

QLDELEC™
齐力达电子

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QLD/SM001

功率半导体模块

POWER SEMICONDUCTOR MODULE

- 晶闸管模块
- 整流管模块
- 固体继电器
- 晶闸管触发装置

齐齐哈尔齐力达电子有限公司
QIQIHAR QILIDA ELECTRONIC CO.,LTD.

企业简介

Company Profile

齐齐哈尔齐力达电子有限公司是研制、生产电力电子器件及其应用设备的专业厂家，是我国最早从国外引进晶闸管功率模块生产技术的厂家之一。上世纪八十年代末，从美国 SPC 公司引进了晶闸管模块生产技术，经过二十多年的技术积累，秉承消化、吸收、创新、提升的理念，形成了公司现有品类齐全、质量优良的晶闸管模块系列产品。公司拥有“鹤导”和“QLDELEC”两件注册商标。

公司占地面积 10000 平方米，厂房面积 2850 平方米，设备设施齐全，2006 年进驻齐齐哈尔市南苑高新技术开发区。公司以“追求完美，不断创新”为经营理念，以功率半导体器件为核心，研制、生产电力电子应用产品，主导产品包括功率半导体模块、三相电机无触点换相控制器、三相电动机软起动机、起重机无触点换相控制器、复合式电力电子开关、固体继电器、电子灭弧器、晶闸管触发模块和触发板等产品，拥有 6 项专利。

公司通过了 ISO9001 质量管理体系认证。2008 年，按国科发火 [2008]172 号《高新技术企业认定管理办法》，公司被认定为高新技术企业。2011 年，公司被黑龙江省知识产权局认定为专利优势试点企业。

满足客户需求是公司经营的核心，我们在产品研发、生产、营销、服务的过程中，为客户提供价值最大化的服务。

模块应用及注意事项

晶闸管模块主要用于受控开关与整流电路，整流管模块主要用于整流电路，可广泛应用于交直流电机控制、工业控制调功、无触点开关、电机软启动、静态无功补偿、整流、逆变等电路。

在模块应用中应注意：

- 晶闸管触发应采用强触发，触发电路提供电流应能达到（4~5）IGT，建议触发脉冲前沿陡度不小于 $1A/\mu s$ 。
- 为确保良好的热接触，必须加装散热器。散热器的接触面必须清洁，表面的平面度应小于 $20\mu m$ ，表面粗糙度应小于 $10\mu m$ 。在安装散热器之前，应在模块与散热器接触面间均匀涂敷导热硅脂。
- 模块应用能承受规定扭矩的高张力 M5 钢螺丝紧固，必须使用平垫和弹垫。安装 3 小时后，在紧固力的作用下，导热硅脂会从接触面挤出，应再次紧固螺丝，以达到规定的扭矩。（模块的紧固力矩请参阅本手册相关内容）
- 四个固定孔的模块紧固宜按对角顺序分 2~3 次紧固至规定的力矩，两个固定孔的模块紧固分 2~3 次轮流紧固至规定的力矩。
- 模块主端子接线螺丝，应用手自由旋进后再以力矩扳手或力矩螺丝刀紧固至规定的力矩。
- 外加阻容吸收回路和压敏电阻，以保护模块产品。
- 模块主电极接线宜采用铜母线、U 型或 O 型端子连接。
- 通电前请确认接线正确，模块控制极与辅助阴极的接线，也应确保连接可靠，避免虚接或接线错误而造成不导通或产品损坏。

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0.1 本手册中常用符号释意:

极小值参数:		特性值参数:	
di/dt	通态电流临界上升率	I_C	控制电流
dv/dt	断态电压临界上升率	I_e	额定工作电流
I^2t	极限负载积分	I_{FAV}	整流管正向平均电流
I_{FSM}	整流管正向不重复浪涌电流	I_D	直流输出电流
I_{GT}	门极触发电流	$I_{overload}$	短时工作过电流
I_H	维持电流	I_P	输出电流峰值
I_{TSM}	晶闸管通态不重复浪涌电流	I_{RMS}	通态(正向)电流交流有效值
V_{DRM}	晶闸管断态重复峰值电压	I_{TAV}	晶闸管通态平均电流
V_{GT}	门极触发电压	M_1	模块安装到散热器的紧固力矩
V_{off}	关断电压	M_2	模块主端子接线紧固力矩
V_{RRM}	反向重复峰值电压	r_F	整流管斜率电阻
极大值参数:		r_T	晶闸管斜率电阻
I_{DRM}	晶闸管断态重复峰值电流	R_G	门极电路电阻
I_{GD}	门极最大非触发电流	V_C	控制电压
I_R	断态漏电流	V_{FO}	整流管阈值电压——门槛电压
I_{RRM}	反向重复峰值电流	V_{ISOL}	绝缘试验电压(均方根值)
R_{ch}	模块基板与散热器的接触热阻	V_T	额定电流下器件端电压
R_{ha}	散热器热阻	V_{TO}	晶闸管阈值电压——门槛电压
R_{ja}	芯片与环境间热阻——总热阻	条件参数及其他:	
R_{jc}	模块结壳热阻	I_{FM}	整流管正向峰值电流
T_a	模块使用环境温度	I_{TM}	晶闸管通态峰值电流
T_c	模块基板温度——壳温	r.m.s.	均方根值——交流有效值
V_{FM}	整流管正向平均电压	sin.180	半正弦波, 导通角 180°
V_{GD}	门极最大非触发电压	T_j	P-N 结温度
V_{on}	开通电压	T_{slg}	贮存温度范围
V_{TM}	晶闸管通态峰值电压		

0.2 器件保护方案

0.2.1 阻容吸收元件参数的选取

a) 经验公式:

$$C=(2\sim 4)I_{TAV}$$

$$R=10\Omega\sim 30\Omega$$

式中, I_{TAV} 的单位取 A, C 的单位为 nF。

b) 电容耐压及电阻功率

电容耐压一般取晶闸管耐压的 1.3 倍或更高。

电阻功率一般可按如下关系选取 (计算中采用国际单位制):

$$P=CU_m^2f$$

式中, P——电阻功率

C——串联电容

U_m ——晶闸管承受的峰值工作电压

f——工作频率

0.2.2 压敏电阻的选取

压敏电阻与被保护器件并联使用, 压敏电压的选取一般可按下列公式计算得出:

$$U_{1mA} = KU_{SP}/(1-a)(1-b)$$

式中, K 为电源质量系数, 一般取 $K = 1.1\sim 1.6$, 电源质量较好的城市可取较小值, 电源质量较差的地区可取较大值。

U_{SP} 为电源电压峰值, 对于交流电源 $U_{SP} = 1.414U_{AC}$ (有效值), 对于直流电源 $U_{SP} = U_{DC}$ 。a 为老化系数, 一般取 0.1; b 为压敏电压公差系数, 一般取 0.1。

按以上公式计算, 220V 交流电源应选用压敏电压为 470V~620V 的压敏电阻比较合适。选用压敏电压略高一点的可以降低故障率, 延长使用寿命, 但残压略有增大。

0.2.3 快速熔断器的选取

以快速熔断器保护功率半导体器件, 应同时满足下面两个条件:

$$I_{CR} \leq I_{RD} \leq 1.57I_{TAV}$$

$$I^2t(\text{快熔}) \leq 0.9I^2t(\text{晶闸管})$$

式中, I_{RD} ——快速熔断器的额定电流

I_{CR} ——快速熔断器工作支路电流有效值

注: 快速熔断器的额定电流、焦尔积分等参数与使用电压、温度有关, 使用时请参阅快熔厂商的相关资料。

0.3 散热器选用

为保证功率半导体器件正常工作, 散热条件至关重要。模块在使用时, 必须配备适当的散热器。散热器的选取原则, 应使模块芯片的实际工作结温低于芯片的最高允许结温。散热器主要选用 6063 (供应状态 T4、T5、T6) 铝合金型材, 6063 导热系数达到 209 W/mK (纯铝的导热系数 237 W/mK)。

晶闸管模块的热阻与功耗计算式:

$$R_{ja} = (T_j - T_a) / P_{T(AV)} = R_{jc} + R_{ch} + R_{ha}$$

$$P_{T(AV)} = V_{TO}I_{TAV} + r_T I_{RMS}^2$$

$$\text{或 } P_{T(AV)} = 0.785V_{TM}I_{TAV} + 0.215V_{TO}I_{TAV}$$

式中, $P_{T(AV)}$ ——模块芯片耗散功率

I_{RMS} ——通态电流交流有效值

整流管模块的散热器选配请参照晶闸管模块。推荐采用 6063-T5 铝合金型材散热器。供应状态 T5 系由高温成型过程冷却后，不经过冷加工（可进行矫直、矫平，但不影响力学性能极限），型材变形系数小，硬度一般，适宜作为功率器件的散热器。

选配散热器时，要注意以下几点：

- 充分考虑环境温度，设计时稍留余量。
- 保证器件的工作空间，尽可能不造成封闭空间。
- 散热器工作时，要保证表面清洁，定期清理灰尘。

本公司可根据用户提供的工作条件、环境温度等因素，为用户选配并验证散热器。

由于各种环境因素对散热条件均有影响，以下推荐表中的数据仅供参考。

表中：首位字母为本手册中给出的常用散热器型号；

中间的数字为散热器长度（mm）；

末位字母为冷却方式，F 表示强制风冷，N 表示自然冷却。

0.3.1 臂对模块的散热器选取

模块电流规格 /A	每支散热器上模块数量		
	1	2	3
25	A120N	A120F	A120F
40	A120N	A120F	A180F
55	A120N	A180F	A200F
90	A120N	A250F	A300F
110	A180F	A300F	A350F
130	A180F	E150F	D150F
160	A200F	E200F	D200F
200	B200F	D200F	D250F
250	B250F	D250F	D250F
300	B300F	D250F	D300F
400	B300F	D300F	D350F
500	B300F	D350F	D400F

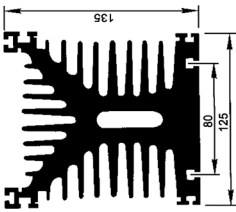
0.3.2 整流桥模块的散热器选取

电流规格 /A	30	50	75	100	160	200
散热器规格	C120N	C150N	A120N	A120F	A200F	A200F

0.3.3 固体继电器的散热器选取

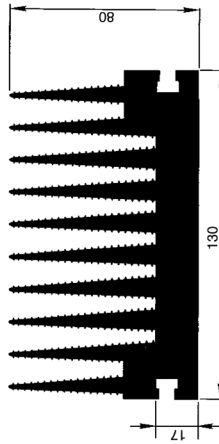
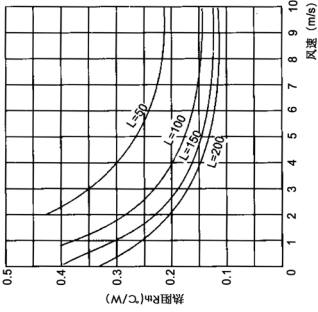
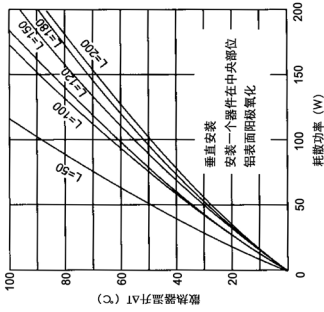
电流规格 /A	单相继电器			三相继电器
	1 块	2 块	3 块	
25	C120N	A120F	A180F	A120N
40	C150N	A120F	A180F	A150F
60	A120N	A120F	A180F	A200F
80	A120N	A120F	A180F	A200F
100	A120N	A180F	A200F	A200F
150	A120F	A180F	A250F	—
200	A120F	A250F	A300F	—
250	A150F	A250F	A300F	—
300	A200F	A300F	A300F	—

0.3.4 散热器外形尺寸及热学数据



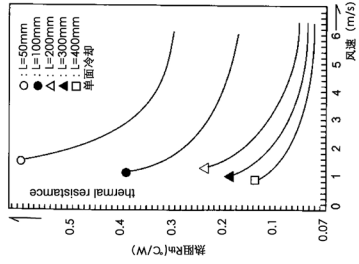
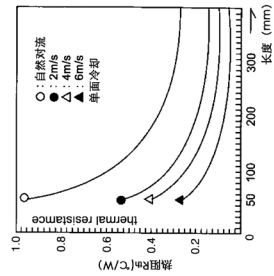
散热器 A

截面积 section area	周长 circumference	重量 weight
77.78cm ²	2302mm	21kg/m



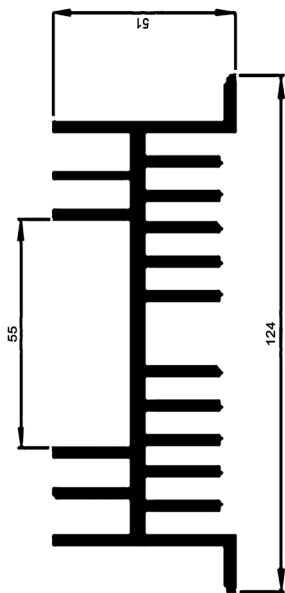
散热器 B

截面积 section area	周长 circumference	重量 weight
52.63cm ²	1558mm	14.2kg/m

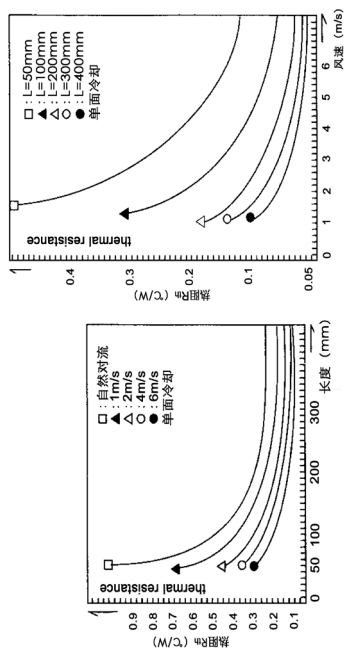
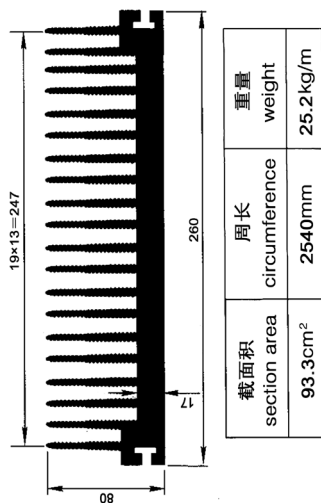


0.3.4 散热器外形尺寸及热学数据 (续)

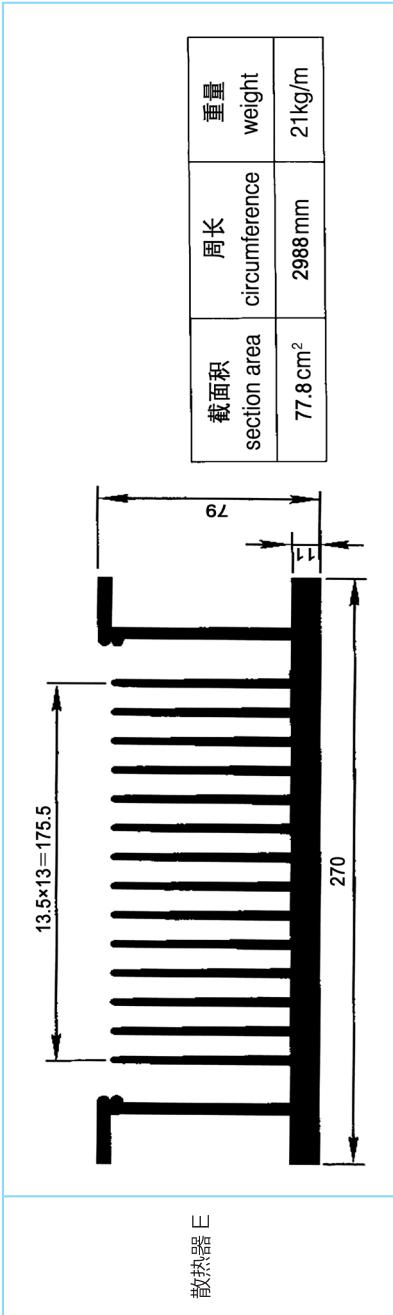
散热器 C



散热器 D



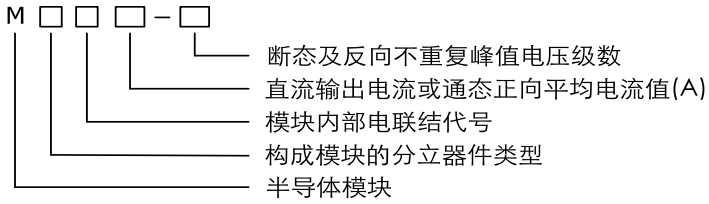
0.3.4 散热器外形尺寸及热学数据 (续)



A series of overlapping blue squares and rectangles of various shades (light blue, medium blue, dark blue) arranged in a stepped, staircase-like pattern. The central text is overlaid on a dark blue rectangular background.

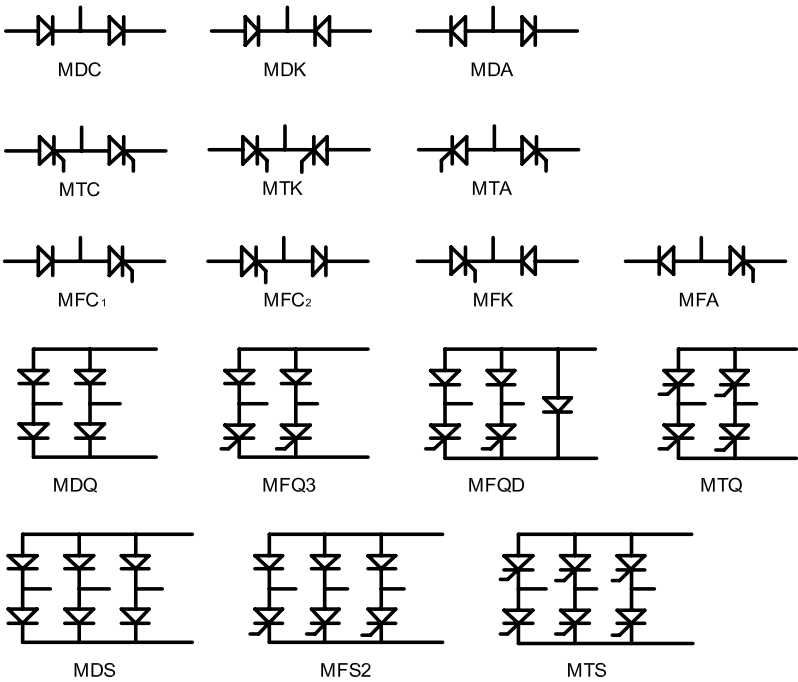
臂对模块和整流桥模块

本手册中，臂对模块、桥式整流模块按机械行业标准进行型号命名与分类。



分立器件类型代号： D——普通整流管
 T——普通晶闸管
 F——普通整流管与普通晶闸管混合

常用模块内部电联结型式及代号：



1.1.1 25A~40A 普通晶闸管模块 (1200V~1800V)

符号	测试条件	M × 27	M × 42	单位
V_{DRM}/V_{RRM} I_{DRM}/I_{RRM}	$T_J=125^{\circ}\text{C}$	1200~1800 10		V mA
I_{TAV}	$\sin.180; T_C=85^{\circ}\text{C}$	25	40	A
I_{TSM} I_{Tt}^2	$T_J=125^{\circ}\text{C}; 10\text{ ms}$	470 1.1	750 2.8	A kA ² s
di/dt dv/dt	$T_J=125^{\circ}\text{C}$	100 500		A/ μs V/ μs
I_H	$T_J=25^{\circ}\text{C}; \text{typ/max}$	150/200		mA
V_{TM}	$T_J=25^{\circ}\text{C}; I_{TM}=\pi I_{TAV}$	1.60	1.60	V
V_{TO} r_T	$T_J=125^{\circ}\text{C}$	0.95 6.45	0.90 3.85	V m Ω
V_{GT} I_{GT}	$T_J=25^{\circ}\text{C}$	2.5 100		V mA
V_{GD} I_{GD}	$T_J=125^{\circ}\text{C}$	0.25 6		V mA
R_{jc} R_{ch}	$\sin.180; \text{chip/Module}$	0.95/0.47 0.20/0.10	0.65/0.32 0.20/0.10	$^{\circ}\text{C/W}$ $^{\circ}\text{C/W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500		V
紧固力矩	基板安装 $M_1: 5 \pm 0.75$ 接线端子 $M_2: 3 \pm 0.45$			Nm Nm
贮存温度	-40 $^{\circ}\text{C}$ ~+125 $^{\circ}\text{C}$			
模块外形				

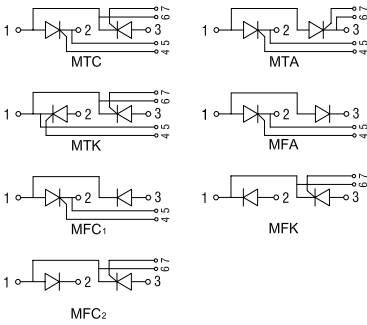


图 1.1.1-1 电路结构图

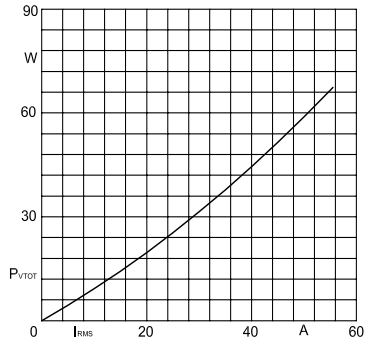


图 1.1.1-2 MTC27 P_V-I_{RMS} 曲线

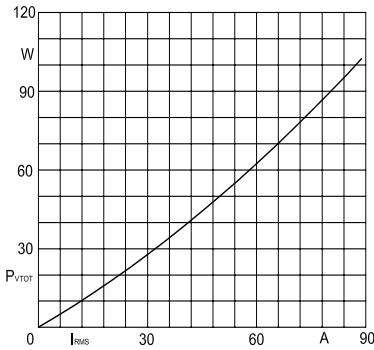


图 1.1.1-3 MTC42 P_V-I_{RMS} 曲线

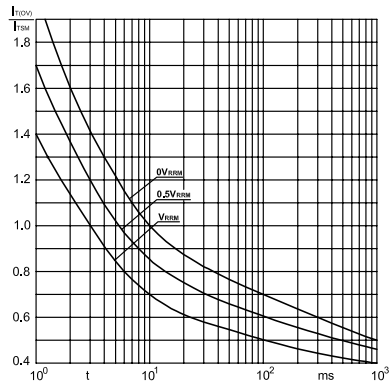


图 1.1.1-4 可控硅过电流与时间曲线

1.1.2 55A~90A 普通晶闸管模块 (1200V~1800V)

符号	测试条件	M × × 57	M × × 70	M × × 92	单位
V_{DRM}/V_{RRM} I_{DRM}/I_{RRM}	$T_j=125^\circ\text{C}$	1200~1800 15			V mA
I_{TAV}	sin.180; $T_c=85^\circ\text{C}$	55	70	90	A
I_{TSM} I_t^2	$T_j=125^\circ\text{C}$; 10 ms	1000 5	1300 8.45	1700 14.5	A kA^2s
di/dt dv/dt	$T_j=125^\circ\text{C}$	100 500			$\text{A}/\mu\text{s}$ $\text{V}/\mu\text{s}$
I_H	$T_j=25^\circ\text{C}$; typ/max	200/250			mA
V_{TM}	$T_j=25^\circ\text{C}$; $I_{TM}=\pi I_{TAV}$	1.60	1.60	1.70	V
V_{TO} r_T	$T_j=125^\circ\text{C}$	0.90 3.20	0.90 2.75	0.90 2.0	V m Ω
V_{GT} I_{GT}	$T_j=25^\circ\text{C}$	2.5 100			V mA
V_{GD} I_{GD}	$T_j=125^\circ\text{C}$	0.25 6			V mA
R_{jc} R_{ch}	sin.180; chip/Module	0.48/0.24 0.20/0.10	0.40/0.20 0.20/0.10	0.32/0.16 0.20/0.10	$^\circ\text{C}/\text{W}$ $^\circ\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500			V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 3 ± 0.45				Nm Nm
贮存温度	$-40^\circ\text{C} \sim +125^\circ\text{C}$				
模块外形	<p>The drawing shows the physical dimensions of the module. The side view indicates a total length of 92 mm, a mounting height of 29.5 ± 0.5 mm, and a base thickness of 6 mm. Three M5 screws are used for mounting. The top view shows a total width of 80 mm, with terminal positions at 15 mm, 20 mm, 20 mm, and 45 mm from the left edge. The terminal diameter is 2-∅6 mm.</p>				

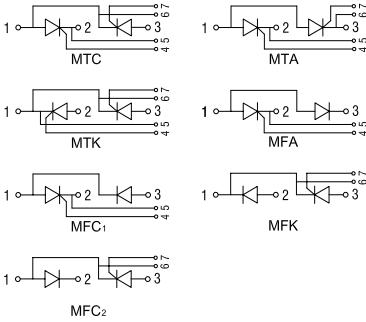


图 1.1.2-1 电路结构图

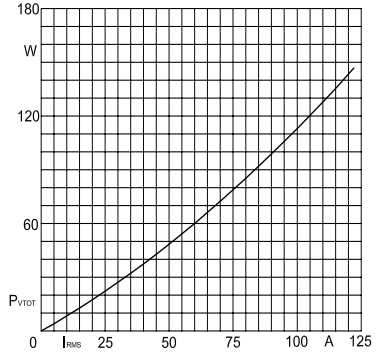


图 1.1.2-2 MTC57 P_V-I_{RMS} 曲线

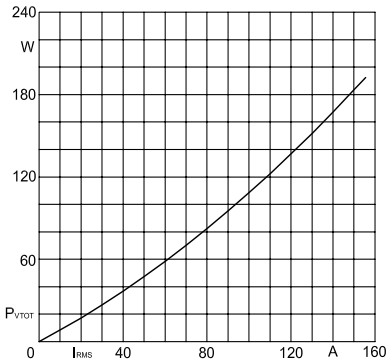


图 1.1.2-3 MTC70 P_V-I_{RMS} 曲线

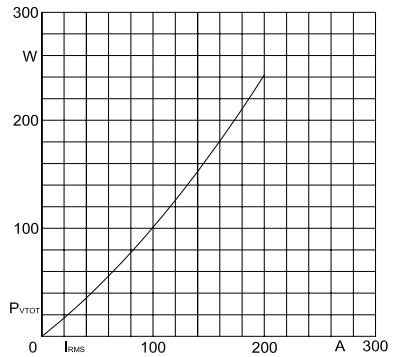


图 1.1.2-4 MTC92 P_V-I_{RMS} 曲线

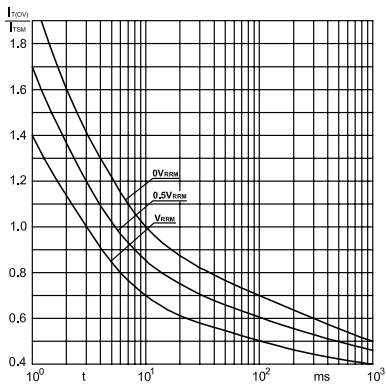


图 1.1.2-5 可控硅过电流与时间曲线

1.1.3 110A 普通晶闸管模块 (1200V~1800V)

符号	测试条件	M × × 110		单位
V_{DRM}/V_{RRM} I_{DRM}/I_{RRM}	$T_j=125^{\circ}\text{C}$	1200~1800 20		V mA
I_{TAV}	sin.180; $T_c=85^{\circ}\text{C}$	110		A
I_{TSM} I_{t}^2	$T_j=125^{\circ}\text{C}$; 10 ms	2000 20		A kA^2s
di/dt dv/dt	$T_j=125^{\circ}\text{C}$	100 500		$\text{A}/\mu\text{s}$ $\text{V}/\mu\text{s}$
I_H	$T_j=25^{\circ}\text{C}$; typ/max	200/250		mA
V_{TM}	$T_j=25^{\circ}\text{C}$; $I_{TM}=\pi I_{TAV}$	1.65		V
V_{TO} r_T	$T_j=125^{\circ}\text{C}$	0.85 1.65		V m Ω
V_{GT} I_{GT}	$T_j=25^{\circ}\text{C}$	2.5 100		V mA
V_{GD} I_{GD}	$T_j=125^{\circ}\text{C}$	0.25 6		V mA
R_{jc} R_{ch}	sin.180; chip/Module	0.28/0.14 0.20/0.10 (B型)	0.28/0.14 0.16/0.08 (C型)	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500		V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 3 ± 0.45			Nm Nm
贮存温度	-40 $^{\circ}\text{C}$ ~ +125 $^{\circ}\text{C}$			
外形结构	D型		C型	
电路结构				

