

关键参数		Key Parameters	
$V_{CES}$		1700	V
$V_{CE(sat)}$	Typ.	1.80	V
$I_C$	Max.	1200	A
$I_{C(RM)}$	Max.	2400	A

典型应用	Typical Applications
● 牵引传动	Traction drives
● 电机控制	Motor Controllers
● 高可靠性逆变器	High Reliability Inverter

特点	Features
● AISiC 基板	AISiC Baseplate
● AlN 衬板	AlN Substrates
● 高热循环能力	High Thermal Cycling Capability
● 10 $\mu$ s 短路承受能力	10 $\mu$ s Short Circuit Withstand

### 电路结构 Circuit Configuration

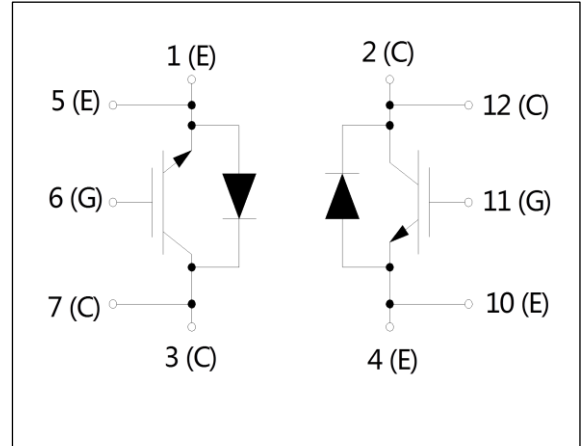


图 1. 电路结构

Fig. 1 Circuit configuration

### 模块外形 Module Appearance

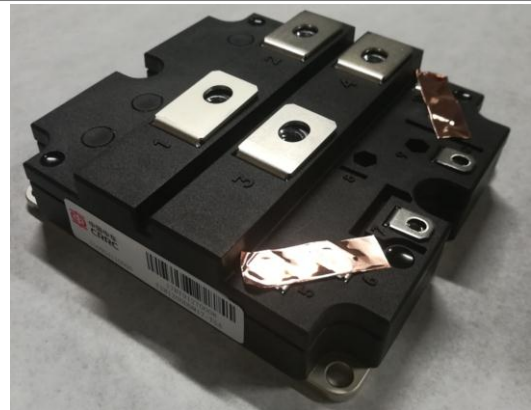


图 2. 模块外形

Fig. 2 Module appearance

**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	$V_{GE} = 0V, T_C = 25\text{ }^\circ\text{C}$	1700	V
$V_{GES}$	栅极-发射极电压 Gate-emitter voltage	$T_C = 25\text{ }^\circ\text{C}$	$\pm 20$	V
$I_C$	集电极电流 Collector-emitter current	$T_C = 75\text{ }^\circ\text{C}$	1200	A
$I_{C(PK)}$	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	$T_{vj} = 150\text{ }^\circ\text{C}, T_C = 25\text{ }^\circ\text{C}$	5.68	kW
$f_t$	二极管 $f_t$ 值 Diode $f_t$	$V_R = 0V, t_p = 10\text{ms}, T_{vj} = 150\text{ }^\circ\text{C}$	130	$\text{kA}^2\text{s}$
$V_{isol}$	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 (Commoned terminals to base plate), AC RMS, 1 min, 50Hz, $T_C = 25\text{ }^\circ\text{C}$	4000	V
$Q_{PD}$	局部放电电荷(模块) Partial Discharge – per module	IEC1287. V1 = 1800V, V2 = 1300V, 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-端子 Terminal to terminal	20.0	mm
绝缘间隙 Clearance	端子-端子 Terminal to terminal	10.0	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.	最大值 Max.	单位 Unit
$R_{th(J-C)}$ IGBT	IGBT 结壳热阻 Thermal resistance – IGBT			22	K / kW
$R_{th(J-C)}$ Diode	二极管结壳热阻 Thermal resistance – Diode			44	K / kW
$R_{th(C-H)}$ IGBT	接触热阻(IGBT) Thermal resistance – case to heatsink (IGBT)	安装力矩 5Nm, 导热脂 1W/m·°C Mounting torque 5Nm, with mounting grease 1W/m·°C		12	K / kW
$R_{th(C-H)}$ Diode	接触热阻(Diode) Thermal resistance – case to heatsink (Diode)	安装力矩 5Nm, 导热脂 1W/m·°C Mounting torque 5Nm, with mounting grease 1W/m·°C		24	K / kW
$T_{vj\ op}$	工作结温 Operating junction temperature	IGBT 部分 ( IGBT )	-40	150	°C
		二极管部分( 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		5	Nm
		电路互连用 – M4 Electrical connections – M4		2	Nm
		电路互连用 - M8 Electrical connections – M8		10	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  $T_C = 25^\circ\text{C}$   $T_C = 25^\circ\text{C}$  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
		$V_{GE} = 0V, V_{CE} = V_{CES}, T_C = 125^\circ\text{C}$			20	mA
		$V_{GE} = 0V, V_{CE} = V_{CES}, T_C = 150^\circ\text{C}$			30	mA
$I_{GES}$	栅极漏电流 Gate leakage current	$V_{GE} = \pm 20V, V_{CE} = 0V$			0.5	$\mu\text{A}$
