HCGM750PHM65-TSA000

半桥型 IGBT 模块 Half Bridge IGBT Module

初版 Preliminary

产品数据手册 Product Datasheet 版本 Ver 23.05

关键参数 Key Parameters

V_{CES}		6500	V
$V_{CE(sat)}$	Typ.	3.1	V
I_C	Max.	750	A
$I_{C(RM)}$	Max.	1500	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

- 直接液冷散热 Direct Liquid-Cooling
- AIN 衬板 AIN Substrates
- 低感设计 Low Inductive Design
- 10μs 短路承受能力 10μs Short Circuit Withstand

电路结构 Circuit Configuration

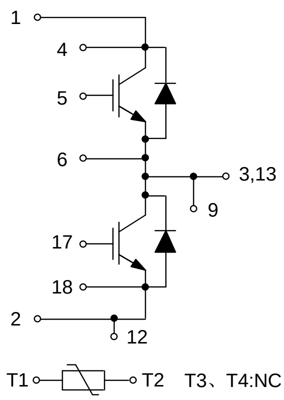


图 1. 电路结构

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

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	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_F = 60 °C	750	A
$I_{C(PK)}$	集电极峰值电流 Peak collector current	t_P=1ms	1500	A
P_{max}	晶体管部分最大损耗 Max. transistor power dissipation	T_{vj} = 125°C, T_F = 60 °C	2826	W
I^2t	二极管 I^2t 值 Diode I^2t	V_R =0V, t_P = 10ms, T_{vj} = 125 °C	460	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	56.0	mm
	端子-端子 Terminal to terminal	56.0	mm
绝缘间隙 Clearance	端子-散热器 Terminal to heatsink	26.0	mm
	端子-端子 Terminal to terminal	26.0	mm
相对漏电起痕指数 CTI (Comparative Tracking Index)		>600	

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
$R_{th(J\text{-}F)\ IGBT}$	IGBT 结壳热阻 Thermal resistance – IGBT	冷却液：50%乙二醇溶液; ΔV/Δt=6.5 dm3/min; T_F = 60 °C Cooling Fluid：50% water / 50% ethylene glycol; ΔV/Δt=6.5 dm3/min; T_F = 60 °C			23.0	K / kW
$R_{th(J\text{-}F)\ Diode}$	二极管结壳热阻 Thermal resistance – Diode				34.4	K / kW
$T_{vj\ op}$	工作结温 Operating junction temperature	IGBT 芯片（IGBT）	-40		125	°C
		二极管芯片(Diode)	-40		125	°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 – M4 Mounting – M4	1.6		2	Nm
		安装紧固用 – M3 Mounting – M3	0.8		1	Nm
		电路互连用 – M3 Electrical connections – M3	0.8		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
△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_C=125 °C			75	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 = 60mA, V_{GE} = V_{CE}	5.50	6.50	7.50	V
$V_{CE(sat)}$(*1)	集电极-发射极饱和电压 Collector-emitter saturation voltage	V_{GE} =15V, I_C = 750A		3.10		V
		V_{GE} =15V, I_C = 750A, T_{vj} = 125 °C		3.75		V
I_F	二极管正向直流电流 Diode forward current	DC		750		A
I_{FRM}	二极管正向重复峰值电流 Diode peak forward current	t_P = 1ms		1500		A
V_F(*1)	二极管正向电压 Diode forward voltage	I_F = 750A, V_{GE} = 0		2.50		V
		I_F = 750A, V_{GE} = 0, T_{vj} = 125 °C		2.90		V
I_{SC}	短路电流 Short circuit current	T_{vj} = 125° C, V_{CC} = 4500V, V_{GE}≤15V, t_p≤10μs, $V_{CE(max)}$ = V_{CES} – $L^{(*2)}$×di/dt, IEC 60747-9		3600		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_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		179		nF
Q_g	栅极电荷 Gate charge	±15V		12		μC
C_{res}	反向传输电容 Reverse transfer capacitance	V_{CE} = 25V, V_{GE} = 0V, f = 100kHz		0.5		nF
L_{sCE}	模块电感 Module inductance			8		nH
$R_{CC'+EE'}$	模块引线电阻，端子-芯片 Module lead resistance, terminal-chip			300		μΩ
R_{Gint}	内部栅极电阻 Internal gate resistor			2.3		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 =750A, V_{CE} = 3600V, V_{GE} = ±15V, $R_{G(OFF)}$ =10Ω, C_{GE} = 220nF, L_S = 60nH, d*v*/dt =4300V/μs (T_{vj}= 125° C).	T_{vj}= 25 °C		1145		ns
			T_{vj}= 125 °C		3270		
t_f	下降时间 Fall time		T_{vj}= 25 °C		990		ns
			T_{vj}= 125 °C		1550		
E_{OFF}	关断损耗 Turn-off energy loss		T_{vj}= 25 °C		2165		mJ
			T_{vj}= 125 °C		2895		
$t_{d(on)}$	开通延迟时间 Turn-on delay time	I_C =750A, V_{CE} = 3600V, V_{GE} = ±15V, $R_{G(ON)}$ = 0.75Ω, C_{GE} = 220nF, L_S = 60nH, - d*i*/dt = 4600A/us (T_{vj}= 125°C).	T_{vj}= 25 °C		1120		ns
			T_{vj}= 125 °C		1245		
t_r	上升时间 Rise time		T_{vj}= 25 °C		205		ns
			T_{vj}= 125 °C		200		
E_{ON}	开通损耗 Turn-on energy loss		T_{vj}= 25 °C		4900		mJ
			T_{vj}= 125 °C		4940		
Q_{rr}	二极管反向恢复电荷 Diode reverse recovery charge	I_F =750A, V_{CE} = 3600V, - di_F/dt = 4600A/us (T_{vj}= 125°C).	T_{vj}= 25 °C		1170		μC
			T_{vj}= 125 °C		1500		
I_{rr}	二极管反向恢复电流 Diode reverse recovery current		T_{vj}= 25 °C		1415		A
			T_{vj}= 125 °C		1440		
E_{rec}	二极管反向恢复损耗 Diode reverse recovery energy		T_{vj}= 25 °C		1785		mJ
			T_{vj}= 125 °C		3000		

