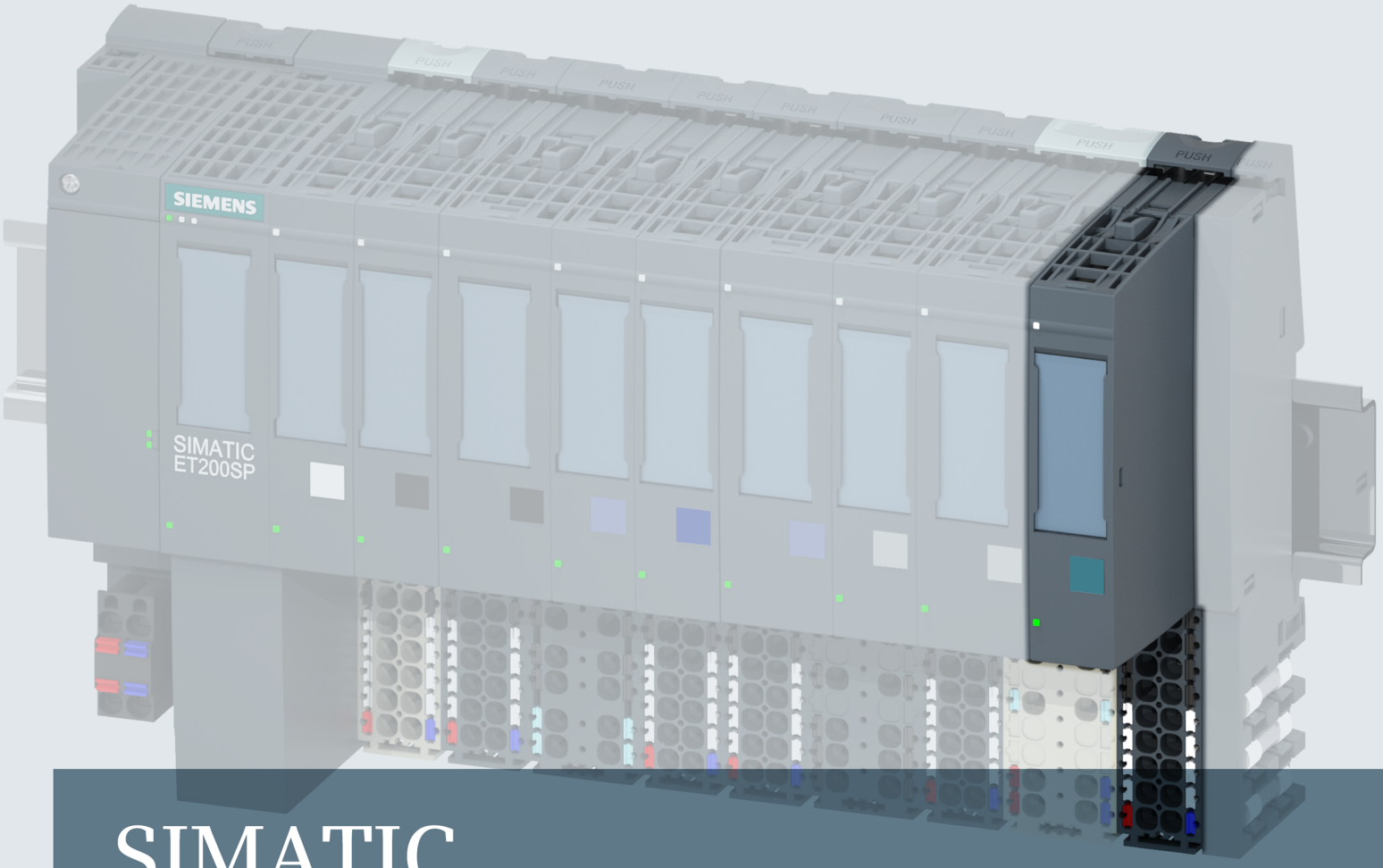
SIEMENS



SIMATIC

ET 200SP

Technology module TM PosInput 1 (6ES7138-6BA00-0AA0)

Output 02/2014

Answers for industry.

SIEMENS

SIMATIC

ET 200SP
Technology module TM PosInput 1 (6ES7138-6BA00-0BA0)

Manual

Preface

Documentation guide 1

Product overview 2

Wiring 3

Configuring/address space 4

Interrupts/diagnostic messages 5

Technical specifications 6

Parameter data records A

02/2014

A5E33015755-AA

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠
indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠WARNING
indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠CAUTION
indicates that minor personal injury can result if proper precautions are not taken.

NOTICE
indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠WARNING
Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

Siemens AG
Industry Sector
Postfach 48 48
90026 NÜRNBERG
GERMANY

A5E33015755-AA
℗ 03/2014 Subject to change

Preface

Purpose of the documentation

This manual includes module-specific information on wiring, diagnostics and the technical specifications of the technology module.

General information regarding the design and commissioning of the ET 200SP is available in the ET 200SP system manual.

The counting and measuring functions as well as the position input of the TM PosInput 1 technology module are described in more detail in the Counting, measurement and position input (http://support.automation.siemens.com/WW/view/en/59709820) function manual.

Conventions

Please observe notes marked as follows:

Note

A note contains important information on the product described in the documentation, on the handling of the product and on the section of the documentation to which particular attention should be paid.

Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, solutions, machines, equipment and/or networks. They are important components in a holistic industrial security concept. With this in mind, Siemens' products and solutions undergo continuous development. Siemens recommends strongly that you regularly check for product updates.

For the secure operation of Siemens products and solutions, it is necessary to take suitable preventive action (e.g. cell protection concept) and integrate each component into a holistic, state-of-the-art industrial security concept. Third-party products that may be in use should also be considered. You can find more information about industrial security on the Internet (http://www.siemens.com/industrialsecurity).

To stay informed about product updates as they occur, sign up for a product-specific newsletter. You can find more information on the Internet (http://support.automation.siemens.com).

Copyright notice for the open-source software used

Open-source software is used in the firmware of the product described. The open-source software is provided free of charge. We are liable for the product described, including the open-source software contained in it, pursuant to the conditions applicable to the product.

Siemens accepts no liability for the use of the open source software over and above the intended program sequence, or for any faults caused by modifications to the software.

For legal reasons, we are obliged to publish the original text of the following copyright notices.

Table of contents

Preface **4**

1 Documentation guide **7**

2 Product overview **9**

2.1 Properties 9

2.2 Functions 11
2.2.1 Acquisition of encoder signals 11
2.2.1.1 Position input with SSI absolute encoder 11
2.2.1.2 Counting with incremental or pulse encoder 12
2.2.2 Measured value determination 14
2.2.3 Switching the outputs at comparison values 15
2.2.4 Position input for Motion Control 16
2.2.5 Additional functions 16

3 Wiring **18**

3.1 Pin assignment 18

4 Configuring/address space **26**

4.1 Configuring 26

4.2 Reaction to CPU STOP 28

4.3 Address space 28

4.4 Parameters 29

4.5 Control and feedback interface 37
4.5.1 Assignment of the control interface 38
4.5.2 Assignment of the feedback interface 40

5 Interrupts/diagnostic messages **41**

5.1 Status and error displays 41

5.2 Diagnostic messages 43

5.3 Interrupts 45
5.3.1 Trigger a diagnostic interrupt 45
5.3.2 Cause of the error triggering a diagnostic interrupt 47
5.3.3 Triggering of a Hardware Interrupt 48
5.3.4 Events which can trigger a hardware interrupt 49

6 Technical specifications **50**

A Parameter data records **58**

Documentation guide

1

Introduction

This modular documentation of the SIMATIC products covers diverse topics concerning your automation system.

The complete documentation for the ET 200SP and S7-1500 systems consists of the respective system manuals, function manuals and device manuals.

The STEP 7 information system (TIA Portal) also helps you configure and program your automation system.

Overview of the documentation provided for technology module TM PosInput 1

The following table lists further documentation that you will need when using the TM PosInput 1 technology module.

Table 1- 1 Documentation for technology module TM PosInput 1

Topic	Documentation	Most important contents
System description	System manual ET 200SP Distributed I/O System (http://support.automation.siemens.com/WW/view/en/58649293)	• Application planning • Installation • Connecting • Commissioning
	S7-1500 Automation System (http://support.automation.siemens.com/WW/view/en/59191792) System Manual	
	Device manual Interface module (http://support.automation.siemens.com/WW/view/en/55683316/133300)	• Connecting • Interrupts, diagnostics, error, and system alarms • Technical specifications • Dimensional drawing
	Device manual ET 200SP BaseUnits (http://support.automation.siemens.com/WW/view/en/58532597/133300)	Technical specifications
Designing interference-free controllers	Designing interference-free controllers (http://support.automation.siemens.com/WW/view/en/59193566) Function Manual	• Basics • Electromagnetic compatibility • Lightning protection

Topic	Documentation	Most important contents
Counting, measurement and position input	Counting, measurement and position input (http://support.automation.siemens.com/WW/view/en/59709820) Function Manual	• Counting functions • Measuring functions • Position input • Control and feedback interface
Motion Control	S7-1500 Motion Control (http://support.automation.siemens.com/WW/view/en/59381279) Function Manual	• Configuration • Programming • Commissioning • Diagnostics

SIMATIC manuals

All current manuals for the SIMATIC products are available for download free of charge from the Internet (http://www.siemens.com/automation/service&support).

Product overview

2

2.1 Properties

Order number

6ES7138-6BA00-0BA0

View of the module

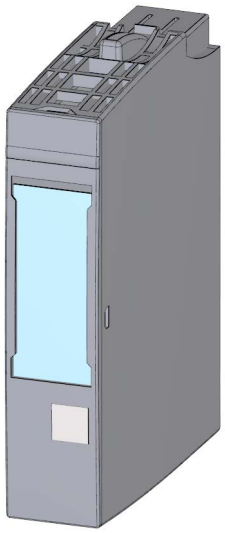


Figure 2-1 View of the TM PosInput 1 module

Properties

The TM PosInput 1 technology module has the following properties:

- Technical properties
  - One channel
  - Interfaces:

    SSI encoder signals DAT and CLK or RS422/TTL encoder signals A, B and N

    24 V encoder supply output, short-circuit proof

    Digital inputs signals DI0 and DI1

    Digital output signals DQ0 and DQ1

    L+ supply voltage
  - Position value range: 31 bits
  - Count range: 32 bits
  - Monitoring of encoder signals for wire break, short-circuit and offset voltage
  - Hardware interrupts configurable
  - Input filters for suppression of interferences at encoder inputs and digital inputs can be configured
- Supported encoder/signal types
  - SSI absolute encoder
  - RS422/TTL incremental encoder with and without signal N
  - RS422/TTL pulse encoder with direction signal
  - RS422/TTL pulse encoder without direction signal
  - RS422/TTL pulse encoders for up & down pulses
- Supported system functions
  - Isochronous mode
  - Firmware Update
  - Identification data I&M

Accessories

The following accessories can be used with the module and are not included in the product package:

- Labeling strip
- Color identification labels
- Reference identification labels
- Shield connector

A BaseUnit of the A0 type is required to operate the technology module. For an overview of the BaseUnits to be used with the technology module, refer to the product information on the documentation for the ET 200SP Distributed I/O System (http://support.automation.siemens.com/WW/view/en/73021864).

For detailed information on the installation procedure, refer to the ET 200SP Distributed I/O System (http://support.automation.siemens.com/WW/view/en/58649293) system manual.

2.2 Functions

2.2.1 Acquisition of encoder signals

2.2.1.1 Position input with SSI absolute encoder

You can use the TM PosInput 1 technology module with an SSI absolute encoder for position input. The technology module reads the position via a synchronous, serial interface from the SSI absolute encoder and sends it to the controller.

You can switch the digital outputs of the technology module exactly at defined position values, independently of the user program. Position input with an SSI absolute encoder does not involve gate control.

Gray-dual conversion

Gray-code and dual-code SSI absolute encoders are supported.