$V_{GE(TH)}$	栅极-发射极阈值电压 Gate threshold voltage	$I_C = 40\text{mA}, V_{GE} = V_{CE}$	5.00	6.00	7.00	V
$V_{CE(sat)}^{(*1)}$	集电极-发射极饱和电压 Collector-emitter saturation voltage	$V_{GE} = 15V, I_C = 1200A$		1.80	2.20	V
		$V_{GE} = 15V, I_C = 1200A, T_{vj} = 125^\circ\text{C}$		2.10	2.50	V
		$V_{GE} = 15V, I_C = 1200A, T_{vj} = 150^\circ\text{C}$		2.20	2.6	V
$I_F$	二极管正向直流电流 Diode forward current	DC		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	$I_F = 1200A, V_{GE} = 0$		1.90	2.30	V
		$I_F = 1200A, V_{GE} = 0, T_{vj} = 125^\circ\text{C}$		2.10	2.50	V
		$I_F = 1200A, V_{GE} = 0, T_{vj} = 150^\circ\text{C}$		2.10	2.50	V
$I_{SC}$	短路电流 Short circuit current	$T_{vj} = 150^\circ\text{C}, V_{CC} = 1000V,$ $V_{GE} \leq 15V, t_p \leq 10\mu\text{s},$ $V_{CE(max)} = V_{CES} - L^{(*2)} \times di/dt,$ IEC 6074-9		4700		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  $L_M$ (\*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  $T_C = 25\text{ }^\circ\text{C}$   $T_C = 25\text{ }^\circ\text{C}$  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	$V_{CE} = 25V, V_{GE} = 0V, f = 100kHz$		109		nF
$Q_g$	栅极电荷 Gate charge	$\pm 15V$		11.6		$\mu C$
$C_{res}$	反向传输电容 Reverse transfer capacitance	$V_{CE} = 25V, V_{GE} = 0V, f = 100kHz$		3.0		nF
$L_M$	模块电感 Module inductance			20		nH
$R_{INT}$	内阻 Internal transistor resistance			0.27		m $\Omega$

**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	$I_C = 1200A,$ $V_{CE} = 900V,$ $V_{GE} = \pm 15V,$ $R_{G(OFF)} = 0.5\Omega,$ $L_S = 150nH,$ $dv/dt = 3500V/us$ ( $T_{vj} = 150^\circ C$ ).	$T_{vj} = 25^\circ C$	1200		ns
			$T_{vj} = 125^\circ C$	1250		
			$T_{vj} = 150^\circ C$	1280		
$t_f$	下降时间 Fall time		$T_{vj} = 25^\circ C$	400		ns
			$T_{vj} = 125^\circ C$	480		
			$T_{vj} = 150^\circ C$	490		
$E_{OFF}$	关断损耗 Turn-off energy loss		$T_{vj} = 25^\circ C$	570		mJ
			$T_{vj} = 125^\circ C$	640		
			$T_{vj} = 150^\circ C$	660		
$t_{d(on)}$	开通延迟时间 Turn-on delay time	$T_{vj} = 25^\circ C$	480		ns	
		$T_{vj} = 125^\circ C$	480			
		$T_{vj} = 150^\circ C$	480			
$t_r$	上升时间 Rise time	$T_{vj} = 25^\circ C$	230		ns	
		$T_{vj} = 125^\circ C$	240			
		$T_{vj} = 150^\circ C$	240			
$E_{ON}$	开通损耗 Turn-on energy loss	$T_{vj} = 25^\circ C$	83		mJ	
		$T_{vj} = 125^\circ C$	116			
		$T_{vj} = 150^\circ C$	128			
$Q_{rr}$	二极管反向恢复电荷 Diode reverse recovery charge	$T_{vj} = 25^\circ C$	240		$\mu C$	
		$T_{vj} = 125^\circ C$	380			
		$T_{vj} = 150^\circ C$	415			
$I_{rr}$	二极管反向恢复电流 Diode reverse recovery current	$T_{vj} = 25^\circ C$	710		A	
		$T_{vj} = 125^\circ C$	835			
		$T_{vj} = 150^\circ C$	870			
$E_{rec}$	二极管反向恢复损耗 Diode reverse recovery energy	$T_{vj} = 25^\circ C$	155		mJ	
		$T_{vj} = 125^\circ C$	265			
		$T_{vj} = 150^\circ C$	295			

