SIEMENS

SIMATIC

Bus Link
FF Link

Operating Instructions

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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.

Proper use of Siemens products

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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Preface

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1.1 Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, solutions, machines, equipment and/or networks. They are important components in a holistic industrial security concept. With this in mind, Siemens' products and solutions undergo continuous development. Siemens recommends strongly that you regularly check for product updates.

For the secure operation of Siemens products and solutions, it is necessary to take suitable preventive action (e.g. cell protection concept) and integrate each component into a holistic, state-of-the-art industrial security concept. Third-party products that may be in use should also be considered. You can find more information about industrial security under: http://www.siemens.com/industrialsecurity

To stay informed about product updates as they occur, sign up for a product-specific newsletter. You can find additional information on this at: http://support.automation.siemens.com.

1.2 Preface

Bus links are gateways between bus systems and enable the communication connection of the bus systems.

The FF Link is a bus link for the communication between PROFIBUS DP and FOUNDATION Fieldbus H1 (hereafter referred to simply as FF). In automation systems configured with *SIMATIC PCS 7* and *SIMATIC STEP 7*, the FF Link enables the integration of FF devices on an FF segment.

Purpose of the operating instructions

These operating instructions provide you with all the information you need to plan, install, wire, and commission a bus link based on the "FF Link" module.

Basic knowledge required

To understand these operating instructions you should have general experience in the field of automation engineering. Basic knowledge of the following is also necessary:

- Automation system S7-400
- Distributed I/O systems on PROFIBUS DP

- *STEP 7 / SIMATIC PCS 7* basic software, in particular:
  - Working with *SIMATIC Manager*
  - Hardware configuration with *HW Config*
  - *SIMATIC PCS 7* Process Control System
  - Process Device Manager *SIMATIC PDM*
- FOUNDATION Fieldbus

Scope of these operating instructions

These operating instructions apply for the following products:

- FF Link IM 153-2: 6ES7153-2DA80-0XB0
- Field Device Coupler FDC 157: 6ES7157-0AC85-0XA0
  Use as spare part for the Field Device Coupler FDC 157 with article number 6ES7157-0AC84-0XA0:
  The Field Device Coupler FDC 157 is a spare part and functionally compatible.
  No modification to the STEP 7 project is necessary.
- Bus module BM PS/IM SIPLUS extreme: 6AG1195-7HA00-2XA0
- Bus module BM IM/IM (redundant): 6ES7195-7HD80-0XA0
- Bus module BM FDC: 6ES7195-7HF80-0XA0
- Bus module BM FDC/FDC (redundant) for redundant link pair: 6ES7195-7HG80-0XA0

For information about the active field distributors (Active Field Distributor AFD, Active Field Splitter AFS), refer to the DP/PA coupler, Active Field Distributor, DP/PA Link, and Y Link (http://support.automation.siemens.com/WW/view/en/1142696) Operating Instructions. All active field distributors described in this documentation can be used on the FF Link.

These operating instructions contain a description of the components that was valid at the time the operating instructions were published. We reserve the right to include product information with information updates with new components and components with a new product status.

Configuring with *SIMATIC PCS 7*

The FF Link can be configured using *SIMATIC PCS 7* V7.1 SP2 and higher and *SIMATIC PDM* V7.0 and higher.

Position in the overall information structure

Depending on the hardware used you require the following manuals in addition to these operating instructions:

- Operating Instructions DP/PA coupler, Active Field Distributor, DP/PA Link, and Y Link (http://support.automation.siemens.com/WW/view/en/1142696)
- The manual for the implemented DP master, including the following special information:
  - Configuring and commissioning of a DP master system
  - Description of the DP master

- The system manual SIMATIC NET, PROFIBUS network manual (http://support.automation.siemens.com/WW/view/en/35222591)
- PCS 7 Manuals (www.siemens.com/pcs7-documentation) that describe the handling of the *SIMATIC PCS 7* Process Control System, e.g.:
  - Engineering System Configuration Manual
  - Fault-Tolerant Process Control Systems Configuration Manual
  - Commissioning Manual PCS 7 Process Control System, FOUNDATION Fieldbus
- Operating Manual Process Control System PCS 7, SIMATIC PDM (https://support.industry.siemens.com/cs/ww/en/view/109217860) that describes how to work with the *SIMATIC PDM* Process Device Manager.

Sign posts

These operating instructions are subdivided into the following subjects:

- Product overview and description of the components
- Mounting, connecting and commissioning
- Operation and diagnostics
- Technical specifications
- Appendices
- Important terms are explained in the glossary.
- The index helps you to quickly find all texts relevant to your keywords.

Conventions

The terms "FOUNDATION Fieldbus" and "FF" are used synonymously in this manual. "FF device", for example, denotes a device that behaves in accordance with the FOUNDATION Fieldbus technology. The same applies to terms such as "FF bus system", "FF segment" etc.

However, the "Fieldbus Foundation" is an organization that is dedicated to the dissemination of the FOUNDATION Fieldbus technology.

Recycling and disposal

The described components are ecologically compatible, and thus suitable for recycling. For environmentally sound recycling and disposal of your old devices please contact a certified disposal service company for electronic scrap.

Additional support

If you have any questions relating to the products described in these operating instructions and do not find the answers in this document, please contact your local Siemens representative (http://w3.siemens.com/aspa_app/).

A guide to the technical documentation for the various SIMATIC products and systems is available on the Internet (http://www.siemens.com/simatic-tech-doku-portal).

The online catalog and online ordering system are available on the Internet (http://mall.automation.siemens.com).

Training Center

Siemens offers a series of courses that will help you getting started with the components, the *SIMATIC S7* Automation System and *SIMATIC PCS 7*. Please contact your regional training center or the central training center in D-90327, Nuremberg, Germany (http://sitrain.automation.siemens.com/sitrainworld/).

Technical Support

You can contact Technical Support for all Industry Automation products by means of the Web form for the Support Request (https://support.industry.siemens.com/My/ww/en/requests).

Additional information about Siemens Technical Support is available on the Internet (https://support.industry.siemens.com/cs/us/en/).

Service & support on the Internet

In addition to our documentation, we offer a comprehensive knowledge base on the Internet (https://support.industry.siemens.com/cs/us/en/).

There you will find:

- Our Newsletter, which constantly provides you with the latest information about your products
- The right documents for you, using our Service & Support search engine
- A bulletin board in which users and specialists worldwide exchange their know-how
- Your local contact partner for Industry Automation in our contacts database
- Information about on-site services, repairs, spare parts, and lots more.

Product overview

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2.1 Bus Link

"FF Link" bus link

The "FF Link" bus link acts as gateway between a PROFIBUS DP master system and a FOUNDATION Fieldbus H1 segment and enables integration of FF devices in *SIMATIC PCS 7*. The FF Link comprises one or two IM 153-2 FF interface modules and one FDC 157 Field Device Coupler, or a redundant FDC 157 coupler pair which are interconnected via passive bus links, or in a redundant configuration via bus modules.

IM 153-2 FF

In the FF Link, the two bus systems are non-interacting through the IM 153-2 FF both physically (galvanically) and in terms of protocols and time.

For operation with two IM 153-2 FF interface modules, the sublevel FF bus system can be connected to a SIMATIC S7-400H. For this purpose, the configuration always contains bus modules.

FDC 157

The Field Device Coupler FDC 157 is the physical link to the FOUNDATION Fieldbus. The FDC 157 provides integrated diagnostic functionality.

The use of two FDC 157 enables redundant operation on an FF segment in ring redundancy with the active field distributor AFD, or in coupler redundancy with the active field distributor AFS.

See also

Configuration variants with FF Link as a bus link (Page 23)

2.2 Integration in the automation environment

2.2.1 What are distributed I/O devices?

Distributed I/O Devices - Field of Application

When a system is configured, the I/Os from and/or to the process are often integrated centrally in the automation system.

In the case of greater distances of the inputs and outputs from the automation system the wiring may be very extensive and confusing. Electromagnetic interference may be impair reliability.

Distributed I/O is suitable for use with systems of this kind.

- The PROFIBUS DP master is located in a central position.
- The distributed I/O devices (inputs and outputs) work at their decentral locations.
- With its high transmission speed, the high performance PROFIBUS DP ensures that the control system CPU and the distributed I/O devices communicate smoothly.

What is PROFIBUS DP?

PROFIBUS DP is an open bus system to IEC 61784-1 CP 3/1 with "DP" transmission protocol (DP stands for Distributed Peripherals).

Physically PROFIBUS DP is implemented either as an electrical network based on shielded twisted-pair cables, or as an optical network based on fiber optic cable.

The "DP" transmission protocol facilitates very fast cyclical data exchange between the control system CPU and the distributed I/O devices.

What is FOUNDATION Fieldbus?

FOUNDATION Fieldbus is an open bus system that permits the use of field devices from different manufacturers within one system. In many aspects, the design of an FF system corresponds to that of the IEC fieldbus model. The FF-H1 bus works in accordance with specifications in IEC 61158-2.

The FF-H1 bus also enables applications in potentially explosive atmospheres.

Transmission from FOUNDATION Fieldbus conforms to the international standard IEC 61784-1 CP 1/1.

FOUNDATION Fieldbus enables transmitters and actuators in potentially explosive atmospheres to communicate with the automation system over long distances. With the FOUNDATION Fieldbus, the field devices can be fed via the data cable at the same time.

The FF Link is available as gateway between the PROFIBUS DP and FOUNDATION Fieldbus transmission technology.

2.2.2 "FF Link" bus link

FF Link

In relation to higher-level systems (for the automation device), FF Link is a DP slave and it is an FF Link Master in relation to lower level systems (for the FF devices). The following figure shows the integration of the FF Link into the system and refers to the documentation of the respective system components.

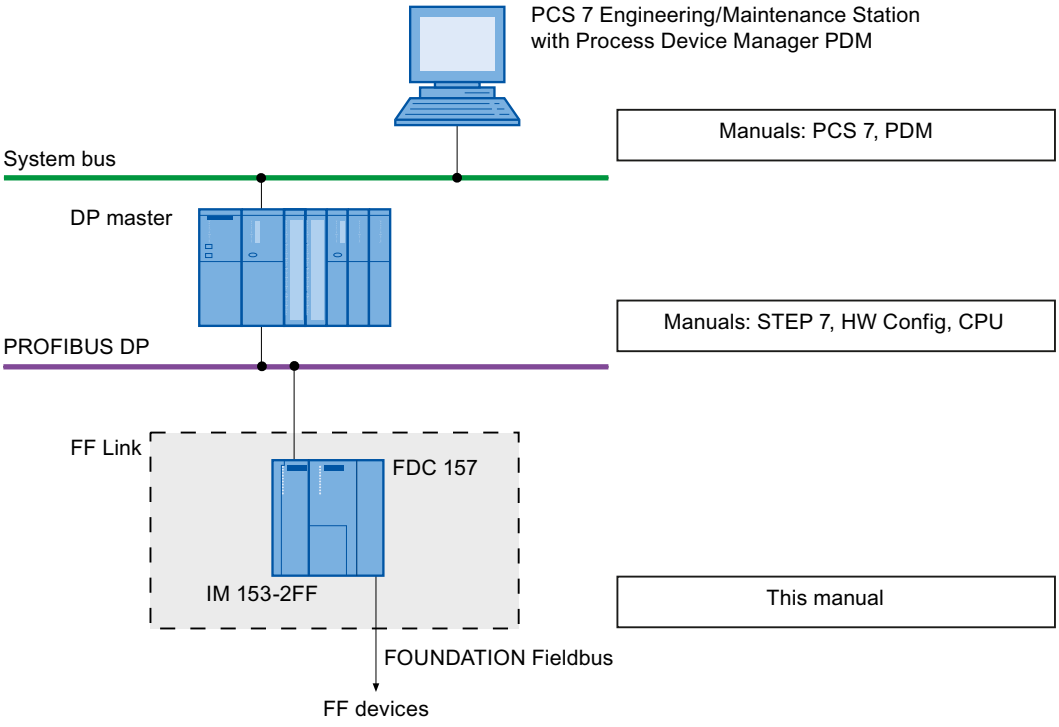

Figure 2-1 Integration of the FF Link into the system landscape

2.2.3 Field Device Coupler FDC 157

Field Device Coupler FDC 157

The Field Device Coupler FDC 157 provides the gateway from PROFIBUS DP to the FOUNDATION Fieldbus H1 (hereafter referred to as FF) to which the FF devices are connected.

Both the Link Master (IM 153-2 FF interface module) and the FDC 157 Field Device Coupler can be set up for redundant operation. A link pair (redundant power conditioning) is interconnected with an FF segment via active AFS field distributor. An FF segment can be configured as ring topology with the help of the active AFD field distributor. Ring redundancy enhances the availability of the FF segment and also includes link redundancy.

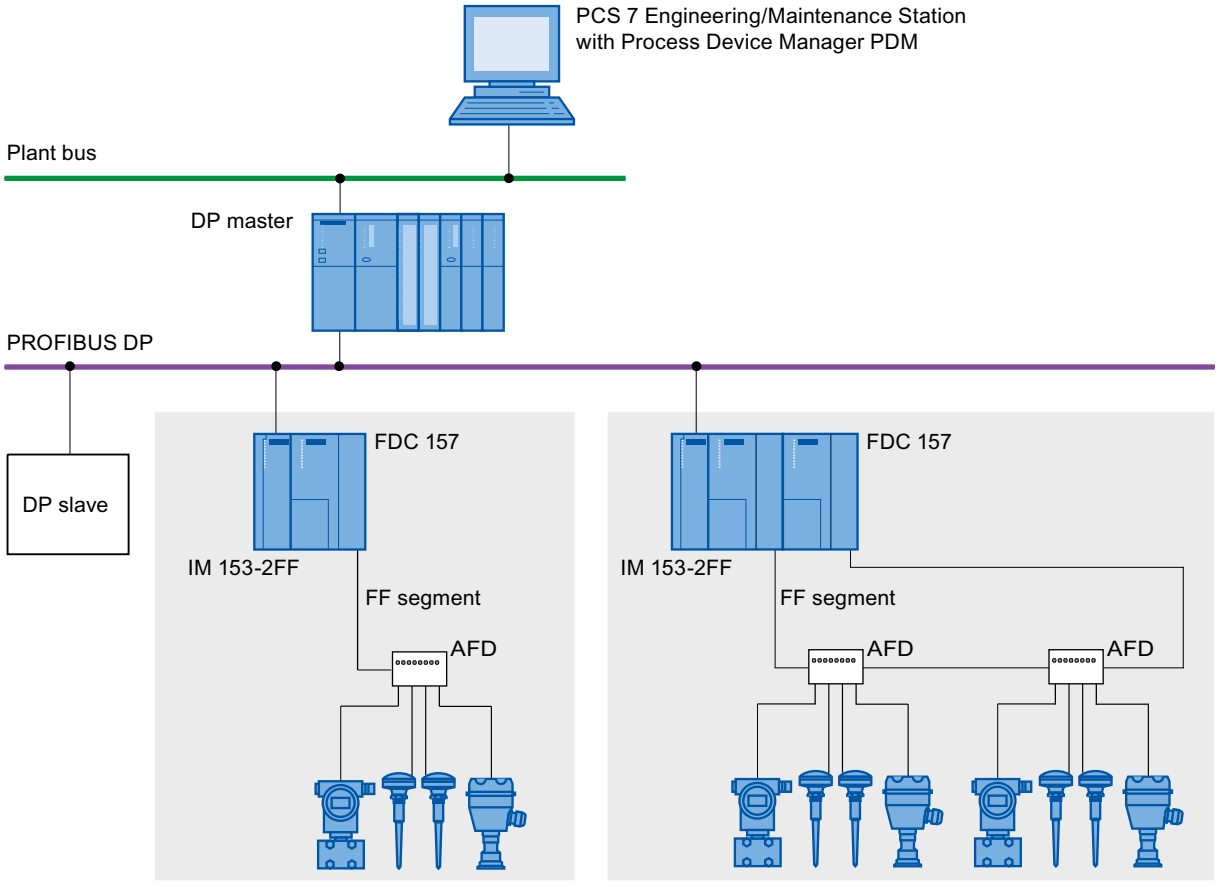

Figure 2-2 Integration of the Field Device Coupler FDC 157 in the system environment

Description of the components

3

3.1 Bus Link

Applications

The FF Link is intended for the following applications:

- S7 standard operation on S7-400
- Redundant operation on S7-400H
- FF Link Master operation

Operating principle

- The FF Link is a DPV1 slave on the higher-level DP master system and acts as a proxy for the nodes connected on the underlying bus system (FF devices).
- The IM 153-2 FF can only be operated as DPV1 slave. A suitable DP master is required for this. In *STEP 7*, the mode for the DP master being used can be selected in the Object Properties, if required: This must be "DPV1".
- The FF Link forms an independent underlying bus system together with the connected FF devices, which is decoupled from the higher-level DP master system in terms of communication.
- Within the FF segment, the IM 153-2 FF (as the FF Link Master) deterministically controls the distributed communication by means of the LAS (Link Active Scheduler). This allows the FF devices to take over process control functions (CiF, Control in the Field).
- CiF functionality does not depend on the availability of the DP segment, which means that the failure of the DP segment does not impair CiF functionality on the FF segment.
- The use of two FDC 157 Field Device Couplers in the redundant configuration increases the availability of the FF segment.

Configuration options

A DP master system can be extended by means of the FF Link in the following way:

- The number of bus links on a DP master system is restricted by:
  - the maximum number of bus nodes supported by the DP master system
  - the number of configurable station addresses (refer to section Setting the PROFIBUS address of the IM 153-2 FF (Page 33)).
- The FF Link comprises one or two IM 153-2 FF interface modules and one FDC 157 Field Device Coupler, or a redundant FDC 157 coupler pair.
- You can connection a maximum of 31 FF devices on an FF Link. Each FF device occupies a slot in the configuration.

- The configuration frame and the user data frame of the FF Link are both derived from the frame contents of the lower-level FF devices.
- The maximum length of the frames for I/O data on the PROFIBUS DP side is 244 bytes in each case.
- An FF segment is limited to the size of the process image of the FF Link (max. 244 bytes each for I/O data).
  - You can distribute the 244 input bytes between the FF devices:
    - Digital inputs (2 bytes per value, but max. 40 DI)
    - Analog inputs (5 bytes per value, but max. 40 AI)
  - You can distribute the 244 output bytes between the FF devices:
    - Digital outputs (2 bytes per value, but max. 40 DO)
    - Analog outputs (5 bytes per value, but max. 40 AO)

Requirements for use

- Software requirements:
  - *PDM* V7.0 or higher and
    - *STEP 7* V5.5 and higher or
    - *SIMATIC PCS 7* V7.1 SP2 and higher
- Hardware requirements:
  - The FF Link is connected via external CP 443-5 communication processor:
    - Standard CPU V4.0 or higher
    - H-CPU V4.0 or higher
  - The FF Link is connected via internal PROFIBUS DP interface of the CPU:
    - Standard CPU V5.1 or higher

Parameterization of the FF devices

The FF devices are parameterized with the aid of *SIMATIC PDM* from a PG/PC, which is connected to the higher-level PROFIBUS DP or the process control system. Additional information can be found in Operating Manual Process Control System PCS 7, Help on SIMATIC PDM (https://support.industry.siemens.com/cs/ww/en/view/109217860)

User data of the FF Link

The DP user data frame of the FF Link depends on the number of configured FF devices. It comprises the data blocks of the configured FF devices arranged one after the other. The data blocks are sorted in ascending order according to FF address.

In accordance with the FOUNDATION Fieldbus guideline (refer to section Standards and Approvals (Page 85)), each process variable is assigned a status byte that specifies the status of the process variable.

If one FF device fails, first the relevant input data are reset, including the status byte in the user data frame of the FF Link. Then the corresponding information is entered into the diagnostic frame.

On recovery of the FF device, the corresponding information is entered in the diagnostic frame. Virtually simultaneously the valid input data of the FF device in the user data frame of the FF Link are again available. The status byte displays the valid data.

Note

The status data of the FF devices is evaluated immediately by the *SIMATIC PCS 7* drivers and diagnostic blocks and is then made available on the operator and maintenance stations.

Switchover time to FF during redundancy mode

When there is a master-standby switchover or the active IM 153-2 FF fails, the FF devices are processed via the standby IM 153-2 FF.

The I/O states are retained during the failover of IM 153-2 FF modules that are operated in redundant mode. Without changes to the FF configuration, the maximum failover time amounts to 70 ms.

The failover time denotes the interval between activation of the standby IM and availability of the input data.

Communication links from the PG / PC to the FF devices

You can communicate with the FF devices via the FF Link by means of *SIMATIC PDM* .

