Product overview

2

2.1 Properties

Article number

6ES7553-1AA00-0AB0

View of the module

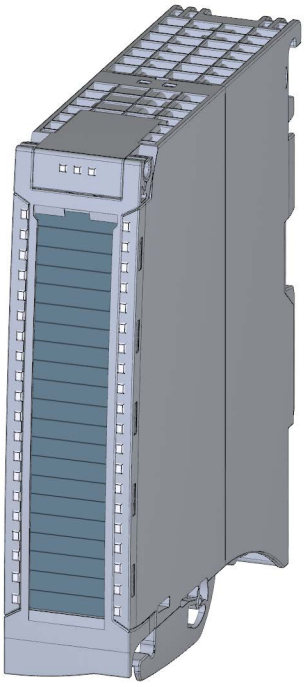


Figure 2-1 View of the TM PTO 4 module

Introduction

The technology module enables you to connect up to four stepper motor axes to an S7-1500 system. The module is linked to technology objects by means of an implementation of the PROFIdrive frame 3 and forms the interface to the drive. The number of steps that are output is returned as the actual position value.

Properties

The TM PTO 4 technology module has the following properties:

- Technical properties
  - 4 channels, quantity can be configured, channel-by-channel parameter assignment
  - Interfaces:

    RS422/TTL(5 V) or 24 V pulse output signals P/A and D/B for the PTO function (per channel, max. 1 MHz for RS422, max. 200 kHz for 24 V / TTL (5 V))

    Digital input signals DI0 and DI1 for the reference switch, measuring input, ready input functions (per channel)

    Digital output signal DQ0 for the PTO or drive enable function (per channel)

    Digital output signal DQ1 for the PTO function (per channel)

    Digital input/output signal DIQ2 for the drive enable or ready input function (per channel)

    Supply voltage L+
  - Configurable diagnostics (per channel)
  - Configurable interpulse period for auto reverse
  - Configurable input delay: none, 0.05 ms ... 20 ms
- Supported signal types for pulse output
  - Pulse encoder with direction signal
  - Pulse encoder with forward signal and backward signal
  - Incremental encoder with two signals with a 90° phase shift
- Supported system functions
  - Isochronous mode
  - Firmware Update
  - Identification data I&M

Accessories

The following components are supplied with the technology module and can also be ordered separately as spare parts:

- Shield bracket
- Shield clamp
- Infeed element
- Labeling strip
- U-connector

Other components

The following component needs to be ordered separately:

- Front connectors, including potential jumpers and cable ties

See also

For more information on accessories, see System Manual S7-1500, ET 200MP Automation System (http://support.automation.siemens.com/WW/view/en/59191792).

2.2 Functions

2.2.1 Pulse Train Output (PTO)

Applications

Pulse Train Output is a simple and universal interface between a SIMATIC controller and a drive. PTO is supported worldwide by many stepper and servo drives and is used in many positioning applications, such as for adjustment axes and feed axes.

PTO is also referred to as the pulse/direction interface. The pulse/direction interface comprises two signals. The frequency of the pulse output represents the speed and the number of pulses that are output represents the distance to be traversed. The direction output defines the traversing direction. The position specification is thereby accurate to within one increment. The pulse/direction interface is especially well-suited for operation with the technology objects TO_SpeedAxis, TO_PositioningAxis and TO_SynchronousAxis.

Control

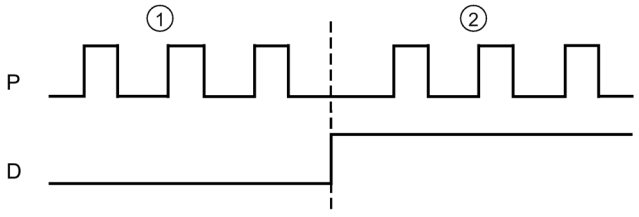
The control of the pulse output channels is provided above all with S7-1500 Motion Control by means of the technology objects TO_SpeedAxis, TO_PositioningAxis and TO_SynchronousAxis . The control and feedback interface (Page 34) of the channels is an implementation of the PROFIdrive interface with standard frame 3.

For a detailed description of configuring the technology module with the axis technology objects, see Function Manual S7-1500T Motion Control, section "Configuring", which is available for download on theInternet (https://support.industry.siemens.com/cs/ww/en/view/109481326).

