

关键参数 Key Parameters

V_{CES}		1200	V
$V_{CE(sat)}$	Typ.	1.50	V
I_C	Max.	600	A
$I_{C(RM)}$	Max.	1200	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

- | | |
|--------------|------------------------|
| ● 铜针翅基板 | Cu Pin-fin Baseplate |
| ● 低开关损耗 | Low Switching Losses |
| ● 1200V 额定电压 | Blocking Voltage 1200V |
| ● 低感设计 | Low Inductive Design |

电路结构 Circuit Configuration

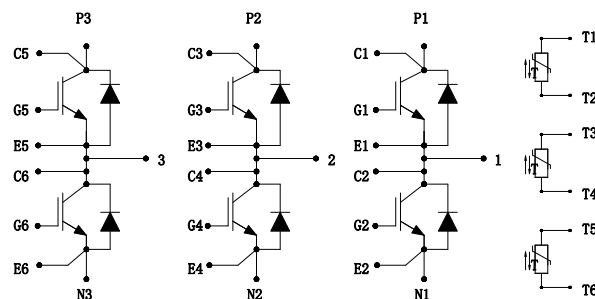


图 1. 电路结构

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	$V_{GE} = 0V, T_C = 25^\circ C$	1200	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	$T_F = 80^\circ C, T_{vj\ max} = 175^\circ C$	450	A
	额定电流 Rating Current		600	A
$I_{C(RM)}$	集电极峰值电流 Peak collector current	$t_P = 1ms$	1200	A
P_{max}	晶体管部分最大损耗 Max. transistor power dissipation	$T_F = 75^\circ C, T_{vj\ max} = 175^\circ C$	910	W
ρ_t	二极管 ρ_t 值 Diode ρ_t	$V_R = 0V, t_P = 10ms, T_{vj} = 150^\circ C$	23.3	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), RMS, f=0 Hz, t=1 sec, $T_C = 25^\circ C$	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	

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
$R_{th(J-F)}$ IGBT	IGBT 热阻 Thermal resistance – IGBT	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% ethylenglycol; $\Delta V/\Delta t=10 \text{ dm}^3/\text{min}$; $T_F = 75 \text{ }^\circ\text{C}$		100	110	K / kW
$R_{th(J-F)}$ Diode	二极管热阻 Thermal resistance – Diode	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% ethylenglycol; $\Delta V/\Delta t=10 \text{ dm}^3/\text{min}$; $T_F = 75 \text{ }^\circ\text{C}$		130	140	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% ethylenglycol; $\Delta V/\Delta t=10 \text{ dm}^3/\text{min}$; $T_F = 25 \text{ }^\circ\text{C}$		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)	-40 150		150 175	$^\circ\text{C}$
		二极管芯片 (Diode)	-40 150		150 175	$^\circ\text{C}$
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

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
		$V_{GE} = 0V, V_{CE} = V_{CES}, T_{vj} = 150\text{ }^\circ\text{C}$			15	mA
		$V_{GE} = 0V, V_{CE} = V_{CES}, T_{vj} = 175\text{ }^\circ\text{C}$			20	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	$I_C = 15\text{mA}, V_{GE} = V_{CE}$	5.40	6.00	6.60	V
$V_{CE(sat)}^{(*1)}$	集电极-发射极饱和电压 Collector-emitter saturation voltage	$V_{GE} = 15V, I_C = 450A$		1.50	1.80	V
		$V_{GE} = 15V, I_C = 450A, T_{vj} = 150\text{ }^\circ\text{C}$		1.75		V
		$V_{GE} = 15V, I_C = 450A, T_{vj} = 175\text{ }^\circ\text{C}$		1.80		V
		$V_{GE} = 15V, I_C = 600A$		1.70	2.00	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			600		A
I_{FRM}	二极管正向重复峰值电流 Diode peak forward current	$t_p = 1\text{ms}$		1200		A
$V_F^{(*1)}$	二极管正向电压 Diode forward voltage	$I_F = 450A, V_{GE} = 0V$		1.70	2.00	V
		$I_F = 450A, V_{GE} = 0V, T_{vj} = 150\text{ }^\circ\text{C}$		1.80		V
		$I_F = 450A, V_{GE} = 0V, T_{vj} = 175\text{ }^\circ\text{C}$		1.75		V
		$I_F = 600A, V_{GE} = 0V$		1.90	2.20	V
I_{SC}	短路电流 Short circuit current	$T_{vj} = 150\text{ }^\circ\text{C}, V_{CC} = 800V,$ $V_{GE} \leq 15V, t_p \leq 6\mu\text{s},$ $V_{CE(max)} = V_{CES} - L^{(*2)} \times di/dt,$ IEC 60747-9		2600		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}).

