

关键参数	Key Parameters	
V_{CES}	3300	V
$V_{CE(sat)}$	(typ) 2.10	V
I_C	(max) 1000	A
$I_{C(RM)}$	(max) 2000	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
● AISiC基板	AISiC Base
● AIN衬板	AIN Substrates
● 高热循环能力	High Thermal Cycling Capability
● 10μs短路承受能力	10μs Short Circuit Withstand
● 低 $V_{ce(sat)}$ 型器件	Low $V_{ce(sat)}$ device
● 高电流密度	High current density

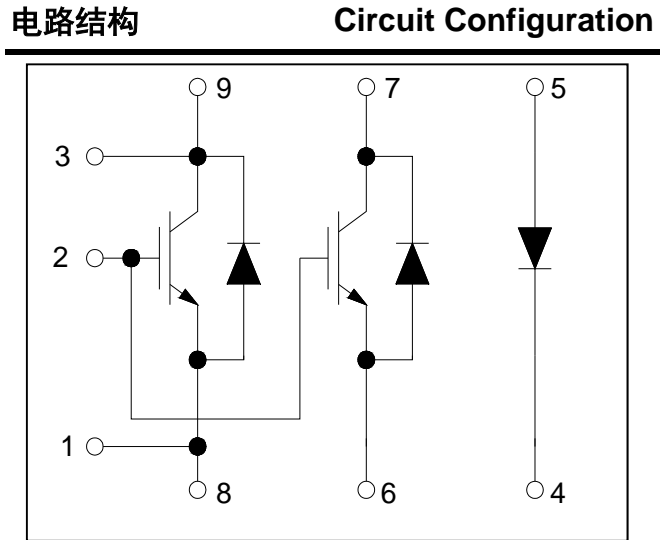


图1. 电路结构
Fig. 1 Circuit configuration



图2. 模块外形
Fig. 2 Module appearance

模块标签说明	Module Label code	
<p>ab1234567890/123456781234</p>	数据位置 Data position	数据内容 Content of data
	1--12	模块产品编码 Module product code
	13	分隔符 virgule
	14--21	模块批次号 Module batch number
	22--25	模块序列号 Module serial number

最大额定值

Absolute Maximum Rating

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	$T_C = 95^\circ C$	1000	A
$I_{C(PK)}$	集电极峰值电流 Peak collector current	$t_P = 1ms$	2000	A
P_{max}	晶体管部分最大损耗 Max. transistor power dissipation	$T_{vj} = 150^\circ C, T_C = 25^\circ C$	10.4	kW
I^2t	二极管 I^2t 值 (IGBT 桥臂) Diode I^2t (IGBT arm)	$V_R = 0V, t_P = 10ms, T_{vj} = 150^\circ C$	320	kA^2s
	二极管 I^2t 值 (FRD 桥臂) Diode I^2t (FRD arm)		320	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 (Commoned terminals to base plate), AC RMS, 1 min, 50Hz, $T_C = 25^\circ C$	6000	V
Q_{PD}	局部放电电荷(模块) Partial discharge – per module	IEC1287. $V_1 = 3500V, V_2 = 2600V,$ 50Hz RMS, $T_C = 25^\circ C$	10	pC

热和机械数据

Thermal & Mechanical Data

爬电距离	Creepage distance	33mm
绝缘间隙	Clearance	20mm
耐漏电起痕指数	CTI (Critical Tracking Index)	>600