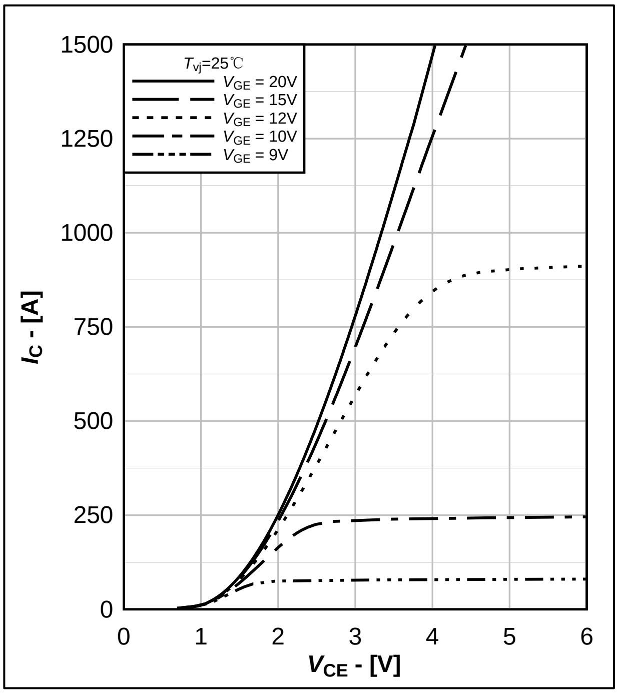


图 3. IGBT 输出特性典型曲线,I_C= f (V_{CE})

