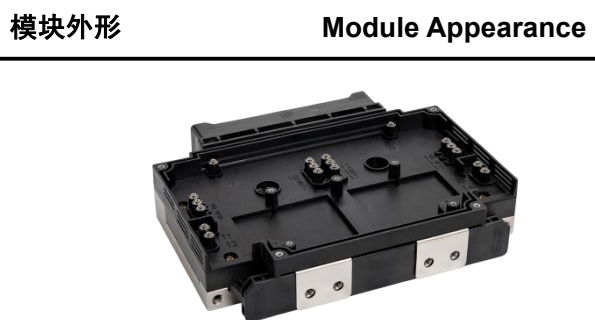
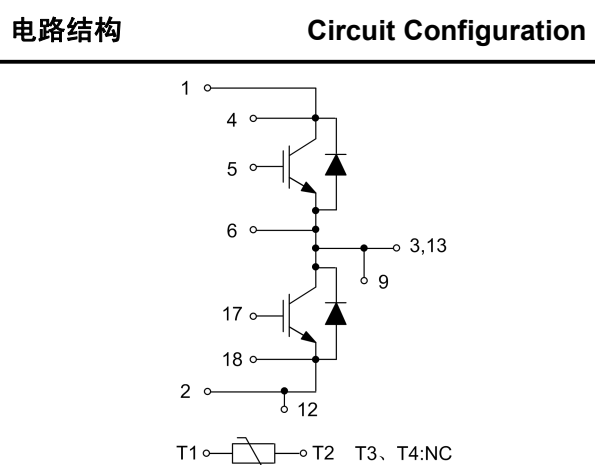


关键参数		Key Parameters	
V_{CES}		3300	V
$V_{CE(sat)}$	Typ.	2.18	V
I_C	Max.	1600	A
$I_{C(RM)}$	Max.	3200	A

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



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	$V_{GE} = 0V, T_C = 25\text{ }^{\circ}\text{C}$	3300	V
V_{GES}	栅极-发射极电压 Gate-emitter voltage	$T_C = 25\text{ }^{\circ}\text{C}$	± 20	V
I_C	集电极电流 Collector-emitter current	$T_F = 40\text{ }^{\circ}\text{C}, T_{vj} = 150\text{ }^{\circ}\text{C}$	1600	A
$I_{C(PK)}$	集电极峰值电流 Peak collector current	$t_P = 1\text{ms}$	3200	A
P_{max}	晶体管部分最大损耗 Max. transistor power dissipation	$T_{vj} = 150\text{ }^{\circ}\text{C}, T_F = 40\text{ }^{\circ}\text{C}$	4650	W
ρ_t	二极管 ρ_t 值 Diode ρ_t	$V_R = 0V, t_P = 10\text{ms}, T_{vj} = 150\text{ }^{\circ}\text{C}$	870	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, $T_C = 25\text{ }^{\circ}\text{C}$	6	kV
Q_{PD}	局部放电电荷(模块) Partial discharge – per module	IEC1287. $V_1 = 3500V, V_2 = 2600V, 50\text{Hz RMS}$	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	63.0	mm
	端子-端子 Terminal to terminal	77.0	mm
绝缘间隙 Clearance	端子-散热器 Terminal to heatsink	27.0	mm
	端子-端子 Terminal to terminal	/	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
$R_{th(J-F)}$ IGBT	IGBT 结壳热阻 Thermal resistance – IGBT	冷却液: 50%乙二醇溶液; $\Delta V/\Delta t=6.5 \text{ dm}^3/\text{min}$; $T_F = 60 \text{ }^\circ\text{C}$		23.60		K / kW
$R_{th(J-F)}$ Diode	二极管结壳热阻 Thermal resistance – Diode	Cooling Fluid: 50% water / 50% ethylene glycol; $\Delta V/\Delta t=6.5 \text{ dm}^3/\text{min}$; $T_F = 60 \text{ }^\circ\text{C}$		29.50		K / kW
$T_{vj \text{ op}}$	工作结温 Operating junction temperature	IGBT 芯片 (IGBT)	-40		150	$^\circ\text{C}$
		二极管芯片 (Diode)	-40		150	$^\circ\text{C}$
T_{stg}	存储温度 Storage temperature range		-40		150	$^\circ\text{C}$
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	$T_C = 25 \text{ }^\circ\text{C}$		5		k Ω
$\Delta R/R$	R100 偏差 Deviation of R100	$T_C = 100 \text{ }^\circ\text{C}$, $R_{100}=493\Omega$	-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

