

关键参数

Key Parameters

V_{CES}		3300	V
$V_{CE(sat)}$	Typ.	2.4	V
I_C	Max.	450	A
$I_{C(RM)}$	Max.	900	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 Inverters |

特点

Features

- | | |
|---------------------|------------------------------------|
| ● AISiC 基板 | AISiC Baseplate |
| ● AlN 衬板 | AlN Substrates |
| ● 低开关损耗 | Low Switching Losses |
| ● 10 μ s 短路承受能力 | 10 μ s Short Circuit Withstand |

电路结构

Circuit Configuration

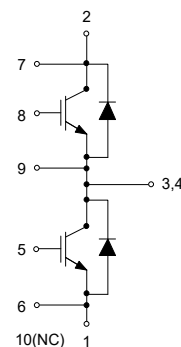


图 1. 电路结构

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	$V_{GE} = 0V, T_C = 25^\circ C$	3300	V
V_{GES}	栅极-发射极电压 Gate-emitter voltage	$T_C = 25^\circ C$	± 20	V
I_C	集电极电流 Collector-emitter current	$T_C = 100^\circ C, T_{vjmax} = 150^\circ C$	450	A
$I_{C(PK)}$	集电极峰值电流 Peak collector current	$t_P = 1ms$	900	A
P_{max}	晶体管部分最大损耗 Max. transistor power dissipation	$T_{vj} = 150^\circ C, T_C = 25^\circ C$	3.9	kW
t_t	二极管 t_t 值 Diode t_t	$V_R = 0V, t_P = 10ms, T_{vj} = 150^\circ C$	93	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, $T_C = 25^\circ C$	6	kV
Q_{PD}	局部放电电荷(模块) Partial discharge – per module	IEC1287. $V_1 = 3500V, V_2 = 2600V, 50Hz$ 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	53.0	mm
	端子-端子 Terminal to terminal	53.0	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	



产品数据手册 Product Datasheet 版本 Ver 22.04

TG450HF33X1-TSA000

半桥型 IGBT 模块 Half Bridge IGBT Module

初版 Preliminary

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
$R_{th(J-C)} \text{ IGBT}$	IGBT 结壳热阻 Thermal resistance – IGBT				32	K / kW
$R_{th(J-C)} \text{ Diode}$	二极管结壳热阻 Thermal resistance – Diode				45.5	K / kW
$R_{th(C-H)} \text{ IGBT}$	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		27.8		K / kW
$R_{th(C-H)} \text{ Diode}$	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		30.5		K / kW
$T_{vj \text{ op}}$	工作结温 Operating junction temperature	IGBT 芯片 (IGBT)	-40		150	°C
		二极管芯片(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	3		6	Nm
		电路互连用– M8 Electrical connections – M8	8		10	Nm
		电路互连用– M3 Electrical connections – M3	0.9		1.1	Nm

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。

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
		$V_{GE} = 0V, V_{CE} = V_{CES}, T_C = 125\text{ }^{\circ}\text{C}$			30	mA
		$V_{GE} = 0V, V_{CE} = V_{CES}, T_C = 150\text{ }^{\circ}\text{C}$			50	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	$I_C = 30\text{mA}, V_{GE} = V_{CE}$	5.4	6.0	6.6	V
$V_{CE(sat)}^{(*1)}$	集电极-发射极饱和电压 Collector-emitter saturation voltage	$V_{GE} = 15V, I_C = 450A$		2.40		V
		$V_{GE} = 15V, I_C = 450A, T_{vj} = 125\text{ }^{\circ}\text{C}$		2.85		V
		$V_{GE} = 15V, I_C = 450A, T_{vj} = 150\text{ }^{\circ}\text{C}$		3.00		V
I_F	二极管正向直流电流 Diode forward current	DC		450		A
I_{FRM}	二极管正向重复峰值电流 Diode peak forward current	$t_P = 1\text{ms}$		900		A
$V_F^{(*1)}$	二极管正向电压 Diode forward voltage	$I_F = 450A, V_{GE} = 0$		2.20		V
		$I_F = 450A, V_{GE} = 0, T_{vj} = 125\text{ }^{\circ}\text{C}$		2.60		V
		$I_F = 450A, V_{GE} = 0, T_{vj} = 150\text{ }^{\circ}\text{C}$		2.70		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		1700		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_{sCE} (*2) indicates L is the circuit stray inductance plus L_{sCE}).



