栅极漏电流 Gate leakage current	V_{GE} = ±20V, V_{CE} = 0V			1	μA
$V_{GE\ (TH)}$	栅极-发射极阈值电压 Gate threshold voltage	I_C = 20mA, V_{GE} = V_{CE}	5.5	6.1	7.0	V
$V_{CE\ (sat)}$(*1)	集电极-发射极饱和电压 Collector-emitter saturation voltage	V_{GE} =15V, I_C = 250A		2.50	2.80	V
		V_{GE} =15V, I_C = 250A,T_{vj} = 125 °C		3.15	3.45	V
		V_{GE} =15V, I_C = 250A,T_{vj} = 125 °C		3.30	3.60	V
I_F	二极管正向直流电流 Diode forward current	DC		250		A
I_{FRM}	二极管正向重复峰值电流 Diode peak forward current	t_P = 1ms		500		A
V_F(*1)	二极管正向电压 Diode forward voltage	I_F = 250A, V_{GE} = 0		2.10	2.40	V
		I_F = 250A, V_{GE} = 0, T_{vj} = 125 °C		2.25	2.55	V
		I_F = 250A, V_{GE} = 0, T_{vj} = 150 °C		2.25	2.55	V
I_{SC}	短路电流 Short circuit current	T_{vj} = 150° C, V_{CC} = 2500V, V_{GE}≤15V, t_p≤10μs, $V_{CE(max)}$ = V_{CES} – $L^{(*2)}$×di/dt, IEC 6074-9		900		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 °CT_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		27		nF
Q_g	栅极电荷 Gate charge	±15V		2.6		μC
C_{res}	反向传输电容 Reverse transfer capacitance	V_{CE} = 25V, V_{GE} = 0V, f = 100kHz		0.9		nF
L_M	模块电感 Module inductance			40		nH
R_{INT}	内阻 Internal transistor resistance			0.5		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 =250A, V_{CE} = 1800V, V_{GE} = ±15V, $R_{G(OFF)}$ = 9.0Ω, C_{GE} = 56nF, L_S = 150nH,	T_{vj}= 25 °C		1480		ns
			T_{vj}= 125 °C		1550		
			T_{vj}= 150 °C		1570		
t_f	下降时间 Fall time		T_{vj}= 25 °C		1280		ns
			T_{vj}= 125 °C		1920		
			T_{vj}= 150 °C		2120		
E_{OFF}	关断损耗 Turn-off energy loss		T_{vj}= 25 °C		300		mJ
			T_{vj}= 125 °C		380		
			T_{vj}= 150 °C		400		
$t_{d(on)}$	开通延迟时间 Turn-on delay time	I_C =250A, V_{CE} = 1800V, V_{GE} = ±15V, $R_{G(ON)}$ = 6.0Ω, C_{GE} = 56nF, L_S = 150nH,	T_{vj}= 25 °C		640		ns
			T_{vj}= 125 °C		650		
			T_{vj}= 150 °C		650		
t_r	上升时间 Rise time		T_{vj}= 25 °C		220		ns
			T_{vj}= 125 °C		235		
			T_{vj}= 150 °C		238		
E_{ON}	开通损耗 Turn-on energy loss		T_{vj}= 25 °C		395		mJ
			T_{vj}= 125 °C		510		
			T_{vj}= 150 °C		565		
Q_{rr}	二极管反向恢复电荷 Diode reverse recovery charge	I_F =250A, V_{CE} = 1800V, - di_F/dt = 1200A/us, (T_{vj}= 125 °C).	T_{vj}= 25 °C		190		μC
			T_{vj}= 125 °C		295		
			T_{vj}= 150 °C		335		
I_{rr}	二极管反向恢复电流 Diode reverse recovery current		T_{vj}= 25 °C		185		A
			T_{vj}= 125 °C		210		
			T_{vj}= 150 °C		216		
E_{rec}	二极管反向恢复损耗 Diode reverse recovery energy		T_{vj}= 25 °C		223		mJ
			T_{vj}= 125 °C		360		
			T_{vj}= 150 °C		410		