符号 (Symbol)	参数名称 (Parameter)	测试条件 (Test Conditions)	最小 (Min)	最大 (Max)	单位 (Unit)
$R_{th(J-C) IGBT}$	IGBT结壳热阻 Thermal resistance – IGBT	结壳恒定功耗 Continuous dissipation - junction to case		12	K/ kW
$R_{th(J-C) Diode}$	二极管结壳热阻 (IGBT 桥臂) Thermal resistance – diode (IGBT arm)	结壳恒定功耗 Continuous dissipation - junction to case		24	K/ kW
	二极管结壳热阻 (FRD 桥臂) Thermal resistance – diode (FRD arm)			24	K/ kW
$R_{th(C-H)}$	接触热阻(模块) Thermal resistance – case to heatsink (per module)	安装力矩5Nm (导热脂 $1W/m^2 \cdot ^\circ C$) Mounting torque 5Nm (with mounting grease $1W/m^2 \cdot ^\circ C$)		6	K/ kW
T_{vj}	结温 Junction temperature	IGBT部分 (IGBT)		150	$^\circ C$
		二极管部分 (Diode)		150	$^\circ C$
T_{stg}	存储温度 Storage temperature range		-40	150	$^\circ C$
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

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 stated otherwise

符号 (Symbol)	参数名称 (Parameter)	条件 (Test Conditions)	最小 (Min)	典型 (Typ)	最大 (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
		$V_{GE} = 0V, V_{CE} = V_{CES}, T_C = 125^\circ\text{C}$			60	mA
		$V_{GE} = 0V, V_{CE} = V_{CES}, T_C = 150^\circ\text{C}$			100	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	$I_C = 80\text{mA}, V_{GE} = V_{CE}$	5.50	6.10	7.00	V
$V_{CE(sat)}^{(*)}$	集电极-发射极饱和电压 Collector-emitter saturation voltage	$V_{GE} = 15V, I_C = 1000A$		2.10	2.50	V
		$V_{GE} = 15V, I_C = 1000A, T_{vj} = 125^\circ\text{C}$		2.60	3.00	V
		$V_{GE} = 15V, I_C = 1000A, T_{vj} = 150^\circ\text{C}$		2.80	3.20	V
I_F	二极管正向直流电流 Diode forward current	DC		1000		A
I_{FRM}	二极管正向重复峰值电流 Diode maximum forward current	$t_P = 1\text{ms}$		2000		A
$V_F^{(*)}$	二极管正向电压 (IGBT桥臂) Diode forward voltage (IGBT arm)	$I_F = 1000A$		2.10	2.50	V
		$I_F = 1000A, T_{vj} = 125^\circ\text{C}$		2.25	2.60	V
		$I_F = 1000A, T_{vj} = 150^\circ\text{C}$		2.25	2.60	V
	二极管正向电压 (二极管桥臂) Diode forward voltage (Diode arm)	$I_F = 1000A$		2.10	2.50	V
		$I_F = 1000A, T_{vj} = 125^\circ\text{C}$		2.25	2.60	V
		$I_F = 1000A, T_{vj} = 150^\circ\text{C}$		2.25	2.60	V
C_{ies}	输入电容 Input capacitance	$V_{CE} = 25V, V_{GE} = 0V, f = 1\text{MHz}$		170		nF
Q_g	栅极电荷 Gate charge	$\pm 15V$		17		μC
C_{res}	反向传输电容 Reverse transfer capacitance	$V_{CE} = 25V, V_{GE} = 0V, f = 1\text{MHz}$		4		nF
L_M	模块电感 Module inductance			15		nH
R_{INT}	内阻 Internal transistor resistance			165		$\mu\Omega$
I_{sc}	短路电流 Short circuit current, I_{sc}	$T_{vj} = 150^\circ\text{C}, V_{CC} = 2500V,$ $V_{GE} \leq 15V, t_p \leq 10\mu\text{s},$ $V_{CE(max)} = V_{CES} - L^{(*)} \times di/dt,$ IEC 6074-9		4200		A

注意: 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);

