

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

- AISiC 基板 AISiC Baseplate
- AIN 衬板 AIN Substrates
- 高热循环能力 High Thermal Cycling Capability
- 10 μ s 短路承受能力 10 μ s Short Circuit Withstand

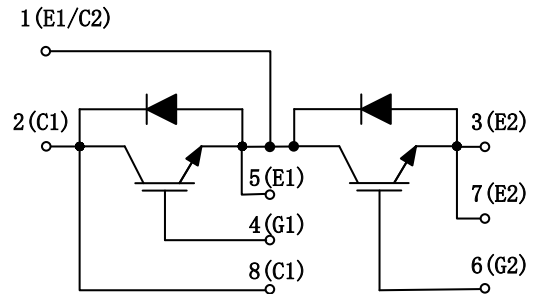
电路结构 Circuit Configuration


图 1. 电路结构

Fig. 1 Circuit configuration

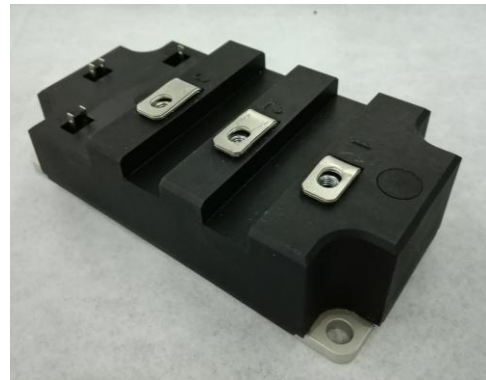
模块外形 Module Appearance


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—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	$V_{GE} = 0V, T_C = 25\text{ }^\circ\text{C}$	3300	V
V_{GES}	栅极-发射极电压 Gate-emitter voltage	$T_C = 25\text{ }^\circ\text{C}$	± 20	V
I_C	集电极电流 Collector-emitter current	$T_C = 100\text{ }^\circ\text{C}$	250	A
$I_{C(PK)}$	集电极峰值电流 Peak collector current	$t_P = 1\text{ms}$	500	A
P_{max}	晶体管部分最大损耗 Max. transistor power dissipation	$T_{vj} = 150\text{ }^\circ\text{C}, T_C = 25\text{ }^\circ\text{C}$	2.6	kW
ρ_t	二极管 ρ_t 值 Diode ρ_t	$V_R = 0V, t_P = 10\text{ms}, T_{vj} = 150\text{ }^\circ\text{C}$	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 (Connected terminals to baseplate), AC RMS, 1 min, 50Hz, $T_C = 25\text{ }^\circ\text{C}$	6	kV
Q_{PD}	局部放电电荷(模块) Partial discharge – per module	IEC1287. $V_1 = 3500V, V_2 = 2600V, 50\text{Hz RMS}$	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 $T_C = 25\text{ }^\circ\text{C}$
 $T_C = 25\text{ }^\circ\text{C}$ 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
		$V_{GE} = 0V, V_{CE} = V_{CES}, T_C = 125\text{ }^\circ\text{C}$			15	mA
		$V_{GE} = 0V, V_{CE} = V_{CES}, T_C = 150\text{ }^\circ\text{C}$			25	mA
I_{GES}	栅极漏电流 Gate leakage current	$V_{GE} = \pm 20V, V_{CE} = 0V$			1	μA
$V_{GE(TH)}$	栅极-发射极阈值电压 Gate threshold voltage	$I_C = 20\text{mA}, V_{GE} = V_{CE}$	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
		$V_{GE} = 15V, I_C = 250A, T_{vj} = 125\text{ }^\circ\text{C}$		3.15	3.45	V
		$V_{GE} = 15V, I_C = 250A, T_{vj} = 150\text{ }^\circ\text{C}$		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	$t_p = 1\text{ms}$		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
		$I_F = 250A, V_{GE} = 0, T_{vj} = 125\text{ }^\circ\text{C}$		2.25	2.55	V
		$I_F = 250A, V_{GE} = 0, T_{vj} = 150\text{ }^\circ\text{C}$		2.25	2.55	V