For more information, refer to the Process Control System PCS 7, FOUNDATION Fieldbus (www.siemens.com/pcs7-documentation) Commissioning Manual.

During redundancy mode all the communication links from the PG / PC to the FF devices remain intact when the active channel is switched over from one IM 153-2 FF to the other.

3.1.1 IM 153-2 FF

Applications

The IM 153-2 FF is intended for the following applications:

- Operation in the FF Link
  - on a non-redundant DP master system
  - Operation on a redundant DP master system on an S7-400H (incl. FF Link Master redundancy)
  - without/with coupler redundancy of the Field Device Coupler FDC 157.

Functions

- Interface module (DPV1 Slave) on the higher-level DP master system for an underlying FF bus system
- FF Link Master functionality
- Link Active Scheduler (LAS) for the central communication control of the distributed communication of the FF segment (active IM 153-2 FF).

Properties

- Any transmission speed between 9.6 Kbps to 12 Mbps for the higher-level DP master system
- Diagnostics via LEDs and the user program
- Bumpless switchover of active channel in redundancy mode
- Support of system modifications during operation, both in S7 standard mode and in redundancy mode.
- Extended environmental conditions

3.1.2 FDC 157

Applications

The Field Device Coupler FDC 157 is intended for the following applications:

- Non-redundant operation:
  - Operation in the FF Link on a simple DP master system or on an S7-400H
- Redundant operation (ring redundancy when using the active field distributor AFD, coupler redundancy when using the active field splitter AFS):
  - Operation in the FF Link on a simple DP master system or on an S7-400H

Availability

- Greater availability due to coupler redundancy
- With the use of AFD active field distributors, it is possible to repair and expand the bus segment during operation. The automatic termination of the cable end allows, for example, additional AFDs to be connected in order to extend the bus segment.

Commissioning

- Simplified commissioning due to automatic bus terminator
- The configuration of the field device coupler for FF operation is implicitly based on the configuration of the FF Link.

Properties

The Field Device Coupler FDC 157 has the following properties:

- Galvanic isolation between IM 153-2 FF and FF segment
- Implementation of transmission physics to symmetrical bus physics according to IEC 61784-1 CP 1/1
- Diagnostics via LEDs
- Diagnostic function via IM 153-2 FF
- Transmission speed on the FF segment 31.25 Kbit/s
- Integrated power supply for FF (Power Conditioner)
- Integrated bus terminator for FF
- Extended environmental conditions
- Max. segment power supplied 1000 mA
- Max. 31 FF devices can be connected

Configuration

The Field Device Coupler FDC 157 can only be used for FF operation in connection with the IM 153-2 FF.

For FF operation, the FDC 157 Field Device Coupler is set up implicitly with the configuration of the FF Link.

Note

The PROFIBUS DP connections on the Field Device Coupler FDC 157 are not needed. The IM 153-2 FF and FDC 157 Field Device Coupler(s) are interconnected via the S7 backplane bus.

Additional information

You can find detailed information on the FDC 157 on the Internet in Product support (https://support.industry.siemens.com/cs/ww/en/ps):

- **Product:** Enter the article number of the FDC 157 used (e.g. 6ES7157-0AC85-0XA0)
- **Entry type:** Manual

3.2 Active field distributor (AFD)

Active Field Distributors AFD

You can connect FF devices such as measuring instruments, sensors, and actuators to the active field distributors AFD.

The number of FF devices you can connect to a field distributor AFD differs depending on the AFD version used. (Refer to the DP/PA coupler, Active Field Distributor, DP/PA Link, and Y Link (http://support.automation.siemens.com/WW/view/en/1142696) operating instructions. These instructions also contain information about the operation of field distributors in potentially explosive atmospheres.)

The total number of FF devices on the FF segment is limited to 31, while the total number of components is limited due to the maximum current of 1000 mA.

Functions

- Connection of devices for FF
- Automatic bus termination
- Extending an FF segment during ongoing operation

Properties

- 2 cable glands for the FF main line
- Cable glands for FF devices
- Connection of the FF main line and the FF stub lines via screw terminals
- Reverse polarity protection connections
- Diagnostics via LEDs
- Power supply via the FF bus
- Suitable for screw mounting on surfaces, or installation on a mounting rail by means of adapter
- Grounding terminal outside

3.3 Active field splitter (AFS)

Active field splitter (AFS)

The field distributor AFS connects 2 FCD 157 Field Device Couplers to the devices of an FF segment. It thus allows the operation of a **coupler redundancy** (Power Conditioner Redundancy) on the FF segment. The total number of FF devices on the FF segment is limited to 31, while the total number of components is limited due to the maximum current of 1000 mA.

Functions

- Automatic switchover of the FF main line to the active Field Device Coupler

Properties

- 2 cable glands for the FF main line
- 1 cable gland for the FF segment
- Optional: Center feed via a cable bushing
- Connection of the FF main lines via screw terminals
- Reverse polarity protection connections
- Termination of up to 31 FF devices, total current consumption of all components max. 1000 mA
- Diagnostics via LEDs
- Power supply via the FF bus
- Suitable for screw mounting on surfaces, or installation on a mounting rail by means of adapter
- Grounding terminal outside

Application planning

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4.1 Configuration variants with FF Link as a bus link

Introduction

You can set up a maximum of 2 IM 153-2 FFs and 2 FDC 157 Field Device Couplers (redundant coupler pair).

- For operation with redundant IM 153-2 FF modules, you need the BM IM/IM (redundant) bus module.
- As far as the hardware and firmware is concerned, you must use identical components (Link and coupler) for operation with ring redundancy or coupler redundancy.
- For operation with ring redundancy, you need the active field distributor AFD, the BM FDC/FDC (redundant) bus module, and the BM PS/IM or BM IM/IM (redundant) bus module.
- For operation with coupler redundancy, you need the active field splitter AFS, the BM FDC/FDC (redundant) bus module, and the BM PS/IM or BM IM/IM (redundant) bus module.
- For configuration variants with coupler redundancy, the FDC 157s monitor each other to detect power failures and faults.

Field Device Coupler FDC 157

You do not need the PROFIBUS DP connections on the FDC 157 Field Device Coupler. The IM 153-2 FF and the Field Device Coupler are connected via the S7 backplane bus.

The diagnostic function of the FDC 157 Field Device Coupler is only available in conjunction with the diagnostics of IM 153-2 FF.

Applications

With the FF Link, you can implement the following applications:

- Configuration variants without FF Link Master redundancy (singe IM 153-2 FF)
  - Use without coupler redundancy (1 x FDC 157)
  - Use with ring redundancy (2 x FDC 157) with active field distributor AFD
  - Use with coupler redundancy (2 x FDC 157) with active field distributor AFS
  - The FF device as backup FF Link Master
- Configuration variants with FF Link Master redundancy (redundant IM 153-2 FF)
  - Use without coupler redundancy (1 x FDC 157)
  - Use with ring redundancy (2 x FDC 157) with active field distributor AFD
  - Use with coupler redundancy (2 x FDC 157) with active field distributor AFS
  - The FF device as backup FF Link Master

Note

Design

- With redundant components, the following must be identical for the respective partner component:
  - Article number
  - Hardware version
  - Firmware version
- Ring redundancy has been tested and approved for use with Siemens network components.

You can find additional information on this in the section "System modification during operation (Page 63)".

Configuration variants with FF Link Master redundancy

For operation with two IM 153-2 FF interface modules, the sublevel FF bus system can be connected to a SIMATIC S7-400H. For this purpose, the configuration always contains bus modules.

Both IM 153-2 FF interface modules have the same configuration information, the same parameterization and receive the same input data from the FF bus. Which of the two IM 153-2 FFs is to be active on the FF bus depends solely on the corresponding command by the higher-level DP master. Only the activated IM 153-2 FF sends cyclic output data to the FF bus (send request to FF devices).

The acyclic data is independent of the cyclical data. The passive IM 153-2 FF can also establish connections to FF devices upon activation.

Note

Note that only one FF segment can be connected per bus link.

Reference

For further details on the configuration variants with the FF Link, refer to

- *DP/PA coupler, Active Field Distributor, DP/PA Link, and Y Link* Operating Instructions
- The Function Manual *PCS 7 Process Control System, Fault-Tolerant Process Control Systems (V7.1)*, section "Redundant PROFIBUS PA".

The statements in these documents apply accordingly, with the following exceptions:

Special features FF Link	
Number of FF segments per bus link	1
Stand-alone mode of the FDC 157 (without IM 153-2 FF)	No
Diagnostic function of the FDC 157	Only via IM 153-2 FF
Power Conditioner redundancy	Supported for ring or coupler redundancy

Special features FF Link	
Intrinsically safe installation	Only with suitable active field distributor
Support of Ex [i] coupler	No

4.2 FF Link Master redundancy

LAS functionality

As a rule, the IM 153-2 FF (as the FF Link Master) takes over the LAS functionality. You can use multiple FF devices as backup FF Link Master for handling LAS functionality upon failure of the IM 153-2 FF. To do this, you must make the corresponding settings on the FF device.

In the course of configuration, the IM 153-2 FF is automatically used as the "primary" FF Link Master. However, the scheduler (processing schedule for communication on the FF segment) is loaded into each additional FF Link Master. Thus, in the event that the IM 153-2 FF fails (e.g. power failure), another FF Link Master will take over the LAS functions. FF Link Master redundancy is always given in a configuration variant with 2 x IM 153-2 FF.

It is prerequisite for all variants of FF Link Master redundancy to safeguard the supply to the FDC 157 Field Device Coupler (Power Conditioner) in order to maintain the bus supply (or at least one FDC 157 for coupler redundancy).

Mounting 5

5.1 Installation rules for FF Link

Mounting position

The IM 153-2 FF modules and FDC 157 Field Device Coupler can be mounted vertically or horizontally.

WARNING

Open equipment

The IM 153-2 FF modules and FDC 157 Field Device Coupler are open equipment. This means that they may only be mounted in enclosures, cabinets. or electrical service rooms that can only be accessed by using a key or a tool. Only authorized personnel may have access to the enclosures, cabinets or electrical service rooms.

Mounting system

The IM 153-2 FF modules and FDC 157 Field Device Coupler are mounted on mounting rails. Free space of 40 mm must be maintained above and below the modules for trouble-free mounting.

Additional instructions for installing modules in the S7 mounting system are available in the installation manual S7-400 Automation System, Installation (http://support.automation.siemens.com/WW/view/en/1117849).

5.2 Mounting rules for active field distributors

Mounting position

The active field distributors AFD and AFS can be installed in any mounting position.

Mounting system

The active field distributors AFD and AFD can be screw-mounted onto planar, vibration-free surfaces of sufficient carrying capacity. The modules can also be installed on a mounting rail using an adapter.

For trouble-free installation of the modules, a clearance of 60 mm must be maintained on their side and below them.

For more information on mounting procedures, refer to the DP/PA Coupler, Active Field Distributors, DP/PA Link and Y Link Operating Instructions.

See also

Active field distributor (AFD) (Page 20)
Active field splitter (AFS) (Page 20)

5.3 Installing "FF Link" bus link

5.3.1 Mounting the FF Link for non-redundant mode

Introduction

A configuration variant without FF Link Master redundancy (single IM 153-2 FF) supports the following applications

- Use without coupler redundancy (1 x FDC 157):
  - Configuration with the "for standard configuration" mounting rail and bus connector between the modules or
  - Optional configuration with the "for hot-swapping modules" mounting rail and active bus modules
- Use for ring redundancy (2 x FDC 157) with active field distributor AFD
  - Configuration with the mounting rail "for hot-swapping modules" and active bus modules.
- Use with coupler redundancy (2 x FDC 157) with active field distributor AFS
  - Configuration with the mounting rail "for hot-swapping modules" and active bus modules.

Installation steps

Depending on your configuration, you have to carry out the following installation steps in consecutive order:

1. Install the mounting rail
2. Install the modules
   - For a standard configuration: Install the modules on the mounting rail
   - For a configuration with active bus modules: Install the active bus modules and modules

Use without coupler redundancy

Components needed for use without coupler redundancy (1 x FDC 157)

- Mounting rail "for standard configuration"
- IM 153-2 FF

- Field Device Coupler FDC 157
- Bus connector (included with the Field Device Coupler FDC 157)

An optional configuration with active bus modules is also supported::

- Mounting rail "for hot-swapping modules" (the active bus modules can be installed only in this rail).
- IM 153-2 FF
- Field Device Coupler FDC 157
- Bus module BM PS/IM or BM IM/IM (redundant)
- Bus module BM FDC

The following figure shows the configuration of the FF Link with bus connectors and with open front doors.

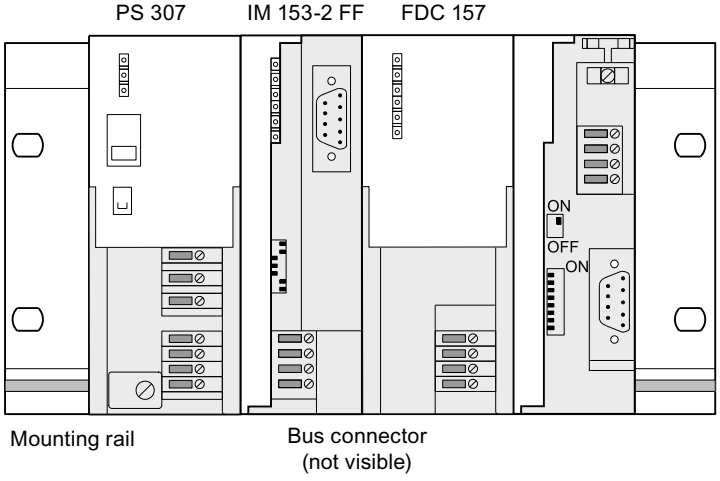


Figure 5-1 Configuration of the FF Link for non-redundant mode

Mounting the FF Link

1. Plug the bus connector that is included with the Field Device Coupler FDC 157 onto the IM 153-2 FF.
2. Hook the IM 153-2 FF into the mounting rail "for standard configuration" and swing it downward.
3. Tighten the mounting screws of the IM 153-2 FF.
4. On the right side of IM 153-2 FF, hook the Field Device Coupler FDC 157 into the mounting rail "for standard configuration" and then swing the FDC downward.
5. Tighten the mounting screws of the Field Device Coupler FDC 157.

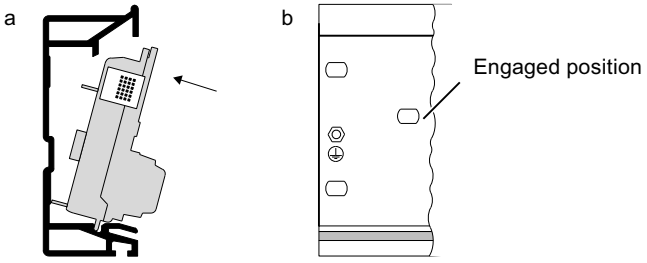
Use with ring redundancy/coupler redundancy

Components required for the use with ring redundancy or coupler redundancy (2 x FDC 157)

- Mounting rail "for hot-swapping modules"
- IM 153-2 FF
- 2 x Field Device Coupler FDC 157 (redundant coupler pair)
- Bus module BM PS/IM or BM IM/IM (redundant)
- BM FDC/FDC (redundant) bus module for connecting a redundant coupler pair

Mounting the FF Link

1. Place the bottom edge of the BM PS/IM or BM IM/IM (redundant) bus module into the mounting rail "for module replacement during operation", snap it onto the rail (a), and then slide it to the left up to the snap-in position (b).
   If using the 482.6 mm or 530 mm mounting rail "for module replacement during operation" and positioning the BM IM/IM (redundant) bus module at the right-hand snap-in position, you can install two additional PS 307; 2A or one PS 307; 5A on its left side.



2. Hook the BM FDC/FDC (redundant) bus module into the mounting rail and then snap it in.
3. Slide the bus modules together so that the module connections are mated.
4. Insert the IM 153-2 FF into the BM PS/IM or BM IM/IM (redundant) bus module.
5. Insert both FDC 157 Field Device Couplers into the BM FDC/FDC (redundant) bus module. Use the lateral guides of the bus module.
6. Tighten the screws of the modules. This also fixes the bus modules to the rail.

Dismounting the FF Link

To remove the FF Link, proceed in the reverse order. Start with the FDC 157 Field Device Coupler that is installed on the extreme right side.

If the FF Link is already in operation, switch off the 24 VDC power supplies prior to removing it.

See also

Accessories for PROFIBUS DP (Page 102)

Accessories for FOUNDATION Fieldbus (Page 102)

5.3.2 Mounting the FF Link for redundant operation

Introduction

A configuration variant with FF Link Master redundancy (redundant IM 153-2 FF) supports the following applications

- Use without coupler redundancy (1 x FDC 157)
- Use for ring redundancy (2 x FDC 157) with active field distributor AFD
- Use with coupler redundancy (2 x FDC 157) with active field distributor AFS

Configuration with bus modules

For the redundancy mode, the FF Link must set up with the mounting rail "for module replacement during operation" and active bus modules.

Installation steps

Carry out the following installation steps in consecutive order:

1. Install the mounting rail
2. Install the active bus modules and modules

Components required

- Mounting rail "for hot-swapping modules"
- 2 x IM 153-2 FF
- Field Device Coupler FDC 157, or 2 x Field Device Coupler FDC 157 (redundant coupler pair)
- Bus module BM IM/IM (redundant)
- BM FDC or BM FDC/FDC (redundant) bus module for accommodating a redundant coupler pair

Typical configuration

The following figure shows the typical configuration of the FF Link for the redundancy mode with two voltage supply modules and with front doors open.

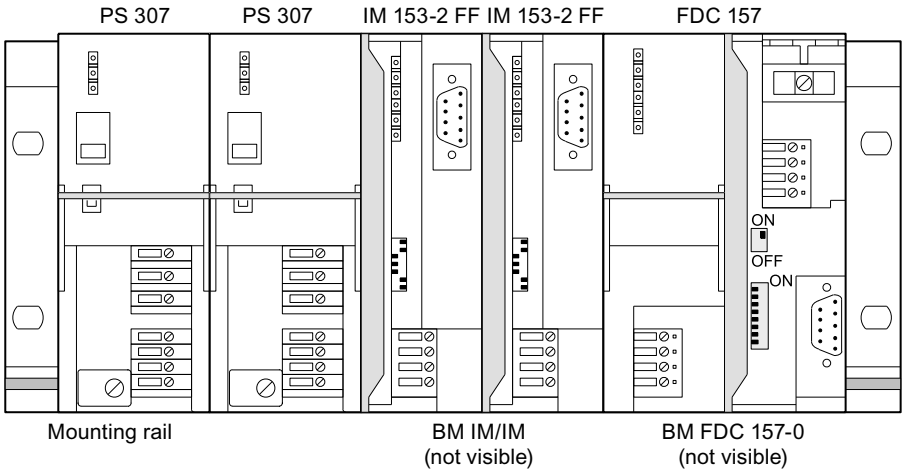
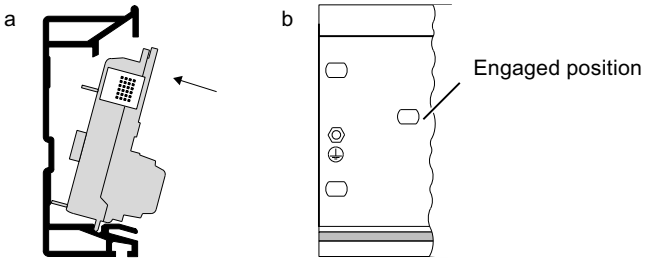


Figure 5-2 Typical configuration of the FF Link for the redundancy mode

Mounting the FF Link

1. Place the bottom edge of the BM IM/IM (redundant) bus module into the mounting rail, push it onto the rail (a), and then slide it to the left up to the snap-in position (b).
   If using the 482.6 mm or 530 mm mounting rail and positioning the BM IM/IM (redundant) in the right-hand snap-in position, you can install two additional PS 307; 2A or one PS 307; 5A on its left side.



2. For the FDC 157 Field Device Coupler(s), place a BM FDC bus module or a BM FDC/FDC (redundant) shared bus module onto the mounting rail and press it into the mounting rail.
3. Slide the bus modules together so that the module connections are mated.
4. Insert both IM 153-2 FF into the BM IM/IM (redundant) bus module.
5. Insert the FDC 157 Field Device Coupler(s) into the BM FDC or BM FDC/FDC (redundant) bus module. Use the lateral guides of the bus module.
6. Tighten the screws of the modules. This also fixes the bus modules to the rail.

Dismounting the FF Link

To remove the FF Link, proceed in the reverse order.

If the FF Link is already in operation, switch off the 24 VDC power supplies prior to removing it.