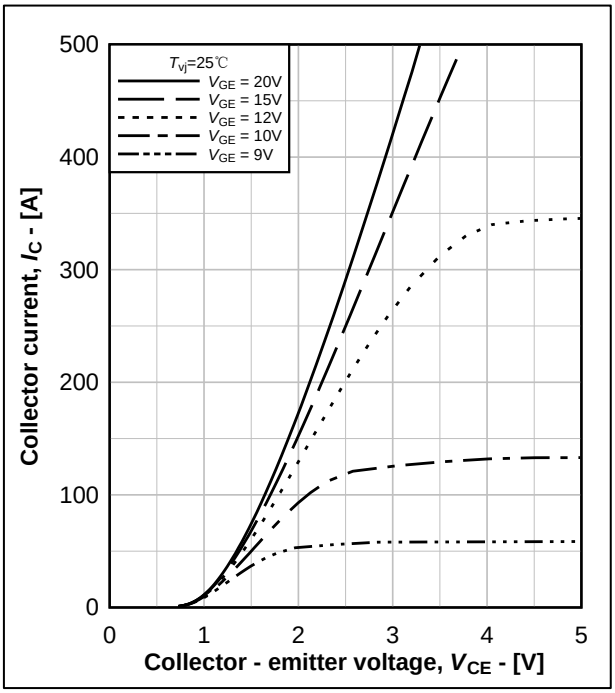


图 3. IGBT 输出特性典型曲线,I_C= f (V_{CE})

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

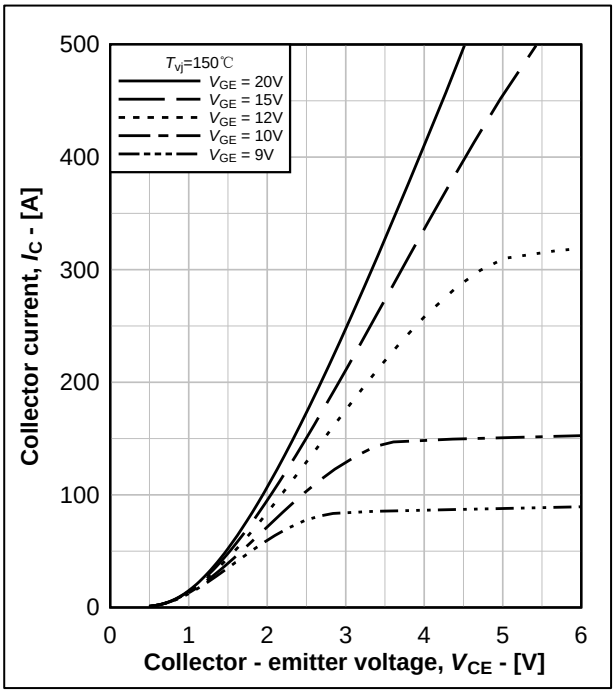


图 4. IGBT 输出特性典型曲线,I_C= f (V_{CE})

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

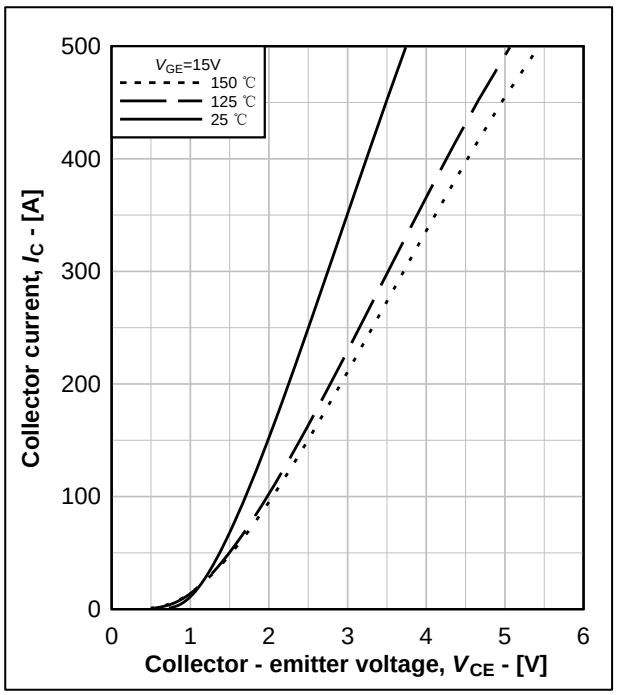


图 5. IGBT 输出特性典型曲线,I_C= f (V_{CE})

