

Application description • 03/2015

Configuration of redundant I/O Modules in SIMATIC PCS 7

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Preface

Purpose of this documentation

Based on PCS 7 applications, this document describes:

- Redundant I/O modules, especially with channel-granular functionality
- Installation, wiring and configuration of redundant ET 200M stations
- The use of MTA terminal modules (Marshaled Termination Assemblies) as an interface between the distributed I/O modules and the actuators or sensors
- Diagnostic options on a fault-tolerant system with redundant peripherals in case of error

Basic knowledge required

This documentation is intended for persons involved in configuration, commissioning and servicing of automation systems and who have basic knowledge of SIMATIC PCS 7.

Validity

Valid from SIMATIC PCS 7 V8.1.

Position in the information landscape

You can find further information regarding the subject of redundancy in PCS 7 and for dealing directly with the different high-availability components in the following documents.

Document	Content
SIMATIC Process Control System PCS 7 Released modules	<ul style="list-style-type: none"> Approved SIMATIC modules for PCS 7 V8.1
SIMATIC Process Control System PCS 7 Fault-tolerant Process Control Systems	<ul style="list-style-type: none"> Solutions for the peripherals Designing high-availability components
SIMATIC Fault-tolerant systems S7-400H	<ul style="list-style-type: none"> Installing a CPU 41x-H Connecting redundant I/O
SIMATIC Distributed I/O device ET 200M	<ul style="list-style-type: none"> Installing the ET 200M
SIMATIC S7-300 S7-300 Module data	<ul style="list-style-type: none"> Technical specifications about the signal modules
ET 200M Marshalled Termination Assemblies Remote I/O Modules	<ul style="list-style-type: none"> Commissioning the MTA boards
SIMATIC PCS 7 Process Control System Advanced Process Library	<ul style="list-style-type: none"> Description of the PCS 7 channel blocks
PCS 7 in Practice - Plant Asset Management	<ul style="list-style-type: none"> Passivation/depassivation of redundant modules
SIMATIC ET 200M distributed I/O device HART analog modules	<ul style="list-style-type: none"> Connecting actuators/sensors in redundant mode

NOTE

You can find the sources listed in the table in the Industry Online Support Portal (<https://support.industry.siemens.com>).

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1 Introduction

1.1 Redundant I/O

The high-availability in PCS 7 is basically applicable to all levels. In this documentation, the focus lies on the application of redundant distributed I/O using ET 200M modules. It explains with particular emphasis the wiring options of the input/output modules as well as the individual configuration steps.

The term I refers to input/output (I/O) modules, which are duplicated and configured/operated redundantly in pairs. If a module fails, a CPU or process signal can be processed by the operational module. The entire signal path to the sensor/actuator is redundant.

As interface modules, the MTA terminal modules (Marshaled Termination Assemblies) offer the possibility of connecting field devices, sensors and actuators in a simple, quick and safe manner to the input/output modules of the ET 200M. The document shows how such MTA are structured, what important features and advantages they possess, and how the implementation can be carried out without complicated wiring and configuration.

Note

The manual "SIMATIC Fault-tolerant systems S7-400H" provides extensive information about the redundancy mechanisms in the AS level.

1.2 Behavior in case of channel interference

The passivation behavior determines how redundant input/output modules behave after a channel fault (e.g. wire break, short-circuit on the signal line). The response to a channel fault is dependent on the following aspects:

- Modules used
- Configuration
- Version of the PCS 7 library
 - As from PCS 7 V7.1, the possible passivation behavior is automatically detected based on the configured modules. The channel-granular passivation behavior is adjusted.
 - The library RedLib V3.x only allows the module-granular passivation behavior to be selected.
 - The library RedLib (from V4) enables the channel-granular passivation behavior to be adjusted.

Channel faults, whether due to discrepancy or due to a diagnostic interrupt (OB82), lead to the passivation of the respective channel. If the fault is cleared, the so-called 'depassivation' activates the channel or the modules passivated due to module faults. Channel-granular passivation significantly increases the availability in the following cases:

- Relatively frequent encoder failures
- Repairs that take a long time
- Multiple channel errors on one module

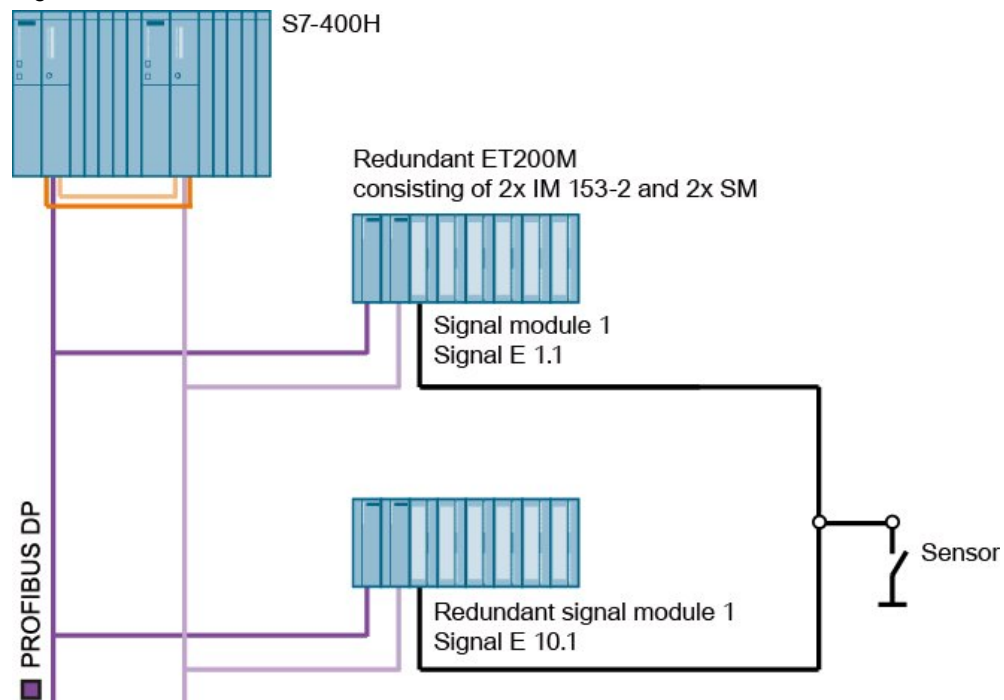
When switching from the "module-granular passivation behavior" (RedLib V3.x) to "channel-granular passivation behavior" (from RedLib V4.x), you must consider the following points:

- When upgrading from PCS 7 V7.1 SP4 to PCS 7 V8.1 (with utilization of new functions) new compatible blocks are imported into the project from the library "Redundant IO CGP V52" if using redundant peripherals.
- When converting a project, make sure that all blocks with the names FB450-453 and FC450-451 have been deleted from the block folder. Perform this step in every relevant program. Compile and load your project.

1.3 Hardware components

Basically, an increase in availability can happen in two ways. On the one hand, via a single-channel switched I/O and on the other, via a redundant peripheral such as the example shown Figure 1-1. The designs in this document are mainly restricted to the use of redundant peripherals with two ET 200M stations.

Figure 1-1



A redundant peripheral exists when the input/output modules are duplicated for a process signal and can be addressed by the AS (S7-400H).

In PCS 7, a redundant peripheral can be built with selected S7-300 I/O modules of the ET 200M series.

The distributed I/O ET 200M is connected as a DP slave to a high-availability automation system (DP master) via PROFIBUS DP. A redundant structure is achieved by an additional ET 200M and an additional PROFIBUS DP connection.

In the following sections, the individual hardware components required to build a high-availability system with redundant distributed I/O are described in detail.

1.3.1 High-availability automation system (AS)

Fault-tolerant automation systems are used to minimize the risk of production failures.

For the S7-400H to remain always available, it is built as a redundant system.

This means that all essential components are duplicated, i.e. the central processing unit CPU, power supply and hardware for coupling the two CPUs.

Table 1-1: CPU types that can be used starting from PCS 7 V8.1

Name	MLFB	FW
CPU 410-5H process automation	6ES7 410-5HX08-0AB0	V8.1.x
CPU 412-5H PN/DP	6ES7 412-5HK06-0AB0	V6.x
CPU 414-5H PN/DP	6ES7 414-5HM06-0AB0	V6.x
CPU 416-5H PN/DP	6ES7 416-5HS06-0AB0	V6.x
CPU 417-5H PN/DP	6ES7 417-5HT06-0AB0	V6.x

1.3.2 Interface modules (IM)

Interface modules (IM) are used by the distributed I/O device ET 200M as a PROFIBUS DP interface. With redundant peripherals, one must ensure that two interface modules (IMs) are used per ET 200M station and that the same bus address is set for both modules (via dip switches).

This ensures that if the active interface module fails during operation, the passive interface module takes over the corresponding function smoothly. The active interface is indicated by the lit ACT LED on the respective interface module.

Table 1–2: IM module for redundant applications

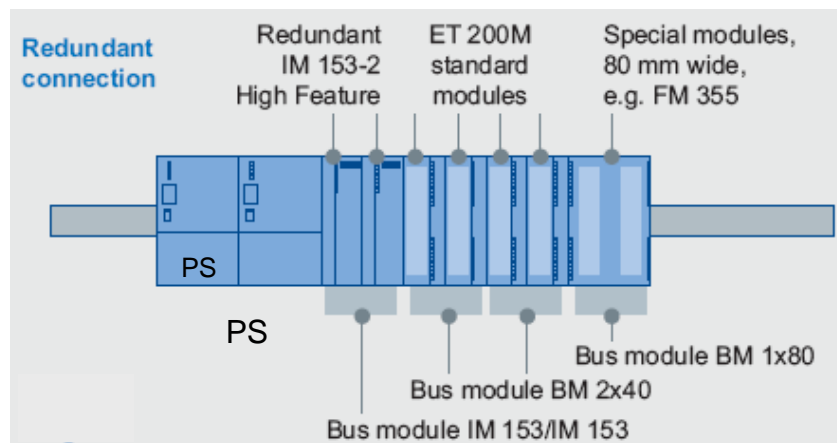
Name	MLFB	Product Brief
ET 200M - IM 153-2	6ES7 153-2BA02-0XB0 V5.x	Bus interface for S7-300 SMs, FMs (without FM 356-4), module exchange during operation, expansion of the instrumentation and control functions, up to 12 I/O modules can be operated
ET 200M - IM 153-2	6ES7 153-2BA82-0XB0 V5.x	Bus interface for S7-300 SMs (outdoor), FMs (without FM 356-4), module exchange during operation, expansion of the instrumentation and control functions, up to 12 I/O modules can be operated
ET 200M - IM 153-2	6ES7 153-2BA70-0XB0	Bus interface for S7-300 SMs (outdoor); FMs (without FM 356-4), module exchange during operation, up to 12 I/O modules can be operated

1.3.3 Bus modules

As mentioned above, in PCS 7 only active bus modules can be used for redundant applications with ET 200M. This enables removal and insertion of modules during operation. To achieve redundant operation, each ET 200M requires two interface modules IM 153-2 high feature to be mounted on the active bus module.

For the ET 200M standard modules (e.g. DI, DO, AI, AO), further bus modules are used.

Figure 1–2: Possible configuration of an ET 200M station. It should be noted that the use of the redundant power supply module (PS) is optional.



Note

For more information about the permitted combination of interfaces and bus modules, as well as available functionalities, please refer to the manual "SIMATIC Distributed I/O device ET 200M".

In practice, an IM 153 redundancy bundle is often ordered for the installation of a redundant ET 200M station. This consists of two IM 153-2 high feature and one active bus module IM 153/IM 153.

1.3.4 Input/output module (I/O)

I/O modules with channel-granular functionality

From PCS 7 V7.0 upwards, you can specify how redundant input/output modules behave in case of a channel fault (e.g. wire break, short circuit on the signal line). For a channel fault, one can expect the following reactions depending on the module used and the configuration:

- If a fault occurs, only the faulty channel is passivated (recommended channel-granular passivation)
- The entire module is passivated when a fault occurs (module-granular passivation)

The following Table 1–3 shows input and output modules, which are suitable for the redundant configuration with ET 200M and equipped with channel-granular functionality. It should be noted that modules with channel-granular properties can be also always used for module-granular functionality but not the other way round.

Table 1–3

Name	MLFB
Digital input module SM321	
DI 16x24 V DC, interrupt	6ES7 321-7BH01-0AB0
DI 16xDC24V, Alarm; high feature	6ES7 321-7BH01-0AB0 ES 6 (revision)
DI 4xNAMUR, Ex	6ES7 321-7RD00-0AB0
DI 16xNAMUR	6ES7 321-7TH00-0AB0
Digital output module SM322	
DO 8xDC24V/2A	6ES7 322-1BF01-0AA0
DO 4xDC24V/10mA, Ex	6ES7 322-5SD00-0AB0
Analog input modules SM331	
AI 8x16Bit	6ES7 331-7NF00-0AB0
AI 8x16Bit	6ES7 331-7NF10-0AB0
AI 6xTC	6ES7 331-7PE10-0AB0
AI 4x0/4...20mA, Ex	6ES7 331-7RD00-0AB0
AI 8x0/4...20mA HART	6ES7 331-7TF01-0AB0
Analog output modules SM332	
AO 4x12Bit	6ES7 332-5HD01-0AB0
AO 8x12Bit	6ES7 332-5HF00-0AB0
AO 4x0/4...20mA, Ex	6ES7 332-5RD00-0AB0
AO 8x0/4...20mA HART	6ES7 332-8TF01-0AB0

Note

When using HART modules, you have to use PCS 7 from V7.0 SP1. Specific interface modules (6ES7 153-2BA02-0XB0 or 6ES7 153-2BA82-0XB0) must also be used.

Special features of HART modules

Note When using redundant HART analog input modules, only one transmitter (encoder) can be connected.

Redundant HART signal modules work as "Primary Master" and "Secondary Master" to allow simultaneous HART communication via both modules with a field device.

The system declares the module with the lower address as the "Primary Master". If this one fails, communication happens via the "Secondary Master".

Note In order not to affect this system behavior, no other HART Master, e.g. handheld, may be connected.

1.3.5 MTA (Marshaled Termination Assemblies) terminal module

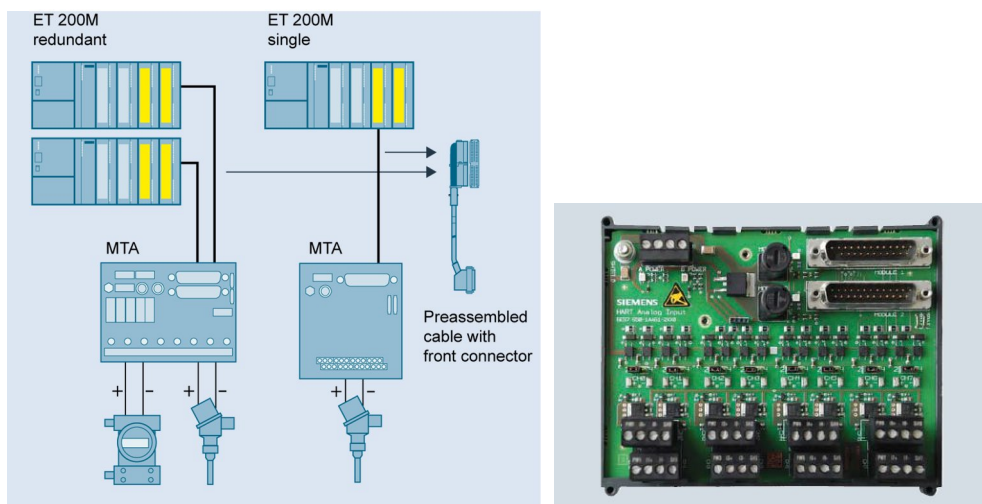
The MTA terminal modules offer the possibility of connecting field devices, sensors and actuators easily and quickly to the I/O modules of the distributed I/O ET 200M.

The MTA are each tailored to specific I/O modules from the ET 200M range. MTA versions for standard I/O modules are also available for redundant and safety-related I/O modules.

They can be used to significantly reduce the costs and required work for cabling and commissioning, and prevent wiring errors.

The following figure illustrates the capabilities of MTA together with ET 200M stations (with an encoder).

Figure 1–3



The MTA terminal modules are connected to the I/O modules of the ET 200M via 3m or 8m long pre-assembled cables.

Product features

MTA are characterized by the following properties:

- Redundant 24 V DC power supply with LED display
- Screw-type terminals for direct (1:1) connection of field devices, sensors and actuators
- Fuse with LED indicator for each I/O channel
- Pre-assembled cables to connect the MTA with the I/O module
- with SUB D connector, 50/25-pin, plug socket version, for MTA
- with Siemens front connector, 40/20-pin, plug socket version, for the ET 200M module
- On-board simulation capabilities for IBS purposes (wire break, to switch ON/OFF a channel)
- Tested as a SIMATIC PCS 7 system component and approved with appropriate approvals (FM, UL, CE, ATEX, TÜV (German Technical Inspectorate))

Advantages

- MTA allow quick and simple wiring to field devices
- Direct connection of field devices
- SUB D connector to connect pre-assembled cables
- A backup for each channel with LED display
- Redundant 24 V DC power supply
- On-board simulation capabilities, e.g. for commissioning purposes
- Support for redundant ET 200M modules
- Channel-granular protection
- Cables must be accessible
- Internal potential distribution
- Easy maintenance with plug connections
- Faster commissioning
- Connection possibility for HART modem to the MTA

Note

For more detailed information, refer to the "ET 200M Marshalled Termination Assemblies Remote I/O Modules".

1.3 Hardware components

In the case of the MTA, please note that an MTA module can only be connected with certain input/output modules. Table 1–4 shows possible connection possibilities.

Table 1–4

Product label	MLFB
8 channels, AI	6ES7650-1AA52-2XX0
8 channels, AO	6ES7650-1AB51-2XX0
8 channels, AI HART	6ES7650-1AA61-2XX0
8 channels, AO HART	6ES7650-1AB61-2XX0
8 channels, AI TC	6ES7650-1AF51-2XX0
8 channels, AI RTD	6ES7650-1AG51-2XX0
16 channels, DO	6ES7650-1AD11-2XX0
6 channels F-AI HART (safety-related)	6ES7650-1AH62-5XX0
16 channels, DI	6ES7650-1AC11-3XX0
24 channels F-DI (safety-related)	6ES7650-1AK11-7XX0
10 channels F-DO (safety-related)	6ES7650-1AL11-6XX0
16 channels DO relay	6ES7650-1AM30-3XX0
10 channels F-DO Relay (safety-related)	6ES7650-1AM31-6XX0

Note

For detailed information about each MTA type, please refer to the product release: <https://support.industry.siemens.com/cs/ww/en/view/29289048>

2 Configuring and wiring

2.1 Redundant PROFIBUS DP connection

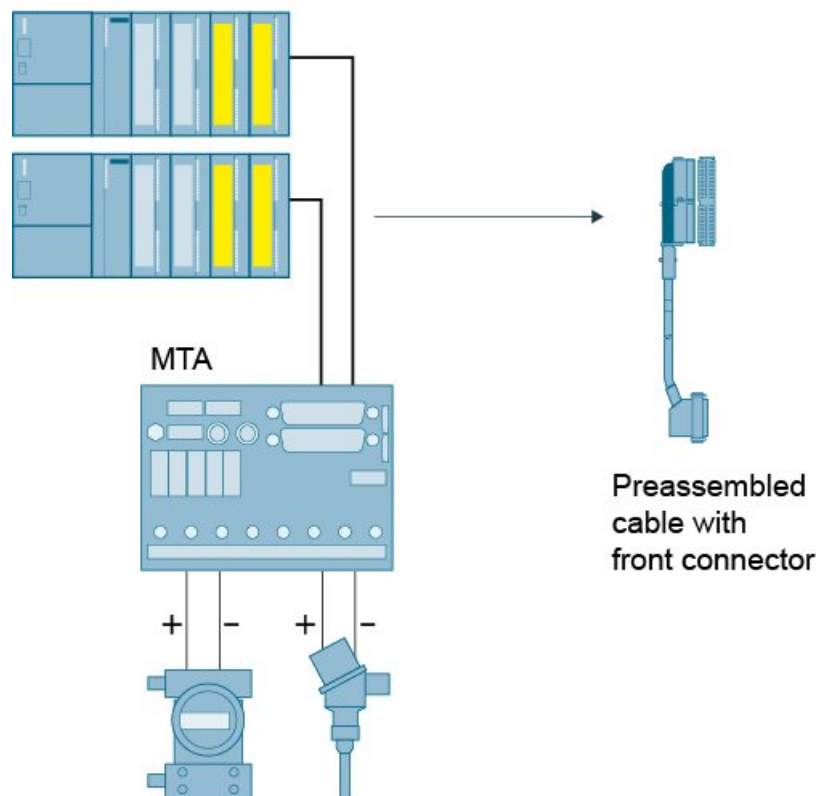
The transition from the automation system to PROFIBUS DP is done via a CP 443-5 Extended or via one of the two internal PROFIBUS DP interfaces of the CPU.