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

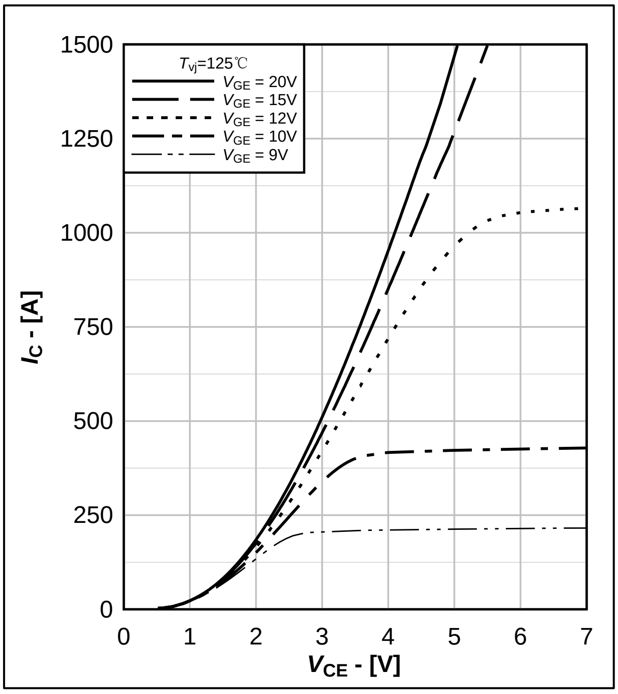


图 4. IGBT 输出特性典型曲线,I_C= f (V_{CE})

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

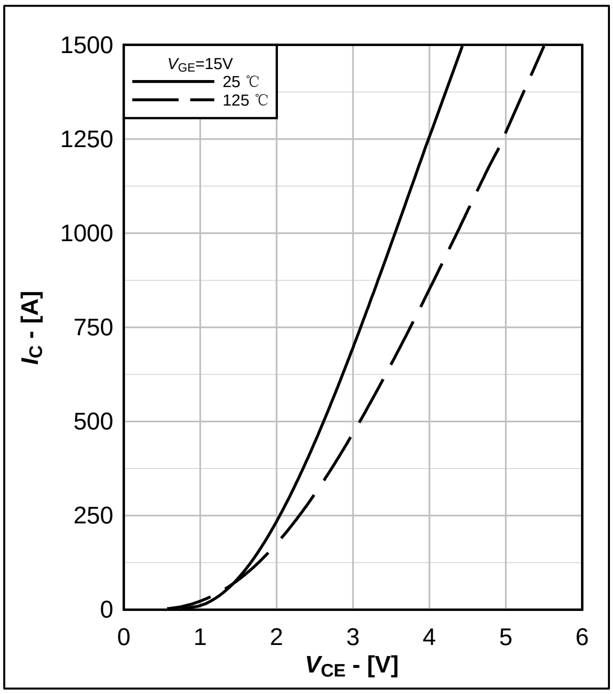


图 5. IGBT 输出特性典型曲线,I_C= f (V_{CE})

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

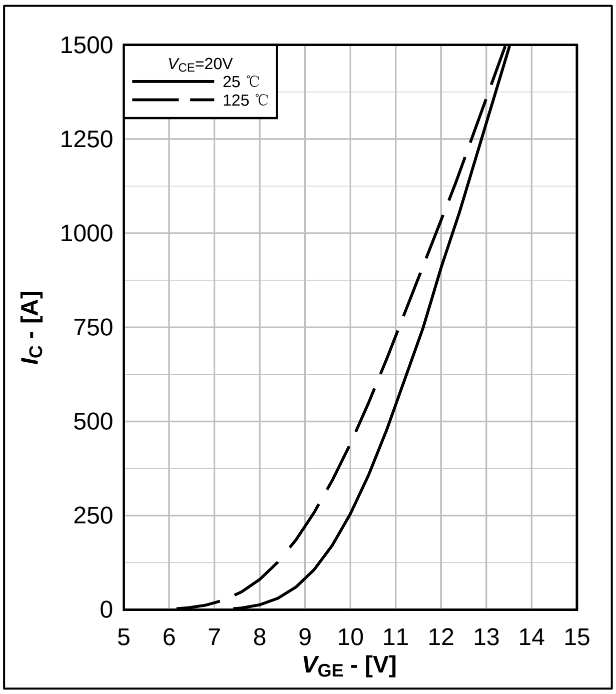


图 6. IGBT 传输特性典型曲线,I_C= f (V_{GE})

