

SIEMENS



# SIMATIC

## S7-1500

数字量输入模块 DI 16x24VDC HF (6ES7521-1BH00-0AB0)

手册

版本

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Answers for industry.

# SIEMENS

## SIMATIC

### S7-1500/ET 200MP DI 16x24VDC HF 数字量输入模块 (6ES7521-1BH00-0AB0)

设备手册

前言

---

文档指南

---

1

产品总览

---

2

接线

---

3

参数/地址空间

---

4

中断/诊断报警

---

5

技术规范

---

6

尺寸图

---

A

参数数据记录

---

B

开源软件




---

C

## 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。

 <b>危险</b>
表示如果不采取相应的小心措施， <b>将会</b> 导致死亡或者严重的人身伤害。
 <b>警告</b>
表示如果不采取相应的小心措施， <b>可能</b> 导致死亡或者严重的人身伤害。
 <b>小心</b>
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。
<b>注意</b>
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：

 <b>警告</b>
<b>Siemens</b> 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 <b>Siemens</b> 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。

# 前言

## 本文档的用途

本手册是对《S7-1500、ET 200MP 系统手册》的补充。

在这些系统手册中，介绍了与这些系统相关的各种功能。

本手册和系统/功能手册中介绍的信息将为您进行系统调试提供技术支持。

## 相对于先前版本的变更

与前一版本相比，本手册包含以下更改内容：

该模块从固件版本 V2.1.0 开始，通道 0 和通道 1 可用于计数

如果将通道 0 和 1 用于计数，则通道 2 至 15 可继续用作数字量输入。

## 约定

**CPU：**本手册中使用的术语“CPU”既可指代 S7-1500 自动化系统的 CPU，也可指代 ET 200MP 分布式 I/O 系统的接口模块。

**STEP 7：**在本文档中，将使用“STEP 7”表示组态和编程软件“STEP 7 (TIA Portal)”的所有版本。

**DI 模式：**DI 16x24VDC HF 作为数字量输入模块，带有 16 个数字量输入（通道 0 至 15）。

**计数模式：**DI 16x24VDC HF 作为数字量输入模块，带 2 个计数器（通道 0 和 1）和 14 个数字量输入（通道 2 至 15）。

另请遵循下列注意事项：

---

## 说明

这些注意事项中包含有关本文档中所述产品、产品操作或应特别关注部分的重要信息。

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## 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。

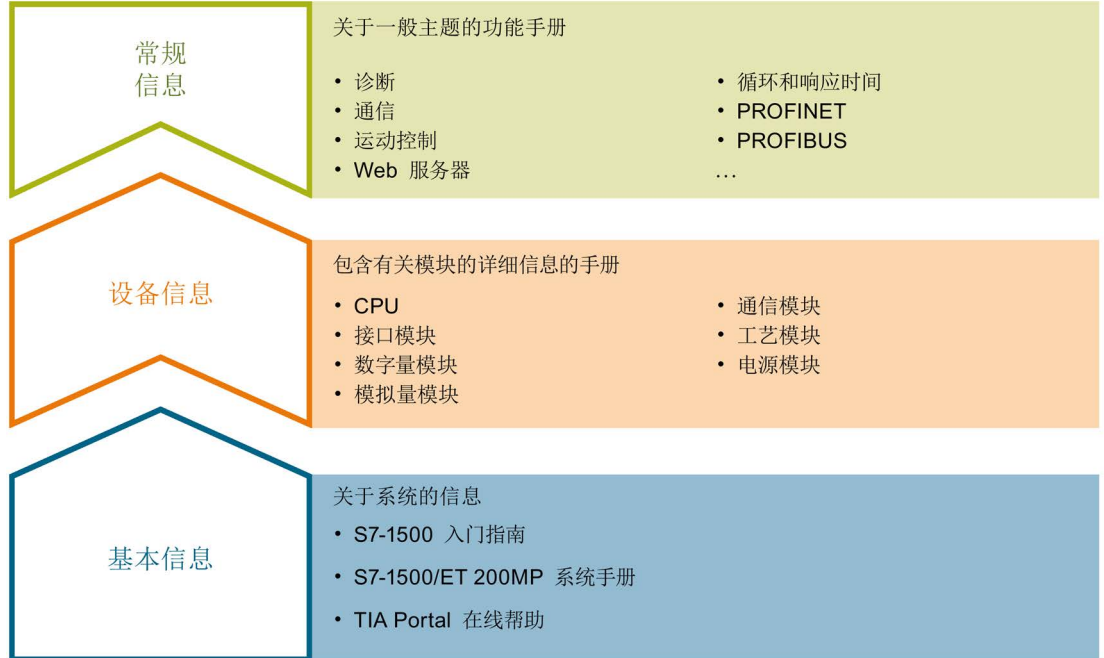
出于法律上的原因，我们有责任原文公布许可条件和版权提示。相关信息请参见附录。

# 目录

	前言 .....	4
<b>1</b>	<b>文档指南 .....</b>	<b>7</b>
<b>2</b>	<b>产品总览 .....</b>	<b>10</b>
	2.1 特性 .....	10
	2.2 功能 .....	13
	2.2.1 计数 .....	13
<b>3</b>	<b>接线 .....</b>	<b>15</b>
<b>4</b>	<b>参数/地址空间 .....</b>	<b>19</b>
	4.1 参数 .....	19
	4.1.1 参数 .....	19
	4.1.2 DI 模式下的参数 .....	20
	4.1.3 DI 模式下参数的说明 .....	21
	4.1.4 计数模式下的参数 .....	22
	4.1.5 计数模式下的参数说明 .....	24
	4.2 地址空间 .....	26
	4.2.1 DI 模式的地址空间 .....	27
	4.2.2 计数模式下的地址空间 .....	31
	4.2.3 计数示例 .....	35
<b>5</b>	<b>中断/诊断报警 .....</b>	<b>40</b>
	5.1 状态和错误指示灯 .....	40
	5.2 中断 .....	43
	5.3 诊断报警 .....	45
<b>6</b>	<b>技术规范 .....</b>	<b>46</b>
<b>A</b>	<b>尺寸图 .....</b>	<b>51</b>
<b>B</b>	<b>参数数据记录 .....</b>	<b>53</b>
	B.1 参数分配和参数数据记录的结构 .....	53
	B.2 DI 模式下参数数据记录的结构 .....	54
	B.3 计数模式下参数数据记录的结构 .....	56
<b>C</b>	<b>开源软件 .....</b>	<b>59</b>

SIMATIC S7-1500 自动化系统和 SIMATIC ET 200MP 分布式 I/O 系统的文档分为 3 个部分。

这样用户可方便访问自己所需的特定内容。



## 基本信息

系统手册和入门指南中详细描述了 SIMATIC S7-1500 和 ET 200MP 系统的组态、安装、接线和调试。STEP 7 在线帮助用户提供了组态和编程方面的支持。

## 设备信息

产品手册中包含模块特定信息的简要描述，如特性、接线图、功能特性和技术数据。

## 常规信息

功能手册中包含有关 SIMATIC S7-1500 和 ET 200MP 系统的常规主题的详细描述，如诊断、通信、运动控制、Web 服务器。

可以从 Internet (<http://www.automation.siemens.com/mcms/industrial-automation-systems-simatic/en/manual-overview/tech-doc-controllers/Pages/Default.aspx>) 上免费下载文档。

产品信息中记录了对这些手册的更改和补充。

## 手册集 S7-1500/ET 200MP

手册集中包含 SIMATIC S7-1500 自动化系统和 ET 200MP 分布式 I/O 系统的完整文档，这些文档都收集在一个文件中。

可以在 Internet (<http://support.automation.siemens.com/WW/view/zh/86140384>) 上找到手册集。

## 我的文档管理器

“我的文档管理器”用于将完整手册或部分手册组合成用户自己的手册。用户可以将该手册导出为 PDF 文件或可供稍后进行编辑的格式。

可以在 Internet (<http://support.industry.siemens.com/My/ww/zh/documentation>) 上找到“我的文档管理器”。

## 应用示例

应用示例提供使用各种工具的支持和用于完成自动化任务的各种示例。自动化系统中的多个组件完美协作，从而组合成不同的解决方案，而用户则无需关注各个单独的产品。

可在 Internet (<https://support.industry.siemens.com/sc/ww/zh/sc/2054>) 上找到应用示例。

## CAx 下载管理器

CAx 下载管理器用于访问 CAx 或 CAe 系统的最新产品数据。

仅需几次单击用户即可组态自己的下载包。

用户可选择：

- 产品图片、2 维图、3 维模型、内部电路图、EPLAN 宏文件
- 手册、功能特性、操作手册、证书
- 产品主数据

可以在 Internet (<http://support.industry.siemens.com/my/ww/zh/CAxOnline>) 上找到 CAx 下载管理器。



## TIA Selection Tool

通过 TIA Selection Tool，用户可以为全集成自动化 (TIA) 选择、组态和订购设备。

该工具是 SIMATIC Selection Tool

的下一代产品，并将自动化技术的已知组态程序集成到一个工具中。

通过 TIA Selection

Tool，用户可以根据产品选择型或产品组态生成一个完整的订购列表。

可以在 Internet (<http://w3.siemens.com/mcms/topics/en/simatic/tia-selection-tool>) 上找到 TIA Selection Tool。

## 产品总览

### 2.1 特性

订货号:

6ES7521-1BH00-0AB0

模块视图

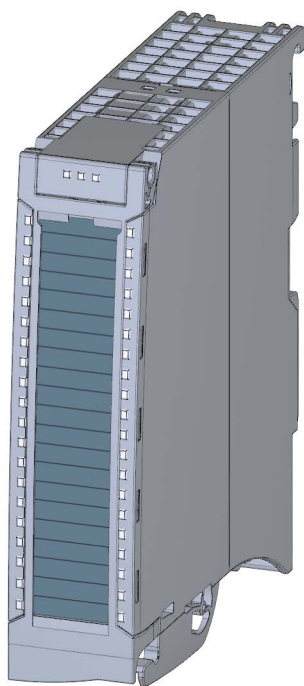


图 2-1 DI 16x24VDC HF 模块的视图

## 特性

该模块具有下列技术特性：

- 16 个数字量输入，按每组 16 个进行电气隔离
  - 其中，通道 0 和 1 可具有计数器功能
- 额定输入电压 24 V DC
- 可组态的输入延时：0.05 ms 到 20 ms
- 可组态的诊断（每个通道）
- 可组态的硬件中断（每个通道）
- 适用于开关以及 2/3/4 线制接近开关