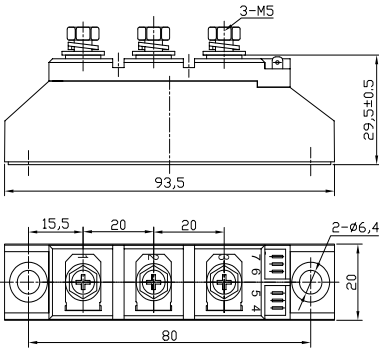


图 1.1.3-1 D 型模块外形图

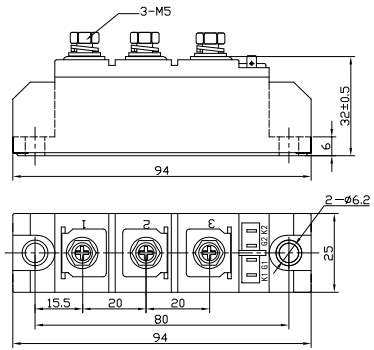


图 1.1.3-2 C 型模块外形图

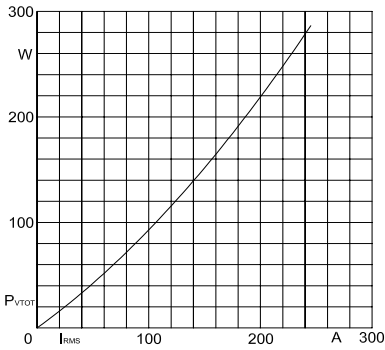


图 1.1.3-3 MTC110 P_V-I_{RMS} 曲线

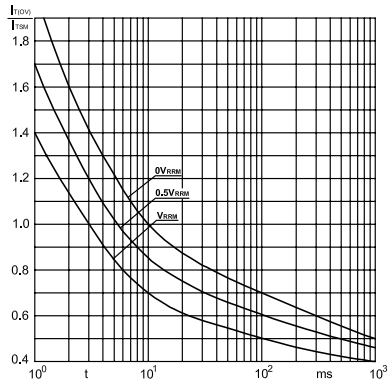
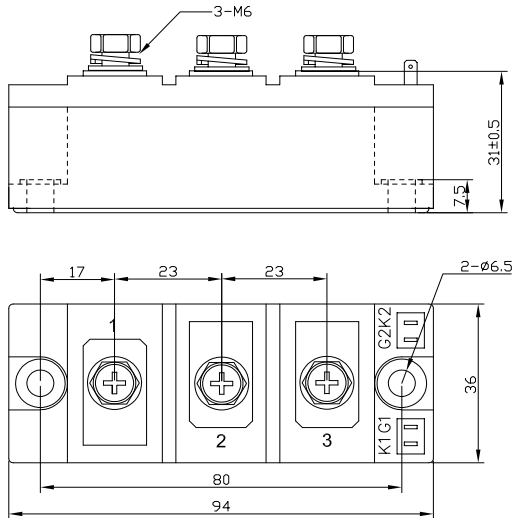


图 1.1.3-4 可控硅过电流与时间曲线

1.1.4 130A~180A 普通晶闸管模块 (1200V~1800V)

符号	测试条件	M × × 132	M × × 162	M × × 182	单位
V_{DRM}/V_{RRM} I_{DRM}/I_{RRM}	$T_j=125^{\circ}\text{C}$	1200~1800 20	1200~1800 25	1200~1800 25	V mA
I_{TAV}	sin.180; $T_c=85^{\circ}\text{C}$	130	160	180	A
I_{TSM} I_{Tt}	$T_j=125^{\circ}\text{C}$; 10 ms	2400 28.8	3000 45	3300 54.4	A kA^2s
di/dt dv/dt	$T_j=125^{\circ}\text{C}$	100 500	150 500	150 500	$\text{A}/\mu\text{s}$ $\text{V}/\mu\text{s}$
I_H	$T_j=25^{\circ}\text{C}$; typ/max	200/250			mA
V_{TM}	$T_j=25^{\circ}\text{C}$; $I_{TM}=\pi I_{TAV}$	1.70	1.70	1.70	V
V_{TO} r_T	$T_j=125^{\circ}\text{C}$	0.85 1.25	0.80 1.0	0.80 0.92	V m Ω
V_{GT} I_{GT}	$T_j=25^{\circ}\text{C}$	2.5 100			V mA
V_{GD} I_{GD}	$T_j=125^{\circ}\text{C}$	0.25 8			V mA
R_{jc} R_{ch}	sin.180; chip/Module	0.22/0.11 0.10/0.05	0.19/0.095 0.10/0.05	0.16/0.08 0.10/0.05	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500			V
紧固力矩	基板安装 $M_1: 5 \pm 0.75$ 接线端子 $M_2: 5 \pm 0.75$				Nm Nm
贮存温度	$-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$				

模块外形



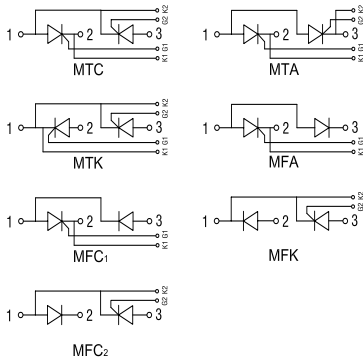


图 1.1.4-1 电路结构图

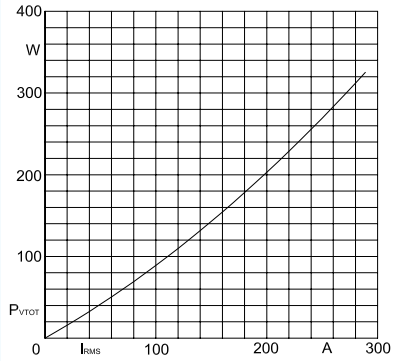


图 1.1.4-2 MTC132 P_V-I_{RMS} 曲线

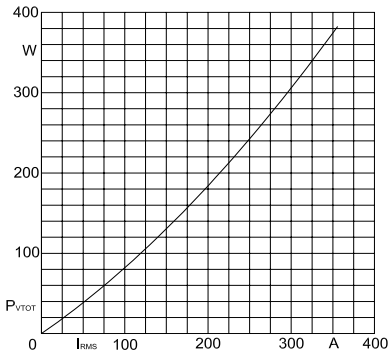


图 1.1.4-3 MTC162 P_V-I_{RMS} 曲线

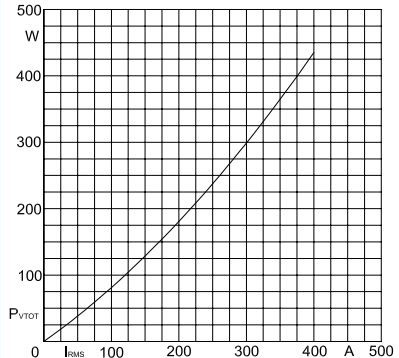


图 1.1.4-4 MTC182 P_V-I_{RMS} 曲线

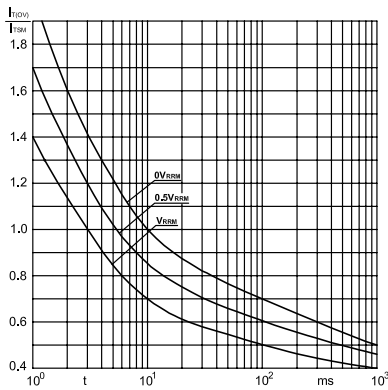
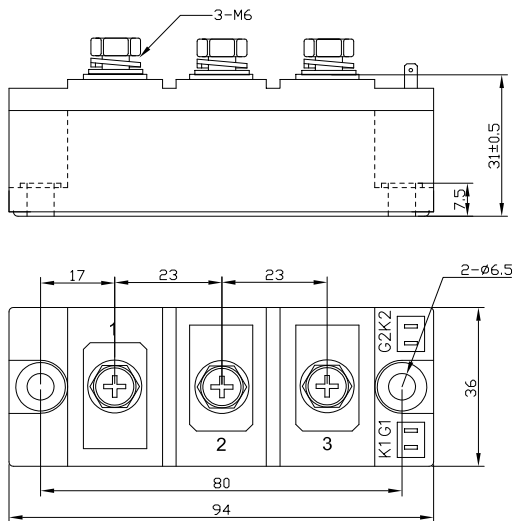


图 1.1.4-5 可控硅过电流与时间曲线

1.1.5 200A~250A 普通晶闸管模块 (1200V~1800V)

符号	测试条件	M × 203	M × 253	单位
V_{DRM}/V_{RRM} I_{DRM}/I_{RRM}	$T_j=125^{\circ}\text{C}$	1200~1800 30	1200~1800 30	V mA
I_{TAV}	sin.180; $T_c=85^{\circ}\text{C}$	200	250	A
I_{TSM} I_t^2	$T_j=125^{\circ}\text{C}$; 10 ms	3800 72	4700 110	A kA^2s
di/dt dv/dt	$T_j=125^{\circ}\text{C}$	150 500	150 500	$\text{A}/\mu\text{s}$ $\text{V}/\mu\text{s}$
I_H	$T_j=25^{\circ}\text{C}$; typ/max	200/250		mA
V_{TM}	$T_j=25^{\circ}\text{C}$; $I_{TM}=\pi I_{TAV}$	1.55	1.55	V
V_{TO} r_T	$T_j=125^{\circ}\text{C}$	0.80 0.85	0.80 0.85	V m Ω
V_{GT} I_{GT}	$T_j=25^{\circ}\text{C}$	2.5 100		V mA
V_{GD} I_{GD}	$T_j=125^{\circ}\text{C}$	0.25 8		V mA
R_{jc} R_{ch}	sin.180; chip/Module	0.15/0.075 0.10/0.05	0.14/0.07 0.10/0.05	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500		V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 5 ± 0.75			Nm Nm
贮存温度	$-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$			

模块外形



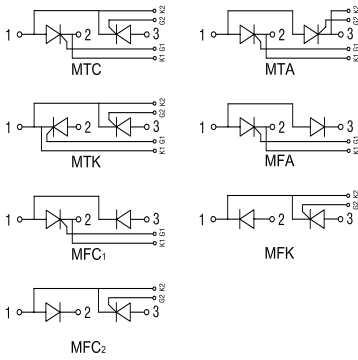


图 1.1.5-1 电路结构图

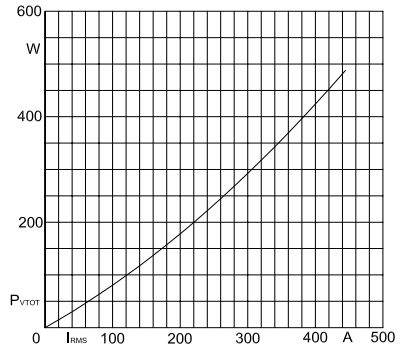


图 1.1.5-2 MTC203 P_V-I_{RMS} 曲线

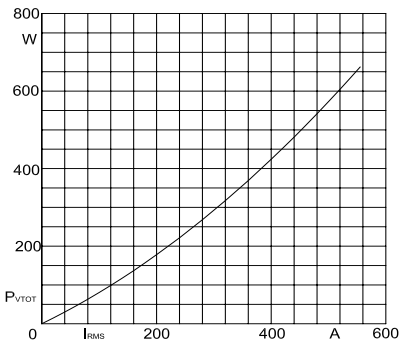


图 1.1.5-3 MTC253 P_V-I_{RMS} 曲线

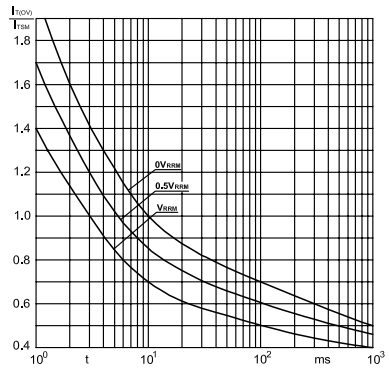
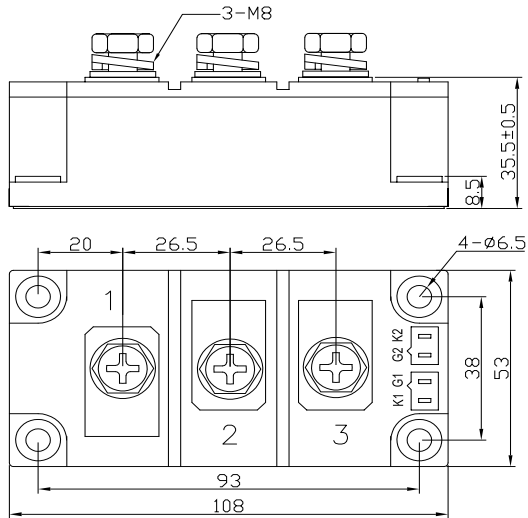


图 1.1.5-4 可控硅过电流与时间曲线

1.1.6 200A~250A 普通晶闸管模块 (1200V~1800V)

符号	测试条件	M × 202	M × 252	单位
V_{DRM}/V_{RRM} I_{DRM}/I_{RRM}	$T_j=125^{\circ}\text{C}$	1200~1800 30		V mA
I_{TAV}	sin.180; $T_c=85^{\circ}\text{C}$	200	250	A
I_{TSM} I_t^2	$T_j=125^{\circ}\text{C}$; 10 ms	3800 72	4700 110	A kA^2s
di/dt dv/dt	$T_j=125^{\circ}\text{C}$	150 500		$\text{A}/\mu\text{s}$ $\text{V}/\mu\text{s}$
I_H	$T_j=25^{\circ}\text{C}$; typ/max	200/250		mA
V_{TM}	$T_j=25^{\circ}\text{C}$; $I_{TM}=\pi I_{TAV}$	1.55		V
V_{TO} r_T	$T_j=125^{\circ}\text{C}$	0.80 0.85		V $\text{m}\Omega$
V_{GT} I_{GT}	$T_j=25^{\circ}\text{C}$	2.5 100		V mA
V_{GD} I_{GD}	$T_j=125^{\circ}\text{C}$	0.25 8		V mA
R_{jc} R_{ch}	sin.180; chip/Module	0.14/0.07 0.06/0.03	0.12/0.06 0.06/0.03	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500		V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 9 ± 1.35			Nm Nm
贮存温度	$-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$			

模块外形



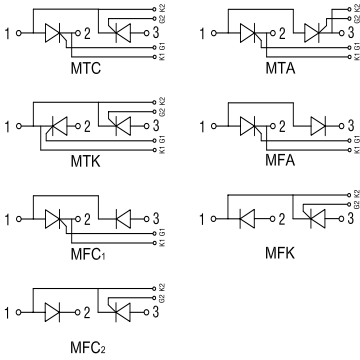


图 1.1.6-1 电路结构图

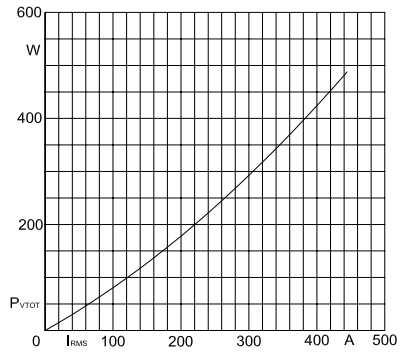


图 1.1.6-2 MTC202 P_V-I_{RMS} 曲线

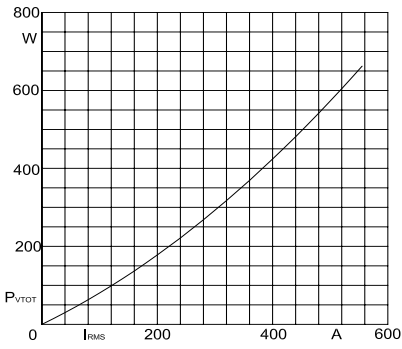


图 1.1.6-3 MTC252 P_V-I_{RMS} 曲线

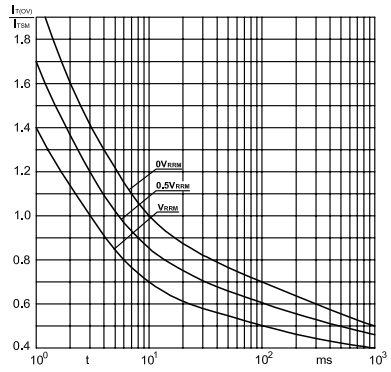


图 1.1.6-4 可控硅过电流与时间曲线

1.1.7 200A~300A 普通晶闸管模块 (1200V~1800V)

符号	测试条件	M × × 200	M × × 250	M × × 303	单位
V_{DRM}/V_{RRM} I_{DRM}/I_{RRM}	$T_j=125^{\circ}\text{C}$	1200~1800 40			V mA
I_{TAV}	sin.180; $T_c=80^{\circ}\text{C}$	200	250	300	A
I_{TSM} I_{Tt}	$T_j=125^{\circ}\text{C}$; 10 ms	4400 97	5500 150	6600 215	A kA^2s
di/dt dv/dt	$T_j=125^{\circ}\text{C}$	150 500			$\text{A}/\mu\text{s}$ $\text{V}/\mu\text{s}$
I_H	$T_j=25^{\circ}\text{C}$; typ/max	200/250			mA
V_{TM}	$T_j=25^{\circ}\text{C}$; $I_{TM}=\pi I_{TAV}$	1.80	1.75	1.55	V
V_{TO} r_T	$T_j=125^{\circ}\text{C}$	1.09 0.65	1.09 0.59	0.96 0.46	V m Ω
V_{GT} I_{GT}	$T_j=25^{\circ}\text{C}$	3 150			V mA
V_{GD} I_{GD}	$T_j=125^{\circ}\text{C}$	0.25 8			V mA
R_{jc} R_{ch}	sin.180; chip/Module	0.14/0.07 0.06/0.03	0.12/0.06 0.06/0.03	0.10/0.05 0.06/0.03	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500			V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 9 ± 1.35				Nm Nm
贮存温度	$-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$				
模块外形	<p>The drawing shows two views of the thyristor module. The top view (side view) shows a rectangular module with a total length of 92 mm. It features three mounting points: a central one with a 3-M8 screw and two side ones. Dimensions include 42 mm from the left edge to the first screw, 36 mm between the two screws, and 25 ± 0.5 mm for the left screw's height. The right side has a height of 48 mm and a total height of 51 ± 0.5 mm. The bottom view (top view) shows a rectangular module with a total length of 115 mm and a width of 53 mm. It has four mounting holes, each with a diameter of 6.2 mm. The distance between the two central holes is 80 mm, and the distance from the left edge to the first hole is 2 mm. The distance from the right edge to the last hole is 1 mm. The distance between the two rightmost holes is 38 mm.</p>				

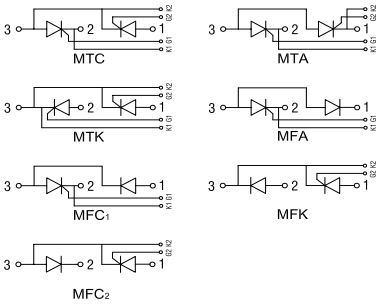


图 1.1.7-1 电路结构图

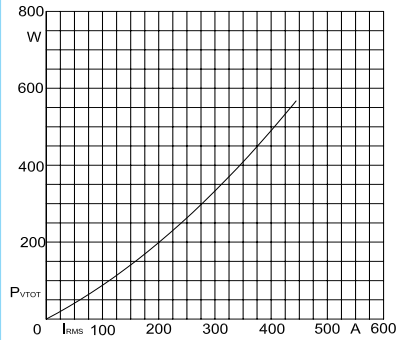


图 1.1.7-2 MTC200 P_V-I_{RMS} 曲线

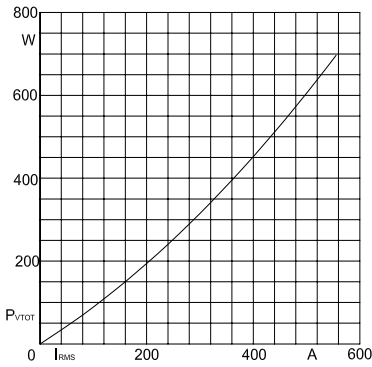


图 1.1.7-3 MTC250 P_V-I_{RMS} 曲线

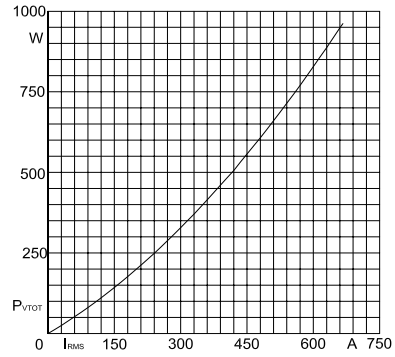


图 1.1.7-4 MTC303 P_V-I_{RMS} 曲线

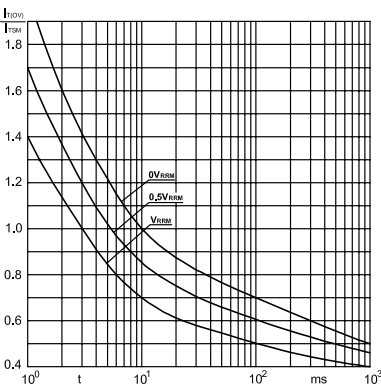
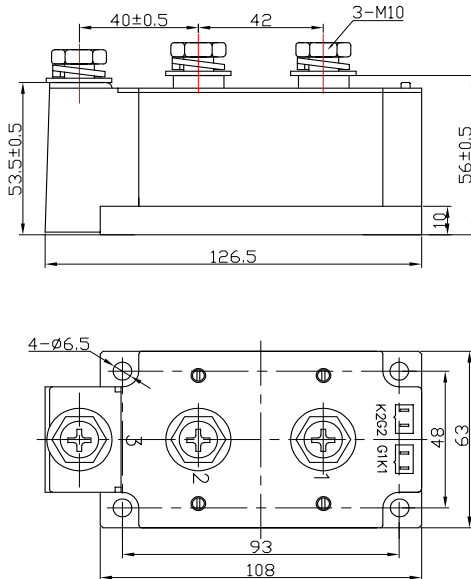


图 1.1.7-5 可控硅过电流与时间曲线

1.1.8 300A~500A 普通晶闸管模块 (1200V~1800V)

符号	测试条件	M × × 300	M × × 350	M × × 400	M × × 500	单位
V_{DRM}/V_{RRM} I_{DRM}/I_{RRM}	$T_J=125^{\circ}\text{C}$	1200~1800 50				V mA
I_{TAV}	sin.180; $T_C=80^{\circ}\text{C}$	300	350	400	500	A
I_{TSM} I_{Tt}	$T_J=125^{\circ}\text{C}$; 10 ms	6600 215	7700 295	8800 380	11000 605	A kA ² s
di/dt dv/dt	$T_J=125^{\circ}\text{C}$	150 500				A/ μs V/ μs
I_H	$T_J=25^{\circ}\text{C}$; typ/max	200/250				mA
V_{TM}	$T_J=25^{\circ}\text{C}$; $I_{TM}=\pi I_{TAV}$	1.55	1.55	1.58	1.50	V
V_{TO} r_T	$T_J=125^{\circ}\text{C}$	0.96 0.46	0.94 0.36	0.94 0.36	0.91 0.36	V m Ω
V_{GT} I_{GT}	$T_J=25^{\circ}\text{C}$	3 150				V mA
V_{GD} I_{GD}	$T_J=125^{\circ}\text{C}$	0.25 8				V mA
R_{jc} R_{ch}	sin.180; chip/Module	0.10/0.05 0.03/0.015	0.08/0.04 0.03/0.015	0.08/0.04 0.03/0.015	0.07/0.035 0.03/0.015	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500				V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 9 ± 1.35					Nm Nm
贮存温度	-40 $^{\circ}\text{C}$ ~+125 $^{\circ}\text{C}$					

模块外形



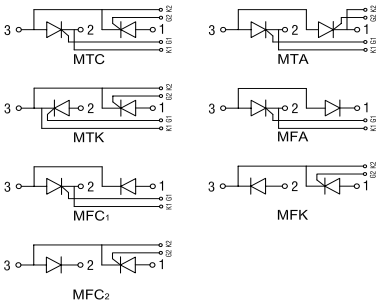


图 1.1.8-1 电路结构图

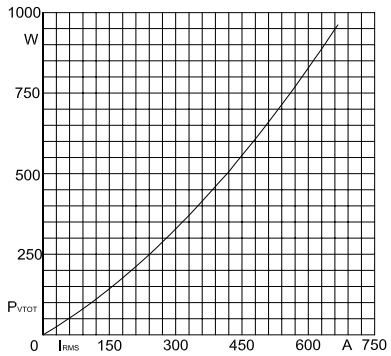


图 1.1.8-2 MTC300 P_V-I_{RMS} 曲线

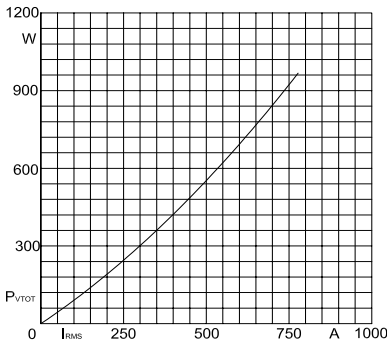


图 1.1.8-3 MTC350 P_V-I_{RMS} 曲线

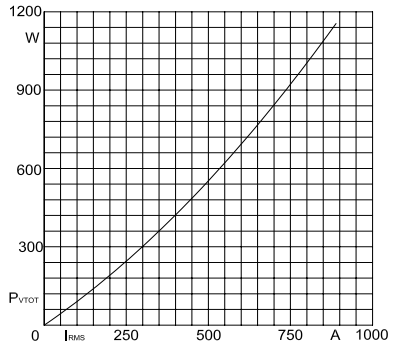


图 1.1.8-4 MTC400 P_V-I_{RMS} 曲线

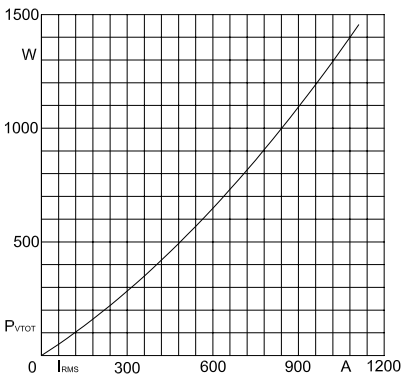


图 1.1.8-5 MTC500 P_V-I_{RMS} 曲线

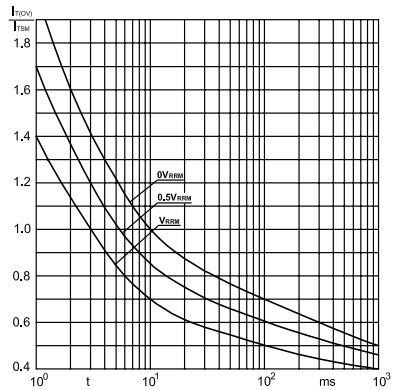


图 1.1.8-6 可控硅过电流与时间曲线

1.1.9 500A~630A 普通晶闸管模块 (1200V~1800V)

符号	测试条件	M × × 500	M × × 630	单位
V_{DRM}/V_{RRM} I_{DRM}/I_{RRM}	$T_J=125^{\circ}\text{C}$	1200~1800 50	1200~1800 60	V mA
I_{TAV}	sin.180; $T_C=85^{\circ}\text{C}$	500	630	A
I_{TSM} I_t^2	$T_J=125^{\circ}\text{C}$; 10 ms	11000 605	13850 959	A kA ² s
di/dt dv/dt	$T_J=125^{\circ}\text{C}$	150 500	150 500	A/ μs V/ μs
I_H	$T_J=25^{\circ}\text{C}$; typ/max	200/250	250/300	mA
V_{TM}	$T_J=25^{\circ}\text{C}$; $I_{TM}=\pi I_{TAV}$	1.50	1.70	V
V_{TO} r_T	$T_J=125^{\circ}\text{C}$	0.91 0.36	0.90 0.26	V m Ω
V_{GT} I_{GT}	$T_J=25^{\circ}\text{C}$		3 150	V mA
V_{GD} I_{GD}	$T_J=125^{\circ}\text{C}$		0.25 10	V mA
R_{jc} R_{ch}	sin.180; chip/Module		0.065/0.033 0.02/0.01	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min		2500	V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 9 ± 1.35			Nm Nm
贮存温度	$-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$			
模块外形	<p>The drawing shows the physical dimensions of the thyristor module. The side view (top) shows a height of 51.5 ± 0.5 mm on the left and 52.5 ± 0.5 mm on the right, with a base thickness of 10 mm. The distance between the first and second screw is 43.5 mm, and between the second and third is 50 mm. The top view (bottom) shows a total width of 149 mm and a total height of 60 mm. It features three screws labeled '3-M10' and four mounting holes labeled '4-φ6.5'. The distance between the first and second screw is 112 mm, and between the second and third is 124 mm. The module is labeled with 'T1' and 'T2' on the right side.</p>			

