



TG1200FF08S3-R6A12

六单元 IGBT 模块 Six-Pack IGBT Module

初版 Preliminary

产品数据手册 Product Datasheet 版本 Ver 24.02

关键参数		Key Parameters	
V_{CES}		750	V
$V_{CE(sat)}$	Typ.	1.18	V
I_C	Max.	1200	A
$I_{C(RM)}$	Max.	2400	A

典型应用		Typical Applications	
● 电动汽车		Automotive Applications	
● 混合动力/纯电动车		Hybrid/Electrical Vehicles	
● 电机驱动		Motor Drives	

特点		Features	
● 椭圆铜针翅基板		Elliptical Cu Pin-fin Baseplate	
● 低开关损耗		Low Switching Losses	
● 高功率密度		High Power Density	
● 低感设计		Low Inductive Design	

电路结构 Circuit Configuration

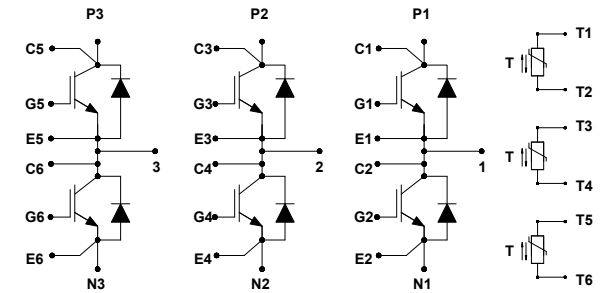


图 1.电路结构

Fig. 1 Circuit configuration

模块外形 Module Appearance

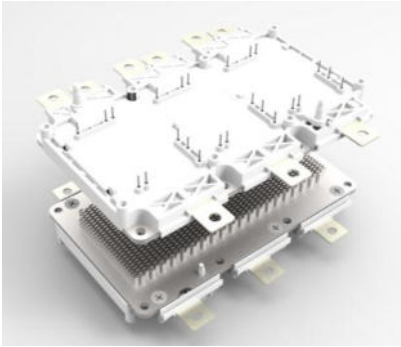


图 2. 模块外形

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	$V_{GE} = 0V, T_{vj} = 25\text{ }^{\circ}\text{C}$	750	V
V_{GES}	栅极-发射极电压 Gate-emitter voltage	$T_{vj} = 25\text{ }^{\circ}\text{C}$	± 20	V
I_C	集电极电流 Collector-emitter current	$T_F = 100\text{ }^{\circ}\text{C}, T_{vj\max} = 175\text{ }^{\circ}\text{C}$	450	A
	额定电流 Rating Current		1200	A
$I_{C(RM)}$	集电极峰值电流 Peak collector current	$t_P = 1\text{ms}$	2400	A
$P_{\max}$	晶体管部分最大损耗 Max. transistor power dissipation	$T_F = 75\text{ }^{\circ}\text{C}, T_{vj\max} = 175\text{ }^{\circ}\text{C}$	1538	W
ρ_t	二极管 ρ_t 值 Diode ρ_t	$V_R = 0V, t_P = 10\text{ms}, T_{vj} = 175\text{ }^{\circ}\text{C}$	26.7	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), $\text{RMS}, f=0\text{ Hz}, t=1\text{ sec}, T_C = 25\text{ }^{\circ}\text{C}$	4200	V

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	9	mm
	端子-端子 Terminal to terminal	9	mm
绝缘间隙 Clearance	端子-散热器 Terminal to heatsink	4.5	mm
	端子-端子 Terminal to terminal	4.5	mm
相对漏电起痕指数 CTI (Comparative tracking index)		>200	

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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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
$R_{th(J-F)}$	热阻 Thermal resistance	冷却液: 50%乙二醇溶液; $\Delta V/\Delta t=10\text{ dm}^3/\text{min}$; $T_F = 75\text{ }^\circ\text{C}$ Cooling Fluid: 50% water / 50% ethylene glycol; $\Delta V/\Delta t=10\text{ dm}^3/\text{min}$; $T_F=75\text{ }^\circ\text{C}$		65	70	K / kW
ΔP	冷却液流阻 Pressure drop in cooling circuit	冷却液: 50%乙二醇溶液; $\Delta V/\Delta t=10\text{ dm}^3/\text{min}$; $T_F = 25\text{ }^\circ\text{C}$ Cooling Fluid: 50% water / 50% ethylene glycol; $\Delta V/\Delta t=10\text{ dm}^3/\text{min}$; $T_F=25\text{ }^\circ\text{C}$		68		mbar
P	冷却液最大压力 Maximum pressure in cooling circuit				2.5	bar
$T_{vj\text{ op}}^{(*)}$	工作结温 Operating junction temperature	IGBT 芯片 (IGBT)	-40		175	$^\circ\text{C}$
		二极管芯片 (Diode)	-40		175	$^\circ\text{C}$
T_{stg}	存储温度 Storage temperature range		-40		125	$^\circ\text{C}$
M	安装力矩 Screw torque	安装紧固用 - M4 Mounting - M4	1.8	2.0	2.2	Nm
		PCB 安装用 PCB Mounting	0.55	0.6	0.65	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	$T_C = 25\text{ }^\circ\text{C}$		5		k Ω
$\Delta R/R$	R_{100} 偏差 Deviation of R_{100}	$T_C = 100\text{ }^\circ\text{C}$, $R_{100}=493\Omega$	-5		5	%
P_{25}	耗散功率 Power dissipation	$T_C = 25\text{ }^\circ\text{C}$			20	mW
$B_{25/50}$	B -值 B -value	$R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298.15\text{ K}))]$		3375		K
$B_{25/80}$	B -值 B -value	$R_2 = R_{25} \exp [B_{25/80}(1/T_2 - 1/(298.15\text{ K}))]$		3411		K
$B_{25/100}$	B -值 B -value	$R_2 = R_{25} \exp [B_{25/100}(1/T_2 - 1/(298.15\text{ K}))]$		3433		K