I_{SC}	短路电流 Short circuit current	$T_{vj} = 150\text{ }^\circ\text{C}, V_{CC} = 2500V,$ $V_{GE} \leq 15V, t_p \leq 10\mu\text{s},$ $V_{CE(max)} = V_{CES} - L^{(*2)} \times di/dt,$ IEC 60747-9		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 $T_C = 25\text{ }^\circ\text{C}$
 $T_C = 25\text{ }^\circ\text{C}$ 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	$\pm 15V$		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_{CC+EE}	模块引线电阻, 端子-芯片 Module lead resistance, terminal-chip			0.5		m 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	$I_C = 250A,$ $V_{CE} = 1800V,$ $V_{GE} = \pm 15V,$ $R_{G(OFF)} = 9.0\Omega,$ $C_{GE} = 56nF,$ $L_S = 150nH,$	$T_{vj} = 25\text{ }^\circ\text{C}$		1480	ns
			$T_{vj} = 125\text{ }^\circ\text{C}$		1550	
			$T_{vj} = 150\text{ }^\circ\text{C}$		1570	
t_f	下降时间 Fall time		$T_{vj} = 25\text{ }^\circ\text{C}$		1280	ns
			$T_{vj} = 125\text{ }^\circ\text{C}$		1920	
			$T_{vj} = 150\text{ }^\circ\text{C}$		2120	
E_{OFF}	关断损耗 Turn-off energy loss		$T_{vj} = 25\text{ }^\circ\text{C}$		300	mJ
			$T_{vj} = 125\text{ }^\circ\text{C}$		380	
			$T_{vj} = 150\text{ }^\circ\text{C}$		400	
$t_{d(on)}$	开通延迟时间 Turn-on delay time	$T_{vj} = 25\text{ }^\circ\text{C}$		640	ns	
		$T_{vj} = 125\text{ }^\circ\text{C}$		650		
		$T_{vj} = 150\text{ }^\circ\text{C}$		650		
t_r	上升时间 Rise time	$T_{vj} = 25\text{ }^\circ\text{C}$		220	ns	
		$T_{vj} = 125\text{ }^\circ\text{C}$		235		
		$T_{vj} = 150\text{ }^\circ\text{C}$		238		
E_{ON}	开通损耗 Turn-on energy loss	$T_{vj} = 25\text{ }^\circ\text{C}$		395	mJ	
		$T_{vj} = 125\text{ }^\circ\text{C}$		510		
		$T_{vj} = 150\text{ }^\circ\text{C}$		565		
Q_{rr}	二极管反向恢复电荷 Diode reverse recovery charge	$T_{vj} = 25\text{ }^\circ\text{C}$		190	μC	
		$T_{vj} = 125\text{ }^\circ\text{C}$		295		
		$T_{vj} = 150\text{ }^\circ\text{C}$		335		
I_{rr}	二极管反向恢复电流 Diode reverse recovery current	$T_{vj} = 25\text{ }^\circ\text{C}$		185	A	
		$T_{vj} = 125\text{ }^\circ\text{C}$		210		
		$T_{vj} = 150\text{ }^\circ\text{C}$		216		
E_{rec}	二极管反向恢复损耗 Diode reverse recovery energy	$T_{vj} = 25\text{ }^\circ\text{C}$		223	mJ	
		$T_{vj} = 125\text{ }^\circ\text{C}$		360		
		$T_{vj} = 150\text{ }^\circ\text{C}$		410		