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
		$V_{GE} = 0V, V_{CE} = V_{CES}, T_C = 125\text{ }^{\circ}\text{C}$			60	mA
		$V_{GE} = 0V, V_{CE} = V_{CES}, T_C = 150\text{ }^{\circ}\text{C}$			75	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	$I_C = 60\text{mA}, V_{GE} = V_{CE}$	5.80	6.40	7.00	V
$V_{CE(sat)}^{(*1)}$	集电极-发射极饱和电压 Collector-emitter saturation voltage	$V_{GE} = 15V, I_C = 1600A$		2.18		V
		$V_{GE} = 15V, I_C = 1600A, T_{vj} = 125\text{ }^{\circ}\text{C}$		2.69		V
		$V_{GE} = 15V, I_C = 1600A, T_{vj} = 150\text{ }^{\circ}\text{C}$		2.79		V
I_F	二极管正向直流电流 Diode forward current	DC		1600		A
I_{FRM}	二极管正向重复峰值电流 Diode peak forward current	$t_P = 1\text{ms}$		3200		A
$V_F^{(*1)}$	二极管正向电压 Diode forward voltage	$I_F = 1600A, V_{GE} = 0$		2.1		V
		$I_F = 1600A, V_{GE} = 0, T_{vj} = 125\text{ }^{\circ}\text{C}$		2.49		V
		$I_F = 1600A, V_{GE} = 0, T_{vj} = 150\text{ }^{\circ}\text{C}$		2.56		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		6300		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 $T_C = 25\text{ }^{\circ}\text{C}$ $T_C = 25\text{ }^{\circ}\text{C}$ 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	$V_{CE} = 25V, V_{GE} = 0V, f = 100kHz$		311		nF
Q_g	栅极电荷 Gate charge	$\pm 15V$		20		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		$\mu\Omega$
R_{Gint}	内部栅极电阻 Internal gate resistor			1.7		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	$I_C = 1600A$, $V_{CE} = 1800V$, $V_{GE} = \pm 15V$, $R_{G(OFF)} = 10\Omega$, $L_S = 60nH$, $dv/dt^{(*)} = 1600V/\mu s$ ($T_{vj} = 150^\circ C$).	$T_{vj} = 25^\circ C$		4650		ns
			$T_{vj} = 125^\circ C$		4965		
			$T_{vj} = 150^\circ C$		5090		
t_f	下降时间 Fall time		$T_{vj} = 25^\circ C$		770		ns
			$T_{vj} = 125^\circ C$		1240		
			$T_{vj} = 150^\circ C$		1425		
E_{OFF}	关断损耗 Turn-off energy loss		$T_{vj} = 25^\circ C$		2185		mJ
			$T_{vj} = 125^\circ C$		2820		
			$T_{vj} = 150^\circ C$		3030		
$t_{d(on)}$	开通延迟时间 Turn-on delay time	$T_{vj} = 25^\circ C$		1445		ns	
		$T_{vj} = 125^\circ C$		1480			
		$T_{vj} = 150^\circ C$		1490			
t_r	上升时间 Rise time	$T_{vj} = 25^\circ C$		245		ns	
		$T_{vj} = 125^\circ C$		255			
		$T_{vj} = 150^\circ C$		260			
E_{ON}	开通损耗 Turn-on energy loss	$T_{vj} = 25^\circ C$		2900		mJ	
		$T_{vj} = 125^\circ C$		3365			
		$T_{vj} = 150^\circ C$		3520			
Q_{rr}	二极管反向恢复电荷 Diode reverse recovery charge	$T_{vj} = 25^\circ C$		1150		μC	
		$T_{vj} = 125^\circ C$		1465			
		$T_{vj} = 150^\circ C$		1590			
I_{rr}	二极管反向恢复电流 Diode reverse recovery current	$T_{vj} = 25^\circ C$		2120		A	
		$T_{vj} = 125^\circ C$		2130			
		$T_{vj} = 150^\circ C$		2140			
E_{rec}	二极管反向恢复损耗 Diode reverse recovery energy	$T_{vj} = 25^\circ C$		1030		mJ	
		$T_{vj} = 125^\circ C$		1390			
		$T_{vj} = 150^\circ C$		1540			

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)

注意:
Note:

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)