注意: 1.(*)1 表示对于结温 $T_{vj\text{ op}} > 150\text{ }^\circ\text{C}$ 时, 须保证基板温度不高于 $125\text{ }^\circ\text{C}$ 。Note: 1.(*)1 For $T_{vj\text{ op}} > 150\text{ }^\circ\text{C}$, baseplate temperature has to be limited to $125\text{ }^\circ\text{C}$.

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
		$V_{GE} = 0V, V_{CE} = V_{CES}, T_{vj} = 150\text{ }^{\circ}\text{C}$			20	mA
		$V_{GE} = 0V, V_{CE} = V_{CES}, T_{vj} = 175\text{ }^{\circ}\text{C}$			30	mA
I_{GES}	栅极漏电流 Gate leakage current	$V_{GE} = \pm 20V, V_{CE} = 0V$			0.5	μA
$V_{GE(th)}$	栅极-发射极阈值电压 Gate threshold voltage	$I_C = 15\text{mA}, V_{GE} = V_{CE}$	6.05	6.65	7.25	V
$V_{CE(sat)}^{(*1)}$	集电极-发射极饱和电压 Collector-emitter saturation voltage	$V_{GE} = 15V, I_C = 450A$		1.18	1.48	V
		$V_{GE} = 15V, I_C = 450A, T_{vj} = 150\text{ }^{\circ}\text{C}$		1.07		V
		$V_{GE} = 15V, I_C = 450A, T_{vj} = 175\text{ }^{\circ}\text{C}$		1.07		V
		$V_{GE} = 15V, I_C = 1200A$		1.70		V
I_F	二极管正向直流电流 Diode forward current	DC		450		A
	二极管额定正向电流 Diode rating forward current			1200		A
I_{FRM}	二极管正向重复峰值电流 Diode peak forward current	$t_p = 1\text{ms}$		2400		A
$V_F^{(*1)}$	二极管正向电压 Diode forward voltage	$I_F = 450A, V_{GE} = 0V^{(*2)}$		2.15	2.45	V
		$I_F = 450A, V_{GE} = 0V, T_{vj} = 150\text{ }^{\circ}\text{C}$		1.90		V
		$I_F = 450A, V_{GE} = 0V, T_{vj} = 175\text{ }^{\circ}\text{C}$		1.70		V
		$I_F = 1200A, V_{GE} = 0V$		3.20		V
I_{SC}	短路电流 Short circuit current	$V_{CC} = 400V, V_{GE} \leq 15V, V_{CE(max)} = V_{CES} - L^{(*3)} \times di/dt, t_p \leq 3\mu\text{s}, T_{vj} = 175\text{ }^{\circ}\text{C}, \text{IEC 60747-9}$		4200		A

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

注意: 2. (*2) 图 14 中也提供了 V_{GE} 为 15V 条件下的 V_F . (*2) V_F with $V_{GE} = 15V$ is also provided in figure 14).

Note: 3. (*3) 表示 L 是电路杂散电感加上 L_{sCE} (*3) indicates L is the circuit stray inductance plus L_{sCE}).

注意: 该器件对静电敏感, 用户须采取 ESD 防护措施。



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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	$V_{CE} = 25\text{V}$, $V_{GE} = 0\text{V}$, $f = 100\text{kHz}$		143		nF
Q_g	栅极电荷 Gate charge	-8/+15V		5.87		μC
C_{res}	反向传输电容 Reverse transfer capacitance	$V_{CE} = 25\text{V}$, $V_{GE} = 0\text{V}$, $f = 100\text{kHz}$		0.59		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	每开关 per switch		0.6		m Ω
R_{Gint}	内部栅极电阻 Internal gate resistor			2.3		Ω