模块支持以下功能：

表格 2-1 模块功能与版本的相关性

功能	模块的固件版本	组态软件	
		STEP 7 (TIA Portal)	STEP 7 (TIA Portal) V12 及更高版本或 STEP 7 V5.5 SP3 及更高版本中的 GSD 文件
固件更新	V1.0.0 或更高版本	V12 或更高版本	--- / √
标识数据 I&M0 到 I&M3	V1.0.0 或更高版本	V12 或更高版本	√
RUN 模式下的参数分配	V1.0.0 或更高版本	V12 或更高版本	√
等时同步模式**	V1.0.0 或更高版本	V12 或更高版本	---
模块内部 Shared Input (MSI)	V2.0.0 或更高版本	V13 Update 3 或更高版本 (仅限 PROFINET IO)	√ (仅限 PROFINET IO)
可组态子模块/ Shared Device 子模块	V2.0.0 或更高版本	V13 Update 3 或更高版本 (仅限 PROFINET IO)	√ (仅限 PROFINET IO)
通道 0 和 1 可具有计数器功能*	V2.1.0 或更高版本	V13 SP1 HSP 0118 或更高版本	√ (仅限 PROFINET IO)

\* 计数器功能的要求：接口模块 IM 155-5 的固件版本为 V3.0 或更高版本，或 CPU S7-15XX 的固件版本为 V1.7 或更高版本

\*\* 不适用于计数模式

可通过 STEP 7 (TIA Portal) 和 GSD 文件组态模块。

## 附件

以下附件既可以随模块一起提供，也可以作为备件单独订购：

- 标签条
- U 型连接器
- 通用前盖板

## 其它组件

以下组件需单独订购：

前连接器，带电位跳线和扎带

有关附件的更多信息，请参见《S7-1500/ET 200MP 系统手册  
(<http://support.automation.siemens.com/WW/view/zh/59191792>)》。

## 2.2 功能

### 2.2.1 计数

#### 简介

该模块从固件版本 V2.1.0 起，“计数”模式下可使用通道 0 和 1，其它通道可用作标准输入（DI 模式）。

如果在“计数”模式下不使用通道 0 和 1，则可将这两个通道用作数字量输入。但通道 0 和 1 用作计数器输入时，必须一起使用。

在进行计数时，系统将捕获数字量输入的信号沿并进行评估判断，如：

- 进行单次计数，直至计数上限
- 进行重复计数

#### 参考

有关计数功能的基本知识及更多信息，请参见功能手册《计数、测量和位置检测 (<http://support.automation.siemens.com/WW/view/zh/59709820>)》。

### 使用通道 0 和通道 1 进行计数

通过该模块的 IO 地址，可对计数功能进行控制。这些 IO 地址也称为控制接口（输出地址）和反馈接口（输入地址），请参见“Auto-Hotspot”部分。

通过以下方式，可设置通道 0 和 1 计数参数：

- 超出某个计数限值时，可执行以下操作：
  - 停止计数
  - 继续计数
- 位 STS\_DQ（反馈接口中的位）将根据具体的参数分配方式，发出信号指示计数值的范围：
  - 介于比较值和计数上限之间。
  - 介于比较值和计数下限之间。
- 发生 DQ 比较事件时，可设置硬件中断参数。
- 定义介于 0 到 4294967295 ( $2^{32}-1$ ) 之间的计数限值和比较值。
- 定义计数的起始值或由用户程序设置计数的加载值。

计数方向仅为加计数。

### 参考

有关使用通道 0 和 1 进行计数的应用示例，请参见“计数示例 (页 35)”部分。

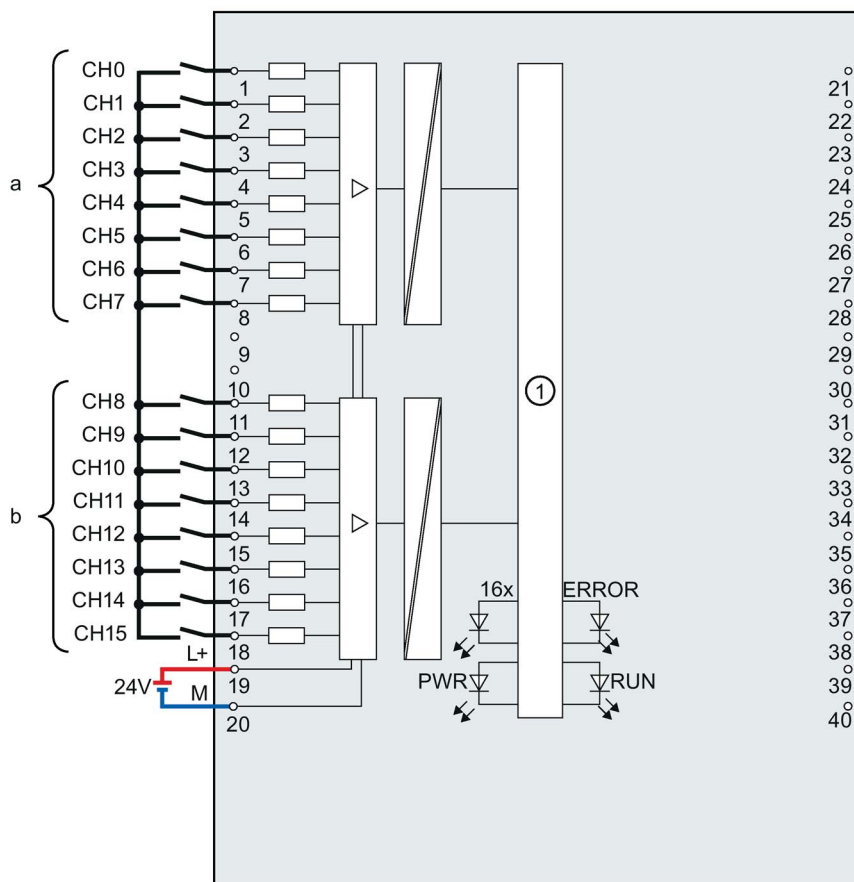
## 接线

下文中介绍了模块的方框图和各种接线方式。

有关前连接器的接线方式和铺设屏蔽电缆等信息，请参见《S7-1500/ET 200MP 系统手册 (<http://support.automation.siemens.com/WW/view/zh/59191792>)》中的“接线”部分。

接线图和方框图

下图显示了如何连接该模块以及如何进行通道寻址（输入字节 a 到输入字节 b）。在此，可以将通道 0 和 1 设置为用于计数，而通道 2 至 15 则继续用作数字量输入。



- |    |                  |       |                        |
|----|------------------|-------|------------------------|
| ①  | 背板总线接口           | CHx   | 通道或通道状态 LED 指示灯（绿色）    |
| L+ | 继电器触点 24 V DC 电源 | RUN   | 状态 LED 指示灯（绿色）         |
| M  | 接地               | ERROR | 错误 LED 指示灯（红色）         |
|    |                  | PWR   | 电源电压 POWER LED 指示灯（绿色） |

图 3-1 方框图和端子分配



### 编码器电阻电路

检测是否断路时，需要通过足够大的静态电流，甚至需要断开编码器触点。为此，可以在编码器触点上连接一个  $25\text{ k}\Omega$  到  $45\text{ k}\Omega$  且功率为  $0.25\text{ W}$  的电阻。

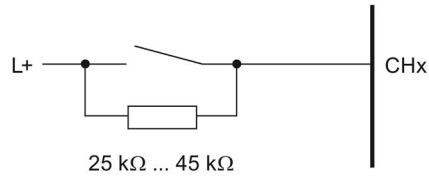


图 3-2 编码器电阻电路

**提示：使用电位跳线**

如果要将 24V DC 电源电压传导到相邻模块，请使用前连接器附带的电位跳线。这样，可以防止将两根线接到同一个端子上。

请按以下步骤操作：

1. 将 24 V DC 电源连接到端子 19 和 20 上。
2. 在端子 19 和 39 (L+) 之间、端子 20 和 40 (M) 之间分别插入电位跳线。
3. 使用端子 39 和 40 将电位传导到下一个模块

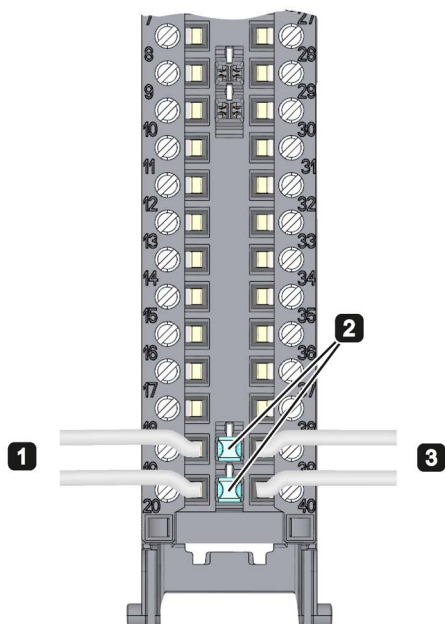


图 3-3 使用电位跳线

**说明**

请确保每个电位跳线上的最大电流负载不超过 8 A。

## 参数/地址空间

### 4.1 参数

#### 4.1.1 参数

##### DI 16x24VDC HF 参数

在 STEP 7

中设置模块参数时，可通过不同的参数设定模块的属性。并根据模块的运行模式为标准模式或计数器模式，进行相应的参数设置。相关参数，请参见“DI 模式下的参数 (页 20)”部分或“计数模式下的参数 (页 22)”部分。可组态参数的有效范围取决于具体的组态方式。可进行以下组态：

- 使用 S7-1500 CPU 进行统一操作
- 在 ET 200MP 系统中，通过 PROFINET IO 进行分布式操作
- 在 ET 200MP 系统中，通过 PROFIBUS DP 进行分布式操作

在用户程序中进行参数分配时，可通过 WRREC 指令（RUN 模式下的参数分配）和数据记录将这些参数传送到模块中；请参见章节参数分配和参数数据记录的结构 (页 53)。

## 4.1 参数

## 4.1.2 DI 模式下的参数

## DI 模式下 DI 16x24VDC HF 的参数

下表列出了“DI 模式”下的各种参数。这些参数适用于通道 0 至 15。

表格 4-1 DI 模式下可设置的参数及默认值

参数	取值范围	默认设置	RUN 模式下的参数重新分配	组态软件中的有效范围，例如，STEP 7	
				集成在硬件目录中（STEP 7 V13 SP1 及更高版本）或 PROFINET IO GSD 文件中	PROFIBUS DP GSD 文件
<b>诊断</b>					
• 电源电压 L+ 缺失	√/-	-	√	通道*	通道组**
• 断路	√/-	-	√	通道	通道组**
<b>输入延时</b>	0.05 ms、 0.1 ms、0.4 ms、 1.6 ms、3.2 ms、 12.8 ms、20 ms	3.2 ms； 等时同步模式 时 0.05 ms (无法更改)	√	通道	通道组**
<b>硬件中断***</b>					
• 上升沿	√/-	-	√	通道	通道
• 下降沿	√/-	-	√	通道	通道
• 上升沿和下降沿	√/-	-	√	通道	通道