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

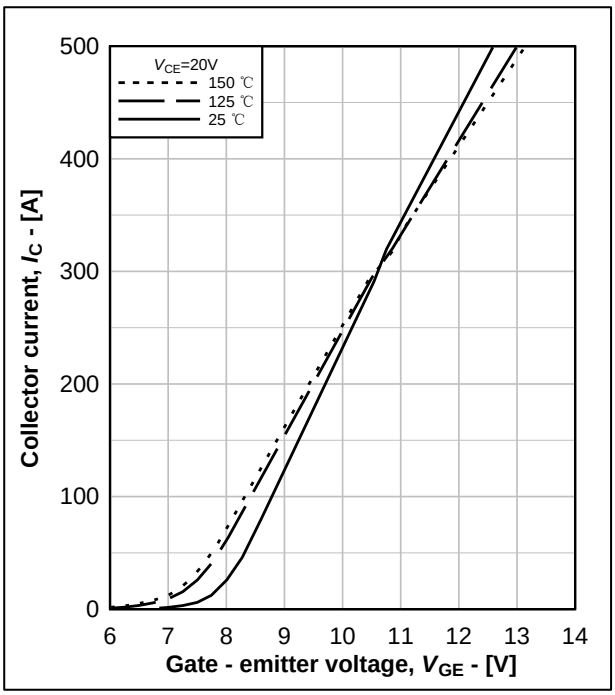


图 6. IGBT 传输特性典型曲线,I_C= f (V_{GE})

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

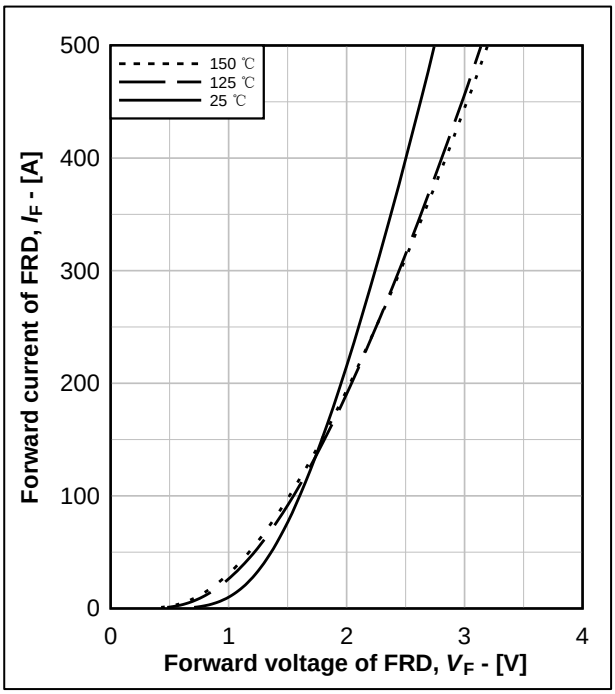


图 7. FRD 输出特性典型曲,IF = f (VF)　　Fig.7
Typical FRD output characteristics, IF = f (VF)