Range for position value

You can specify a frame length of 10 bits to 40 bits for the SSI absolute encoder. The configurable bit numbers of the LSB and the MSB of the position value in the frame define the value range. The technology module can read in a position value with a maximum length of 31 bits and transfer it to the PLC. The position value is treated as unsigned positive value and can assume values between 0 and $2^{(MSB-LSB+1)}-1$.

Complete SSI frame

Instead of having a measured variable returned, you can choose to have the least significant 32 bit of the current unprocessed SSI frame returned. This provides you with encoder-specific additional bits, such as error bits, in addition to the position value. If the SSI frame is shorter than 32 bits, the complete SSI frame is returned right-aligned and the top unused bits are returned with "0" in the feedback interface.

Capture

You can save the current position value as Capture value using the edge of the digital input. The Capture function is triggered by rising, falling or both edges.

Hysteresis

You can specify hysteresis for the comparison values, within which a digital output will be prevented from switching again. An encoder can come to a standstill at a specific position, and slight movements may make the position value fluctuate around this position. If a comparison value or a position value limit lies within this fluctuation range, the corresponding digital output is switched on and off with corresponding frequency if hysteresis is not used. The hysteresis prevents these unwanted switching operations.

2.2.1.2 Counting with incremental or pulse encoder

Counting refers to the recording and adding up of events. The counters of the technology module detect encoder signals and pulses and evaluate them accordingly. The count direction can be specified using encoder or pulse signals or through the user program.

You can control the counting processes with the digital inputs.

You can specify the counter characteristics using the functions described below.

Counting limits

The counting limits define the counter value range used. The counting limits are configurable and can be modified during runtime with the user program.

The maximum possible counting limit is 2147483647 (2^{31}–1). The minimum possible counting limit is –2147483648 (–2^{31}).

You can configure the response of the counter at the counting limits:

- Continue or stop counting upon violation of a counting limit (automatic gate stop)
- Set counter value to start value or to other counting limit upon violation of a counting limit

Start value

You can configure a start value within the counting limits. The start value can be modified during runtime with the user program.

Depending on the parameter assignment, the technology module can set the current counter value to the start value upon synchronization, upon Capture function activation, upon violation of a counting limit or when the gate is opened.

Gate control

Opening and closing the hardware gate and software gate defines the period of time during which the counting signals are captured.

The control of the hardware gate takes place externally via the digital inputs of the technology module. Control of the software gate takes place via the user program. The hardware gate can be enabled through parameter assignment. The software gate (bit in the control interface of the cyclic I/O data) cannot be disabled.

Capture

You can configure an external reference signal edge that triggers the saving of the current counter value as Capture value. The following external signals can trigger the Capture function:

- Rising or falling edge of a digital input
- Both edges of a digital input
- Rising edge of the N signal at the encoder input

When using a digital input, you can specify whether counting is to continue from the current counter value or from the start value after the Capture function.

Synchronization

You can configure the edge of an external reference signal to load the counter with the specified start value. The following external signals can trigger a synchronization:

- Rising or falling edge of a digital input
- Rising edge of the N signal at the encoder input
- Rising edge of the N signal at the encoder input depending on the level of the assigned digital input

Hysteresis

You can specify hysteresis for the comparison values, within which a digital output will be prevented from switching again. An encoder can come to a standstill at a specific position, and slight movements may make the counter value fluctuate around this position. If a comparison value or a counting limit lies within this fluctuation range, the corresponding digital output will be switched on and off with corresponding frequency if hysteresis is not used. The hysteresis prevents these unwanted switching operations.

2.2.2 Measured value determination

The following measuring functions are available:

Measurement type	Description
Frequency measurement	The mean frequency is calculated at set measuring intervals on the basis of the time profile of the count pulses or position value changes and returned in Hertz as floating point number.
Period measurement	The mean period duration is calculated at set measuring intervals on the basis of the time profile of the count pulses or position value changes and returned in seconds as floating point number.
Velocity measurement	The mean velocity is calculated at set measuring intervals on the basis of the time profile of the count pulses or position value changes and other parameters, and returned in the configured unit of measurement.

The measured value and the counter value are available concurrently in the feedback interface. Instead of having a measured variable returned, you can choose to have the least significant 32 bit of the current unprocessed SSI frame returned when using an SSI absolute encoder.

Update time

You can configure the interval at which the technology module updates the measured values cyclically as the update time. Setting longer update time intervals allows uneven measured variables to be smoothed and increases measuring accuracy.

Gate control for incremental and pulse encoders

Opening and closing the hardware gate and software gate defines the period of time during which the counting signals are captured. The update time is asynchronous to the opening of the gate, which means that the update time is not started when the gate is opened. After closing, the last measured value captured continues to be returned.

Measuring ranges

The measuring functions have the following measuring range limits:

Measurement type	Low measuring range limit	High measuring range limit
Frequency measurement	0.04 Hz	4 MHz*
Period measurement	0.25 µs*	25 s
Velocity measurement	Depends on the configured number of "increments per unit" and the "time base for velocity measurement"	

* Applies to incremental encoders and "Quadruple" signal evaluation.

All measured values are returned as signed values. The sign indicates whether the counter value or position value increased or decreased during the relevant time period.

2.2.3 Switching the outputs at comparison values

You define two comparison values that can control the two digital outputs independent of the user program. The comparison values are configurable and can be modified during runtime with the user program.

Comparison values in the Counting mode

Depending on the encoder, you define two position or counter values as comparison values in the Counting mode. If the current position or counter value meets the configured comparison condition, the corresponding digital output can be set to directly initiate control processes in the process.

Comparison values in the Measuring mode

You define two comparison values in the Measuring mode. If the current measured value meets the configured comparison condition, the corresponding digital output can be set to directly initiate control processes in the process.

2.2.4 Position input for Motion Control

You can use the technology module for position input with S7-1500 Motion Control .

To do this, select "Position input for Motion Control" in the device configuration of the technology module in STEP 7 (TIA Portal).

When using an incremental encoder or pulse encoder, the position input is based on the counting function of the technology module. With an SSI absolute encoder, the absolute value is read in via a synchronous, serial interface and prepared according to the parameter assignment to be made available for S7-1500 Motion Control.

Additional information

A detailed description of the use of Motion Control and its configuration is available in the function manual S7-1500 Motion Control as a download from the Internet (http://support.automation.siemens.com/WW/view/en/59381279).

2.2.5 Additional functions

Hardware interrupts

The technology module can trigger a hardware interrupt in the CPU, for example, if a compare event occurs, in the event of a zero crossing and/or a change of count direction (direction reversal). You can specify which events (Page 49) are to trigger a hardware interrupt during operation.

Diagnostic interrupt

The technology module can trigger a diagnostic interrupt in the event of a missing supply voltage or an error at the digital outputs, for example. Select the diagnostic interrupts (Page 47) in the device configuration freely.

Monitoring of encoder signals

The technology module monitors signals of an encoder for wire breaks, short-circuits and offset voltages. In the case of an SSI absolute value encoder, the technology module also monitors SSI frames for errors.

If you enable the diagnostic interrupts, the technology module triggers a diagnostic interrupt in the event of a corresponding error.

Input filter

To suppress interference, you can configure an input filter for the RS422/TTL encoder inputs and for the digital inputs.

Distributed application

You can use the technology module in a distributed configuration by using an interface module in the ET 200SP distributed I/O system. The following applications are possible:

- Distributed operation in an S7-1500 system
- Distributed operation in an S7-1200 system
- Distributed operation in an S7-300/400 system
- Distributed operation in a third-party system

Isochronous mode

The technology module supports the system function "Isochronous mode". This system function enables position, counter and measured values to be recorded in a defined system cycle.

In isochronous mode, the cycle of the user program, the transmission of the input signals and processing in the technology module are synchronized. The output signals switch immediately if the relevant comparison condition is met. A change in the state of a digital input immediately affects the planned reaction of the technology module and changes the status bit of the digital input in the feedback interface (Page 40).

Data processing

The data that was transmitted to the technology module in the current bus cycle via the control interface takes effect when it is processed in the internal technology module cycle. The position or counter value and, if required, the measured value and the status bits as well are captured at the time T_i and made available in the feedback interface for retrieval in the current bus cycle.

In isochronous mode, there is always data consistency across all bytes in the feedback interface.

Wiring

3

3.1 Pin assignment

The TM PosInput 1 is used with a BaseUnit of the A0 type.

The encoder signals, the digital input and output signals and the encoder supply are connected to the BaseUnit of the technology module. The supply voltage feed on the light BaseUnit BU...D of the associated potential group supplies the module and the digital outputs, and generates the encoder supply voltage.

BaseUnit

The BaseUnit is not included in the product package of the module and must be ordered separately.

For an overview of the BaseUnits to be used with the technology module, refer to the product information on the documentation for the ET 200SP Distributed I/O System (http://support.automation.siemens.com/WW/view/en/73021864).

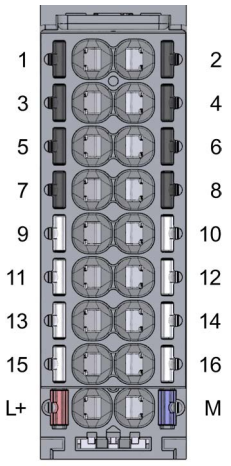
You can find information about selecting a suitable BaseUnit in the ET 200SP Distributed I/O System (http://support.automation.siemens.com/WW/view/en/58649293) system manual and ET 200SP BaseUnits (http://support.automation.siemens.com/WW/view/en/58532597/133300) device manual.

You can find information on wiring the BaseUnit, connecting cable shields, etc. in the Connecting section of the ET 200SP Distributed I/O System (http://support.automation.siemens.com/WW/view/en/58649293) system manual.

Pin assignment of the BaseUnit

The table below shows the pin assignment, using the BaseUnit BU15-P16+A0+2B as an example.

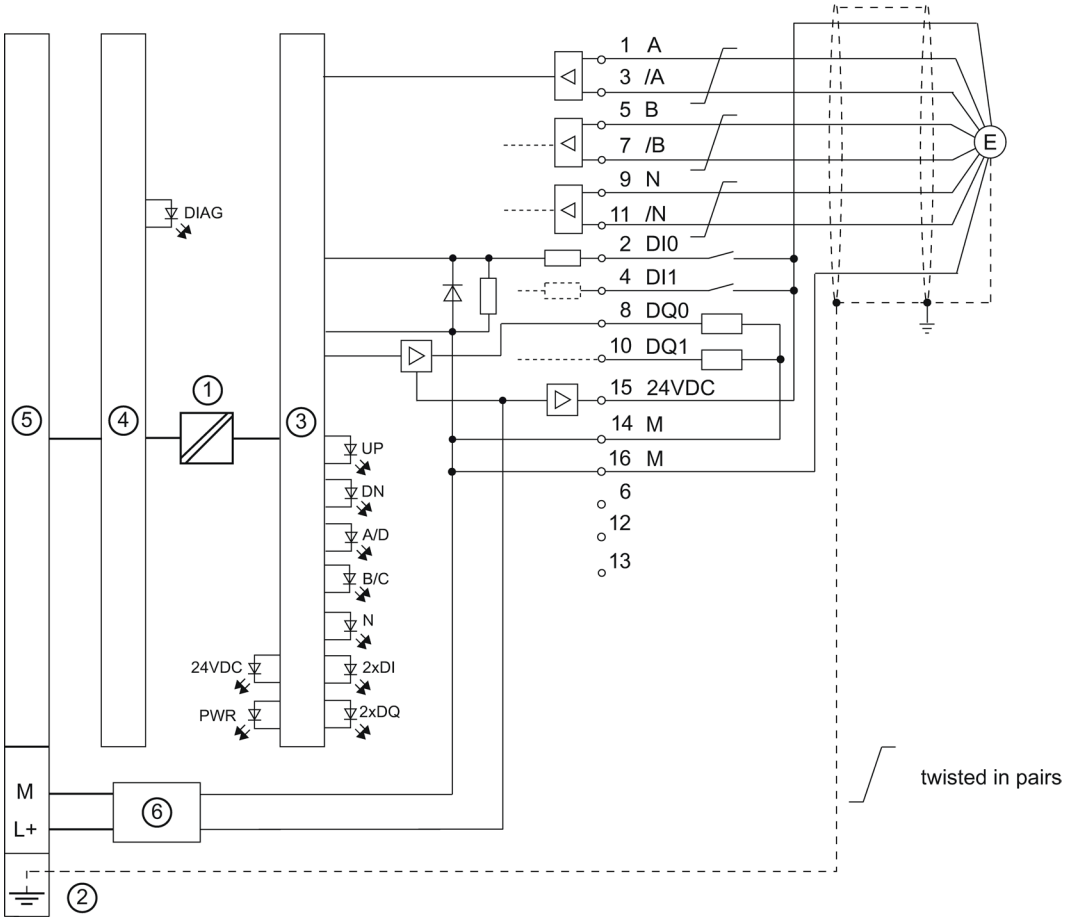
Table 3- 1 Pin assignment of the BaseUnit BU15-P16+A0+2B