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

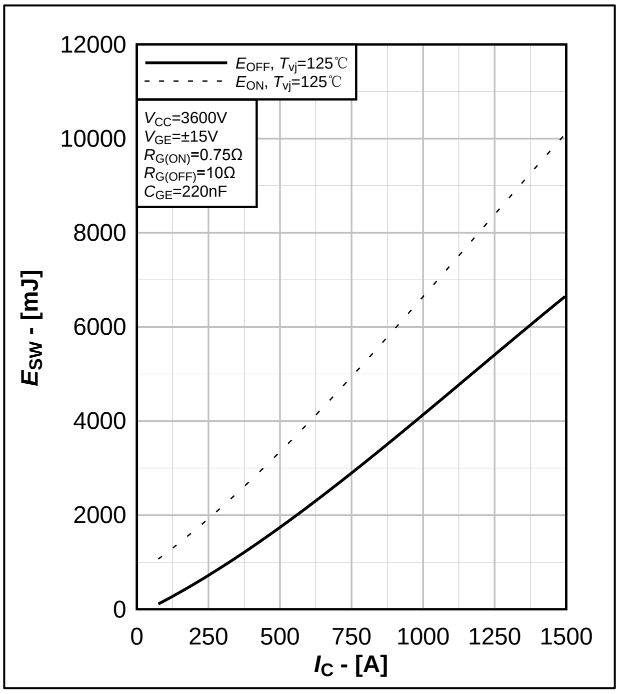


图 7. IGBT 开关损耗典型曲线, E_{on}= f (I_C), E_{off}= f (I_C)

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

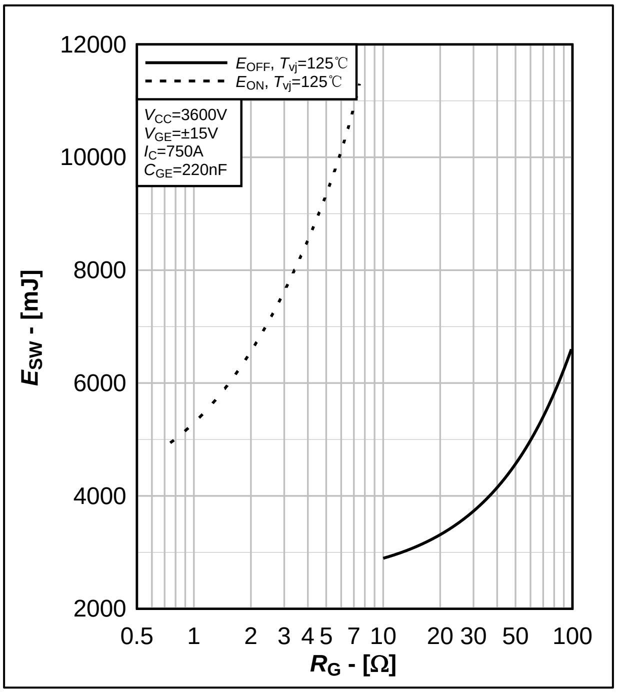


图 8. IGBT 开关损耗典型曲线, E_{on}= f (R_G), E_{off}= f (R_G)

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

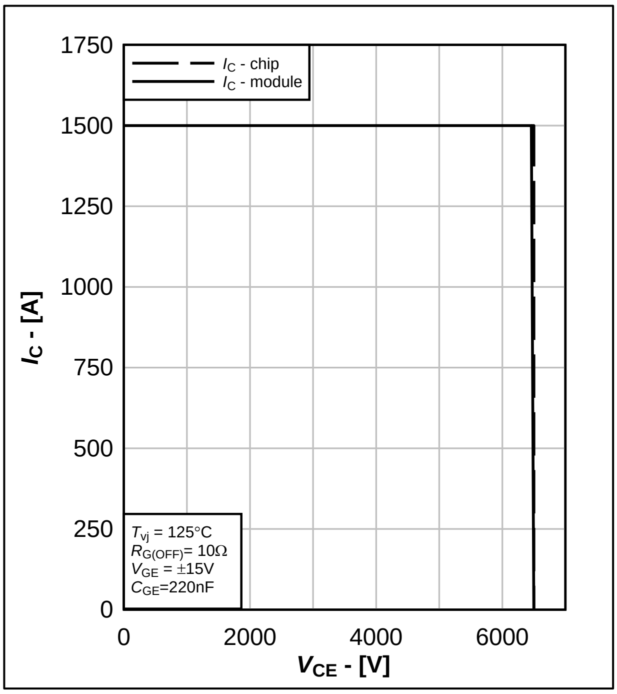


图 9. IGBT 反偏安全工作区, I_C = f (V_{CE})