See also

Accessories for PROFIBUS DP (Page 102)

Accessories for FOUNDATION Fieldbus (Page 102)

5.4 Setting the PROFIBUS address of the IM 153-2 FF

Definition

All nodes must be assigned a PROFIBUS address for unambiguous identification on PROFIBUS DP.

Rules

The following rules apply to the PROFIBUS address of the IM 153-2 FF in the higher-level DP master system:

- Valid PROFIBUS addresses: 1 to 125
- In a DP master system, each PROFIBUS address must be assigned once only.
- In redundant mode, the same PROFIBUS address must be set for both IM 153-2 FF.

Tools required

You need a 3 mm screwdriver to set the PROFIBUS address.

Procedure

1. Open the front door of the IM 153-2 FF.
2. Using the screwdriver, set the PROFIBUS address. The PROFIBUS address represents the total value of all switches in the "ON" position (switch position to the right).

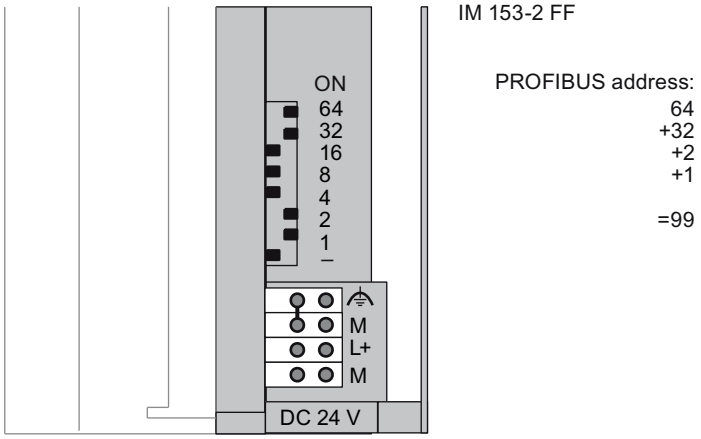


Figure 5-3 Example for setting the PROFIBUS address

Changing the PROFIBUS address

Such a change is not allowed at runtime. The IM 153-2 FF does not activate the new PROFIBUS address until you cycled the 24 V DC power supply off and on.

Note

To ensure that changes to the PROFIBUS address are not done by accident and unnoticed by the plant operator, the IM 153-2 FF outputs a corresponding diagnostic message when it detects changes to the PROFIBUS address at runtime (see chapter Diagnostics of the FF Link (Page 71)).

5.5 Setting the bus address, redundancy mode, and FF bus terminator of the FDC 157

Introduction

You do not need to set the bus address of the FDC 157 Field Device Coupler for operation in the FF Link.

With factory default, the bus address is set to "0" and "coupler redundancy" mode is enabled.

Rules

- Bus address "0" is the only one valid for (both) FDC 157.
- The redundancy mode set on the FDC 157 coupler pair ("RING" switch) must match the configuration settings (ring or coupler redundancy).

Tools required

- Screwdriver with 3 mm blade

Setting the bus address, redundancy mode, and FF bus terminator

1. Open the front door of the FDC 157 Field Device Coupler.
2. Set the bus address "0" using the DIP switches, if applicable (= default setting).
3. Set the redundancy mode to "RING" using the bottom DIL switch.
4. Set up the FF bus terminator switch in accordance with the planned wiring.
5. Close the front door of the Field Device Coupler FDC 157.

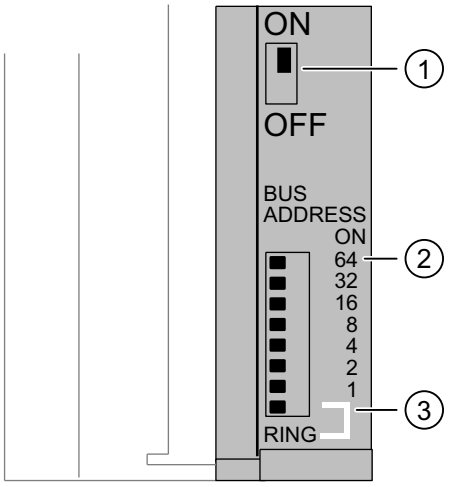


Figure 5-4 Setting the bus address and redundancy mode for FDC 157

①	FF bus terminator switch (not relevant for ring or coupler redundancy) ON: Bus terminating resistor enabled (= default setting) OFF: Bus terminating resistor disabled
②	Bus address 0 (= default)
③	Redundancy mode (not relevant for non-redundant operation) ON: Ring redundancy OFF: Coupler redundancy (= default setting)

Changing the DIL switch and FF bus terminator settings

This action is not allowed at runtime. All changes must be carried in off-voltage state.

See also

Connecting the FOUNDATION Fieldbus to the Field Device Coupler FDC 157 (Page 45)

Connecting 6

6.1 Electrical isolation and grounding

Introduction

You can wire the 24 V power supply to the described modules for grounded or ungrounded configurations, depending on the requirements of your system configuration.

Properties of the IM 153-2 FF

- The S7 backplane bus and 24 V power supply are connected to the same potential
- PROFIBUS DP is electrically isolated from the 24 V power supply and the S7 backplane bus

Properties of the FDC 157 Field Device Coupler

- The S7 backplane bus and FOUNDATION Fieldbus are electrically isolated from the 24 V power supply of the FDC 157 Field Device Coupler
- The S7 backplane bus is electrically isolated from the FOUNDATION Fieldbus

Power supply

If IM 153-2 FF and the FDC 157 are operated on the same power supply, the potential of IM 153-2 FF between the backplane bus and the 24 V power supply overrides the electrical isolation of the FDC 157 Field Device Coupler between the 24 V power supply and the S7 backplane bus. To avoid this situation, you must install two electrically isolated 24 V power supplies.

Note

In an ungrounded configuration with common power supply, observe that the FDC 157 has an additional internal 10 MOhm resistance that is active in parallel to the 10 MOhm resistance between electrical ground and earth on the IM 153-2 FF.

Reference

For more information about these topics, refer to the DP/PA coupler, Active Field Distributor, DP/PA Link, and Y Link Operating Instructions

- General rules and regulations
- Grounding the field distributors

- Operating on grounded power supply
- Operation with ungrounded reference potential

Due to the same physical conditions, the specifications made there apply accordingly.

For information on the cable used, refer to chapter Order numbers (Page 101).

6.2 Terminating the IM 153-2 FF

6.2.1 Wiring the IM 153-2 FF for non-redundant mode

IM 153-2 FF connections

The figure below shows all connections to be made on the IM 153-2 FF for non-redundant operation.

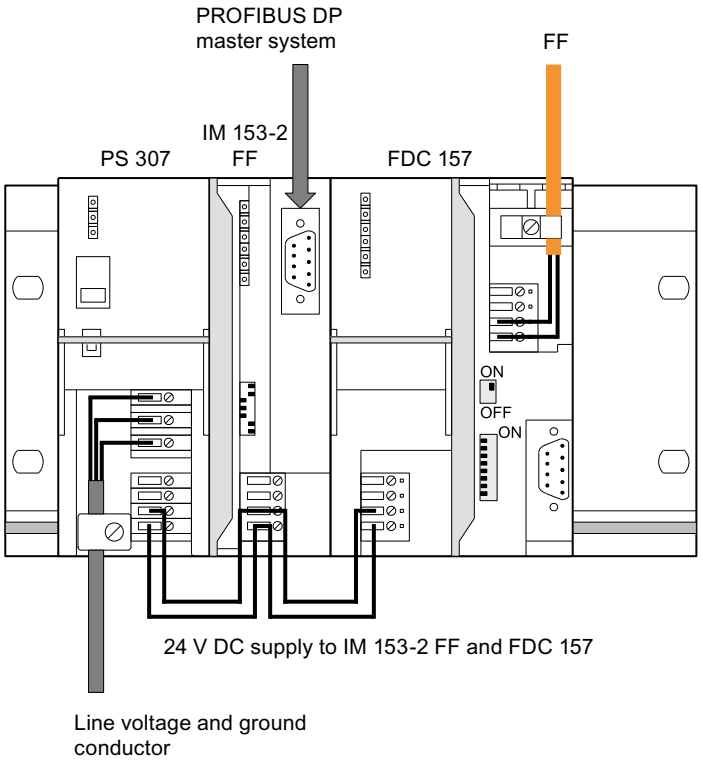


Figure 6-1 Connections of the IM 153-2 FF for non-redundant mode

6.2.2 Wiring the IM 153-2 FF for redundant operation

IM 153-2 FF connections

The figure below shows all connections to be made on the IM 153-2 FF for redundant operation.

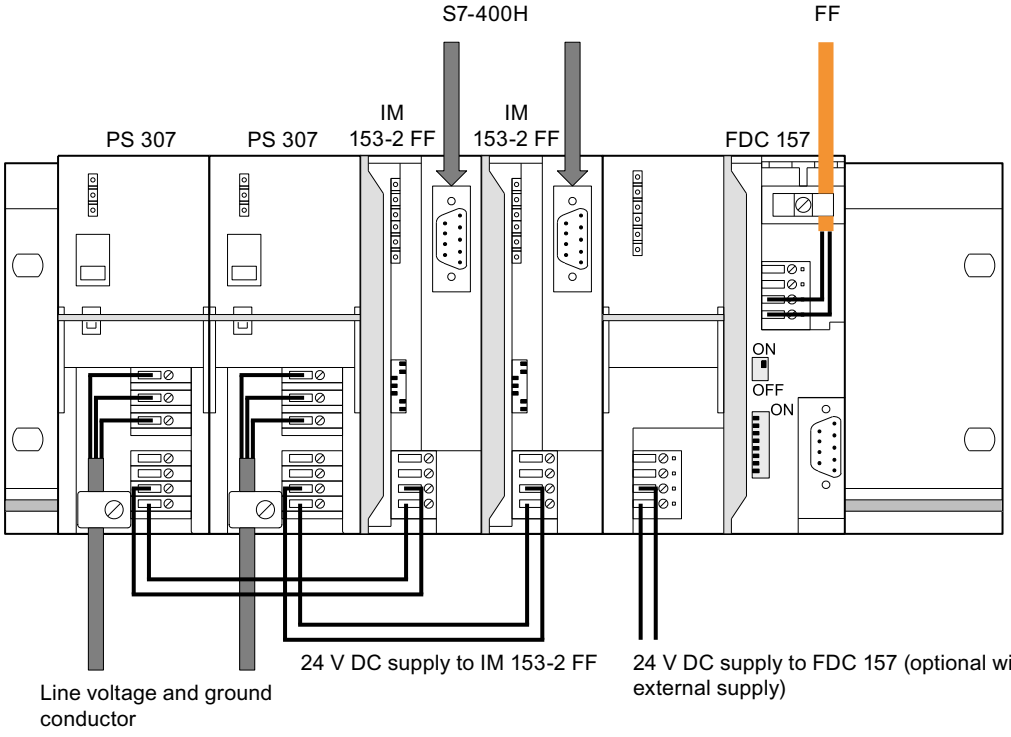


Figure 6-2 Connections of the IM 153-2 FF for redundant mode

Power supply

You need power supplies for both IM 153-2 FF.

PROFIBUS DP

You need PROFIBUS DP connections to the S7-400H on both IM 153-2 FF.

Note

Always interconnect the left IM 153-2 FF interface module of the FF Link to rack 0 of the fault-tolerant system.

6.3 Terminating the FDC 157

6.3.1 Connecting the FDC 157 without redundancy

Connections of the FDC 157 Field Device Coupler

The figure below shows all the connections you must make to an FF Link with a redundant PROFIBUS DP connection in order to operate the FDC 157 Field Device Coupler:

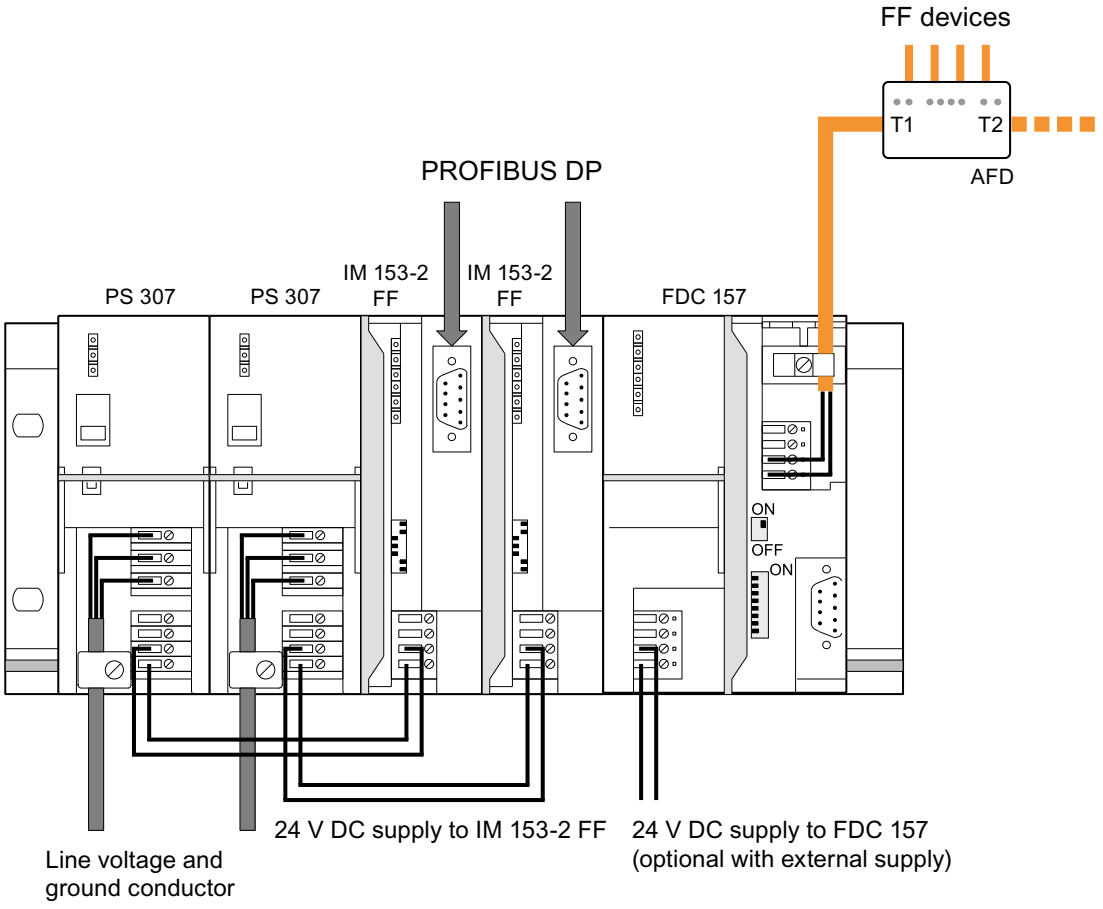


Figure 6-3 Connections for the FDC 157 Field Device Coupler in a redundant FF Link

6.3.2 Connecting the FDC 157 with ring redundancy

Connections of the FDC 157 Field Device Couplers with ring redundancy

The figure below shows all the connections you must make to a redundant FF Link to operate the FDC 157 Field Device Couplers with ring redundancy:

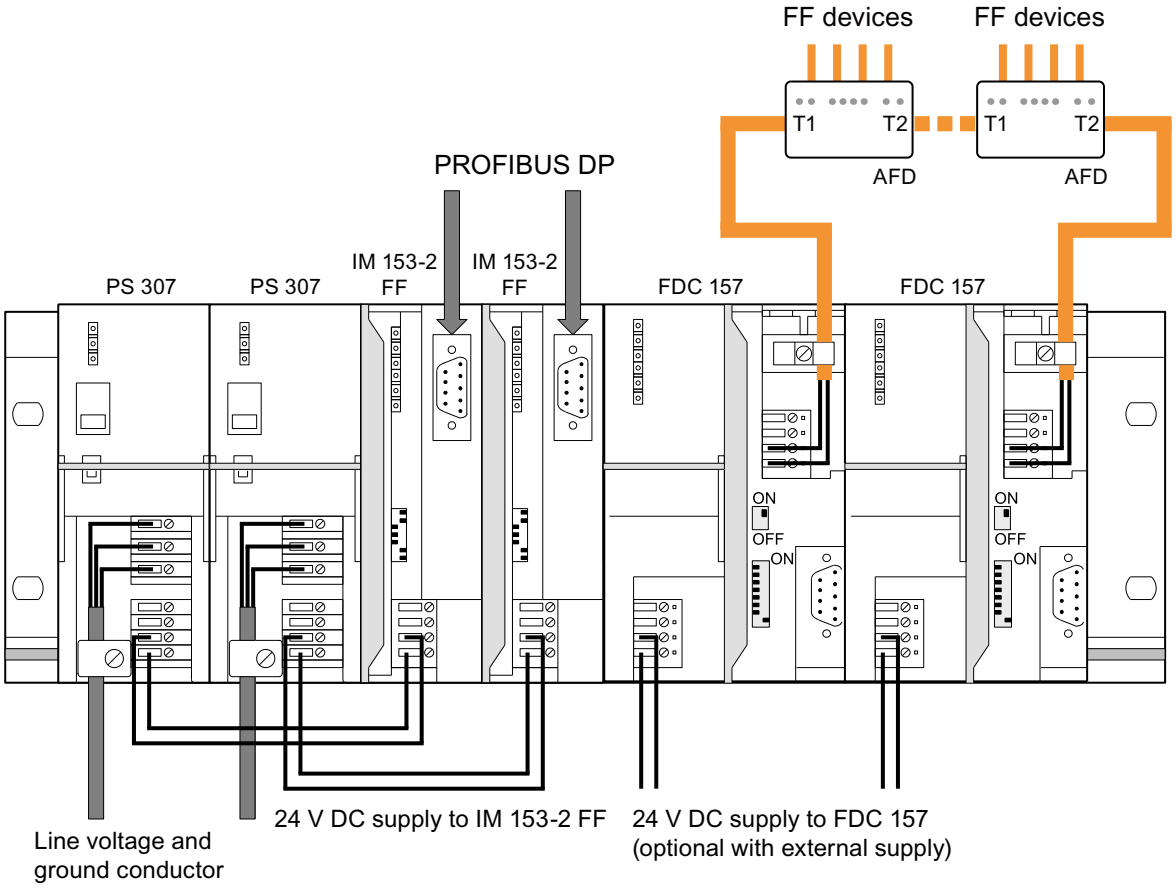


Figure 6-4 Connections for the FDC 157 Field Device Coupler with ring redundancy in a redundant FF Link

6.3.3 Connecting the FDC 157 with coupler redundancy

Connections of the FDC 157 Field Device Couplers with coupler redundancy

The figure below shows all the connections you must make to a redundant FF Link to operate the FDC 157 Field Device Couplers with coupler redundancy:

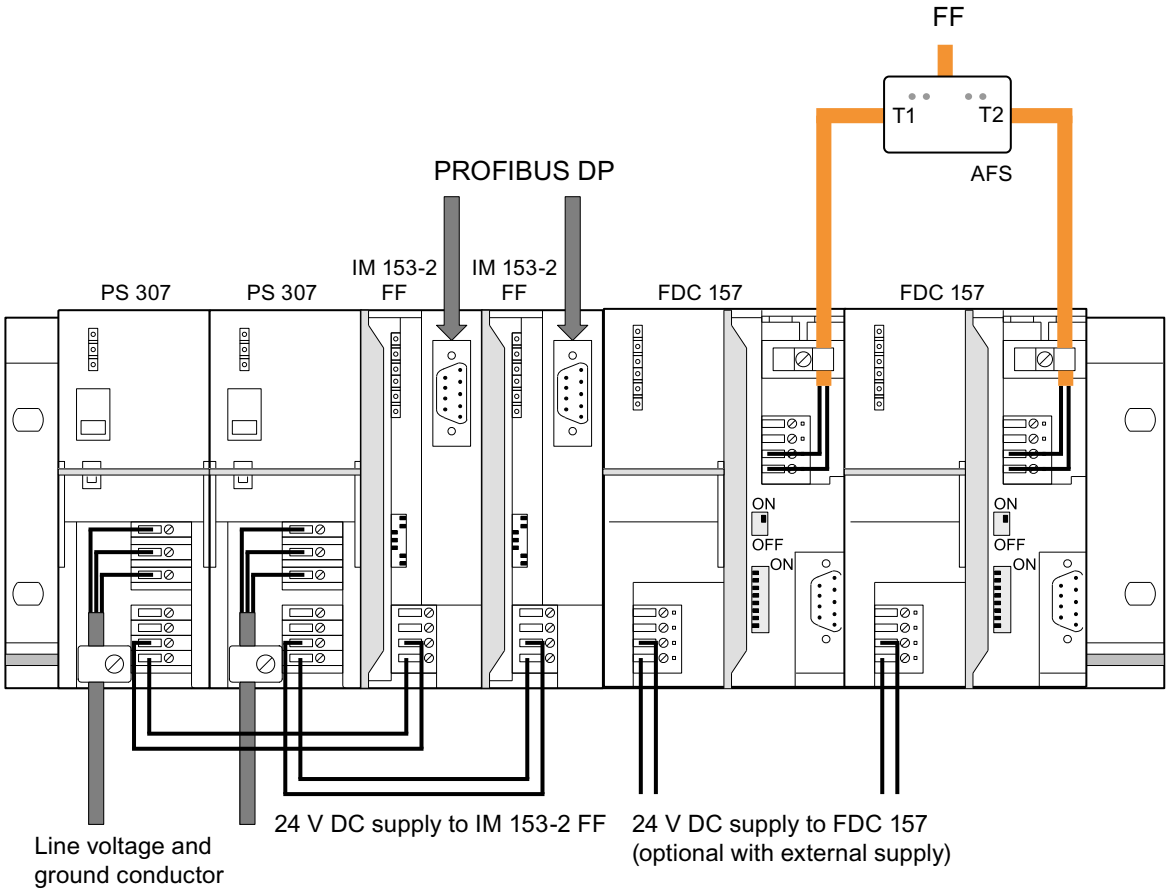


Figure 6-5 Connections for the FDC 157 Field Device Coupler with coupler redundancy in a redundant FF Link

6.3.4 Connecting the FOUNDATION Fieldbus to the active field distributor (AFD)

Reference

For more information about the following topics, refer to the *DP/PA coupler, Active Field Distributor, DP/PA Link, and Y Link* operating instructions:

- Connection on the active field distributor AFD
- Terminating the cables at the terminal block

- Pin assignment of the active field distributor AFD
- Terminating the field distributor

Due to the same physical conditions, the specifications made there for PROFIBUS PA also apply to FF.