\*如果启用了多通道诊断，则将在电源突发故障时一次收到多条信息，这是由于每个启用的通道都会检测这一故障。

为避免一次收到多条报警，可以只启用一个通道的诊断功能。

\*\* 在 RUN 模式下，可在进行参数分配时为每个通道指定该范围。

\*\*\* 组态为 4 x 8 通道模块时，最多可组态 16 个硬件中断（通道 0 到 15）。

### 4.1.3 DI 模式下参数的说明

#### 电源电压 L+ 缺失

如果电源电压 L+ 缺失或不足，则启用诊断。

#### 断路

如果连接编码器的线路断路，则启用诊断。

#### 输入延时

此参数可用于抑制信号中断。仅在信号更改的持续暂挂时间大于所设置的输入延时时间时，才能检测到该更改。

#### 硬件中断

指定是否禁用硬件中断或触发硬件中断的事件。

- 上升沿
- 下降沿
- 上升沿和下降沿

## 4.1 参数

## 4.1.4 计数模式下的参数

## 计数模式下，DI 16x24VDC HF Count 的参数

如果要使用该模块进行计数，则需将模块参数设置为 DI 16x24VDC HF Count。对于通道 0 和通道 1，可进行以下参数设置。对于通道 2 至 15，参数设置与 DI 16x24VDC HF，的相同。请参见“DI 模式下的参数 (页 20)”部分。

表格 4-2 计数模式下可设置的参数及默认值

参数	取值范围	默认设置	RUN 模式下的 参数 重新分 配	组态软件中的有效范围，例如， STEP 7	
				集成在硬件目录 中 (STEP 7 V13 SP1 HSP 0118 或更高版本) 或 PROFINET IO GSD 文件中	PROFIBUS DP GSD 文件
诊断					
• 电源电压 L+ 缺失	√/-	-	√	通道*	---
• 断路	√/-	-	√	通道	---
输入延时	0.05 ms、0.1 ms、 0.4 ms、1.6 ms、 3.2 ms、12.8 ms、 20 ms	3.2 ms； 等时同步模式 时 0.05 ms (无法更改)	√	通道	---
硬件中断	<ul style="list-style-type: none"> <li>禁用</li> <li>发生了 DQ 比较事件</li> </ul>	禁用	√	通道	---
置位输出 DQ	<ul style="list-style-type: none"> <li>介于比较值和计 数上限之间。</li> <li>介于比较值和计 数下限之间。</li> </ul>	介于比较值和 计数上限之间 。	√	通道	---
边沿选择	<ul style="list-style-type: none"> <li>上升沿</li> <li>下降沿</li> <li>上升沿和下降沿</li> </ul>	上升沿	√	通道	---
计数上限	0 到 4294967295	4294967295	√	通道	---

参数	取值范围	默认设置	RUN 模式下的 参数 重新分 配	组态软件中的有效范围，例如， STEP 7	
				集成在硬件目录 中（STEP 7 V13 SP1 HSP 0118 或更高版本）或 PROFINET IO GSD 文件中	PROFIBUS DP GSD 文件
比较值	0 到 4294967295**	1	√	通道	---
起始值	0 到 4294967295**	0	√	通道	---
超过计数限值时的行为	<ul style="list-style-type: none"> <li>• 停止计数</li> <li>• 继续计数</li> </ul>	停止计数器	√	通道	---

\*如果启用了多通道诊断，则将在电源突发故障时一次收到多条信息，这是由于每个启用的通道都会检测这一故障。

为避免一次收到多条报警，可以只启用一个通道的诊断功能。

\*\* 比较值或起始值必须小于或等于计数上限值。

## 4.1 参数

## 4.1.5 计数模式下的参数说明

## 电源电压 L+ 缺失

如果电源电压 L+ 缺失或不足，则启用诊断。

## 断路

如果连接编码器的线路断路，则启用诊断。

## 输入延时

此参数可用于抑制信号中断。仅在信号更改的持续暂挂时间大于所设置的输入延时时间时，才能检测到该更改。

## 硬件中断

指定是否在发生“DQ 比较事件”（STS\_DQ 处于上升沿）时，触发硬件中断。

## 置位输出 DQ

通过此参数，可指定反馈接口中的 STS\_DQ 位。可以在用户程序中指定该位（例如，通过硬件输出），请参见Auto-Hotspot。

行为	含义
介于 比较值和计数上限之间	如果满足以下条件，则置位 STS_DQ 位： 比较值 $\leq$ 计数值 $\leq$ 计数上限
介于 比较值和计数下限之间	如果满足以下条件，则置位 STS_DQ 位： 计数下限 $\leq$ 计数值 $\leq$ 比较值

## 边沿选择

通过此参数，可以指定触发计数的边沿。

可选择以下方式：

- 上升沿
- 下降沿
- 上升沿和下降沿



### 计数上限

通过此参数，可以限制计数的范围。可输入一个不超过 4294967295 ( $2^{32} - 1$ ) 的值。

### 比较值

通过该参数，可以指定数字量输出 DQ（反馈接口的 STS\_DQ 位）因发生指定的比较事件而进行切换时的计数值。

### 起始值

通过该参数，可指定发生指定事件时的计数起始值和继续计数值。必须满足以下条件：  
计数下限  $\leq$  起始值  $\leq$  计数上限

### 超过计数限值时的行为

通过该参数，可指定超出计数限值时的行为。

行为	含义
停止计数	超出计数限值时，计数过程中止，并复位 STS_GATE 位（内部门）。 重新开始计数时，需通过控制接口将 SW_GATE 位进行复位并再次置位。
继续计数	超出计数限值时，将计数值置位为其它计数限值并继续计数。

## 4.2 地址空间

在 STEP 7

中，可采用不同方式对模块进行组态；具体设置，请见下表。根据组态的不同，将在输入的过程映像中另外指定地址或指定不同地址。

模块上通常会印有字母“a 到 b”。例如，“EB a”是指模块起始地址的输入字节 a。

### DI 16x24VDC HF 的组态方式

可通过 STEP 7 (TIA Portal) 或 GSD 文件组态模块。

使用 GSD 文件组态模块时，可使用不同的缩写/模块名来表示组态。

可进行以下组态：

表格 4-3 组态方式

组态	GSD 文件中的简短标识/ 模块名	组态软件，如 STEP 7 (TIA Portal)	
		集成在硬件目录 STEP 7 (TIA Portal) 中	STEP 7 (TIA Portal) V12 或更高版本/STEP 7 V5.5 SP3 或更高版本中的 GSD 文件
1 x 16 通道（不带值状态）	DI 16x24VDC HF	V12 或更高版本	√
1 x 16 通道（带值状态）	DI 16x24VDC HF QI	V12 或更高版本	√
2 x 8 通道（不带值状态）	DI 16x24VDC HF S	V13 Update 3 或更高版本 (仅限 PROFINET IO)	√ (仅限 PROFINET IO)
2 x 8 通道（带值状态）	DI 16x24VDC HF S QI	V13 Update 3 或更高版本 (仅限 PROFINET IO)	√ (仅限 PROFINET IO)
1 x 16 通道（带最多 4 个子模块中模块内部共享输 入的值状态）	DI 16x24VDC HF MSI	V13 Update 3 或更高版本 (仅限 PROFINET IO)	√ (仅限 PROFINET IO)
1 x 16 通道，带值状态（通道 0 和通道 1 用于计数，通道 2 至 15 作为数字量输入）。	DI 16x24VDC HF Count	V13 SP1 HSP 0118 或更高版本	√ (仅限 PROFINET IO)

## 值状态 (Quality Information, QI)

以下模块的值状态始终为激活状态：

- DI 16x24VDC HF QI,
- DI 16x24VDC HF S QI
- DI 16x24VDC HF MSI
- DI 16x24VDC HF Count

系统将为每个通道的值状态指定一个附加位。通过值状态位，可指示所读取的数字值是否有效。（0 = 值不正确）。

### 4.2.1 DI 模式的地址空间

#### 组态为 16 通道 DI 16x24VDC HF QI 的地址空间

下图显示了组态为带值状态的 16 通道模块的地址空间分配。其中，模块的起始地址可任意指定。各通道的地址将从该起始地址开始分配。



图 4-1 组态为带值状态的 16 通道 DI 16x24VDC HF QI 的地址空间

4.2 地址空间

组态为 2 x 8 通道 DI 16x24VDC HF S QI 的地址空间

组态为 2 x 8

通道模块时，模块的通道应分为多个子模块。在共享设备中使用该模块时，可将子模块分配给不同的 IO 控制器。

可用的子模块数量取决于所使用的接口模块。请遵循本手册中有关特定接口模块的信息。

与 1 x 16 通道模块组态不同，这 2 个子模块都可任意指定起始地址。

过程映像输入 (PII) 中的分配

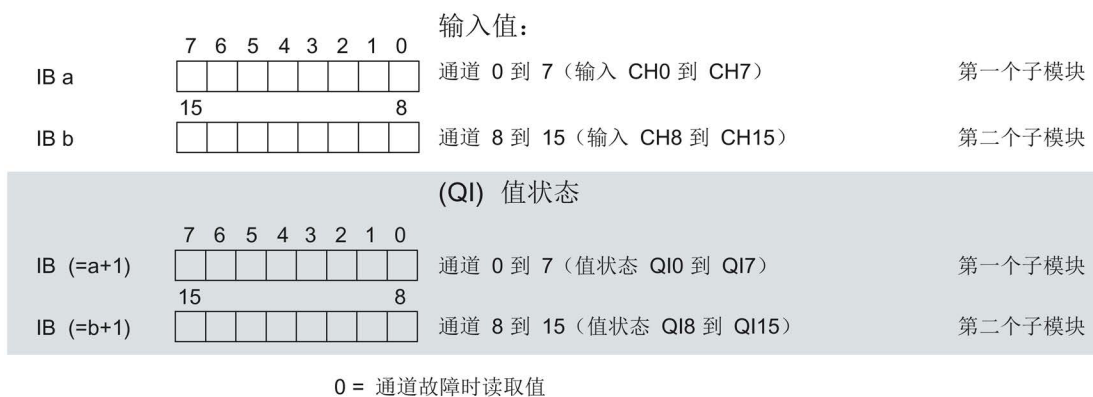


图 4-2 组态为 2 x 8 通道 DI 16x24VDC HF S QI 的地址空间

### 组态为 1 x 16 通道 DI 16x24VDC HF MSI 的地址空间

组态 1 x 16 通道模块（模块内部共享输入，MSI）时，可在最多 4 个子模块中复制模块的通道 0 到 15。之后，在各个子模块中通道 0 到 15 的输入值都将相同。在共享设备中使用该模块时，可将这些子模块分配给最多 4 个 IO 控制器。而每个 IO 控制器都对这些通道具有读访问权限。