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

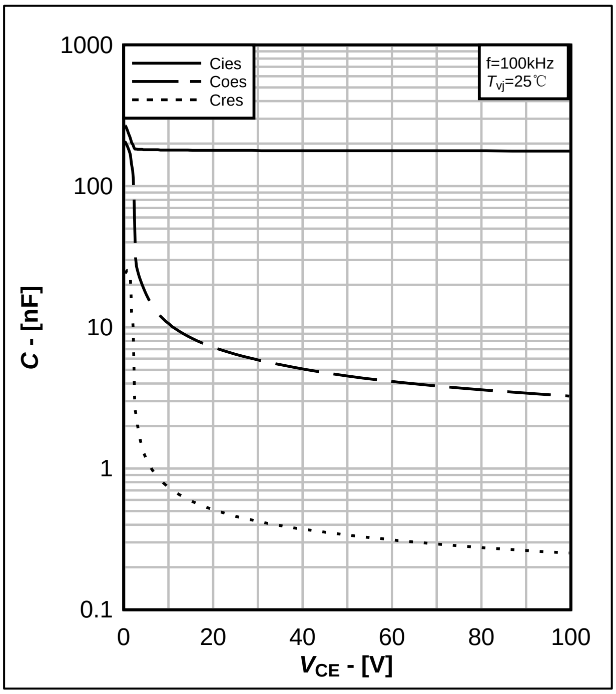


图 10. 电容特性典型曲线, C= f (V_{CE})

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

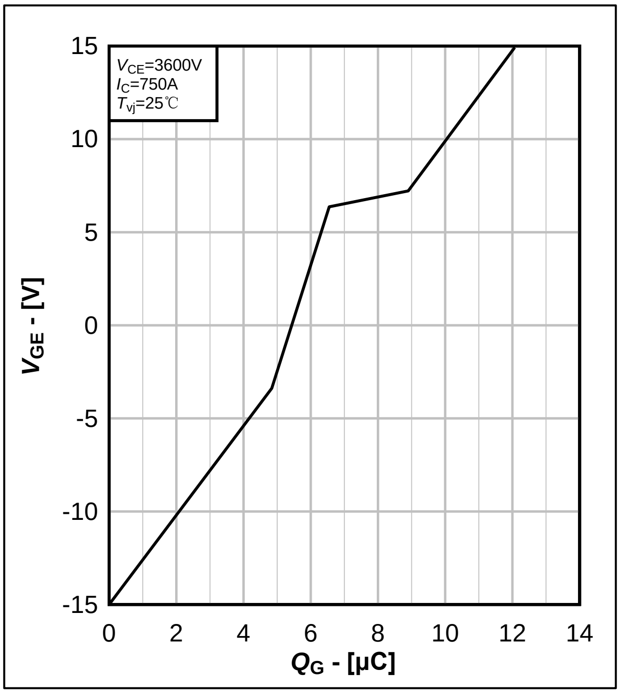


图 11. 栅极电荷特性典型曲线, V_{GE} = f (Q_G)