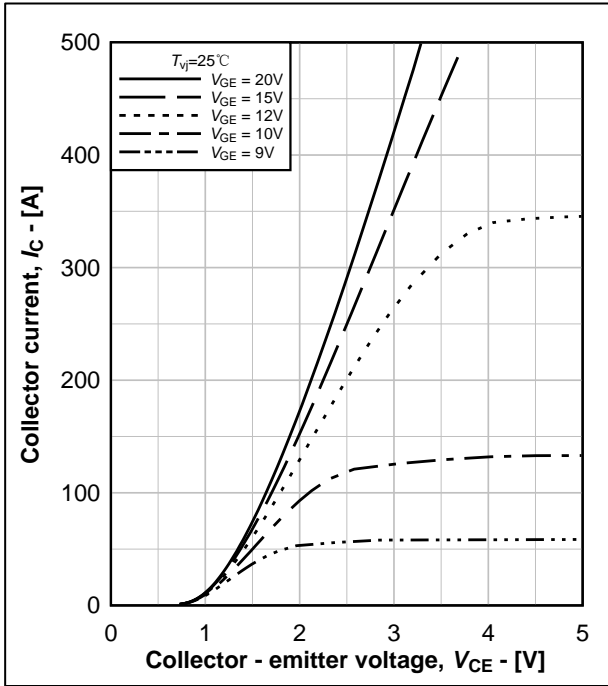


图 3. IGBT 输出特性典型曲线, $I_C = f(V_{CE})$

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

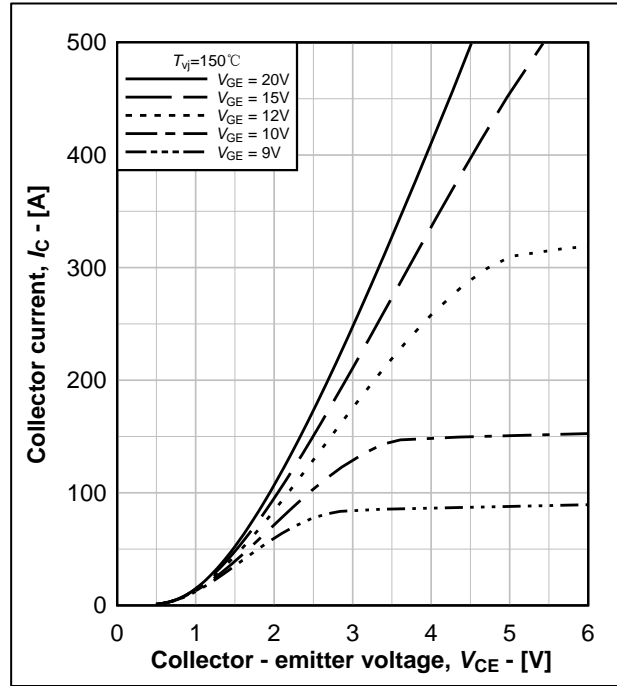


图 4. IGBT 输出特性典型曲线, $I_C = f(V_{CE})$

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

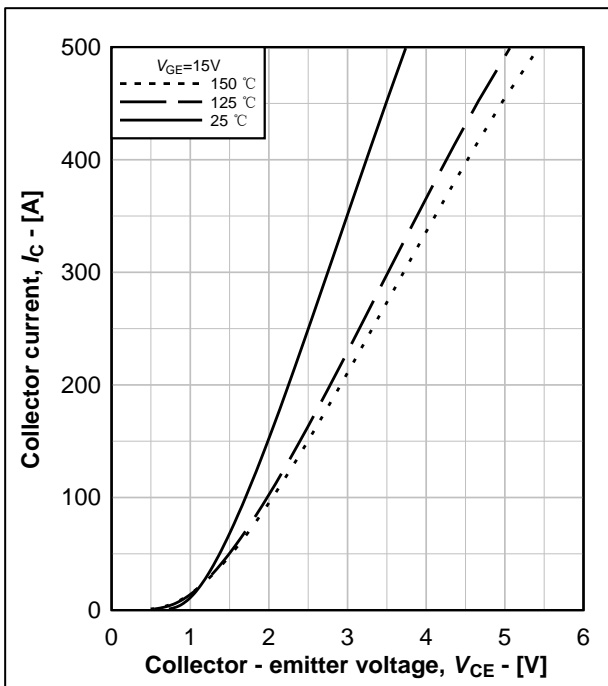


图 5. IGBT 输出特性典型曲线, $I_C = f(V_{CE})$

