

AMIKON TECHNICAL DOCUMENTATION

Installation Instructions

Siemens 6ES7138-6BA01-0BA0

Encoder Position Input Module

CHANNEL	INTERFACES	DIGITAL I/O	BASEUNIT
1 encoder	RS422 / SSI / TTL	2 DI / 2 DQ	Type A0

For qualified personnel only. Isolate the equipment and follow the complete manufacturer and site safety procedures. This reference does not replace the approved project design or the full installation manual.

01

PREPARATION AND WIRING CHECKS

- Use the specified A0 BaseUnit and confirm the potential-group L-/M supply arrangement.
- Select the SSI, RS422 or TTL terminal diagram that matches the actual encoder output signals.
- Ground encoder-cable shields at the BaseUnit shield contact and at the encoder; twist RS422 pairs.
- Use shielded digital-input cables when selecting None or 0.05 ms input delay.
- Apply the 5 V sensor-supply and digital-output derating curves; verify mode-dependent process-image mapping.

02

ORIGINAL WIRING REFERENCE

Original source PDF pages 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 115, 116, 117, 2, 3, 4, 5, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 107, 108, 109, 110, 111, 112, 113, 114. The following pages retain the original Siemens drawings and printed page numbers.

[Siemens original documentation and product reference](#)

Wiring

The TM PosInput 1 technology module is used with a BaseUnit of type A0 (article number 6ES7193-6BPx0-0xA0).

You connect the encoder signals, digital input and output signals and the sensor supply to the BaseUnit of the technology module. The supply voltage feed on the light-colored 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 scope of delivery of the module and must be ordered separately.

You can find an overview of the BaseUnits that you can use with the technology module in the product information for the documentation of 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>) manual.

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

Supply voltage L+/M

With a light-colored BaseUnit, you connect the supply voltage to the L+ and M terminals. With a dark BaseUnit, the supply voltage of the left-hand module is used. An internal protection circuit protects the technology module from reverse polarity of the supply voltage. The technology module monitors whether the supply voltage is connected.

Encoder supply

For supplying the encoders and sensors connected to the digital inputs, the technology module provides supply voltages of 24 V DC (terminal 15) and 5 V DC (terminal 13) with reference to M (terminals 14 and 16). Both voltages are monitored for short circuits and overload.

You can find information on the derating information for the 5 V sensor supply in section Technical specifications (Page 106).

Digital inputs DI0 and DI1

The digital inputs are used for gate control, synchronization and the Capture function.

The digital inputs are not isolated from each other.

Input delay for digital inputs

In order to suppress noise you can configure an input delay for the digital inputs.

Note

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

Digital outputs DQ0 and DQ1

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 per channel. They are protected against overload and short-circuit.

Relays and contactors can be directly connected without an external protective circuit. You can find information on the maximum possible operating frequencies and the inductive loads connected to the digital outputs in section Technical specifications (Page 106).

3.1 SSI encoder signals

SSI encoder signals

The TM PosInput 1 can process SSI encoder signals. These are designated with data and clock and use the RS422 signal standard.

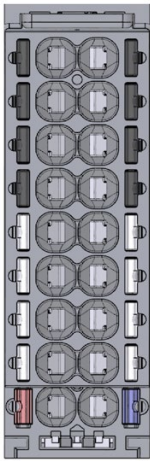
An RS422 encoder signal uses a pair of wires and the information is transmitted as differential voltage. This ensures interference-free transmission of RS422 encoder signals even with high frequencies over long distances. The RS422 wire pairs must be twisted together in the cable.

The SSI encoder signals data and clock are connected via the D and C terminals. The N terminals remain unconnected. The inputs are not isolated from each other. The inputs are isolated from the backplane bus.

Terminal assignment of the BaseUnit

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

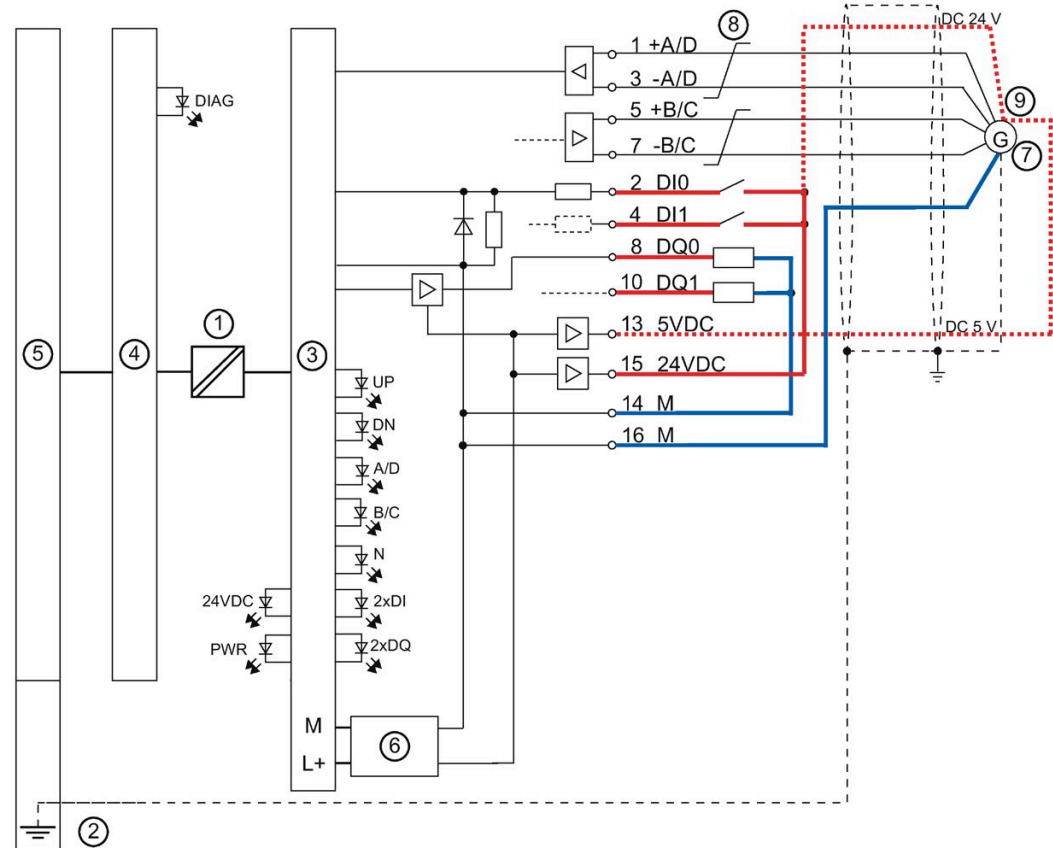
Table 3- 1 Terminal assignment of the BaseUnit BU15-P16+A0+2B

