中国中车 CRRC

产品数据手册 Product Datasheet 版本 Ver 25.04

TIM1000A2SM65-TSA000

单管型 IGBT 模块 Single Switch IGBT Module

初版 Preliminary

关键参数 Key Parameters

V_{CES}		6500	V
$V_{CE(sat)}$	Typ.	2.45	V
I_C	Max.	1000	A
$I_{C(RM)}$	Max.	2000	A

典型应用 Typical Applications

- 牵引传动 Traction Drives
- 电机控制 Motor Controllers
- 智能电网 Smart Grid
- 高可靠性逆变器 High Reliability Inverter

特点 Features

- AlSiC 基板 AlSiCBaseplate
- AIN 衬板 AIN 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

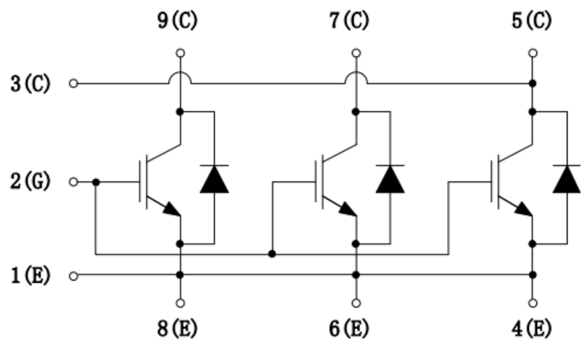


图 1. 电路结构

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

ab1234567890

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	6500	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 = 80 °C, T_{vj} = 150°C	1000	A
$I_{C(PK)}$	集电极峰值电流 Peak collector current	t_P=1ms	2000	A
P_{max}	晶体管部分最大损耗 Max. transistor power dissipation	T_{vj} = 150°C, T_C = 25 °C	15.63	KW
I^2t	二极管 I^2t 值 Diode I^2t	V_R =0V, t_P = 10ms, T_{vj} = 150 °C	TBD	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	10.2	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	60.0	mm
	端子-端子 Terminal to terminal	56.0	mm
绝缘间隙 Clearance	端子-散热器 Terminal to heatsink	40.0	mm
	端子-端子 Terminal to terminal	26.0	mm
相对漏电起痕指数 CTI (Comparative Tracking Index)		>600	

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。

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
$R_{th(J\text{-}C)\ IGBT}$	IGBT 结壳热阻 Thermal resistance – IGBT				8	K / kW
$R_{th(J\text{-}C)\ Diode}$	二极管结壳热阻 Thermal resistance – Diode				12.9	K / kW
$R_{th(C\text{-}H)\ IGBT}$	接触热阻(IGBT) Thermal resistance – case to heatsink (IGBT)	安装力矩 5Nm，导热脂 1W/m·K Mounting torque 5Nm, with mounting grease 1W/m·K			7	K / kW
$R_{th(C\text{-}H)\ Diode}$	接触热阻(Diode) Thermal resistance – case to heatsink (Diode)	安装力矩 5Nm，导热脂 1W/m·K Mounting torque 5Nm, with mounting grease 1W/m·K			8	K / kW
$T_{vj\ op}$	工作结温 Operating junction temperature	IGBT 芯片 （IGBT）	-50		150	°C
		二极管芯片(Diode)	-50		150	°C
T_{stg}	存储温度 Storage temperature range		-50		125	°C
M	安装力矩 Screw torque	安装紧固用 – M6 Mounting – M6	4.25		5.75	Nm
		电路互连用 - M8 Electrical connections – M8	1.8		2.1	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_C=150 °C			120	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 = 90mA, V_{GE} = V_{CE}	5.00	6.00	7.00	V
$V_{CE\ (sat)}^{(*1)}$	集电极-发射极饱和电压 Collector-emitter saturation voltage	V_{GE} =15V, I_C = 1000A		2.45		V
		V_{GE} =15V, I_C = 1000A, T_{vj} = 150 °C		3.40		V
I_F	二极管正向直流电流 Diode forward current	DC		1000		A
I_{FRM}	二极管正向重复峰值电流 Diode peak forward current	t_P = 1ms		2000		A
$V_F^{(*1)}$	二极管正向电压 Diode forward voltage	I_F = 1000A, V_{GE} = 0		2.45		V
		I_F =1000A, V_{GE} = 0, T_{vj} = 150 °C		3.05		V
I_{SC}	短路电流 Short circuit current	T_{vj} = 150° C, V_{CC} = 4500V, V_{GE}≤15V, t_p≤10μs, $V_{CE(max)}$ = V_{CES} – $L^{(*2)}$×di/dt, IEC 60747-9		4800		A

