TIM2400ESM17-TSA000　　单管型IGBT模块　　Single Switch IGBT

产品数据手册　Product Datasheet

版本 Ver 17.05

关键参数　Key Parameters

V_{CES}		1700	V
$V_{CE(sat)}$	(typ)	1.75	V
I_C	(max)	2400	A
$I_{C(RM)}$	(max)	4800	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

- AlSiC基板　AlSiC Base
- AlN衬板　AlN 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

电路结构　Circuit Configuration

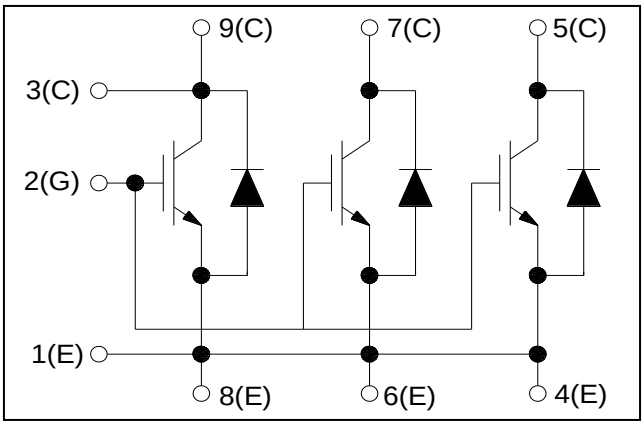

图1.　电路结构
Fig. 1 Circuit configuration



图2.　模块外形
Fig. 2　Module appearance

模块标签说明　Module Label code

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

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。

中国中车 CRRC

TIM2400ESM17-TSA000

额定值 Absolute Maximum Rating

除非特别声明，否则T_{case} = 25 °C

T_{case} = 25°C unless stated otherwise

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,Tvj = 25°C	1700	V
V_{GES}	栅极-发射极电压 Gate-emitter voltage		± 20	V
I_C	集电极电流 Collector-emitter current	T_{case} = 100 °C, Tvj = 150 °C	2400	A
$I_{C(PK)}$	集电极峰值电流 Peak collector current	t_p = 1ms	4800	A
P_{max}	晶体管部分最大损耗 Max. transistor power dissipation	T_{vj} = 150°C, T_{case} = 25 °C	19.2	kW
I^2t	二极管I^2t值 Diode I^2t	V_R =0V, t_P = 10ms, T_{vj} = 150 °C	1170	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	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

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		6.5	K / kW
$R_{th(J-C)\ Diode}$	二极管结壳热阻 Thermal resistance – diode	结壳恒定功耗 Continuous dissipation - junction to case		13	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·°C) Mounting torque 5Nm (with mounting grease 1W/m·°C)		6	K / kW
T_{vj}	结温 Junction temperature	IGBT部分 (IGBT)		150	°C
		二极管部分(Diode)		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

电特性值 Electrical Characristics

除非特别声明，否则T_{case} = 25 °C　　T_{case} = 25°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_{case} =125 ° C			40	mA
		V_{GE} = 0V, V_{CE} = V_{CES}, T_{case} =150 ° C			60	mA
I_{GES}	栅极漏电流 Gate leakage current	V_{GE} = ±20V, V_{CE} = 0V			1	μA
$V_{GE\ (TH)}$	栅极-发射极阈值电压 Gate threshold voltage	I_C = 80mA, V_{GE} = V_{CE}	5.0	6.0	7.0	V
$V_{CE\ (sat)}$(*1)	集电极-发射极饱和电压 Collector-emitter saturation voltage	V_{GE} =15V, I_C = 2400A		1.75		V
		V_{GE} =15V, I_C = 2400A,Tvj = 125 ° C		1.95		V
		V_{GE} =15V, I_C = 2400A,Tvj = 150 ° C		2.05		V
I_F	二极管正向直流电流 Diode forward current	DC		2400		A
I_{FRM}	二极管正向重复峰值电流 Diode maximum forward current	t_P = 1ms		4800		A
V_F(*1)	二极管正向电压 Diode forward voltage	I_F = 2400A		1.65		V
		I_F = 2400A, Tvj = 125 ° C		1.75		V
		I_F = 2400A, Tvj = 150 ° C		1.75		V
C_{ies}	输入电容 Input capacitance	V_{CE} = 25V, V_{GE} = 0V, f = 1MHz		400		nF
Q_g	栅极电荷 Gate charge	±15V		19		μC
C_{res}	反向传输电容 Reverse transfer capacitance	V_{CE} = 25V, V_{GE} = 0V, f = 1MHz		3		nF
L_M	模块电感 Module inductance			10		nH
R_{INT}	内阻 Internal transistor resistance			110		μΩ
I_{SC}	短路电流 Short circuit current, I_{SC}	T_{vj} = 150° C, V_{CC} = 1000V, V_{GE}≤15V, t_p≤10μs, $V_{CE(max)}$ = V_{CES} – L (*2)×di/dt, IEC 60747-9		12000		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);