Designation	Signal name		View	Signal name		Designation
SSI data signal +D	+A/D	1		2	DI0	Digital input DI0
SSI data signal -D	-A/D	3		4	DI1	Digital input DI1
SSI clock signal +C	+B/C	5		6	—	—
SSI clock signal -C	-B/C	7		8	DQ0	Digital output DQ0
—	+N	9		10	DQ1	Digital output DQ1
—	-N	11		12	—	—
5 V DC sensor supply	5VDC	13		14	M	Ground for encoder supply, digital inputs and digital outputs
Encoder supply 24 V DC	24VDC	15		16	M	
Supply voltage DC 24 V	L+				M	Ground for supply voltage

Block diagram

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

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



- ① Electrical isolation
- ② Shield contact on the BaseUnit
- ③ Technology
- ④ Backplane bus interface module of the technology module
- ⑤ Backplane bus
- ⑥ Input filter
- ⑦ SSI absolute encoder
- ⑧ Twisted in pairs
- ⑨ Sensor supply either 5 V DC or 24 V DC

Figure 3-1 Block diagram with SSI absolute encoder

3.2 RS422 encoder signals

RS422 encoder signals/count signals

The TM PosInput 1 can process encoder signals that use the RS422 signal standard. These counting encoder signals are designated with the letters A, B and N.

An RS422 encoder signal uses a pair of wires and the counter information is transmitted as differential voltage. This ensures interference-free transmission of RS422 encoder signals even with high frequencies over long distances. The RS422 wire pairs must be twisted together in the cable.

You can connect the following encoder types:

- RS422 incremental encoder with N signal:

The encoder signals A, B and N are connected using the correspondingly marked terminals. A and B are the two incremental signals phase-shifted by 90°. N is the zero mark signal that supplies one pulse per revolution.

- RS422 incremental encoder without N signal:

The encoder signals A and B are connected using the correspondingly marked terminals. A and B are the two incremental signals phase-shifted by 90°. The N terminals remain unconnected.

- RS422 pulse encoder without direction signal:

The counting signal is connected to the A terminals. The count direction can be specified via the control interface. The B and N terminals remain unconnected.

- RS422 pulse encoder with direction signal:

The counting signal is connected to the A terminals. The direction signal is connected to the B terminals. Counting down takes place at a high level of the direction signal. The N terminals remain unconnected.

- RS422 pulse encoder with up/down count signal

The up counting signal is connected to the A terminals. The down counting signal is connected to the B terminals. The N terminals remain unconnected.

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

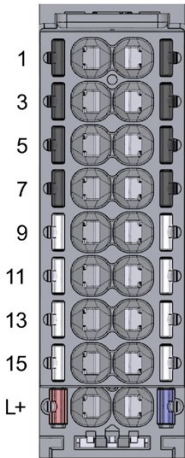
Note

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.