IO 控制器数量取决于所使用的接口模块。请遵循本手册中有关特定接口模块的信息。

#### 值状态 (Quality Information, QI)

值状态的含义取决于各自的子模块。

对于第一个子模块（基本子模块），值状态为 0 表示值不正确。

对于第二到第四个子模块（MSI 子模块），值状态为 0 表示值不正确或基本子模块尚未组态（未就绪）。

下图显示了子模块 1 和 2 的地址空间分配和值状态。

第一个和第二个子模块的过程映像输入（PII）中的分配



0 = 通道故障时读取值

图 4-3 组态为 1 x 16 通道 DI 16x24VDC HF MSI 的地址空间

4.2 地址空间

下图显示了子模块 3 和 4 的地址空间分配和值状态。

第三个和第四个子模块的过程映像输入 (PII) 中的分配



图 4-4 组态为 1 x 16 通道 DI 16x24VDC HF MSI 的地址空间

参考

有关模块内部共享输入/共享输出 (MSI/MSO) 功能的信息, 请参见《使用 STEP 7 V13 组态 PROFINET (<http://support.automation.siemens.com/WW/view/zh/49948856>)》手册中的“模块内部共享输入/共享输出 (MSI/MSO)”部分。

## 4.2.2 计数模式下的地址空间

### 组态为 1 x 16 通道 DI 16x24VDC Count 的地址空间

进行计数时，通道 0 和通道 1

的地址空间内包含有控制接口和反馈接口。通过这两个接口可直接控制计数功能。并通过相应的参数分配，触发一个硬件中断。

在“计数模式”下（通道 0 和 1），该模块将占用以下地址空间：

- 过程映像输出（控制接口）中的 16 个字节
- 过程映像输入（反馈接口）中的 24 个字节

### 控制接口

下图显示了过程映像输出中模块的地址分配。例如，可以使用控制接口启动计数器或设置计数器值。使用“SW 门”控制位，打开和关闭相应通道的软件门。

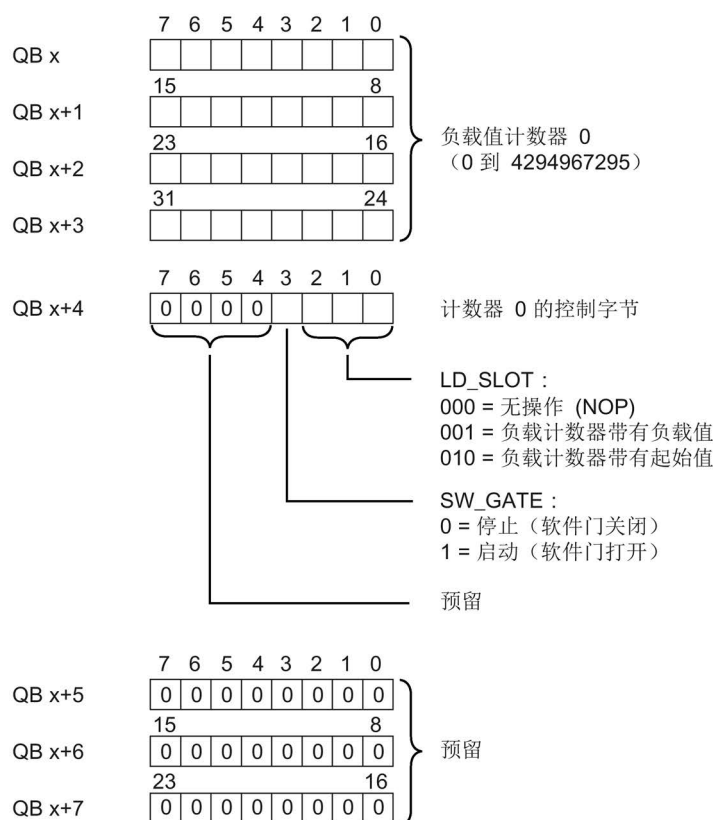


图 4-5 DI 16x24VDC Count 的控制接口地址空间分配（字节 0 至 7）

4.2 地址空间

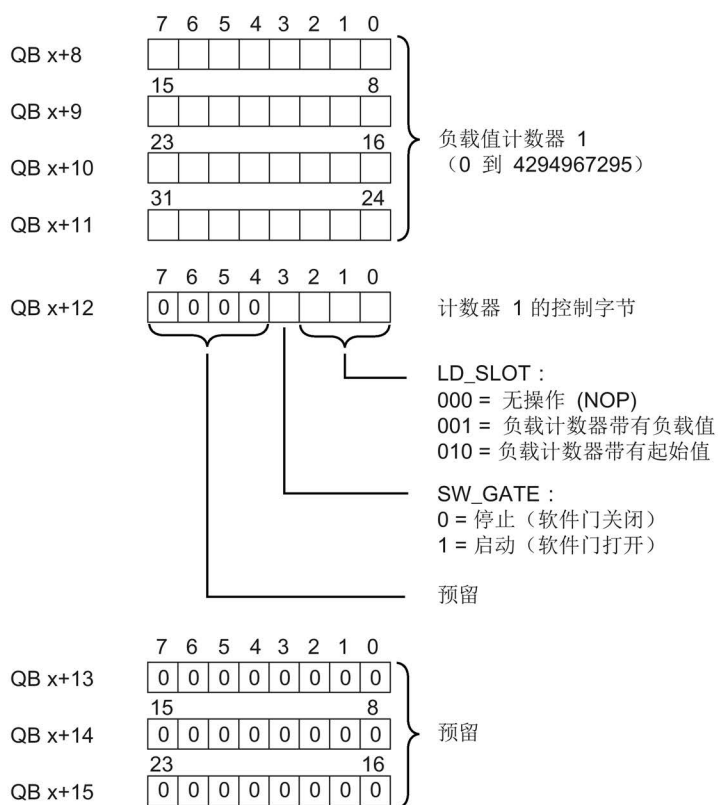


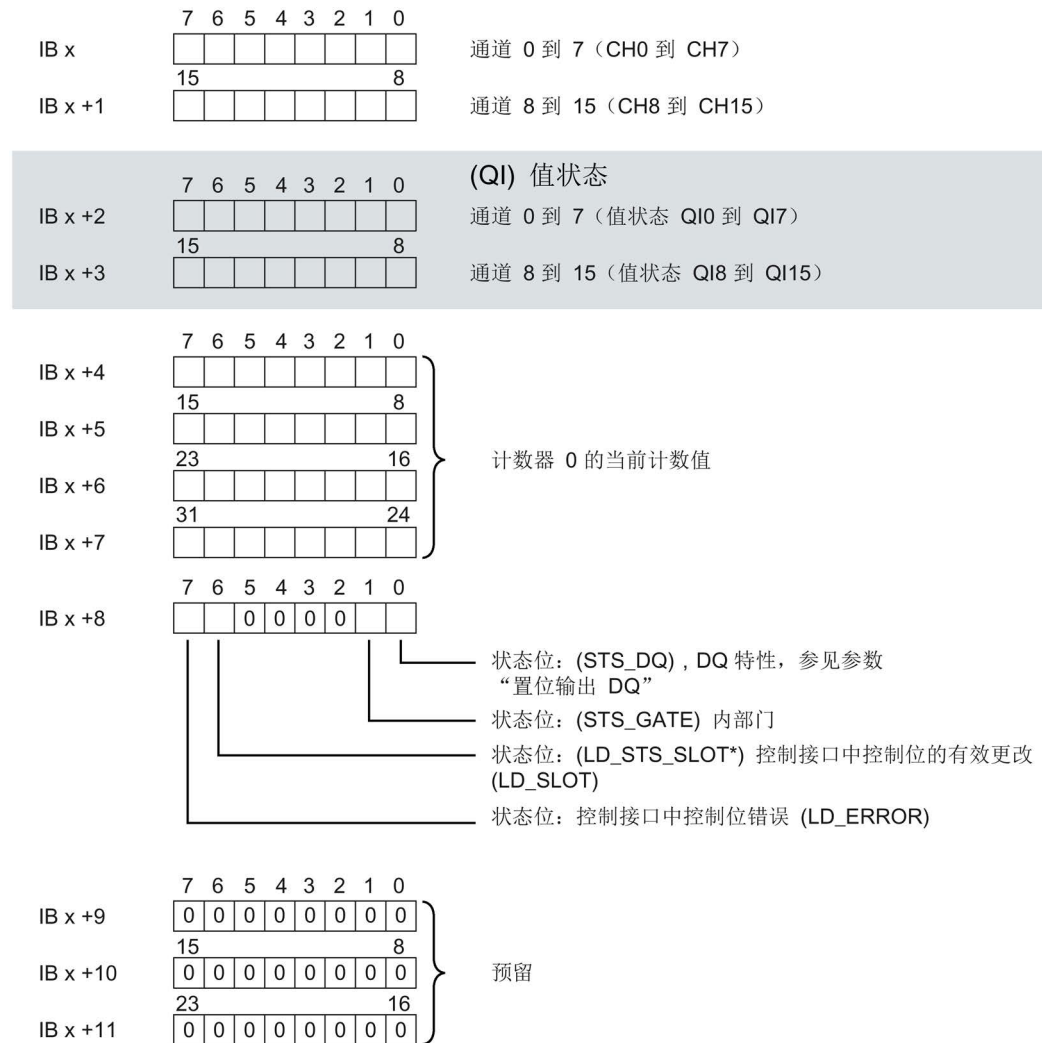
图 4-6 DI 16x24VDC Count 的控制接口地址空间分配 (字节 8 至 15)