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

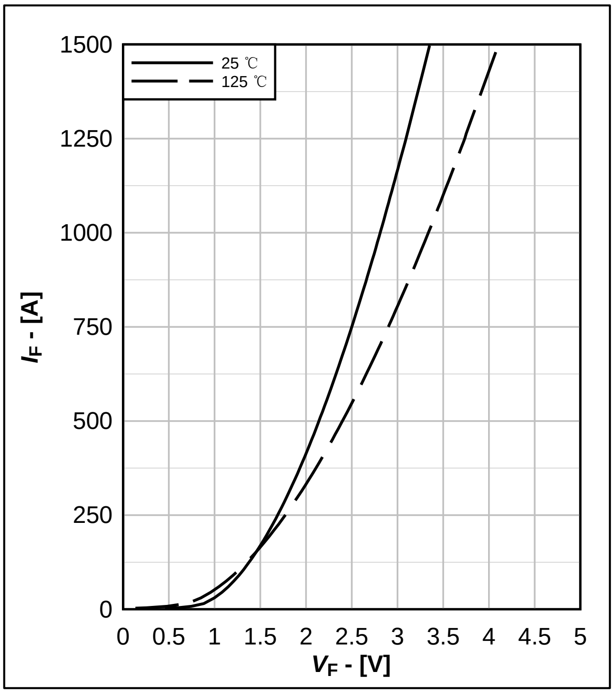


图 12. FRD 输出特性典型曲线, I_F = f (V_F)

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

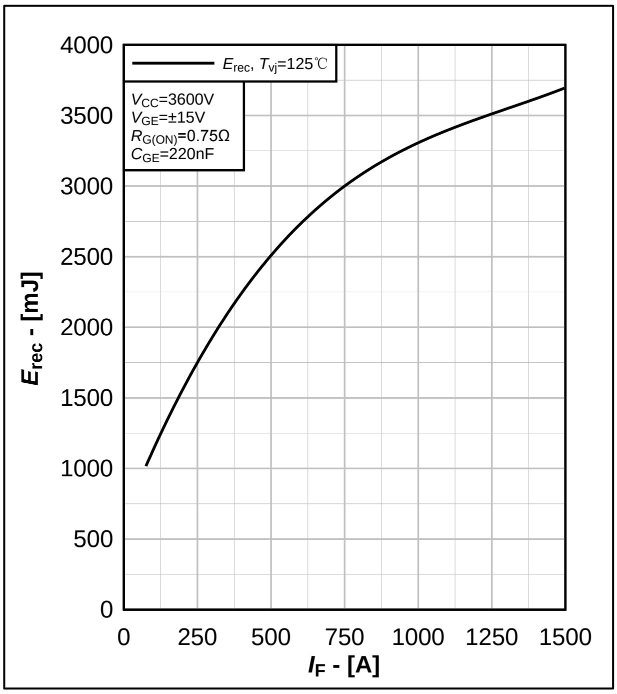


图 13. FRD 反向恢复损耗典型曲线, E_{rec}=f(I_F)

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

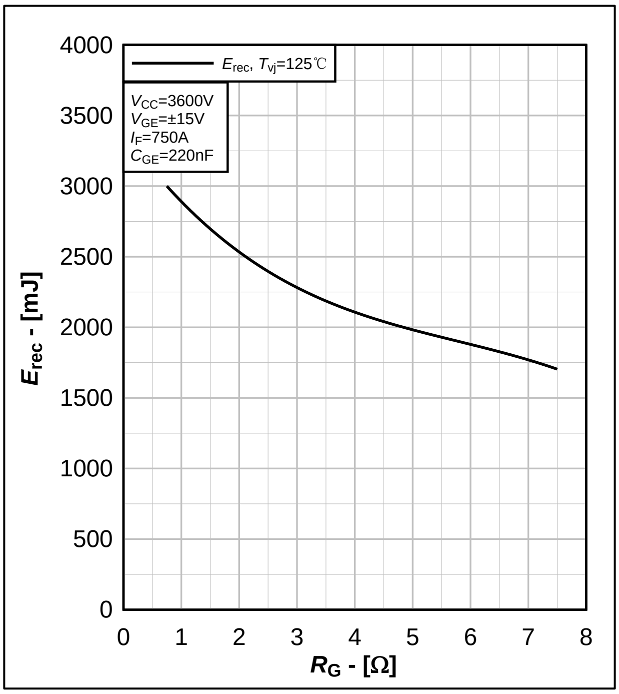


图 14. FRD 反向恢复损耗典型曲线, E_{rec}=f(R_G)