Signal types

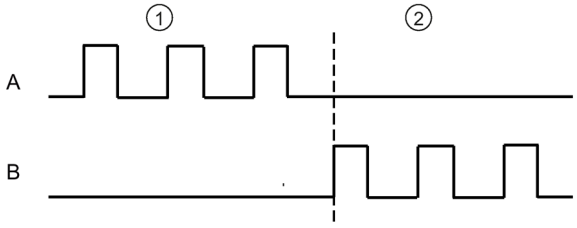
The technology module supports the following four signal types:

- Pulse (P) and direction (D):
  One output (P) controls the pulses and one output (D) controls the direction. D is 'high' (active) when pulses are generated in the negative direction. D is 'low' (inactive) when pulses are generated in the positive direction.



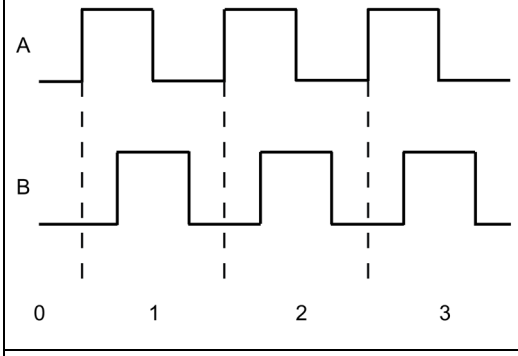
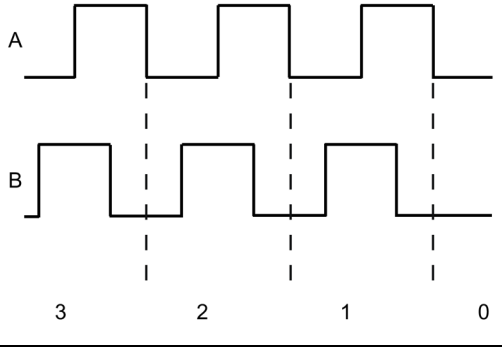
① Positive direction of rotation
② Negative direction of rotation

- Count up (A), count down (B):
  One output (A) outputs pulses for positive directions and another output (B) outputs pulses for negative directions.

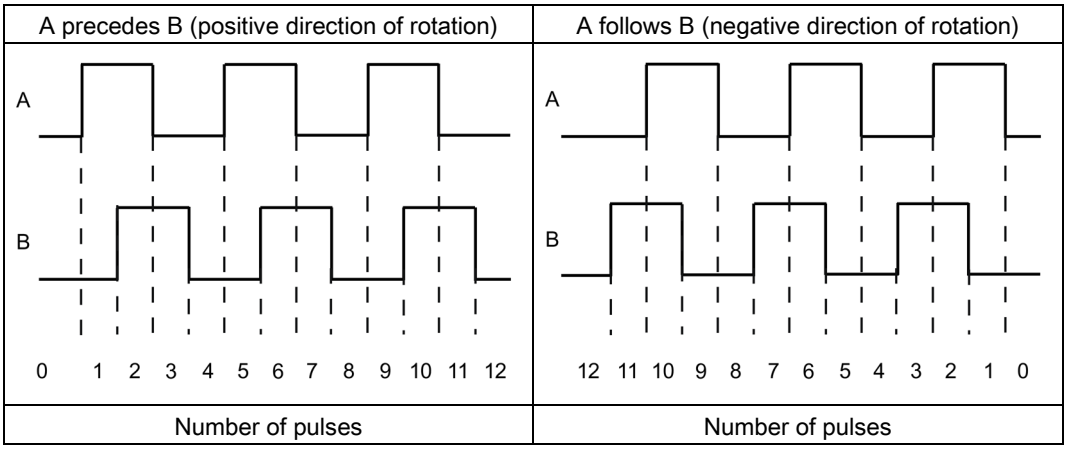


① Positive direction of rotation
② Negative direction of rotation

- Incremental encoder (A, B phase-shifted):
  Output pulses are output by both outputs at the specified velocity, but phase-shifted by 90 degrees. This involves a single pulse output in which the duration of the pulse is the time between two transitions of signal A while signal B is in low state.
  A positive direction of rotation is generated at a positive edge of signal A while signal B is in low state. A negative direction of rotation is generated at a negative edge of signal A while signal B is in low state.