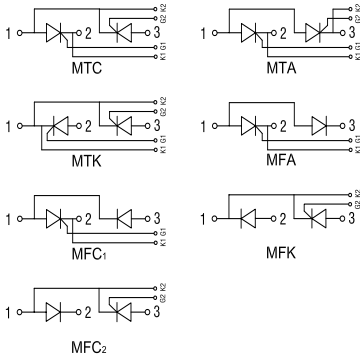


图 1.1.9-1 电路结构图

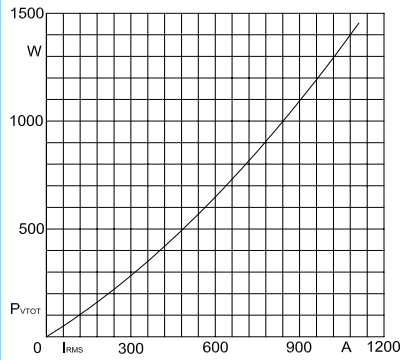


图 1.1.9-2 MTC500 P_V-I_{RMS} 曲线

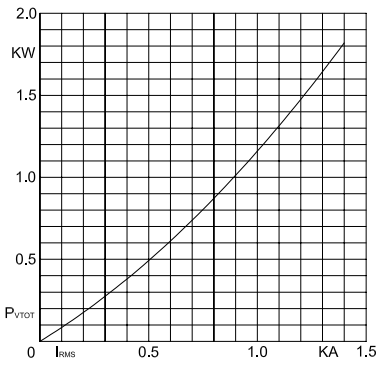


图 1.1.9-3 MTC630 P_V-I_{RMS} 曲线

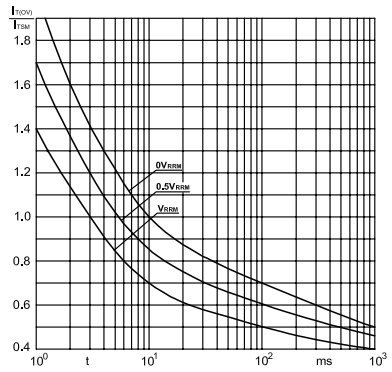


图 1.1.9-4 可控硅过电流与时间曲线

1.1.10 630A 普通晶闸管模块 (1200V~1800V)

符号	测试条件	M × × 630	单位
V_{DRM}/V_{RRM} I_{DRM}/I_{RRM}	$T_j=125^{\circ}\text{C}$	1200~1800 60	V mA
I_{TAV}	sin.180; $T_c=80^{\circ}\text{C}$	630	A
I_{TSM} I_t^2	$T_j=125^{\circ}\text{C}$; 10 ms	13850 959	A kA ² s
di/dt dv/dt	$T_j=125^{\circ}\text{C}$	150 500	A/ μs V/ μs
I_H	$T_j=25^{\circ}\text{C}$; typ/max	250/300	mA
V_{TM}	$T_j=25^{\circ}\text{C}$; $I_{TM}=\pi I_{TAV}$	1.70	V
V_{TO} r_T	$T_j=125^{\circ}\text{C}$	0.90 0.26	V m Ω
V_{GT} I_{GT}	$T_j=25^{\circ}\text{C}$	3 150	V mA
V_{GD} I_{GD}	$T_j=125^{\circ}\text{C}$	0.25 10	V mA
R_{jc} R_{ch}	sin.180; chip/Module	0.065/0.033 0.02/0.01	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500	V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 12 ± 1.8		Nm Nm
贮存温度	$-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$		
模块外形	<p>The drawing shows the physical dimensions of the module. The side view indicates a height of 55±0.5 mm, a total width of 64±0.5 mm, and a base thickness of 12 mm. Three mounting holes are spaced 50 mm apart, with a diameter of 3-M10. The top view shows a total length of 150 mm and a width of 66 mm. The central section has a width of 128 mm and 112 mm between mounting points. Four mounting holes are arranged in a 4-Ø6.4 pattern. Terminal positions are labeled 1, 2, K1, G1, G2, and K2.</p>		

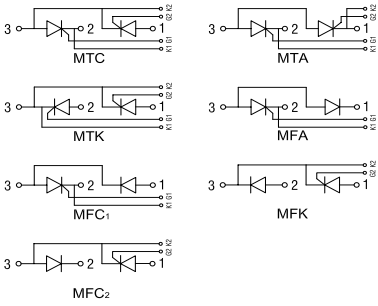


图 1.1.10-1 电路结构图

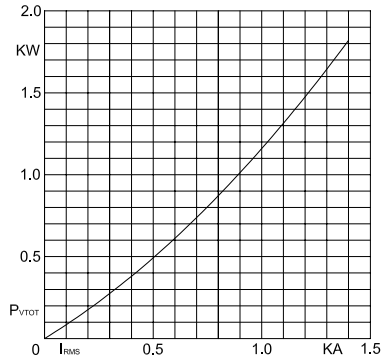


图 1.1.10-2 MTC630 P_V-I_{RMS} 曲线

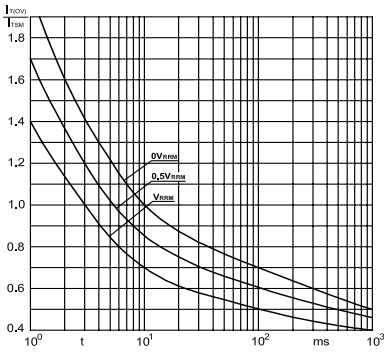


图 1.1.10-3 可控硅过电流与时间曲线

1.1.11 800A 普通晶闸管模块 (1200V~1800V)

符号	测试条件	M × 800	单位
V_{DRM}/V_{RRM} I_{DRM}/I_{RRM}	$T_j=125^{\circ}\text{C}$	1200~1800 80	V mA
I_{TAV}	sin.180; $T_c=80^{\circ}\text{C}$	800	A
I_{TSM} I_t^2	$T_j=125^{\circ}\text{C}$; 10 ms	15000 1125	A kA^2s
di/dt dv/dt	$T_j=125^{\circ}\text{C}$	150 500	$\text{A}/\mu\text{s}$ $\text{V}/\mu\text{s}$
I_H	$T_j=25^{\circ}\text{C}$; typ/max	250/300	mA
V_{TM}	$T_j=25^{\circ}\text{C}$; $I_{TM}=\pi I_{TAV}$	1.70	V
V_{TO} r_T	$T_j=125^{\circ}\text{C}$	0.88 0.20	V $\text{m}\Omega$
V_{GT} I_{GT}	$T_j=25^{\circ}\text{C}$	3 150	V mA
V_{GD} I_{GD}	$T_j=125^{\circ}\text{C}$	0.25 10	V mA
R_{jc} R_{ch}	sin.180; chip/Module	0.054/0.027 0.02/0.01	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500	V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 12 ± 1.8		Nm Nm
贮存温度	$-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$		
模块外形	<p>The drawing shows the physical dimensions of the module. The side view (top) indicates a total length of 180 mm, with three mounting points spaced 60 mm apart. The height is 79 mm, with a base thickness of 15 mm. Three M12 screws are used for mounting. The top view (bottom) shows a rectangular footprint of 180 mm by 76 mm. It features three main terminals (1, 2, 3) and four auxiliary terminals (4) with a diameter of 8.2 mm. The distance between the main terminals is 150 mm, and the distance between the auxiliary terminals is 60 mm. The terminal 1 is 132 mm from the left edge, and terminal 2 is 60 mm from the right edge. The terminal 3 is 60 mm from the left edge. The terminal 4 is 58 mm from the right edge. The terminal 1 is labeled 'K1 G1', terminal 2 is 'K2 K2', and terminal 3 is 'G2 K2'.</p>		

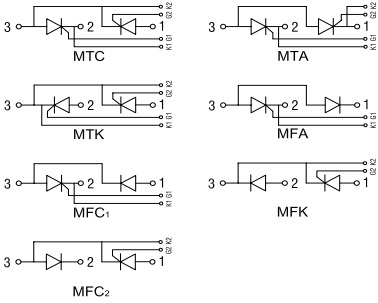


图 1.1.11-1 电路结构图

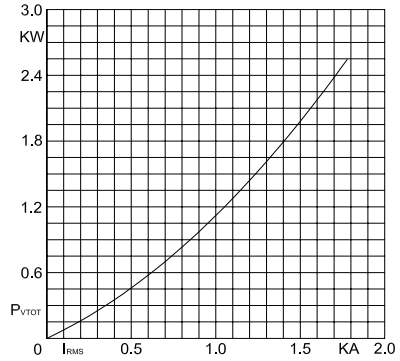


图 1.1.11-2 MTC800 P_V-I_{RMS} 曲线

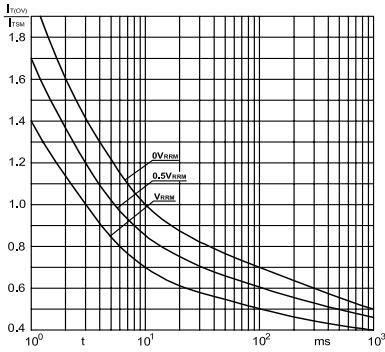


图 1.1.11-3 可控硅过电流与时间曲线

1.1.12 1000A~1200A 普通晶闸管模块 (1200V~1800V)

符号	测试条件	M × × 1000	M × × 1200	单位
V_{DRM}/V_{RRM} I_{DRM}/I_{RRM}	$T_j=125^{\circ}\text{C}$		1200~1800 80	V mA
I_{TAV}	sin.180; $T_c=55^{\circ}\text{C}$	1000	1200	A
I_{TSM} I_t^2	$T_j=125^{\circ}\text{C}$; 10 ms	16000 1280	19000 1800	A kA^2s
di/dt dv/dt	$T_j=125^{\circ}\text{C}$		150 500	$\text{A}/\mu\text{s}$ $\text{V}/\mu\text{s}$
I_H	$T_j=25^{\circ}\text{C}$; typ/max		250/300	mA
V_{TM}	$T_j=25^{\circ}\text{C}$; $I_{TM}=\pi I_{TAV}$	1.70	1.65	V
V_{TO} r_T	$T_j=125^{\circ}\text{C}$	0.88 0.16	0.85 0.16	V m Ω
V_{GT} I_{GT}	$T_j=25^{\circ}\text{C}$		3 150	V mA
V_{GD} I_{GD}	$T_j=125^{\circ}\text{C}$		0.25 10	V mA
R_{jc} R_{ch}	sin.180; chip/Module		0.054/0.027 0.02/0.01	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min		2500	V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 12 ± 1.8			Nm Nm
贮存温度	$-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$			
模块外形				

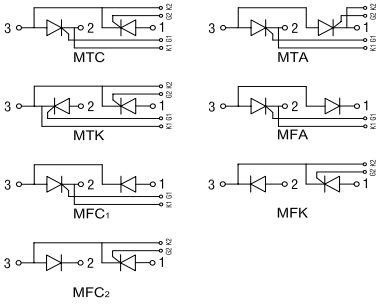


图 1.1.12-1 电路结构图

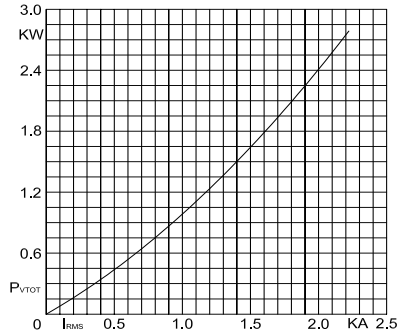


图 1.1.12-2 MTC1000 P_V-I_{RMS} 曲线

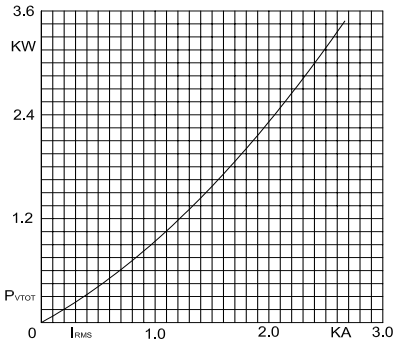


图 1.1.12-3 MTC1200 P_V-I_{RMS} 曲线

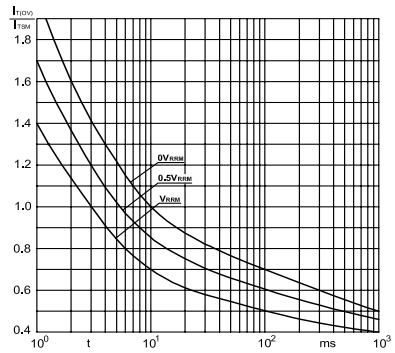
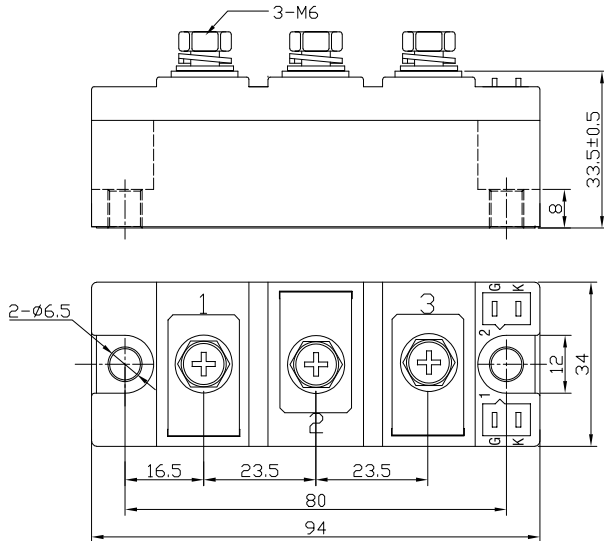


图 1.1.12-4 可控硅过电流与时间曲线

1.2.1 110A~160A 普通晶闸管模块（1900V 及以上）

符号	测试条件	M × × 110	M × × 130	M × × 160	单位
V_{DRM}/V_{RRM} I_{DRM}/I_{RRM}	$T_j=125^{\circ}\text{C}$	3000~3600 30	1900~3600 30	1900~2800 30	V mA
I_{TAV}	sin.180; $T_C=80^{\circ}\text{C}$	110	130	160	A
I_{TSM} I_t^2	$T_j=125^{\circ}\text{C}$; 10 ms	2200 24.2	2400 28.8	3000 45	A kA^2s
di/dt dv/dt	$T_j=125^{\circ}\text{C}$		150 1000		$\text{A}/\mu\text{s}$ $\text{V}/\mu\text{s}$
I_H	$T_j=25^{\circ}\text{C}$; typ/max		150/250		mA
V_{TM}	$T_j=25^{\circ}\text{C}$; $I_{TM}=\pi I_{TAV}$	2.00	1.75	1.75	V
V_{TO} r_T	$T_j=125^{\circ}\text{C}$	1.04 1.97	1.04 1.73	1.01 1.30	V $\text{m}\Omega$
V_{GT} I_{GT}	$T_j=25^{\circ}\text{C}$		3 150		V mA
V_{GD} I_{GD}	$T_j=125^{\circ}\text{C}$		0.25 6		V mA
R_{jc} R_{ch}	sin.180; chip/Module	0.20/0.10 0.10/0.05	0.19/0.095 0.10/0.05	0.19/0.095 0.10/0.05	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	3500			V
紧固力矩	基板安装 $M_1: 5 \pm 0.75$ 接线端子 $M_2: 5 \pm 0.75$				Nm Nm
贮存温度	$-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$				

模块外形



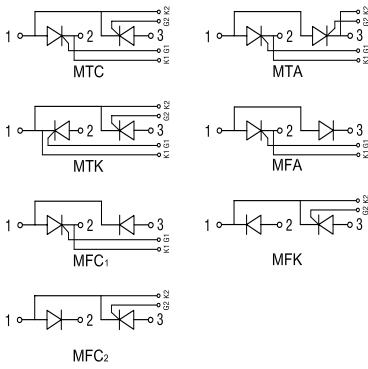


图 1.2.1-1 电路结构图

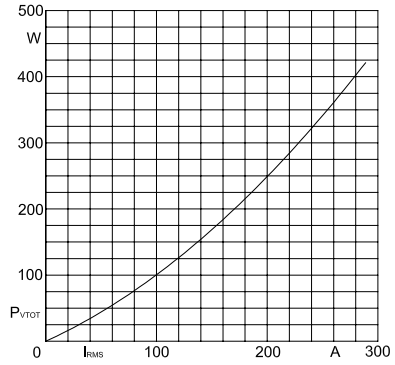


图 1.2.1-2 MTC110 P_{VTOT} - I_{RMS} 曲线

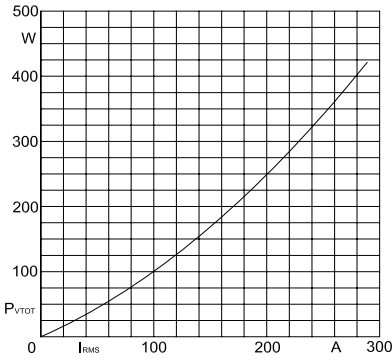


图 1.2.1-3 MTC130 P_{VTOT} - I_{RMS} 曲线

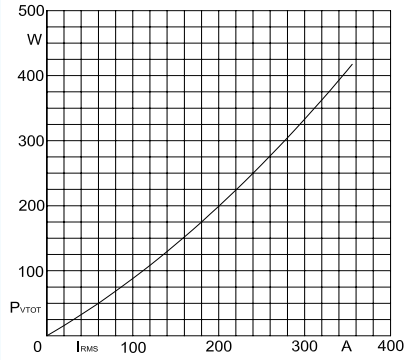


图 1.2.1-4 MTC160 P_{VTOT} - I_{RMS} 曲线

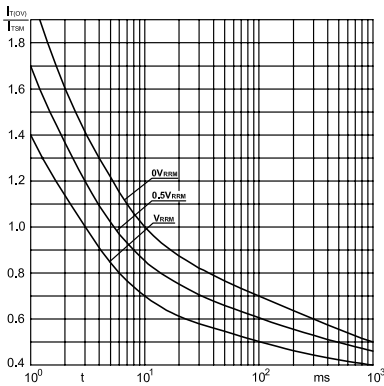
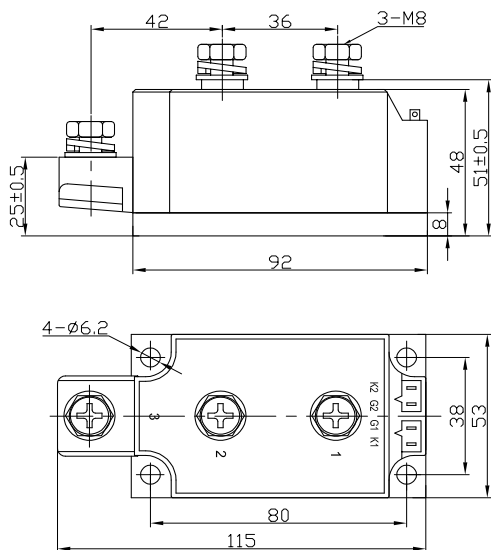


图 1.2.1-5 可控硅过电流与时间曲线

1.2.2 160A~250A 普通晶闸管模块 (1900V 及以上)

符号	测试条件	M × × 160	M × × 200	M × × 250	单位
V_{DRM}/V_{RRM} I_{DRM}/I_{RRM}	$T_j=125^{\circ}\text{C}$	3000~5000 40	1900~3600 40	1900~3600 40	V mA
I_{TAV}	sin.180; $T_c=80^{\circ}\text{C}$	160	200	250	A
I_{TSM} I^2t	$T_j=125^{\circ}\text{C}$; 10 ms	3000 45	3750 70	4700 110	A kA^2s
di/dt dv/dt	$T_j=125^{\circ}\text{C}$		150 1000		$\text{A}/\mu\text{s}$ $\text{V}/\mu\text{s}$
I_H	$T_j=25^{\circ}\text{C}$; typ/max		200/300		mA
V_{TM}	$T_j=25^{\circ}\text{C}$; $I_{TM}=\pi I_{TAV}$	3.00	2.00	2.00	V
V_{TO} r_T	$T_j=125^{\circ}\text{C}$	1.05 1.75	1.05 1.25	1.03 1.25	V $\text{m}\Omega$
V_{GT} I_{GT}	$T_j=25^{\circ}\text{C}$		3 150		V mA
V_{GD} I_{GD}	$T_j=125^{\circ}\text{C}$		0.25 10		V mA
R_{jc} R_{ch}	sin.180; chip/Module	0.14/0.07 0.06/0.03	0.12/0.06 0.06/0.03	0.10/0.05 0.06/0.03	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min		3500		V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 9 ± 1.35				Nm Nm
贮存温度	$-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$				

模块外形



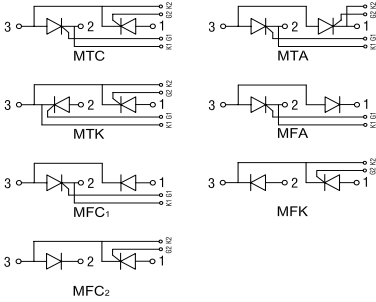


图 1.2.2-1 电路结构图

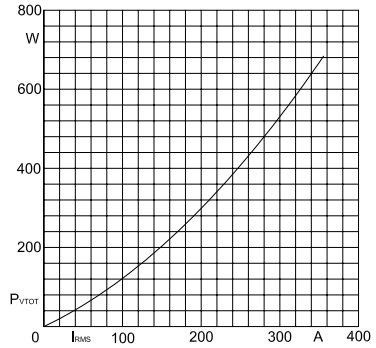


图 1.2.2-2 MTC160 P_V-I_{RMS} 曲线

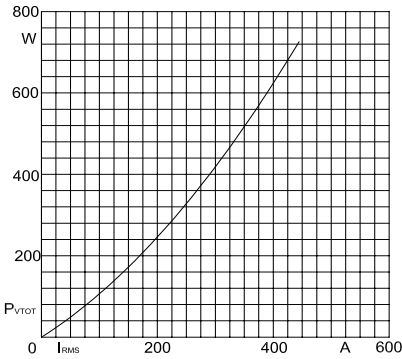


图 1.2.2-3 MTC200 P_V-I_{RMS} 曲线

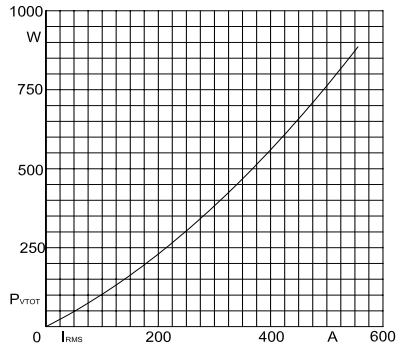


图 1.2.2-4 MTC250 P_V-I_{RMS} 曲线

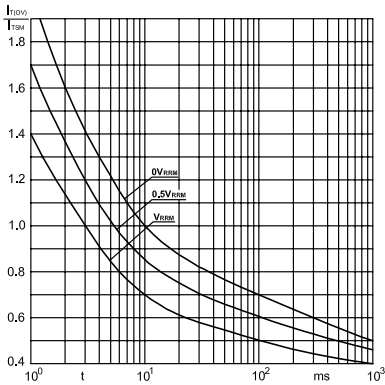
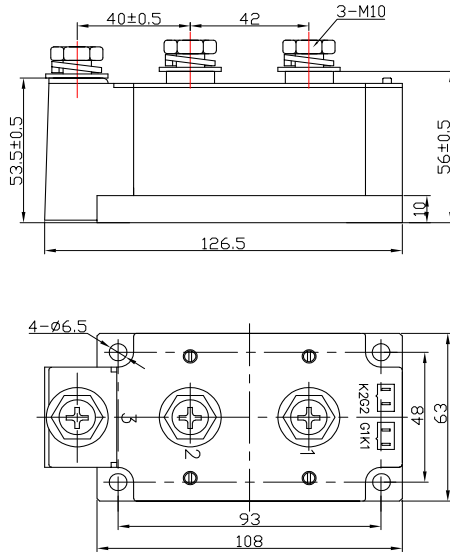


图 1.2.2-5 可控硅过电流与时间曲线

1.2.3 200A~400A 普通晶闸管模块（1900V 及以上）

符号	测试条件	M × × 200	M × × 250	M × × 300	M × × 400	单位
V_{DRM}/V_{RRM} I_{DRM}/I_{RRM}	$T_j=125^\circ\text{C}$	3800~5000 40	3800~5000 40	1900~3000 50	1900~3000 50	V mA
I_{TAV}	$\sin.180; T_C=80^\circ\text{C}$	200	250	300	400	A
I_{TSM} I_t	$T_j=125^\circ\text{C}; 10\text{ ms}$	3750 70	4700 110	5600 157	7500 280	A kA ² s
di/dt dv/dt	$T_j=125^\circ\text{C}$	150 1000				A/ μs V/ μs
I_H	$T_j=25^\circ\text{C}; \text{typ/max}$	250/300				mA
V_{TM}	$T_j=25^\circ\text{C}; I_{TM}=\pi I_{TAV}$	3.00	3.00	1.90	1.90	V
V_{TO} r_T	$T_j=125^\circ\text{C}$	1.20 1.80	1.20 1.80	1.00 0.60	1.00 0.60	V m Ω
V_{GT} I_{GT}	$T_j=25^\circ\text{C}$	3 150				V mA
V_{GD} I_{GD}	$T_j=125^\circ\text{C}$	0.25 10				V mA
R_{jc} R_{ch}	$\sin.180; \text{chip/Module}$	0.10/0.05 0.03/0.015	0.10/0.05 0.03/0.015	0.08/0.04 0.03/0.015	0.08/0.04 0.03/0.015	$^\circ\text{C/W}$ $^\circ\text{C/W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	3500				V
紧固力矩	基板安装 $M_1: 5 \pm 0.75$ 接线端子 $M_2: 9 \pm 1.35$					Nm Nm
贮存温度	$-40^\circ\text{C} \sim +125^\circ\text{C}$					

模块外形



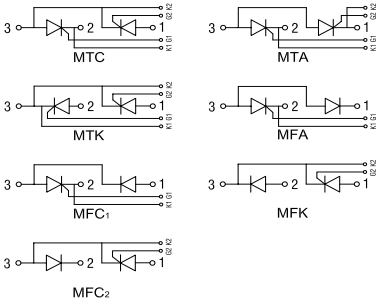


图 1.2.3-1 电路结构图

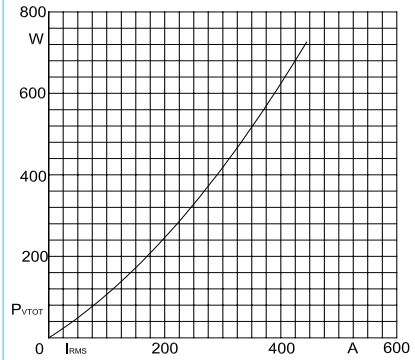


图 1.2.3-2 MTC200 P_V-I_{RMS} 曲线

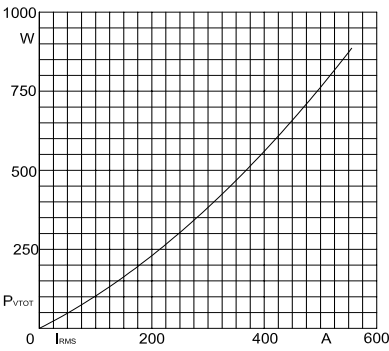


图 1.2.3-3 MTC250 P_V-I_{RMS} 曲线

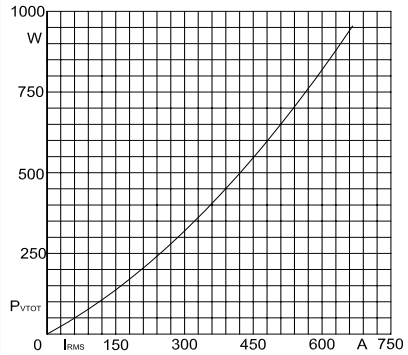


图 1.2.3-4 MTC300 P_V-I_{RMS} 曲线

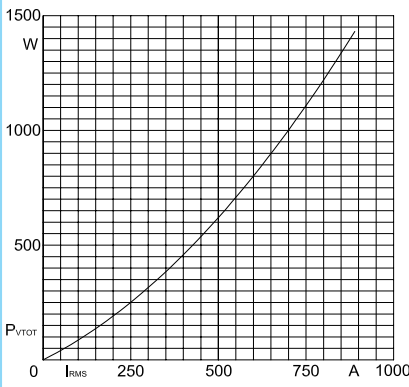


图 1.2.3-5 MTC400 P_V-I_{RMS} 曲线

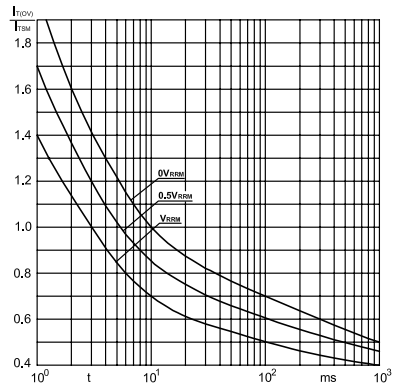


图 1.2.3-6 可控硅过电流与时间曲线

1.2.4 300A~500A 普通晶闸管模块 (1900V 及以上)