View	Signal name		Designation					
			RS422/TTL incremental encoder		RS422/TTL pulse encoder			SSI absolute encoder
			with signal N	without signal N	with direction signal	without direction signal	up/down	
	1	A or D	Encoder signal A		Counting signal A		Up counting signal A	SSI data signal DAT
	3	/A or /D	Encoder signal /A (RS422 only)		Counting signal /A (RS422 only)		Up counting signal /A (RS422 only)	SSI data signal /DAT
	5	B or C	Encoder signal B		Direction signal B	—	Down counting signal B	SSI clock signal CLK
	7	/B or /C	Encoder signal /B (RS422 only)		Direction signal /B (RS422 only)		Down counting signal /B (RS422 only)	SSI clock signal /CLK
	9	N	Encoder signal N	—				
	11	/N	Encoder signal /N (RS422 only)	—				
	2	DI0	Digital input DI0					
	4	DI1	Digital input DI1					
	8	DQ0	Digital output DQ0					
	10	DQ1	Digital output DQ1					
	6	—	—					
	12	—	—					
	13	—	—					
	Supply voltage, encoder supply and ground							
	15	24VDC	24 V encoder supply					
	14	M	Ground for encoder supply, digital inputs and digital outputs					
	16	M						
		L+	DC 24V supply voltage					
		M	Ground for supply voltage					

Block diagrams

You must ground the shields of the cables between encoder and technology module both through the shield terminal on the BaseUnit (shield bracket and terminal) and also on the encoder.

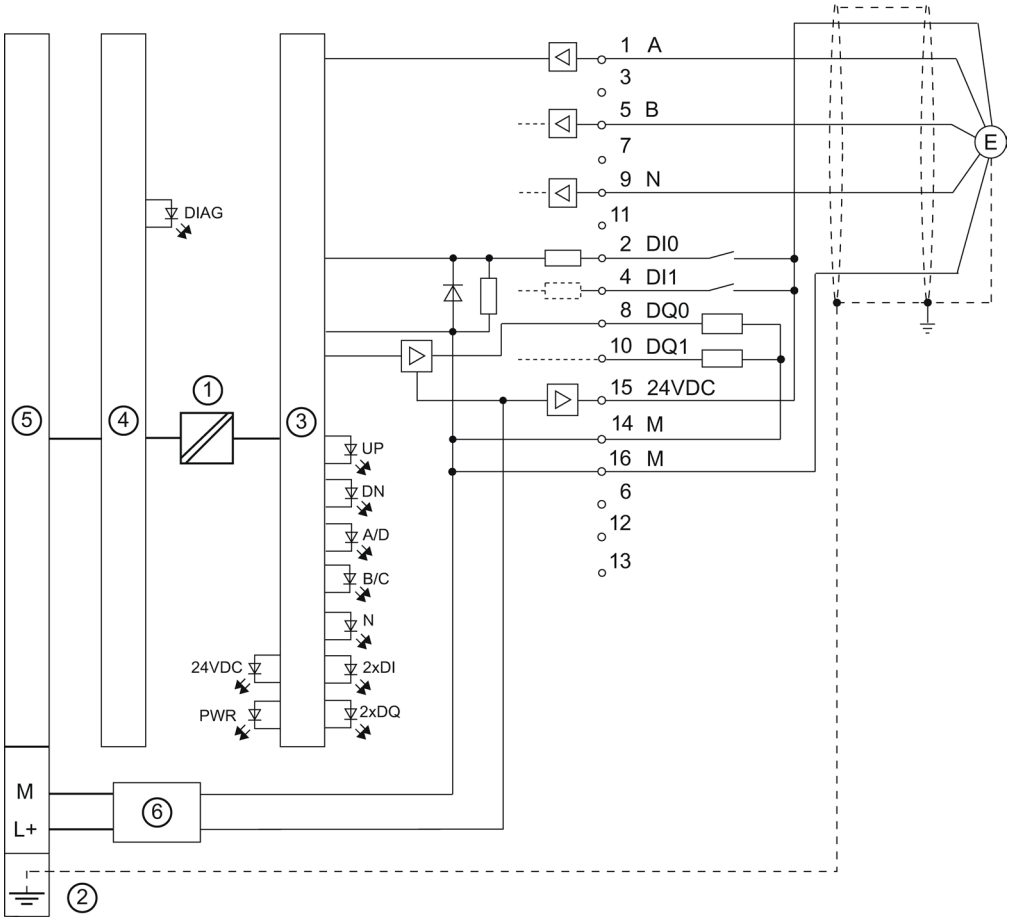
The figure below shows the block diagram of the technology module with one connected RS422 incremental encoder.



① Electrical isolation
② Shield connection on the BaseUnit
③ Technology
④ Backplane bus interface module of the technology module
⑤ Backplane bus
⑥ Input filter

Figure 3-1 Block diagram with RS422 incremental encoder

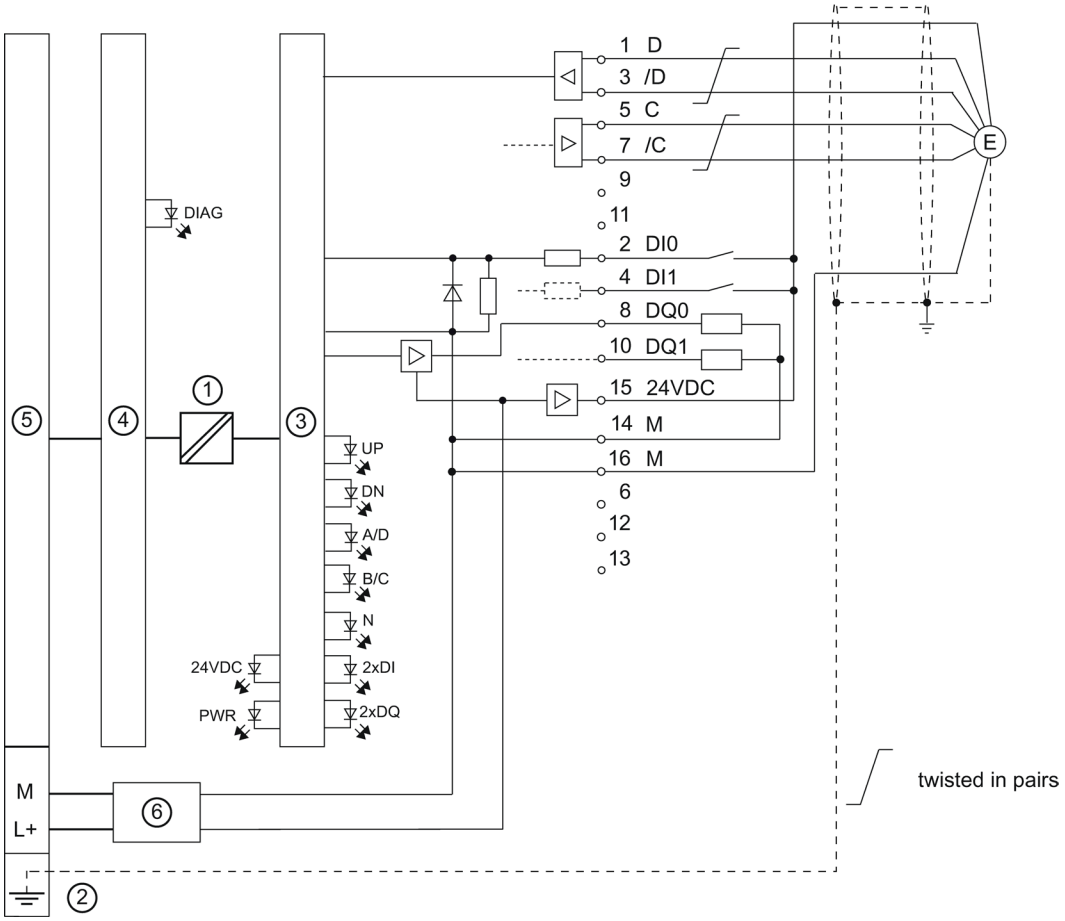
The figure below shows the block diagram of the technology module with one connected TTL incremental encoder.



① Electrical isolation
② Shield connection on the BaseUnit
③ Technology
④ Backplane bus interface module of the technology module
⑤ Backplane bus
⑥ Input filter

Figure 3-2 Block diagram with TTL incremental encoder

The figure below shows the block diagram of the technology module with one connected SSI absolute encoder.



① Electrical isolation
② Shield connection on the BaseUnit
③ Technology
④ Backplane bus interface module of the technology module
⑤ Backplane bus
⑥ Input filter

Figure 3-3 Block diagram with SSI absolute encoder

L+/M supply voltage

Connect the supply voltage (DC 24V) to the L+ and M connections. An internal protective circuit protects the technology module from polarity reversal of the supply voltage. The technology module monitors the connection of the supply voltage.

24VDC encoder supply

To supply the encoder and sensors at the digital inputs, the technology module supplies the DC 24V supply voltage at the 24VDC output with reference to M. Voltage is supplied from the L+/M supply voltage and monitored for short circuits and overload.

RS422/TTL encoder signals/count signals and SSI encoder signals

The TM PosInput 1 can process either counting or SSI encoder signals. The counting encoder signals are designated A, B and N and use either the RS422 or TTL signal standard. The SSI encoder signals are designated DAT (letter D) and CLK (letter C) and use the RS422 signal standard.

An encoder signal with TTL standard uses a single cable. An RS422 encoder signal uses one cable pair and the count/SSI information is transmitted as differential voltage. This ensures interference-free transmission of RS422 encoder signals even with high frequencies over long distances. The RS422 line pairs must be twisted together in the cable.

You can connect the following encoder types:

- SSI absolute encoder:

  The SSI encoder signals CLK and DAT are connected via the C and D terminals. The N terminals remain disconnected.

- RS422/TTL incremental encoder with signal N:

  The encoder signals A, B and N are connected using the terminals labeled accordingly. A and B are the two incremental signals phase-shifted by 90°. N is the zero mark signal which returns one pulse per revolution.

- RS422/TTL incremental encoder without signal N:

  The encoder signals A and B are connected via the terminals labeled accordingly. A and B are the two incremental signals phase-shifted by 90°. The N terminals remain disconnected.

- RS422/TTL pulse encoder without direction signal:

  The counting signal is connected at the A terminals. The count direction is specified via the control interface. The B and N terminals remain disconnected.

- RS422/TTL pulse encoder with direction signal:

  The counting signal is connected at the A terminals. The direction signal is connected at the B terminals. The N terminals remain disconnected.

- RS422/TTL pulse encoder with up/down count signal:

  The up counting signal is connected at the A terminals. The down counting signal is connected at the B terminals. The N terminals remain disconnected.

The inputs are not electrically isolated from each other. The inputs are isolated against the backplane bus.

Note

The RS422 signal standard offers greater interference immunity than the TTL signal standard. If your incremental encoder or pulse encoder supports the RS422 **and** the TTL signal standard, we recommend using the RS422 signal standard.

Input filter for RS422/TTL signals from incremental encoders and pulse encoders

To suppress interference, you can configure an input filter for the encoder inputs A, B and N. The selected filter frequency is based on a pulse-break ratio of between 40: 60 and 60: 40. This produces a set minimum pulse/break time. Signal changes with a duration shorter than the minimum pulse/break time are suppressed.