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

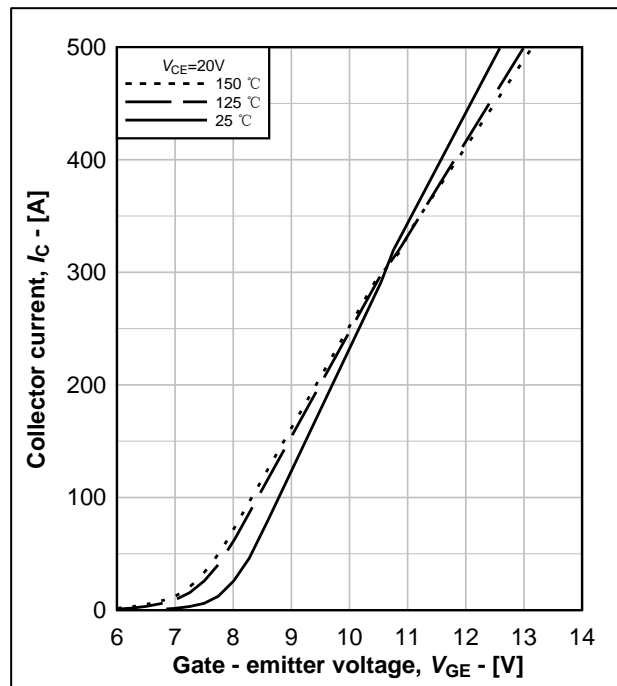


图 6. IGBT 传输特性典型曲线, $I_C = f(V_{GE})$

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

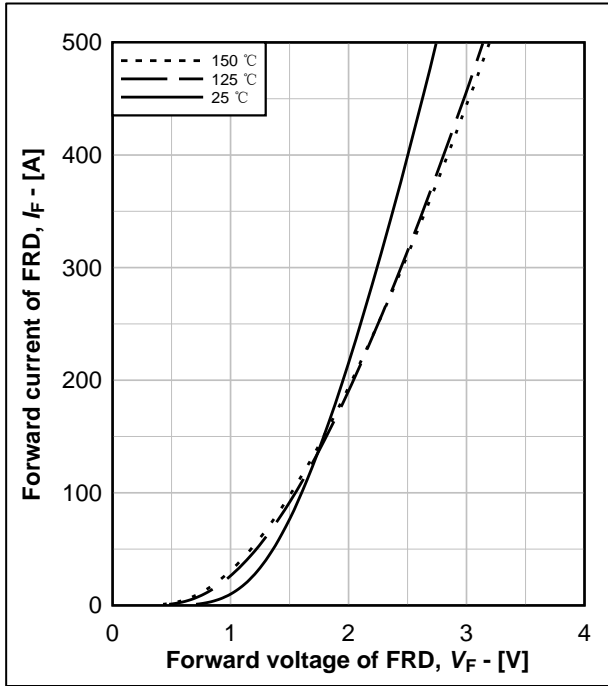

 图 7. FRD 输出特性典型曲线, $I_F = f(V_F)$

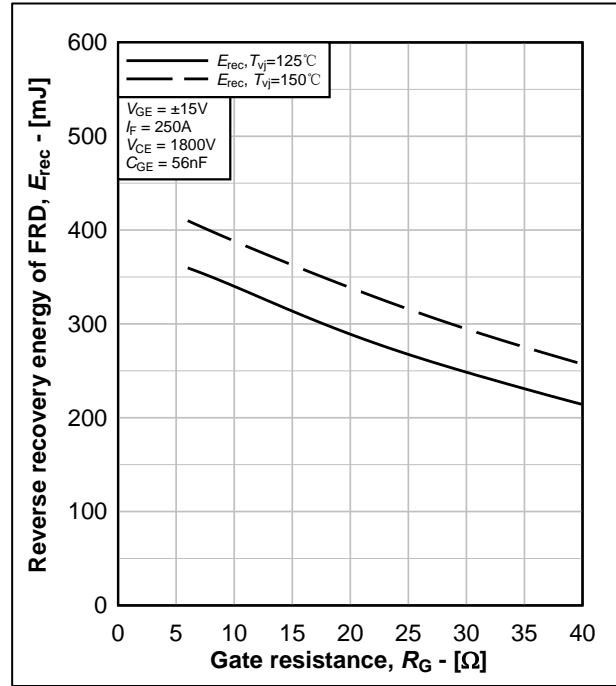
 Fig.7 Typical FRD output characteristics, $I_F = f(V_F)$