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。

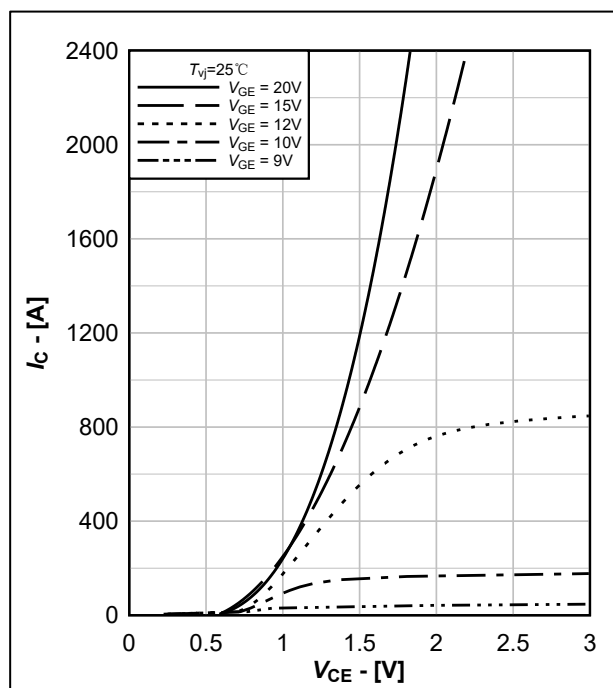
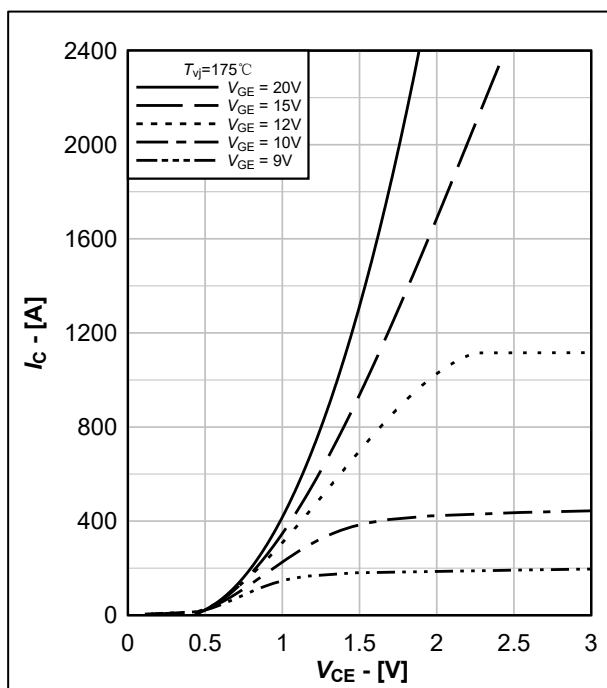
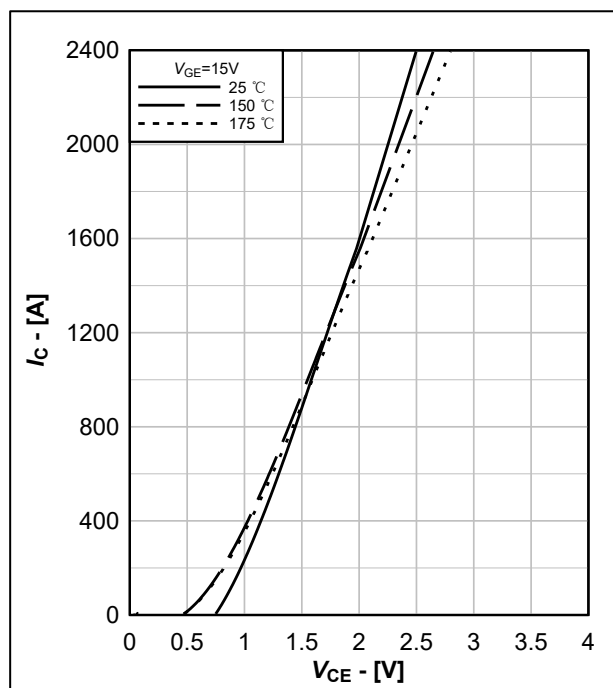
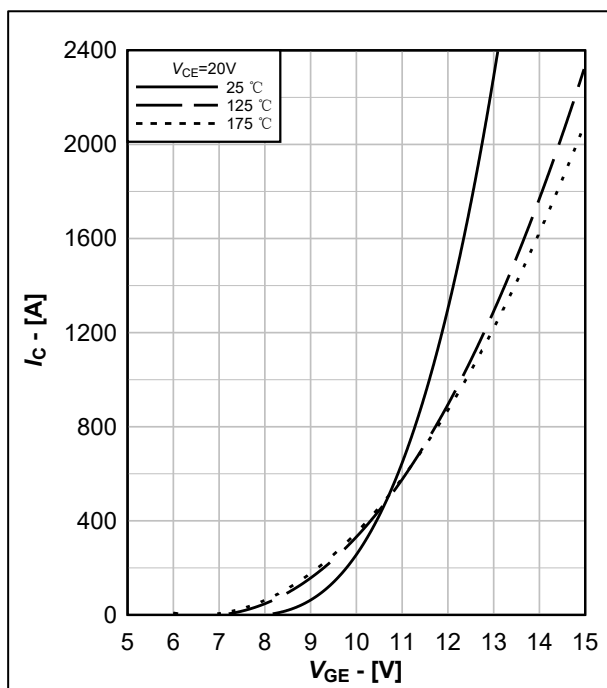
电特性值
Electrical Characteristics