2.2 Connecting an MTA terminal module

MTA provide quick and easy connection of the field level to the ET 200M I/O modules. They reduce the amount of wiring effort and avoid mistakes.

Figure 2-1

ET 200M
redundant



Note

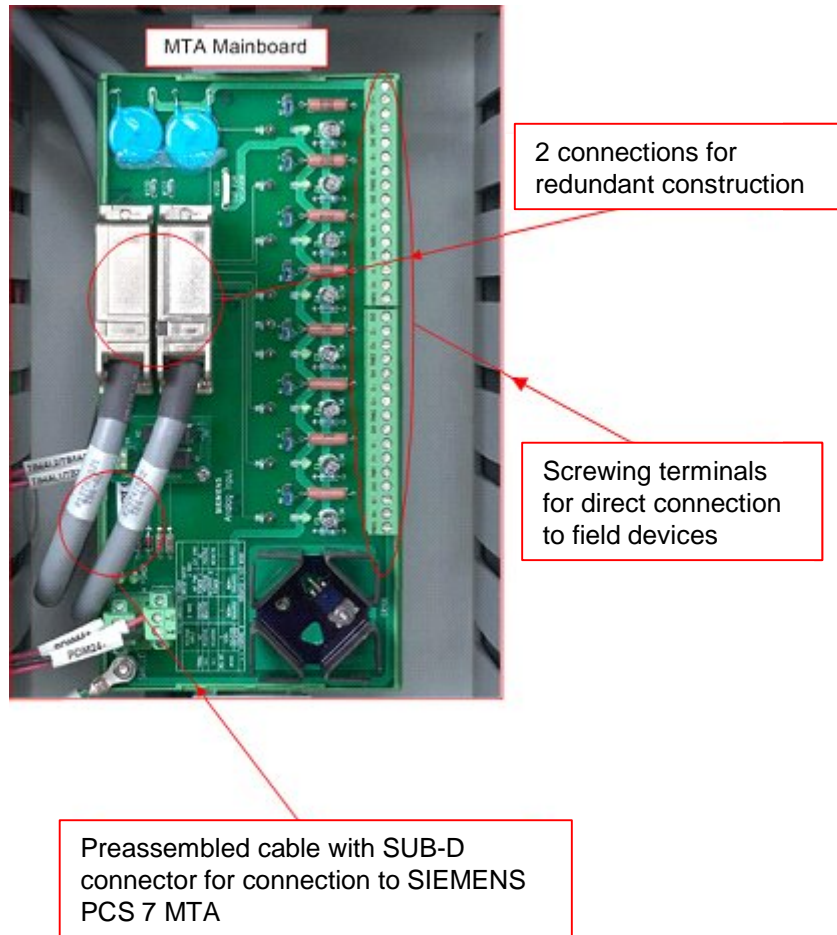
To achieve maximum availability with redundant encoders, two MTA are also required, each being connected between the input modules and the encoders.

2 Configuring and wiring

2.2 Connecting an MTA terminal module

The connection of the ET 200M modules to the MTA is established via the connecting cable of the correct type, as also shown in the following figure with an MTA AI as an example.

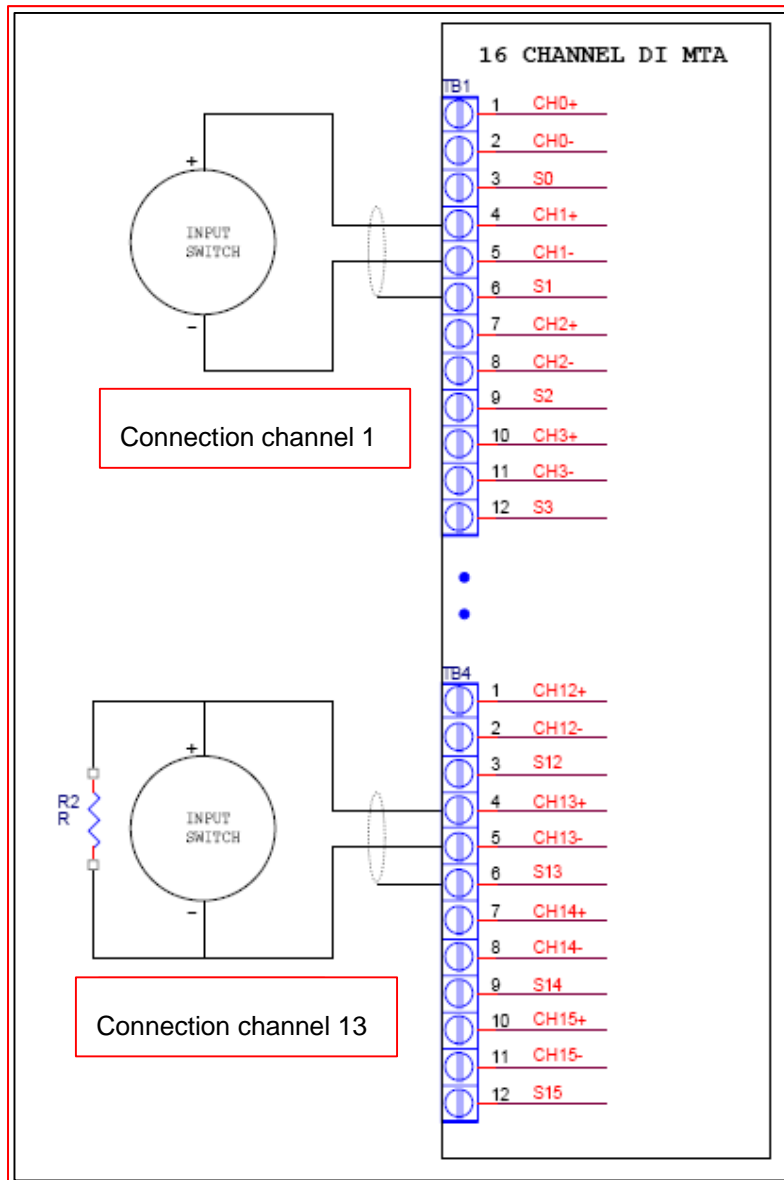
Figure 2–2



Connection example of sensors to the screw-type terminals on the MTA

The following figure shows the encoder connection using the example of digital inputs.

Figure 2–3



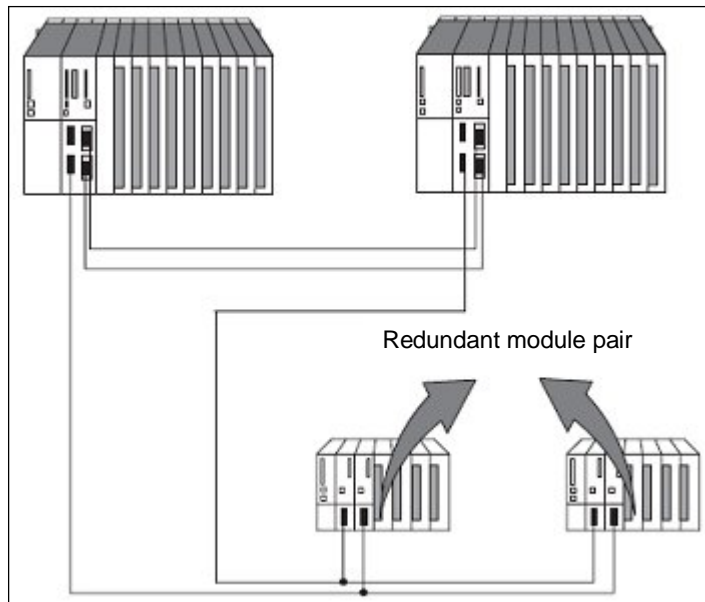
Note

For more detailed information, refer to the "ET 200M Marshalled Termination Assemblies Remote I/O Modules".

2.3 Redundant connections of the distributed I/O

Figure 2–4 shows an example of the redundant peripherals connection, switched in the DP slave mode. In contrast to the redundant peripherals in the one-sided DP slave mode, the signal modules in the ET 200M distributed I/O devices are hereby used in pairs.

Figure 2–4



The following chapters describe how to connect the sensor to the signal modules.

Note

For detailed diagrams and assembly data, refer to the manual "SIMATIC S7-300 S7-300 Module data".

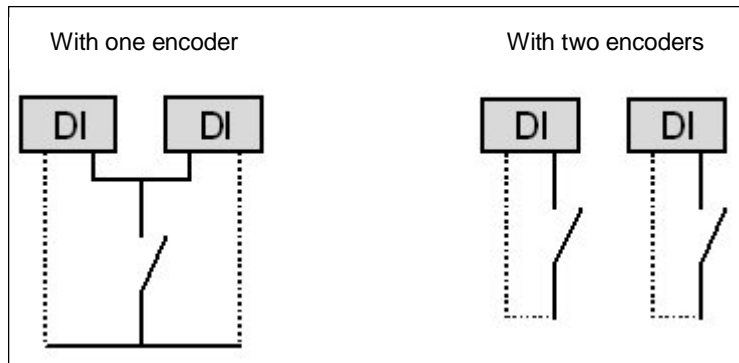
Specific notes for the redundant use of certain signal modules, can be found in the manual "SIMATIC Fault-tolerant systems S7-400H" or in the manual "SIMATIC PCS 7 process control system CPU 410-5H Process Automation"

2.3.1 Digital input

Sensor connection

One or two sensors are connected to two redundant SM 321; DI 16 x DC 24 V (1 of 2 structure).

Figure 2-5



To achieve maximum availability, it is recommended to use two encoders.

Note

When connecting an encoder to several digital input modules, the redundant modules must operate at the same reference potential.

2 Configuring and wiring

2.3 Redundant connections of the distributed I/O

Connection and schematic circuit diagram of the SM 321; DI 16 x DC 24 V

The following picture shows the schematic circuit diagram of the digital input module with channel-granular functionality (6ES7 321-7BH01-0AB0).

Figure 2–6

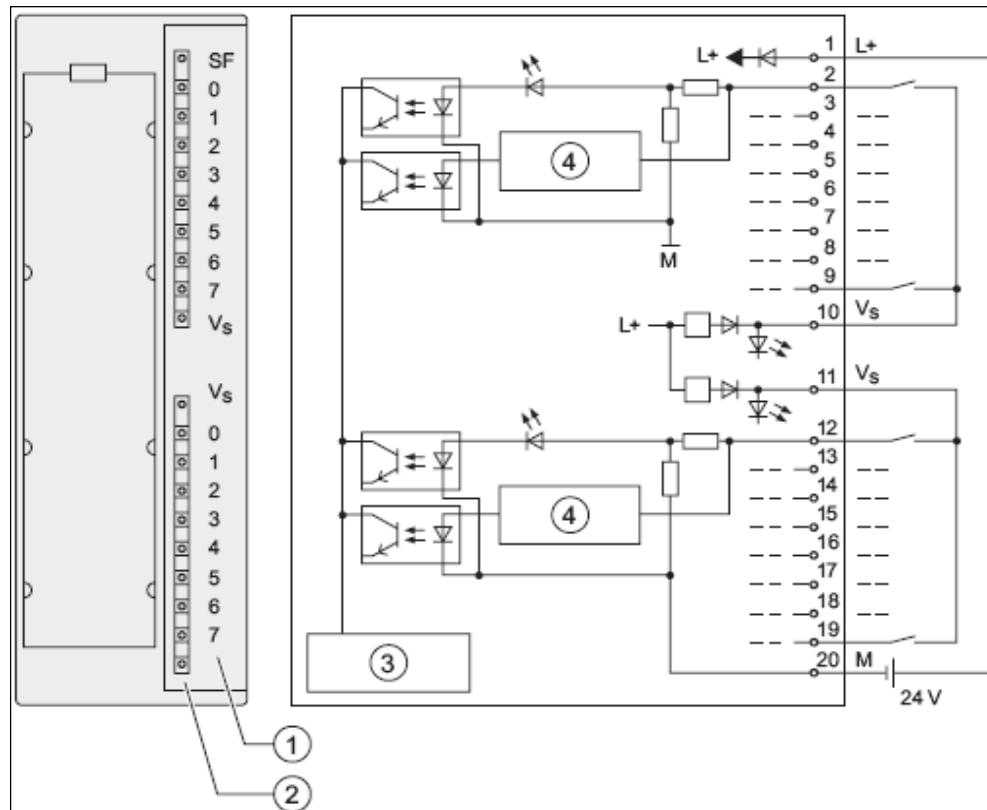


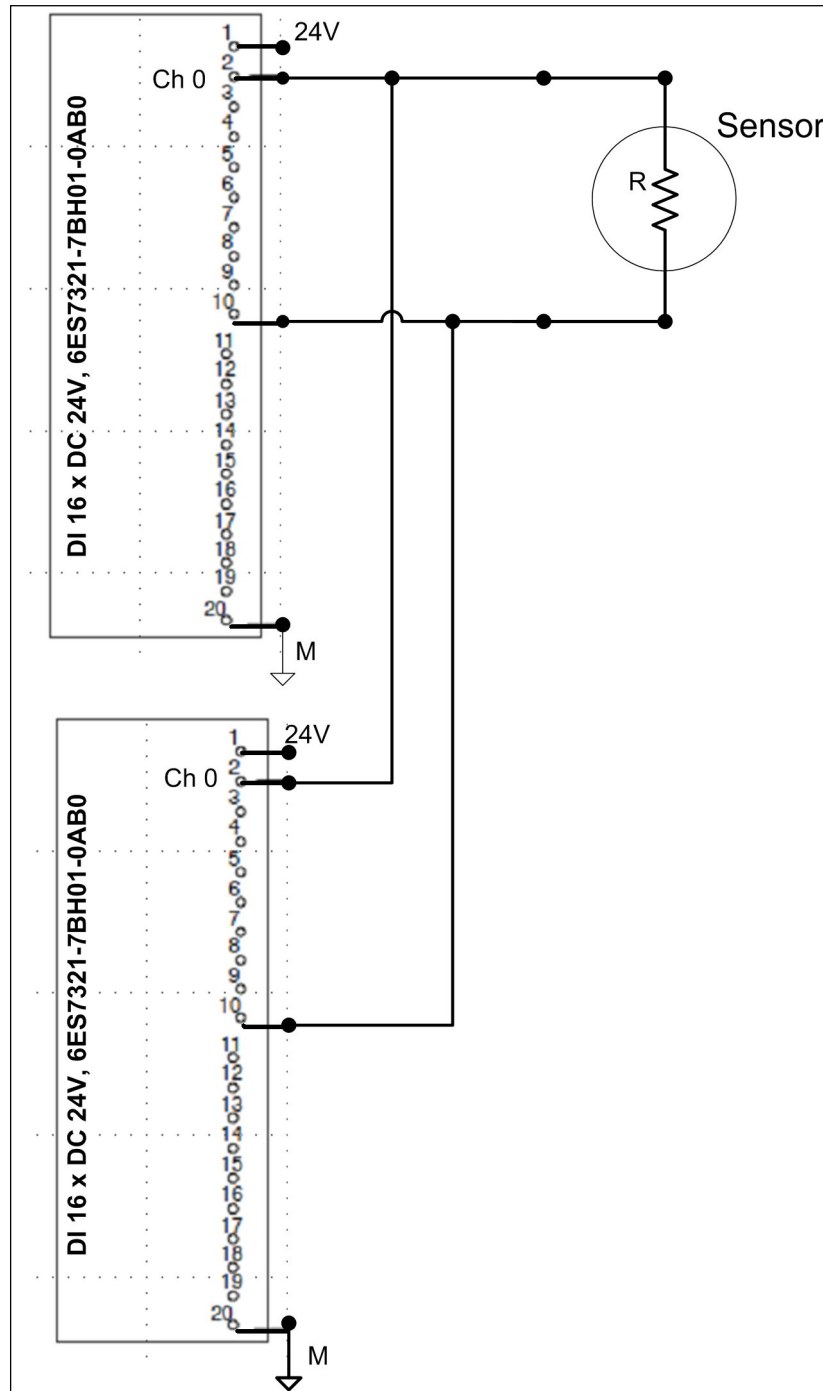
Table 2–1

Digit	Description
1	Channel number
2	Status displays – green Fault display – red Encoder supply VS – green
3	Backplane bus interface
4	Open-circuit detection

Example

An encoder is connected to channel 0 of each of the two SM 321; DI 16 x DC 24 V:

Figure 2–2



2.3.2 Digital output

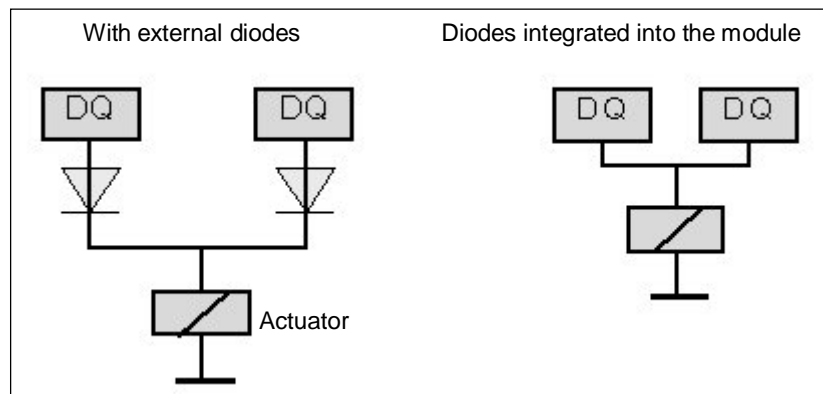
Controlling the final element control

The actuator is connected to two redundant SM322; DO 16 x DC 24 V / 0.5 A (1 of 2 structure). Depending on the type of digital output modules, additional diodes must be used in redundant mode.

Note

You can find the overview about which digital output modules you have to interconnect via external diodes in table 8-4 of the manual "S7-400H Automation System, High-availability Systems".

Figure 2-7



The digital output module with channel-granular functionality (6ES7 322-8BH01-0AB0) is interconnected without external diodes.

Note

The digital output modules must be connected to a common load voltage supply.

2 Configuring and wiring

2.3 Redundant connections of the distributed I/O

Connection and schematic circuit diagram of the SM 322; DO 16 x DC 24 V / 0.5 A

The following picture shows the schematic circuit diagram of the digital output module with channel-granular functionality (6ES7 322-8BH01-0AB0).

