SIEMENS

SIMATIC

S7-1500/ET 200MP

工艺模块 **TM Timer DIDQ 16x24V (6ES7552-1AA00-0AB0)**

设备手册

版本 08/2014

Answers for industry.

SIEMENS

SIMATIC

ET 200MP/S7-1500
工艺模块 TM Timer DIDQ 16x24V
(6ES7552-1AA00-0AB0)

设备手册

08/2014

A5E34078542-AA

法律资讯

警告提示系统

为了您的人身安全以及避免财产损失，必须注意本手册中的提示。人身安全的提示用一个警告三角表示，仅与财产损失有关的提示不带警告三角。警告提示根据危险等级由高到低如下表示。

⚠危险
表示如果不采取相应的小心措施，**将会**导致死亡或者严重的人身伤害。

⚠警告
表示如果不采取相应的小心措施，**可能**导致死亡或者严重的人身伤害。

⚠小心
表示如果不采取相应的小心措施，可能导致轻微的人身伤害。

注意
表示如果不采取相应的小心措施，可能导致财产损失。

当出现多个危险等级的情况下，每次总是使用最高等级的警告提示。如果在某个警告提示中带有警告可能导致人身伤害的警告三角，则可能在该警告提示中另外还附带有可能导致财产损失的警告。

合格的专业人员

本文件所属的产品/系统只允许由符合各项工作要求的**合格人员**进行操作。其操作必须遵照各自附带的文件说明，特别是其中的安全及警告提示。
由于具备相关培训及经验，合格人员可以察觉本产品/系统的风险，并避免可能的危险。

按规定使用Siemens 产品

请注意下列说明：

⚠警告
Siemens 产品只允许用于目录和相关技术文件中规定的使用情况。如果要使用其他公司的产品和组件，必须得到 Siemens 推荐和允许。正确的运输、储存、组装、装配、安装、调试、操作和维护是产品安全、正常运行的前提。必须保证允许的环境条件。必须注意相关文件中的提示。

商标

所有带有标记符号 ® 的都是西门子股份有限公司的注册商标。本印刷品中的其他符号可能是一些其他商标。若第三方出于自身目的使用这些商标，将侵害其所有者的权利。

责任免除

我们已对印刷品中所述内容与硬件和软件的一致性作过检查。然而不排除存在偏差的可能性，因此我们不保证印刷品中所述内容与硬件和软件完全一致。印刷品中的数据都按规定经过检测，必要的修正值包含在下一版本中。

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前言

本文档用途

本手册包含有关具体工艺模块的接线、诊断和技术规范信息。

有关设计和调试 ET 200MP 或 S7-1500 的常规信息，请参见 ET 200MP 或 S7-1500 系统手册。

有关 TM Timer DIDQ 16x24V 工艺模块所支持的“Time-based IO”技术的详细信息，请参见功能手册带 Time-based IO 的高精度输入/输出 (http://support.automation.siemens.com/WW/view/zh/82527590)。

约定

请遵循下面所标注的注意事项：

说明

注意事项包含有关本文档所述的产品、使用该产品或应特别关注的文档部分的重要信息。

安全信息

西门子为其产品及解决方案提供工业安全功能，以支持工厂、解决方案、机器、设备和/或网络的安全运行。 这些功能是整个工业安全机制的重要组成部分。
有鉴于此，西门子不断对产品和解决方案进行开发和完善。
西门子强烈建议您定期检查产品的更新和升级信息。

要确保西门子产品和解决方案的安全操作，还须采取适当的预防措施（例如：设备单元保护机制），并将每个组件纳入全面且先进的工业安全保护机制中。
此外，还需考虑到可能使用的所有第三方产品。 更多有关工业安全的信息，请访问 Internet (http://www.siemens.com/industrialsecurity)。

要及时了解有关产品的更新和升级信息，请订阅相关产品的实事信息。
更多相关信息，请访问 Internet (http://support.automation.siemens.com)。

开源软件

在所述产品的固件中采用了开源软件 (Open Source Software)。 “开源软件”免费提供。 我们根据适用于产品的规定对所述产品及包含在内的开源软件负责。 Siemens 不对开源软件的非预期用途或因修改开源软件引起的任何故障承担任何责任。

出于法律上的原因，我们有责任原文公布许可条件和版权提示。 相关信息请参见附录。

目录

文档指南

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简介

此 SIMATIC 产品的模块化文档涵盖了与您的自动化系统相关的各种主题。
ET 200MP 和 S7-1500 系统的完整文档包含相应的系统手册、功能手册和设备手册。
STEP 7 信息系统 (TIA Portal) 还可帮助您组态和编程自动化系统。

TM Timer DIDQ 16x24V 工艺模块的文档概述

下表列出了使用工艺模块 TM Timer DIDQ 16x24V 时，您将需要的其它文档。

表格 1- 1　TM Timer DIDQ 16x24V 工艺模块的文档

主题	文档	重要内容
系统描述	系统手册 ET 200MP 分布式 I/O 系统 (http://support.automation.siemens.com/WW/view/zh/59193214)	• 应用规划 • 安装 • 连接 • 调试
	S7-1500 自动化系统 (http://support.automation.siemens.com/WW/view/zh/59191792)系统手册	
组态防干扰型控制器	设计防干扰型控制器 (http://support.automation.siemens.com/WW/view/zh/59193566)功能手册	• 基本信息 • 电磁兼容性 • 避雷
Time-based IO	功能手册 带 Time-based IO 的高精度输入/输出 (http://support.automation.siemens.com/WW/view/zh/82527590)	• 基本信息 • 组态 • 编程 • 诊断
等时模式	使用 STEP 7 组态 PROFINET (http://support.automation.siemens.com/WW/view/zh/49948856) 功能手册	• 优点 • 使用 • 参数设置

SIMATIC 手册

SIMATIC 产品的所有最新手册均可从互联网(http://www.siemens.com/automation/service&support)免费下载。

产品总览

2

2.1 属性

部件编号

6ES7552-1AA00-0AB0

模块视图

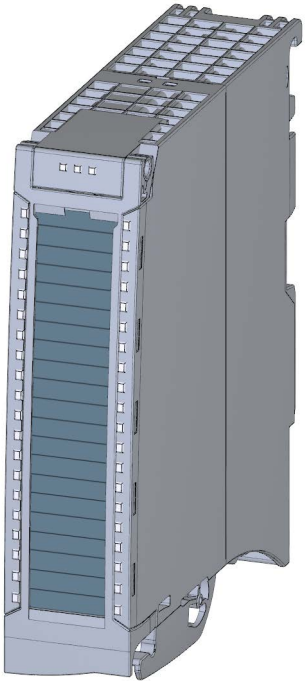


图 2-1 TM Timer DIDQ 16x24V 模块的视图

属性

工艺模块 TM Timer DIDQ 16x24V 具有以下属性：

- 技术特性
  - 16 个数字量输入和输出，按每组 8 个进行电气隔离
  - 数字量输入和输出可以组态为多种组合：

    0 个数字量输入和 16 个数字量输出（适用于具有多个输出的凸轮应用）

    3 个数字量输入和 13 个数字量输出（适用于类似 FM 352 应用的应用）

    4 个数字量输入和 12 个数字量输出（适用于灵活的混合操作）

    8 个数字量输入和 8 个数字量输出（适用于探针和增量编码器）
  - 额定输出电压 24V DC
  - 每个数字量输出的额定输出电流 0.5 A 或 0.1 A（高速操作）
  - 24 V 编码器电源输出，防短路
  - 可组态的替换值（每个数字量输出）
  - 两个电源电压 L+
  - 可组态的诊断
  - 用于抑制数字量输入干扰的可组态输入滤波器
- 数字量输入支持的编码器/信号类型
  - 具有 A 和 B 信号的 24 V 增量编码器
  - 具有 A 信号的 24 V 脉冲编码器
- 所支持的功能
  - 输入和输出的时间戳功能（精度 1 µs）
  - 计数（计数范围 32 位）
  - 输入和输出的Oversampling
  - 脉冲宽度调制
- 支持的系统功能
  - 等时模式
  - 固件更新
  - 标识数据 I&M

附件

以下组件既可以随工艺模块一起提供，也可以作为备件单独订购：

- 屏蔽托架
- 屏蔽端子
- 标签条
- U 形连接器

其它组件：

以下组件需要单独订货：

- 前连接器，包括电位跳线和束线带

2.2 功能

2.2.1 检测输入信号

最多可为工艺模块组态八个数字量输入。 可以针对以下功能评估数字量输入信号：

时间戳检测（Timer DI）

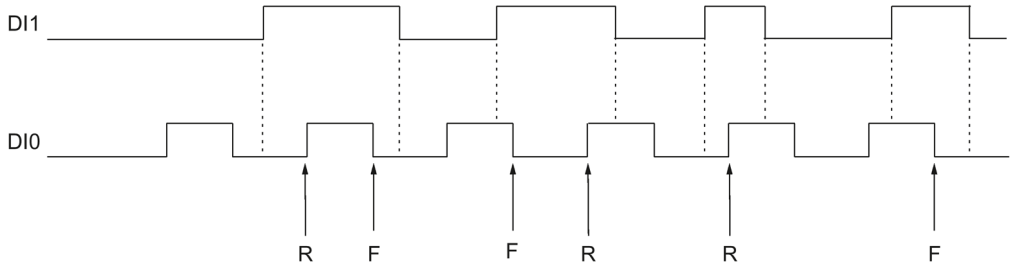
该工艺模块可以检测数字量输入沿的相关时间戳。
时间戳指示检测到沿的时间（相对于时基）。 这些时间戳可用于计算时差。

时间戳基于工艺模块所支持的“Time-based IO”技术且需要等时模式。

硬件使能（HW 使能）

可以通过数字量输入组态硬件使能来检测时间戳。
硬件使能定义采集时间戳的时间窗口。 可通过控制接口 (页 34)的 SETEN 位覆盖硬件使能。

下图显示了在上升沿和下降沿检测时间戳的示例（DI0 通过 DI1 的高电平使能）：



R 在 DI0- 的上升沿检测到的相关时间戳
F 在 DI0 的下降沿检测到的相关时间戳

计数

计数是指对事件进行记录和统计。 最多可为工艺模块组态四个计数器。
可以使用数字量输入上的增量编码器和脉冲编码器。
将对来自增量编码器的两个相移信号进行四次评估。
仅有上升沿或下降沿会通过脉冲编码器信号进行计数。

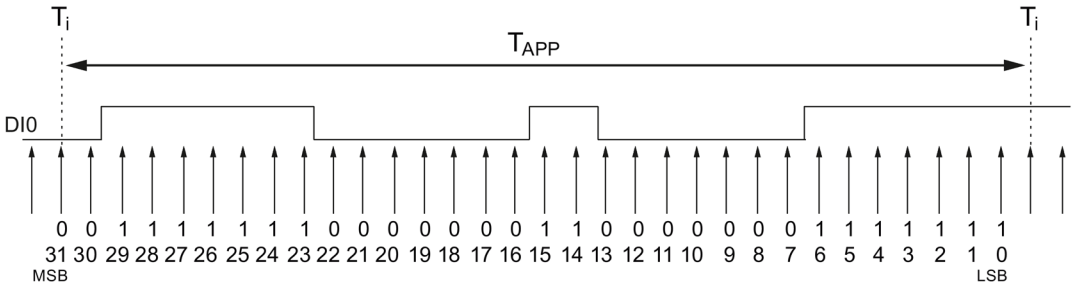
计数器从 0 开始，增加至 $2^{32}-1$ 然后再从 0 开始（上溢）。
如果使用增量编码器，工艺模块也可以向下计数。
对于每个数字量输入，计数器值都会作为 32 位值返回到反馈接口 (页 39)中。