A precedes B (positive direction of rotation)	A follows B (negative direction of rotation)
	
Number of pulses	Number of pulses

- Incremental encoder (A, B phase-shifted, quadruple):
  Output pulses are output by both outputs at the specified velocity, but phase-shifted by 90 degrees. This signal type involves a quadruple pulse output in which each edge transition corresponds to one increment. Therefore, a complete period of signal A contains four increments. In this way, it is possible, for example, to use two outputs, each with 100 kHz signal frequency, to output a control signal that supplies 400,000 increments per second.
  Whether count pulses are generated in the positive or negative direction of rotation depends on the edge direction of one signal and the logic state of the other signal in each case.



2.2.2 Isochronous mode

The technology module supports the system function "isochronous mode" in distributed mode on PROFINET.

In isochronous mode, the cycle of the user program, the transmission of the input and output data and the processing in the technology module are synchronized with each other.

Data processing

At time T_i the current position value is acquired and made available in the feedback interface for retrieval in the current bus cycle. At time T_o the pulse output is adjusted to the current speed setpoint.

Connecting

3

3.1 Pin assignment

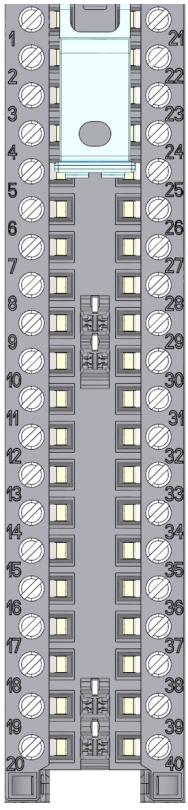
You connect the pulse output signals, digital input signals and digital output signals to the 40-pin front connector of the technology module. In addition, you connect the supply voltage for supplying the module and the digital outputs to the 4-pin infeed element.

For information on wiring the front connector, connecting the cable shield, etc., see System ManualS7-1500, ET 200MP Automation System (http://support.automation.siemens.com/WW/view/en/59191792), section Wiring.

Pin assignment for the front connector

The table below shows the pin assignment of the front connector for the respective signal interface.

Table 3- 1 Pin assignment of the front connector

View	Signal name		Designation		
			24 V, asymmetrical	RS422, symmetrical	TTL (5 V), asymmetrical
	Channel 0				
	1	CH0.P/A	—	Pulse signal P/A	Pulse signal P/A
	2	/CH0.P/A		Inverted pulse signal P/A	—
	3	CH0.D/B		Pulse signal D/B	Pulse signal D/B
	4	/CH0.D/B		Inverted pulse signal D/B	—
	5	DQ0.0	Pulse signal P/A	Digital output DQ0	Digital output DQ0
	6	DQ0.1	Pulse signal D/B	—	—
	7	DI0.0	Digital input DI0		
	8	DI0.1	Digital input DI1		
	9	DIQ0.2	Digital input/output DIQ2		
	Channel 1				
	10	CH1.P/A	—	Pulse signal P/A	Pulse signal P/A
	11	/CH1.P/A		Inverted pulse signal P/A	—
	12	CH1.D/B		Pulse signal D/B	Pulse signal D/B
	13	/CH1.D/B		Inverted pulse signal D/B	—
	14	DQ1.0	Pulse signal P/A	Digital output DQ0	Digital output DQ0
	15	DQ1.1	Pulse signal D/B	—	—
	16	DI1.0	Digital input DI0		
	17	DI1.1	Digital input DI1		
	18	DIQ1.2	Digital input/output DIQ2		
	19	—	—		
	20				