Terminal assignment of the BaseUnit

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

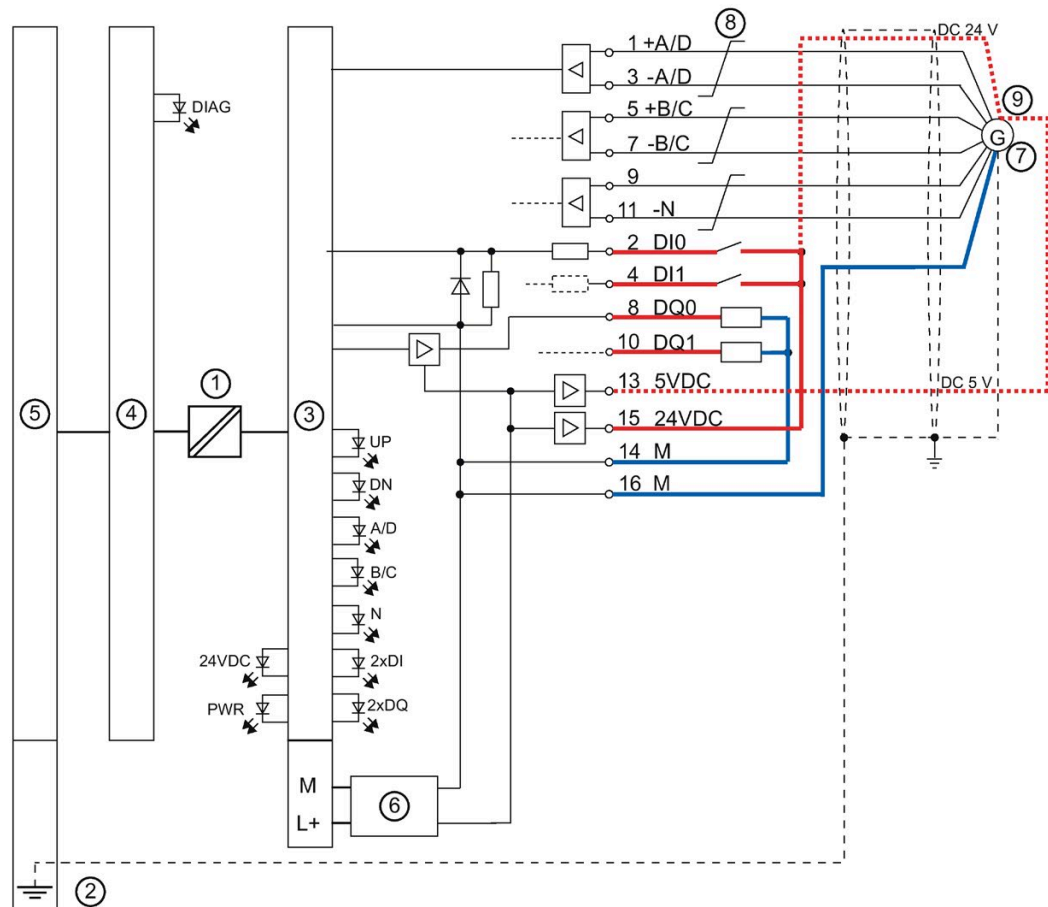
Table 3- 2 Terminal assignment of the BaseUnit BU15-P16+A0+2B

Designation					Signal name		View	Signal name		Designation
RS422 incremental encoder		RS422 pulse encoder								
with sig- nal N	without sig- nal N	with direc- tion signal	without direc- tion signal	up/down						
Encoder signal +A		Counting signal A		Up counting signal +A	+A/D	1		2	DI0	Digital input DI0
Encoder signal -A		Counting signal -A		Up counting signal -A	-A/D	3		4	DI1	Digital input DI1
Encoder signal +B		Direction signal +B	—	Down counting signal +B	+B/C	5		6	—	—
Encoder signal -B		Direction signal -B	—	Down counting signal -B	-B/C	7		8	DQ0	Digital output DQ0
Encoder signal +N	—				+N	9		10	DQ1	Digital output DQ1
Encoder signal -N	—				-N	11		12	—	—
5 V DC sensor supply					5VDC	13		14	M	Ground for encoder supply, digital inputs and digital outputs
Encoder supply 24 V DC					24VDC	15		16	M	
Supply voltage DC 24 V					L+				M	Ground for supply voltage

Block diagram

You must ground the shields of the cables between encoder and technology module both through the shield contact on the BaseUnit (shield bracket and terminal) and 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 contact on the BaseUnit
- ③ Technology
- ④ Backplane bus interface module of the technology module
- ⑤ Backplane bus
- ⑥ Input filter
- ⑦ RS422 incremental encoder
- ⑧ Twisted in pairs
- ⑨ Sensor supply either 5 V DC or 24 V DC

Figure 3-2 Block diagram with RS422 incremental encoder

3.3 TTL encoder signals

TTL encoder signals/counting signals

The TM PosInput 1 can process encoder signals that use the TTL signal standard. The counting encoder signals are designated with the letters A, B and N. An encoder signal with TTL standard uses a single cable.

You can connect the following encoder types:

- TTL incremental encoder with N signal:

The encoder signals A, B and N are connected using the correspondingly marked terminals. A and B are the two incremental signals phase-shifted by 90°. N is the zero mark signal that supplies one pulse per revolution.

- TTL incremental encoder without N signal:

The encoder signals A and B are connected using the correspondingly marked terminals. A and B are the two incremental signals phase-shifted by 90°. The N terminal remains unconnected.

- TTL pulse encoder without direction signal:

The counting signal is connected to the A terminal. The count direction can be specified via the control interface. The B and N terminals remain unconnected.

- TTL pulse encoder with direction signal:

The counting signal is connected to the A terminal. The direction signal is connected to the B terminal. Counting down takes place at a high level of the direction signal. The N terminal remains unconnected.

- TTL pulse encoder with up/down counting signal

The up counting signal is connected to the A terminal. The down counting signal is connected to the B terminal. The N terminal remains unconnected.

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

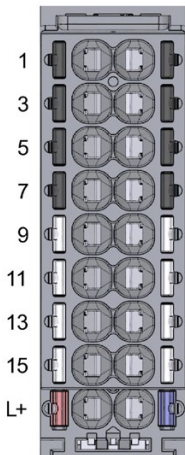
Note

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.

