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SIMATIC

ET 200S distributed I/O Interface module IM151-3 PN (6ES7151-3AA23-0AB0)

Manual

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Preface

Preface

Purpose of the manual

This manual supplements the *ET 200S Distributed I/O System* Operating Instructions. General functions of the ET 200S are described in the SIMATIC Distributed I/O System ET 200S (http://support.automation.siemens.com/WW/view/en/1144348) Operating Instructions.

The information in this document along with the operating instructions enables you to commission the ET 200S.

Basic knowledge requirements

To understand these operating instructions you should have general knowledge of automation engineering.

Scope of the manual

The manual applies to this ET 200S module. It describes the components that are valid at the time of publication.

The manual is valid for the IM151-3 PN(6ES7151-3AA23-0AB0) as of firmware version V7.0.

Changes since the previous version

The following changes have been implemented compared to the IM151-3 PN(6ES7151-3AA23-0AB0), Manual, Edition 03/2009 with the number A5E01638906-02.

- Shared Device
- Media redundancy
- Option handling
- LED display of the configuration and parameter assignment errors

Recycling and disposal

Thanks to the fact that it is low in contaminants, this ET 200S module is recyclable. For environmentally compliant recycling and disposal of your electronic waste, please contact a company certified for the disposal of electronic waste.

Additional support

If you have any questions relating to the products described in this manual and do not find the answers in this document, please contact your local Siemens representative.

Your contact persons are listed in the Internet (http://www.siemens.com/automation/partner).

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 ordering systems are available on the Internet (http://mall.automation.siemens.com).

Training Center

We offer courses to help you get started with the ET 200S and the SIMATIC S7 automation system. Please contact your regional training center or the central training center in D -90327, Nuremberg, Germany.

You will find more information in the Internet (http://www.sitrain.com).

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You can contact Technical Support for all Industry Automation products by means of the Internet Web form (http://www.siemens.com/automation/support-request) for the Support Request.

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- Our Newsletter, which constantly provides you with the latest information about your products.
- The right documentation for you using our Service & Support search engine.
- The bulletin board, a worldwide knowledge exchange for users and experts.
- Your local contact for Automation & Drives in our contact database.
- Information about on-site services, repairs, spare parts, and lots more.

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Properties

1

1.1 Interface module IM151-3 PN

Properties

The IM151-3 PN interface module offers the following features:

- It connects the ET 200S with PROFINET IO.
- It prepares the data for the assembled electronic modules and motor starters.
- It supplies the rear panel bus.
- Transfer and backup of the device name on SIMATIC Micro Memory Card
- Updating firmware
  - Via SIMATIC Micro Memory Card
  - Via PROFINET IO
- The reference potential M of the rated supply voltage of the IM151-3 PN to the rail (protective conductor) is connected by means of an RC combination and therefore enables earth-free configuration.
- Interrupts
  - Diagnostic interrupts
  - Process interrupts
  - Insert/remove module interrupts
  - Maintenance interrupts
- The maximum address space is 256 bytes I/O data.
- IM151-3 PN can be operated with up to 63 I/O modules.
- The maximum bus length at the rear panel bus is 2 m.
- Grouping of modules within one byte (packing).
- Records for IO modules
- Option handling

Properties via PROFINET IO

- Integrated switch with 2 ports
- Supported Ethernet services: ping, arp, Net diagnostics (SNMP)/MIB-2, LLDP
- Port diagnostics
- Port disabling
- Isochronous Real-Time Communication
- Minimum update time 250 µs
- Prioritized startup
- Device replacement without exchangeable media/programming device
- Shared Device
- Media redundancy

Isochronous Real-Time Communication

Synchronized transmission procedure for the cyclic exchange of IRT data between PROFINET devices. A reserved bandwidth within the send clock is available for the IRT IO data. The reserved bandwidth ensures that the IRT data can be transmitted at reserved, synchronized intervals whilst remaining uninfluenced even by other greater network loads (e.g. TCP / IP communication or additional real time communication).

- IRT option "high flexibility"

  Maximum flexibility in planning and extending the system. A topological configuration is not required.

- IRT option "high performance"

  Topological configuration is required.

Note

IO controller as a sync master at IRT communication with the IRT option "high performance"

We recommend also operating the IO controller as a Sync-Master if you configure the IRT communication with the option "high performance".

Otherwise, IRT and RT configured IO devices may fail if the sync master fails.

Note

Quantity structure of modules up to EZ3 and IRT option "high performance"

The maximum address space is 146 bytes I/O data when the IRT option "high performance" is used. If you use a module having the product version EZ1, EZ2 or EZ3, you should limit the quantity structure to 146 bytes I/O data. Otherwise communication may be interrupted.

For more information about configuring synchronized PROFINET devices in Sync domains, refer to the STEP 7 online help and the PROFINET System Description (http://support.automation.siemens.com/WW/view/en/19292127) manual.

Prioritized startup

Prioritized startup denotes the PROFINET functionality for accelerating the startup of IO devices within a PROFINET IO system with IRT and RT communication.

The function reduces the time that the correspondingly configured IO devices require in order to return to the cyclic user data exchange in the following cases:

- After the power supply has returned
- After a station has come back online
- After IO devices have been activated

Note

At a prioritized startup a firmware update using the Micro Memory Card is not possible. It is possible to perform a firmware update via the LAN network.

Note

The ramp-up time depends on the number and type of modules.

Cabling with fixed connection setting

If you set a fixed connection setting of the port in STEP 7, you will also have to disable "Autonegotiation/Autocrossover."

For additional information, refer to the STEP 7 online help and the PROFINET System Description (http://support.automation.siemens.com/WW/view/en/19292127) manual.

Device replacement without exchangeable media/programming device

IO devices having this function can be replaced simply:

- An exchangeable medium (such as Micro Memory Card) with the stored device name is not required.
- The device name does not have to be assigned using the programming device.

Instead of being assigned a device name from the exchangeable medium or programming device, the IO device is now assigned a device name by the IO controller. The IO controller uses the configured topology and the correlations derived from the IO devices. The configured setpoint topology must agree with the actual topology.

We recommend that you reset IO devices that have already been operated to their default settings before you use them again.

For additional information, refer to the STEP 7 Online Help and the PROFINET System Description (http://support.automation.siemens.com/WW/view/en/19292127) Manual.

Reset to factory settings

NOTICE
The stations of a bus segment can fail during the reset to factory settings.

SNMP parameters in non-volatile memory are reset to factory settings (as of *STEP 7* V5.3 SP 3) in the HW Config dialog "Target system > Ethernet > Edit Ethernet nodes", "Reset" button at "Reset to factory settings".

The following data is **not** deleted during the reset:

- The MAC address
- The I&M0 data

Note

Deleting the device name

Deleting the device name using a "Reset to factory setting".

Note

Substitute value behavior at a reset to factory setting

At a "Reset to factory setting" the modules in the station take on the configured substitute value behavior or the non-configured state.

Compatibility with the predecessor module

The interface module IM151-3 PN(6ES7151-3AA23-0AB0) is compatible with interface module IM151-3 PN (6ES7151-3AA20-0AB0 and 6ES7151-3AA22-0AB0).

The new interface module directly replaces the predecessor module in an existing system without the need for reconfiguration.

An IM151-3AA23 that has been in operation and will now be used as spare part has to be reset to the state "resetting to default settings."

Firmware updates on the predecessor module IM151-3AA22 are not supported.

Spare parts of aIM151-3 PN (6ES7151-3AA10-0AB0)

In case of replacement, you can replace a IM151-3 PN (6ES7151-3AA10-0AB0) with a IM151-3 PN (6ES7151 3AA23-0AB0) if the following conditions are met:

- 15 mm of free space to the left of the IM151-3 PN
- *STEP 7* V5.3 SP 3
- The user program is adapted in accordance with the "From PROFIBUS DP to PROFINET IO" Programming Manual, Edition 01/06.