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 stated otherwise

符号 (Symbol)	参数名称 (Parameter)	测试条件 (Test Conditions)	最小 (Min)	典型 (Typ)	最大 (Max)	单位 (Unit)	
$t_{d(off)}$	关断延迟时间 Turn-off delay time	$I_C = 1000\text{A}$ $V_{CE} = 1800\text{V}$ $C_{GE} = 220\text{nF}$ $L \sim 150\text{nH}$ $V_{GE} = \pm 15\text{V}$ $R_{G(ON)} = 1.5\Omega$ $R_{G(OFF)} = 2.2\Omega$		2420		ns	
t_f	下降时间 Fall time			600		ns	
E_{OFF}	关断损耗 Turn-off energy loss				2300		mJ
$t_{d(on)}$	开通延迟时间 Turn-on delay time				950		ns
t_r	上升时间 Rise time				340		ns
E_{ON}	开通损耗 Turn-on energy loss				1250		mJ
Q_{rr}	二极管反向恢复电荷 Diode reverse recovery charge	$I_F = 1000\text{A}$ $V_{CE} = 1800\text{V}$ $di_F/dt = 3300\text{A/us}$		750		μC	
I_{rr}	二极管反向恢复电流 Diode reverse recovery current				780		A
E_{rec}	二极管反向恢复损耗 Diode reverse recovery energy				950		mJ
Q_{rr}	二极管反向恢复电荷 Diode reverse recovery charge	$I_F = 1000\text{A}$ $V_{CE} = 1800\text{V}$ $di_F/dt = 3300\text{A/us}$		750		μC	
I_{rr}	二极管反向恢复电流 Diode reverse recovery current				780		A
E_{rec}	二极管反向恢复损耗 Diode reverse recovery energy				950		mJ

电特性值

Electrical Characteristics

除非特别声明，否则 $T_C = 125\text{ }^\circ\text{C}$

$T_C = 125\text{ }^\circ\text{C}$ unless stated otherwise

符号 (Symbol)	参数名称 (Parameter)	测试条件 (Test Conditions)	最小 (Min)	典型 (Typ)	最大 (Max)	单位 (Unit)	
$t_{d(off)}$	关断延迟时间 Turn-off delay time	$I_C = 1000\text{A}$ $V_{CE} = 1800\text{V}$ $C_{GE} = 220\text{nF}$ $L \sim 150\text{nH}$ $V_{GE} = \pm 15\text{V}$ $R_{G(ON)} = 1.5\Omega$ $R_{G(OFF)} = 2.2\Omega$		2450		ns	
t_f	下降时间 Fall time			640		ns	
E_{OFF}	关断损耗 Turn-off energy loss				2700		mJ
$t_{d(on)}$	开通延迟时间 Turn-on delay time				920		ns
t_r	上升时间 Rise time				360		ns
E_{ON}	开通损耗 Turn-on energy loss				1620		mJ
Q_{rr}	二极管反向恢复电荷 Diode reverse recovery charge	$I_F = 1000\text{A}$ $V_{CE} = 1800\text{V}$ $di_F/dt = 3300\text{A/us}$		1150		μC	
I_{rr}	二极管反向恢复电流 Diode reverse recovery current				850		A
E_{rec}	二极管反向恢复损耗 Diode reverse recovery energy				1470		mJ
Q_{rr}	二极管反向恢复电荷 Diode reverse recovery charge	$I_F = 1000\text{A}$ $V_{CE} = 1800\text{V}$ $di_F/dt = 3300\text{A/us}$		1150		μC	
I_{rr}	二极管反向恢复电流 Diode reverse recovery current				850		A
E_{rec}	二极管反向恢复损耗 Diode reverse recovery energy				1470		mJ