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TG450HF33X1-TSA000
半桥型 IGBT 模块 Half Bridge IGBT Module
初版 Preliminary

电特性值

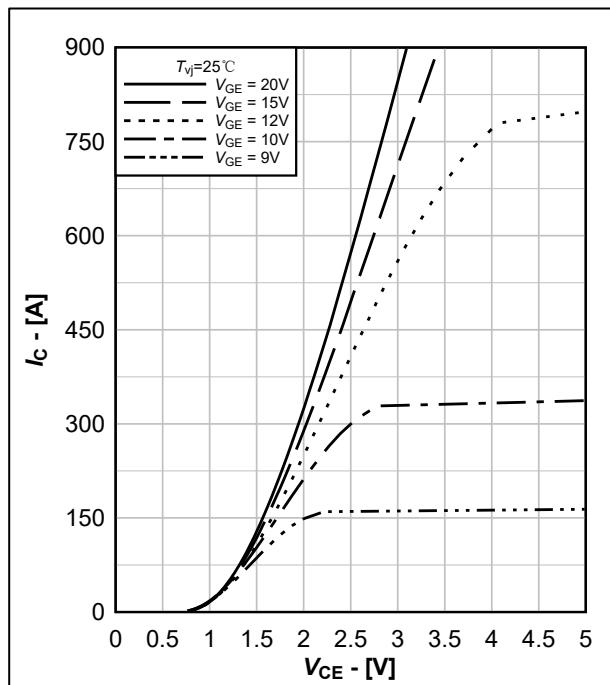
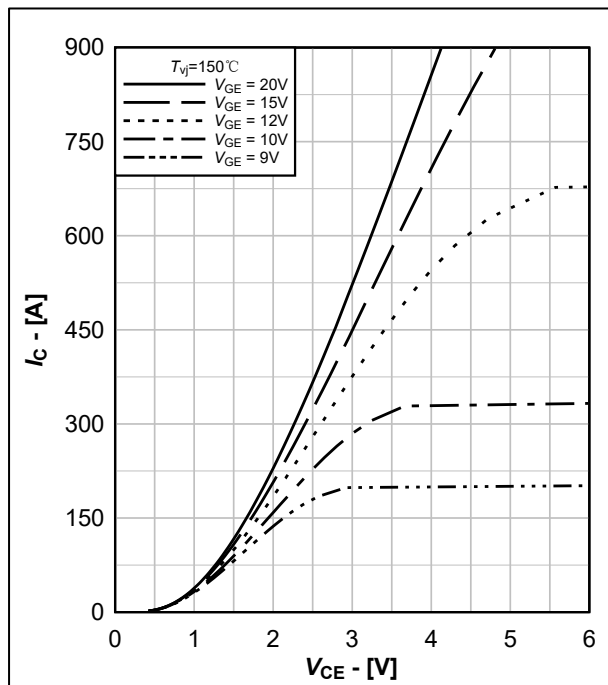
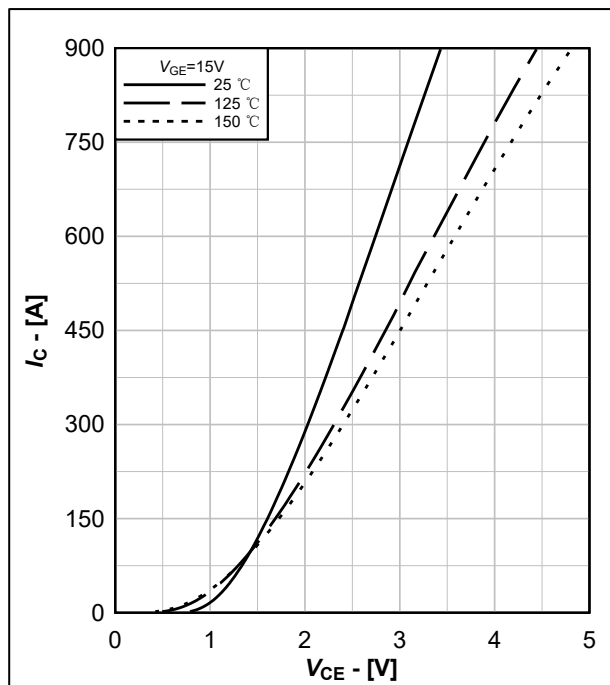
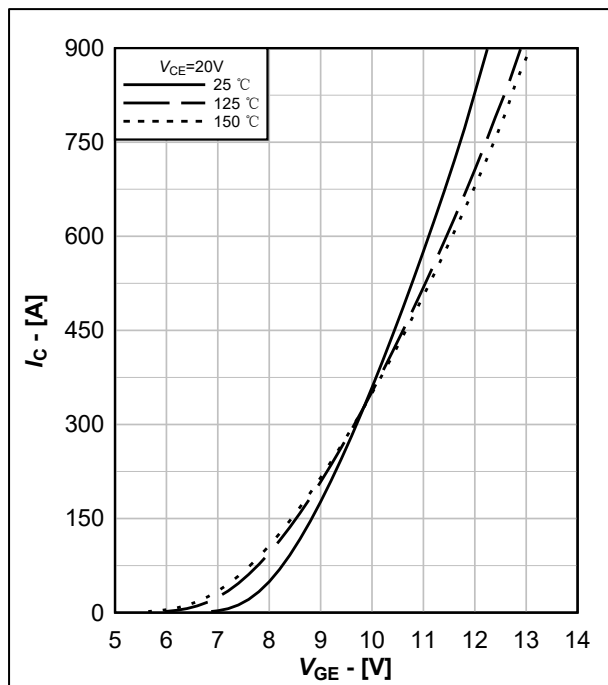
Electrical Characteristics