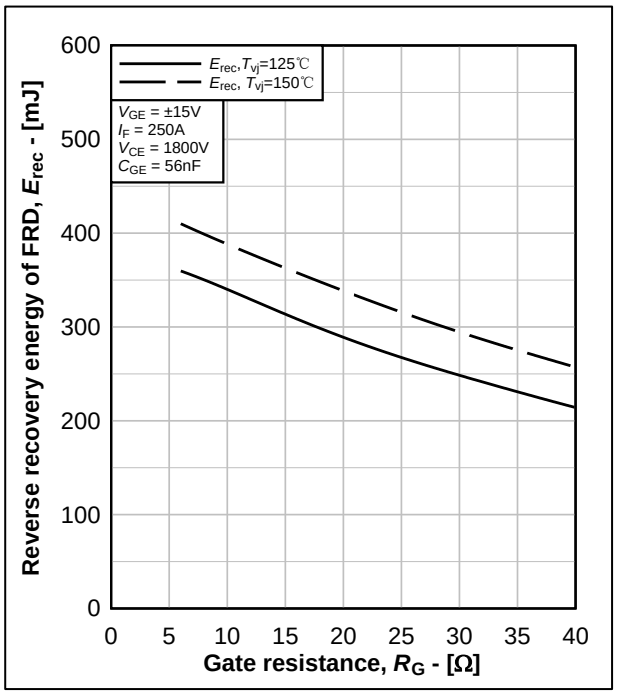


图 8. FRD 反向恢复能耗典型曲线,E_{rec}=f(R_G)
Fig.8　Typical FRD E_{rec}, E_{rec}=f(R_G)

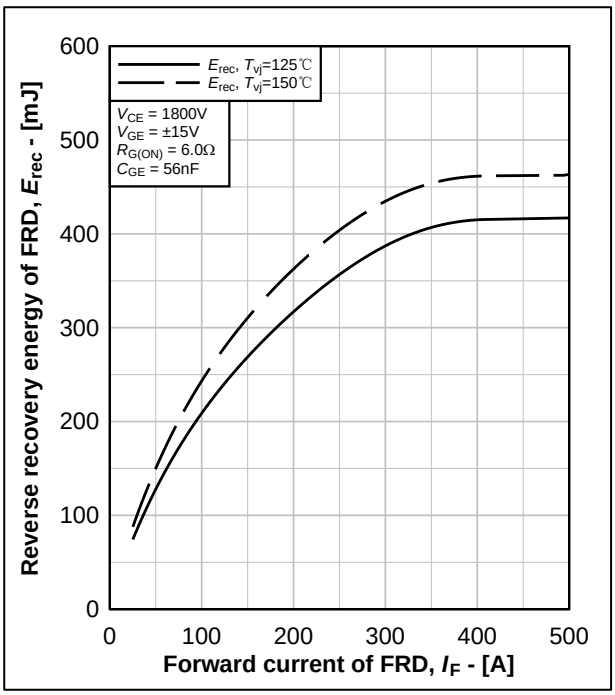


图 9. FRD 反向恢复能耗典型曲线,E_{rec}=f(I_F)
Fig.9　Typical FRD E_{rec}, E_{rec}=f(I_F)

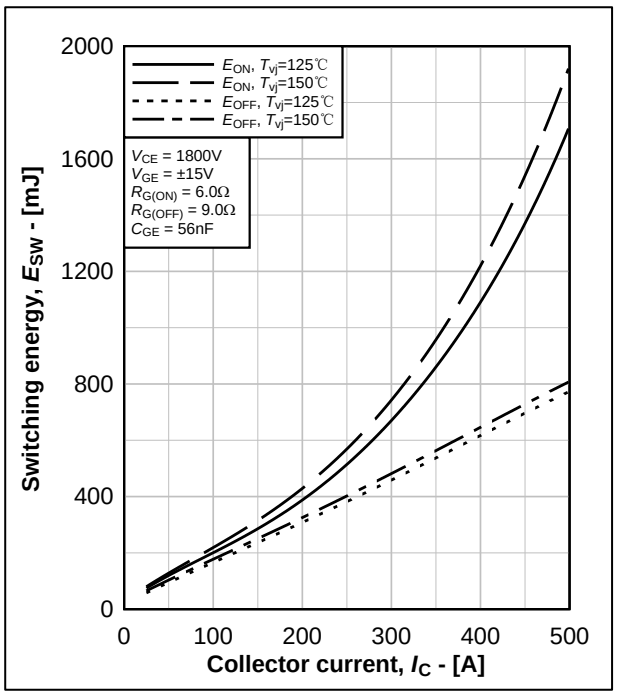


图 10. IGBT 开关能耗典型曲线,E_{on}= f (I_C), E_{off}= f (I_C)
Fig.10 Typical IGBT switching energy, E_{on}= f (I_C), E_{off}= f (I_C)