View	Signal name		Designation		
			24 V, asymmetrical	RS422, symmetrical	TTL (5 V), asymmetrical
	Channel 2				
	21	CH2.P/A	—	Pulse signal P/A	Pulse signal P/A
	22	/CH2.P/A		Inverted pulse signal P/A	—
	23	CH2.D/B		Pulse signal D/B	Pulse signal D/B
	24	/CH2.D/B		Inverted pulse signal D/B	—
	25	DQ2.0	Pulse signal P/A	Digital output DQ0	Digital output DQ0
	26	DQ2.1	Pulse signal D/B	—	—
	27	DI2.0	Digital input DI0		
	28	DI2.1	Digital input DI1		
	29	DIQ2.2	Digital input/output DIQ2		
	Channel 3				
	30	CH3.P/A	—	Pulse signal P/A	Pulse signal P/A
	31	/CH3.P/A		Inverted pulse signal P/A	—
	32	CH3.D/B		Pulse signal D/B	Pulse signal D/B
	33	/CH3.D/B		Inverted pulse signal D/B	—
	34	DQ3.0	Pulse signal P/A	Digital output DQ0	Digital output DQ0
	35	DQ3.1	Pulse signal D/B	—	—
	36	DI3.0	Digital input DI0		
	37	DI3.1	Digital input DI1		
	38	DIQ3.2	Digital input/output DIQ2		
	39	M	Ground for digital outputs, digital inputs and pulse signals of the technology module		
	40	M			

Note

Use of jumper links in the front connector is not permitted.

Pin assignment for the infeed element

The infeed element is inserted into the front connector and serves to supply power to the technology module. You must connect the supply voltage to terminal 41 (L+) and terminal 44 (M) for this.

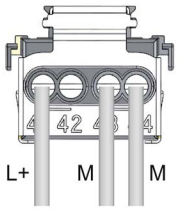


Figure 3-1 Infeed element wiring

L+	24 V DC supply voltage
M	Ground for supply voltage

Behavior of the digital outputs following a wire break at the ground connection of the outputs

Due to the characteristics of the output driver used in the module, a wire break causes approximately 10 mA supply current to drain from the digital outputs via a parasitic diode. This behavior may lead to a high signal state even at outputs that are not set. Depending on the nature of the load, 10 mA may be enough to activate a load with high signal state.

Duplicate wiring of ground

To prevent unintended switching of the outputs in the event of a ground connection wire break, follow these steps:

1. Route the first ground connection from terminal 44 to the ground connection of the central power supply of the system.
2. Route the second ground connection from terminal 43 to the ground connection of the central power supply of the system.

If one of the two ground connection cables is interrupted, the outputs are maintained at the required potential by the remaining ground connection.