You can specify the following values for the filter frequency:

Table 3- 2 Filter frequency and respective minimum pulse/break time

Filter frequency	Minimum pulse/break time
100 Hz	4.0 ms
200 Hz	2.0 ms
500 Hz	800 µs
1 kHz	400 µs
2 kHz	200 µs
5 kHz	80 µs
10 kHz	40 µs
20 kHz	20 µs
50 kHz	8.0 µs
100 kHz	4.0 µs
200 kHz	2.0 µs
500 kHz	0.8 µs
1 MHz (default)	0.4 µs

Digital inputs DI0 and DI1

Two digital outputs are available. The digital inputs are used for gate control, synchronization and the Capture function. Alternatively, you can use one or both digital inputs without the functions named and read the signal state of the respective digital input via the feedback interface.

The digital inputs are not electrically isolated from each other.

Input filters for digital inputs

To suppress interferences, you can configure an input filter for the digital inputs.

You can specify the following values for the filter time:

- None
- 0.05 ms
- 0.1 ms (default)
- 0.4 ms
- 0.8 ms
- 1.6 ms
- 3.2 ms
- 12.8 ms
- 20 ms

Note

If you select the "None" or "0.05 ms" option, you have to use shielded cables for connection of the digital inputs.

Digital outputs DQ0 and DQ1

There are two digital outputs. The two digital outputs DQ0 and DQ1 can be activated/switched directly by the specified comparison values or by the user program.

The digital outputs are not isolated from each other.

The digital outputs are 24 V sourcing outputs in reference to M and can carry a rated load current of 0.5 A. They are protected from overload and short-circuit.

Note

Relays and contactors can be connected direct without external circuitry. You can find information on the maximum possible operating frequencies and the inductive loads at the digital outputs in the section Technical specifications (Page 50).

Configuring/address space

4

4.1 Configuring

Introduction

The technology module is configured and assigned parameters with the configuration software.

The technology module functions are controlled and monitored by the user program.

System environment

The technology module can be used in the following system environments:

Applications	Components required	Configuration software	In the user program
Distributed operation in an S7-1500 system	• S7-1500 automation system • ET 200SP distributed I/O system • TM PosInput 1	STEP 7 (TIA Portal): • Device configuration with hardware configuration (HWCN) • Parameter setting with High_Speed_Counter technology object	Position input with SSI absolute encoder: Direct access to the control and feedback interface (Page 37) of the TM PosInput 1 in the I/O data Counting and measuring functions: High_Speed_Counter instruction for the technology object
		STEP 7 (TIA Portal): Device configuration with hardware configuration (HWCN) in operating mode "Position Detection for Motion Control"	Control by means of a technology object

Applications	Components required	Configuration software	In the user program
Distributed operation in an S7-300/400 or S7-1200 system	• S7-300/400 or S7-1200 automation system • ET 200SP distributed I/O system • TM PosInput 1	STEP 7 (TIA Portal): Device configuration and parameter settings with hardware configuration (HWCN) STEP 7: Device configuration and parameter settings with HSP	Direct access to the control and feedback interface (Page 37) of the TM PosInput 1 in the I/O data
Distributed operation in a third-party system	• Third-party automation system • ET 200SP distributed I/O system • TM PosInput 1	Third-party configuration software: Device configuration and parameter settings with GSD file	Direct access to the control and feedback interface (Page 37) of the TM PosInput 1 in the I/O data

Additional information

A detailed description of the counting and measuring functions and their configuration is available:

- In the Counting, measurement and position input function manual available as a download from the Internet (http://support.automation.siemens.com/WW/view/en/59709820)
- In the STEP 7 (TIA Portal) information system under "Using technology functions > Counting, measurement and position input"> Counting, measurement and position input (S7-1500)"

A detailed description of the use of Motion Control and its configuration is available:

- In the S7-1500 Motion Control function manual, available as a download from the Internet (http://support.automation.siemens.com/WW/view/en/59381279)
- In the STEP 7 (TIA Portal) information system under "Using technology functions > Motion Control > Motion Control (S7-1200, S7-1500)"

GSD file

The or GSD file for the ET 200SP distributed I/O system is available for download from the Internet:

- GSD file PROFINET IO (http://support.automation.siemens.com/WW/view/en/57138621)
- GSD file PROFIBUS DP (http://support.automation.siemens.com/WW/view/en/73016883)

See also

Parameters (Page 29)

4.2 Reaction to CPU STOP

Reaction to CPU STOP

You set the response of the technology module to CPU STOP for each channel in the basic parameters of the device configuration.

Table 4- 1 Response of the technology module to CPU STOP depending on parameter assignment

Basic parameters	Reaction to CPU STOP
Continue operation	The technology module remains fully functional. Incoming count pulses are processed or the position value is read in. The digital outputs continue to switch according to the parameter assignment.
Output substitute value	The technology module outputs the configured substitute values at the digital outputs until the next CPU STOP-RUN transition. The technology module is returned to its startup state after a STOP-RUN transition: The counter value is set to the Start value (with incremental encoders or pulse encoders) and the digital outputs switch according to the parameter assignment.
Keep last value	The technology module outputs the values at the digital outputs that were valid when the transition to STOP took place until the next CPU STOP-RUN transition. The technology module is returned to its startup state after a STOP-RUN transition: The counter value is set to the Start value (with incremental encoders or pulse encoders) and the digital outputs switch according to the parameter assignment.

4.3 Address space

Address space of the technology module

Table 4- 2 Range of the input addresses and output addresses of the TM PosInput 1

	Inputs	Outputs
Range	16 bytes	12 bytes

Table 4- 3 Range of the input and output addresses of the TM PosInput 1 in the "Position input for Motion Control" mode

	Inputs	Outputs
Range	16 bytes	4 bytes

Additional information

A description on how to use the control and feedback interface of TM PosInput 1 can be found in the section Control and feedback interface (Page 37).

4.4 Parameters

You can use various parameters to define the properties of the technology module. Depending on the settings, not all parameters are available. You can change the parameter assignment in the user program using data record 128 (Page 58).

You have the following options for setting the module's parameters:

Parameter setting via ...	Basic procedure
Hardware configuration and technology object High_Speed_Counter in STEP 7 (TIA Portal)	1. Set the device configuration in the hardware configuration. "Operating with technology object" must be set as the operating mode. 2. Adapt the parameters using the High_Speed_Counter technology object. 3. Download the parameter assignment to the module.
Hardware configuration in STEP 7 (TIA Portal)	1. Set the device configuration in the hardware configuration. "Manual operation" or "Position input for Motion Control" must be set as the operating mode. 2. Set the parameters in the hardware configuration. 3. Download the parameter assignment to the module.
Hardware configuration in STEP 7 using HSP file	1. Install the corresponding HSP file. You will then find the module in the Hardware catalog under "ET 200SP". 2. Set the device configuration and the parameters in the hardware configuration. 3. Download the parameter assignment to the module.

Parameter setting via ...	Basic procedure
Hardware configuration using GSD file for distributed operation on the PROFINET IO	1. Install the latest PROFINET GSD file. You will then find the module in the Hardware catalog under "Other field devices". 2. Set the parameters of the PROFINET GSD file in the hardware configuration. 3. Download the parameter assignment to the module.
Hardware configuration using GSD file for distributed operation on the PROFIBUS DP	1. Install the latest PROFIBUS GSD file. You will then find the module in the Hardware catalog under "Other field devices". 2. Set parameters of the PROFIBUS GSD file in the hardware configuration. The following tables with [1] highlighted parameters are not configured in the PROFIBUS GSD file. 3. Download the parameter assignment to the module. This will download the parameters marked with [1] in the following tables with the default setting. You can change these parameters in the user program using data record 128 (Page 58).

The parameters are listed in the following tables.

Parameters of the TM PosInput 1 with incremental or pulse encoder

If you use an incremental or pulse encoder, you can set the following parameters:

Table 4- 4 Configurable parameters and their defaults

Parameter	Value range	Default setting	Re-configuration in RUN
Operating mode	• Counting • Measuring	Counting	No
Interface standard	• RS422, symmetrical • TTL (5 V), asymmetric	RS422, symmetrical	Yes
Reaction to CPU STOP[1]	• Output substitute value • Keep last value • Continue operation	Output substitute value	Yes
Enable additional diagnostic interrupts	• Deactivated • Activated	Deactivated	Yes
Enabling diagnostic interrupts for wire break[2]	• Deactivated • Activated	Deactivated	Yes

Parameter	Value range	Default setting	Re-configuration in RUN
Signal type	• Pulse (A) • Pulse (A) and direction (B) • Count up (A), count down (B) • Incremental encoder (A, B phase-shifted) • Incremental encoder (A, B, N)	Pulse (A) and direction (B)	Yes
Signal evaluation	• Single • Double • Quadruple	Single	Yes
Filter frequency[1]	• 100 Hz • 200 Hz • 500 Hz • 1 kHz • 2 kHz • 5 kHz • 10 kHz • 20 kHz • 50 kHz • 100 kHz • 200 kHz • 500 kHz • 1 MHz	1 MHz	Yes
Invert direction[1]	• No • Yes	No	Yes
Reaction to signal N[1] (corresponds in operating mode "Position input for Motion Control": Signal selection for reference mark 0)	• No reaction to signal N (corresponds in operating mode "Position input for Motion Control": DI0) • Synchronization at signal N • Capture to signal N (corresponds in operating mode "Position input for Motion Control": Signal N of incremental encoder)	No reaction to signal N (corresponds in operating mode "Position input for Motion Control": DI0)	Yes
Hardware interrupt: Gate start[1]	• Deactivated • Activated	Deactivated	Yes
Hardware interrupt: Gate stop[1]	• Deactivated • Activated	Deactivated	Yes

Parameter	Value range	Default setting	Re-configuration in RUN
Hardware interrupt: Overflow (high counting limit violated)[1]	• Deactivated • Activated	Deactivated	Yes
Hardware interrupt: Underflow (low counting limit violated)[1]	• Deactivated • Activated	Deactivated	Yes
Hardware interrupt: Change of direction[1]	• Deactivated • Activated	Deactivated	Yes
Hardware interrupt: Comparison event for DQ0 occurred[1]	• Deactivated • Activated	Deactivated	Yes
Hardware interrupt: Comparison event for DQ1 occurred[1]	• Deactivated • Activated	Deactivated	Yes
Hardware interrupt: Zero crossing[1]	• Deactivated • Activated	Deactivated	Yes
Hardware interrupt: New Capture value available[1]	• Deactivated • Activated	Deactivated	Yes
Hardware interrupt: Synchronization of the counter by an external signal[1]	• Deactivated • Activated	Deactivated	Yes
Set output DQ	• Use by user program • Between comparison value and high counting limit • Between comparison value and low counter limit • At comparison value for a pulse duration • After set command from CPU until comparison value • Between comparison value 0 and 1 • Not between comparison value 0 and 1	DQ0, DQ1: Between comparison value and high counting limit	Yes
Substitute value for DQ[1]	• 0 • 1	DQ0, DQ1: 0	Yes
Count direction[1]	• Forward • Backward • In both directions	In both directions	Yes
Pulse duration [ms/10][1]	0...65535	5000 (corresponds to 0.5 s)	Yes

Parameter	Value range	Default setting	Re-configuration in RUN
Behavior of DI	• Gate start/stop (level-triggered) • Gate start (edge-triggered) • Gate stop (edge-triggered) • Synchronization • Enable synchronization at signal N • Capture • Digital input without function	• DI0: Gate start/stop (level-triggered) • DI1: Digital input without function	Yes
Select level[1]	• Active with high level • Active with low level	Active with high level	Yes
Edge selection[1]	• At rising edge • At falling edge • At rising and falling edge	At rising edge	Yes
Behavior of counter value after Capture[1]	• Continue counting • Set to start value and continue counting	Continue counting	Yes
Filter time[1]	• Deactivated • 0.05 ms • 0.1 ms • 0.4 ms • 0.8 ms • 1.6 ms • 3.2 ms • 12.8 ms • 20 ms	0.1 ms	Yes
Frequency[1]	• Once • Periodic	Once	Yes
High counting limit[1]	-2147483648...2147483647	2147483647	Yes
Comparison value 0[1]	-2147483648...2147483647	0	Yes
Comparison value 1[1]	-2147483648...2147483647	10	Yes
Start value[1]	-2147483648...2147483647	0	Yes
Low counting limit[1]	-2147483648...2147483647	-2147483648	Yes
Update time [µs][1] of the measuring function (corresponds in operating mode "Position input for Motion Control": Reference speed [10^{-2} rpm])	0...25000000 (in operating mode "Position input for Motion Control": 600...21000000)	10000 (corresponds to 10 ms) (in operating mode "Position input for Motion Control": 300000)	Yes
Reset when counting limit is violated	• To other counting limit • To start value	To other counting limit	Yes

Parameter	Value range	Default setting	Re-configuration in RUN
Reaction to violation of a counting limit	• Stop counting • Continue counting	Continue counting	Yes
Reaction to gate start	• Set to start value • Continue with current value	Continue with current value	Yes
Measured variable	• Frequency • Period • Velocity	Frequency	Yes
Time base for velocity measurement[1]	• 1 ms • 10 ms • 100 ms • 1 s • 60 s/1 min	60 s/1 min	Yes
Increments per unit[1]	1...65535	1	Yes
Hysteresis[1]	0...255	0	Yes
Potential group	• Use the potential group of the left module (dark BaseUnit) • Enable new potential group (light BaseUnit)	Use the potential group of the left module (dark BaseUnit)	No

1 This parameter cannot be configured using PROFIBUS GSD file. The parameter is loaded to the module with the default setting and can be adapted using the data record 128.