电特性值

Electrical Characteristics

除非特别声明，否则 $T_C = 150^\circ\text{C}$

$T_C = 150^\circ\text{C}$ unless stated otherwise

符号 (Symbol)	参数名称 (Parameter)	测试条件 (Test Conditions)	最小 (Min)	典型 (Typ)	最大 (Max)	单位 (Unit)	
$t_{d(off)}$	关断延迟时间 Turn-off delay time	$I_C = 1000\text{A}$ $V_{CE} = 1800\text{V}$ $C_{GE} = 220\text{nF}$ $L \sim 150\text{nH}$ $V_{GE} = \pm 15\text{V}$ $R_{G(ON)} = 1.5\Omega$ $R_{G(OFF)} = 2.2\Omega$		2480		ns	
t_f	下降时间 Fall time			650		ns	
E_{OFF}	关断损耗 Turn-off energy loss				2900		mJ
$t_{d(on)}$	开通延迟时间 Turn-on delay time				900		ns
t_r	上升时间 Rise time				360		ns
E_{ON}	开通损耗 Turn-on energy loss				1750		mJ
Q_{rr}	二极管反向恢复电荷 Diode reverse recovery charge	$I_F = 1000\text{A}$ $V_{CE} = 1800\text{V}$ $di_F/dt = 3300\text{A/us}$		1360		μC	
I_{rr}	二极管反向恢复电流 Diode reverse recovery current			890		A	
E_{rec}	二极管反向恢复损耗 Diode reverse recovery energy				1850		mJ
Q_{rr}	二极管反向恢复电荷 Diode reverse recovery charge	$I_F = 1000\text{A}$ $V_{CE} = 1800\text{V}$ $di_F/dt = 3300\text{A/us}$		1360		μC	
I_{rr}	二极管反向恢复电流 Diode reverse recovery current			890		A	
E_{rec}	二极管反向恢复损耗 Diode reverse recovery energy				1850		mJ