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	$I_C=450A$, $V_{CE}=400V$, $V_{GE}=-8/+15V$, $R_{G(OFF)}=3.3\Omega$, $L_S=30nH$, $dv/dt=2900V/\mu s^{(*)}$ ($T_{vj}=175\text{ }^{\circ}C$).	$T_{vj}=25\text{ }^{\circ}C$		845		ns
			$T_{vj}=150\text{ }^{\circ}C$		875		
			$T_{vj}=175\text{ }^{\circ}C$		910		
t_f	下降时间 Fall time		$T_{vj}=25\text{ }^{\circ}C$		78		ns
			$T_{vj}=150\text{ }^{\circ}C$		90		
			$T_{vj}=175\text{ }^{\circ}C$		98		
E_{OFF}	关断损耗 Turn-off energy loss		$T_{vj}=25\text{ }^{\circ}C$		25.2		mJ
			$T_{vj}=150\text{ }^{\circ}C$		29.2		
			$T_{vj}=175\text{ }^{\circ}C$		29.8		
$t_{d(on)}$	开通延迟时间 Turn-on delay time	$T_{vj}=25\text{ }^{\circ}C$		190		ns	
		$T_{vj}=150\text{ }^{\circ}C$		195			
		$T_{vj}=175\text{ }^{\circ}C$		195			
t_r	上升时间 Rise time	$T_{vj}=25\text{ }^{\circ}C$		50		ns	
		$T_{vj}=150\text{ }^{\circ}C$		60			
		$T_{vj}=175\text{ }^{\circ}C$		60			
E_{ON}	开通损耗 Turn-on energy loss	$T_{vj}=25\text{ }^{\circ}C$		2.6		mJ	
		$T_{vj}=150\text{ }^{\circ}C$		6.0			
		$T_{vj}=175\text{ }^{\circ}C$		6.58			
Q_{rr}	二极管反向恢复电荷 Diode reverse recovery charge	$T_{vj}=25\text{ }^{\circ}C$		36		μC	
		$T_{vj}=150\text{ }^{\circ}C$		57			
		$T_{vj}=175\text{ }^{\circ}C$		64			
I_{rr}	二极管反向恢复电流 Diode reverse recovery current	$T_{vj}=25\text{ }^{\circ}C$		445		A	
		$T_{vj}=150\text{ }^{\circ}C$		630			
		$T_{vj}=175\text{ }^{\circ}C$		660			
E_{rec}	二极管反向恢复损耗 Diode reverse recovery energy	$T_{vj}=25\text{ }^{\circ}C$		14.5		mJ	
		$T_{vj}=150\text{ }^{\circ}C$		21.4			
		$T_{vj}=175\text{ }^{\circ}C$		23.4			

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

注意:
Note:

2.(*) di/dt : 定义为开通波形电流 I_C 上升段, 40% I_C 至 60% I_C 区间的斜率((*) 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 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, $I_C = f(V_{GE})$