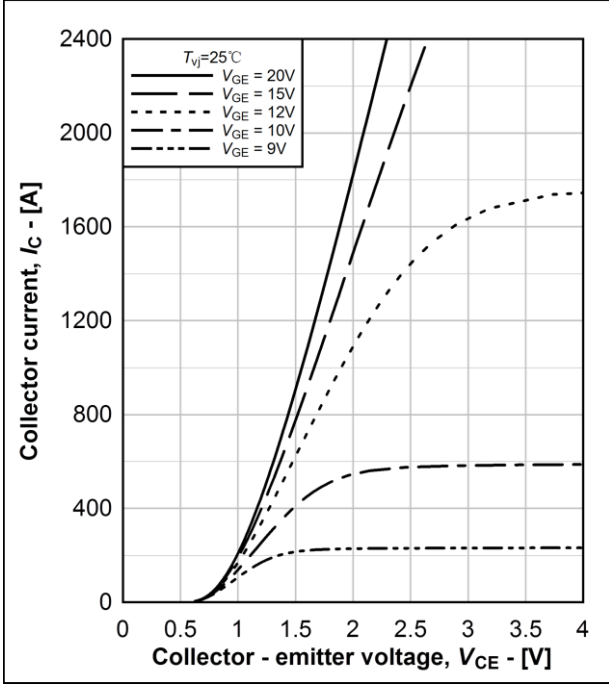


图 3. IGBT 输出特性典型曲线,  $I_C = f(V_{CE})$

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

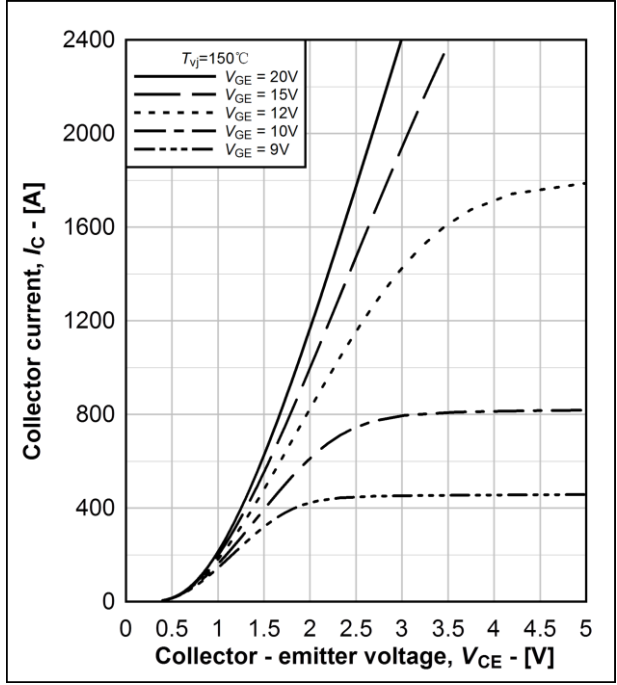


图 4. IGBT 输出特性典型曲线,  $I_C = f(V_{CE})$

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

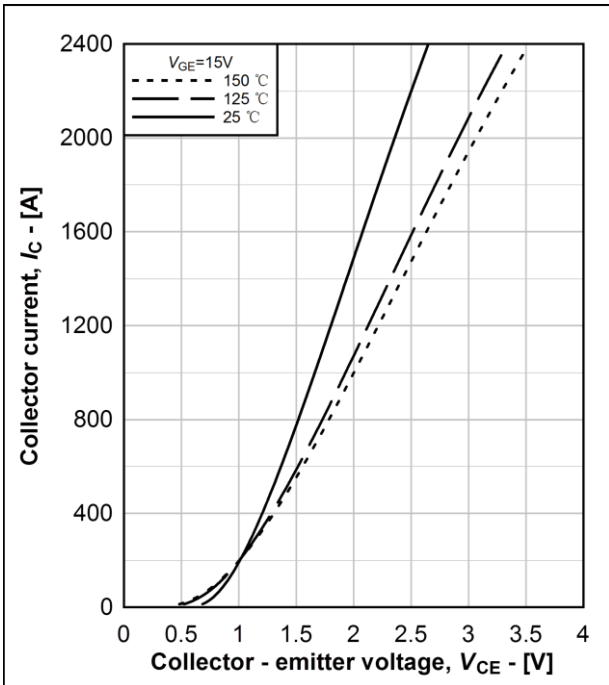


图 5. IGBT 输出特性典型曲线,  $I_C = f(V_{CE})$