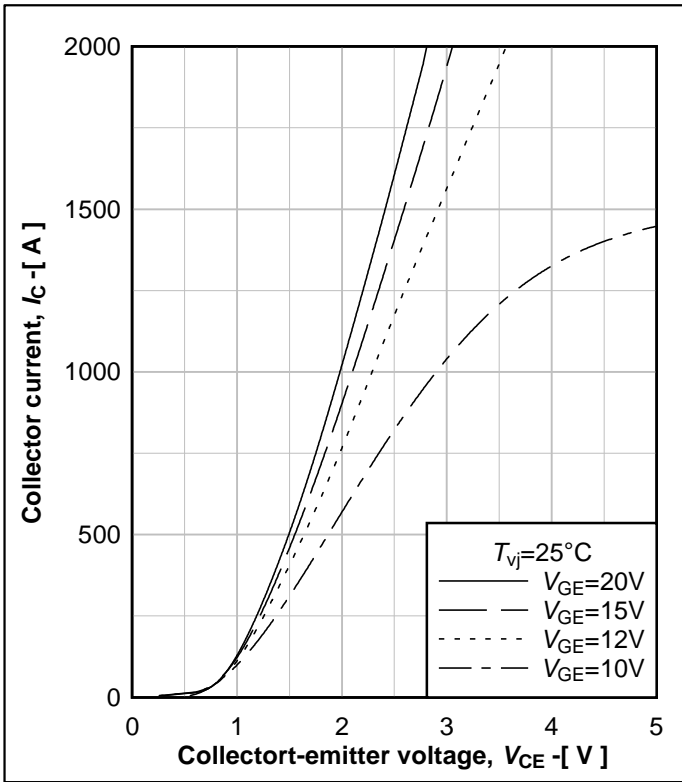


图3. 输出特性典型曲线

Fig.3 Typical output characteristics

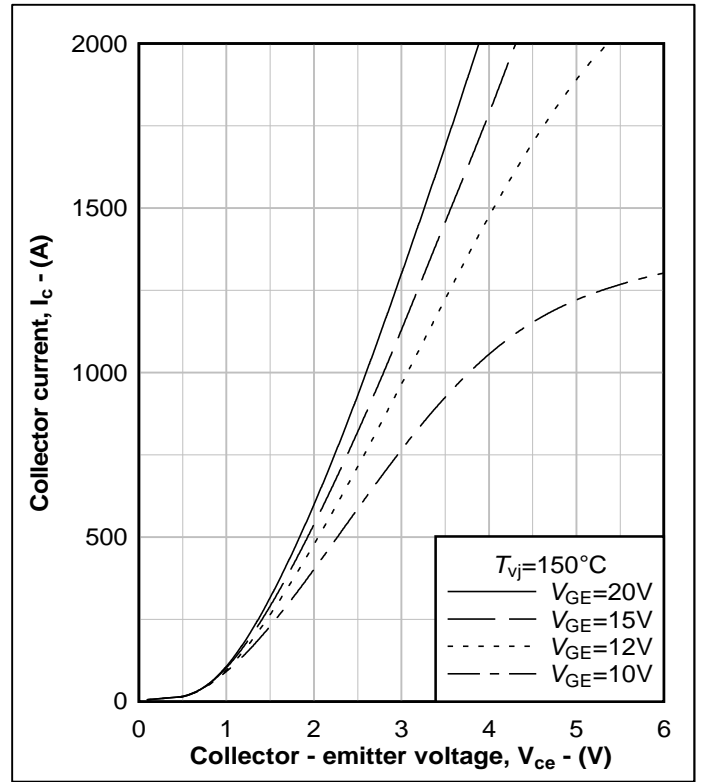


图4. 输出特性典型曲线

Fig.4 Typical output characteristics

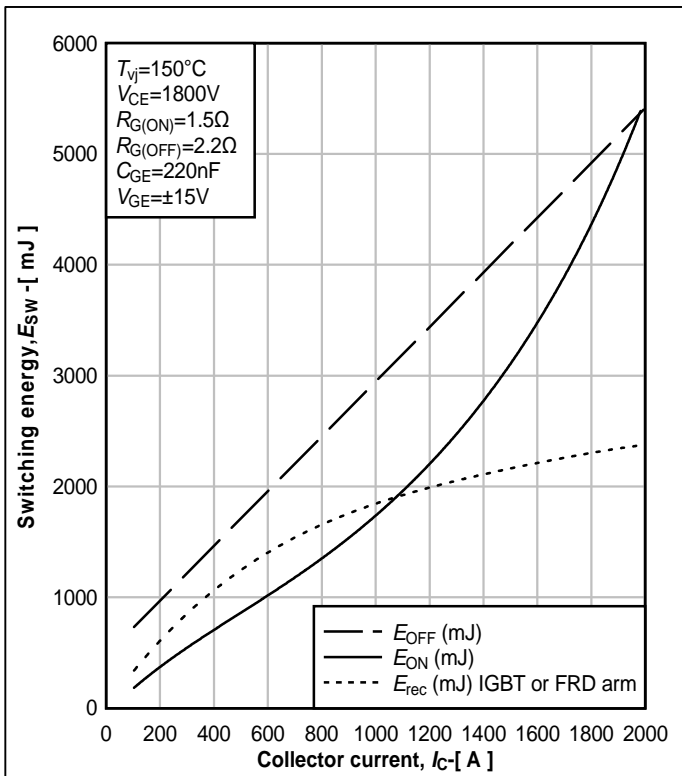


图5. 开关能耗与集电极电流关系曲线