## 反馈接口

下图显示了过程映像输出中模块的地址分配。计数器的反馈接口（通道 0 和 1）从输入字节  $x+4$  处开始。

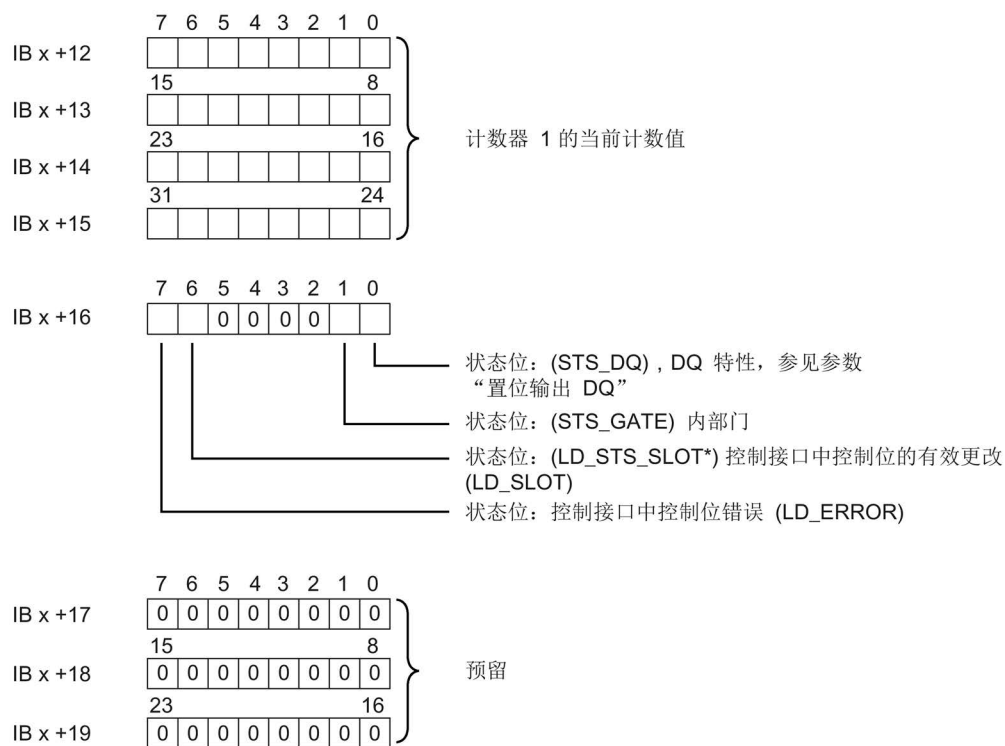
通过反馈接口，用户程序从模块中接收当前计数值和状态信息。



\* 控制接口 (LD\_SLOT) 中, 位 0 到 2 的“确认位”。这些位将更改其状态 LD\_SLOT 中输入一个有效的新命令时。

图 4-7 DI 16x24VDC Count 的反馈接口地址空间分配 (字节 0 至 11)

4.2 地址空间



\* 控制接口 (LD\_SLOT) 中, 位 0 到 2 的“确认位”。这些位将更改其状态 LD\_SLOT 中输入一个有效的新命令时。

图 4-8 DI 16x24VDC Count 的反馈接口地址空间分配 (字节 12 至 19)

### 4.2.3 计数示例

下文介绍了有关计数器行为示例以及如何指定这种行为。可以在参数分配中指定计数器的属性。

#### 超出计数限值时的行为 — 停止计数

下文中将介绍参数“超出计数限值时的行为 — 停止计数”的影响。可使用控制接口处控制字节的各个位控制计数器，请参见“计数模式下的地址空间 (页 31)”部分。

从当前计数值开始计数（在控制字节中置位 **SW\_GATE**），控制接口处控制字节中的位序列为 **0000 1000**。

超出计数上限时，计数中止（停止），同时计数值跳转至下限值 **0**。复位 **STS\_GATE** 位。

要重新开始计数，则需通过控制接口将 **SW\_GATE** 位进行复位并再次置位。

从当前计数值开始计数，或是从起始值开始计数，具体取决于控制接口中的命令字节。控制接口处控制字节中的位序列：

- 位 0 至 2 = "000"，从当前计数值开始计数
- 位 0 至 2 = "010"，从起始值开始计数

达到计数上限前，如果控制接口处控制字节中的 **SW\_GATE** 位复位，则停止计数。

下图举例说明了超出计数限值时停止计数的原理。

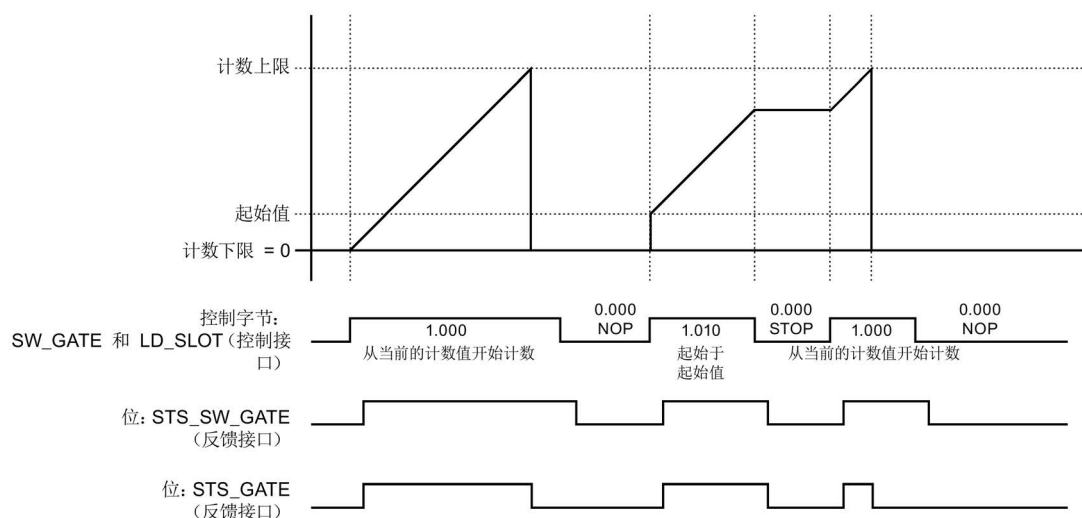


图 4-9 原理：停止计数

### 超过计数限值时的行为 — 继续计数

下文中将介绍参数“超出计数限值时的行为 — 继续计数”的影响。通过控制接口处控制字节的各个位，可控制计数器。具体参见“计数模式下的地址空间 (页 31)”部分的“控制接口”内容。

从当前计数值开始计数（在控制字节中置位 **SW\_GATE**）。控制接口处控制字节中的位序列为 **0000 1000**。

超出计数上限后，计数值跳转到计数下限 **0** 并继续计数。

达到计数上限前，如果控制接口处控制字节中的 **SW\_GATE** 位复位，则停止计数。

下图举例说明了超出计数限值时继续计数的原理。

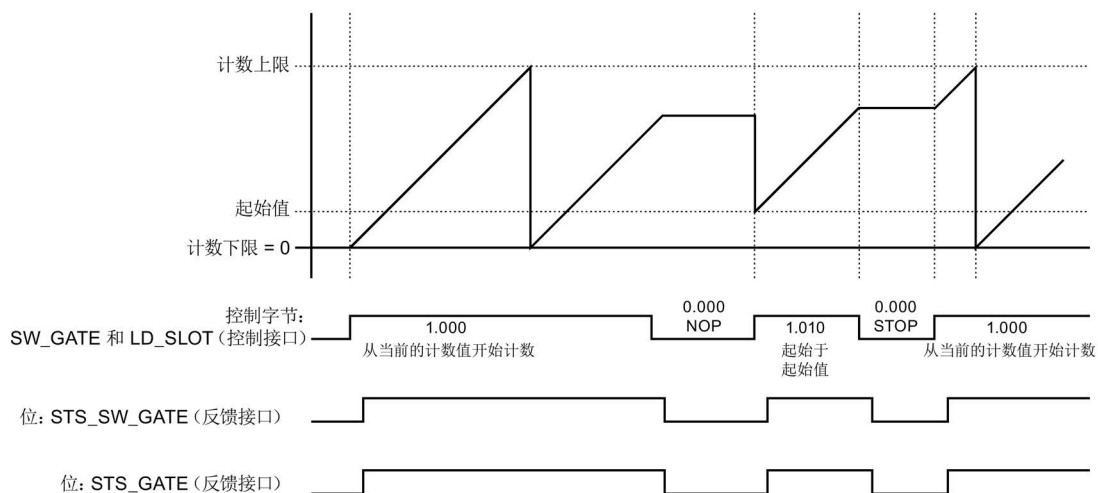


图 4-10 原理：继续计数

## 置位输出 DQ - STS\_DQ 位的行为

下文中介绍了参数设置为“置位输出 DQ 介于比较值和计数上限之间”时，STS\_DQ 位的行为。

STS\_DQ 置位为 1。

比较值  $\leq$  计数值  $\leq$  计数上限时。

也可以通过在参数分配中启用硬件中断，并在 STS\_DQ 位的参数为上升沿时触发中断。

下图举例说明了 STS\_DQ 位介于比较值和计数上限值之间时的行为。

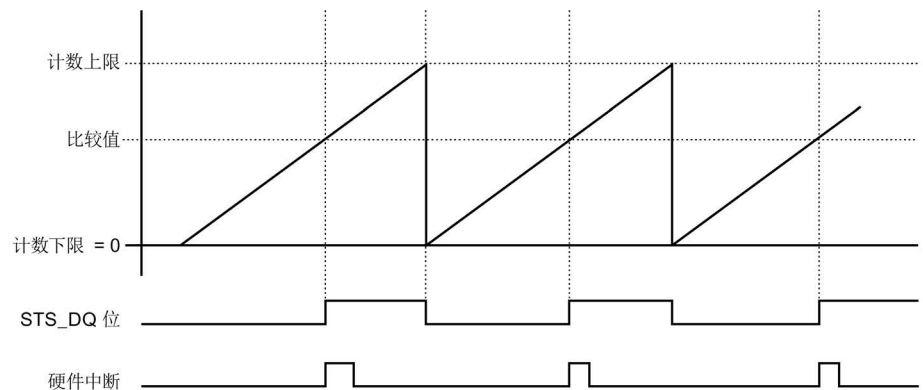


图 4-11 STS\_DQ 位的行为与硬件中断

下文中介绍了参数设置为“置位输出 DQ 介于比较值和计数下限之间”时，STS\_DQ 位的行为。

STS\_DQ 置位为 1。

计数下限  $\leq$  计数值  $\leq$  比较值时。

也可以通过在参数分配中启用硬件中断，并在 STS\_DQ 位的参数为上升沿时触发中断。

下图举例说明了 STS\_DQ 位介于比较值和计数下限值之间时的行为。

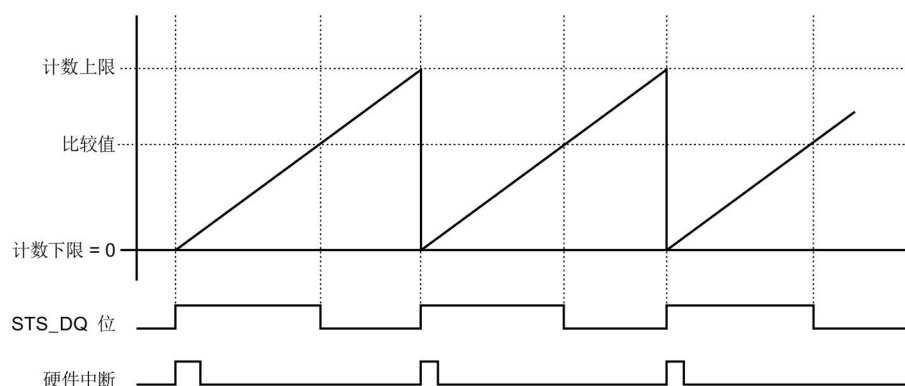


图 4-12 STS\_DQ 位的行为与硬件中断

## 计数限值

计数限值用于定义计数值的值范围。计数限值可在参数中设置，并在运行时通过用户程序更改。

可设置的计数上限：4294967295 ( $2^{32}-1$ )。

计数下限（不可设置）：0

超出了计数限值时，可继续计数或终止计数（自动门停止），具体参见参数“超出计数限值时的行为”。

## 起始值/加载值

起始值在 STEP 7 (TIA Portal)

