SIEMENS

SIMATIC

Distributed I/O
PROFIBUS module IM 174

Manual

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Preface

Purpose of this manual

The accompanying documentation describes the standard functionality of the IM 174 module. It can be executable in the module of other functions not mentioned in this documentation. This does not, however, represent an obligation to supply such functions with a new controller or when servicing.

Basic knowledge required

Knowledge required to understand this manual:

- General knowledge of automation
- Knowledge of motion control
- Knowledge of the STEP 7 basic software.
  For further information, refer to the 'Programming with STEP 7 V5.4 manual.

Scope of this manual

This manual is valid for the following module (distributed I/O device). The current hardware version can be read from the device nameplate attached on the side.

Table 1 Scope of this manual

Distributed I/O device	Order no.	As of version	
		Firmware	Hardware
IM 174	6ES7174-0AA10-0AA0	V1.1	1.0

Note

This manual contains the descriptions of all current modules.

For new modules, or modules of a more recent version, we reserve the right to include a Product Information containing latest information.

Documentation classification

You can download this manual from the Internet (http://www.automation.siemens.com/support).

All of these manuals are available as electronic manuals on the CD-ROM of the S7-Technology option package.

Table 2 Documentation for the Technology CPU

Title	Contents
Getting Started	
CPU 317T-2 DP: Controlling a SINAMICS S120 *CPU 317T-2 DP: Controlling a physical axis* *CPU 317T-2 DP: Controlling a virtual axis*	The example used in this Getting Started guides you through the various steps in commissioning required to obtain a fully functional application.
CPU Data Reference Manual	
CPU data: CPU 31xT	Description of the operation, functions and technical data of the CPU 315T-2 DP and CPU 317T-2 DP
Distributed I/Os Device Manual	
PROFIBUS module IM 174 (V1.1)	Description of the operation, functions and technical specifications of the IM 174 (V1.1) module
Manual	
Programming with STEP 7 V5.4	
S7-Technology	Description of the individual technological functions: • Application and benefits • Fundamentals and configuration • Loading, testing and diagnostics • PLCopen functions
Software Installation Manual	
S7-300 Automation Systems: Installation: CPU 31xC and CPU 31x	Description of the configuration, installation, wiring, networking and commissioning of an S7-300
Module Data Reference Manual	
S7-300 Automation Systems: Module Data	Technical data and descriptions of the functions of signal modules, power supply modules and interface modules
Instruction List	
CPU 31xC, CPU 31x IM 151-7 CPU, BM 147-1 CPU, BM 147-2 CPU	List of the CPU operation set and their execution times. List of the executable blocks (OBs/SFCs/SFBs) and their execution times

Table 3 Additional useful documentation

System Software for S7-300/400, System and Standard Functions reference manual	
The reference manual is part of the STEP 7 documentation package	Description of the SFCs, SFBs and OBs of the CPUs. You can also find the description in the online help for STEP 7.
SIMATIC isochronous mode reference manual	Description of the isochronous mode of S7 CPUs.

Additional support

Do you have more questions about using the products described in the manual? Then contact the Siemens representative (http://www.siemens.com/automation/partner) or office nearest you.

Training center

SIEMENS offers a range of courses to help you to get started with your S7-300 automation system. Please contact your regional training center, or the central training center (http://www.sitrain.com) in D-90327 Nuremberg.

Further SIMATIC documentation on the Internet

You can find the documentation free of charge on the Internet (http://www.automation.siemens.com/support):

You can enter any questions or suggestions for the documentation in the forum. You will receive a quick reply.

Technical support

You can contact the Technical Support for all A&D products by means of the Web form for the support request (http://www.siemens.de/automation/support-request).

For additional information about Siemens Technical Support, refer to Internet (http://www.siemens.com/automation/service&support).

Service & Support on the Internet

In addition to our documentation, we offer a comprehensive knowledge base online on the Internet at:

There you can find:

- The latest product information, FAQs (Frequently Asked Questions), downloads, tips and tricks
- Our newsletter, providing you with the latest information about your products
- A Knowledge Manager to find the right documents for you
- Our bulletin board, where users and specialists share their knowledge worldwide
- Your local contact partner for Automation & Drives in our Partner Database
- Information about field service, repairs, spare parts and lots more under "Services"

See also

Service (http://www.siemens.com/automation/service)

Table of contents

What is new in the PROFIBUS module IM 174 V1.1

1

What is new in the PROFIBUS module IM 174 V1.1

- Installation via HSP 2038
  The HSP of the PROFIBUS module IM 174 V1.1 is not part of the option package S7 Technology 4.1. The installation of an HSP in HW Config is necessary in order to configure the module.
- Operation with isochronous controllers such as the S7-300 CPU (without Technology)
  Operation with controllers (that support isochronous mode) is possible with the PROFIBUS module IM 174 V1.1:
  e.g. S7-300, S7-400, WinAC RTX, SIMOTION
- Transfer of the actual velocity at incremental encoders
  The actual velocity is calculated directly by the PROFIBUS module IM 174 V1.1 (in the past the actual velocity was calculated by the controller)
- Diagnostics (see *Diagnostics with STEP 7*)
  Online diagnostics is possible in HW Config
- Tolerable errors
  When an encoder fails at a position-controlled axis, the axis can be traveled further speed-controlled
- Firmware status display
- LED screen

Product overview

2

Introduction

In the SIMATIC and SIMOTION automation environment, control capability for both analog and stepper motors is required for certain application cases. In addition, operational capabilities must be implemented in the TIA world for older drives or non-Siemens drives that have only an analog interface.

Interface module for analog drives and stepper motors

An IM 174 module (interface module) is an interface module suitable for running up to four drives with an analog setpoint interface and with one TTL or SSI encoder per axis on the isochronous PROFIBUS.

There is also the possibility of operating up to four stepper drives with one TTL or SSI encoder per axis or also without encoder on the isochronous PROFIBUS.

The combination (mixed operation) of analog drives and stepper drives is also possible.

Communication between the controller and the IM 174 is performed exclusively via PROFIBUS (a backplane connection is not possible), via an IM 174-specific message frame type which, in addition to digital input/output data, also contains a message frame type (standard message frame 3 and 81) for each drive specified according to a PROFIDrive profile. As part of cyclic DP communication, the actual drive values (encoder values) are transferred from the IM 174 module to the controller via the isochronous PROFIBUS, and the speed setpoints calculated by the controller are transferred to the IM 174 module.

The transferred speed setpoints are then output from the IM 174 module to the drives as analog values or pulses.

Field of application

The IM 174 can be used for the following control tasks:

A Technology CPU / SIMOTION CPU / S7 300 CPU is to be used with an isochronous PROFIBUS

- To control analog drives
- To control stepper motors
- The encoder data is read in.

Interfaces

The IM 174 has the following interfaces:

- An isochronous PROFIBUS interface
- Setpoint interface +/- 10V for 4 analog drives or pulse / direction for four stepper motors
- Four encoder interfaces

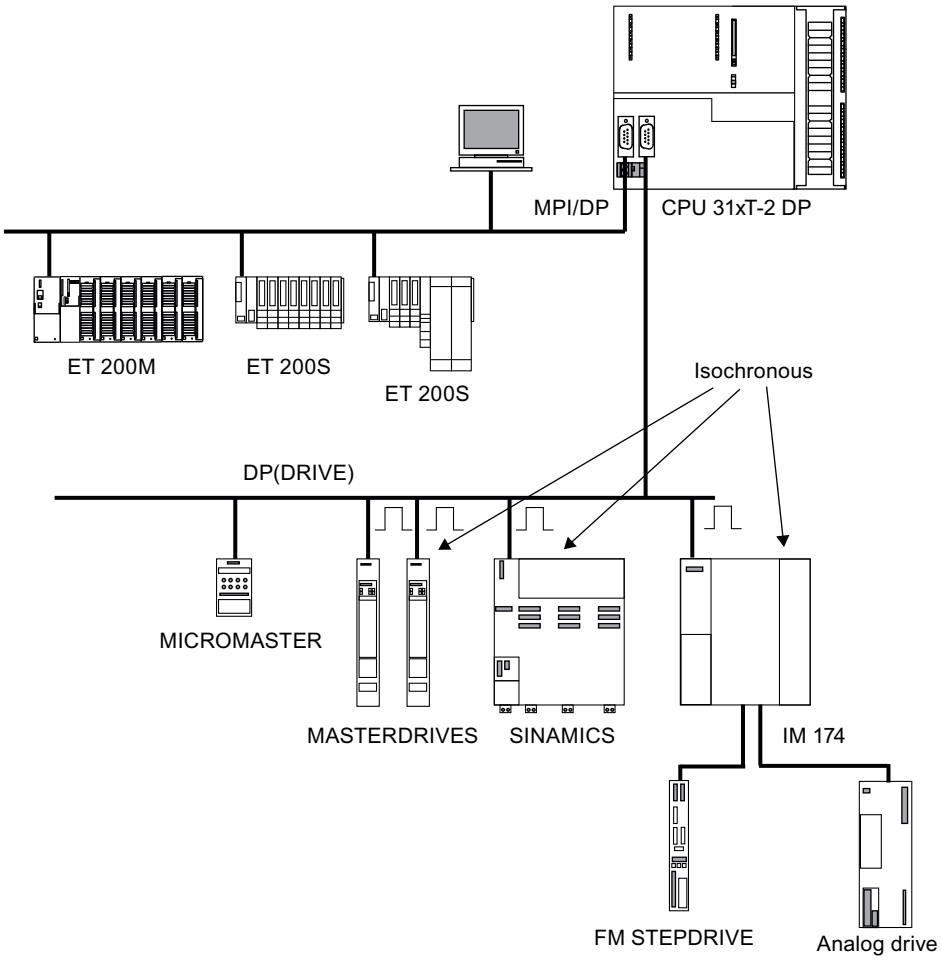


Figure 2-1 Typical configuration with the Technology CPU

Isochronous PROFIBUS interface

The maximum transmission rate is 12 Mbit/s.

The minimum cycle time of the isochronous PROFIBUS amounts to 1.5 ms.

Setpoint interface for analog drives and stepper motors

Up to four servo drives or four stepper motors can be attached to the setpoint interface.
The mixed operation of analog drives and stepper motors is possible.

Encoder interfaces

An encoder (TTL/SSI encoder for incremental and absolute measuring systems) must be connected for each axis with an analog drive.

Axes with a stepper motor can be operated both with TTL or SSI encoders and also encoderless (pulse refeed).

Digital inputs and outputs

The IM 174 has ten digital inputs and eight digital outputs. You use these inputs and outputs for technology functions, e.g. reference point acquisition (reference cams) or measuring input. The inputs and outputs can also be used in the *STEP 7* user program.

When operating the IM174 on the DP (DRIVE) of an S7 technology CPU, this can only be used restrictively via technology functions.

Configuring and programming

You can configure the hardware of the IM 174 using STEP7 HW Config. To be able to do that you have to first install the HSP 2038 for the IM 174 in HW Config.

You can download the HSP for the PROFIBUS module IM 174 V1.1 in HW Config under Extras -> Install HW updates. After installation, the PROFIBUS module IM 174 V1.1 is included in the HW profile under function modules.

Technology CPU / SIMOTION CPU:

The configuration of the axes is carried out with S7 technology / SIMOTION SCOUT in screens specially designed for this purpose.

S7-300 CPU

An IM 174 can only be operated on an S7 300 CPU that supports isochronous mode.

The signals required for the standard message frames 3 and 81 in accordance with the PROFIdrive profile protocol must be available in the OB6x of the user program.

Installation and dismantling

3

Overview

The IM 174 multi-axis module is operated as distributed PROFIBUS I/O module on a SIMATIC or SIMOTION controller with isochronous PROFIBUS.

Configuring the mechanical structure

Refer to the *S7-300 Automation System, Installation* manual for possibilities for the mechanical structure and how to proceed when configuring.

The following offers brief extra information.

Installation position of the IM 174

The horizontal configuration should be used if possible.

For the vertical configuration you must take account of the limited ambient temperatures (max. 40° C).

Important safety information

For the integration of an S7-300 with an IM 174 in a system or unit, there are important rules that you must observe.

These rules and regulations are explained in the *S7-300 Automation System, Installation, CPU Data and S7-300, M7-300 Module Data* manuals.

3.1 Installation of the IM 174

Rules

No special protection measures (ESD guidelines) are required for installing an IM 174.

Required tools

Screwdriver with 4.5 mm blade

Procedure

To install the IM 174, proceed as follows:

1. Hang the IM 174 onto the rail and swing it down.
2. Tighten the screw on the IM 174 (tightening torque approximately 80 to 110 Ncm).

3.2 Removal and replacement of the IM 174

Overview

The IM 174 can only be replaced as a complete unit.

Required tools

Screwdriver with 4.5 mm blade

Removing a faulty module

To remove the IM 174, proceed as follows:

1. Open the front door panels. If necessary, remove the labeling strips.
2. Undo the connections on the terminal strip for the power supply.
3. Undo the Sub-D plug to the encoder and to the drive unit.
4. Remove the fixing screw from the middle of the front connector. Pull the front connector out while holding the grips.
5. Unscrew the module's mounting screws and swing it upwards and out.

Installing a new module

Proceed as follows:

1. Remove the upper part of the front connector coding from the new module.
2. Insert a module of the same type, swing it down and screw it in tightly.
3. Plug in the front connector and move it into operating position (tighten mounting screw). The coding element will adjust such that the front connector only fits this module.
4. Connect the PROFIBUS cable and the Sub-D connectors.
5. Connect the load power supply on the terminal strip.
6. Close the front panels and insert the labeling strip.

Note

The controller is now ready for operation again and can be commissioned.

Setting the PROFIBUS address

The PROFIBUS address must then be set.

Refer to the section:

Wiring → PROFIBUS → Interface (X1): PROFIBUS address

Wiring

4

4.1 Overview of interfaces

4.1.1 Overview of operating and display elements

The module has the following operating and display elements:

Table 4- 1 Overview of the IM 174 operating and display elements

Operator controls and indicators	Designation	Type
External +24 V power supply	DC24V	Connector
Isochronous PROFIBUS	X1	Socket
Isochronous PROFIBUS address	BUS ADDRESS	DIP switch
Analog setpoint interface	X2	Connector
Encoder connection for Axis 1	X3	Socket
Encoder connection for Axis 2	X4	Socket
Encoder connection for Axis 3	X5	Socket
Encoder connection for Axis 4	X6	Socket
Digital outputs or inputs	X11	Connector
Module status	SF/BF/TEMP/ON/RDY	LEDs

4.1.2 Overview of connections

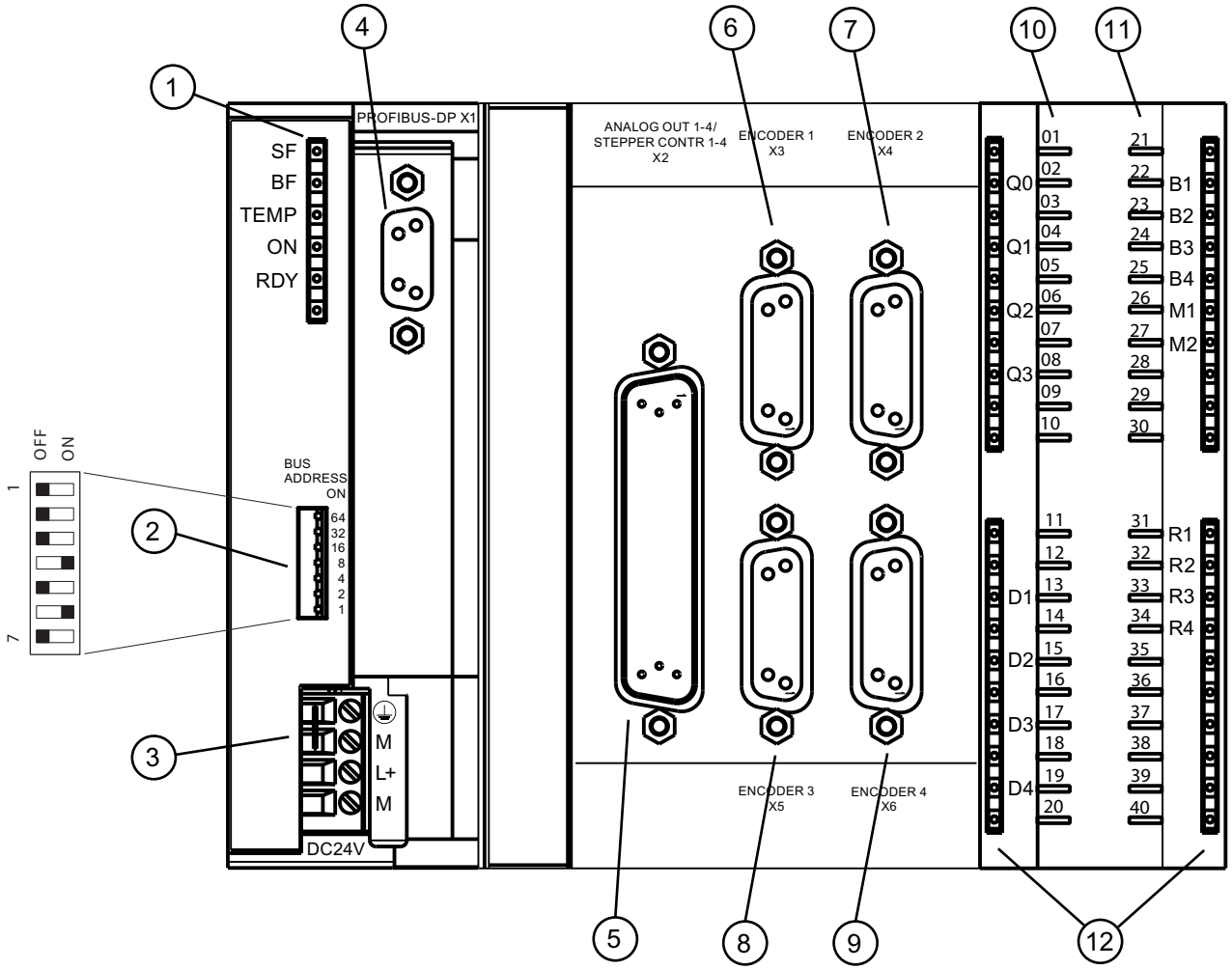


Figure 4-1 IM 174 connection overview

Table 4- 2 Overview of the connections by item number

Number	Designation	Type
1	SF/BF/TEMP/ON/RDY	Diagnostic LEDs
2	BUS ADDRESS	DIP switch corresponds to $A_H=10_{(decimal)}$
3	DC24V	External power supply
4	X1	PROFIBUS connection
5	X2	Analog setpoint outputs ±10 VDC, Axis 1 - 4 or Stepper motor outputs 1 - 4

Number	Designation	Type
6	X3	Encoder connection for Axis 1
7	X4	Encoder connection for Axis 2
8	X5	Encoder connection for Axis 3
9	X6	Encoder connection for Axis 4
10	X11	Connections for digital output signals
11	X11	Connections for digital input signals
12		Status LEDs of the digital inputs/outputs (LED display for signal level)

4.2 Wiring diagram

Safety notes for the wiring

In order to ensure the safe operation of your equipment, implement the following measures, adapting them to suit your conditions:

- An EMERGENCY OFF concept in accordance with the generally accepted rules of current engineering practice (e.g. European Standards EN 60204, EN 418 and similar).
- Additional measures for end position limiting of axes (e.g. hardware limit switches).
- Equipment and measures for protection of motors and power electronics in accordance with the installation guidelines for SIMODRIVE and FM STEPDRIVE/SIMOSTEP.

In addition, in order to identify hazards, we recommend that a risk analysis be conducted on the complete system in accordance with the basic safety requirements set out in Appendix 1 of EU Machinery Directive 89/392/EEC.

Additional references

Please also observe the following section in the S7-300 Automation System, Installation manual:

- Lightning protection and overvoltage protection: Section 4.2
- Guidelines on Handling Electrostatic Sensitive Devices (ESD)
- Configuring the electrical structure (assembly)
- Wiring

For further information about EMC guidelines, we recommend the publication: Equipment for forming machines, EMC regulations for WS/WF technology, order number: 6ZB5 440-0QX01-0BA1.

Standards and Specifications

You must observe the appropriate VDE regulations for wiring the IM 174.

4.2.1 Wiring diagram of an IM 174 with servo drive (analog)

IM 174 with servo drive (analog)

The following figure shows how the individual components of the multiple-axis controller are connected to the IM 174 and analog servo drives.

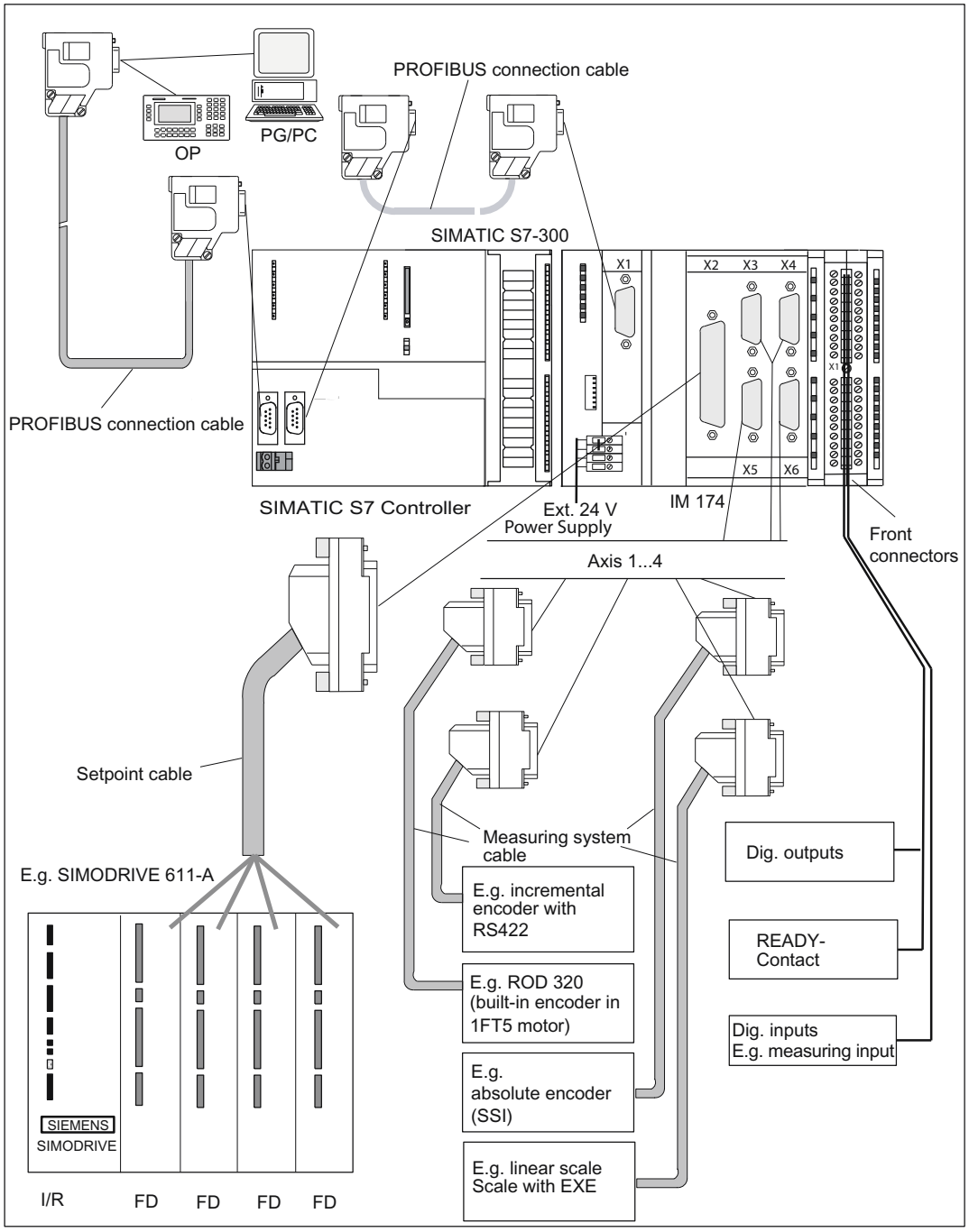


Figure 4-2 Overview of the connecting cables for IM 174 with analog servo drives

4.2.2 Wiring diagram of an IM 174 with stepper drive

IM 174 with stepper drive

The following figure shows how the individual components of the multiple-axis controller are connected to the IM 174 and stepper drives.

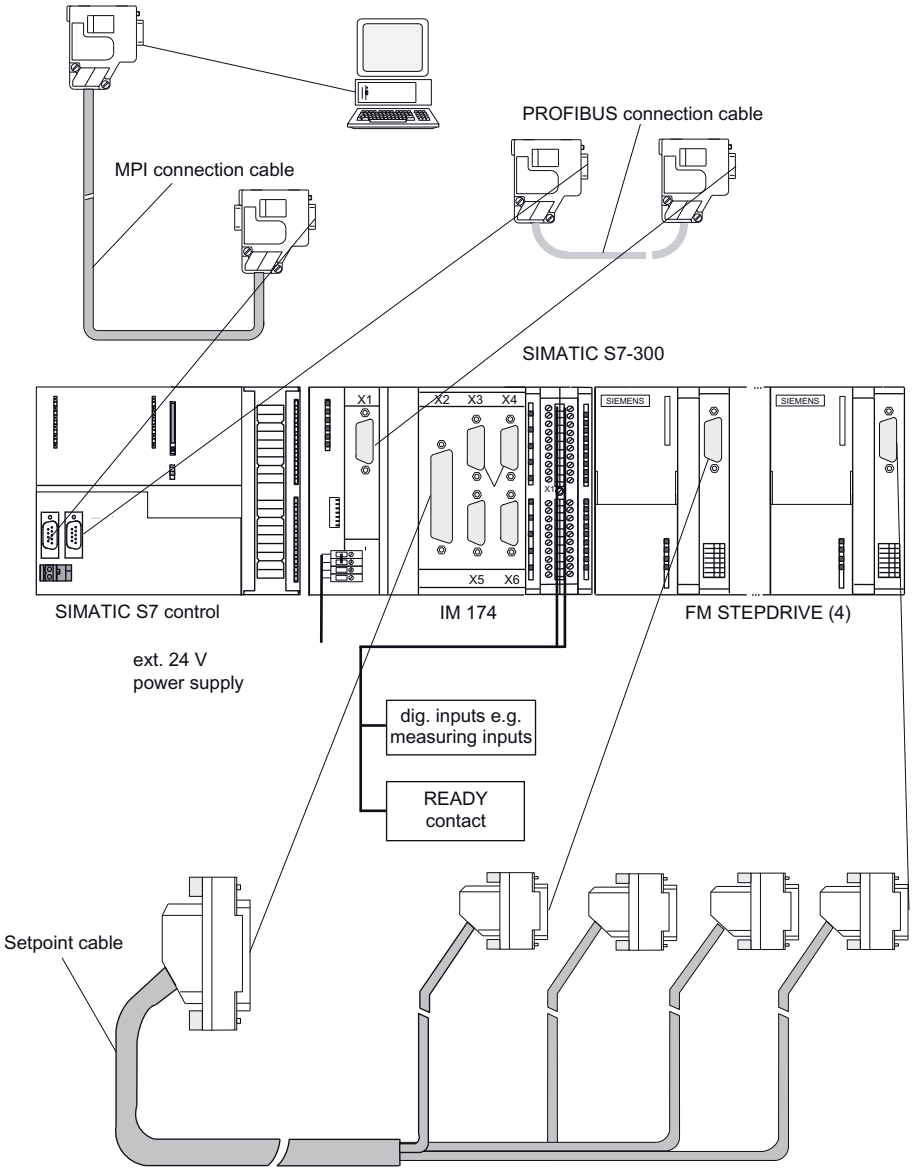


Figure 4-3 Overview of the connecting cables for IM 174 with stepper drive (example)

4.2.3 Connection cable

Configured connecting cables

Table 4- 3 Connecting cables for a multi-axis controller

Connecting cables for a multi-axis controller with IM 174		
Type	Order No.	Description
Connecting cable Isochronous PROFIBUS	refer to the S7-300 Automation System; Installation manual	Connection between IM 174 and S7-300 CPU or SIMOTION C2xx
Setpoint cable	6FX2002-3AD01-1□□0	Connection between IM 174 and SIMODRIVE 611-A ±10 V
Setpoint cable	6FX2002-3AE00-1□□0	Connection between IM 174 and four stepper drives
Setpoint cable	6FX2002-3AD02-1□□0	Connection between IM 174 with three stepper drives and a SIMODRIVE (end of the cable cut off)
Measuring system cable	6FX8002-2CD01-1□□0	Incremental position encoder with RS422 and IM 174 (EXE with linear scale)
Measuring system cable	6FX8002-2CE02-□□□0	ROD 320 encoder with 1FT5 motor and IM 174
Measuring system cable	6FX8002-2CC11-□□□0	Connection of absolute encoder (SSI) and IM 174

Setpoint and Measuring System Cables

The setpoint and measuring system cables are available in various lengths. See:

- NC 60 Catalog, order no.: E86060-K4460-A101-B1

or

- ST 70 Catalog, order no.: E86060-K4670-A111-A9

Front Connectors

For the wiring of the digital I/Os, you require a 40-pin screwed front connector.
This must be ordered separately. See:

- ST 70 Catalog, order no.: E86060-K4670-A111-A

or

- NC 60 Catalog, order no.: E86060-K4460-A101-B

PROFIBUS connectors

- RS-485 bus connectors up to 12 Mbit/s with 90° cable outlet without PG interface 6ES7972-0BA12-0XA0, with PG interface 6ES7972-0BB12-0XA0
- Fast Connect RS-485 bus connector up to 12 MBit/s with 90° cable outlet in snap-on/screw-on technology without PG interface 6ES7972-0BA50-0XA0, with PG interface 6ES7972-0BB50-0XA0

PROFIBUS cable

- 6XV1830-0EH10; by the meter, non-trailable
- 6XV1830-3EH10; by the meter, trailable

4.3 External power supply

4.3.1 Connection of the external 24 VDC power supply

Screw-terminal block

The required 24 VDC load power supply is wired to the screw-terminal block via the 24 VDC connection at the front panel of the IM 174 module.

Features of the load power supply

Observe the installation guidelines for SIMATIC. In particular, the M connection (reference potential) must be connected with the device ground of the automation device (M connection on the terminal block of the S7-300-CPU)

Refer to the software installation manual

S7-300 Automation System, Installation

Note

The 24 VDC should be configured as functional extra-low voltage with safe isolation.

The connecting cable between the voltage source and the load current supply connector L+ and the associated reference potential M should not exceed a maximum length of 10 m.

Table 4- 4 Electrical parameters of load power supply

Parameter	min	max.	Unit	Condition
Voltage range mean value	20,4	28,8	V	
Ripple		3,6	Vpp	
Non-periodic overvoltage			V	500 ms duration 50 s recovery time
Starting current		2,5	A	

Note

Operation of the module outside of the specified range

If you operate the module outside of the specified range, there are no displays or error messages. In this case, the behavior is undefined.

Pin assignment

The table below shows the pin connections on the screw-type terminal block (external power supply).

Table 4- 5 Pin assignment: External power supply (24 VDC)

Pin	Designation	Type[1)]	Function
1	≙	VI	Protective conductor of the external supply
2	M	VI	Reference for external supply (ground)
3	L+	VI	External supply for module (+24 V)
4	M	VI	Reference for external supply (ground)
[1)] VI: Voltage input			

Removable jumper between M (Pin 2) and PE conductor connection.
Contacts 2 and 4 are connected internally in the device.

Note

The IM 174 and the Technology CPU / SIMOTION C230 should be connected to a shared load power supply. The PS 307 S7-300 power supply modules or other SIEMENS load power supplies (e.g. the 6EP1 series), for example, can be used. Otherwise an equipotential bonding between the power supplies is required.

Mains buffering

The PS 307 load power supplies for S7-300 provide mains buffering for 20 ms.

Note

If you use a load power supply other than the PS 307, it must guarantee the required power failure bridging time of 20 ms.

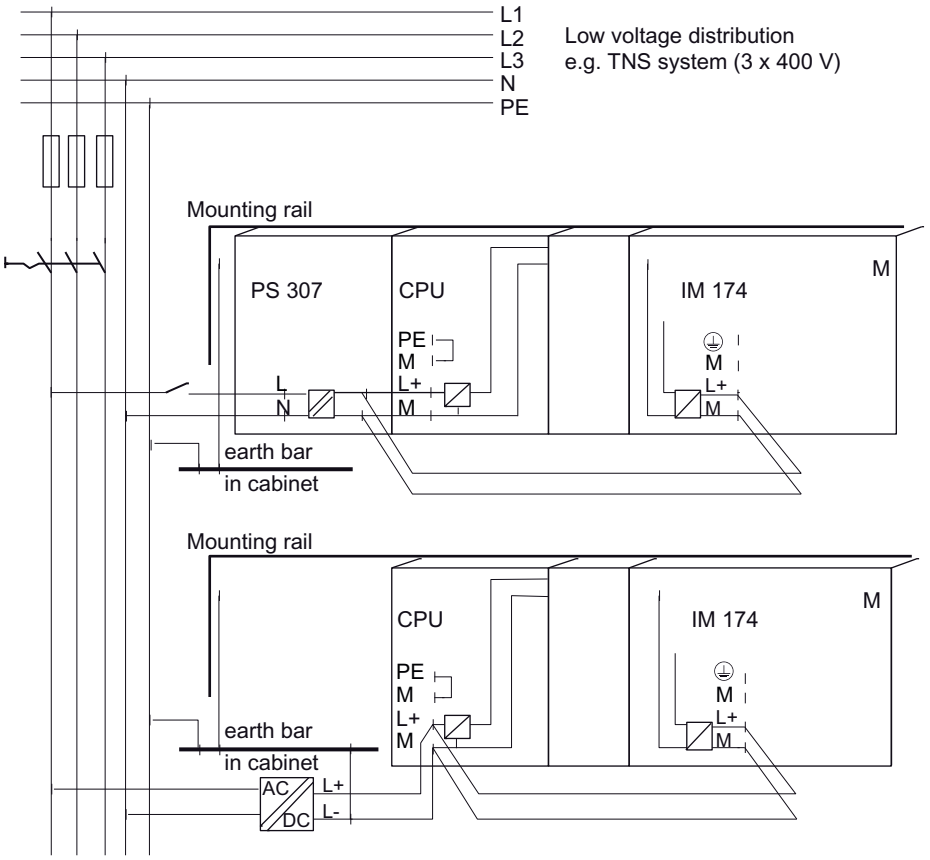


Figure 4-4 Module supply options

Note

Always switch off power before you start wiring the IM 174!