Fig.5 Typical switching energy vs collector current

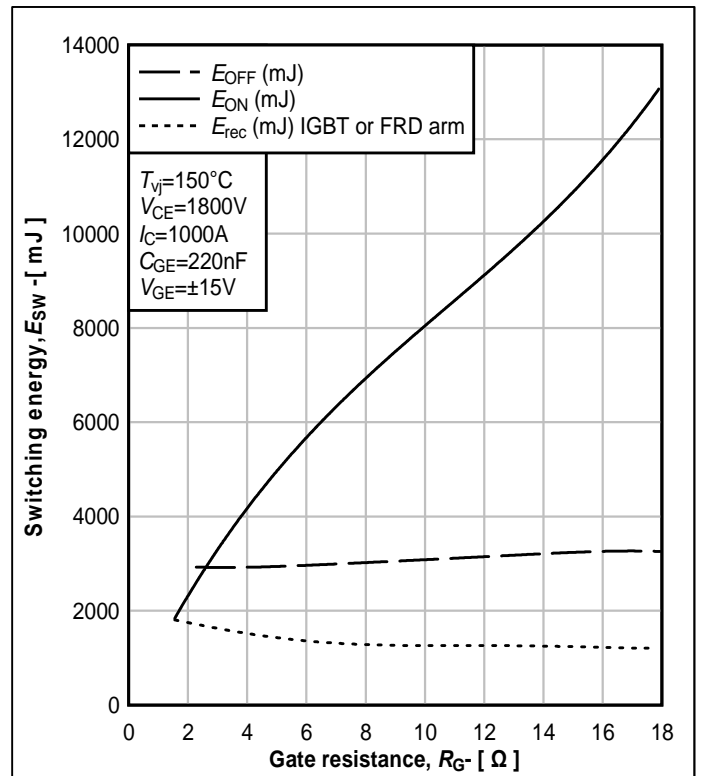


图6. 开关能耗与栅极电阻的关系曲线

Fig. 6 Typical switching energy vs gate resistance

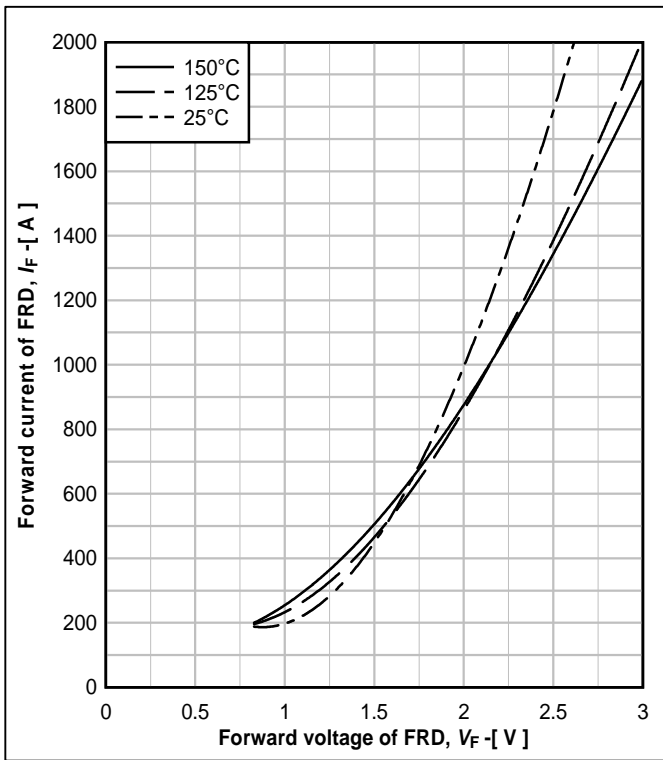


图7. 二极管正向特性典型曲线 (IGBT或FRD桥臂)
Fig.7 Diode typical forward characteristics (IGBT or FRD arm)