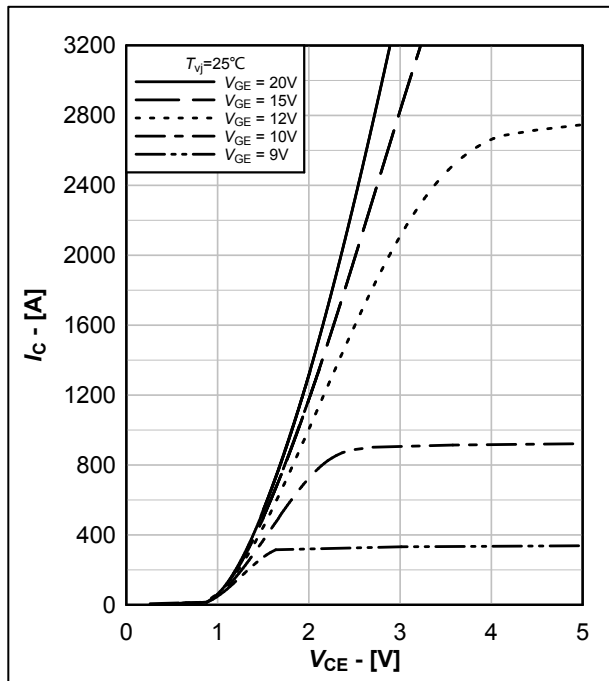

图 3. IGBT 输出特性典型曲线, $I_C = f(V_{CE})$

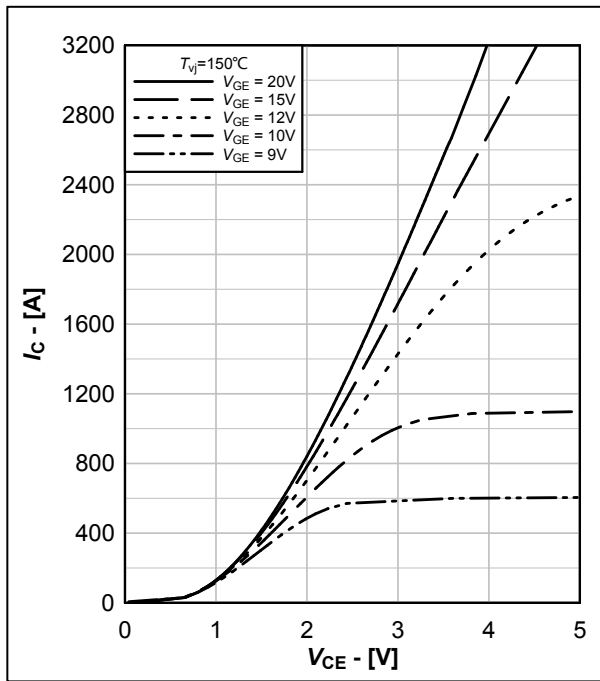
Fig.3 Typical IGBT output characteristics, $I_C = f(V_{CE})$

图 4. IGBT 输出特性典型曲线, $I_C = f(V_{CE})$

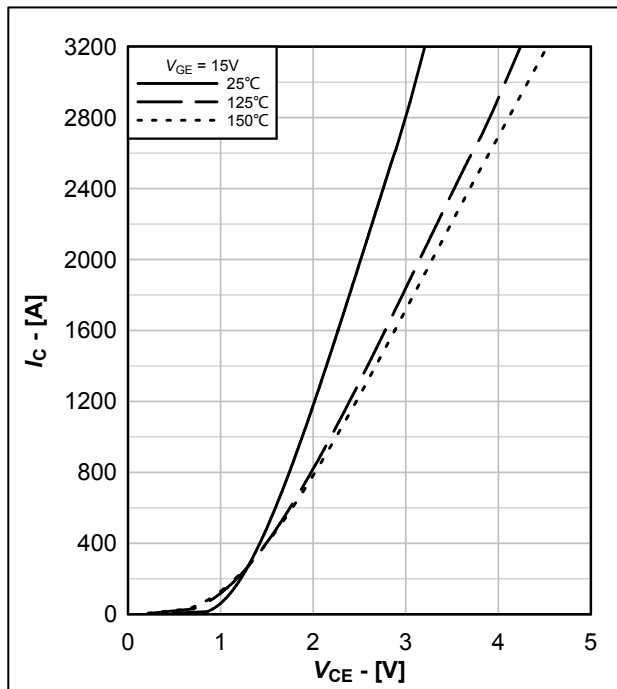
Fig.4 Typical IGBT output characteristics, $I_C = f(V_{CE})$