2 When a GSD file is used, this diagnostic interrupt is activated via the "Enable additional diagnostic interrupts" parameter and cannot be set separately.

Parameters of the TM PosInput 1 with SSI absolute encoder

If you use an SSI absolute encoder, you can set the following parameters:

Table 4- 5 Configurable parameters and their defaults

Parameter	Value range	Default setting	Re-configuration in RUN
Operating mode	• Counting • Measuring	Counting	No
Reaction to CPU STOP[1]	• Output substitute value • Keep last value • Continue operation	Output substitute value	Yes
Enable additional diagnostic interrupts	• Deactivated • Activated	Deactivated	Yes

Parameter	Value range	Default setting	Re-configuration in RUN
Enabling diagnostic interrupts for wire break[2]	• Deactivated • Activated	Deactivated	Yes
Monoflop time[1]	• Automatically • 16 µs • 32 µs • 48 µs • 64 µs	Automatically	Yes
Type of code	• Gray • Dual	Gray	Yes
Parity	• None • Even • Odd	None	Yes
Invert direction[1]	• No • Yes	No	Yes
Transmission rate	• 125 kHz • 250 kHz • 500 kHz • 1 MHz • 1.5 MHz • 2 MHz	125 kHz	Yes
Frame length	10 bits to 40 bits	13 bits	Yes
Bit number LSB of the position value	0...38	0	Yes
Bit number MSB of the position value	1...39	12	Yes
Hardware interrupt: Change of direction[1]	• Deactivated • Activated	Deactivated	Yes
Hardware interrupt: Comparison event for DQ0 occurred[1]	• Deactivated • Activated	Deactivated	Yes
Hardware interrupt: Comparison event for DQ1 occurred[1]	• Deactivated • Activated	Deactivated	Yes
Hardware interrupt: Zero crossing[1]	• Deactivated • Activated	Deactivated	Yes
Hardware interrupt: New Capture value available[1]	• Deactivated • Activated	Deactivated	Yes

Parameter	Value range	Default setting	Re-configuration in RUN
Set output DQ	• Use by user program • Between comparison value and high counting limit • Between comparison value and low counter limit • Between comparison value 0 and 1 • Not between comparison value 0 and 1 • At comparison value for a pulse duration • After set command from CPU until comparison value	DQ0, DQ1: Between comparison value and high counting limit	Yes
Substitute value for DQ[1]	• 0 • 1	DQ0, DQ1: 0	Yes
Count direction[1]	• Forward • Backward • In both directions	In both directions	Yes
Pulse duration [ms/10][1]	0...65535	5000 (corresponds to 0.5 s)	Yes
Behavior of DI	• Capture • Digital input without function	DI0, DI1: Digital input without function	Yes
Edge selection[1]	• At rising edge • At falling edge • At rising and falling edge	At rising edge	Yes
Filter time[1]	• Deactivated • 0.05 ms • 0.1 ms • 0.4 ms • 0.8 ms • 1.6 ms • 3.2 ms • 12.8 ms • 20 ms	0.1 ms	Yes
Frequency[1]	• Once • Periodic	Once	Yes
Comparison value 0[1]	-2147483648...2147483647	0	Yes
Comparison value 1[1]	-2147483648...2147483647	10	Yes

Parameter	Value range	Default setting	Re-configuration in RUN
Update time [µs][1] of the measuring function (corresponds in operating mode "Position input for Motion Control": Reference speed [10^{-2} rpm])	0...25000000 (in operating mode "Position input for Motion Control": 600...21000000)	10000 (corresponds to 10 ms) (in operating mode "Position input for Motion Control": 300000)	Yes
Measured variable	• Frequency • Period • Velocity • Complete SSI frame	Frequency	Yes
Time base for velocity measurement[1]	• 1 ms • 10 ms • 100 ms • 1 s • 60 s/1 min	60 s/1 min	Yes
Increments per unit[1]	1...65535	1	Yes
Hysteresis[1]	0...255	0	Yes
Potential group	• Use the potential group of the left module (dark BaseUnit) • Enable new potential group (light BaseUnit)	Use the potential group of the left module (dark BaseUnit)	No

1 This parameter cannot be configured using PROFIBUS GSD file. The parameter is loaded to the module with the default setting and can be adapted using the data record 128.

2 When a GSD file is used, this diagnostic interrupt is activated via the "Enable additional diagnostic interrupts" parameter and cannot be set separately.

4.5 Control and feedback interface

Information on using the control and feedback interface can be found in the chapter Configuring (Page 26).

A detailed description of the TM PosInput 1 control and feedback bits is available in the Counting, measurement and position input function manual which can be downloaded from the Internet (http://support.automation.siemens.com/WW/view/en/59709820).

Note

The control and feedback interface is compatible with the control and feedback interface of the TM PosInput 2 technology module of the S7-1500 automation system.

4.5.1 Assignment of the control interface

The user program uses the control interface to influence the behavior of the technology module.

Control interface

The following table shows control interface assignment:

Offset to the start address	Parameter	Meaning				
Bytes 0 to 3	Slot 0	Load value (significance of the value is specified in LD_SLOT_0)				
Bytes 4 to 7	Slot 1	Load value (significance of the value is specified in LD_SLOT_1)				
Byte 8	LD_SLOT_0*	Specifies the significance of the value in Slot 0				
		Bit 3	**Bit 2**	**Bit 1**	**Bit 0**	
		0	0	0	0	No action, idle
		0	0	0	1	Load count value (with incremental or pulse encoder)
		0	0	1	0	Reserve
		0	0	1	1	Load Start value (with incremental encoder or pulse encoder)
		0	1	0	0	Load comparison value 0
		0	1	0	1	Load comparison value 1
		0	1	1	0	Load Low counting limit (with incremental encoder or pulse encoder)
		0	1	1	1	Load High counting limit (with incremental encoder or pulse encoder)
		1	0	0	0	Reserve
		to				
		1	1	1	1	

Offset to the start address	Parameter	Meaning				
Byte 8	LD_SLOT_1*	Specifies the significance of the value in Slot 1				
		Bit 7	**Bit 6**	**Bit 5**	**Bit 4**	
		0	0	0	0	No action, idle
		0	0	0	1	Load count value (with incremental or pulse encoder)
		0	0	1	0	Reserve
		0	0	1	1	Load Start value (with incremental encoder or pulse encoder)
		0	1	0	0	Load comparison value 0
		0	1	0	1	Load comparison value 1
		0	1	1	0	Load Low counting limit (with incremental encoder or pulse encoder)
		0	1	1	1	Load High counting limit (with incremental encoder or pulse encoder)
		1	0	0	0	Reserve
		to				
		1	1	1	1	
Byte 9	EN_CAPTURE	Bit 7: Capture function enable				
	EN_SYNC_DN	Bit 6: Enable synchronization down (with incremental encoder or pulse encoder)				
	EN_SYNC_UP	Bit 5: Enable synchronization up (with incremental encoder or pulse encoder)				
	SET_DQ1	Bit 4: Set DQ1				
	SET_DQ0	Bit 3: Set DQ0				
	TM_CTRL_DQ1	Bit 2: Enable technological function DQ1				
	TM_CTRL_DQ0	Bit 1: Enable technological function DQ0				
	SW_GATE	Bit 0: Software gate (with incremental encoder or pulse encoder)				
Byte 10	SET_DIR	Bit 7: Count direction (for encoders without direction signal)				
	–	Bits 2 to 6: Reserve; bits must be set to 0				
	RES_EVENT	Bit 1: Reset of saved events				
	RES_ERROR	Bit 0: Reset of saved error states				
Byte 11	–	Bits 0 to 7: Reserve; bits must be set to 0				

* If values are loaded simultaneously via LD_SLOT_0 and LD_SLOT_1, the first value is taken internally from Slot 0 and then the value from Slot 1 is taken. This may lead to unexpected intermediate states.

4.5.2 Assignment of the feedback interface

The user program receives current values and status information from the technology module by means of the feedback interface.

Feedback interface

The following table shows the assignment of the feedback interface:

Offset to the start address	Parameter	Meaning
Bytes 0 to 3	COUNT VALUE	Current counter value or position value
Bytes 4 to 7	CAPTURED VALUE	The last acquired Capture value
Bytes 8 to 11	MEASURED VALUE	Current measured value or complete SSI frame
Byte 12	–	Bits 3 to 7: Reserve; set to 0
	LD_ERROR	Bit 2: Error when loading via control interface
	ENC_ERROR	Bit 1: Faulty encoder signal or SSI frame
	POWER_ERROR	Bit 0: Supply voltage L+ too low
Byte 13	–	Bits 6 to 7: Reserve; set to 0
	STS_SW_GATE	Bit 5: Software gate status (with incremental encoder or pulse encoder)
	STS_READY	Bit 4: Technology module started up and configured
	LD_STS_SLOT_1	Bit 3: Load request for Slot 1 detected and carried out (toggling)
	LD_STS_SLOT_0	Bit 2: Load request for Slot 0 detected and carried out (toggling)
	RES_EVENT_ACK	Bit 1: Reset of event bits active
	–	Bit 0: Reserve; set to 0
Byte 14	–	Bit 7: Reserve; set to 0
	STS_DI1	Bit 6: Status DI1
	STS_DI0	Bit 5: Status DI0
	STS_DQ1	Bit 4: Status DQ1
	STS_DQ0	Bit 3: Status DQ0
	STS_GATE	Bit 2: Internal gate status (with incremental encoder or pulse encoder)
	STS_CNT	Bit 1: Count pulse or position value change detected within the last ca. 0.5 s
	STS_DIR	Bit 0: Direction of last counter value or position value change
Byte 15	STS_M_INTERVAL	Bit 7: Count pulse or position value change detected in previous measurement interval
	EVENT_CAP	Bit 6: Capture event has occurred
	EVENT_SYNC	Bit 5: Synchronization has occurred (with incremental encoder or pulse encoder)
	EVENT_CMP1	Bit 4: Comparison event for DQ1 has occurred
	EVENT_CMP0	Bit 3: Comparison event for DQ0 has occurred
	EVENT_OFLW	Bit 2: An overflow has occurred
	EVENT_UFLW	Bit 1: An underflow has occurred
	EVENT_ZERO	Bit 0: A Zero crossing has occurred

Interrupts/diagnostic messages

5

5.1 Status and error displays

LEDs

The following figure shows you the LED displays (status and error displays) of TM PosInput 1.