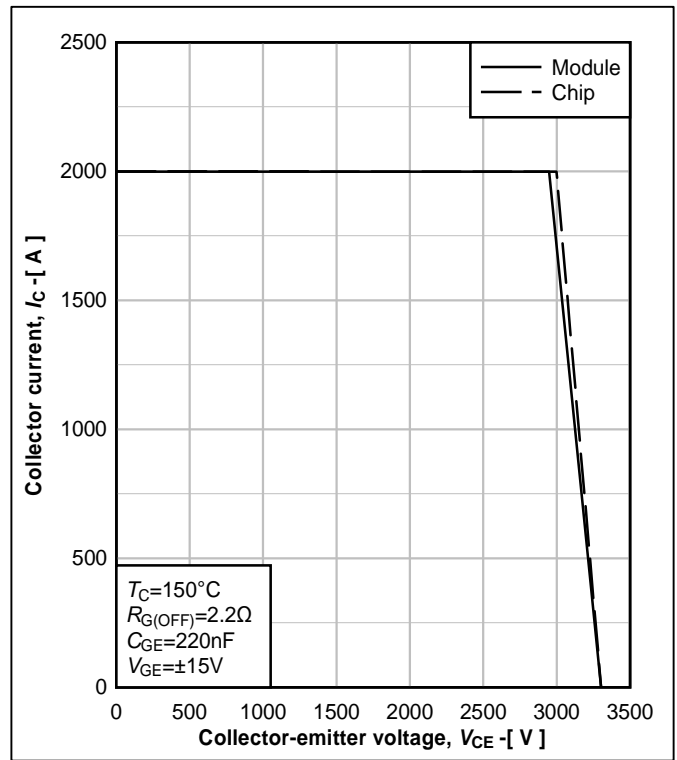


图8. 反偏安全工作区
Fig.8 Reverse bias safe operating area

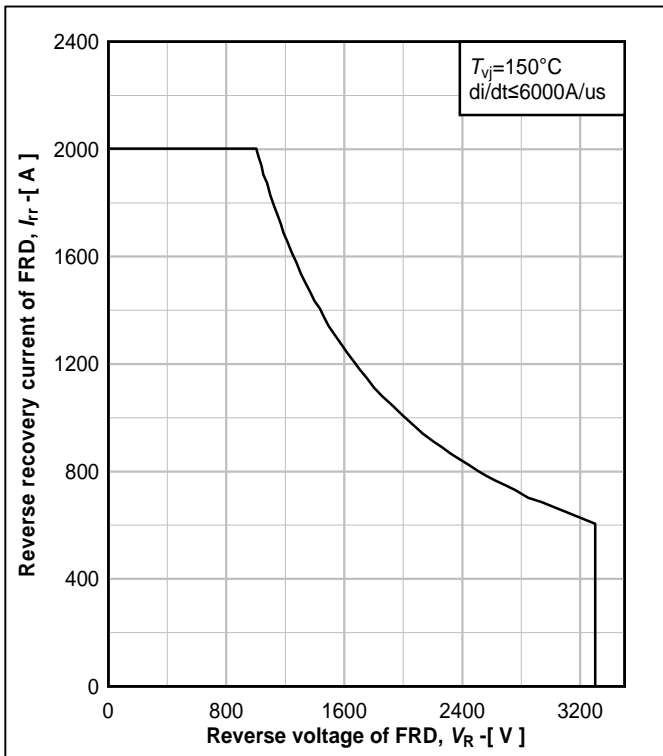


图9. 二极管反偏安全工作区 (IGBT或FRD桥臂)
Fig.9 Diode reverse bias safe operating area (IGBT or FRD arm)