Oversampling

工艺模块使用Oversampling功能在每个应用循环内按固定间隔检测 32 个时间点中相应数字量输入的状态（例如，OB61）。 这 32 个状态将作为一个 32 位值一起返回到反馈接口 (页 39)中。

Oversampling需要等时模式。 如果类型为“Synchronous Cycle”的 OB 使用与发送时钟不同的时钟，则必须使用 TIO_SYNC 指令。

下图显示了 DI0 的Oversampling示例：



T_{APP} 应用周期
MSB Most significant bit
LSB Least significant bit

2.2.2 切换输出

最多可以为工艺模块组态 16 个数字量输出。 可组态切换数字量输出的以下功能：

时间控制的切换（Timer DQ）

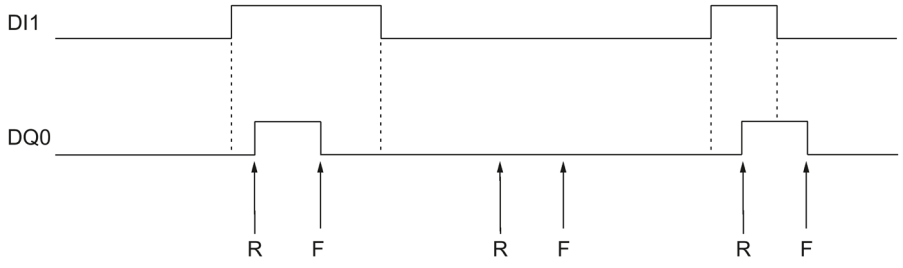
使用时间戳可让受控操作以非常精准的时间再现。
使用该功能，工艺模块可以按精确定义的时间点在相应的数字量输出中输出沿。
例如，可以结合数字量输入在输入和输出之间实施定义的响应时间。

Timer功能基于 Time-based IO 并需要等时模式。

硬件使能（HW 使能）

可以通过数字量输入为Timer数字量输出组态硬件使能。
硬件使能定义可设置相应数字量输出的时间窗口。 数字量输出的复位与硬件使能无关。
可通过控制接口 (页 34)的 SETEN 位覆盖硬件使能。

下图显示了输出上升沿和下降沿的示例（DQ0 通过 DI1 的高电平使能）：



R 上升 DQ0- 沿的指定时间
F 下降 DQ0- 沿的指定时间

脉冲宽度调制 (PWM)

脉冲宽度调制功能可以为相应数字量输出指定硬件组态中的时间段和控制接口 (页 34)中的脉冲间歇比率。 脉冲间歇比率的设定值为百分比，使用大约 3% 的精度进行评估。

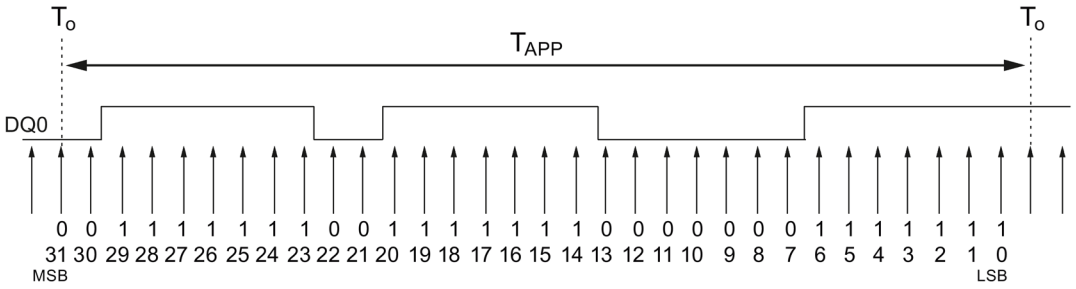
Oversampling

工艺模块会使用Oversampling功能按固定的时间间隔为每个应用周期（如 OB61）输出 32 个状态。 这就允许相应数字量输出在每个应用周期内最多包含 32 个沿。

对于相应数字量输出，这 32 个状态将作为 32 位字符串通过控制接口 (页 34)发送到工艺模块。

Oversampling需要等时模式。 如果类型为“Synchronous Cycle”的 OB 使用与发送时钟不同的时钟，则必须使用 TIO_SYNC 指令。

下图显示了 DQ0 的Oversampling示例：



T_{APP} 应用周期
MSB Most significant bit
LSB Least significant bit

说明

使用 Oversampling 功能时，请确保应用周期和 32 位输出序列的组合并不会导致输出频率超过数字量输出的最大切换频率。

2.2.3 附加功能

等时模式

工艺模块在 PROFINET 的分布模式下支持“等时模式”系统功能。
工艺模块的以下功能需要该系统功能：

- 时间戳检测（Timer DI）
- 时间控制的切换（Timer DQ）
- 数字量输入的Oversampling
- 数字量输出的Oversampling

在等时模式中，用户程序的周期、输入信号的传输以及工艺模块中的处理都将同步。

数据处理

在 T_i
时将检测时间戳、计数器值、和Oversampling位字符串以及状态位，并使这些信息在反馈接口中可用以便在当前总线周期中进行检索。 当前Oversampling位字符串从时间 T_o
开始输出。

诊断中断

此外，在无可用的电源电压或数字量输出出错时，工艺模块还可触发诊断中断 (页 47)。

输入滤波器

要抑制干扰，可以为数字量输入组态输入滤波器。

分布式应用

通过 ET 200MP 分布式 I/O
设备中的接口模块方式，可以在分布式系统中使用工艺模块。 可进行以下应用：

- S7-1500 系统中的分布式运行
- S7-300/400 系统中的分布式运行

集中应用

可以在 S7-1500 自动化系统中集中使用工艺模块。

连接 3

3.1 针脚分配

将编码器信号、数字量输入信号和数字量输出信号及编码器电源和电源电压连接至工艺模块的 40 针前连接器，为模块和数字量输出供电。

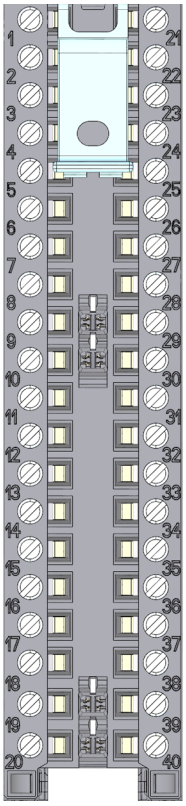
有关如何连接前连接器、布置电缆屏蔽等信息，请参见 ET 200MP 分布式 I/O 系统 (http://support.automation.siemens.com/WW/view/zh/59193214)系统手册和 S7-1500 自动化系统 (http://support.automation.siemens.com/WW/view/zh/59191792)系统手册的连接部分。

前连接器的针脚分配

前连接器的针脚分配取决于 TM Timer DIDQ 16x24V 的通道组态。

下表给出了通道组态为“0 个输入，16 个输出”时前连接器的针脚分配。

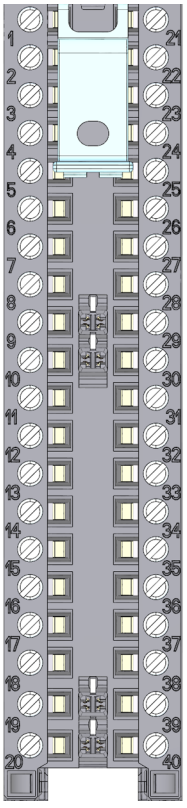
表格 3- 1　前连接器的针脚分配，通道组态为“0 个输入，16 个输出”

名称	信号名称		视图	信号名称		名称
—	—	1		21	DQ0	数字量输出 DQ0
		2		22	DQ1	数字量输出 DQ1
		3		23	DQ2	数字量输出 DQ2
		4		24	DQ3	数字量输出 DQ3
		5		25	DQ4	数字量输出 DQ4
		6		26	DQ5	数字量输出 DQ5
		7		27	DQ6	数字量输出 DQ6
		8		28	DQ7	数字量输出 DQ7
		9		29	—	—
数字量输出 DQ0 至 DQ7 的接地	1M	10		30		
	1M	11		31	DQ8	数字量输出 DQ8
	1M	12		32	DQ9	数字量输出 DQ9
	1M	13		33	DQ10	数字量输出 DQ10
	1M	14		34	DQ11	数字量输出 DQ11
	1M	15		35	DQ12	数字量输出 DQ12
	1M	16		36	DQ13	数字量输出 DQ13
	1M	17		37	DQ14	数字量输出 DQ14
	1M	18		38	DQ15	数字量输出 DQ15
数字量输出 DQ0 至 DQ7 的电源电压 DC 24 V*	1L+	19		39	2L+	数字量输出 DQ8 至 DQ15 的电源电压 DC 24 V *
电源电压 1L+ 的接地	1M	20		40	2M	电源电压 2L+ 的接地

*　如果要通过共享电源为两个负载组供电，请在端子 19 和 39 之间以及端子 20 和 40 之间插入电位跳线。

下表给出了通道组态为“3 个输入，13 个输出”时前连接器的针脚分配。

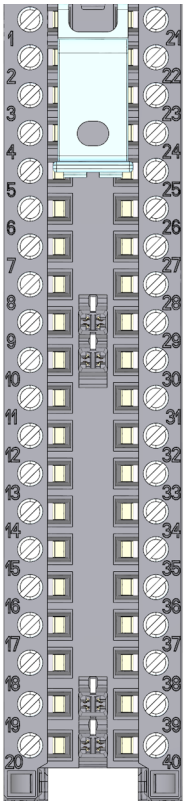
表格 3- 2　前连接器的针脚分配，通道组态为“3 个输入，13 个输出”

名称	信号名称		视图	信号名称		名称
数字量输入 DI0	DI0	1		21	DQ0	DI0 的编码器电源 24 V
数字量输入 DI1	DI1	2		22	DQ1	DI1 的编码器电源 24 V
—	—	3		23	DQ2	数字量输出 DQ2
数字量输入 DI3	DI3	4		24	DQ3	DI3 的编码器电源 24 V
—	—	5		25	DQ4	数字量输出 DQ4
		6		26	DQ5	数字量输出 DQ5
		7		27	DQ6	数字量输出 DQ6
		8		28	DQ7	数字量输出 DQ7
		9		29	—	—
编码器电源、数字量输入 DI0、DI1 和 DI3 以及数字量输出 DQ2 和 DQ4 至 DQ7 的接地	1M	10		30		
	1M	11		31	DQ8	数字量输出 DQ8
	1M	12		32	DQ9	数字量输出 DQ9
	1M	13		33	DQ10	数字量输出 DQ10
	1M	14		34	DQ11	数字量输出 DQ11
	1M	15		35	DQ12	数字量输出 DQ12
	1M	16		36	DQ13	数字量输出 DQ13
	1M	17		37	DQ14	数字量输出 DQ14
	1M	18		38	DQ15	数字量输出 DQ15
数字量输入 DI0、DI1 和 DI3 以及数字量输出 DQ2 和 DQ4 至 DQ7 的电源电压 DC 24 V*	1L+	19		39	2L+	数字量输出 DQ8 至 DQ15 的电源电压 DC 24 V *
电源电压 1L+ 的接地	1M	20		40	2M	电源电压 2L+ 的接地