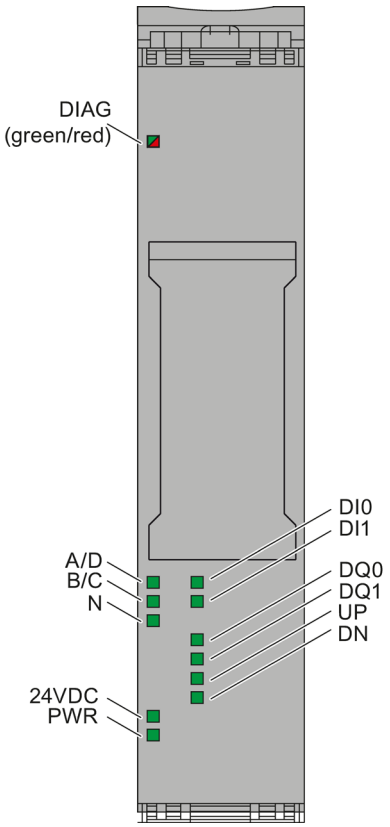


Figure 5-1 LEDs of the TM PosInput 1

Meaning of the LED displays

The following tables explain the meaning of the status and error displays. Remedial measures for diagnostic alarms can be found in the section Diagnostic messages (Page 43).

Table 5- 1 Status and error displays DIAG

LED DIAG	Meaning	To correct or avoid errors
Off	Backplane bus supply of the ET 200SP not OK	Check the supply voltage or turn it on at the interface module.
Flashes	Technology module not configured	---
On	Technology module configured but no module diagnostics	
Flashes	Technology module configured and module diagnostics (at least one error pending)	Evaluate the diagnostic alarms and eliminate the error.

Table 5- 2 PWR/24VDC status displays

LEDs		Meaning	To correct or avoid errors
PWR	24VDC		
Off	Off	No supply voltage	• Check the supply voltage. • Check the BaseUnit type and the wiring of the BaseUnit.
On	On	Supply voltage is present and OK	---
On	Off	Short-circuit or overload at the encoder supply or supply voltage too low	• Check the encoder wiring. • Check the loads connected to the encoder supply. • Check the supply voltage.

ChannelLEDs

The LEDs A, B, N and DIm indicate the current level of the associated signals. The LEDs of the digital outputs DQm indicate the desired state.

The flashing frequency of the channel LEDs is limited to approximately 12 Hz. If higher frequencies are present, the channel LEDs will flash at 12 Hz instead of indicating the current status.

If you are using an SSI absolute encoder, the LEDs D and C light up green during the transmission of encoder frames. The LEDs D and C are off when an error has occurred.

Table 5- 3 A/B/N/DIm/DQm status displays

A/B/N/DIm/DQm LEDs	Meaning
□ Off	Counter input/digital input/digital output at 0 level
■ On	Counter input/digital input/digital output at 1 level

Table 5- 4 Status displays UP/DN

LEDs		Meaning
UP	DN	
□ Off	□ Off	No count pulse has been detected for the last 0.5 s.
■ On	□ Off	The last count pulse incremented the counter and occurred no more than 0.5 s ago.
□ Off	■ On	The last count pulse decremented the counter and occurred no more than 0.5 s ago.

5.2 Diagnostic messages

Diagnostic alarms

If a diagnostic alarm is pending, the DIAG LED flashes red.

The diagnostic alarms are displayed as clear text in STEP 7 (TIA Portal) in the online and diagnostics view. You can evaluate the error codes with the user program.

The following diagnostics can be signaled:

Table 5- 5 Diagnostic alarms, their meaning and remedies

Diagnostic alarm	Error code	Meaning	To correct or avoid errors
Error	9_H	• Internal module error occurred • Possible cause: Technology module defective	Replace technology module
Load voltage missing	11_H	No technology module L+ supply voltage	• Check BaseUnit type • Check the wiring of the supply voltage L+ on the BaseUnit
Hardware interrupt lost	16_H	• Technology module cannot send an interrupt because a previous interrupt has not been processed • Possible causes: – Parameter assignment error – Too many hardware interrupts in too short a time	Change interrupt processing in the CPU and re-assign technology module parameters correspondingly
Module temporarily unavailable	$1F_H$	• No normal operation of the technology module possible • Possible cause: Technology module is performing a firmware update	Wait until technology module is available again
Internal error	100_H	Technology module defective	Replace technology module
Watchdog tripped. Module is defective.	103_H	Firmware error	Run firmware update
		Technology module defective	Replace technology module
Short circuit or overload at external encoder supply	$10E_H$	• Error at encoder supply • Possible causes: – Short circuit – Overload	• Check encoder wiring • Check consumers connected to encoder supply
Error at digital outputs	$10F_H$	• Error at the digital outputs • Possible causes: – Short circuit – Overload	• Check wiring at the digital outputs • Check consumers connected to the digital outputs
Faulty external auxiliary voltage	110_H	• Error at supply voltage L+ • Possible causes: – Low voltage – Wiring of L+ supply voltage defective	• Check the L+ supply voltage • Check the wiring of the supply voltage L+ on the BaseUnit
Illegal A/B signal ratio	500_H	• Time profile of signals A and B of the incremental encoder does not meet certain specifications • Possible causes: – Signal frequency too high – Encoder faulty – Process wiring faulty	• Check process wiring • Check encoder/sensor • Check parameter assignment

Diagnostic alarm	Error code	Meaning	To correct or avoid errors
RS422/TTL error	502H	• Error at RS422 or TTL encoder connection • Possible causes: – Wire break – No encoder connected – Cable too long – Short circuit – Overload – External voltage – Overheating – Parameter assignment error	• Check process wiring • Check encoder/sensor • Check parameter assignment
Error at SSI encoder	503H	• Error at SSI absolute encoder connection • Possible causes: – Wire break – Cable too long – Frame error (error of the start bit or stop bit) – Parity error – Parameter assignment error	• Check process wiring • Check encoder/sensor • Check parameter assignment
Overheating	506H	• Short circuit or overload at the digital outputs or outputs of the encoder supplies • Ambient temperature outside specifications	• Check process wiring • Improve cooling • Check connected loads

5.3 Interrupts

5.3.1 Trigger a diagnostic interrupt

Enabling the diagnostic interrupts

You enable the diagnostic interrupt for wire break and the diagnostic interrupts for additional errors in the basic parameters during device configuration.

A list of all errors that can trigger a diagnostic interrupt is available at Cause of the error triggering a diagnostic interrupt (Page 47).

Reactions to a diagnostic interrupt

The following happens when an event occurs that triggers a diagnostic interrupt:

- The DIAG LED flashes red.

  Once you have remedied the error, the DIAG LED goes out.
- The S7-1500 CPU interrupts processing of the user program. The diagnostic interrupt OB (e.g. OB 82) is called. The event that triggered the interrupt is entered in the start information of the diagnostic interrupt OB.
- The S7-1500 CPU remains in RUN even if no diagnostic interrupt OB is present in the CPU. The technology module continues working unchanged if this is possible despite the error.

Detailed information on the error event is available with the instruction "RALRM" (read additional interrupt information).

Default setting

The diagnostic interrupt for wire break and the diagnostic interrupts for additional errors are not enabled by default.

5.3.2 Cause of the error triggering a diagnostic interrupt

Which errors can trigger a diagnostic interrupt?

The technology module can trigger the following diagnostic interrupts:

Table 5- 6 Possible diagnostic interrupts

Diagnostic interrupt	Monitoring
• Internal error • Watchdog tripped. Module is defective.	Monitoring is always active. A diagnostic interrupt is triggered each time an error is detected.
• RS422/TTL error	Monitoring is always active. A detected error only triggers a diagnostic interrupt if "Enable diagnostic interrupt for wire break" has been enabled in the device configuration.
• Error • Load voltage missing • Hardware interrupt lost • Module temporarily unavailable • Short circuit or overload at external encoder supply • Error at digital outputs • Faulty external auxiliary voltage • Error at SSI encoder • Illegal A/B signal ratio • Overheating	Monitoring is always active. A detected error only triggers a diagnostic interrupt if "Enable additional diagnostic interrupts" has been enabled in the device configuration.

5.3.3 Triggering of a Hardware Interrupt

Introduction

For the technology module, you can configure which events are to trigger a hardware interrupt during operation.

What is a Hardware Interrupt?

The technology module will trigger a hardware interrupt as configured in response to specific events/states. When a hardware interrupt occurs, the CPU interrupts execution of the user program and processes the assigned hardware interrupt OB. The event that triggered the interrupt is entered in the start information of the assigned hardware interrupt OB by the CPU.

Activating the hardware interrupts

You activate the hardware interrupts in STEP 7 (TIA Portal) under "Basic parameters > Hardware interrupts" during device configuration of the technology module.

A list of the individual hardware interrupts is available at Events which can trigger a hardware interrupt (Page 49).

Lost hardware interrupt

If an event occurs which is supposed to trigger a hardware interrupt but there is an identical, previous event which has not yet been processed, no further hardware interrupt will be triggered. The hardware interrupt is lost. This may lead to the "Hardware interrupt lost" diagnostic interrupt, depending on the parameter assignment.

Default setting

No hardware interrupts are activated in the default setting.

5.3.4 Events which can trigger a hardware interrupt

Which events can trigger a hardware interrupt?

A hardware interrupt is triggered if the condition for changing the respective status bit or event bit in the feedback interface is fulfilled.

The EventType tag, among others, is entered in the start information of the assigned hardware interrupt OB when a hardware interrupt is triggered. The EventType tag specifies the number of the event type to which the event triggering the interrupt belongs.

You can configure hardware interrupts to be triggered for the following event types:

Hardware interrupt	EventType number
Internal gate opening (Gate start)[1)]	1
Internal gate closing (Gate stop)[1)]	2
Overflow (high counting limit violated)[1)]	3
Underflow (low counting limit violated)[1)]	4
Comparison event for DQ0 occurred	5
Comparison event for DQ1 occurred	6
Zero crossing	7
New Capture value available[2)]	8
Synchronization of the counter by an external signal[1)]	9
Change of direction[3)]	10

1) Not for SSI absolute encoder

2) Can only be configured in Counting mode

3) The feedback bit STS_DIR has the default value "0". A hardware interrupt is not triggered when the first counter value or position value is changed immediately after switching on the technology module in *down direction*.

You can activate any combination of events to trigger hardware interrupts.

Technical specifications

6

	6ES7138-6BA00-0BA0
Product type designation	TM PosInput 1
General information	
BaseUnits that can be used	BU type A0
Product function	
I&M data	Yes; I&M0 to I&M3
Engineering with	
STEP 7 TIA Portal can be configured/integrated as of version	V13 / V13
STEP 7 can be configured/integrated as of version	V5.5 SP3 / V5.5 SP4
Supply voltage	
Load voltage L+	
Rated value (DC)	24 V
Low limit of valid range (DC)	19.2 V
High limit of valid range (DC)	28.8 V
Reverse polarity protection	Yes
Input current	
Current consumption, max.	75 mA; without load
Encoder supply	
Number of outputs	1
24 V encoder supply	
24 V	Yes; L+ (-0.8 V)
Short-circuit protection	Yes
Output current, max.	300 mA
Power loss	
Power loss, typ.	1.9 W
Address area	
Occupied address area	
Inputs	16 bytes
Outputs	12 bytes; 4 bytes with Motion Control

	6ES7138-6BA00-0BA0
Digital inputs	
Number of inputs	2
Digital inputs, configurable	Yes
Input characteristics to IEC 61131, Type 3	Yes
Digital input functions, configurable	
Gate start/stop	Yes; only with pulse & incremental encoder
Capture	Yes
Synchronization	Yes; only with pulse & incremental encoder
Freely assignable digital input	Yes
Input voltage	
Rated value, DC	24 V
For signal "0"	-30 V to +5 V
For signal "1"	+11 to +30 V
Permitted voltage at input, min.	-30 V
Permitted voltage at input, max.	30 V
Input current	
for signal "1", typ.	2.5 mA
Input delay (at rated value of input voltage)	
For standard inputs	
• Configurable	Yes; none / 0.05 / 0.1 / 0.4 / 0.8 / 1.6 / 3.2 / 12.8 / 20 ms
• at "0" to "1", min.	6 µs; with parameter assignment "none"
• at "1" to "0", min.	6 µs; with parameter assignment "none"
For counters/technological functions	
• Configurable	Yes
Cable length	
Cable length shielded, max.	1000 m
Cable length unshielded, max.	600 m
Digital outputs	
Type of digital output	Transistor
Number of outputs	2
Digital outputs, configurable	Yes
Short-circuit protection	Yes; electronic/thermal
• Response threshold, typ.	1 A
Limiting of inductive shutdown voltage to	L+ (-33 V)
Control of a digital input	Yes
Digital output functions, configurable	
Switch at comparison values	Yes
Freely assignable digital output	Yes
Output switching capacity	
With resistive load, max.	0.5 A; per digital output
With lamp load, max.	5 W