Cables

Use flexible cables with a cross-section of 1.0...2.5 mm² (or AWG 18...AWG 14).

Length stripped of insulation 12 mm

Ferrules are not required.

You can use ferrules without an insulating collar in accordance with DIN 46228, Form A long version.

Connecting the power supply

Follow the steps outlined below:

1. Open the left-hand front shutter of the IM 174.
2. Connect the flexible cable to the terminals of the screw-terminal block.
   Ensure the correct polarity.
3. Tighten the cables using a 3.5 mm screwdriver with a torque of approx. 50...80 Ncm.
4. Connect to the power supply unit (e.g. PS 307).

Polarity reversal protection

If the connection is correct and the power supply is switched on, the "ON" LED illuminates green.

Note

The supply line must be protected with a 4 A circuit-breaker (C characteristic).

Your module will not work in the case of reverse polarity.

Fuse

A built-in fuse will trigger only for a module defect. In this case, the module must be replaced.

The 24 VDC power supply is protected at the module against

- Overvoltage
- Polarity reversal
- Overload: 4 A / 125 V fusible link

4.3.2 Grounding

Grounding by Installing on Mounting Rails

The following figure shows how the protective conductor must be connected to the mounting rail:

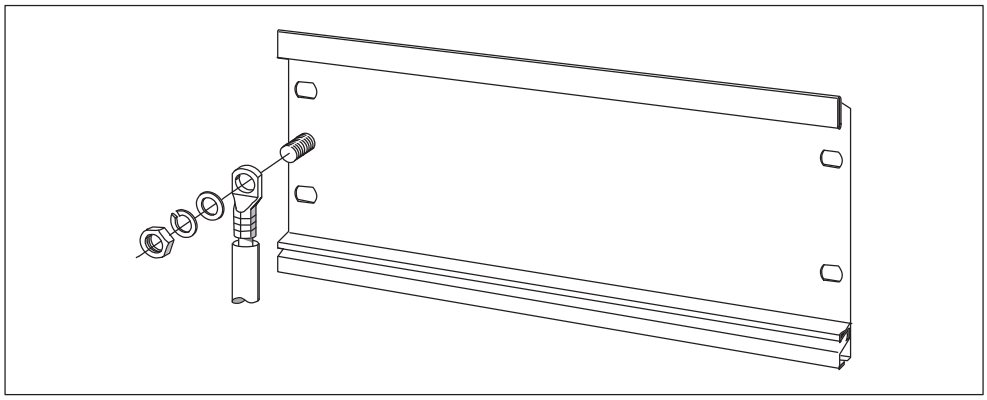


Figure 4-5 Protective conductor terminal on the mounting rails

The module must be installed according to EN 60204.

Also refer to:

S7-300, CPU 31xC and CPU 31x
Hardware and Installation operating instructions

in the *Connecting the Mounting Rails with Protective Conductor* section

Installing IM 174 with Non-grounded Reference Potential

For the installation of the IM 174 with non-grounded reference potential, any occurring interference currents will be dissipated using an integrated RC network.

Application

In extensive units it may be necessary, e.g. for the purposes of ground leakage monitoring, to configure the IM 174 with ungrounded reference potential. This is the case in the chemicals industry or power plants, for example.

Connection diagram

The following figure shows the installation of an IM 174 with ungrounded reference potential. If you do not want to ground the reference potential, then you must remove the bridge on the IM 174 between the M terminals and the functional ground.

If the bridge is not connected then the reference potential of the IM 174 is connected internally to the grounding wire via an RC combination and via the rail. This dissipates high-frequency interference currents and avoids static charge.

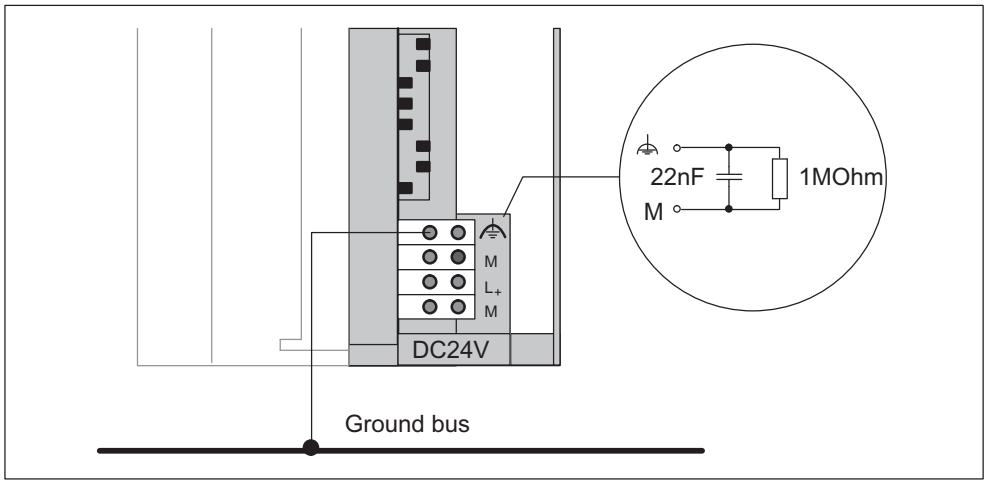


Figure 4-6 Installation of an IM 174 with ungrounded reference potential

4.4 PROFIBUS

4.4.1 Interface (X1): Isochronous PROFIBUS

Connection

9-pin SUB D socket

Pin assignment

Table 4- 6 Pin assignment: Isochronous PROFIBUS (X1)

Pin	Designation	Type	Function
1	-	-	-
2	-	-	-
3	RxD/TxD-P	I/O	Receive/transmit data P (B line)
4	RTS	I	Request to Send
5	DGND	VO	Data reference potential (M5V)
6	VP	VO	Plus supply voltage (P5V), output current max. 90 mA
7	-	-	-
8	RxD/TxD-N	I/O	Receive/transmit data N (A line)
9	-	-	-

Signal types

I signal input

I/O signal input/output

VO voltage output

Additional technical specifications

Maximum possible data rate: 12 Mbit/s

4.4.2 Interface (X1): PROFIBUS address

Setting

The PROFIBUS address of the IM 174 DP slave is set via the BUS ADDRESS switch.

- Adjustable PROFIBUS address: 1...125

Table 4- 7 Meaning of the BUS ADDRESS switch

Switch	Meaning
1	PROFIBUS address: $2^6 = 64$
2	PROFIBUS address: $2^5 = 32$
3	PROFIBUS address: $2^4 = 16$
4	PROFIBUS address: $2^3 = 8$
5	PROFIBUS address: $2^2 = 4$
6	PROFIBUS address: $2^1 = 2$
7	PROFIBUS address: $2^0 = 1$

Note

A newly set PROFIBUS address will only come into effect after power OFF/ON.

4.5 Drive units

4.5.1 Interface (X2): Setpoint interface for analog drives or stepper motors

Connection

Power units with an analog interface (±10 V) or stepper motor power units with at least one clock pulse input and direction input can be connected to the 50-pin Sub-D socket X2 of the IM 174. Any hybrid configuration can be used for up to four drives.

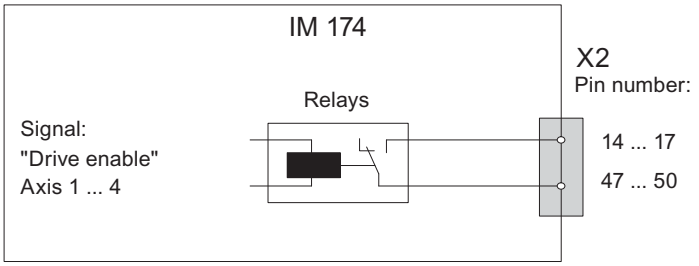
The IM 174 also provides an enable signal for each axis.

Pin assignment

Table 4- 8 Pin assignment: Setpoint interface (X2)

Pin	Designation	Type[1)]	Function
1	SW1	VO	Setpoint of Axis 1 (±10 V)
2	BS2	VO	Reference for setpoint of Axis 2
3	SW3	VO	Setpoint of Axis 3 (±10 V)
4	BS4	VO	Reference for setpoint of Axis 4
5	PULSE1	O	Pulse axis 1
6	DIR1	O	Direction axis 1
7	PULSE2_N	O	Pulse_N axis 2
8	DIR2_N	O	Direction_N axis 2
9	PULSE3	O	Pulse axis 3
10	DIR3	O	Direction axis 3
11	PULSE4_N	O	Pulse_N axis 4
12	DIR4_N	O	Direction_N axis 4
13	-	-	-
14	RF1.1	K	"Drive enable" of Axis 1, Relay Contact 1
15	RF2.1	K	"Drive enable" of Axis 2, Relay Contact 1
16	RF3.1	K	"Drive enable" of Axis 3, Relay Contact 1
17	RF4.1	K	"Drive enable" of Axis 4, Relay Contact 1
18	ENABLE1	O	Enable axis 1
19	ENABLE1_N	O	Enable_N axis 1
20	ENABLE2	O	Enable axis 2
21	ENABLE2_N	O	Enable_N axis 2
22-25	GND	O	
26	ENABLE3	O	Enable axis 3
27	ENABLE3_N	O	Enable_N axis 3
28	ENABLE4	O	Enable axis 4
29	ENABLE4_N	O	Enable_N axis 4
30-33	-		
34	BS1	VO	Reference for setpoint of Axis 1
35	SW2	VO	Setpoint of Axis 2 (±10 V)
36	BS3	VO	Reference for setpoint of Axis 3
37	SW4	VO	Setpoint of Axis 4 (±10 V)
38	PULSE1_N	O	Pulse_N axis 1
39	DIR1_N	O	Direction_N axis 1
40	PULSE2	O	Pulse axis 2
41	DIR2	O	Direction axis 2
42	PULSE3_N	O	Pulse_N axis 3
43	DIR3_N	O	Direction_N axis 3
44	PULSE4	O	Pulse axis 4
45	DIR4	O	Direction axis 4

Pin	Designation	Type[1)]	Function
46	-	-	-
47	RF1.2	K	"Drive enable" of Axis 1, Relay Contact 2
48	RF2.2	K	"Drive enable" of Axis 2, Relay Contact 2
49	RF3.2	K	"Drive enable" of Axis 3, Relay Contact 2
50	RF4.2	K	"Drive enable" of Axis 4, Relay Contact 2



Pin assignment of 50-pin SUB D connector

Signal designation

- For stepper drives:

PULSE[1…4], PULSE[1…4]_N	Clock pulse true and negated
DIR[1…4], DIR[1…4]_N	Direction signal true and negated
ENABLE[1…4], ENABLE[1…4]_N	Controller enable true and negated
GND	Signal ground

- For analog drives:

SW[1…4]	Setpoint for analog drives
BS[1…4]	Reference potential for setpoint
RF[1.1…4.1], RF[1.2…4.2]	Controller-enable contact

Signal type

- **O** Signal output
- **VO** Voltage output
  - Max. current carrying capacity: +/- 3 mA (RL: > 3 K³ ohm)
- **K** Switching contact
  - Max. current carrying capacity: 1 A
  - Max. switching voltage: 30 VDC
  - Max. switching capacity: 30 VA
  - Mechanical service life: Type 10^9
  - Electrical lifetime (30 VDC / 1 A): Type $5*10^5$

Analog drives

Signals:

One voltage and one enable signal are provided per axis.

- SETPOINT (SW)
  Analog voltage signal in the ±10 V range for the output of a speed setpoint.
- REFERENCE SIGNAL (BS)
  Reference potential (analog ground) for the setpoint signal, connected internally to logic ground.
- CONTROLLER ENABLE (RF)
  Contact assembly mated set (NO contact), used for axis-specific enabling of the drive, e.g. a SIMODRIVE drive unit.

Signal parameters

The setpoint is output as analog difference signal.

Table 4- 9 Electrical parameters of the setpoint signal

Parameter	min	max.	Unit
Rated voltage range	-10	10	V
Operational limit (in relation to output value)		± 5,5 %	
Output current	-3	3	mA

Table 4- 10 Electrical parameters of the relay contacts

Parameter	max.	Unit
Switching voltage (DC)	30	V
Switching current	1	A
Switching capacity	30	VA

Stepper drives

Signals:

One clock pulse signal, direction signal, and enable signal is provided as a true and negated signal.

- **PULSE (CLOCK)**
  The clock pulses control the motor. The motor performs one step for each rising pulse edge.
  The number of output pulses so determines the angle of rotation, i.e. the path to be traveled.
  The pulse frequency determines the rotational speed, i.e. the traversal velocity.

  Note

  If your drive device responds to falling pulse edges, you must replace the true pulse signal with the negated pulse signal when performing the wiring; failure to do so can cause deviations to occur between the position calculated by the controller and the actual position.

- **DIRECTION**
  The output signal level determines the direction of rotation of the motor.
  Signal ON: "Counterclockwise rotation"
  Signal OFF: "Clockwise rotation"
- **ENABLE**
  The IM 174 activates this signal when the cyclical control operation is assumed.
  Signal ON: Power control circuit enabled
  Signal OFF: Depending on the power unit, one or more of the following responses can occur:
  - Disable pulse input
  - Deenergize motor

  Note

  The ENABLE signal is output at the same time with controller enable contact RF. Alternatively, you can also use the relay contacts.

Signal parameters

All signals for stepper drives are output by means of differential signal line drivers in accordance with the RS422 standard. For optimal reliability, the power unit should have differential signal receivers or optical coupler inputs to enable symmetrical signal transmission. An asymmetrical transmission is also possible, however, the maximum cable length in this case is limited to 10 m.

Note

Because of the wide range of non-standardized input circuits of the drive devices during asymmetrical transmission, no responsibility can be taken for this function. In particular, cable lengths and the limit frequency depend on the properties of the input circuit and the cable being used. In addition, the GND reference potential should be isolated to prevent electrical interference.

All outputs are electronically protected against short-circuit and thermal overload.

The following table summarizes the electrical data for the interface output signals.

Table 4- 11 Electrical parameters of the signal outputs for stepper drives

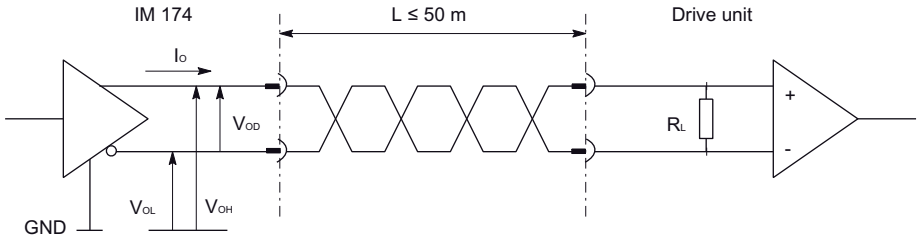
Parameter	min	max.	Unit	for
Error output voltage V_{OD}	2		V	R_L = 100 Ω
Output voltage "High" V_{OH}	3,7		V	I_D = -20 mA
	4,5		V	I_D = -100 µA
Output voltage "Low" V_{OL}		1	V	I_D = 20 mA
Load resistance R_L	55		Ω	
Output current I_O		± 60	mA	
Pulse frequency f_P		750	kHz	

Cable length:

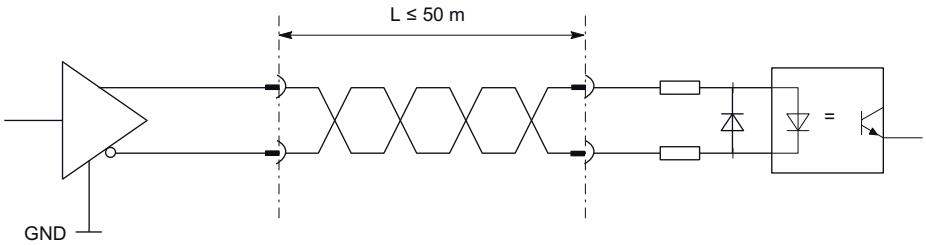
- Maximum 50 m
- For mixed operation with analog axes, max. 35 m
- For asymmetrical transmission, max. 10 m

The following figure shows different possibilities for protective signal circuits.

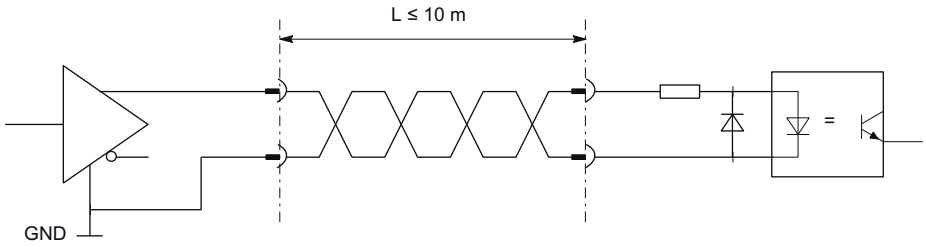
Symmetric transmission with differential input according to RS422



Symmetrical transmission with optical coupler input



Asymmetrical transmission with optical coupler input



Asymmetrical transmission with voltage input

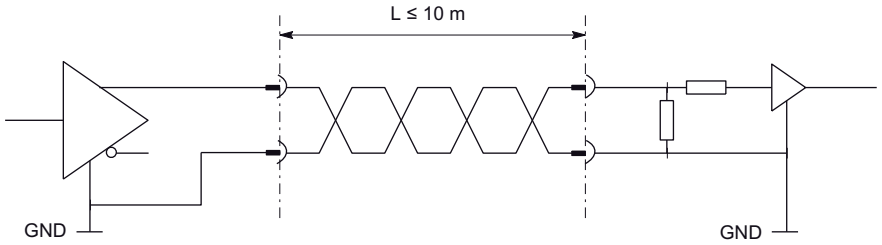


Figure 4-7 Protective signal circuits of the stepper motor interface

Setpoint assignment

Allocation of the command values for axes 1 to 4 is fixed.

Command value signals (X2) for **analog drive**:

- SW1, BS1, RF1.1, RF1.2 for axis 1
- SW2, BS2, RF2.1, RF2.2 for axis 2
- SW3, BS3, RF3.1, RF3.2 for axis 3
- SW4, BS4, RF4.1, RF4.2 for axis 4

Command value signals (X2) for **stepper drive**:

- PULSE1, PULSE1_N, DIR1, DIR1_N, ENABLE1, ENABLE1_N for axis 1
- PULSE2, PULSE2_N, DIR2, DIR2_N, ENABLE2, ENABLE2_N for axis 2
- PULSE3, PULSE3_N, DIR3, DIR3_N, ENABLE3, ENABLE3_N for axis 3
- PULSE4, PULSE4_N, DIR4, DIR4_N, ENABLE4, ENABLE4_N for axis 4

Connecting the Connecting Cables

Note the following:

Only use shielded, twisted-pair cables; the shield must be connected to the metallic or metalized connector housing on the controller side. We recommend that you do not ground the shield on the drive side. This is to separate low-frequency interferences from the analog setpoint signal.

The cable set offered as accessories provides maximum interference immunity.

Prefabricated cables

Order No.: 6FX2002-3AD01-□□□□

Cable length: ≤ 35 m

Information regarding the length codes is provided in: NC 60 Catalog or ST 70 Catalog

4.5.2 Connection of analog drives

Connection Description

The figure below shows the connection of the IM 174 to a SIMODRIVE 611-A drive unit.

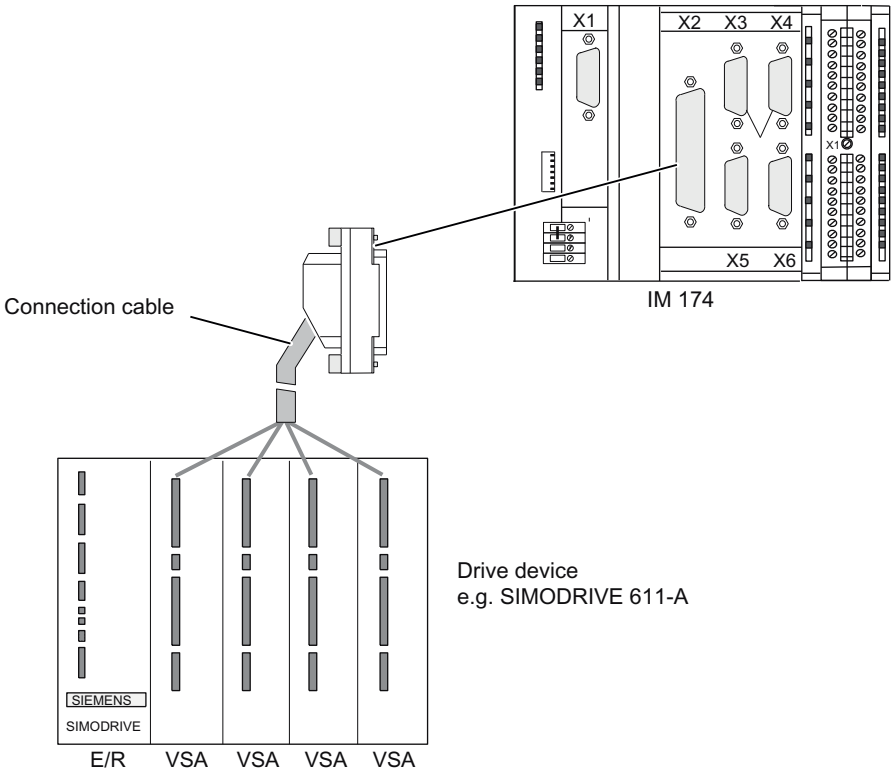


Figure 4-8 Connection of a SIMODRIVE 611-A drive unit

Procedure

1. Wire the free cable end of the connecting cable to the terminals on the drive unit. (The terminal markings on the cable ends indicate the corresponding terminals for SIMODRIVE devices.)
2. Open the front panel of the IM 174 and insert the Sub-D socket (50-pin) into the X2 connector.
3. Lock the connector using the finger screws. Close the front panel.

Connecting cable

The connecting cable is a pre-assembled cable for four axes with an analog interface and terminal designation for SIMODRIVE drives.

The connecting cable is available in a choice of lengths.

- see NC 60 Catalog or ST 70 Catalog

4.5.3 Connection of stepper drives

Connection Description

The figure below shows the connection of the IM 174 to FM STEPDRIVE drive devices.

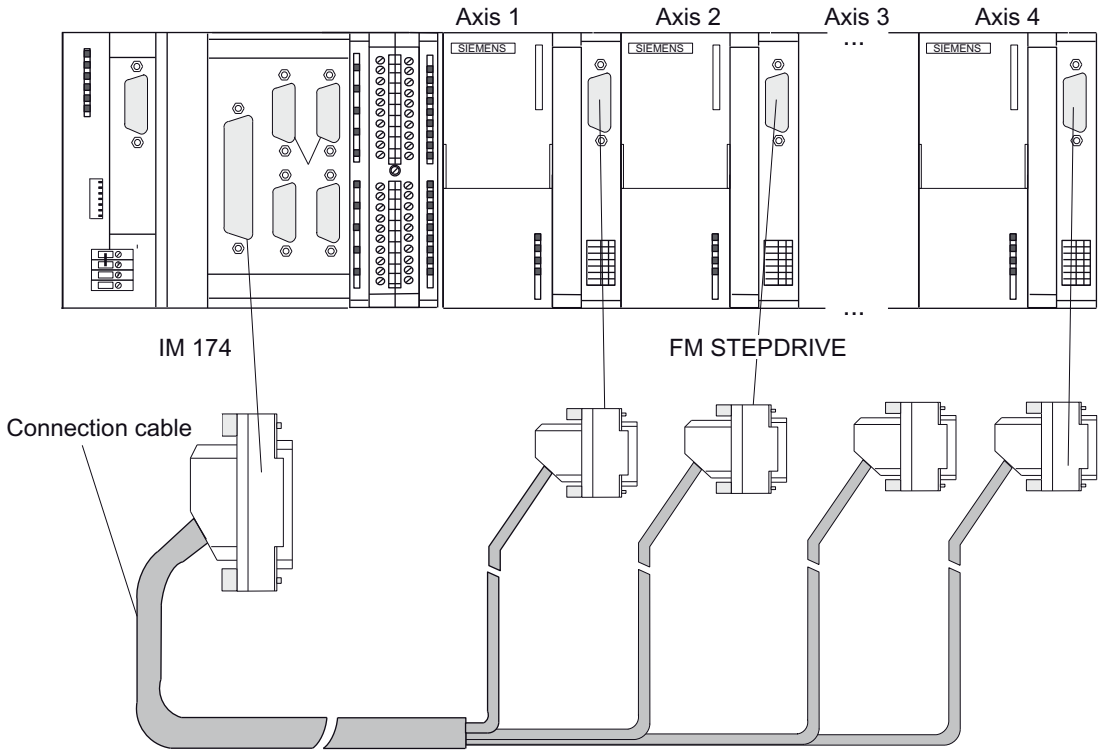


Figure 4-9 Connection of FM STEPDRIVE drive devices

Procedure

1. Insert the Sub-D socket (15-pin) in the FM STEPDRIVE module.
2. Open the front panel of the IM 174 and insert the Sub-D socket (50-pin) into the X2 connector.
3. Lock the connector using the finger screws. Close the front panel.

Connecting cable

The connecting cable is a prefabricated cable for four FM STEPDRIVE stepper motor drive devices.

The connecting cable is available in a choice of lengths.

- see NC 60 Catalog or ST 70 Catalog

4.5.4 Connection of analog drives and stepper drives in mixed operation

Mixed operation of analog drives and stepper drives

Connection cables for your configuration are available on request.

Follow the procedure outlined for connecting analog drives or stepper drives. The design conditions determine whether you install a terminal block or perform the wiring directly with pre-assembled cables.

Note

Ensure that the polarity assignment of the signals is correct. Check in the technical documentation of your drive device (e.g. FM STEPDRIVE manual, function description)

4.6 Encoder

4.6.1 Interfaces (X3, X4, X5, X6): Encoder interfaces

Connection

15-pin SUB D socket

Pin assignment

Pin assignment: Encoder interface of axis 1 to 4 (X3/X4/X5/X6) for incremental encoder (TTL) and absolute encoder (SSI)

Table 4- 12 Pin assignment: Encoder interface of axis 1 to 4 (X3/X4/X5/X6) for incremental encoder (TTL) and absolute encoder (SSI)

Pin	Designation[1)]		Type[2)]	Function
	Incremental	Absolute (SSI)		
1	Not assigned		-	-
2	-	CLS	O	SSI shift clock
3	-	CLS_N	O	SSI shift clock inverted
4	P5EXT		VO	5 VDC supply voltage
5	P24EXT		VO	24 VDC supply voltage
6	P5EXT		VO	5 VDC supply voltage
7	MEXT		VO	Reference for supply voltage
8	-		-	-
9	MEXT		VO	Reference for supply voltage
10	Z	-	I	Zero mark signal (U_{a0})
11	Z_N	-	I	Zero mark signal inverted ($/U_{a0}$)
12	B_N	-	I	Encoder signal Track B inverted ($/U_{a2}$)
13	B	-	I	Encoder signal Track B (U_{a2})
14	A_N	-	I	Encoder signal Track A inverted (U_{a1})
	-	DATA_N	I	SSI data inverse
15	A	-	I	Encoder signal Track A (U_{a1})
	-	DATA	I	SSI data

Female connector pins assignment

Designation: **X3, X4, X5, X6** ENCODER 1…4

X3: Axis1

X4: Axis2

X5: Axis3

X6: Axis4

Signal names

A, A_N	Track A true and negated (incremental encoder)
B, B_N	Track B true and negated (incremental encoder)
Z, Z_N	Zero mark true and negated (incremental encoder)
CLS, CLS_N	SSI shift clock true and negated (absolute encoder)
DATA, DATA_N	SSI data true and negated (absolute encoder)
P5EXT	+5 V supply
P24EXT	+24 V supply
MEXT	Supply ground

Signal type

VO	Voltage output
O	Output (5 V signal)
I	Input (5 V signal)

Note

Pin assignment of the encoders

To recognize zero mark, A=1 and B=1 and Z=1 have to be true. Interchanging of the connections can otherwise result in sporadic errors during homing.

4.6.2 Encoder types

Connectable measuring systems

Incremental encoders and absolute encoders can be connected to the IM 174.

The PULSE REFEED setting is used for stepper motors.

Incremental encoder (TTL)

- Differential transmission with RS422 (5 V or 24 V encoder supply voltage):
- Track A as true and negated signal (Ua1+, Ua1-)
- Track B as true and negated signal (Ua2+, Ua2-)
- Zero signal N as true and negated signal (Ua0+, Ua0-)
- Maximum output frequency: 1 MHz
- Phase shift of Track A to Track B: 90 degrees ± 30 degrees
- Current consumption: 300 mA max.
- Encoders with distance-coded zero marks / reference marks are not generally enabled

Absolute value encoder SSI

Transmission procedure: Synchronous serial interface (SSI) with 5 V differential signal transmission (RS422 standard, 5 V or 24 V encoder supply voltage):

Output signal: Data as true and inverted signal

Input signal: Shift clock as true and inverted signal

The following SSI encoders are supported:

- All SSI encoders in the pine tree format, the MsgLength of which is equal to the number of "significant data bits"
  - 25-bit with 12-bit multiturn and 13-bit single-turn information (setting of the MsgLength 25)
  - 21-bit with 8-bit multiturn and 13-bit single-turn information (setting of the MsgLength 21)
  - 13-bit with 13-bit single-turn information (setting of the MsgLength 13)
- SSI encoder in the pine tree format with the following data
  - 25-bit with 12-bit multiturn and 12-bit single-turn (setting of the MsgLength 24)
  - 21-bit with 8-bit multiturn and 12-bit single-turn information (setting of the MsgLength 20)
  - 13-bit with 12-bit single-turn information (setting of the MsgLength 12)
  - This applies as long as the encoder permits that not all available data is read!
- All right-justified encoders that satisfy the first condition indicated above.
  - Resolution: max. 25 bits
  - Transmission frequency: max. 1 Mbits/s
  - Current consumption: 300 mA max.

Examples for multiturn and single-turn encoders

The six examples listed describe various multiturn and single-turn encoders.

The following settings must be made in HW Config (HWC) and S7T Config for the associated encoder types:

Table 4- 13 Settings in HW Config

Setting	Description
Msg.Length	Non-relevant bits + multiturn + single-turn
Fine resolution	Reserved bits for fine resolution

Table 4- 14 Settings in S7T Config

Setting	Description
Number of encoder pulses	2^single-turn
Multiplic. factor of the cycl. actual value	2^reserved bits for fine resolution
Data bits	Multiturn + single-turn

Example 1: 25-bit multiturn encoder, pine tree format (12-bit multiturn, 13-bit single-turn)

Multiturn												Singleturn												
SSI Cycle Number																								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
M12	M11	M10	M9	M8	M7	M6	M5	M4	M3	M2	M1	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13

		Settings in ...	HWC	HWC	S7T Config	S7T Config	S7T Config
Non-rel. bits	Multiturn	Single-turn	Msg. Length	Fine resolution	No. of encoder marks	Multipl. factor	Data bits
0	12	13	25	11	8192	2048	25

Example 2: 25-bit multiturn encoder, pine tree format (12-bit multiturn, 12-bit single-turn)

Multiturn												Singleturn												
SSI Cycle Number																								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
M12	M11	M10	M9	M8	M7	M6	M5	M4	M3	M2	M1	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	0

		Settings in ...	HWC	HWC	S7T Config	S7T Config	S7T Config
Non-rel. bits	Multiturn	Single-turn	Msg. Length	Fine resolution	No. of encoder marks	Multipl. factor	Data bits
0	12	12	24	11	4096	2048	24

Example 3: 25-bit multiturn encoder, pine tree format (8-bit multiturn, 12-bit single-turn)

Multiturn												Singleturn												
SSI Cycle Number																								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
0	0	0	0	M8	M7	M6	M5	M4	M3	M2	M1	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	0

		Settings in ...	HWC	HWC	S7T Config	S7T Config	S7T Config
Non-rel. bits	Multiturn	Single-turn	Msg. Length	Fine resolution	No. of encoder marks	Multipl. factor	Data bits
4	8	12	24	11	4096	2048	20

Example 4: 25-bit multiturn encoder, pine tree format (9-bit multiturn, 13-bit single-turn)

Multiturn												Singleturn												
SSI Cycle Number																								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
0	0	0	M9	M8	M7	M6	M5	M4	M3	M2	M1	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13

		Settings in …	HWC	HWC	S7T Config	S7T Config	S7T Config
Non-rel. bits	Multiturn	Single-turn	Msg. Length	Fine resolution	No. of encoder marks	Multipl. factor	Data bits
3	9	13	25	11	8192	2048	22

Example 5: 21-bit multiturn encoder, pine tree format (8-bit multiturn, 13-bit single-turn)

Multiturn								Singleturn											
SSI Cycle Number																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
M8	M7	M6	M5	M4	M3	M2	M1	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13

		Settings in …	HWC	HWC	S7T Config	S7T Config	S7T Config
Non-rel. bits	Multiturn	Single-turn	Msg. Length	Fine resolution	No. of encoder marks	Multipl. factor	Data bits
0	8	13	21	11	8192	2048	21

Example 6: 13-bit single-turn encoder, left-aligned format

Singleturn												
SSI Cycle Number												
1	2	3	4	5	6	7	8	9	10	11	12	13
S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13

		Settings in …	HWC	HWC	S7T Config	S7T Config	S7T Config
Non-rel. bits	Multiturn	Single-turn	Msg. Length	Fine resolution	No. of encoder marks	Multipl. factor	Data bits
0	0	13	13	11	8192	2048	13

Note

The MsgLength must always be set to be the same as the cycles required to read out all "significant encoder data bits".