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

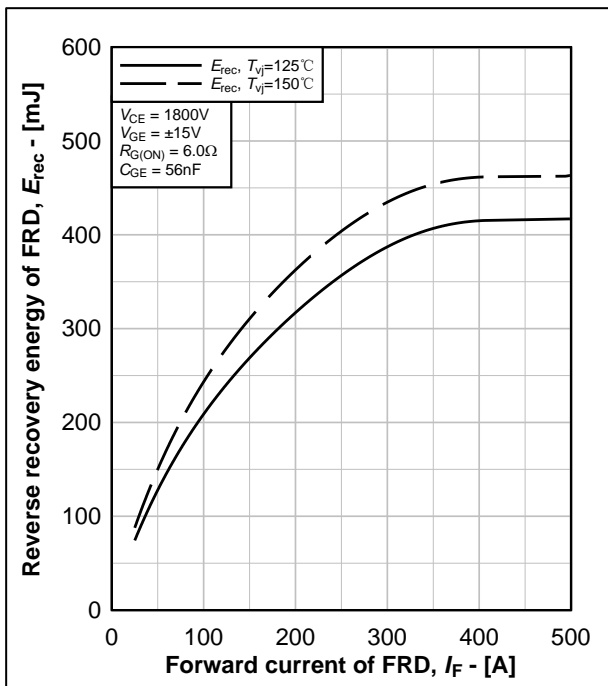
 Fig.8 Typical FRD E_{rec} $E_{rec} = f(R_G)$

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

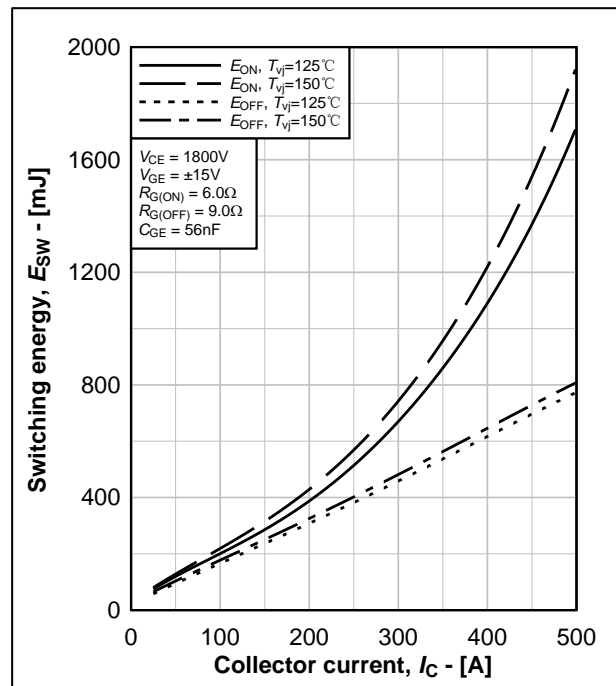
 Fig.9 Typical FRD E_{rec} $E_{rec} = f(I_F)$

 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, $E_{on} = f(I_C)$, $E_{off} = f(I_C)$