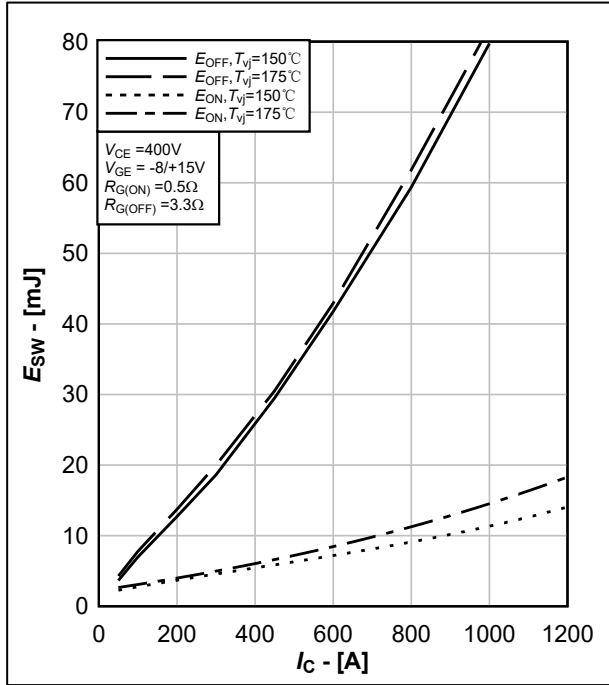


图 7. IGBT 开关损耗典型曲线, $E_{on}=f(I_c)$, $E_{off}=f(I_c)$

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

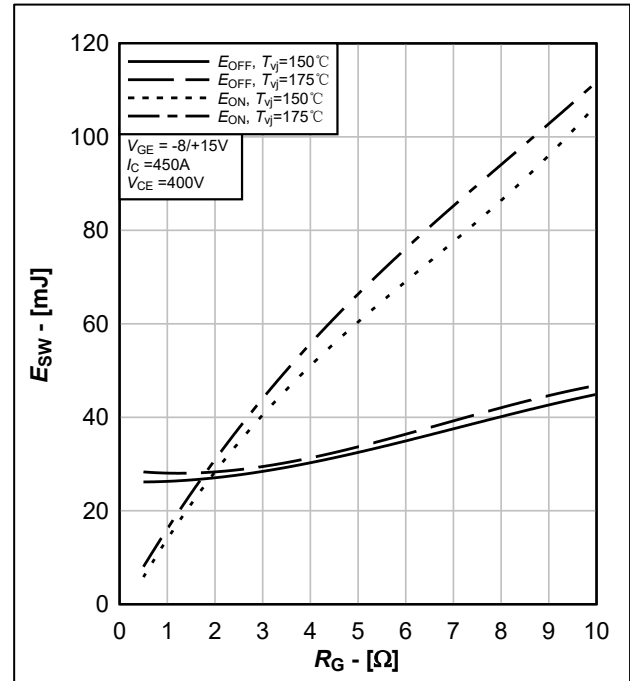


图 8. IGBT 开关损耗典型曲线, $E_{on}=f(R_g)$, $E_{off}=f(R_g)$

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

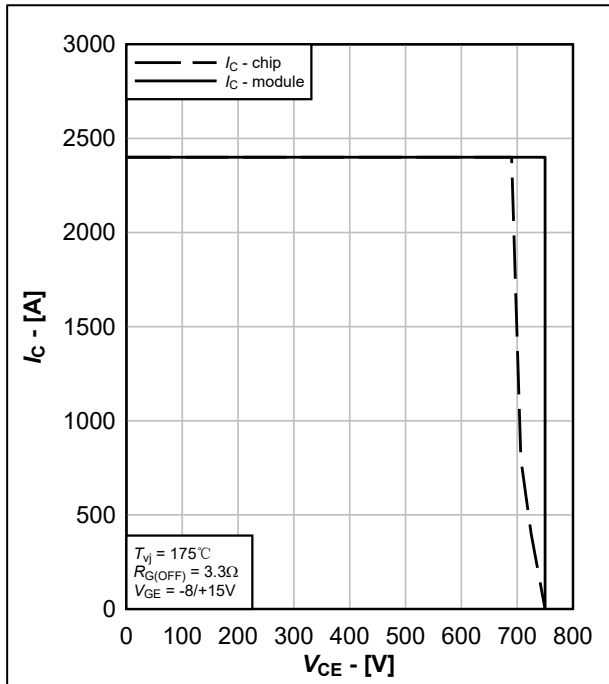


图 9. IGBT 反偏安全工作区, $I_c=f(V_{ce})$

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

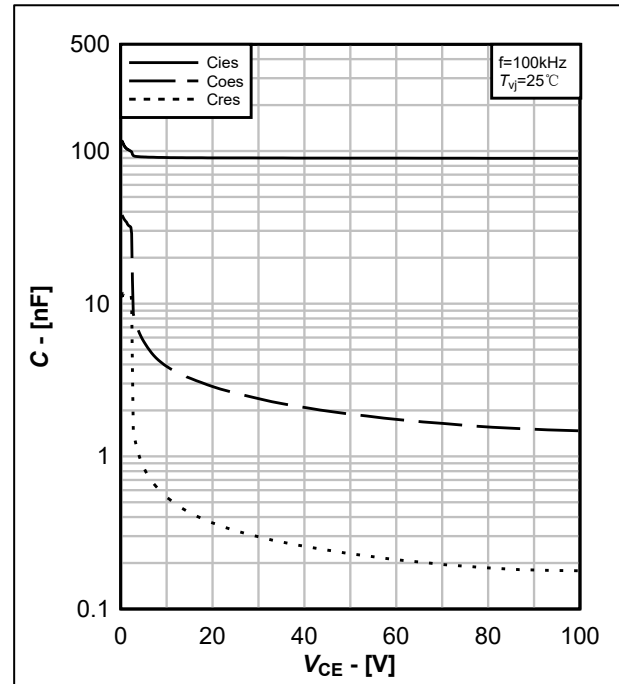
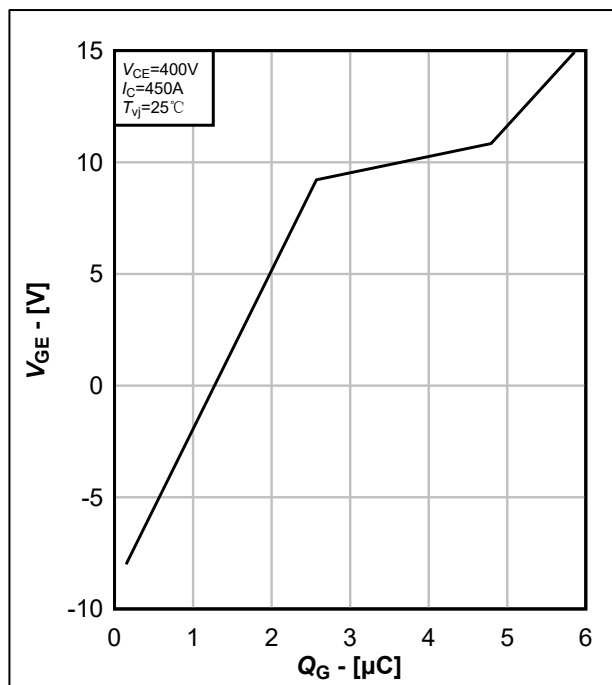
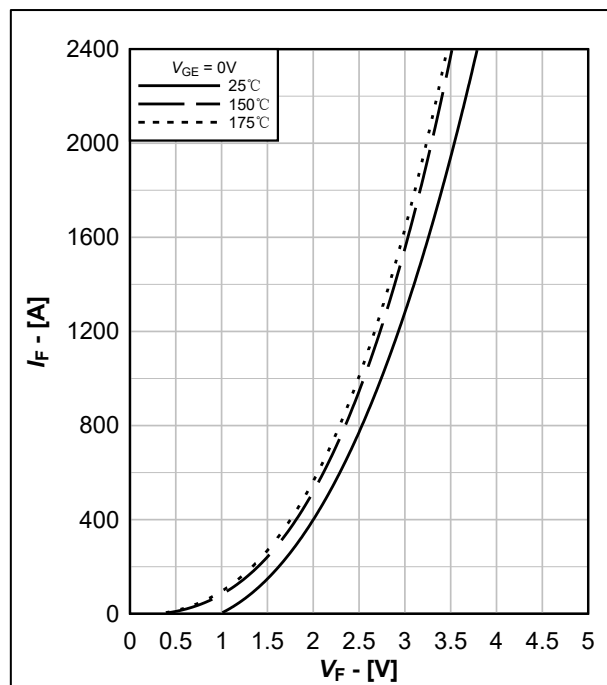