Media redundancy

Function for ensuring the network and system availability. Redundant transmission links (ring topology) ensure that an alternative communication path is made available if a transmission link fails.

For additional information, refer to the STEP 7 online help and the PROFINET System Description (http://support.automation.siemens.com/WW/view/en/19292127) manual.

Shared Device

IO device that makes its data available to several IO controllers.

The function Shared Device is not available with the IRT option "high flexibility".

Note

Note that the power and electronics modules of a potential group have to be assigned to the same IO controller so that a load voltage failure can be diagnosed.

For additional information, refer to the STEP 7 online help and the PROFINET System Description (http://support.automation.siemens.com/WW/view/en/19292127) manual.

Option handling

Option handling enables you to set up your automation system for future expansions or options. Option handling means that you configure the planned maximum configuration of your automation system in advance and can vary later depending on the user program. Option handling exists with and without RESERVE modules and adding options.

For additional information, refer to the sections Option handling (Page 24) in the STEP 7 online help and the PROFINET System Description (http://support.automation.siemens.com/WW/view/en/19292127) manual.

Configuring

You configure the interface module IM151-3 PN with *STEP 7* V5.4 SP 4.

Limitations for operation of the modules with IM151-3 PN

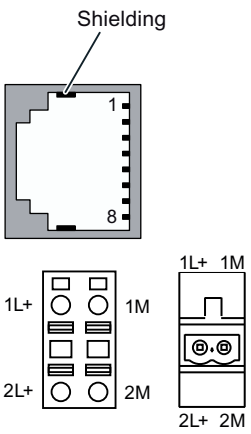
The following modules cannot be used with the IM151-3 PN:

Module	Up to order number	Up to product version
2AO U; HIGH FEATURE	6ES7135-4LB01-0AB0	3
2AO I; HIGH FEATURE	6ES7135-4MB01-0AB0	3
1SI serial interface module	6ES7138-4DF00-0AB0	4
Modbus/USS serial interface module	6ES7138-4DF01-0AB0	4
2PULSE	6ES7138-4DD00-0AB0	6
1Count 24V/100kHz	6ES7138-4DA03-0AB0	-
Motor starter • Direct starter • Reversing starter		 3RK1301-xxxxx-1AA1 3RK1301-xxxxx-1AA1

Pin assignment

The following table shows the pin assignment of the IM151-3 PN interface module for the 24 VDC voltage supply and of the RJ45 interfaces for PROFINET IO:

Table 1- 1 Pin assignment of the IM151-3 PN

View	Signal name		Description
	1	TD	Transmit Data +
	2	TD_N	Transmit Data –
	3	RD	Receive Data +
	4	GND	Ground
	5	GND	Ground
	6	RD_N	Receive Data –
	7	GND	Ground
	8	GND	Ground
	1L+		24 V DC
	2L+		24 V DC (for loop through)
	1M		Ground
	2M		Ground (for loop through)

Schematic circuit diagram

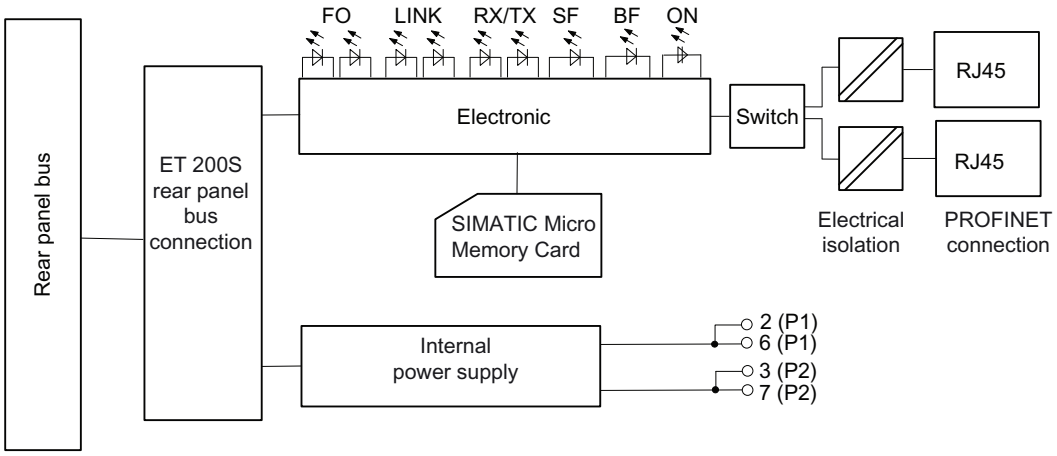


Figure 1-1 Block diagram of the IM151-3 PN interface module

Technical data IM151-3 PN (6ES7151-3AA23-0AB0)

Dimensions and weight	
Dimension B (mm)	60
Weight	Approx. 150 g
Module-specific specifications	
Data transmission rate	• 10 Mbps for Ethernet services • 100 Mbps full duplex for PROFINET IO
Transmission procedure	100BASE-TX
Send cycle	• IRT with the option "high performance" 250 µs to 4 ms in 125-µs increments • RT and IRT with the option "high flexibility": 250 µs, 500 µs, 1 ms
Autonegotiation	Yes
Autocrossing	Yes
Bus protocol	PROFINET IO
Supported Ethernet services	• ping • arp • LLDP • Net diagnostics (SNMP)/MIB-2 • Prioritized startup • Media redundancy • Shared Device
PROFINET interface	2x RJ45
Manufacturer ID (vendor ID)	$002A_H$
Device ID (DeviceID)	0301_H

Voltages, currents, potentials	
Rated supply voltage of the electronic components (1L+)	24 V DC
• Incorrect polarity protection	Yes
• Power failure bypass	Min. 20 ms
Galvanic isolation	
• Between the rear panel bus and electronic components	No
• Between Ethernet and electronic components	Yes
• Between the supply voltage and electronic components	No
Permitted potential difference (to the rail)	75 V DC/60 V AC
Insulation test voltage	500 V DC
Current consumption from rated supply voltage (1L+)	Approx. 200 mA
Power dissipation of the module	Approx. 3.3 W
Status, interrupts, diagnostics	
Interrupts	Yes
Diagnostic function	Yes
• Batch error	Red LED "SF"
• Bus monitoring PROFINET IO	Red "BF" LED
• Monitoring of the supply voltage of the electronics	Green "ON" LED
• Maintenance requirements (maintenance)	yellow "maint" LED
• Existing connection to network	One green LED "LINK" per interface

1.2 SNMP

SNMP

The interface module supports the Ethernet service SNMP. MIB-2 (RFC1213) is supported. R/W objects can be changed using SNMP tools and are stored in the module.

Following replacement with a brand new module, the R/W objects of the interface module are set to the factory settings.

1.3 SIMATIC Micro Memory Card

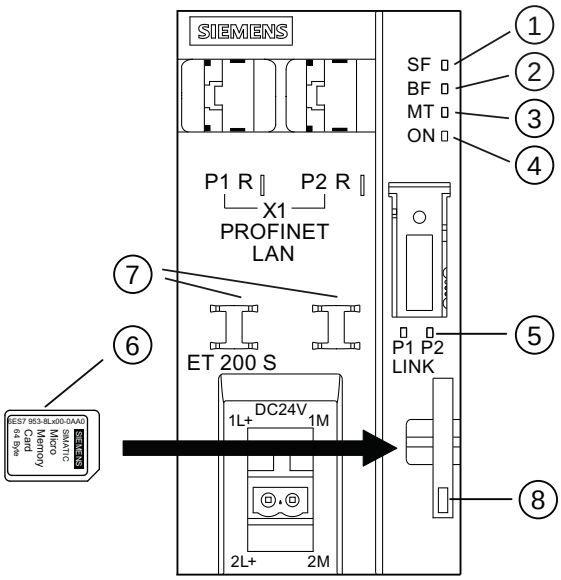
SIMATIC Micro Memory Card (MMC) as memory medium

A SIMATIC Micro Memory Card is used as a memory medium for the IM 151-3 PN.