6.3.5 Connecting the FOUNDATION Fieldbus to the active field splitter (AFS)

Reference

For more information about the following topics, refer to the *DP/PA coupler, Active Field Distributor, DP/PA Link, and Y Link* operating instructions:

- Connection on the active field splitter AFS
- Terminating the cables at the terminal block
- Pin assignment for the active field splitter (AFS)
- Terminating the field splitter

Due to the same physical conditions, the specifications made there for PROFIBUS PA also apply to FF.

6.4 Connecting the power supply

Introduction

The power supply is terminated to both IM 153-2 FF and FDC 157 in the same way.

Tools required

You need a 3 mm screwdriver to terminate the power supply.

Power supply

Always use SELV power supplies with protective extra-low voltage and safe electrical isolation (max 28.8 V DC).

The capacity of the power supply used depends on the power consumption of the connected components.

Power supply terminals

On the IM 153-2 FF and FD 157, the 4-pin screw terminals for the 24 V power supply are located behind the front door at the bottom. The terminals have the following functions:

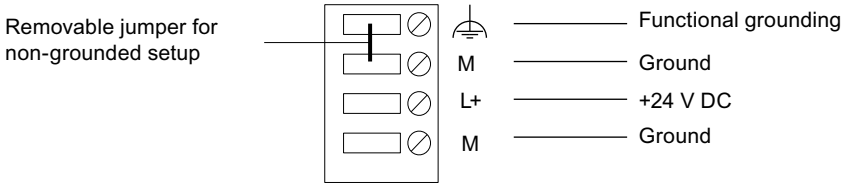


Figure 6-6 Power supply to IM 153-2 FF

The maximum conductor cross-section is 2.5 mm^2. A strain relief is not available.

Redundancy mode

For operation of an FF segment with two IM 153-2 FF (redundant), we recommend the use of a separate power supply for each IM 153-2 FF.

To ensure availability in coupler redundancy mode, it is similarly recommended to provide a separate power supply for each FDC 157.

See also

Wiring the IM 153-2 FF for non-redundant mode (Page 38)

Wiring the IM 153-2 FF for redundant operation (Page 39)

6.5 Connecting PROFIBUS DP to the IM 153-2 FF

Tools required

You require a 3 mm screwdriver to fix the bus connector to the IM 153-2 FF.

Bus cable and connector

Use only the specified accessories for PROFIBUS DP.

Procedure

Connect the PROFIBUS DP as follows:

1. Plug the bus connector into the PROFIBUS socket.
2. Tighten the fixing screws of the bus connector.

Additional information

All the information required for handling bus cables and connectors can be found in the ET 200 Distributed I/O System (http://support.automation.siemens.com/WW/view/en/1142470) manual.

6.6 Connecting the FOUNDATION Fieldbus to the Field Device Coupler FDC 157

Important notes:

The following content is binding for installation of the FOUNDATION Fieldbus:

- FOUNDATION Fieldbus Application Guide, 31.25 Kbit/s Intrinsically Safe Systems, AG-163, Revision 2.0
- Wiring and Installation 31.25 Kbit/s, Voltage, Mode, Wire Medium, AG-140, Revision 1.0
- FOUNDATION Fieldbus System Engineering Guidelines, AG-181, Revision 2.0
  More information is available on the Internet at:
  `http://www.fieldbus.org`
- Installation regulations in accordance with IEC 60079-14 (Electrical equipment in potentially explosive atmospheres)

Tools required

You require a 3 mm screwdriver to terminate the FOUNDATION Fieldbus .

Bus cable

See chapter Order numbers (Page 101).

FOUNDATION Fieldbus terminals

On the FDC 157 Field Device Coupler, the 4-pin screw terminals for the FOUNDATION Fieldbus are located behind the right front door at the top. The terminals have the following meaning:

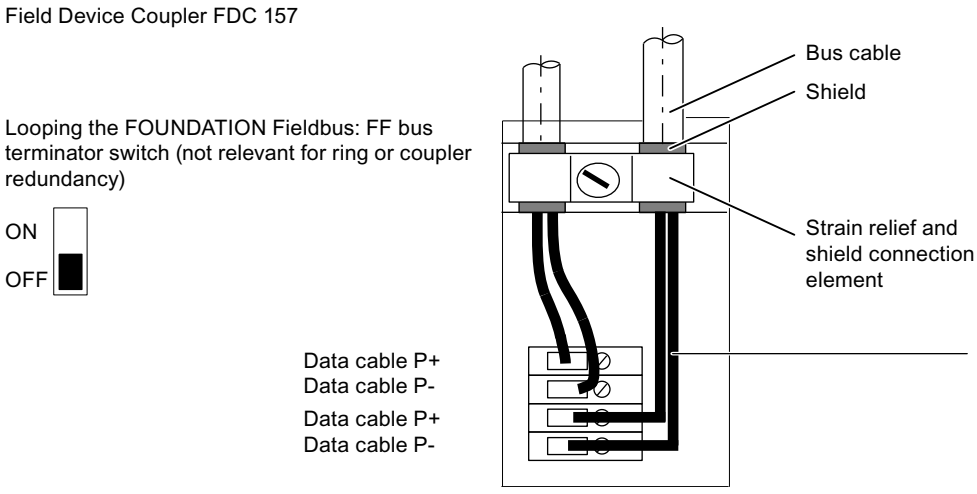


Figure 6-7 FOUNDATION Fieldbus terminals

FF bus terminator switch

On the Field Device Coupler FDC 157, you can loop the FF bus using a FF bus terminator switch.

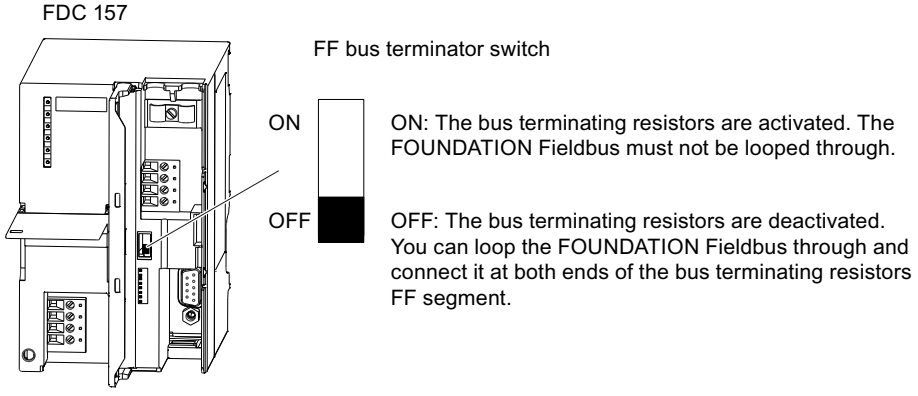


Figure 6-8 FF bus terminator switch

Bus terminator for the FF segment

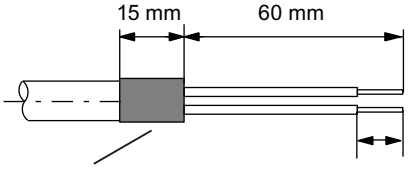
To ensure reliable operation, it is indispensible to install a bus terminator at the end of an FF bus cable. With AFD active field distributors, the bus is terminated automatically at the last AFD (automatic bus termination of the AFDs).

Use a series RC element for bus termination
(R = 100 Ω ± 2 %; C = 1 µF ± 20 %).

Procedure

Terminate the FOUNDATION Fieldbus as follows:

1. Strip the bus cable as shown in the figure and pull the shielding braid over the outer insulation.



2. Insert the shielding braid of the bus cable into the strain relief clamp and then tighten the screws.
3. Terminate the wires of the bus cable to the P+ and P- screw terminals. Make sure that you do not reverse the polarity of the wires (brown = plus, blue = minus).
4. Install a bus terminator on both ends of the bus cable.

Commissioning 7

7.1 Overview for commissioning the FF Link

Requirements

The following requirements must be met before you commission the FF Link:

- You have completely installed and connected the FF Link (1 or 2 IM 153-2 FF and 1 or 2 FDC 157 Field Device Couplers).
- You completed the installation of PROFIBUS DP. PROFIBUS DP is ready for operation.
- You terminated the FF bus cable. FOUNDATION Fieldbus is ready for operation.

Commissioning the FF Link

1. Configure the FF Link using the "FF Link" entry in the hardware catalog.
2. Set the PROFIBUS address of the IM 153-2 FF modules.
3. Set the bus address of the FDC 157 Field Device Coupler to "0" (= default) and select redundancy mode.
4. Switch on the power supply to IM 153-2 FF and to the FDC 157 Field Device Coupler(s).
5. Download the configuration to the target system.

Configuration of the FF Link

Configuration is the planning and parameterization of the FF Link, FF bus, and FF devices on the FF segment. Use *STEP 7* and *SIMATIC PDM* to configure the system.

The FDC 157 Field Device Couplers are transition points between the S7 backplane bus of the IM 153-2 FF and the FOUNDATION Fieldbus with the FF devices. For FF operation, set up the FDC 157 Field Device Coupler(s) implicitly based on the configuration of the FF Link.

Reference

For more information about the steps for configuring and commissioning an FF Link bus link, refer to the Process Control System PCS 7, FOUNDATION Fieldbus (http://support.automation.siemens.com/WW/view/en/35214553/133300) Commissioning Manual.

Operation of the FF Link

8

8.1 Startup/operation without CPU

Introduction

The FF bus parameters and LAS data (schedule) can be loaded to the FF Link and the FF devices using *SIMATIC PDM* or *HW Config*. The data is stored retentively in those applications. Due to the retentivity of the saved FF parameter assignments in the FF Link and in the FF devices, the FF bus starts up automatically after Power ON.

Requirements

All FF devices are configured, the FF bus is running and is controlled by the FF Link (with CiF, if applicable).

Startup scenarios without CPU

During power up without CPU, only non-cyclic communication with the FF devices is possible via *SIMATIC PDM* that is connected directly to PROFIBUS DP, e.g. for commissioning. The following cases are distinguished:

- FF bus parameters are missing
  - The FF bus starts up with default bus parameters
- The FF bus parameters are available, LAS data (scheduler) are missing
  - The FF bus starts up with the specified bus parameters
- The FF bus parameters and LAS data (schedule) are available
  - If the FF devices have not received their configuration, the FF bus starts up with its cyclical communication. However, there is no process image update and communication between the FF devices.
  - Once all FF devices have received their configuration data, the FF bus starts up with its cyclic communication. However, there is no process image update. Output data from the FF Link are set to "0". CiF is functioning.

8.2 Startup with CPU

Startup behavior

The following cases are distinguished:

- Once it is detected that all FF devices are available in accordance with the configuration, all output data is transferred and all input data is reported to the CPU.
- If at least one FF device does not correspond to the configuration (not available, or incorrect name), the startup delay is maintained. The I/O data is then enabled for all FF devices with error-free configuration (previously "0") and relevant interrupts (removal or diagnostic interrupt) are reported for incorrectly configured FF devices.
  You must set the startup delay according to the size of your system configuration in the properties dialog of IM 153-2 FF.

8.3 Behavior after certain events in the redundancy mode

Behavior of the IM 153-2 FF

The following table shows the response of IM 153-2 FF to specific events when operating in redundancy mode.

Table 8-1 Behavior following specific events in redundancy mode

Event	Response
Master to standby failover with modified configuration	There is a bumpless switchover of the FF Link from the active channel to the channel that has been passive up to now.
Failure of a CPU	If this also leads to a failure of the active channel of the redundant DP master system: see failure of the active channel. Otherwise: see failure of the passive channel.
Failure of an IM 153-2 FF	A diagnostic message is generated in the system. If the active IM 153-2 FF fails, the previously passive channel is activated in a bumpless failover operation.
Failure of the active channel.	There is a bumpless switchover of the FF Link from the active channel to the channel that has been passive up to now. The "BF 1" LED on the associated IM 153-2 FF indicates the faulty channel.

Event	Response
Failure of the passive channel.	No affect on the FF Link. A diagnostic message is generated in the system. The "BF 1" LED on the associated IM 153-2 FF indicates the faulty channel.
Failure of an FDC 157 Field Device Coupler	A diagnostic message is generated in the system. Upon failure of the active FDC 157, the previously passive FDC 157 is activated in a bumpless fail-over operation.

8.4 Startup behavior

Startup conditions for IM 153-2 FF

- A valid PROFIBUS address is set on the IM 153-2 FF.
- The DP master on the higher-level PROFIBUS DP is in operation.
- The "FF Link" bus link is correctly configured.

The further startup behavior of the FF Link depends on whether it is operating in non-redundant mode or in redundant mode.

8.4.1 Startup behavior in non-redundant mode

Startup behavior

The flow diagram below shows the startup behavior of IM 153-2 FF after power ON.

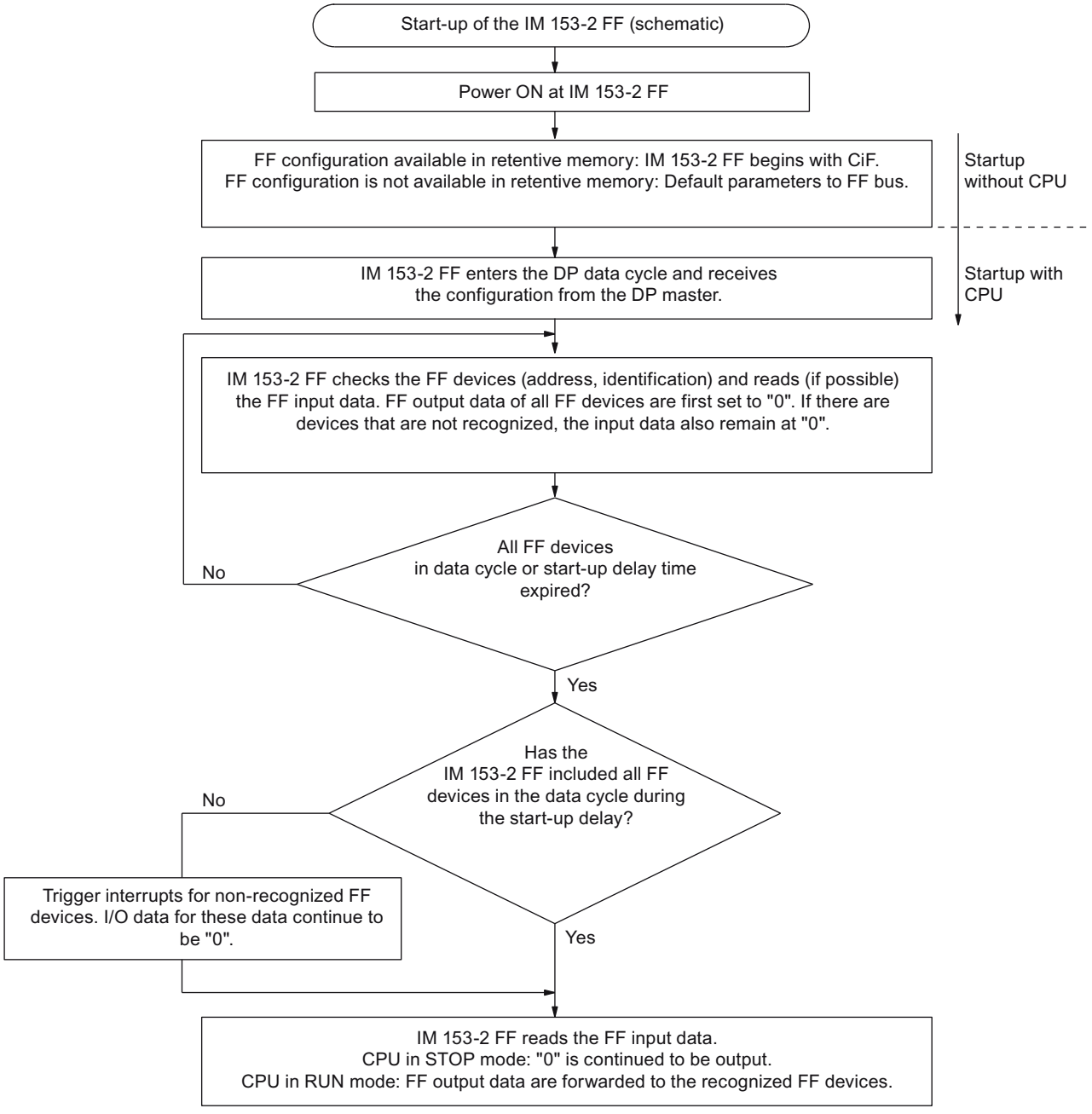


Figure 8-1 Startup behavior of IM 153-2 FF after power ON

8.4.2 Startup behavior in redundant mode

Startup diagram of IM 153-2 FF on S7-400H

The two IM 153-2 FF are addressed independently during startup:

- Each DP master configures and parameterizes its assigned IM 153-2 FF (independently from other DP masters) and sends the corresponding configuration.
- In faultless operation, the IM 153-2 FF that is connected to the subsystem of the master CPU is activated.
- Once the partner DP master has also successfully completed the configuration, parameterization, and transfer of all configuration data to its IM 153-2 FF, the IM 153-2 FF is available as standby.
  The IM 153-2 FF on the subsystem of the standby CPU is in passive state. On failure of the active IM 153-2 FF fails, the partner IM can continue the processing of the FF devices.

The figure below provides a simplified overview of the mutually independent behavior of the two IM 153-2 FF.

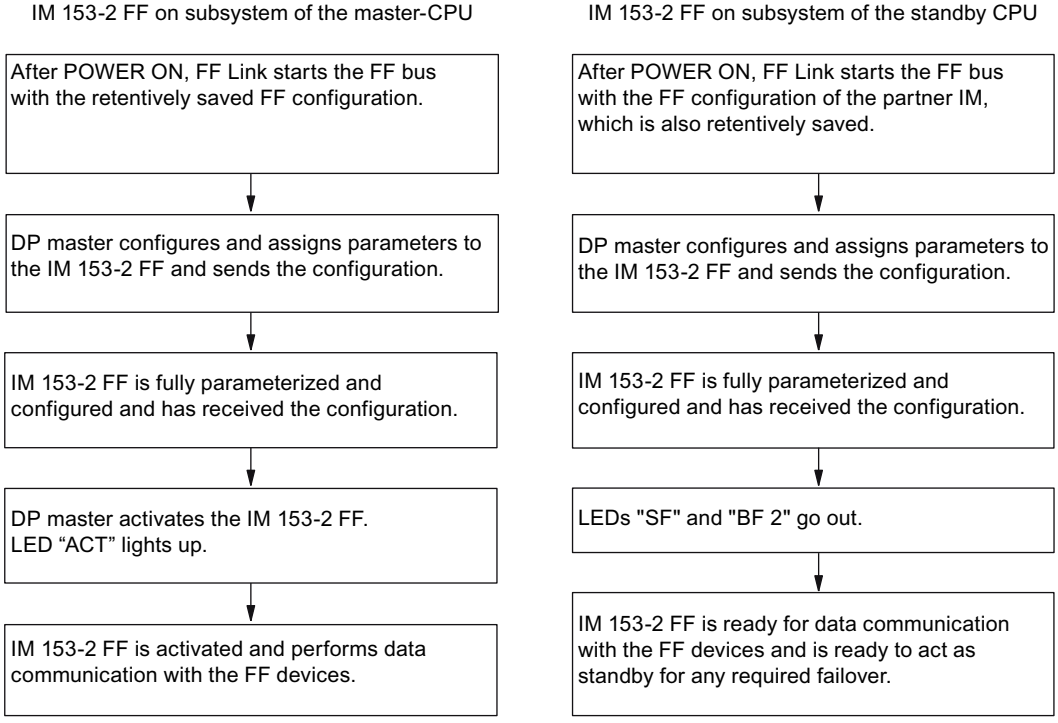


Figure 8-2 Startup behavior of the two IM 153-2 FF in redundant mode

8.5 Handling the quality code of cyclic data

Quality code of cyclic data

During startup, the IM 153-2 FF internally initializes the I/O data for FF devices with a "0" value. This action also sets the quality code to "Bad".