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 Characristics

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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 = 2400A V_{CE} = 900V L_S ~ 50nH V_{GE} = ±15V $R_{G(ON)}$ = 0.5Ω $R_{G(OFF)}$= 0.5Ω		2320		ns
t_f	下降时间 Fall time			500		ns
E_{OFF}	关断损耗 Turn-off energy loss			1050		mJ
$t_{d(on)}$	开通延迟时间 Turn-on delay time			450		ns
t_r	上升时间 Rise time			210		ns
E_{ON}	开通损耗 Turn-on energy loss			410		mJ
Q_{rr}	二极管反向恢复电荷 Diode reverse recovery charge	I_F = 2400A V_{CE} = 900V di_F/dt =10000A/us		480		μC
I_{rr}	二极管反向恢复电流 Diode reverse recovery current			1000		A
E_{rec}	二极管反向恢复损耗 Diode reverse recovery energy			320		mJ

除非特别声明，否则T_{case} = 125 °C　　T_{case} = 125°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 = 2400A V_{CE} = 900V L_S ~ 50nH V_{GE} = ±15V $R_{G(ON)}$ = 0.5Ω $R_{G(OFF)}$= 0.5Ω		2340		ns
t_f	下降时间 Fall time			510		ns
E_{OFF}	关断损耗 Turn-off energy loss			1320		mJ
$t_{d(on)}$	开通延迟时间 Turn-on delay time			450		ns
t_r	上升时间 Rise time			220		ns
E_{ON}	开通损耗 Turn-on energy loss			660		mJ
Q_{rr}	二极管反向恢复电荷 Diode reverse recovery charge	I_F = 2400A V_{CE} = 900V di_F/dt =10000A/us		750		μC
I_{rr}	二极管反向恢复电流 Diode reverse recovery current			1200		A
E_{rec}	二极管反向恢复损耗 Diode reverse recovery energy			550		mJ

电特性值 Electrical Characristics

除非特别声明，否则T_{case} = 150 °C　　T_{case} = 150°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 = 2400A V_{CE} = 900V L_S ~ 50nH V_{GE} = ±15V $R_{G(ON)}$ = 0.5Ω $R_{G(OFF)}$= 0.5Ω		2340		ns
t_f	下降时间 Fall time			510		ns
E_{OFF}	关断损耗 Turn-off energy loss			1400		mJ
$t_{d(on)}$	开通延迟时间 Turn-on delay time			450		ns
t_r	上升时间 Rise time			220		ns
E_{ON}	开通损耗 Turn-on energy loss			820		mJ
Q_{rr}	二极管反向恢复电荷 Diode reverse recovery charge	I_F = 2400A V_{CE} = 900V di_F/dt =12000A/us		820		μC
I_{rr}	二极管反向恢复电流 Diode reverse recovery current			1250		A
E_{rec}	二极管反向恢复损耗 Diode reverse recovery energy			620		mJ