注意： 1.(*1) 表示该参数基于芯片水平给出((*1) indicates it is given at chip level),

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		215		nF
Q_g	栅极电荷 Gate charge	±15V		10.6		μC
C_{res}	反向传输电容 Reverse transfer capacitance	V_{CE} = 25V, V_{GE} = 0V, f = 100kHz		0.2		nF
L_{sCE}	模块电感 Module inductance			13		nH
$R_{CC'+EE'}$	模块引线电阻，端子-芯片 Module lead resistance, terminal-chip			100		μΩ
R_{Gint}	内部栅极电阻 Internal gate resistor			2.1		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 =1000A, V_{CE} = 3600V, V_{GE} = ±15V, $R_{G(OFF)}$ = 18.0Ω, C_{GE} = 220nF, L_S =65nH,	T_{vj}= 25 °C		6096		ns
			T_{vj}= 150 °C		6928		
t_f	下降时间 Fall time		T_{vj}= 25 °C		2648		ns
			T_{vj}= 150 °C		4296		
E_{OFF}	关断损耗 Turn-off energy loss		T_{vj}= 25 °C		5647		mJ
			T_{vj}= 150 °C		8030		
$t_{d(on)}$	开通延迟时间 Turn-on delay time	I_C =1000A, V_{CE} = 3600V, V_{GE} = ±15V, $R_{G(ON)}$ = 2.2Ω, C_{GE} = 220nF, L_S =65nH,	T_{vj}= 25 °C		1312		ns
			T_{vj}= 150 °C		1272		
t_r	上升时间 Rise time		T_{vj}= 25 °C		136		ns
			T_{vj}= 150 °C		152		
E_{ON}	开通损耗 Turn-on energy loss		T_{vj}= 25 °C		5887		mJ
			T_{vj}= 150 °C		8123		
Q_{rr}	二极管反向恢复电荷 Diode reverse recovery charge	I_F =1000A, V_{CE} = 3600V, - di_F/dt = 4990A/us, (T_{vj}= 150°C).	T_{vj}= 25 °C		1311		μC
			T_{vj}= 150 °C		2405		
I_{rr}	二极管反向恢复电流 Diode reverse recovery current		T_{vj}= 25 °C		1459		A
			T_{vj}= 150 °C		1201		
E_{rec}	二极管反向恢复损耗 Diode reverse recovery energy		T_{vj}= 25 °C		2215		mJ
			T_{vj}= 150 °C		4979		

注意：
Note:

1.(*1) dv/dt：定义为关断波形电压 V_{CE} 上升段，40% V_{CE} 至 60% V_{CE} 区间段的斜率((*1) dv/dt：Defined as the slope of waveform of 40% V_{CE} to 60% V_{CE} during turn off)

2.(*2) di/dt：定义为开通波形电流 I_C 上升段，40% I_C 至 60%I_C 区间段的斜率((*2) di/dt：Defined as the slope of waveform of 40% V_{CE} to 60% di/dt during turn on)