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	$V_{CE} = 25\text{V}, V_{GE} = 0\text{V},$ $f = 100\text{kHz}$		57		nF
Q_g	栅极电荷 Gate charge	-8/+15V		2.56		μC
C_{res}	反向传输电容 Reverse transfer capacitance	$V_{CE} = 25\text{V}, V_{GE} = 0\text{V},$ $f = 100\text{kHz}$		0.24		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			0.5		m Ω
R_{Gint}	内部栅极电阻 Internal gate resistor			4		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	$I_C = 600A,$ $V_{CE} = 600V,$ $V_{GE} = -8/+15V,$ $R_{G(OFF)} = 4.7\Omega,$ $L_S = 35nH,$ $dv/dt = 3000V/\mu s$ ($T_{vj} = 150^\circ C$).	$T_{vj} = 25^\circ C$	1040		ns	
			$T_{vj} = 150^\circ C$	1140			
			$T_{vj} = 175^\circ C$	1145			
t_f	下降时间 Fall time		$T_{vj} = 25^\circ C$		150		ns
			$T_{vj} = 150^\circ C$		235		
			$T_{vj} = 175^\circ C$		250		
E_{OFF}	关断损耗 Turn-off energy loss		$T_{vj} = 25^\circ C$		75.5		mJ
			$T_{vj} = 150^\circ C$		95.0		
			$T_{vj} = 175^\circ C$		98.5		
$t_{d(on)}$	开通延迟时间 Turn-on delay time	$T_{vj} = 25^\circ C$		500		ns	
		$T_{vj} = 150^\circ C$		510			
		$T_{vj} = 175^\circ C$		510			
t_r	上升时间 Rise time	$T_{vj} = 25^\circ C$		90		ns	
		$T_{vj} = 150^\circ C$		105			
		$T_{vj} = 175^\circ C$		110			
E_{ON}	开通损耗 Turn-on energy loss	$T_{vj} = 25^\circ C$		73.0		mJ	
		$T_{vj} = 150^\circ C$		83.0			
		$T_{vj} = 175^\circ C$		85.5			
Q_{rr}	二极管反向恢复电荷 Diode reverse recovery charge	$T_{vj} = 25^\circ C$		42		μC	
		$T_{vj} = 150^\circ C$		75			
		$T_{vj} = 175^\circ C$		84			
I_{rr}	二极管反向恢复电流 Diode reverse recovery current	$T_{vj} = 25^\circ C$		300		A	
		$T_{vj} = 150^\circ C$		350			
		$T_{vj} = 175^\circ C$		360			
E_{rec}	二极管反向恢复损耗 Diode reverse recovery energy	$T_{vj} = 25^\circ C$		16.5		mJ	
		$T_{vj} = 150^\circ C$		32.0			
		$T_{vj} = 175^\circ C$		35.5			