的参数分配中指定。加载值则可通过用户程序进行更改。这两个值都必须介于计数下限和计数上限之间。

## 比较值

可以为每个通道指定一个比较值，该比较值可直接控制反馈位 STS\_DQ，而无需通过用户程序。当前计数值符合参数设置中的比较条件时，将置位反馈位 STS\_DQ。反馈位 STS\_DQ 可直接控制数字量输出模块的数字量输出。

比较值可在参数中设置，并在运行时通过用户程序更改。

## 门控制

### 软件门 (SW-GATE)

的打开和关闭定义了计数信号采集的时间段。软件门由用户程序控制。

## 参考

有关计数功能的更多信息，请参见功能手册《S7-1500、ET 200MP、ET 200SP 计数、测量和位置检测 (<http://support.automation.siemens.com/WW/view/zh/59709820>)》。

## 中断/诊断报警

### 5.1 状态和错误指示灯

#### LED 指示灯

下图显示了 DI 16x24VDC HF 的 LED 指示灯（状态和错误指示灯）。

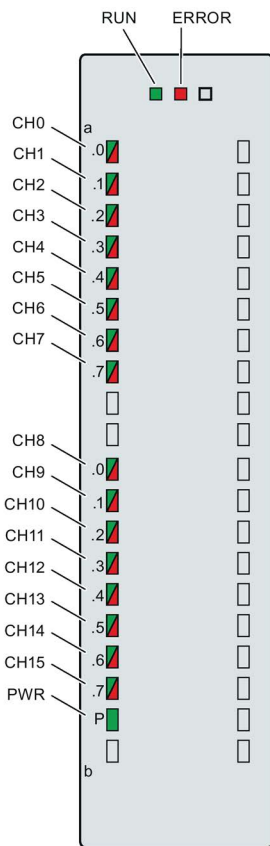


图 5-1 DI 16x24VDC HF 模块的 LED 指示灯

#### LED 指示灯的含义

下表列出了状态和错误指示灯的含义。有关诊断信息的补救措施，请参见“诊断报警 (页 45)”部分。



## RUN 和 ERROR 指示灯

表格 5-1 状态和错误指示灯 RUN 和 ERROR

LED		含义	补救措施
RUN	ERROR		
□ 灭	□ 灭	背板总线上电压缺失或过低。	<ul style="list-style-type: none"> <li>• 接通 CPU 和/或系统电源模块。</li> <li>• 检查是否插入 U 型连接器。</li> <li>• 检查是否插入了过多的模块。</li> </ul>
⚡ 闪烁	□ 灭	模块启动并在设置有效参数分配之前持续闪烁。	---
■ 亮	□ 灭	模块已组态。	
■ 亮	⚡ 闪烁	表示模块错误（至少一个通道上存在故障，如断路）。	判断诊断数据并消除该错误（如，断路）。
⚡ 闪烁	⚡ 闪烁	硬件故障。	更换模块。

## PWR LED 指示灯

表格 5-2 PWR 状态指示灯

LED PWR	含义	补救措施
□ 灭	电源电压 L+ 过低或缺失。	检查电源电压 L+。
■ 亮	有电源电压 L+ 且电压正常。	---

5.1 状态和错误指示灯

CHx LED 指示灯

表格 5-3 CHx 状态指示灯

LED CHx	含义	补救措施
□ 灭	0 = 输入信号的状态	---
■ 亮	1 = 输入信号的状态	---
■ 亮	诊断：断路	检查接线。使用简单开关输入时，可以禁用诊断或者在编码器触点上连接一个 25KΩ 到 45kΩ 的电阻。
	电源电压 L+ 过低或缺失。	检查电源电压 L+。

## 5.2 中断

数字量输入模块 DI 16x24VDC HF 支持诊断中断和硬件中断。

### 诊断中断

在发生以下事件时，该模块将生成诊断中断：

- 电源电压 L+ 缺失
- 断路
- 参数分配错误

### 硬件中断

在发生以下事件时，该模块将生成硬件中断：

- 上升沿
- 下降沿
- 上升沿和下降沿
- 发生了 DQ 比较事件（仅“计数模式”）

有关错误事件的详细信息，请参见指令“RALRM”（读取附加中断信息）的硬件中断组织块和 STEP 7 在线帮助。

触发硬件中断的模块通道记录在组织块的起始信息中。下图显示了本地数据中地址为 8 的双字的各个位的分配。

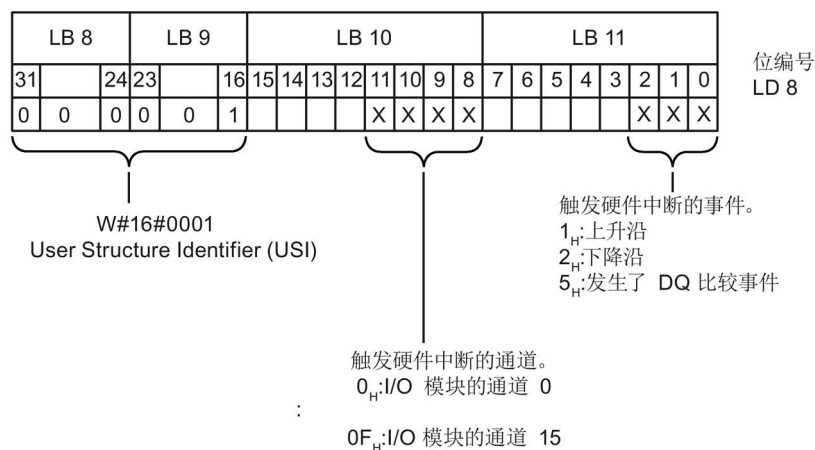


图 5-2 组织块的启动信息

5.2 中断

附加中断信息的结构

表格 5- 4 USI 结构 = W#16#0001

数据块名称	内容	注释	字节
<b>USI</b> (用户结构标识符)	W#16#0001	I/O 模块硬件中断的附加中断信息	2
触发硬件中断的通道紧随其后。			
<b>通道</b>	B#16#00 到 B#16#0F	事件触发型通道的数量 (模块的通道 0 到通道 15)	1
跟随在触发硬件中断的错误事件后。			
<b>事件</b>	B#16#01	上升沿	1
	B#16#02	下降沿	
	B#16#05	发生了 DQ 比较事件 (仅“计数模式”)	

## 5.3 诊断报警

### 诊断报警

为每个诊断事件输出一个诊断报警，同时模块上的 **ERROR LED** 指示灯闪烁。例如，从 CPU 的诊断缓冲区中读取诊断报警。并通过用户程序评估该错误代码。

如果在 ET 200MP 系统中通过 PROFIBUS DP 对模块进行分布式操作，则可使用指令 RDREC 或 RD\_REC 通过数据记录 0 和 1 读取诊断数据。有关数据记录结构，请参见 Internet 上的《接口模块 IM 155-5 DP ST (6ES7155-5BA00-0AB0) 手册》。

表格 5-5 诊断报警、含义以及更正措施

诊断报警	错误代码	含义	更正措施
断路*	6H	编码器电路的阻抗过高	使用其它型号的编码器或更改接线方式，例如，使用横截面积较大的电缆
		模块与传感器之间断路	连接电缆
		通道未连接（断开）	<ul style="list-style-type: none"> <li>禁用诊断</li> <li>在编码器触点上连接一个 25 kΩ 到 45 kΩ 的电阻</li> </ul>
参数分配错误	10H	<ul style="list-style-type: none"> <li>模块无法评估通道参数</li> <li>参数分配错误</li> </ul>	更正参数分配
负载电压缺失	11H	模块的电源电压 L+ 缺失	将电源电压 L+ 连接到模块/通道上
硬件中断丢失	16H	由于之前的中断尚未确认，因此模块无法触发中断；可能是由于组态错误	<ul style="list-style-type: none"> <li>更改 CPU 中的中断处理，必要时编辑模块参数。</li> <li>错误将一直持续到为该模块分配了新参数为止</li> </ul>

\* 如果在进行断路诊断过程中发生电源电压故障，则该值状态将立即指示一个错误值。

## DI 16x24VDC HF 的技术规范

	6ES7521-1BH00-0AB0
产品类型标识	DI 16x24VDC HF
<b>常规信息</b>	
硬件版本	FS01
固件版本	V2.1.0
<b>产品功能</b>	
I&M 数据	√; I&M0 到 I&M3
<b>工程组态方式</b>	
STEP 7 (TIA Portal)	V13 SP1 / -
可组态/可集成的最低版本	
STEP 7 可组态的版本/可集成的版本 (或更高版本)	V5.5 SP3 / -
PROFIBUS 的 GSD 最低版本/修订版	V1.0 / V5.1
PROFINET 的 GSD 最低版本/修订版	V2.3 / -
<b>操作模式</b>	
数字量输入 (DI)	√
计数器	√
MSI	√
<b>电源电压</b>	
直流额定电压	24 V
直流电压下限	20.4 V
直流电压上限	28.8 V
反极性保护	√
<b>输入电流</b>	
最大电流损耗	20 mA; 使用 24 V DC 电源时

	6ES7521-1BH00-0AB0
<b>功率</b>	
背板总线上的功耗	1.1 W
<b>功耗</b>	
典型功耗	2.6 W
<b>数字量输入</b>	
输入的数量	16
数字量输入, 可组态	√
读取 m/p	读取 p
输入特性曲线符合 IEC 61131, 类型 3	√
<b>数字量输入功能, 可在参数中设置</b>	
门启动/停止	√
数字量输入可用于各种用途	√
计数器	
• 最大数量	2
• 最大计数频率	1 kHz
• 计数宽度	32 位
• 计数方向 - 加/减计数	加计数
<b>输入电压</b>	
输入电压的类型	直流
直流额定电压	24 V
信号“0”	-30 到 +5 V
信号“1”	+11 到 +30 V
<b>输入电流</b>	
信号“1”, 典型值	2.5 mA