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

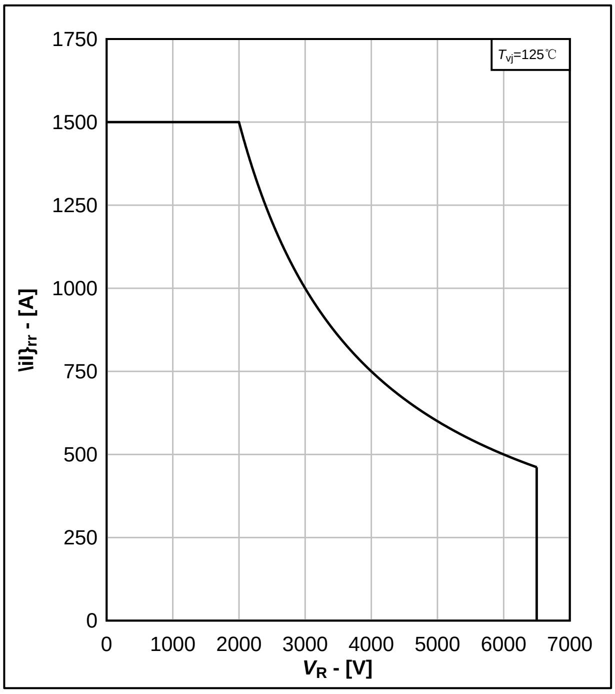


图 15. FRD 反偏安全工作区, I_{rr} = f (V_R)

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

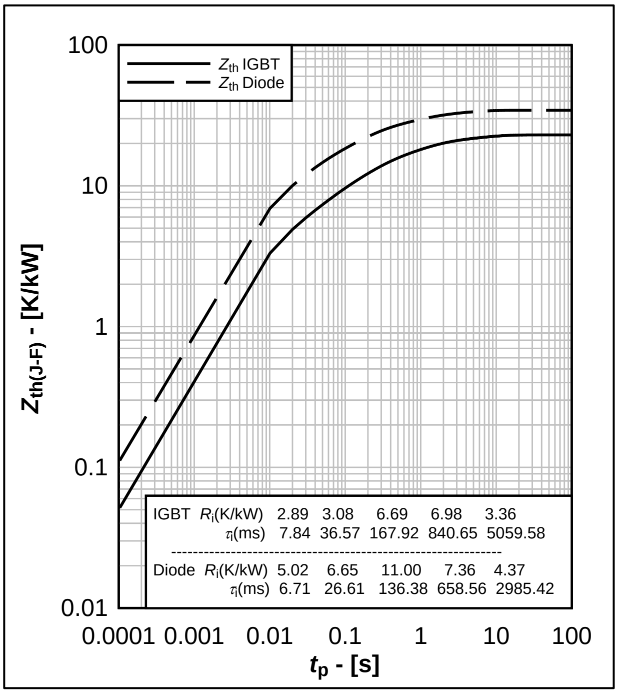


图 16. 瞬态热阻抗曲线, $Z_{th(J-F)}$ = f (t_p)