Figure 2–5

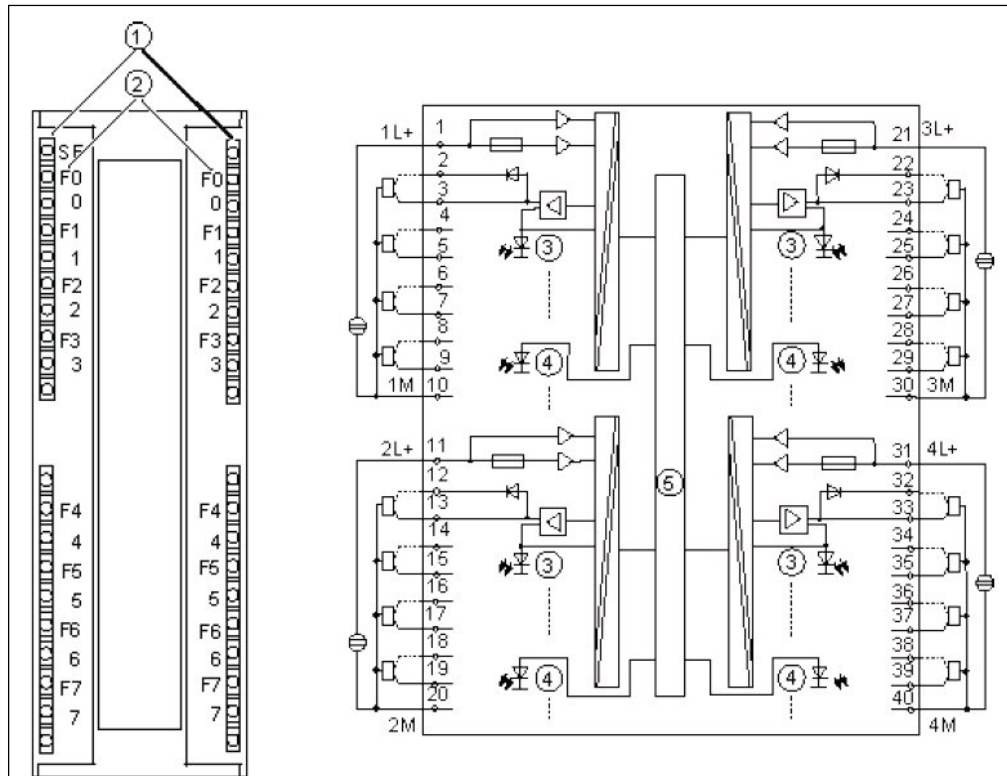


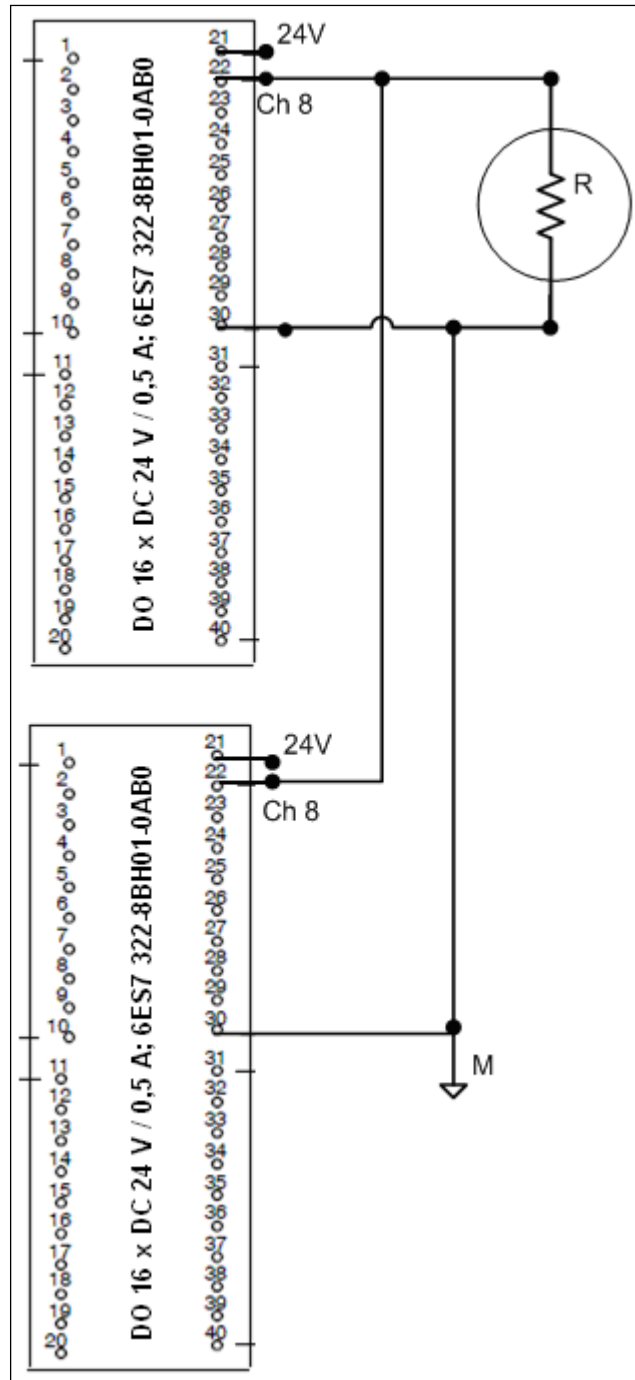
Table 2–2

Digit	Description
1	Status displays (green) Fault display (red)
2	Channel number The numbers 0 to 7 on the right side are the channel numbers 8 to 15
3	Channel status (green)
4	Channel fault (red)

Example

An actuator is connected via channel 8 to each of the two SM 322;
DO 16xDC 24V/0.5A:

Figure 2–8

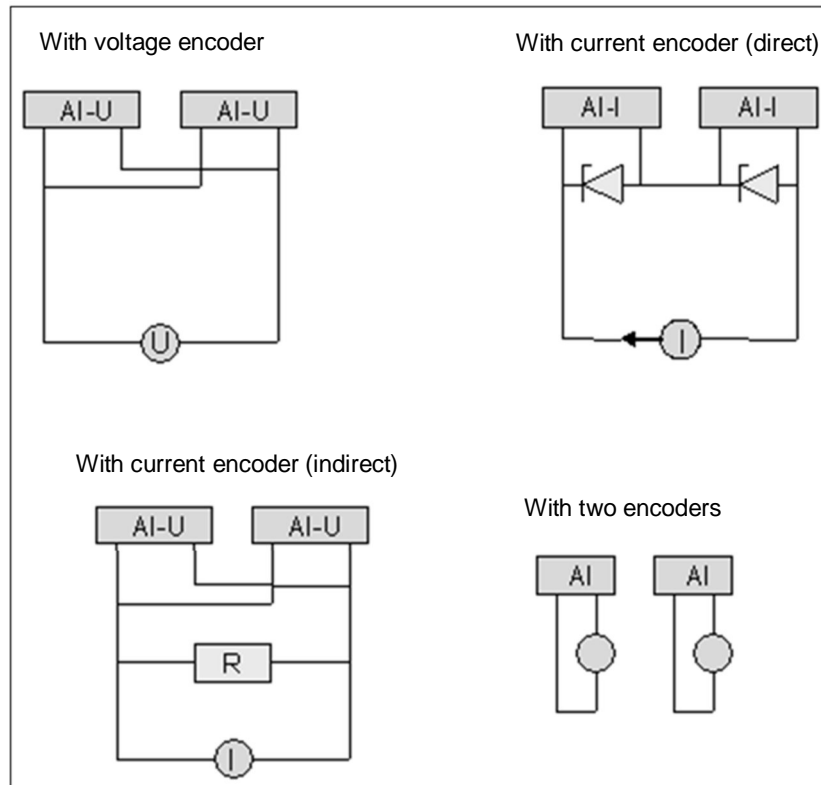


2.3.3 Analog input

Encoder connection

The analog input module SM331; AI 8x16 bit can be used with one or two encoders in redundant operation (1 of 2 structure).

Figure 2–9



To achieve maximum availability, it is recommended to use redundant encoders.

Note

When using redundant HART analog input modules, only one transmitter (encoder) can be connected.

2 Configuring and wiring

2.3 Redundant connections of the distributed I/O

Connection and schematic circuit diagram of the SM 331; AI 8 x 16 bit (voltage measurement)

The following two pictures each show the schematic circuit diagram of the analog input module SM331 AI 8x16 bit (6ES7 331-7NF00-0AB0) with channel-granular functionality for voltage and current measurement.

Figure 2–10

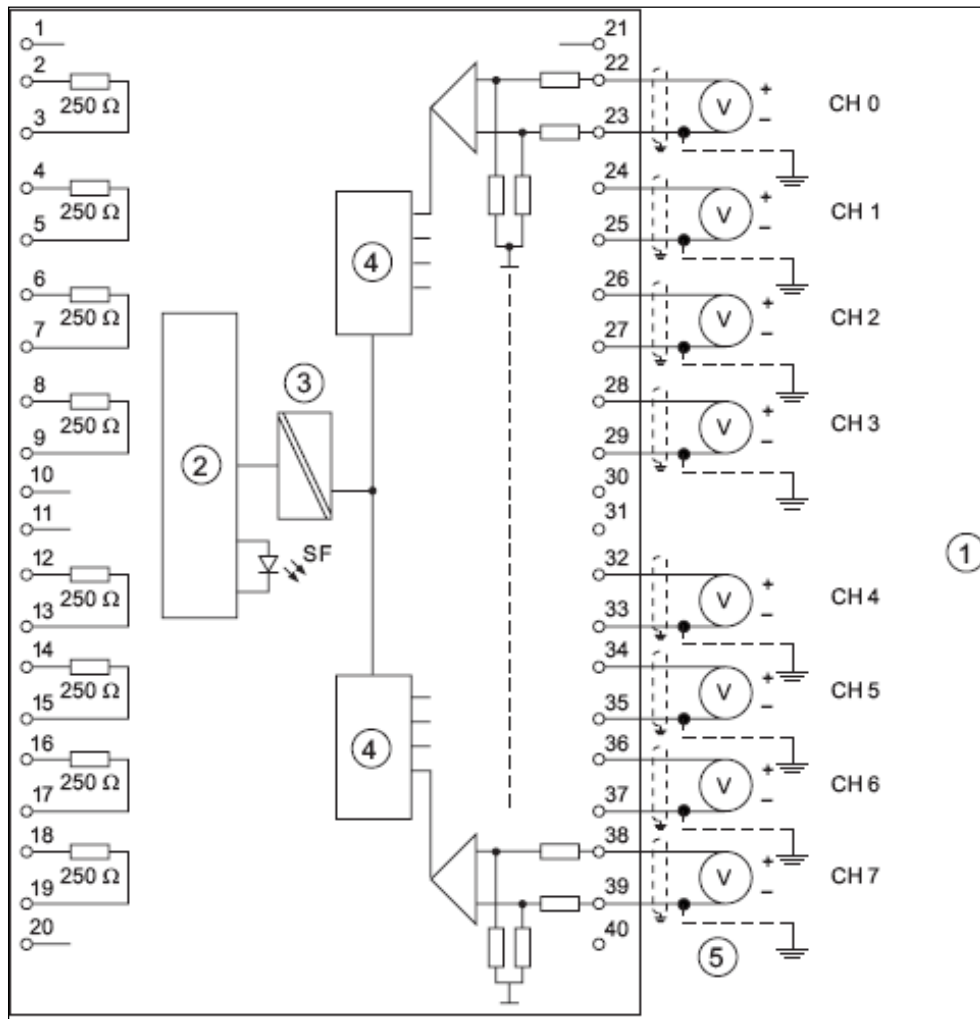


Table 2–3

Digit	Description
1	Voltage measurement
2	Backplane bus interface
3	Electrical isolation
4	Analog-to-Digital Converter (ADC)
5	Equipotential bonding

Connection and schematic circuit diagram of the SM 331; AI 8 x 16 bit (current measurement)

For current measurements, the voltage terminals are closed in parallel with the corresponding current sensing resistor. Bridge the channel input terminals with the adjacent connector terminals.

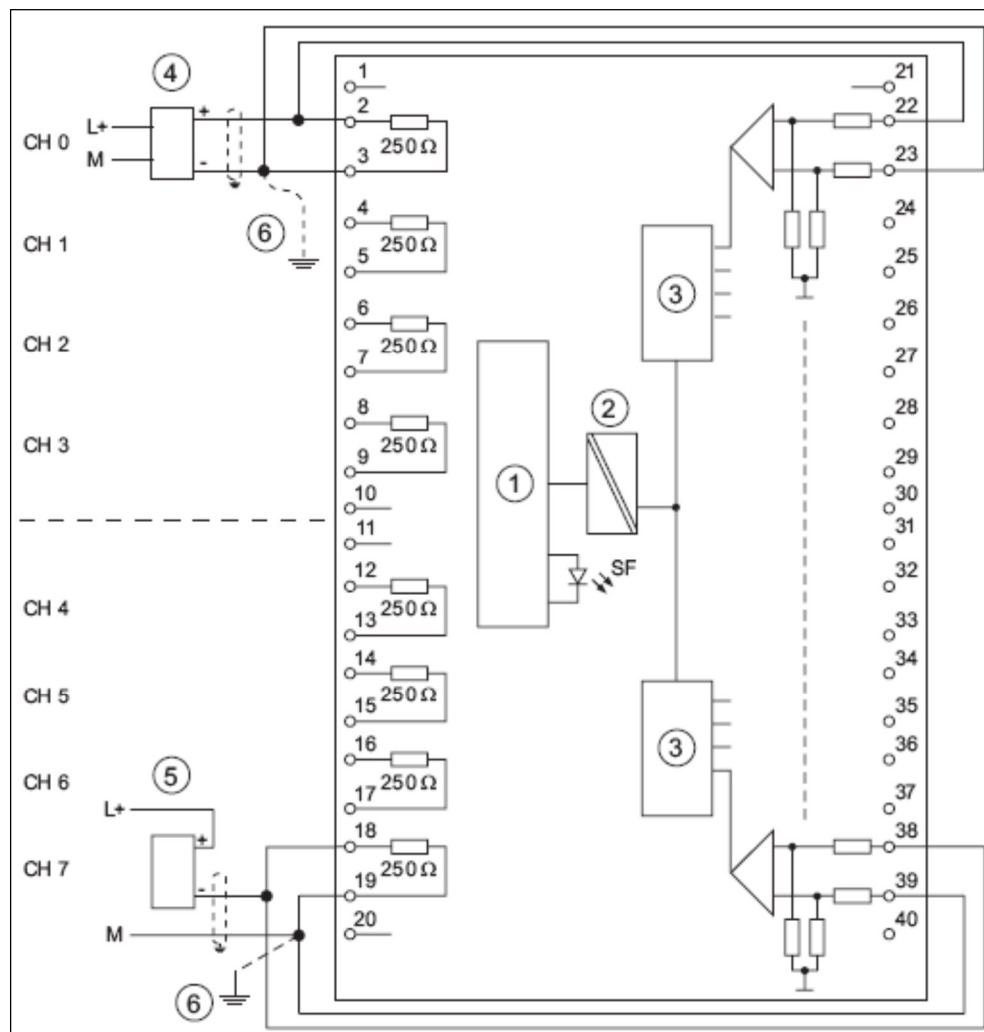
For example, to configure channel 0 for the current measurement, you have to bridge the terminals 22 and 2 and the terminals 23 and 3.

At the channel configured for current measurements, connect the current sensing resistor to the adjacent channel terminals in order to achieve the specified precision.

4-wire transducer (channel 0) or

2-wire transducer with external power supply (channel 7)

Figure 2–11



2 Configuring and wiring

2.3 Redundant connections of the distributed I/O

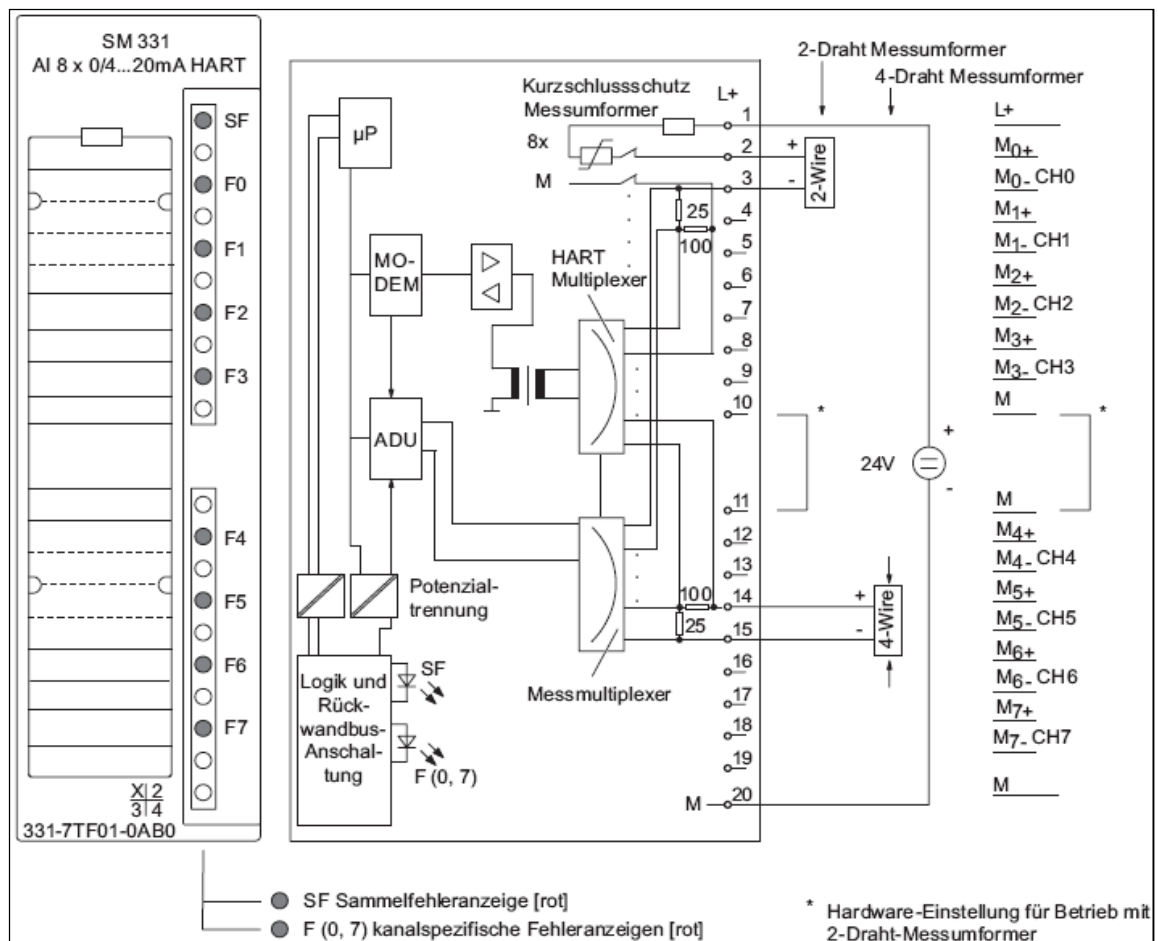
Table 2–4

Digit	Description
1	Backplane bus interface
2	Electrical isolation
3	Analog-to-Digital Converter (ADC)
4	CH 0 for 4-wire transducer
5	CH 7 for 2-wire transducer (with external supply)
6	Equipotential bonding

Connection and schematic circuit diagram of the SM 331; AI 8 x 0/4...20 mA HART

The following picture shows the schematic circuit diagram of the analog HART input module SM331 AI 8x0/4...20 mA (6ES7 331-7TF01-0AB0) with channel-granular functionality.

