

SIEMENS

SIMATIC

ET 200S distributed I/O Interface module IM151-3 PN HIGH SPEED (6ES7151-3BA60-0AB0)

Manual

Preface

Properties

1

Parameters

2

Functions

3

Interrupt, error, and system messages

4

Response times

5

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
with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.
CAUTION
without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.
NOTICE
indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

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 for the specific task, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

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Note the following:

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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 adhered to. 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.

Preface

Preface

Purpose of the manual

This manual supplements the *ET 200S Distributed I/O System* Operating Instructions. Functions that apply generally to the ET 200S are described in the ET 200S distributed I/O system (<http://support.automation.siemens.com/WW/view/en/1144348>) operating instructions.

The information in this manual, the *ET 200S Distributed I/O System* Operating Instructions and the *SIMOTION SCOUT Communication System* Manual, enables you to commission the ET 200S.

Required basic knowledge

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 HIGH SPEED (6ES7151-3BA60-0AB0) firmware version V3.0 and higher.

Changes compared to the previous version

The following changes have been implemented compared to the IM151-3 PN HIGH SPEED (6ES7151-3BA60-0AB0) Manual, Edition 07/2009, with the number A5E01584178-02

- Shared Device
- Media redundancy
- Isochronous mode with SIMATIC CPU
- New I/O modules
- 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, 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 in the Internet (<http://www.siemens.com/simatic-tech-doku-portal>).

The online catalog and ordering systems are available in the Internet (<http://mall.automation.siemens.com>).

Training center

Siemens offers a series of courses that will help you getting started with 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>).

Technical Support

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.

Additional information about Siemens Technical Support is available on the Internet (<http://www.siemens.com/automation/service>).

Service & Support on the Internet

In addition to our documentation, we offer a comprehensive knowledge base on the Internet (<http://www.siemens.com/automation/service&support>).

There you will find:

- 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.

Table of contents

	Preface	3
1	Properties	7
1.1	IM151-3 PN HIGH SPEED interface module	7
1.2	SNMP	13
1.3	SIMATIC Micro Memory Card	14
1.4	Updating firmware	16
2	Parameters	17
2.1	Parameters for the IM151-3 PN HIGH SPEED interface module	17
2.2	Parameter description	17
2.2.1	Interference frequency suppression	17
2.2.2	Reference junction slot	17
2.2.3	Reference junction input	18
3	Functions	19
3.1	Identification data for PROFINET IO	19
3.2	Isochronous mode	21
3.3	Configuring port 1 and port 2	22
4	Interrupt, error, and system messages	23
4.1	Diagnostics using LED display	23
4.2	Diagnostic messages of the electronic modules	27
4.3	Substitute value behavior	28
4.4	Diagnostics	29
4.4.1	Diagnostics readout	29
4.4.2	Channel diagnostics	30
4.4.3	Incorrect module configurations of ET 200S on the PROFINET IO	32
4.4.4	Interruption of the ET 200S backplane bus	32
4.4.5	Failure of the load voltage from the power module	33
4.4.6	STOP of the IO controller and recovery of the IO device	34
4.5	Maintenance alarms	34
4.6	Evaluating the interrupts of the ET 200S	35
5	Response times	37
5.1	Response times of PROFINET IO	37
5.2	Response time for digital input modules	37
5.3	Response time for digital output modules	38
5.4	Response time for analog input modules	38
5.5	Reaction times of analog output modules	39
5.6	Response times for technology modules	40
	Index	41

Properties

1.1 IM151-3 PN HIGH SPEED interface module

Properties

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

- It interconnects ET 200S with PROFINET IO.
- It prepares the data for the connected electronic modules.
- It supplies the backplane 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 HIGH SPEED to the rail (protective conductor) is connected by means of an RC combination and therefore enables earth-free configuration.
- Interrupts
 - Diagnostic interrupts
 - Hardware interrupts
 - Maintenance interrupts
- Records for IO modules
- IM151-3 PN HIGH SPEED can be operated with up to 32 I/O modules.
- The maximum address space for the 32 I/O modules is 180 bytes of I/O data.
- The maximum bus length on the backplane bus is 0.5 m.

Properties via PROFINET IO

The IM151-3 PN HIGH SPEED interface module offers the following properties via PROFINET IO:

- Integrated switch with 2 ports
- Supported Ethernet services: ping, arp, net diagnostics (SNMP)/MIB-2, can be synchronized with the PNIO update cycle (isochronous mode), LLDP.
- Port diagnostics
- Port disabling
- Isochronous real time communication
- Isochronous mode
- Minimum update time 250 μ s
- 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. 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.

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 describes the PROFINET functionality to accelerate the startup of IO devices for RT and IRT communication within a PROFINET IO system.

The function shortens the time required by the respective configured IO devices to reach the cyclic user data communication in the following cases:

- after power supply has been restored
- after a station returns
- after activating IO devices

Note

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

Note

What factors influence startup times

The startup time depends on the number and type of modules.