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	$V_{CE} = 25V, V_{GE} = 0V, f = 100kHz$		84		nF
Q_g	栅极电荷 Gate charge	$\pm 15V$		5.3		μC
C_{res}	反向传输电容 Reverse transfer capacitance	$V_{CE} = 25V, V_{GE} = 0V, f = 100kHz$		0.3		nF
L_{sCE}	模块电感 Module inductance			25		nH
$R_{CC'+EE'}$	模块引线电阻, 端子-芯片 Module lead resistance, terminal-chip			0.38		m Ω
R_{Gint}	内部栅极电阻 Internal gate resistor			3.8		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 =450A, V_{CE} = 1800V, V_{GE} = ± 15 V, $R_{G(OFF)}$ =2.7 Ω , C_{GE} =100nF, L_S = 45nH, dv/dt =4900V/ μ s, (T_{vj} = 150 $^{\circ}$ C).	T_{vj} = 25 $^{\circ}$ C		1375		ns
			T_{vj} = 125 $^{\circ}$ C		1440		
			T_{vj} = 150 $^{\circ}$ C		1470		
t_f	下降时间 Fall time		T_{vj} = 25 $^{\circ}$ C		650		ns
			T_{vj} = 125 $^{\circ}$ C		845		
			T_{vj} = 150 $^{\circ}$ C		935		
E_{OFF}	关断损耗 Turn-off energy loss		T_{vj} = 25 $^{\circ}$ C		350		mJ
			T_{vj} = 125 $^{\circ}$ C		425		
			T_{vj} = 150 $^{\circ}$ C		445		
$t_{d(on)}$	开通延迟时间 Turn-on delay time	T_{vj} = 25 $^{\circ}$ C		670		ns	
		T_{vj} = 125 $^{\circ}$ C		680			
		T_{vj} = 150 $^{\circ}$ C		680			
t_r	上升时间 Rise time	T_{vj} = 25 $^{\circ}$ C		90		ns	
		T_{vj} = 125 $^{\circ}$ C		100			
		T_{vj} = 150 $^{\circ}$ C		100			
E_{ON}	开通损耗 Turn-on energy loss	T_{vj} = 25 $^{\circ}$ C		605		mJ	
		T_{vj} = 125 $^{\circ}$ C		715			
		T_{vj} = 150 $^{\circ}$ C		735			
Q_{rr}	二极管反向恢复电荷 Diode reverse recovery charge	T_{vj} = 25 $^{\circ}$ C		330		μ C	
		T_{vj} = 125 $^{\circ}$ C		390			
		T_{vj} = 150 $^{\circ}$ C		390			
I_{rr}	二极管反向恢复电流 Diode reverse recovery current	T_{vj} = 25 $^{\circ}$ C		698		A	
		T_{vj} = 125 $^{\circ}$ C		698			
		T_{vj} = 150 $^{\circ}$ C		698			
E_{rec}	二极管反向恢复损耗 Diode reverse recovery energy	T_{vj} = 25 $^{\circ}$ C		320		mJ	
		T_{vj} = 125 $^{\circ}$ C		390			
		T_{vj} = 150 $^{\circ}$ C		405			