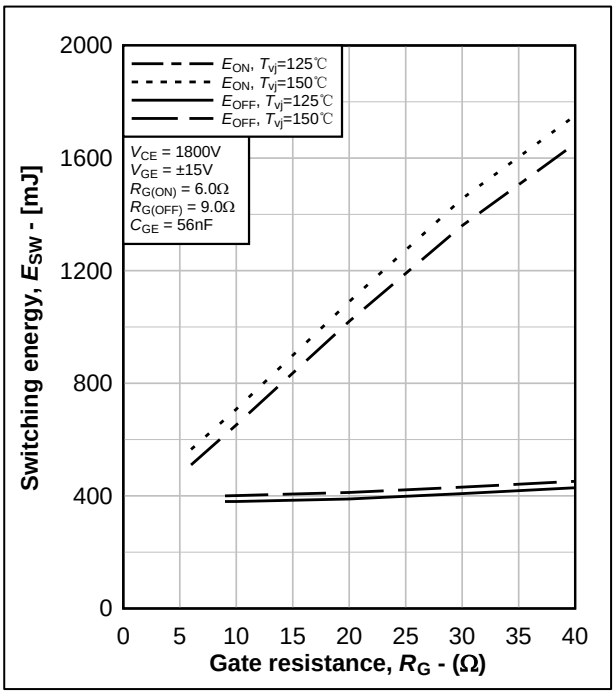


图 11. IGBT 开关能耗典型曲线,E_{on}= f (R_G), E_{off}= f (R_G)

Fig.11 Typical IGBT switching energy,

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

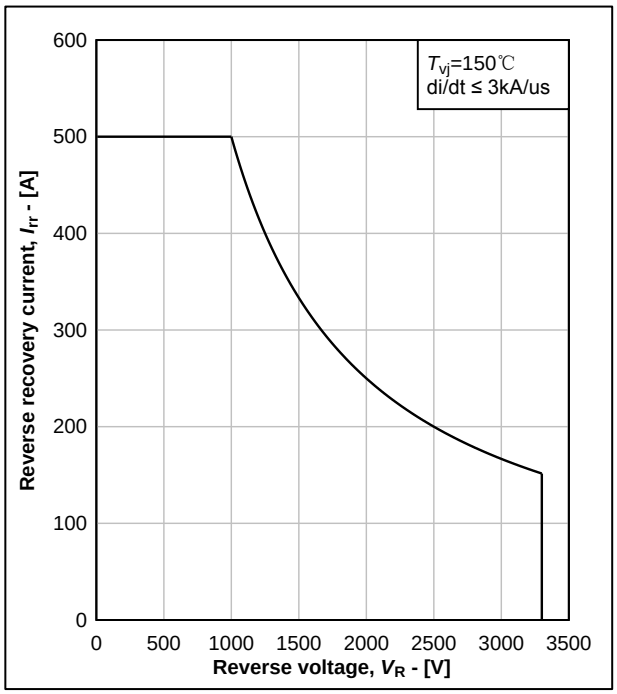


图 12. 二极管反偏安全工作区

Fig.12 Diode reverse bias safe operating area

I_{rr} = f (V_R)

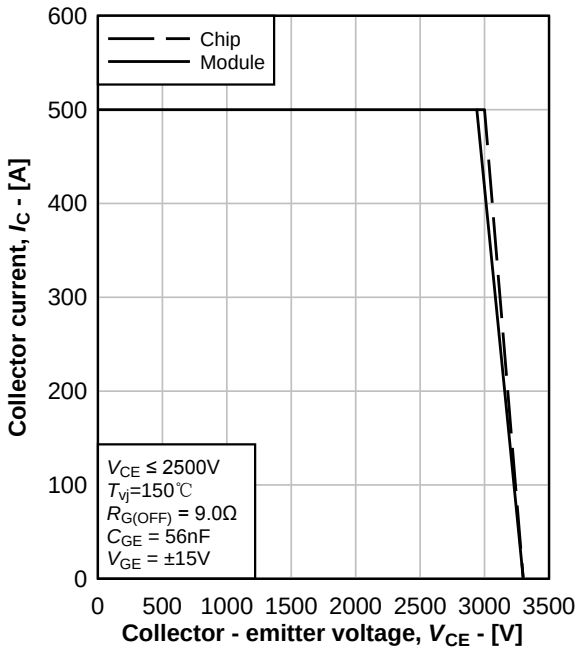


图 13. IGBT 反偏安全工作区,I_C = f (V_{CE})