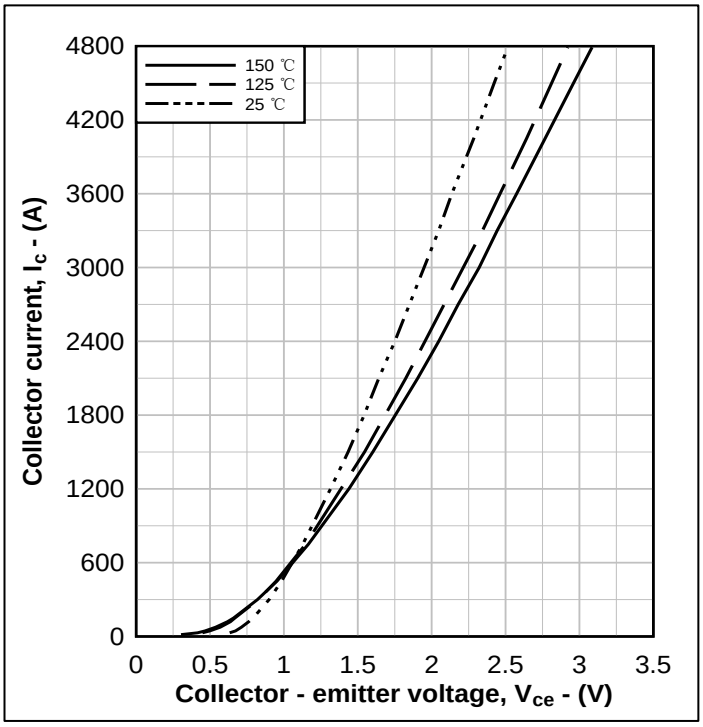


图3. 输出特性典型曲线

Fig.3 Typical output characteristics

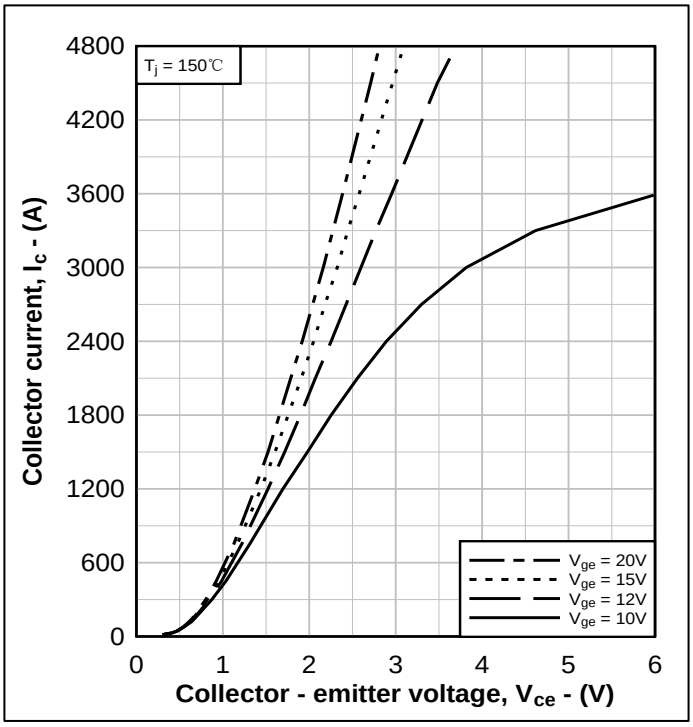


图4. 输出特性典型曲线

Fig.4 Typical output characteristics

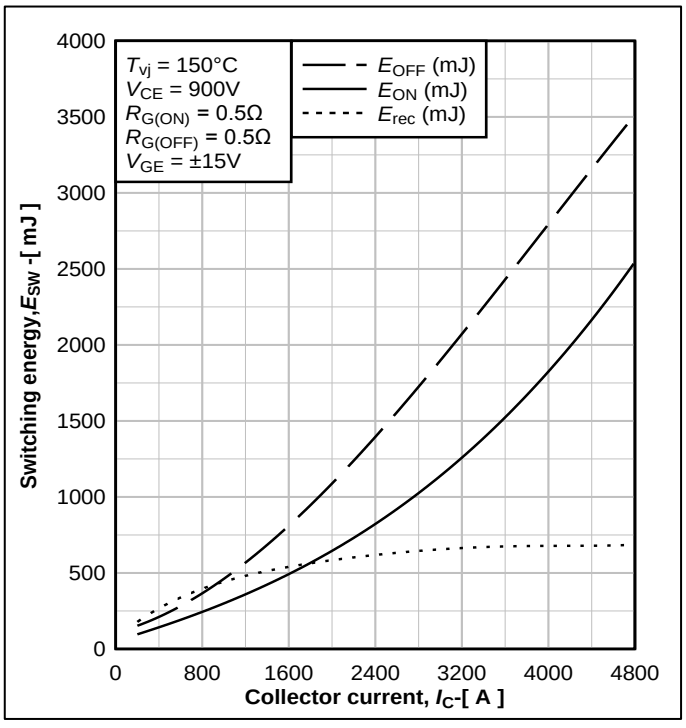