PULSE REFEED (only for stepper motors)

For the "Stepper“ encoder type setting, the incremental encoder signal is formed by the IM 174.

If a stepper with 500 steps/revolution is configured, the IM 174 will supply the following value:

500 multiplied with the set fine resolution increments / revolution.

Encoder supply voltages

The encoder supply voltages must comply with the following specification:

Table 4- 15 Specification of encoder supply voltages

	Supply voltage[1)]	
	P5EXT	P24EXT
Voltage		
Minimum	4.75 V	20.4 V
Nominal	5 V	24 V
Maximum	5.25 V	28.8 V
Current load		
Per encoder connection	0.3 A	
Maximum	1.2 A	1.4 A
Ripple		
Maximum	50 mV_{pp}	3.6 V_{pp}
[1)] P5EXT: Supply voltage for encoder (+5 VDC) P24EXT: Supply voltage for encoder (+24 VDC)		

Encoder power supply 5 V

The 5 V supply voltage for the encoders is generated inside the module and is therefore present at the Sub-D socket. This means you can supply the encoders via the connecting cable without the need for additional wiring. The voltage supplied is protected electronically against short-circuits and thermal overload, and it is monitored.

Encoder power supply 24 V

For encoders with an operating voltage of 24 V, the 24 VDC power is supplied to the Sub-D sockets. This means you can supply the encoders via the connecting cable without the need for additional wiring. The voltage supplied is protected electronically against short-circuits and thermal overload, and it is monitored.

Connecting cable to the encoder

The maximum cable length depends on the specification for the *encoder supply* and the *transmission frequency*. For problem-free operation, you must not exceed the following values when using SIEMENS prefabricated connecting cables (see Catalogs NC 60/ST 70):

Table 4- 16 Encoder supply voltage

Supply voltage: 5 VDC		
Tolerance	**Current consumption**	**Max. cable length**
4.75 V to 5.25 V	≦ 300 mA	25 m
4.75 V to 5.25 V	≦ 220 mA	35 m

Supply voltage: 24 VDC		
Tolerance	**Current consumption**	**Max. cable length**
20.4 V to 28.8 V	≦ 300 mA	100 m
11 V to 30 V	≦ 300 mA	300 m

Table 4- 17 Transmission frequency

Encoder type	Supply voltage	Frequency	Max. cable length
Incremental (TTL)	5 V	1 MHz	10 m
		500 kHz	35 m
	24 V	500 kHz	150 m
Absolute (SSI)	24 V	1.5 Mbit/s	10 m
		187.5 kbit/s	250 m

Connecting cables available for encoders

Available connecting cables:

- Pre-assembled cable for external encoder or EXEs
  (for the connection of linear position encoders)
- Pre-assembled cable for built-in encoder with 17-pin round connector
- pre-assembled cable for absolute encoders (SSI)
- Pre-assembled cable for SIMODRIVE 611-A closed-loop control module 1FK6 motors with resolver

The connecting cables are available in a choice of lengths.

Prefabricated cables

The following prefabricated cables can be used, depending on the encoder type:

- **Incremental encoder (TTL) with RS422 (5 V or 24 V encoder supply voltage) 6FX2 001-2...**

  Order number (MLFB): 6FX8 002-2CD01-1□□0 (5 V)

  Order number (MLFB): 6FX8 002-2CD24-1□□0 (24 V)
  Information on the cable length can be found in the *Connecting cables to the encoder* section.

- **Absolute encoder with SSI 6FX2 001-5...**

  Order number (MLFB): 6FX8 002-2CC11-□□□0

  Information on the cable lengths can be found in the *Connecting cables to the encoder* section

- **1FT5 motor with integrated ROD320 encoder**

  Order number (MLFB): 6FX8 002-2CE02-1□□0

  Cable length: can be found in the *Connecting cables to the encoder* section

  Information regarding the length codes is provided in:

  References: NC 60 Catalog or ST 70 Catalog

Note

If cable lengths longer than 25 m or 35 m are needed for incremental encoders, encoder types with a 24 VDC supply voltage can be used instead.

To ensure error-free transmission of encoder data, do not exceed the maximum cable lengths shown in these tables.

4.6.3 Encoder connections

Connecting the Connecting Cables

Note the following:

Always use shielded data cables. The shielding must be connected with the metallic or metalized connector housing.

The pre-assembled cable available as an accessory provides the best possible immunity to interference and adequately dimensioned cross-sections for the power supply to the encoders.

Note

To protect the encoder when it is connected, power should be removed from the IM 174 module.

Wiring the Encoders

The figure below shows the connection of the IM 174 to various encoder types.

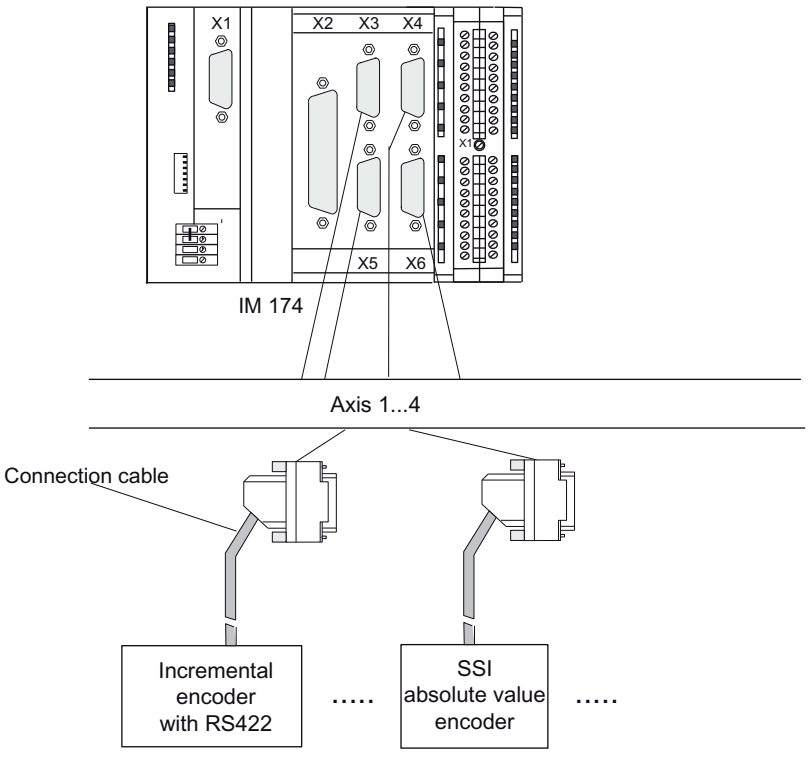


Figure 4-10 Encoder connection

Procedure for Connecting Encoders

Proceed as follows to connect the encoders:

1. Connect the cable to the encoders.
2. Open the front panel of the IM 174 and insert the Sub-D connectors (15-pin) into the sockets X3 to X6.
3. Lock the connector using the finger screws. Close the front panel.

Actual value assignment

The assignment of actual values for axes 1 to 4 is fixed.

- The encoder for axis 1 must be connected to actual value input X3
- The encoder for axis 2 must be connected to actual value input X4
- The encoder for axis 3 must be connected to actual value input X5
- The encoder for axis 4 must be connected to actual value input X6

Effect of the cabling on homing (Page 56)

4.6.4 Effect of the cabling on homing

Homing using the encoder zero mark on the basis of the encoder tracks

Note

Pin assignment of the encoders

To recognize zero mark, A=1 and B=1 and Z=1 have to be true. Interchanging of the connections can otherwise result in sporadic errors during homing.

In the following two examples the encoder tracks are used to illustrate when homing with the encoder zero mark functions:

Example 1: Homing with the encoder zero mark functions.

The encoder zero mark is recognized. All three tracks of the encoder are set to high.

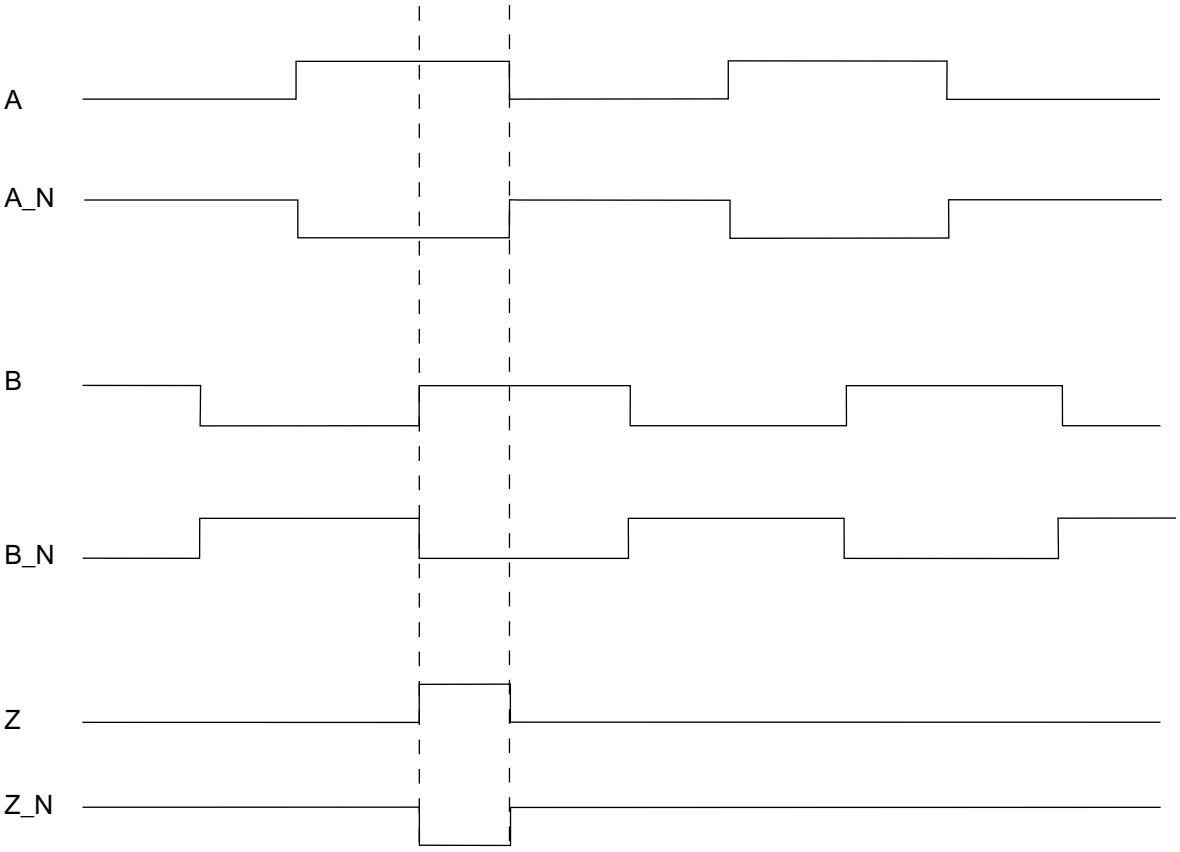


Figure 4-11 Encoder zero mark functions

Example 2: Homing with the encoder zero mark does not function.

The encoder zero mark is not recognized, for example because the wiring of the encoder is incorrect. The A-track of the encoder is inverted. The A-track is therefore not high at the zero track moment. However, all three tracks have to be high as a precondition for detecting the encoder zero mark.

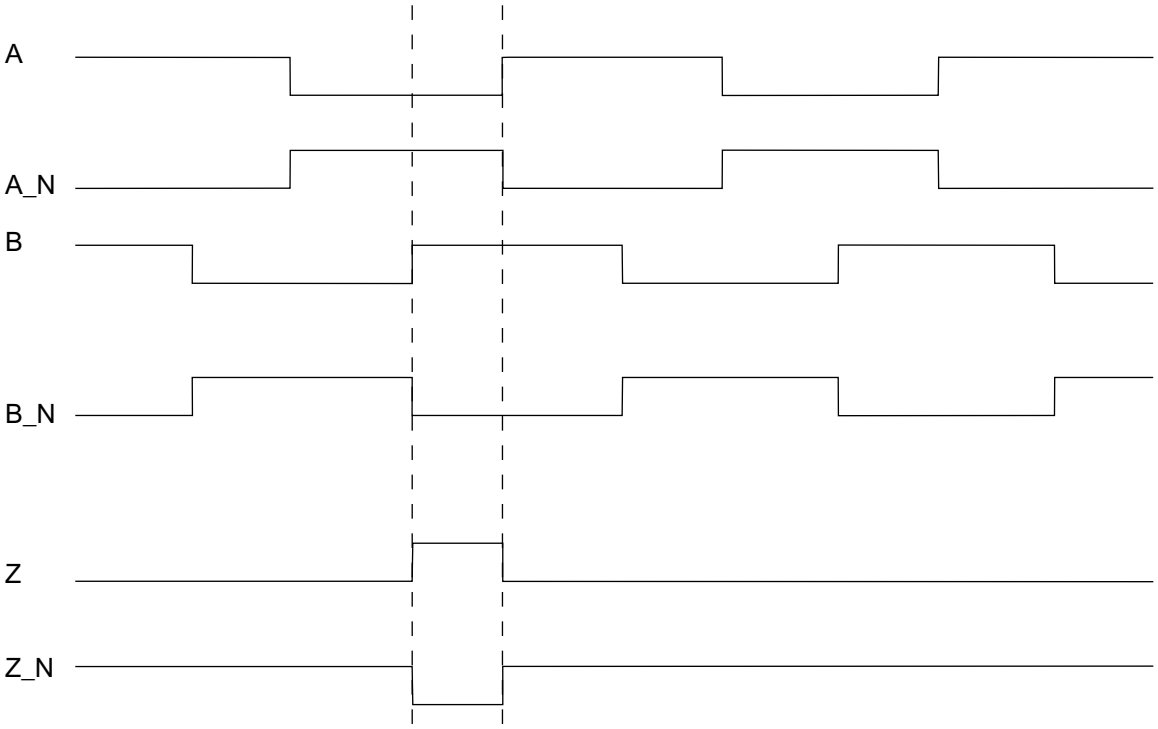


Figure 4-12 The encoder zero mark does not function

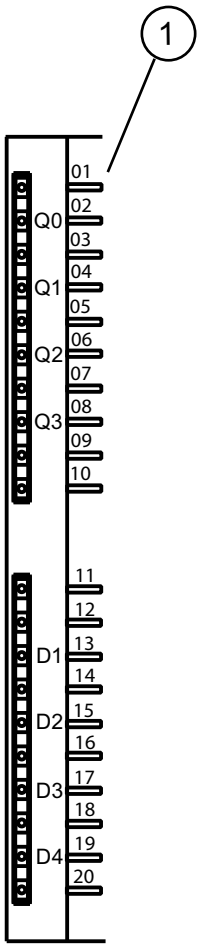
4.7 Digital outputs/inputs

4.7.1 Interface (X11): Digital outputs

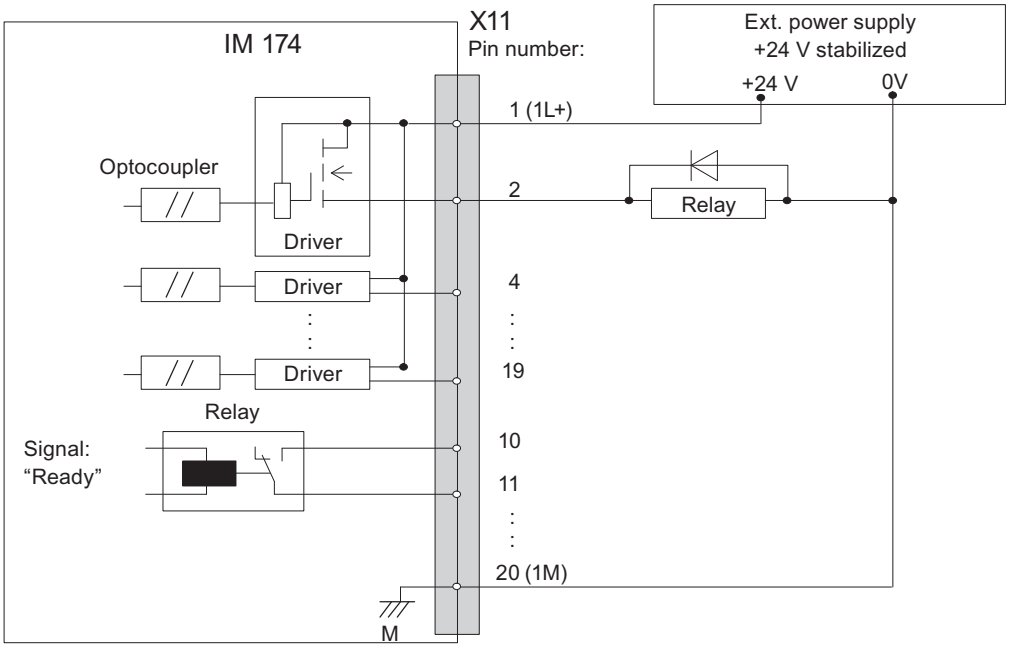
Pin assignment

Table 4- 18 Pin assignment: Digital output interface (X11)

Pin	Designation	Type[1)]	Function
1	1L+	VI	Ext. 24 VDC supply voltage
2	Q0	DO	Digital output signal 1
3	-		
4	Q1	DO	Digital output signal 2
5	-		
6	Q2	DO	Digital output signal 3
7	-		
8	Q3	DO	Digital output signal 4
9	-		
10	RDY1	K	"Ready" signal of Relay Contact 1
11	RDY2	K	"Ready" signal of Relay Contact 2
12	-		
13	D1	DO	Digital output signal 5 or directional signal of Axis 1[1)]
14	-		
15	D2	DO	Digital output signal 6 or directional signal of Axis 2[1)]
16	-		
17	D3	DO	Digital output signal 7 or directional signal of Axis 3[1)]
18	-		
19	D4	DO	Digital output signal 8 or directional signal of Axis 4[1)]
20	1M	VI	Reference of the external supply voltage
1) for the "Unipolar spindle" function			

Pin	Designation	Type[1)]	Function
1.			 Pin assignment of the digital output interface ① PIN 1

Pin	Designation	Type[1)]	Function



Pin assignment of the digital output interface

Note

Controlling the digital outputs

To control the digital outputs of the IM 174 with a T-CPU, you must first assign the IM 174 an Axis or External Encoder technology object in S7T Config.

Signal designation

RDY.1 … 2	Ready for operation (READY contact 1…2)
QO … Q3, D1 … D4 [1)]	Digital outputs
1L+	Power supply for digital outputs
1M	Reference potential for digital outputs
1) for the "Unipolar spindle" function	

Signal type

- **DO** digital output (24 V signal)
  - Max. current carrying capacity: 0.5 A
- **VI** Voltage input
- **K** Switching contact
  - Max. current carrying capacity: 1 A
  - Max. switching voltage: 30 VDC
  - Max. switching capacity: 30 VA
  - Mechanical service life: Type 10^9
  - Electrical lifetime (30 VDC / 1 A): Type $5*10^5$

General electrical properties

- Galvanic isolation using optocouplers
- Current limitation to a maximum of 500 mA
- Protection against: short-circuit, overtemperature, and loss of ground
- Automatic disconnection in case of undervoltage

Relay contact: "Ready" signal

The relay contact remains/is **opened** if the module is in one of the following states:

- Initialization of the module after Power ON
- Power failure or hardware interrupt (NMI)
- No cyclic communication to the DP master
- PLL error
- Synchronization error
- Overtemperature

The relay contact is **closed** if the following conditions are present:

- Module status "Ready"
- Cyclic communication with the DP master
- The master has to be in RUN mode. Only then can the signs-of-life be exchanged and only then does the Ready contact close.
- The Ready contact also remains closed when one or more external encoders are operated with Message frame 3, since there is no exchange of the sign-of-life in this case. As soon as an external encoder is operated with Message frame 81 or an axis with Message frame 3, the Ready contact closes.

Note

Cyclic communication with the DP master

The relay contact closes only when a data exchange also takes place between the master and the IM 174. It does not suffice that the master detects a new slave (IM 174) on the PROFIBUS network.

4.7.2 Electrical Parameters of the digital outputs

Digital outputs

These fast outputs (onboard) are PLC-compatible (24 V P-switching).

Digital outputs

Number of outputs	8
Supply voltage	24 VDC (permissible range: 20.4 … 28.8 V)
Counter voltage	Yes
Galvanic isolation	Yes
Output voltage	1 signal: (V_L 1) - 3) V … V_L 1) V
Short-circuit protection	Yes
Max. output current • Rated value • Permitted range • Lamp load	1 signal • 0.5 A • 0.5 mA ... 0.6 A from the power supply • 5 W max.
Operating frequency for • Ohmic load • Inductive load	 • 100 Hz • 1 Hz
Max. residual current	0 signal: 0.4 mA
Output delay (Q0 … Q3, D1 … D4)	• 0 → 1 signal: Typ. 500 µs • 1 → 0 signal: Typ. 400 µs

1) V_L - supply voltage of the outputs

4.7.3 Electrical parameters of the Ready output (RDY)

READY output (RDY)

Ready for operation as potential-free relay contact (NO contact).

Table 4- 19 Electrical parameters of RDY relay contact

Parameter	max.	Unit
DC switching voltage	30	V
Switching current	1	A
Switching capacity	30	VA

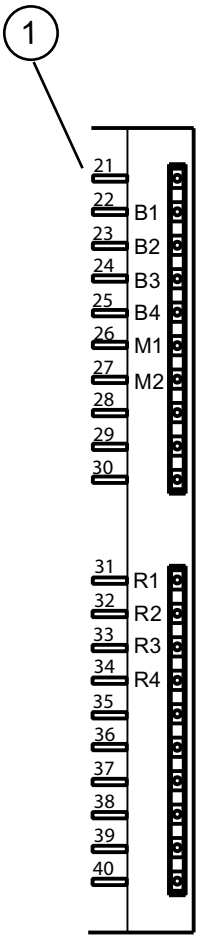
4.7.4 Interface (X11): Digital inputs

Pin assignment

Table 4- 20 Pin assignment: Digital input interface (X11)

Pin	Designation	Type[1)]	Function
21	-		
22	B1	DI	Input signal of BERO / external zero mark 1
23	B2	DI	Input signal of BERO / external zero mark 2
24	B3	DI	Input signal of BERO / external zero mark 3
25	B4	DI	Input signal of BERO / external zero mark 4
26	M1	DI	Measuring signal of Measuring Input 1 (see "Measuring inputs" below)
27	M2	DI	Measuring signal of Measuring Input 2 (see "Measuring inputs" below)
28	-		
29	-		
30	-		
31	R1	DI	"Drive Ready" signal of Axis 1
32	R2	DI	"Drive Ready" signal of Axis 2
33	R3	DI	"Drive Ready" signal of Axis 3
34	R4	DI	"Drive Ready" signal of Axis 4
35	-		
36	-		
37	-		
38	-		
39	-		

Pin	Designation	Type[1)]	Function
40	2M	VI	Reference of the supply voltage



Pin assignment of the digital input interface

① PIN 21

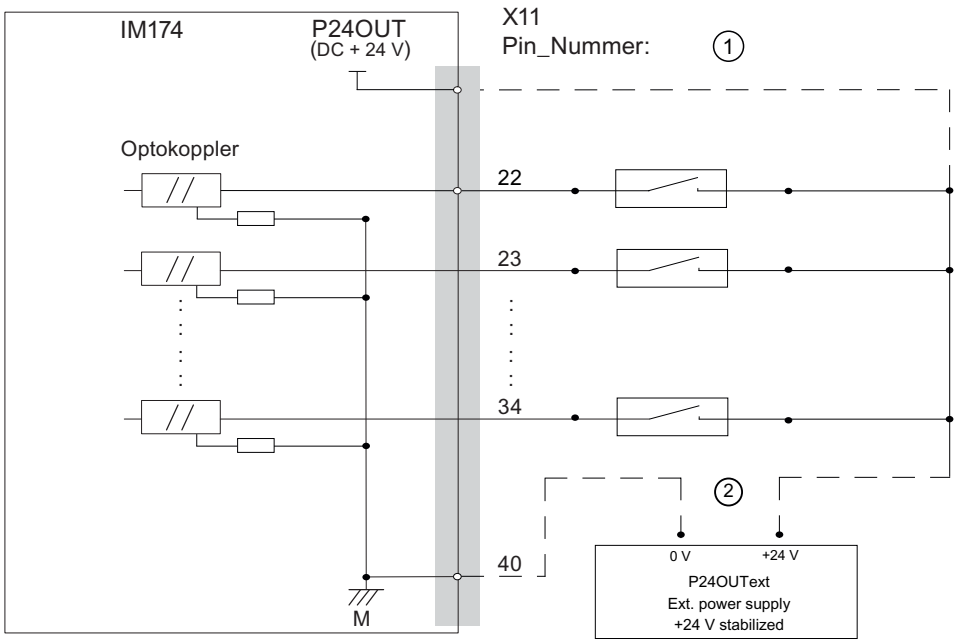


Figure 4-13 Pin assignment of the digital input interface

Signal designation

B1 … B4	BERO input for axis 1 … 4
M1, M2	Measuring pulse input 1 and 2
R1 … R4	"Drive Ready" signal, axis 1 - 4
2M	Reference potential for digital inputs

Signal type

- **DI** Digital input (24 V signal)
- **VI** Voltage input

General electrical properties

- Galvanic isolation using optocouplers
- Active current limitation of the inputs
- Protection from negative input voltage

Measuring input

The IM 174 module supports measurement of a rising **or** falling edge of the measuring input. A simultaneous request for measurement of a rising edge and a falling edge of the measuring input cannot be parameterized.

Drive enable and drive ready signal

To allow the drive to be switched on by the Technology CPU using the FB MC_Power, the drive must signal its readiness (IM 174 X11-Rx input = TRUE). This means the ready message of the drive should be wired to the IM 174 (X11-Rx). The signal must also remain when the drive is switched on. If the signal is cleared, the drive will stop.

If such a signal is not available, the IM 174 X11-Rx input can also be assigned 24 V statically. This, however, has the disadvantage that the MC_Power FB also returns the TRUE status even when the drive has failed.

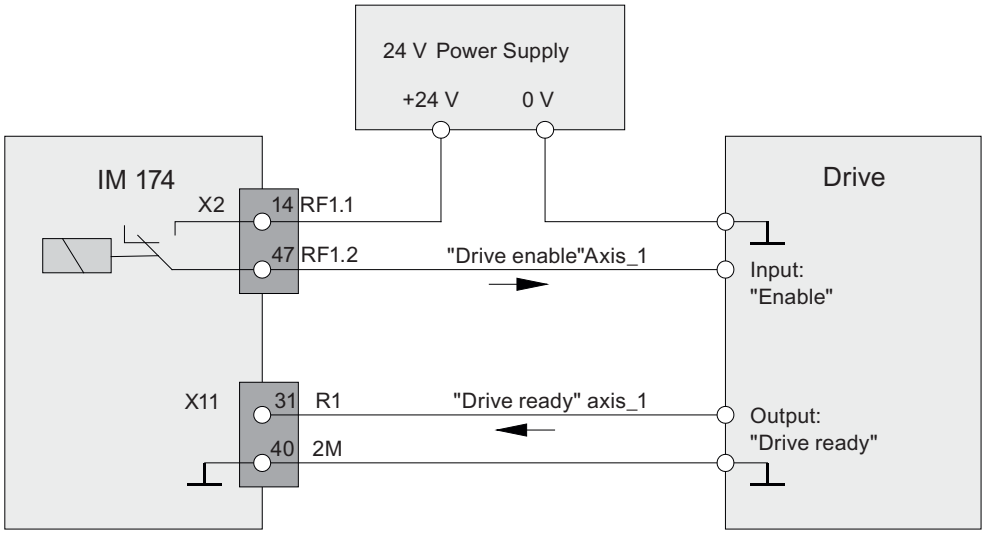


Figure 4-14 Drive enable for Axis 1 (principle)

The IM174 supports 2 different types of Drive Ready signals:

- Drive Ready (Ready for switching on) is usually required for analog drives.
- Alt.Drive Ready (Operation) is usually required for stepper drives.

The Drive Ready signal for the IM 174 can be configured in HW Config with the "Alt.DrvRdy" checkbox.

The figures below show the drive enable procedure in each case.

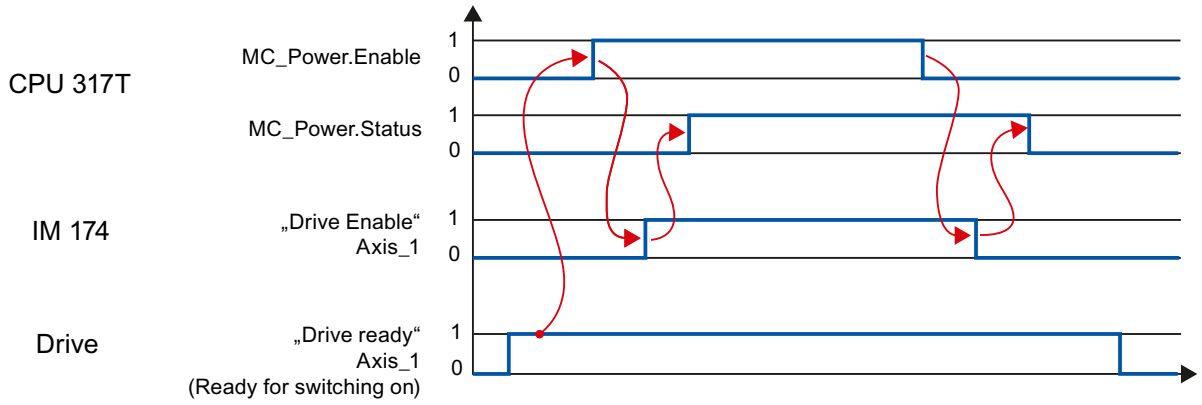


Figure 4-15 Drive enable procedure when the drive reports "Ready for switching on" (Alt.DrvRdy deselected)

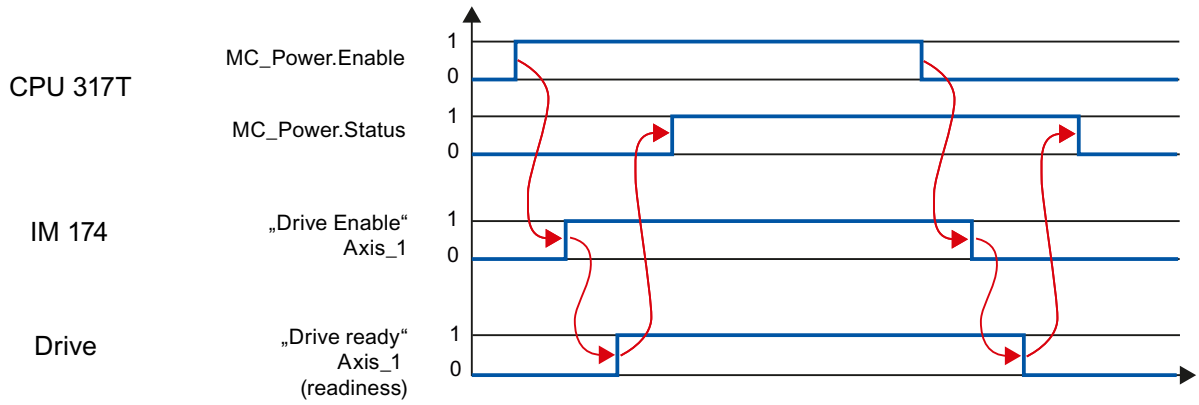


Figure 4-16 Drive enable procedure when the drive reports "Operation" (Alt.DrvRdy selected)

4.7.5 Electrical parameters of the digital inputs

Digital inputs (with 2 measuring inputs and 4 BEROs)

These high-speed inputs (onboard) are PLC-compatible (24 V switching to P potential). Switches or proximity encoders (2- or 3-wire encoders) can be connected.

They can be used:

- As switches for homing (BERO1...BERO4), the inputs are permanently assigned to axes 1 to 4 (only applies for stepper motor, not RPS)
- As measuring inputs (M1, M2), the assignment to the axes is performed in the programming
- As free inputs (B1 … B4, M1, M2, R1 … R4)

Note

Input signal on the sensor probe

The input signal on the sensor probe must have a minimum length of one DP cycle so that the signal is recognized.

Digital inputs

Number of inputs	10
Supply voltage	24 VDC (permissible range: 20.4 … 28.8 V)
Galvanic isolation	Yes
Input voltage	• 0 signal: -3 … 5 V • 1 signal: 15 … 30 V
Input current	• 0 signal: ≤ 2 mA • 1 signal: 4 … 8 mA
Input delay (B1 … B4, M1, M2, R1 … R4)	• 0 → 1 signal: Typ. 15 µs • 1 → 0 signal: Typ. 150 µs
Connection of a 2-wire encoder	possible

4.7.6 Supply voltage of the digital inputs and outputs

Digital outputs

To supply (+24 VDC) the digital outputs, an external power source is needed. The power is supplied via the X11 connection, Pin 1 (1L+). The reference source of the external voltage source must be connected with X11, pin 20 (1M).

Digital inputs

To supply (+24 VDC) the digital inputs, an external power source is needed. The reference ground of the external voltage source must be connected with X11, Pin 40 (2M).