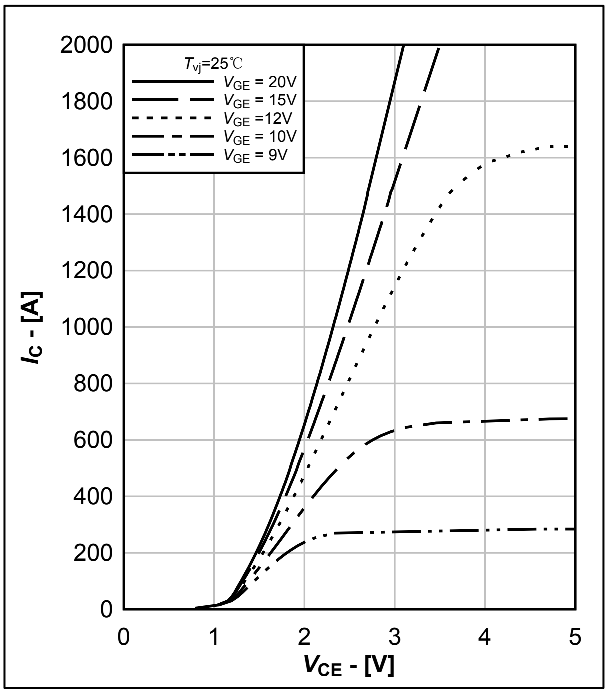


图 3. IGBT 输出特性典型曲线,I_C= f (V_{CE})

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

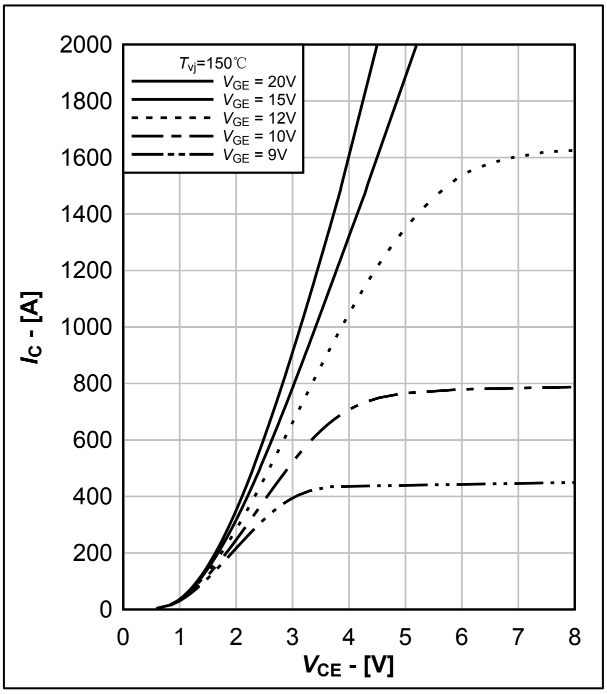


图 4. IGBT 输出特性典型曲线,I_C= f (V_{CE})

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

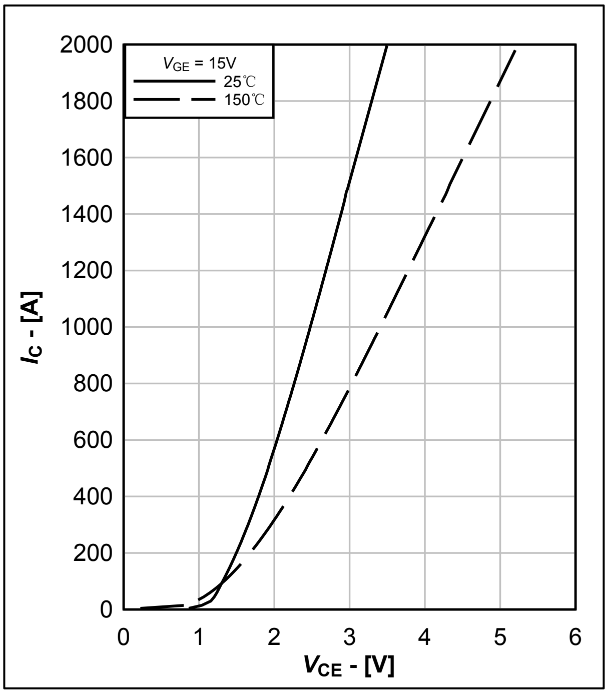


图 5. IGBT 输出特性典型曲线,I_C= f (V_{CE})