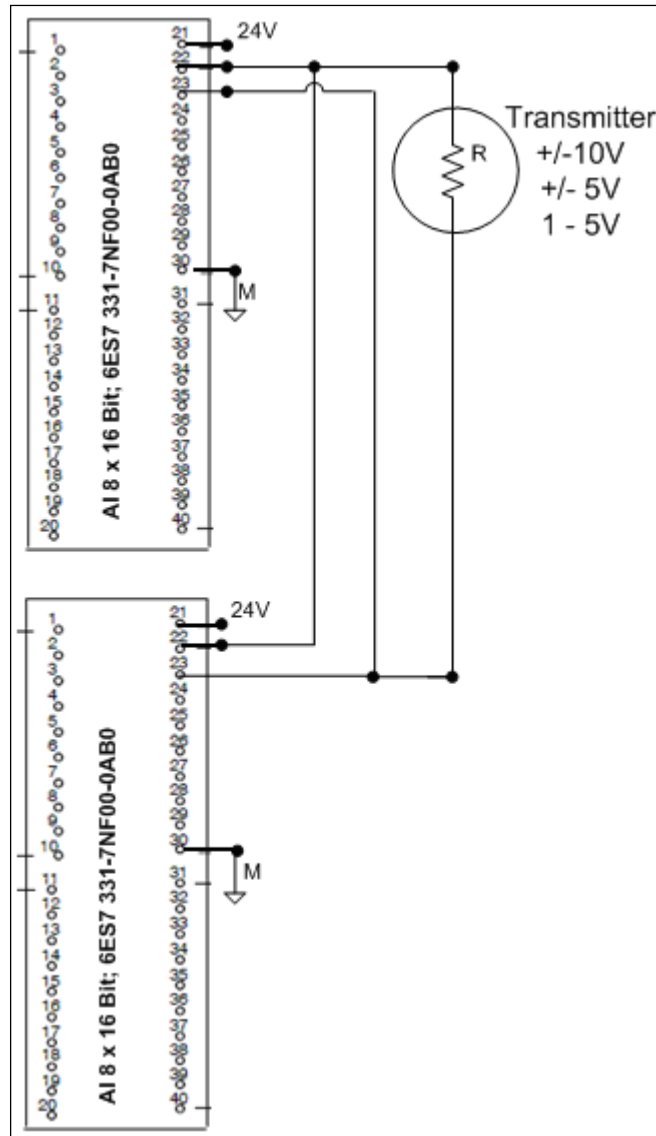
Figure 2–12



Example of an SM 331; AI 8 x 16 bit

The following figure shows the connection of a transmitter to two AI 8 x 16 bit modules for the voltage measurement.

Figure 2-13



Example of an SM 331; AI 8x0/4...20 mA HART (2-wire transducer)

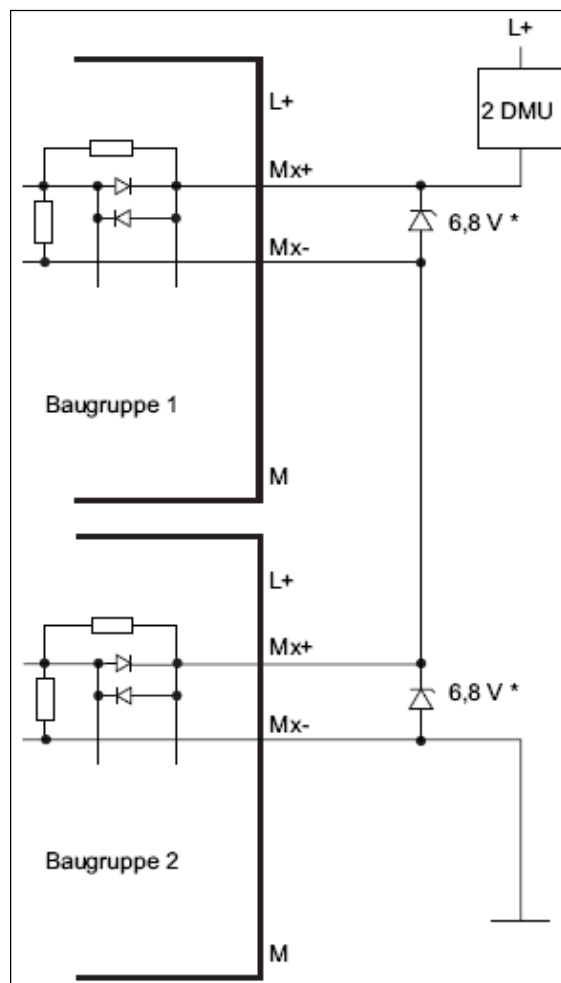
Note

A 2-wire transducer must be connected and configured to two redundant HART analog input modules as a 4-wire transducer.

You can find more detailed information in the manual "Distributed I/O Device ET 200M HART Analog Modules".

The terminals 10 and 11 may not be connected to the front connector (see Figure 2-12).

Figure 2-14

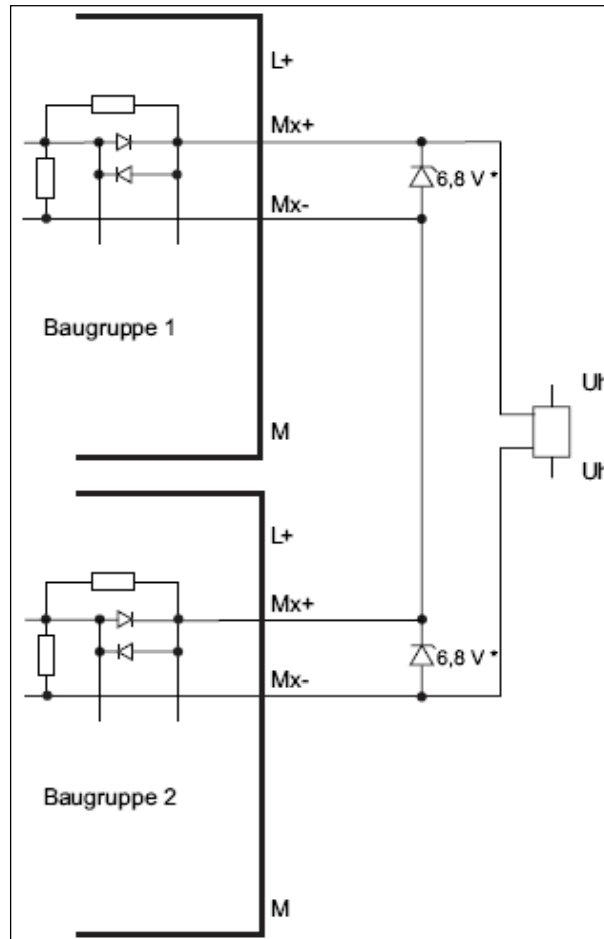


The interconnected Zener diodes are required if the system is to continue functioning while dragging a module.

Example of an SM 331; AI 8x0/4...20 mA HART (4-wire transducer)

A 4-wire transducer is connected to two redundant HART analog input modules:

Figure 2-15



The interconnected Zener diodes are required if the system is to continue functioning while dragging a module.

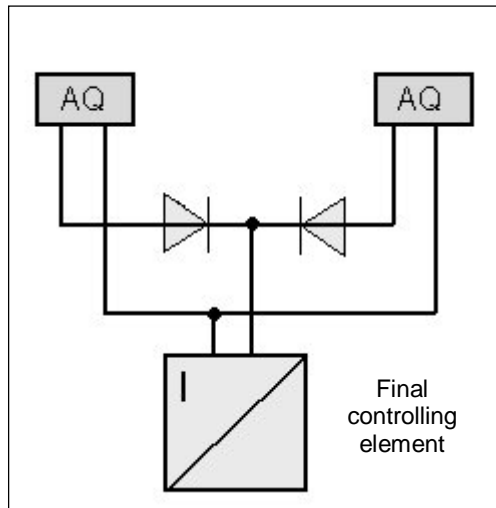
2.3.4 Analog output

Controlling the final element control

For the high-availability control of a final controlling element, two outputs of two SM 332; AO 8x12 bit are switched in parallel via diodes (1 of 2 structure).

Only analog output modules with current outputs can be operated redundantly (0 to 20 mA or 4 to 20 mA).

Figure 2-16



Each of both outputs transmits half the value. If one of the modules fails, the other output transmits the full value.

2 Configuring and wiring

2.3 Redundant connections of the distributed I/O

Connection and schematic circuit diagram of the SM 332; AO 8 x 12 bit (voltage output)

The following picture shows the schematic circuit diagram of the analog output module SM332 AO 8x12 bit (6ES7 332-5HF00-0AB0) with channel-granular functionality in the 2 and 4-wire connection for voltage output.

- 2-wire connection without compensation of line resistance
- 4-wire connection with compensation of line resistance

Figure 2–17

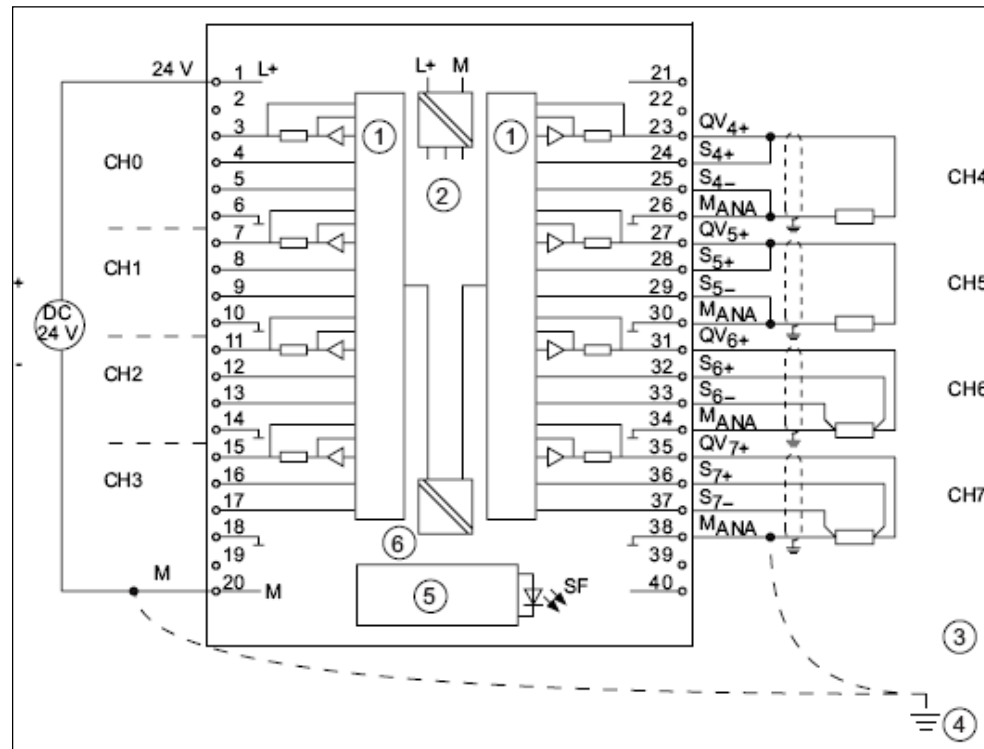


Table 2–5

Digit	Description
1	DAC
2	Internal supply
3	Equipotential bonding
4	Functional grounding
5	Backplane bus interface
6	Electrical isolation

2 Configuring and wiring

2.3 Redundant connections of the distributed I/O

Connection and schematic circuit diagram of the SM 332; AO 8 x 12 bit (current output)

The following picture shows the schematic circuit diagram of the analog output module SM332 AO 8x12 bit (6ES7 332-5HF00-0AB0) with channel-granular functionality as current output.

Figure 2–18

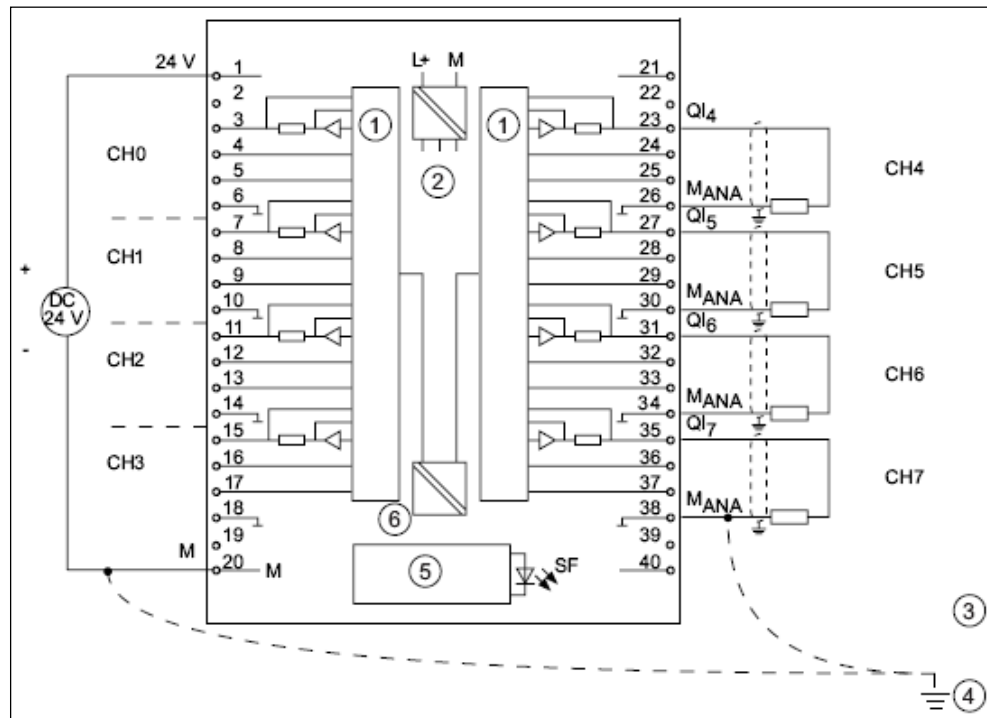


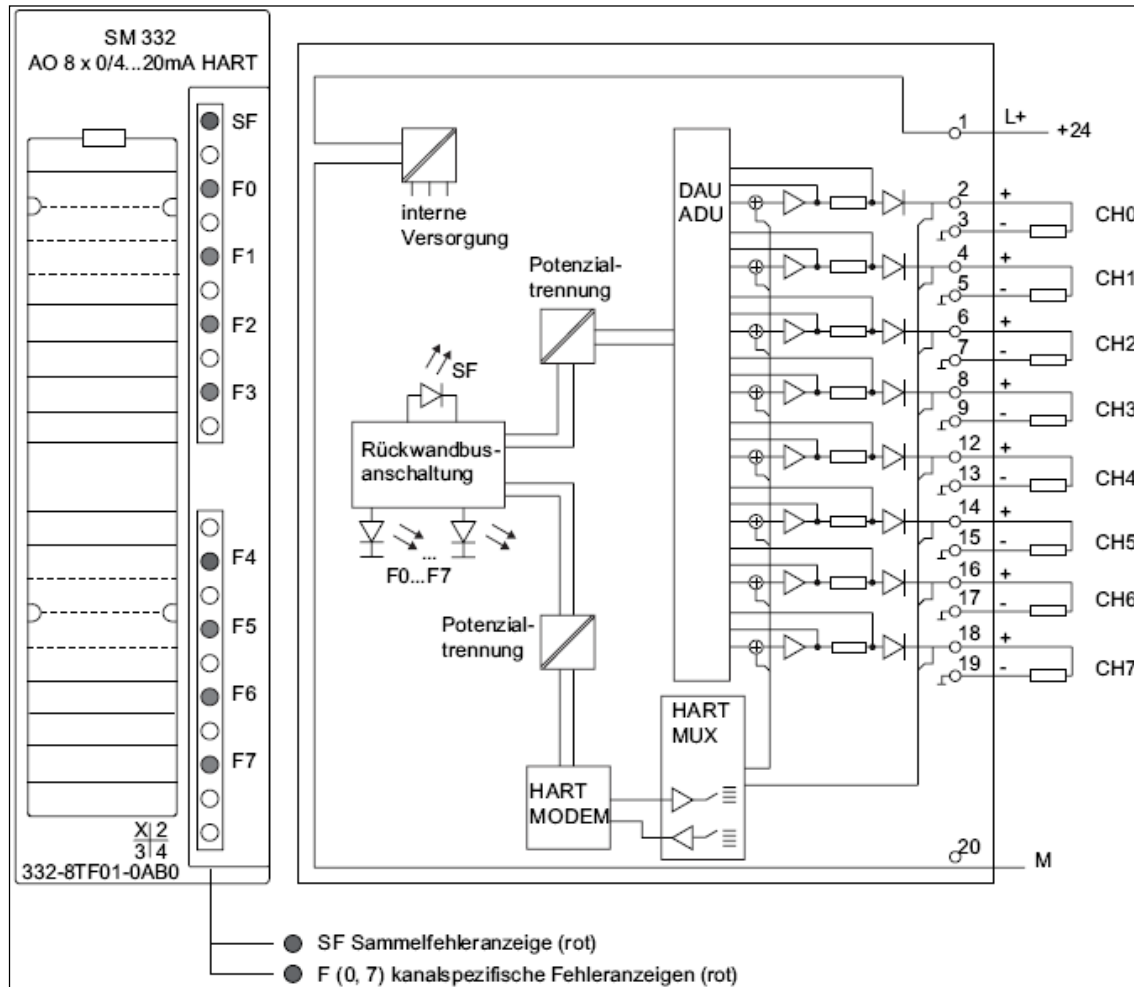
Table 2–6

Digit	Description
1	DAC
2	Internal supply
3	Equipotential bonding
4	Functional grounding
5	Backplane bus interface
6	Electrical isolation

Connection and schematic circuit diagram of the SM 332; AO 8 x 16Bit, 0/4...20mA HART

The following picture shows the schematic circuit diagram of the analog HART output module SM332 AO 8x16 bit, 0/4...20mA (6ES7 332-8TF01-0AB0) with channel-granular functionality.

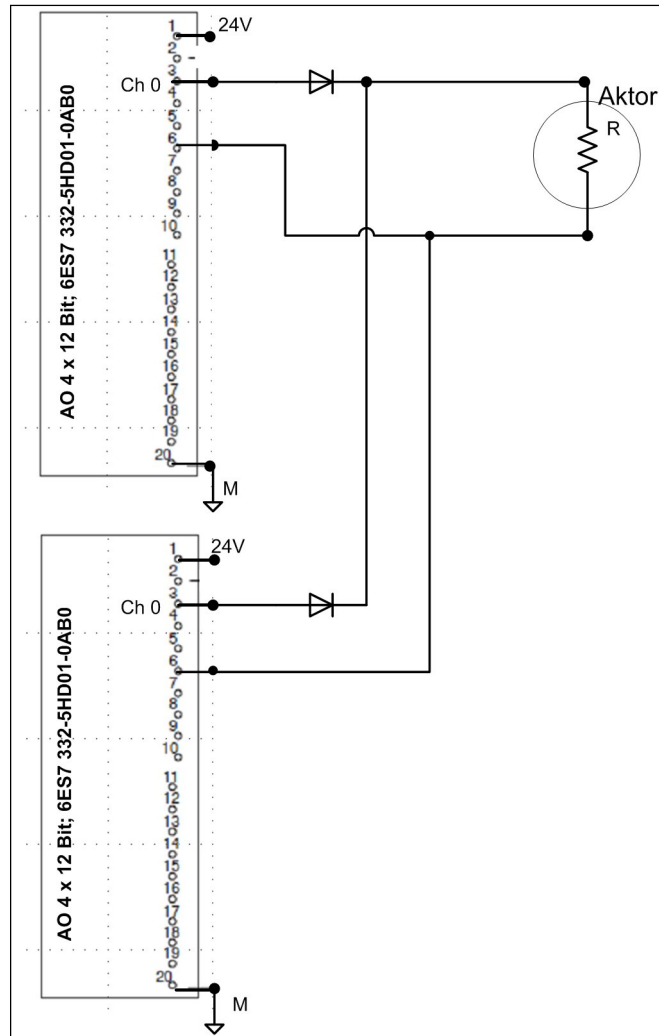
Figure 2–19



Example of an SM 332; AO 8 x 12 bit

The actuator is connected to channel 0 of each of the two redundant SM 332; AO 8 x 12 bit.