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

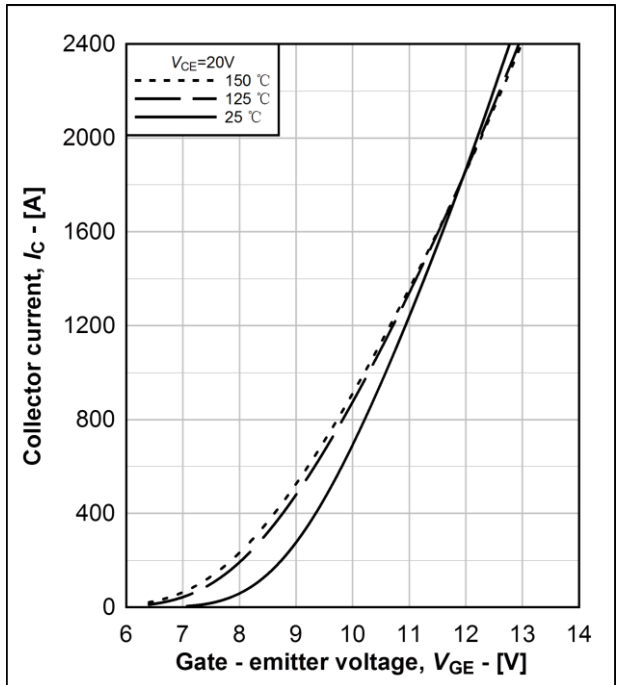


图 6. IGBT 传输特性典型曲线,  $I_C = f(V_{GE})$

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

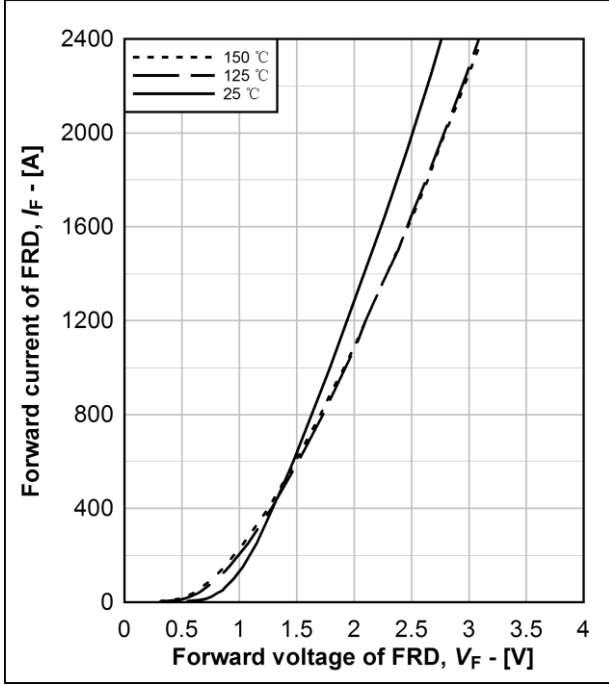


图 7. FRD 输出特性典型曲,  $I_F = f(V_F)$

Fig.7 Typical FRD output characteristics,  $I_F = f(V_F)$