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

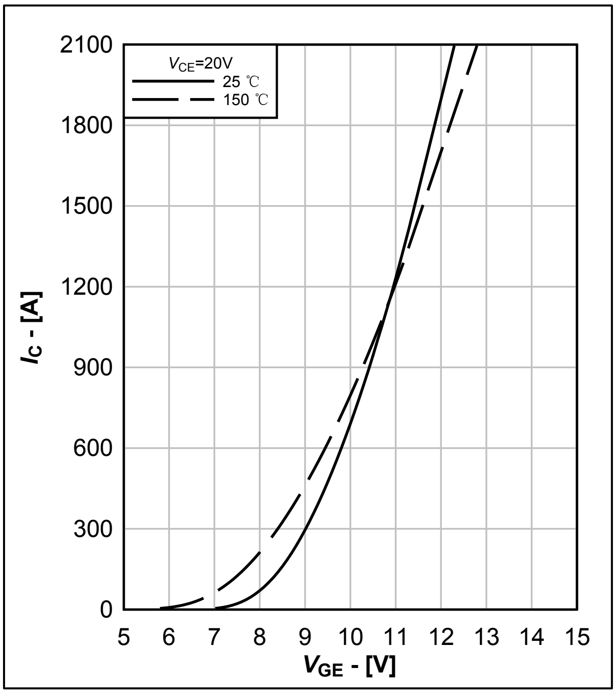


图 6. IGBT 传输特性典型曲线,I_C= f (V_{GE})

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

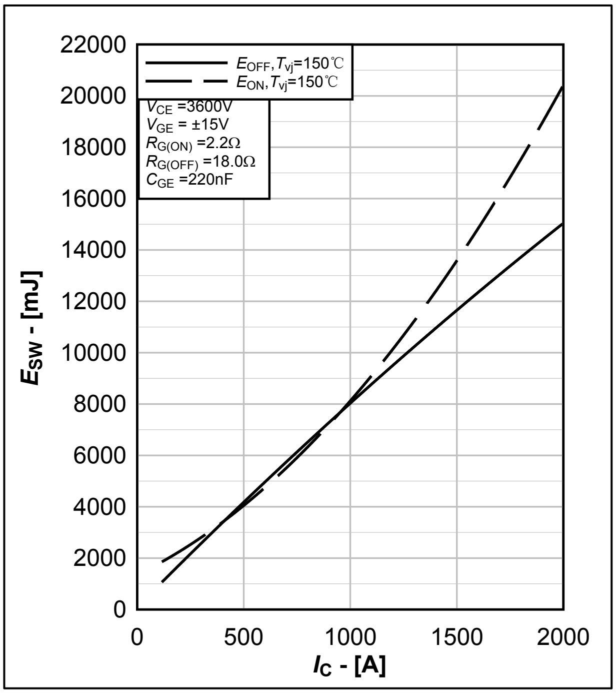


图 7. IGBT 开关损耗典型曲线, E_{on}= f (I_C), E_{off}= f (I_C)