Specification of the digital inputs and outputs

The external encoder supply voltages for the digital outputs must satisfy the specifications in the "Specification of the external encoder supply voltage" table.

Table 4- 21 Specification of the external supply voltages

	Supply voltage	
Supply voltage for the digital outputs and inputs	**1L+**	**2L+**
Voltage		
Minimum	18.5 V	18.5 V
Nominal	24 V	24 V
Maximum	30.2 V	30.2 V
Ripple		
Maximum	3.6 Vpp	3.6 Vpp
Current load		
Maximum	8 A	8 A
Power consumption		
Maximum	241.6 W	241.6 W

NOTICE

External supply voltages

The external supply voltages must each be generated as functional extra-low voltage with safe electrical isolation (DIN EN 60204-1, PELV).

Note

24 V supply

The 24 V power supply is to be designed as functional extra-low voltage with protective separation in accordance with EN60204-1, Section 6.4, PELV (with M ground).

Note

Connecting cables

The connecting cable between the voltage source and the load power supply connector L+ and the associated reference potential M should **not** exceed a maximum length of 10 m

Fuse

On the module side, the supply voltage 1L+ is protected against:

- Overvoltage
- Short-circuit (electrical current limitation of outputs)
- Polarity reversal
- Overload: Fuse 10 A / 125 V

4.7.7 Connection of the digital inputs and outputs

Connection

A 40-pin cable connector from Siemens: 6ES7392-1AM00-0AA0

For the wiring of the outputs

- The required connection cables must be provided by the user:
  - Digital outputs X11, Pins 2 to 19:
    Wire, cable cross-section 0.5 mm^2 to max. 1.5 mm^2 (AWG20 - AWG16)
- Connection conditions
  - Refer to
    S7-300, CPU 31xC and CPU 31x Hardware and Installation operating instructions
    In the Wiring section, Table: Wiring conditions for front connectors

Note

The maximum length of the digital signal cable is 30 m.

For the wiring of the inputs

- The required connection cables must be provided by the user:
  - Digital inputs X11, Pins 22 to 39:
    Wire, cable cross-section 0.5 - 1.5 mm^2 (AWG20 - AWG16)
- Connection conditions
  - refer to
    S7-300, CPU 31xC and CPU 31x Hardware and Installation operating instructions
    In the Wiring section, table: Wiring conditions for front connectors

Wiring of the front connector

The following figure shows how the cables are routed to the front connector and how to suppress line interference through the use of the shield connecting element.

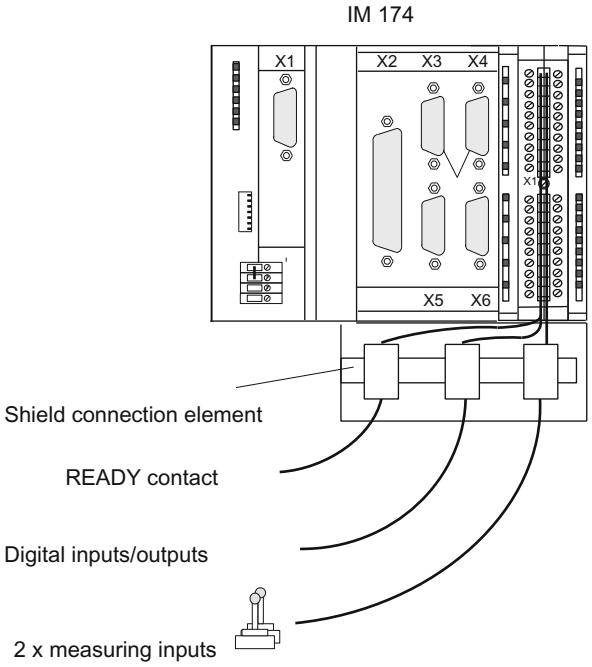


Figure 4-17 Wiring of the front connectors

Connecting cables

Flexible cable, cross-section 0.5...1.5 mm^2

Ferrules are not required.

You can use ferrules without an insulating collar in accordance with DIN 46228, Form A long version.

You can connect two cables of 0.5...0.75 mm^2 each in one ferrule.

Note

To achieve optimum interference suppression, shielded cables must be used to connect measuring inputs or BEROs.

Required tools

3.5 mm screwdriver or power screwdriver

Procedure for the front connector wiring

Proceed as follows for the terminal strip wiring:

1. Strip 6 mm of insulation off the cable. It may be necessary to fit a ferrule.
2. Open the front cover. Move the front connector into position for wiring.
   To do this, push the front connector into the module until it locks into position. In this position, the front connector still protrudes from the module.
   The connector is locked, but does not have electrical contact to the module.
3. If the wires leave the module at the bottom, begin wiring at the bottom, otherwise begin at the top. Also screw tight unassigned terminals.
   The tightening torque is 40...70 Ncm.
4. Place the strain relief around the cable harness and the front connector.
5. Pull the cable strain-relief assembly tight. Push the retainer on the strain-relief assembly in to the left; this will improve utilization of the available space.
6. Tighten the mounting screw to move the front connector into its operating position.

   When the front connector is moved into its operating position, a front connector coding in the front connector engages. The front connector then only fits this type of module.
7. Close the front panel.
8. You can fill out the labeling field provided and insert it in the front cover.

A detailed description of the wiring of a front connector can be found in the S7-300 Automation System Software Installation Manual.

Shielded cables

If shielded cable is used, the following additional actions are required:

- Once the cable has entered the cabinet, the cable shield must be connected to a grounded shield bus (strip the cable first).
  For this purpose, you can use the shield connecting element, which is fitted onto the mounting rail and accepts up to eight shielding terminals.
  Refer to S7-300 Automation System Software Installation Manual.
- Continue routing the shielded cable as far as the module, but do not make a connection to the shield there.

Shield connecting element

This element can be inserted in the mounting rail to provide screening for shielded cables. It accepts up to eight shielding terminals (KLBÜ series from Weidmüller).

Refer to S7-300 Automation System Installation Manual, (Wiring section)

Connection of measuring inputs or proximity encoders (BEROs)

Follow the steps outlined below:

1. Wire the power supply for the encoders. These must meet the same criteria as the load power supply for the IM 174. You can use the load power supply terminals of the IM 174 for the supply.
2. Connect the shielded signal line to the encoders.
3. Remove a sufficient length of the cable sheath at the controller end so that you can connect the shield to the shield connecting element and the free cable ends to the front connector.
4. Wire the signal line to the front connector.

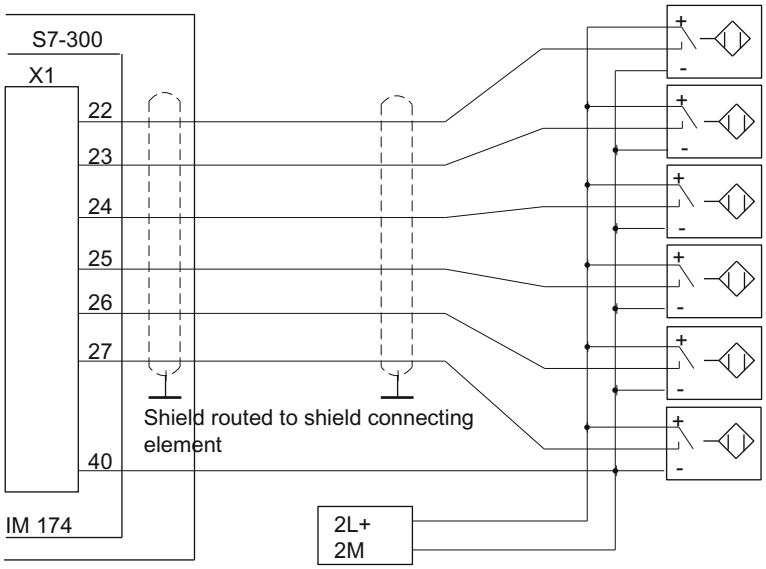


Figure 4-18 Overview of connections for measuring inputs or proximity switches

Parameterization 5

5.1 Supplementary conditions

Boundary conditions on the isochronous PROFIBUS

The following boundary conditions must be taken into account for the operation of an IM 174 DP slave on the isochronous PROFIBUS:

- An IM 174 DP slave is a certified DP standard slave as defined by the PROFIDrive profile V4.1. For example, an IM 174 DP slave does not enable acyclic communication. An IM 174 DP slave can only be operated on a DP master specially released for this purpose.
- An IM 174 DP slave can only be operated on an isochronous PROFIBUS. The minimum DP cycle is 1.5 ms.

5.2 Preconditions SIMATIC S7-300 CPU

Components for parameter assignment

The following components are required for assigning parameters for an IM 174 DP slave:

- Module IM 174, as from order no. 6ES7174-0AA10-0AA0
- HSP 2038 for module IM 174, as from order no. 6ES7174-0AA10-0AA0
- SIMATIC STEP 7 Version 5.4 SP4 or higher

Recommendation:

The following components are also recommended:

- CPU 315T-2DP order no. 6ES7315-6TH13-0AB0 as from V2.6/4.1 or higher
- CPU 317T-2DP order no. 6ES7317-6TK13-0AB0 as from V2.6/4.1 or higher
- S7 Technology as of V4.1

5.3 Requirements for SIMOTION

Components for parameter assignment

The following components are required for assigning parameters for an IM 174 DP slave:

- Module IM 174, as from order no. 6ES7174-0AA10-0AA0
- HSP 2038 for module IM 174, as from order no. 6ES7174-0AA10-0AA0
- SIMATIC STEP 7 Version 5.4 SP4 and higher
- SIMOTION
  - SIMOTION P or C: SIMOTION V4.1.2 and higher (SCOUT and Runtime)
  - SIMOTION D: SIMOTION V4.1.2 and higher (SCOUT and Runtime)

5.4 Inserting an IM 174 DP slave in the configuration

Procedure

1. To insert an IM 174 DP slave in the configuration, open the hardware catalog in HW Config using the **View > Catalog** menu command.

   The IM 174 DP slave is located under:

   – Profile: **Standard**

   under **PROFIBUS DP > Function modules > IM 174**

2. Using a drag-and-drop operation, select the IM 174 DP slave and drag it on to the DP master system in the station window.

   The DP master system is displayed in the station window with the following symbol:

5.5 Parameterization sequence

Basic procedure

The parameterization of an isochronous PROFIBUS in HW Config for the IM 174 DP slave can be generally divided into the following steps:

Step 1

After inserting the IM 174 DP slave in the configuration, the following parameters are assigned on a slave-specific basis:

- PROFIBUS parameters (see the *Parameterizing an isochronous PROFIBUS - "General" and "Configuration" tabs* section)
- Function parameters (see *Function parameters - "Encoders and drives" tab* and *Function parameters - "Parameters" tab* section)

Step 1 should first be carried out for **all** IM 174 DP slaves required for the configuration.

Step 2

Parameterization of the equidistant cyclic DP communication (see *Parameterization of the DP communication - "Isochronous mode" tab* section).

Step 2 can be performed **last** on **any** IM 174 DP slave. The settings made during the operational sequence above can be transferred to all of the remaining IM 174 DP slaves using the alignment function of the slave.

5.6 Parameterizing an isochronous PROFIBUS - "General" and "Configuration" tabs

5.6.1 Enter PROFIBUS address

Procedure

Inserting an IM 174 DP slave into the configuration will open the dialog box "Properties - PROFIBUS Interface IM 174", "Parameters" tab.

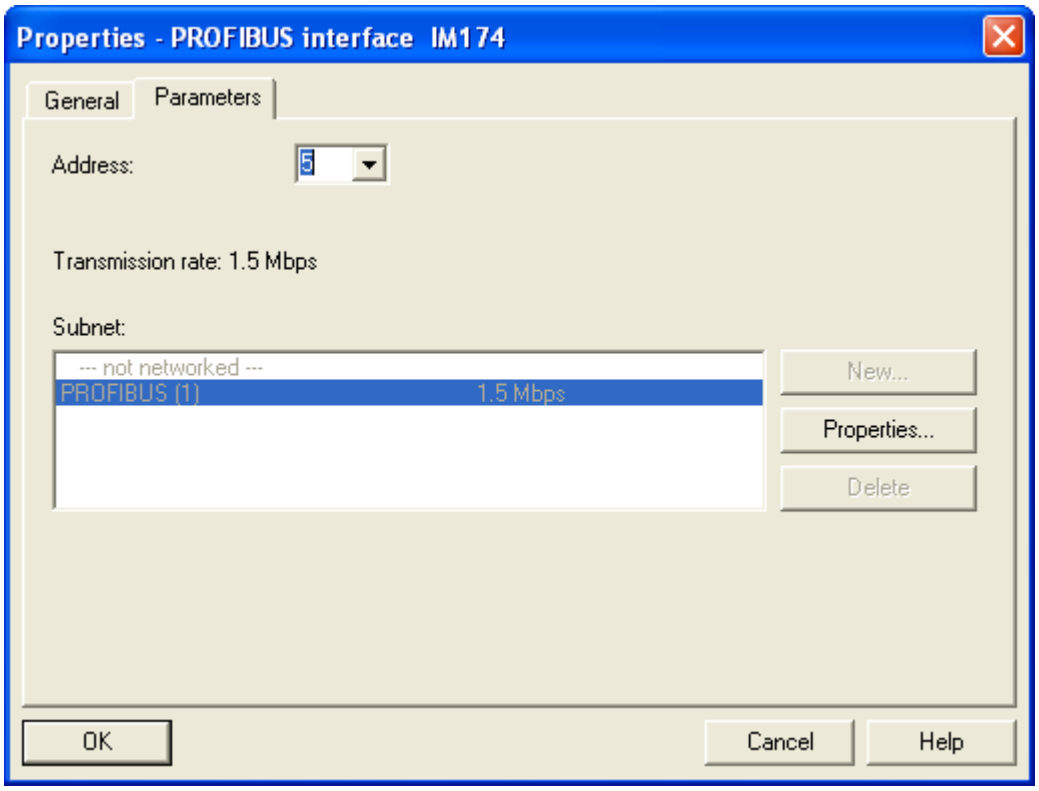


Figure 5-1 PROFIBUS address

The displayed address value was automatically set by HW Config to the next available PROFIBUS address within the configuration.

Compliance of the PROFIBUS addresses

The PROFIBUS addresses automatically assigned in HW Config can be changed manually within the specified address range.

The PROFIBUS address of the IM 174 DP slave is set via the DIP switch.

However, it must be ensured that the PROFIBUS address setting in HW Config matches the DIP switch setting on the IM 174 DP slave.

Note

No automatic adjustment takes place!

After confirming the dialog with "OK", the "DP Slave Properties" dialog box is opened. Continue with the parameter assignment for the message frame type.

5.6.2 Selecting the message frame type

Message frame type

The IM 174 DP slave is operated with two specific message frame types:

Four axes, each with one encoder (Standard message frame 3 and 81) and I/O data

Note

Message frame type

It is not possible to use four External encoder technology objects simultaneously with the standard message frame 3. Message frame 81 has to be used in order to use four External encoder technology objects with the IM 174 module.

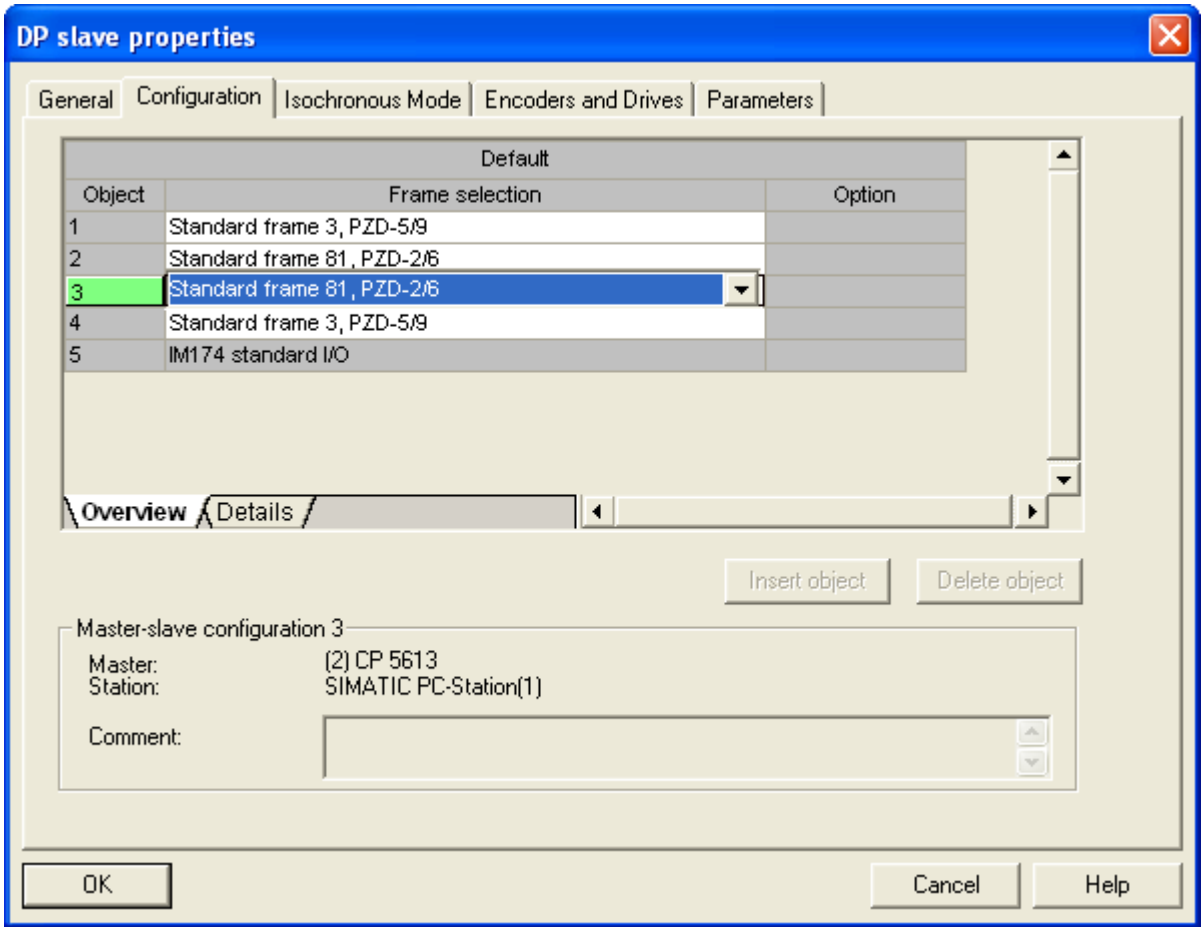
Set the message frame type

Message frame 3 is chosen as standard. To change the message frame type, proceed as follows:

1. In the "DP Slave Properties" dialog box, select tab: "Configuration > Overview".
2. In the list box: "Message frame selection", select the required message frame for each connected encoder.
3. Confirm with "OK".

Example of encoder configuration

The following graphic shows an exemplary encoder configuration. Message frame 3 is selected for the encoder on the first and fourth axes, message frame 81 is selected for the encoder on the second and third axes.



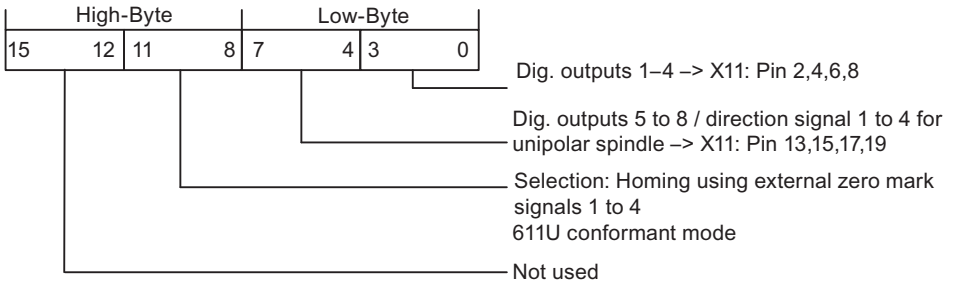
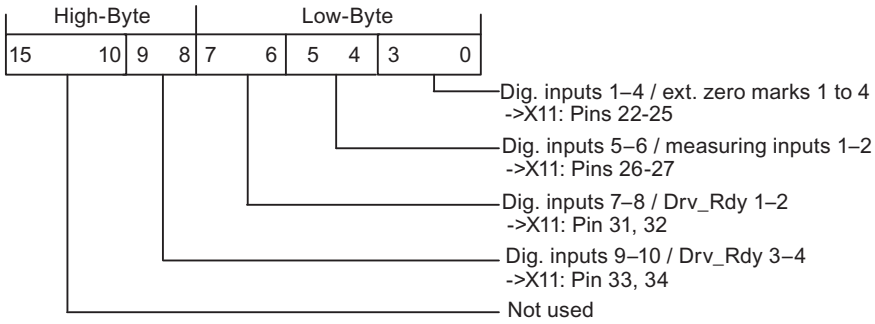
5.6.3 Message frame structure

Message frame structure

The message frame is structured as follows:

Table 5- 1 Message frame structure

Message frame type	Description
4 axes, each with one encoder, standard message frame 3 + IO, PZD-5/9 O/I 1/1 or message frame 81 + IO, PZD-2/6 + I/O 1/1	4 x Standard message frame 3 or 81 and 1 PZD word each for digital I/O data
PZD x/y Number of process data words, x: Setpoint, y: Actual value, e.g. PZD-5/9: 5 process data words for setpoints 9 process data words for actual values	
IM174 message frame structure Axis1 / Axis2 / Axis3 / Axis4 / I/O STD 3 or STD 81 / STD 3 / STD 3 / STD 3 / O word — Setpoints (master -> slave) Low — Axis1 / Axis2 / Axis3 / Axis4 / I/O — High STD 3 or STD 81 / STD 3 / STD 3 / STD 3 / I word — Actual values (slave -> master) STD 3: standard message frame 3 per PROFIDrive V3.0 Q word: digital output data (16 bits) I word: digital input data (16 bits)	
Standard message frame 3: speed setpoint interface 32 bits with 1 encoder PZD1 / PZD1 / PZD3 / PZD4 / PZD5 STW1 / NSOLL_B / STW2 / G1_STW — Setpoint (master -> slave) Low — High PZD1 / PZD2 / PZD3 / PZD4 / PZD5 / PZD6 / PZD7 ZSW1 / NIST_B / ZSW2 / G1_ZSW / G1_XIST1 PZD8 / PZD9 G1_XIST2 — Actual value (slave -> master)	
Standard message frame 81: speed setpoint interface 32 bits with 1 encoder PZD1 / PZD2 STW2 / G1_STW1 — Setpoint (master -> slave) PZD1 / PZD2 / PZD3 / PZD4 / PZD5 / PZD6 ZSW2 / G1_ZSTW1 / G1_XIST1 / G1_XIST2 — Actual value (slave -> master)	

Message frame type	Description
O word (dig. output data 16 bits)  	
I word (dig. input data 16 bits)  	

Note

The message frame type setting for the IM 174 DP slave in HW Config must agree with the message frame type setting in the controller.

There is no automatic adjustment.

Encoder control word Gx_STW

Description of the encoder control word (extract) for:

- Find reference mark
- On-the-fly measurement
- Encoder error

<table>
<tr><th>Bit</th><th>Identifier</th><th></th><th colspan="3">Signal state/description</th></tr>
<tr><td rowspan="15">0
1
2
3
4
5
6
7</td><td rowspan="15">Find reference mark
or
On-the-fly measurement</td><td rowspan="14">Functions</td><td colspan="3">Bit 7 = 0 => Request: Find reference mark</td></tr>
<tr><td>Bit</td><td>Meaning</td><td>Homing using:</td></tr>
<tr><td>0</td><td>Function 1:</td><td>Encoder zero mark (except in "611 U conform mode")</td></tr>
<tr><td>1</td><td>Function 2:</td><td>Not used</td></tr>
<tr><td>2</td><td>Function 3:</td><td>Not used</td></tr>
<tr><td>3</td><td>Function 4:</td><td>Not used</td></tr>
<tr><td colspan="3">Bit 7 = 1 => Request: On-the-fly measurement</td></tr>
<tr><td>Bit</td><td>Meaning</td><td></td></tr>
<tr><td>0</td><td>Function 1:</td><td>Measuring input 1 rising edge</td></tr>
<tr><td>1</td><td>Function 2:</td><td>Measuring input 1 falling edge</td></tr>
<tr><td>2</td><td>Function 3:</td><td>Measuring input 2 rising edge</td></tr>
<tr><td>3</td><td>Function 4:</td><td>Measuring input 2 falling edge</td></tr>
<tr><td colspan="3">Note
• Bit x = 1 Function requested
Bit x = 0 Function not requested
• If more than one function is enabled, the values for all functions cannot be read until all functions have ended and this has been signaled via the relevant status bit (G1_ZSW, Bit 0 - Bit 3 = 0).
• On-the-fly measurement
The rising and falling edges of the measuring input can be enabled simultaneously. The measuring input signal is detected according to the direction of the signal change. The measured values are read out consecutively.</td></tr>
<tr><td rowspan="4">Command</td><td>Bits 6, 5, 4</td><td>Meaning</td></tr>
<tr><td>000</td><td>--</td></tr>
<tr><td>001</td><td>Enable function x</td></tr>
<tr><td>010
011</td><td>Read value x
Cancel function x</td></tr>
<tr><td>Mode</td><td>0
1</td><td>Find reference mark
On-the-fly measurement</td></tr>
<tr><td>15</td><td colspan="2">Acknowledge encoder error</td><td>0
1</td><td>--
Acknowledge encoder error</td></tr>
</table>

Note

Measurement on rising or falling edge

IM 174 only supports measurement on a rising or falling edge.

Additional encoder actual value Gx_XIST2

Error codes in Gx_XIST2 where G1_ZSW, Bit 15 == 1

Table 5- 2 Error codes in Gx_XIST2

G1_XIST2	Meaning	Possible causes / description
1_{Hex}	Encoder sum error	The encoder signal levels are too low, faulty (inadequate shielding) or open-circuit monitoring has been tripped.
2_{Hex}	Zero mark monitoring	A fluctuation in the measured rotor position has arisen between two encoder zero marks (encoder pulses may be lost).

Status word ZSW_1 - Bit 11 to Bit 14

Description of the status word ZSW_1 with regard to the module-specific messages Bit 11 to Bit 14:

Table 5- 3 Status word ZSW_1

Bit	Identifier	Description
11	Temperature error	A specific temperature in the housing of module IM 174 has been exceeded.
12	PLL synchronization error	The IM 174 cannot be synchronized with the global check-back signal.
13	Master life sign error	The IM 174 cannot be synchronized with the master life sign signal.
14	Drive error	A drive error exists, for example the Drive ready signal is missing.

5.6.4 Assigning process image partition

Process image partition

Under the "Configuration > Details" tab you can configure the address range for the input and output parameters and the process image partition.

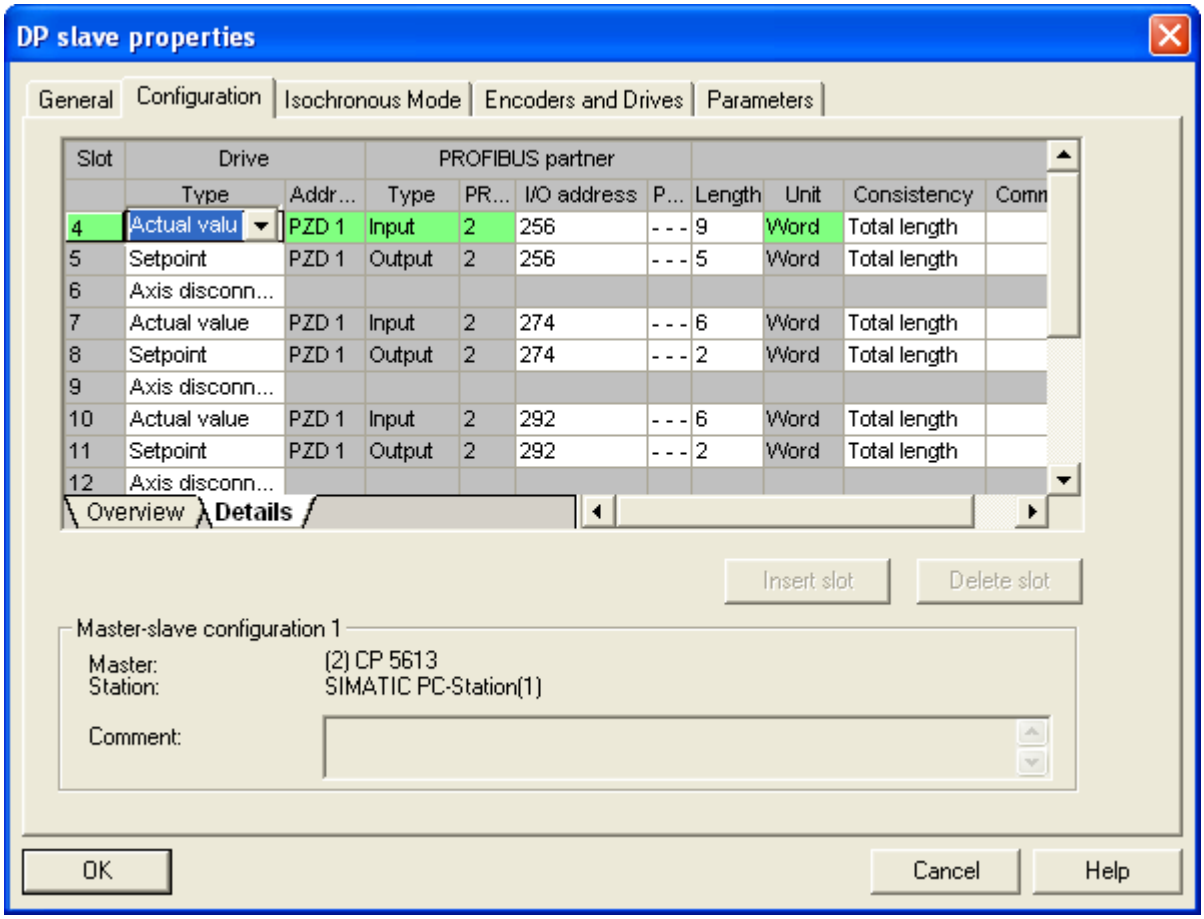


Figure 5-2 Configuration > Details tab

Assigning process image partition

To assign the address ranges and the process image partition, proceed as follows:

1. In the "DP Slave Properties" dialog box, select the "Configuration > Details" tab.
2. Carry out the required changes in the "I/O address" and "process image" columns.
   - In the "I/O address" column, establish in which input address of the control the data should be written. For the CPU to read the data, the address must be located in the process image of the CPU.

     Changes to the I/O address should therefore only be made if you have sufficient programming knowledge.
   - In the "I/O address" column, establish in which output address of the CPU the data should be written.

     Changes to the I/O address should therefore only be made if you have sufficient programming knowledge.
   - Allocate the data to a process image partition under the "Process image" column.

     This is only essentially if using a SIMATIC S7 controller in isochronous mode.
     If you are using a technology CPU or an FM 458, you do not require this setting.
3. Confirm with "OK".

5.7 Function parameters - "Encoders and drives" tab

5.7.1 Function parameters for SIMOTION and SIMATIC S7-300 CPU

Parameter

In addition to the drive and encoder parameters, further function-specific parameters of the IM 174 DP slave are set via the "Encoders and drives" tab:

- Drive type
- Encoder type
- Speed calculation
- Normalization speed

The figure below shows the corresponding dialog box with sample values for the various drive and encoder types and further function-specific parameters.

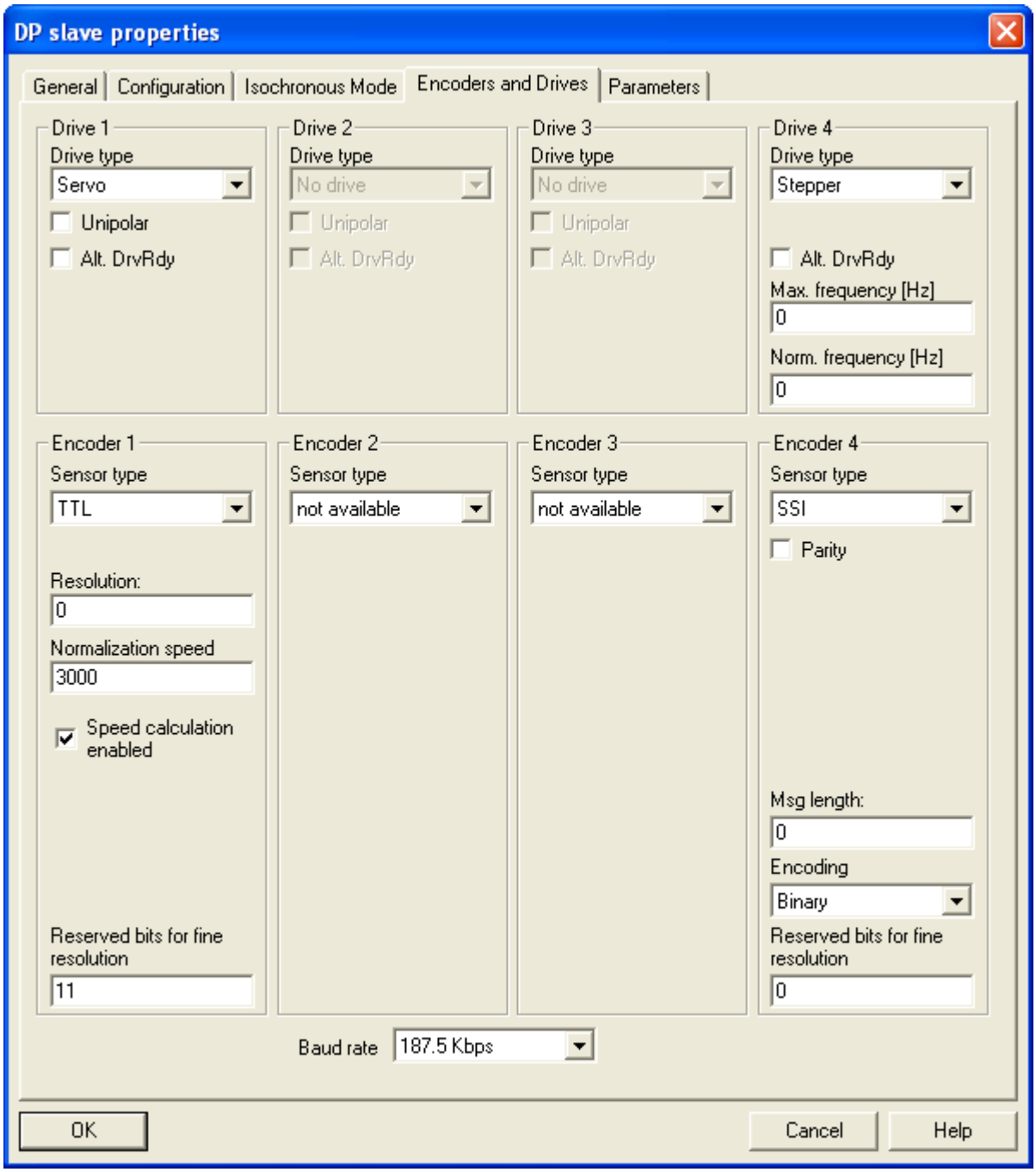


Figure 5-3 "DP Slave Properties" dialog box, "Encoders and drives" tab

5.7.2 Drive parameters

You can select the following drive types:

- Servo (analog drive)
- Stepper (stepper drive)

Servo drive type

If you have selected the servo drive type, you can switch the voltage range of the analog output voltage via the "Unipolar" check box.