图 3. IGBT 输出特性典型曲线, $I_C = f(V_{CE})$ Fig.3 Typical IGBT output characteristic, $I_C = f(V_{CE})$ 图 4. IGBT 输出特性典型曲线, $I_C = f(V_{CE})$ Fig.4 Typical IGBT output characteristic, $I_C = f(V_{CE})$ 图 5. IGBT 输出特性典型曲线, $I_C = f(V_{CE})$ Fig.5 Typical IGBT output characteristic, $I_C = f(V_{CE})$ 图 6. IGBT 传输特性典型曲线, $I_C = f(V_{GE})$ Fig.6 Typical IGBT transfer characteristic, $I_C = f(V_{GE})$

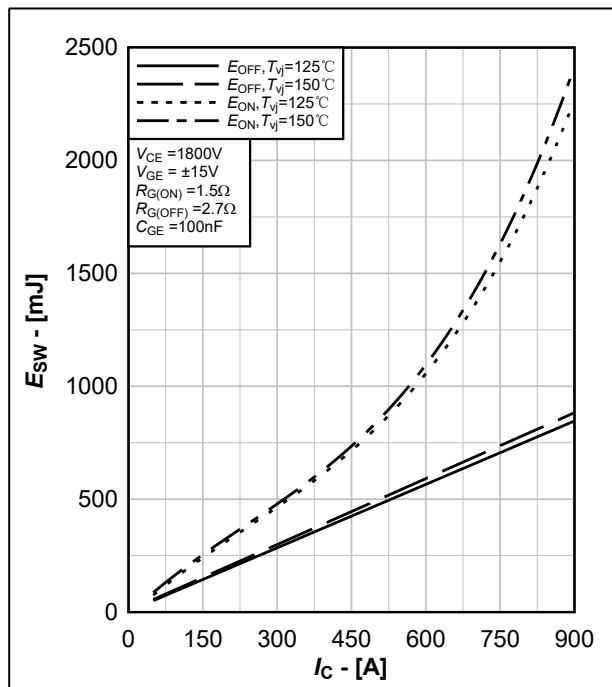

 图 7. IGBT 开关损耗典型曲线, $E_{on}=f(I_c)$, $E_{off}=f(I_c)$

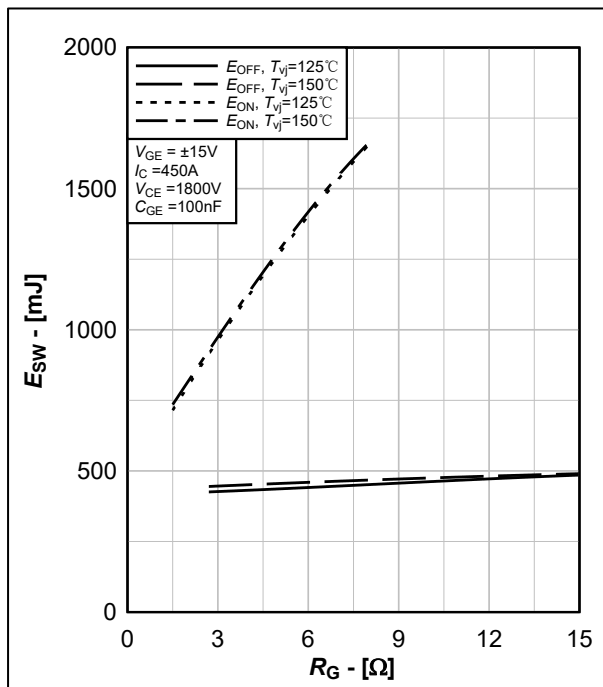
 Fig.7 Typical IGBT switching energy, $E_{on}=f(I_c)$, $E_{off}=f(I_c)$

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

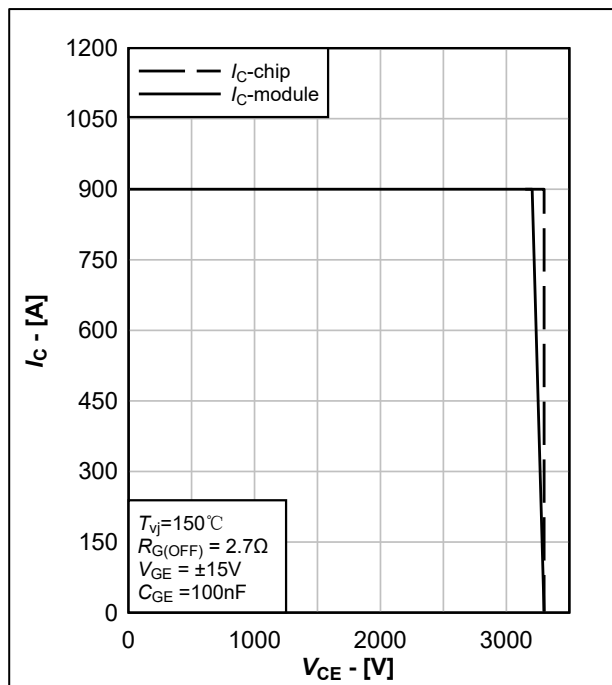
 Fig.8 Typical IGBT switching energy, $E_{on}=f(R_g)$, $E_{off}=f(R_g)$