Once an FF device has been identified (correct name and address), its output data is transferred to the FF bus by the DP master, while the FF device transfers the input data to the DP master. (A special feature during the startup delay time is that the output data is retained at "0" status.)

Upon failure of an FF device, the I/O data and the quality code will be deleted (= "0").

On failure of the higher-level DP master (e.g. transition from RUN to STOP, DP cable disconnected, CPU switched off), all output data and the quality code will be deleted (= "0").

During normal operation (CPU in RUN), the output data is transferred in a transparent operation.

In normal operation, the input data is adapted (alignment with the PROFIBUS PA definition):

- Quality codes 0x84 ... 0x87 are mapped to: 0x80 ... 0x83
- Quality codes 0x90 ... 0x93 are mapped to: 0x80 ... 0x83

Service and maintenance

9

9.1 IM 153-2 FF replacement

Replacing a faulty IM 153-2 FF

Take the following steps to replace a faulty IM 153-2 FF.

1. Switch off the power supply to the faulty IM 153-2 FF.
2. Disconnect the faulty module from the power supply.
3. Remove the bus connector from the PROFIBUS DP interface of the faulty module.
4. Replace the faulty module.
5. Set the PROFIBUS address of the new IM 153-2 FF.
6. Plug the bus connector into the PROFIBUS DP interface of the new module.
7. Connect the new module to the power supply.

Note

When replacing a single IM 153-2 FF, you must also load the FF bus parameters and LAS data (scheduler) in the interface module.

With active CiF: When replacing a single IM 153-2 FF, you must also load the FF bus parameters and LAS data (scheduler) to the interface module **before you install the IM in the system**. (With CiF, it is not necessary to load the FF devices with this data; for more information, see section Control in the Field (CiF) (Page 64)).

Implementing a used IM 153-2 FF

To use an IM 153-2 FF that was already in use in a different system, you must first restore it to the factory settings.

For more, see section Restoring IM 153-2 FF to factory state (Page 59).

With IM 153-2 FF in redundant mode

On a SIMATIC S7-400H, you can hot-swap modules when operating in redundant mode. Observe the following special features:

- Insertion and removal of an IM 153-2 FF is only allowed in off-voltage state. Accordingly, switch off the DC 24 V supply of the IM 153-2 FF. To prevent the underlying FF segment from failing, the FF Link should be configured with independently switchable voltage supplies to the two IM 153-2 FF (for example by using two voltage supply modules).

In redundancy mode, it is not necessary to load parameters to the new IM 153-2 FF if the partner IM 153-2 FF is still running.

Note

When replacing the active IM 153-2 FF ("ACT" LED on), the FF Link will only continue to run smoothly if the BF LED is not lit up or flashing on the passive IM 153-2 FF, or if the SF LED is not flashing in 0.5 Hz cycles.

Have you replaced an active IM 153-2 FF ("ACT" LED is On)?	Have you replaced a passive IM 153-2 FF ("ACT" LED is Off)?
In this case, in the FF Link there was a switchover to the other IM 153-2 FF and this also upholds the data traffic to its DP master.	No change in data traffic The active IM 153-2 FF has maintained the data traffic to its DP master.

9.2 Replacing the Field Device Coupler FDC 157

Replacing a faulty Field Device Coupler FDC 157

Note

Replacement of a single FDC 157 leads to the failure of all FF devices.

To replace a faulty Field Device Coupler FDC 157, perform the following steps:

1. Disconnect the faulty module from the power supply.
2. Disconnect the FOUNDATION Fieldbus connection of the faulty module.
3. Replace the faulty module.
4. Set the bus address "0" using the DIP switches, if applicable (= default setting).
5. Set the redundancy mode correctly via the "RING" DIL switch, if applicable.
6. Set the FF bus terminator switch correctly.
7. Wire the FOUNDATION Fieldbus to the new FDC 157.
8. Wire the power supply to the new FDC 157.

Note

Removal/failure of a Field Device Coupler FDC 157

It is only possible to remove a Field Device Coupler FDC 157 if it is de-energized.

If you remove a live Field Device Coupler FDC 157 you possibly trigger the overvoltage protection. You can reset this switch-off if you turn off the mains for at least 10 seconds.

Prior to removing a Field Device Coupler FDC 157, disconnect its 24 V DC power supply.

For operation with coupler redundancy

It is possible to replace an Field Device Coupler FDC 157 during operation with coupler redundancy. The FF devices that are connected to the redundant FDC 157 coupler pair remain in operation. The following special characteristics should be noted:

- The ACT LED of the Field Device Coupler FDC 157 must not be lit. Otherwise several FF devices or the FF segment could fail.
- An FDC 157 may only be removed and inserted if it is de-energized. Switch off the 24 V DC supply to the FDC 157 for this purpose. To prevent the underlying FF segment from failing, the FF Link should be configured with independently switchable voltage supplies to the two FDC 157 (for example by using two voltage supply modules).

9.3 Replacing active field distributors

Reference

When replacing an AFD or AFS, strictly follow the instructions in the DP/PA Coupler, Active Field Distributors, DP/PA Link, and Y Link Operating Instructions.

9.4 Firmware update of the IM 153-2 FF

When should you update the IM 153-2 FF?

Following functional enhancements or troubleshooting routines, you should update the IM 153-2 FF interface module to the latest firmware version.

Reference

The firmware update is a standard mechanism in *STEP 7*. Instructions and the relevant firmware updates are available for download from the Internet (http://www.siemens.com/automation/service&support).

9.5 Restoring IM 153-2 FF to factory state

Procedure

To restore an IM 153-2 FF to the factory state, proceed as follows:

1. Establish a connection from *SIMATIC PDM* to the FF Link.
2. Select the **Restore default state** menu command.

The parameters stored in the IM 153-2 FF flash memory are deleted and the cyclic FF communication is stopped. On redundant stations, both IMs are reset.

OR

1. Plug in the IM 153-2 FF without connected power supply.
2. Set the PROFIBUS address "0".
3. Switch the power supply on.
   The IM 153-2 FF automatically restores its factory state.
4. Switch off the power supply.
5. Set the correct PROFIBUS address.
6. Switch the power supply on.
   The IM 153-2 FF is ready for operation again.

See also section LEDs of the IM 153-2 FF (Page 67).

9.6 Maintenance

Maintenance

The transfer characteristics of the IM 153-2 FF interface module, the Field Device Coupler FDC 157, the active field distributors (AFD) and active field splitters (AFS) are stable over long periods and regular maintenance is unnecessary.

Functions

10

10.1 Redundancy with IM 153-2 FF

Usage

You can operate the IM 153-2 FF of the FF Link on the SIMATIC S7-400H redundantly (e.g. CPU 417-4H).

Requirements

- Installation of active bus modules
  The BM IM/IM bus module (redundant) (6ES7195-7HD80-0XA0) ensures high FF Link availability and short switchover times with redundancy.
- Mutually redundant components are identical in terms of hardware and firmware.
- 2 x IM 153-2 FF on bus module BM IM/IM (redundant)
  The installation rules specified in section "Mounting (Page 27)" apply for the active bus modules and interface modules used.
- In the redundancy mode, the same PROFIBUS address must be set for both IM 153-2 FF.
- Always interconnect the left IM 153-2 FF interface module of the FF Link to rack 0 of the fault-tolerant system.

Note

The SYNC/FREEZE function must not be activated during the redundancy mode.

Note

Configuration

With redundant components, the following must be identical for the respective partner component:

- Article number
- Hardware version
- Firmware version

You can find additional information on this in the section "System modification during operation (Page 63)".

S7-400H as DP Master

DP master 1 and DP master 2:

- Execute the same user program.
- Have the same parameterization and configuration for the IM 153-2 FF.

Voltage supply for the IM 153-2 FF

To ensure availability in the redundancy mode with 2 x IM 153-2 FF, we recommend using a separate power supply unit for each IM 153-2 FF.

Additional information

- You can find information about article numbers in section Preface (Page 7).
- You can find information on upgrading in redundant operation in section "System modification during operation (Page 63)"

10.2 Identification and maintenance data (I&M data)

Definition and features

Identification and maintenance data (I&M) is information stored in a module to support you in

- Checking the plant configuration
- Locating hardware modifications in a plant
- Correcting errors in a plant

Identification data (I data) are information on the module, such as order number and serial number, some of which are printed onto the module housing. I data are manufacturer information about the module and are for reading only.

Maintenance data (M data) are system-related information, such as the installation location and installation date. M data are created during configuration and written onto the module where they are saved retentively.

Modules can be uniquely identified online by means of the I&M data.

This data is available on IM 153-2 FF.

Reading and writing the I&M data with *STEP 7*

In *STEP 7* the I&M data are displayed in the "Module status - IM 153-2 FF" and "Properties - DP slave" tabs (please refer to the *STEP 7*) online help.

The M data of modules can be entered in *HW Config* (for example in a dialog box during configuration).

The I&M data are accessed in accordance with the IEC 61158-6 standard.

The interface module from which the I&M data is to be read must be available online.

10.3 System modification during operation

Adding an FF Link

Perform the following steps to add a complete new FF Link including underlying FF bus system to an existing system while it is operating.

1. Mount the new FF Link.
2. Connect the voltage supply of all modules,
3. Connect the FOUNDATION Fieldbus to the new Field Device Coupler FDC 157.
4. In non-redundant mode:
   Plug the bus connector of the DP master system into the PROFIBUS DP interface of the new IM 153-2 FF.
   In redundancy mode:
   Plug the bus connector of the passive channel of the redundant DP master system into the PROFIBUS DP interface of the partner IM 153-2 FF.

The whole sequence of a system modification and the requirements that must be met for it are described in detail in the manuals:

- Modifying the system during operation via CiR (http://support.automation.siemens.com/WW/view/en/14044916)
- S7-400H Fault-Tolerant Systems (http://support.automation.siemens.com/WW/view/en/1186523), section *System modification during operation,* step "Modification of hardware".

The statements in the manuals mentioned above on DP/PA Link and PA master system apply accordingly to the FF Link bus link and the FF bus system.

Adding an FF device

When expanding an existing system with a new FF device at runtime, read the Connecting (Page 37) section in this manual and in the DP/PA coupler, Active Field Distributor, DP/PA Link, and Y Link (http://support.automation.siemens.com/WW/view/en/1142696) operating instructions.

Information on configuring can be found in:

PCS 7 Process Control System, FOUNDATION Fieldbus (http://support.automation.siemens.com/WW/view/en/35214553/133300) Commissioning Manual.

Upgrading a redundant Compact FF Link

Note

Current information

- Unless specified otherwise, temporary differences for the following are acceptable for the subcomponents (IM or Field Device Coupler FDC 157) during an upgrade:
  - Article number
  - Hardware version
  - Firmware version
- It is not possible in every case to skip upgrades or perform them without intermediate steps.

Please make sure to observe the current product information and notes on updates on the Internet.

Using a previously used FF device

To use an FF device that was already in use in a different system, you must first restore it to its factory settings.

Additional information

- Section "IM 153-2 FF replacement (Page 57)"
- Section "Replacing the Field Device Coupler FDC 157 (Page 58)"
- Section "Replacing active field distributors (Page 59)"

10.4 Control in the Field (CiF)

Control in the Field (CiF)

The "Control in the Field" (CiF) FF function enables you to control the I/O blocks between the FF devices on an FF segment without CPU intervention, i.e. without transfer to the process image. Control loops are also possible. Control of the data transmission is taken over by the IM 153-2 FF as an FF Link Master or LAS on an FF segment; or by an FF device that also has Link Master functionality.

In this context, CiF functionality runs regardless of whether or not the DP segment or IM 153-2 FF is available. The DP segment, for example, can be disconnected from the IM 153-2 FF without disrupting the CiF function.

CiF versions

- IM 153-2 FF is FF Link master:
  - The IM 153-2 FF and FDC 157 Field Device Coupler must be switched on
  - PROFIBUS DP is not required
- The FF device is the FF Link master:
  - The Field Device Coupler FDC 157 must be switched on
  - IM 153-2 FF is not required
    In this case, if the higher-level system (including IM 153-2 FF) is switched on subsequently, it must be configured to match the FF segment running in CiF mode. Otherwise, the CiF function will fail (failure of FF devices or FF segments).

After power was cycled OFF/ON at the IM 153-2 FF or Field Device Coupler FDC 157, the CiF function is resumed because the scheduler is retentive (refer to chapter Startup behavior in non-redundant mode (Page 54)).

Reference

For more information about "Control in the Field", refer to the PCS 7 Process Control System, FOUNDATION Fieldbus (www.siemens.com/pcs7-documentation) Commissioning Manual.

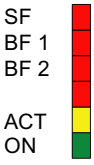
Alarm, error, and system messages

11

11.1 Diagnostics using LEDs

11.1.1 LEDs of the IM 153-2 FF

Status and error messages of the IM 153-2 FF



Group error (red)
Bus fault higher-level PROFIBUS DP (red)
Bus fault lower-level FF bus (red)

IM 153-2 FF has active channel (yellow) - only with redundant IM 153-2 FF
24 V power supply IM 153-2 FF (green)

Table 11-1 Status and error messages of the IM 153-2 FF

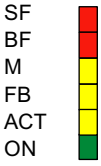
LEDs					Meaning	Remedy
SF	BF 1	BF 2	ACT	On		
Off	Off	Off	Off	Off	• No voltage present on the IM 153-2 FF. • Applied supply voltage is not within permissible range. • Hardware fault of the IM 153-2 FF.	• Switch on the power supply module. • Check the voltage applied • Replace the IM 153-2 FF.
On	Off	Off	Off	Off	Reset state for the fraction of a second immediately following Power ON.	-
On	On	On	On	On	All LEDs are switched on for approx. 1 s. IM 153-2 FF is in the startup phase.	-
Off	Off	Off	Off	On	In non-redundant mode: The IM 153-2 FF is exchanging data with the DP master and the underlying FF devices.	-
					In redundancy mode: The IM 153-2 FF is passive and ready for switchover.	
Off	Off	Off	On	On	Only in redundancy mode: The IM 153-2 FF is active and exchanging data with the DP master and the underlying FF devices.	-
Off	*	On	*	On	Loading of the DP parameters is not finished; therefore no data exchange between DP and FF end. The FF bus operates with default bus parameters.	-

LEDs					Meaning	Remedy
SF	BF 1	BF 2	ACT	On		
Off	*	flashes	*	On	Loading of the DP parameters is not finished; therefore no data exchange between DP and FF end. FF bus runs independently of the DP master (CiF) with the last loaded configuration.	-
Off	Off	flashes rapidly	*	On	IM 153-2 FF has received all DP parameters and is starting up. Startup delay is in progress (see chapter Startup with CPU (Page 52)).	-
On	Off	flashes	*	On	IM 153-2 FF in operation. At least one configured FF device is not available.	Evaluate the diagnosis of the IM 153-2 FF and check the reported FF devices.
*	On	*	*	*	No connection to the DP master.	-
*	flashes	*	*	On	No data exchange is taking place between DP master and IM 153-2 FF.	• Check the PROFIBUS address. • Test whether the right project is loaded in the CPU.
On	Off	Off	Off	On	After startup: Inadmissible PROFIBUS address	Check the PROFIBUS address of the DIL switch. See chapter Setting the PROFIBUS address of the IM 153-2 FF (Page 33).
					In non-redundant mode: • FF devices are exchanging data. At least one FF device has an incorrect Physical Device (PD) tag. • An FDC 157 with diagnostic message.	Evaluate the diagnosis of the IM 153-2 FF and check the reported FF devices and FDC 157.
					In redundancy mode: • The IM 153-2 FF is passive and ready for switchover. At least one FF device has an incorrect Physical Device (PD) tag. • An FDC 157 with diagnostic message.	Evaluate the LED display on the active IM 153-2 FF.
On	Off	Off	On	On	In redundancy mode: The IM 153-2 FF is active and exchanging data with the DP master and the underlying FF devices. • FF devices are exchanging data. At least one FF device has an incorrect Physical Device (PD) tag. • An FDC 157 with diagnostic message.	Evaluate the diagnosis of the IM 153-2 FF and check the reported FF devices and FDC 157.
flashes	flashes	flashes	flashes	flashes	After POWER ON: In the current mode the IM 153-2 FF is not compatible with the redundant IM 153-2 FF.	Check whether compatible product versions of the IM 153-2 FF are used in the redundant configuration.

LEDs					Meaning	Remedy
SF	BF 1	BF 2	ACT	On		
On	On	Off	Off	Off	This only occurs when the PROFIBUS address (DIL switches) is "0" at Power ON. Temporary state during which the default FF configuration data is restored in re-tentive memory.	-
Off	flashes	Off	Off	Off	This only occurs when the PROFIBUS address (DIL switch) is "0" at Power ON. The default FF configuration data are written to the retentive memory. Waiting for new Power ON.	-

11.1.2 LEDs of the Field Device Coupler FDC 157

Status and error messages of the Field Device Coupler FDC 157



Group error (red)
Bus fault (red)
Bus monitoring PROFIBUS DP (yellow)
Bus monitoring FF bus (yellow)
Field Device Coupler activated, feeding / conducting (yellow) - only with coupler redundancy
24 V power supply Field Device Coupler (green)

Table 11-2 Status and error messages of the Field Device Coupler FDC 157

LEDs						Meaning	Remedy
SF	BF	M	FB	ACT	ON		
Off	Off	Off	Off	Off	Off	• No voltage is applied to the FDC 157. • Error in the FDC 157.	• Switch on the power supply module. • Check the voltage applied • Replace the FDC 157.
*	*	*	*	*	flashes	Overload of the FF bus	Check the number of connected FF devices and the total current.
*	*	*	*	On	On	FDC 157 mounted on redundant bus module and active.	-
*	*	*	*	Off	On	FDC 157 mounted on redundant bus module and passive, or not on redundant bus module.	-

LEDs						Meaning	Remedy
SF	BF	M	FB	ACT	ON		
*	*	Off	*	*	On	IM 153-2 FF is not operating/not available Causes: • IM 153-2 FF is not operating. • Bus modules are not connected correctly. • Connector to backplane bus is faulty.	• Check if the IM 153-2 FF is available and operating. • Check if the bus modules are correctly connected.
*	*	flashes	*	*	On	IM 153-2 FF available, communication from the IM 153-2 FF to the FF bus is functioning	-
*	On	flashes	*	*	On	Diagnostics communication between the IM 153-2 FF and FDC 157 is not functioning. Causes: • IM 153-2 FF is not operating • No IM 153-2 FF available.	• See above (IM 153-2 FF is not operating/not available) • Make sure that the IM 153-2 FF is being used.
*	flashes	flashes	*	*	On	Diagnostics communication between the IM 153-2 FF and FDC 157 is being established.	-
*	Off	flashes	*	*	On	Diagnostics communication between the IM 153-2 FF and FDC 157 is functioning.	-
*	*	flashes	Off	Off	On	FF communication is not functioning. Causes: • FDC 157 is not active in redundancy mode • No FF devices connected • FF bus cable damaged or not connected.	• Check the other FDC 157, which must be active - at least one FDC 157 must be active in redundancy mode. • Check if FF devices are connected. • Check the cables and connections.
*	*	flashes	Off	On	On	FDC 157 is active, but the FF communication is not functioning. Causes: • No FF devices connected • FF bus cable damaged or not connected.	• Check if FF devices are connected. • Check the cables and connections.
*	Off	flashes	flashes	*	On	Fault-free operation: FF communication and diagnostics communication between the IM 153-2 FF and FDC 157 are functioning (with coupler redundancy on active FDC 157).	-

LEDs						Meaning	Remedy
SF	BF	M	FB	ACT	ON		
On	*	*	*	*	*	• Deviations from configuration • External or internal errors, such as short circuit, open circuit, voltage error	• Check the redundant/non-redundant configuration; set the redundancy mode correctly on the FDC 157 (DIL switch) • Check the connections and cables between FDC 157 and the next AFD / AFS. • Replace the FDC 157.
Off	On	Off	On	On	On	Incorrect terminating resistor	• Correct the setting of the FF bus terminator switch. • Install a bus terminator on both ends of the bus cable.