Unipolar not selected

If the "Unipolar" check box is **not** selected, an analog voltage in the range of **-10 V** to **+10 V** is output as the setpoint. The drive can then be traversed in two directions.

Unipolar selected

If the "Unipolar" check box **is selected**, an analog voltage in the range of **0 V** to **+10 V** is output as the setpoint. The direction of rotation is then output from the IM 174, depending on the current speed setpoint, via a digital output of the IM 174:

- Direction of rotation signal for Axis 1 -> Digital output X11, Pin 13
- Direction of rotation signal for Axis 2 -> Digital output X11, Pin 15
- Direction of rotation signal for Axis 3 -> Digital output X11, Pin 17
- Direction of rotation signal for Axis 4 -> Digital output X11, Pin 19

Note

Unipolar function

The unipolar function (or unipolar motor) is not available for SIMATIC Technology CPU and SIMOTION.

Alt.DrvRdy

Depending on the drive you use, the Drive Ready signal returns different status messages:

- The drive signals "Ready for switching on" with the Drive Ready signal.
  An enable from the controller is still required to switch the drive on.
- The drive signals "Ready" with the Signal Drive Ready signal.
  The drive is ready for control in this state and directly follows a setpoint.

Do **not** activate the "Alt.DrvRdy" function when the drive signals "Ready for switching on" with a Drive Ready signal (mostly with analog drives).

Activate the "Alt.DrvRdy" function when the drive signals "Ready" with a Drive Ready signal (mostly with servo drives).

Information on which status message the drive you use returns can be found in the product information for your drive.

Stepper drive type

The necessary power electronics (e.g. FM Stepdrive) and the stepper motor are required for the operation of a stepper motor on the IM 174.

The basic structure of an IM 174 with stepper drives and without encoders is shown in the following figure:

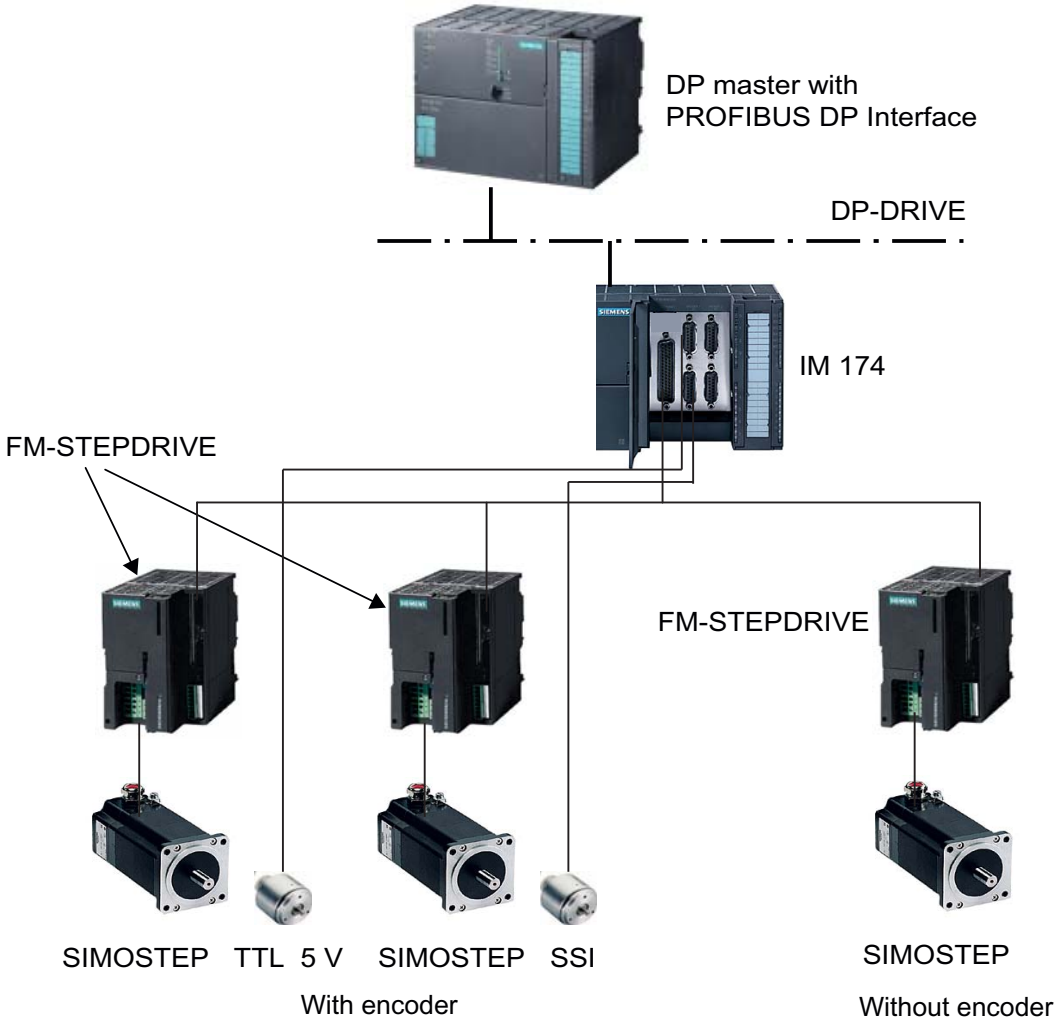


Figure 5-4 Basic structure of an IM 174 with FM STEPDRIVE and SIMOSTEP motor

Alt.DrvRdy

Depending on the drive you use, the Drive Ready signal returns different status messages:

- The drive signals "Ready for switching on" with the Drive Ready signal. An enable from the controller is still required to switch the drive on.
- The drive signals "Ready" with the Signal Drive Ready signal. The drive is ready for control in this state and directly follows a setpoint.

Do **not** activate the "Alt.DrvRdy" function when the drive signals "Ready for switching on" with a Drive Ready signal (mostly with analog drives).

Activate the "Alt.DrvRdy" function when the drive signals "Ready" with a Drive Ready signal (mostly with servo drives).

Information on which status message the drive you use returns can be found in the product information for your drive.

Max. frequency [Hz] and norm. frequency [Hz]

In the fields

- "Max. frequency [Hz]" (maximum frequency) and
- "Norm. frequency [Hz]" (nominal frequency)

you must enter drive-specific or process-specific frequency values [Hz].

Note

The maximum calculated motor speed and the nominal motor speed also need to be entered in S7 Technology or SIMOTION and/or in the higher-level controller.

To do this, you need to adjust the following variables in S7-Technology or SIMOTION:

For the maximum speed

Achse_1.TypeOfAxis.SetPointDriverInfo.DriveData.maxSpeed

For the nominal speed

Achse_1.TypeOfAxis.SetPointDriverInfo.DriveData.nominalSpeed

The normalized speed may be identical with the maximum speed.

Calculation of the norm. frequency

The norm. frequency can be calculated using the following formula:

Norm. frequency [Hz] = n [rpm] / 60 * resolution on the stepper motor

n [rpm]:	Speed of the stepper motor (characteristic values lie between 500 and 1000 rpm)
Resolution on the stepper motor:	Number of increments on the stepper motor (characteristic values: 500, 1000, 5000)

Calculation of the max. frequency

The max. frequency is calculated according to the following formula:

Max. frequency [Hz] = n_{max} [rpm] / 60 * resolution on the stepper motor

n_{max} [rpm]:	Maximum speed of the stepper motor (characteristic values lie between 500 and 1000 rpm)
Resolution on the stepper motor:	Number of increments on the stepper motor (characteristic values: 500, 1000, 5000)

The maximum speed n_{max} can be calculated from the characteristic operational characteristic for

stepper motors. The technologically required torque M_t is

used to determine a maximum speed n_{max} of the motor, which corresponds to a maximum

velocity of the axis.

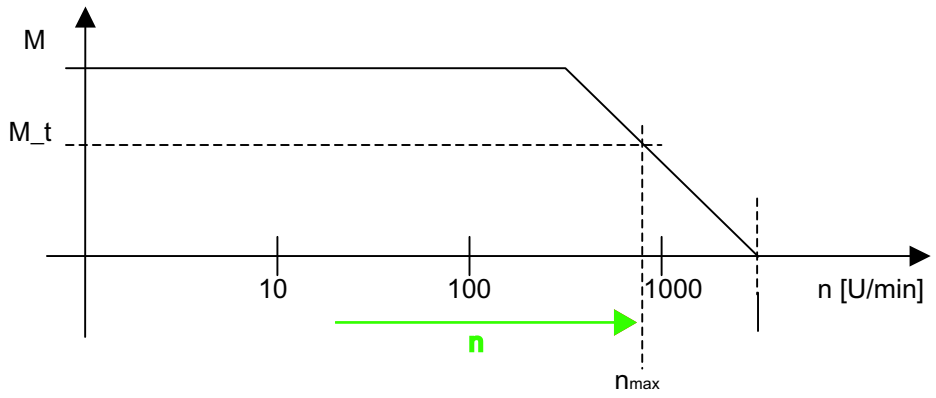


Figure 5-5 Characteristic operational characteristic of a stepper motor

Note

Overload range

To avoid operating in the overload range, use the drive only at norm. frequency!

Description of the behavior of a stepper motor

The positioning accuracy, the speed n as well as the torque M produced by the motor are very important for the process-specific requirements. For the optimum determination of these values, the behavior of the stepper motor must be considered. From a given speed of rotation of the stepper motor (around 500 rpm), the torque produced by the motor drops logarithmically, and approaches zero at a maximum speed (around 3000 rpm). The specific data can be found in the data sheet for the motor used.

Consequences of operation in the overload range

If the stepper motor is ever unable to produce the requested torque, it loses synchronization with the predefined frequency and its speed drops suddenly. This can lead to standstill. In this state, motion cannot be resumed unless a setpoint of 0 is entered in the meantime. For a position axis without additional encoders, the traversing position and thus synchronization of the axis are lost.

Note

Stepper drive with "Stepper" encoder type (PULSE REFEED operation)

During operation with a "Stepper" encoder type (PULSE REFEED operation), the stepper motor may vibrate at standstill.

This occurs with the default parameterization of a project when the stepper is traversed in a preceding traversing motion to a position value which is exactly between two natural step divisions of the stepper.

Example

Linear positioning axis with 10 mm leadscrew pitch

- Drive:

  FM-STEPDRIVE

- Settings:

  1000 steps per revolution

  Step resolution 0.010 mm

  Positioning to 1.12x mm

Step

The stepper motor vibrates between the positions 1.12 and 1.13.

Remedy

The following settings must be made to suppress the vibration of the stepper motor:

Therefore, change the following default values:

- In HW Config in the IM 174 object manager (slave OM):
  - Reserved bits for fine resolution = 0
- In the configuration data in S7T Config:
  - IncEncoder.incResolutionMultiplierCyclic = 1
- In the configuration data in S7T Config
  - TypeOfAxis.CommandValueQuantization = YES

With these settings, the axis remains stable at the target position which is closest to the corresponding step position of the stepper.

Stepper drive with TTL/SSI encoders

When using TTL/SSI encoders, the ratio of the encoder resolution (incl. fine resolution) to the step resolution of the stepper must be taken into account.

To prevent vibration between two position values at standstill, the stepper increment distance must be less than the distance representation in the encoder feedback (i.e. the increment of the stepper must be greater than the encoder resolution).

If necessary, encoders with a lower resolution must be used or a higher step resolution set on the stepper.

5.7.3 Encoder parameters

The following encoder types can be selected for analog drives

- Encoder type not available
- Encoder type TTL
- Encoder type SSI

The following encoder types can be selected for stepper drives

- Encoder type not available
- Encoder type TTL
- Encoder type SSI
- Encoder type stepper

Encoder type "not available"

The following applies for the **"Servo" drive type**:

Axis x is not available or should not be operated. Useful data transmitted for this axis in the PROFIBUS message frame are empty.

The following applies for the **"Stepper" drive type**:

The stepper is operated without an encoder.

If the stepper is parameterized for encoderless operation, only the use as a speed-controlled axis is possible within the SIMATIC (Technology CPU) or SIMOTION. Operation as a positioning axis or synchronized axis requires an actual value.

If no encoder (SSI/TTL) iis used, the encoder type stepper can be selected to enable operation as a positioning/synchronized axis even if no encoder is connected.

See also "Encoder type stepper" in this chapter.

Encoder type TTL

In the case of encoder type "TTL" you can set the following encoder parameters:

- Resolution

  Encoder resolution in encoder pulses per encoder revolution

- Enabling the speed calculation

  The IM 174 calculates the speed if the checkbox is enabled.

- Normalization speed
  This input box is only visible if the "Rotary speed calculation enabled" option is set.
  Enter the nominal speed of the motor in revolutions per minute.

- Reserved bits for fine resolution

  Setting: 0 - 15

  The "Reserved bits for fine resolution" parameter specifies the desired pulse multiplication of the encoder increments transmitted in actual encoder value G1_XIST1.

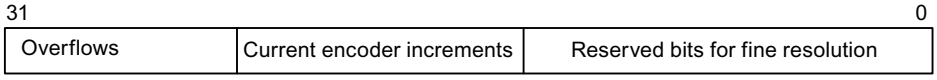
  The setting corresponds to a pulse multiplication between 2^0 = 1 to 2^{15} = 32768.

Note

Minimum fine resolution for TTL encoders

A minimum fine resolution of 2^2 (= 4) must always be taken into account and set for TTL encoders.

Transmitted actual encoder value G1_XIST1



Spindles with low-resolution encoder

In the case of spindles with a low-resolution encoder, the actual-value characteristic (incrementing) may be displayed in a non-linear fashion. The incrementing that is visible on the actual-value display is the result of the speed resolution (RR), where:

- Tdp (position-control cycle = PROFIBUS cycle clock): [ms]
- ER (encoder resolution): [Encoder pulse / revolution]
- PM (pulse multiplication)
- RR: 60000 / (Tdp * ER * PM)
- RR (speed resolution): [(revolutions/min) / encoder pulse]

Example

- Tdp (position-control cycle = PROFIBUS cycle clock): 2 ms
- ER (encoder resolution): 2500 pulses per revolution
- PM (pulse multiplication): 4
- RR = 60000 / (2 * 2500 * 4) = 3 (revolutions/min) / encoder pulse

Encoder type SSI

Encoder parameters:

- Parity

  Select this check box if the encoder data are to be transmitted from the encoder to the IM 174 with a parity bit.

- MsgLength

  Setting: 0 - 25

  Number of useful data bits transmitted by the encoder

- Encoding

  The following encoder codes are supported:

  – Binary

  – Gray

- Baud rate

  The following baud rates are supported:

  – 187.5 Kbps

  – 375 Kbps

  – 750 Kbps

  – 1.5 Mbps

  – 3.0 Mbps

  Note

  Configure a maximum of 187.5 Kbps. It is not practical to set a quicker transmission rate for this module.

- Reserved bits for fine resolution

  Setting: 0 - 15

  The "Reserved bits for fine resolution" parameter specifies the desired pulse multiplication of the encoder increments transmitted in actual encoder value G1_XIST1.

  The setting corresponds to a pulse multiplication between 20 = 1 to 215 = 32768.

  With G1_XIST2, the pulse multiplication is fixed at 0 bits (multiplication factor 1).

Encoder type stepper

Stepper drive during PULSE REFEED operation: An Axis x with the "Stepper" drive type can be operated with a "Stepper" encoder type. In this mode, the setpoints are signaled back as actual values from the IM 174 to the controller.

Parameter settings

- **Motor monitoring**

  If the "Motor monitoring" check box is activated, the number of steps of a stepper motor must be constantly monitored for a preset reference point distance (see "BERO distance"). In the case of encoderless operation, the stepper drive used simultaneously signals the actual values (pulse refeed).

  Note

  Activation of the motor monitoring

  In S7 Config or SIMOTION SCOUT, in addition to the motor monitoring, the TO axis configuration data "TypeofAxis.NumberOfEncoders.encoder_1.IncEncoder.enableZeroMonitoring" must be set to "Yes".

- **BERO distance**

  In the case of "BERO distance" the number of steps (for the stepper drive used) between two BERO signals is entered. The distance between the two BERO signals is the reference point distance.

- **BERO tolerance**

  Setting: 0 - 65535

  In the case of "BERO tolerance" the permissible deviation of the steps is entered. The resulting step range is within the following tolerance:
  Resulting step range = BERO distance ± 1/2 * BERO tolerance

  Example:

  BERO distance: 100 steps

  BERO tolerance: 20 steps

  Resulting step range: Between 90 and 110 steps

  The tolerance refers to the number of steps entered for "Bero distance" and the number of steps actually required (e.g. in the load case) by the stepper motor used for the reference point distance.

  Message:

  In the case of overshoot or undershoot of the specified tolerance, the IM 174 triggers the alarm Error 20005: Device type: 2, log. address: xxx faulted (Bit: 0, Reason: 0x100h) in S7T Config.

- **Reserved bits for fine resolution**

  Setting: 0 - 15

  The "Reserved bits for fine resolution" parameter specifies the desired pulse multiplication of the encoder increments transmitted in actual encoder value G1_XIST1.

  The setting corresponds to a pulse multiplication between 2^0 = 1 to 2^{15} = 32768.

5.7.4 Enabling the speed calculation

Validity

The speed calculation applies for positioning axes and external encoders.

You can activate speed calculation only for TTL encoders and at selection of Message frame 3.

Settings in S7T Config and HW Config

The calculated rotary speed or speed is transmitted by the drive (IM 174) to the technology object Positioning axis or External encoder by NIST_B at Message frame 3.

To this purpose the following settings are required in S7T Config:

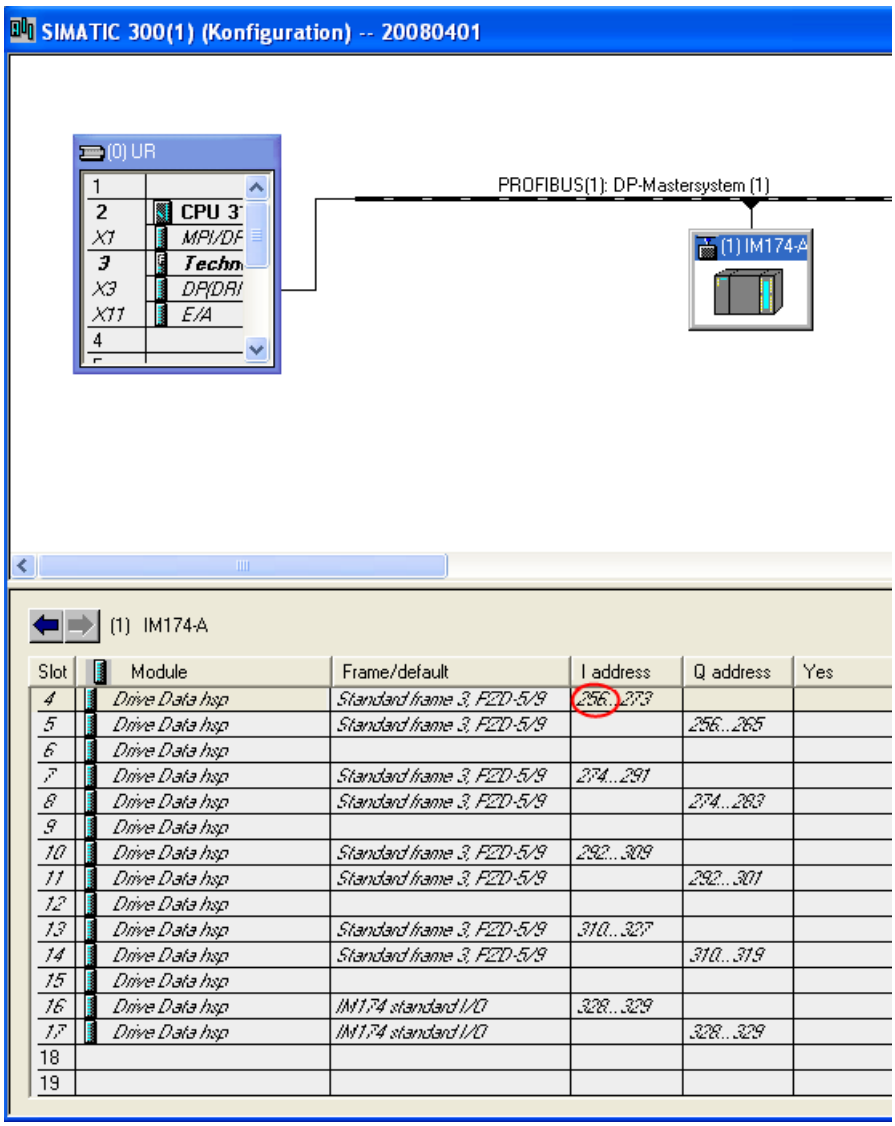
Positioning axis

1. Use the axis wizard to create a positioning axis for the drive IM 174.
   Note:
   Take the TTL encoder setting and the corresponding nominal speed of your motor into account.
2. Go to the expert list of the Technology Object Axis.
   In the configuration data
   TypeOfAxis -> SetPointDriverInfo -> DriveData -> **NominalSpeed,**
   enter the same nominal speed of your motor as is entered in the slave OM.

The speed calculation is now carried out by the drive (IM 174).

External encoder

1. Use the axis wizard to create an external encoder for the drive IM 174.
   Note:
   Take the TTL encoder setting and the corresponding nominal speed of your motor into account.
2. Go to the expert list of the external encoder.
   In the configuration data
   TypeOfAxis -> Encoder_x **-> EncoderValueType,**
   select the value**Position and Direct_NIST_B (3)** .
   It is on the same level as the new configuration data **SensorNIST**.
   Under **ReferenceValue**, enter the same nominal speed of your motor which you have already entered in the Slave OM.
3. From HW Config select the e-address of the encoder, (e.g. 256, see screenshot) and add 2.
   Enter the new value (e.g. 258) under **LogAdress** in the configuration data **SensorNIST**.



Slot	Module	Frame/default	I address	Q address	Yes
4	Drive Data hsp	Standard frame 3, PZD-5/9	256...273		
5	Drive Data hsp	Standard frame 3, PZD-5/9		256...265	
6	Drive Data hsp				
7	Drive Data hsp	Standard frame 3, PZD-5/9	274...291		
8	Drive Data hsp	Standard frame 3, PZD-5/9		274...283	
9	Drive Data hsp				
10	Drive Data hsp	Standard frame 3, PZD-5/9	292...309		
11	Drive Data hsp	Standard frame 3, PZD-5/9		292...301	
12	Drive Data hsp				
13	Drive Data hsp	Standard frame 3, PZD-5/9	310...327		
14	Drive Data hsp	Standard frame 3, PZD-5/9		310...319	
15	Drive Data hsp				
16	Drive Data hsp	IM174 standard I/O	328...329		
17	Drive Data hsp	IM174 standard I/O		328...329	
18					
19					

Figure 5-6 I address in HW Config

The speed calculation is now carried out by the drive (IM 174).

5.7.5 Homing using external zero mark

System structure

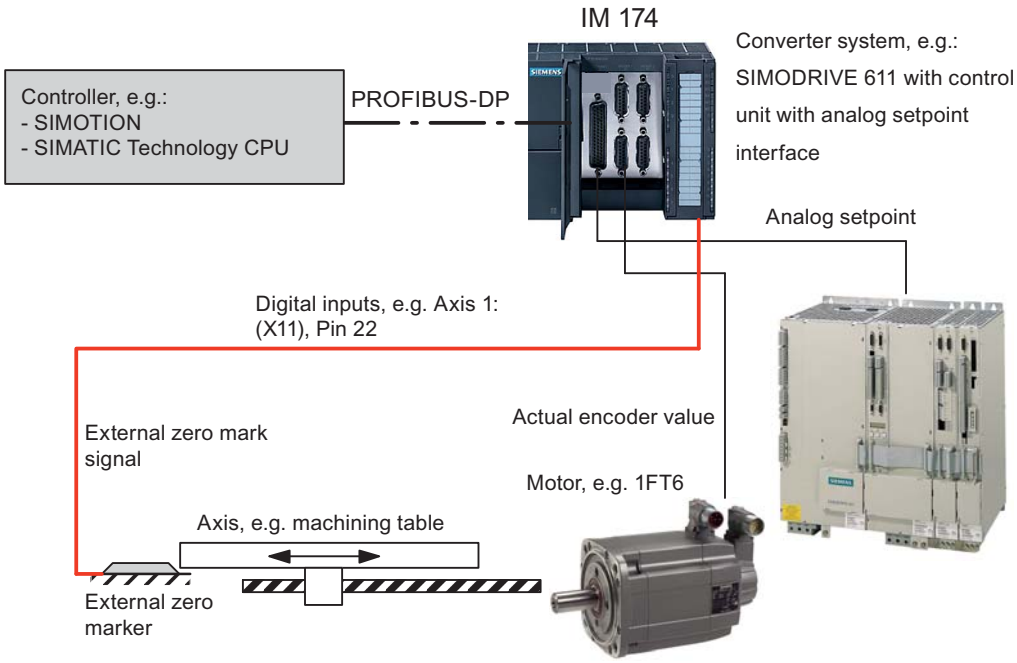


Figure 5-7 Basic system structure: Homing using external zero mark

Function

Once the controller requests homing, the IM 174 transmits the actual encoder value to the controller as the home position the next time it detects an external zero mark signal.

Note

Simultaneous measuring and homing

With the IM 174, the simultaneous execution of an MC_MeasuringInput job and an MC_Home job is not possible.

Note

Required mode

Homing using an external zero mark requires 611U conformant mode to be selected.

If SIMOTION / S7Technology is to reference using external zero markers, the 611U conformant mode must also be chosen.

With 611U conformant mode

The relevant signal for the axis to be homed (e.g. Axis 1) must be set in the digital output word:

- Digital output word:
  Bit 8: = 1 => "Axis 1: Rising edge of External zero mark 1 (X11, Pin 22)"

5.7.6 Homing using encoder zero mark

System structure

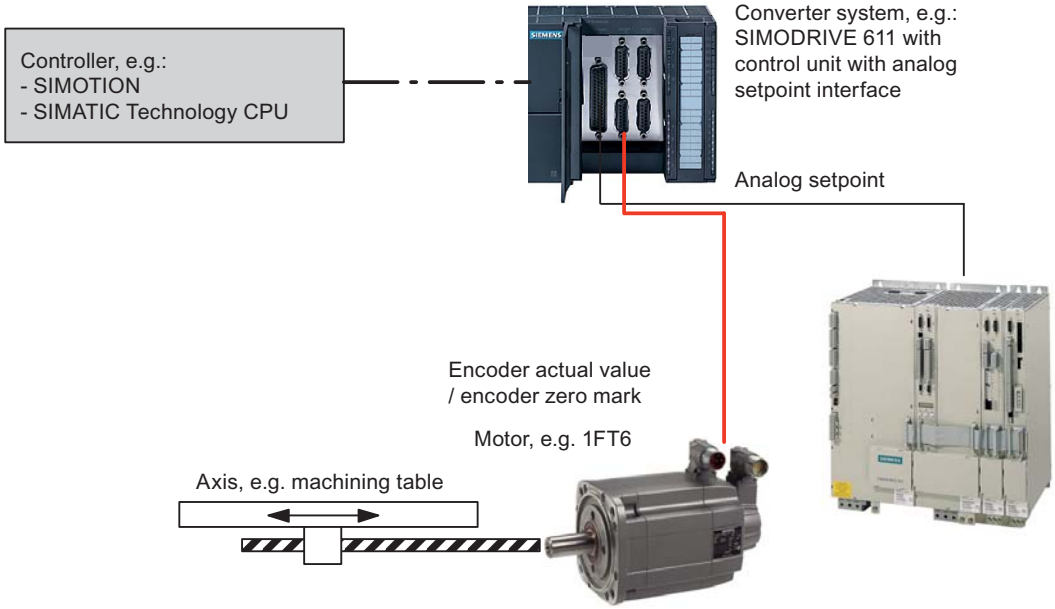


Figure 5-8 Basic system structure: Homing using encoder zero mark

Transfer of the encoder actual values

Once the controller requests homing, the IM 174 transmits the actual encoder value to the controller as the home position the next time it detects an encoder zero mark.

Note

Simultaneous measuring and homing

With the IM 174, the simultaneous execution of an MC_MeasuringInput job and an MC_Home job is not possible.

Without 611U conformant mode

No further measures are required.

With 611U conformant mode

The relevant signal for the axis to be homed (e.g. Axis 1) must be set in the digital output word:

- Digital output word:
  Bit 8: = 0 => "Axis 1: Zero mark of Encoder 1 (X3)"

Effect of the cabling on homing (Page 56)

5.7.7 Homing using encoder zero mark and homing output cam

System structure

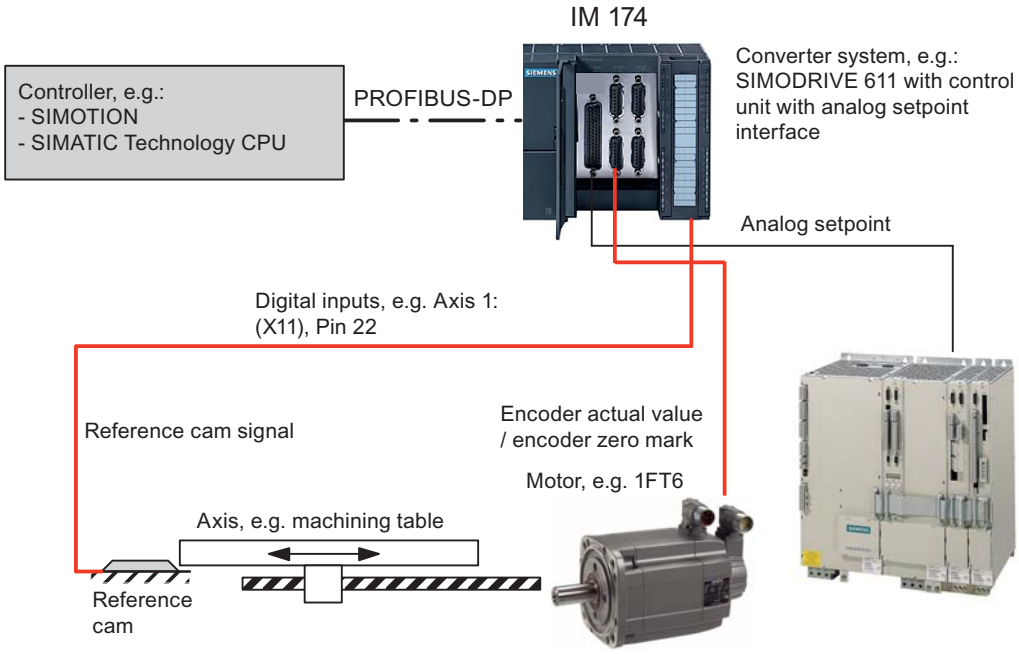


Figure 5-9 Basic system structure: Homing using encoder zero mark and homing output cam

Function

The homing output cam signal must be connected to a digital input on the IM 174 (X11, Pins 22 to 25). The homing output cam signal is processed in the controller as part of the homing operation.

Once the homing output cam signal is detected, the controller reduces the axis velocity to the homing approach velocity and requests the IM 174 to home to the next encoder zero mark. Once the request is detected, the IM 174 transmits the actual encoder value to the controller as the home position the next time it detects an encoder zero mark.

Note

Simultaneous measuring and homing

With the IM 174, the simultaneous execution of an MC_MeasuringInput job and an MC_Home job is not possible.

Without 611U conformant mode

No further measures are required.

With 611U conformant mode

The relevant signal for the axis to be homed (e.g. Axis 1) must be set in the digital output word:

- Digital output word:
  Bit 8: = 0 => "Axis 1: Zero mark of Encoder 1 (X3)"

Effect of the cabling on homing (Page 56)

5.7.8 Boundary conditions

Measuring input or on-the-fly measurement

IM 174 only supports measurement using a rising **or** falling edge of the measuring input. It is not possible to parameterize simultaneous measurement on a rising edge and a negative edge.

Actual speed value

The actual speed value (PZD2/3: NIST_B) contained in standard message frame 3 (see table "Message frame structure" in the "Message frame type" section) is not supported by the IM 174. The IM 174 calculates the actual speed value and writes this in the value NIST_B.