图 5. IGBT 输出特性典型曲线, $I_C = f(V_{CE})$

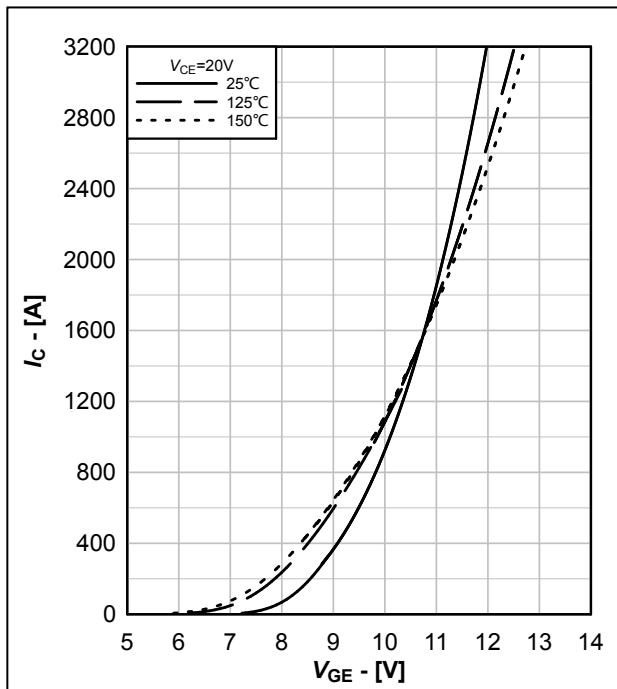
Fig.5 Typical IGBT output characteristics, $I_C = f(V_{CE})$

图 6. IGBT 传输特性典型曲线, $I_C = f(V_{GE})$

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

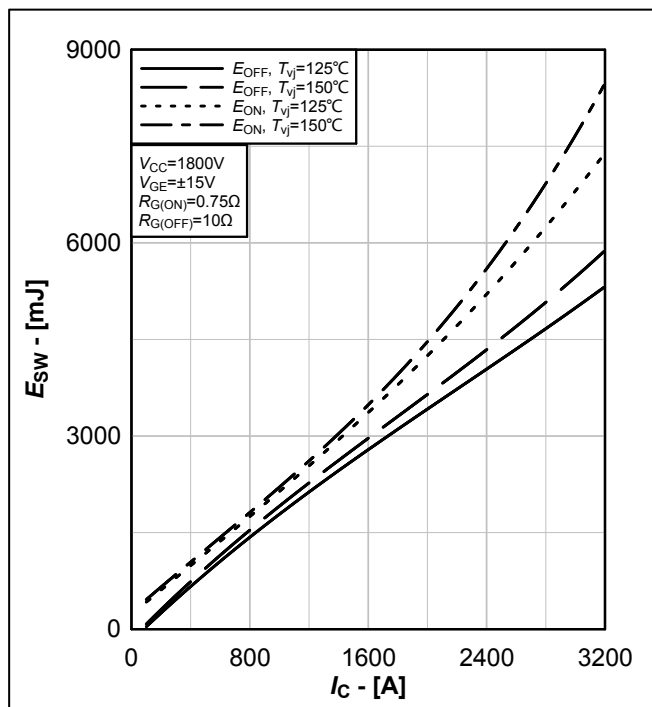

图 7. IGBT 开关损耗典型曲线, $E_{on}=f(I_c)$, $E_{off}=f(I_c)$

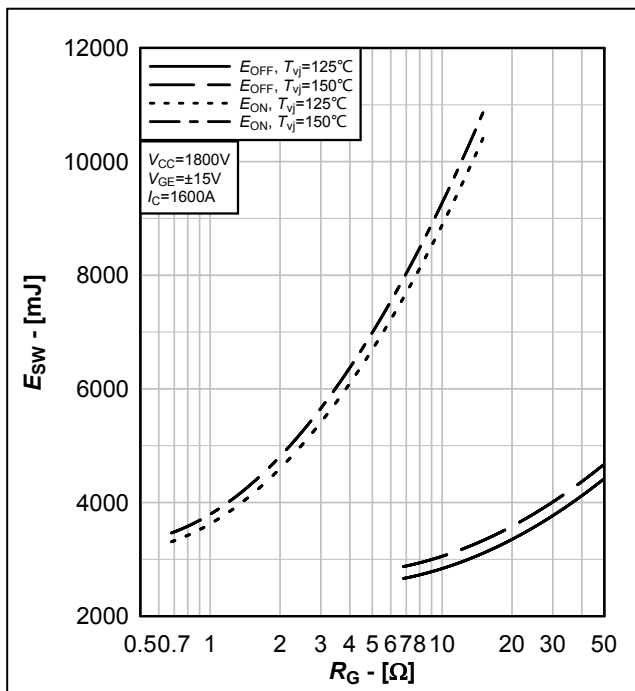
Fig.7 Typical IGBT switching energy, $E_{on}=f(I_c)$, $E_{off}=f(I_c)$