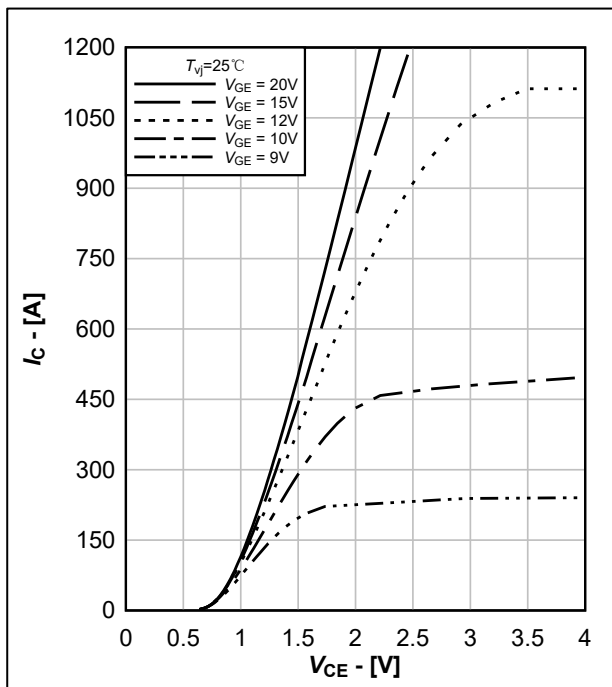


图 3. IGBT 输出特性典型曲线, $I_C = f(V_{CE})$

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

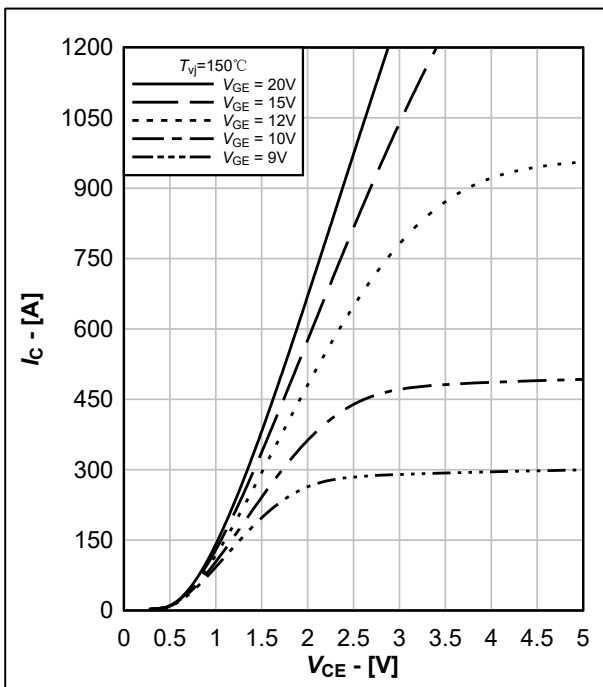


图 4. IGBT 输出特性典型曲线, $I_C = f(V_{CE})$

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

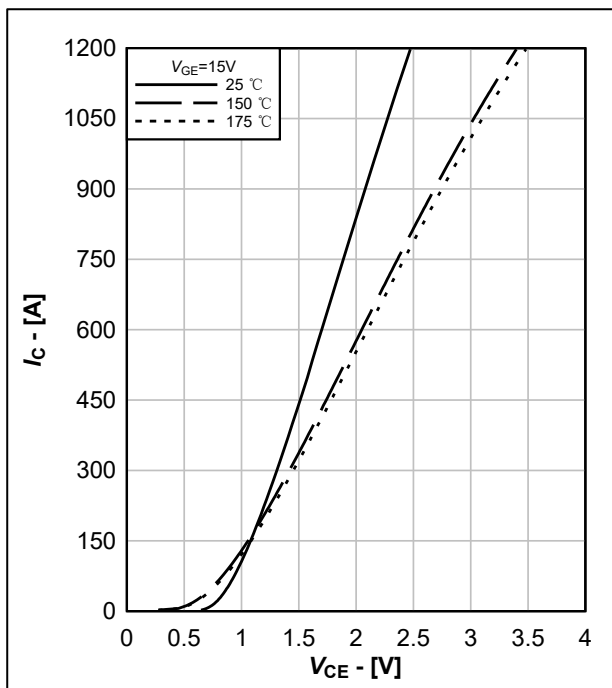


图 5. IGBT 输出特性典型曲线, $I_C = f(V_{CE})$

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

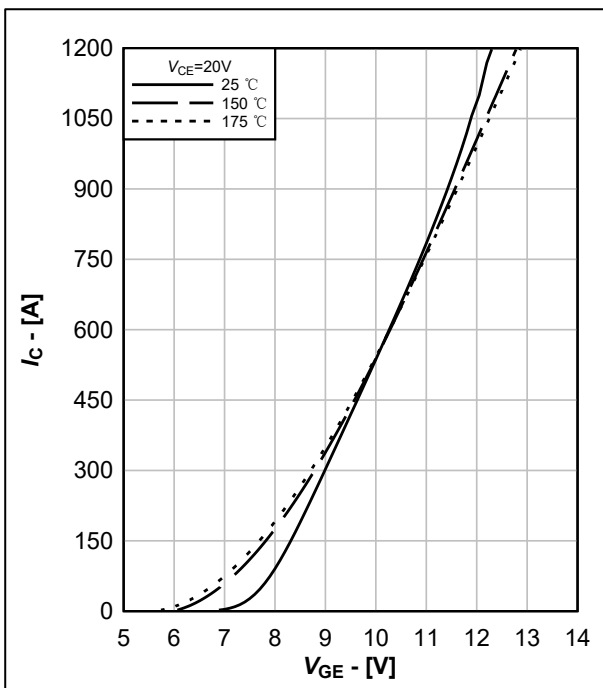


图 6. IGBT 传输特性典型曲线, $I_C = f(V_{GE})$