A SIMATIC Micro Memory Card with 64 KB is sufficient for storing the name of the device.

An MMC of 4 MB or higher is required for a firmware update.

Position of the module slot for the SIMATIC Micro Memory Card



① Group error (red)
② Bus fault (red)
③ Maintenance display (yellow)
④ Supply voltage (green)
⑤ Connection to a switch or IO controller (green)
⑥ SIMATIC Micro Memory Card
⑦ Cable connection
⑧ Locking / unlocking of the Micro Memory Card

Insertion of the SIMATIC Micro Memory Card

Note

You can save **either** process-related data (device names) **or** firmware update data on **one** MMC.

Service life of a SIMATIC Micro Memory Card

The service life of a SIMATIC Micro Memory Card essentially depends on the following factors:

- Number of deletion or programming operations
- External factors, such as ambient temperature

At an ambient temperature of up to 60°C, a SIMATIC Micro Memory Card has a service life of 10 years, with a maximum of 100,000 write/delete operations.

NOTICE
Possible data loss
If the maximum number of write/delete operations is exceeded, data loss is possible.

Available SIMATIC Micro Memory Cards

Table 1- 2 Available SIMATIC Micro Memory Cards

Description	As of order number	Memory size
SIMATIC Micro Memory Card 64k	6ES7953-8LFxx-0AA0	64 KB
SIMATIC Micro Memory Card 128k	6ES7953-8LGxx-0AA0	128 KB
SIMATIC Micro Memory Card 512k	6ES7953-8LJxx-0AA0	512 KB
SIMATIC Micro Memory Card 2M	6ES7953-8LLxx-0AA0	2 MB
SIMATIC Micro Memory Card 4M	6ES7953-8LMxx-0AA0	4 MB
SIMATIC Micro Memory Card 8M	6ES7953-8LPxx-0AA0	8 MB

Inserting/replacing the SIMATIC Micro Memory Card

Note

In order to ensure that it will function correctly, the SIMATIC Micro Memory Card must only be inserted or removed with the power turned off.

The beveled corner of the SIMATIC Micro Memory Card prevents it from being inserted the wrong way round (reverse polarity protection).

To eject the card, push in the ejector with a suitable object (such as a small screwdriver or ball-point pen).

1.4 Firmware update

Updating firmware

You can update the firmware of an IM151-3 PN:

- Using a SIMATIC Micro Memory Card with at least 4 MB of memory.

  Additional information can be found on the Internet (http://support.automation.siemens.com/WW/view/en/19241998/133100).

- Via PROFINET IO, using HW Config or in the SIMATIC Manager via "Target system > Display accessible nodes".

  For additional information, refer to the *STEP 7* online help.

Requirements

To update the firmware of an IM151-3 PN you need:

- *STEP 7* as of V5.3 SP 2
- SIMATIC Micro Memory Card (MMC) for the MMC update
- A PC or programming device with a facility for writing to a SIMATIC Micro Memory Card

NOTICE
When the firmware is updated, the stations in a line can fail.

Note

A firmware update with SIMATIC Micro Memory Card is not possible for interface modules that were started with the "Prioritized startup" parameter. In this case you can delete the parameter "Prioritized startup" by a "Reset to factory settings". Firmware updating with the SIMATIC Micro Memory Card is subsequently possible again.

Parameters 2

2.1 Parameters for the IM151-3 PN interface module

Table 2- 1 Parameters for IM151-3 PN interface module

IM151-3	Value range	Default setting	Applicability
Bus length	≤ 1 m/> 1 m	≤ 1 m	ET 200S
Interference frequency suppression	50 Hz/60 Hz	50 Hz	ET 200S
Reference junction slot	None/2 to 63	None	ET 200S
Reference junction input	RTD on channel 0/ RTD on channel 1	0	ET 200S
Release option handling	Yes/no	No	ET 200S

2.2 Parameter description

2.2.1 Bus length

≤ 1 m: The default setting for the maximum bus length is 1 m.

> 1 m: The bus length of the ET 200S is > 1 m and can be up to 2 m. However, this setting will increase the response time of the ET 200S.

2.2.2 Interference frequency suppression

The frequency of your AC power system can interfere with the measured value especially when measuring in low voltage ranges and using thermocouple elements. Enter the line frequency for your system here (50 Hz or 60 Hz).

The interference frequency suppression parameter applies to analog electronic modules. This parameter is also used to specify the integration and conversion time of the various modules. See the technical data for the analog electronic modules.

2.2.3 Reference junction slot

This parameter allows you to assign a slot (none, 2 to 63) with a channel for measuring the reference temperature (calculation of the compensation value).

Reference

Refer to the *manuals* for the *analog electronic modules* for information on connecting thermocouples.

2.2.4 Reference junction input

This parameter can be used to set the channel (0/1) for measuring the reference temperature (calculation of the compensation value) for the assigned slot.

Reference

Refer to the *manuals* for the *analog electronic modules* for information on connecting thermocouples.

2.2.5 Release option handling

Release option handling

Use this parameter to release the function option handling in the ET 200S.

Note

If you configure the release, then the ET 200S requires a control data record from the user program so that the station can serve the I/O modules.

Functions

3

3.1 Identification data for PROFINET IO

Definition

Identification data are data that are stored in a module for assisting the user in:

- checking the system configuration
- locating modified system hardware
- troubleshooting a system

Identification data enable modules to be uniquely identified online.

In *STEP 7*, the identification data are displayed in the "Module states - IM 151" and "Properties ..." tabs and are loaded to the modules with "Load module identification data..." under the menu command "Target system" (see *STEP 7* Online Help).

Identification data

You can directly access specific identification data by selecting **Read data record**. Obtain the corresponding part of the identification data under the associated data record index.

The data records are structured as follows:

Table 3- 1 Basic structure of data records with identification data for PROFINET IO

Contents	Length (bytes)	Coding (hex)
Header information		
BlockType	2	I&M0: 0020 I&M1: 0021 I&M2: 0022 I&M3: 0023
BlockLength	2	I&M0: 0038 I&M1: 0038 I&M2: 0012 I&M3: 0038
BlockVersionHigh	1	01
BlockVersionLow	1	00
Identification data		
Identification data (see table below)	I&M0 / Index AFF0: 54 I&M1 / Index AFF1: 54 I&M2 / Index AFF2: 16 I&M3 / Index AFF3: 54	

The data structures in the data records correspond to the PROFINET IO definitions.

Table 3- 2 Identification data for PROFINET IO

Identification data	Access	Default setting	Description
Identification data 0: (data record index AFF0 hex)			
VendorIDHigh	read (1 bytes)	00 hex	The name of the manufacturer is stored here. (42 dec = SIEMENS AG)
VendorIDLow	read (1 bytes)	2A hex	
Order_ID	read (20 bytes)		Order number of the module
IM_SERIAL_NUMBER	read (16 bytes)	-	Serial number (device specific)
IM_HARDWARE_REVISION	read (2 bytes)	1	Corresponding hardware version
IM_SOFTWARE_REVISION	read	Firmware version	Indicates the firmware version of the module.
• SWRevisionPrefix	(1 byte)	V, R, P, U, T	
• IM_SWRevision_Functional_ Enhancement	(1 byte)	00 - FF hex	
• IM_SWRevision_Bug_Fix	(1 byte)	00 - FF hex	
• IM_SWRevision_Internal_ Change	(1 byte)	00 - FF hex	
IM_REVISION_COUNTER	read (2 bytes)	0000	Provides information on the assigned changes on the module. (not used)
IM_PROFILE_ID	read (2 bytes)	0000	Generic device
IM_PROFILE_SPECIFIC_TYPE	read (2 bytes)	0005 hex	on interface modules
IM_VERSION	read	0101 hex	Provides information on the identification data version (0101 hex = version 1.1)
• IM_Version_Major	(1 byte)		
• IM_Version_Minor	(1 byte)		
IM_SUPPORTED	read (2 bytes)	000E hex	Provides information on existing identification data (I&M1 to I&M3)
Maintenance data 1: (data record index AFF1 hex)			
IM_TAG_FUNCTION	Read/write (32 bytes)	-	Define a unique identifier for the module in this record.
IM_TAG_LOCATION	Read/write (22 bytes)	-	Define the installation location of the module.
Maintenance data 2: (data record index AFF2 hex)			
IM_DATE	Read/write (16 bytes)	YYYY-MM-DD HH:MM	Enter the installation date of the module here.
Maintenance data 3: (data record index AFF3 hex)			
IM_DESCRIPTOR	Read/write (54 bytes)	-	Define a comment describing the module in this record.