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

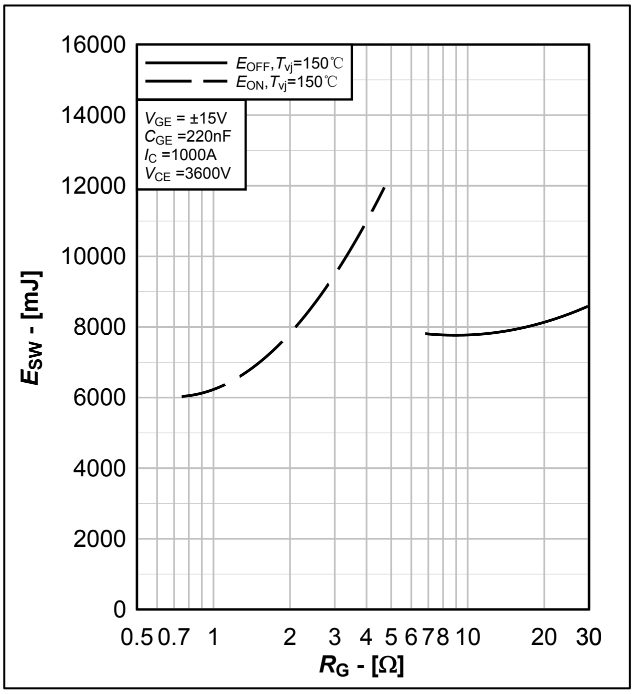


图 8. IGBT 开关损耗典型曲线, E_{on}= f (R_G), E_{off}= f (R_G)

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

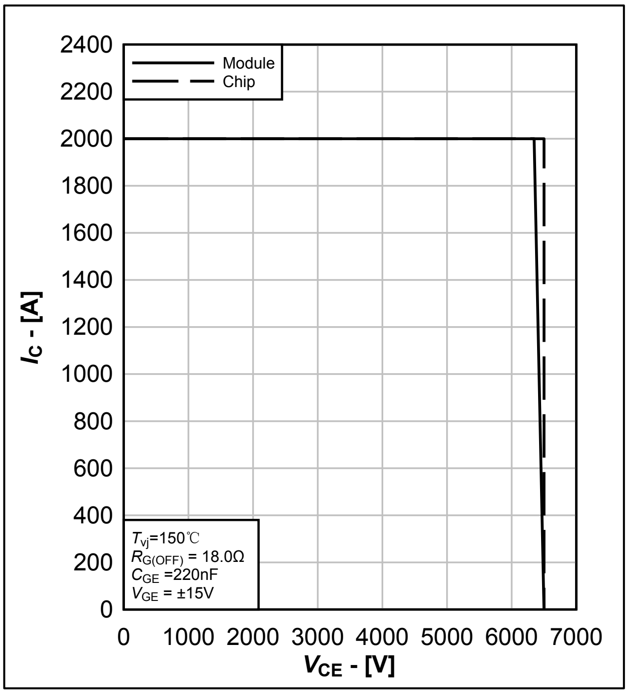


图 9. IGBT 反偏安全工作区, I_C = f (V_{CE})

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

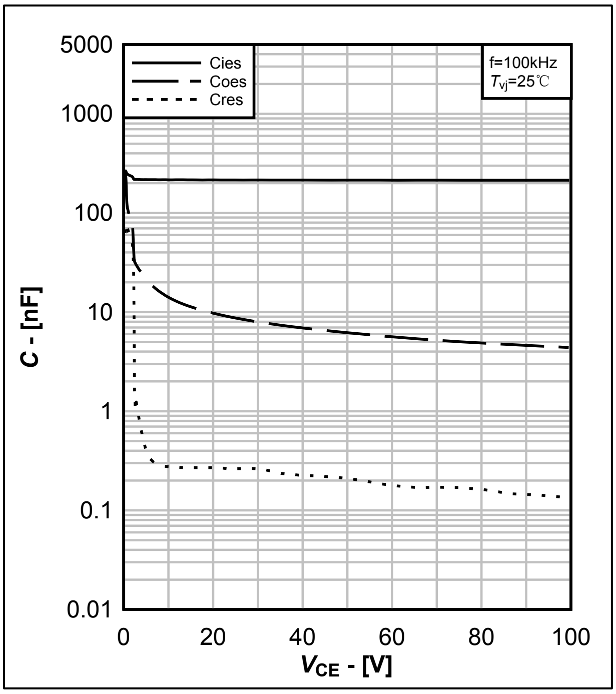


图 10. 电容特性典型曲线, C= f (V_{CE})