Figure 2–20



Note

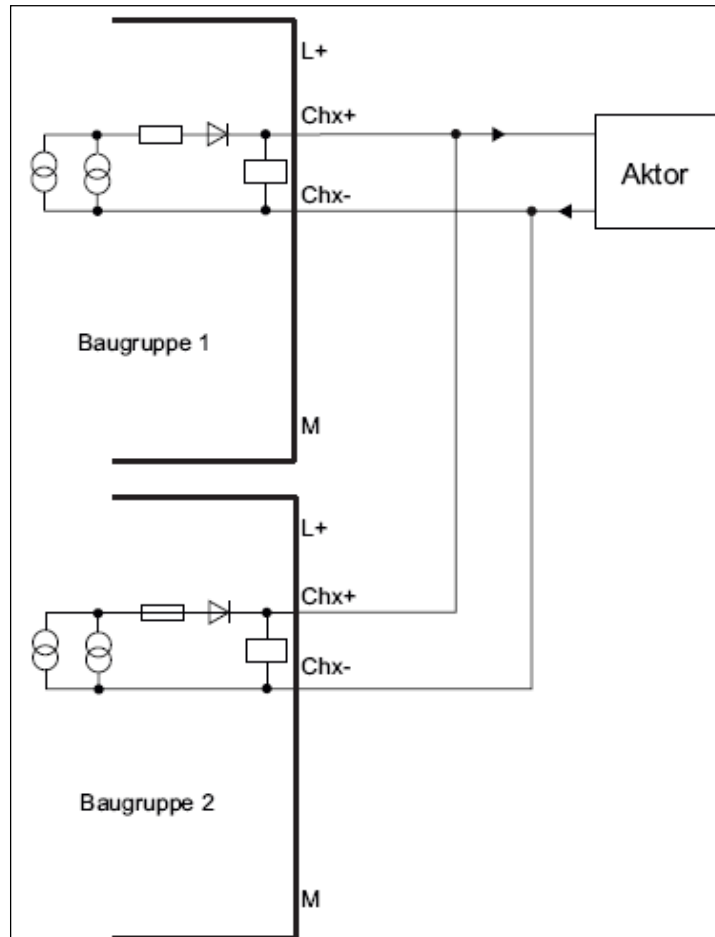
Suitable diodes include, for example, types from the series 1N4003 ... 1N4007 or any other diode with $U_{r>} = 200 \text{ V}$ and $I_{F>} = 1 \text{ A}$.

It makes sense to separate module weight and load weight. There must be equipotential bonding between both.

Example of an SM 332; AO 8 x 16Bit, 0/4...20mA HART

The actuator is connected to two redundant HART analog output modules.

Figure 2–21



3 Configuring the redundant peripherals

The following sections describe the configuration of individual components of the distributed IO with PCS 7. It is assumed that a PCS 7 project has been already created with an H station using the Project Wizard.

The following configuration steps are described:

- CPU settings (H parameters)
- Configuring the first ET 200M (IM 153-2 interface module)
- Configuring the individual signal modules IOs
- Configuring the second ET 200M via copying
- Redundancy settings at the signal modules
- Symbolic name assignment
- CFC configuration

3.1 CPU settings

To enable redundant operation between the AS and the distributed I/O, the CPU requires a certain configuration.

Requirements

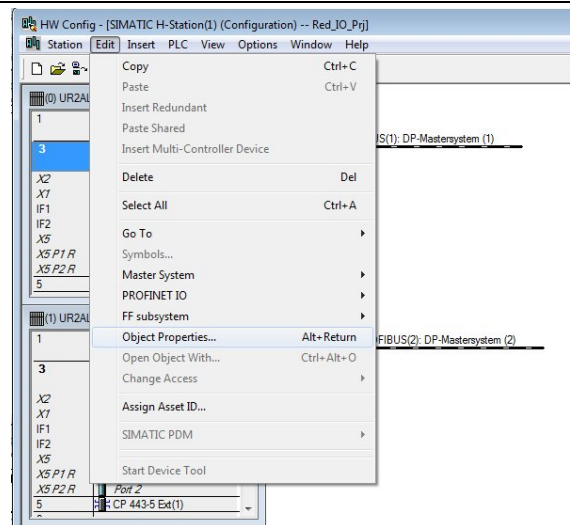
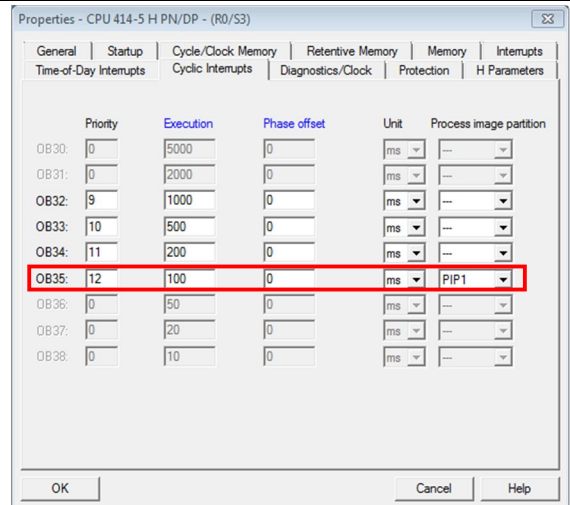
- The PCS 7 project with a SIMATIC H station is opened in SIMATIC Manager.
- If channel-granular passivation behavior is required, corresponding signal modules must be used when configuring the ET 200M (see ch. 1.3).

3 Configuring the redundant peripherals

3.1 CPU settings

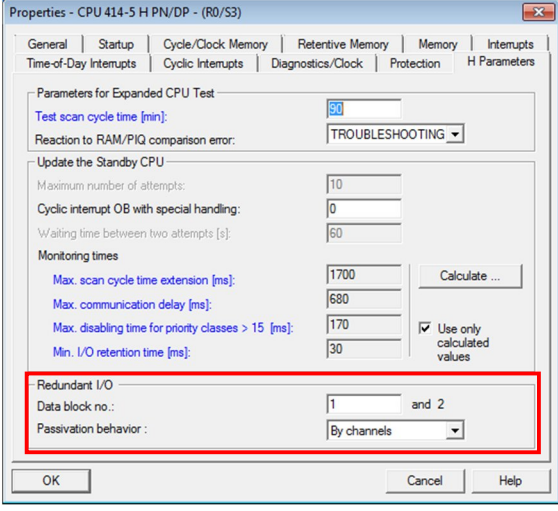
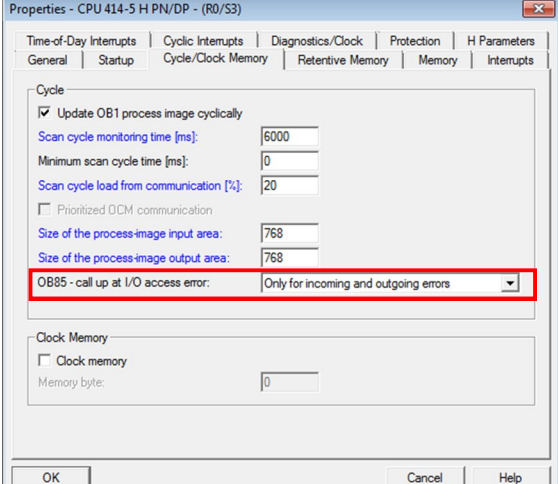
Procedure

Table 3–1

	Activity	Screenshot																																																												
1.	Open the SIMATIC H station in the HW Configure.																																																													
2.	Select the first used CPU in slot 3 of the rack (0) and select the menu command "Edit > Object Properties".																																																													
3.	Switch to the "Cyclic Interrupts" tab. Use the drop down list to select the desired process picture for those OB cyclic interrupts, where the channel blocks are to be installed at a later stage.	 <table><thead><tr><th></th><th>Priority</th><th>Execution</th><th>Phase offset</th><th>Unit</th><th>Process image partition</th></tr></thead><tbody><tr><td>OB30:</td><td>0</td><td>5000</td><td>0</td><td>ms</td><td>---</td></tr><tr><td>OB31:</td><td>0</td><td>2000</td><td>0</td><td>ms</td><td>---</td></tr><tr><td>OB32:</td><td>9</td><td>1000</td><td>0</td><td>ms</td><td>---</td></tr><tr><td>OB33:</td><td>10</td><td>500</td><td>0</td><td>ms</td><td>---</td></tr><tr><td>OB34:</td><td>11</td><td>200</td><td>0</td><td>ms</td><td>---</td></tr><tr><td>OB35:</td><td>12</td><td>100</td><td>0</td><td>ms</td><td>PIP1</td></tr><tr><td>OB36:</td><td>0</td><td>50</td><td>0</td><td>ms</td><td>---</td></tr><tr><td>OB37:</td><td>0</td><td>20</td><td>0</td><td>ms</td><td>---</td></tr><tr><td>OB38:</td><td>0</td><td>10</td><td>0</td><td>ms</td><td>---</td></tr></tbody></table>		Priority	Execution	Phase offset	Unit	Process image partition	OB30:	0	5000	0	ms	---	OB31:	0	2000	0	ms	---	OB32:	9	1000	0	ms	---	OB33:	10	500	0	ms	---	OB34:	11	200	0	ms	---	OB35:	12	100	0	ms	PIP1	OB36:	0	50	0	ms	---	OB37:	0	20	0	ms	---	OB38:	0	10	0	ms	---
	Priority	Execution	Phase offset	Unit	Process image partition																																																									
OB30:	0	5000	0	ms	---																																																									
OB31:	0	2000	0	ms	---																																																									
OB32:	9	1000	0	ms	---																																																									
OB33:	10	500	0	ms	---																																																									
OB34:	11	200	0	ms	---																																																									
OB35:	12	100	0	ms	PIP1																																																									
OB36:	0	50	0	ms	---																																																									
OB37:	0	20	0	ms	---																																																									
OB38:	0	10	0	ms	---																																																									

3 Configuring the redundant peripherals

3.1 CPU settings

	Activity	Screenshot
4.	<p>Switch to the "H Parameters" tab.</p> <p>Take note of those data blocks in the field "Data block no.", which are defined as a standard encoder, so that you don't use them elsewhere in your configuration.</p> <p>In the drop-down list "Passivation behavior", select the desired setting (channel-granular or module-granular).</p> <p>Click the button "Calculate..." in the field "Update the Standby CPU".</p> <p>These settings are performed to calculate the monitoring times.</p> <p>Note: This defines how the redundant input/output modules behave in case of channel faults (see chapter 1.4). This setting is intended for all redundantly configured signal modules that are connected to the CPU.</p>	
5.	<p>Switch to the "Cycle/Clock Memory" tab.</p> <p>Under "OB 85 - call up at I/O access error", select "Only for incoming and outgoing errors" from the drop-down list.</p> <p>Click "OK" to close the properties dialog.</p>	

Note

For more information about the settings on the CPU, refer to the manual "SIMATIC Process Control System PCS 7 Fault-tolerant Process Control Systems".

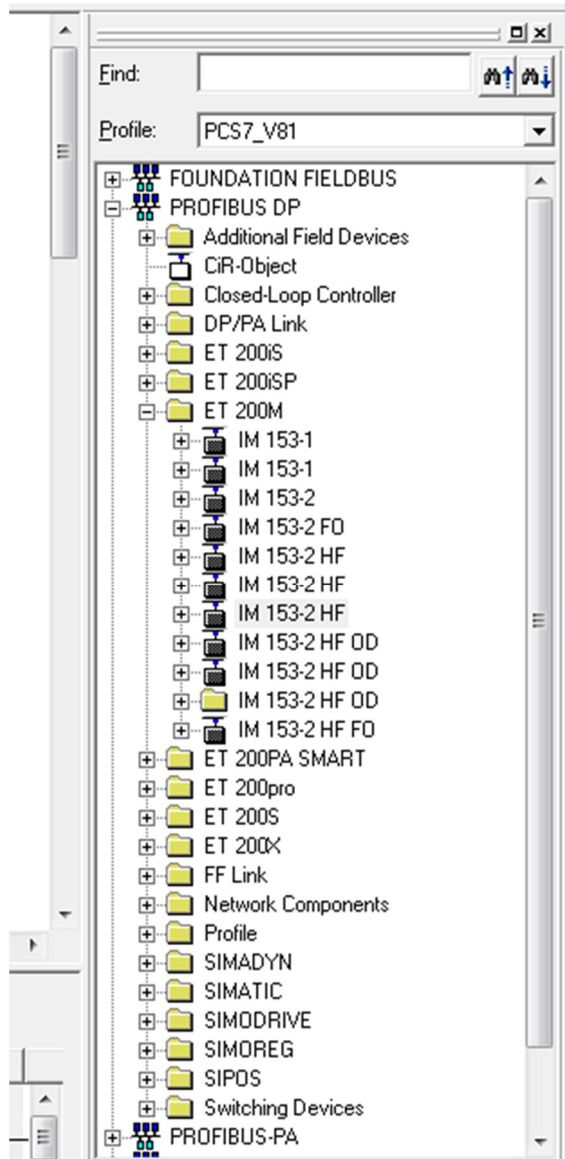
3.2 Configuring the ET 200M (IM 153-2 interface module)

Requirements

- The PCS 7 project with a SIMATIC H station is opened in SIMATIC Manager.
- In HW Config, a redundant PROFIBUS-DP master system is configured for the SIMATIC H station.
- The HW Config of the SIMATIC H station is open. If the hardware catalog is not visible, select the menu command "View > Catalog".

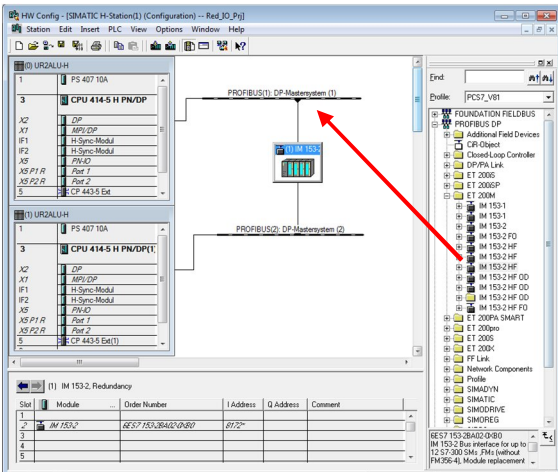
Procedure

Table 3–2

	Activity	Screenshot
6.	<p>In the "Profile" field of the hardware catalog, select the current PCS 7 profile from the drop-down menu.</p> <p>Double-click on the catalog "PROFIBUS DP". In the catalog, go to "PROFIBUS DP> ET 200M", select the suitable redundancy capable interface module IM 153-2 and drag-and-drop it onto one of the two PROFIBUS DP streams.</p>	

3 Configuring the redundant peripherals

3.3 Configuring the signal modules

	Activity	Screenshot
7.	<p>Enter the address in the dialog box "PROFIBUS IM 153-2 Interface Properties" and click "OK".</p> <p>The connection to the redundant PROFIBUS DP stream is automatically established.</p>	

3.3 Configuring the signal modules

The following section explains the procedure for configuring the standard and HART signal modules.

Note

For the time being do not add any HART field devices to the HART signal modules. This sequence will be explained in chapter 3.7.

Requirements

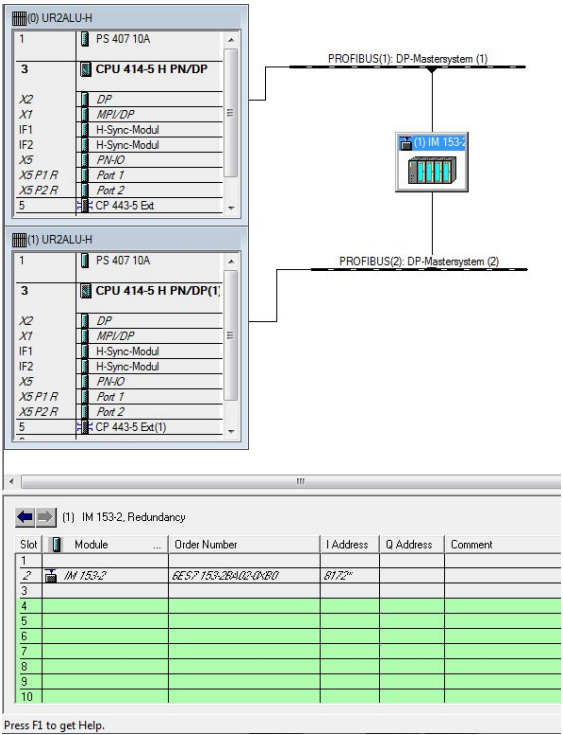
- The PCS 7 project with an H CPU has been created and is open in SIMATIC Manager.
- A redundant PROFIBUS-DP master system is configured for the SIMATIC H station in HW Config
- In HW Config, the interface module IM 153-2 is configured for the ET 200M at the redundant PROFIBUS DP.

3 Configuring the redundant peripherals

3.3 Configuring the signal modules

Procedure

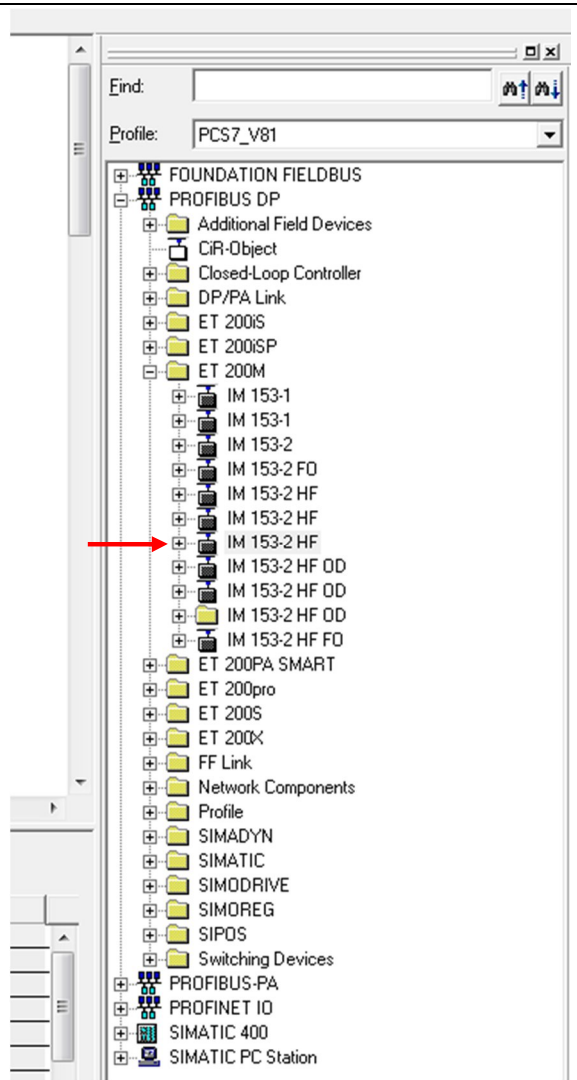
Table 3–3

	Activity	Screenshot
1.	Select the configured IM 153-2. The module overview is shown in the lower pane.	