Terminal assignment of the BaseUnit

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

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

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

Block diagram

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

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

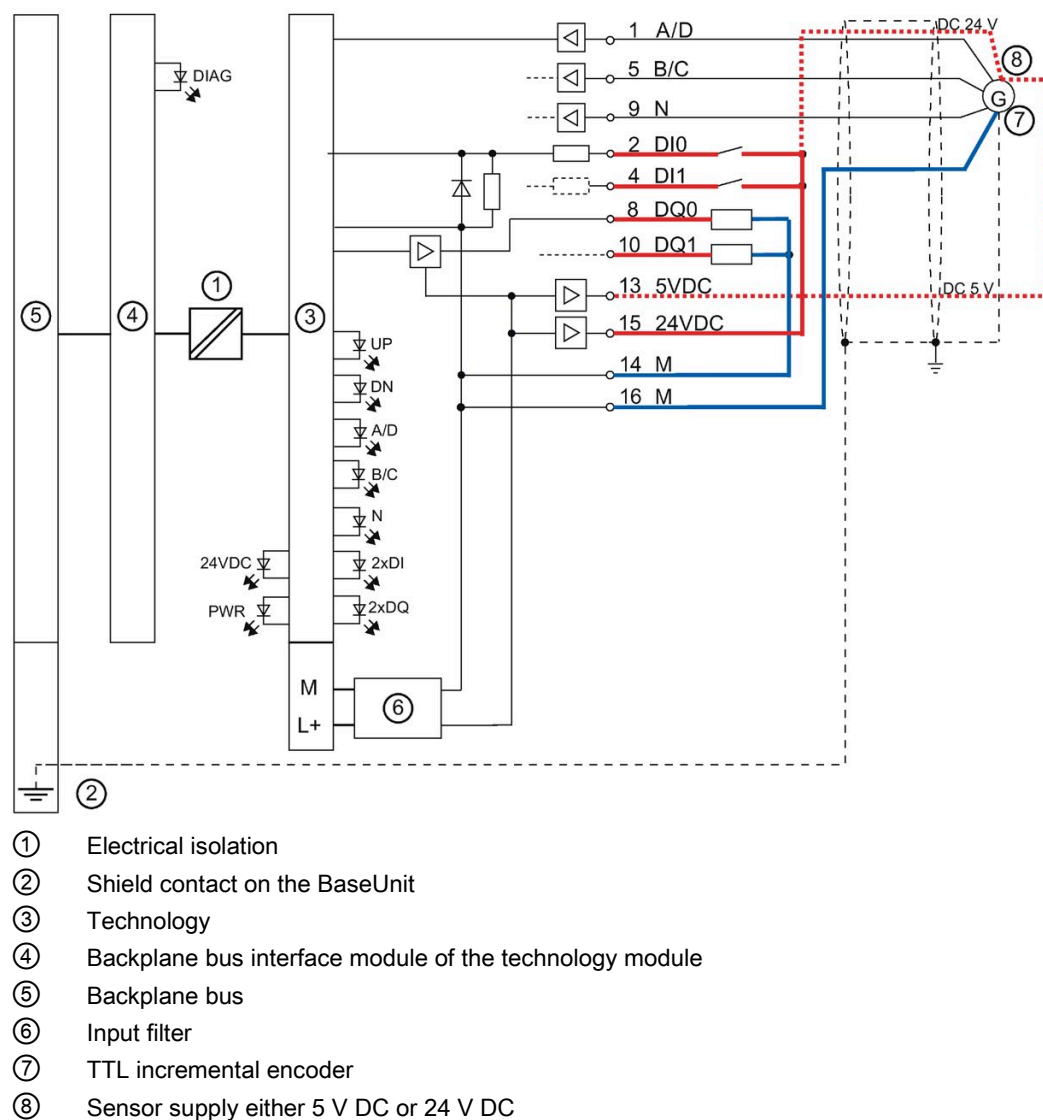
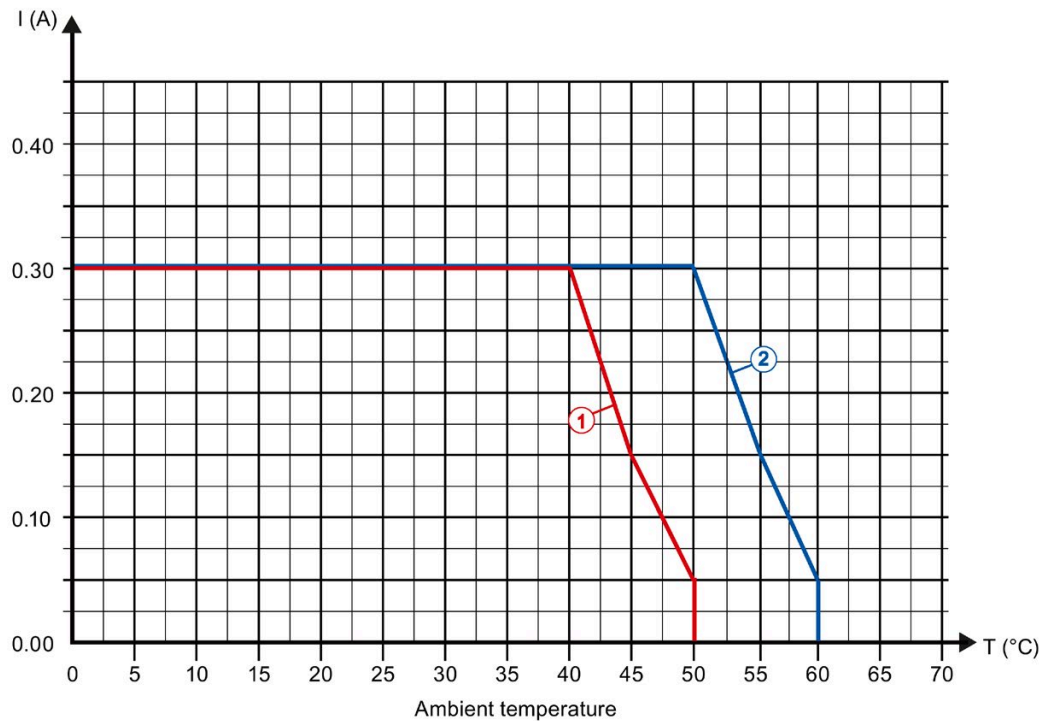