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

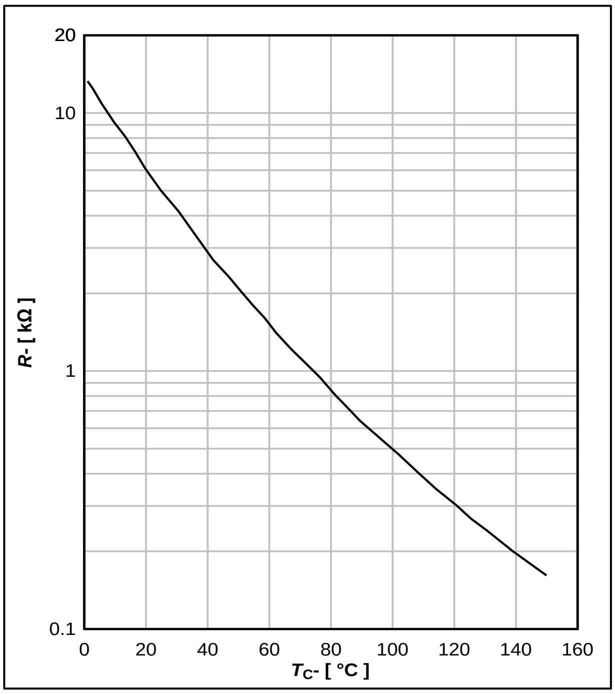
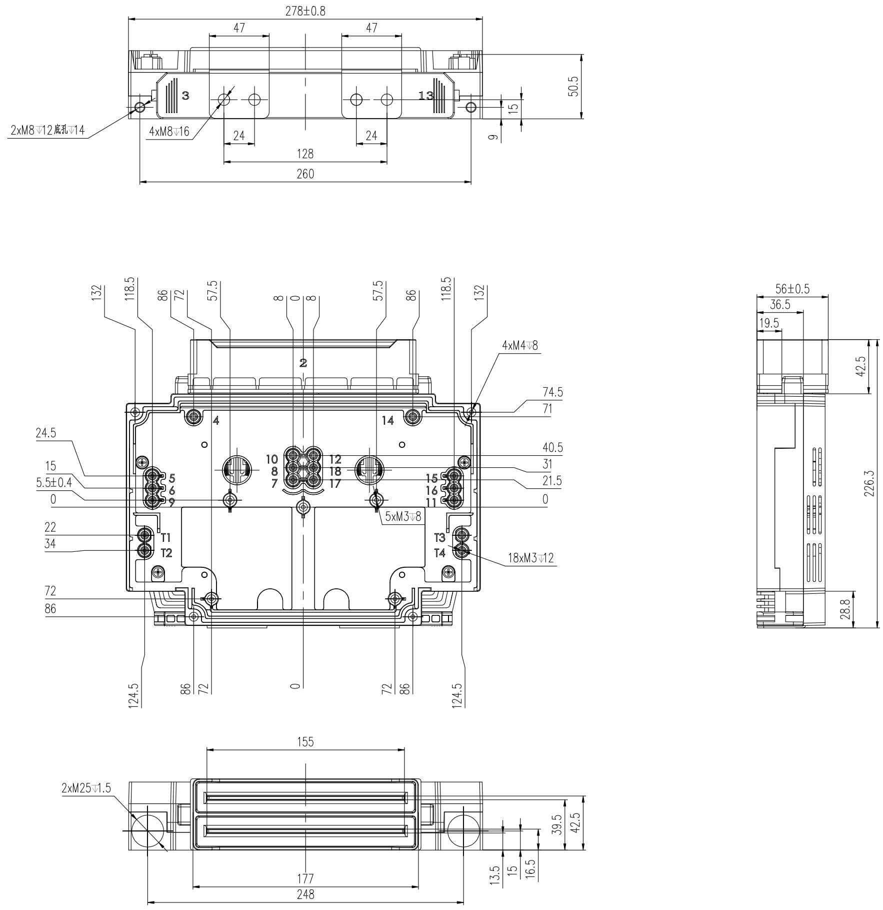


图 17. 热敏电阻典型特性曲线, R= f (T_C)

Fig.17 Typical NTC thermistor characteristic, R= f(T_C)



重量 Weight：4500g 模块外观类型 Module outline code：PCU

图 18. 模块外观尺寸

Fig. 18 Module outlines

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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。

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(3) If there are special requirements for the product, or apply it in special industries (such as aerospace, medical, life support, etc.), we strongly recommend that to perform joint application risk and quality assessments, get the quality agreements.

(4) During the application, if the working conditions are beyond the limitation of temperature, voltage, current or safe operating area of the product defined in the product datasheet, our company cannot guarantee the reliability of the product.

(5) When the products are in use, it is strictly prohibited to touch. After power off, to ensure that there is no residual charge and the products have been cooled before they can be touched. And all operations must be under ESD protection measures.

(6) We annotate datasheet in the top right hand corner of the front page, to indicate product status. The annotation“Preliminary” indicates the product design is complete and final characterization for volume production is in progress，the product information in the datasheet is currently can be referenced, but some details may change in the future. There is no annotation indicates the product is capable to produce in batch quantity.