*　如果要通过共享电源为两个负载组供电，请在端子 19 和 39 之间以及端子 20 和 40 之间插入电位跳线。

下表给出了通道组态为“4 个输入，12 个输出”时前连接器的针脚分配。

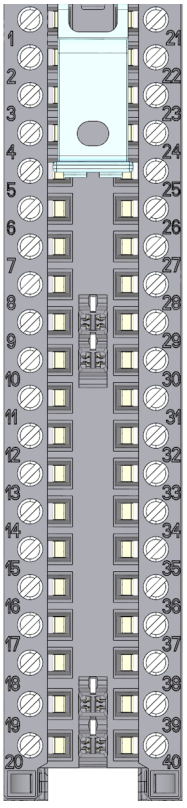
表格 3- 3　前连接器的针脚分配，通道组态为“4 个输入，12 个输出”

名称	信号名称		视图	信号名称		名称
—	—	1		21	DQ0	数字量输出 DQ0
数字量输入 DI1	DI1	2		22	DQ1	DI1 的编码器电源 24 V
—	—	3		23	DQ2	数字量输出 DQ2
数字量输入 DI3	DI3	4		24	DQ3	DI3 的编码器电源 24 V
—	—	5		25	DQ4	数字量输出 DQ4
数字量输入 DI5	DI5	6		26	DQ5	DI5 的编码器电源 24 V
—	—	7		27	DQ6	数字量输出 DQ6
数字量输入 DI7	DI7	8		28	DQ7	DI7 的编码器电源 24 V
—	—	9		29	—	—
编码器电源、数字量输入 DI1、DI3、DI5 和 DI7 以及数字量输出 DQ0、DQ2、DQ4 和 DQ6 的接地	1M	10		30		
	1M	11		31	DQ8	数字量输出 DQ8
	1M	12		32	DQ9	数字量输出 DQ9
	1M	13		33	DQ10	数字量输出 DQ10
	1M	14		34	DQ11	数字量输出 DQ11
	1M	15		35	DQ12	数字量输出 DQ12
	1M	16		36	DQ13	数字量输出 DQ13
	1M	17		37	DQ14	数字量输出 DQ14
	1M	18		38	DQ15	数字量输出 DQ15
数字量输入 DI1、DI3、DI5 和 DI7 以及数字量输出 DQ0、DQ2、DQ4 和 DQ6* 的电源电压 DC 24 V	1L+	19		39	2L+	数字量输出 DQ8 至 DQ15 的电源电压 DC 24 V *
电源电压 1L+ 的接地	1M	20		40	2M	电源电压 2L+ 的接地

- 如果要通过共享电源为两个负载组供电，请在端子 19 和 39 之间以及端子 20 和 40 之间插入电位跳线。

下表给出了通道组态为“8 个输入，8 个输出”时前连接器的针脚分配。

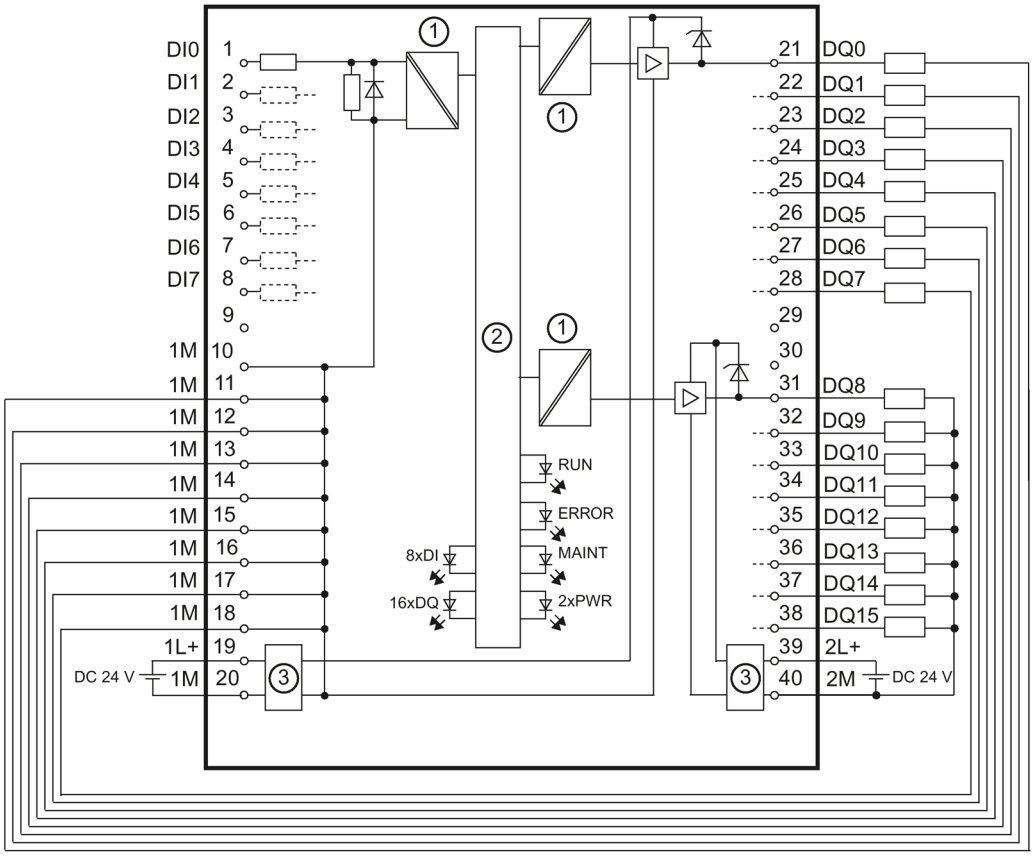
表格 3- 4　前连接器的针脚分配，通道组态为“8 个输入，8 个输出”

名称	信号名称		视图	信号名称		名称
数字量输入 DI0	DI0	1		21	DQ0	DI0 的编码器电源 24 V
数字量输入 DI1	DI1	2		22	DQ1	DI1 的编码器电源 24 V
数字量输入 DI2	DI2	3		23	DQ2	DI2 的编码器电源 24 V
数字量输入 DI3	DI3	4		24	DQ3	DI3 的编码器电源 24 V
数字量输入 DI4	DI4	5		25	DQ4	DI4 的编码器电源 24 V
数字量输入 DI5	DI5	6		26	DQ5	DI5 的编码器电源 24 V
数字量输入 DI6	DI6	7		27	DQ6	DI6 的编码器电源 24 V
数字量输入 DI7	DI7	8		28	DQ7	DI7 的编码器电源 24 V
—	—	9		29	—	—
编码器电源和数字量输入 DI0 至 DI7 的接地	1M	10		30		
	1M	11		31	DQ8	数字量输出 DQ8
	1M	12		32	DQ9	数字量输出 DQ9
	1M	13		33	DQ10	数字量输出 DQ10
	1M	14		34	DQ11	数字量输出 DQ11
	1M	15		35	DQ12	数字量输出 DQ12
	1M	16		36	DQ13	数字量输出 DQ13
	1M	17		37	DQ14	数字量输出 DQ14
	1M	18		38	DQ15	数字量输出 DQ15
数字量输入 DI0 至 DI7* 的电源电压 DC 24 V	1L+	19		39	2L+	数字量输出 DQ8 至 DQ15 的电源电压 DC 24 V *
电源电压 1L+ 的接地	1M	20		40	2M	电源电压 2L+ 的接地

*　如果要通过共享电源为两个负载组供电，请在端子 19 和 39 之间以及端子 20 和 40 之间插入电位跳线。

方框图

下图显示了使用所有 16 个数字量输出的工艺模块的方框图。

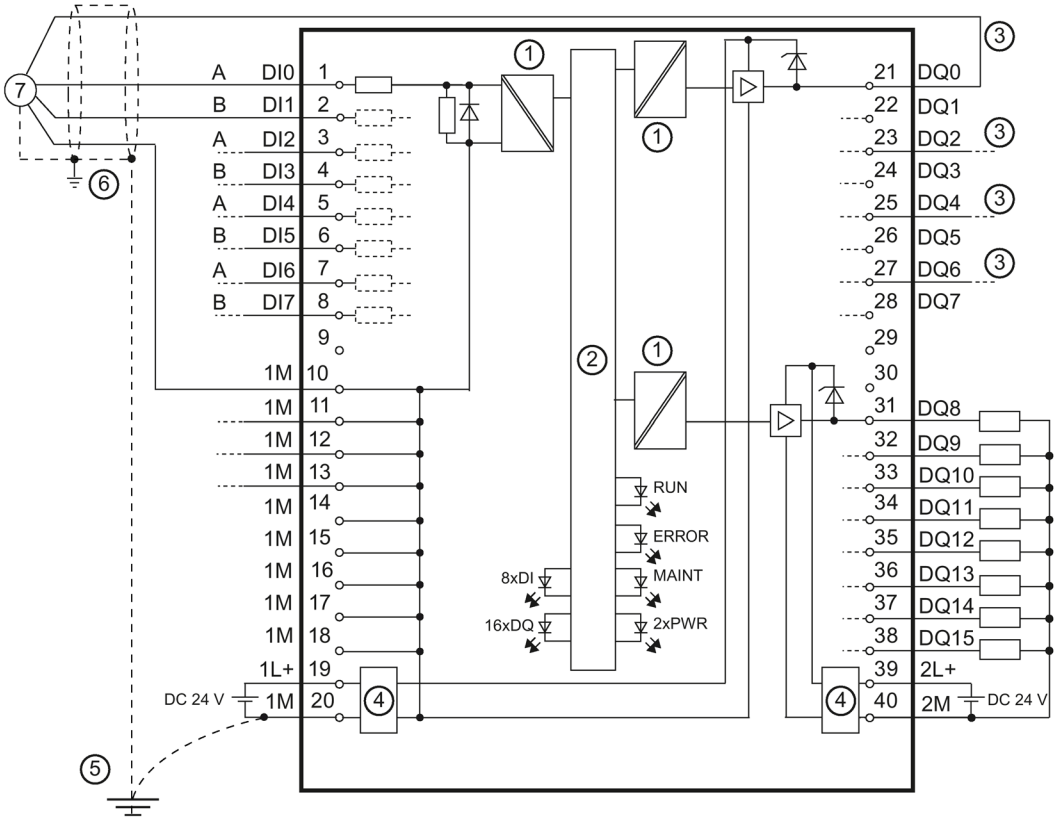


① 电气隔离
② 工艺和背板总线接口
③ 电源电压的输入滤波器

图 3-1 使用 16 个数字量输出的方框图

连接编码器时，必须通过前连接器处和编码器处的屏蔽连接元件（屏蔽托架和端子）将编码器与工艺模块之间的电缆屏蔽层接地，具体取决于组态的“输入延迟”(input delay)和电位干扰程度。