图5. 开关能耗与集电极电流关系曲线

Fig.5 Typical switching energy vs collector current

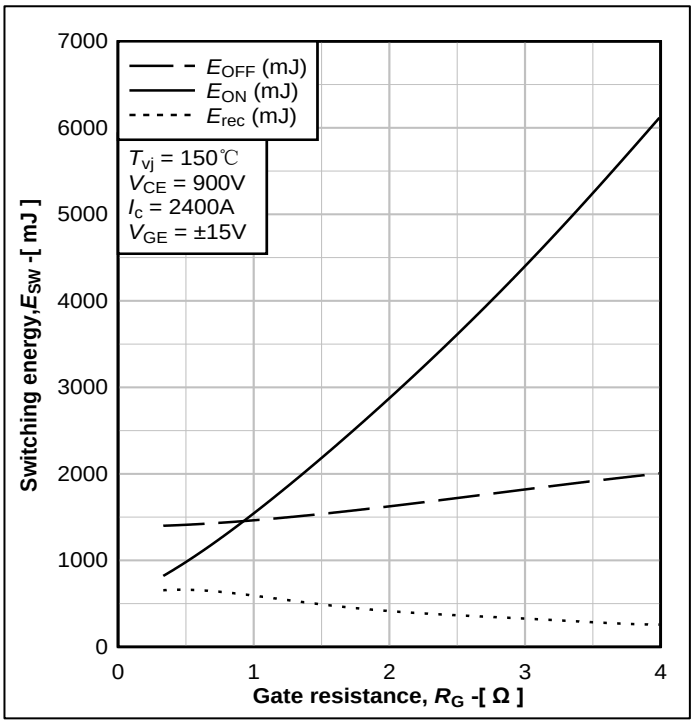


图6. 开关能耗与栅极电阻的关系曲线

Fig. 6 Typical switching energy vs gate resistance

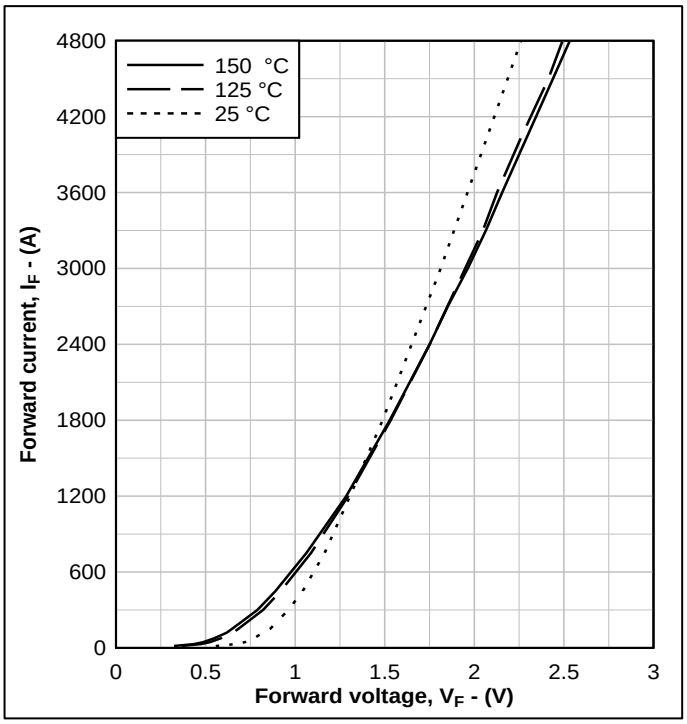