3.2 Configuring port 1 and port 2

Introduction

The interface module IM 151-3 PN has two ports, X1P1 and X1P2.

Configuring the ports in HW Config

Configure both ports in the "Properties of IM151-3 PN - Port..." dialog box of HW Config:

- Addresses tab: Diagnostic address of the respective port.
- Topology tab:

  You can specify a "Port interconnection".
- Options tab:

  To enable the port diagnostics, select the following for "Connection" under "Transmission Medium/Duplex": "Automatic settings (monitor)".

Reference

For more information about configuring, refer to the and the *STEP 7* online help.

See also

PROFINET system description
(http://support.automation.siemens.com/WW/view/en/19292127)

3.3 Option handling

3.3.1 Option handling and control data record

Operating principle

Option handling is a procedure which allows distributed stations with different real configurations (options) to be operated on the basis of just one configuration. Option handling is available with and without RESERVE modules and adding options.

Requirements

The parameter "Enable option handling" must be selected during configuration. Control takes place via a control data record used to define the desired options. The station will not be operational without a control data record.

Option handling

Option handling is available with and without RESERVE modules and adding options.

Control data record

A control data record 196 containing a slot assignment is defined for option handling.

Table 3- 3 Control data record

Byte	Element	Coding	Explanation
0	Block length	4 + number of slots	Header
1	Block ID	196	
2	Version	1	
3	Version	0	
4	Assignment of configured slot 1	Real slot 1	Describes which real slot in the device has been assigned to the configured slot in each element. Bit 7 = 1: indicates that a RESERVE module is valid.
5	Assignment of configured slot 2	Real slot 2	
:	:	:	
4 + max. slot - 1	Assignment of configured maximum slot	Real maximum slot	

Each element must contain the following information about the slot:

- Assignment of configured slot ⇔ real slot
- A slot can be qualified as a reserve module

Table 3- 4 Control element coding

Bit	Meaning
0 ... 6	0: Module not available (option handling without reserve modules) 1: Real slot (1 ... maximum slot)
7	1: RESERVE module permitted (only for option handling with RESERVE modules)

Special features

There are certain specific aspects of which you must be aware:

- Remanent storage of control data set in the interface module.
- Slot entries outside the target configuration are disregarded.
- This also applies to modules assigned to another IO controller in the shared device.
- The control data record can be reduced, but it must contain all entries up to the last slot of the current target configuration.
- Each real slot may exist only once in the data record.

Note

Changed options

Writing a control data record with changed options will lead to station failure followed by a cold station restart with the changed options.

Combination of option handling and shared device

Option handling is controlled by the head module (slot 0/subslot 1). The option handling function in a shared device is reserved only for those modules of the IO controller that have subscribed to the head module. Modules which have been assigned to another IO controller are therefore not relevant in the control data record. 1 to 1 assignment is implicitly assumed for these modules.

If a reference junction is used (RTD module), you must ensure that the RTD module slot is not changed if you also require the reference junction in TC modules of the sharing IO controller.

Error Messages

The control data record will return the following error messages, if necessary:

Error code	Meaning
0x80B1	Invalid length
0x80B5	Option handling not configured
0x80B8	Parameter error

3.3.2 Feedback data record

Feedback data record

The feedback data record is mapped via a separate data record, 197.

The feedback data record only exists for configured option handling. It always refers to the maximum quantity structure, which means 63 I/O slots. Partial reading is not possible.

Table 3- 5 Feedback data record

Byte	Element	Coding	Meaning
0	Block length	67	Header
1	Block ID	197	
2	Version	1	
3		0	
4	Status, slot 1	1	Bit 0 = 0: Reserve module, module removed or invalid Bit 0 = 1: Slot with correct module Bit 1-7: Reserved
5	Status, slot 2	2	
:	:	:	
66	Status, slot n	Maximum slot	

Error Messages

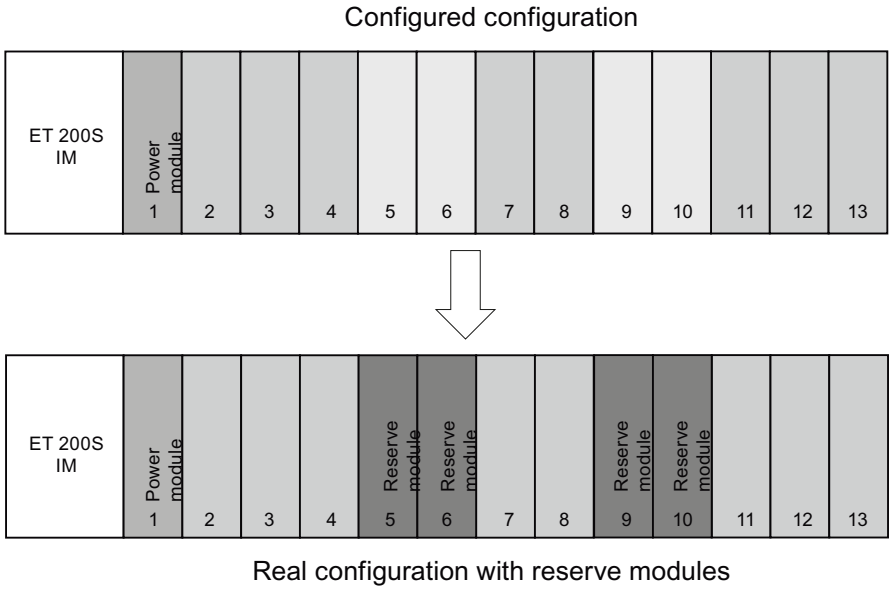
The feedback data record will return the following error messages, if necessary:

Error code	Meaning
0x80B1	Invalid length
0x80B5	Option handling not configured
0x80B8	Parameter error

3.3.3 Option handling when using RESERVE modules

Configuration versions

In option handling, the RESERVE modules will be inserted instead of the original modules in the slots that are not required.



Data record of the example

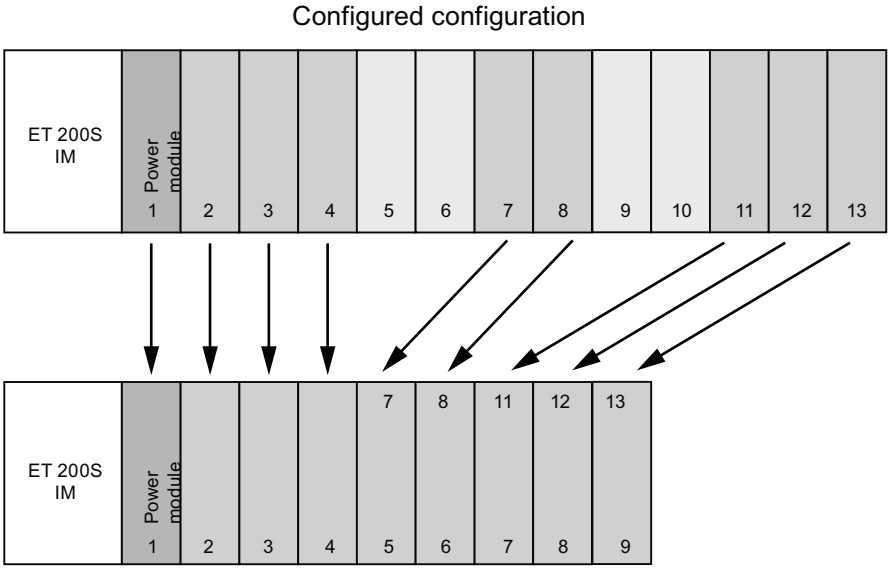
The following control data record structure applies for the example given above:

Byte	Element	Coding	Explanation
0	Block length	17	Header
1	Block ID	196	
2	Version	1	
3	Version	0	
4	Slot 1	1	The configured slot 1 is real slot 1.
5	Slot 2	2	The configured slot 2 is real slot 2.
6	Slot 3	3	The configured slot 3 is real slot 3.
7	Slot 4	4	The configured slot 4 is real slot 4.
8	Slot 5	5 + 0x80	The configured slot 5 is real slot 5 (and RESERVE module).
9	Slot 6	6 + 0x80	The configured slot 6 is real slot 6 (and RESERVE module).
10	Slot 7	7	The configured slot 7 is real slot 7.
11	Slot 8	8	The configured slot 8 is real slot 8.
12	Slot 9	9 + 0x80	The configured slot 9 is real slot 9 (and RESERVE module).
13	Slot 10	10 + 0x80	The configured slot 10 is real slot 10 (and RESERVE module).
14	Slot 11	11	The configured slot 11 is real slot 11.
15	Slot 12	12	The configured slot 12 is real slot 12.
16	Slot 13	13	The configured slot 13 is real slot 13.

3.3.4 Option handling without reserve modules

Configuration version

This version does not include the real modules that are not required. The configuration is compressed to the left towards IM151-3 PN.



Real (reduced) configuration

Data record of the example

The following control data record structure applies for the example given above:

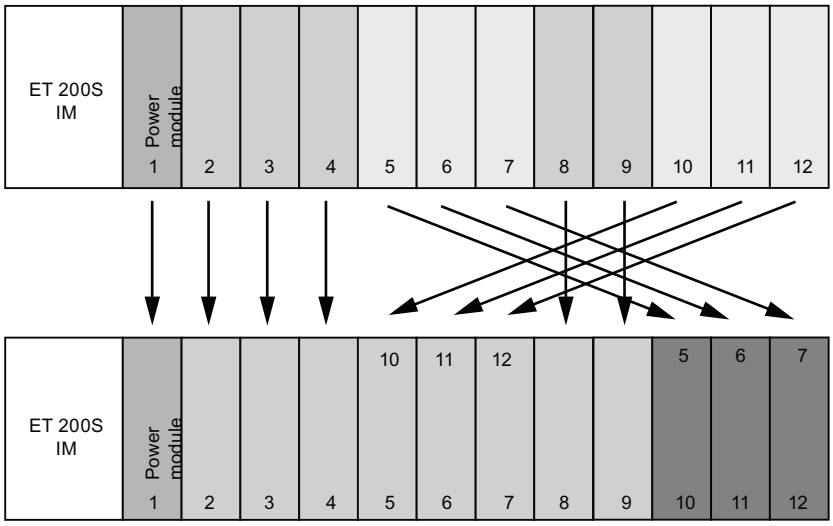
Byte	Element	Coding	Explanation
0	Block length	17	Header
1	Block ID	196	
2	Version	1	
3	Version	0	
4	Slot 1	1	The configured slot 1 is real slot 1.
5	Slot 2	2	The configured slot 2 is real slot 2.
6	Slot 3	3	The configured slot 3 is real slot 3.
7	Slot 4	4	The configured slot 4 is real slot 4.
8	Slot 5	0	The configured slot 5 does not exist.
9	Slot 6	0	The configured slot 6 does not exist.
10	Slot 7	5	The configured slot 7 is real slot 5.
11	Slot 8	6	The configured slot 8 is real slot 6.
12	Slot 9	0	The configured slot 5 does not exist.
13	Slot 10	0	The configured slot 6 does not exist.
14	Slot 11	7	The configured slot 11 is real slot 7.
15	Slot 12	8	The configured slot 12 is real slot 8.
16	Slot 13	9	The configured slot 13 is real slot 9.

3.3.5 Adding options

Configuration version

This version allows modules to be added to the end of the configuration. If the "add" option is not selected, RESERVE modules need not necessarily be inserted for these modules. You can also add options from the middle of the configurations using free slot assignment.

Configured configuration



Real upgraded configuration

Data record of the example

The following control data record structure applies for the example given above:

Byte	Element	Coding	Explanation
0	Block length	16	Header
1	Block ID	196	
2	Version	1	
3	Version	0	
4	Slot 1	1	The configured slot 1 is real slot 1.
5	Slot 2	2	The configured slot 2 is real slot 2.
6	Slot 3	3	The configured slot 3 is real slot 3.
7	Slot 4	4	The configured slot 4 is real slot 4.
8	Slot 5	10	The configured slot 5 is real slot 10.
9	Slot 6	11	The configured slot 6 is real slot 11.
10	Slot 7	12	The configured slot 7 is real slot 12.
11	Slot 8	8	The configured slot 8 is real slot 8.
12	Slot 9	9	The configured slot 9 is real slot 9.
13	Slot 10	5	The configured slot 10 is real slot 5.
14	Slot 11	6	The configured slot 11 is real slot 6.
15	Slot 12	7	The configured slot 12 is real slot 7.

3.3.6 Option handling and combining procedures

Configuration versions

You can combine all procedures with option handling.

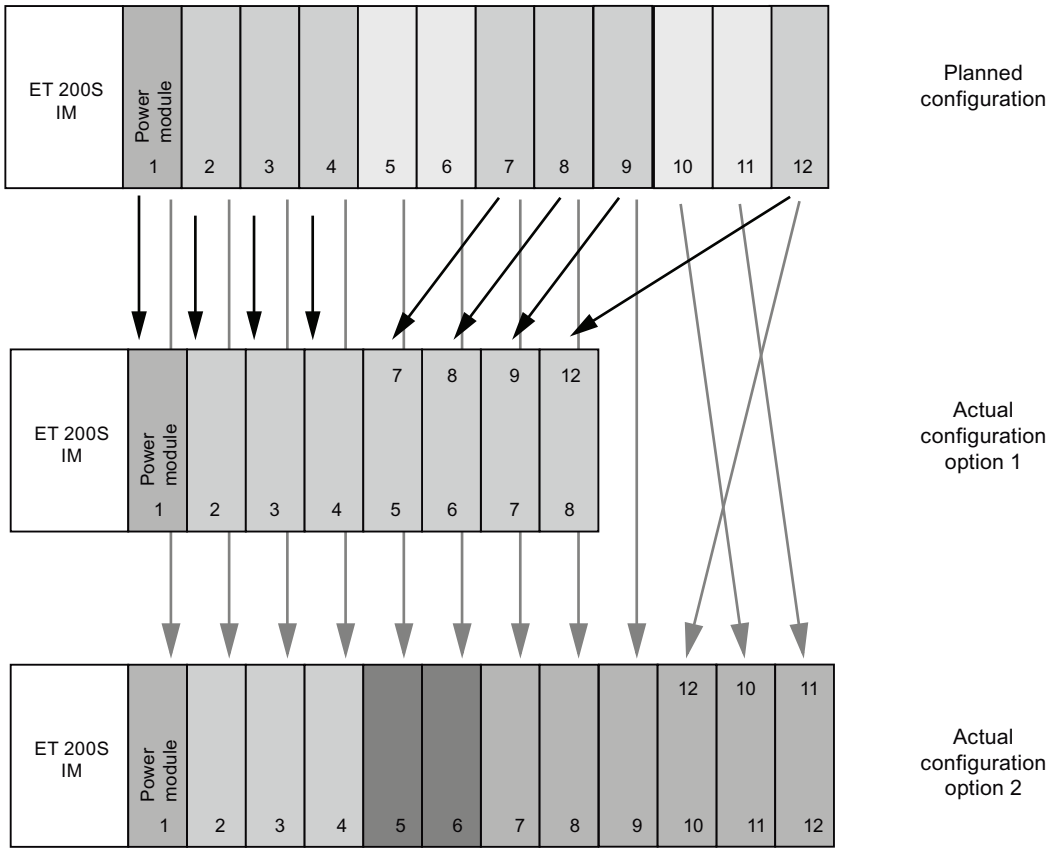


Figure 3-1 Combination of all procedures

Data record of the example

The following control data record structure applies for the example given above:

Byte	Element	Coding option 1	Coding option 2	Explanation
0	Block length	16		Header
1	Block ID	196		
2	Version	1		
3	Version	0		
4	Slot 1	1	1	The configured slot 1 is real slot 1.
5	Slot 2	2	2	The configured slot 2 is real slot 2.
6	Slot 3	3	3	The configured slot 3 is real slot 3.
7	Slot 4	4	4	The configured slot 4 is real slot 4.
8	Slot 5	0	5 + 0x80	The configured slot 5 does not exist (option 1). The configured slot 5 is real slot 5 and RESERVE module (option 2).
9	Slot 6	0	6 + 0x80	The configured slot 6 does not exist (option 1). The configured slot 6 is real slot 6 and RESERVE module (option 2).
10	Slot 7	5	7	The configured slot is real slot 5 (option 1). The configured slot 7 is real slot 7 (option 2).
11	Slot 8	6	8	The configured slot is real slot 6 (option 1). The configured slot 8 is real slot 8 (option 2).
12	Slot 9	7	9	The configured slot 9 is real slot 7 (option 1). The configured slot 9 is real slot 9 (option 2).
13	Slot 10	0	11	The configured slot 10 does not exist (option 1). The configured slot 10 is real slot 11 (option 2).
14	Slot 11	0	12	The configured slot 11 does not exist (option 1). The configured slot 11 is real slot 12 (option 2).
15	Slot 12	8	10	The configured slot 12 is real slot 8 (option 1). The configured slot 12 is real slot 10 (option 2).

Option handling with the packing function

You can combine option handling with the packing function (summary of modules within one byte). However, it is not possible to change the slot order of packed modules.

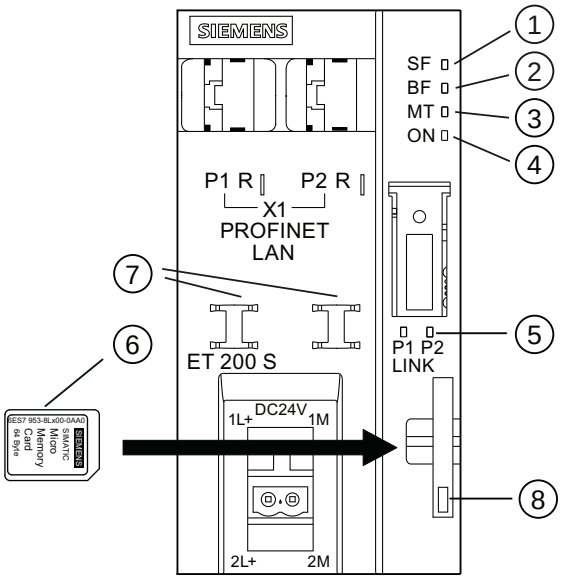
Interrupt, error, and system messages

4

4.1 Diagnostics using LED display

LED display

LED display on the IM151-3 interface module:



① Group error (red)
② Bus fault (red)
③ Maintenance display (yellow)
④ Supply voltage (green)
⑤ Connection to a switch or IO controller (green)
⑥ SIMATIC Micro Memory Card
⑦ Cable connection
⑧ Locking / unlocking (ejector) of the Micro Memory Card

Status and error displays

Table 4- 1 Status and error displays of the IM151-3

LEDs				Meaning	Remedy
SF	**BF**	**MAINT**	**ON**		
Off	Off	Off	Off	There is no voltage at the interface module, or the interface module has a hardware defect.	• Switch on the 24 V DC supply voltage at the interface module.
*	*	*	On	There is voltage at the interface module.	–
*	Flashing 0.5 Hz	*	On	Faulty or no connect message frame - no data transfer between the IO controller and the interface module (IO device), although the device is physically connected to the switch. Causes: • Incorrect device name • Configuration error • Parameter assignment error • The I/O controller is disconnected/defective or the bus cable to the controller is missing.	• Check the interface module. • Check the configuration and parameter assignment. • Check the device name. • Assign a valid device name to the interface module. • Check the IO controller • Check to see if the rear panel bus has been configured correctly (all modules inserted, terminating resistor installed)
*	On	*	On	The IO device is not connected to a switch.	• Establish a connection to the IO controller (via a switch). • Assign a valid device name to the interface module. • Check the bus configuration. • Check that the bus connector is correctly inserted. • Check whether the bus cable to the I/O controller is interrupted.
On	*	*	On	The configured structure of the ET 200S does not match the actual structure of the ET 200S.	• Check the ET 200S configuration to see whether a module is missing or defective, or whether a non-configured module has been installed. • Check the configuration (e.g. in *STEP 7*) and correct any parameterization errors.
				• There is an error in an I/O module, or the interface module is defective. • Diagnostics data available	• Replace the interface module, or contact your Siemens representative. • Remove error, e.g.: wire break
On	On	*	On	A brand new SIMATIC Micro Memory Card is being formatted.	• Wait until the formatting sequence is complete. This may take several minutes. The formatting sequence is completed when the SF LED goes out.

LEDs				Meaning	Remedy
SF	BF	MAINT	ON		
Off	Off	*	On	Data exchange is taking place between the IO controller and the ET 200S. The target configuration and actual configuration of the ET 200S match.	–
On	On	*	Off	FW update (with Micro Memory Card) is running	
Off	Flashing 0.5 Hz	*	Off	FW update (with Micro Memory Card) has been carried out successfully	
On	Flashing 0.5 Hz	*	Off	External error during FW update (with Micro Memory Card) (incorrect FW, for example)	• Use the correct FW for the update.
On	Flashing 2 Hz		Off	Internal error during FW update (with Micro Memory Card) (read/write error, for example)	• Repeat the FW update.
*	*	On	On	• Loss of synchronization	See alsoMaintenance alarms (Page 45)
*) not relevant					

LEDs P1/P2	Meaning	Remedy
Off	No connection to switch/IO controller.	Check whether the bus cable to the switch/IO controller is interrupted.
On	Connection to switch/IO controller.	-

LED display of setup errors

Properties

The configuration and parameter assignment errors of the ET 200S distributed I/O system are output at the interface module by means of the LEDs group error **SF** (red) and bus error **BF** (red).

Requirements

The function is available at the IM151-3 starting with order number 6ES7151-3AA23--0AB0, firmware version 7.0:

Principle of operation

The information about the cause of the problem is determined by means of the LED fault display. After an announcement by means of a flashing signal, the respective error type and after that the error location / error code are displayed.

The LED fault display of the configuration and parameter assignment errors

- Is activated both during POWER ON and during operation.
- Takes precedence over all other states that are displayed by the SF and BF LED.
- Remains activated until the cause of the problem has been eliminated.

After a change in the ET 200S configuration, a POWER OFF/POWER ON is required at the interface module.

Procedure		Description
1	LEDs SF and BF flash 3x at 0.5 Hz	Announcement of error type
2	LED BF flashes at 1 Hz	Display of the error type (decimal)
3	LEDs SF and BF flash 3x at 2 Hz	Announcement of the error location / error code
4	LED SF flashes at 1 Hz	Display of the decade (decimal) of the error location / error code
5	LED BF flashes at 1 Hz	Display of the unit position (decimal) of the error location / error code
6	Repetition of 1 - 5 until the cause of the problem has been eliminated.	