Fig.13 Reverse bias safe operating area of IGBT,

I_C = f (V_{CE})

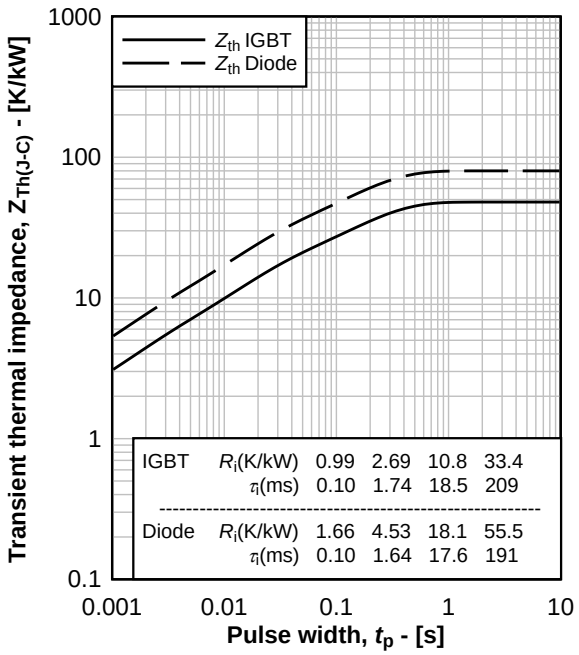
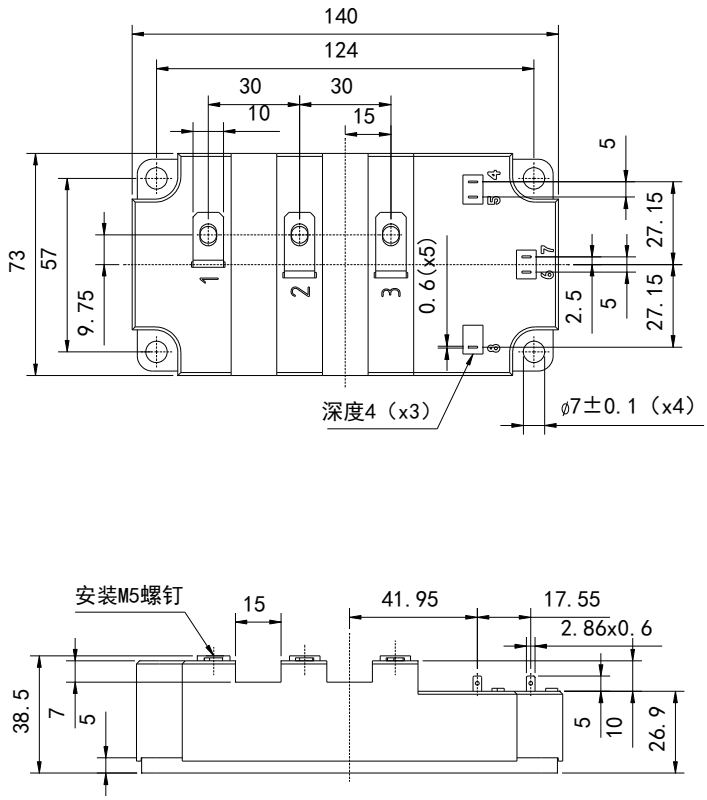


图 14. 瞬态热阻抗曲线,$Z_{Th(J-C)}$ = f (t)

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



重量 Weight：750g　　模块外观类型 Module outline code：P

图 14.　模块外观尺寸

Fig. 14　Module outlines

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