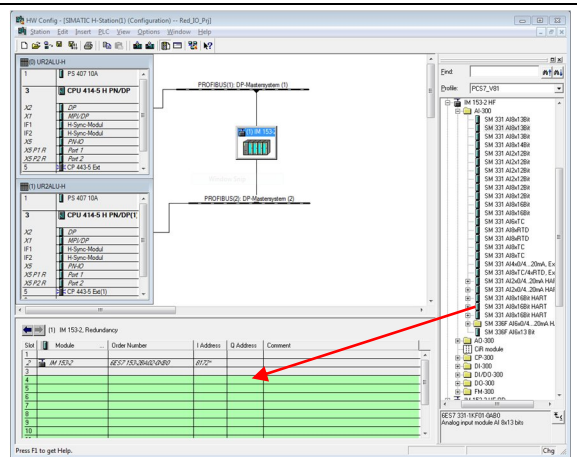
3 Configuring the redundant peripherals

3.3 Configuring the signal modules

2. In the hardware catalog, under "PROFIBUS DP > ET 200M", select the same interface module, which you have already dragged to the PROFIBUS DP master system via drag-and-drop.



3. Select a redundancy capable signal module in the subdirectories and drag-and-drop it into a free slot of the IM 153-2 (module overview).



3.3 Configuring the signal modules

- [illegible]

3.4 Configuring the second ET 200M

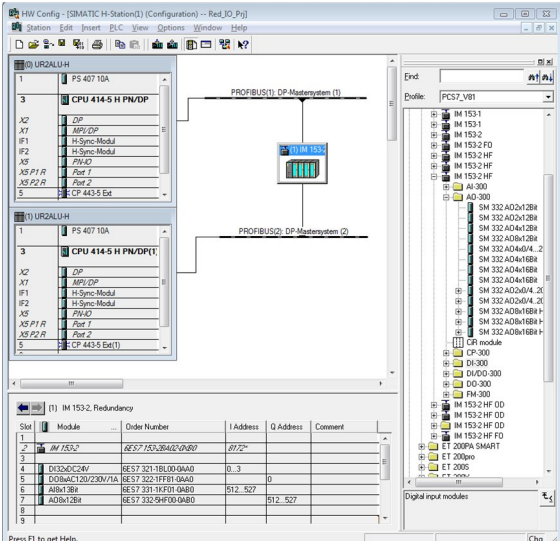
Once you have configured the first ET 200M with all the necessary components (IM 153-2 interface module, signal modules), you must now configure the second redundant ET 200M. It should be noted that redundant operation is only possible with modules that have the same MLFB. To avoid configuration errors, it is therefore advisable to copy the first ET 200M and paste it in the same master system.

Requirements

- The PCS 7 project with an H CPU has been created and is open in SIMATIC Manager.
- A redundant PROFIBUS-DP master system is configured for the SIMATIC H station in HW ConFigure
- In HW Config, the interface module IM 153-2 is configured for the ET 200M at the redundant PROFIBUS DP.
- All required signal modules are configured.

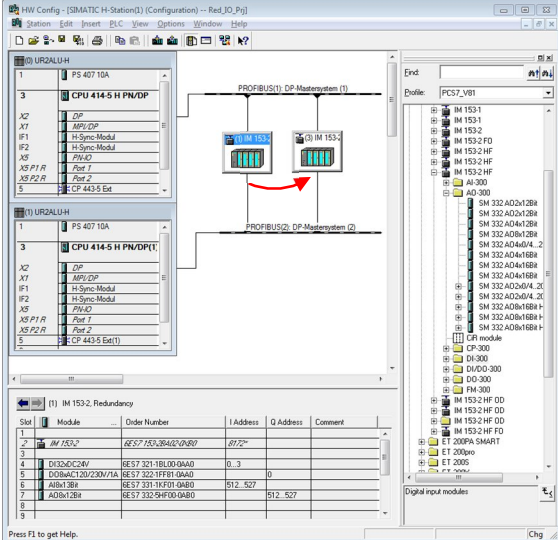
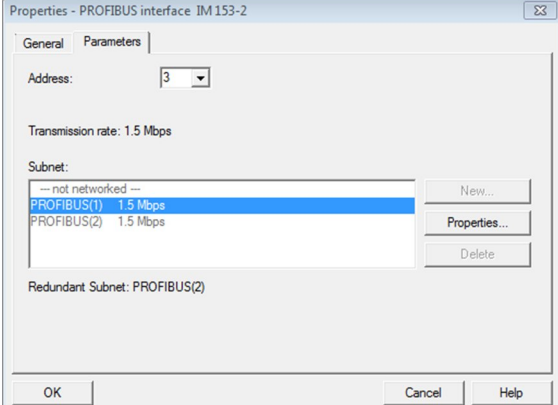
Procedure

Table 3–4

	Activity	Screenshot
1.	Open HW KonFigure Select the already configured ET 200M and copy it to the clipboard.	

3 Configuring the redundant peripherals

3.4 Configuring the second ET 200M

	Activity	Screenshot
2.	Select one of the PROFIBUS DP streams and paste the copied ET 200M.	
3.	Allocate the address of the redundant slave in the appearing properties dialog "PROFIBUS Interface IM 153-2" and click "OK". Make sure that this address is different from the address of the first ET 200M.	

3.5 Signal module settings

Once you have configured both ET 200M stations, you have to change various settings in your standard and HART signal modules.

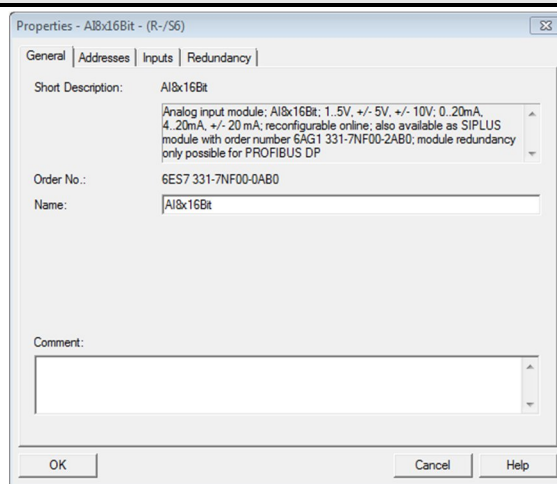
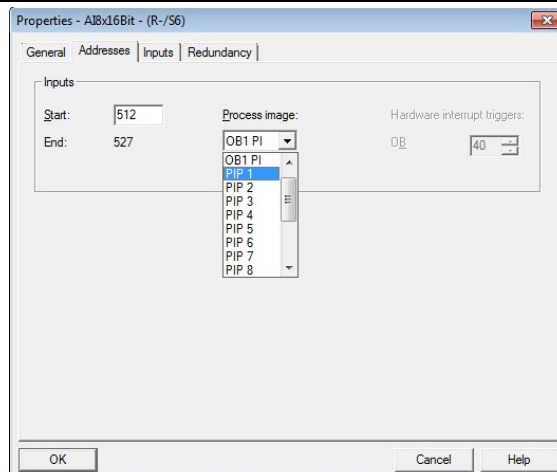
Redundant modules must be in the process image of the inputs or outputs.
Redundant modules are always accessed using the process image.

Requirements

- The PCS 7 project with an H CPU has been created and is open in SIMATIC Manager.
- A redundant PROFIBUS-DP master system is configured for the SIMATIC H station in HW Configure
- In HW Config, the interface module IM 153-2 is configured for the ET 200M at the redundant PROFIBUS DP.
- All required signal modules are configured.
- The redundant ET 200M has been configured.

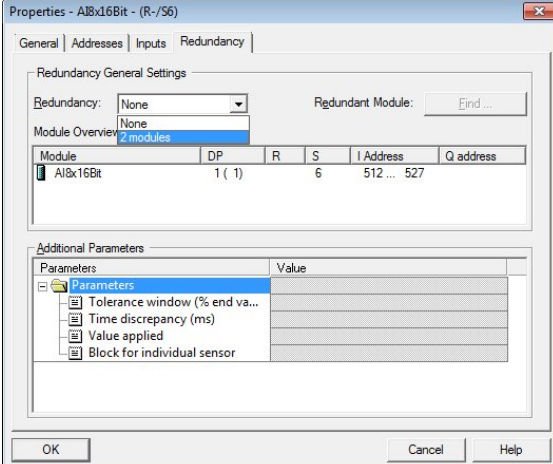
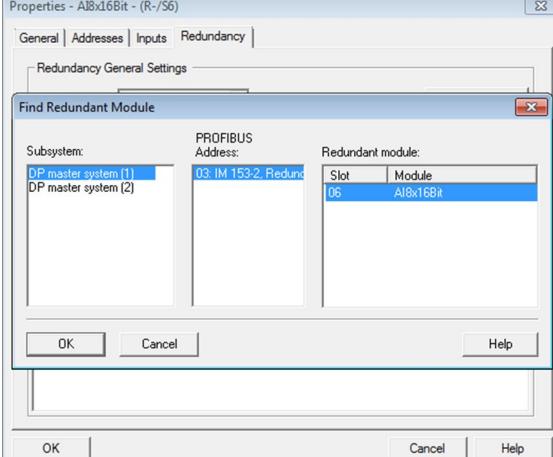
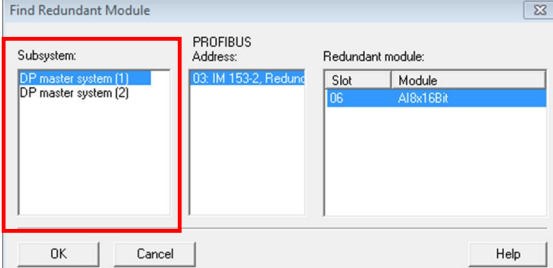
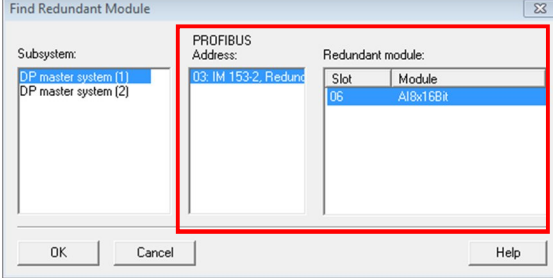
Procedure

Table 3–5

	Activity	Screenshot
1.	Open HW KonFigure Select once again the first IM 153-2. Double-click a signal module in the module overview. The dialog box "Properties" of this module is opened.	
2.	Switch to the "Addresses" tab. Select the desired process image partition from the drop-down list "Process image".	

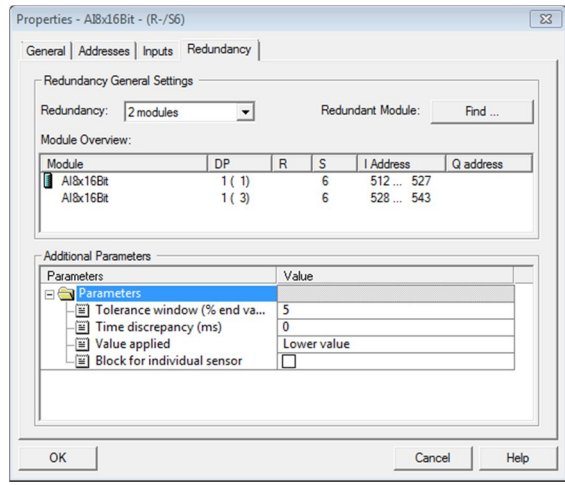
3 Configuring the redundant peripherals

3.5 Signal module settings

	Activity	Screenshot
3.	<p>Then select the "Redundancy" tab. In the "Redundancy" drop-down list, select the entry "2 modules".</p>	
4.	<p>Click on the "Find" button. The dialog window "Find Redundant Module" opens.</p>	
5.	<p>In the "Subsystem" list, select the DP master system in which the redundant signal module is configured. All PROFIBUS addresses, available on this DP master system, are displayed in the field "PROFIBUS Address".</p>	
6.	<p>In the field "PROFIBUS Address", select the IM 153-2 in which the redundant signal module is configured. The redundant module field: shows the redundancy capable signal modules available in this IM 153-2, for which no redundancy has yet been configured. In the Redundant module field, select the signal module which is to be used as a redundant signal module and click the "OK" button.</p>	

3 Configuring the redundant peripherals

3.5 Signal module settings

	Activity	Screenshot
7.	<p>The redundant signal modules are now listed in the "Module Overview" field. You can also set additional parameters for the configuration of the redundant AI modules"). These additional parameters can only be set for the input modules DI and AI. Click the "OK" button to apply the settings.</p> <p>By clicking the "Help" button you can get further information about each parameter.</p>	
8.	Repeat steps 1 to 7 for all the signal modules you wish to connect redundantly.	

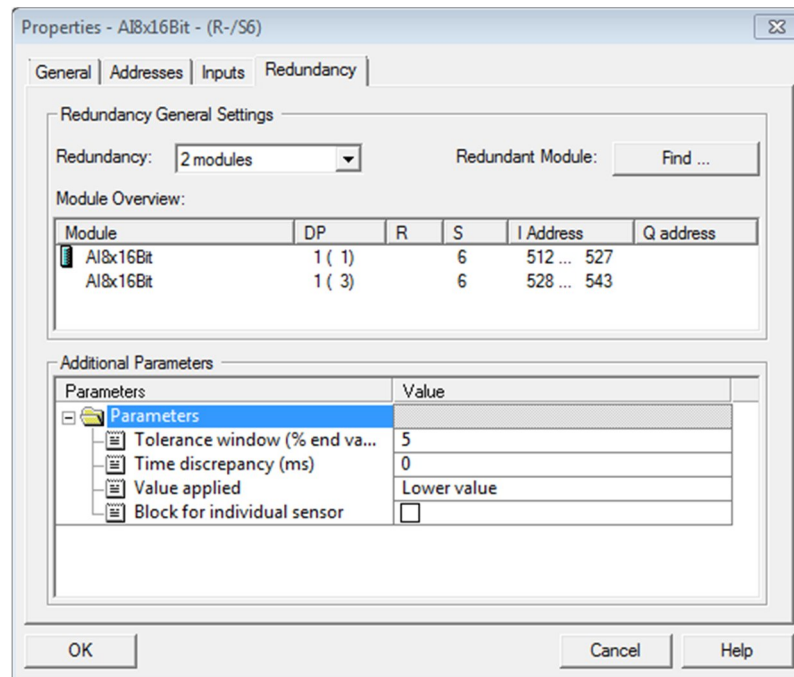
3.6 Additional parameter settings for the configuration of the redundant AI modules

This chapter is intended to assist you in configuring the various parameters that must be set for redundant AI modules.

To do so, you have to take two main points into account:

- Special redundancy-related parameters in the HW Config
- Time or cycle considerations

Figure 3–1



By clicking the "Help" button you can get further information about the following parameters:

- Tolerance window
A percentage of the full-scale value of the measuring range is configured. Two analog values are equal if they are within the tolerance window.
- Time discrepancy
It is the maximum allowable time in which the redundant input signals can be different.
- Value applied
The "Value applied" is the value of the two analog input values (higher value / lower value), which is transferred to the user program.

3 Configuring the redundant peripherals

3.6 Additional parameter settings for the configuration of the redundant AI modules

Discrepancy time / deviation time

As described in the help for AI modules, the deviation time of AI modules should be a multiple of the update time. To calculate the update time, the following parameters must be considered:

- Update time of the AI modules
- Cycle time of the PROFIBUS (can be ignored if the baud rate is ≥ 1.5 Mpps).
- Update time of the (partial) process images (TPA)

The update time of an analog value for an analog input card, such as 6ES 7331-7TF01, can be taken from the table 3–6.

First, select the parameter "Integration time / interference frequency suppression". Then you allocate the number of channels used.

Table 3–6: Analog value for parameters

Analog value conversion			
Principle of measurement	SIGMA DELTA		
Integration time / interference frequency suppression (per channel)	60 Hz	50 Hz	10 Hz
Integration time error	$\pm 0.05\%$	$\pm 0.04\%$	$\pm 0.02\%$
Integration time in ms	16.6	20	100
Basic reaction time including integration time in ms (per channel)	55	65	305
Basic module execution time in ms (all channels enabled)	440	520	2440
Smoothing the measured value	Step: None Weak Average Strong	Time constant: 1 x cycle time *** 4 x cycle time *** 32 x cycle time *** 64 x cycle time ***	Max module cycle: 2.44 s 9.76 s 78.08 s 156.16 s

Table 3–7: Examples

Integration time / interference frequency suppression	Number of channels used	Update time of module
50 Hz	1	65 ms
50 Hz	4	260 ms
50 Hz	8	520 ms
10 Hz	1	305 ms
10 Hz	4	1220 ms
10 Hz	8	2440 ms

3 Configuring the redundant peripherals

3.6 Additional parameter settings for the configuration of the redundant AI modules

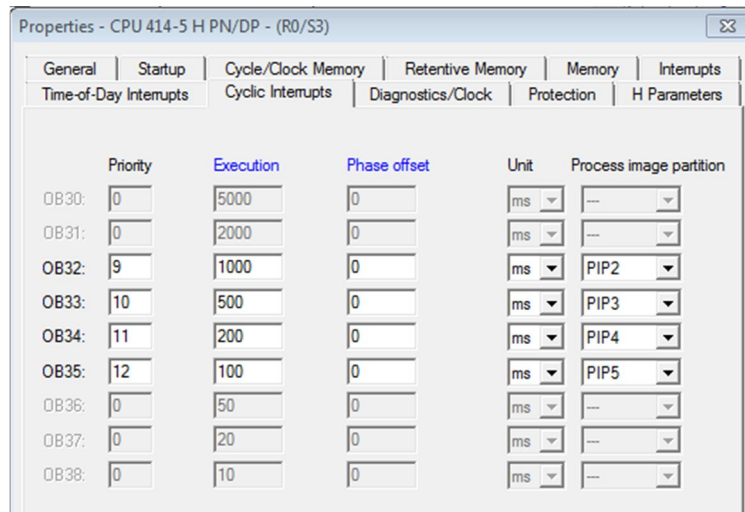
To obtain the update time of the (partial) process image (TPA), in the first step, the assigned (partial) process image of the AI module in question must be found, as shown in this picture.

Figure 3–2



In the second step, the cycle time is determined in the properties of the CPU. In this example, the update time of the (partial) process image (TPA) is 500ms for the used TPA 3

Figure 3–3



Calculation of total deviation time:

$$\text{Time}_{\text{deviation}} = 2 * (\text{time}_{\text{module}} + \text{time}_{\text{TPA}})$$

3 Configuring the redundant peripherals

3.6 Additional parameter settings for the configuration of the redundant AI modules

The factor 2 is the smallest factor that may be used. If the process conditions allow a higher value, the factor can also be 3 or 4.

Table 3–8. Examples

Parameter	Discrepancy time to be set
50 Hz, 1 channel, TPA = 500 ms	1130 ms
50 Hz, 4 channels, TPA = 500 ms	1520 ms
50 Hz, 8 channels, TPA = 500 ms	2040 ms
10 Hz, 8 channels, TPA = 50 ms	5880 ms

Note

In the event that two different integration times are assigned to the channels of a module (10 Hz and 50 Hz), the worst case is calculated. This means that the calculation is performed with 10 Hz.

Tolerance window

Depending on the quality of the field signal, a tolerance range of 5% to 20% should be set.

General time or cycle assessment

The redundant modules may only be accessed via the process image.

For more information on how to configure the I/O modules, please refer to chapter 3.5 "Signal module settings".

The same process image partition must be assigned to both modules of a redundant pair.

The relevant channel blocks should either have the same cycle time as the process image process image partition or have their cycle slowed down. No advantage is gained from being faster than the process image partition.