Figure 3-3 Block diagram with TTL incremental encoder

Derating information for the 5 V sensor supply

When encoders are supplied by the 5 V sensor supply of the TM PosInput 1, derating of the output current of the encoder supply must be taken into consideration. The following derating curve shows the load capacity of the 5 V sensor supply depending on the ambient temperature and mounting position:



- ① Non-horizontal installation of the system
- ② Horizontal installation of the system

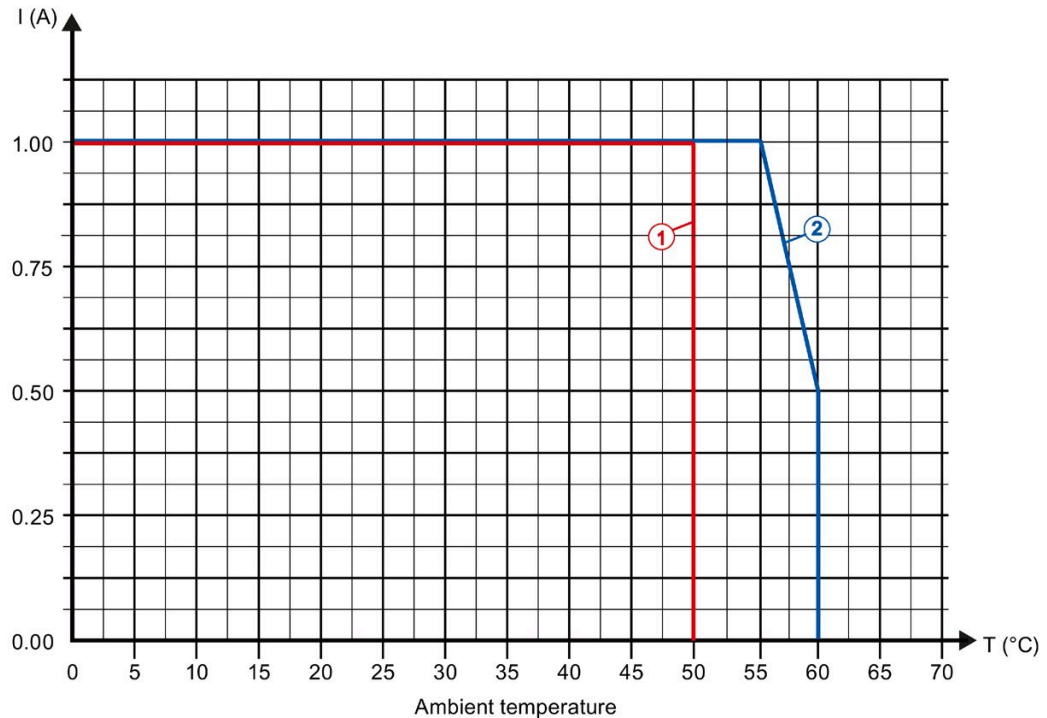
Figure 6-1 Output current depending on ambient temperature and mounting position

Derating information for total current of digital 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)

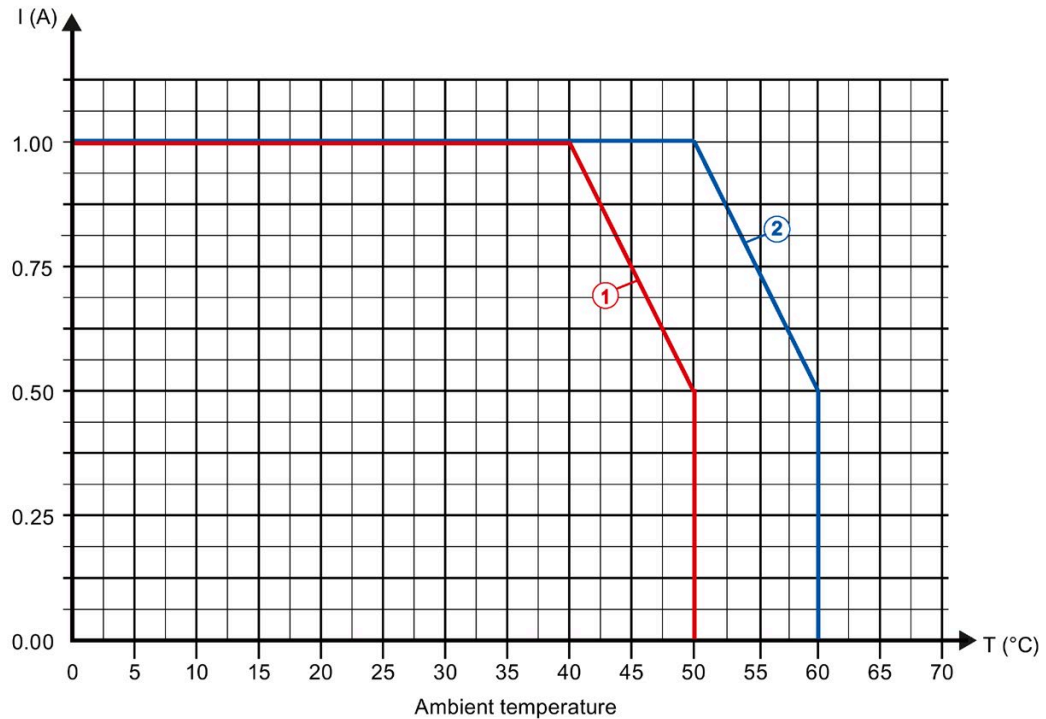


- ① Non-horizontal installation of the system
- ② Horizontal installation of the system

Figure 6-2 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 Non-horizontal installation of the system
 ② Horizontal installation of the system

Figure 6-3 Total current depending on 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

SIMATIC

ET 200SP Technology module TM PosInput 1 (6ES7138-6BA01-0BA0)

Equipment Manual



Preface

Documentation guide

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Product overview

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Legal information

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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.