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

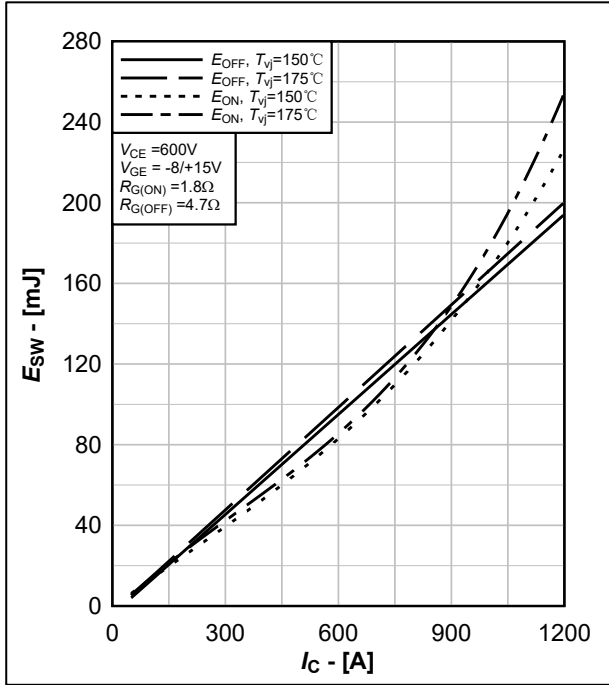


图 7. IGBT 开关损耗典型曲线, $E_{on}=f(I_c)$, $E_{off}=f(I_c)$

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

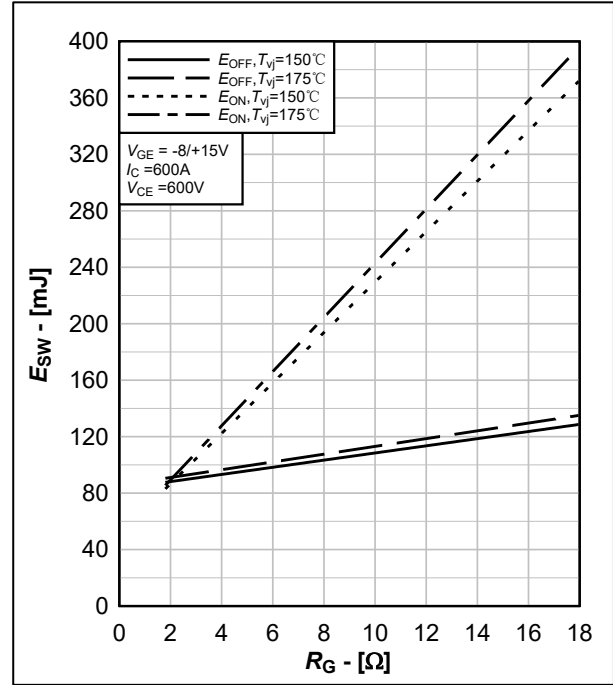


图 8. IGBT 开关损耗典型曲线, $E_{on}=f(R_g)$, $E_{off}=f(R_g)$

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

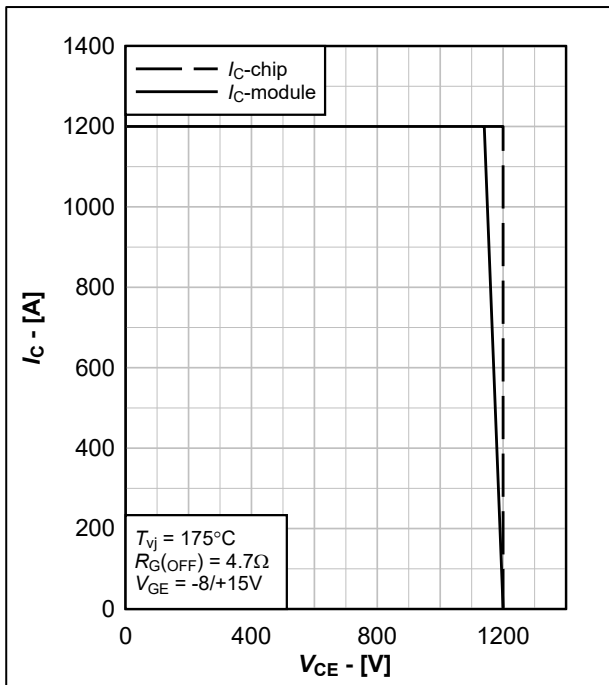


图 9. IGBT 反偏安全工作区, $I_c=f(V_{ce})$

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

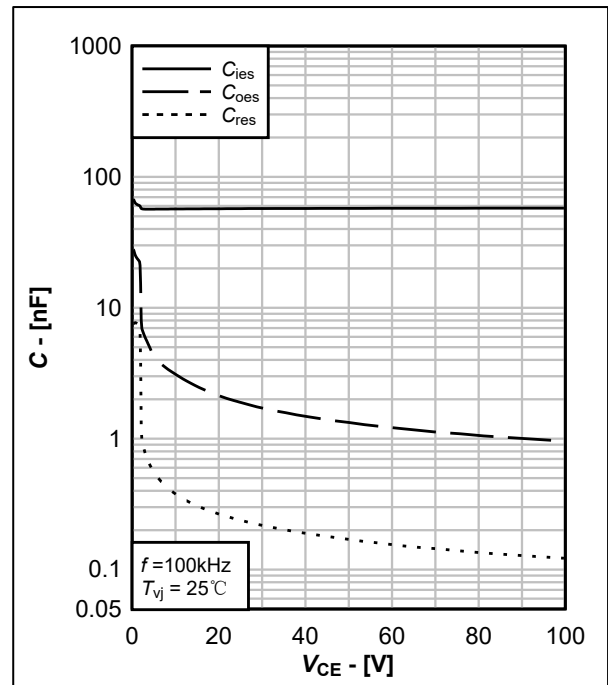