	6ES7138-6BA00-0BA0
Load resistance range	
Low limit	48 Ω
High limit	12 kΩ
Output voltage	
for signal "1", min.	23.2 V; L+ (-0.8 V)
Output current	
for signal "1" rated value	0.5 A; per digital output
for signal "1" permissible range, max.	0.6 A; per digital output
for signal "1" minimum load current	2 mA
for signal "0" residual current, max.	0.5 mA
Output delay with resistive load	
"0" to "1", max.	50 µs
"1" to "0", max.	50 µs
Switching frequency	
With resistive load, max.	10 kHz
With inductive load, max.	0.5 Hz; to IEC 947-5-1, DC-13; observe derating curve
With lamp load, max.	10 Hz
Total current of outputs	
Max. current per module	1 A
Cable length	
Cable length shielded, max.	1000 m
Cable length unshielded, max.	600 m
Encoders	
Encoder signals, incremental encoder (symmetrical)	
Input voltage	RS422
Input frequency, max.	1 MHz
Counting frequency, max.	4 MHz; with quadruple evaluation
Signal filter, configurable	Yes
Cable length shielded, max.	32 m; with 1 MHz
Incremental encoder with A/B tracks, phase-shifted by 90°	Yes
Incremental encoder with A/B tracks, phase-shifted by 90°, and zero track	Yes
Pulse encoder	Yes
Pulse encoder with direction	Yes
Pulse encoder with one pulse signal per count direction	Yes

	6ES7138-6BA00-0BA0
Encoder signals, incremental encoders (asymmetrical)	
Input voltage	5 V TTL (only push-pull encoders)
Input frequency, max.	1 MHz
Counting frequency, max.	4 MHz; with quadruple evaluation
Signal filter, configurable	Yes
Incremental encoder with A/B tracks, phase-shifted by 90°	Yes
Incremental encoder with A/B tracks, phase-shifted by 90°, and zero track	Yes
Pulse encoder	Yes
Pulse encoder with direction	Yes
Pulse encoder with one pulse signal per count direction	Yes
Encoder signals, absolute encoder (SSI)	
Input signal	to RS 422
Frame length, configurable	10 ... 40 bits
Clock frequency, max.	2 MHz; 125 kHz, 250 kHz, 500 kHz, 1 MHz, 1.5 MHz or 2 MHz
Binary code	Yes
Gray code	Yes
Cable length shielded, max.	320 m; Cable length, RS-422 SSI absolute encoders, Siemens type 6FX2001-5, 24 V supply: 125 kHz, 320 meters shielded, max.; 250 kHz, 160 meters shielded, max.; 500 kHz, 60 meters shielded, max.; 1 MHz, 20 meters shielded, max.; 1.5 MHz, 10 meters shielded, max.; 2 MHz, 8 meters shielded, max.
Parity bit, configurable	Yes
Monoflop time	16, 32, 48, 64 µs & automatic
Multi-turn	Yes
Single-turn	Yes
Interface hardware	
RS422	Yes
TTL 5 V	Yes
Isochronous mode	
Isochronous mode (application synchronized until terminal)	Yes
Interrupts/diagnostics/status information	
Activation of substitute values	Yes; configurable
Interrupts	
Diagnostic interrupt	Yes
Hardware interrupt	Yes
Diagnostic messages	
Monitoring of supply voltage	Yes
Wire break	Yes
Short circuit	Yes
A/B transition error with incremental encoder	Yes
Frame error with SSI encoder	Yes
Group error	Yes

	6ES7138-6BA00-0BA0
LED diagnostics display	
Monitoring of supply voltage	Yes, green PWR LED
For module diagnostics	Yes; green / red DIAG LED
Count down status display (green)	Yes
Count up status display (green)	Yes
Integrated functions	
Number of counters	1
Counting frequency (counters), max.	4 MHz; with quadruple evaluation
Counting functions	
Can be used with TO High_Speed_Counter	Yes; only with pulse & incremental encoder
Continuous counting	Yes
Counter response configurable	Yes
Hardware gate by means of digital input	Yes
Software gate	Yes
Event-triggered stop	Yes
Synchronization by means of digital input	Yes
Counting range, configurable	Yes
Comparator	
• Number of comparators	2
• Direction-dependent	Yes
• Can be changed from user program	Yes
Position detection	
Incremental detection	Yes
Absolute detection	Yes
Suitable for S7-1500 Motion Control	Yes
Measuring functions	
Measuring time, configurable	Yes
Dyn. measuring time adjustment	Yes
Number of threshold values, configurable	2
Measuring range	
• Frequency measurement, min.	0.04 Hz
• Frequency measurement, max.	4 MHz
• Period measurement, min.	0.25 µs
• Period measurement, max.	25 s
Accuracy	
• Frequency measurement	100 ppm; depends on measuring interval and signal evaluation
• Velocity measurement	100 ppm; depends on measuring interval and signal evaluation
• Period measurement	100 ppm; depends on measuring interval and signal evaluation
Electrical isolation	

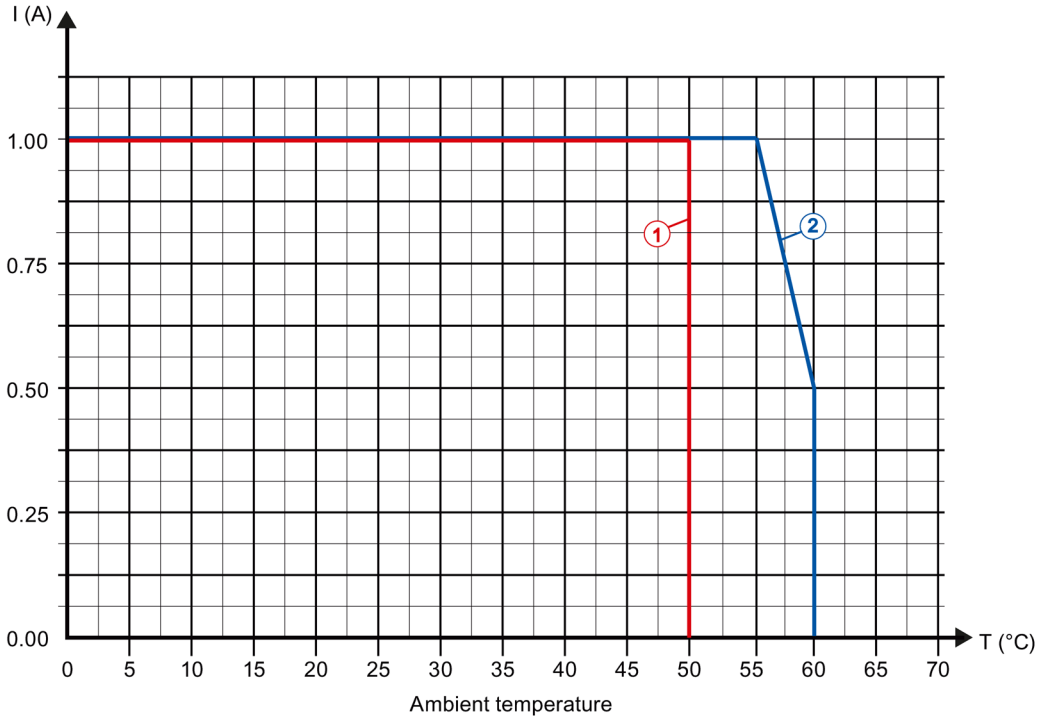
	6ES7138-6BA00-0BA0
Electrical isolation channels	
Between the channels and the backplane bus	Yes
Permitted potential difference	
Between the different circuits	75 V DC / 60 V AC (basic insulation)
Insulation	
Insulation tested with	707 V DC (type test)
Ambient conditions	
Operating temperature	
Horizontal installation, min.	0 °C
Horizontal installation, max.	60 °C; note derating
Vertical installation, min.	0 °C
Vertical installation, max.	50 °C; note derating
Dimensions	
Width	15 mm
Weights	
Weight, approx.	45 g

Derating information for total current of outputs

If the digital outputs of the TM PosInput 1 are operated with resistive or inductive loads, you should derate the total current of the loads at the digital outputs of the technology module. The total current is the sum of the load currents at all digital outputs of the module (without encoder supply).

The following derating curve shows the load capacity of the digital outputs depending on the ambient temperature and mounting position under the following conditions:

- Load resistance: 48 Ω (IEC 947-5-1)

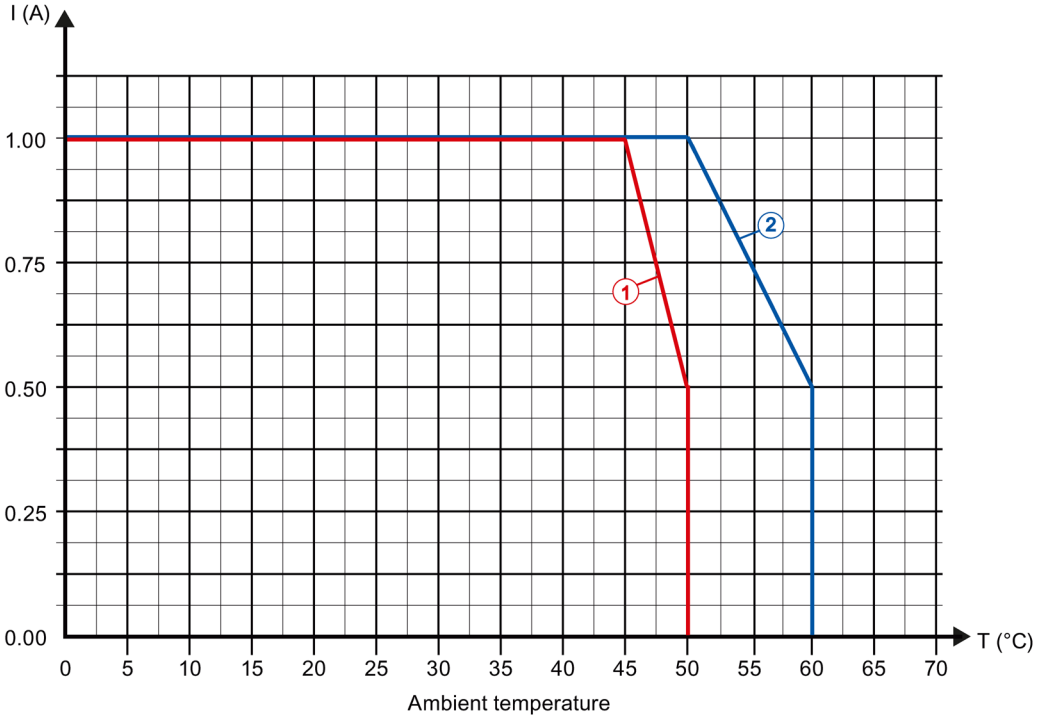


① Vertical installation of the system
② Horizontal installation of the system

Figure 6-1 Total current depending on ambient temperature and mounting position for resistive loads

The following derating curve shows the load capacity of the digital outputs depending on the ambient temperature and mounting position under the following conditions:

- Maximum switching frequency at digital outputs of 0.5 Hz
- Load resistance: 48 Ω (IEC 947-5-1)
- Load inductance: 1150 mH (IEC 947-5-1)



① Vertical installation of the system
② Horizontal installation of the system

Figure 6-2 Total current by ambient temperature and mounting position for inductive loads

Note

If the switching frequency is greater than 0.5 Hz or there is greater inductance at the digital outputs, the total current must be reduced further.