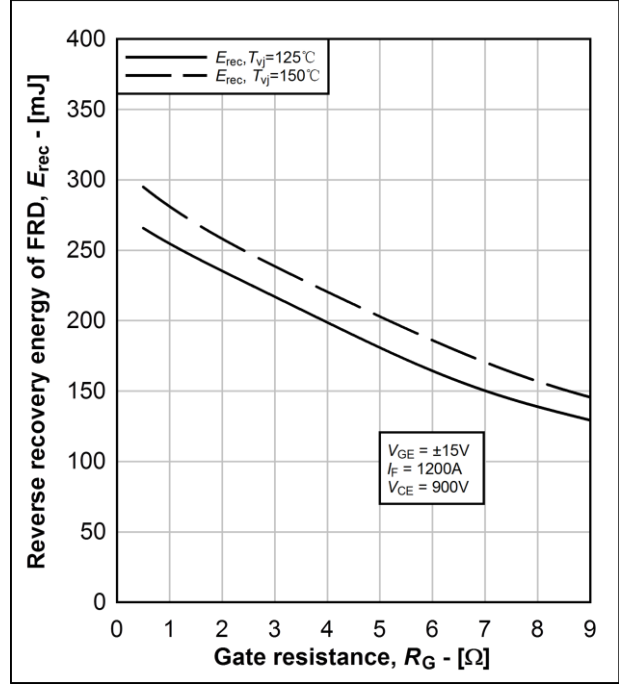


图 8. FRD 反向恢复能耗典型曲线,  $E_{rec}=f(R_G)$

Fig.8 Typical FRD  $E_{rec}$ ,  $E_{rec}=f(R_G)$

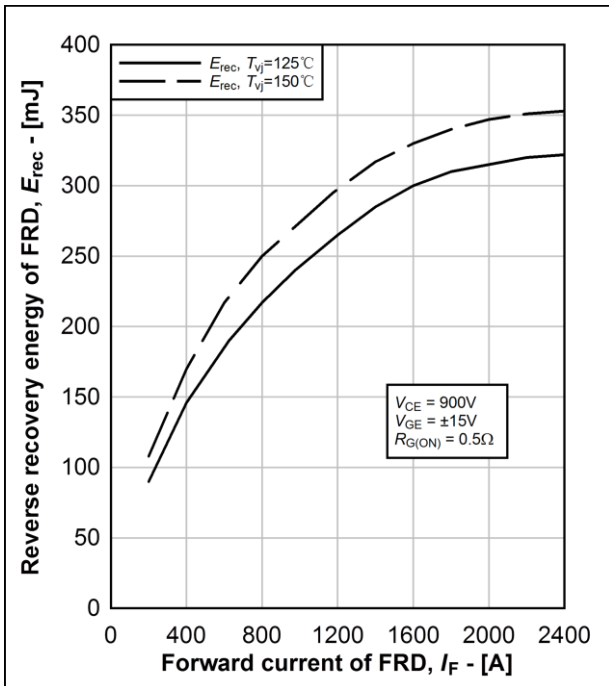


图 9. FRD 反向恢复能耗典型曲线,  $E_{rec}=f(I_F)$

Fig.9 Typical FRD  $E_{rec}$ ,  $E_{rec}=f(I_F)$

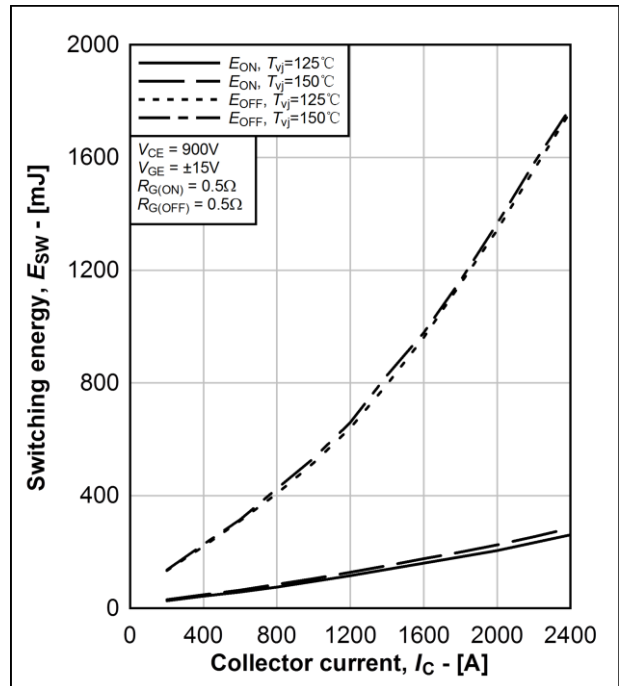


