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Bus links Product Information on the PN/MF Coupler




Product Information

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Legal information

Warning notice system

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

 DANGER
indicates that death or severe personal injury will result if proper precautions are not taken.
 WARNING
indicates that death or severe personal injury may result if proper precautions are not taken.
 CAUTION
indicates that minor personal injury can result if proper precautions are not taken.
NOTICE
indicates that property damage can result if proper precautions are not taken.


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

Qualified Personnel

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

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Note the following:

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

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Disclaimer of Liability

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

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Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

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To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed visit (<https://www.siemens.com/industrialsecurity>).

Content

Content

This product information contains additions and corrections to the **PN/MF Coupler** documentation.

The product information is part of the supplied product. The statements provided in it should be considered more up-to-date than other documentation if uncertainties arise.

Area of application and function

Area of application and customer benefits

You use the PN/MF Coupler in order to:

- interconnect two PROFINET subnets with system redundancy S2
- connect an EtherNet/IP network to a PROFINET subnet
- interconnect two PROFINET subnets

To do this, use:

- User data via input or output address ranges which can be separated or coupled

The maximum size of the transferable input and output data is:

- 1440 bytes of inputs and 1440 bytes of outputs for PROFINET IO
- 1000 bytes of inputs and 1000 bytes of outputs with system redundancy S2
- 500 bytes of inputs and 496 bytes of outputs for EtherNet/IP

The input and output data can be divided as desired. For example, you configure 1200 bytes of input data and 1340 bytes of output data.

The PN/MF Coupler is a device with two Ethernet interfaces:

- X1 for EtherNet/IP or PROFINET IO
- X2 for PROFINET IO

The two Ethernet networks are electrically isolated.

During configuring, STEP 7 creates two IO devices with their subnets from one PN/MF Coupler. The other part of the PN/MF Coupler in each case is known as the coupling partner. You can configure the line side X1 for EtherNet/IP with MFCT and network side X2 for PROFINET with STEP 7.

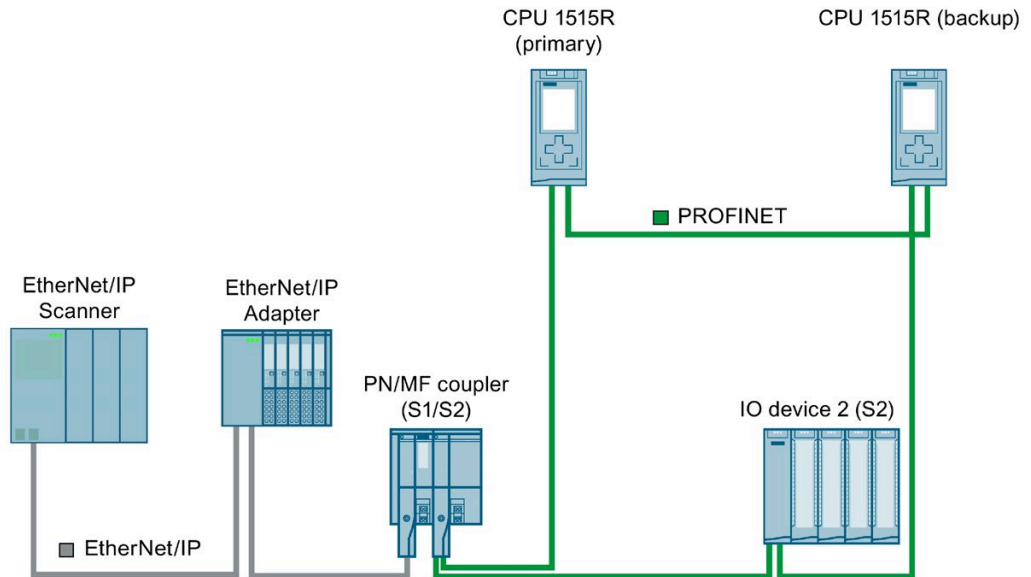


Figure 2-1 Coupling of an EtherNet/IP network and a PROFINET IO subnet with a PN/MF Coupler (system redundancy on one side (S1/S2))