Error display

Error type (BF)	Error location (SF/BF)	Cause of error	Remedy
1	01 to 63 (slot)	**Communication interruption** Displays the first slot at which no I/O module is recognized. • Missing I/O module during POWER ON or several I/O modules are missing during operation. • Interruptions at the rear panel bus • Short-circuit at the rear panel bus ("01" is output as the slot) • Terminating module missing If the termination module is missing, the number of inserted I/O modules + 1 is output (if there is no set configuration)	Check the configuration of the ET 200S.

4.2 Diagnostics messages of the electronic modules

Actions after a diagnostics message

Each diagnostics message triggers the following actions:

- The SF LED on the interface module lights up.
- Several diagnostics messages can be output simultaneously.
- Diagnostics data is reported as diagnostics interrupts and can be read from data records.
- When a diagnostics message is output, it is saved to the diagnostics buffer of the I/O controller.
- OB 82 is called. If OB 82 is not available, the I/O controller will switch to STOP.
- Acknowledgment of the diagnostics interrupt (thereafter a new interrupt is possible).

Causes of errors and troubleshooting

The causes of faults and corrective measures for the diagnostics messages are described in this manual in the chapter entitled "Channel diagnostics" under "Interrupt, cause and system messages to the PROFINET IO."

See also

Channel diagnostics (Page 41)

4.3 Substitute value behavior

Substitute value behavior

In the IM 151-3 PN station the substitute value behavior is effected slot-granularly specifically by controller.

The respective output behaves in accordance with its configured substitute value behavior:

- "De-energized / power down"
- "Output substitute value"
- "Retain last value"

The substitute value behavior is triggered in the following cases:

- Stop controller
- Controller failure (communication interruption)
- FW update
- Reset to factory settings
- Failure of two or more modules in the station

Note

Reduction of a configuration

If you reduce the configuration of the station and load the configuration into the CPU, the modules that are no longer configured but still exist in the station retain their original substitute value behavior until the supply voltage at the power module or at the interface module is interrupted.

4.4 Diagnostics

4.4.1 Reading out diagnostics

Options for reading out diagnostics

Table 4- 2 Reading diagnostics data in STEP 7

Automation system with IO controller	Block or tab in *STEP 7*	Application	See ...
SIMATIC S7	In HW Config with the menu command "Station > Open online"	Device diagnostics in plain text on the STEP 7 interface (in the Quick View, Diagnostics View, or Module Status windows)	"Diagnosing hardware" in *STEP 7 online help*
	SFB 52 "RDREC"	Reading data sets from the I/O device	SFB see *STEP 7 online help* (System functions/Function blocks)
	SFB 54 "RALRM"	Receiving interrupts from the I/O device	SFB see *STEP 7 online help* (System functions/Function blocks)
SIMOTION SCOUT	System function _ReadRecord	This system function causes a data record transfer from an I/O module to the user program.	Online help for SIMOTION SCOUT

4.4.2 Channel diagnostics

Function

Channel diagnostics provide information about channel errors in the modules.

Channel errors are mapped as channel diagnoses in I/O diagnostics data records.

The data record is read with the SFB 52 RDREC (read data record).

Structure of diagnostic data records

Data records supported by ET 200S are based on PROFINET IO - Application Layer Service Definition V2.0.

The standard can be downloaded free of charge from the homepage of the PROFIBUS user organization (http://www.profibus.com).

Additional information regarding the data records for PROFINET IO

You can find the structure of the diagnostic data records and examples for programming in the *From PROFIBUS DP to PROFINET IO* Programming Manual in the Internet (http://support.automation.siemens.com/WW/view/en/19289930).

Structure of the manufacturer-specific diagnostic data records

The structure of the diagnostic data records is differentiated by the BlockVersion. The following BlockVersions apply to the IM 151-3 PN interface module:

Interface Module IM 151-3 PN	BlockVersion
6ES7151-3AA10-0AB0	W#16#0100
6ES7151-3xx2x-0AB0 and later	W#16#0101

Manufacturer-specific diagnostics in the User Structure Identifier (USI)

For the IM 151-3 PN interface module, the following manufacturer-specific diagnostics are signaled in the USI.

- Interruption of the ET 200S rear panel bus: USI = W#16#0001
- Incorrect module combination: USI = W#16#0002

Structure USI = W#16#0001

Table 4- 3 Structure USI = W#16#0001

Data block name		Contents	Comments	Bytes
USI		W#16#0001	Manufacturer-specific diagnostics for interruption of the ET 200S rear panel bus	2
3 reserved bytes follow				
	Reserved			1
	Reserved			1
	Reserved			1
Slot number starting at which the rear panel bus is interrupted.				
	SlotNumber	B#16#00 to B#16#11		1

Structure USI = W#16#0002

Table 4- 4 Structure of USI = W#16#0002

Data block name		Contents	Comments	Bytes
USI		W#16#0002	Manufacturer-specific diagnostics for incorrect module combinations	2
The slot number at which the incorrect combination was configured.				
	SlotNumber	B#16#00 to B#16#11		1

Structure USI = W#16#0000

If USI = W#16#0000 is signaled, then the IM151-3 signals a process interrupt. Consult the device manual for a description of the structure.

4.4.3 Incorrect ET 200S module configurations on PROFINET IO

Incorrect module configurations

The following incorrect configuration states of the ET 200S result in a failure of the ET 200S IO device or prevent data exchange.

- Starting with 2 missing modules
- Terminating module missing
- Number of modules exceeds maximum configuration
- Rear panel bus fault (for example, defective terminal module)

Note

The IO device will not start up if one or more modules are missing (gap) and the ET 200S is switched on.

See also:

Diagnostics using LED display (Page 35)

4.4.4 Interruption of the ET 200S backplane bus

Separate diagnostics of bus interruption

If the ET 200S does not start up, the causes can be as follows:

- One or several missing modules
- Terminating module missing
- Number of modules exceeds maximum configuration
- Backplane bus fault (for example, defective terminal module)

If the data exchange is interrupted, it may have the following causes:

- At least two modules (compared to a missing module, this is no longer a gap, but rather a loose backplane bus)
- Terminating module missing
- Backplane bus fault (for example, defective terminal module)

ET 200S backplane bus interruptions do not trigger an interrupt.

You can read this information with STEP 7 in the SIMATIC Manager via "Accessible participants" in the "Module status" window. To this end, the PD must be available in the PROFINET sub-net. The information is displayed in text format.

Additional information

You will find additional information in the programming instructions "From PROFIBUS DP to PROFINET IO (http://support.automation.siemens.com/WW/view/en/19289930)."

See also:

Diagnostics using LED display (Page 35)

4.4.5 Failure of the load voltage from the power module

Load voltage failure

Should the load voltage of the power module fail, the electronic modules will behave as follows:

- If an electronic module is removed during a load voltage failure, a remove-module interrupt is triggered.
- If an electronic module is inserted during a load voltage failure, an insert-module interrupt is triggered.

Note

Electronic modules that are re-parameterized during operation must be parameterized yet again once the load voltage has been restored to the power module.

4.4.6 STOP of the IO controller and recovery of the IO device

Diagnostics events triggered by a STOP of the IO controller

Diagnostics frames received from the IO device while the IO controller is in STOP will not initiate a call of any corresponding OBs after when the IO controller goes into RUN. To obtain an overview of the device state, call OB 100.

Diagnostics after recovery of the IO device

After the recovery of an IO device, call SFB 52 to read data record $E00C_H$. This record contains all diagnostics data of the IO device slots IO assigned to an IO controller.

4.5 Maintenance alarms

Introduction

The PROFINET interfaces of the interface module support the diagnostic and maintenance concept in PROFINET in accordance with IEC 61158-6-10. The goal is early detection and correction of potential errors.

On the interface module, maintenance interrupts signal to the the user when network components must be checked or replaced.