图 10. IGBT 开关能耗典型曲线,  $E_{on}=f(I_c)$ ,  $E_{off}=f(I_c)$

Fig.10 Typical IGBT switching energy,  $E_{on}=f(I_c)$ ,  $E_{off}=f(I_c)$

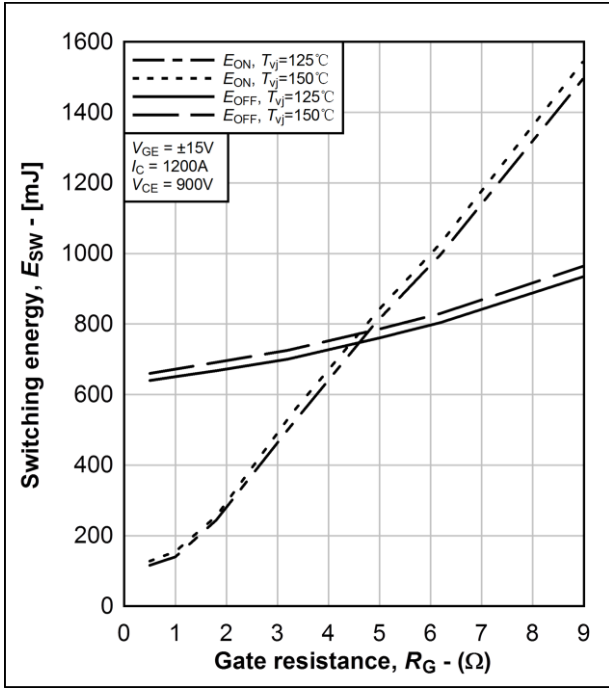

 图 11. IGBT 开关能耗典型曲线,  $E_{on}=f(R_G)$ ,  $E_{off}=f(R_G)$ 

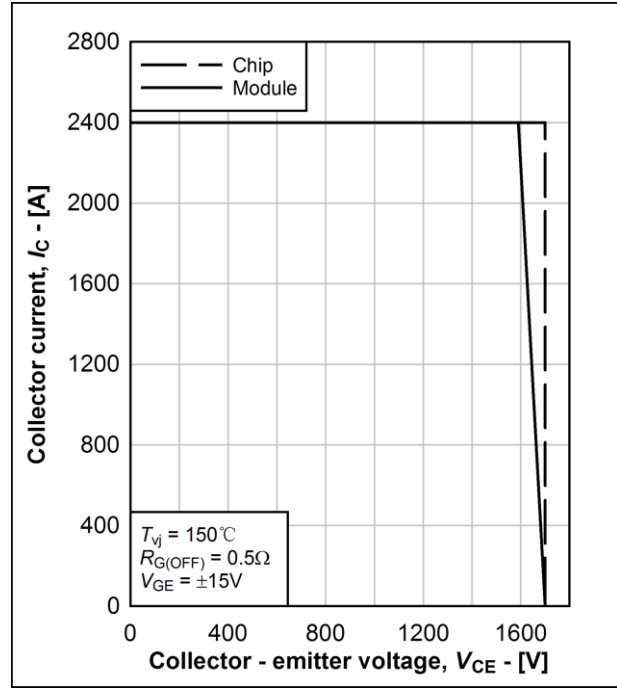
 Fig.11 Typical IGBT switching energy,  
 $E_{on}=f(R_G)$ ,  $E_{off}=f(R_G)$ 