Note

Calculating the actual speed value

To calculate the actual speed value, in the "Encoders and drives" tab of the slave OM, enable the "Actual speed value enabled" check box for each TTL encoder individually.

External encoder interface (encoders without an axis)

A maximum of 4 external encoders can be configured. However, Message frame 81 has to be selected.

The following applies for Message frame 3:

If encoders are connected to the IM 174 without at least one axis being parameterized, i.e. the IM 174 uses the encoder as an external encoder interface only, a "Ready" signal (interface X11, Pin 10/11) will not be output. For information on the "Ready" signal, refer to section "Interface (X11): Digital outputs".

5.7.9 Boundary conditions for SIMATIC Technology CPU

Homing using external zero mark

Homing always occurs at a rising edge, irrespective of which external zero mark edge (rising or falling) was selected for homing in S7T Config.

Access to I/O data

The I/O data of the IM 174 can only be accessed from the user program using the I/O image of DP(DRIVE). This requires that the I/O data be within the address range of 0 to 63. The I/O data are accessed using the "MC_ReadPeriphery" and "MC_WritePeriphery" technology functions.

5.7.10 Boundary conditions for SIMOTION

Error 20005

In conjunction with an IM 174 DP slave, the following message is displayed when the SIMOTION C230 switches from RUN to STOP mode:

- Error 20005: Device type: 1/2, log. address: x faulted. (Bit: 0, Reason: 0x...)

The message can be ignored.

This message is automatically deleted by the system the next time there is a transition from STOP to RUN mode.

Homing using external zero mark

Homing always occurs at a rising edge, irrespective of which external zero mark edge (rising or falling) was selected for homing in SIMOTION.

5.8 Function parameters - Parameters tab

5.8.1 Shutdown ramp

Shutdown ramp

Setting: 0 - 65535 ms

The "Shutdown ramp" parameter specifies a function that is linear with respect to time. If an error is detected, all drives that are connected to the IM 174 are decelerated down to setpoint 0 in accordance with this function.

The shutdown ramp takes effect for the following errors:

- Temperature alarm of the module (approx. 90° C ON, approx. 85° C OFF)
- Sign-of-life error
- Synchronization error between master and slave

Note

Parameter value 0

A parameter value of 0 causes the drive to coast to a standstill when an error occurs.

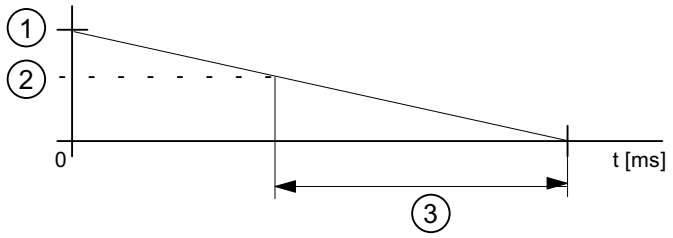


Figure 5-10 Parameters: Shutdown ramp

① Maximum setpoint
② Current setpoint
③ Parameter value: Shutdown ramp

5.8.2 Shutdown delay time

Shutdown delay time parameter:

Setting: 0 - 65535 s

The "Shutdown delay time" parameter can be used to specify a time after which, after a **temperature alarm** has occurred, the shutdown ramp is activated.

The shutdown delay time is is started when a temperature of 90° C is exceeded in the module.

If the temperature drops to approx. 85° C while the delay time is active, the shutdown ramp is not activated and the shutdown delay time is reset.

5.8.3 Tolerable sign-of-life errors

"Tolerable sign-of-life errors" parameter

Setting: 0 - 15

The "Tolerable sign-of-life errors" parameter specifies the number of sign-of-life errors tolerated for the DP master. The shutdown ramp is activated when the parameterized number is exceeded.

5.8.4 611U conformant mode

Setting options

In 611U conformant mode, the signal source for homing of axes is no longer specified using the PROFIDrive standard message frame (STD3, encoder control word G1_STW), but rather using the additional digital output word in the PROFIBUS message frame of the IM 174 (see table "Message frame structure" in the "Message frame type" section).

611U conformant mode:

- Not selected
  The signal source for homing is specified via the encoder control word Gx_STW in the PROFIDrive standard message frame.
- Selected
  The signal source for homing is specified via the additional digital output word in the PROFIBUS message frame.

Digital output word

The signal sources for the homing are selected on an axis-specific basis via the following bits of the output word (see also output word in the table "Message frame structure" in the "Message frame type" section)

Table 5- 4 Output word: signal sources for homing

Bit	Value	Signal source for homing
8	0	Axis 1: Zero mark of Encoder 1 (X3)
	1	Axis 1: **Rising** edge of External zero mark 1 (X11, Pin 22)
9	0	Axis 2: Zero mark of Encoder 2 (X4)
	1	Axis 2: **Rising** edge of External zero mark 2 (X11, Pin 23)
10	0	Axis 3: Zero mark of Encoder 3 (X5)
	1	Axis 3: **Rising** edge of External zero mark 3 (X11, Pin 24)
11	0	Axis 4: Zero mark of Encoder 4 (X6)
	1	Axis 4: **Rising** edge of External zero mark 4 (X11, Pin 25)

If the 611U conformant mode has been parameterized for an axis to be homed, the axis-specific signal for selection of the signal source must be set in the digital output word of the IM 174 from the PLC user program, before the "Find reference mark" function is requested in the encoder control word.

The following sections show the basic system structure and the respective boundary conditions of the individual homing methods.

SIMOTION

With 611U conformant mode

- For homing of an axis using an encoder zero mark and an external zero mark the appropriate axis-specific bit must be set to 0 (encoder zero mark) in the digital output word by the PLC user program.
- The signal source for homing can be switched during operation.

Without 611U conformant mode

- Homing is always performed in relation to the zero mark of the encoder.

SIMATIC Technology CPU

The following options are available for using 611U conformant mode with signal source selection:

- Use the "output cam" technology object for signal source selection. To do so, configure an output cam in S7T Config with its output pointing to the relevant bit address for selection of the signal source on the corresponding axis.
- You place the address of the additional data word in the IM 174 message frame in the DP(DRIVE) I/O image. This address is placed using the "MC_ReadPeriphery" and "MC_WritePeriphery" technology functions. The address of the data word must be adapted manually for the module in HW Config; it must be within the address range of 0 to 63 bytes.

Exiting the dialog box

If the "DP Slave Properties" dialog box is exited with "OK", the data are accepted and the dialog box is closed.

5.9 Parameterization of the DP communication - "Isochrone operation" tab

5.9.1 Parameterization of the equidistant cyclic DP communication

Steps to be taken

Once all the intended DP slaves have been inserted in the configuration and their function parameters have been assigned as described (Step 1), parameters are assigned for the equidistant cyclic DP communication (Step 2).

Parameters are also assigned to the equidistant cyclic DP communication in two steps:

Step 1

- Activation of the equidistant DP cycle
- Equidistant master cyclic component T_{DX}

Step 2

- Equidistant DP cycle T_{DP}
- DP cycle T_{DP}
- Master application cycle T_{MAPC}
- Actual value acquisition T_i
- Setpoint acceptance T_o

Note

When assigning parameters for DP communication, you must observe the boundary conditions applicable to the individual parameters.

5.9.2 Activation of the equidistant DP cycle

Equidistant DP slave types of the same type

It is recommended that the equidistant DP cycle be enabled for all IM 174 DP slaves by enabling the equidistant DP cycle for the selected IM 174 DP slave, and then performing an alignment.

During an alignment, all values displayed in the "DP Slave Properties" dialog box, "Isochrone Mode" tab are transferred to all DP slaves of the same type, IM 174 DP slave here, of the configuration.

Procedure

1. Double-click an IM 174 DP slave.

   In the station window of HW Config, the dialog box: "DP Slave Properties" opens.
2. In the dialog box: "DP Slave Properties", open the "Isochrone mode" tab.
3. Select the "Synchronize drive with equidistant DP cycle" check box ☑
4. Click "Match".

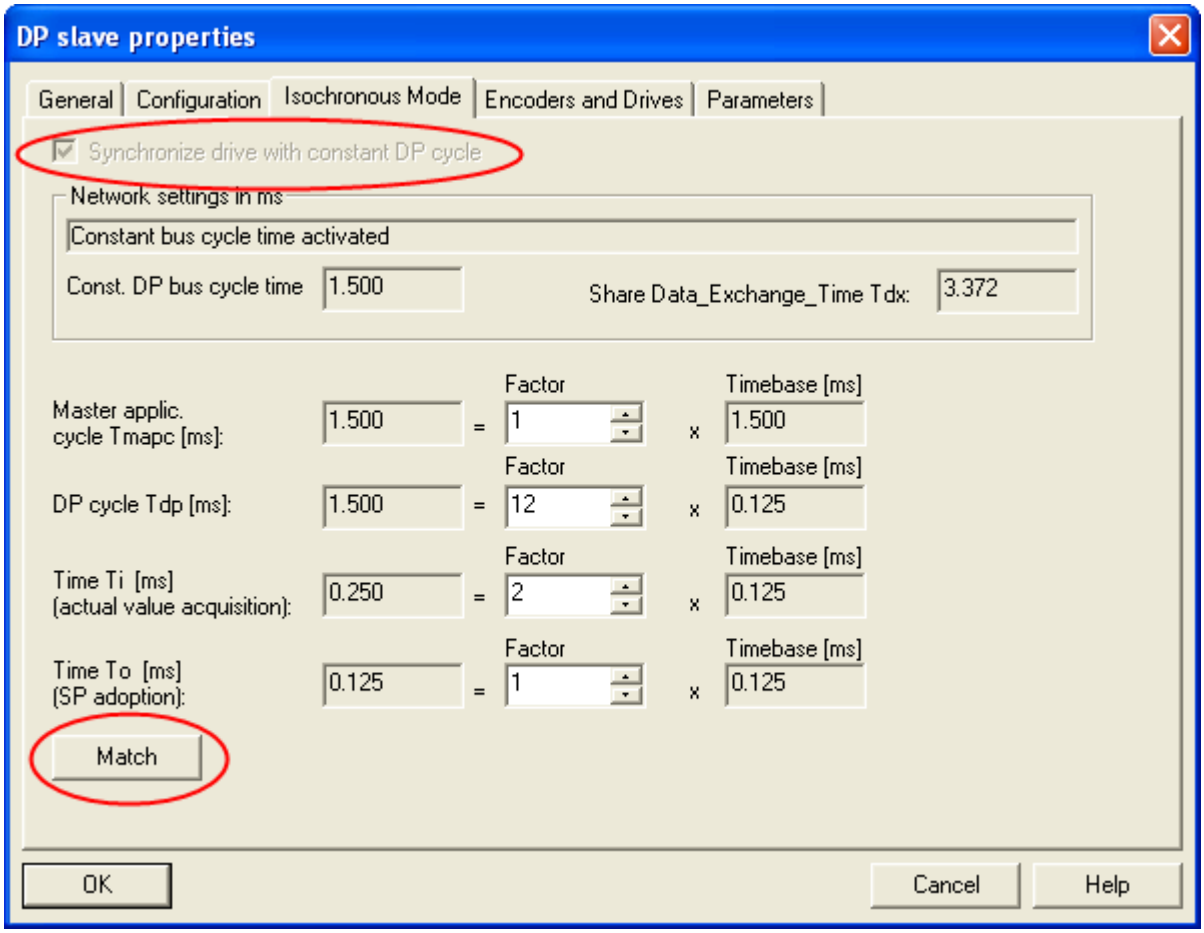


Figure 5-11 "DP Slave Properties" dialog box

Equidistant DP slave types of the same type

If there are different equidistant DP slave types (for example, different SIMODRIVE drives, IM 174, etc.) in an S7 project, the steps

- Synchronize drive to equidistant DP cycle
- Perform alignment

must be performed for each type of DP slave first before you can continue to set the other parameters.

5.9.3 Equidistant master cyclic component TDX

Introduction

Once synchronization to the equidistant DP cycle has been enabled for all DP slaves, the time required for the cyclic component of the DP communication must be recalculated.

The calculation is performed automatically by the DP master each time the equidistant bus cycle is enabled. This is performed in the following dialog box by selecting/clearing the "Activate constant bus cycle time" check box.

Procedure

1. In the "DP Slave Properties" dialog box, open the "General" tab.
2. In the "Nodes / master system" group, click the "PROFIBUS..." button.
3. In the "Properties - IM 174 PROFIBUS Interface ..." dialog box, open the "Parameters" tab.
4. Click the "Properties..." button.
5. In the "PROFIBUS Properties" dialog box, open the "Network settings" tab.
6. Click the "Options..." button.
7. In the "Options" dialog box, open the "Constant Bus Cycle Time" tab.
8. Clear the "Activate constant bus cycle time" check box (see figure in the "Equidistant DP cycle T_{DP}" section)
9. Select the "Activate constant bus cycle time" check box (see figure in the "Equidistant DP cycle T_{DP}" section).

5.9.4 Equidistant DP cycle TDP

Introduction

When the cyclic component of the DP communication is calculated, the DP master automatically changes the value for the equidistant DP cycle to the maximum permissible time (32 ms). This change must be undone by re-entering the intended value for the equidistant DP cycle.

Procedure

1. Open the "Options" dialog box.
2. Select a "constant bus cycle time" for the "Constant DP Cycle" field.
3. Click "OK".
4. Click "OK" in the "Properties - PROFIBUS" dialog box.
5. Click "OK" in the "Properties - IM 174 PROFIBUS Interface" dialog box.

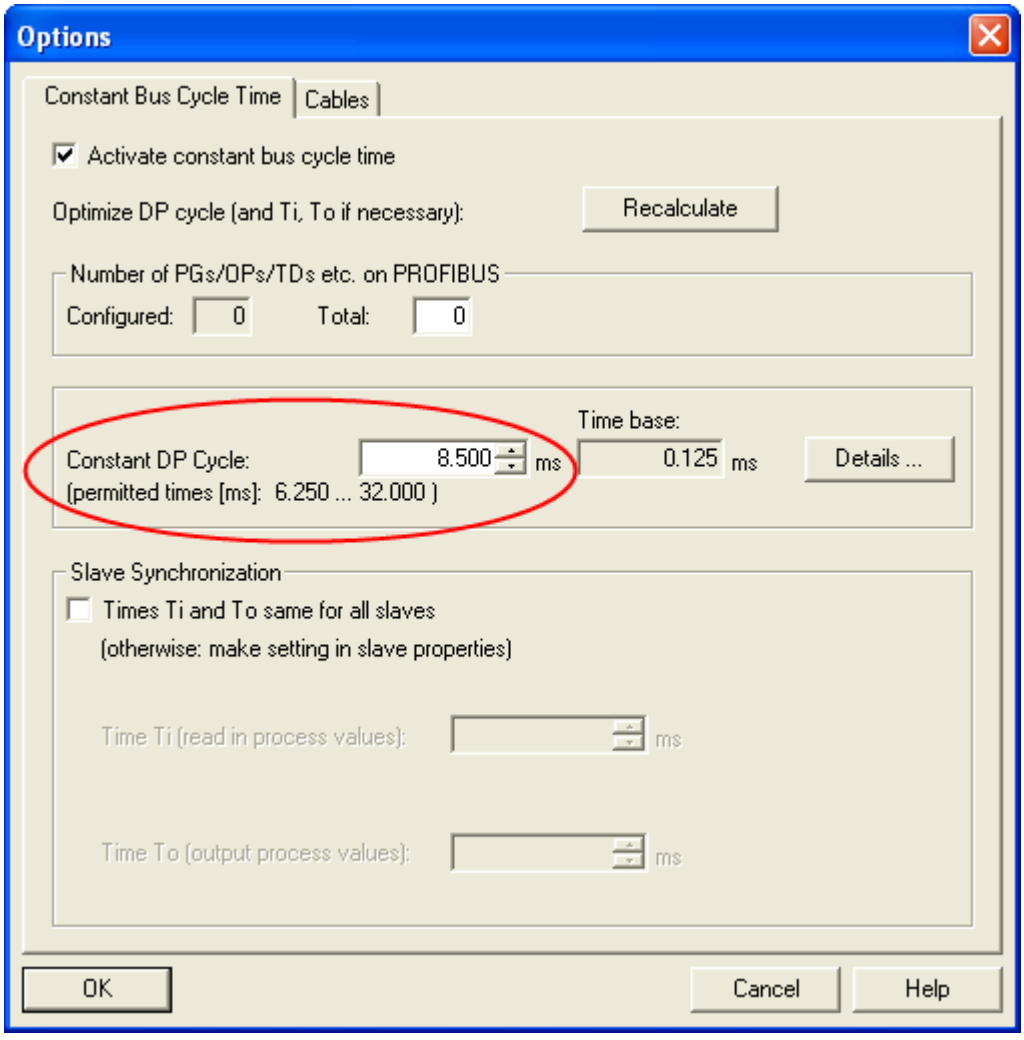


Figure 5-12 "Options" dialog box

5.9.5 DP cycle TDP

Procedure

1. In the "DP Slave Properties" dialog box, select the "Isochrone mode" tab.
2. Enter a < *factor* > in the "DP cycle TDP (ms)" input field.

Compliance of the DP cycle time

The DP cycle time ("DP cycle TDP" parameter) of the IM 174 DP slave must be set to the same value as the DP cycle time setting for the DP master ("Equidistant DP cycle" parameter):

DP cycle TDP = equidistant DP cycle

5.9.6 Master application cycle TMAPC

Introduction

The "Master application cycle T_{MAPC}" parameter specifies the integer ratio between the master application (position controller) and the equidistant DP cycle.

Using ratios other then 1:1, the dead times of the position controller can be reduced if control hardware of the lower performance range is used.

Procedure

1. In the dialog box: "DP Slave Properties", open the "Isochrone mode" tab.
2. Enter a < *factor* > in the "Master application cycle T_{MAPC} (ms)" input field.
   (See figure in the "Alignment" section.)

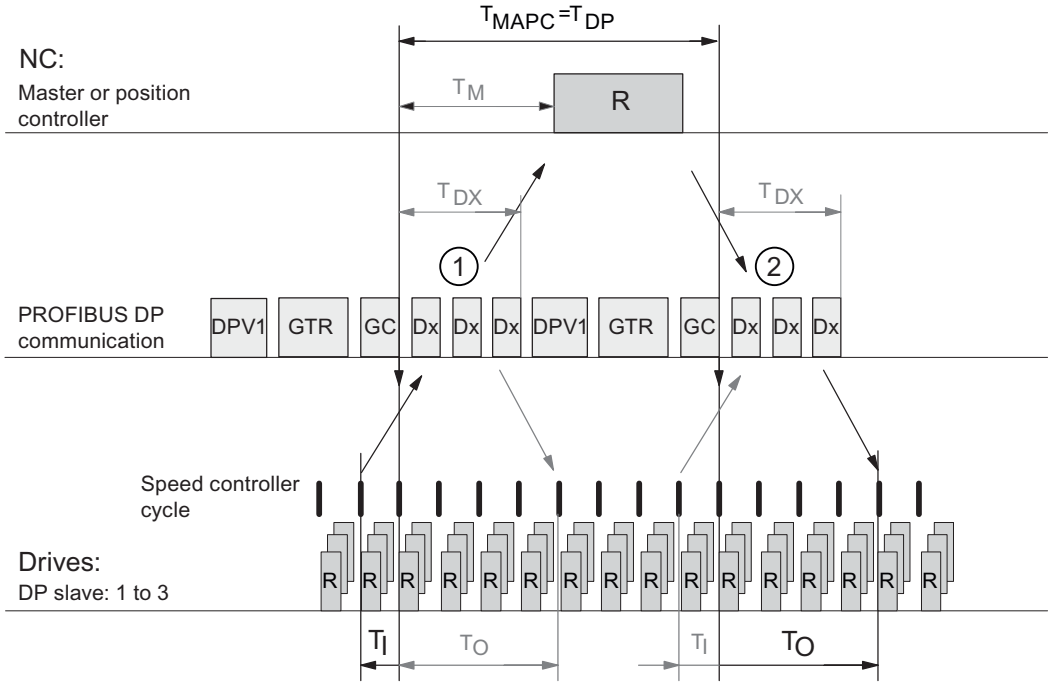


Figure 5-13 Example: Optimized DP cycle with T_{MAPC} : TDP = 1 : 1

Explanations for the figure:

T_{MAPC}	Master application cycle: Position control cycle
T_{DP}	DP cycle time: DP cycle time
T_{DX}	Data exchange time: Total transfer time for all DP slaves
T_M	Master time: Start time delay of the position control
T_I	Input time: Time of the actual value acquisition. The actual values are transferred to the DP master in the **next** DP cycle.
T_O	Output time: Time of the setpoint acceptance. The setpoints were generated by the DP master application in the **previous** DP cycle.
GC	Global control message frame (broadcast message frame) for cyclic synchronization of the equidistance between the DP master and DP slaves
R	Computation time for speed or position control
Dx	Useful data exchange between the DP master and DP slaves
DPV1	After cyclic communication, an acyclic service is sent, if the token holding time T_{TH} has not yet been exceeded. T_{TH} is calculated by the engineering system.

GTR GAP, TOKEN, RESERVE:
GAP: An attempt is made during GAP to accept new active stations.
TOKEN: The token passing is either to itself or other masters.
RESERVE: The reserve is used as an "active pause" for the station to send the token to itself until the equidistant cycle expires.

① The actual values for the current DP cycle / position control cycle are transferred from the DP slave drives to the position controller.

② The setpoints computed by the position controller are transferred to the DP slave drives.

Note

The ratio between master application cycle T_{MAPC} and DP cycle time T_{DP} **must** be 1:1.

5.9.7 Actual value acquisition Ti

Introduction

The "Actual value acquisition T_i" parameter specifies the time when an IM 174 DP slave reads in the actual values (actual position value).

It is recommended that the time of the actual value acquisition T_i be set the same for all IM 174 DP slaves, particularly if axes of different IM 174 DP slaves travel on the same path by interpolation.

The following condition must be observed for the time of actual value acquisition Ti:

DP cycle >= actual value acquisition >= base time

Procedure

1. In the dialog box: "DP Slave Properties", open the "Isochrone mode" tab.
2. Enter a < *factor* > in the "Actual value acquisition [ms]" input field.
   (See figure in the "Alignment" section.)

5.9.8 Setpoint acceptance To

Introduction

The Setpoint acceptance T_o parameter specifies the time when the IM 174 DP slave receives the speed setpoint from the position controller.

It is recommended that setpoint acceptance time T_o is the same for all IM 174 DP slaves, particularly if axes are interpolated together.

The following condition must be observed for the time of setpoint acceptance T_o:

DP cycle >= setpoint accept. >= equidist. master cycl. component + base time

Procedure

1. In the dialog box: "DP Slave Properties", open the "Isochrone mode" tab.
2. Enter a < *factor* > in the "Setpoint acceptance [ms]" input field (see figure in "Alignment" section).

5.9.9 Alignment

Equidistant DP slave types of the same type

With the alignment, the values displayed in the tab: "Isochrone mode" of the current IM 174 DP slave are transferred to all other IM 174 DP slaves of the configuration.

Procedure

1. Call the "Isochrone mode" tab in the "Properties - DP-Slave" dialog.
2. Click "Match".

The alignment only transfers the values displayed in the "Isochrone mode" tab to the DP slaves **of the same** type.

Equidistant DP slave types of different types

If an S7 project includes different equidistant DP slave types, such as different SIMODRIVE drives, IM 174, etc., the following parameter settings must be made for each DP slave type as described above, and an alignment must be performed:

- Master application cycle TMAPC
- Equidistant DP cycle TDP
- Actual value acquisition Ti
- Setpoint acceptance To

Procedure

1. Open the "Isochrone mode" tab in the "Properties - DP-Slave" dialog
2. Select the "Synchronize drive with equidistant DP cycle" option.
3. Adapt the parameters.
4. Click "Match".

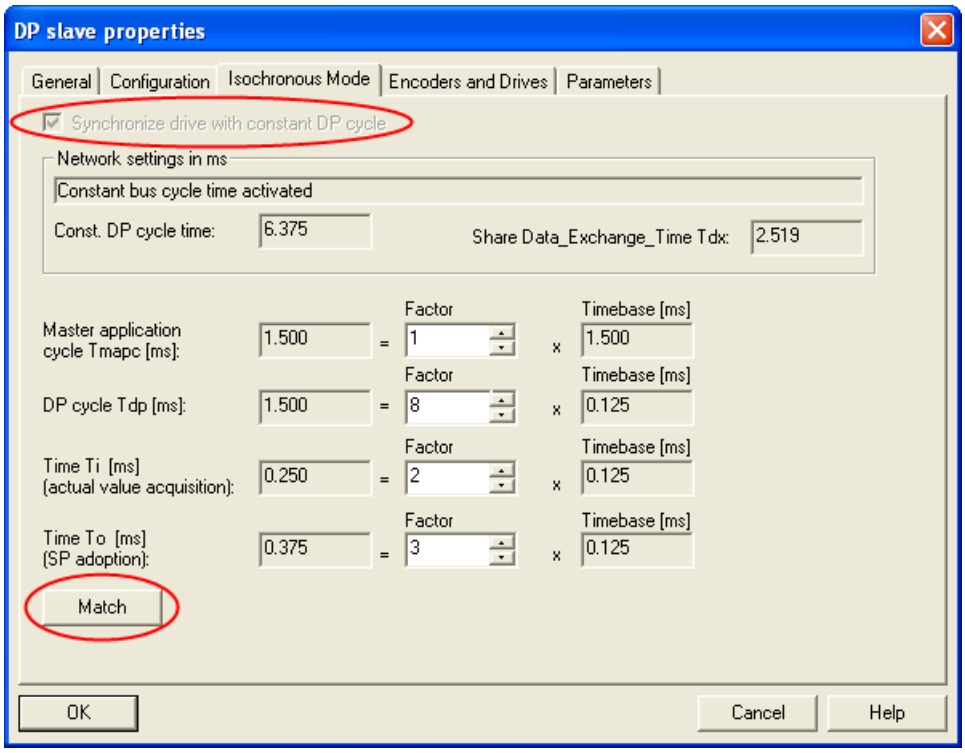


Figure 5-14 "DP Slave Properties" dialog box

The alignment transfers the values displayed in the "Isochrone mode" tab to all the DP slaves.

5.9.10 Boundary conditions

IM 174

The following boundary conditions must be taken into account in the final parameterization of the equidistant DP cycle:

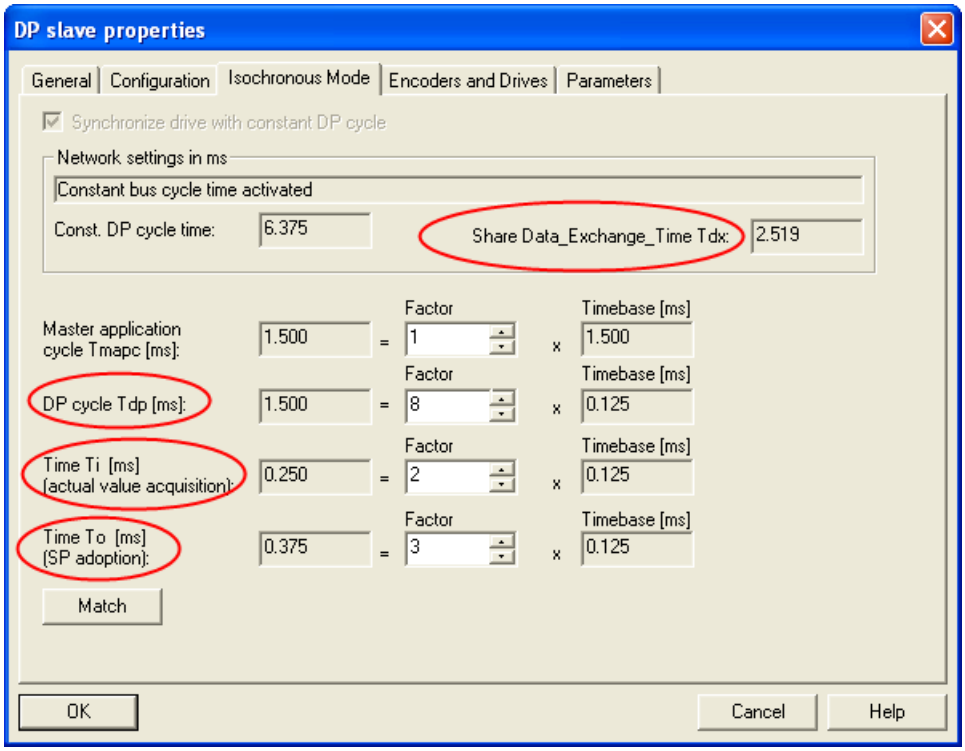


Figure 5-15 Zoom area of "DP Slave Properties" dialog box

- Equidistant DP cycle (T_{DP})

  T_{DP} = n * 250 µs;

  with 64 (8 ms) ≧ n ≧ 12 (1.5 ms)
- Setpoint acceptance (T_o)

  (TDX + 125 µs) ≤TO < TDP;

  with TDX = rounded up to an integer multiple of 125 µs

- Actual value acquisition (T_i)

  250 µs ≤ **T_I** ≤ 625 µs

  Ti = 250 µs, 375 µs, 500 µs, 625 µs
- If T_O = (T_{DP} - 125 µs) = $T_{O\text{-}Max}$

  then for T_I, the following must apply: **T_I** ≧ 3 * 125 µs

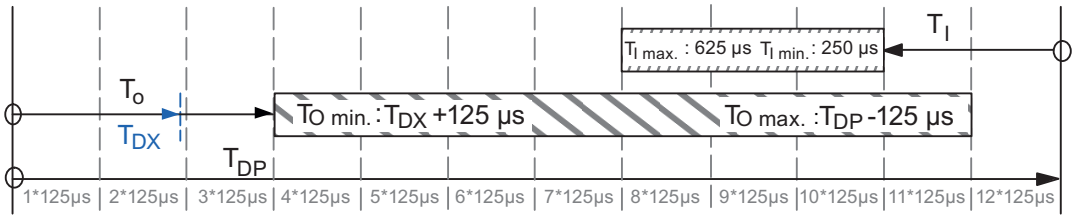


Figure 5-16 Graphic illustration of the boundary conditions

SIMOTION and SIMATIC Technology CPU

Typical parameter values are:

- Equidistant DP cycle (T_{DP}): 2.000 ms
- Actual value acquisition (T_i): 0.250 ms
- Setpoint acceptance (T_o): 1.250 ms

5.10 Tolerable failure of an encoder

Description

The following settings have to be carried out in the axis wizard of S7T Config to move an axis without encoder:

Note

The encoder may not be involved in controlling.

Set a check mark in the axis wizard of S7T Config at "Tolerate the encoder failure when it is not involved in the closed-loop control" (see screenshot).

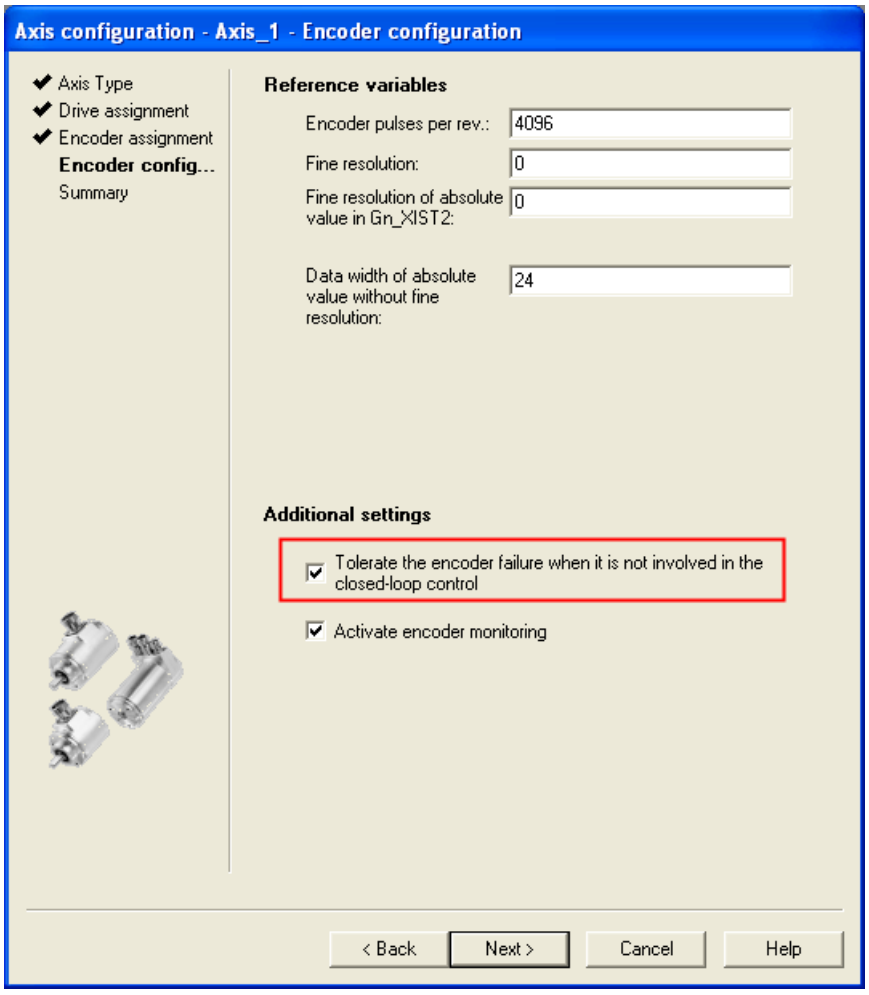


Figure 5-17 Encoder setting (here for an absolute encoder) in the axis wizard of S7T Config

Enable the axis speed-controlled in MC_Power.

After the settings have been completed, the axis can be moved without an encoder.