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

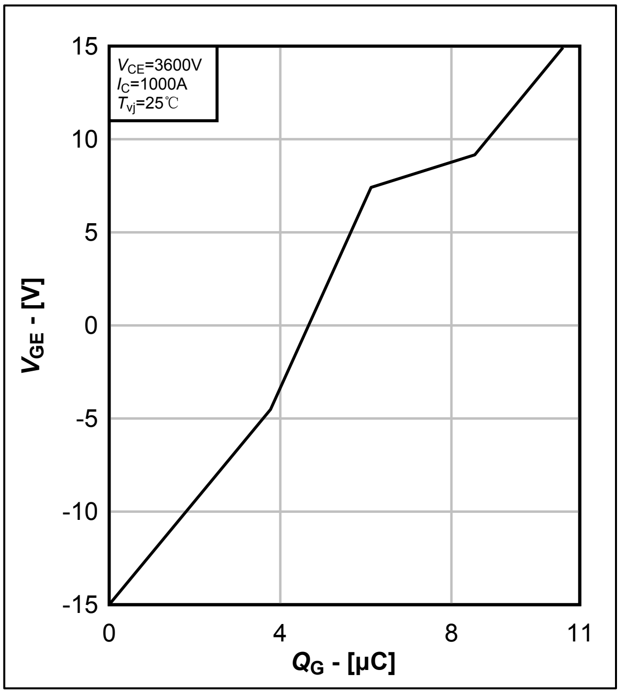


图 11. 栅极电荷特性典型曲线, V_{GE} = f (Q_G)

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

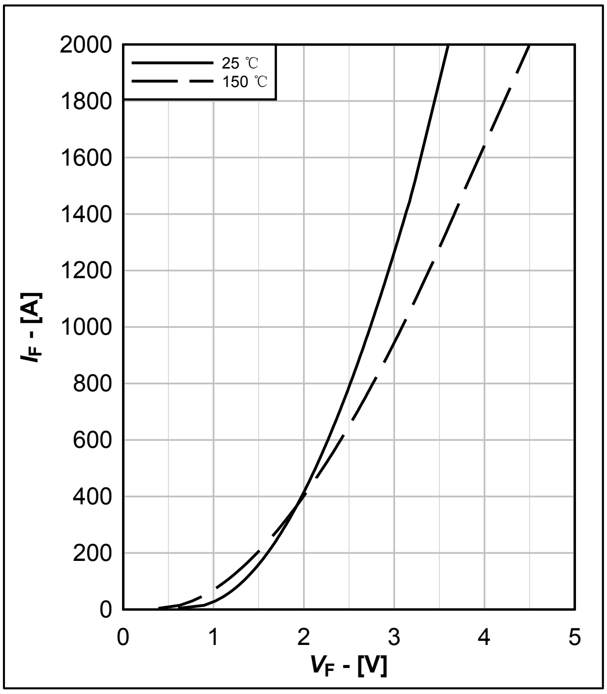


图 12. FRD 输出特性典型曲线, I_F = f (V_F)

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

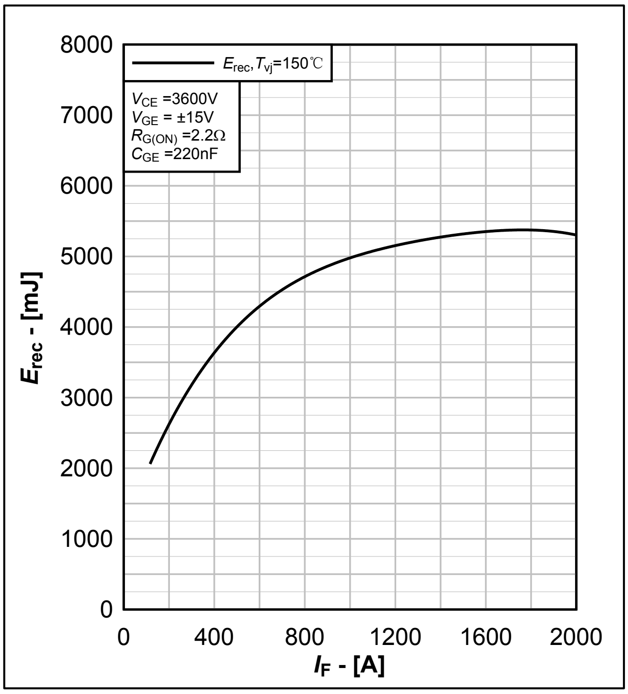


图 13. FRD 反向恢复损耗典型曲线, E_{rec}=f(I_F)