	6ES7521-1BH00-0AB0
<b>输入延时（输入额定电压时）</b>	
标准输入	
• 可组态	√; 0.05 / 0.1 / 0.4 / 1.6 / 3.2 / 12.8 / 20 ms
• 从“0”到“1”时的最短时间	0.05 ms
• 从“0”到“1”时的最长时间	20 ms
• 从“1”到“0”时的最短时间	0.05 ms
• 从“1”到“0”时的最长时间	20 ms
中断输入	
• 可组态	√
计数器/工艺功能	
• 可组态	√
<b>电缆长度</b>	
屏蔽电缆最大长度	1000 m
非屏蔽电缆最大长度	600 m
<b>编码器</b>	
<b>可连接的编码器</b>	
2 线制传感器	√
• 允许的最大静态电流（2 线制传感器）	1.5 mA
<b>等时同步模式</b>	
等时同步模式（应用程序最多同步到终端）	√
最短滤波和处理时间 (TCI)	80 μs（包含 50 μs 的滤波时间）
最短总线循环时间 (TDP)	250 μs
<b>中断/诊断/状态信息</b>	
<b>中断</b>	
诊断中断	√
硬件中断	√



<b>6ES7521-1BH00-0AB0</b>	
<b>诊断报警</b>	
诊断	√
电源电压监视	√
断路	√, I < 350 μA 时
短路	-
熔断器熔断	-
<b>诊断 LED 指示灯</b>	
RUN LED 指示灯	√; 绿色 LED 指示灯
ERROR LED 指示灯	√; 红色 LED 指示灯
电源电压监视 (PWR LED 指示灯)	√; 绿色 LED 指示灯
通道状态显示	√; 绿色 LED 指示灯
通道诊断	√; 红色 LED 指示灯
模块诊断	√; 红色 LED 指示灯
<b>电气隔离</b>	
<b>通道的电气隔离</b>	
通道之间	-
通道之间, 每组个数	16
通道和背板总线之间	√
通道与电子元件的电源之间	-
<b>允许的电位差</b>	
不同电路之间	75 V DC/60 V AC (基本绝缘)
<b>绝缘</b>	
绝缘测试	707 V DC (型式试验)
<b>分布式模式</b>	
优先启动	√
<b>尺寸</b>	
宽	35 mm
高	147 mm
深	129 mm

	<b>6ES7521-1BH00-0AB0</b>
<b>重量</b>	
约重	240 g

可编程输入延时的允许误差

表格 6-1 可编程输入延时的允许误差

输入延时	容差范围
0.05 ms	43 $\mu$ s 到 57 $\mu$ s
0.1 ms	86 $\mu$ s 到 114 $\mu$ s
0.4 ms	344 $\mu$ s 到 456 $\mu$ s
1.6 ms	1.5 ms 到 1.9 ms
3.2 ms (预设)	3 ms 到 4 ms
12.8 ms	12 ms 到 15 ms
20 ms	19 ms 到 23 ms

# 尺寸图

# A

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

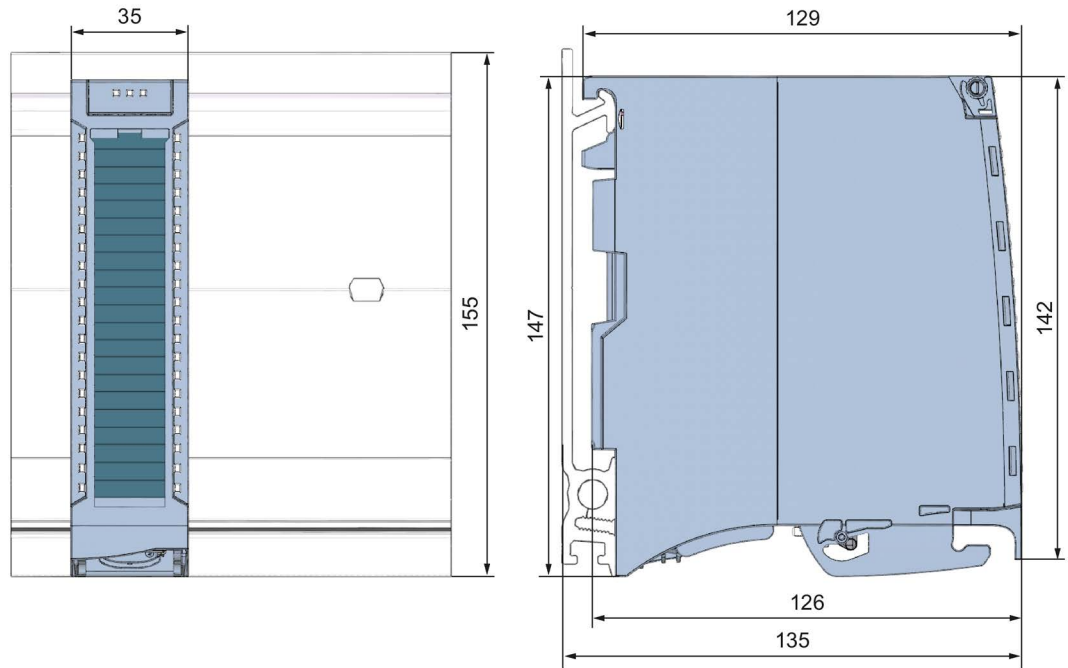


图 A-1 DI 16x24VDC HF 模块的尺寸图

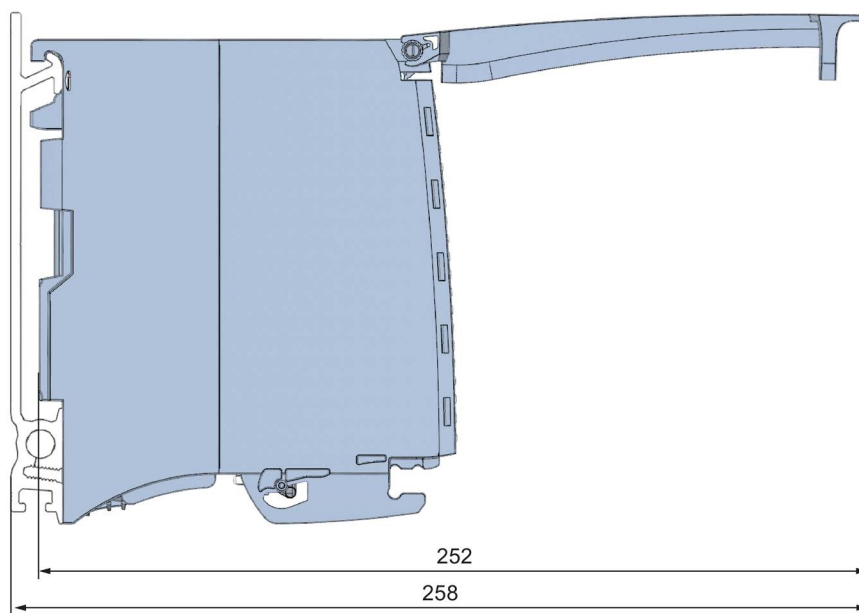


图 A-2 DI 16x24VDC HF 模块的尺寸图，带开放式前盖的侧视图

## 参数数据记录

### B.1 参数分配和参数数据记录的结构

该模块的数据记录结构相同，与通过 PROFIBUS DP 或 PROFINET IO 组态模块无关。

#### GSD 文件与组态的相关性

使用 GSD

文件组态模块时，请注意某些参数设置之间的相关性。参数传送到模块之后，模块只进行真实性检查。

**DI 模式：**参数间无关联。可按不同的组合形式进行参数分配。

**计数模式：**下表列出了各参数之间的相互关联性。

表格 B-1 使用 GSD 文件进行组态时参数的相关性

设备特定参数 (GSD 文件)	相关参数
比较值	0 到计数上限
起始值	0 到计数上限

#### 用户程序中的参数分配

在 RUN

模式下，可以对模块进行重新组态（例如，可以对所选通道的输入延时值进行编辑，而不影响其它通道）

#### RUN 模式下的参数分配

WRREC 指令用于通过数据记录 0 至 15 将参数传送到模块。STEP 7 中设置的参数在 CPU 中保持不变。即，STEP 7 中设置的参数在重新启动后仍然有效。

参数传送到模块之后，模块只进行真实性检查。

## 输出参数 STATUS

该模块将忽略 WRREC

指令在传输参数过程中发生的错误，并继续使用之前分配的参数进行操作。但会将相应的错误代码写入 STATUS 输出参数中。

有关 WRREC 指令的说明和错误代码，请参见 STEP 7 在线帮助。

## PROFIBUS DP 接口模块后的模块操作

如果操作 PROFIBUS DP 接口模块后面的模块，则系统不会回读参数数据记录 0 和 1。而通过回读参数数据记录 0 和 1，可获取诊断数据记录 0 和 1。更多信息，请参见 Internet (<http://support.automation.siemens.com/WW/view/zh/78324181>) 上《PROFIBUS DP 接口模块设备手册》中的“中断”部分。

## B.2 DI 模式下参数数据记录的结构

### 数据记录和通道的分配

组态为 1 x 16 通道时，参数分别位于数据记录 0 到 15 中，可进行如下分配：

- 数据记录 0 对应通道 0
- 数据记录 1 对应通道 1
- ...
- 数据记录 14 对应通道 14
- 数据记录 15 对应通道 15

组态为 2 x 8 通道模块时，该模块带有 2 个子模块，且每个子模块 8 个通道。通道参数将分别位于数据记录 0 到 7 中，具体分配如下所示：

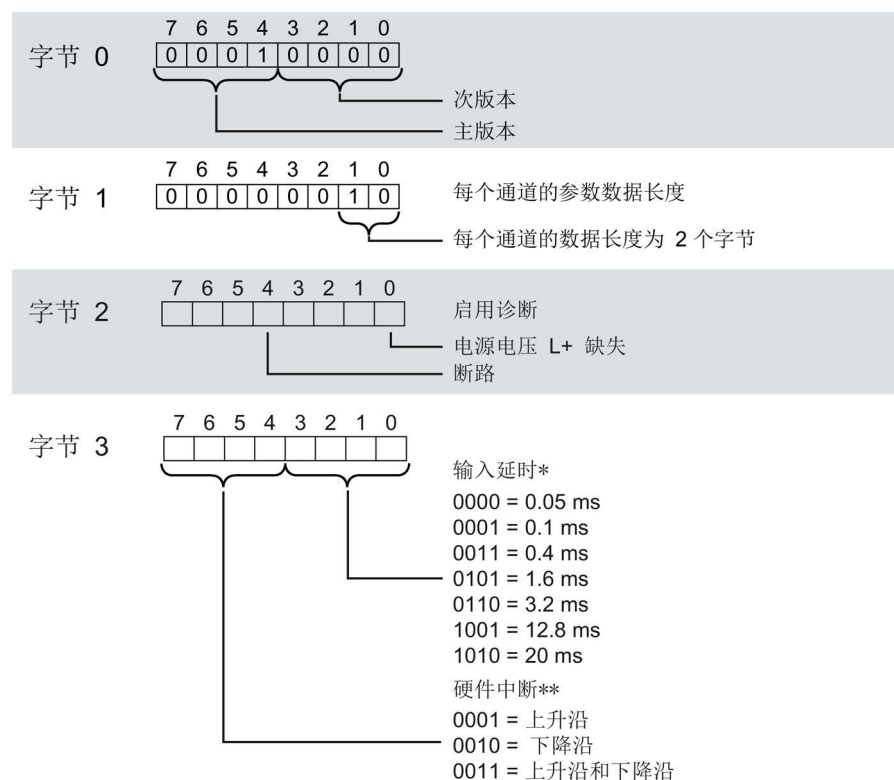
- 数据记录 0 到 7 对应通道 0 到 7（子模块 1）
- 数据记录 0 到 7 对应通道 8 到 15（子模块 2）