符号	测试条件	M × × 300	M × × 400	M × × 500	单位
V_{DRM}/V_{RRM} I_{DRM}/I_{RRM}	$T_j=125^{\circ}\text{C}$	3200~5000 50	3200~5000 50	1900~3600 50	V mA
I_{TAV}	sin.180; $T_c=80^{\circ}\text{C}$	300	400	500	A
I_{TSM} I_t^2	$T_j=125^{\circ}\text{C}$; 10 ms	5600 157	7500 280	9400 440	A kA^2s
di/dt dv/dt	$T_j=125^{\circ}\text{C}$		150 1000		$\text{A}/\mu\text{s}$ $\text{V}/\mu\text{s}$
I_H	$T_j=25^{\circ}\text{C}$; typ/max		250/300		mA
V_{TM}	$T_j=25^{\circ}\text{C}$; $I_{TM}=\pi I_{TAV}$	2.45	2.55	2.15	V
V_{TO} r_T	$T_j=125^{\circ}\text{C}$	1.18 1.30	1.18 1.30	1.05 0.73	V $\text{m}\Omega$
V_{GT} I_{GT}	$T_j=25^{\circ}\text{C}$		3 150		V mA
V_{GD} I_{GD}	$T_j=125^{\circ}\text{C}$		0.25 10		V mA
R_{jc} R_{ch}	sin.180; chip/Module	0.08/0.04 0.02/0.01	0.065/0.033 0.02/0.01	0.065/0.033 0.02/0.01	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	3500			V
紧固力矩	基板安装 $M_1: 5 \pm 0.75$ 接线端子 $M_2: 9 \pm 1.35$				Nm Nm
贮存温度	$-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$				
模块外形	<p>The technical drawing shows two views of the thyristor module. The top view (left) shows a rectangular module with a total width of 149 mm and a height of 60 mm. It features three main sections labeled 1, 2, and 3. Section 1 is a terminal on the left, section 2 is a central terminal, and section 3 is a central terminal. There are three M10 mounting holes spaced 112 mm apart, and four $\phi 6.5$ mounting holes. The side view (right) shows a total height of 52.5 ± 0.5 mm, with a base height of 48 mm and a top section height of 51.5 ± 0.5 mm. The distance between the first and second terminal is 43.5 mm, and the distance between the second and third terminal is 50 mm. A 10 mm gap is shown at the bottom right.</p>				

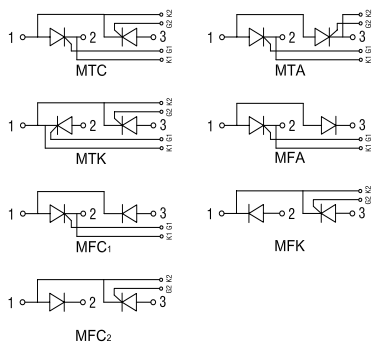


图 1.2.4-1 电路结构图

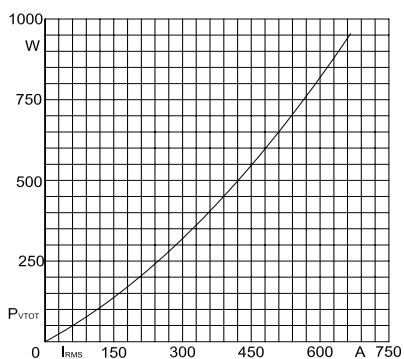


图 1.2.4-2 MTC300 P_V-I_{RMS} 曲线

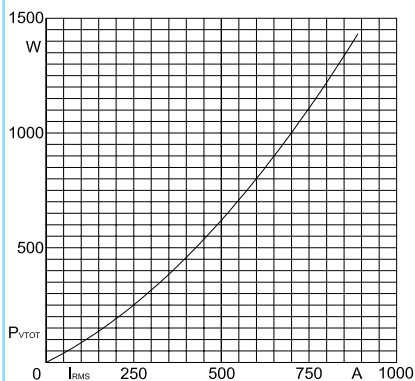


图 1.2.4-3 MTC4000 P_V-I_{RMS} 曲线

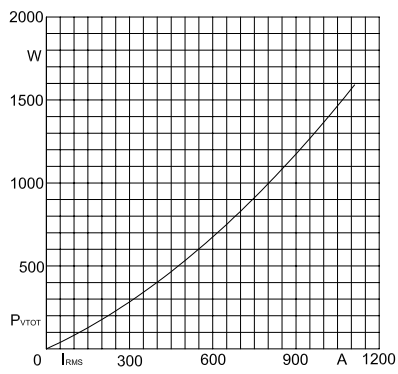


图 1.2.4-4 MTC500 P_V-I_{RMS} 曲线

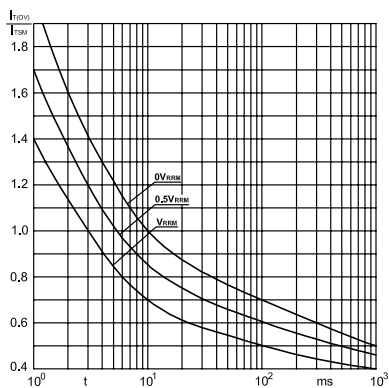


图 1.2.4-5 可控硅过电流与时间曲线

1.3.1 25A~90A 普通整流管模块 (1200V~1800V)

符号	测试条件	M × × 27	M × × 42	M × × 57	单位
V_{RRM} I_{RRM}	$T_j=150^{\circ}\text{C}$	1200~1800 10			V mA
I_{FAV}	sin.180; $T_c=100^{\circ}\text{C}$	25	40	55	A
I_{FSM} I_t^2	$T_j=150^{\circ}\text{C}$; 10 ms	470 1.1	750 2.8	1000 5	A kA ² s
V_{FM}	$T_j=25^{\circ}\text{C}$; $I_{FM}=\pi I_{FAV}$	1.40	1.40	1.40	V
V_{FO} r_F	$T_j=150^{\circ}\text{C}$	0.75 2.35	0.75 2.15	0.80 1.65	V m Ω
R_{jC} R_{ch}	sin.180; chip/Module	1.30/0.65 0.20/0.10	0.96/0.48 0.20/0.10	0.70/0.35 0.20/0.10	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500			V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 3 ± 0.45				Nm Nm
贮存温度	-40 $^{\circ}\text{C}$ ~ +125 $^{\circ}\text{C}$				
模块外形	<p>The technical drawing shows the physical dimensions of the module. The top view shows a trapezoidal shape with a height of 29.5 ± 0.5 mm. Three mounting holes are indicated as $3-M5$. The front view shows a rectangular profile with a height of 20 mm. The terminal layout includes a central terminal (1) and two side terminals (2 and 3), with a total width of 92 mm. A detail of the terminal connection shows a $2-\phi 6$ hole and a terminal width of 4.5 mm.</p>				

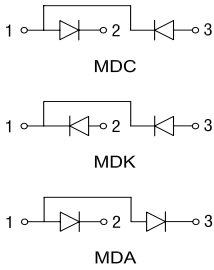


图 1.3.1-1 电路结构图

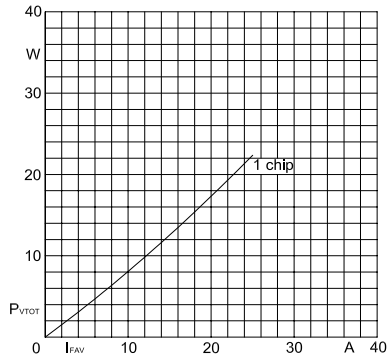


图 1.3.1-2 MDC27 P_V-I_{FAV} 曲线

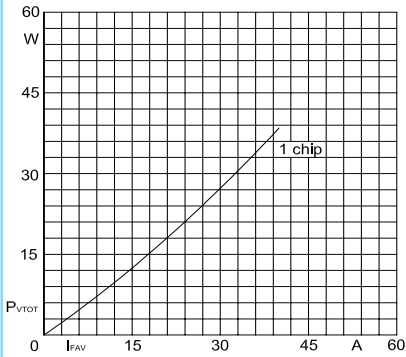


图 1.3.1-3 MDC42 P_V-I_{FAV} 曲线

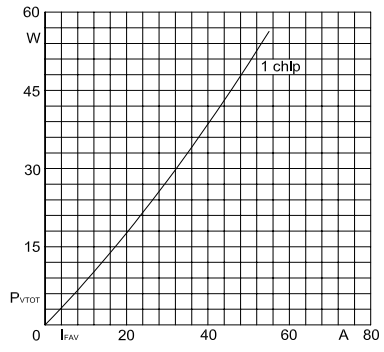


图 1.3.1-4 MDC57 P_V-I_{FAV} 曲线

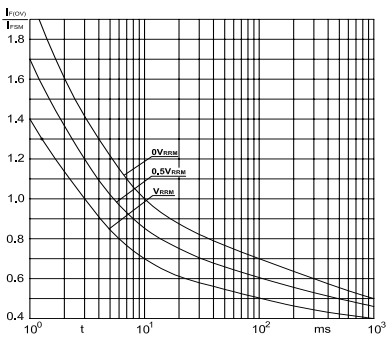


图 1.3.1-5 整流管过电流与时间曲线

1.3.2 70A~110A 普通整流管模块 (1200V~1800V)

符号	测试条件	M × 70	M × 92	M × 110	单位
V_{RRM} I_{RRM}	$T_j=150^{\circ}\text{C}$	1200~1800 15			V mA
I_{FAV}	sin.180; $T_c=100^{\circ}\text{C}$	70	90	110	A
I_{FSM} I_t^2	$T_j=150^{\circ}\text{C}$; 10 ms	1300 8.45	1700 14.5	2000 20	A kA ² s
V_{FM}	$T_j=25^{\circ}\text{C}$; $I_{FM}=\pi I_{FAV}$	1.40	1.40	1.40	V
V_{FO} r_F	$T_j=150^{\circ}\text{C}$	0.80 1.55	0.80 1.45	0.80 1.30	V mΩ
R_{jC} R_{ch}	sin.180; chip/Module	0.48/0.24 0.20/0.10	0.40/0.20 0.20/0.10	0.32/0.16 0.20/0.10	°C/W °C/W
V_{ISOL}	50Hz; r.m.s.; 1 min	2500			V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 3 ± 0.45				Nm Nm
贮存温度	-40°C ~+125°C				
模块外形	<p>The technical drawing shows two views of the module. The top view shows a trapezoidal shape with three M5 screws on top, labeled '3-M5'. A vertical dimension line on the right indicates a height of 29.5±0.5. The front view shows a rectangular profile with a height of 20. It features three circular terminals labeled 1, 2, and 3, and a terminal block with terminals 4, 5, 6, and 7. Horizontal dimensions are provided: 15 from the left edge to terminal 1, 20 between terminals 1 and 2, 20 between terminals 2 and 3, 80 from the left edge to the start of the terminal block, and 92 from the left edge to the right edge of the terminal block. A label '2-∅6' points to a hole in the terminal block.</p>				

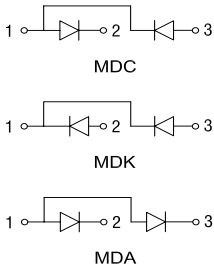


图 1.3.2-1 电路结构图

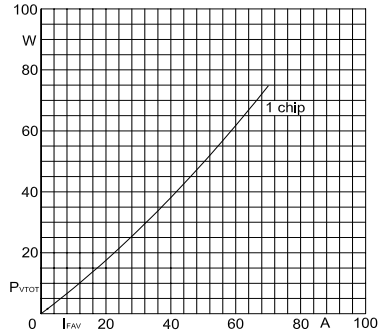


图 1.3.2-2 MDC70 P_V-I_{FAV} 曲线

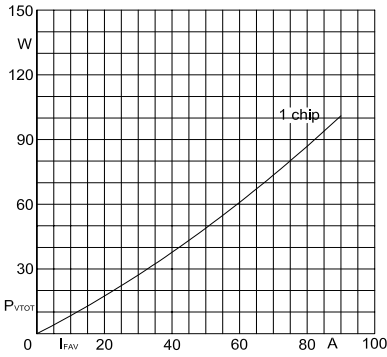


图 1.3.2-3 MDC92 P_V-I_{FAV} 曲线

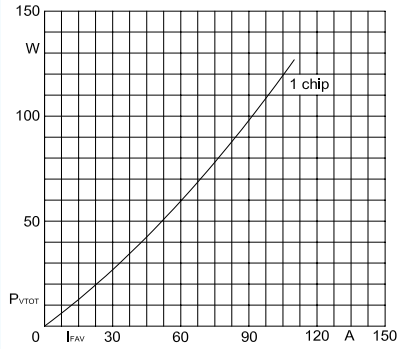


图 1.3.2-4 MDC110 P_V-I_{FAV} 曲线

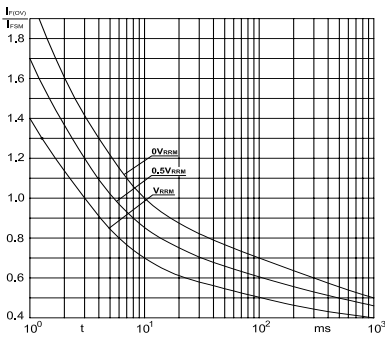


图 1.3.2-5 整流管过电流与时间曲线

1.3.3 110A~130A 普通整流管模块 (1200V~1800V)

符号	测试条件	M × × 110	M × × 130	单位
V_{RRM} I_{RRM}	$T_J=150^{\circ}\text{C}$	1200~1800 15		V mA
I_{FAV}	sin.180; $T_C=100^{\circ}\text{C}$	110	130	A
I_{FSM} I_t^2	$T_J=150^{\circ}\text{C}$; 10 ms	2000 20	2400 28.8	A kA ² s
V_{FM}	$T_J=25^{\circ}\text{C}$; $I_{FM}=\pi I_{FAV}$	1.40	1.40	V
V_{FO} r_F	$T_J=150^{\circ}\text{C}$	0.80 1.30	0.75 0.90	V mΩ
R_{jc} R_{ch}	sin.180; chip/Module	0.32/0.16 0.16/0.08	0.32/0.16 0.16/0.08	°C/W °C/W
V_{ISOL}	50Hz; r.m.s.; 1 min	2500		V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 3 ± 0.45			Nm Nm
贮存温度	-40°C ~+125°C			
模块外形	<p>The technical drawing shows two views of the module. The top view shows a rectangular module with three M5 screws on top and a height of 32±0.5 mm. The front view shows a module with a total width of 94 mm and a height of 25 mm. The front view includes four circular terminals with a diameter of 2-∅6 mm. The terminal spacing is 15.5 mm between the first and second, and 20 mm between the second, third, and fourth. The module is labeled 'K1G11GZK2'.</p>			

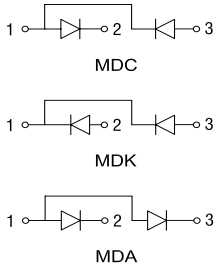


图 1.3.3-1 电路结构图

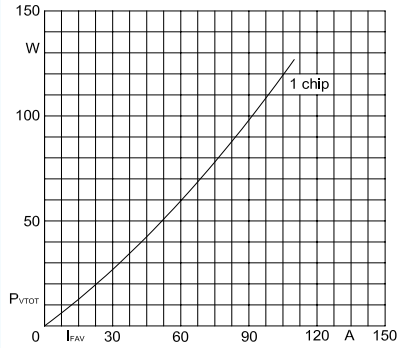


图 1.3.3-2 MDC110 P_V-I_{FAV} 曲线

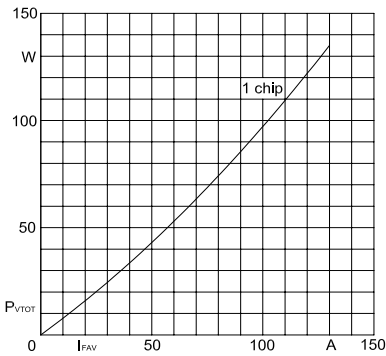


图 1.3.3-3 MDC130 P_V-I_{FAV} 曲线

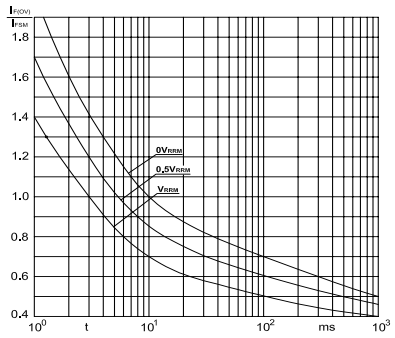


图 1.3.3-4 整流管过电流与时间曲线

1.3.4 130A~200A 普通整流管模块 (1200V~1800V)

符号	测试条件	M × × 132	M × × 162	M × × 182	单位
V_{RRM} I_{RRM}	$T_j=150^{\circ}\text{C}$	1200~1800 20	1200~1800 25	1200~1800 25	V mA
I_{FAV}	sin.180; $T_c=100^{\circ}\text{C}$	130	160	180	A
I_{FSM} I^2t	$T_j=150^{\circ}\text{C}$; 10 ms	2400 28.8	3000 45	3300 54.4	A kA ² s
V_{FM}	$T_j=25^{\circ}\text{C}$; $I_{FM}=\pi I_{FAV}$	1.40	1.40	1.40	V
V_{FO} r_F	$T_j=150^{\circ}\text{C}$	0.80 1.12	0.80 1.05	0.80 0.95	V m Ω
R_{jC} R_{ch}	sin.180; chip/Module	0.28/0.14 0.10/0.05	0.22/0.11 0.10/0.05	0.20/0.10 0.10/0.05	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500			V
紧固力矩	基板安装 $M_1: 5 \pm 0.75$ 接线端子 $M_2: 5 \pm 0.75$				Nm Nm
贮存温度	-40 $^{\circ}\text{C}$ ~+125 $^{\circ}\text{C}$				
模块外形	<p>The technical drawing shows the module's physical dimensions and features. The top view shows a rectangular module with three mounting holes labeled '3-M6' and a height of 31±0.5 mm. The front view shows a width of 94 mm, with a central section of 80 mm. It features three circular terminals labeled '2' and '3', and two smaller terminals labeled 'K1G1' and 'G2K2'. The distance between the first and second terminal is 17 mm, and between the second and third is 23 mm. The terminal diameter is 2-ϕ6.5 mm. The overall height of the front view is 36 mm.</p>				

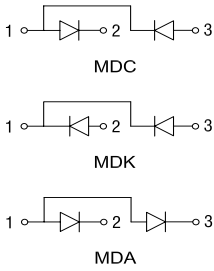


图 1.3.4-1 电路结构图

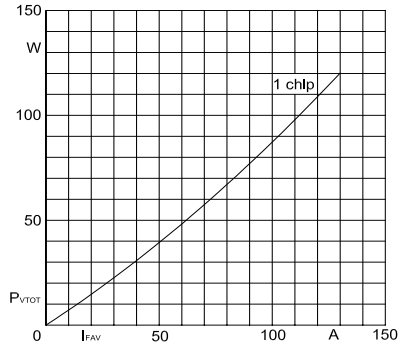


图 1.3.4-2 MDC132 P_V-I_{FAV} 曲线

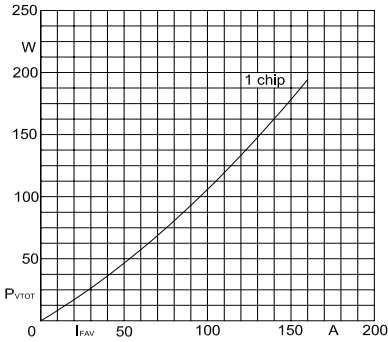


图 1.3.4-3 MDC162 P_V-I_{FAV} 曲线

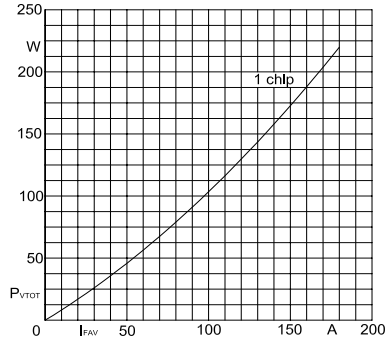


图 1.3.4-4 MDC182 P_V-I_{FAV} 曲线

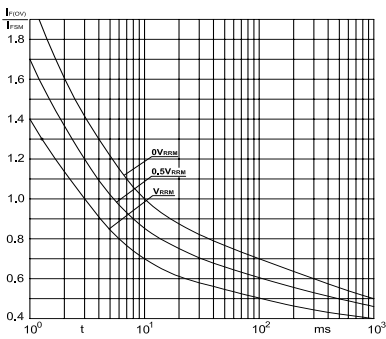


图 1.3.4-5 MDC203 P_V-I_{FAV} 曲线

1.3.5 200A~250A 普通整流管模块 (1200V~1800V)

符号	测试条件	M × × 203	M × × 253	单位
V_{RRM} I_{RRM}	$T_j=150^{\circ}\text{C}$	1200~1800 25	1200~1800 30	V mA
I_{FAV}	sin.180; $T_c=85^{\circ}\text{C}$	200	250	A
I_{FSM} I_t^2	$T_j=150^{\circ}\text{C}$; 10 ms	3800 72	4700 110	A kA ² s
V_{FM}	$T_j=25^{\circ}\text{C}$; $I_{FM}=\pi I_{FAV}$	1.40	1.40	V
V_{FO} r_F	$T_j=150^{\circ}\text{C}$	0.75 0.70	0.75 0.65	V mΩ
R_{jC} R_{ch}	sin.180; chip/ Module	0.18/0.09 0.10/0.05	0.12/0.06 0.10/0.05	°C/W °C/W
V_{ISOL}	50Hz; r.m.s.; 1 min	2500		V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 5 ± 0.75			Nm Nm
贮存温度	-40°C ~ +125°C			
模块外形	<p>The technical drawing shows the physical dimensions and features of the power semiconductor module. The top view (bottom diagram) shows a rectangular module with a total width of 94 mm and a height of 36 mm. It features three main sections, each 23 mm wide, and a terminal section on the right that is 17 mm wide. The terminal section contains two terminals labeled K1G1 and G2K2, with a diameter of 2-Ø6.5 mm. The side view (top diagram) shows a total height of 31 ± 0.5 mm and a mounting flange thickness of 7.5 mm. Three M6 screws are used for mounting, indicated by the label '3-M6'.</p>			

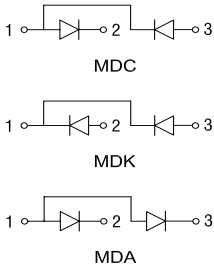


图 1.3.5-1 电路结构图

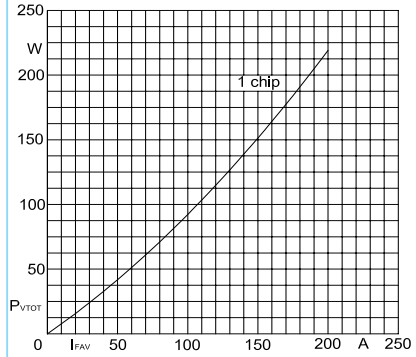


图 1.3.5-2 MDC203 P_V-I_{FAV} 曲线

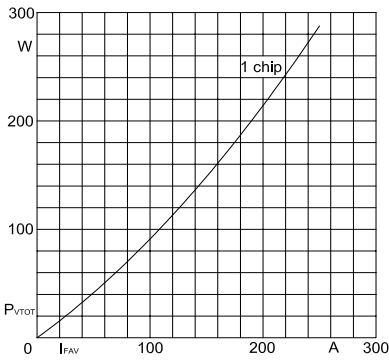


图 1.3.5-3 MDC253 P_V-I_{FAV} 曲线

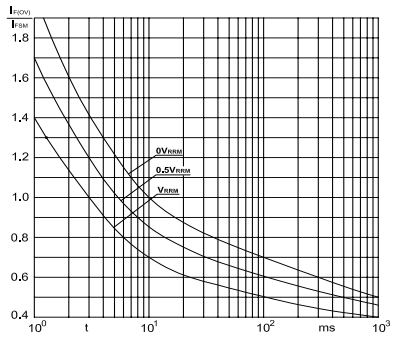


图 1.3.5-4 整流管过电流与时间曲线

1.3.6 200A~250A 普通整流管模块 (1200V~1800V)

符号	测试条件	M × × 202	M × × 252	单位
V_{RRM} I_{RRM}	$T_j=150^{\circ}\text{C}$	1200~1800 40		V mA
I_{FAV}	sin.180; $T_c=100^{\circ}\text{C}$	200	250	A
I_{FSM} I_t^2	$T_j=150^{\circ}\text{C}$; 10 ms	3800 72	4700 110	A kA ² s
V_{FM}	$T_j=25^{\circ}\text{C}$; $I_{FM}=\pi I_{FAV}$	1.40	1.40	V
V_{FO} r_F	$T_j=150^{\circ}\text{C}$	0.75 0.70	0.75 0.65	V mΩ
R_{jC} R_{ch}	sin.180; chip/Module	0.18/0.09 0.06/0.03	0.12/0.06 0.06/0.03	°C/W °C/W
V_{ISOL}	50Hz; r.m.s.; 1 min	2500		V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 9 ± 1.35			Nm Nm
贮存温度	-40°C ~ +125°C			
模块外形	<p>The technical drawing shows the physical dimensions of the module. The top view indicates a total width of 108 mm and a height of 53 mm. The distance between the centers of the three main components is 26.5 mm, with a 20 mm margin on the left. The terminal block on the right has a height of 38 mm and four terminals with a diameter of 6.5 mm. The side view shows a total height of 35.5 ± 0.5 mm and a base thickness of 8.5 mm. Three M8 screws are used for mounting on the top surface.</p>			

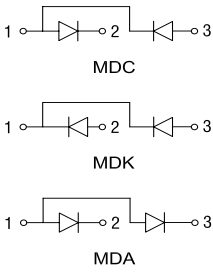


图 1.3.6-1 电路结构图

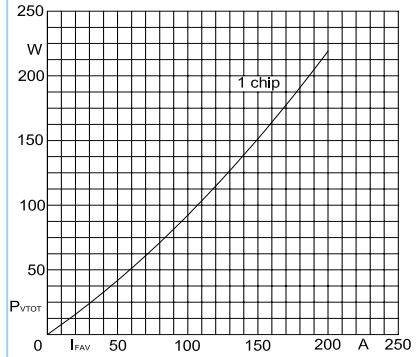


图 1.3.6-2 MDC202 P_V-I_{FAV} 曲线

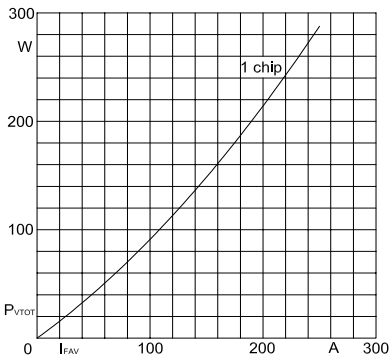


图 1.3.6-3 MDC252 P_V-I_{FAV} 曲线

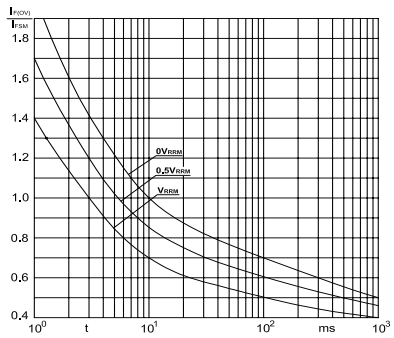


图 1.3.6-4 整流管过电流与时间曲线

1.3.7 200A~300A 普通整流管模块 (1200V~1800V)