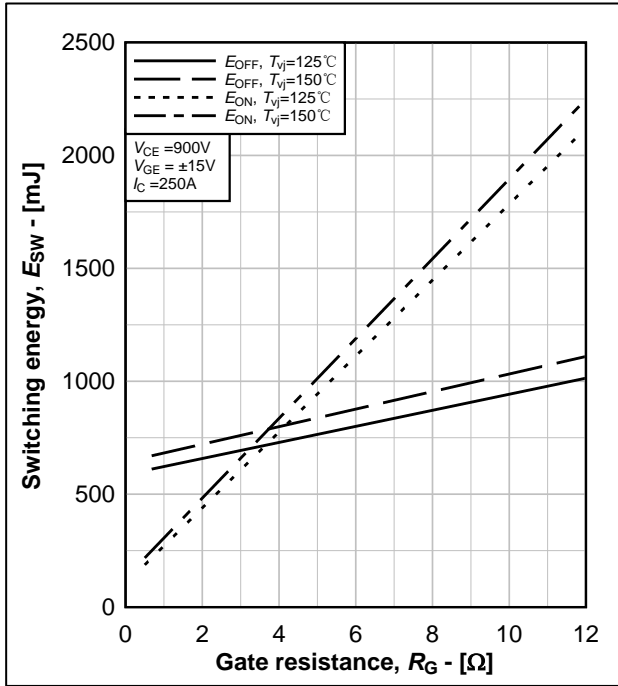

 图 11. IGBT 开关能耗典型曲线, $E_{on} = f(R_G)$, $E_{off} = f(R_G)$

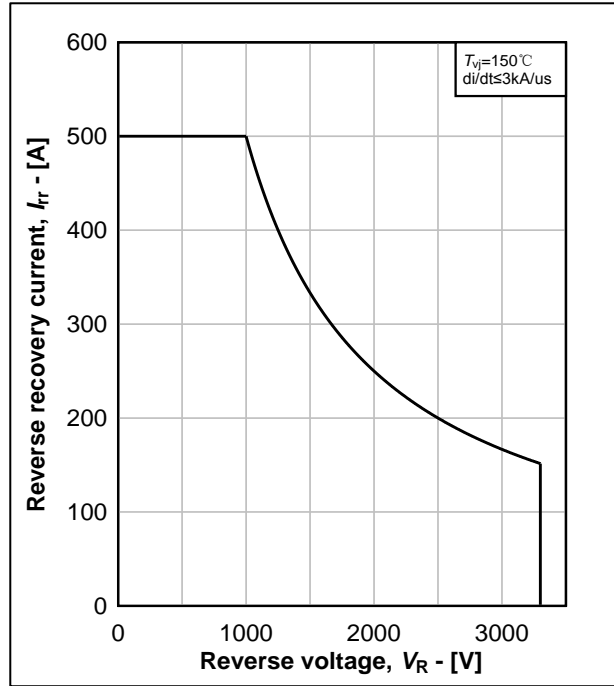
 Fig.11 Typical IGBT switching energy, $E_{on} = f(R_G)$, $E_{off} = f(R_G)$

 图 12. 二极管反偏安全工作区, $I_{rr} = f(V_R)$

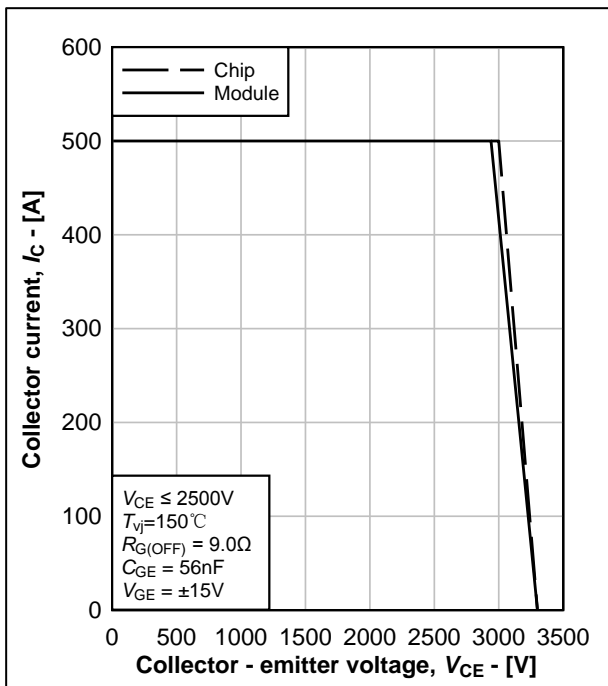
 Fig.12 Diode reverse bias safe operating area, $I_{rr} = f(V_R)$