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Product overview

2.1 Properties

Article number

6ES7138-6BA01-0BA0 (packing unit: pack of 1)

6ES7138-6BA01-2BA0 (packing unit: pack of 10)

The TM PosInput 1 technology module with article number 6ES7138-6BA01-0BA0 and firmware version V2.0 is a compatible replacement for the TM PosInput 1 with article number 6ES7138-6BA00-0BA0.

Firmware version

This manual describes the properties of firmware version V2.0 of the module.

Properties

The TM PosInput 1 technology module has the following properties:

- Technical properties
 - One channel
 - Interfaces:
 - SSI encoder signals D und C or RS422/TTL encoder signals A, B and N
 - 5 V and 24 V sensor supply, short-circuit proof
 - Digital inputs signals DI0 and DI1
 - Digital output signals DQ0 and DQ1
 - Supply voltage L+
 - Count range: 32 bits
 - Channel-by-channel monitoring of encoder signals for wire break, short-circuit and faulty supply 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 N signal
 - RS422/TTL incremental encoder without N signal
 - RS422/TTL pulse encoder with direction signal
 - RS422/TTL pulse encoder without direction signal
 - RS422/TTL pulse encoder with up/down count signal

The module supports the following functions:

Table 2- 1 Version dependencies of the functions

Function	Firmware version of module	Configurable as of			
		STEP 7 (TIA Portal)	STEP 7	GSD	
				PROFINET IO	PROFIBUS DP
Firmware update	V1.0 or higher	V13	V5.5 SP4	X	—
I&M identification data	V1.0 or higher	V13	V5.5 SP4	X	X
Parameter reassignment in RUN	V1.0 or higher	V13	V5.5 SP4	X	X
Isochronous mode	V1.0 or higher	V13	V5.5 SP4	—	—
Counting/measuring	V1.0 or higher	V13	V5.5 SP4 or V5.5 SP3 with HSP0240 V1.0	X	X
Operating with "Counting and measurement" technology object	V1.0 or higher	V13	—	—	—
Position input for "Motion Control" technology object	V1.0 or higher	V13	—	—	—
Central operation on CPU 151xSP	V1.1 or higher	V13 SP1	—	—	—
Fast Mode	V1.2 or higher	V14 SP1 or V14 with HSP0199	V5.6 or V5.5 SP4 with HSP0240 V5.0	X	X
Operating with "Measuring input" technology object	V1.3 or higher	V15 with HSP0256	—	—	—
Position value range of 32 bits	V1.3 or higher	V15 with HSP0256	—	X	X
Display of digital input states in the process image for position input for "Motion Control" technology object	V2.0 or higher	V16 with HSP0184	—	—	—

Firmware versions V1.x are available for the article number 6ES7138-6BA00-0BA0.

Firmware version V2.0 is available for the article number 6ES7138-6BA01-xBA0.

Accessories

A **BaseUnit** of **type A0** is needed for operation of the technology module. You can find an overview of the BaseUnits that you can use with the technology module in the product information for the documentation of 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 32 bits and transfer it to the controller.

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 (Latch)

You can configure the edge of an external reference signal that triggers saving of the current position value as a 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

The "Frequency of Capture function" parameter specifies whether the function is executed at each configured edge or only once after each enable.

Measuring input

If you use Position input for Motion Control (Page 20), you can use the "Measuring input" technology object to execute a measuring input function with a hardware digital input.

Hardware interrupts

The technology module can trigger a hardware interrupt in the CPU when a comparison event, zero crossing and/or direction reversal occurs. You can specify which events during operation are to trigger a hardware interrupt.

2.2.1.2 Counting with incremental or pulse encoder

Counting is the detecting 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. In addition, you can read the signal state of the respective digital input via the feedback interface.

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.

You can configure the behavior of the counter at the counting limits.

Start value

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

Gate control

You can define the time window in which the count signals are acquired with the hardware gate (HW gate) and software gate (SW gate).

Capture (Latch)

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

The "Frequency of Capture function" parameter specifies whether the function is executed at each configured edge or only once after each enable.

Measuring input

If you use Position input for Motion Control (Page 20), you can use the "Measuring input" technology object to execute a measuring input function with a hardware digital input.

Hardware interrupts

The technology module can trigger a hardware interrupt in the CPU when a comparison event, zero crossing and/or direction reversal occurs. You can specify which events during operation are to trigger a hardware interrupt.

2.2.2 Measured value determination

The following high-accuracy measurement functions are available (accuracy up to 100 ppm):

- Frequency measurement with the unit of hertz
- Period measurement with the unit of seconds
- Velocity measurement with a flexibly adaptable unit
- Complete SSI frame instead of a measured quantity

Update time

You can configure the interval at which the technology module updates the measured values cyclically as the update time.