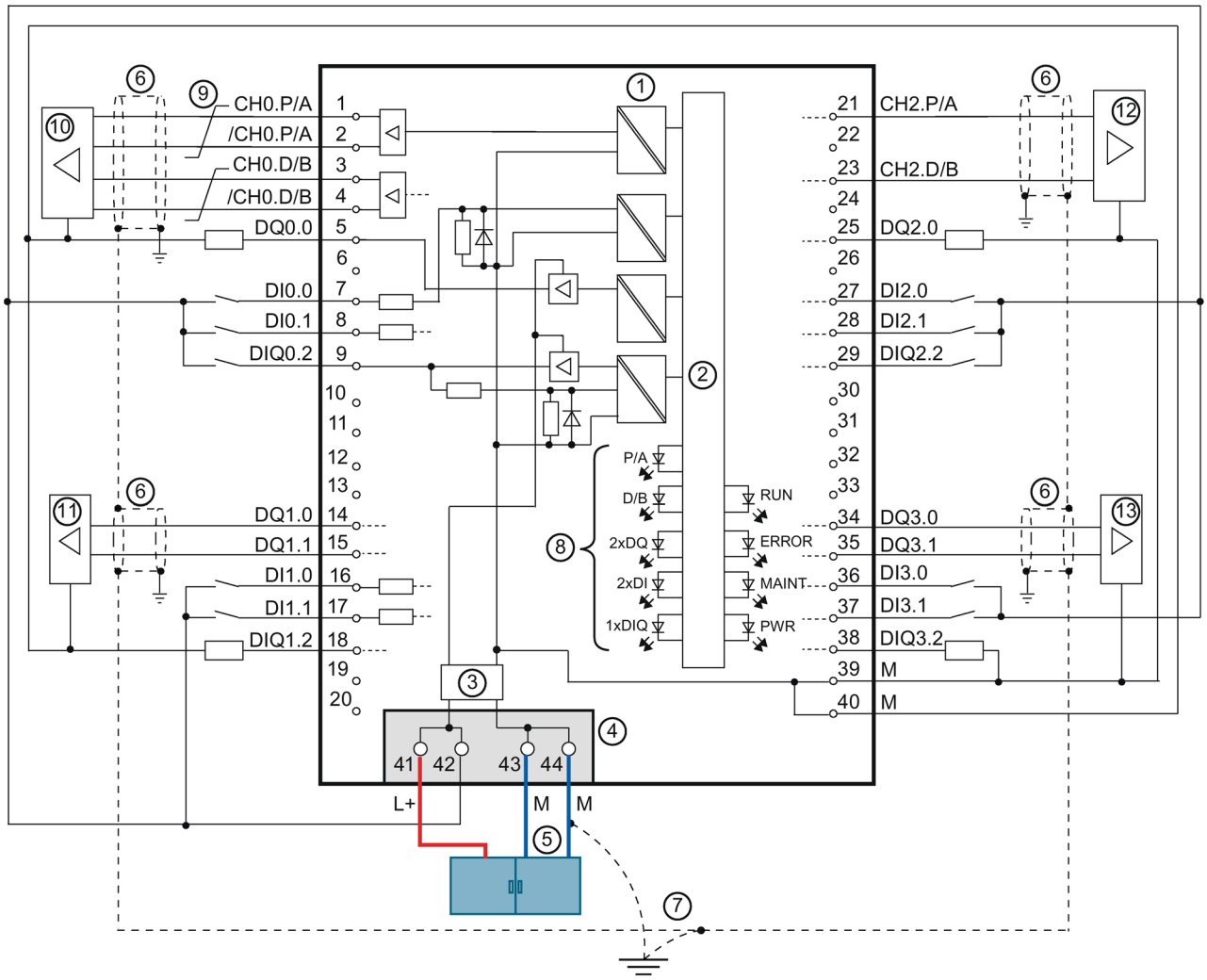
⚠ WARNING

Wire break at ground connection

Always connect *two* cables to the ground connection of the central power supply of the system.

Circuit diagram

The figure below shows an example circuit diagram of the technology module. In this example, four channels are used with the RS422, 5 V-TTL and 24 V signal interfaces:



① Electrical isolation
② Technology and backplane bus interface
③ Input filter for supply voltage
④ Supply voltage via infeed element
⑤ Duplicate wiring to the ground connection of the central power supply of the system
⑥ Shield connection at the front connector
⑦ Equipotential bonding
⑧ LEDs per channel
⑨ Twisted-pair cables
⑩ Motor with drive stage at RS422 signal interface
⑪, ⑬ Motor with drive stage at 24 V signal interface
⑫ Motor with drive stage at TTL signal interface

Figure 3-2 Circuit diagram when using RS422, 5 V-TTL and 24 V signal interfaces

Supply voltage L+/M

Connect the supply voltage (24 V DC) 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.

ThePWR LED (Page 44) at terminal 19 indicates the presence of supply voltage.

RS422/TTL and 24 V pulse output signals

The technology module can output pulse signals either via the RS422/TTL or 24 V signal interface for each channel. The pulse signals are designated with P/A and D/B.

A TTL pulse signal and a 24 V pulse signal use a single wire. An RS422 pulse signal uses a pair of wires and the pulse information is transmitted as differential voltage. This ensures interference-free transmission of RS422 encoder signals, even of higher-frequency signals over longer distances. The RS422 wire pairs must be twisted in the cable and terminated with a 100 Ω resistance.

For an overview of the signal types you can output, see section Pulse Train Output (PTO) (Page 14).

When the RS422/TTL signal interface is used, you connect the P/A signal to the Chn.P/A connections and the D/B signal to the CHn.D/B connections. When the 24 V signal interface is used, you connect the P/A signal to digital output DQn.0 and the D/B signal to digital output DQn.1. When the 5 V TTL signal interface is used, you must provide a resistance of 220 Ω to 1 kΩ between connection CHn.P/A and ground M as well as between connection CHn.D/B and ground M.

The outputs of the channels are not electrically isolated from each other. The outputs are electrically isolated from the backplane bus.

Digital inputs DI0, DI1 and DIQ2

Up to three digital inputs are available per channel. The digital inputs are used for additional functions for the respective drive control:

Function	Meaning
Reference switch input	You can use a reference switch at digital input DIn.0 to synchronize the reference mark with the current position of the drive axis.
Measuring input	You can use a measuring input at digital input DIn.1 to save the current position of the drive axis.
"Drive ready" input	You can use digital input DIn.0, DIn.1 or DIQn.2 as an input for the ready signal of the drive.