Dimension drawing

See ET 200SP BaseUnits (http://support.automation.siemens.com/WW/view/en/58532597/133300) manual

Parameter data records

A

You may edit the module parameters in RUN. The parameters are transferred to the module using the using data record 128, for example with the instruction WRREC.

If errors occur during the transfer of parameters with the WRREC instruction, the module continues operation with the previous parameter assignment. A corresponding error code is then written to the STATUS output parameter. If no errors occur, the STATUS output parameter contains the length of the actually transferred data.

The description of the WRREC instruction and the error codes is available in the STEP 7 (TIA Portal) Online Help.

Structure of data record 128

The following table shows you the structure of data record 128 for TM PosInput 1. The values in byte 0 to byte 3 are fixed and may not be changed. The value in byte 4 can only be changed by means of new parameter assignment and not in RUN mode of the CPU.

Table A- 1 Parameter data record 128

Bit → / Byte ↓	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0...3	**Header**							
0	Major Version = 0				Minor Version = 1			
1	Length of the parameter data per channel = 48							
2	Reserved[2)]							
3	Reserved[2)]							
4	**Operating mode**							
4	Reserved[2)]				Operating mode:			
					0000_B: Reserved			
					0001_B: Counting/Position input			
					0010_B: Measuring			
					0011 to 1111_B: Reserved			

Bit → / Byte ↓	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
5	**Basic parameters**							
5	Interface standard:	Reserved[2]				Enable additional diagnostic interrupts[1]	Reaction to CPU STOP:	
							00_B: Output substitute value	
							01_B: Keep last value	
	0_B: RS422, symmetrical						10_B: Continue operation	
	1_B: TTL (5 V), asymmetrical						11_B: Reserved	
6...7	**Counter inputs** (parameters for incremental encoders and pulse encoders)							
6	Reserved[2]		Signal evaluation:		Signal type:			
			00_B: Single		0000_B: Pulse (A)			
			01_B: Double		0001_B: Pulse (A) and direction (B)			
			10_B: Quadruple		0010_B: Count up (A), count down (B)			
			11_B: Reserved		0011_B: Incremental encoder (A, B phase-shifted)			
					0100_B: Incremental encoder (A, B, N)			
					0101_B: Absolute encoder (SSI)			
					0110 to 1111_B: Reserved			
7	Reaction to signal N:		Invert direction[1]	Enable diagnostic interrupt on wire break[1]	Filter frequency:			
	00_B: No reaction to signal N				0000_B: 100 Hz			
	01_B: Synchronization at signal N				0001_B: 200 Hz			
	10_B: Capture At signal N				0010_B: 500 Hz			
	11_B: Reserved				0011_B: 1 kHz			
					0100_B: 2 kHz			
					0101_B: 5 kHz			
					0110_B: 10 kHz			
					0111_B: 20 kHz			
					1000_B: 50 kHz			
					1001_B: 100 kHz			
					1010_B: 200 kHz			
					1011_B: 500 kHz			
					1100_B: 1 MHz			
					1101 to 1111_B: Reserved			

Bit → / Byte ↓	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
6...7	**Counter inputs** (parameters for SSI absolute encoder)							
6	Monoflop time:			Code type:	Signal type:			
	000_B: Automatically			0_B: Gray	0000_B: Pulse (A)			
	001_B: 16 µs			1_B: Dual	0001_B: Pulse (A) and direction (B)			
	010_B: 32 µs				0010_B: Count up (A), count down (B)			
	011_B: 48 µs				0011_B: Incremental encoder (A, B phase-shifted)			
	100_B: 64 µs				0100_B: Incremental encoder (A, B, N)			
	101 to 111_B: Reserved				0101_B: Absolute encoder (SSI)			
					0110 to 1111_B: Reserved			
7	Parity:		Invert direction[1]	Enable diagnostic interrupt on wire break[1]	Reserved[2]	Transmission rate:		
	00_B: None					000_B: 125 kHz		
	01_B: Even					001_B: 250 kHz		
	10_B: Odd					010_B: 500 kHz		
	11_B: Reserved					011_B: 1 MHz		
						100_B: 1.5 MHz		
						101_B: 2 MHz		
						110 to 111_B: Reserved		
8...9	**Hardware interrupts**[1]							
8	Reserved[2]	Reserved[2]	Reserved[2]	Change of direction	Underflow (low counting limit violated)	Overflow (high counting limit violated)	Gate stop[3]	Gate start[3]
9	Synchronization of the counter by an external signal[3]	New capture value available	Reserved[2]	Zero crossing	Reserved[2]	Comparison event for DQ1 occurred	Reserved[2]	Comparison event for DQ0 occurred

<table>
<tr><th>Bit →
Byte ↓</th><th>Bit 7</th><th>Bit 6</th><th>Bit 5</th><th>Bit 4</th><th>Bit 3</th><th>Bit 2</th><th>Bit 1</th><th>Bit 0</th></tr>
<tr><td>10...15</td><td colspan="8">Behavior of a DQ</td></tr>
<tr><td rowspan="9">10</td><td colspan="4">Set output (DQ1):</td><td colspan="4">Set output (DQ0):</td></tr>
<tr><td colspan="4">0000_B: Use by user program</td><td colspan="4">0000_B: Use by user program</td></tr>
<tr><td colspan="4">0001_B: Between comparison value and high counting limit; Measuring: Measured value >= comparison value</td><td colspan="4">0001_B: Between comparison value and high counting limit; Measuring: Measured value >= comparison value</td></tr>
<tr><td colspan="4">0010_B: Between comparison value and low counting limit; Measuring: Measured value <= comparison value</td><td colspan="4">0010_B: Between comparison value and low counting limit; Measuring: Measured value <= comparison value</td></tr>
<tr><td colspan="4">0011_B: At comparison value for a pulse duration</td><td colspan="4">0011_B: At comparison value for a pulse duration</td></tr>
<tr><td colspan="4">0100_B: Between comparison value 0 and 1</td><td colspan="4">0100_B: Reserved</td></tr>
<tr><td colspan="4">0101_B: After set command from CPU until comparison value</td><td colspan="4">0101_B: After set command from CPU until comparison value</td></tr>
<tr><td colspan="4">0110_B: Not between comparison value 0 and 1</td><td colspan="4" rowspan="2">0110 to 1111_B: Reserved</td></tr>
<tr><td colspan="4">0111 to 1111_B: Reserved</td></tr>
<tr><td rowspan="5">11</td><td colspan="2">Count direction (DQ1):</td><td colspan="2">Count direction (DQ0):</td><td rowspan="5">Reserved[2)]</td><td rowspan="5">Reserved[2)]</td><td rowspan="5">Substitute value for DQ1</td><td rowspan="5">Substitute value for DQ0</td></tr>
<tr><td colspan="2">00_B: Reserved</td><td colspan="2">00_B: Reserved</td></tr>
<tr><td colspan="2">01_B: Forward</td><td colspan="2">01_B: Forward</td></tr>
<tr><td colspan="2">10_B: Backward</td><td colspan="2">10_B: Backward</td></tr>
<tr><td colspan="2">11_B: In both directions</td><td colspan="2">11_B: In both directions</td></tr>
<tr><td>12</td><td colspan="8" rowspan="2">Pulse duration (DQ0):
WORD: Value range in ms/10: 0 to 65535_D</td></tr>
<tr><td>13</td></tr>
<tr><td>14</td><td colspan="8" rowspan="2">Pulse duration (DQ1):
WORD: Value range in ms/10: 0 to 65535_D</td></tr>
<tr><td>15</td></tr>
<tr><td>16</td><td colspan="8">Behavior of DI0</td></tr>
<tr><td rowspan="8">16</td><td rowspan="4">Behavior of counter value after Capture[3)] (DI0):</td><td>Edge selection (DI0):</td><td rowspan="2">Select level (DI0):</td><td rowspan="8">Reserved[2)]</td><td colspan="3">Set function of DI (DI0):</td></tr>
<tr><td>00_B: Reserved</td><td colspan="3">000_B: Gate start/stop (level-triggered)[3)]</td></tr>
<tr><td>01_B: At rising edge</td><td rowspan="3">0_B: Active with high level</td><td colspan="3">001_B: Gate start (edge-triggered)[3)]</td></tr>
<tr><td>10_B: At falling edge</td><td colspan="3">010_B: Gate stop (edge-triggered)[3)]</td></tr>
<tr><td rowspan="2">0_B: Continue counting</td><td rowspan="2">11_B: At rising and falling edge</td><td colspan="3">011_B: Synchronization[3)]</td></tr>
<tr><td rowspan="3">1_B: Active with low level</td><td colspan="3">100_B: Enable synchronization at signal N[3)]</td></tr>
<tr><td rowspan="3">1_B: Set to start value and continue counting</td><td rowspan="3"></td><td colspan="3">101_B: Capture</td></tr>
<tr><td colspan="3">110_B: Digital input without function</td></tr>
<tr><td colspan="3">111_B: Reserved</td></tr>
</table>

Bit → / Byte ↓	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
17	**Behavior of DI1**: See Byte 16							
18	Reserved[2]							
19	Frequency:	Reserved[2]			Filter time:			
	0_B: Once				0000_B: None			
	1_B: Periodic				0001_B: 0.05 ms			
					0010_B: 0.1 ms			
					0011_B: 0.4 ms			
					0100_B: 0.8 ms			
					0101_B: 1.6 ms			
					0110_B: 3.2 ms			
					0111_B: 12.8 ms			
					1000_B: 20 ms			
					1001 to 1111_B: Reserved			
20...43	**Values**							
20...23	High counting limit[3]: DWORD: Value range: –2147483648 to 2147483647_D or 80000000 to $7FFFFFFF_H$							
24...27	Comparison value 0: Operating mode Counting: DWORD: Value range: –2147483648 to 2147483647_D or 80000000 to $7FFFFFFF_H$; Operating mode Measuring: REAL: Floating point number in the configured unit of the measured variable							
28...31	Comparison value 1: Operating mode Counting: DWORD: Value range: –2147483648 to 2147483647_D or 80000000 to $7FFFFFFF_H$; Operating mode Measuring: REAL: Floating point number in the configured unit of the measured variable							
32...35	Start value[3]: DWORD: Value range: –2147483648 to 2147483647_D or 80000000 to $7FFFFFFF_H$							
36...39	Low counting limit[3]: DWORD: Value range: –2147483648 to 2147483647_D or 80000000 to $7FFFFFFF_H$							
40...43	Update time: DWORD: Value range in µs: 0 to 25000000_D							
44	**Counter behavior at limits and gate start**							
44	Reaction to gate start[3]:		Reaction to violation of a counting limit[3]:			Reset when counting limit is violated[3]:		
	00_B: Set to start value		000_B: Stop counting			000_B: To other counting limit		
	01_B: Continue with current value		001_B: Continue counting			001_B: To start value		
	10 to 11_B: Reserved		010 to 111_B: Reserved			010 to 111_B: Reserved		

Bit → / Byte ↓	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
45	**Specify measured value**							
45	Reserved[2]			Time base for velocity measurement:			Measured variable:	
				000_B: 1 ms			00_B: Frequency	
				001_B: 10 ms			01_B: Period	
				010_B: 100 ms			10_B: Velocity	
				011_B: 1 s			11_B: Complete SSI frame	
				100_B: 60 s/1 min				
				101 to 111_B: Reserved				
46	Increments per unit:							
47	WORD: Value range: 1 to 65535_D							
48	Set the hysteresis range: Value range: 0 to 255_D:							
49...51	**Parameters for SSI absolute encoder**							
49	Reserved[2]		Frame length: 10 to 40_D: Value range					
50	Reserved[2]		Bit number LSB of the position value: 0 to 38_D: Value range					
51	Reserved[2]		Bit number MSB of the position value: 0 to 39_D: Value range					

[1] You enable a specific parameter by setting the corresponding bit to 1.

[2] Reserved bits must be set to 0.

[3] For signal type "Absolute encoder (SSI)": Reserved[2]