Gate control for incremental and pulse encoders

You can define the time window in which the count signals are acquired with the hardware gate (HW gate) and software gate (SW gate).

2.2.3 Switching the outputs at comparison values

The available digital outputs DQ0 and DQ1 can be directly activated/switched by the specified comparison values or via the user program. The comparison values are configurable and can be modified during runtime with the user program. This enables very fast reaction times to be achieved.

Comparison values in the Counting/Position input operating mode

In Counting/Position input operating mode you specify two position or counter values as comparison values depending on the encoder. 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 detection for the following axis technology objects of S7-1500 Motion Control:

- TO_PositioningAxis
- TO_SynchronousAxis
- TO_ExternalEncoder

In this operating mode, you can use the measuring input technology object (TO_MeasuringInput) to execute a measuring input function with hardware digital input DI1.

Additional information

You can find a detailed description of the use of Motion Control and its configuration in the following:

- Function manual S7-1500 Motion Control available for download on the Internet (<https://support.industry.siemens.com/cs/ww/en/view/59381279>)
- Function manual S7-1500T Motion Control available for download on the Internet (<https://support.industry.siemens.com/cs/ww/en/view/109481326>)

2.2.5 Fast Mode

You can use the technology module in Fast Mode for very fast acquisition of counter or position value with compressed functionality. A reduced feedback interface but no control interface is available in Fast Mode. This allows you to use a shorter send clock for the CPU.

2.2.6 Additional functions

Synchronization for incremental and pulse encoder

You can configure the edge of an external reference signal that loads 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 signal N at the encoder input
- Rising edge of signal N at the encoder input depending on the level of the assigned digital input

The "Frequency of synchronization" parameter specifies whether the function is executed at each configured edge or only once after each enable.

Hysteresis

You can specify a hysteresis for the comparison values within which a digital output will be prevented from switching again.

Diagnostic interrupt

The technology module can trigger diagnostic interrupts. You enable the diagnostic interrupts in the device configuration.

Input filter

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

Isochronous mode

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

Technical specifications

Article number	6ES7138-6BA01-0BA0
General information	
Product type designation	TM PosInput 1
Firmware version	V2.0
FW update possible	Yes
usable BaseUnits	BU type A0
Color code for module-specific color identification plate	CC00
Product function	
I&M data	Yes; I&M0 to I&M3
Isochronous mode	Yes
Engineering with	
STEP 7 TIA Portal configurable/integrated as of version	STEP 7 V16 or higher
STEP 7 configurable/integrated as of version	V5.6 (use previous version *6BA00*)
PROFIBUS as of GSD version/GSD revision	GSD Revision 5
PROFINET as of GSD version/GSD revision	GSDML V2.34
Supply voltage	
Load voltage L+	
Rated value (DC)	24 V
permissible range, lower limit (DC)	19.2 V
permissible range, upper limit (DC)	28.8 V
Reverse polarity protection	Yes
Input current	
Current consumption, max.	75 mA; without load
Encoder supply	
Number of outputs	2
5 V encoder supply	
5 V	Yes
Short-circuit protection	Yes; electronic/thermal
Output current, max.	300 mA; Total current of all encoders

Article number	6ES7138-6BA01-0BA0
24 V encoder supply	
• 24 V	Yes; L+ (-0.8 V)
• Short-circuit protection	Yes; electronic/thermal
• Output current, max.	300 mA; Total current of all encoders
Power loss	
Power loss, typ.	1.5 W
Address area	
Address space per module	
• Inputs	16 byte; 4 bytes in Fast mode
• Outputs	12 byte; 4 bytes for Motion Control, 0 bytes for Fast mode
Digital inputs	
Number of digital inputs	2
Digital inputs, parameterizable	Yes
Input characteristic curve in accordance with IEC 61131, type 3	Yes
Digital input functions, parameterizable	
• Gate start/stop	Yes; only for pulse and incremental encoders
• Capture	Yes
• Synchronization	Yes; only for pulse and incremental encoders
• Freely usable digital input	Yes
Input voltage	
• Rated value (DC)	24 V
• for signal "0"	-5 ... +5 V
• for signal "1"	+11 to +30V
• permissible voltage at input, min.	-30 V; -5 V continuous, -30 V brief reverse polarity protection
• permissible voltage at input, max.	30 V
Input current	
• for signal "1", typ.	2.5 mA
Input delay (for rated value of input voltage) for standard inputs	
– parameterizable	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; for parameterization "none"
– at "1" to "0", min.	6 µs; for parameterization "none"
for technological functions	
– parameterizable	Yes

Article number	6ES7138-6BA01-0BA0
Cable length	
shielded, max.	1 000 m
unshielded, max.	600 m
Digital outputs	
Type of digital output	Transistor
Number of digital outputs	2
Digital outputs, parameterizable	Yes
Short-circuit protection	Yes; electronic/thermal
Response threshold, typ.	1 A
Limitation of inductive shutdown voltage to	L+ (-53 V)
Controlling a digital input	Yes
Digital output functions, parameterizable	
Switching tripped by comparison values	Yes
Freely usable digital output	Yes
Switching capacity of the outputs	
with resistive load, max.	0.5 A; Per digital output
on lamp load, max.	5 W
Load resistance range	
lower limit	48 Ω
upper limit	12 k Ω
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 μ s
"1" to "0", max.	50 μ s
Switching frequency	
with resistive load, max.	10 kHz
with inductive load, max.	0.5 Hz; Acc. to IEC 60947-5-1, DC-13; observe derating curve
on lamp load, max.	10 Hz
Total current of the outputs	
Current per module, max.	1 A