图 10. 电容特性典型曲线, $C=f(V_{ce})$

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

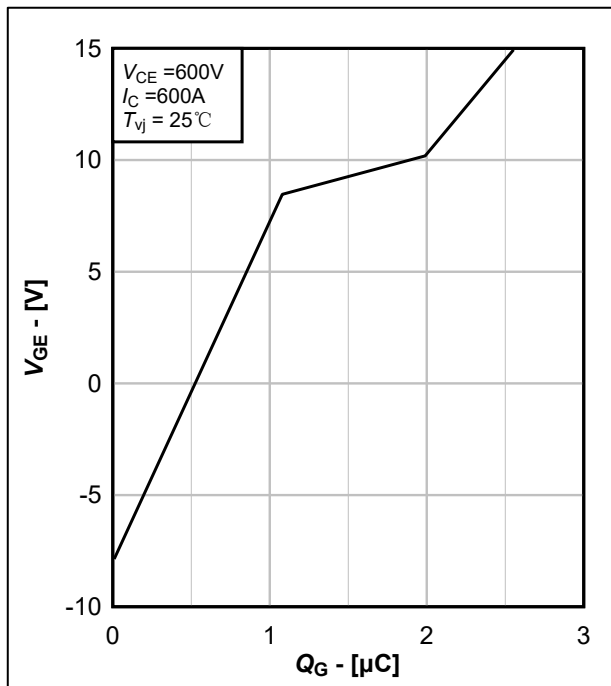


图 11. 栅极电荷特性典型曲线, $V_{GE} = f(Q_G)$

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

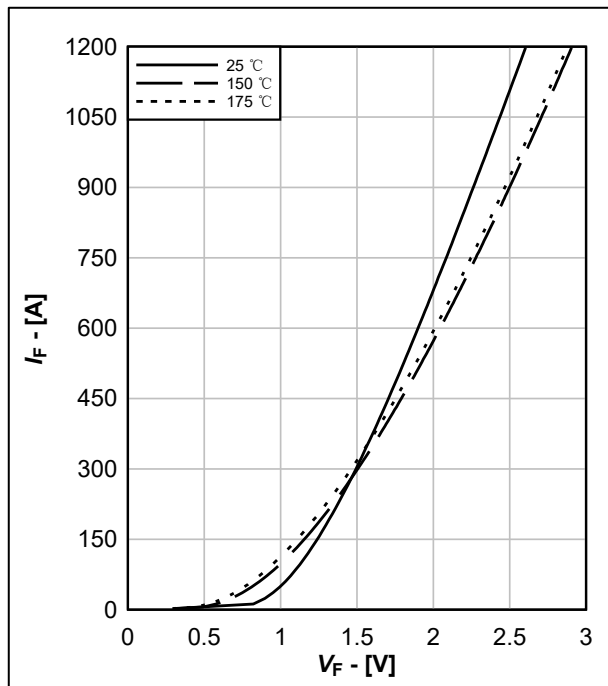


图 12. FRD 输出特性典型曲线, $I_F = f(V_F)$

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

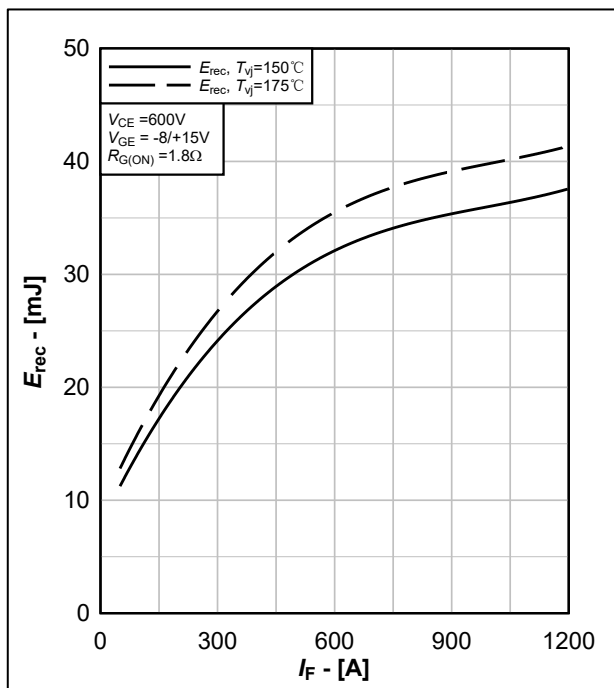


图 13. FRD 反向恢复损耗典型曲线, $E_{rec} = f(I_F)$

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