Maintenance interrupts

The interface module signals a maintenance interrupt to the higher-level diagnostics unit when the following events occur:

Maintenance interrupts	Event	Message/Meaning
Maintenance demanded LED MT is lit	Loss of synchronization	• No synchronization message frame received After parameter assignment or during operation, the sync master did not receive a synchronization message frame within the timeout period. • Successive synchronization telegrams lie outside the permitted limits (jitter)

System alarms in *STEP 7*

The maintenance information is generated in *STEP 7* with the following system alarms:

- Maintenance required, identified by a yellow wrench per port.

4.6 Evaluating the interrupts of the ET 200S

Introduction

The I/O device generates interrupts as a reaction to specific error events. Interrupts are evaluated based on the I/O controller used.

Evaluating interrupts with IO controller

The ET 200S supports the following interrupts

- Diagnostic interrupts
- Process interrupts
- Insert/remove module interrupts
- Maintenance interrupts

An interrupt automatically initiates execution of the interrupt OBs in the CPU of the IO controller (see the *Programming Manual System Software for S7-300/S7-400*, under "Program design.".

Information on the cause and class of the error is already available based on the OB number and start information.

You can obtain detailed information on the error event in the error OB with SFB 54 RALRM (read supplementary interrupt information).

Triggering of a diagnostic interrupt

When an incoming or outgoing event (e.g., wire break) is registered the module triggers a diagnostic interrupt: if "Enable: Diagnostic interrupt" is set.

The CPU interrupts processing of the user program and processes the OB 82 diagnostic block instead. The event that triggered the interrupt is entered in the OB 82 start information.

Triggering a process interrupt

When the CPU receives a process interrupt it interrupts the user program and processes the OB 40 process interrupt. The event that triggered the interrupt is entered in the OB 40 start information.

Note

Process interrupts should not be used for technological purposes (e.g., cyclical generation of process interrupts).

Triggering of an insert/remove-module interrupt

The CPU interrupts processing of the user program and processes the OB 83 diagnostic block instead. The event that triggered the interrupt is entered in the OB 83 start information.

Diagnosis "Process interrupt lost"

The "Process interrupt lost" diagnosis is not currently available for the following modules:

- 2DI DC24V HF (6ES7131-4BB01-0AB0),
- 4DI DC24V HF (6ES7131-4BD01-0AB0) and
- 4DI UC24..48V HF (6ES7131-4CD00-0AB0)

Note

Process interrupts should not be used for technological purposes (e.g., cyclical generation of process interrupts).

Depending on the number of I/O modules and the communication load, process interrupts may be lost if more than approx. 50 are generated per second.

Response times

5

5.1 Response times of PROFINET IO

Calculating the response time of the IM151-3 PN

Use the following formula for an approximate calculation of the ET 200S response time.

Response time [µs]: 390

+ Maximum of (380 + 9m + 11do) or (24m + 40ai + 80t)

+ Maximum of (120 + 9m) or (24 + 9do + 40ao + 80t)

m	Total number of all modules (power modules, digital electronic modules, analog electronic modules, technological modules)
do	Sum total of all digital output modules
di	Sum total of all digital input modules
ao	Sum total of all analog output modules
ai	Sum total of all analog input modules and electronic modules 1SSI fast, 1COUNT fast
t	Number of all technology modules (except 1SSI fast, except 1COUNT fast)

Note

The formula specified applies to cyclic data transfer. The following requirements must be fulfilled:

- No diagnostics are reported.
- No process interrupts are reported.
- No data record traffic to I/O modules.

5.2 Response time for digital input modules

Input delay

The reaction times of the digital input modules depend on the input delay.

Reference

Information on the input delays can be found in the technical data of the *manual* for the relevant digital electronic module.

5.3 Response time for digital output modules

Output delay

The response times correspond to the output delay.

Reference

Information on the output delays can be found in the technical data of the *manual* for the relevant digital electronic module.

5.4 Response time for analog input modules

Conversion time

The conversion time comprises the basic conversion time and the processing time for wire break check diagnostics.

In integrative conversion processes, the integration time is included directly in the conversion time.

Cycle time

The analog/digital conversion and the transfer of the digitized measured values to memory or to the backplane bus take place sequentially. In other words, the analog input channels are converted one after the other. The cycle time, that is, the time until an analog output value is converted again, is the sum of the conversion times of all the activated analog output channels of the analog input modules. You should deactivate unused analog input channels during parameter assignment in order to reduce the cycle time. The conversion and integration time for a deactivated channel is 0.

The following figure gives you an overview of what the cycle time for an n-channel analog input module comprises.

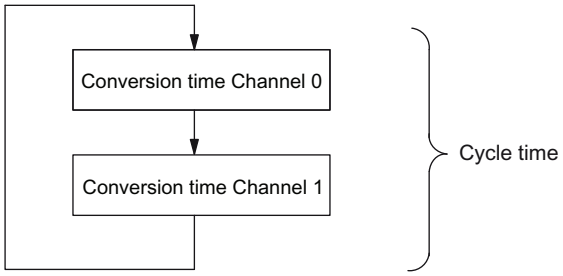


Figure 5-1 Cycle time of the analog input module

Reference

Information on the conversion times can be found in the technical data of the *manual* for the relevant analog electronic module.

5.5 Reaction times of analog output modules

Conversion time

The conversion time of the analog output channels comprises the time for the transfer of the digitized output values from internal memory and the digital/analog conversion.

Cycle time

The conversion of the analog output channels for the module takes place with a processing time and sequentially with a conversion time for channels 0 and 1.

The cycle time, i.e. the time until an analog output value is converted again, is the sum of the conversion times of all the activated analog output channels and of the processing time of the analog output module.

The following figure provides you with an overview of what makes up the cycle time for an analog output module.

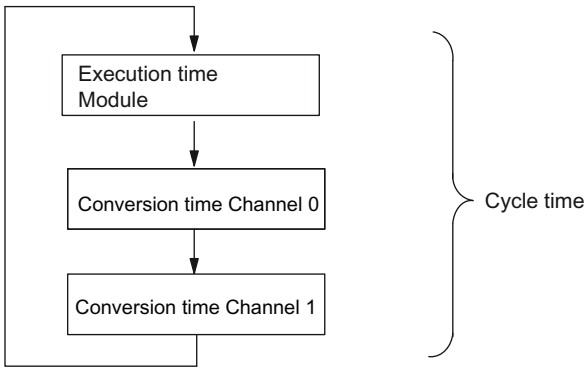


Figure 5-2 Cycle time of the analog output module

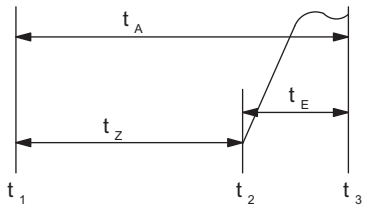
Settling time

The settling time (t_2 to t_3) i.e. the time from the application of the converted value until the specified value is obtained at the analog output - depends on the load. A distinction must be drawn between resistive, capacitive, and inductive loads.

Response time

The response time (t_1 to t_3) i.e., the time from the application of the digital output values in internal memory until the specified value is obtained at the analog output - is, in the most unfavorable case, the sum of the cycle time and the settling time. The most unfavorable case is when the analog channel is converted shortly before the transfer of a new output value and is not converted again until after the conversion of the other channels (cycle time).

This figure shows the response time of an analog output channel:



t_A Response time

t_Z Cycle time, corresponding to the processing time of the module and the conversion time of the channel

t_E Settling time

t_1 new digital value applied

t_2 output value transferred and converted

t_3 specified output value obtained

Figure 5-3 Response time of an analog output channel

Reference

Information on the conversion times can be found in the technical data of the *manual* for the relevant analog electronic module.

5.6 Response times for a 4 IQ-SENSE electronic module

The response time of the 4 IQ-SENSE electronic module is specified as a cycle time in the Technical Data.

5.7 Response times for technology modules

The response times of the technology modules are specified as response time or update rate in the Technical Data. See *ET 200S Technological Functions* Manual.

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