符号	测试条件	M × × 200	M × × 250	M × × 303	单位
V_{RRM} I_{RRM}	$T_j=150^{\circ}\text{C}$	1200~1800 40			V mA
I_{FAV}	sin.180; $T_c=85^{\circ}\text{C}$	200	250	300	A
I_{FSM} I_t^2	$T_j=150^{\circ}\text{C}$; 10 ms	4400 97	5500 150	6600 215	A kA ² s
V_{FM}	$T_j=25^{\circ}\text{C}$; $I_{FM}=\pi I_{FAV}$	1.40	1.40	1.40	V
V_{FO} r_F	$T_j=150^{\circ}\text{C}$	0.75 0.95	0.80 0.75	0.70 0.55	V m Ω
R_{jC} R_{ch}	sin.180; chip/Module	0.18/0.09 0.06/0.03	0.12/0.06 0.06/0.03	0.12/0.06 0.06/0.03	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500			V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 9 ± 1.35				Nm Nm
贮存温度	-40 $^{\circ}\text{C}$ ~ +125 $^{\circ}\text{C}$				
模块外形	<p>The technical drawing shows two views of the module. The side view (top) shows a rectangular module with a total length of 92 mm and a height of 51 ± 0.5 mm. It features three M8 screws on top, with the first two spaced 42 mm apart and the second two spaced 36 mm apart. The bottom edge has a 25 ± 0.5 mm wide section on the left and an 8 mm wide section on the right. The top view (bottom) shows a rectangular footprint with a total length of 115 mm and a width of 53 mm. It has four mounting holes (4-∅6.2) and two terminal positions labeled 1 and 2. The distance between the terminal positions is 38 mm, and the distance from the right edge to the terminal positions is 14, 13, 20, and 24 mm.</p>				

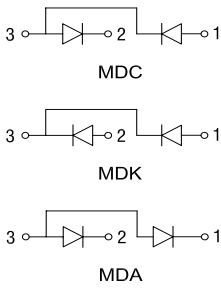


图 1.3.7-1 电路结构图

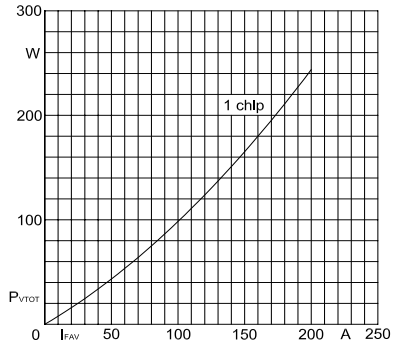


图 1.3.7-2 MDC200 P_V-I_{FAV} 曲线

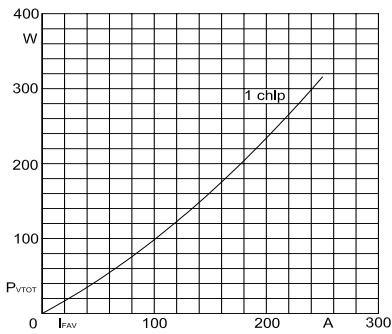


图 1.3.7-3 MDC250 P_V-I_{FAV} 曲线

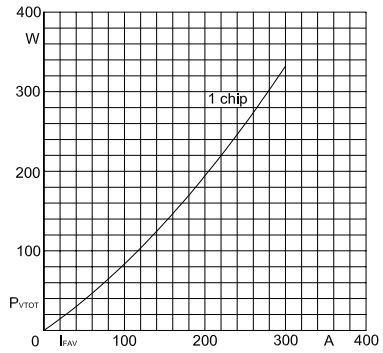


图 1.3.7-4 MDC303 P_V-I_{FAV} 曲线

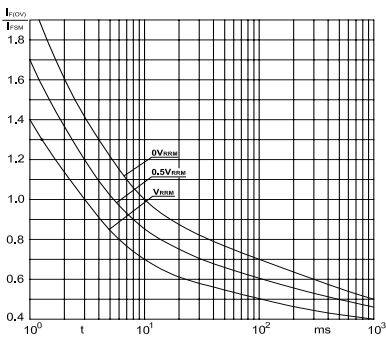


图 1.3.7-5 整流管过电流与时间曲线

1.3.8 300A~500A 普通整流管模块 (1200V~1800V)

符号	测试条件	M × × 300	M × × 350	M × × 400	M × × 500	单位
V_{RRM} I_{RRM}	$T_j=150^{\circ}\text{C}$	1200~1800 50				V mA
I_{FAV}	sin.180; $T_c=85^{\circ}\text{C}$	300	350	400	500	A
I_{FSM} I_{Tt}	$T_j=150^{\circ}\text{C}$; 10 ms	6600 215	7700 296	8800 380	11000 605	A kA ² s
V_{FM}	$T_j=25^{\circ}\text{C}$; $I_{FM}=\pi I_{FAV}$	1.40	1.40	1.40	1.40	V
V_{FO} r_F	$T_j=150^{\circ}\text{C}$	0.70 0.55	0.75 0.50	0.75 0.50	0.75 0.45	V mΩ
R_{jc} R_{ch}	sin.180; chip/Module	0.12/0.06 0.03/0.015	0.10/0.05 0.03/0.015	0.085/0.043 0.03/0.015	0.085/0.043 0.03/0.015	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500				V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 9 ± 1.35					Nm Nm
贮存温度	$-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$					
模块外形	<p>The technical drawing shows two views of the module. The side view (top) shows a rectangular module with a total length of 126.5 mm and a height of 53.5 ± 0.5 mm. The top view (bottom) shows a rectangular module with a total width of 63 mm and a total length of 108 mm. The top view also shows four mounting holes with a diameter of 4-φ6.5 mm and a distance of 93 mm between the center of the first and last holes. The top view also shows a terminal block with a width of 48 mm and a distance of 10 mm from the left edge to the start of the terminal block. The side view shows three M10 mounting holes with a distance of 40 ± 0.5 mm between the first and second holes, and a distance of 42 mm between the second and third holes. The top view shows a terminal block with a width of 48 mm and a distance of 10 mm from the left edge to the start of the terminal block. The top view also shows a terminal block with a width of 48 mm and a distance of 10 mm from the left edge to the start of the terminal block. The top view also shows a terminal block with a width of 48 mm and a distance of 10 mm from the left edge to the start of the terminal block.</p>					

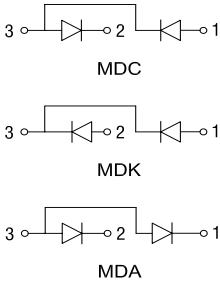


图 1.3.8-1 电路结构图

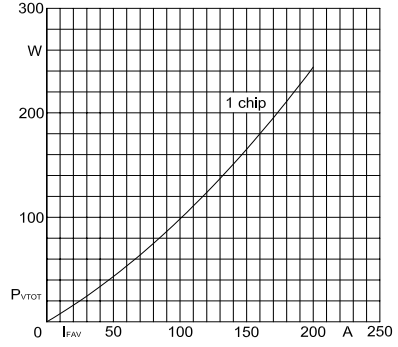


图 1.3.8-2 MDC300 P_V-I_{FAV} 曲线

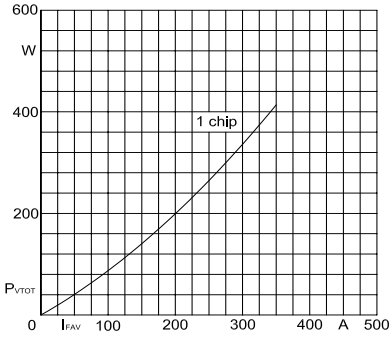


图 1.3.8-3 MDC350 P_V-I_{FAV} 曲线

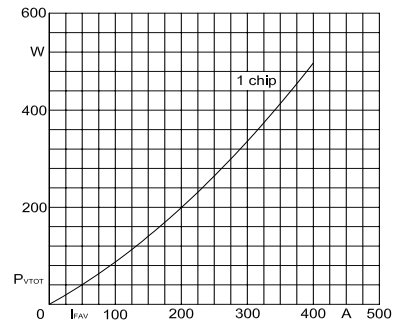


图 1.3.8-4 MDC400 P_V-I_{FAV} 曲线

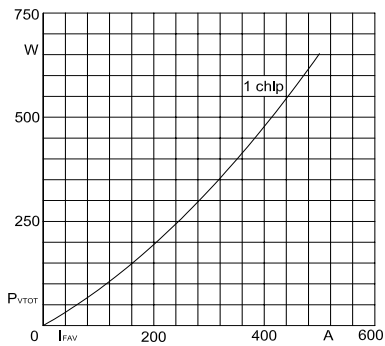


图 1.3.8-5 MDC500 P_V-I_{FAV} 曲线

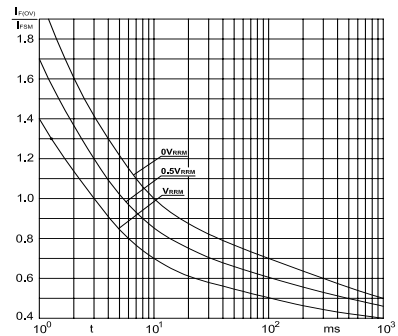


图 1.3.8-6 整流管过电流与时间曲线

1.3.9 630A 普通整流管模块 (1200V~1800V)

符号	测试条件	M × 630	单位
V_{RRM} I_{RRM}	$T_j=150^{\circ}\text{C}$	1200~1800 60	V mA
I_{FAV}	sin.180; $T_c=80^{\circ}\text{C}$	630	A
I_{FSM} I_t^2	$T_j=150^{\circ}\text{C}$; 10 ms	13850 959	A kA ² s
V_{FM}	$T_j=25^{\circ}\text{C}$; $I_{FM}=\pi I_{FAV}$	1.40	V
V_{FO} r_F	$T_j=150^{\circ}\text{C}$	0.80 0.45	V mΩ
R_{jc} R_{ch}	sin.180; chip/Module	0.065/0.033 0.03/0.015	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500	V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 12 ± 1.8		Nm Nm
贮存温度	$-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$		
模块外形 与 电路结构			

模块外形与
电路结构

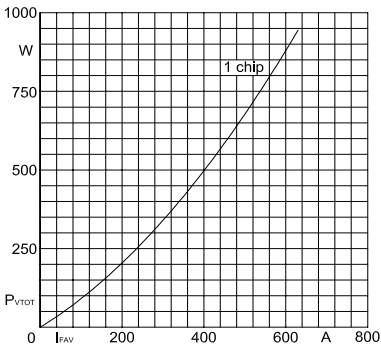
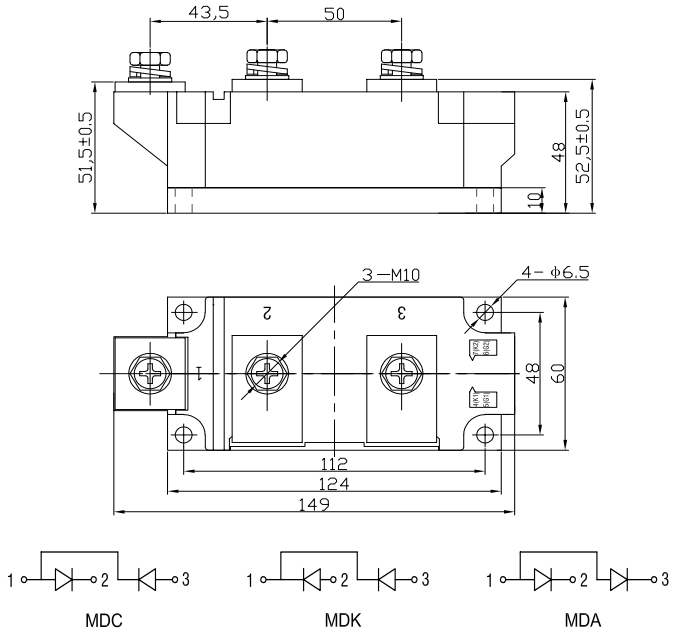


图 1.3.9-1 MDC630 P_V-I_{FAV} 曲线

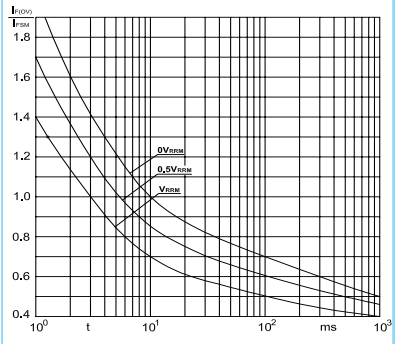


图 1.3.9-2 整流管过电流与时间曲线

1.3.10 800A 普通整流管模块 (1200V~1800V)

符号	测试条件	M × 800	单位
V_{RRM} I_{RRM}	$T_j=150^{\circ}\text{C}$	1200~1800 80	V mA
I_{FAV}	sin.180; $T_c=80^{\circ}\text{C}$	800	A
I_{FSM} I_{Tt}^2	$T_j=150^{\circ}\text{C}$; 10 ms	15000 1125	A kA ² s
V_{FM}	$T_j=25^{\circ}\text{C}$; $I_{FM}=\pi I_{FAV}$	1.40	V
V_{FO} r_F	$T_j=150^{\circ}\text{C}$	0.75 0.38	V mΩ
R_{jc} R_{ch}	sin.180; chip/Module	0.054/0.027 0.02/0.01	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500	V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 12 ± 1.8		Nm Nm
贮存温度	$-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$		
模块外形	<p>The technical drawing shows the physical dimensions and terminal layout of the 800A rectifier module. The side view (top) shows a height of 79 mm, with a base thickness of 15 mm. The top surface has three M12 mounting holes spaced 60 mm apart. The top view (bottom) shows a total width of 180 mm and a height of 76 mm. The main body width is 150 mm, with a central section of 132 mm. There are four mounting holes with a diameter of 8.2 mm. The terminal layout includes a 3-pin terminal block on the left and a 2-pin terminal block on the right, labeled K1, G1, G2, and K2. The distance between the terminal blocks is 60 mm.</p>		

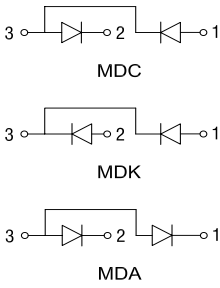


图 1.3.10-1 电路结构图

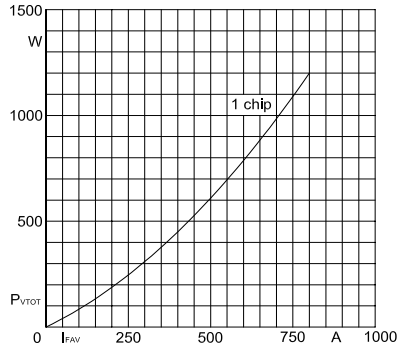


图 1.3.10-2 MDC800 P_V-I_{FAV} 曲线

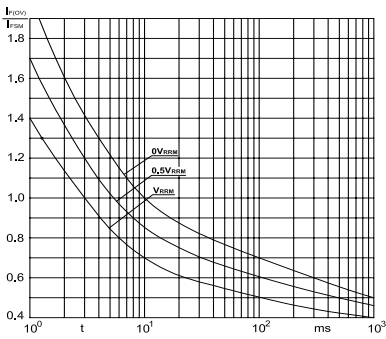


图 1.3.10-3 整流管过电流与时间曲线

1.3.11 1000A~1200A 普通整流管模块 (1200V~1800V)

符号	测试条件	M × × 1000	M × × 1200	单位
V_{RRM} I_{RRM}	$T_j=150^{\circ}\text{C}$	1200~1800 80	1200~1800 80	V mA
I_{FAV}	$\sin.180; T_c=55^{\circ}\text{C}$	1000	1200	A
I_{FSM} I_t^2	$T_j=150^{\circ}\text{C}; 10\text{ ms}$	16000 1280	19000 1805	A kA ² s
V_{FM}	$T_j=25^{\circ}\text{C}; I_{FM}=\pi I_{FAV}$	1.40	1.35	V
V_{FO} r_F	$T_j=150^{\circ}\text{C}$	0.80 0.21	0.78 0.09	V m Ω
R_{jc} R_{ch}	$\sin.180; \text{chip/Module}$	0.054/0.027 0.02/0.01	0.054/0.027 0.02/0.01	$^{\circ}\text{C} / \text{W}$ $^{\circ}\text{C} / \text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500	2500	V
紧固力矩	基板安装 $M_1: 5 \pm 0.75$ 接线端子 $M_2: 12 \pm 1.8$			Nm Nm
贮存温度	-40 $^{\circ}\text{C}$ ~ +125 $^{\circ}\text{C}$			
模块外形				

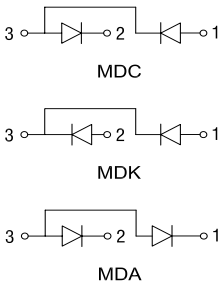


图 1.3.11-1 电路结构图

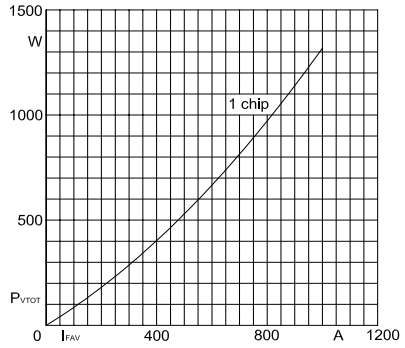


图 1.3.11-2 MDC1000 P_V-I_{FAV} 曲线

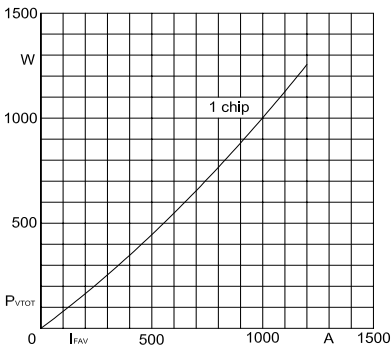


图 1.3.11-3 MDC1200 P_V-I_{FAV} 曲线

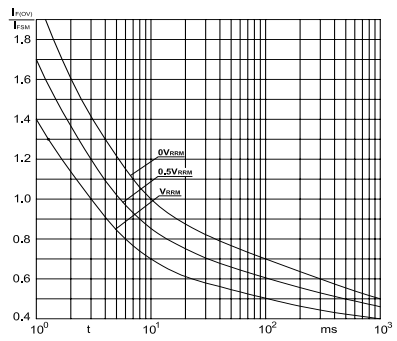


图 1.3.11-4 整流管过电流与时间曲线

1.4.1 110A~160A 普通整流管模块 (1900V 及以上)

符号	测试条件	M × × 110	M × × 130	M × × 160	单位
V_{RRM} I_{RRM}	$T_j=150^{\circ}\text{C}$	1900~3600 20	1900~3600 30	1900~2800 30	V mA
I_{FAV}	sin.180; $T_c=80^{\circ}\text{C}$	110	130	160	A
I_{FSM} I_t^2	$T_j=150^{\circ}\text{C}$; 10 ms	2420 29	2850 40	3500 61	A kA ² s
V_{FM}	$T_j=25^{\circ}\text{C}$; $I_{FM}=\pi I_{FAV}$	1.80	1.80	1.60	V
V_{FO} r_F	$T_j=150^{\circ}\text{C}$	0.90 3.85	0.90 3.85	0.85 2.25	V m Ω
R_{JC} R_{ch}	sin.180; chip/Module	0.25/0.125 0.10/0.05	0.25/0.125 0.10/0.05	0.20/0.10 0.10/0.05	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	3500			V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 5 ± 0.75				Nm Nm
贮存温度	-40 $^{\circ}\text{C}$ ~+125 $^{\circ}\text{C}$				
模块外形	<p>The technical drawing shows the physical dimensions of the module. The top view (bottom diagram) shows a rectangular module with a total width of 94 mm and a total height of 34 mm. It features three main sections labeled 1, 2, and 3, each containing a circular terminal. Section 1 is 16.5 mm wide, section 2 is 23.5 mm wide, and section 3 is 23.5 mm wide. The distance between the centers of the first and second terminals is 23.5 mm, and between the second and third is 23.5 mm. The total distance between the first and third terminals is 80 mm. On the right side, there are two smaller terminals labeled 4, 5, 6, and 7. The distance between the center of the third terminal and the center of terminal 4 is 12 mm. The total height of the module is 34 mm. The side view (top diagram) shows a height of 33.5 ± 0.5 mm and a base thickness of 8 mm. Three M6 screws are used for mounting, labeled '3-M6'.</p>				

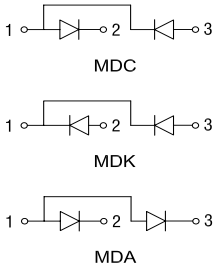


图 1.4.1-1 电路结构图

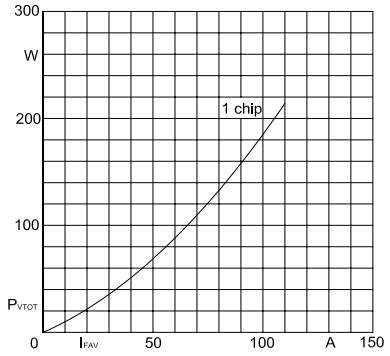


图 1.4.1-2 MDC110 P_V-I_{FAV} 曲线

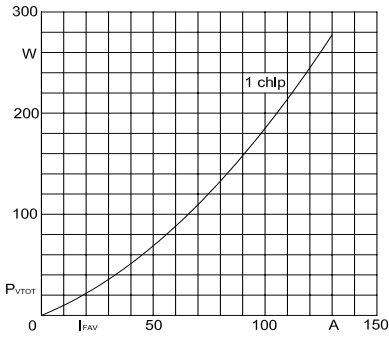


图 1.4.1-3 MDC130 P_V-I_{FAV} 曲线

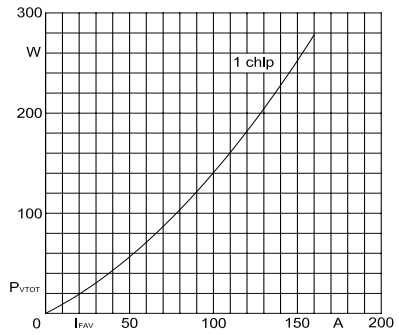


图 1.4.1-4 MDC160 P_V-I_{FAV} 曲线

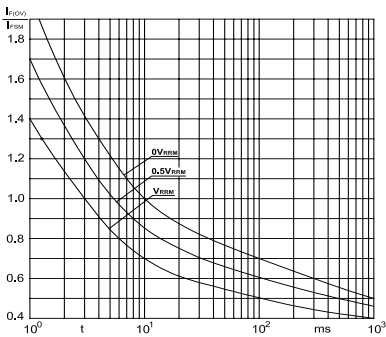


图 1.4.1-5 整流管过电流与时间曲线

1.4.2 160A~250A 普通整流管模块（1900V 及以上）

符号	测试条件	M × × 160	M × × 200	M × × 250	单位
V_{RRM} I_{RRM}	$T_j=150^{\circ}\text{C}$	3000~5000 40	1900~3600 40	1900~3600 40	V mA
I_{FAV}	sin.180; $T_c=80^{\circ}\text{C}$	160	200	250	A
I_{FSM} I_t^2	$T_j=150^{\circ}\text{C}$; 10 ms	3500 61	4400 97	5500 150	A kA ² s
V_{FM}	$T_j=25^{\circ}\text{C}$; $I_{FM}=\pi I_{FAV}$	1.60	1.60	1.60	V
V_{FO} r_F	$T_j=150^{\circ}\text{C}$	0.85 2.15	0.85 1.65	0.85 1.25	V m Ω
R_{jC} R_{ch}	sin.180; chip/Module	0.16/0.08 0.06/0.03	0.12/0.06 0.06/0.03	0.12/0.06 0.06/0.03	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	3500			V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 9 ± 1.35				Nm Nm
贮存温度	-40 $^{\circ}\text{C}$ ~+125 $^{\circ}\text{C}$				
模块外形	<p>The technical drawing shows two views of the module. The top view (side view) shows a rectangular module with a total length of 92 mm. It has three M8 screws on top, with the first two spaced 42 mm apart and the second two spaced 36 mm apart. The height of the module is 51 ± 0.5 mm, with a base thickness of 8 mm and a top section height of 48 mm. The bottom view shows a rectangular footprint with a total width of 115 mm and a total height of 53 mm. It features four mounting holes, each with a diameter of 6.2 mm, spaced 80 mm apart. The terminal block on the right has a height of 38 mm. The terminal block is labeled with '1', '2', and '3' and 'IN 15 20 2k'.</p>				

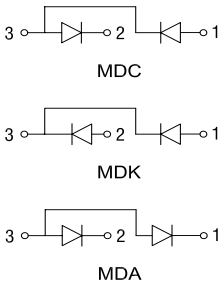


图 1.4.2-1 电路结构图

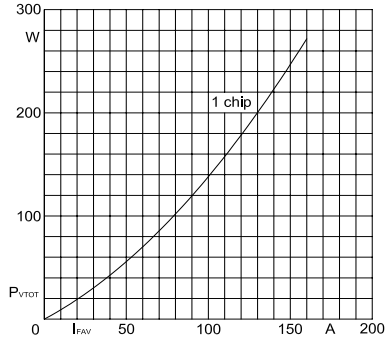


图 1.4.2-2 MDC160 P_{V-TOR} - I_{FAV} 曲线

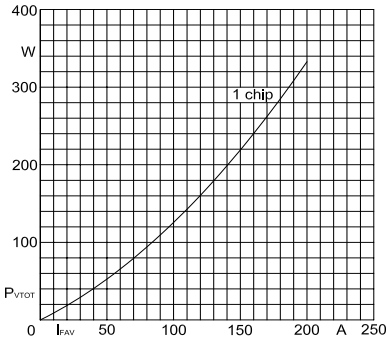


图 1.4.2-3 MDC200 P_{V-TOR} - I_{FAV} 曲线

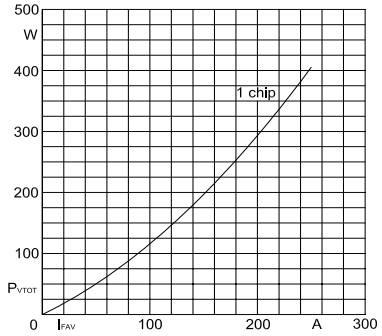


图 1.4.2-4 MDC250 P_{V-TOR} - I_{FAV} 曲线

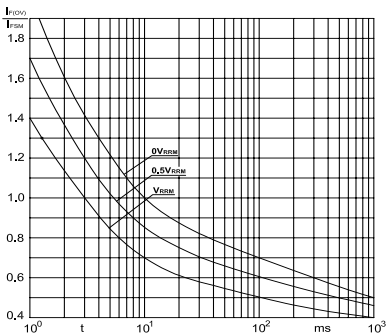


图 1.4.1-5 整流管过电流与时间曲线

1.4.3 200A~300A 普通整流管模块（1900V 及以上）

符号	测试条件	M × × 200	M × × 250	M × × 300	单位
V_{RRM} I_{RRM}	$T_j=150^{\circ}\text{C}$	3800~5000 40	3800~5000 40	1900~5000 50	V mA
I_{FAV}	sin.180; $T_c=80^{\circ}\text{C}$	200	250	300	A
I_{FSM} I_t^2	$T_j=150^{\circ}\text{C}$; 10 ms	4400 97	5500 150	6600 217	A kA ² s
V_{FM}	$T_j=25^{\circ}\text{C}$; $I_{FM}=\pi I_{FAV}$	1.80	1.80	1.80	V
V_{FO} r_F	$T_j=150^{\circ}\text{C}$	0.85 2.55	0.85 1.95	0.85 1.55	V m Ω
R_{jC} R_{ch}	sin.180; chip/Module	0.12/0.06 0.03/0.015	0.10/0.05 0.03/0.015	0.08/0.04 0.03/0.015	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	3500			V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 9 ± 1.35				Nm Nm
贮存温度	$-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$				
模块外形	<p>The technical drawing shows the physical dimensions of the module. The side view (top) indicates a total length of 126.5 mm, a main body height of 53.5 ± 0.5 mm, and a base height of 56 ± 0.5 mm. The distance between the first and second screw holes is 40 ± 0.5 mm, and the distance between the second and third is 42 mm. There are three M10 screws. The top view (bottom) shows a total width of 63 mm and a total length of 108 mm. The distance between the first and second screw holes is 93 mm. There are four Ø6.5 mm holes. The terminal markings are K202 and G1K1.</p>				