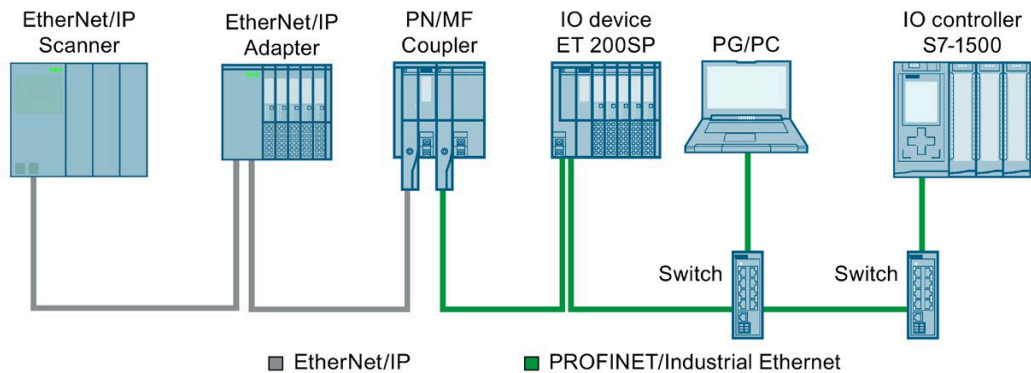


Figure 2-2 Coupling of an EtherNet/IP network and a PROFINET IO subnet with one PN/MF Coupler

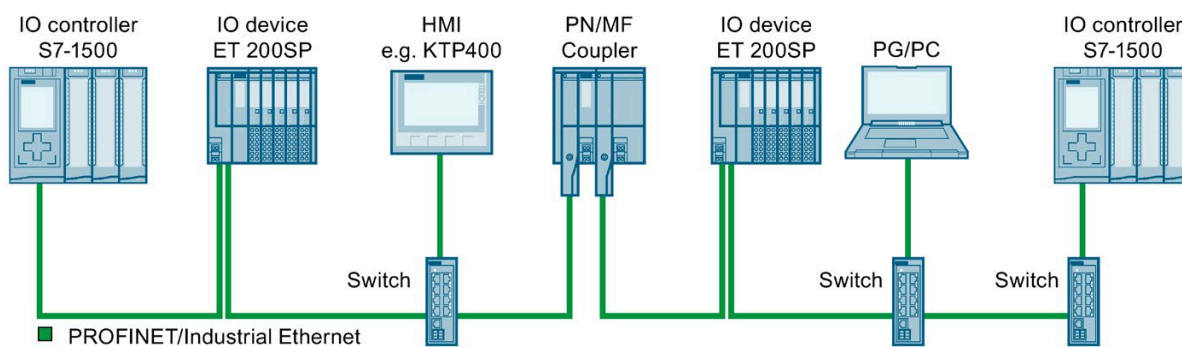


Figure 2-3 Coupling of two PROFINET IO subnets with one PN/MF Coupler

Principle of operation

- Data exchange with I/O modules:

Through the configured inputs of a slot, the local CPU or EtherNet/IP scanner reads the values that the CPU of the other subnet writes over the configured outputs of the coupling partner.

Through the configured outputs of a slot, the local CPU or EtherNet/IP scanner writes values that the CPU of the other subnet receives over the configured inputs of the coupling partner.

- System redundancy S2

You can connect a system-redundant structured subnet via a PN/MF coupler with an EtherNet/IP network (see system redundancy S2 (Page 12)).

Using a redundancy system with S7-1500R/H or S7-400H is required for the implementation of system-redundant subnets. The redundant system consists of two high-availability controllers (lead and redundant CPU). The IO devices used in the subnet connected with system redundancy must also support system redundancy.