5.11 Zero mark monitoring

Method of functioning of the zero mark monitoring

Zero mark monitoring compares the recognized encoder increments between two zero marks with the configured encoder resolution. If a difference is found, an encoder error is reported.

Track A and Track B as well as Track Z of the encoder have to be on the high level simultaneously so that zero mark monitoring is carried out correctly.

Restrictions:

- The failure of a zero mark in itself does not inevitably result in an error, since checking is not started until a zero mark is reached.
- If the number of encoder increments per revolution is a multiple of 10 (parameter assignment in HW Config)), the result of the counted encoder increments MOD10 must not be equal to zero for an error to be reported.
- If the number of encoder increments per revolution is not a multiple of 10 (parameter assignment in HW Config)), the result of the counted encoder increments MOD16 must not be equal to zero for an error to be reported.

Example:

Encoder configuration: TTL 2048 pulses

Counted encoder increments 2049 -> encoder error

Counted encoder increments 1024 -> no encoder error

Note

The zero mark monitoring is active at all times.

OB 82 is called if the CPU is not connected to the DP-DRIVE of a Technology CPU.

The module status of the IM 174 reports zero mark errors in HW Config. For encoder zero mark monitoring to also function in S7 Technology, it has to the activated in the expert list of S7T Config. Only then is an interrupt also reported at the technology object.

Activation status of the zero mark monitoring:

In order for the encoder zero mark monitoring to also function in S7 Technology, it has to the activated in the Expert list of S7T Config under TypeOfAxis -> NumberOfEncoders -> Encoder_x -> IncEncoder -> EnableZeroMonitoring.

Commissioning

6

6.1 Operating an IM 174on an S7-CPU

Condition

If you are using a SIMATIC S7 CPU without a technology functionality as a DP master, you cannot use any technology functions. In this case, you must realize the supply of the IM 174 with data from your user program.

We therefore most definitely recommend that you use the IM 174 in connection with a SIMATIC T CPU.

6.2 Absolute encoder (SSI), single-turn

General

The parameterization of a single-turn absolute encoder (SSI) illustrated in the following example is performed using the TO externalEncoder.

If the encoder belongs permanently to an axis, parameterization is via the TO axis.

Basic procedure

The following is a description of the basic procedure for the commissioning:

- Creation of a new STEP 7 project and configuration of the hardware in HW Config with the major hardware components:
  - SIMATIC Technology CPU, SIMATIC S7 CPU - isochronous, SIMOTION C230
  - IM 174 (with servo or stepper motor, with SSI encoder)
- Parameterization in SIMATIC S7T Config or SIMOTION SCOUT
  - Creation of an "external encoder" technology object
  - Configuring the values in the axis wizard (drive IM 174, SSI encoder)

Description of the most important input fields

The most important input fields are described in more detail below:

Encoder data

The encoder used in this example is a Siemens encoder, order number:

6FX2001-5HS12 with the following data:

Parameters	Value
Encoder kind	Rotary
Encoder type	Absolute encoder
Increments/revolution	4096
Useful data length	12
Message length	13
Message frame format	PINETREE
Actual value protocol format	GRAY

STEP 7 settings, HW Config

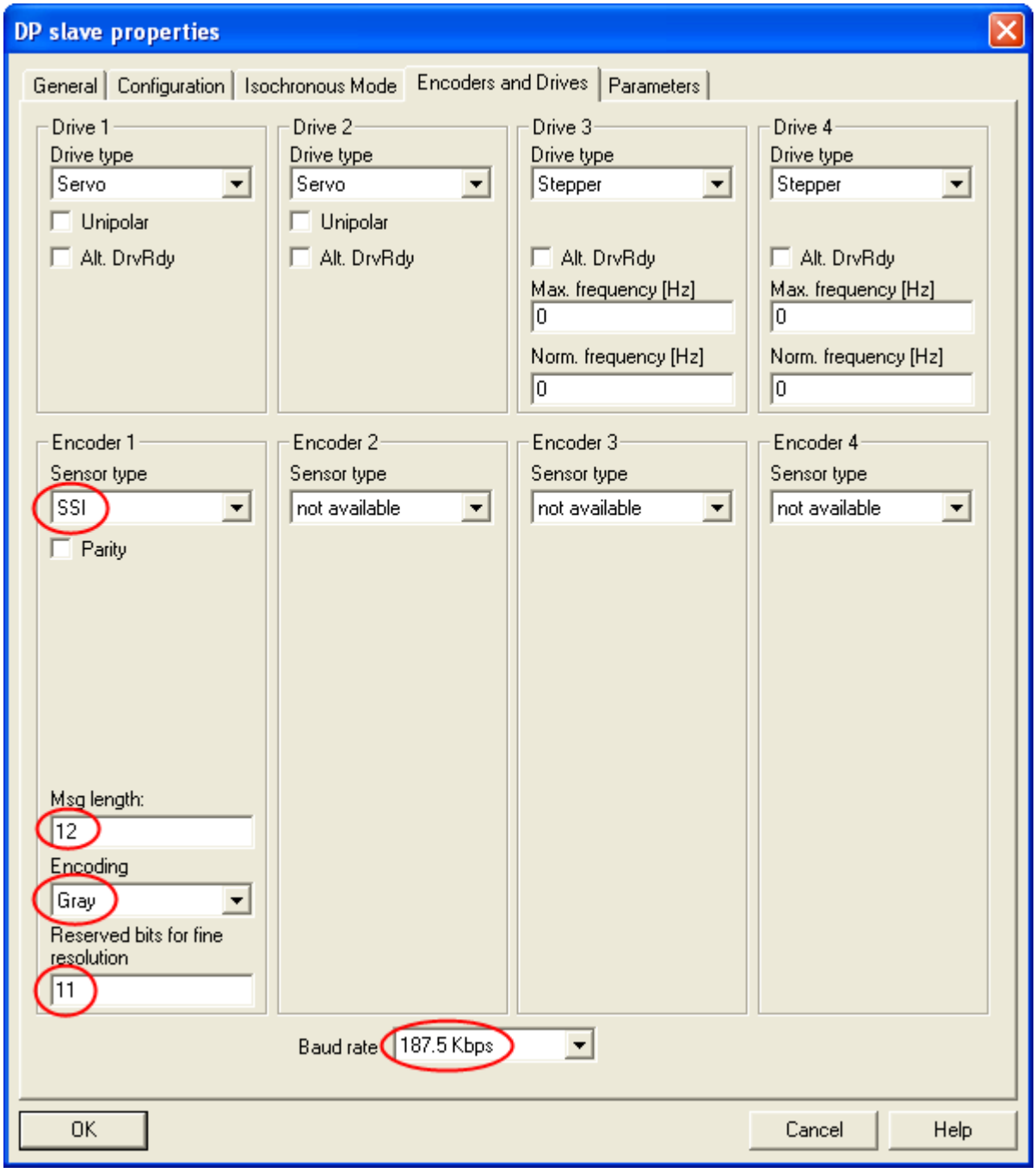


Figure 6-1 Encoder settings: STEP 7, HW Config

Settings	
MsgLength	Encoder parameter: "Useful data length"
Encoding	Encoder parameter: "Actual value protocol format"
Reserved bits for fine resolution	0 - 15

Settings in SIMATIC S7T Config / SIMOTION SCOUT

After you have created a new encoder in the project navigator (SIMATIC S7T Config / SIMOTION SCOUT) under "EXTERNAL ENCODERS" and then parameterized the technology object in the displayed dialog boxes, e.g. "Axis Type", "Units", the encoder data must be entered in the dialog boxes "Encoder Assignment" and "Encoder - Data".

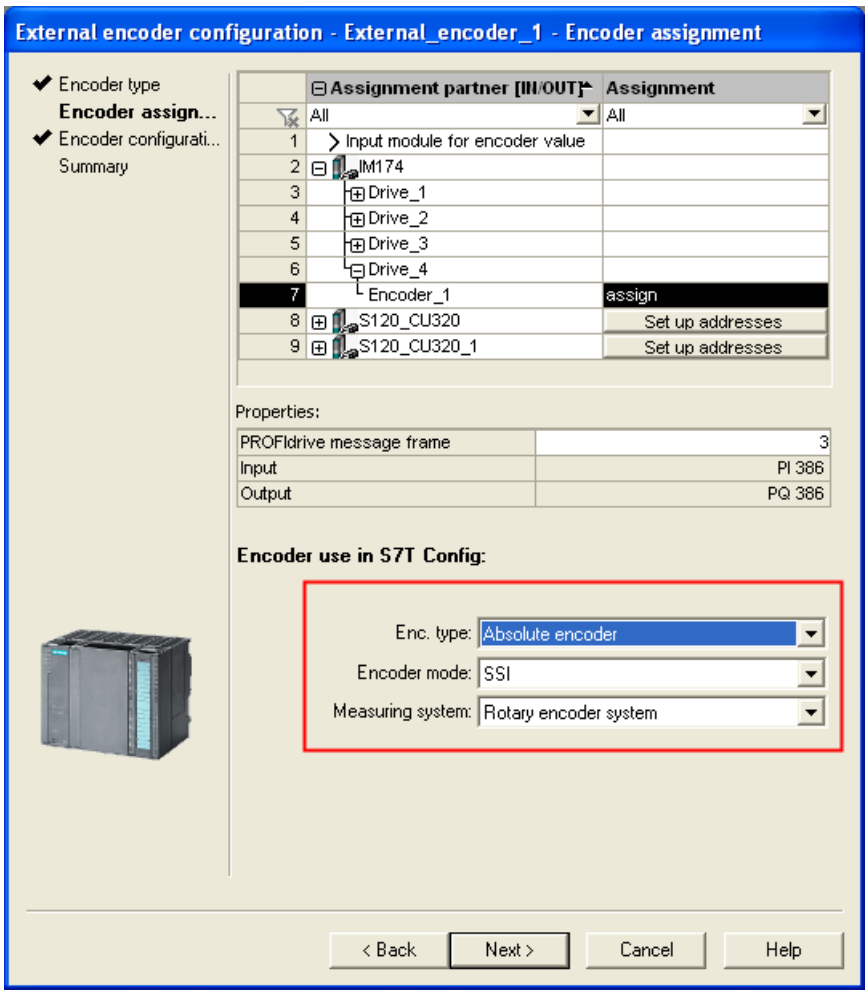


Figure 6-2 Settings in the "Encoder Assignment" dialog box

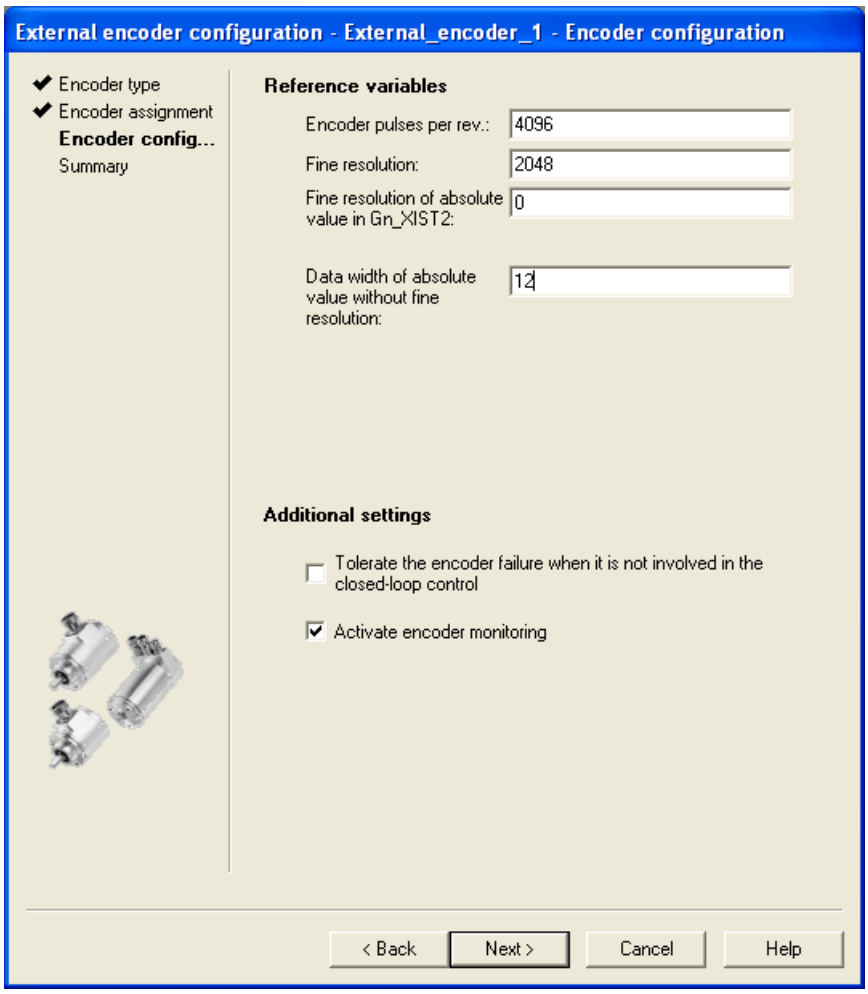


Figure 6-3 Settings in the "Encoder - Data" dialog box (zoom area)

Settings:

Encoder data settings	
Number of encoder pulses	Encoder parameter: "Increments/revolution (resolution)"
Data width of absolute value without fine resolution	Encoder parameter: "Useful data length of the encoder"
Fine resolution for absolute value in Gn_XIST2	1 The absolute actual value (Gn_XIST2) is taken over directly.
Fine resolution	2^(Step 7, HW Config: "Reserved bits for fine resolution") = 2^{11} = 2048

Overview of the encoder parameters in the SIMATIC S7T Config / SIMOTION SCOUT expert list

Parameters: TypeOfAxis > Encoder_1 >	Value
encoderTyp	SENSOR_ABSOLUTE
encoderMode	SSI_MODE
encoderSystem	ROTATORY_SYSTEM
AbsEncoder > absResolution	4096
AbsEncoder > absDataLength	12
AbsEncoder > absResolutionMutiplierAbsolute	1 [1]
AbsEncoder > absResolutionMutiplierCyclic	2048 [2]
[1] After the ramp-up of the controller, the absolute actual value of the encoder is read out once. [2] 2048 = 2^{11}; corresponds to STEP 7, HW Config: "Reserved bits for fine resolution" = 11	

6.3 Incremental encoder (TTL)

General

The parameterization of an incremental encoder (TTL) illustrated in the following example is performed using the TO externalEncoder.

If the encoder belongs permanently to an axis, parameterization is via the TO axis.

Note

Missing zero track on the encoder

If there is no zero track on the encoder, the zero track in the connector of the IM 174 module must be bridged:

Z → ground and Z_N → +5 V

Basic procedure

The following is a description of the basic procedure for the commissioning:

- Creation of a new STEP 7 project and configuration of the hardware in HW Config with the major hardware components:
  - SIMATIC Technology CPU and SIMOTION C230
  - IM 174 (with servo or stepper motor, with TTL encoder)
- Parameterization in SIMATIC S7T Config or SIMOTION SCOUT
- Creation of an "external encoder" technology object
  - Configuring the values in the axis wizard (drive IM 174, TTL encoder)

Description of the most important input fields

The most important input fields are described in more detail below:

Encoder data

The encoder used in this example is a Siemens encoder, order number: 6FX2001-2GB02 with the following data:

Parameters	Value
Encoder kind	Rotary
Encoder type	Incremental encoder
Increments/revolution (resolution)	1024
Encoder mode	RECTANGLE_TTL

Settings: STEP 7, HW Config

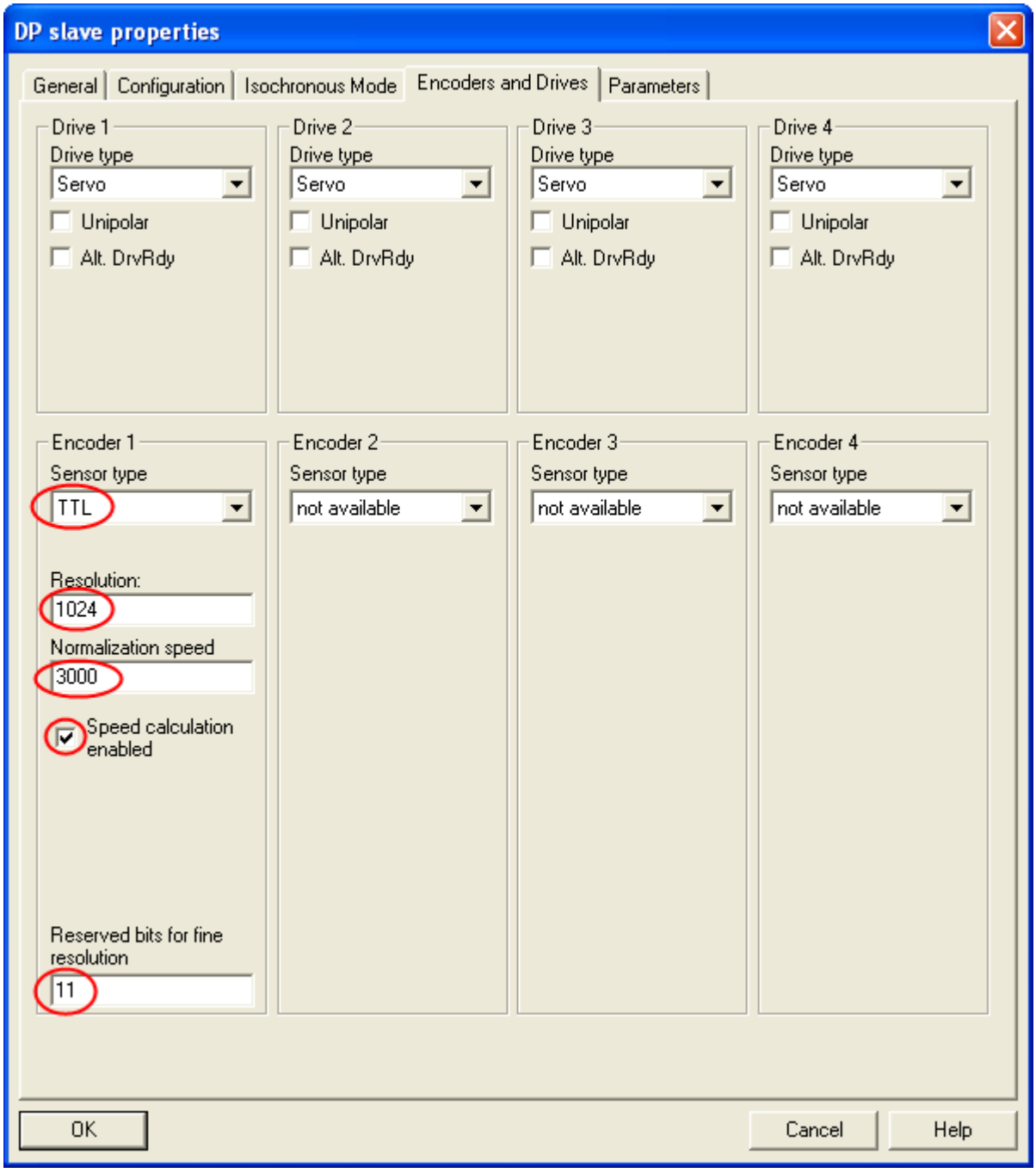


Figure 6-4 STEP 7 HW Config encoder settings

Settings:

Settings	
Resolution	Encoder parameter: "Increments/revolution (resolution)"
Reserved bits for fine resolution	0 - 15

Settings in SIMATIC S7T Config / SIMOTION SCOUT

After you have created a new encoder in the project navigator (SIMATIC S7T Config / SIMOTION SCOUT) under "EXTERNAL ENCODERS" and then parameterized the technology object in the displayed dialog boxes, e.g. "Units", the encoder data must be entered in the dialog boxes "Encoder Assignment" and "Encoder - Data":

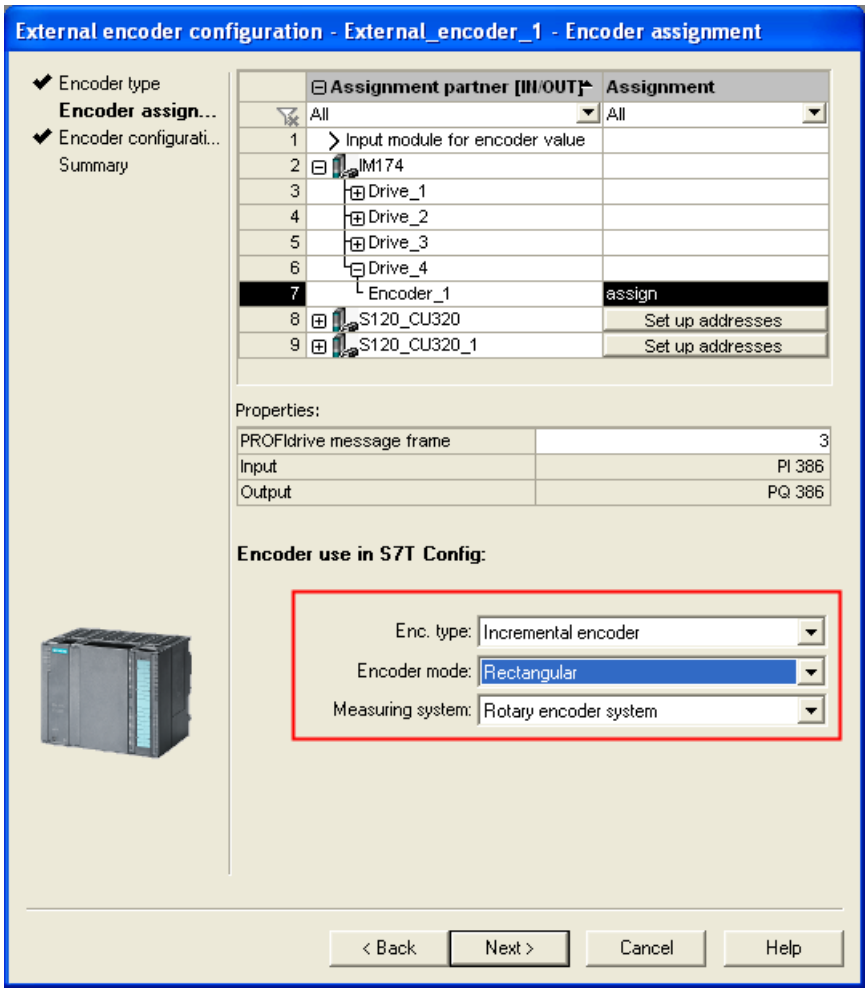


Figure 6-5 Settings in the "Encoder Assignment" dialog box

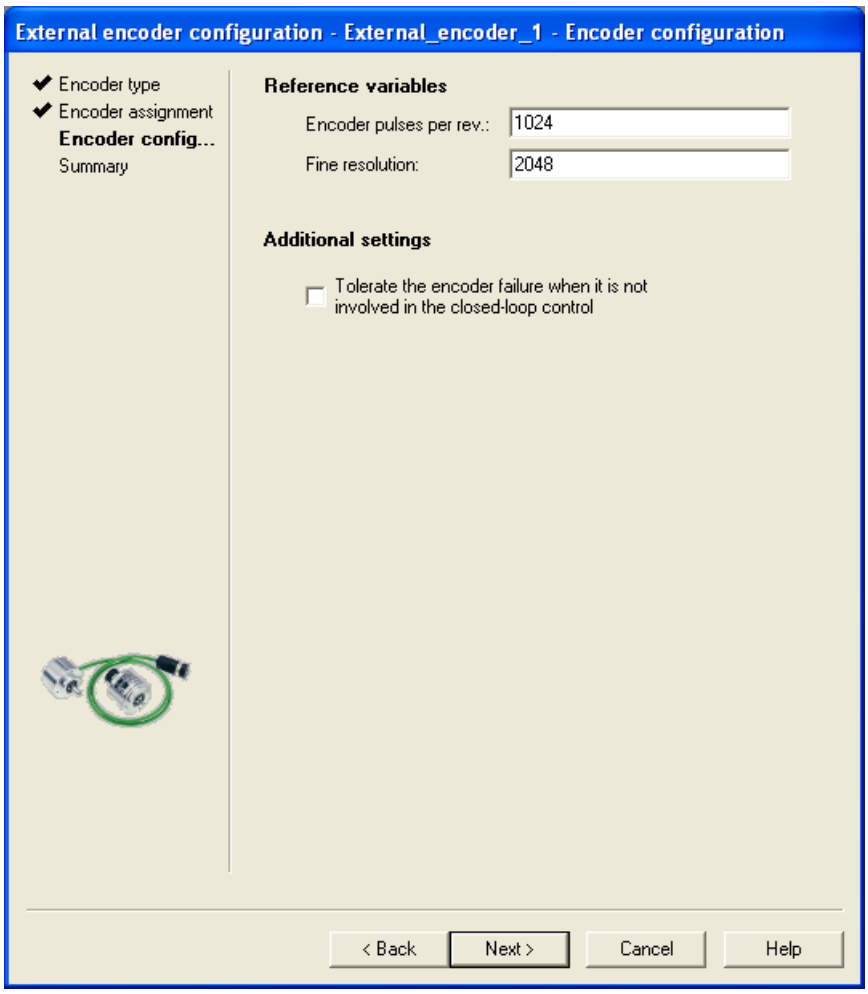


Figure 6-6 Settings in the "Inc. Encoder - Data" dialog box

Settings:

Settings	
Number of encoder pulses	Encoder parameter: "Increments/revolution (resolution)"
Fine resolution	2^(STEP 7, HW Config: "Reserved bits for fine resolution") = 2^{11} = 2048

Overview of the encoder parameters in the SIMATIC S7T Config / SIMOTION SCOUT expert list

Parameters: TypeOfAxis > Encoder_1 >	Value
encoderTyp	SENSOR_INCREMENTAL
encoderMode	RECTANGLE_TTL
encoderSystem	ROTATORY_SYSTEM
IncEncoder > incResolution	1024
IncEncoder > incResolutionMutiplierCyclic	2048 [1)]
[1)] 2048 = 2^{11}; corresponds to STEP 7, HW Config: "Reserved bits for fine resolution" = 11	

Interrupt, error and system messages 7

7.1 LED displays

The module status is displayed on the front of the module with four diagnostic LEDs.

The LEDs are explained in the order in which they are arranged on the IM 174 module.

Table 7- 1 Meaning of the color assignment for the diagnostics LEDs

LED	Color	Meaning
SF	Red	Group error
BF	Red	Error at the isochronous PROFIBUS
TEMP	Red	Temperature error
ON	Green	Power supply
RDY	Green	Status of the RDY contact

Table 7- 2 Significance of the diagnostics LEDs

LEDs					Meaning	Remedy
SF	BF	TEMP	ON	RDY		
On	Off	Off	On	*	The IM 174 module has detected an error	The corresponding error and its remedy are listed in the diagnostics.
*	*	*	On	*	The power supply to the IM 174 is in order.	
*	Flashes	*	On	*	No data exchange between the DP master and the IM 174. Possible causes: • The PROFIBUS address is set incorrectly. • There is a bus error.	• Check the parameter assignment. • Check the PROFIBUS address on the IM 174 and in the STEP 7 project. • Check the cable length dependent on the set baud rate. • Check the settings for the terminating resistors.
*	On	*	On	*	No connection to the DP master. Possible cause: The bus communication via the isochronous PROFIBUS to the IM 174 has been interrupted.	Check the bus configuration. • Check to see if the connector is correctly inserted. • Check to see if the PROFIBUS cable is faulty.

LEDs					Meaning	Remedy
SF	BF	TEMP	ON	RDY		
On	*	*	On	*	Any type of system error.	
*	*	On	*	*	Temperature error The LED is illuminated when a certain temperature in the housing is exceeded. In this case, the drives are shut down in accordance with the parameterized shutdown delay time and shutdown ramp.	
Off	Off	*	On	*	The DP master exchanges data with the DP slave cyclically.	
*	*	*	*	On	The RDY contact is closed. The module is working without error.	

* Not relevant

7.2 Diagnostic messages of the electronic modules

Actions after a diagnostics message

- The SF LED of the IM 174
- Several diagnostic messages can be output simultaneously.
- After a diagnostic message is signaled, the message is entered in the diagnostic frame as a diagnostic interrupt block (only one interrupt at any one time)
- The SF LED of the interface module lights up.
- If the IM 174 is not operated at a Technology CPU, the following applies:
  The OB 82 is called. If OB 82 is not available, the CPU goes into STOP.
- Acknowledgment of the diagnostic interrupt (thereafter a new interrupt is possible).

7.3 Diagnostics with STEP 7

7.3.1 Diagnostics with HW Config

Calling the diagnostics in HW Config

The diagnostics of the module can be called in HW Config by using the **PLC -> Module information** menu command.

The "Module information" window opens:

Meaning of the messages in the diagnostics window

A channel-specific diagnostics with corresponding error messages for the respective slots is displayed in the module state window.

Table 7- 3 Assignment of the slot

Slot	Application
4	The encoder connected to Encoder 1 (X3) has an error.
7	The encoder connected to Encoder 2 (X4) has an error.
10	The encoder connected to Encoder 3 (X5) has an error.
13	The encoder connected to Encoder 4 (X6) has an error.

Table 7- 4 Assignment of the channel number

Channel number	Application
0	Always 0

Table 7- 5 Description of the error messages

Error class	Error designation	Description	Remedy
Internal error	Master Sign-of-Life error / PLL synchronization error	The IM 174 cannot be synchronized with the Master Sign-of-Life error or the global check-back signal.	1. Check the connection of the PROFIBUS cable. The connecting plug must be connected firmly. 2. Verify correct transfer of the sign-of-life signal to the CPU
	Temperature error	The IM 174 reports an excessive module temperature	Cool the module
	Command not supported (The "Failure" text is displayed in the module information of the IM 174 instead of the text "Command not supported")	The IM 174 does not support the following bit assignments in the encoder control word for external encoders: - Gx_STW.BIT12: - Gx_STW.BIT11: - Gx_STW.BIT10: - Gx_STW.BIT9: - Gx_STW.BIT8:	Set a valid command.
External error	Encoder wire break	The IM 174 reports a wire break or an incorrect connection of the encoder cable	Check the cable or the correct wiring respectively
	Drive Ready signal missing	The IM 174 reports a missing Drive Ready signal	Check the wiring
	Encoder zero mark error	**For TTL encoders** The IM 174 reports an error at the TTL zero mark monitoring **For stepper drives** The IM 174 reports problems with stepper motor monitoring by a BERO signal	**For TTL encoders** • Check the resolution setting of the TTL encoder in HW Config • Check whether the phase groupings A/A_N, B/B_N and Z/Z_N fulfill the functionality of the encoder zero mark monitoring of the IM 174. **For stepper motors** • Increase the monitoring tolerance and/or • Check the stepper drive for step signal losses

7.3.2 Reading diagnostics data

Introduction

Diagnostics can be read out with *STEP 7*.

Length of the diagnostics frame

- The maximum message frame length is 45 bytes.
- The minimum message frame length is 6 bytes.

Options for reading out the diagnostics

The table below shows the options for reading out the diagnostics with *STEP 7* on the isochronous PROFIBUS.

Table 7- 6 Reading out the diagnostics with STEP 7 at the isochronous PROFIBUS

Automation system with DP master	Block or tab in *STEP 7*	Application	Reference
SIMATIC S7-300	"DP Slave Diagnostics" tab	Slave diagnostics in plain text on the STEP 7 user interface	"Diagnosing hardware" in *STEP 7* online help
	SFC 13 "DP NRM_DG"	Reading slave diagnostics data (stored in the data area of the user program)	SFC see *Online Help in STEP 7*
	SFC 59 "RD_REC"	Reading out data records of the S7 diagnostics (store in the data area of the user program)	See the system and standard functions reference manual
	SFB 52 "RDREC"	Read data records from the DP slave	SFB see *STEP 7 online help* (system functions/-function blocks)
Technology CPU (DP drive)	MC_ReadRecord	Read data records from the slave	Online help on S7-Technology

Note

Error ID 80A7

Meaning of Error ID 80A7: Slave is not yet ready for data exchange

If, when reading the data record, one of the above-mentioned modules show Error ID 80A7, then reading of the data record must be activated once more since the module is still not ready yet.

7.3.3 Structure of the DP slave diagnostics

Structure of the DP slave diagnostics

The figure below shows the structure of the DP slave diagnostics.

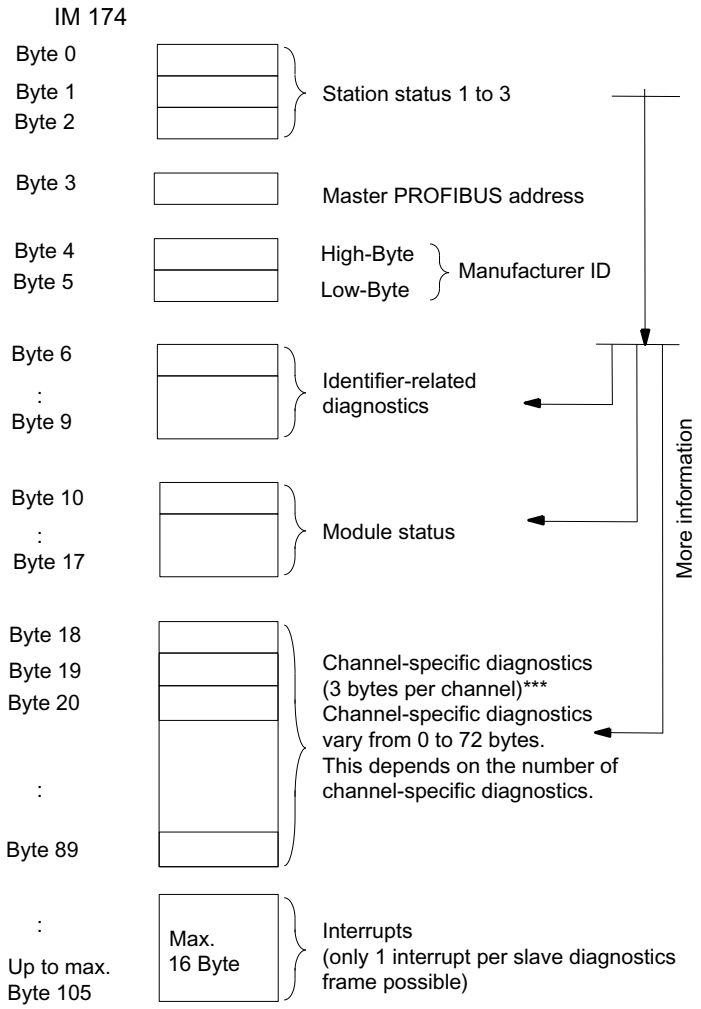


Figure 7-1 Structure of the DP slave diagnostics

Note

Length of the diagnostics frame

The length of the diagnostic message varies between 6 and 45 bytes.