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

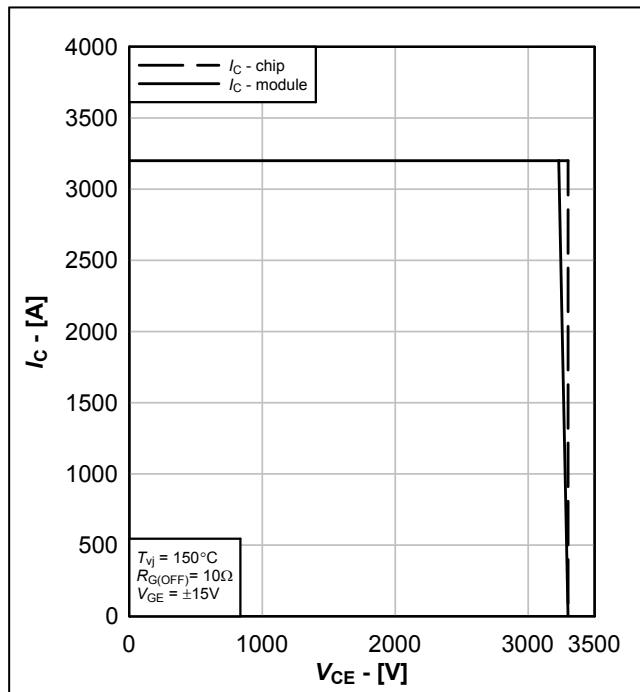
Fig.8 Typical IGBT switching energy, $E_{on}=f(R_g)$, $E_{off}=f(R_g)$

图 9. IGBT 反偏安全工作区, $I_c=f(V_{ce})$

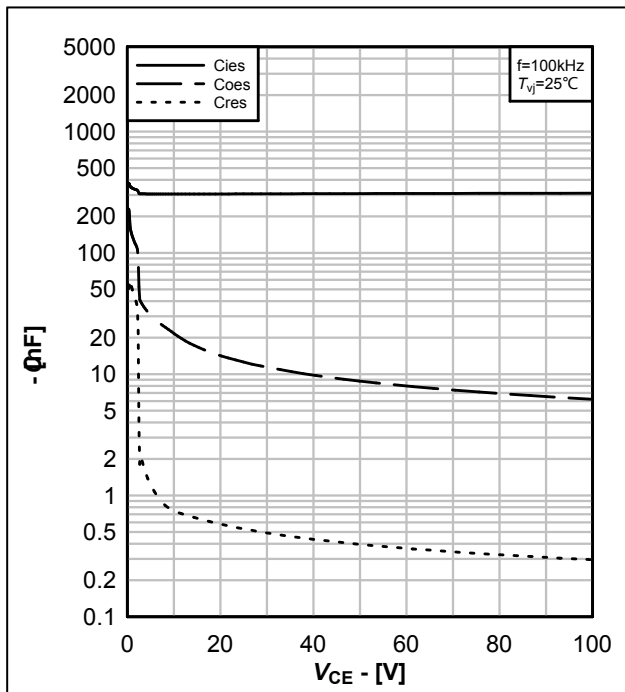
Fig.9 Reverse bias safe operating area of IGBT, $I_c=f(V_{ce})$