 图 9. IGBT 反偏安全工作区, $I_c=f(V_{ce})$

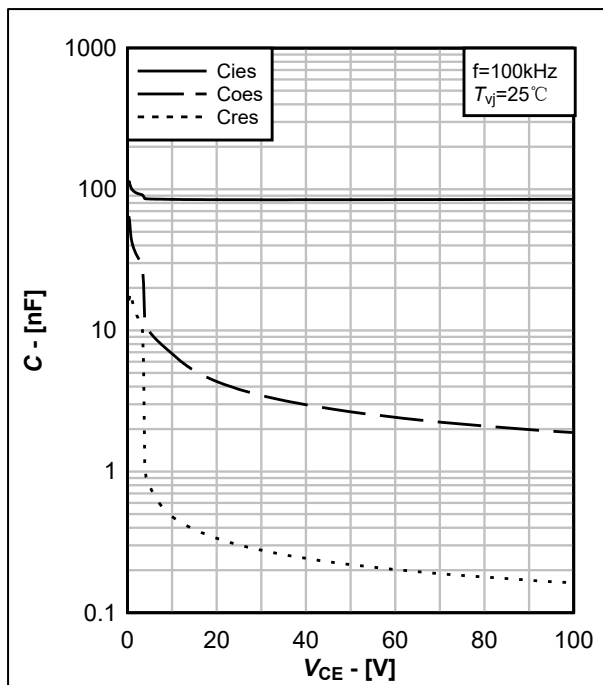
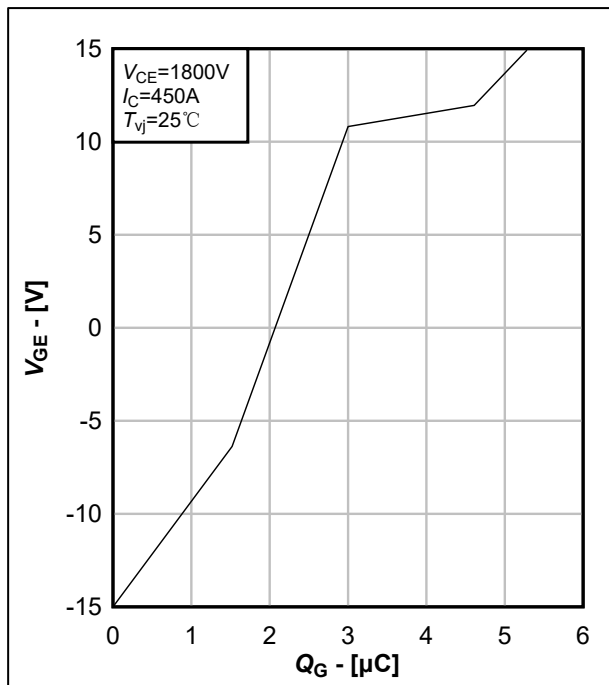
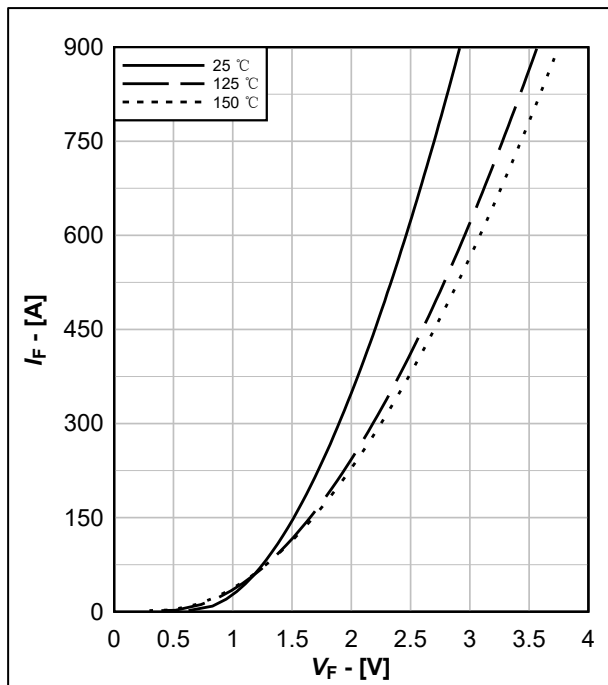