You can identify the length of the last received diagnostics frame in *STEP 7* by referring to the RET_VAL parameter of the SFC 13.

7.3.4 Station statuses 1 to 3

Definition

Station statuses 1 to 3 provide an overview of the status of a DP slave.

Structure of station status 1 (byte 0)

Table 7- 7 Structure of station status 1 (byte 0)

Bit	Meaning	Cause/Remedy
0	1: The DP slave cannot be accessed by the DP master.	• Is the correct PROFIBUS address set on the DP slave? • Is the bus connector plugged in? • Is the DP slave connected to the voltage supply? • Is the RS-485 repeater set correctly? • Has the DP slave been reset?
1	1: The DP slave is not yet ready to exchange data.	• Wait, the DP slave is currently starting up.
2	1: The configuration data transferred from the DP master to the DP slave does not match the slave configuration.	• Has the correct station type or the correct DP slave configuration been entered in the configuration software?
3	1: External diagnostics information is pending. (Group diagnostics display)	• Evaluate the ID-specific diagnostics information, the module status, and/or the channel-specific diagnostics information. As soon as all errors have been eliminated, bit 3 will be reset. The bit will be set again when there is a new diagnostics message in the bytes of the aforementioned diagnostics.
4	1: The required function is not supported by the DP slave (for example, changing the PROFIBUS address by means of software).	• Check the configuration.
5	1: The DP master cannot interpret the response of the DP slave.	• Check the bus configuration.
6	1: The DP slave type does not match the software configuration.	• Has the correct station type been entered in the configuration software?
7	1: Parameters have been assigned to the DP slave by a different DP master (not the one that currently has access to the DP slave).	• The bit is always 1, for example, if you access the DP slave with the programming device or another DP master. • The PROFIBUS address of the DP master that assigned parameters to the DP slave is located in the "Master PROFIBUS address" diagnostics byte.

Structure of station status 2 (byte 1)

Table 7- 8 Structure of station status 2 (byte 1)

Bit	Meaning
0	The DP slave parameters need to be reassigned.
1	A diagnostics message is pending. The DP slave will not operate until the problem is eliminated (static diagnostics message).
2	The bit on the DP slave is always "1".
3	The watchdog is activated for this DP slave.
4	The DP slave has received the "FREEZE" control command [1].
5	The DP slave has received the "SYNC" control command [1].
6	Bit is always "0".
7	The DP slave is disabled, that is, it has been removed from the processing in progress.
[1] The bit is updated only if another diagnostics message changes also.	

Structure of station status 3 (byte 2)

Table 7- 9 Structure of station status 3 (byte 2)

Bit	Meaning	
0 to 6	0:	Bits are always set to "0".
7	1:	• There are more diagnostics messages pending than the DP slave is able to store. • The DP master cannot enter all the diagnostics messages sent by the DP slave in its diagnostics buffer (channel-specific diagnostics).

7.3.5 Master PROFIBUS address

Definition

The Master PROFIBUS address diagnostics byte contains the PROFIBUS address of the DP master:

- That assigned parameters to the DP slave
- That has read and write access to the DP slave

The master PROFIBUS address is located in byte 3 of the slave diagnostics.

7.3.6 Manufacturer ID

Definition

Byte 4 and Byte 5 are manufacturer's IDs.

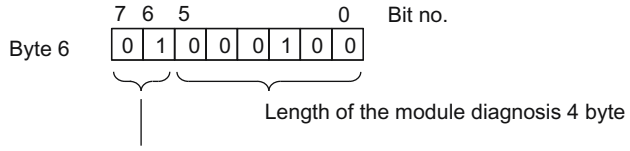
Low Byte 4 is 81.
High Byte 5 is 33.

7.3.7 Identifier-related diagnostics

Definition

The identifier-related diagnostic data indicate whether encoders of the IM 174 are faulty or not. ID-related diagnostic data start at byte 6 and are 4 bytes long.

Identifier-related diagnostic data are structured as follows:



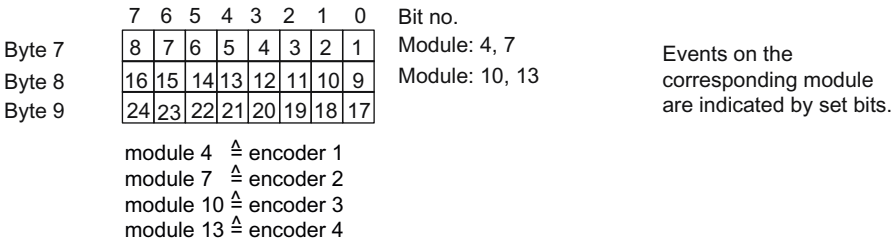


Figure 7-2 Structure of the identifier-related diagnostic data

7.3.8 Module status

Definition

The module status indicates the status of the configured modules and provides more information on the identifier-related diagnostics with respect to the configuration.
The module status starts after the identifier-related diagnostic data and consists of 8 bytes.

The module status is structured as follows:

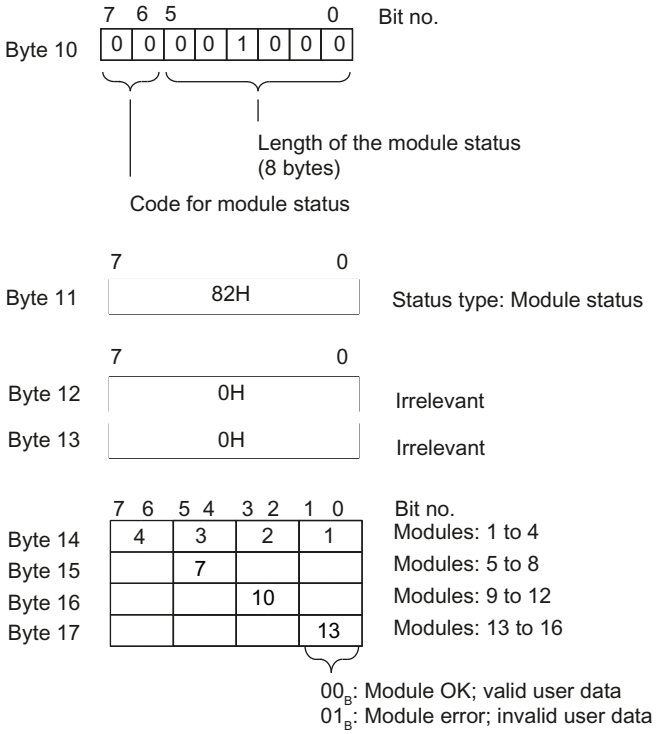


Figure 7-3 Structure of the module status

7.3.9 Channel-specific diagnostics

Definition

Channel-specific diagnostics provide information about channel errors in modules and details of the identifier-related diagnostics. The channel-specific diagnostics follows the module status. Channel-specific diagnostics do not affect the module status.

Up to 24 channel-specific diagnostic messages are possible.

Channel-specific diagnostics are structured as follows:

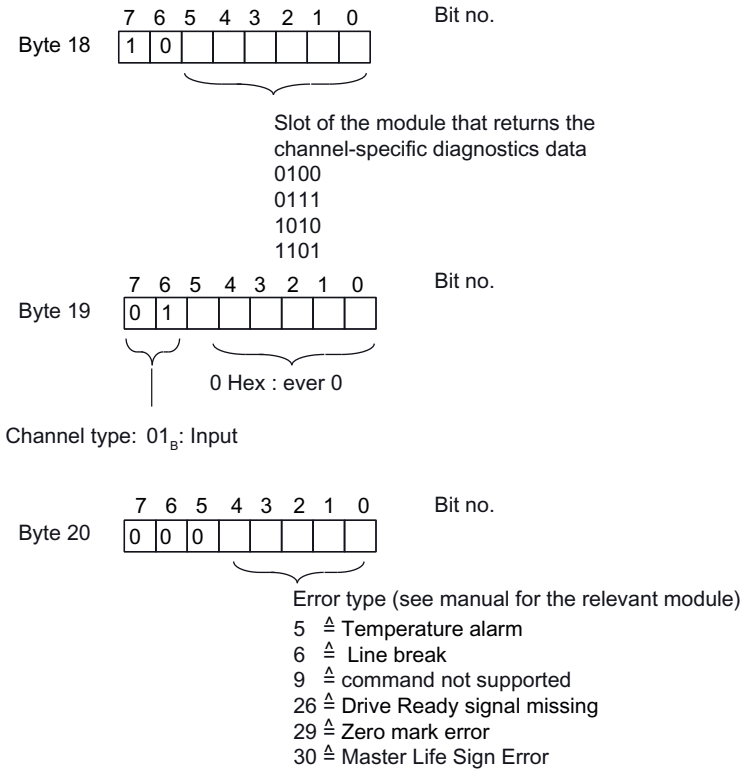


Figure 7-4 Structure of the channel-specific diagnostics

Note

The module slot coding is contained in Byte 18, Bits 0 to 5. The following applies:
Displayed number +1 ≙ Slot of the module (0 ≙ Slot 1; 1 ≙ Slot 2; 3 ≙ Slot 4, etc.)

7.3.10 Interrupts

Definition

The interrupt section of the slave diagnostics provides information on the interrupt type and the cause that led to the triggering of the interrupt. The interrupt section comprises 16 bytes.

Position in the diagnostic frame

The interrupt section comes after the channel-specific diagnostics.

Data record

The diagnostic data of a module can be up to 12 bytes in length and is located in Data records 0 and 1:

- Data record 0 contains 4 bytes of diagnostic data describing the current status of an automation system.
  If the IM 174 is not operated at a Technology CPU, the following applies:
  The DS0 forms part of the header information of the OB 82 (local data bytes 8 to 11).
- Data record 1 contains the 4 bytes of diagnostic data that are also contained in Data record 0 and in addition 8 bytes of module-specific diagnostic data.

You can read out the DS0 and DS1 by using the SFC 59 "RD_REC" if the IM 174 is operated at an S7-300 CPU.

If the IM 174 is operated at the DP(DRIVE) of a SIMATIC Technology-CPU, you can read out the DS0 and DS1 by using the MC_ReadRecord function block.

Structure of interrupts

Once configuration with *STEP 7* is completed the alarm data is evaluated and transferred to the relevant organization blocks (OBs). This transfer does not function if the IM 174 is operated at the DP (DRIVE) of a Technology-CPU.

The interrupt section has the following structure:

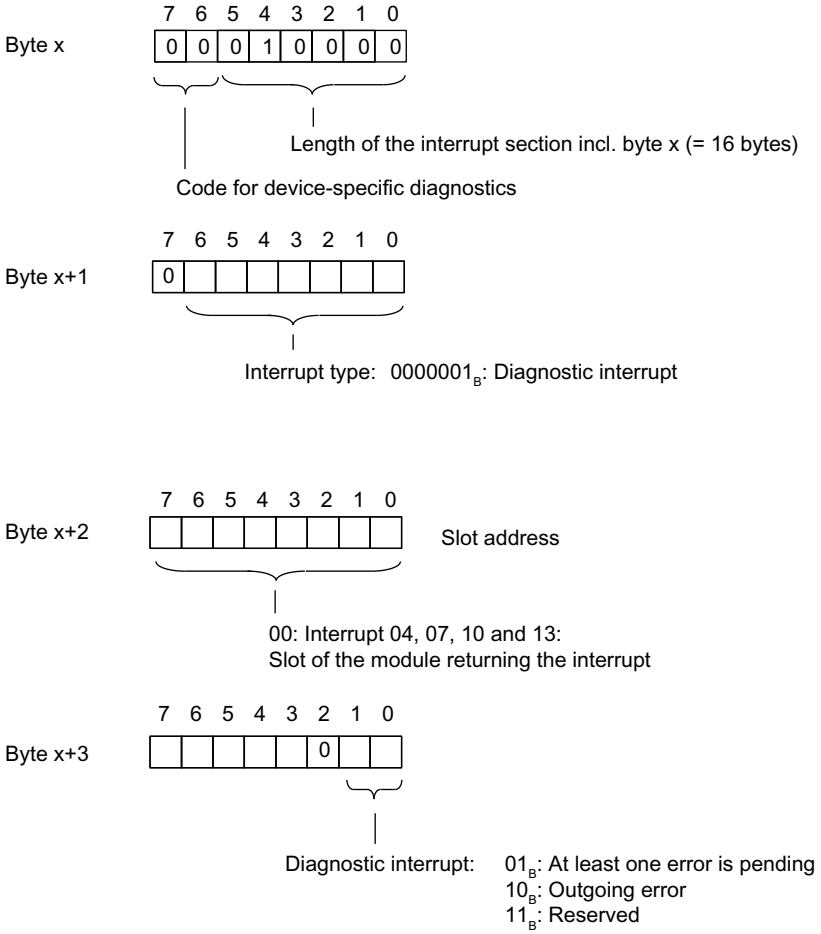


Figure 7-5 Structure of the interrupt status of the interrupt section

Diagnostic interrupt, Byte x+4 to x+7 (Data record 0)

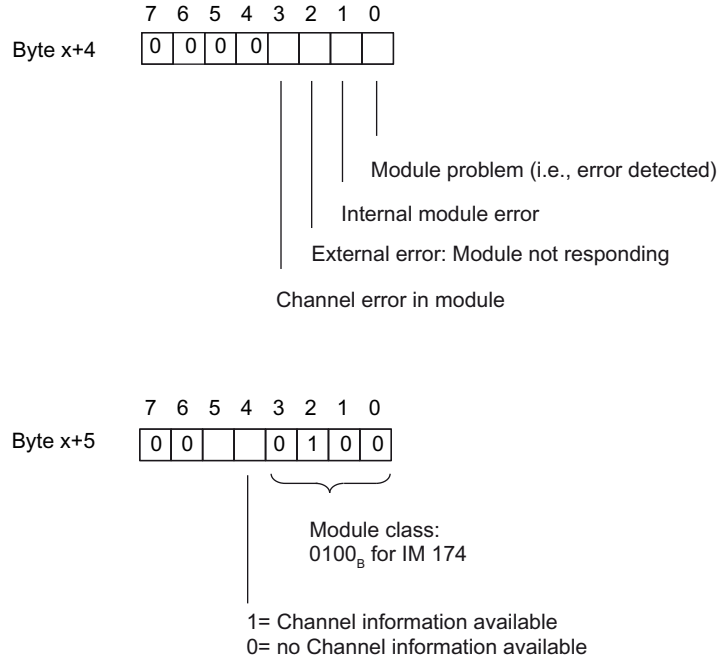


Figure 7-6 Structure of bytes x+4 to x+7 for diagnostic interrupt

Diagnostic interrupt from the modules, Bytes x+8 to x+11 (Data record 1)

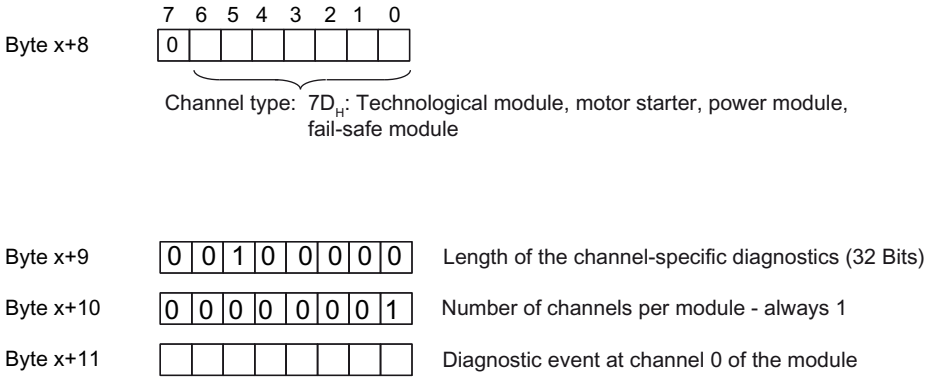


Figure 7-7 Structure of bytes x+8 to x+11 for the diagnostics frame

Diagnostic interrupt from the modules, Bytes x+12 to x+15 (Data record 1)

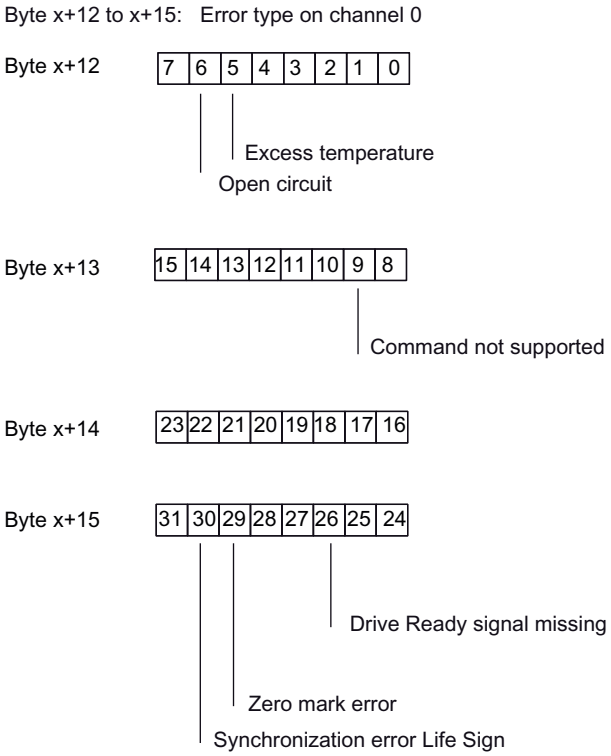


Figure 7-8 Structure of bytes x+12 to x+15 for the diagnostics frame

7.3.11 Diagnostics with a "300" control system

Description

Alarms are reported via the cyclic message frame 3 or 81 gemeldet as well as via diagnostics alarm in OB 82. In the case of a **CPU 300** (without technology) the messages of the cyclic message frame must be acknowledged as well as in the following table.

Table 7- 10 Description of the error messages

Error messages	OB 82 behavior		Cyclic message frame behavior
	Error received	Error cleared	
Sensor wire break	OB 82 reports "Incoming event"	OB 82 reports "Outgoing event"	Error is not reported. The error is reported in the encoder status word, but does not have to be acknowledged! Important for the user when the cyclic message frame is checked
Drive Ready signal missing	OB 82 reports "Incoming event"	Outgoing event is not reported until after acknowledging in the cyclic message frame and subsequent activation of the axis.	Error is reported in the cyclic interface. Bit 3 and 14 are set in the Status word 1 (ZSW1). In Control word 1 (STW1), the error reported must be acknowledged by setting Bit7 (Fault Acknowledge). the axis must then be switched on again. An outgoing message appears in the diagnostics buffer only after module IM174 has detected a switch-on command of the axis.
Master Sign-of-Life error / PLL synchronization error	OB 82 reports "Incoming event"	OB 82 reports an "outgoing event" The error bit is still active in the Status word 1 (ZSW1) and has to be acknowledged as described.	Error is reported in the cyclic interface. In Status word 1 (ZSW1) bits 3 and 13 are set The occurring error has to be indicated by setting Bit 7 (Fault Acknowledge) in Control word 1 (STW1).
Invalid command	OB 82 reports "Incoming event"	OB 82 reports "Outgoing event"	Error is not reported The error is reported in the encoder status word, but does not have to be acknowledged! Important for the user when the cyclic message frame is checked

Error messages	OB 82 behavior		Cyclic message frame behavior
Temperature error	OB 82 reports "Incoming event"	Outgoing message in the CPU! Bit 3 is still active in Status word 1 (ZSW1) Temp LED goes off	Error is reported in the cyclic interface. Bit 3 and 11 are set in the Status word 1 (ZSW1). The occurring error has to be acknowledged by setting Bit 7 (Fault Acknowledge) in Control word 1 (STW1).
Encoder zero mark error	OB 82 reports "Incoming event"	OB 82 reports "Outgoing event"	Error is not reported. The error is reported in the encoder status word, but does not have to be acknowledged! Important for the user when the cyclic message frame is checked

Technical data

A

A.1 Standards and certifications

Introduction

Contents of general technical specifications:

- The standards and test values to which the IM 174 conforms.
- The test criteria according to which the IM 174 was tested.

Note

Information about the nameplate

You can find the currently valid identifiers and approvals on the nameplate of the module.

Information about the currently valid identifiers and approvals is available on the Internet (http://support.automation.siemens.com/WW/view/en/28421943/134200).

Safety information

⚠ WARNING

Explosion hazard - Risk of injury and damage to property

In potentially explosive environments, there is a risk of personal injury and damage to property if you remove IM 174 connectors in runtime.

In potentially explosive environments, always isolate the IM 174 from power before you remove any connectors.

⚠ WARNING

Use in hazardous areas

If you replace components, compliance with Class I, DIV. 2 could be compromised.

This device is only appropriate for use in Class I, Div. 2, Group A, B, C, D, or in non-hazardous areas.

Test logos and their meaning

The section below describes the test logos attached to the module and explains their meaning.

CE Label

IM 174 satisfies the requirements and safety-related objectives according to EC Directives listed below, and conforms with the harmonized European standards (EN) for programmable controllers announced in the Official Journals of the European Community:

- 2006/95/EC "Electrical Equipment Designed for Use within Certain Voltage Limits" (Low-Voltage Directive)
- 2004/108/EC "Electromagnetic Compatibility" (EMC Directive)
- 94/9/EC "Equipment and protective systems intended for use in potentially explosive atmospheres" (Explosion Protection Directive)

The EC declaration of conformity is held on file available to competent authorities at:

Siemens AG
Industry Sector
I IA AS R&D DH A
P.O. Box 1963
D-92209 Amberg

These files are also available for download on the Customer Support Internet pages, keyword "Declaration of Conformity".

UL approval

Underwriters Laboratories Inc., complying with

- UL 508 (Industrial Control Equipment)

CSA approval

Canadian Standards Association to

- C22.2 No. 142 (Process Control Equipment)

or

cULus approval

Underwriters Laboratories Inc., complying with

- UL 508 (Industrial Control Equipment)
- CSA C22.2 No. 142 (Process Control Equipment)

or

cULus HAZ. LOC approval

Underwriters Laboratories Inc., complying with

- UL 508 (Industrial Control Equipment)
- CSA C22.2 No. 142 (Process Control Equipment)
- UL 1604 (Hazardous Location)
- CSA C22.2 No. 213 (Hazardous Location)

APPROVED for use in
Class I, Division 2, Group A, B, C, D Tx;
Class I, Zone 2, Group IIC Tx

FM approval

Factory Mutual Research (FM) to
Approval Standard Class Number 3611, 3600, 3810
APPROVED for use in Class I, Division 2, Group A, B, C, D Tx;
Class I, Zone 2, Group IIC Tx

Tick mark for Australia and New Zealand

IM 174 meets the requirements of standards to AS/NZS CISPR 16.

Note

The UL/CSA or cULus approvals for your product are specified by the identifiers on the rating plate.

IEC 61131

The IM 174 meets the requirements and criteria of the standard
IEC 61131-2, (Programmable logic controllers, part 2: Equipment requirements and tests).

Marine approval

Classification societies:

- ABS (American Bureau of Shipping)
- BV (Bureau Veritas)
- DNV (Det Norske Veritas)
- GL (Germanischer Lloyd)
- LRS (Lloyds Register of Shipping)
- Class NK (Nippon Kaiji Kyokai)

Use in industrial environments

SIMATIC products are designed for industrial applications.

Table A- 1 Use in industrial environments

Field of application	Noise emission requirements	Noise immunity requirements
Industry	EN 61000-6-4: 2007	EN 61000-6-2: 2005

Use in residential areas

Note

The IM 174 is intended for use in industrial environments and can cause interference on radio/television reception if operated in residential areas.

To operate an IM 174 in a residential area, its radio interference emissions must comply with limit class B in accordance with EN 55011.

Suitable measures for achieving radio interference level Class B include, for example:

- IM 174 installation in grounded control cabinets/control boxes
- Use of noise filters in the supply lines

A.2 Establishing the firmware version

Requirements

- You are in HW Config and an IM 174 V1.1 is configured.
- An IM 174 V1.1 is connected and available online.

Establishing the firmware version

To establish the current firmware version of the module, proceed as follows:

1. Select the graphic view of the IM 174 V1.1 in the station window.
2. Select the "Module status ..." command in the shortcut menu of the module.

   The "Module status - IM 174" dialog box will open.
3. You can now read off the firmware version from the "General > Version" tab.

A.3 Technical data

General information

This section describes the technical data of the IM 174 interface module

- Dimensions and weight
- Encoder inputs
- Drive interface
- Digital inputs/outputs

Note the installation guidelines

SIMATIC products fulfill the requirements provided the manual´s installation guidelines are followed during installation and operation.

Connected loads

Supply voltage	20.4 V to 28.8 V
Reverse polarity protection	Yes
Current consumption from 24 V	0.5 A
Power loss	12 W
Starting current	2.5 A
Encoder supply 5 V max. output current	1.2 A
Encoder supply 24 V max. output current	1.4 A

Dimensions and weight

Dimensions W x H x D [mm]	160 x 125 x 118
Weight [g]	1000

Isochronous PROFIBUS cycle (isochronous)

Supported cycle times	1.5 - 8 ms
Settable steps	250 µs

Drive interface

Analog drive

Setpoint signal	
Rated voltage range	± 10 V 0 V to 10 V
Operational limit (in relation to output value)	± 5,5 %
Short-circuit protection	Yes
Max. short-circuit current	45 mA
Electrical isolation	No
Output current	-3 … 3 mA
Load impedance • Ohmic load • Capacitive load	 • Min. 3K3 • 1 µF max.
Relay contact controller enable	
Operational voltage	30 VDC max.
Switching current	1 A max.
Switching capacity	30 VA max. Switching cycles with the maximum values: For 30 VDC, 1 A: Min 5 x 10^5
Potential difference between internal ground and output	2500 V
Length of cable	35 m max.

Stepper drive

5 V output signals according to RS422 standard	
Error output voltage V_{OD}	Min. 2 V (R_L = 100 Ω)
Output voltage "1" V_{OH}	3.7 V (I_O = -20 mA) 4.5 V (I_O = -100 µA)
Output voltage "0" V_{OL}	1 V (I_O = 20 mA) max.
Load resistance R_L	Min. 55 Ω
Output current I_O	±60 mA max.
Pulse frequency f_P	750 kHz max.
Length of cable	50 m max. For mixed operation with analog axes, max. 35 m For asymmetrical transmission, max. 10 m

Encoder inputs

Position measuring	- incremental - absolute (SSI)
Signal voltages	Inputs: 5 V as per RS422
Encoder supply voltages	• 5 V/300 mA • 24 V/300 mA
Input frequency and cable length for incremental encoders	• 1 MHz max. for 10 m shielded cable length • 500 MHz max. for 35 m shielded cable length
Data transmission rate and cable length for absolute encoder	• 1.5 Mbit/s max. for 10 m shielded cable length • 187.5 kbit/s max. or 250 m shielded cable length
Cable length for incremental encoders • 5 V encoder supply 24 V encoder supply	 • 25 m max. for 300 mA max. (tolerance 4.75 to 5.25 V) • 35 m max. for 210 mA max. (tolerance 4.75 to 5.25 V) • Short-circuit protection available • 100 m max. or 300 mA max. (tolerance 20.4 to 28.8 V) • 300 m max. for 300 mA max. (tolerance 11 ... 30 V) • Short-circuit protection available
Cable length for absolute encoder (SSI)	See Data transmission rate

Digital inputs

Number of inputs	10
Supply voltage	24 VDC (permissible range: 20.4 … 28.8 V)
Galvanic isolation	Yes
Input voltage	• 0 signal: -3 … 5 V • 1 signal: 15 … 30 V
Input current	• 0 signal: ≤ 2 mA • 1 signal: 4 … 8 mA
Input delay (B1 … B4, M1, M2, R1 … R4)	• 0 → 1 signal: Typ. 15 µs • 1 → 0 signal: Typ. 150 µs
Connection of a 2-wire encoder	possible

Digital outputs

Number of outputs	8
Supply voltage	24 VDC (permissible range: 20.4 … 28.8 V)
Counter voltage	Yes
Galvanic isolation	Yes
Output voltage	1 signal: (V_L[1] - 3) V … V_L[1] V
Short-circuit protection	Yes
Max. output current • Rated value • Permitted range • Lamp load	1 signal • 0.5 A • 0.5 mA ..0.5 A from the power supply • 5 W max.
Operating frequency for • Ohmic load • Inductive load	 • 100 Hz • 1 Hz
Max. residual current	0 signal: 0.4 mA
Output delay (Q0 … Q3, D1 … D4)	• 0 → 1 signal: Typ. 500 µs • 1 → 0 signal: Typ. 400 µs

1) V_L - supply voltage of the outputs

READY output (RDY)

Parameter	max	Unit
DC switching voltage	30	V
Switching current	1	A
Switching capacity	30	VA

A.4 Dimensional diagram

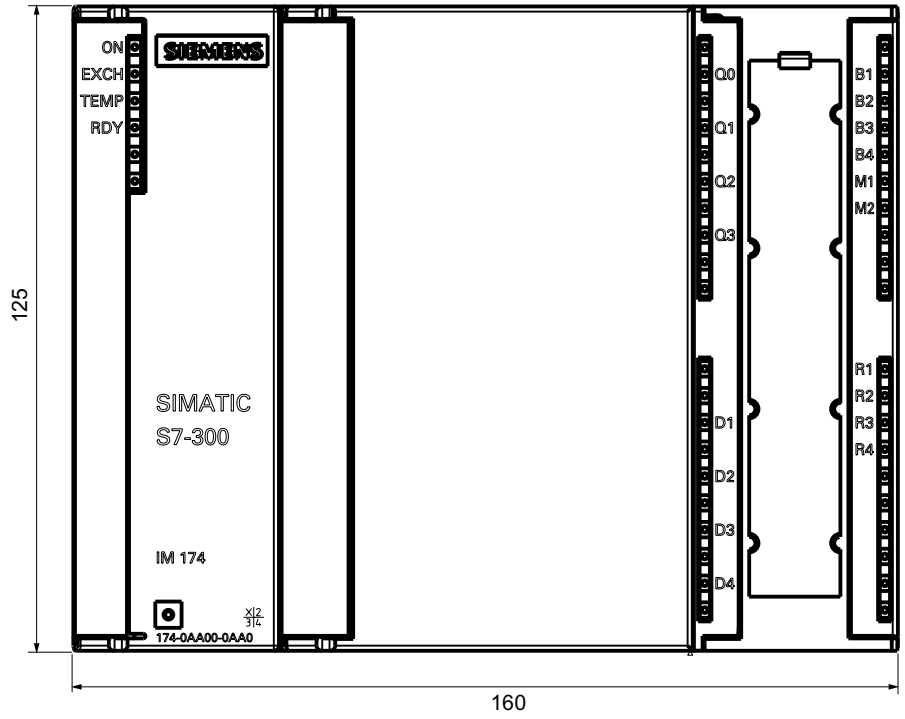


Figure A-1 Dimension drawing: IM174 front view

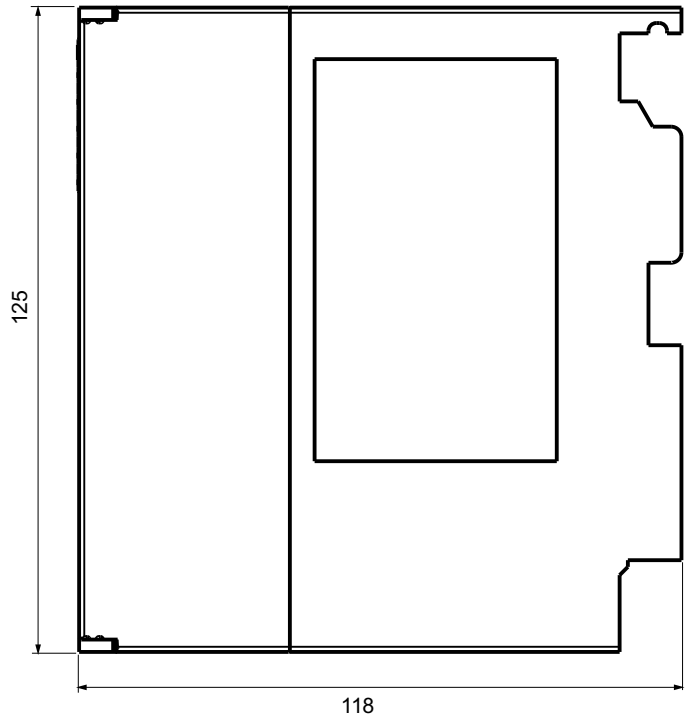


Figure A-2 IM 174 dimension drawing: Side view

List of abbreviations

B

List of abbreviations

Table B- 1 List of abbreviations

Abbreviation	Explanation
DP	Distributed I/O
FB	Function block
HSP	Hardware Support Package
IM	Interface module
MC	Motion Control
MPI	Multipoint Interface
OP	Operation Panel
PG	Programming device
PS	Power Supply
PZD	Process data word
T_{DP}	Equidistant DP cycle
T_{MAPC}	Master application cycle

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