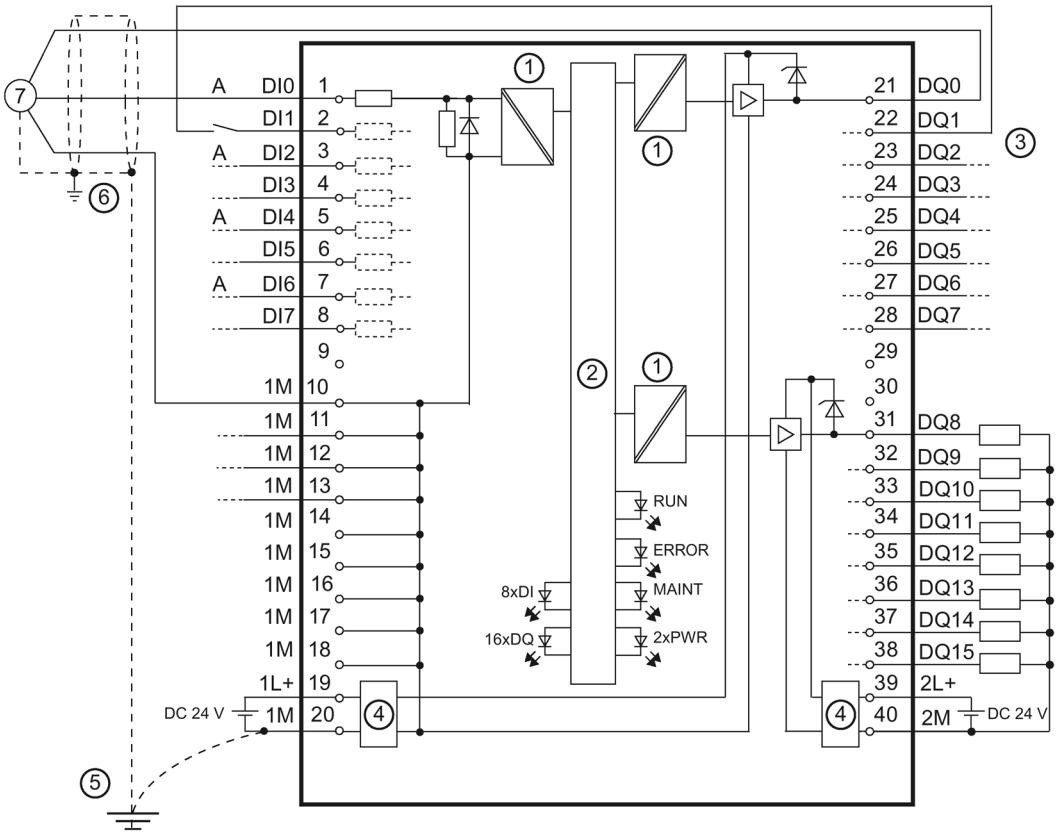
下图显示了与四个增量编码器相连的工艺模块的方框图。



① 电气隔离
② 工艺和背板总线接口
③ 相应增量编码器的 24 V 电源
④ 电源电压的输入滤波器
⑤ 等电位连接
⑥ 前连接器处的屏蔽支架
⑦ 具有 A 和 B 信号的增量编码器

图 3-2 带增量编码器的方框图

下图给出了四个脉冲编码器和四个传感器连接到的工艺模块的方框图。



① 电气隔离
② 工艺和背板总线接口
③ 脉冲编码器和传感器的 24 V 电源
④ 电源电压的输入滤波器
⑤ 等电位连接
⑥ 前连接器处的屏蔽支架
⑦ 具有信号 A 的脉冲编码器

图 3-3 带脉冲编码器和传感器的方框图

说明

如果要同时使用Timer数字量输入和高速输出，应通过端子对 19 和 20 以及 39 和 40 对输入和输出的电源进行电气隔离以将干扰程度降至最低。

电源电压

工艺模块的数字量输入和输出分为两个负载组，均由 DC 24 V 电源供电。 数字量输入 DI0 至 DI7 以及数字量输出 DQ0 至 DQ7 通过 1L+ 和 1M 连接供电。 数字量输出 DQ8 至 DQ15 通过 2L+ 和 2M 连接供电。

可以按电气隔离或非电气隔离的方式对两个负载组供电。
如果要为两个负载组提供相同的电位（非隔离），则可以使用电位跳线从已供电的负载组连接至另一个负载组以获取回路电源电压。

工艺模块可监视电源电压的连接。 某个负载组断电后，电源电压的缺失会生成诊断中断 (页 48)。 如果在仅使用一个负载组时想阻止这种反应，则请插入电位跳线。

内部保护电路可保护工艺模块免受电源电压反极性造成的损坏。
电源电压反极性时，数字量输出会发生无法预料的状况。

说明

请注意，每个电位跳线上的最大电流负载不能超过 8 A。

数字量输入 DI0 至 DI7

可以使用三个、四个或八个数字量输入，相应地，可用的数字量输出数便会随之减少。
工艺模块可以针对以下功能评估数字量输入的沿：

表格 3- 5　评估数字量输入信号

针对以下功能评估信号...	可用的数字量输入							
	DI0	DI1	DI2	DI3	DI4	DI5	DI6	DI7
时间戳检测	✓	✓	✓	✓	✓	✓	✓	✓
时间戳检测的硬件使能	—	✓	—	✓	—	✓	—	✓
时间控制的切换的硬件使能	—	✓	—	✓	—	✓	—	✓
使用具有信号 A 和 B 的增量编码器进行计数	✓	✓	✓	✓	✓	✓	✓	✓
使用具有信号 A 的脉冲编码器进行计数	✓	—	✓	—	✓	—	✓	—
Oversampling	✓	✓	✓	✓	✓	✓	✓	✓

使用计数功能时，可将以下具有 24 V 信号的编码器类型连接至数字量输入：

- 具有信号 A 和 B 的增量编码器：

  信号 A 和 B 分别通过数字量输入对 DI0/DI1、DI2/DI3、DI4/DI5 和 DI6/DI7 的连接进行连接。 信号 A 和 B 是通过将相移 90° 得到的两个增量信号。

- 具有信号 A 的脉冲编码器/传感器：

  信号 A 通过数字量输入 DI0、DI2、DI4 或 DI6 的连接进行连接。

数字量输入之间或与数字量输出 DQ0 至 DQ7 之间互不电气隔离。
数字量输入与数字量输出 DQ8 至 DQ15 以及背板总线之间进行电气隔离。

数字量输入的输入滤波器

为抑制干扰，可以为每个数字量输入组态输入滤波器。
将抑制脉冲宽度比组态的“输入延迟”(input delay) 更短的信号。

可以为“输入延迟”(input delay) 指定以下值：

- “无”(None)
  （输入延迟 4 µs，最小脉冲宽度 3 µs）
- 0.05 ms
- 0.1 ms（默认值）
- 0.4 ms
- 0.8 ms

输入延迟在功能上对数字量输入中的信号评估具有以下影响：

表格 3- 6　输入延迟的影响

功能	输入延迟的影响
时间戳检测	输入延迟会移动检测到的时间戳。
计数	将返回在 T_i 减去输入延迟的时间点有效的计数器值。
Oversampling	输入延迟将一同移动检测到的状态。

说明

如果选择“无”或“0.05 ms”选项，则必须使用屏蔽电缆来连接数字量输入。
要提高时间戳功能的精度，建议使用屏蔽电缆，即使这样会增大输入延迟。
使用屏蔽电缆会将抖动限制为不超过 1 µs。

编码器电源

使用数字量输入时，可以连接增量编码器和脉冲编码器。
与数字量输入相对的端子将提供与 1M 相对应的 DC 24 V 电源电压和 0.5 A 的额定负载电流以为编码器供电。 从 1L+/1M 电源电压提供电压，并监视电压是否短路及过载。

说明

请注意，所有编码器电源的总电流不得超过 1.2 A。

说明

工艺模块在启动过程中会禁用输出功能。 因此，在相关系统的 PROFINET 连接中断后，会短暂禁用编码器电源。

数字量输出 DQ0 至 DQ15

可以使用 8 个、12 个、13 个或 16
个数字量输出，相应地，可用的数字量输入数便会随之减少。
数字量输出可在定义的时间点或通过用户程序直接进行切换。
此外，还可以在相应数字量输出中输出脉冲宽度调制或Oversampling。

数字量输出 DQ0 至 DQ7 与数字量输出 DQ8 至 DQ15
以及背板总线之间进行电气隔离，但与数字量输入不进行电气隔离。 数字量输出 DQ8 至 DQ15 与数字量输出 DQ0 至 DQ7
之间进行电气隔离；数字量输入与背板总线之间进行电气隔离。

可将每次数字量输出用作高速输出或源型输出：

- 高速输出（默认）：
  数字量输出以快速推挽方式切换，并可承受 0.1 A
  的额定负载电流。推挽式切换交替切换为 DC 24 V 和接地。 这样便可用于陡变边沿。
- 源型输出：
  数字量输出以相对于 M 的 24 V 源型输出形式工作，且可承受 0.5 A
  的额定负载电流。

数字量输出具有过载和短路保护功能。

注意
不当负载会导致过热 高速输出会生成陡变边沿。 这会在连接的负载上形成强大的电荷反转，而这种高频率的反转切换会加热设备。 因此，连接的负载必须获准用于高输入频率。

说明

如果将数字量输出用作源型输出，则关闭响应/关闭沿取决于负载。
因此，非常短的脉冲可能无法正确输出。

说明

可以直接连接继电器和接触器而无需外部电路。

组态/地址空间

4

4.1 组态

简介

使用组态软件为工艺模块组态和分配参数。
通过用户程序控制和监视工艺模块功能。

系统环境

工艺模块可以在下列系统环境中使用：

表格 4- 1　带有 PROFINET IO 的工艺模块的应用

应用	所需组件	组态软件	在用户程序中
S7-1500 系统中的分布式运行	• S7-1500 自动化系统 • ET 200MP 分布式 I/O 系统 • TM Timer DIDQ 16x24V	STEP 7 (TIA Portal): 使用硬件配置进行设备组态和参数设置 (HWCN)	时间戳功能： TIO 指令 TIO_SYNC、TIO_DI 和 TIO_DQ 计数、PWM 和 Oversampling： 直接访问 I/O 数据中 TM Timer DIDQ 16x24V 的控制和反馈接口 (页 34)
S7-1500 系统中的集中操作	• S7-1500 自动化系统 • TM Timer DIDQ 16x24V	STEP 7 (TIA Portal): 使用硬件配置进行设备组态和参数设置 (HWCN)	计数和 PWM： 直接访问 I/O 数据中 TM Timer DIDQ 16x24V 的控制和反馈接口 (页 34)
S7-300/400 系统中的分布式运行	• S7-300/400 自动化系统 • ET 200MP 分布式 I/O 系统 • TM Timer DIDQ 16x24V	STEP 7 (TIA Portal): 使用硬件配置进行设备组态和参数设置 (HWCN)	时间戳功能*、计数、PWM 和Oversampling： 直接访问 I/O 数据中 TM Timer DIDQ 16x24V 的控制和反馈接口 (页 34)

* 应请求提供

更多信息

有关时间戳功能及其通过 TIO 指令 TIO_SYNC、TIO_DI 和 TIO_DQ 进行的组态的详细说明，请参见：

- 带 Time-based IO 的高精度输入/输出功能手册，可从 Internet (http://support.automation.siemens.com/WW/view/zh/82527590) 下载
- STEP 7 (TIA Portal) 信息系统的“使用工艺功能 > 计数、测量和定位输入 > 计数、测量和定位输入 (S7-1500)”(Using technology functions > Counting, measurement and position input > Counting, measurement and position input (S7-1500))下

4.2 对 CPU STOP 模式的响应

可在基本参数中设置工艺模块对每个通道的 CPU STOP 的响应。

表格 4- 2　工艺模块根据参数分配对 CPU STOP 的响应

对 CPU STOP 模式的响应	含义
输出替换值	工艺模块在数字量输出上输出组态的替换值，直到下一次 CPU STOP-RUN 转换。 发生 STOP-RUN 转换后，工艺模块返回到其启动状态：如果使用计数器，将计数器值设为 0，这样数字量输出就可以根据参数分配和设定值进行切换。
保持上一个值	工艺模块在数字量输出上输出转换到 STOP 状态时有效的值，并保持该值，直到发生下一次 CPU STOP-RUN 转换为止。 之后将为组态的脉宽调制输出上次有效周期持续时间和上次有效脉冲间歇比率，直到下一次 STOP-RUN 转换。 发生 STOP-RUN 转换后，工艺模块返回到其启动状态：如果使用计数器，将计数器值设为 0，这样数字量输出就可以根据参数分配和设定值进行切换。