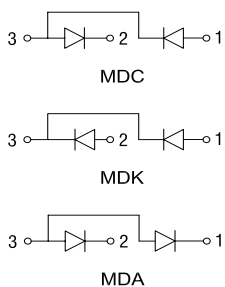


图 1.4.3-1 电路结构图

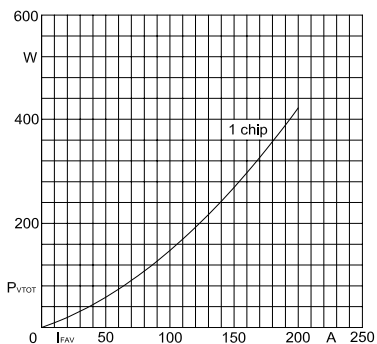


图 1.4.3-2 MDC200 P_V-I_{FAV} 曲线

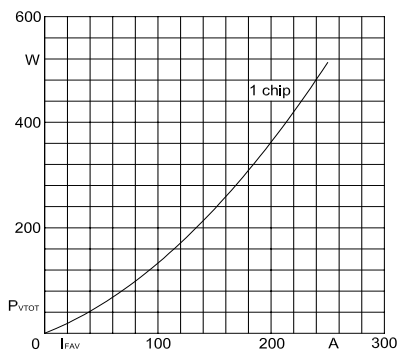


图 1.4.3-3 MDC250 P_V-I_{FAV} 曲线

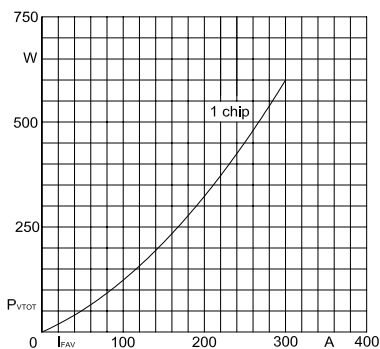


图 1.4.3-4 MDC300 P_V-I_{FAV} 曲线

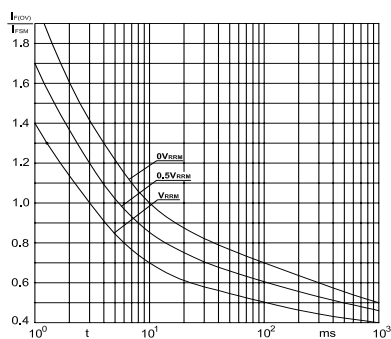


图 1.4.3-5 整流管过电流与时间曲线

1.4.4 350A~400A 普通整流管模块 (1900V 及以上)

符号	测试条件	M × × 350	M × × 400	单位
V_{RRM} I_{RRM}	$T_j=150^{\circ}\text{C}$	1900~3000 50	1900~3000 50	V mA
I_{FAV}	sin.180; $T_c=80^{\circ}\text{C}$	350	400	A
I_{FSM} I_t^2	$T_j=150^{\circ}\text{C}$; 10 ms	7700 296	8800 380	A kA ² s
V_{FM}	$T_j=25^{\circ}\text{C}$; $I_{FM}=\pi I_{FAV}$	1.60	1.60	V
V_{FO} r_F	$T_j=150^{\circ}\text{C}$	0.85 0.85	0.85 0.85	V mΩ
R_{JC} R_{ch}	sin.180; chip/ Module	0.08/0.04 0.03/0.015	0.08/0.04 0.03/0.015	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	3500		V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 9 ± 1.35			Nm Nm
贮存温度	$-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$			
模块外形	<p>The technical drawing shows two views of the module. The side view (top) shows a rectangular module with a total length of 126.5 mm and a total height of 53.5 ± 0.5 mm. The base height is 10 mm. Three mounting holes are shown on top, with a center-to-center distance of 42 mm between the first two and 40 ± 0.5 mm between the second and third. The holes are labeled '3-M10'. The top view (bottom) shows a rectangular footprint with a total width of 63 mm and a total length of 108 mm. There are four mounting holes on the left side, labeled '4-φ6.5'. The terminal block on the right is labeled 'K252 6K1'. The terminal positions are marked with '1', '2', and '3'.</p>			

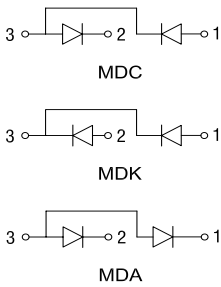


图 1.4.4-1 电路结构图

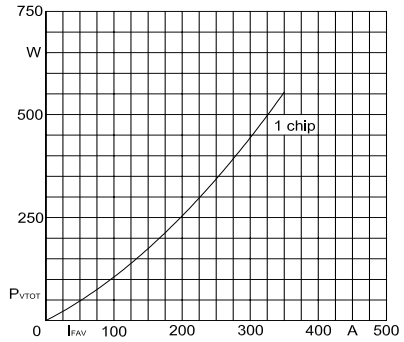


图 1.4.4-2 MDC350 P_V-I_{FAV} 曲线

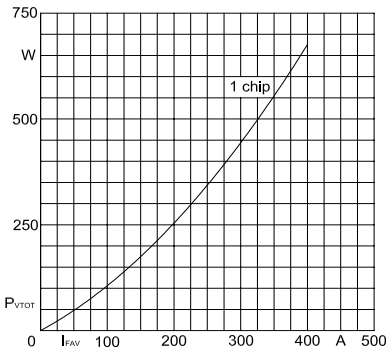


图 1.4.4-3 MDC400 P_V-I_{FAV} 曲线

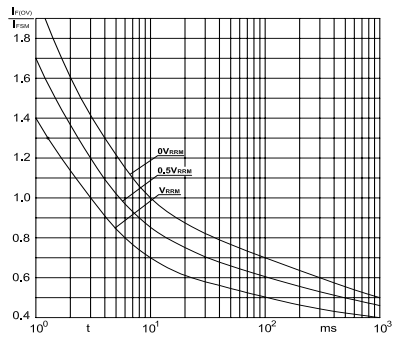


图 1.4.4-4 整流管过电流与时间曲线

1.4.5 500A 普通整流管模块 (1900V 及以上)

符号	测试条件	M × 500	单位
V_{RRM} I_{RRM}	$T_j=150^{\circ}\text{C}$	1900~5000 50	V mA
I_{FAV}	sin.180; $T_c=80^{\circ}\text{C}$	500	A
I_{FSM} I_t^2	$T_j=150^{\circ}\text{C}$; 10 ms	11000 605	A kA^2s
V_{FM}	$T_j=25^{\circ}\text{C}$; $I_{FM}=\pi I_{FAV}$	1.80	V
V_{FO} r_F	$T_j=150^{\circ}\text{C}$	0.95 0.85	V $\text{m}\Omega$
R_{jc} R_{ch}	sin.180; chip/Module	0.065/0.033 0.03/0.015	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	3500	V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 9 ± 1.35		Nm Nm
贮存温度	$-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$		
模块外形	<p>The technical drawing shows two views of the module. The top view (upper part) shows a side profile with dimensions: a total width of 149 mm, a mounting hole offset of 43.5 mm from the left edge, a distance of 50 mm between the first and second mounting holes, a total height of 51.5 ± 0.5 mm, a base height of 48 mm, and a bottom flange height of 52.5 ± 0.5 mm. The bottom view (lower part) shows a top-down perspective with dimensions: a total width of 149 mm, a distance of 112 mm between the first and second mounting holes, a distance of 124 mm between the second and third mounting holes, a total height of 60 mm, and a base height of 48 mm. It also shows 3 M10 mounting holes and 4 φ6.5 holes. Labels 'M1' and 'M2' indicate the mounting points for the base and terminals respectively.</p>		

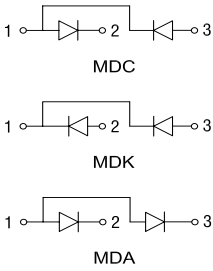


图 1.4.5-1 电路结构图

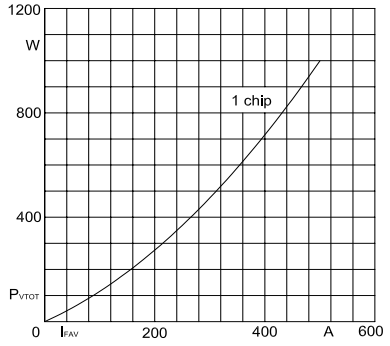


图 1.4.5-2 MDC500 P_V-I_{FAV} 曲线

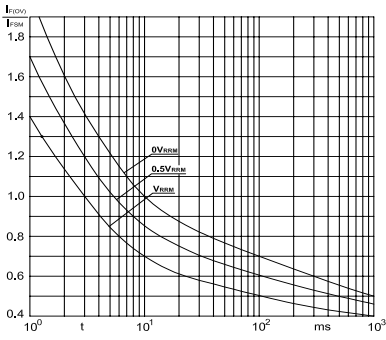


图 1.4.5-3 整流管过电流与时间曲线

1.5.1 30A~50A 单相整流桥模块

符号	测试条件	MDQ 30	MDQ 50	单位
V_{RRM} I_{RRM}	$T_j=150^{\circ}\text{C}$	800~1600 6		V mA
I_D	$T_c=80^{\circ}\text{C}$	30	50	A
I_{FSM} I_t^2	$T_j=150^{\circ}\text{C}; 10\text{ ms}$	250 0.32	400 0.8	A kA ² s
V_{FM}	$T_j=25^{\circ}\text{C}; I_{FM}=1.57I_o$	1.40	1.40	V
V_{FO} r_F	$T_j=150^{\circ}\text{C}$	0.75 5.55	0.75 3.50	V m Ω
R_{jC} R_{ch}	sin.180; chip/Module sin.180; Module	2.08/0.52 0.10	1.28/0.32 0.10	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500		V
紧固力矩	基板安装 $M_1: 5 \pm 0.75$			Nm
贮存温度	-40 $^{\circ}\text{C}$ ~+125 $^{\circ}\text{C}$			
模块外形				

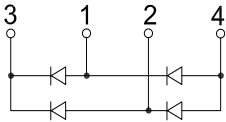


图 1.5.1-1 电路结构图

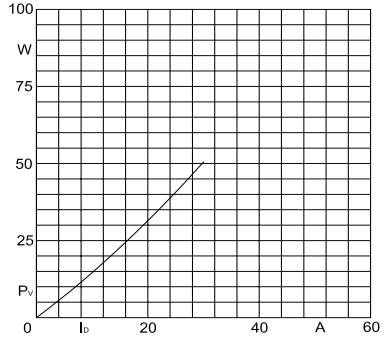


图 1.5.1-2 MDQ30 P_v-I_b 曲线

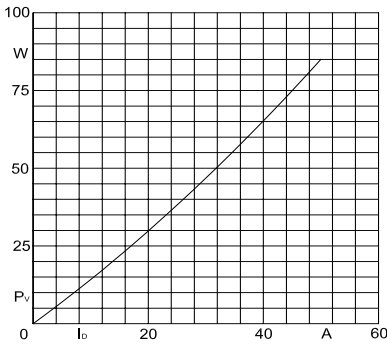


图 1.5.1-3 MDQ50 P_v-I_b 曲线

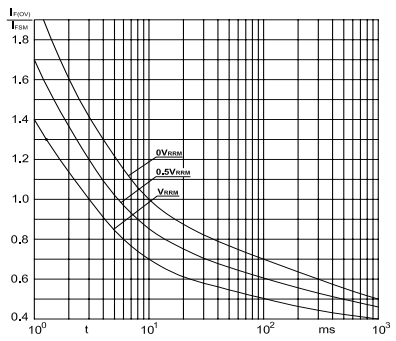


图 1.5.1-4 整流管过电流与时间曲线

1.5.2 30A~100A 单相整流桥模块

符号	测试条件	MDQ 30	MDQ 50	MDQ 75	MDQ 100	单位
V_{RRM} I_{RRM}	$T_j=150^{\circ}\text{C}$	800~1600 6	800~1600 6	800~1600 10	800~1600 15	V mA
I_D	$T_c=80^{\circ}\text{C}$	30	50	75	100	A
I_{FSM} I_{T^2t}	$T_j=150^{\circ}\text{C}; 10\text{ ms}$	250 0.32	400 0.8	600 1.8	800 3.2	A kA ² s
V_{FM}	$T_j=25^{\circ}\text{C}; I_{FM}=1.57I_D$	1.40	1.40	1.40	1.40	V
V_{FO} r_F	$T_j=150^{\circ}\text{C}$	0.75 5.55	0.75 3.50	0.75 1.95	0.75 1.85	V m Ω
R_{jc} R_{ch}	sin.180; chip/Module sin.180; Module	2.08/0.52 0.08	1.28/0.32 0.08	1.00/0.25 0.08	0.72/0.18 0.08	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500				V
紧固力矩	基板安装 $M_1: 5 \pm 0.75$ 接线端子 $M_2: 3 \pm 0.45$					Nm Nm
贮存温度	-40 $^{\circ}\text{C}$ ~ +125 $^{\circ}\text{C}$					
模块外形						

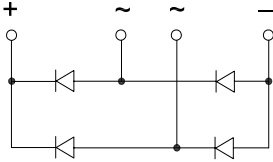


图 1.5.2-1 电路结构图

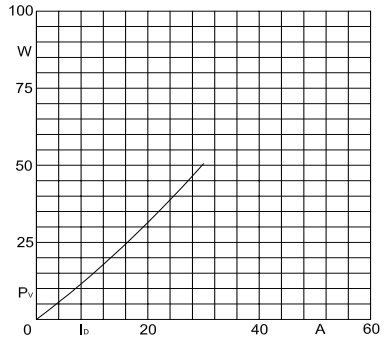


图 1.5.2-2 MDQ30 P_V-I_D 曲线

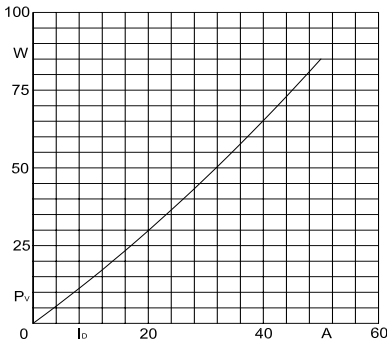


图 1.5.2-3 MDQ50 P_V-I_D 曲线

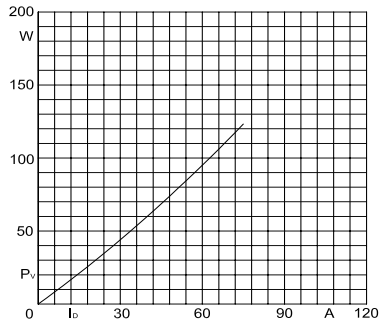


图 1.5.2-4 MDQ75 P_V-I_D 曲线

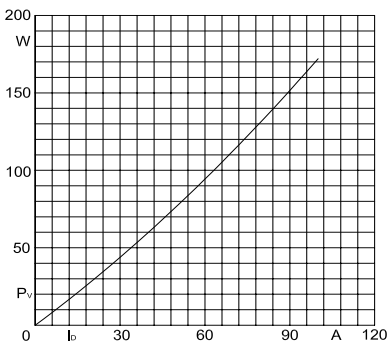


图 1.5.2-5 MDQ100 P_V-I_D 曲线

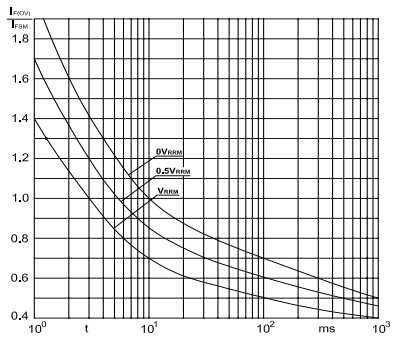


图 1.5.2-6 整流管过电流与时间曲线

1.5.3 100A~200A 单相整流桥模块

符号	测试条件	MDQ 100	MDQ 130	MDQ 160	MDQ 200	单位
V_{RRM} I_{RRM}	$T_j=150^{\circ}\text{C}$	800~1600 10	800~1600 10	800~1600 15	800~1600 20	V mA
I_D	$T_c=80^{\circ}\text{C}$	100	130	160	200	A
I_{FSM} I_{Tt}	$T_j=150^{\circ}\text{C}$; 10 ms	800 3.2	1000 5	1200 7.2	1400 9.8	A kA ² s
V_{FM}	$T_j=25^{\circ}\text{C}$; $I_{FM}=1.57I_D$	1.40	1.40	1.40	1.40	V
V_{FO} r_F	$T_j=150^{\circ}\text{C}$	0.75 1.85	0.75 1.65	0.75 1.35	0.75 0.98	V m Ω
R_{jc} R_{ch}	sin.180; chip/Module sin.180; Module	0.80/0.20 0.05	0.68/0.17 0.05	0.60/0.15 0.05	0.40/0.10 0.05	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500				V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 5 ± 0.75					Nm Nm
贮存温度	$-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$					
模块外形						

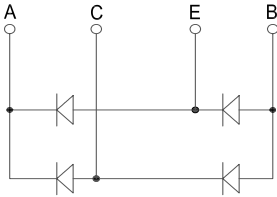


图 1.5.3-1 电路结构图

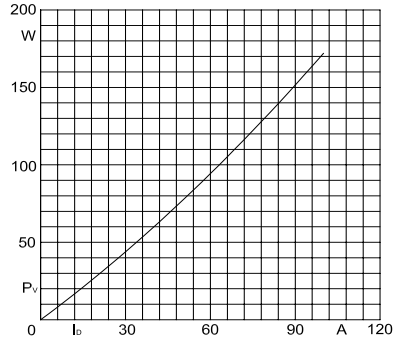


图 1.5.3-2 MDQ100 P_V - I_D 曲线

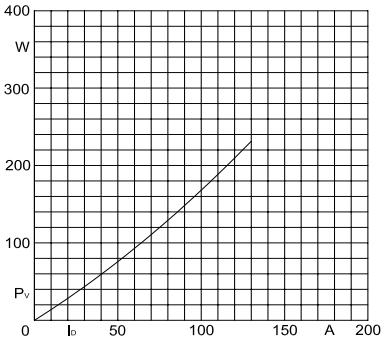


图 1.5.3-3 MDQ130 P_V - I_D 曲线

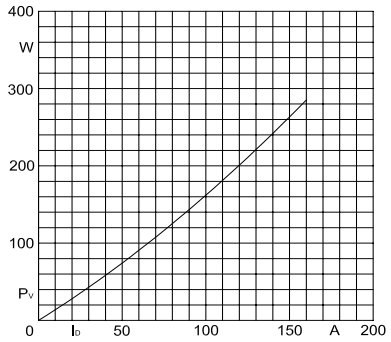


图 1.5.3-4 MDQ160 P_V - I_D 曲线

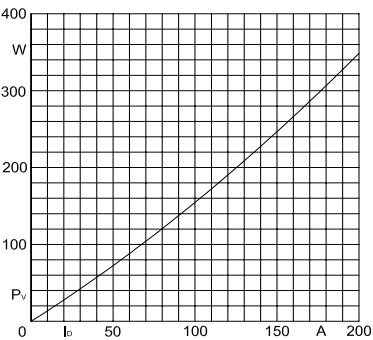


图 1.5.3-5 MDQ200 P_V - I_D 曲线

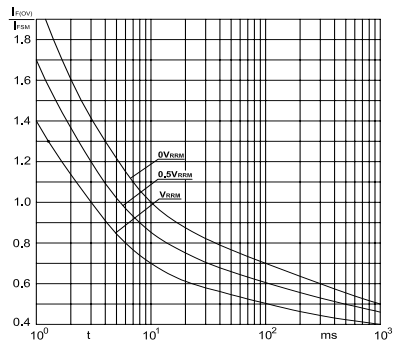


图 1.5.3-6 整流管过电流与时间曲线

1.6.1 30A~50A 三相整流桥模块

符号	测试条件	MDS 30	MDS 50	单位
V_{RRM} I_{RRM}	$T_j=150^{\circ}\text{C}$	800~1600 6		V mA
I_D	$T_c=80^{\circ}\text{C}$	30	50	A
I_{FSM} I^2t	$T_j=150^{\circ}\text{C}; 10\text{ ms}$	250 0.32	400 0.8	A kA ² s
V_{FM}	$T_j=25^{\circ}\text{C}; I_{FM}=I_o$	1.40	1.40	V
V_{FO} r_F	$T_j=150^{\circ}\text{C}$	0.75 5.32	0.75 3.15	V m Ω
R_{jC} R_{ch}	sin.180; chip/Module sin.180; Module	2.52/0.42 0.10	1.80/0.30 0.10	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500		V
紧固力矩	基板安装 $M_1: 5 \pm 0.75$			Nm
贮存温度	-40 $^{\circ}\text{C}$ ~+125 $^{\circ}\text{C}$			
模块外形	<p>The technical drawing shows two views of the module. The top view (side profile) shows a rectangular module with a height of 26 mm. The base has a thickness of 5 mm, and the main body height is 17.5 mm. Three mounting holes are spaced 6.4 mm apart. The bottom view (top-down) shows a square footprint with overall dimensions of 64 mm by 48 mm. It features four mounting holes (1, 2, 3, 4) and two circular features (5, 6) with a diameter of 5.3 mm. Other dimensions include 8 mm, 10 mm, 12 mm, 14 mm, 16 mm, 18 mm, 20 mm, 22 mm, 24 mm, 26 mm, 28 mm, 30 mm, 32 mm, 34 mm, 36 mm, 38 mm, 40 mm, 42 mm, 44 mm, 46 mm, 48 mm, 50 mm, 52 mm, 54 mm, 56 mm, 58 mm, 60 mm, 62 mm, 64 mm, 66 mm, 68 mm, 70 mm, 72 mm, 74 mm, 76 mm, 78 mm, 80 mm, 82 mm, 84 mm, 86 mm, 88 mm, 90 mm, 92 mm, 94 mm, 96 mm, 98 mm, 100 mm.</p>			

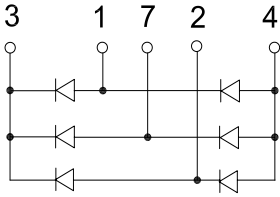


图 1.6.1-1 电路结构图

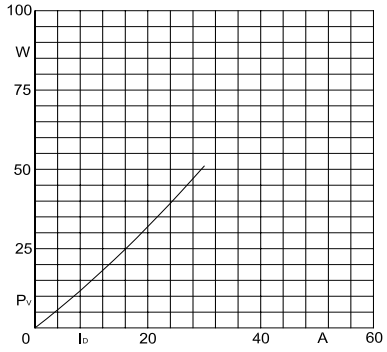


图 1.6.1-2 MDS30 P_v-I_D 曲线

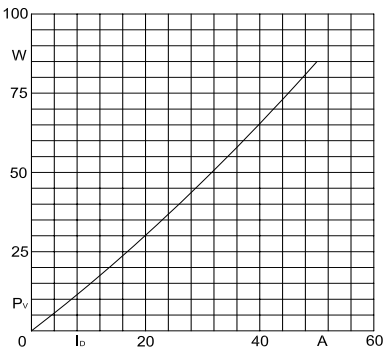


图 1.6.1-3 MDS50 P_v-I_D 曲线

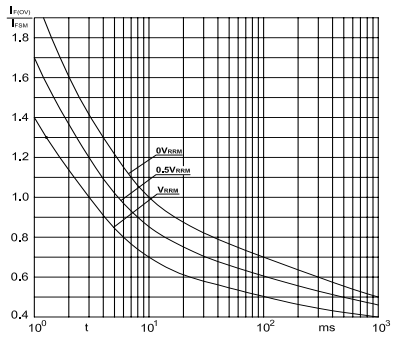


图 1.6.1-4 整流管过电流与时间曲线

1.6.2 30A~100A 三相整流桥模块

符号	测试条件	MDS 30	MDS 50	MDS 75	MDS 100	单位
V_{RRM} I_{RRM}	$T_j=150^{\circ}\text{C}$	800~1600 6	800~1600 6	800~1600 10	800~1600 15	V mA
I_D	$T_c=80^{\circ}\text{C}$	30	50	75	100	A
I_{FSM} I_{Tt}^2	$T_j=150^{\circ}\text{C}; 10\text{ ms}$	250 0.32	320 0.52	500 1.3	700 2.5	A kA^2s
V_{FM}	$T_j=25^{\circ}\text{C}; I_{FM}=I_O$	1.40	1.40	1.40	1.40	V
V_{FO} r_F	$T_j=150^{\circ}\text{C}$	0.75 5.32	0.75 3.15	0.75 2.85	0.75 2.13	V $\text{m}\Omega$
R_{jc} R_{ch}	sin.180; chip/Module sin.180; Module	2.52/0.42 0.08	1.80/0.30 0.08	1.44/0.24 0.08	0.96/0.16 0.08	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500				V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 3 ± 0.45					Nm Nm
贮存温度	$-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$					
模块外形						

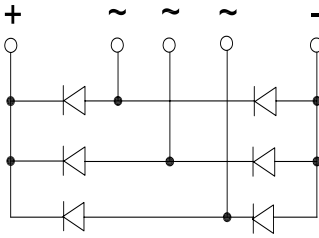


图 1.6.2-1 电路结构图

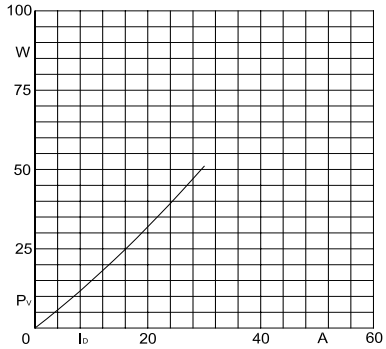


图 1.6.2-2 MDS30 P_V-I_D 曲线

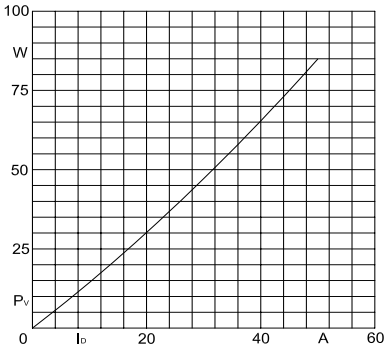


图 1.6.2-3 MDS50 P_V-I_D 曲线

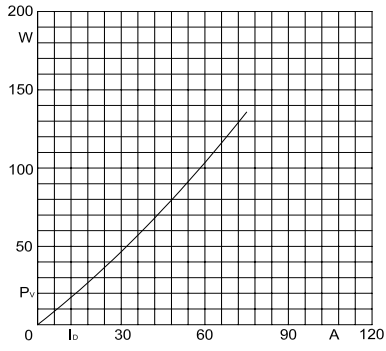


图 1.6.2-4 MDS75 P_V-I_D 曲线

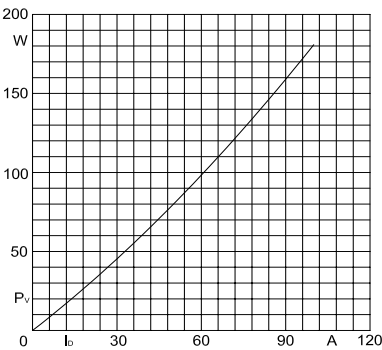


图 1.6.2-5 MDS100 P_V-I_D 曲线

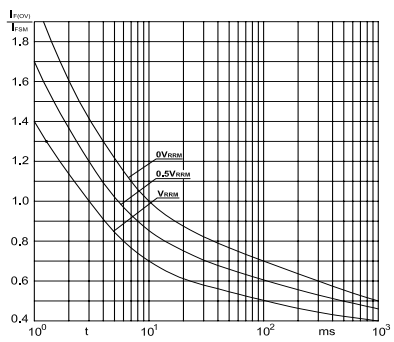


图 1.6.2-6 整流管过电流与时间曲线

1.6.3 100A~200A 三相整流桥模块

符号	测试条件	MDS 100	MDS 130	MDS 160	MDS 200	单位
V_{RRM} I_{RRM}	$T_J=150^{\circ}\text{C}$	800~1600 10	800~1600 10	800~1600 15	800~1600 20	V mA
I_D	$T_c=80^{\circ}\text{C}$	100	130	160	200	A
I_{FSM} I_{t}^{FSM}	$T_J=150^{\circ}\text{C}; 10\text{ ms}$	800 3.2	1000 5	1200 7.2	1400 9.8	A kA^2s
V_{FM}	$T_J=25^{\circ}\text{C}; I_{FM}=1.57I_o$	1.40	1.40	1.40	1.40	V
V_{FO} r_F	$T_J=150^{\circ}\text{C}$	0.75 2.13	0.75 1.65	0.75 1.35	0.75 0.98	V m Ω
R_{jc} R_{ch}	sin.180; chip/Module sin.180; Module	0.80/0.20 0.05	0.68/0.17 0.05	0.60/0.15 0.05	0.40/0.10 0.05	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500				V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 5 ± 0.75					Nm Nm
贮存温度	$-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$					
模块外形						