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

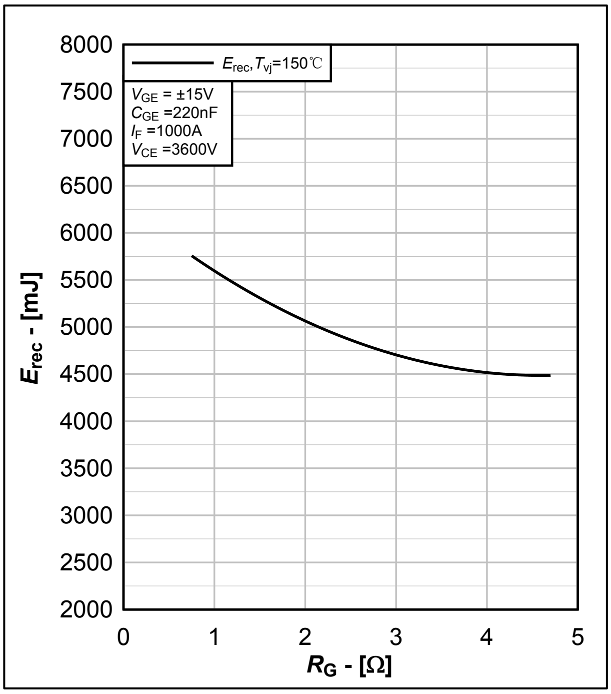


图 14. FRD 反向恢复损耗典型曲线, E_{rec}=f(R_G)

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

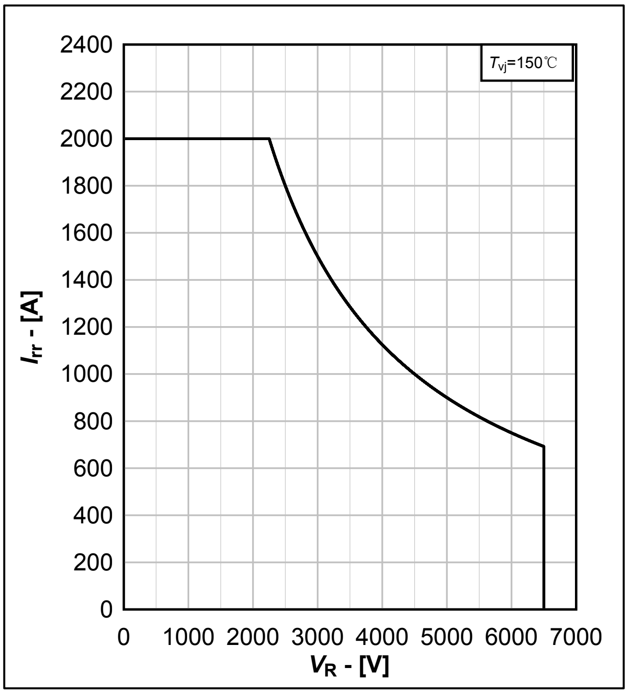


图 15. FRD 反偏安全工作区, I_{rr} = f (V_R)