图7. 二极管正向特性典型曲线

Fig.7 Diode typical forward characteristics

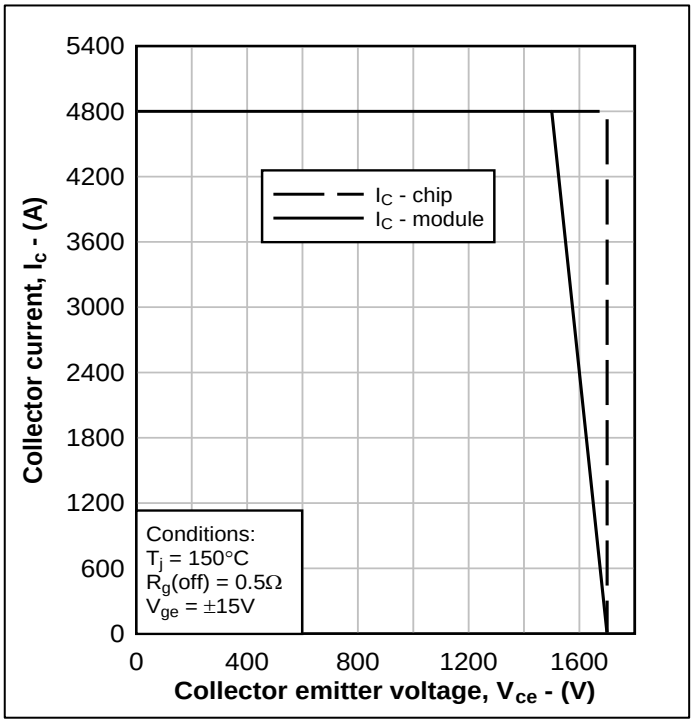


图8. 反偏安全工作区

Fig.8 Reverse bias safe operating area

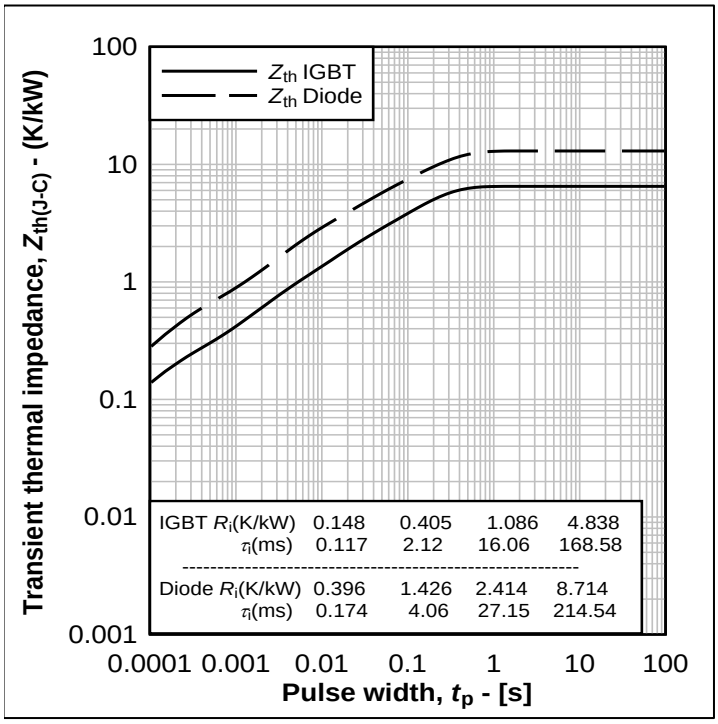