The digital inputs of the channels are not electrically isolated from each other. The digital inputs are electrically isolated from the backplane bus.

Interpulse period following auto reverse

You can configure the minimum amount of time the technology module must pause the pulse output following reversal of the direction of rotation. After the interpulse period elapses, the pulse output is resumed.

You can specify the following values for the interpulse period:

- 0 (default)
- 1 ms
- 4 ms
- 10 ms

Input delay

This parameter can be used to suppress signal noise at the digital inputs of a channel. Changes to the signal are only detected if they remain stable for longer than the configured input delay time.

You can specify the following values for the input delay:

- None
  (input delay of 4 µs, minimum pulse width of 3 µs)
- 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, DQ1 and DIQ2

Up to three digital outputs are available per channel. When you use the "RS422, symmetrical / TTL (5 V), asymmetrical" signal interface, you can use digital output DQn.0 to enable the drive. When the "24 V, asymmetrical" signal interface is used, you connect the P/A signal to digital output DQn.0 and the D/B signal to digital output DQn.1. In this case, you can use digital output DIQn.2 to enable the drive.

The digital outputs of the channels are not electrically isolated from each other. The digital outputs are electrically isolated from the backplane bus.

The digital outputs are 24 V current-sourcing switches in relation to M. DQn.0 and DQn.1 can be loaded with 0.1 A rated load current and DQn.2 can be loaded with 0.5 A rated load current. The digital outputs are protected from overload and short-circuit.

Note

Relays and contactors can be connected direct without external circuitry.

Possible combinations of the DI and DQ functions

The possible combinations of additional DI and DQ functions are dependent on the signal interface:

- Reference switch input (RS, Reference Switch)
- Measuring input (MI, Measuring Input)
- "Drive ready" input (DR, Drive Ready)
- Drive enable output (ED, Enable Drive)

When you use the "RS422, symmetrical / TTL (5 V), asymmetrical" signal interface, you have the following possible combinations for the named functions:

Table 3- 2 Possible combinations for "RS422, symmetrical / TTL (5 V), asymmetrical" signal interface

DIn.0	DIn.1	DIQn.2		DQn.0	DQn.1
		Input	Output		
—	—	—	—	—	Not supported
RS	—	—	—	—	
RS	—	DR	—	—	
RS	—	DR	—	ED	
RS	—	—	ED	—	
RS	MI	—	—	—	
RS	MI	DR	—	—	
RS	MI	DR	—	ED	
RS	MI	—	ED	—	
—	MI	—	—	—	
—	MI	DR	—	—	
—	MI	DR	—	ED	
—	MI	—	ED	—	
DR	—	—	—	—	
DR	—	—	—	ED	
DR	—	—	ED	—	
DR	MI	—	—	—	
DR	MI	—	—	ED	
DR	MI	—	ED	—	
—	DR	—	—	—	
—	DR	—	—	ED	
—	DR	—	ED	—	
RS	DR	—	—	—	
RS	DR	—	—	ED	
RS	DR	—	ED	—	

When you use the "24 V, asymmetrical" signal interface, you have the following possible combinations for the named functions:

Table 3- 3 Possible combinations for "24 V, asymmetrical" signal interface

DIn.0	DIn.1	DIQn.2		DQn.0	DQn.1
		Input	Output		
—	—	—	—	P/A signal	D/B signal
RS	—	—	—		
—	—	DR	—		
RS	—	DR	—		
—	—	—	ED		
RS	—	—	ED		
RS	MI	—	—		
RS	MI	DR	—		
RS	MI	—	ED		
—	MI	—	—		
—	MI	DR	—		
—	MI	—	ED		
DR	—	—	—		
DR	—	—	ED		
DR	MI	—	—		
DR	MI	—	ED		
—	DR	—	—		
—	DR	—	ED		
RS	DR	—	—		
RS	DR	—	ED		