11.1.3 LEDs of the active field distributors

Status and error messages from the active field distributors

For more information on the status and error messages of the active field distributors, refer to the DP/PA Coupler, Active Field Distributors, DP/PA Link, and Y Link operating instructions.

11.2 Diagnostics of the FF Link

Slot allocation

You can operate max. 31 FF devices on the FF bus. One slot is assigned per FF device; the FF devices therefore occupy max. 31 slots.

- Slot 0
  IM 153-2 FF occupies slot 0 (also in redundant mode with 2 x IM 153-2 FF).
- Slot 1
  Slot 1 is needed to send IM 153-2 FF-specific messages, e.g. in the event of a CiR conflict.
- Slots 2 and 3
  Slots 2 and 3 are required for diagnostic communication of the FDC 157 Field Device Coupler(s).
  - For operation without ring or coupler redundancy: Slot 2
  - For operation with ring or coupler redundancy: Slot 2 = left FDC 157, slot 3 = right FDC 157
- Slots 4-34
  The first slot of the first FF device is always slot 4 (also in non-redundant operation). The other slots are determined by the number of configured FF devices.

Slave diagnostics of the IM 153-2 FF

Slave diagnostics behaves in accordance with IEC 61784-1 CP 3/1. Depending on the DP master, this data can be read using *STEP 7*, *SIMATIC PDM* or any other configuration tool.

The IM 153-2 FF supplies the diagnosis for itself, the Field Device Coupler FDC 157, and the FF devices.

If the IM 153-2 FF fails, the CPU sets the quality code for all FF devices to "Bad" in the process image.

Diagnosis of the Field Device Coupler FDC 157

The IM 153-2 FF can detect the following errors for the FDC 157:

- Failure of the FDC 157
- Discrepancies with the configuration of the FDC 157
- External errors, e.g. short circuit or open circuit on the FF connection side of the FDC 157

These errors are reported by the IM 153-2 FF in its diagnostics.

Note

If diagnostics of the FDC 157 **and** FF devices are available, you should first evaluate the diagnostic messages of the Field Device Coupler FDC 157 and clear the fault.

Diagnostics of the FF devices

The IM 153-2 FF can detect the following errors for each FF device:

- FF device not available (address not found)
- Name ("Physical Device (PD) Tag") does not match address (configuration error).

These errors are reported by the IM 153-2 FF in its diagnostics. If an FF device fails, the quality code of the FF device is set to "Bad" in the input data by the IM 153-2 FF.

Diagnostic frame

In the above diagnostic events, relevant IDs are set in the DP diagnostic frame in the identifier-related and module-specific ranges. In addition, swapping and diagnostic interrupts are triggered. Details can be found in the following sections.

Further preparation of the diagnostics data is handled by means of the *PCS 7* "Advanced Process Library" (APL) in the CPU. One module block per channel checks the quality code of the channel and issues an interrupt if necessary.

You can read additional diagnostics data from the FF device using the diagnostic page of the faceplate on the *PCS 7* Maintenance Station.

Note

The diagnostics data of the FF devices can only be read using the Maintenance Station or *SIMATIC PDM*.

If a new configuration does not match the version of the FF device, neither the FF Link nor the CPU will detect it. Active verification can be performed with *SIMATIC PDM*.

Additional information

For additional information, please refer to the *STEP 7* online help topic "How to diagnose hardware"

For more information on reading out diagnostics information, refer to the Programming with STEP 7 (http://support.automation.siemens.com/WW/view/en/18652056) manual.

See also

Structure of slave diagnostics (Page 73)

Reading out diagnostics from FF devices (Page 83)

Interrupts (Page 81)

11.2.1 Structure of slave diagnostics

Influencing factors

The structure of the slave diagnostics depends on whether the IM 153-2 FF is working in S7 standard mode or redundancy mode on an S7-400H.

Diagnostic blocks in S7 standard mode and in the redundancy mode

The table below shows the lengths of the diagnostics blocks and their offset in the diagnostics frame.

Table 11-3 Length and offset of the diagnostic blocks in S7 standard mode and in redundancy mode

Diagnostic block	Length in bytes	Offset in the non-redundancy mode	Offset in the redundancy mode
Default diagnosis	6	0	0
Identifier-related diagnostics	6	6	6
Module status	13	12	12
Status message	38	25	25
H status	8	-	63

Diagnostic block	Length in bytes	Offset in the non-redundancy mode	Offset in the redundancy mode
Interrupt section	(max. 63 *)	(63 *)	(71 *)
Total length		63 (max. 126 *)	71 (max. 134 *)
* only if interrupts are reported			

11.2.2 Structure of the diagnostic blocks

11.2.2.1 Default diagnosis

Structure of the default diagnosis

The default diagnosis consists of 6 bytes and is subdivided as follows:

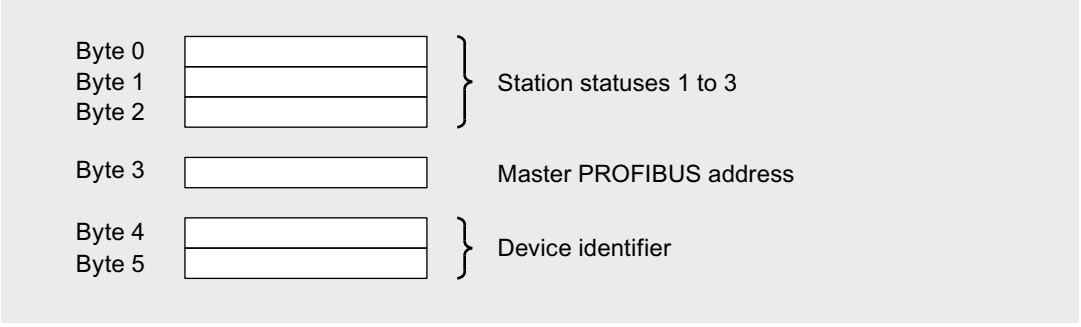


Figure 11-1 Structure of the default diagnosis

Station statuses 1 to 3

Station status 1 to 3 provides an overview of the state of the IM 153-2 FF.

Table 11-4 Structure of station status 1

Bit	Meaning	Cause / remedy
0	1: The IM 153-2 FF cannot be addressed by the DP master.	• Is the correct PROFIBUS address set on the IM 153-2 FF? • Is the bus connector plugged in? • Voltage on the IM 153-2 FF?
1	1: The IM 153-2 FF is not yet ready for data exchange.	• Wait, because IM 153-2 FF is currently performing the startup.
2	1: The configuration data sent by the DP master to the IM 153-2 FF do not correspond with the setup of the IM 153-2 FF, or are not correct in terms of syntax or max. supported quantity framework.	• Have you entered the right station type or right IM 153-2 FF structure into the configuration software?

Bit	Meaning	Cause / remedy
3	1: External diagnostics available. (Group diagnostic display)	• Evaluate the ID-specific diagnosis, the module status, and any reported interrupts. As soon as all errors have been eliminated, bit 3 is reset. The bit is set again when there is a new diagnostic message in the bytes of the aforementioned diagnostics.
4	1: The required function is not supported by the IM 153-2 FF.	• Check the configuration.
5	1: DP master cannot interpret the response from the IM 153-2 FF.	• Check the bus configuration.
6	1: The station type configured does not correspond to the IM 153-2 FF.	• Correct station type entered in the configuration software for this DP address?
7	1: The IM 153-2 FF was parameterized by a different DP master (not by the DP master that has access to the IM 153-2 FF at the moment).	• Bit is always set to "1" when you are accessing the IM 153-2 FF using a PG or a different DP master. The PROFIBUS address of the DP master that parameterized the IM 153-2 FF is to be found in the "Master-PROFIBUS-address" diagnostic byte.

Table 11-5 Structure of station status 2

Bit	Meaning
0	1: The IM 153-2 FF must be parameterized again.
1	0: The bit is always set to "0."
2	1: The bit is always set to "1" if the IM 153-2 FF with this PROFIBUS address is present.
3	1: The response monitor is enabled for IM 153-2 FF.
4	0: The bit is always set to "0."
5	0: The bit is always set to "0."
6	0: The bit is always set to "0."
7	1: The IM 153-2 FF is disabled; this means that it is detached from current processing.

Table 11-6 Structure of station status 3

Bit	Meaning
0 to 7	0: Bits are always set to "0".

Master PROFIBUS address

The PROFIBUS address of the specific DP master that parameterized the IM 153-2 FF and that has reading and writing access to the IM 153-2 FF is stored in byte 3 of the default diagnosis.

Device identifier

The device identifier is a code that uniquely identifies the DP slave (PROFIBUS ID number).

Table 11-7 Structure of the device identifier

Byte 4	Byte 5	Description
81	6C	IM 153-2 FF

11.2.2.2 Identifier-related diagnostics

Definition

The identifier-related diagnosis specifies for which slots of the FF Link a diagnosis is available.

Example of slot assignment

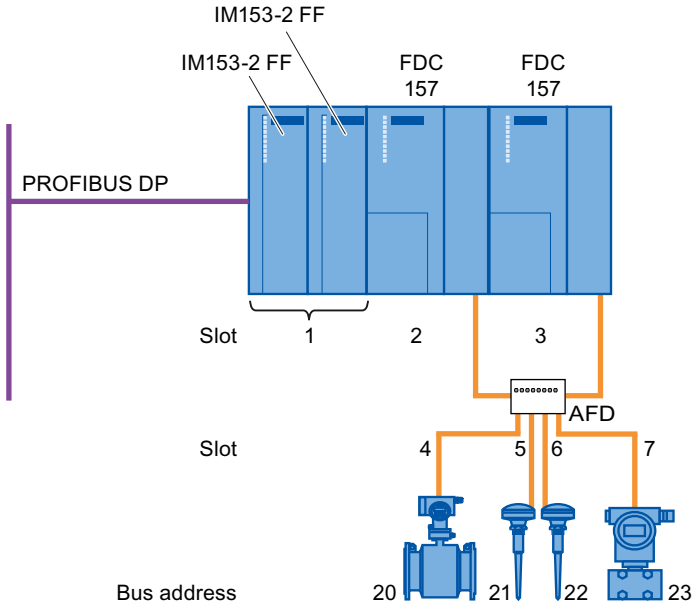


Figure 11-2 Example of slot assignment

Structure of the identifier-related diagnostics

The identifier-related diagnosis comprises 6 bytes.

The IM 153-2 FF, each Field Device Coupler FDC 157, and each FF device occupy one bit. The FF devices are arranged in ascending order according to their FF addresses.

One bit is set:

- If the IM 153-2 FF has received non-matching DP and FF configuration data

Note

This state can occur temporarily with CiR processes. It is only necessary to take steps if the error persists.

- If the FDC 157 is not present or is faulty, the FDC 157 setup does not correspond to the configuration (redundant/non-redundant) or the DIL switch setting of the redundancy mode does not correspond to the configuration
- If the associated FF device is not available or with regard to configuration has an FF address that does not match its "Physical Device (PD) Tag".

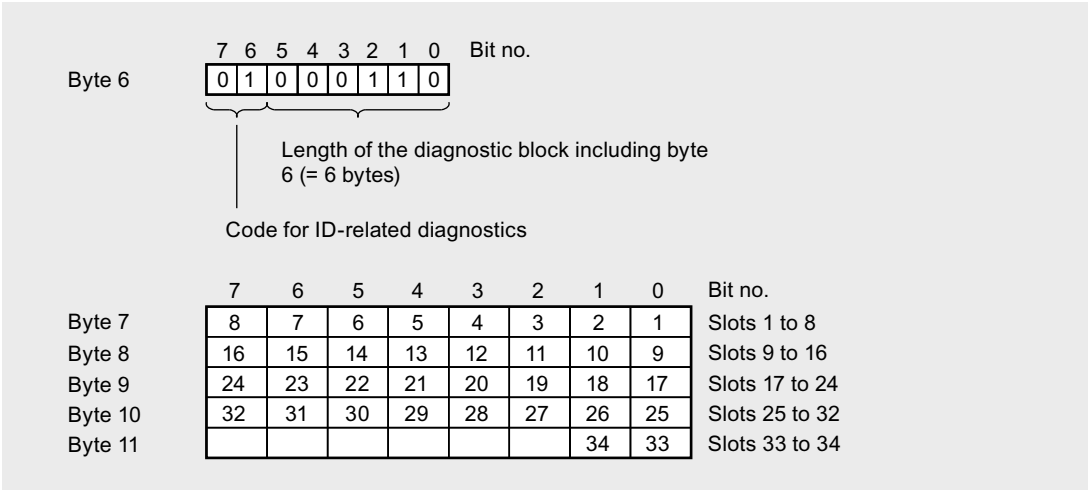


Figure 11-3 Structure of the identifier-related diagnostics

11.2.2.3 Module status

Definition

The module status is part of the device-related diagnostics and reports the status of the configured IM 153-2 FF, Field Device Coupler FDC 157 and FF devices.

Structure of the module status

The modules status comprises 13 bytes.

In S7 standard operation and redundancy mode, the start address is equal to 12.

The status of each slot is coded by 2 bits in the module status.

The following applies to the entry in the module status:

- For IM 153-2 FF:
  - 00_B: IM 153-2 FF is OK
  - 01_B: External error, PROFIBUS address differs from the one used at startup; the redundant IM 153-2 FF has a different PROFIBUS address
  - 10_B: Configuration error (e.g. inconsistency between the DP configuration and the retentive FF configuration in IM 153-2 FF)
- For Field Device Coupler FDC 157:
  - 00_B: FDC 157 is OK
  - 01_B: External error, short-circuit or wire break, loss of ring redundancy
  - 10_B: Configuration does not match detected setup
  - 11_B: No FDC 157
- For FF devices, the status is entered as follows:
  - 00_B: Module OK; valid user data
  - 10_B: Incorrect PD Tag; user data I/O invalid
  - 11_B: No module; user data I/O invalid.

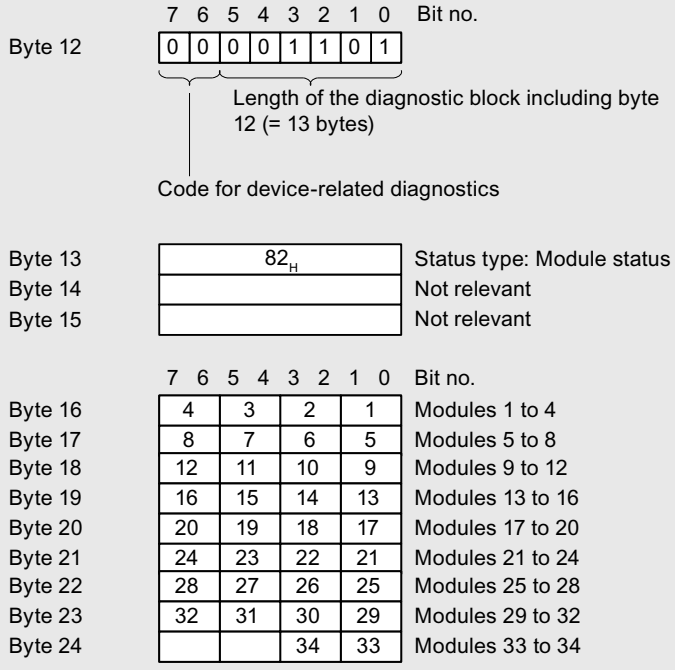


Figure 11-4 Structure of the module status

11.2.2.4 Status message

Definition

The status message is part of the device-related diagnostics and supplies the assignment of slots to the configured FF device addresses. As soon as the configuration data is available in IM 153-2 FF and the IM 153-2 FF has switched to data exchange, the data will be updated. When IM 153-2 FF exits data exchange, the data is retained and updated only if new configuration data is generated. For non-configured slots, the FF device address 0 is given.

Structure of the status message

The status message comprises 38 bytes.

In S7 standard operation and redundancy mode, the start address is equal to 25.

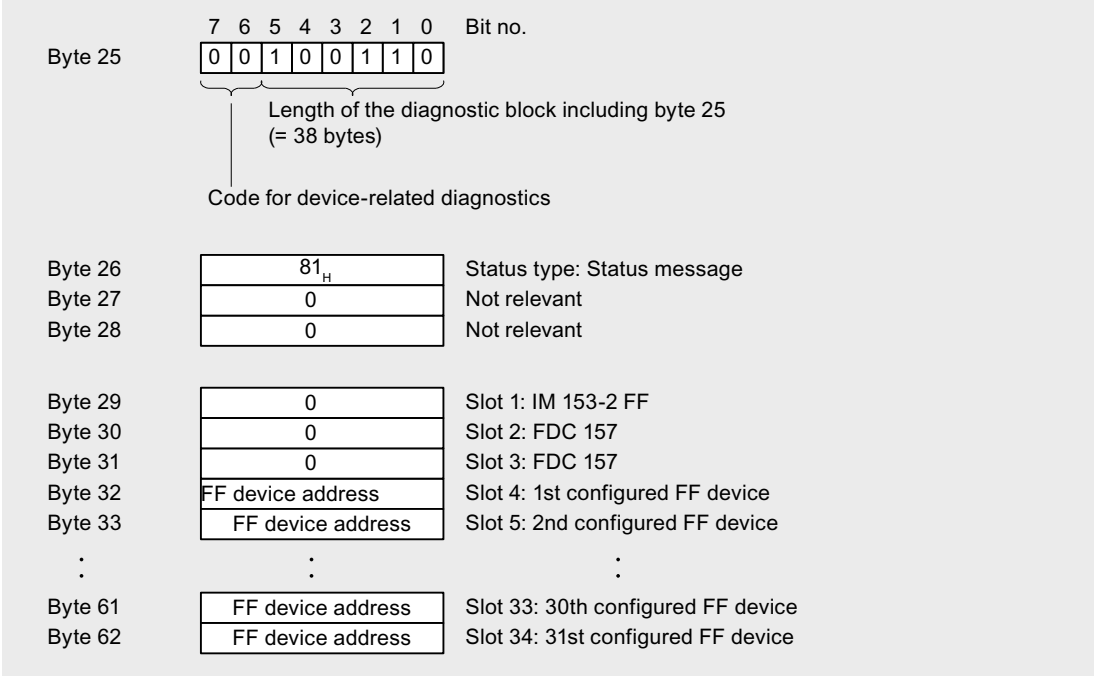


Figure 11-5 Structure of the status message

11.2.2.5 H status

Definition

If inserted in an active BM IM/IM (redundant) bus module, the IM 153-2 FF returns the fault-tolerance status.

The H status gives information on the state of an active and passive IM 153-2 FF. The H status consists of 8 bytes.