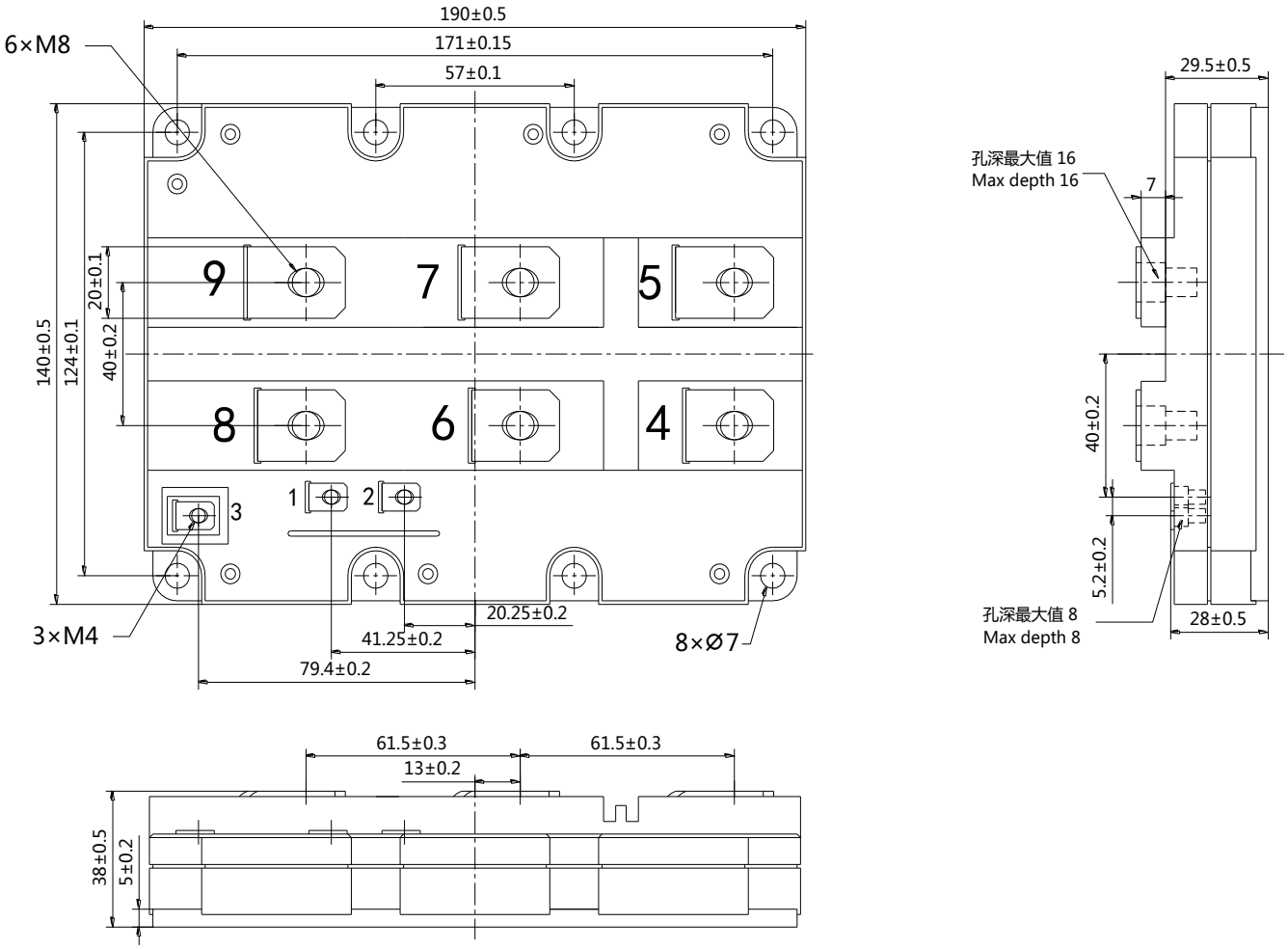


图9. 瞬态热阻抗曲线

Fig. 9 Transient thermal impedance



重量Weight：1400g　　模块外观类型 Module outline code：E

图10. 模块外观尺寸

Fig. 10 Module outline drawing

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