Properties

Article number

6ES7158-3MU10-0XA0

View

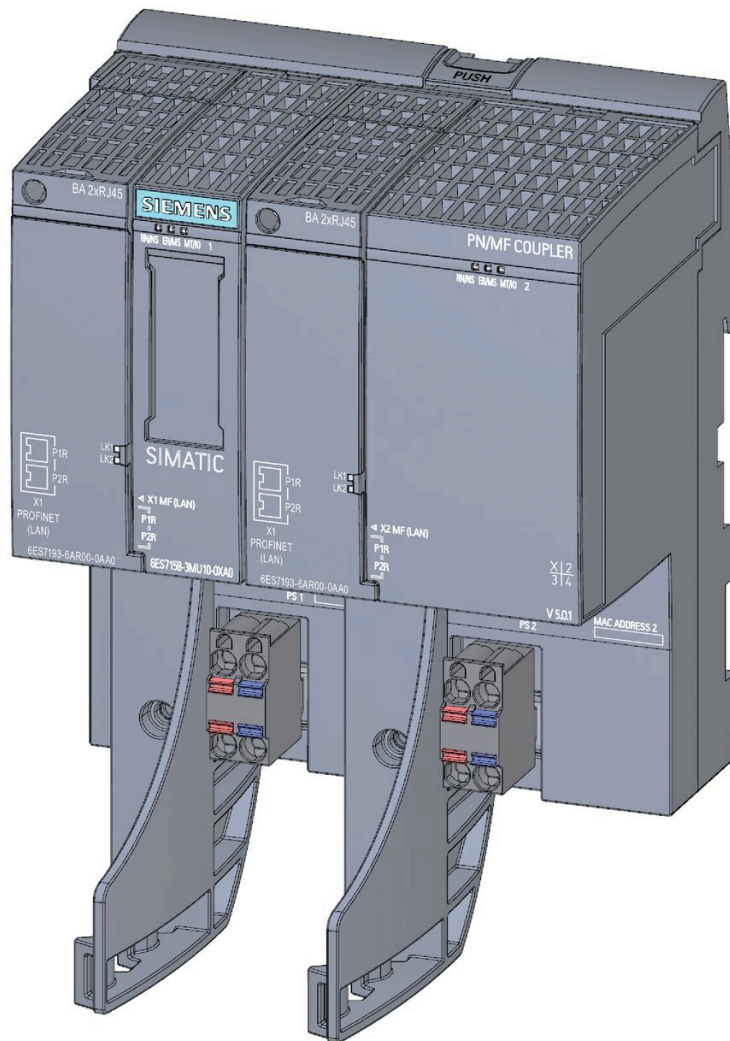


Figure 3-1 View of the PN/MF Coupler with mounted accessories BusAdapter BA 2xRJ45 and strain relief

Properties

The PN/MF Coupler has the following properties:

- Data exchange between controllers across different Ethernet protocols across network boundaries while maintaining network separation, which means no support of routing functions.

Two alternative coupling types are supported:

- Data exchange between an EtherNet/IP scanner and a PROFINET IO controller
- Data exchange between 2 PROFINET IO controllers
- Compatible with the PN/PN Coupler V4.2 (except data set coupling, local coupling, MSI/MSO module, Shared Device, IRT and MRDP)
- Maximum of 16 input areas/output areas for exchange of data with the following virtual modules:
 - IN
 - OUT
 - PROFIsafe IN/OUT
- Electrical isolation between the two connected EtherNet subnets (PROFINET IO OR EtherNet/IP)
- Redundant power supply
- Supply voltage 1L+/2L+ 24 V DC (SELV/PELV)
- Usable BusAdapters
 - BA 2×RJ45 for RJ45 bus connector
 - BA 2×FC for direct connection of the bus cable
 - BA 2×M12 for bus cable with M12 plug
- Diagnostics interrupts
- Extended channel diagnostics
- Status information of the input user data
- Reset to factory settings via RESET button
- Docking station
- Errors on one network side do not have an effect on the opposite network side but can be diagnosed.

Properties via PROFINET IO

- Data exchange in total of maximum
 - 1440 bytes of input data and 1440 bytes of output data
 - 1000 bytes of input data and 1000 bytes of output data with system redundancy S2
- Integrated switch on both sides with 2 ports
- Supported Ethernet services: ping, arp, SNMP, LLDP
- Port diagnostics
- Port disabling
- Device replacement without removable medium/programming device
- Firmware update via PROFINET IO
- Prioritized startup
- Media redundancy MRP
- System redundancy S2

Properties via EtherNet/IP

- Data exchange in total of maximum
 - 500 bytes of input data and 496 bytes of output data
- I/O communication with scanner
- Configuring from the user program
- Read diagnostics (interrupts are not supported)
- Normative CIP objects
- Reset PN/MF Coupler with MFCT to factory settings
- Diagnostics bit in data status of cyclic I/O data per submodule

Accessories

You order the following accessories separately:

- SIMATIC BusAdapter
- Strain relief
- Labeling strips
- Reference identification label

You can find a detailed list of available accessories in the appendix Article Numbers and Accessories.