Structure of the H status

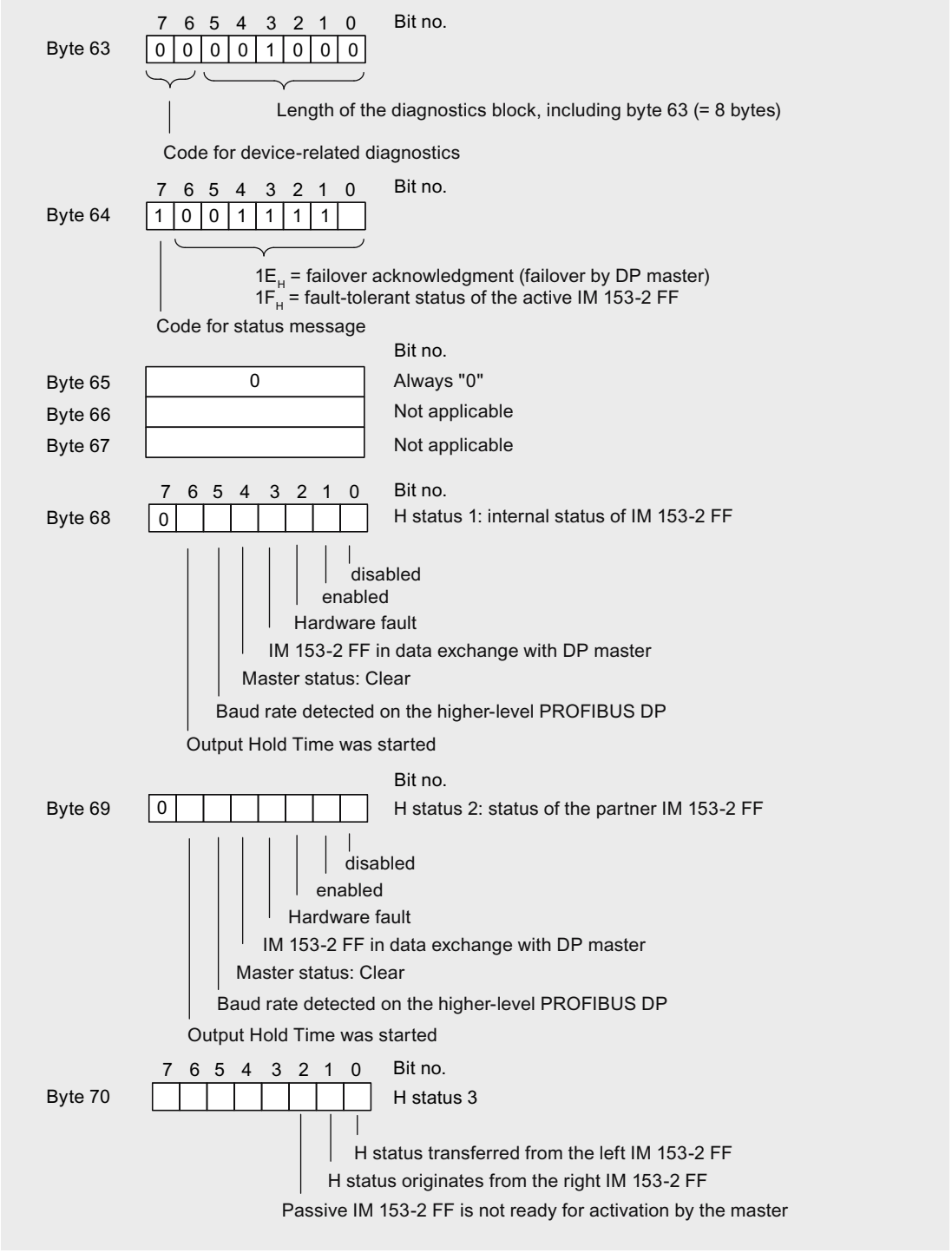


Figure 11-6 Structure of the H status of the IM 153-2 FF in redundancy mode

11.3 Interrupts

Definition

The interrupt section provides information on the type of interrupt and the cause leading to the interrupt being triggered. The interrupt section is only transmitted if there is an interrupt.

The interrupt part consists of a maximum of 63 bytes.

Structure of the interrupt section

The interrupt section consists of an interrupt header and the additional interrupt information. The interrupt header always comprises 4 bytes. The structure of the additional interrupt information depends on the interrupt type; its length is 59 bytes maximum.

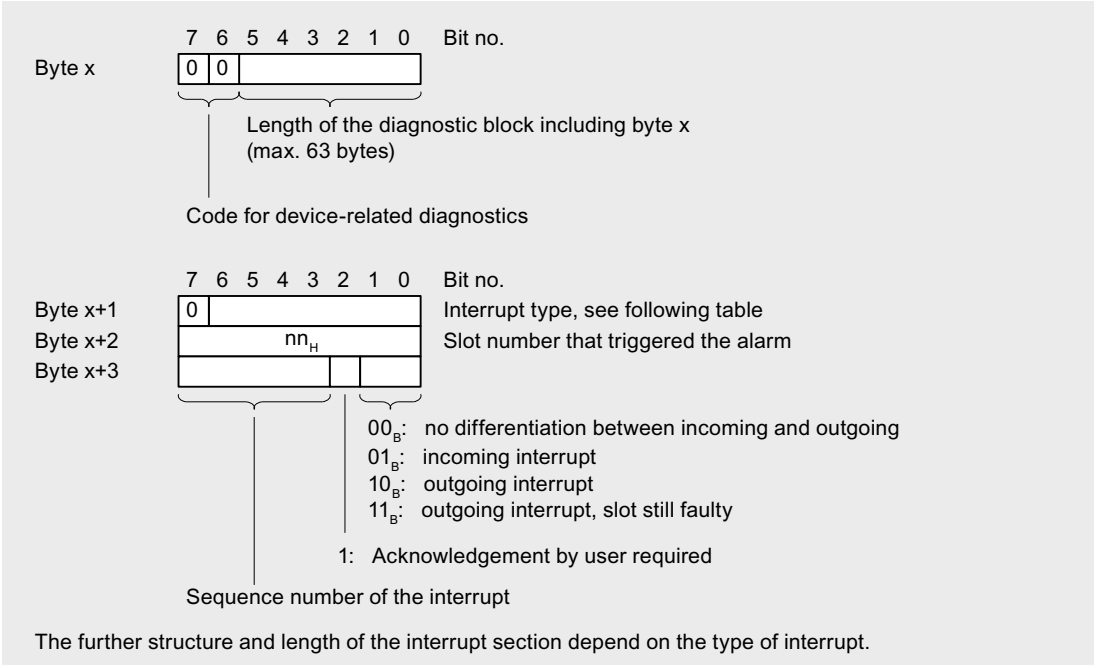


Figure 11-7 Structure of alarm header

Interrupt type

The IM 153-2 FF generates interrupts for internal purposes, as well as for the FDC 157 Field Device Coupler and FF devices. The following interrupt types are used:

- Diagnostic interrupt
- Remove / insert interrupt

Table 11-8 Interrupt type (bytes x+1 in the interrupt section)

Byte x+1	Interrupt type	Byte x+1	Interrupt type
00_H	Reserved	05_H	Status interrupt *
01_H	Diagnostic interrupt	06_H	Update interrupt *
02_H	Process interrupt *	07_H to $1F_H$	Reserved
03_H	Removal interrupt	20_H to $7E_H$	Manufacturer-specific interrupt *
04_H	Insertion interrupt	$7F_H$	Reserved
* These interrupt types are not generated in IM 153-2 FF.			

Additional interrupt information for diagnostic interrupt

IM 153-2 FF must generate the interrupt-specific data for FF devices. The ID 0xFF and cause of diagnostics are always entered at the beginning of the auxiliary interrupt data (ID in byte x +4, cause in byte x+5).

For redundant IM 153-2 FF, the active IM 153-2 FF reports the event, even for the passive IM 153-2 FF.

IM 153-2 FF reports the following diagnostic interrupts:

- For the IM 153-2 FF (slot 1):
  - 0x02 = configuration error (e.g. inconsistency between the DP configuration and the retentive FF configuration in IM 153-2 FF)
  - 0x04 = external error, PROFIBUS address differs from the one used at startup; the redundant IM 153-2 FF has a different PROFIBUS address
- For the Field Device Coupler FDC 157 (slots 2 and 3):
  - 0x02 = configuration error (e.g. configuration data does not match the hardware configuration)
  - 0x04 = external error, short-circuit or wire break
  - 0x08 = loss of ring redundancy (open ring, e.g. caused by a short-circuit, cable break between 2 AFD, or failure of an AFD)
- For the FF devices (slots 4-34):
  - 0x02 = incorrect assignment of the "Physical Device Tag" (name) to the configured FF device (address)

Additional interrupt information for remove/insert interrupts

When an FDC 157 or an FF device on the underlying FF bus fails or is restored, the IM 153-2 FF triggers a remove or insert interrupt on the higher-level DP master system.

The FF address of the mapped FF device is entered in the additional interrupt information (in byte x+4); in FDC 157 the value "0" is entered (in byte x+4).

Field Device Coupler FDC 157 (slots 2 and 3)

The remove interrupt for the Field Device Coupler FDC 157 is generated if:

- On expiration of the startup delay time of IM 153-2 FF, the FDC 157 cannot be reached
- Communication to the FDC 157 breaks off during operation.

The insert interrupt for the Field Device Coupler FDC 157 is generated if:

- An new FDC 157 is detected during operation.

In the non-redundant case, the loss of power to the Field Device Coupler FDC 157 would be reported as a remove interrupt. In addition, the connected FF devices are also reported as failed (remove interrupt).

In the case of redundancy, the two FDC 157 Field Device Couplers monitor each other and detect errors. Here, a loss of power to a Field Device Coupler FDC 157 is also reported as a remove interrupt. Due to the redundant coupling setup, the communication to the FF devices is maintained.

FF devices (slots 4-34)

The remove interrupt for FF devices is generated if:

- On expiration of the startup delay time of IM 153-2 FF, a configured FF device is not found on the FF bus
- An FF device is no longer recognized in operation

The insert interrupt for FF devices is generated if:

- A configured FF device is newly detected in operation based on its address.

The following table shows the relationship between remove/insert interrupts and diagnostic interrupts for FF devices.

Table 11-9 Alarm behavior when an FF device is added

Required configuration	Device added	Reaction during startup delay	Response in Normal operation
Addr a, Name c	Addr a, Name c	FF device is added	FF device is added (insert interrupt)
	Addr a, Name y	Name incorrect (after startup delay diagnostic interrupt)	Name incorrect (insert interrupt and diagnostic interrupt)
	Addr z, Name c	Remove interrupt for FF devices with address a (after startup delay); no interrupt for FF devices with address z	No interrupt for FF devices with address z, if z does not belong to the project

11.4 Reading out diagnostics from FF devices

Overview

The diagnostic data of the FF devices can only be read out with *SIMATIC PDM*. *SIMATIC PDM* displays the status of FF devices which generate their diagnostics data in accordance with the FOUNDATION Fieldbus guideline (refer to chapter Standards and Approvals (Page 85)).

The diagnostic information alongside the status byte (quality code) made available by the FF device (e.g. device state) is implemented accordingly and the system is made available.

This makes it possible to access FF devices object-specifically. A direct path is created to the asset management here, i.e. FF devices are available in the maintenance station as individual objects for cyclic diagnostics through automatic linking. Non-cyclic diagnostics is also possible by means of *SIMATIC PDM*.

Reference

For more information about the diagnostics of FF devices, refer to the PCS 7 Process Control System, FOUNDATION Fieldbus (http://support.automation.siemens.com/WW/view/en/35214553/133300) Commissioning Manual.

See also

The Process Device Manager (http://support.automation.siemens.com/WW/view/en/10806857/133300)

Technical data

12

12.1 General technical data

What are general technical specifications?

The technical specifications contain:

- The standards and test values that observe and fulfil the described components.
- The test criteria used to test the described components.

12.1.1 Standards and Approvals

Standards and Approvals

The components described meet the following standards and approvals.

Exceptions:

Active field distributors:
Valid standards and approvals are specified in the relevant certificates and/or on the rating plates.

Note

Currently valid certifications can be found on the rating of the relevant module.

CE Label

CE

The described components meet the requirements and protective aims of the following EC directives and comply with the harmonized European Standards (EN), published for programmable logic controllers (PLC) in the official gazettes of the European Union.

- 2004/108/EC "Electromagnetic Compatibility" (EMC Directive)
- 94/9/EC "Equipment and protective systems intended for use in potentially explosive atmospheres" (ATEX).

The EC declarations of conformity are kept available for the responsible authorities at the following address:

Siemens AG
Gleiwitzer Str. 555
DE-90475 Nuremberg
Germany

The EC Declaration of Conformity is also available for download from the Internet (http://www.siemens.com/automation/service&support) (keyword "Declaration of Conformity").

ATEX Approval

DEKRA 14ATEX 0026 X
to EN 60079-15 (Electrical apparatus for potentially explosive atmospheres; Type of protection "n") and EN 60079-0 (Explosive atmospheres; General requirements)

WARNING

Personal injury and material damage can be incurred.

In potentially explosive atmospheres, personal injury and material damage can be incurred if plug connections are disconnected during operation.

In potentially explosive atmospheres, only disconnect the plug connections of all components when they are not under current.

IECEx approval

IECEx DEK 14.0082X

WARNING

Personal injury and material damage can be incurred.

In potentially explosive atmospheres, personal injury and material damage can be incurred if plug connections are disconnected during operation.

In potentially explosive atmospheres, only disconnect the plug connections of all components when they are not under current.

UL / CSA Approval

Underwriters Laboratories Inc. in accordance with

Ordinary locations

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

Hazardous locations

- ISA 12.12.01
- CSA C22.2 No. 213

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

Note the following information:

Note

This product must be installed according to the NEC (National Electric Code) stipulations.

When used in environments according to class I, division 2 (see above), S7-400 must be mounted in an enclosure that corresponds to at least IP54 according to EN 60529.

WARNING

Installation Instructions according cULus

WARNING – Explosion Hazard - Do not disconnect while circuit is live unless area is known to be non-hazardous.

WARNING – Explosion Hazard - Substitution of components may impair suitability for Class I, Division 2 or Class I, Zone 2

This equipment is suitable for use in Class I, Division 2, Groups A, B, C or D; Class I, Zone 2, Group IIC, or non-hazardous locations only.

FM Approval

Factory Mutual Research (FM) in accordance with

Approval Standard Class Number 3611, 3600, 3810

Class I, Division 2, Group A, B, C, D Tx;
Class I, Zone 2, Group IIC Tx

Tick mark for Australia and New Zealand

The components described satisfy the requirements of the following standard:
EN 61000-6-4: 2007 + A1: 2011

IEC 61131

The described components meet the requirements and criteria of the IEC 61131-2 standard (programmable logic controllers, part 2 Equipment requirements and tests).

PROFIBUS standard

The components described are based on the following standards:

IEC 61784-1 CP 3/1

FOUNDATION Fieldbus

The FF Link, i.e. IM 153-2 FF and FDC 157, conform to the requirements and criteria of the FOUNDATION Fieldbus guidelines.

IEC 61158-2

Host registration by the Fieldbus Foundation; refer to the Internet (http://www.fieldbus.org/index.php?option=com_mtree&task=viewlink&link_id=1586&ffbstatus=Registered&Itemid=324).

Use in industry

SIMATIC products are designed for industrial applications.

Area of application	Interference emission requirements	Interference immunity requirements
Industry	EN 61000-6-4: 2007 + A1: 2011	EN 61000-6-2 : 2005

Use in residential areas

If you use the described components in residential areas, you must ensure that they comply with the radio interference emission values of the following standard:
EN 61000-6-3 + A1

Suitable measures for achieving RF interference Limit Class B include, for example:

- Installation in grounded control cabinets / switch boxes
- Use of interference filters in the supply lines

12.1.2 Use in zone 2 potentially explosive areas

See product information Using the modules in the hazardous zone 2 (http://support.automation.siemens.com/WW/view/en/19692172).

12.1.3 Electromagnetic Compatibility

Introduction

This chapter provides you with information on the immunity to interference of the described components as well as on radio interference suppression.

The described components meet, among others, the requirements of the EMC legislation of the European single market.

Definition: EMC

Electromagnetic compatibility (EMC) is the capacity of an electrical installation to function satisfactorily in its electromagnetic environment without affecting that environment.

Pulse-shaped Interference

The table below shows the electromagnetic compatibility of the described components with regard to pulse-shaped interference. The prerequisite for this is that the system complies with the relevant requirements and guidelines relating to electrical equipment.

Table 12-1 Pulse-shaped Interference

Pulse-shaped disturbance	Tested at	Corresponds to severity
Electrostatic discharge according to IEC 61000-4-2	8 kV 6 kV	3 (air discharge) 3 (contact discharge)
Burst impulses (fast transient interference) according to IEC 61000-4-4	2 kV (supply line) 2 kV (signal line)	3
High-energy current surge according to IEC 61000-4-5 External protective circuit needed (refer to the Automation System S7-400, Hardware and Installation (http://support.automation.siemens.com/WW/view/en/1117849) Installation Manual, chapter *Lightning protection and overvoltage protection*) It is not necessary to install an external protection circuit for the FF bus.		
• Asymmetric interference	2 kV (supply line) 2 kV (signal cable/data line)	3
• Symmetric interference	1 kV (supply line) 1 kV (signal line / data line)	

Sinusoidal disturbance

EMC performance of the described components in relation to sinusoidal disturbance variables:

- HF radiation acc. to IEC 61000-4-3
  Electromagnetic HF field, amplitude modulated
  - 80 MHz to 1000 MHz / 1.4 GHz to 2 GHz
  - 10 V/m
  - 80% AM (1 kHz)
- HF coupling according to IEC 61000-4-6
  - 0.15 to 80 MHz
  - 10 Veff unmodulated
  - 80% AM (1 kHz)
  - 150 Ω source impedance

Emission of Radio Interferences

Emission of electromagnetic interference to EN 55016: limit value class A, group 1

from 30 to 230 MHz	< 40 dB (µV/m)Q
from 230 to 1000 MHz	< 47 dB (µV/m)Q
measured at a distance of 10 m	

Disturbance via supply lines to EN 55016: Limit Class A, Group 1

from 0.15 to 0.5 MHz	< 79 dB (µV)Q < 66 dB (µV) M
from 0.5 to 5 MHz	< 73 dB (µV)Q < 60 dB (µV) M
from 5 to 30 MHz	< 73 dB (µV)Q < 60 dB (µV) M

12.1.4 Shipping and storage conditions

Transport and Storage of Modules

With regard to their transport and storage conditions, the described components exceed the requirements according to IEC 61131, Part 2. The following specifications apply to modules transported and stored in the original packaging.

Table 12-2 Transport and storage conditions

Type of condition	Permitted range
Free fall (in transport packaging)	≤ 0.3 m
Temperature	from -40 °C to + 70 °C
Atmospheric pressure	from 1080 to 660 hPa (corresponds to an altitude of -1000 to 3500 m)
Relative humidity	of 10 to 95 %, without condensation
Sinusoidal vibrations according to IEC 60068-2-6	5 to 9 Hz: 3.5 mm 9 to 150 Hz: 9.8 m/s^2
Shock according to IEC 60068-2-29	250 m/s^2, 6 ms, 1000 shocks

12.1.5 Mechanical and climatic ambient conditions for operation

Conditions of use

The described components are designed for use in a fixed, sheltered location. The operating conditions exceed the requirements of IEC 61131 Part 2.

The described components meet the operating conditions of Class 3C3 in accordance with DIN EN 60721-3-3.

Use with additional measures

The described components must not be operated without additional measures:

- at locations with a high degree of ionizing radiation
- in aggressive environments caused, for example, by
  - the development of dust
  - corrosive vapors or gases
  - strong electric or magnetic fields
- in installations requiring special monitoring, for example
  - elevators
  - electrical plants in potentially hazardous areas

An additional measure can be installation in a cabinet or in an enclosure, for instance.

Mechanical ambient conditions

The mechanical ambient conditions for the described components are specified in the table below for sinusoidal vibrations.

Table 12-3 Mechanical ambient conditions

Frequency range in Hz	Continuous	Infrequently
10 ≤ f ≤ 58	0.0375 mm amplitude	0.075 mm amplitude
58 ≤ f ≤ 150	0.5 *g* constant acceleration	1 *g* constant acceleration

Reduction of vibrations

If the described components are subject to big shocks or vibrations appropriate measures must be taken to reduce the acceleration or the amplitude.

We recommend fixing the described components on damping materials (rubber-metal anti-vibration mountings, for example).

Checking mechanical environmental conditions

The following table provides information on the type and scope of checks regarding mechanical environmental conditions.

Table 12-4 Checking Mechanical Environmental Conditions

Checking for	Test standard	Remarks
Vibrations	Vibration test in compliance with IEC 60068-2-6 (sine)	Type of vibration: Frequency sweeps with a sweep rate of 1 octave/minute. 10 Hz ≤ f ≤ 58 Hz, constant amplitude 0.075 mm 58 Hz ≤ f ≤ 150 Hz, constant acceleration 1 g Period of oscillation: 10 frequency sweeps per axis in each of the 3 axis which are vertical to each other.
Shock	Shock test in accordance with IEC 60068-2-29	Type of shock: half-sine Strength of shock: 15 g peak value, 11 ms duration Shock direction: 3 shocks each in +/- direction in each of the 3 axes that are vertical to each other

Climatic environmental conditions

The described components can be used in the following climatic environmental conditions:

Table 12-5 Climatic environmental conditions

ambient conditions	Permitted range	Remarks
Temperature: Horizontal installation Vertical installation	 from -25 to 60 °C from -25 to 40 °C	IM 153-2 FF 6ES7153-2DA80-0XB0 Field Device Coupler FDC157 6ES7157-0AC84-0XA0 Bus module BM PS/IM SIPLUS extreme 6AG1195-7HA00-2XA0 Bus module BM IM/IM (redundant) 6ES7195-7HD80-0XA0 Bus module BM FDC 6ES7195-7HF80-0XA0 Bus module BM FDC/FDC (redundant) 6ES7195-7HG80-0XA0
Temperature: any type of installation	from -25 to 70 °C	Active field distributors Refer to the DP/PA coupler, Active Field Distributor, DP/PA Link, and Y Link Operating Instructions

ambient conditions	Permitted range	Remarks
Relative humidity	from 10 to 95 %	Without condensation, corresponds to relative humidity (RH) stress class 2 in accordance with IEC 61131-2 With condensation: Active field distributors Refer to the DP/PA coupler, Active Field Distributor, DP/PA Link and Y Link Operating Instructions
Atmospheric pressure	from 1080 to 795 MHz	corresponds to a height of -1000 to 2000 m
Contaminant concentration	SO_2: < 0.5 ppm; RH < 60 %, no condensation H_2S: < 0.1 ppm; RH < 60 %, no condensation	Test: 10 ppm; 4 days Test: 1 ppm; 4 days

12.1.6 Specifications for insulation tests, protection class and degree of protection

Test voltages

Table 12-6 Test voltages

Circuits with a rated voltage of U_e relative to other circuits or ground	Test voltage
0 V < U_e ≤ 50 V	600 V DC, 2 s

Protection class

Protection class I in compliance with IEC 61140; this means that a grounding terminal to the rail is required!