图 10. 电容特性典型曲线, $C=f(V_{ce})$

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

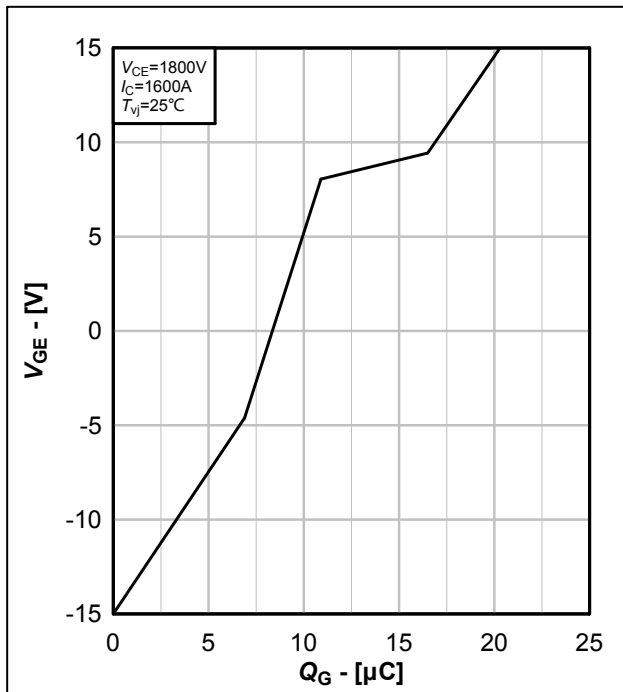

 图 11. 栅极电荷特性典型曲线, $V_{GE} = f(Q_G)$

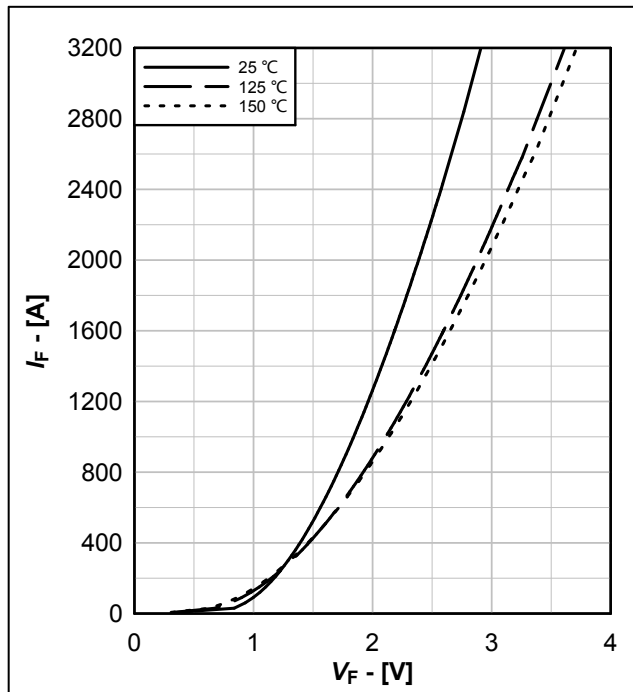
 Fig.11 Typical gate charge characteristic, $V_{GE} = f(Q_G)$

 图 12. FRD 输出特性典型曲线, $I_F = f(V_F)$

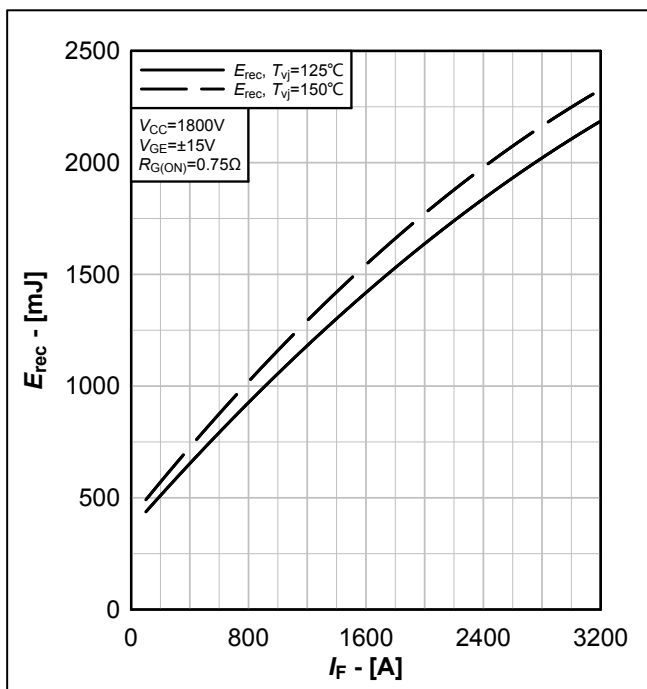
 Fig.12 Typical FRD output characteristic, $I_F = f(V_F)$