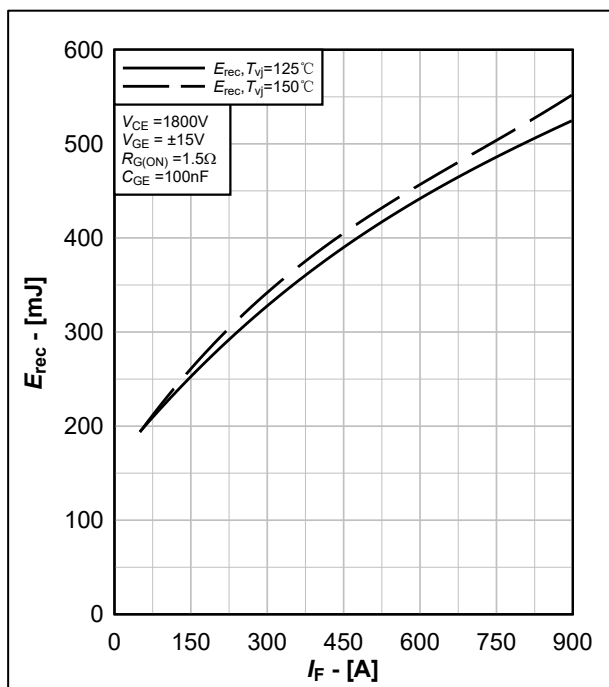
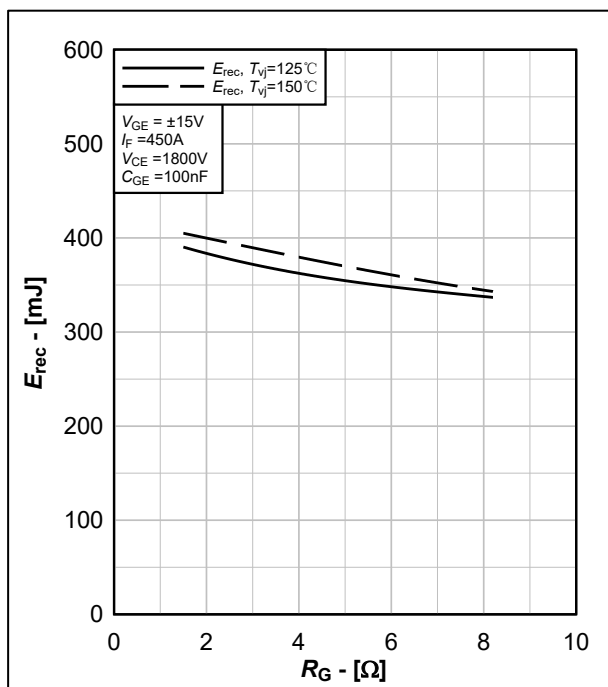
 Fig.9 Reverse bias safe operating area of IGBT, $I_c=f(V_{ce})$