System redundancy S2

4.1 Field of application

Advantages of high-availability automation systems

- Optimization of failure, functional and operational safety
- Avoidance of expensive downtimes and restart times
- Increased productivity

Field of application

You can connect redundantly-configured subnets to each other via PN/MF Coupler. You can also connect a subnet with system redundancy and a subnet without system redundancy.

The maximum size of the transferable input and output data in system-redundant mode is

- 1000 bytes of inputs and 1000 bytes of outputs with system redundancy S2 (2 AR with primary CPU and backup CPU)

The following examples illustrate how you can configure close to the maximum amount of input and output data:

- CPU 1 with system redundancy S2: 1000 inputs and 1000 outputs
- CPU 2 with system redundancy S2: 1000 inputs and 1000 outputs
- CPU 3 with system redundancy S2: 1000 inputs and 1000 outputs
- CPU 4 with system redundancy S2: 1000 inputs and 1000 outputs

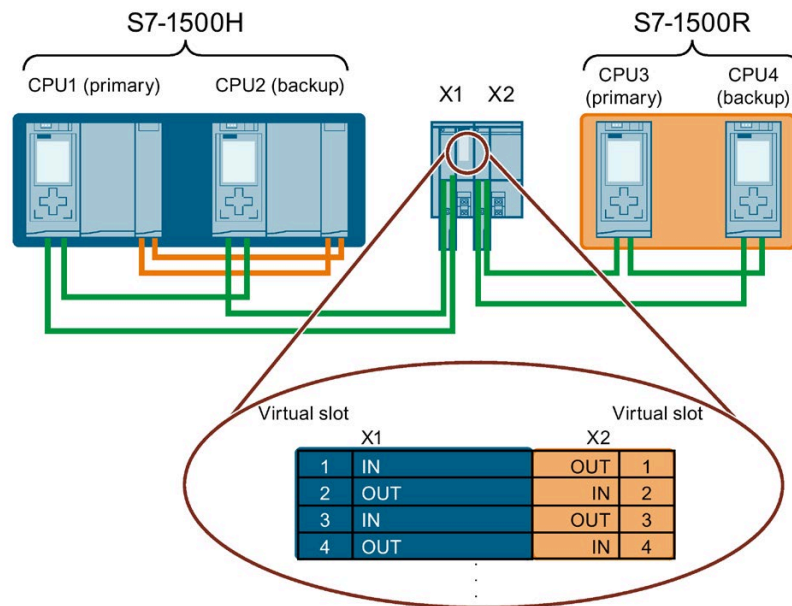


Figure 4-1 Two-sided system redundancy with S7-1500H and S7-1500R

PROFINET interface (X1)				
Virtual slot	Type	I-length ¹	Q-length	Access ²
1	IN	244 bytes	-	Primary CPU 1
2	OUT	-	244 bytes	Primary CPU 1
3	IN	244 bytes	-	Primary CPU 1
4	OUT	-	244 bytes	Primary CPU 1
5	IN	250 bytes	-	Primary CPU 1
6	OUT	-	250 bytes	Primary CPU 1
7	IN	250 bytes	-	Primary CPU 1
8	OUT	-	250 bytes	Primary CPU 1

¹ Length of the user data including data status and without user data qualifier

² As with the configuration, only the primary CPU is shown but the backup CPU is working with the same values in the background

PROFINET interface (X2)				
Virtual slot	Type	I-length ¹	Q-length	Access ²
1	OUT	-	244 bytes	Primary CPU 3
2	IN	244 bytes	-	Primary CPU 3
3	OUT	-	244 bytes	Primary CPU 3
4	IN	244 bytes	-	Primary CPU 3
5	OUT	-	250 bytes	Primary CPU 3
6	IN	250 bytes	-	Primary CPU 3
7	OUT	-	250 bytes	Primary CPU 3
8	IN	250 bytes	-	Primary CPU 3

¹ Length of the user data including data status and without user data qualifier

² As with the configuration, only the primary CPU is shown but the backup CPU is working with the same values in the background

Requirement

Using a system with S7-1500R/H controllers is required for the implementation of system-redundant subnets. The system consists of two high-availability controllers (lead and redundant CPU). The IO devices used in the subnet connected with system redundancy must also support system redundancy.