4.3 地址空间

工艺模块的地址空间

表格 4- 3 TM Timer DIDQ 16x24V 输入地址和输出地址的范围

	输入	输出
范围	44 字节	74 字节

更多信息

有关如何使用 TM Timer DIDQ 16x24V
的控制和反馈接口的说明，请参见控制和反馈接口 (页 34)一章。

4.4 参数

在 STEP 7 (TIA Portal) 中，可以使用硬件配置中的多种参数来定义工艺模块的属性。
根据设置的不同，并非所有参数均可用。 可使用数据记录 128
(页 62)在用户程序中更改参数分配。

TM Timer DIDQ 16x24V 的参数

可以组态以下参数：

表格 4- 4 可组态的参数及其默认值

参数	值范围	默认设置
基本参数		
模块的通道组态	• 0 输入，16 输出 • 3 输入，13 输出 • 4 输入，12 输出 • 8 输入，8 输出	0 输入，16 输出

参数	值范围	默认设置
数字量输出的 PWM 周期	• 10 ms • 5 ms • 2 ms • 1 ms • 0.5 ms • 0.2 ms	10 ms
对 CPU STOP 模式的响应	• 输出替换值 • 保持上一个值	输出替换值
启用诊断中断	• 禁用 • 启用	禁用

参数	值范围	默认设置
通道参数		
数字量输出的工作模式	• Timer DQ • Oversampling • 脉冲宽度调制 PWM	Timer DQ
数字量输出的替换值	• 0 • 1	0
高速输出 (0.1 A)	• 禁用 • 启用	启用
反转输入或输出信号	• 禁用 • 启用	禁用
通过数字量输入触发 HW 使能	• 电平触发 • 沿触发	电平触发
HW 使能的电平选择	• 高电平激活 • 低电平激活	高电平激活
组态 DI 组	• 增量编码器（A、B 相移） • Timer-DI 带使能输入 • 单独使用输入	增量编码器（A、B 相移）
反转计数方向（增量编码器）	• 禁用 • 启用	禁用
数字量输入的工作模式	• 计数器 • Timer-DI • Oversampling	Timer-DI
数字量输入的输入延迟	• 无 • 0.05 ms • 0.1 ms • 0.4 ms • 0.8 ms	0.1 ms

参数	值范围	默认设置
计数器的信号评估	• 在上升沿 • 在下降沿	在上升沿
组态 DQ/DI 组	• Timer DQ 带使能输入 • 单独使用输入/输出	Timer DQ 带使能输入

4.5 控制和反馈接口

对于 S7-1500 系统中的分布式运行，不必直接访问 PROFINET 上的控制和反馈接口即可使用时间戳功能。 使用 TIO 指令 TIO_SYNC、TIO_DI 和 TIO_DQ 即可达到这一目的。 有关使用 TIO 指令的详细说明，请参见带 Time-based IO 的高精度输入/输出功能手册，该手册可从 Internet (http://support.automation.siemens.com/WW/view/zh/82527590) 下载。

有关使用控制与反馈接口的更多信息，请参见组态 (页 28)部分。

4.5.1 控制接口的分配

用户程序使用控制接口来影响工艺模块的行为。

控制接口

下表显示了控制接口分配：

表格 4- 5　工艺模块的控制接口

相对起始地址的偏移	参数	含义
字节 0	SET_DQ (DQ0 ... DQ7)	位 7： 设置 DQ7
		位 6： 设置 DQ6
		位 5： 设置 DQ5
		位 4： 设置 DQ4
		位 3： 设置 DQ3
		位 2： 设置 DQ2
		位 1： 设置 DQ1
		位 0： 设置 DQ0

相对起始地址的偏移	参数	含义		
字节 1	SET_DQ (DQ8 ... DQ15)	位 7： 设置 DQ15		
		位 6： 设置 DQ14		
		位 5： 设置 DQ13		
		位 4： 设置 DQ12		
		位 3： 设置 DQ11		
		位 2： 设置 DQ10		
		位 1： 设置 DQ9		
		位 0： 设置 DQ8		
字节 2	SETEN (DI0/DQ0 ... DI7/DQ7)	位 7： 覆盖 DI7 或 DQ7 的硬件使能		
		位 6： 覆盖 DI6 或 DQ6 的硬件使能		
		位 5： 覆盖 DI5 或 DQ5 的硬件使能		
		位 4： 覆盖 DI4 或 DQ4 的硬件使能		
		位 3： 覆盖 DI3 或 DQ3 的硬件使能		
		位 2： 覆盖 DI2 或 DQ2 的硬件使能		
		位 1： 覆盖 DI1 或 DQ1 的硬件使能		
		位 0： 覆盖 DI0 或 DQ0 的硬件使能		
字节 3	SETEN (DQ8 ... DQ15)	位 0 至 7： 覆盖 DQ8 至 DQ15 的硬件使能		
字节 4 至 7	TEC_OUT (DQ0)	用于 DQ 工作模式“定时器 DQ”：	用于 DQ 工作模式“Over-sampling”：	用于 DQ 工作模式“脉冲宽度调制 PWM”：
		字节 0...1: OFF TIME: 启动模块的时间戳来复位 DQ0	字节 0 至 3： Oversampling的 32 个状态	字节 0 至 2： 预留；这些位必须置 0
		字节 2 至 3： ON TIME: 启动模块的时间戳来置位 DQ0		字节 3： PWM 的脉冲间歇比率百分比

相对起始地址的偏移	参数		含义
字节 8 至 11	TEC_OUT (DQ1)		请参见字节 4 至 7
字节 12 至 15	TEC_OUT (DQ2)		
字节 16 至 19	TEC_OUT (DQ3)		
字节 20 至 23	TEC_OUT (DQ4)		
字节 24 至 27	TEC_OUT (DQ5)		
字节 28 至 31	TEC_OUT (DQ6)		
字节 32 至 35	TEC_OUT (DQ7)		
字节 36 至 39	TEC_OUT (DQ8)		
字节 40 至 43	TEC_OUT (DQ9)		
字节 44 至 47	TEC_OUT (DQ10)		
字节 48 至 51	TEC_OUT (DQ11)		
字节 52 至 55	TEC_OUT (DQ12)		
字节 56 至 59	TEC_OUT (DQ13)		
字节 60 至 63	TEC_OUT (DQ14)		
字节 64 至 67	TEC_OUT (DQ15)		
字节 68	SEL (DI1)	EDGESEL	位 5...7: DI1时间戳检测的沿选择：
			000_B： 预留
			001_B： 仅上升沿
			010_B： 仅下降沿
			011_B： 上升沿和下降沿（顺序取决于发生时间）
			100_B： 预留
			101_B： 先上升沿，后下降沿
			110_B： 先下降沿，后上升沿
			111_B： 预留
		REARM	位 4: DI1 周期性时间戳检测
	SEL (DI0)	EDGESEL	位 0...3: ，请参见 SEL (DI1)
		REARM	

相对起始地址的偏移	参数		含义
字节 69	SEL (DI3)		请参见字节 68
	SEL (DI2)		
字节 70	SEL (DI5)		请参见字节 68
	SEL (DI4)		
字节 71	SEL (DI7)		请参见字节 68
	SEL (DI6)		
字节 72 至 73	STW	MSL	位 12...15: 生命符号计数器（Master Sign of Life）
		—	位 1...11: 预留；这些位必须置 0
		SYN	位 0： 通过用户程序同步模块

有关控制位的说明

控制位	备注
SEL (DIm)	该值由 TIO 指令 TIO_DI 提供。
SET_DQm	可以使用该位在 DQ 的工作模式“定时器 DQ”下设置 DQm 数字量输出。
SETEN (DIm/DQm)	可以使用该位覆盖为数字量输入 DIm 或数字量输出 DQm 组态的硬件使能。
STW	该值由 TIO 指令 TIO_SYNC 控制。 可应要求提供详细信息。
TEC_OUT (DQm)	如果使用相应数字量输出 DQm 的时间戳功能，则 TIO 指令 TIO_DQ 将在此值中为模块返回两个输出时间戳。 如果使用相应数字量输出 DQm 的Oversampling功能，则通过该值指定 32 个状态。 如果使用相应数字量输出 DQm 的脉冲宽度调制，则通过该值指定脉冲间歇比率百分比。 以下概览给出了工艺模块评估指定百分比的方法。

PWM 的脉冲间歇比率

以百分比形式指定脉冲间歇比率的设定值。
各种情况下，工艺模块会输出以下脉冲间歇比率：

设定值 (%)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
输出值 (%)	0		3.13			6.25			9.38			12.50				15.63			18.75			21.88		

24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
25			28.13			31.25			34.38			37.50				40.63			43.75			46.88			50		

52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
53.13			56.25			59.38			62.50				65.63			68.75			71.88			75			78.13		

80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
81.25			84.38			87.50			90.63				93.75			96.88			100	

更多信息

可应要求通过Technical Support提供有关时间戳功能的详细信息。

4.5.2 反馈接口的分配

用户程序通过反馈接口从工艺模块中接收当前值和状态信息。

反馈接口

下表显示了反馈接口的分配：

表格 4- 6 工艺模块的反馈接口

相对起始地址的偏移	参数	含义
字节 0	STS_DI (DI0 ... DI7)	位 7： 状态 DI7（使用 DI7 时）
		位 6： 状态 DI6（使用 DI6 时）
		位 5： 状态 DI5（使用 DI5 时）
		位 4： 状态 DI4（使用 DI4 时）
		位 3： 状态 DI3（使用 DI3 时）
		位 2： 状态 DI2（使用 DI2 时）
		位 1： 状态 DI1（使用 DI1 时）
		位 0： 状态 DI0（使用 DI0 时）
字节 1	QI (DI0 ... DI7)	位 7： Quality Information DI7
		位 6： Quality Information DI6
		位 5： Quality Information DI5
		位 4： Quality Information DI4
		位 3： Quality Information DI3
		位 2： Quality Information DI2
		位 1： Quality Information DI1
		位 0： Quality Information DI0

相对起始地址的偏移	参数	含义		
字节 2	QI (DQ0 ... DQ7)	位 7： Quality Information DQ7		
		位 6： Quality Information DQ6		
		位 5： Quality Information DQ5		
		位 4： Quality Information DQ4		
		位 3： Quality Information DQ3		
		位 2： Quality Information DQ2		
		位 1： Quality Information DQ1		
		位 0： Quality Information DQ0		
字节 3	QI (DQ08 ... DQ15)	位 7： Quality Information DQ15		
		位 6： Quality Information DQ14		
		位 5： Quality Information DQ13		
		位 4： Quality Information DQ12		
		位 3： Quality Information DQ11		
		位 2： Quality Information DQ10		
		位 1： Quality Information DQ9		
		位 0： Quality Information DQ8		
字节 4 至 7	TEC_IN (DI0)	对于 DI 工作模式“定时器 DI”：	对于 DI 工作模式“增量编码器（A、B 相移）”或“计数器”：	对于 DI 工作模式 “Over-sampling”：
		字节 0...1: 2nd TIME/OFF TIME： 模块的第二个输入时间戳	当前计数器值	Over-sampling值
		字节 2...3: 1st TIME/ON TIME： 模块的第一个输入时间戳		
字节 8 至 11	TEC_IN (DI1)	请参见字节 4 至 7		
字节 12 至 15	TEC_IN (DI2)			
字节 16 至 19	TEC_IN (DI3)			
字节 20 至 23	TEC_IN (DI4)			