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

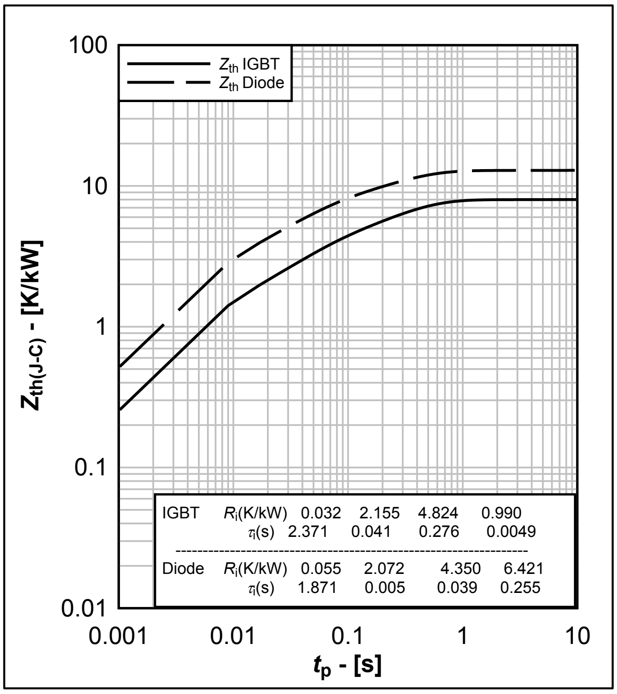
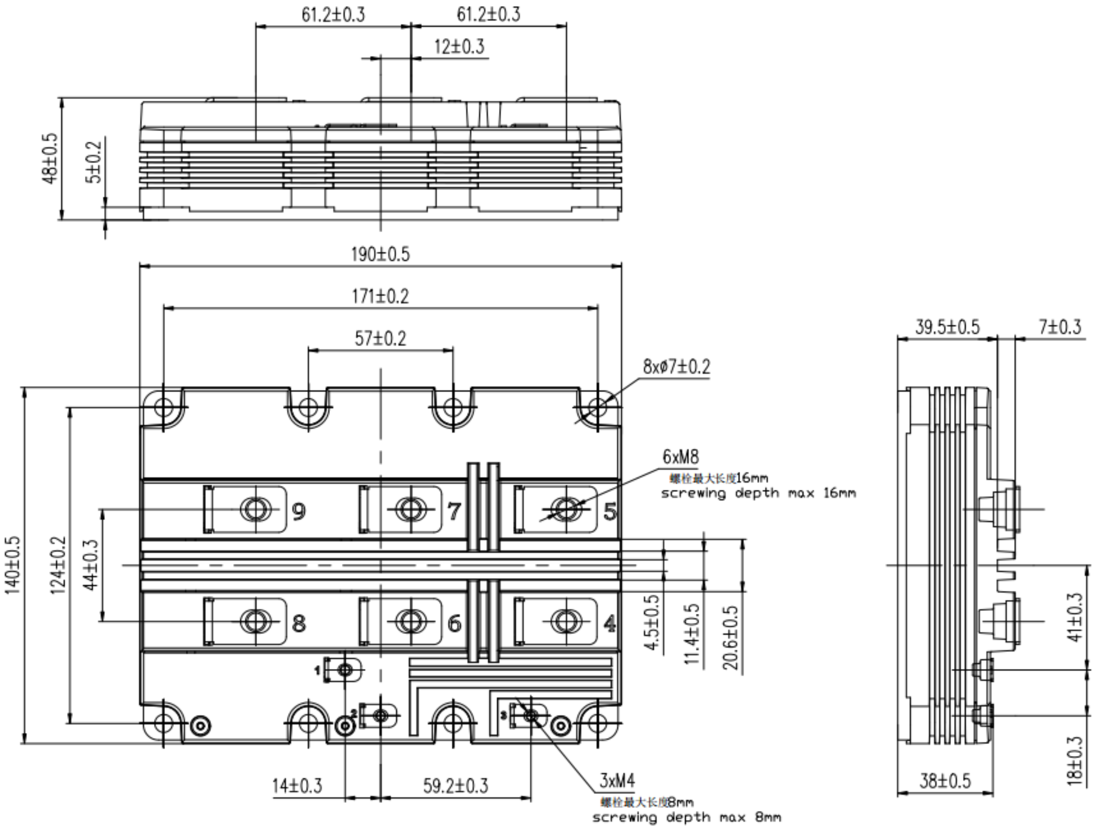


图 16. 瞬态热阻抗曲线, $Z_{th(J-C)}$ = f (t_p)

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



重量 Weight：1500g　　模块外观类型 Module outline code：A2

图 17.　模块外观尺寸

Fig. 17　Module outlines

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