Supported functions for system redundancy

The PN/MF Coupler supports only the functions listed below:

- One-sided and two-sided system redundancy
 - maximum connection of one redundant system each (S7-1500R/H) per subnet of the PN/MF Coupler
 - maximum connection of 50 PN/MF Coupler to one redundant system (S7-1500R/H)
 - maximum data volume in system-redundant mode is 1000 bytes of inputs and 1000 bytes of outputs per PN/MF Coupler
-

Note

IO Modules operating mode

For S7-1500R/H redundant systems, use I/O modules of the "IO Modules" operating mode for the system-redundant S2 mode.

Hardware and software requirements

- PN/MF Coupler
 - S7-1500R/H, firmware version as of V2.6
 - STEP 7 TIA V15.1 (in the MF mode with GSDML)
-

Note

PROFINET ring

A PROFINET ring is required between the devices.

Note

Compatibility

The compatibility with older firmware versions is not guaranteed.

4.2 Media and system redundancy S2

Media redundancy on the redundant S7 1500R/H system

In the redundant S7 1500R/H system, both CPUs are in a ring topology with MRP (media redundancy method) (PROFINET ring). All PROFINET devices in the PROFINET ring are connected to the S7 1500R/H media redundant. If the PROFINET ring is interrupted, reconfiguration may occur. After a short reconfiguration time, the PROFINET devices can be accessed again via an alternative path.

In redundant mode, the redundant S7 1500H system uses two redundancy connections via optical fibers to synchronize the two CPUs. The primary CPU and the backup CPU continuously send H Sync frames via the H-Sync interfaces X3 and X4 of the CPUs.

In redundant mode, the redundant S7 1500R system uses the PROFINET ring to synchronize the two CPUs. The primary CPU and the backup CPU continuously send H Sync frames via the two ports of the PROFINET interface X1 via the PROFINET ring. All PROFINET devices in the PROFINET ring of the S7 1500R must support H Sync Forwarding.

System redundancy S2

In S2 operating mode, an IO device establishes one system redundancy AR each to both IO controllers of the redundant system.

Response in redundant mode:

- The primary CPU is always the active IO controller. The active PROFINET communication runs on the system redundancy AR between the IO device and the primary CPU (primary AR).
- The backup CPU also maintains PROFINET communication with the IO device but it is marked as invalid (backup). The I/O data of the system redundancy AR between the IO device and the backup CPU are not used (backup AR).

If the primary CPU fails, the previous backup CPU takes over the PROFINET communication with the IO device. To do this, the CPU uses the previous backup AR.

Note

Reconfiguration time

Media redundancy and system redundancy generally do not influence each other. However, if the reconfiguration time of the media redundancy is too long, the redundant system assumes there is an interruption in the PROFINET connection and switches from the lead CPU to the redundant CPU. The reconfiguration time must be sufficiently short (≤ 224 ms) to prevent this switchover of the system redundancy. The reconfiguration time in a ring with up to 50 stations is 224 ms in the worst case scenario.

Configuring the watchdog timer of the PN/MF Coupler in subnet 1 in STEP 7 TIA Portal

Note

Watchdog time

If the media redundancy reconfiguration time is greater than the selected watchdog timer of the PN/MF Coupler, the communication path is interrupted. This means the configured watchdog time must be ≥ 224 ms.

Follow these steps to configure the watchdog time:

1. Drag the PN/PN Coupler as of V4.2 from the hardware catalog to the PROFINET network.
2. Left-click the symbol of the PN/PN Coupler to select it.
3. Right-click to select slot X1 in the station window.
4. Go to the "Real time settings" menu command and select the "IO cycle" tab.
5. Configure the watchdog time in the "Number of accepted update cycles with missing IO data" field.