相对起始地址的偏移	参数	含义
字节 24 至 27	TEC_IN (DI5)	
字节 28 至 31	TEC_IN (DI6)	
字节 32 至 35	TEC_IN (DI7)	
字节 36	EN (DI1/DQ1)	位 7: DI1 激活为 Timer DI 或 DQ1 激活为 Timer DQ
	LEC (DI1)	DI1 的位 4...6: Lost edge counter
	EN (DI0/DQ0)	位 3: DI0 激活为 Timer DI 或 DQ0 激活为 Timer DQ
	LEC (DI0)	DI0 的位 0...2: Lost edge counter
字节 37	EN (DI3/DQ3)	请参见字节 36
	LEC (DI3)	
	EN (DI2/DQ2)	
	LEC (DI2)	
字节 38	EN (DI5/DQ5)	
	LEC (DI5)	
	EN (DI4/DQ4)	
	LEC (DI4)	
字节 39	EN (DI7/DQ7)	
	LEC (DI7)	
	EN (DI6/DQ6)	
	LEC (DI6)	

相对起始地址的偏移	参数		含义
字节 40	EN (DQ15)		位 7： DQ15 激活为Timer DQ
	EN (DQ14)		位 6： DQ14 激活为Timer DQ
	EN (DQ13)		位 5： DQ13 激活为Timer DQ
	EN (DQ12)		位 4： DQ12 激活为Timer DQ
	EN (DQ11)		位 3： DQ11 激活为Timer DQ
	EN (DQ10)		位 2： DQ10 激活为Timer DQ
	EN (DQ9)		位 1： DQ9 激活为Timer DQ
	EN (DQ8)		位 0： DQ8 激活为Timer DQ
字节 41	Layout Property		模块特定的值
字节 42 至 43	ZSW	SSL	位 12...15: 生命符号计数器（Slave Sign of Life）
		—	位 10 至 11： 预留
		SYNC	位 8： 通过用户程序同步模块
		Channel address	位 4 至 7 和 9： 相应 DI 或 DQ 的数目
		Channel mode	位 0 至 3： 相应 DI 或 DQ 的工作模式

有关反馈位的说明

反馈位	备注
STS_DI (DIm)	该位指示相应数字量输入 DIm 的状态。
EN (DIm/DQm)	该位指示 • 相应的数字量输入激活为 Timer DI，可根据需要启用，或者 • 相应的数字量输出激活为 Timer DQ，可根据需要启用。 对于工作模式“计数器”、“Oversampling”、“脉冲宽度调制 PWM”下的数字量输入和数字量输出以及电平控制的硬件使能，此位永久为“0”。
Layout Property	该值为模块特定的常数，TIO 指令通过该值识别工艺模块。
LEC (DIm)	该值指示相应数字量输入 DIm 的沿数目（无法为其存储时间戳）。模块在每个应用周期最多可以计数七个沿。计数器在每个新的应用周期都会复位。
QI (DIm)	该位指示相应的数字量输入上有错误发生。 0 表示：电源电压 1L+ 不可用或电压过低，或未插入前连接器 1 表示： 电源电压存在且状态良好 如果启用了诊断中断，则 1L+ 电源电压出现问题时会触发诊断中断。 有关诊断中断的详细信息，请参见诊断报警 (页 48)部分。
QI (DQm)	该位指示相应的数字量输出上有错误发生。 0 表示： 短路、过载或过热 1 表示： 电源电压存在且状态良好 如果启用了诊断中断，则数字量输出发生故障时，会触发诊断中断。 有关诊断中断的详细信息，请参见诊断报警 (页 48)部分。
TEC_IN (DIm)	如果使用相应数字量输入 DIm 的时间戳功能，则该值将为模块返回两个输入时间戳。输入时间戳由 TIO 指令 TIO_DI 读取并被转换为 TIO_Time。 如果使用相应数字量输入 DIm 的计数功能，则该值将返回当前的计数值。 如果使用相应数字量输入 DIm 的Oversampling功能，则该值将返回 DIm 的 32 个状态。
ZSW	该值由工艺模块控制，用于和 TIO 指令 TIO_SYNC 进行通信。

更多信息

可应要求通过Technical Support提供有关时间戳功能的详细信息。

中断/诊断消息

5

5.1 状态和错误指示灯

LED

下图给出了 TM Timer DIDQ 16x24V 的 LED 指示灯（状态和错误指示灯）。

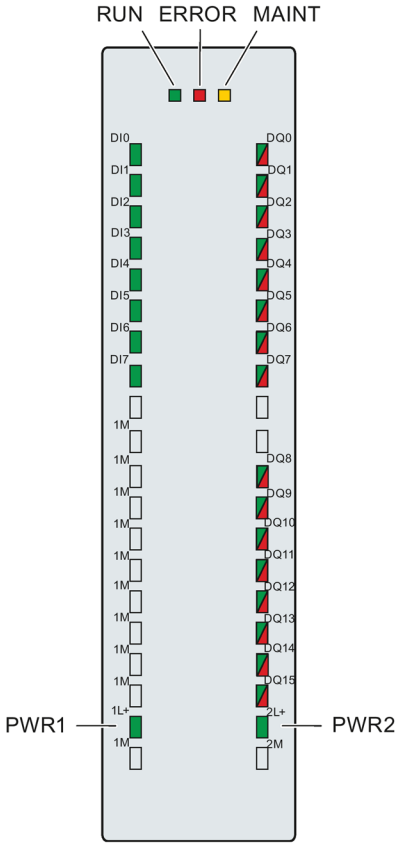


图 5-1 TM Timer DIDQ 16x24V 的 LED

LED 指示灯的含义

下表说明了状态和错误指示灯的含义。
有关诊断报警的修正措施的相关信息，请参见诊断报警 (页 48)小节。

表格 5- 1　状态和错误指示灯 RUN/ERROR/MAINT

LED			含义	要纠正或避免错误
RUN	ERROR	MAINT		
□ 灭	□ 灭	□ 灭	CPU/电源模块的电源电压不存在或过低	检查或打开 PS、CPU 或接口模块上的电源电压。
☼ 闪烁	□ 灭	□ 灭	工艺模块启动并在参数分配完成前一直闪烁	—
■ 亮	□ 灭	□ 灭	已分配工艺模块的参数。	
■ 亮	☼ 闪烁	□ 灭	指示组错误（至少一个未决错误）	判断诊断报警并消除错误。
☼ 闪烁	☼ 闪烁	☼ 闪烁	硬件或固件存在故障	更换工艺模块。

表格 5- 2　PWRm/DQm*/ERROR 状态指示灯

LEDs			含义	要纠正或避免错误
PWRm	DQm*	ERROR		
□ 灭	□ 灭	☼ 闪烁	电源电压缺失或过低	• 检查电源电压。 • 确保正确插入前连接器。
■ 亮	■ 亮	□ 灭	电源电压存在且状态良好	—
■ 亮	■ 亮	☼ 闪烁	编码器电源短路或过载	• 更正编码器接线。 • 检查连接到编码器电源的负载。

*　用作编码器电源时，适用于 DQ0 至 DQ7

通道LED

DIm LED 指示相关信号的当前电平。 数字量输出 DQm 的 LED 指示期望的状态。

通道 LED 的闪烁频率限制为约 14 Hz。 如果存在更高的频率，通道 LED 将以 14 Hz 的频率闪烁，而不指示当前状态。

表格 5- 3　状态指示灯 DIm/DQm*

LED DIm/DQm*	含义	要纠正或避免错误
▫ 灭	数字量输入/数字量输出处于 0 电平	—
■ 亮	数字量输入/数字量输出处于 1 电平	—
■ 亮 (DQm)	诊断报警： 例如“数字量输出出错”	检查接线或连接的负载。

*　用作数字量输出时，适用于 DQm

5.2 触发诊断中断

启用诊断中断

在基本参数中启用诊断中断。

工艺模块可触发以下诊断中断：

表格 5- 4 可能的诊断中断

诊断中断	监视
• 内部错误 • 看门狗跳闸。 模块发生故障。	监视始终处于激活状态。 每次检测到错误时都触发诊断中断。
• 无电源电压 • 编码器电源短路或过载 • 数字量输出出错 • 电源电压错误 • 过热	监视始终处于激活状态。 只有在设备参数中启用“启用诊断中断”后，检测到的错误才会触发诊断中断。 默认设置中不启用这些诊断中断。

对诊断中断的响应

如果发生触发诊断中断的事件，则会发生以下情况：

- ERROR LED 闪烁。

  消除错误后，ERROR LED 就会熄灭。

- S7-1500 CPU 中断对用户程序的处理。 调用诊断中断 OB（例如 OB 82）。
  触发了中断的事件将输入到诊断中断 OB 的启动信息中。

- S7-1500 CPU 保持 RUN 模式，即使 CPU 中不存在诊断中断 OB 也是如此。
  只要有可能，工艺模块就会继续工作，无论是否存在错误。

有关错误事件的详细信息，可以使用指令“RALRM”进行获取（读取更多中断信息）。

5.3 诊断报警

诊断报警

如果诊断报警未决，ERROR-LED 将闪烁。

诊断在 STEP 7 (TIA Portal) 的在线和诊断视图中以纯文本形式显示。
可通过用户程序评估错误代码。

工艺模块只有一个通道可用于诊断功能。 因此，会为每个诊断都显示通道编号“0”。

可能指示以下诊断信息：

表格 5- 5　诊断报警、含义以及补救措施

诊断报警	错误代码	含义	要纠正或避免错误
内部错误	100_H	工艺模块有故障	更换工艺模块
看门狗跳闸。 模块发生故障。	103_H	固件出错	运行固件更新
		工艺模块有故障	更换工艺模块
无电源电压	$10A_H$	未为工艺模块提供 1L+ 和/或 2L+ 电源电压。	通过电源电压 1L+（端子 19）和/或 2L+（端子 39）为工艺模块供电
		前连接器插入不正确	正确插入前连接器
编码器电源短路或过载	$10E_H$	• 编码器电源出现故障 • 可能原因： – 短路 – 过载	• 更正编码器接线 • 检查连接到编码器电源的用户
数字量输出出错	$10F_H$	• 数字量输出出错（DQm LED 呈红色点亮） • 可能原因： – 短路 – 过载	• 更正数字量输出的布线 • 检查连接到数字量输出的用户

诊断报警	错误代码	含义	要纠正或避免错误
电源电压错误	110_H	• 1L+ 和/或 2L+ 电源电压出错 • 可能原因： – 电压低 – 1L+ 和/或 2L+ 电源电压接线故障	• 检查 1L+ 和/或 2L+ 电源电压 • 检查 1L+ 和/或 2L+ 电源电压的接线
过热	506_H	• 可能原因： – 数字量输出或编码器电源的输出发生短路或过载 – 环境温度超出规范	• 更正过程布线 • 改善冷却效果 • 检查连接的负载