 图 13. IGBT 反偏安全工作区, $I_C = f(V_{CE})$

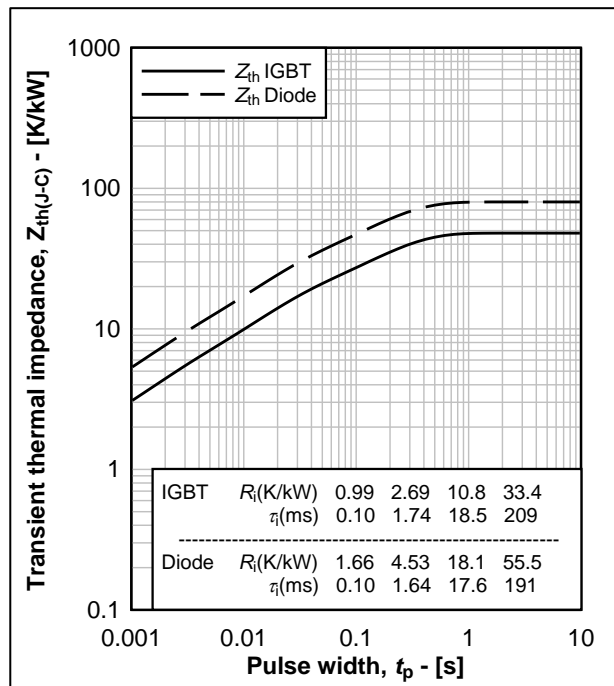
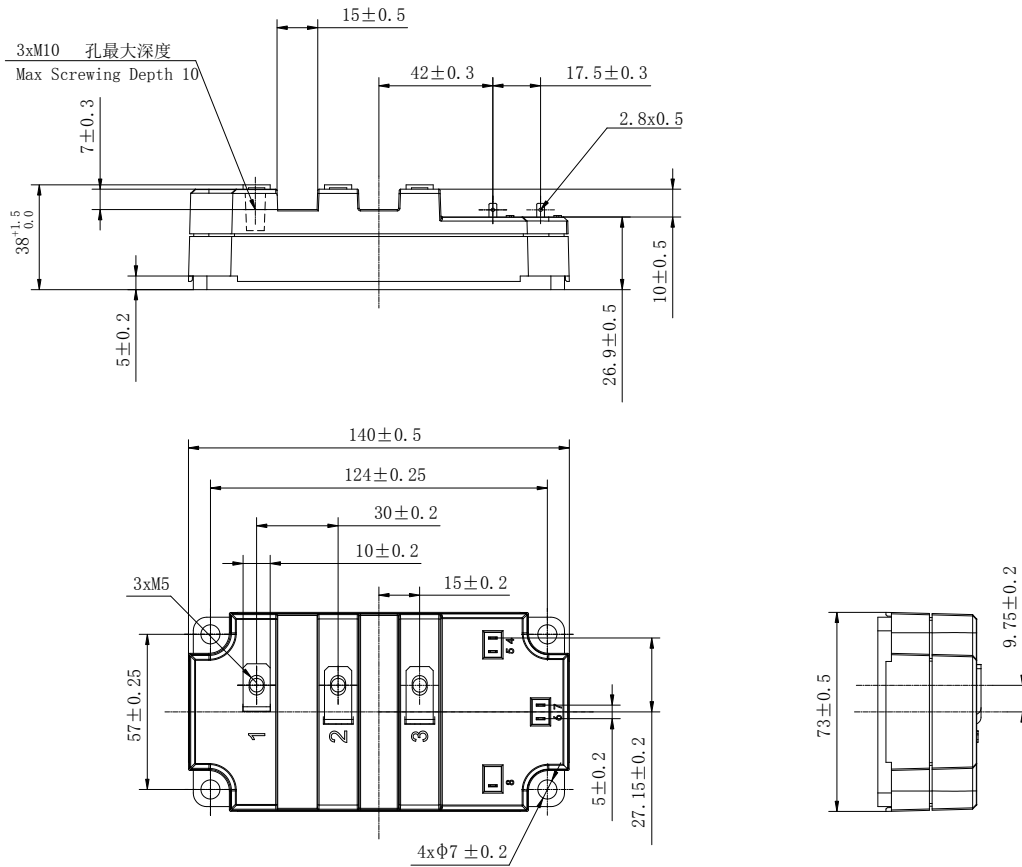
 Fig.13 Reverse bias safe operating area of IGBT, $I_C = f(V_{CE})$

 图 14. 瞬态热阻抗曲线, $Z_{th(j-c)} = f(t_p)$

 Fig.14 Transient thermal impedance, $Z_{th(j-c)} = f(t_p)$



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

图 15 模块外观尺寸

Fig. 15 Module outlines

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