Article number	6ES7138-6BA01-0BA0
Cable length	
• shielded, max.	1 000 m
• unshielded, max.	600 m
Encoder signals, incremental encoder (symmetrical)	
• Input voltage	RS 422
• Input frequency, max.	1 MHz
• Counting frequency, max.	4 MHz; with quadruple evaluation
• Cable length, shielded, max.	32 m; at 1 MHz
• Signal filter, parameterizable	Yes
• Incremental encoder with A/B tracks, 90° phase offset	Yes
• Incremental encoder with A/B tracks, 90° phase offset and zero track	Yes
• Pulse encoder	Yes
• Pulse encoder with direction	Yes
• Pulse encoder with one impulse signal per count direction	Yes
Encoder signals, incremental encoder (asymmetrical)	
• Input voltage	5 V TTL (push-pull encoders only)
• Input frequency, max.	1 MHz
• Counting frequency, max.	4 MHz; with quadruple evaluation
• Signal filter, parameterizable	Yes
• Incremental encoder with A/B tracks, 90° phase offset	Yes
• Incremental encoder with A/B tracks, 90° phase offset and zero track	Yes
• Pulse encoder	Yes
• Pulse encoder with direction	Yes
• Pulse encoder with one impulse signal per count direction	Yes

Article number	6ES7138-6BA01-0BA0
Encoder signals, absolute encoder (SSI)	
• Input signal	to RS-422
• Telegram length, parameterizable	10 ... 40 bit
• 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, parameterizable	Yes
• Monoflop time	16, 32, 48, 64 µs & automatic
• Multiturn	Yes
• Singleturn	Yes
Interface types	
• TTL 5 V	Yes; push-pull encoders only
• RS 422	Yes
Interrupts/diagnostics/status information	
Substitute values connectable	Yes; Parameterizable
Alarms	
• Diagnostic alarm	Yes
• Hardware interrupt	Yes
Diagnostic messages	
• Monitoring the supply voltage	Yes
• Wire-break	Yes
• Short-circuit	Yes
• A/B transition error at incremental encoder	Yes
• Telegram error at SSI encoder	Yes
• Group error	Yes

Article number	6ES7138-6BA01-0BA0
Diagnostics indication LED	
Monitoring of the supply voltage (PWR-LED)	Yes; green PWR LED
Channel status display	Yes; Green LED
for module diagnostics	Yes; green/red DIAG LED
Status indicator backward counting (green)	Yes
Status indicator forward counting (green)	Yes
Integrated Functions	
Number of counters	1
Counting frequency (counter) max.	4 MHz; with quadruple evaluation
Fast mode	Yes
Counting functions	
Can be used with TO High_Speed_Counter	Yes; only for pulse and incremental encoders
Continuous counting	Yes
Counter response parameterizable	Yes
Hardware gate via digital input	Yes
Software gate	Yes
Event-controlled stop	Yes
Synchronization via digital input	Yes
Counting range, parameterizable	Yes
Comparator	
Number of comparators	2
Direction dependency	Yes
Can be changed from user program	Yes
Position detection	
Incremental acquisition	Yes
Absolute acquisition	Yes
Suitable for S7-1500 Motion Control	Yes
Measuring functions	
Measuring time, parameterizable	Yes
Dynamic measurement period adjustment	Yes
Number of thresholds, parameterizable	2

Article number	6ES7138-6BA01-0BA0
Measuring range	
– Frequency measurement, min.	0.04 Hz
– Frequency measurement, max.	4 MHz
– Cycle duration measurement, min.	0.25 µs
– Cycle duration measurement, max.	25 s
Accuracy	
– Frequency measurement	100 ppm; depending on measuring interval and signal evaluation
– Cycle duration measurement	100 ppm; depending on measuring interval and signal evaluation
– Velocity measurement	100 ppm; depending on measuring interval and signal evaluation
Potential separation	
Potential separation channels	
• between the channels and backplane bus	Yes
Isolation	
Isolation tested with	707 V DC (type test)
Ambient conditions	
Ambient temperature during operation	
• horizontal installation, min.	-30 °C
• horizontal installation, max.	60 °C; Observe derating
• vertical installation, min.	-30 °C
• vertical installation, max.	50 °C; Observe derating
• ceiling installation, min.	-30 °C
• ceiling installation, max.	50 °C; Observe derating
• floor installation, min.	-30 °C
• floor installation, max.	50 °C; Observe derating
Altitude during operation relating to sea level	
• Installation altitude above sea level, max.	5 000 m; Restrictions for installation altitudes > 2 000 m, see manual
Decentralized operation	
to SIMATIC S7-300	Yes
to SIMATIC S7-400	Yes
to SIMATIC S7-1200	Yes
to SIMATIC S7-1500	Yes
to standard PROFIBUS master	Yes
to standard PROFINET controller	Yes

Article number	6ES7138-6BA01-0BA0
Dimensions	
Width	15 mm
Height	73 mm
Depth	58 mm
Weights	
Weight, approx.	45 g

Note

Installation heights > 2000 m

You can find information on the restrictions when using the ET 200SP distributed I/O system at more than 2000 m above sea level in the "Mechanical and climatic environmental conditions" section of the ET 200SP Distributed I/O system

(<http://support.automation.siemens.com/WW/view/en/58649293>) system manual.