 图 12. IGBT 反偏安全工作区,  $I_C=f(V_{CE})$ 

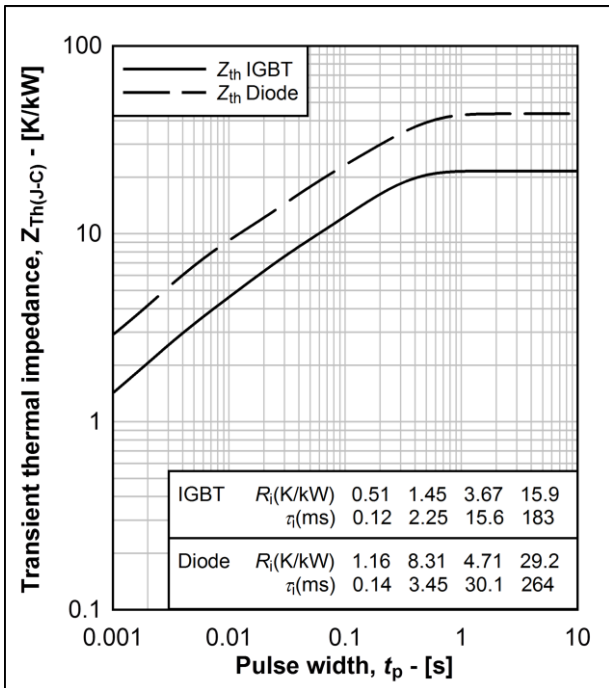
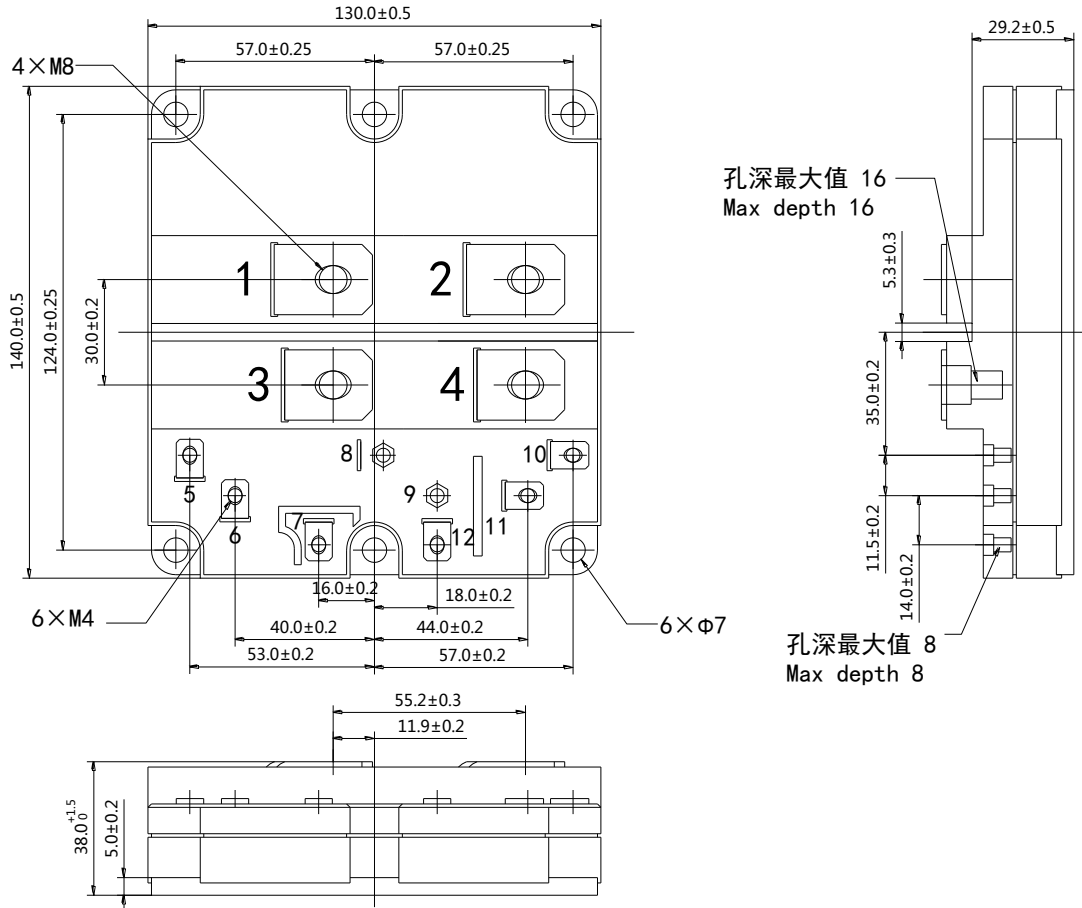
 Fig.12 Reverse bias safe operating area of IGBT,  
 $I_C=f(V_{CE})$ 

 图 13. 瞬态热阻抗曲线,  $Z_{Th(J-C)}=f(t)$ 

 Fig.13 Transient thermal impedance,  $Z_{Th(J-C)}=f(t)$



重量 Weight: 900g      模块外观类型 Module outline code: D

图 14. 模块外观尺寸

Fig. 14 Module outlines

株洲中车时代电气股份有限公司半导体事业部

**Semiconductor Business Unit, Zhuzhou CRRC Times Electric Co., Limited**

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株洲中车时代电气股份有限公司半导体事业部

**Semiconductor Business Unit, Zhuzhou CRRC Times Electric Co., Limited**

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