Protection against foreign bodies and water

Protection class IP 20 according to IEC 60529; that is protection against contact with standard probes.

There is no protection from penetration by water.

12.1.7 Rated voltage

Rated voltage for operation

The described components work with a rated voltage of 24 V DC.
The tolerance range extends from 20.4 V DC to 28.8 V DC.

Exceptions

- Active field distributors:
  For corresponding specifications, refer to the DP/PA Coupler, Active Field Distributor, DP/PA Link and Y Link Operating Instructions.

12.2 Technical specifications IM 153-2 FF (6ES7153-2DA80-0XB0)

Dimensions and weight	
Dimension W x H x D (mm)	40 x 125 x 130
Weight	Approx. 350 g
Module-specific data	
Transmission speed for the higher level DP master system	9.6; 19.2; 45.45; 93.75; 187.5; 500 Kbps 1.5; 3; 6; 12 Mbps
Bus protocol	PROFIBUS DP / FOUNDATION Fieldbus H1
Frame length I / O data	Max. 244 bytes
Length of configuration frame	Max. 244 bytes
Length of diagnostic frame	Max. 244 bytes
Length of parameterization frame	Max. 244 bytes
suitable for system modifications during operation	Yes
Voltages, currents, potentials	
Rated supply voltage	24 V DC (20.4 V to 28.8 V)
• Polarity reversal protection	Yes
• Power failure backup	20 ms
Electrical isolation	
• to a high-level DP master system	Yes
• to the Field Device Coupler FDC 157	No
Isolation tested with	500 V DC
• Power consumption (24 V DC)	Max. 100 mA
• Power loss	Typically 2 W
Status, interrupts, diagnostics	
Status display	Yes
• Group error	Red LED "SF"
• Bus error on higher level DP master system	Red LED "BF 1"
• Bus error on underlying bus system	Red LED "BF 2"
• IM has an active channel in redundant configuration	Yellow LED "ACT"

• Monitoring 24 V power supply	Green "ON" LED
Interrupts	Yes
Diagnostics function	Yes
Data for connecting underlying bus components	
Field Device Coupler FDC 157 can be connected	max. 1 or one redundant coupler pair
lower-level FF devices can be connected	max. 31
Number of slots for lower-level FF devices	max. 31

12.3 Technical specifications FDC 157 (6ES7157-0AC85-0XA0)

Technical specifications FDC 157 (6ES7157-0AC85-0XA0)

	6ES7157-0AC85-0XA0
Product type designation	Field Device Coupler FDC 157
General information	
Product description	Field Device Coupler for PROFIBUS PA and Foundation Fieldbus
Supply voltage	
24 V DC	Yes
Low limit of permissible range (DC)	20.4 V
High limit of permissible range (DC)	28.8 V
Polarity reversal protection	Yes
Overvoltage protection	Yes
Input current	
Current consumption, max.	2.3 A; at 24 V DC
Power loss	
Typical power loss	13.4 W
Interfaces	
PROFIBUS DP	Yes
PROFIBUS DP	
Transmission rate, max.	45.45 Kbps
PROFIBUS DP	9-pin sub D
PROFIBUS PA	
PROFIBUS PA	Yes
Transmission rate, max.	31.25 Kbps
Number of connectable PA field devices	31
Current output to PA field devices, max.	1 A
Power failure buffering	5 ms
Protocols	
Other protocols	
Other bus systems	Yes; Foundation Fieldbus (FF)

	6ES7157-0AC85-0XA0
Interrupts/diagnostics/status information	
Status display	Yes; Group error (red)
Interrupts	
Interrupts	Yes
Diagnostics alarms	
Diagnostic functions	Yes
Diagnostic indicator LED	
Bus activity DP (yellow)	Yes
Bus activity PA (yellow)	Yes
Bus fault (red)	Yes
Group fault (red)	Yes
Monitoring 24 V power supply ON (green)	Yes
Electrical isolation	
between the backplane bus and other circuit elements	Yes
between PROFIBUS DP and all other circuits	Yes
between PROFIBUS PA and all other circuits	Yes
between supply and all other circuits	Yes
Insulation	
Insulation tested with	600 V DC
Degree of protection and protection class	
IP20	Yes
Ambient conditions	
Operating temperature	
min.	-25 °C
max.	60 °C
Storage/transport temperature	
min.	-40 °C
max.	70 °C
Relative humidity	
Operation, max.	95%
Dimensions	
Width	80 mm
Height	125 mm
Depth	130 mm
Weights	
Weight, approx.	550 g

12.4 Technical specifications of active field distributors

Reference

Technical specifications of the active field distributors are available in the DP/PA Coupler, Active Field Distributor, DP/PA Link and Y Link Operating Instructions.

12.5 Technical specifications AFDiSD (6ES7655-5DX60-1BB0)

Technical specifications AFDiSD (6ES7655-5DX60-1BB0)

	6ES7655-5DX60-1BB0
Product type designation	Active field distributor
General information	
Hardware version	01
Product description	Active field distributor with diagnostics
Product function	
Repeater function	Yes
Operator control and monitoring	
Illuminant	LED
Supply voltage	
Description	Via fieldbus
Low limit of permissible range (DC)	16 V
High limit of permissible range (DC)	32 V
Polarity reversal protection	Yes; only in conjunction with FDC 157
Overvoltage protection	Yes; only in conjunction with FDC 157
Input current	
Current consumption, max.	400 mA; at 20 V input voltage
Current consumption in the case of short-circuit at all spur lines	100 mA; at 24 V input voltage
Power loss	
Typical power loss	1.4 W; minimum - typical specification not possible because load-dependent
Power loss, max.	5.9 W
Interfaces	
PROFIBUS DP	No
FOUNDATION Fieldbus H1	Yes
AS interface	No
PROFIBUS PA	
PROFIBUS PA	Yes
Transmission rate, max.	31.25 Kbps
Number of connectable PA field devices	6

	6ES7655-5DX60-1BB0
Current output to PA field devices, max.	260 mA; max. 180 mA total current of all field devices for operation in the permitted operating voltage range from 16 V to 32 V
Permitted current per spur line	40 mA; first spur line 60 mA
Interrupts/diagnostics/status information	
Status display	Yes
Interrupts	
Interrupts	No
Diagnostics alarms	
Diagnostic functions	Yes
Diagnostic indicator LED	
Trunk line status	Yes
Trunk line fault	Yes
Spur line status/fault	Yes
Automatic bus termination	Yes
Electrical isolation	
between trunk line and spur lines	Yes
Insulation	
Insulation tested with	2550 V DC
Degree of protection and protection class	
IP 66	Yes
Standards, approvals, certificates	
Use in hazardous areas	
EX Zone 1	Yes
EX Zone 11	No; EX zone 21
EX Zone 2	Yes
EX Zone 22	Yes
Class I Zone 1	Yes
Class I Zone 2, Division 2	Yes
Test number KEMA	14 ATEX 0044
Type of protection to KEMA	14 ATEX 0044
Ambient conditions	
Operating temperature	
min.	-40 °C
max.	70 °C
Storage/transport temperature	
min.	-40 °C
max.	70 °C
Relative humidity	
Operation, max.	95%
Connection system	
Trunk line	

	6ES7655-5DX60-1BB0
Number of trunk lines	2
Design of terminals	Screw terminal block
Type of connection (enclosure cable gland)	M20
Line type	Type A
Line diameter, min.	6 mm
Line diameter, max.	13 mm
Line cross-section, min.	0.2 mm²
Line cross-section, max.	2.5 mm²
Automatic bus termination	Yes
Permitted trunk line current	1 A
Spur line	
Number of spur lines	6
Design of terminals	Screw terminal block
Type of connection (enclosure cable gland)	M16
Line type	Type A
Line diameter, min.	4 mm
Line diameter, max.	9 mm
Line cross-section, min.	0.2 mm²
Line cross-section, max.	2.5 mm²
Total current output to field devices, max.	260 mA; max. 180 mA total current of all field devices for operation in the permitted operating voltage range from 16 V to 32 V
Number of connectable field devices	6
Current limitation per field device, max.	40 mA; 60 mA at S1
No-load voltage, max.	15.3 V
Short circuit-proof	Yes
Short-circuit current (test current); max.	6 mA
Intrinsically safe according to FISCO model	Yes
Debounce logic	Yes
Dimensions	
Width	380 mm
Height	85 mm
Depth	170 mm
Weights	
Weight, approx.	4500 g

Order numbers

A

A.1 Components for the use of FF Link

Article numbers for components of the bus link

Component	Article number
FF Link IM 153-2	6ES7153-2DA80-0XB0
Field Device Coupler FDC 157	6ES7157-0AC84-0XA0
Bus module BM PS/IM SIPLUS extreme	6AG1195-7HA00-2XA0
Bus module BM IM/IM (redundant)	6ES7195-7HD80-0XA0
Bus module BM FDC	6ES7195-7HF80-0XA0
Bus module BM FDC/FDC (redundant)	6ES7195-7HG80-0XA0
Active field distributors (Active Field Distributor AFD, Active Field Splitter AFS)	Refer to the Operating Instructions DP/PA coupler, Active Field Distributor, DP/PA Link, and Y Link (http://support.automation.siemens.com/WW/view/en/1142696)

Article numbers for installation accessories

Component	Article number
Mounting rail "for standard configuration"	e.g. 6ES7390-1AE80-0AA0
Bus connector for mounting rail "for standard configuration" (included with each Field Device Coupler FDC 157)	6ES7390-0AA00-0AA0
Mounting rail for the "hot-swapping modules" function • 482.6 mm • 530 mm • 620 mm • 2000 mm	6ES7195-1GA00-0XA0 6ES7195-1GF30-0XA0 6ES7195-1GG30-0XA0 6ES7195-1GC00-0XA0
Covers (included are 4 backplane bus covers and 1 bus module cover)	6ES7195-1JA00-0XA0
PS 307 power supply with jumper	e.g. 6ES7307-1BA00-0AA0

A.2 Accessories for PROFIBUS DP

Article numbers for PROFIBUS DP accessories

Accessories	Article number
PROFIBUS DP bus connector (up to 12 Mbps)	
• without PG port	6ES7972-0BA12-0XA0
• with PG port	6ES7972-0BB12-0XA0
PROFIBUS DP FastConnect connector	
• without PG port	6ES7972-0BA52-0XA0
• with PG port	6ES7972-0BB52-0XA0
PROFIBUS DP bus cable	
• 2-core, shielded	6XV1830-0EH10
PROFIBUS DP terminator	6ES7972-0DA00-0XA0

A.3 Accessories for FOUNDATION Fieldbus

Article numbers for FOUNDATION Fieldbus accessories

Accessories	Article number
FF cable (blue)	6XV1830-5GH10
FF cable (orange)	6XV1830-5HH10

Additional information

For additional information please refer to the *ST PI Catalog*.

Glossary

Address

The address of a node is used for locating it in the network. It has to be unique in the entire network.

Aggregate current

Aggregate current of all PA or FF field devices.

Automation system

An automation system is a programmable control system, consisting of at least one CPU, various input and output modules as well as operating and monitoring devices.

Bus

A common transfer route to which all nodes are connected; it has two defined ends.

Bus connector

Physical connection between the bus node and bus cable.

Control in the Field (CiF)

The FOUNDATION fieldbus function "Control in the Field" (CiF) provides the option to control I/O blocks between FF devices on an FF segment without CPU intervention, i.e. without transfer to the process image. Control loops are also possible.

The Link Active Scheduler (LAS) controls data transmission on the FF segment.

Diagnostic interrupt

Diagnostics-capable components report system errors they have detected to the central CPU by means of diagnostic interrupts.

In SIMATIC S7: When an error is detected or disappears (e.g. wire break), provided the interrupt is enabled, the module initiates a diagnostic interrupt. The CPU interrupts the processing of the user program and lower priority priority classes and processes the diagnostic interrupt block (OB 82).

In SIMATIC S5: The diagnostic interrupt is shown within the device-related diagnostics You can identify errors, such as wire break, by cyclically scanning the diagnostic bits.

Diagnostics

Diagnostics is the detection, localization, classification, display and further evaluation of errors, faults and messages.

Diagnostics provides monitoring functions that run automatically while the plant is in operation. This increases the availability of plants by reducing commissioning times and downtimes.

DP master

A master that behaves in conformity with IEC 61784-1 CP 3/1 is termed a DP master.

DP slave

A slave that is operated on the PROFIBUS bus with the PROFIBUS DP protocol and that behaves in conformity with IEC 61784-1 CP 3/1 is termed a DP slave.

DP standard

is the bus protocol of the distributed I/O system in accordance with IEC 61784-1 CP 3/1.

DPV0

PROFIBUS DP mode between master and slave with the following properties:

- Cyclical data exchange between the central control system and slaves
- Configuration using GSD files
- Diagnostics

DPV1

Extension of DPV0:

- Non-cyclic data exchange between the central control system and slaves
- Integration in the engineering systems via EDD
- Transferable PLC software function blocks (IEC 61131-3)
- Fail-safe communication (PROFIsafe)
- Interrupts

EDD file

Standardized device descriptions (EDD - Electronic Device Description) permit the integration of intelligent field devices from different manufacturers into different control systems. The IEC 61804-3 standard stipulates the structure of device descriptions. This standard has been developed in cooperation with the following organizations:

- PROFIBUS International (PI)
- HART Communication Foundation (HCF)

- Fieldbus Foundation
- OPC Foundation

The EDDL (Electronic Device Description Language) is used as basis for the device descriptions.

Electromagnetic compatibility

Electromagnetic compatibility is the capacity of electrical equipment to function faultlessly in a specified environment without affecting the environment in an inadmissible manner.

Equipment, associated

A piece of electrical equipment that contains both intrinsically safe and non-intrinsically safe power circuits and is configured so that the non-intrinsically safe power circuits cannot impede the intrinsically safe ones.

Equipment, electrical

Components, power circuits or parts of power circuits that are normally to be found in their entirety in a single housing.

Equipment, intrinsically safe, electrical

A piece of electrical equipment in which all power circuits are intrinsically safe.

Equipotential bonding

Electrical connection (equipotential bonding conductor) that brings the bodies of electrical equipment and external conductive bodies to an equal or almost equal potential level to prevent disturbing or dangerous voltages between these bodies.

FF Link Master

A master that behaves in conformity with IEC 61784-1 CP 1/1 is termed a FOUNDATION Fieldbus Link Master. The "FF Link" bus link acts as a DP slave for "higher-level" systems (for the automation system) and as an FF Link Master for "lower-level" systems (for the FF devices).

Field bus

The field bus is a serial bus system for the distributed integration of field devices in an automation system

Ground

The conductive earth whose electrical potential can be set equal to zero at any point.

Ground refers to the entirety of all interconnected inactive parts of a piece of equipment that cannot possess a dangerous contact voltage, even in the event of a malfunction.

Ground

The conductive earth whose electrical potential can be set equal to zero at any point.

Ground refers to the entirety of all interconnected inactive parts of a piece of equipment that cannot possess a dangerous contact voltage, even in the event of a malfunction.

Ground terminal PE

Name of the connector on electrical equipment in potentially explosive atmospheres that is wired to the equipotential bonding system.

Grounding

Grounding means connecting an electrically conductive part to a grounding system by means of the ground electrode.

GSD file

All slave-specific properties are stored in a Device Data Base File (DDBF file). The format of the DDBF file is to be found in the PROFIBUS guideline: Specification for PROFIBUS Device Description and Device Integration Vol.1: GSD V4.1, 07/2001 of the PROFIBUS-Nutzerorganisation (PNO).

H system

High availability system consisting of at least two central modules or two separate devices, for example PCs (master / reserve). The user program is processed identically in the master and in ther reserve devices.

HW Config

Integral part of *STEP 7* for configuring hardware.

Identification and maintenance data

Identification data (I data) is information on the module, some of which are printed onto the module housing. I data are for reading only.

Maintenance data (M data) is plant-dependent information such as installation location, installation date etc. M data are created during configuration and written onto the module.

Identification and maintenance data (I&M) is information stored in a module to support you in

- Checking the plant configuration
- Locating hardware modifications in a plant
- Correcting errors in a plant

Modules can be uniquely identified online by means of the I&M data.

Link Active Scheduler

The Link Active Scheduler (LAS) is a function of the FOUNDATION Fieldbus Link Master. The LAS uses schedules to control and coordinate data transmission between the FF devices on the FF segment. In standard mode of operation, the IM 153-2 FF takes over the LAS function. If no IM 153-2 FF is online on the FF segment, suitable FF devices (Link Master) can take over the LAS function.

Link Master

-> FF Link Master

Master

When a master is in possession of the token, it can send data to other nodes and request data from other nodes (= active node). DP master are, for example, the CPU 315-2 DP or IM 308-C.

Parameter assignment

Parameter assignment is the transfer of slave parameters from the master to the slave.

PNO

PROFIBUS User Organization

Power supply

A power supply feeds power to the field devices and to their connected distributed process I/Os.

PROFIBUS

PROcess FIeld BUS, process and fieldbus standard as specified in IEC 61784-1 CPF 3 PROFIBUS and PROFINET. It specifies functional, electrical, and mechanical properties for a bit-serial field bus system.

PROFIBUS is available with the protocols: DP (=distributed I/O) and FMS (= Field bus Message Specification)

PROFIBUS address

For the purpose of unique identification on PROFIBUS DP, each node must be given a PROFIBUS address.

PC / PG or the ET 200 Handheld have the PROFIBUS address "0".

DP master and DP slaves have a PROFIBUS address from the 1 to 125 range.

PROFIBUS DP

PROFIBUS bus system with the DP protocol. DP stands for the German equivalent of distributed I/O.

PROFIBUS PA

PA stands for Process Automation and increases the range of usage of the PROFIBUS DP family to include the field of process engineering. Process engineering refers to both the intrinsically safe sectors of the chemicals industry and to the non-intrinsically safe sectors, such as nuclear power plant automation, the food industry and waste water technology.

Redundant systems

Redundant systems are characterized by the multiple (redundant) presence of important automation components. If a redundant component fails there the processing of the program is not interrupted.

Reference potential

The potential to which voltages of participating circuits are referenced when they are viewed and/or measured.

Scheduler

The scheduler is used on the FOUNDATION Fieldbus to specify the time at which an FF device transmits or reads cyclic data. The scheduler helps to a avoid conflicts in publisher/subscriber communication on the FF segment.

Segment

A segment or bus segment is a self-contained section of a serial bus system.

SELV

Safety extra low voltage (SELV) is voltage < 30 V AC / 60 V DC that is generated by means of safety transformer, accumulator etc.

SIMATIC PDM

SIMATIC PDM (Process Device Manager) is a universal tool that is not manufacturer-specific and is used for configuring, parameterizing, commissioning and diagnosing intelligent process devices. *SIMATIC PDM* makes it possible to configure a large variety of process devices with a single software on a standardized user interface.

Terminating resistor

A terminating resistor is a resistor that terminates the data transmission line to avoid reflections.

Time synchronization

Time synchronization ensures that all clocks run synchronously. A master clock distributes the time in a configurable cycle to all other components in the automation system that have a clock. The components use this distributed time to set their own clocks.

TN-S system

In a TN-S system, the neutral conductor (N) and protective conductor (PE) are routed separately from each other. The neutral conductor is connected to the grounded protective conductor at a central point, and only there. The conductor can be grounded any number of times.

Token

In network technology a token refers to a bit pattern that is passed from one bus node to another, enabling that node to access the bus.

Transmission speed

The transmission speed specifies the number of bits transmitted per second.

Type of ignition protection

The special measures applied to electrical equipment to prevent the ignition of an ambient potentially explosive atmosphere.

Ungrounded

Having no conductive connection to ground

Update

Following (compatible) functional extensions or improvements to performance you should update the IM 153-2 interface module to the respective most recent firmware version.

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