You can find additional information on configuring the watchdog time in the STEP 7 online help.

Note

Configure only those virtual modules specified in the section "Properties".

Active redundancy

Active redundancy means that all redundant resources are constantly in operation and are simultaneously involved in the execution of the control task. Active redundancy makes it possible to compensate for the failure of a CPU, an IO device or the interruption of the ring without the loss of information. The user program is completely identical in both CPUs for the S7-1500H. Both CPUs process the user program asynchronously. The system synchronizes the data between the CPUs event-controlled and thus ensures fast and bumpless switchover.

4.3 One-sided system redundancy S2

One-sided system redundancy S2

The redundant S7-1500R/H system cyclically exchanges IO data with an EtherNet/IP scanner via a PN/MF Coupler.

In the following figure, the PN/MF Coupler connects a redundant S7-1517H system to an EtherNet/IP. The right-hand side of the PN/MF Coupler is assigned to the S7-1517H redundant system. This means this side of the PN/MF Coupler is operated with system redundancy and media redundancy. The left-hand side of the PN/MF Coupler is assigned to the EtherNet/IP scanner.

The subnet in the left half is connected in neither a system-redundant nor a media-redundant manner. This means failures are not compensated. The purpose of this subnet is, for example, to transmit production data from the field level to the production management level.

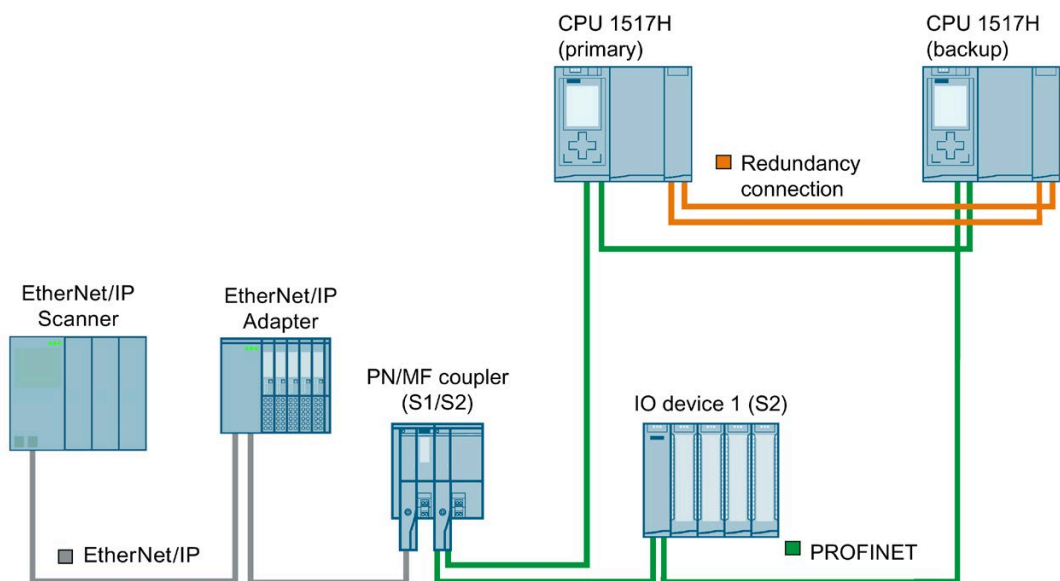


Figure 4-2 Configuration with the PN/MF Coupler with system redundancy (S2/S1) on one side.

Note

Topology

The topology of the plant alone does not indicate if an IO device is connected with one-sided, two-sided system redundancy or no system redundancy at all. You specify the design in your configuration.

4.4 Configuration

STEP 7 TIA Portal

In STEP 7 TIA Portal from V15.1 onwards, you can find a PN/MF Coupler from V4.2 onwards in the hardware catalog.

Configuration in STEP 7

You can find information on configuring redundant systems in the system manual for Redundant System S7-1500R/H.

You can find information on configuring the PN/MF Coupler in the section Configuring, parameter assignment and commissioning with PROFINET IO.

See also

PROFINET with STEP 7 V15 (<https://support.industry.siemens.com/cs/ww/en/view/49948856>)