进行数据记录传输时，将寻址相应的子模块。

## DI 模式下数据记录的结构

下图举例说明了对应通道 0 的数据记录 0 的结构。通道 1 到 15 的结构相同。字节 0 和字节 1 中的值为固定值，不可更改。

通过将相应位设置为“1”，可启用该参数。



\* 等时同步模式时 0.05 ms（无法更改）

\*\* 仅当在 STEP 7 中为通道分配了硬件中断 OB 时，才能根据数据记录激活硬件中断

图 B-1 数据记录 0 的结构：字节 0 到 3

## B.3 计数模式下参数数据记录的结构

### 数据记录和通道的分配

组态为 1 x 16 通道时，参数分别位于数据记录 0 到 15 中，可进行如下分配：

- 数据记录 0 对应具有计数功能的通道 0
- 数据记录 1 对应具有计数功能的通道 1
- 数据记录 2 对应通道 2（结构与 DI 模式中的相同）
- ...
- 数据记录 14 对应通道 14（结构与 DI 模式中的相同）
- 数据记录 15 对应通道 15（结构与 DI 模式中的相同）

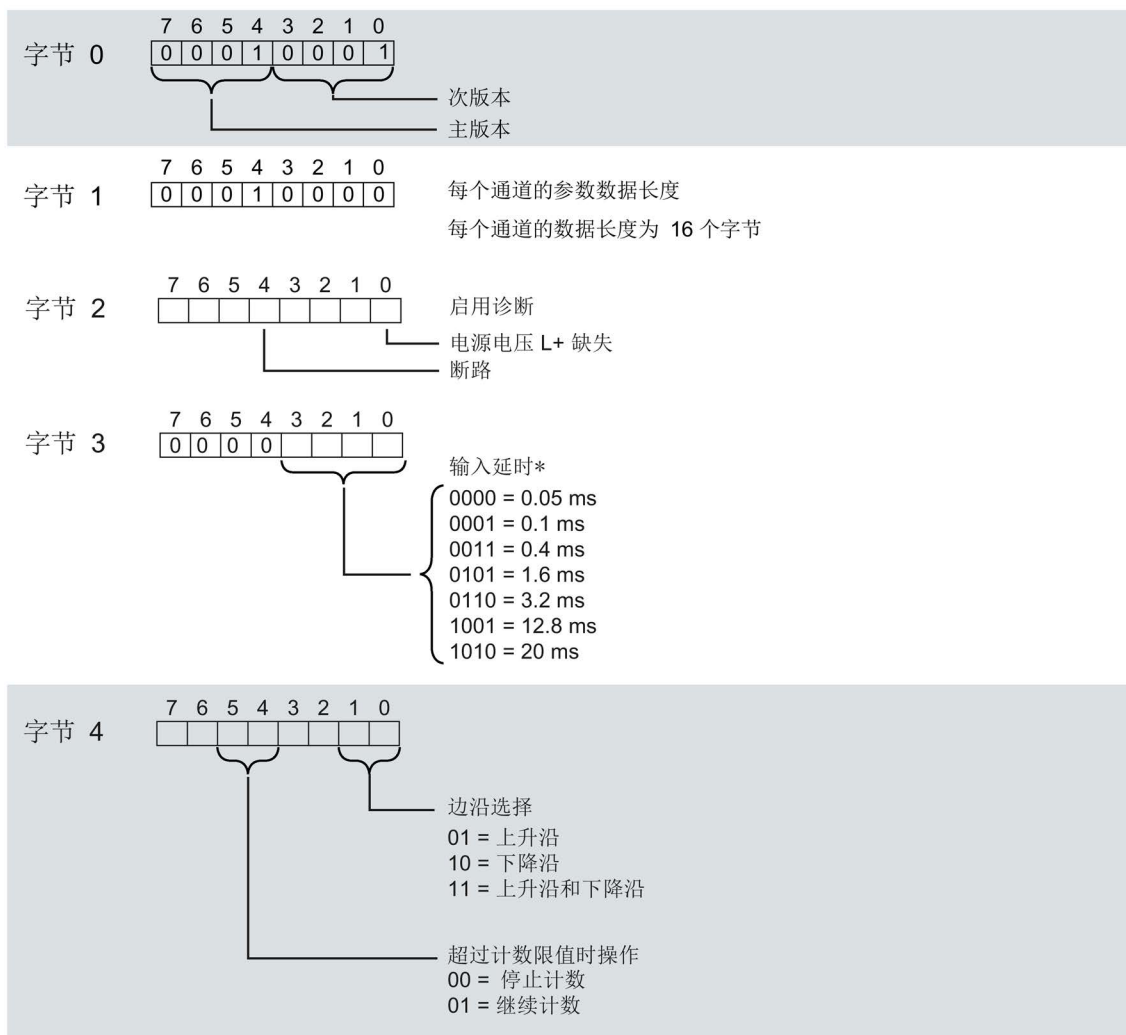


### 计数模式下数据记录 0 的结构

下图举例说明了对应通道 0 的数据记录 0 的结构。通道 1 的结构与其相同，只是值位于数据记录 1 中。

字节 0 和字节 1 中的值为固定值，不可更改。

通过将相应位设置为“1”，可启用该参数。



\* 等时同步模式时 0.05 ms (无法更改)

图 B-2 数据记录 0 的结构：字节 0 至 4

B.3 计数模式下参数数据记录的结构

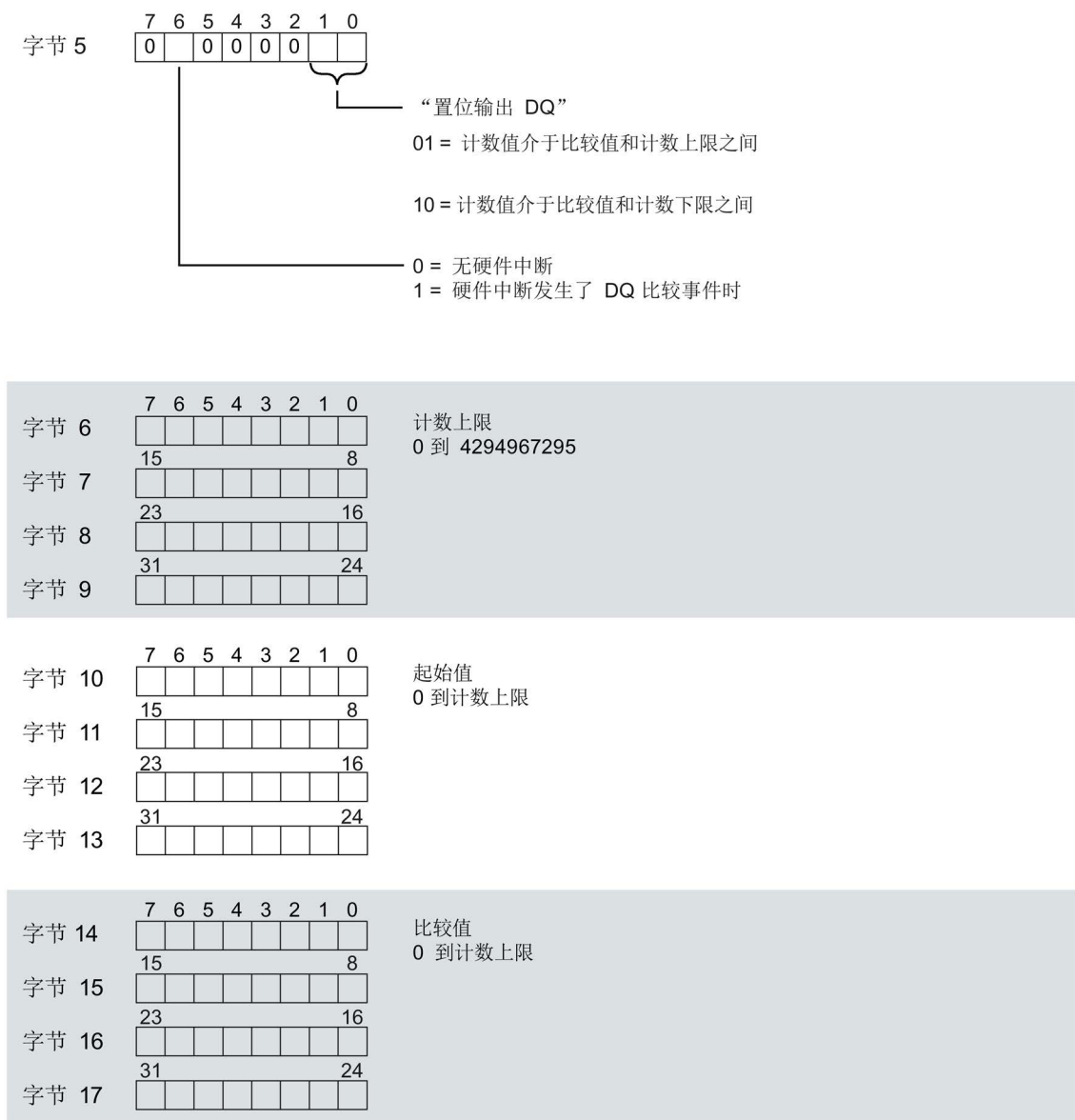


图 B-3 数据记录 0 的结构：字节 5 至 17

请注意，计数参数更改后，计数器将停止计数并复位到起始值。而更改参数“诊断”和“硬件中断”，不会影响计数器计数。

数据记录 2 到 15 的结构

对应于通道 2 至 15 的数据记录 2 至 15 的结构与 DI 中的相同，具体参见图“DI 模式下参数数据记录的结构 (页 54)数据记录 0 的结构：字节 0 至 3”部分。



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