 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} , $E_{rec} = f(R_G)$

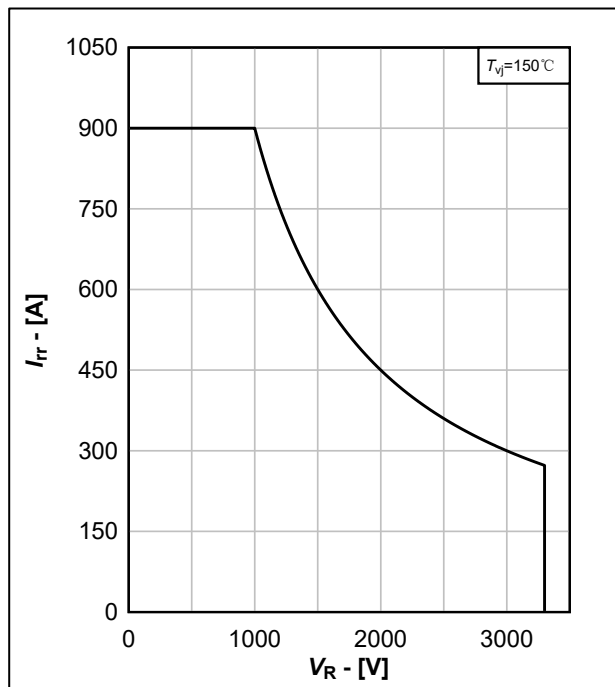


图 15. FRD 反偏安全工作区, $I_{rr} = f(V_R)$

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

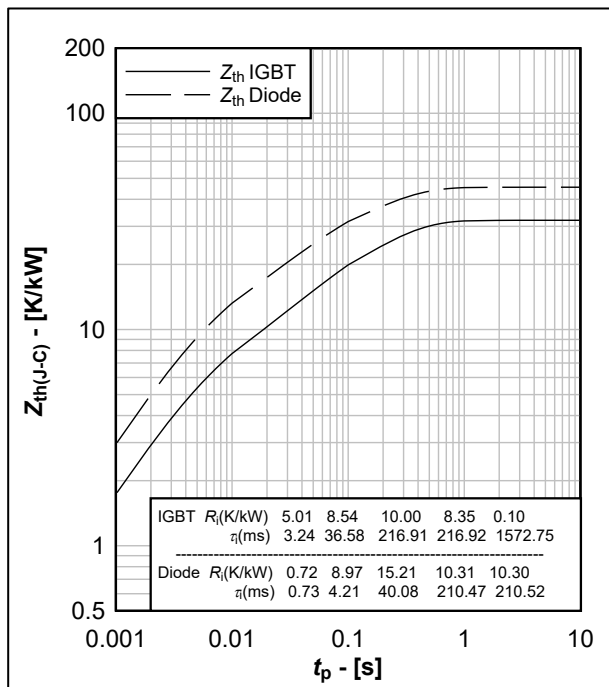