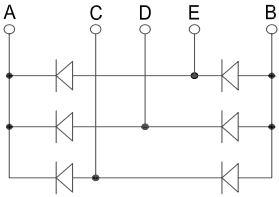


图 1.6.3-1 电路结构图

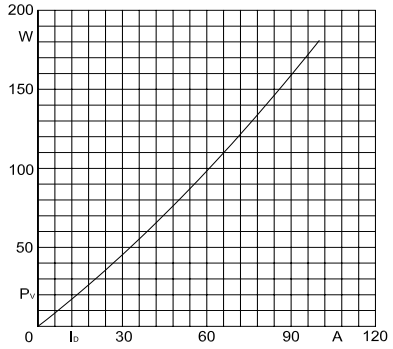


图 1.6.3-2 MDS100 P_V-I_b 曲线

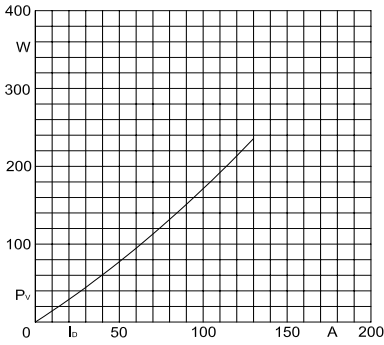


图 1.6.3-3 MDS130 P_V-I_b 曲线

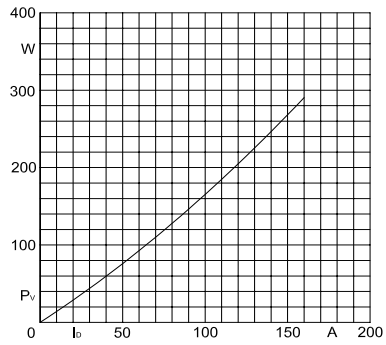


图 1.6.3-4 MDS160 P_V-I_b 曲线

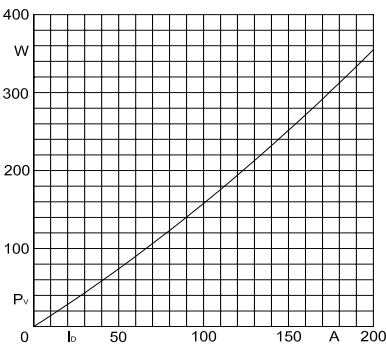


图 1.6.3-5 MDS200 P_V-I_b 曲线

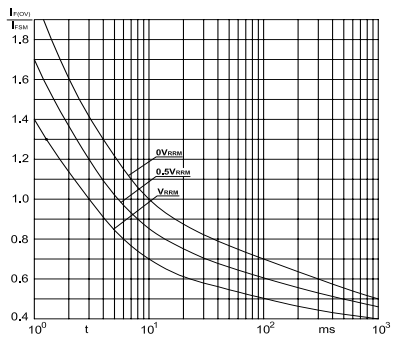


图 1.6.3-6 整流管过电流与时间曲线

1.7.1 30A~50A 单相半控整流桥模块

符号	测试条件	MFQ3 30	MFQ3 50	MFQD 30*	MFQD 50*	单位
V_{RRM} I_{RRM}	$T_j=125^{\circ}\text{C}$	800~1600 6				V mA
I_o	$T_c=80^{\circ}\text{C}$	30	50	30	50	A
I_{FSM} I_{Tt}^{SM}	$T_j=125^{\circ}\text{C}; 10\text{ ms}$	250 0.32	320 0.52	250 0.32	320 0.52	A kA ² s
di/dt dv/dt	$T_j=125^{\circ}\text{C}$	100 500				A/ μs V/ μs
I_{GT} V_{GT}	$T_j=25^{\circ}\text{C}$	100 2.5				mA V
V_{TM}	$T_j=25^{\circ}\text{C}; I_{TM}=1.57I_o$	1.60	1.60	1.60	1.60	V
V_{TO} r_T	$T_j=125^{\circ}\text{C}$	1.0 3.15	0.85 2.88	1.0 3.15	0.85 2.88	V m Ω
R_{jc} R_{ch}	sin.180; chip/Module sin.180; Module	1.88/0.47 0.10	0.96/0.24 0.10	1.88/0.47 0.10	0.96/0.24 0.10	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500				V
紧固力矩	基板安装 $M_i: 5 \pm 0.75$					Nm
贮存温度	-40 $^{\circ}\text{C}$ ~+125 $^{\circ}\text{C}$					
模块外形						

* 含有续流二极管

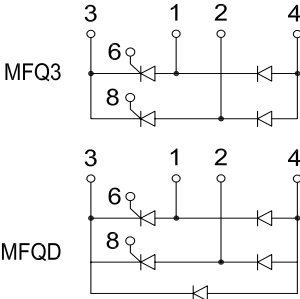


图 1.7.1-1 电路结构图

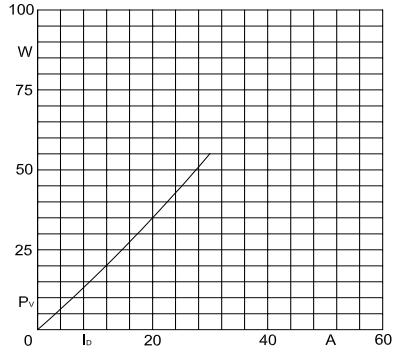


图 1.7.1-2 MFQ(D)30 P_V - I_D 曲线

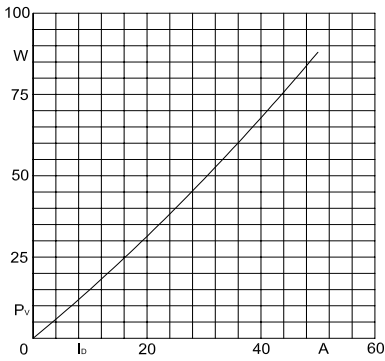


图 1.7.1-3 MFQ(D)50 P_V - I_D 曲线

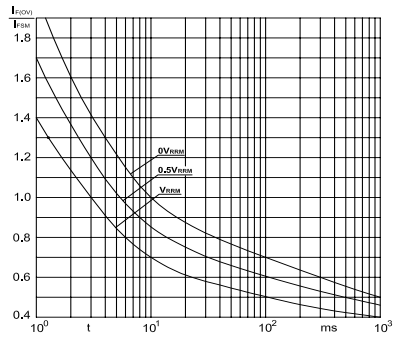


图 1.7.1-4 过电流与时间曲线

1.7.2 30A~50A 单相半控整流桥模块

符号	测试条件	MFQ3 30	MFQ3 50	MFQD 30*	MFQD 50*	单位
V_{RRM} I_{RRM}	$T_j=125^\circ\text{C}$	800~1600 6				V mA
I_o	$T_c=80^\circ\text{C}$	30	50	30	50	A
I_{FSM} I_{Tt}	$T_j=125^\circ\text{C}; 10\text{ ms}$	250 0.32	320 0.52	250 0.32	320 0.52	A kA ² s
di/dt dv/dt	$T_j=125^\circ\text{C}$	100 500				A/ μs V/ μs
I_{GT} V_{GT}	$T_j=25^\circ\text{C}$	100 2.5				mA V
V_{TM}	$T_j=25^\circ\text{C}; I_{TM}=1.57I_o$	1.40	1.40	1.40	1.40	V
V_{TO} r_T	$T_j=125^\circ\text{C}$	1.0 3.15	0.85 2.88	1.0 3.15	0.85 2.88	V m Ω
R_{jc} R_{ch}	sin.180; chip/Module sin.180; Module	2.08/0.52 0.08	1.28/0.32 0.08	2.08/0.52 0.08	1.28/0.32 0.08	$^\circ\text{C}/\text{W}$ $^\circ\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500				V
紧固力矩	基板安装 $M_1: 5 \pm 0.75$ 接线端子 $M_2: 3 \pm 0.45$					Nm Nm
贮存温度	-40 $^\circ\text{C}$ ~+125 $^\circ\text{C}$					
模块外形						

* 含有续流二极管

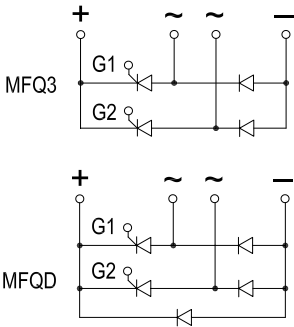


图 1.7.2-1 电路结构图

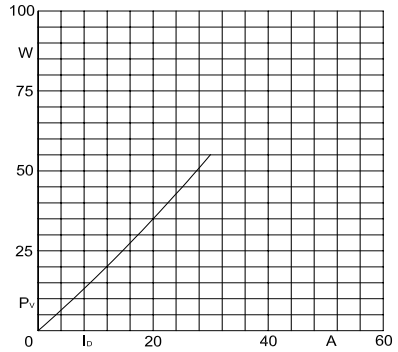


图 1.7.2-2 MFQ(D)30 P_V-I_D 曲线

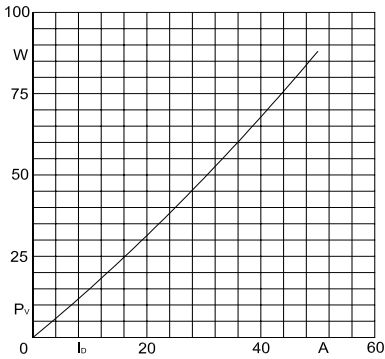


图 1.7.2-3 MFQ(D)50 P_V-I_D 曲线

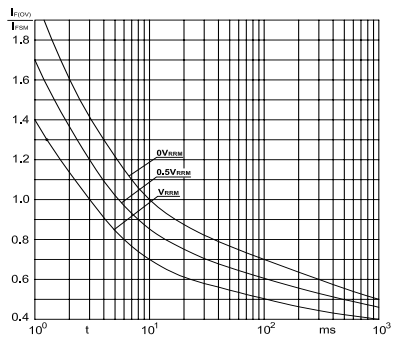


图 1.7.2-4 过电流与时间曲线

1.7.3 110A~175A 三相半控整流桥模块

符号	测试条件	MFS2 110	MFS2 175	单位
V_{RRM} I_{RRM}	$T_j=125^{\circ}\text{C}$	1200~1600 5	1200~1600 8	V mA
I_{dAV}	$T_c=80^{\circ}\text{C}$	110	175	A
I_{TSM}, I_{FSM} I_{Tt}, I_{Ft}	$T_j=125^{\circ}\text{C}; 10\text{ ms}$	1150 6.6	1500 11.2	A kA ² s
di/dt dv/dt	$T_j=125^{\circ}\text{C}$		150 1000	A/ μs V/ μs
I_{GT} V_{GT}	$T_j=25^{\circ}\text{C}$		100 1.5	mA V
I_{GD} V_{GD}	$T_j=125^{\circ}\text{C}$		6 0.25	mA V
V_{TM}, V_{FM}	$T_j=25^{\circ}\text{C}; I_T/I_F=200\text{A}$	1.75	1.50	V
V_{TO} r_T	$T_j=125^{\circ}\text{C}$	0.90 3.2	0.90 2.0	V m Ω
R_{jc} R_{ch}	sin.180; chip/Module sin.180; Module	0.65/0.108 0.15	0.46/0.077 0.15	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500		V
紧固力矩	基板安装 $M_1: 5 \pm 0.75$ 接线端子 $M_2: 5 \pm 0.75$			Nm Nm
贮存温度	$-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$			
模块外形				

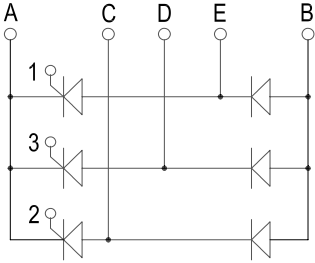


图 1.7.3-1 电路结构图

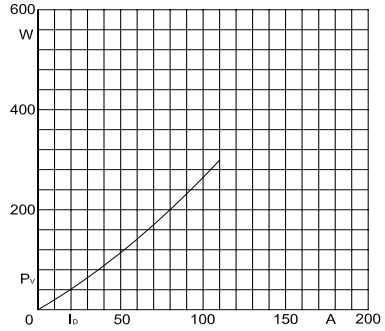


图 1.7.3-2 MFS2 110 P_v-I_D 曲线

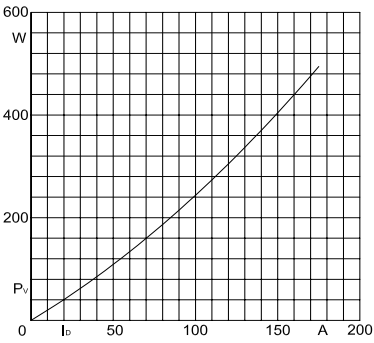


图 1.7.3-3 MFS2 175 P_v-I_D 曲线

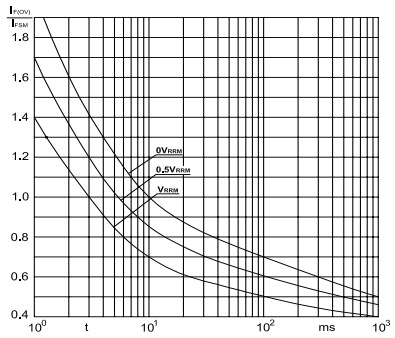


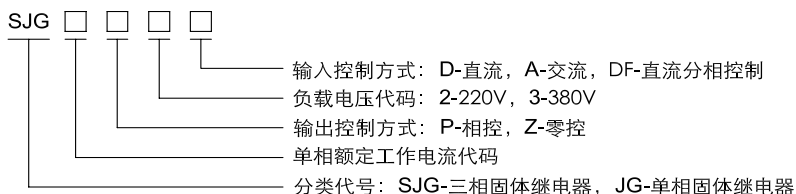
图 1.7.3-4 过电流与时间曲线

The page features several overlapping rectangular blocks in various shades of blue, ranging from light sky blue to dark navy blue. These blocks are arranged in a stepped, descending pattern from the top left towards the bottom right, creating a modern, abstract background for the title.

固体继电器

固体继电器（单相晶闸管反并联输出）是由微电子技术、光电隔离技术与电力半导体技术相结合的无触点继电器，可广泛应用于航空、矿山、化工、电控、防爆、通信、医疗仪器等行业。

固体继电器型号与分类：



固体继电器使用时请注意：

- 为确保良好的热接触，必须加装散热器。散热器的接触面必须清洁，表面的平面度应小于 $20\ \mu\text{m}$ ，表面粗糙度应小于 $10\ \mu\text{m}$ 。在安装散热器之前，应在固体继电器与散热器接触面间均匀涂敷导热硅脂。

- 应用能承受规定扭矩的高张力 M5 钢螺丝紧固，必须使用平垫和弹垫。安装 3 小时后，在紧固力的作用下，硅脂会从接触面挤出，应再次紧固螺丝，以达到规定的扭矩。

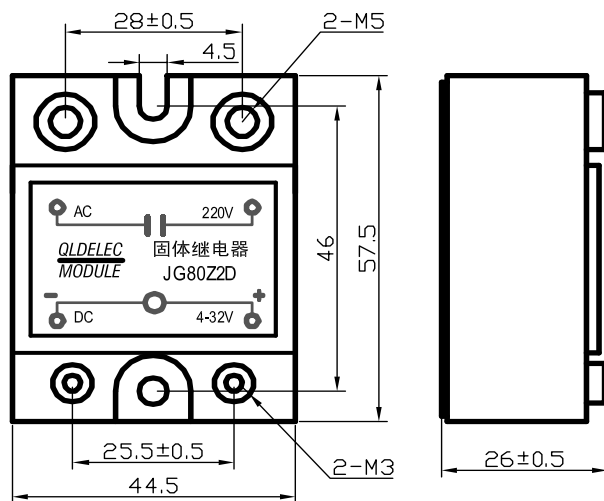
（紧固力矩请参阅本手册相关内容）

- 紧固直按对角顺序分 2~3 次紧固。
- 外加阻容吸收回路和压敏电阻，以保护固体继电器。
- 通电前请确认接线正确，避免因接线错误导致设备损坏等故障。

2.1.1 20A~100A 单相交流固体继电器

符号	测试条件	JG20	JG40	JG60	JG80	JG100	单位
V_{RMS} I_R V_P	$T_J=80^{\circ}\text{C}$			220~380 20 800/1200			V mA V
V_C I_C V_{ON} V_{OFF}	$T_J=25^{\circ}\text{C}$			4.0~32 20 4.0 1.0			V mA V V
I_e	sin.180; r.m.s.; $T_C=80^{\circ}\text{C}$	20	40	60	80	100	A
I_{TSM} I_t	$T_J=25^{\circ}\text{C}$; 10 ms	200 0.2	400 0.8	600 1.8	800 3.2	1000 5	A kA ² s
dv/dt	$T_J=25^{\circ}\text{C}$			500			V/ μ s
V_T	$T_J=25^{\circ}\text{C}$; $I_{RMS}=I_e$			1.60			V
R_{jc} R_{ch}	sin.180	1.30 0.05	0.60 0.05	0.45 0.05	0.30 0.05	0.25 0.05	$^{\circ}\text{C}/\text{W}$ $^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min			2500			V
紧固力矩	基板安装 $M_1: 5 \pm 0.75$ 接线端子 $M_2: 3 \pm 0.45$						Nm Nm
贮存温度	$-25^{\circ}\text{C} \sim +65^{\circ}\text{C}$						

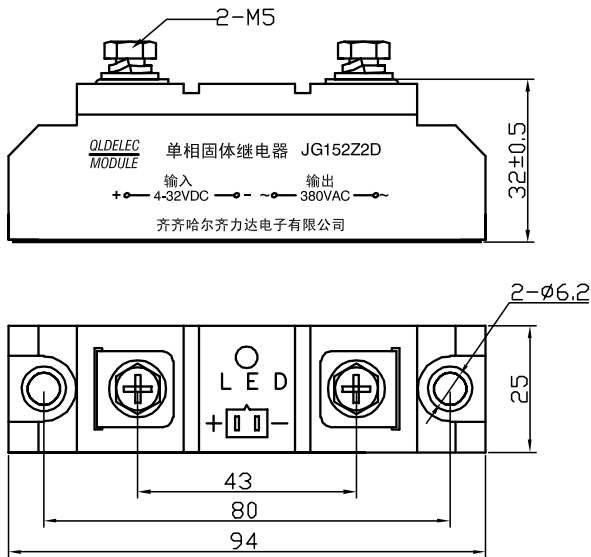
外形尺寸



2.1.2 120A~150A 单相交流固体继电器

符号	测试条件	JG122	JG152	单位
V_{RMS} I_R V_P	$T_J=80^\circ\text{C}$		220~380 20 800/1200	V mA V
V_C I_C V_{ON} V_{OFF}	$T_J=25^\circ\text{C}$		4.0~32 20 4.0 1.0	V mA V V
I_e	sin.180; r.m.s.; $T_C=80^\circ\text{C}$	120	150	A
I_{TSM} I_t	$T_J=25^\circ\text{C}$; 10 ms	1200 7.2	1500 11	A kA ² s
dv/dt	$T_J=25^\circ\text{C}$		500	V/ μs
V_T	$T_J=25^\circ\text{C}$; $I_{RMS}=I_e$		1.60	V
R_{jc} R_{ch}	sin.180	0.20 0.10	0.16 0.10	$^\circ\text{C}/\text{W}$ $^\circ\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min		2500	V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 3 ± 0.45			Nm Nm
贮存温度	$-25^\circ\text{C} \sim +65^\circ\text{C}$			

外形尺寸



2.1.3 200A~400A 单相交流固体继电器

符号	测试条件	JG202	JG252	JG302	JG352	JG402	单位
V_{RMS} I_R V_P	$T_j=80^\circ\text{C}$			220~380 20 800/1200			V mA V
V_C I_C V_{ON} V_{OFF}	$T_j=25^\circ\text{C}$			4.0~32 20 4.0 1.0			V mA V V
I_e	sin.180; r.m.s.; $T_c=80^\circ\text{C}$	200	250	300	350	400	A
I_{TSM} I_t	$T_j=25^\circ\text{C}$; 10 ms	2000 20	2500 31	3000 45	3300 54.4	3800 72	A kA ² s
dv/dt	$T_j=25^\circ\text{C}$			500			V/ μs
V_T	$T_j=25^\circ\text{C}$; $I_{RMS}=I_e$			1.60			V
R_{jc} R_{ch}	sin.180	0.18 0.05	0.16 0.05	0.14 0.05	0.13 0.05	0.12 0.05	$^\circ\text{C/W}$ $^\circ\text{C/W}$
V_{ISOL}	50Hz; r.m.s.; 1 min			2500			V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 5 ± 0.75						Nm Nm
贮存温度	$-25^\circ\text{C} \sim +65^\circ\text{C}$						
外形尺寸							

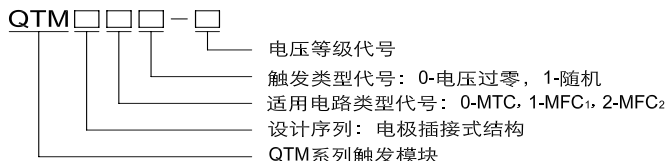
2.2 20A~100A 三相交流固体继电器

符号	测试条件	SJG20	SJG40	SJG60	SJG80	SJG100	单位
V_{RMS} I_R V_P	$T_j=80^\circ\text{C}$			380 20 1200			V mA V
V_C I_C V_{ON} V_{OFF}	$T_j=25^\circ\text{C}$			9.0~32 20 6.0 2.0			V mA V V
I_e	sin.180; r.m.s.; $T_c=80^\circ\text{C}$	20	40	60	80	100	A
I_{TSM} I_t	$T_j=25^\circ\text{C}$; 10 ms	200 0.2	400 0.8	600 1.8	800 3.2	1000 5	A kA ² s
dv/dt	$T_j=25^\circ\text{C}$	500					V/ μs
V_T	$T_j=25^\circ\text{C}$; $I_{RMS}=I_e$	1.60					V
R_{IC} R_{ch}	sin.180	0.45 0.015	0.25 0.015	0.15 0.015	0.12 0.015	0.10 0.015	$^\circ\text{C}/\text{W}$ $^\circ\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	2500					V
紧固力矩	基板安装 M_1 : 5 ± 0.75 接线端子 M_2 : 3 ± 0.45						Nm Nm
贮存温度	$-25^\circ\text{C} \sim +65^\circ\text{C}$						
外形尺寸							

晶闸管触发装置

3.1 QTM500 系列触发模块

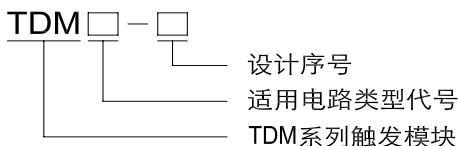
本系列触发模块采用 IGBT 作为驱动元件，是脉冲变压器触发电路的换代产品。传统的触发电路一般由 MOC 系列光电耦合器构成，当断态电压上升率 dv/dt 过大时会导致光电耦合器误导通。与 MOC 系列光耦触发电路相比，本产品具有触发功率大、抗干扰能力强等特点，特别适合于电磁环境较为复杂的场合使用，如无源滤波、功率因数补偿设备的电容投切等。



特性参数	符号	参数值
主回路电压 正反向重复峰值电压	V_{RMS} V_{DRM}/V_{RRM}	380 V 1200 V~1600 V
控制电压 控制电流	V_C I_C	4.0 V~32 V 20 mA
输入压降 ($I_C=12$ mA) 输入端反向击穿电压	V_{in} V_{inr}	1.5 V 6 V
开通延迟时间 交流端电压上升率	t_{gd} dv/dt	25 μ s 2000 V/ μ s
过零电压	V_O	20 V
输入输出间绝缘电压 (50 Hz, r.m.s., 1 min)	V_{ISOL}	2500 V
贮存温度	-25°C ~+85°C	
模块外形		

- 各接线端必须接触良好，不可虚接或悬空；
- 通电前请确认接线正确，避免因接线错误导致元件、设备损坏等故障。

3.2 TDM 晶闸管触发模块



电路类型代号:

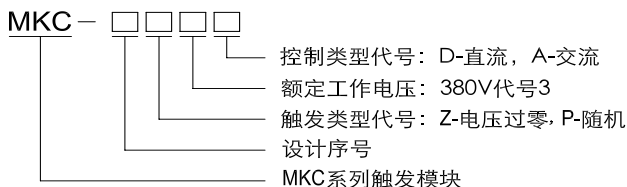
- 1——适用于 MFC1 型模块;
- 2——适用于 MFC2 型模块;
- 3——适用于感性负载的 MTC 型模块;
- 4——适用于 MTC 型模块。

产品主要技术性能指标:

特性参数	符号	参数值	单位
主回路电压	V_{RMS}	380	V
正反向重复峰值电压	V_{DRM}/V_{RRM}	1600	V
控制晶闸管最大触发电流	I_C	100	mA
控制电压	V_C	4.0~32	V
控制电流范围	I_C	20	mA
输入端反向击穿电压	V_{inr}	6	V
过零电压	V_O	12	V
交流端电压上升率	dv/dt	1000	V/ μ s
输入输出间绝缘电压 (50 Hz, r.m.s., 1 min)	V_{ISOL}	2500	V
贮存温度	-25℃ ~+85℃		
模块外形			

- 各接线端必须接触良好，不可虚接或悬空；
- 通电前请确认接线正确，避免因接线错误导致元件、设备损坏等故障。

3.3 MKC 晶闸管触发模块



产品主要技术性能指标：

特性参数	符号	参数值	单位
主回路电压	V_{RMS}	380	V
正反向重复峰值电压	V_{DRM}/V_{RRM}	1600	V
控制晶闸管最大触发电流	I_G	100	mA
控制电压	V_C	4~32	V
控制电流范围	I_C	20	mA
输入端反向击穿电压	V_{inr}	6	V
过零电压	V_O	12	V
交流端电压上升率	dv/dt	1000	V/ μ s
输入输出间绝缘电压 (50 Hz, r.m.s., 1 min)	V_{ISOL}	2500	V
贮存温度	-25℃ ~+85℃		
模块外形			

- 各接线端必须接触良好，不可虚接或悬空；
- 通电前请确认接线正确，避免因接线错误导致元件、设备损坏等故障。

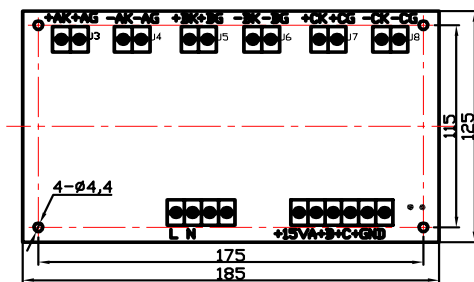
3.4 QTC 晶闸管三相有源触发控制器

产品采用高可靠的晶闸管电压过零触发电路，三相独立控制，采用脉冲变压器输出，具有较大的输出功率。适用于三相交流无触点开关电路，特别是三相共补电容器的交流无触点开关装置。

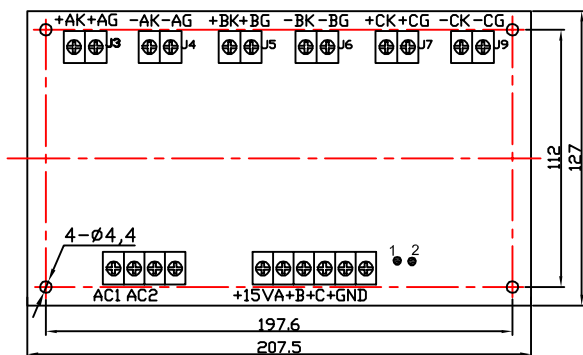
特性参数	符号	QTC-3LP	QTC-3MP	QTC-3HP
主回路电压	V_{RMS}	380 V	660 V	1140 V
控制极触发电流	I_G	≥ 600 mA		
控制极触发电压	V_G	≥ 5 V		
最大功率损耗	P_M	10 W		
工作电源电压	V_{in}	220 V_{AC}		
输入输出间绝缘电压 (50 Hz, r.m.s., 1 min)	V_{ISOL}	2500 V	2500 V	3500 V
控制方式	接点控制或直流电压 (5V~24V) 控制			
贮存温度	-25°C ~+85°C			

本产品为 PCB 板式结构，可垂直或水平安装

外形尺寸



QTC-3LP、QTC-3MP 外形图



QTC-3HP 外形图

端子	定义与说明
+AK、+AG	A 相电路正向晶闸管阴极、门极控制端子
-AK、-AG	A 相电路反向晶闸管阴极、门极控制端子
+BK、+BG	B 相电路正向晶闸管阴极、门极控制端子
-BK、-BG	B 相电路反向晶闸管阴极、门极控制端子
+CK、+CG	C 相电路正向晶闸管阴极、门极控制端子
-CK、-CG	C 相电路反向晶闸管阴极、门极控制端子
L、N	220 V _{AC} 工作电源接线端子
+15V	+15V 电压输出端子
GND	公共端子
A+、B+、C+	A、B、C 相控制输入端子，高电平有效。

控制方式:

● 采用开关控制: 输入端子 A+、B+、C+ 分别对应 +15V 连接, GND 悬空, 焊盘 1 与焊盘 2 必须短接。出厂默认为开关控制方式。

● 采用外部电平信号控制: 输入端子 A+、B+、C+ 分别对应 GND 连接, +15V 悬空, 焊盘 1 与焊盘 2 必须断开。

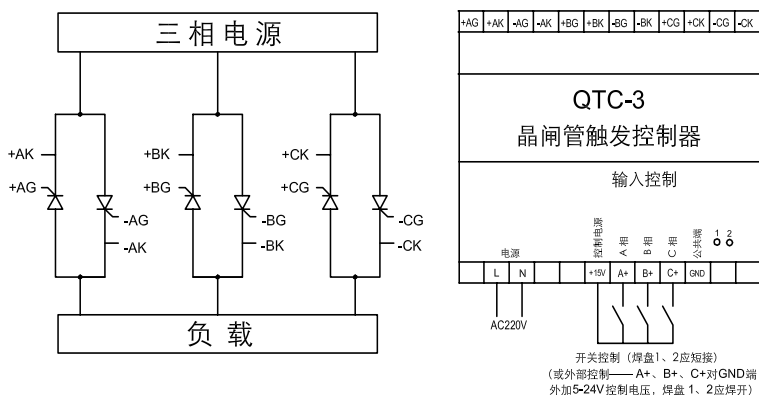
注意事项:

● 为防止干扰, 建议控制线、交流电源线分别接线, 并尽可能短, 控制线应使用综合屏蔽线。

● 通电前检查接线, 并用万用表检查电源线间及与其它控制线间绝缘, 确保一切正确无误。

● 脱离负载, 用白炽灯或电炉接成与工作电压相适应的连接形式做试验负载, 经试验确认无误后, 再恢复实际负载。

● 输出各端子要严格对应每一相的晶闸管, 否则会造成相间短路。



晶闸管交流开关电路接线图

软起动器专用晶闸管组件

4.1 单面散热 MTX 系列晶闸管模块组件

MTX 系列晶闸管模块组件专为矿用 1140V 软起动器而研究设计，与平板型元件相比，因组件的基板绝缘，可将组件直接安装固定在防爆箱体上，不仅使整机产品的结构设计更为合理，而且能够将模块的热功通过防爆箱体传导至外界，减少防爆箱内的热量蓄积。

产品技术性能指标：

符号	测试条件	MTX500	MTX800	单位
V_{DRM}/V_{RRM} I_{DRM}/I_{RRM}	$T_J=125^{\circ}\text{C}$	4000 30	4000 50	V mA
I_{overload}	W1C; sin.180; ≥ 25 sec; $T_J=125^{\circ}\text{C}$; $T_{j\text{start}}=35^{\circ}\text{C}$	500	800	A
I_{TSM} I_t^2	$T_J=125^{\circ}\text{C}$; 10 ms	7 245	11 605	kA kA ² s
di/dt dv/dt	$T_J=125^{\circ}\text{C}$	150 1000	150 1000	A/ μ s V/ μ s
I_H	$T_J=25^{\circ}\text{C}$	20~250	20~250	mA
V_{TM}	$T_J=25^{\circ}\text{C}$; $I_{TM}=1000\text{A}$	2.62	2.23	V
V_{TO} r_T	$T_J=125^{\circ}\text{C}$	1.15 1.47	1.15 1.08	V m Ω
V_{GT} I_{GT}	$T_J=25^{\circ}\text{C}$	3 150	3 150	V mA
V_{GD} I_{GD}	$T_J=125^{\circ}\text{C}$	0.25 10	0.25 10	V mA
R_{jc}	sin.180	0.048	0.045	$^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	4200		V
紧固力矩	接线紧固力矩: 12 ± 1.8			Nm
贮存温度	-40 $^{\circ}\text{C}$ ~+125 $^{\circ}\text{C}$			

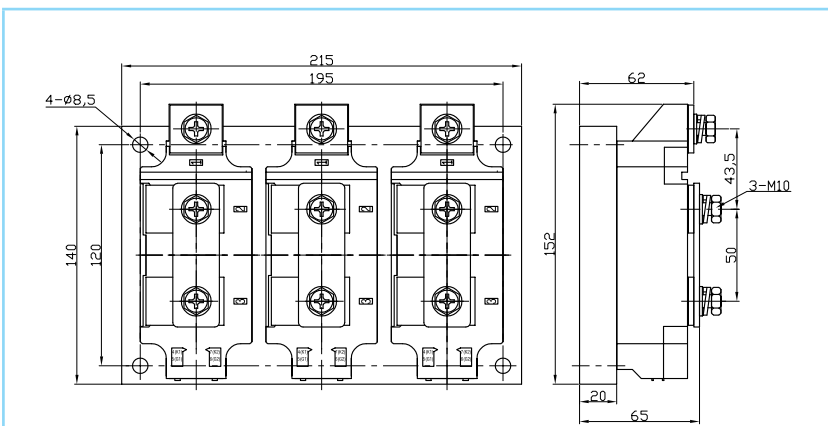


图 4.1 MTX500 外形结构图

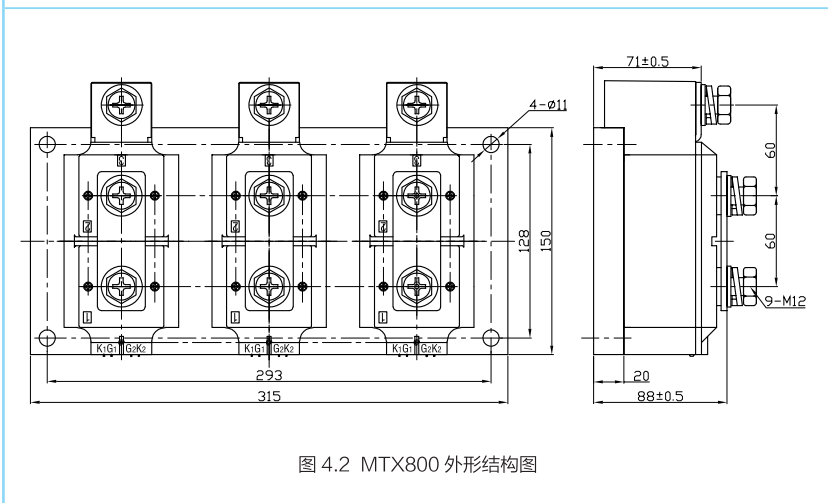


图 4.2 MTX800 外形结构图

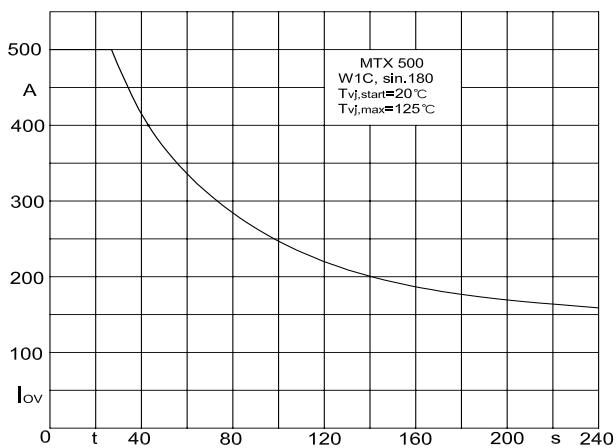


图 4.3 MTX500 电流时间曲线

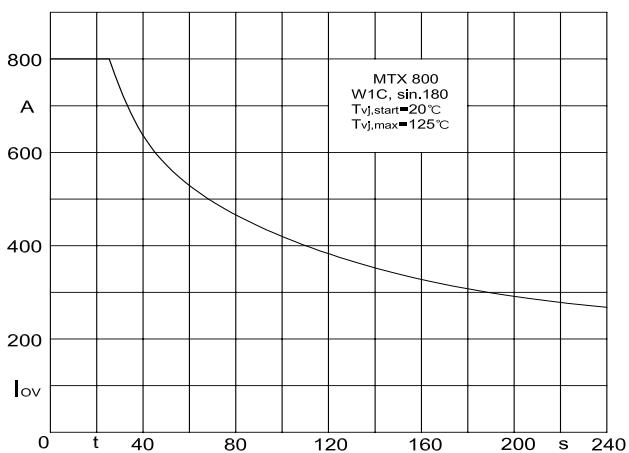


图 4.4 MTX800 电流时间曲线

4.2 双面散热 MTX 系列晶闸管模块组件

双面散热 MTX 系列晶闸管模块组件，采用新型结构，既有平板型元件双面散热的特点，同时因组件的基板绝缘，可将组件直接安装固定在防爆箱体上，不仅使整机产品的结构设计更为合理，而且能够将模块的热功通过防爆箱体传导至外界，减少防爆箱内的热量蓄积。

1200A~1600A 组件技术性能指标：

符号	测试条件	MTX1200	MTX1600	单位
V_{DRM}/V_{RRM} I_{DRM}/I_{RRM}	$T_j=125^{\circ}\text{C}$	4000 100	4000 100	V mA
I_{overload}	W1C; sin.180; ≥ 25 sec; $T_j=125^{\circ}\text{C}$; $T_{j\text{start}}=35^{\circ}\text{C}$	1200	1600	A
I_{TSM} I_{Tt}^2	$T_j=125^{\circ}\text{C}$; 10 ms	13 845	15 1125	kA kA ² s
di/dt dv/dt	$T_j=125^{\circ}\text{C}$	150 1000	150 1000	A/ μs V/ μs
I_H	$T_j=25^{\circ}\text{C}$	20~250	20~250	mA
V_{TM}	$T_j=25^{\circ}\text{C}$; $I_{TM}=1500\text{A}$	2.25	2.35	V
V_{TO} r_T	$T_j=125^{\circ}\text{C}$	1.18 0.85	1.15 0.80	V m Ω
V_{GT} I_{GT}	$T_j=25^{\circ}\text{C}$	3 150	3 150	V mA
V_{GD} I_{GD}	$T_j=125^{\circ}\text{C}$	0.25 10	0.25 10	V mA
R_{jc}	sin.180	0.032	0.030	$^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	4200		V
紧固力矩	接线紧固力矩: 12 ± 1.8			Nm
贮存温度	$-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$			

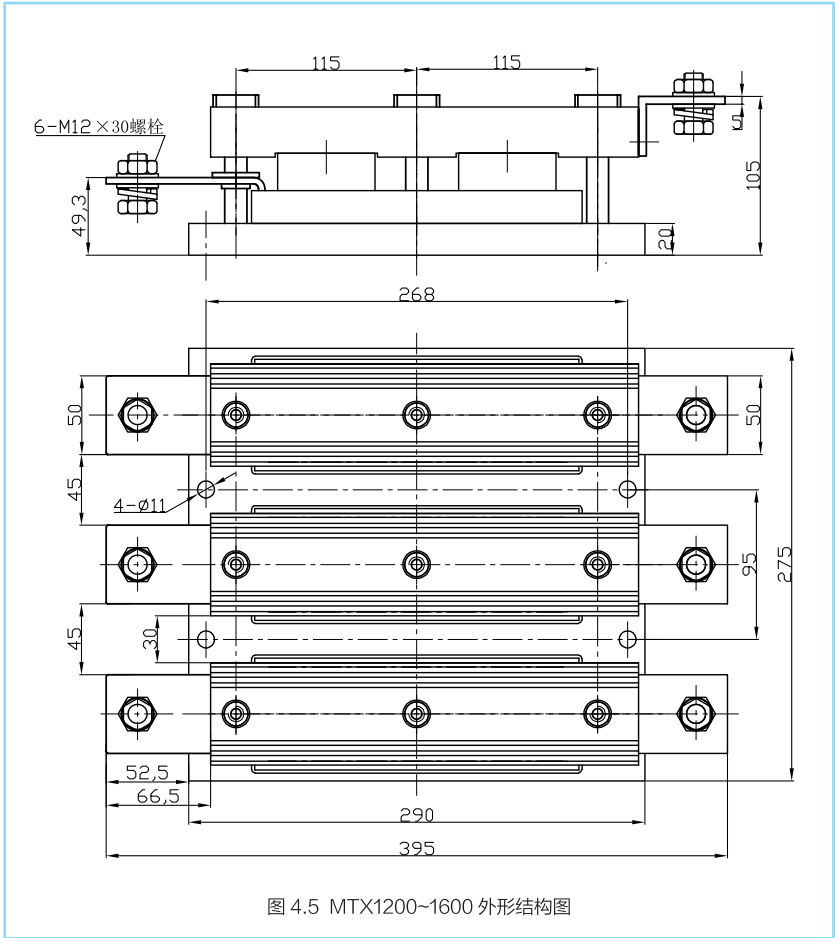


图 4.5 MTX1200~1600 外形结构图

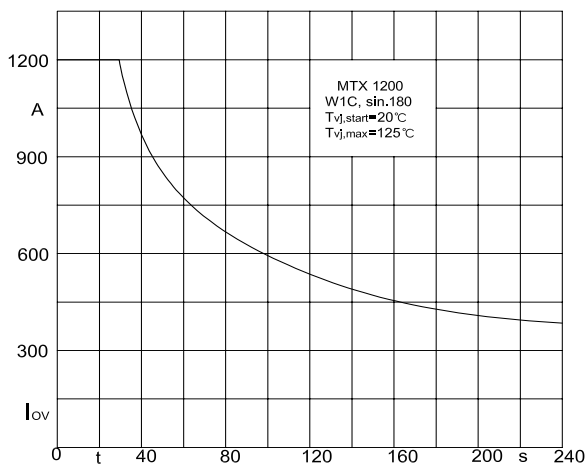


图 4.6 MTX1200 电流时间曲线

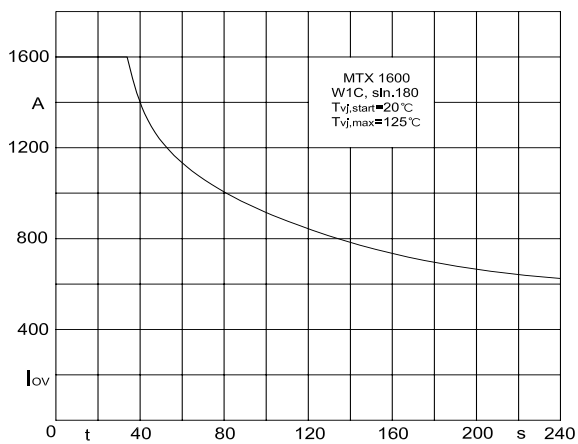
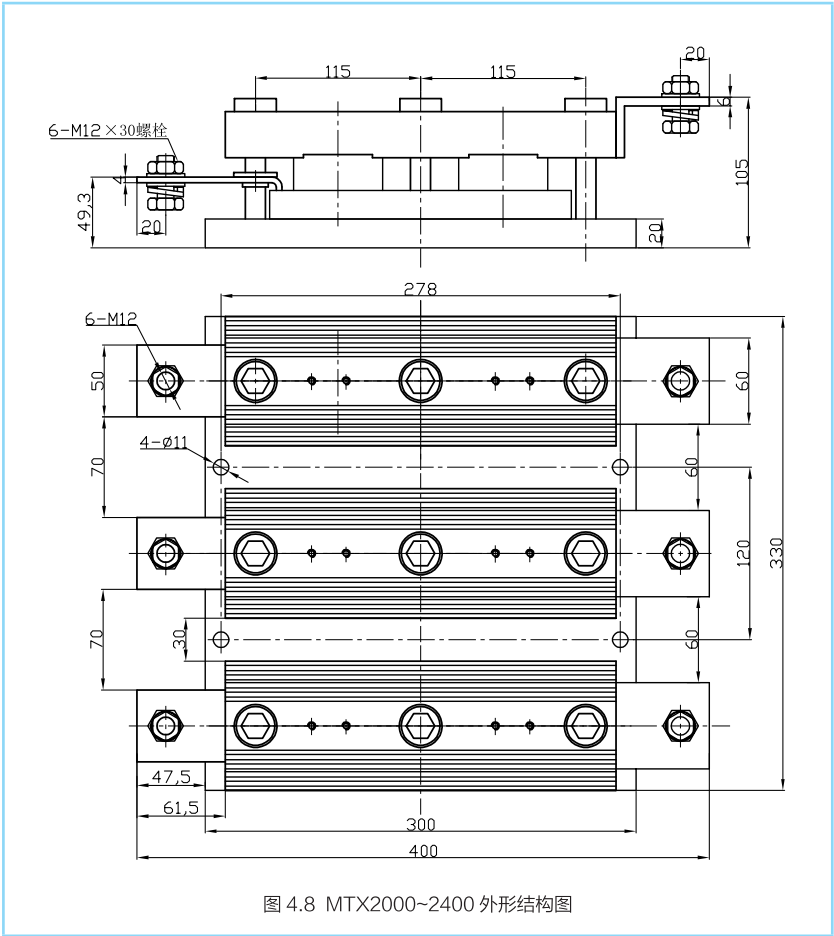


图 4.7 MTX1600 电流时间曲线

2000A~2400A 组件技术性能指标:

符号	测试条件	MTX2000	MTX2400	单位
V_{DRM}/V_{RRM} I_{DRM}/I_{RRM}	$T_j=125^{\circ}\text{C}$	4000 100	4000 100	V mA
I_{overload}	W1C; sin.180; ≥ 25 sec; $T_j=125^{\circ}\text{C}$; $T_{j\text{start}}=35^{\circ}\text{C}$	2000	2400	A
I_{TSM} I_{Tt}^2	$T_j=125^{\circ}\text{C}$; 10 ms	17.8 1584	21 2205	kA kA^2s
di/dt dv/dt	$T_j=125^{\circ}\text{C}$	150 1000	150 1000	$\text{A}/\mu\text{s}$ $\text{V}/\mu\text{s}$
I_H	$T_j=25^{\circ}\text{C}$	20~250	20~250	mA
V_{TM}	$T_j=25^{\circ}\text{C}$; $I_{TM}=1500\text{A}$	2.17	1.95	V
V_{TO} r_T	$T_j=125^{\circ}\text{C}$	1.15 0.68	1.15 0.53	V $\text{m}\Omega$
V_{GT} I_{GT}	$T_j=25^{\circ}\text{C}$	3 150	3 150	V mA
V_{GD} I_{GD}	$T_j=125^{\circ}\text{C}$	0.25 10	0.25 10	V mA
R_{jc}	sin.180	0.027	0.025	$^{\circ}\text{C}/\text{W}$
V_{ISOL}	50Hz; r.m.s.; 1 min	4200		V
紧固力矩	接线紧固力矩: 12 ± 1.8			Nm
贮存温度	$-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$			



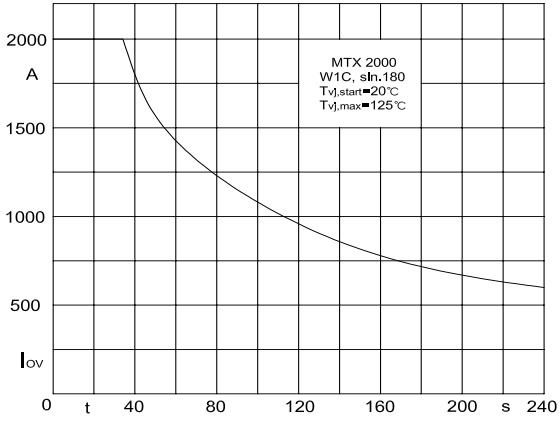


图 4.9 MTX2000 电流时间曲线

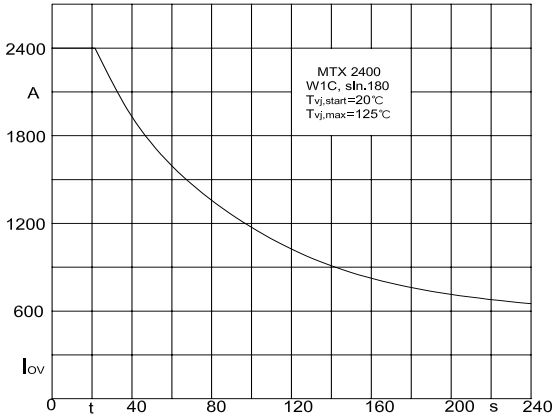


图 4.10 MTX2400 电流时间曲线

附录 A

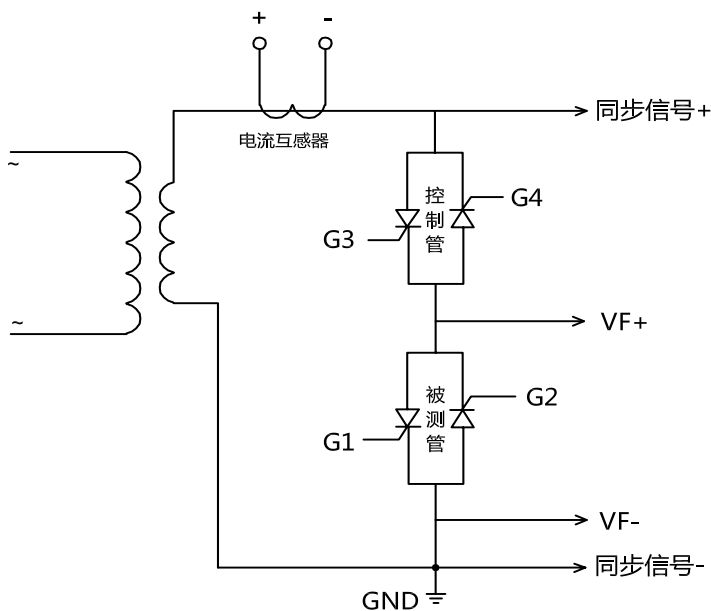
反并联晶闸管热学特性测试

为充分保证产品质量，满足客户在晶闸管模块产品应用中的需要，我公司自行设计了一台晶闸管热学特性测试仪。该设备不仅可以测试晶闸管、整流管的热阻，最主要的是可以根据晶闸管实际的工作电流和相应的散热条件下，模拟测试出晶闸管实际工作时的结温，为晶闸管应用整机产品的设计提供设计验证。

短时工作制下，我们对部分晶闸管模块进行电流耐受能力试验，原理如下：

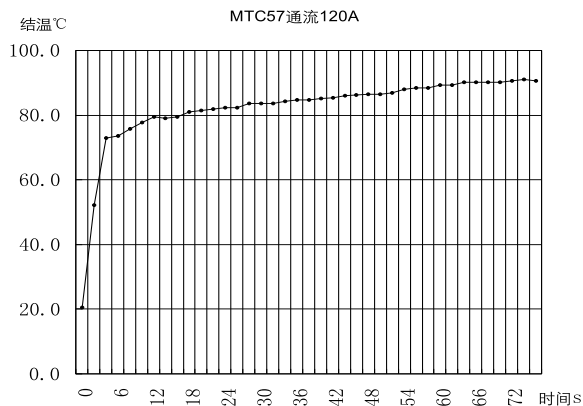
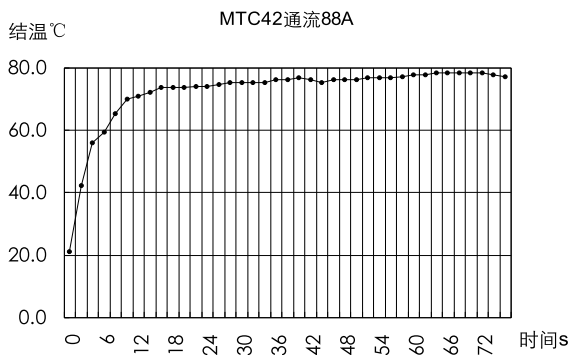
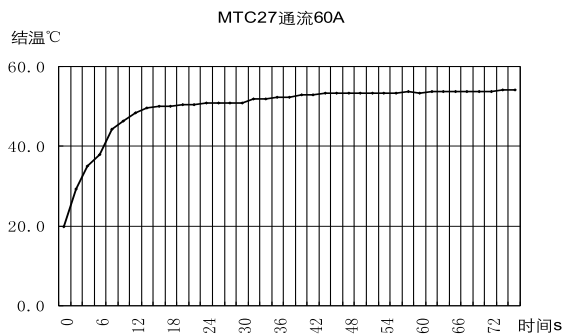
利用环境试验设备和晶闸管热学特性测试设备，得到晶闸管在一系列温度下对应的热敏电压，从而绘制出晶闸管的热敏特性曲线，该曲线近似一条直线。这些曲线在晶闸管短时工作制状态可作为参考，我们可针对顾客的个性化需求提供单独的热学性能验证。

进行大电流试验时，利用晶闸管热学特性测试设备读取各时间点的热敏电压值，对照热敏特性曲线即可得到与之相对应的结温。

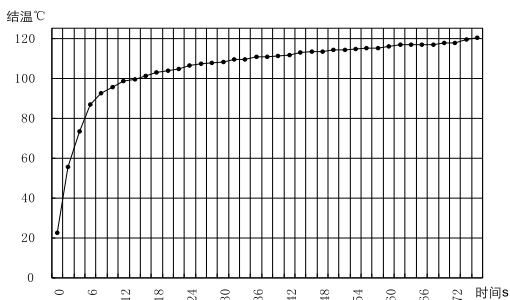


晶闸管热学特性测试主电路原理图

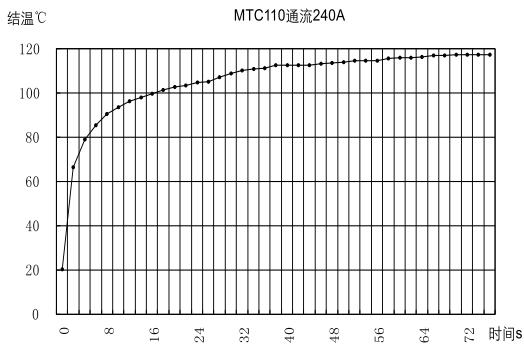
部分晶闸管模块的温升曲线如下，仅供参考。试验条件：环境温度 20℃，3 支模块平行安装在一块散热器上，散热器为 DXC616，长度 150mm，自然冷却，测量中间模块的温升。



MTC92通流144A

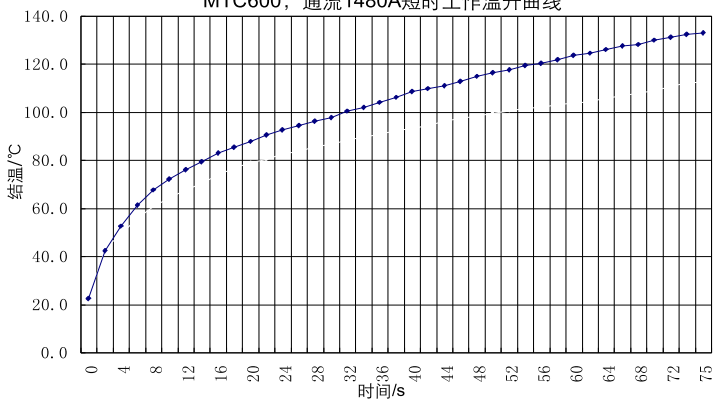


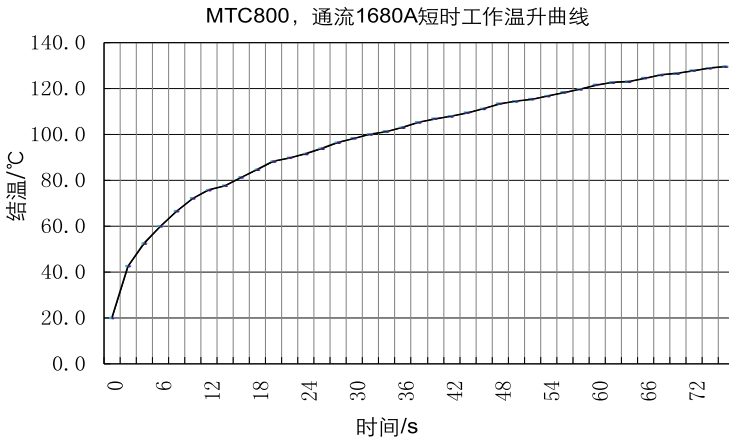
MTC110通流240A



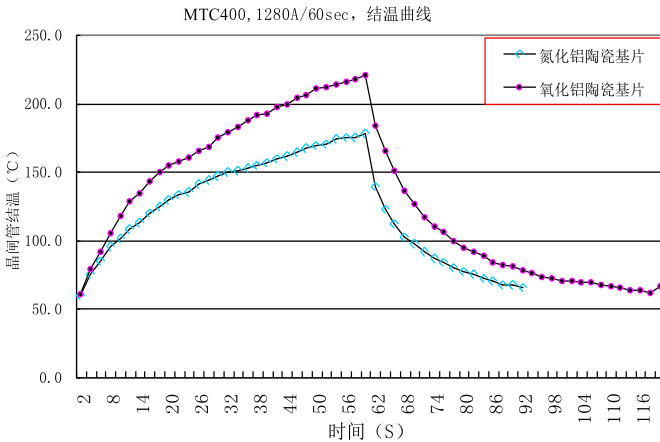
以下MTC600和MTC800模块的通流试验，采用300mm×150mm×12mm铝板散热，环境温度20℃。

MTC600，通流1480A短时工作温升曲线





氧化铝陶瓷与氮化铝陶瓷的热导率有较大差异，我们就相同的晶闸管芯片分别采用氧化铝陶瓷基片、氮化铝陶瓷基片，通流 60 秒后撤掉电流，并从通流起监视其结温，得到以下曲线。



QJD ELEG

Power Semiconductor Module

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