Technical specifications

6

	6ES7553-1AA00-0AB0
General information	
Product type designation	TM PTO 4
Number of channels	4; axes
Product function	
I&M data	Yes; I&M0 to I&M3
Isochronous mode	Yes
Engineering with	
STEP 7 TIA Portal can be configured/integrated as of version	STEP 7 V14
STEP 7 can be configured/integrated as of version	V5.5 SP3 with GSD file / -
PROFINET as of GSD version/GSD revision	GSDML V2.32
Installation type/mounting	
Rail mounting possible	Yes; S7-1500 mounting rail
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.	70 mA; without load
Power	
Power from the backplane bus	1.3 W
Power loss	
Power loss, typ.	4 W
Address area	
• Inputs	18 bytes; per channel
• Outputs	10 bytes; per channel

	6ES7553-1AA00-0AB0
Digital inputs	
Number of inputs	12; 3 per channel, including 1 DIQ
Digital inputs configurable	Yes
Input characteristics to IEC 61131, Type 3	Yes
Digital input functions, configurable	
Synchronization	Yes
Measuring input	Yes
Drive ready	Yes
Input voltage	
Type of input voltage	DC
Nominal value (DC)	24 V
For signal "0"	-5 ... +5 V
For signal "1"	+11 ... +30 V
Permitted voltage at input, min.	-5 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.	4 µs; with parameter assignment "none"
• at "1" to "0", min.	4 µs; with parameter assignment "none"
For technological functions	
• Configurable	Yes
Cable length	
Shielded, max.	1000 m
Unshielded, max.	600 m
Digital outputs	
Number of outputs	12; 3 per channel, including 1 DIQ
• In groups of	
Current sinking	Yes; push-pull for DQn.0 und DQn.1
Current sourcing	Yes
Digital outputs configurable	Yes
Short-circuit protection	
• Response threshold, typ.	0.2 A for DQn.0 and DQn.1, 0.9 A for DIQn.2
Control of a digital input	Yes

	6ES7553-1AA00-0AB0
Digital output functions, configurable	
PTO (Pulse Train Output) signal interface	
• 24 V asymmetrical	Yes
• RS 422 symmetrical	Yes
• TTL (5 V) asymmetrical	Yes; min. 2.4 V, min. 220 ohm
PTO (Pulse Train Output) signal type	
• Pulse and direction	Yes
• Count up, count down	Yes
• Incremental encoder (A, B phase-shifted)	Yes
• Incremental encoder (A, B phase-shifted, quadruple)	Yes
Output switching capacity	
With resistive load, max.	0.1 A; 0.5 A for DIQn.2
With lamp load, max.	1 W; 5 W for DIQn.2
Load resistance range	
Low limit	240 Ω; 48 Ω for DIQn.2
High limit	12 kΩ
Output voltage	
Type of output voltage	DC
for signal "1", min.	23 V; L+ (-2.0 V)
Output current	
for signal "1" rated value	0.1 A; 0.5 A for DIQn.2
for signal "1" permissible range, max.	0.12 A; 0.6 A for DIQn.2
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", typ.	1 µs; 28 µs for DIQn.2
"1" to "0", typ.	1 µs; 25 µs for DIQn.2
Switching frequency	
With resistive load, max.	1 kHz; for DIQn.2
With inductive load, max.	0.5 Hz; according to IEC 60947-5-1, DC-13, for DIQn.2
With lamp load, max.	10 Hz; for DIQn.2
With 24 V asymmetrical signal interface	200 kHz; for DQn.0 and DQn.1
With RS 422 symmetrical signal interface	1 MHz
With TTL (5 V) asymmetrical signal interface	200 kHz
Cable length	
Shielded, max.	320 m; RS422 / TTL Siemens Type 6FX2001-5: 125 kHz, 320 m; 250 kHz, 160 m; 500 kHz, 60 m; 1 MHz, 32 m; 24 V (DQn.m / DIQn.2): 10 kHz, 600 m; 200 kHz, 50 m