技术规范

6

	6ES7552-1AA00-0AB0
产品型号名称	TM 定时器 DIDQ 16x24V
常规信息	
产品功能	
I&M 数据	√；I&M 0
工程组态方式	
TIA Portal 中 STEP 7 可组态的版本/可集成的版本（或更高版本）	V13 Update 3
安装类型/安装	
可以采用导轨安装	有；S7-1500 安装导轨
电源电压	
负载电压 1L+	
额定值（直流）	24 V
有效范围（直流）的下限	19.2 V
有效范围（直流）的上限	28.8 V
反极性保护	是，防止毁坏
负载电压 2L+	
额定值（直流）	24 V
有效范围（直流）的下限	19.2 V
有效范围（直流）的上限	28.8 V
反极性保护	是，防止毁坏
输入电流	
来自负载电压 1L+（无负载），最大值	40 mA；无负载
来自负载电压 2L+（无负载），最大值	30 mA；无负载

	6ES7552-1AA00-0AB0
编码器电源	
输出数量	8；取决于参数分配的最大值
24 V 编码器电源	
24 V	√；L+ (-0.8 V)
短路保护	√
最大输出电流	1.2 A；所有编码器/通道的总电流，每个输出最大 0.5 A
功率	
背板总线的功率	1.3 W
功耗	
典型功耗	5 W
地址区	
已占用地址区	
输入	44 个字节
输出	74 个字节
数字量输入	
输入数量	8；取决于参数分配的最大值
• 每组个数	8
数字量输入，可组态	√
输入特性符合 IEC 61131，类型 3	√
数字量输入功能，可组态	
具有时间戳功能的数字量输入	√
• 最大数	8
计数器	√
• 最大数	4
增量式编码器的计数器	√
• 最大数	4
具有过采样功能的数字量输入	√
• 最大数	8

	6ES7552-1AA00-0AB0
数字量输入的硬件使能	√
• 最大数	4
数字量输出的硬件使能	√
• 最大数	4
输入电压	
输入电压的类型	DC
额定值（直流）	24 V
信号为“0”时	-30 V 到 +5 V
信号为“1”时	+11 V 到 +30 V
输入上允许的最小电压	-30 V
输入上允许的最大电压	30 V
输入电流	
信号为“1”时的典型值	2.5 mA
输入延时（在输入额定电压时）	
程序响应的最小脉冲宽度	3 µs；参数分配为“无”
标准输入	
• 可组态	是；（无/0.05/0.1/0.4/0.8 ms）
• “0”到“1”时的最小值	4 µs；参数分配为“无”
• “1”到“0”时的最小值	4 µs；参数分配为“无”
电缆长度	
屏蔽电缆的最大长度	1000 m；取决于传感器、电缆质量和沿的斜率
未屏蔽电缆的最大长度	600 m；取决于传感器、电缆质量和沿的斜率

	6ES7552-1AA00-0AB0
数字量输出	
数字量输出的类型	晶体管
输出数量	16；取决于参数分配的最大值
• 每组个数	8
M 开关	是；具有高速输出
源式	√
数字量输出，可组态	√
短路保护	√；电子/热
• 典型响应阈值	标准输出时为 1.7 A；高速输出时为 0.5 A
电感关断电压的限制	-0.8 V
数字量输入的控制	√
数字量输出功能，可组态	
具有时间戳功能的数字量输出	√
• 最大数	16
PWM 输出	√
• 最大数	16
具有过采样功能的数字量输出	√
• 最大数	16
输出切换容量	
最大阻性负载	0.5 A；高速输出时为 0.1 A
最大灯负载	5 W；高速输出时为 1 W
负载电阻范围	
下限	48 Ω；高速输出时为 240 Ω
上限	12 kΩ
输出电压	
输出电压的类型	DC
信号“0”最大值	1 V；高速输出时
信号为“1”时的最小值	23.2 V；L+ (-0.8 V)

	6ES7552-1AA00-0AB0
输出电流	
信号为“1”时的额定电流	0.5 A；高速输出时为 0.1 A，注意降额
信号为“1”时的最大允许范围	0.6 A；高速输出时为 0.12 A，注意降额
信号为“1”时的最小负载电流	2 mA
信号为“0”时残余电流的最大值	0.5 mA
输出延时，有阻性负载	
“0”到“1”时的最大值	1 µs；针对高速输出，标准输出时为 5 µs
“1”到“0”时的最大值	1 µs；针对高速输出，标准输出时为 6 µs
切换频率	
最大阻性负载	10 kHz
最大灯负载	10 Hz
输出的总电流	
每个组的最大电流	4 A
每个模块的最大电流	8 A；注意降额
电缆长度	
屏蔽电缆的最大长度	1000 m；取决于负载和电缆质量
未屏蔽电缆的最大长度	600 m；取决于负载和电缆质量
编码器	
支持的编码器	
增量编码器（非对称）	√
24 V 启动器	√
2 线制传感器	√
• 允许的最大静态电流（2 线制传感器）	1.5 mA

	6ES7552-1AA00-0AB0
编码器信号，增量编码器（非对称）	
输入电压	24 V
最大输入频率	50 kHz
最大计数频率	200 kHz；具有四重评估
屏蔽电缆的最大长度	600 m；取决于输入频率、编码器和电缆质量；50 kHz 时最长 200 m
具有 A/B 轨迹（相移 90°）的增量编码器	√
脉冲编码器	√
24 V 编码器信号	
• 输入上允许的最小电压	-30 V
• 输入上允许的最大电压	30 V
接口硬件	
输入特性符合 IEC 61131，类型 3	√
等时模式	
等时模式（应用程序同步至终端）	√
最短总线循环时间 (TDP)	250 µs
最大抖动时间	1 µs
中断/诊断/状态信息	
激活替代值	√
中断	
诊断中断	√
诊断报警	
诊断	√
电源监视	√
短路	√

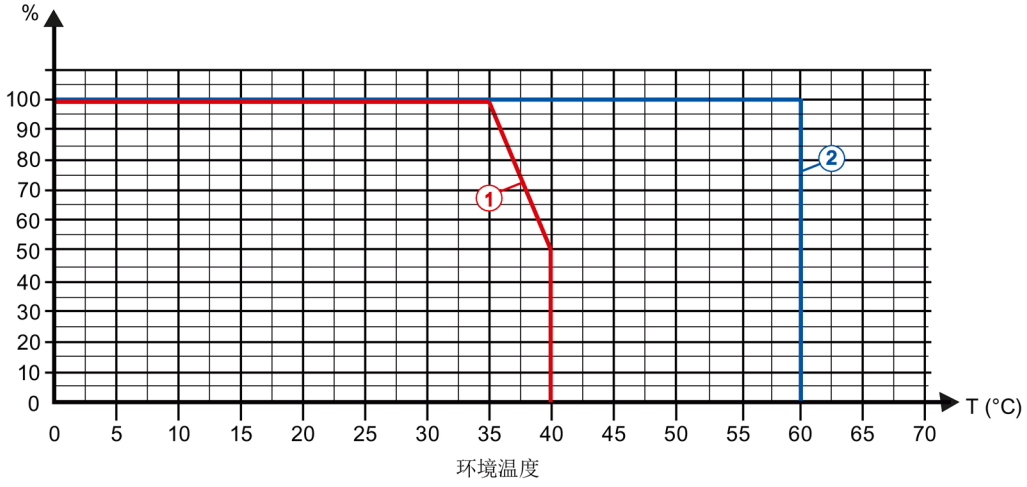
	6ES7552-1AA00-0AB0
LED 诊断显示	
RUN LED	有；绿色 LED
ERROR LED	有；红色 LED
MAINT LED 指示灯	有；黄色 LED
电源电压监视 (PWR LED)	有；绿色 LED
通道状态显示	有；绿色 LED
通道诊断	有；红色 LED
集成的功能	
计数器数量	4
最大计数频率（计数器）	200 kHz；具有四重评估
计数功能	
连续计数	√
电气隔离	
电气隔离通道	
通道和背板总线之间	√
允许的电位差	
不同电路之间	75 V DC/60 V AC（基本绝缘）
隔离	
绝缘测试	707 V DC（型式试验）
环境条件	
工作温度	
水平安装时的最低温度	0 °C
水平安装时的最高温度	60 °C
垂直安装时的最低温度	0 °C
垂直安装时的最高温度	40 ℃；注意降额
分布式运行	
SIMATIC S7-1500 中	√

	6ES7552-1AA00-0AB0
尺寸	
宽度	35 mm
高度	147 mm
厚度	129 mm
重量	
近似重量	320 g

输出标准化总电流的降额信息

如果 TM Timer DIDQ 16x24V
的数字量输出与阻性负载配合使用，应对工艺模块每个负载组的数字量输出上的负载进行标准化总电流降额。
标准化总电流是所有数字量输出和编码器电源（与其额定电流相关）的平均输出电流的标准化总和。

仅当系统垂直安装时才应进行降额。
以下降额曲线显示了每个负载组中数字量输出的负载能力与环境温度和安装位置之间的关系：



① 系统垂直安装
② 系统水平安装

图 6-1 取决于环境温度和安装位置的阻性负载的每个负载组的标准化总电流

示例

下表给出了通道组态为“3 个输入，13 个输出”时每个负载组的标准化总电流计算。

表格 6- 1　标准化总电流的计算 (1L+)

电源电压 1L+ 的负载组					
数字量输出	用作编码器电源	高速输出 (0.1 A)	输出电流		
			取决于参数分配的额定值	平均值	与额定值有关的平均值
DQ0	√	—	0.5 A	0.3 A	60 %
DQ1	√	—	0.5 A	0.4 A	80 %
DQ2	-	-	0.5 A	0.5 A	100 %
DQ3	√	—	0.5 A	0.4 A	80 %
DQ4	-	√	0.1 A	0.05 A	50 %
DQ5	-	-	0.5 A	0.15 A	30 %
DQ6	-	√	0.1 A	0.09 A	90 %
DQ7	-	-	0.5 A	0.35 A	70 %
总和					560 %
标准化总电流 = 总和/输出数 = 560 % / 8 输出					**70 %**

表格 6- 2　标准化总电流的计算 (2L+)

电源电压 2L+ 的负载组					
数字量输出	用作编码器电源	高速输出 (0.1 A)	输出电流		
			取决于参数分配的额定值	平均值	与额定值有关的平均值
DQ8	—	√	0.1 A	0.05 A	50 %
DQ9	—	√	0.1 A	0.07 A	70 %
DQ10	—	-	0.5 A	0.5 A	100 %
DQ11	—	-	0.5 A	0.4 A	80 %
DQ12	—	√	0.1 A	0.09 A	90 %
DQ13	—	-	0.5 A	0.15 A	30 %
DQ14	—	√	0.1 A	0.04 A	40 %
DQ15	—	-	0.5 A	0.25 A	50 %
总和					510 %
标准化总电流 = 总和/输出数 = 510 % / 8 输出					**64 %**

确定工艺模块最高环境温度时，要考虑两个负载组的较高标准化总电流。
在本例中，可达 70 %。 对于 70 %
的标准化总电流和垂直安装的系统，根据降额曲线，最大环境温度可达约 38 °C 。