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

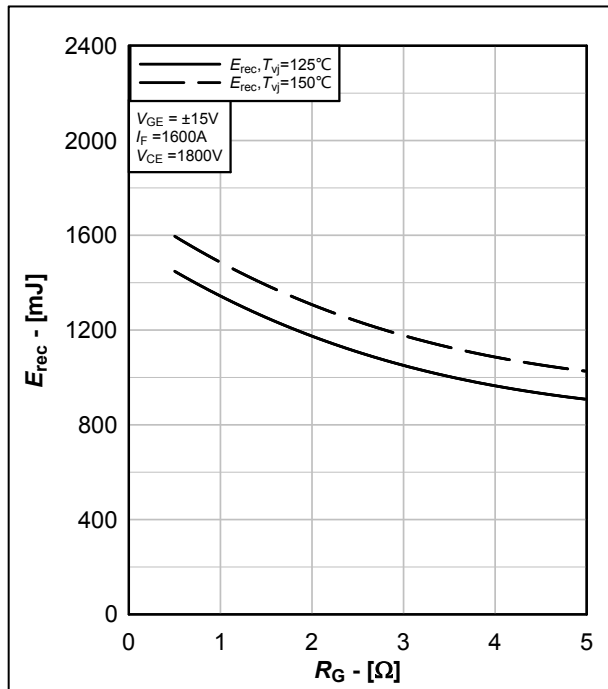
 Fig.13 Typical FRD switching loss E_{rec} , $E_{rec} = f(I_F)$

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

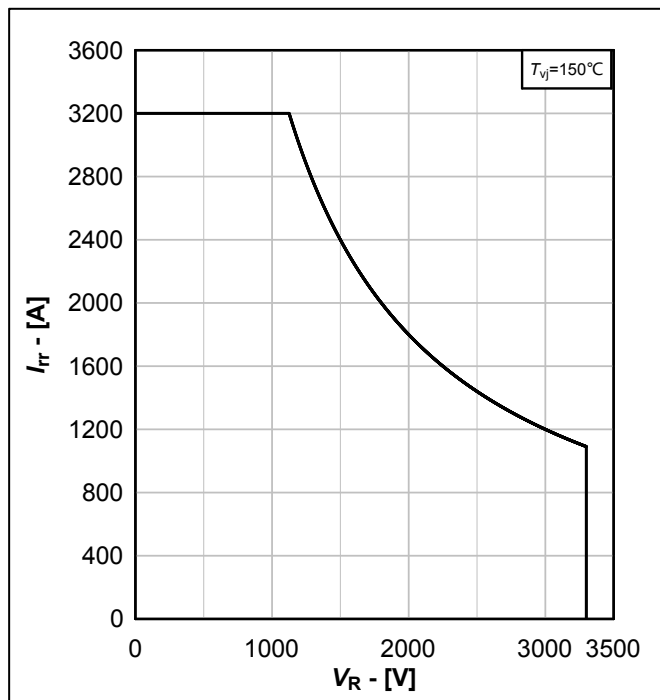

图 15. FRD 反偏安全工作区, $I_{rr} = f(V_R)$

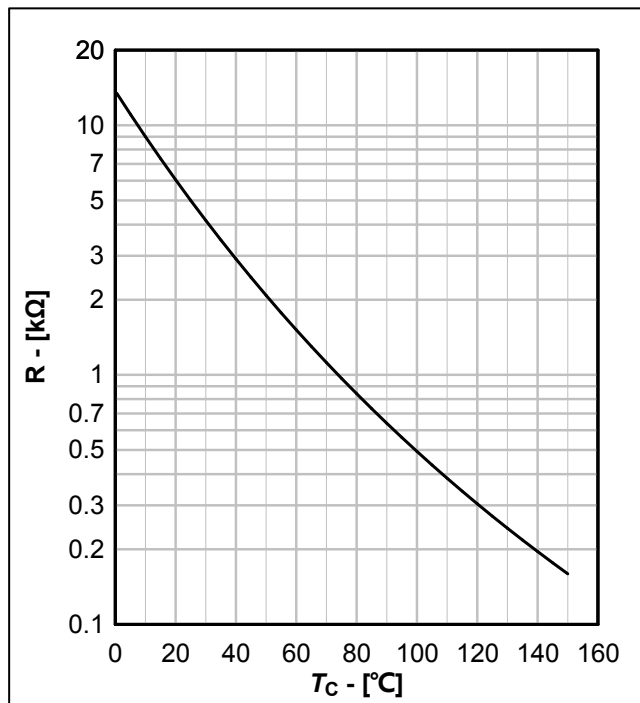
Fig.15 Reverse bias safe operating area of FRD, $I_{rr} = f(V_R)$