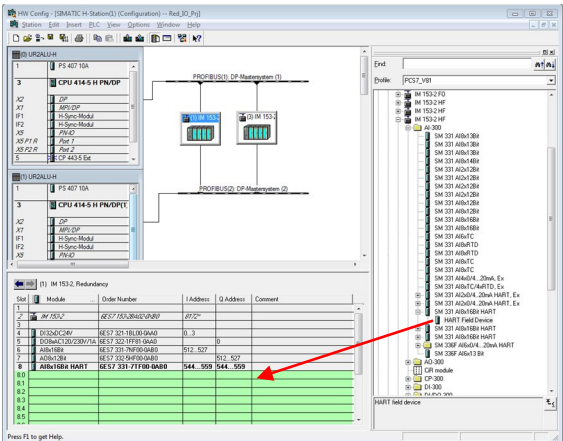
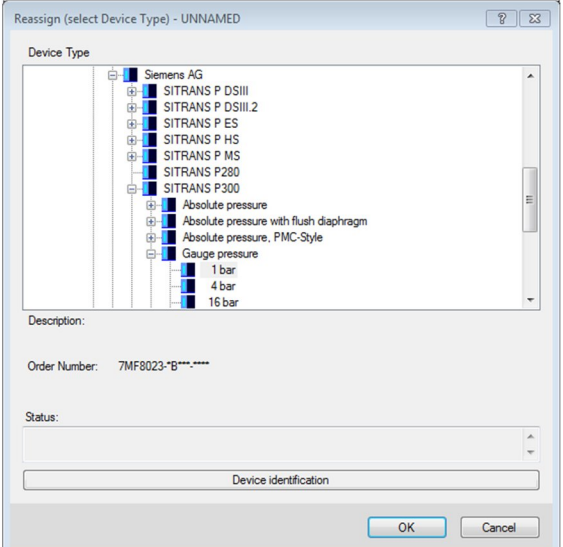
3.7 Configuring the HART field devices

Requirements

- The PCS 7 project with an H CPU has been created and is open in SIMATIC Manager.
- A redundant PROFIBUS-DP master system is configured for the SIMATIC H station in HW Config
- In HW Config, the interface module IM 153-2 is configured for the ET 200M at the redundant PROFIBUS DP.
- All required signal modules are configured.
- The redundant ET 200M has been configured.
- The settings on the signal module have been done

Procedure

Table 3–9

	Activity	Screenshot
1.	Open HW Config Select the HART field device in the hardware catalog and drag-and-drop it into a free slot of the HART module in the module overview.	
2.	Double-click the HART field device. In the appearing dialog box, select the appropriate device and click "OK".	

3 Configuring the redundant peripherals

3.8 Symbolic name assignment

	Activity	Screenshot
3.	The HART field device is opened in SIMATIC PDM. Here you can adjust other device parameters (such as TAG).	
4.	Select again the HART field device in the hardware catalog and drag-and-drop it into a free slot of the redundant partner (HART signal module of the second ET 200M). After a brief loading, the configured field device of the first ET 200M is automatically assigned.	

3.8 Symbolic name assignment

For the symbolic name assignment it is assumed that the input/output modules have been already added in the HW ConFigure Once this is done, you can assign self-explanatory symbolic names to the inputs and outputs of these modules. You use these names to connect CFC charts with the input and output modules.

Requirements

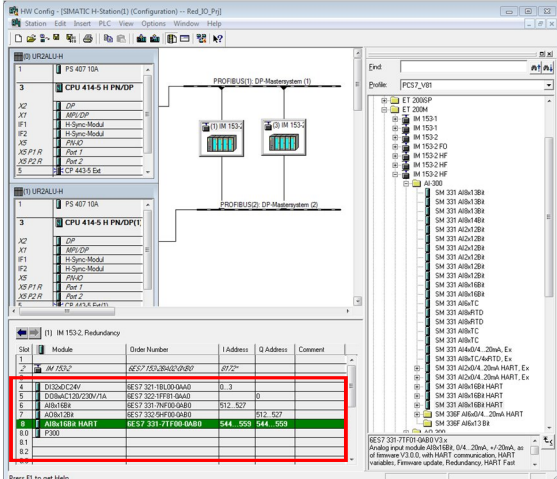
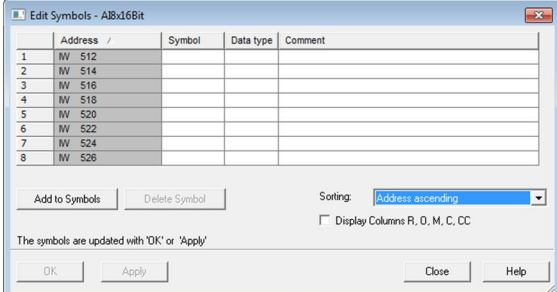
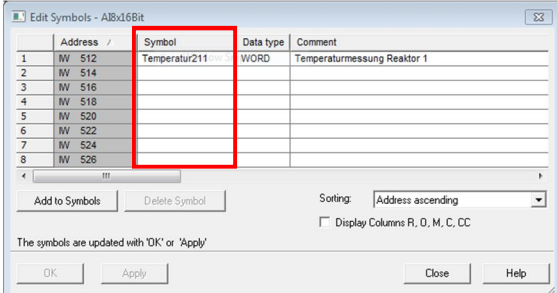
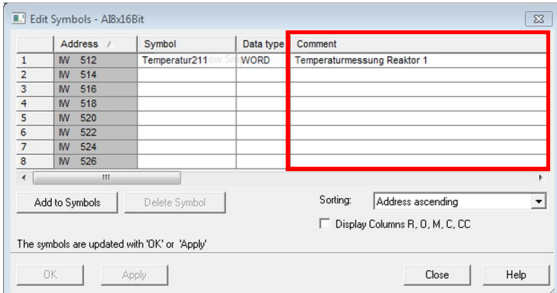
- The PCS 7 project with an H CPU has been created and is open in SIMATIC Manager.
- A redundant PROFIBUS-DP master system is configured for the SIMATIC H station in HW ConFigure
- In HW Config, the interface module IM 153-2 is configured for the ET 200M at the redundant PROFIBUS DP.
- All required signal modules are configured.
- The redundant ET 200M has been configured.
- The settings on the signal module have been done

3 Configuring the redundant peripherals

3.8 Symbolic name assignment

Procedure

Table 3–10

	Activity	Screenshot
1.	<p>Open HW KonFigure</p> <p>Select one of the two interface modules IM 153-2 in the working range. The module overview shows you all input/output modules that you have already added in the HW ConFigure.</p>	
2.	<p>In the module overview, select the first signal module, e.g. "AI8x16Bit".</p>	
3.	<p>Select the "Edit > Symbols" menu command. The dialog box "Edit Symbols..." opens. All absolute addresses of the inputs of these modules are specified in the list.</p>	
4.	<p>Position the cursor in the "Symbol" column next to the address, e.g. "EW 512". Enter, for example "Temperatur211" and press the "TAB" key. The entered value is set and the system automatically fills in the "WORD" data type.</p>	
5.	<p>Switch to the "Comment" column. Here, you can enter an appropriate comment, or else just press the "TAB" key again to move the cursor to the next line, i.e. the "Symbol" column.</p>	

3 Configuring the redundant peripherals

3.9 CFC configuration

	Activity	Screenshot
6.	If necessary, edit additional symbols and save your entries by clicking the "OK" button. The dialog box "Edit Symbols" is closed.	
7.	Select each signal module, one after the other, in the module overview and assign them symbolic names. To do this, follow the steps 2 to 6.	

3.9 CFC configuration

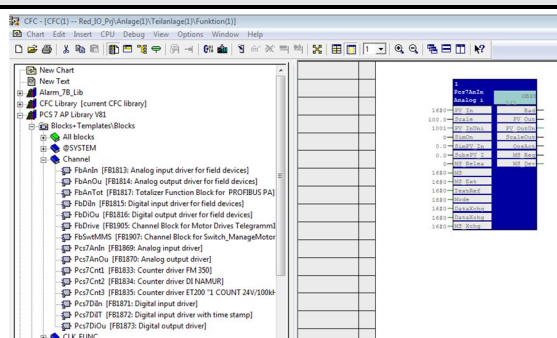
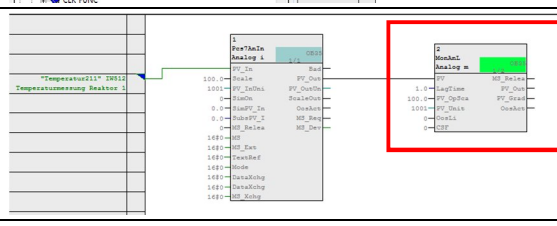
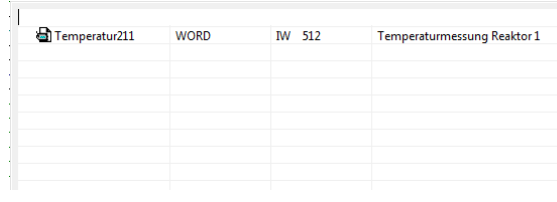
Once you have completed the necessary configurations, you have to create CFC charts. In this step you connect the input/output modules you added in the HW Config with the corresponding channel blocks.

Requirements

- All the required I/O modules have been configured in the HW Config and the associated symbols have been assigned.
- The CFC chart has been created and is open.

Procedure

Table 3–11

	Activity	Screenshot
1.	Select the "Libraries" tab In the lower left pane. Select the path "PCS 7 AP Library V81 > Blocks+Templates\Blocks > Channel". Now drag the driver module Pcs7AnIn, Pcs7AnOu, Pcs7DiIn or Pcs7DiOu and drop it into your plan, depending on the input/output module.	
2.	To connect further building blocks, drag them into your plan. For example, if you want to measure temperature, you can connect the channel block with a MonAnS or MonAnL, which allow the measured temperature to be displayed later on during operation.	
3.	To connect the channel module with its configured I/O module, select the block, click on "PV_In" of the channel block and open the menu command "Insert > Connection to Address". The symbol table opens.	

3.9 CFC configuration

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4 Function mechanisms

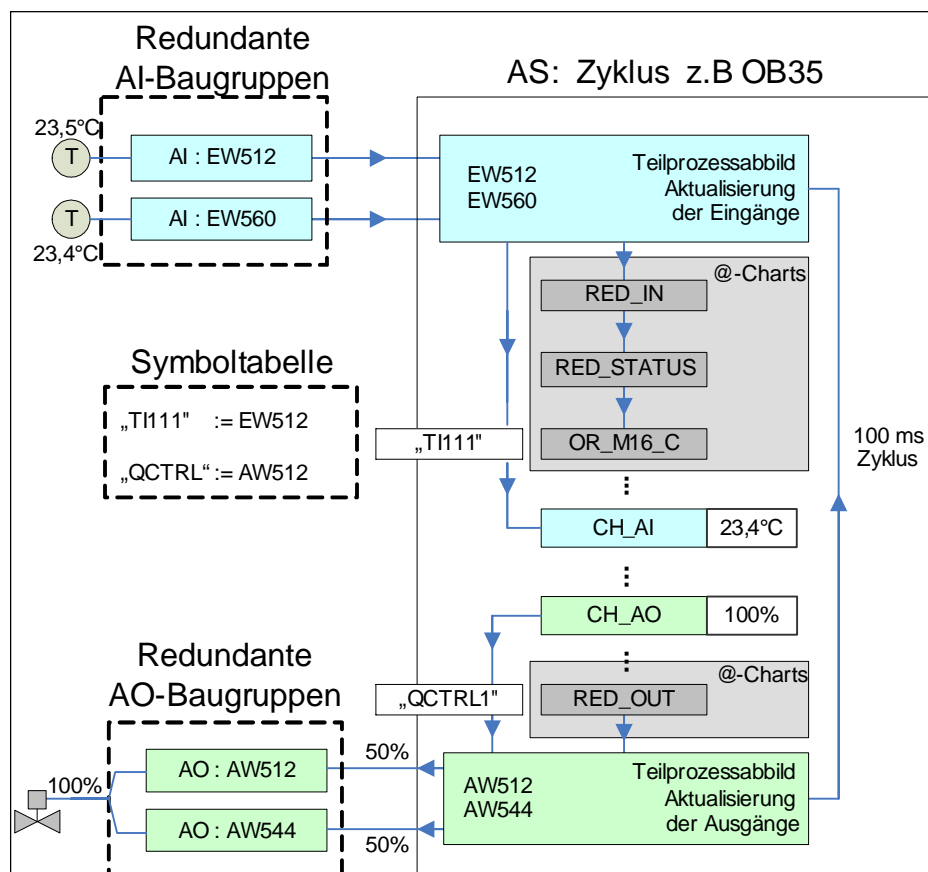
4.1 Example of a flowchart

The following figure shows an example of a flowchart for redundant I/O modules and the signal processing in the AS.

Note

The example shows the use of two sensors. In the process industry, the connection of a sensor to a redundant module pair is also typical (see chapter [2.3](#)).

Figure 4–1



Description of the upper part of the flowchart

In the upper part, two temperature measurements are transferred by two encoders via two redundant AI modules and written via two addresses (EW512, EW560) in the process image partition of the inputs.

Depending on the setting of the transfer value (see Additional Parameters Table 3–5 point 7), the smaller or greater value is written in the user program on the channel block CH_AI via the corresponding "TI111" symbol.

The @-charts, where the blocks from the redundant IO CGP (RED_IN, RED_STATUS, etc.) and from the PCS 7 Library (OR_M16_C) are placed, allow the diagnostic and redundancy analysis to be performed. The block OR_M16_C transmits the corresponding diagnostic or redundancy status to the channel block CH_AI.

This automatically leads to the corresponding redundancy message behavior, depending on the status (OR_M16_C, see below).

Description of the lower part of the flowchart

In the lower part of the flowchart, a control valve is controlled by two redundant analog output modules.

Note

Only analog output modules with current outputs can be operated redundantly (0...20mA, 4...20mA). See chapter 2.3.4 "Analog output".

A value is written into the process image partition of the outputs from the channel block CH_AO via the pre-configured symbol "QCTRL1". The @-charts and especially the RED_OUT allow information to be analyzed and corresponding output values to be given out by the system. This is done via the process image partition of the outputs (addresses AW512 and AW544).

The value to be transferred is halved and each of the two channels transmits half the value. If one of the channels or modules fails, this is detected and the remaining channel or module transmits the full value.

This flowchart is repeated cyclically according to call and cycle time of the OBs used (in this case OB35→every 100 ms).

4.2 Library functions

The following section describes the blocks/functions used from the PCS 7 and the Redundant IO CGP libraries.

4.2.1 PCS 7 Basic Library V8.1

OR_M_16C

The block OR_M_16C serves to form a channel-granular value status from two redundant signal modules.

MOD-D1

The module MOD_1 monitors a max of 16-channel S7-300/400 SM modules which have no diagnostics capabilities (no mixed modules).

In H systems, only modules in switched racks are supported.

4.2.2 Redundant IO CGP V5.2

RED_IN

The FB 450 ensures reading of the signal from the redundant input peripherals (DI, AI), which is assigned to the process image partition in the priority class of the calling OB.

The FB 450 performs a discrepancy analysis of the redundant input peripherals and saves the valid value to the lower address in the process image inputs (PII). The user can only access his application this way. The PII of the high module is irrelevant.

RED_STATUS

The FB 453 "RED_STATUS" represents an interface block and contains information regarding the passivation of modules.

RED_OUT

The FB 451 transmits those redundant peripheral signals that are assigned to the process image partition in the priority class of the calling OB.

RED_DIAG

The FB 452 RED_DIAG evaluates the start information of individual fault and diagnostic OBs to refer to a corresponding processing sequence.

It is called up in the acyclic OBs (e.g. OB 82, OB 85).

RED_DEPA

This function starts a depassivation by the user program.

The FC checks whether a redundant module or channel is passivated. If a module or channel is passivated, a complete depassivation is started in the FB 450 "RED_IN". In the opposite case (no passivation of a module or a channel present), the processing of the FC 451 is terminated immediately.

The function is called up in the acyclic OBs (e.g. OB 82, OB 85).

RED_INIT

With the FC 450 "RED_INIT", the peripheral redundancy is initialized in the startup of an H system.

When the FC 450 is called up, it generates administration data blocks for functional peripheral redundancy and it either occupies it with default values or else it updates pre-existing administration DBs. The function triggers a complete depassivation, which is then executed in FB 450 "RED_IN".

The function is called up in the acyclic OBs (e.g. OB 82, OB 85).

4.3 OS messages of the modules

When compiling the OS, the following module messages are created in the OS.

Redundancy reporting behavior (OR_M_16C)

- BG x/y/z: Failure of module redundancy pair
- BG x/y/z: Module redundancy loss
- BG x/y/z: Module status cannot be determined
- BG x/y/z: Discrepancy time has expired
- BG x/y/z: Failure of redundancy pair channel xx

Table 4-1

Letter	Description
X	DP master system no.
Y	DP slave address
Z	Slot no.
XX	Channel no.

Reporting behavior of a module with diagnostic capability (MOD_D1)

- Possible module fault (output parameter QMODF = TRUE):
 - External auxiliary voltage missing
 - Front connector missing
 - Module parameters not set
 - incorrect parameters in module
 - Missing/wrong module
 - CPU communication fault
 - Time monitoring activated (watchdog)
 - Module internal supply voltage failure
 - Rack failure
 - Processor failure
 - EPROM error
 - RAM error
 - ADC/DAC error
 - Fuse blown
 - Power supply 1: Fault
 - Power supply 2: Fault
- Possible channel fault ("invalid value" value status, OMODE_xx = 16#00xxxx):
 - Configuration/parameter assignment error
 - Common mode error, only analog input/output
 - I/O short circuit
 - Short-circuit to M
 - Output transistor is interrupted
 - Wire break
 - Reference channel fault (only analog input)
 - Below measuring range (only analog input)
 - Above measuring range (only analog input)
 - Missing load voltage (only analog and digital output)
 - Missing encoder power supply (only digital output)
 - Fuse blown (only digital output)
 - Grounding fault (only digital input/output)
 - Temperature rise (only digital output)

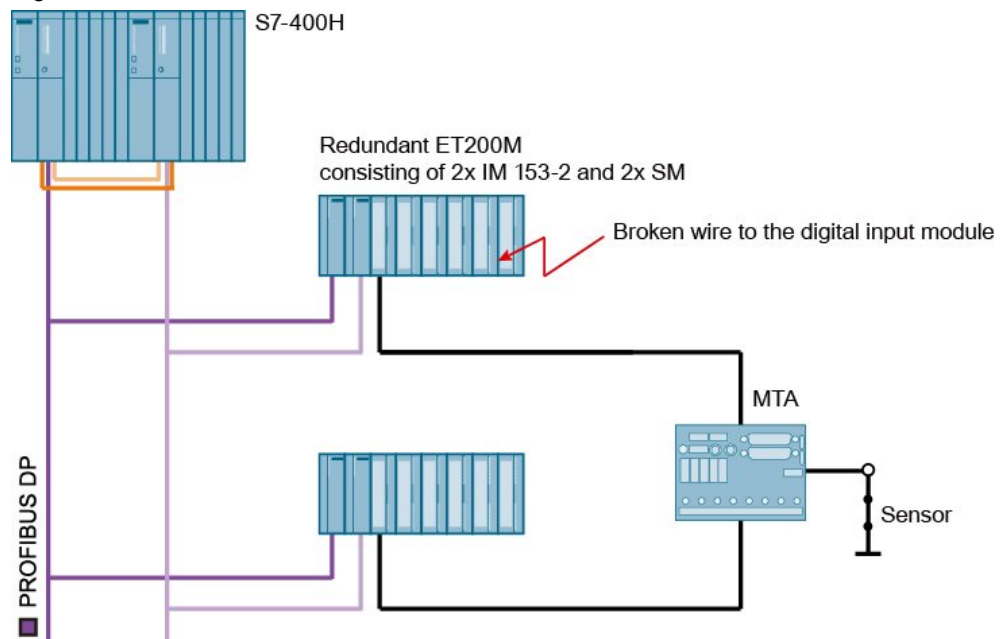
5 Diagnostics

This chapter presents an example of the diagnostic possibilities with PCS 7 in terms of redundant peripherals.