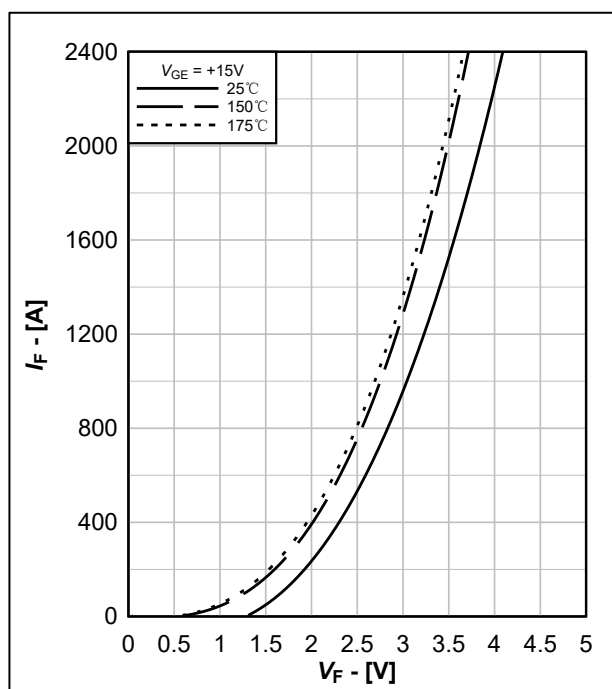
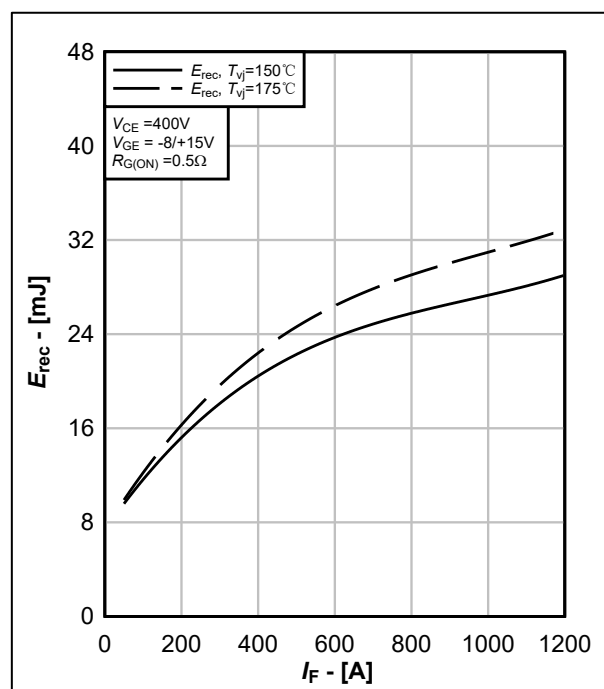


图 10. 电容特性典型曲线, $C=f(V_{ge})$

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

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, $V_{GE} = 0V, I_F = f(V_F)$ Fig.12 Typical FRD output characteristic, $V_{GE} = 0V, I_F = f(V_F)$ 图 13. FRD 输出特性典型曲线, $V_{GE} = 15V, I_F = f(V_F)$ Fig.13 Typical FRD output characteristic, $V_{GE} = 15V, I_F = f(V_F)$ 图 14. FRD 输出特性典型曲线, $I_F = f(V_F)$ Fig.14 Typical FRD output characteristic, $I_F = f(V_F)$