尺寸图

A

在附录中提供模块在安装轨道上的尺寸图，以及带前面板的尺寸图。
务必遵守在控制柜、控制室等地方安装时的具体尺寸要求。

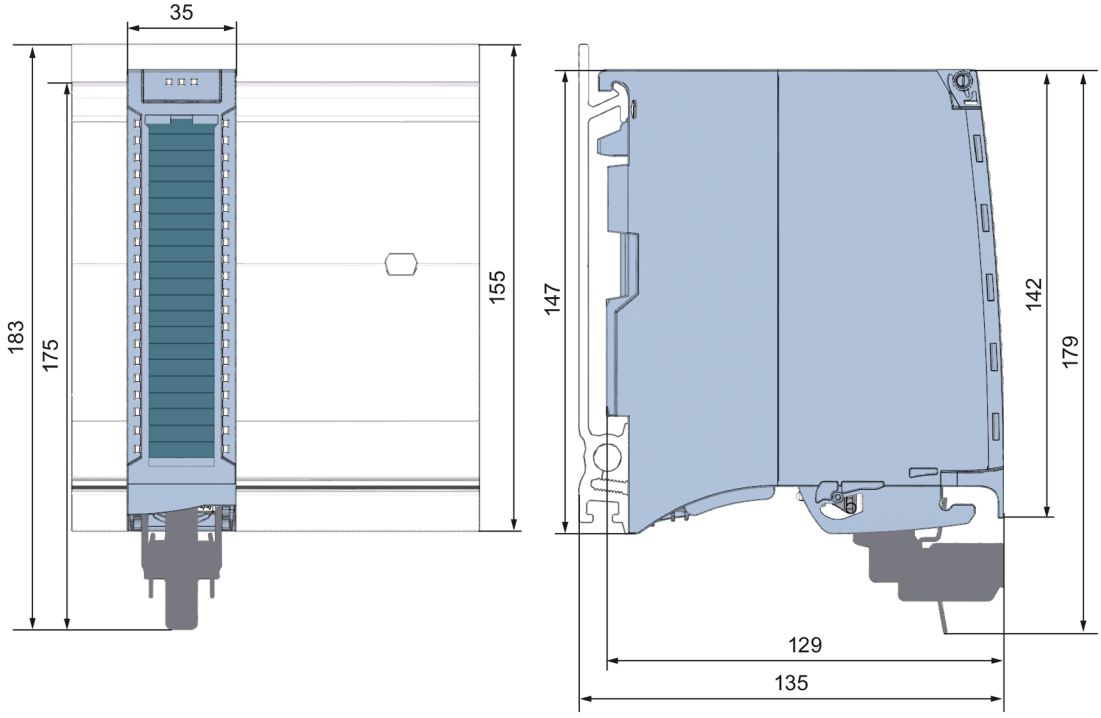


图 A-1　　TM Timer DIDQ 16x24V 工艺模块的尺寸图

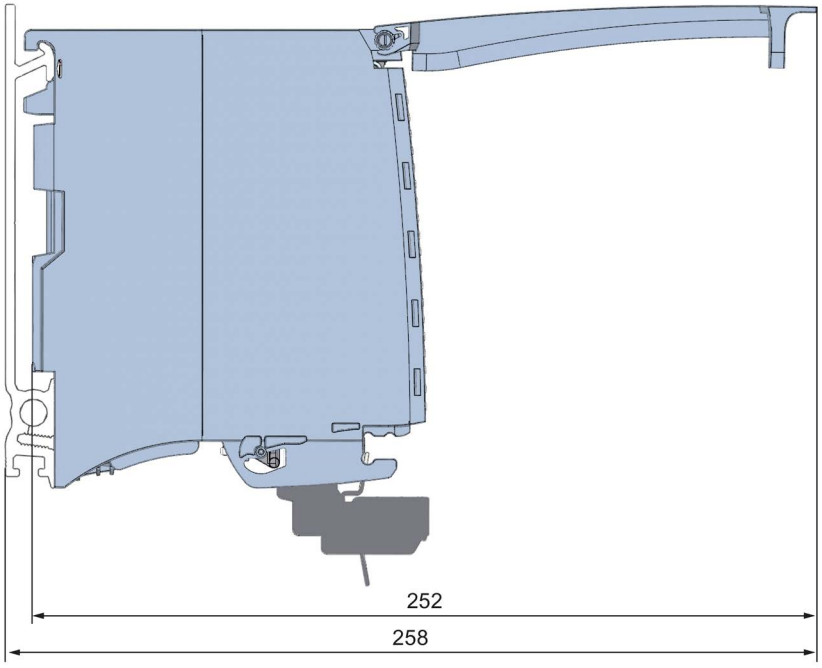


图 A-2　　TM Timer DIDQ 16x24V 模块的尺寸图，带开放式前面板的侧面图

参数数据记录

B

可以在 RUN 模式下编辑模块参数。 WRREC 指令用于将参数传送到使用数据记录 128 的模块中。

如果在使用 WRREC 指令传送或验证参数期间发生错误，模块将使用之前的参数分配继续操作。 相应的错误代码随后将写入 STATUS 输出参数。 如果未发生错误，STATUS 输出参数将包含实际传送数据的长度。

有关 WRREC 指令的说明和错误代码，请参见 STEP 7 在线帮助 (TIA Portal)。

数据记录的结构

下表给出了 TM Timer DIDQ 16x24V 的数据记录 128 的结构。 字节 0 到字节 3 中的值是固定的且不可更改。

表格 B- 1　参数数据记录 128

位 → 字节 ↓	位 7	位 6	位 5	位 4	位 3	位 2	位 1	位 0
0...3	标头							
0	预留[2)]		Major Version = 0		Minor Version = 1			
1	参数数据的长度 = 36							
2	预留[2)]							
3								

位 → 字节 ↓	位 7	位 6	位 5	位 4	位 3	位 2	位 1	位 0
4...7	**基本参数**							
4	预留[2)]				数字量输出的 PWM 周期：			
					0000_B： 10 ms			
					0001_B： 5 ms			
					0010_B：2 ms			
					0011_B：1 ms			
					0100_B： 0.5 ms			
					0101_B： 0.2 ms			
					0110 到 1111_B： 预留			
5	预留[2)]					启用诊断中断[1)]	对 CPU STOP 模式的响应：	
							00_B： 输出替换值	
							01_B： 保持上一个值	
							10 到 11_B： 预留	
6	预留[2)]							
7								

位 → 字节 ↓	位 7	位 6	位 5	位 4	位 3	位 2	位 1	位 0
8...9	**DI0 的通道参数**							
8	预留[2)]		反转输入信号[1]	通过下一个数字量输入设置 HW 使能[1]	数字量输入的工作模式：			
					0000_B： Timer-DI			
					0001_B： 预留			
					0010_B：Oversampling			
					0011_B： 计数器			
					0100_B： 增量编码器（A、B 相移）			
					0101 至 1111_B： 预留			
9	预留[2)]				输入延迟/滤波频率：			
					0000_B：无			
					0001_B：0.05 ms			
					0010_B：0.1 ms			
					0011_B：0.4 ms			
					0100_B：0.8 ms			
					0101 至 1110_B：预留			
					1111_B: 50 kHz			
8...9	**DQ0 的通道参数**							
8	高速输出 (0.1 A)[1]	替换值	反转输出信号[1]	通过下一个数字量输入设置 HW 使能[1]	数字量输出的工作模式：			
					0000 至 0111_B：预留			
					1000_B：Timer DQ			
					1001_B：预留			
					1010_B：Oversampling			
					1011_B：PWM			
					1100 至 1111_B： 预留			
9	预留[2)]							

位 → 字节 ↓	位 7	位 6	位 5	位 4	位 3	位 2	位 1	位 0
10...11	**DI1 的通道参数**							
10	预留[2)]		反转输入信号[1]	预留[2)]	数字量输入的工作模式：			
					0000_B： Timer-DI			
					0001_B： 预留			
					0010_B： Oversampling			
					0011 至 1111_B： 预留			
11	预留[2)]				输入延迟：			
					0000_B：无			
					0001_B：0.05 ms			
					0010_B：0.1 ms			
					0011_B：0.4 ms			
					0100_B：0.8 ms			
					0101 至 1111_B： 预留			
10...11	**DQ1 的通道参数**							
10	高速输出 (0.1 A)[1]	替换值	反转输出信号[1]	预留[2)]	数字量输出的工作模式：			
					0000 至 0111_B：预留			
					1000_B：Timer DQ			
					1001_B：预留			
					1010_B：Oversampling			
					1011_B：PWM			
					1100 至 1111_B： 预留			
11	预留[2)]							
12...13	**DI2/DQ2 的通道参数：** 请参见字节 8 和 9							
14...15	**DI3/DQ3 的通道参数：** 请参见字节 10 和 11							
16...17	**DI4/DQ4 的通道参数：** 请参见字节 8 和 9							

位 → 字节 ↓	位 7	位 6	位 5	位 4	位 3	位 2	位 1	位 0
18...19	**DI5/DQ5 的通道参数：** 请参见字节 10 和 11							
20...21	**DI6/DQ6 的通道参数：** 请参见字节 8 和 9							
22...23	**DI7/DQ7 的通道参数：** 请参见字节 10 和 11							
24...25	**DQ8 的通道参数：** 请参见字节 10 和 11							
26...27	**DQ9 的通道参数：** 请参见字节 10 和 11							
28...29	**DQ10 的通道参数：** 请参见字节 10 和 11							
30...31	**DQ11** 的**通道参数：** 请参见字节 10 和 11							
32...33	**DQ12** 的**通道参数：** 请参见字节 10 和 11							
34...35	**DQ13** 的**通道参数：** 请参见字节 10 和 11							
36...37	**DQ14** 的**通道参数：** 请参见字节 10 和 11							
38...39	**DQ15** 的**通道参数：** 请参见字节 10 和 11							

1) 通过将相应位设置为 1 启用特定参数。

2) 必须设置为 0。

计数

下表给出了可以在相应数字量输入的通道参数中进行设置的计数属性。

表格 B- 2　计数设置选项

计数工作模式	可用的数字量输入	“反转输入信号”设置为...	
		0	1
计数器 (0011_B)	• DI0 • DI1 • DI2	上升沿计数	下降沿计数
增量编码器（A、B 相移）(0100_B)	• DI0 和 DI1（DI1 通道参数的所有位都设置为 0） • DI2 和 DI3（DI3 通道参数的所有位都设置为 0） • DI4 和 DI5（DI5 通道参数的所有位都设置为 0） • DI6 和 DI7（DI7 通道参数的所有位都设置为 0）	计数方向未反向	计数方向反向

硬件使能（HW 使能）

可以通过使能输入为工作模式“Timer DI”和“Timer DQ”使用硬件使能。
可通过相应通道参数的位 4 设置硬件使能。

可以为以下输入和输出设置硬件使能：

表格 B- 3　硬件使能选项

数字量输入/数字量输出	设置硬件使能的数字量输入...
DI0 或 DQ0	DI1
DI2 或 DQ2	DI3
DI4 或 DQ4	DI5
DI6 或 DQ6	DI7

使用使能输入“工作模式”和“反转”信号输入的通道参数设置硬件使能：

表格 B- 4　使能输入设置选项

工作模式	“反转输入信号”设置为...	
	0	1
Oversampling (0010_B)	通过**高**电平设置硬件使能	通过**低**电平设置硬件使能
Timer DI (0000_B)	仅使用 SIMOTION 控制系统时	

输入滤波器

以下总览显示了可以针对数字量输入的特定工作模式进行设置的输入滤波器：

表格 B- 5　输入滤波器设置选项

数字量输入的工作模式	输入滤波器的类型	可分配值
• Timer DI (0000_B) • Oversampling (0010_B)	输入延迟	• 无 • 0.05 ms • 0.1 ms • 0.4 ms • 0.8 ms
• 计数器 (0011_B) • 增量编码器（A、B 相移）(0100_B)	滤波频率	50 kHz （无法更改）

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* @file splay_tree_.hpp
* Contains an implementation class for splay_tree_.
*/
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