	6ES7553-1AA00-0AB0
Isochronous mode	
Isochronous mode (application synchronized until terminal)	Yes
Bus cycle time (TDP), min.	250 µs; 375 µs, when all 4 channels are used
Jitter, max.	1 µs
Interrupts/diagnostics/status information	
Diagnostics function	Yes
Interrupts	
Diagnostic interrupt	Yes
Diagnostic alarms	
Monitoring of supply voltage	Yes
Short-circuit	Yes; thermal overload protection
Group error	Yes
LED diagnostics display	
RUN LED	Yes; green LED
ERROR LED	Yes; red LED
MAINT LED	Yes; yellow LED
Monitoring of supply voltage (PWR LED)	Yes; green LED
Channel status display	Yes; green LED
For channel diagnostics	Yes; red LED
Electrical isolation	
Electrical isolation channels	
Between channels	No
Between the channels and backplane bus	Yes
Between the channels and load voltage L+	No
Isolation	
Isolation tested with	707 V DC (type test)
Ambient conditions	
Ambient temperature in operation	
Horizontal installation, min.	0 °C
Horizontal installation, max.	60 °C; note derating
Vertical installation, min.	0 °C
Vertical installation, max.	40 °C; note derating
Distributed operation	
on SIMATIC S7-300	Yes; via control and feedback interface
on SIMATIC S7-400	Yes; via control and feedback interface
on SIMATIC S7-1200	Yes
on SIMATIC S7-1500	Yes
on Standard PROFINET Controller	Yes; via control and feedback interface

	6ES7553-1AA00-0AB0
Dimensions	
Width	35 mm
Height	147 mm
Depth	129 mm
Weights	
Weight, approx.	300 g

Note

Derating information for output current

In the following cases, the maximum output current is reduced to 0.05 A for digital outputs DQn.m and 0.1 A for digital outputs DIQn.2:

- When the system is mounted vertically, as of an ambient temperature of 30 °C.
  In addition, you may only use channels 0 to 2 in this case.
- When the system is mounted horizontally, as of an ambient temperature of 50 °C.

Dimensional drawing

A

The dimensional drawing of the module on the mounting rail, as well as a dimensional drawing with open front panel, are provided in the appendix. Always observe the specified dimensions for installation in cabinets, control rooms, etc.

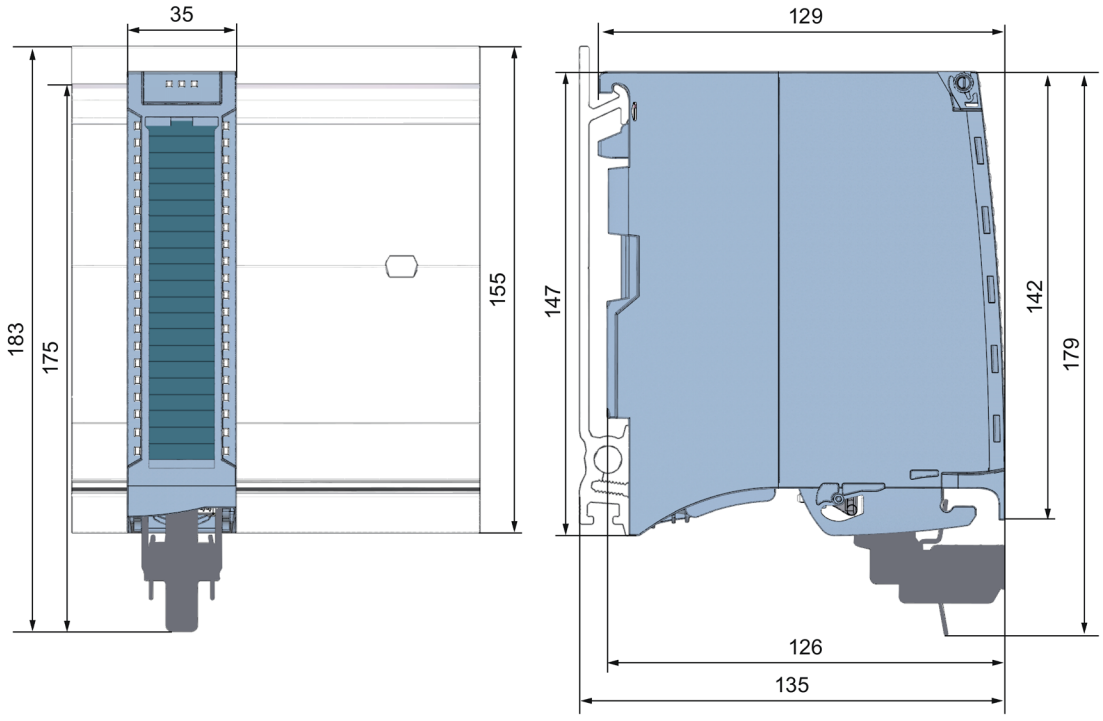


Figure A-1 Dimensional drawing of technology module TM PTO 4