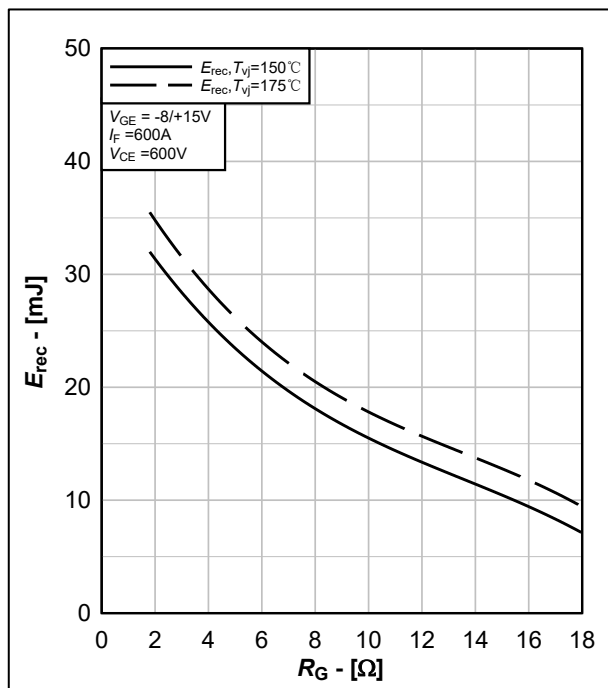


图 14. FRD 反向恢复损耗典型曲线, $E_{rec} = f(R_G)$

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

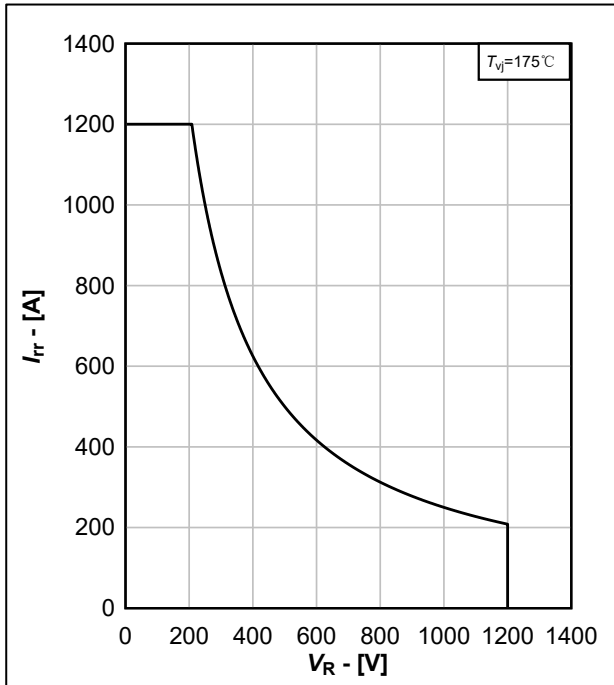


图 15. FRD 反偏安全工作区, $I_{rr} = f(V_R)$

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

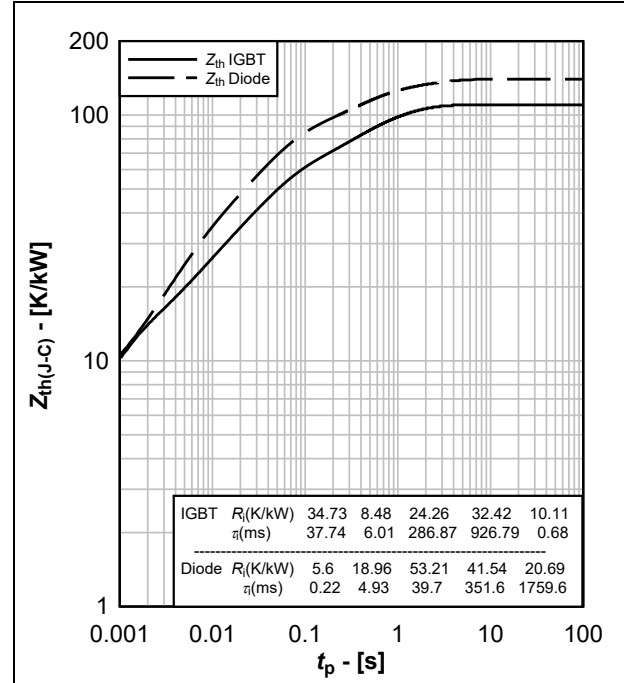


图 16. 瞬态热阻抗曲线, $Z_{th(U-F)} = f(t_p)$

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

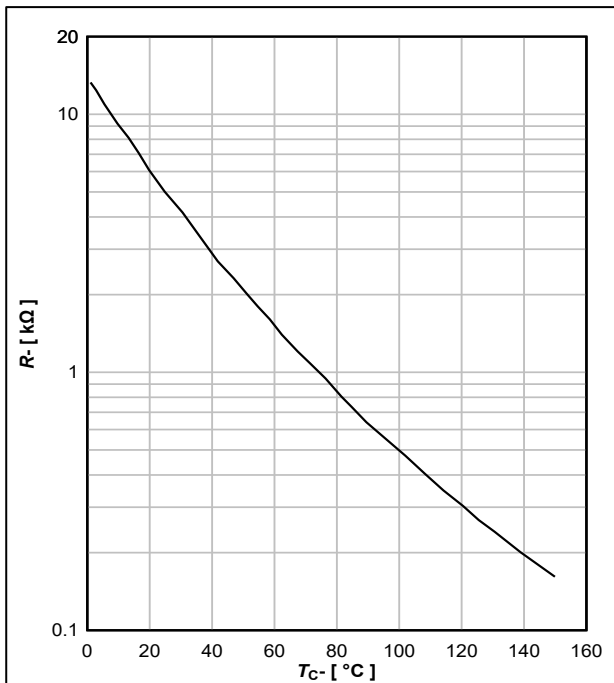
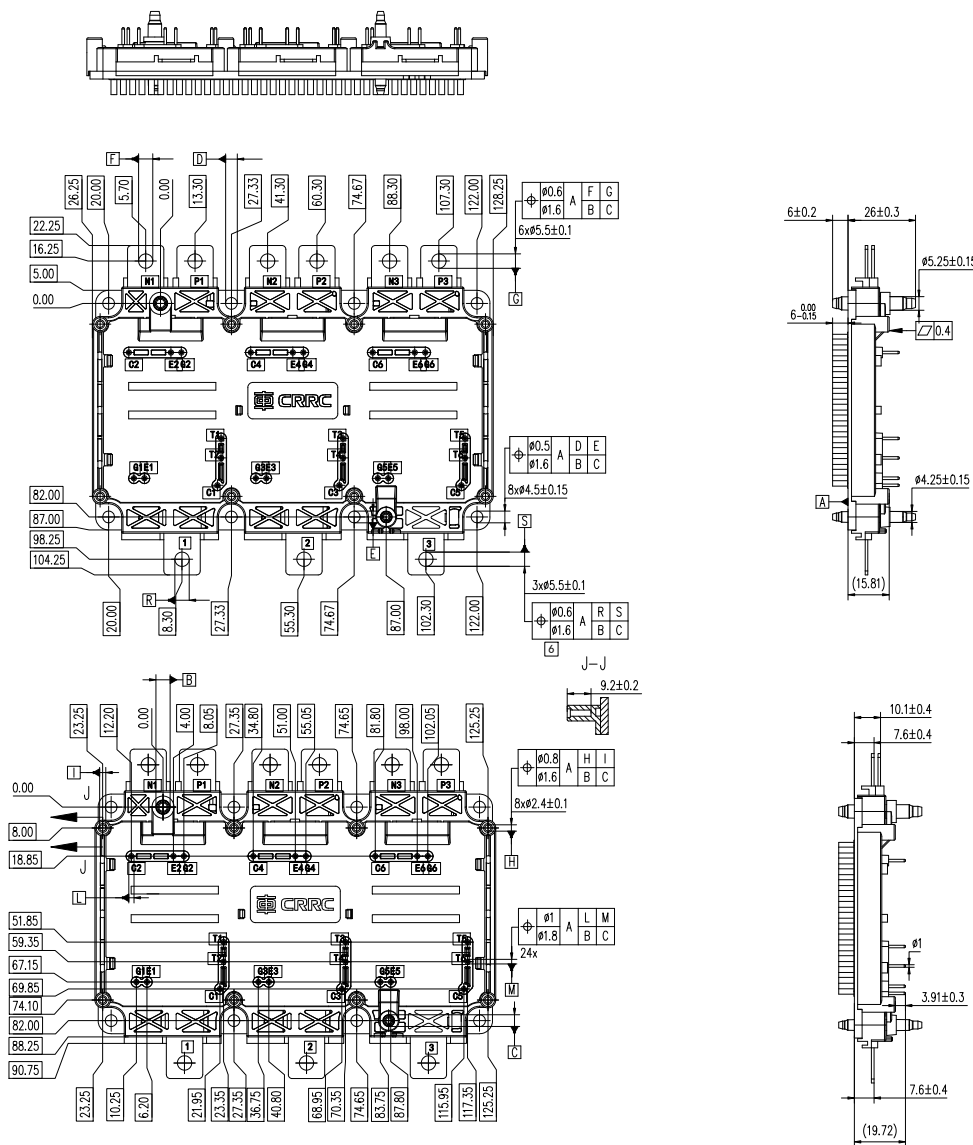


图 17. 热敏电阻典型特性曲线, $R = f(T_c)$

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



技术要求

- 1、未注尺寸X公差，参考IGBT-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) $10 \leq X < 30 \pm 0.25$;
 - (c) $30 \leq X < 50 \pm 0.32$;
 - (d) $50 \leq X < 100 \pm 0.5$;
 - (e) $100 \leq X < 200 \pm 0.8$ 。

重量 Weight: 730g 模块外观类型 Module outline code: S3

图 18. 模块外观尺寸

Fig. 18 Module outlines

株洲中车时代半导体有限公司

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(2) Some product data in the datasheet of this product are the typical values, the actual factory testing data may deviate slightly from



产品数据手册 Product Datasheet 版本 Ver 21.09

TG600FF12S3-S4A01

六单元 IGBT 模块 Six-Pack IGBT Module

typical values, but our company guarantees that these deviations will not affect the normal use of the product. If the product information changes, our company will promptly amend the datasheet, please keeps your attention to product information changing in our company website.

(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.