5.1 Failure scenario

A channel fault due to a wire break is simulated on a digital input module with the running system.

Figure 5-1



It should be noted that the components used in the example are channel-granular. A wire break at a terminal of the digital input module results in the passivation of the faulty channel (or channel group) only and not the entire module. The occurred fault can be diagnosed in the following ways:

- OS messages
- Asset management
- HW Config
- CFC test mode

In the practical environment, the fault is first seen by the plant operator on the OS in the control room. Then, the maintenance engineer will have a look at the appropriate message list.

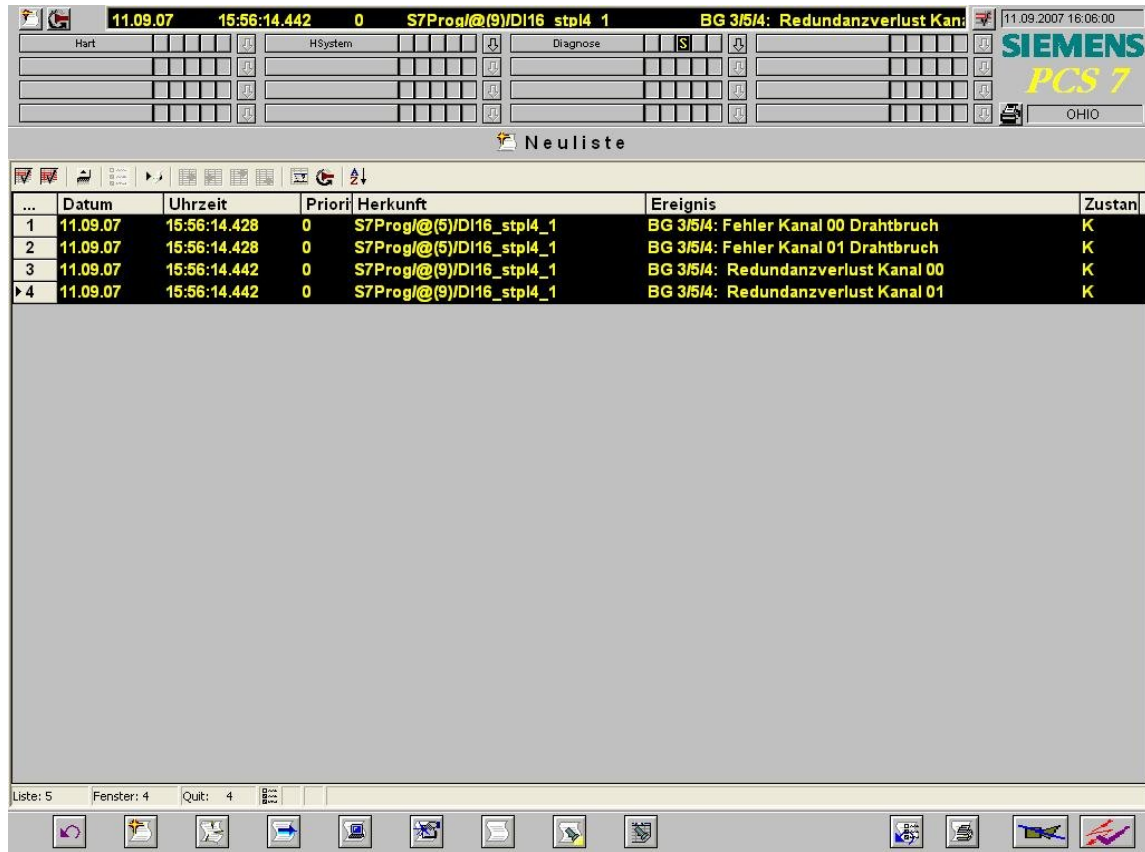
At the same time, the Asset Management gives him further information about the condition of the signal module. Thanks to a button, Asset Management provides the possibility of opening the HW Config to receive further diagnostics entries in the module status of the H CPU and the signal module.

At the same time, other status values of the signal module are available in the CFC test mode.

5.2 OS messages

In the OS, you receive corresponding error messages via the button "New List".

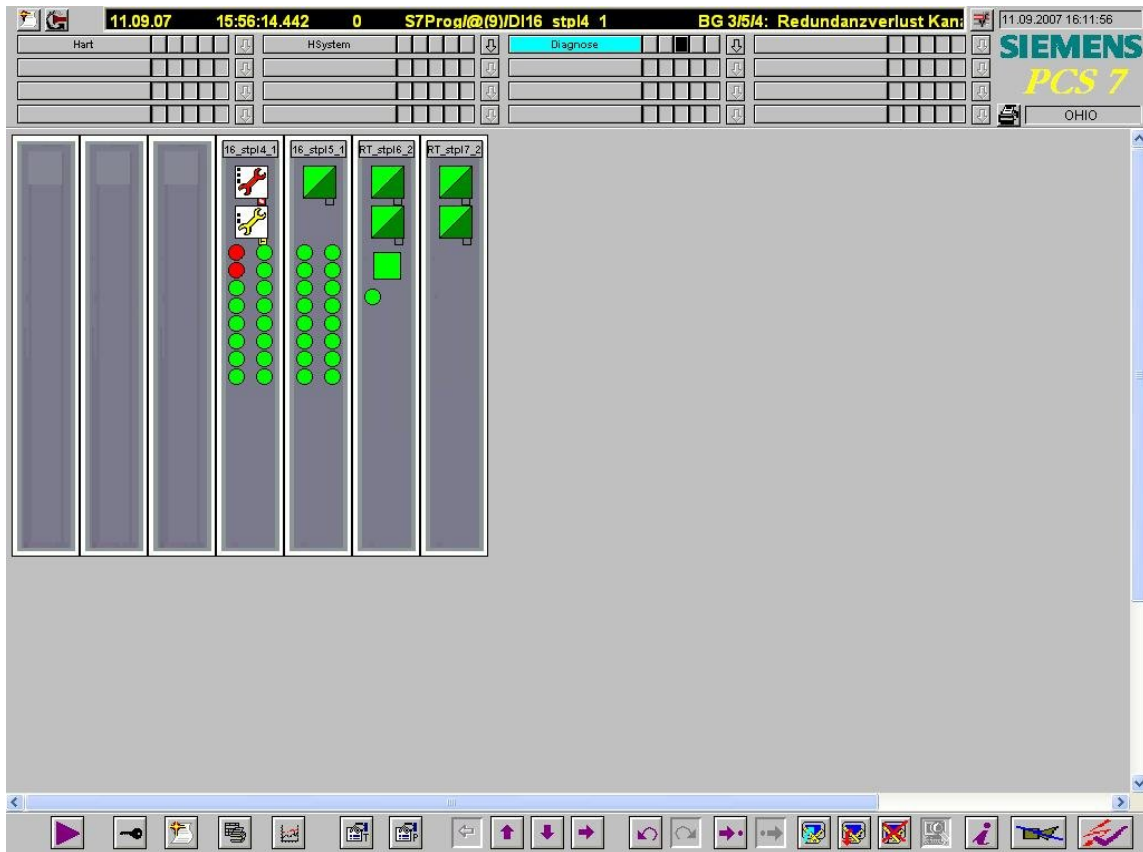
Figure 5–2



5.3 Asset management

If Asset Management is implemented in your PCS 7 project, you also get data about faults in redundant peripherals.

Figure 5–3



Note

You can find further information in the Application Example "PCS 7 in Practice - Plant Asset Management".

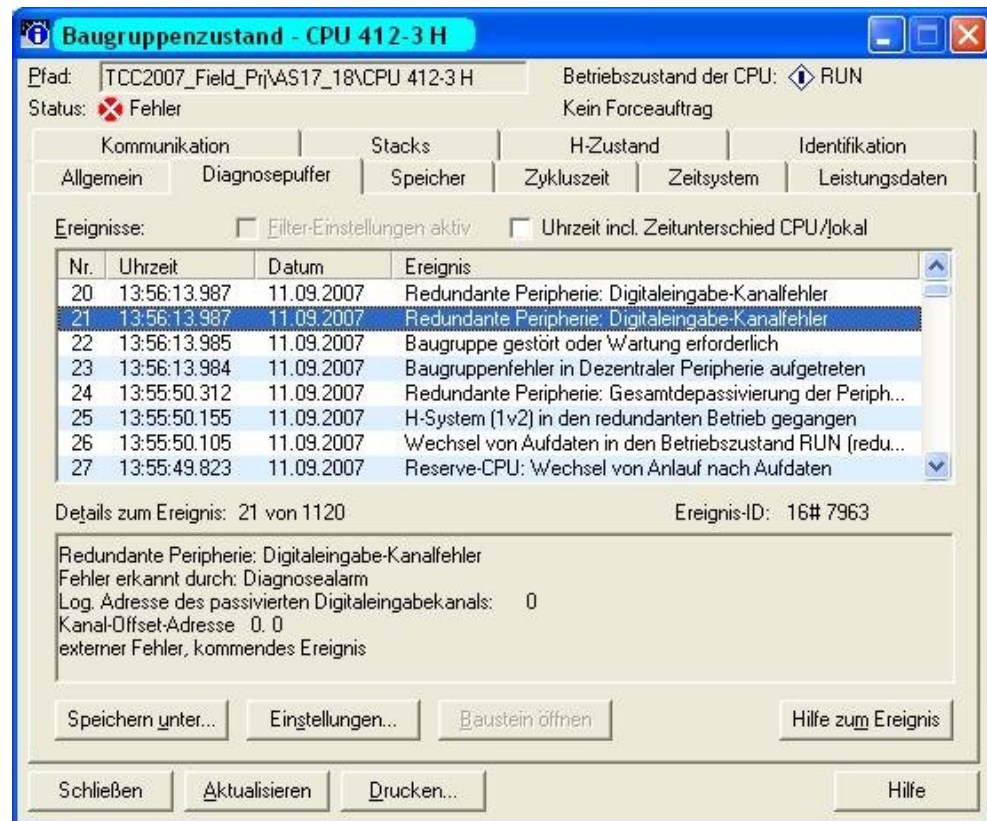
5.4 HW Config Online

Diagnostics buffer

In the online mode of the HW Config, you can see the event information shown Figure 5-4, under the "Diagnostic Buffer" tab inside the "Module State" of the H CPU. In addition to fault messages, even information about the behavior of the modules is listed here.

The wire break is listed here in the "Events" field via the numbers 20 to 23. By highlighting the corresponding message, further information is displayed in the "Event details" field.

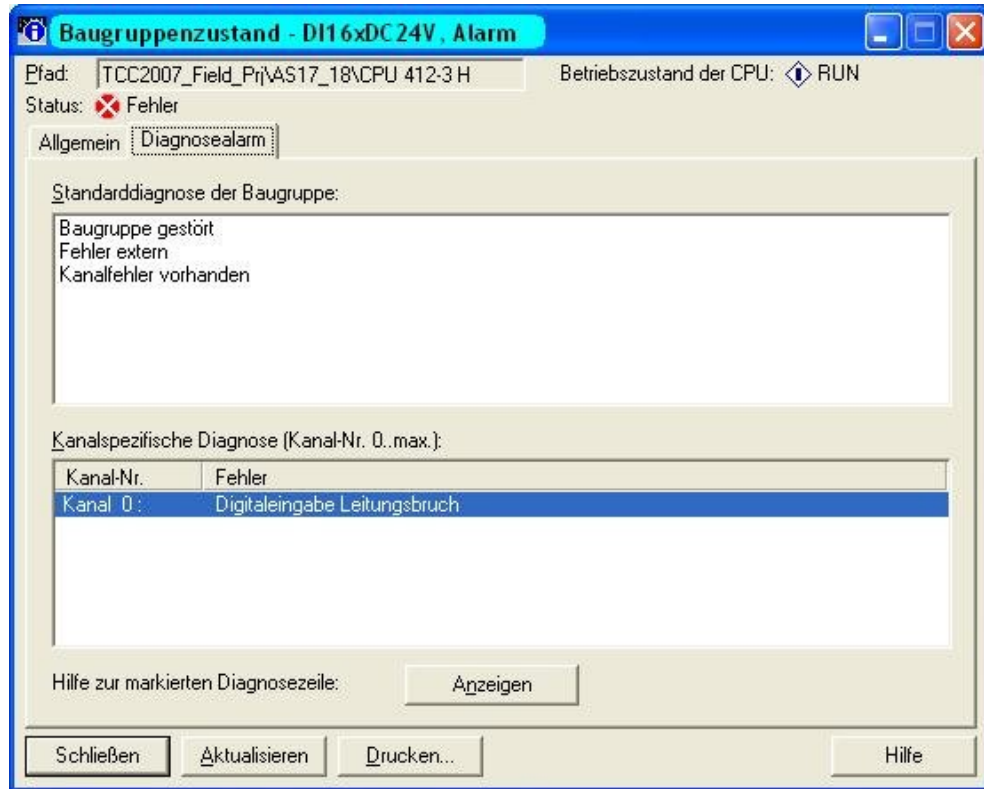
Figure 5-4



Diagnostic interrupt

The "Module state" of the signal module (Figure 5-5) is another diagnostic possibility in HW Config. In the "Diagnostic Interrupt" tab you can find the "Standard module diagnostics" and the "Channel-specific diagnostics".

Figure 5-5



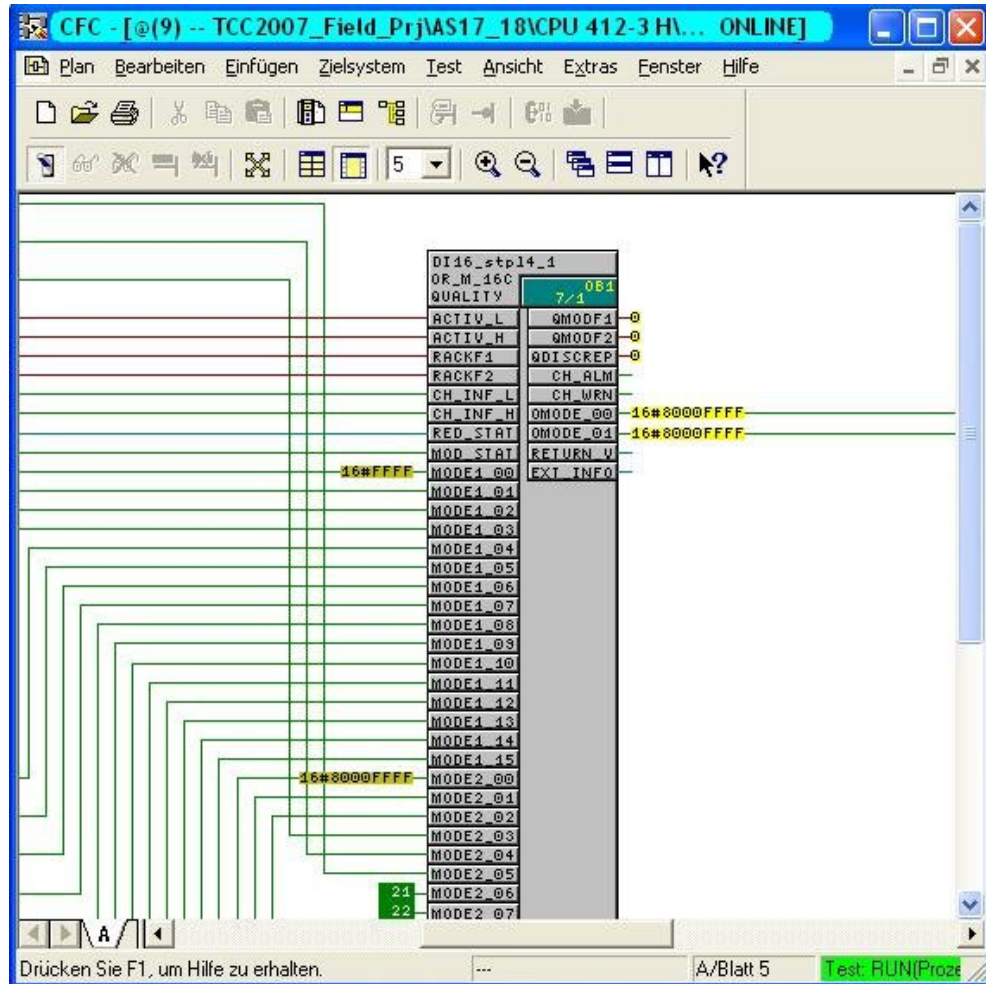
By clicking on the "Show" button you receive further information about the selected diagnostic line.

5.5 CFC test mode

The OR_M_16C enables the value status of the redundant signal modules to be diagnosed (Figure 5–6) in the CFC chart.

Here, the different connections of the module can be registered in test mode.

Figure 5–6



From the outputs QMODF1 and QMODF2, you can see that there is no module fault. From the inputs ACTIV_L or ACTIV_H, you can see whether one of the two modules is active or passive.

The wire break at the connection MODE1_00 with status 16#FFFF gives an invalid value.

The MODE1_00 connection shows the status for channel 0 of the primary digital input module.

The MODE2_00 connection shows the status for channel 0 of the second redundant digital input module. The 16#8000FFFF at connection MODE2_00 is a valid value.

The following table shows further connection properties of the OR_M_16C:

Table 5–1

Connection	Meaning	Data Type	Default Setting	Type
MODE1_xx	Channel operating mode (xx = 00 – 07 / 00 – 15) of the primary module	DWORD	0	I
MODE2_xx	Channel operating mode (xx = 00 – 07 / 00 – 15) of the redundant module	DWORD	0	I
OMODE_xx	Channel operating mode (xx = 00 – 07 / 00 – 15)	DWORD	0	O
QDISCREP	1 = expired discrepancy time	BOOL	0	O
QMODF1	1 = error in module 1	BOOL	0	O
QMODF2	1 = error in module 2	BOOL	0	O

Note

Further information about the connections of the OR_M_16 and its fault messages can be found in the manual "SIMATIC Process Control System PCS 7 Basic Library (V8.1)".

Examples of the value status

- Byte 3:
 - 16#80: Value status "valid value"
 - 16#00: Value status "invalid value" (channel fault)
 - 16#40: Value status "invalid value" (higher-level fault)
- Byte 2:
 - 16#01: Restart (OB 100) done
 - 16#02: Above measuring range (channel fault diagnostics)
 - 16#04: Below measuring range (channel fault diagnostics)

6 Related literature

Table 6-1

	Topic	Title / Link
\1\	Siemens Industry Online Support	http://support.industry.siemens.com
\2\	Download page of this entry	https://support.industry.siemens.com/cs/ww/en/view/28430682
\3\	SIMATIC Process Control System - PCS 7 High-availability Process Control Systems (V8.1)	https://support.industry.siemens.com/cs/ww/en/view/90682535
\4\	SIMATIC PCS 7 process control system CPU 410-5H Process Automation	https://support.industry.siemens.com/cs/ww/en/view/74736822
\5\	SIMATIC Process Control System PCS 7 Basic Library (V8.1)	https://support.industry.siemens.com/cs/ww/en/view/90683135

7 History

Table 7-1

Version	Date	Modifications
V1.0	02/2008	First version
V1.1	04/2010	Figure 2-6 corrected
V1.2	10/2013	New chapter: 3.6 "Additional parameter settings for the configuration of the redundant AI modules"
V2.0	03/2015	Revision for PCS 7 V8.1