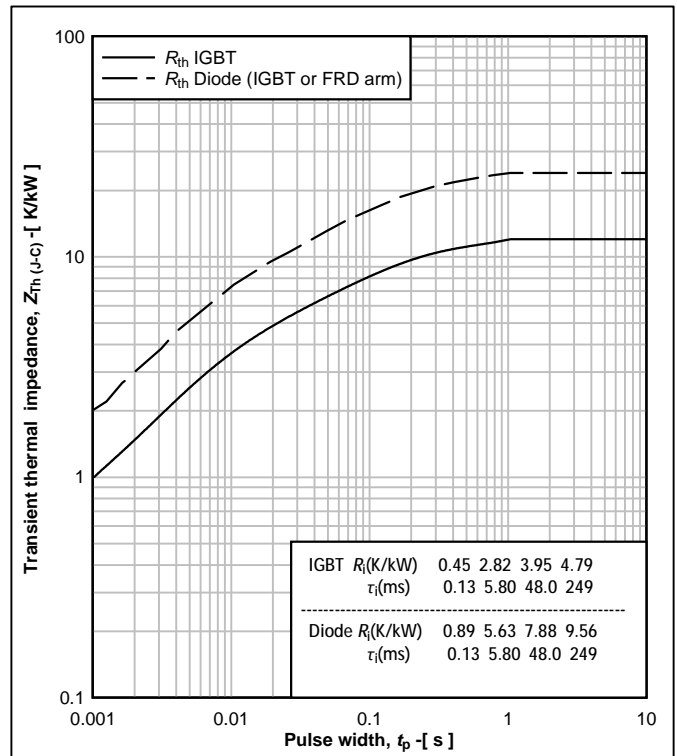
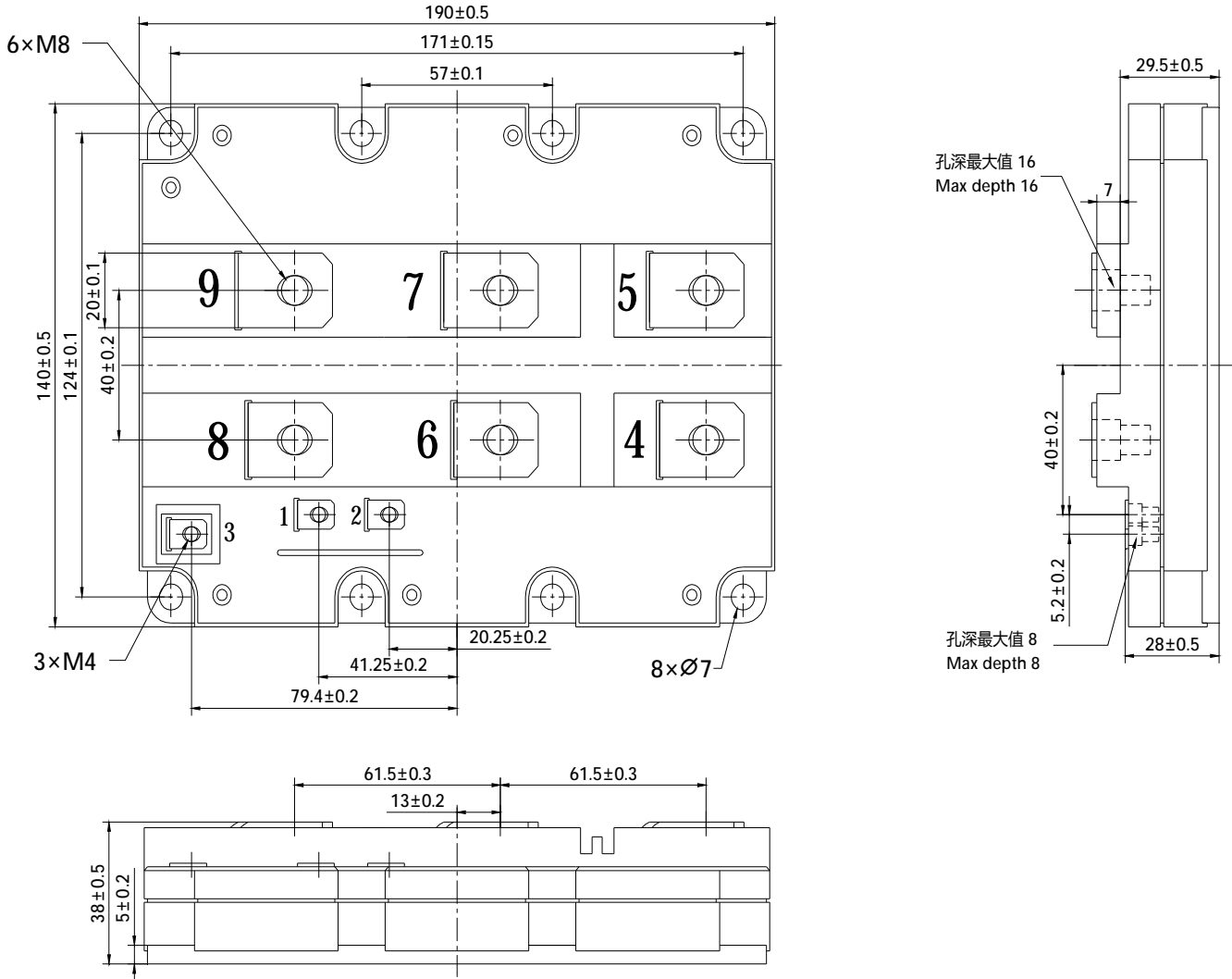


图10. 瞬态热阻抗曲线
Fig. 10 Transient thermal impedance



重量Weight: 1400g

模块外观类型 Module outline code: E

图11. 模块外观尺寸

Fig.11 Module outline drawing

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