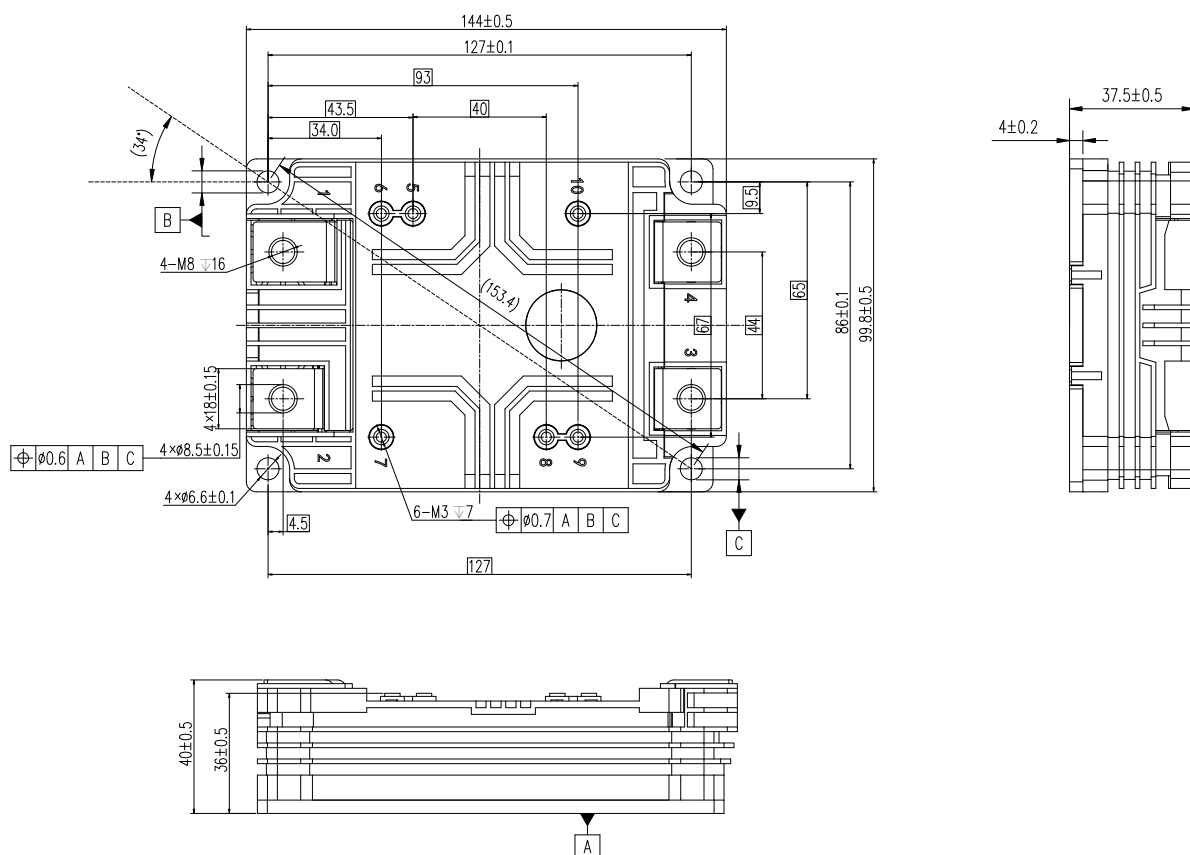


图 16. 瞬态热阻抗曲线, $Z_{th(J-C)} = f(t_p)$

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



重量 Weight: 680g 模块外观类型 Module outline code: X1

图 17 模块外观尺寸

Fig. 17 Module outlines

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