图 17. 热敏电阻典型特性曲线, $R = f(T_c)$

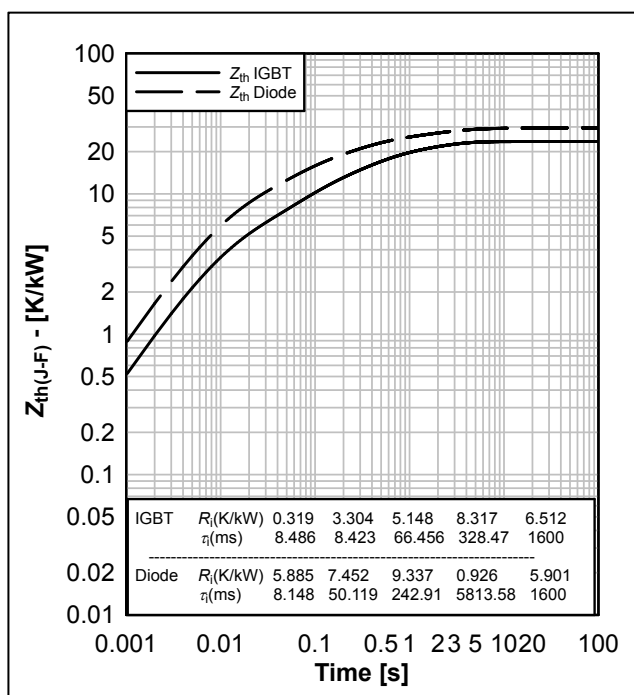
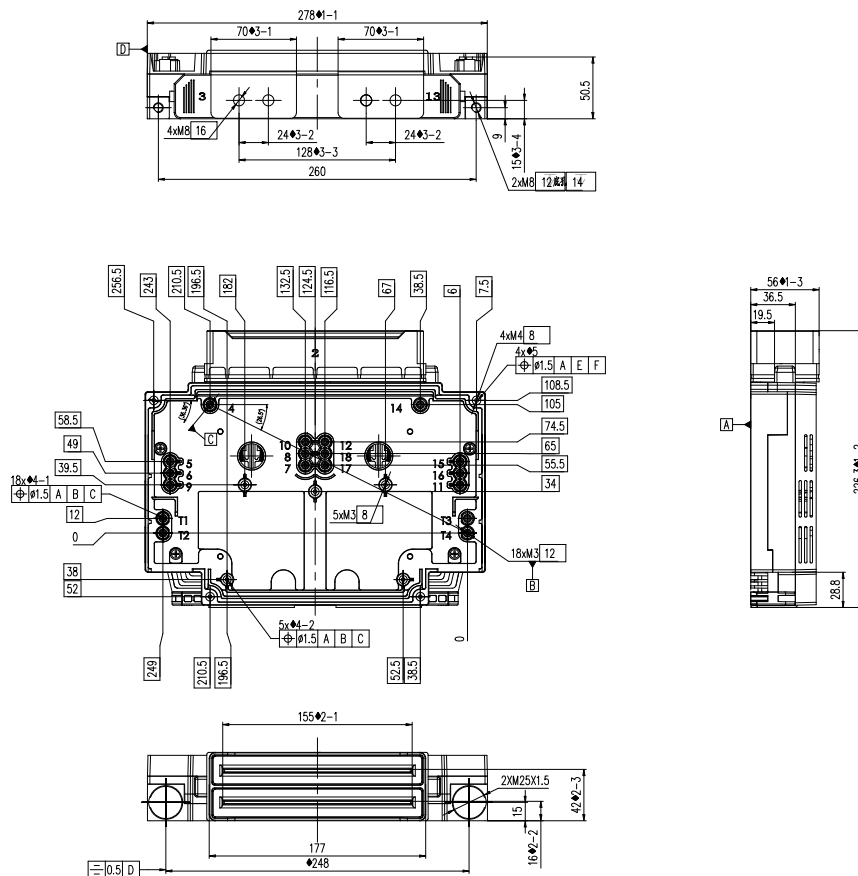
Fig.17 Typical NTC thermistor characteristic, $R = f(T_c)$

图 16. 瞬态热阻抗曲线, $Z_{th(j-F)} = f(t_p)$

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



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

株洲中车时代半导体有限公司

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