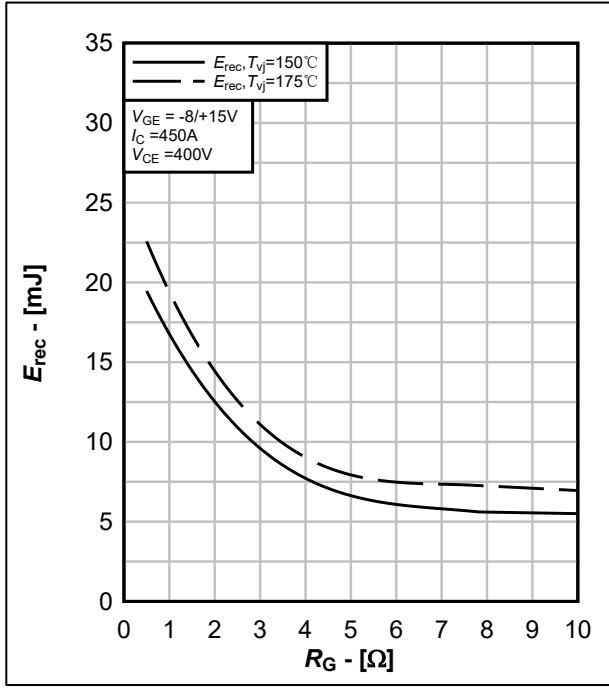


图 15. FRD 反向恢复损耗典型曲线, $E_{rec}=f(R_G)$

Fig.15 Typical FRD switching loss E_{rec} , $E_{rec}=f(R_G)$

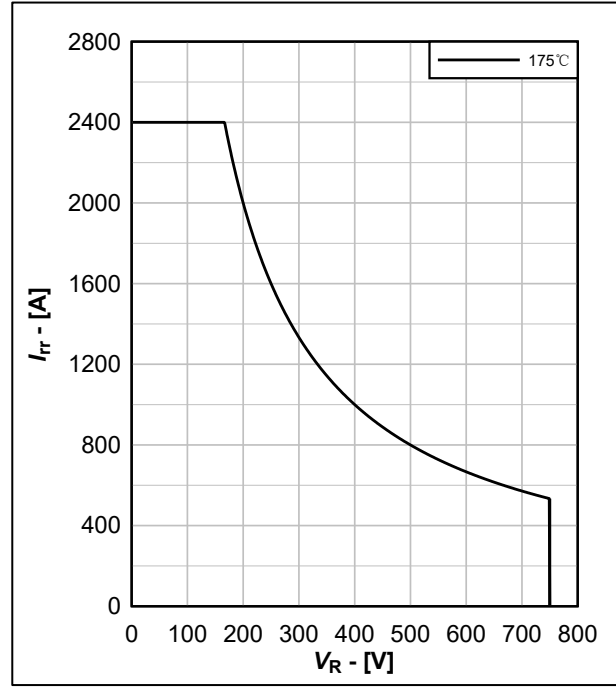


图 16. FRD 反偏安全工作区, $I_{rr} = f(V_R)$

Fig.16 Reverse bias safe operating area of FRD, $I_{rr} = f(V_R)$

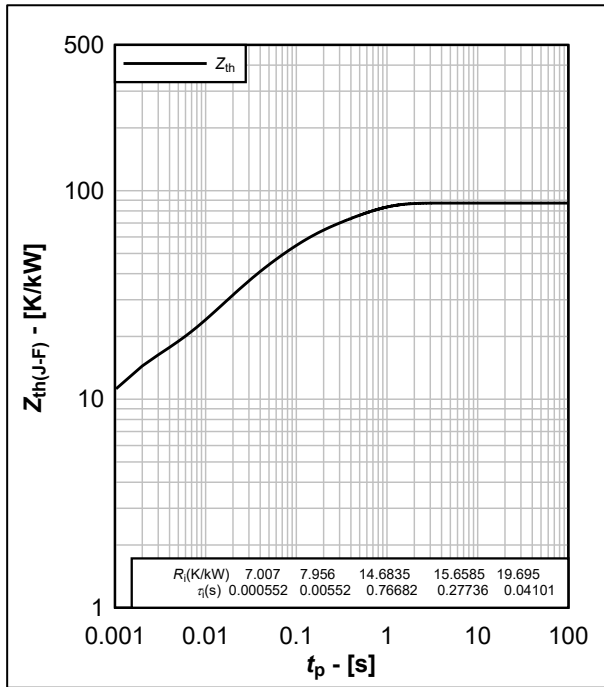


图 17. 瞬态热阻抗曲线, $Z_{th(J-F)} = f(t_p)$

Fig.17 Transient thermal impedance, $Z_{th(J-F)} = f(t_p)$

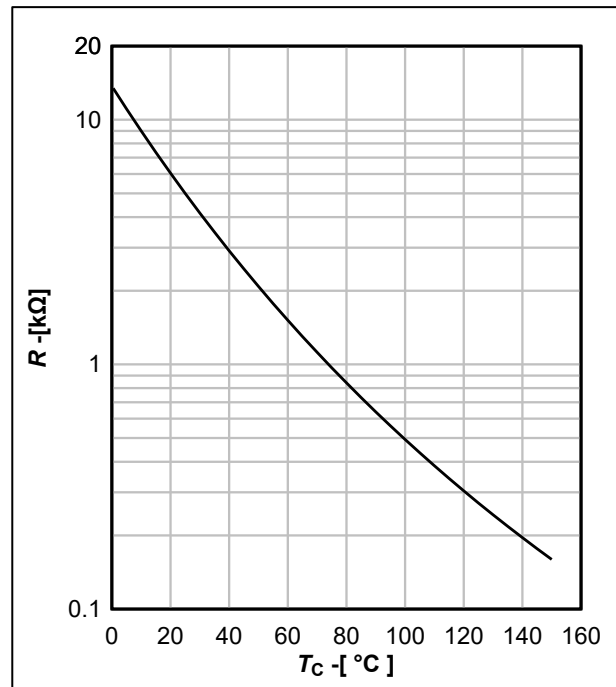
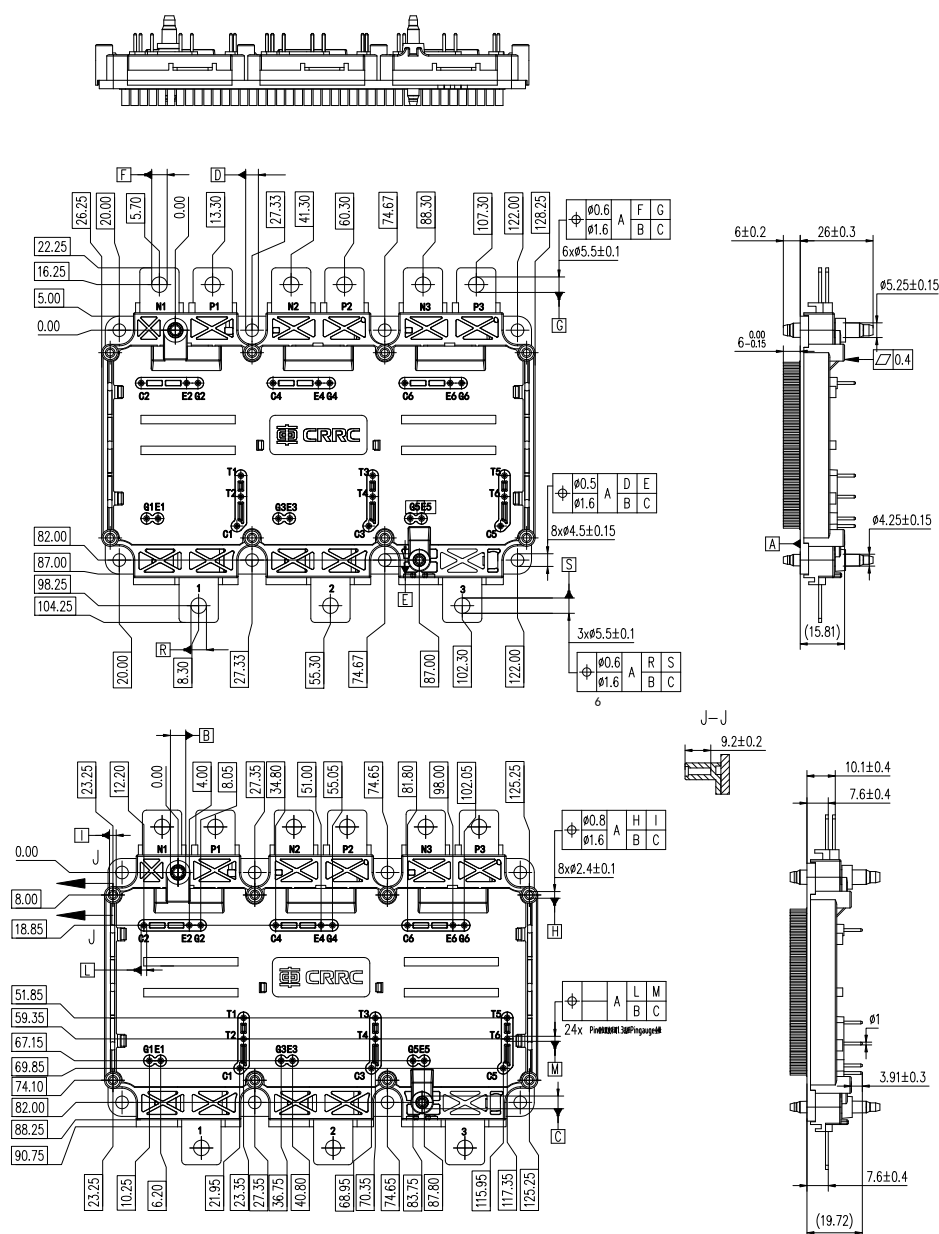


图 18. 热敏电阻典型特性曲线, $R = f(T_C)$

Fig.18 Typical NTC thermistor characteristic, $R = f(T_C)$



技术要求

1、未注尺寸公差，参考GB/T-14486-2008《塑料模塑件尺寸公差》中MT5级，参照如下：

(a) $X < 10 \pm 0.14$; (b) $10 < X < 30 \pm 0.25$; (c) $30 < X < 50 \pm 0.32$; (d) $50 < X < 100 \pm 0.5$;

(e) $100 < X < 200 \pm 0.8$;

2、PIN 针位置度采用 pin gauge 检测

重量 Weight: 770g 模块外观类型 Module outline code: S3

图 18. 模块外观尺寸

Fig. 18 Module outlines

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。

株洲中车时代半导体有限公司

ZHUZHOU CRRC TIMES SEMICONDUCTOR CO., LTD.

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电子邮箱	Email	sbu@crcczic.cc	
网 址	Web Site	http://www.sbu.crcczic.cc	

使用条件和条款

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