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.

Cabling with fixed connection setting

If you set a fixed connection setting of the port in STEP 7, you should also 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 with this function can be exchanged easily:

- You do not require any removable media (e.g. Micro Memory Card) with saved device names.
- The device name does not have to be assigned with the PD.

The substituted IO device is given a device name by the IO controller and not by the removable media or the PD. To do this, the IO controller uses the configured topology and the neighborhood classifications established from the IO devices. In doing so, the configured set topology must agree with the actual topology.

We recommend that you reset IO devices that have already been in operation 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.

Requirements

The following conditions apply for a configuration with the IM151-3 PN HIGH SPEED (6ES7151-3BA60-0AB0) interface module:

- You can only use the IM151-3 PN HIGH SPEED in operation with RT/IRT settings with STEP 7 as of V5.5 also for Shared Device and ring structures per media redundancy.
- Topology configuration when you configure IRT with the option "high performance".

Resetting 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

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

Restrictions

- Switching off / on of the encoder or load voltage results in diagnostic or process interrupts.
- Switching off of the encoder or load voltage results in a CPU stop of the device in isochronous mode.
- The removal of modules during operation results in a CPU stop of the device.

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 Manual (<http://support.automation.siemens.com/WW/view/en/19292127>) Manual.

Shared Device

The Shared Device function describes the simultaneous operation in RT Class RT/IRT (option "high performance") of the device at a maximum of two controllers. The module slots of the device are assigned one to each controller.

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.

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.

Modules that you can use

Modules that you can use are specified in the Internet (<http://support.automation.siemens.com/WW/view/en/43256755>).

Note

Plugging of modules that are not approved

The plugging of or presence of modules that are not approved can result in the M151-3 PN HIGH SPEED not starting up.

Pin assignment

The following table shows the pin assignment of the IM151-3 PN HIGH SPEED 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 HIGH SPEED

View	Signal name	Designation	
	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+		24V DC
	2L+		24 V DC (for loop through)
	1M		Ground
	2M		Chassis ground (for loop through)

Block diagram

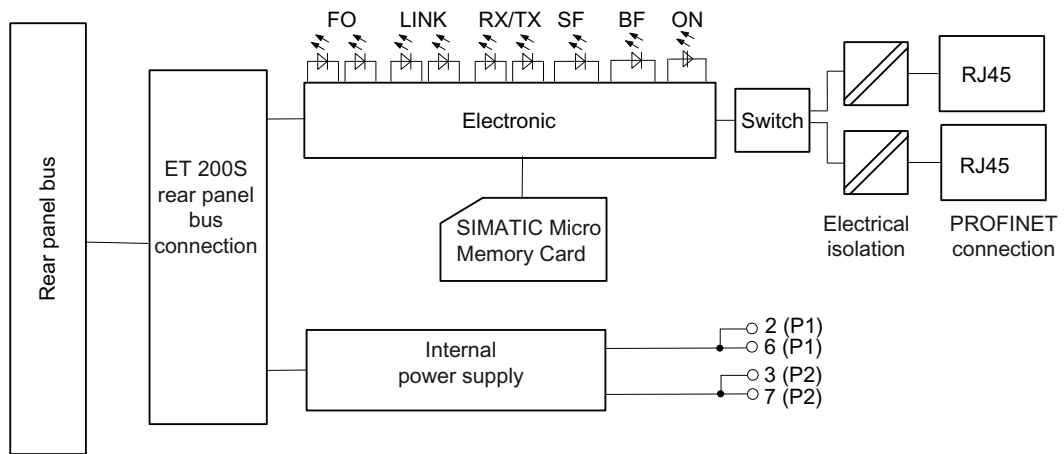


Figure 1-1 Block diagram of the IM151-3 PN HIGH SPEED interface module

Technical data IM151-3 PN HIGH SPEED (6ES7151-3BA60-0AB0)

Dimensions and weight	
Dimension B (mm)	60
Weight	Approx. 150 g
Module-specific data	
Data transmission rate	<ul style="list-style-type: none"> 10 Mbps for Ethernet services 100 Mbps full duplex for PROFINET IO
Transmission procedure	<ul style="list-style-type: none"> 100BASE-TX
Send clock	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> ping LLDP arp 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, electrical potentials	
Rated supply voltage of the electronics (1L+)	24 VDC
• Reverse polarity protection	Yes
• Power failure bypass	min. 20 ms
Electrical isolation	
• between the backplane 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 VDC / 60 V AC
Insulation tested with	500 VDC
Current consumption from rated supply voltage (1L+)	Approx. 350 mA
Power loss of the module	Max. 3.5 W
Status, interrupts, diagnostics	
Interrupts	Yes
Diagnostics function	Yes
• Group error	red "SF" LED
• Bus monitoring PROFINET IO	red "BF" LED
• Monitoring of the power supply voltage of the electronic circuit	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.

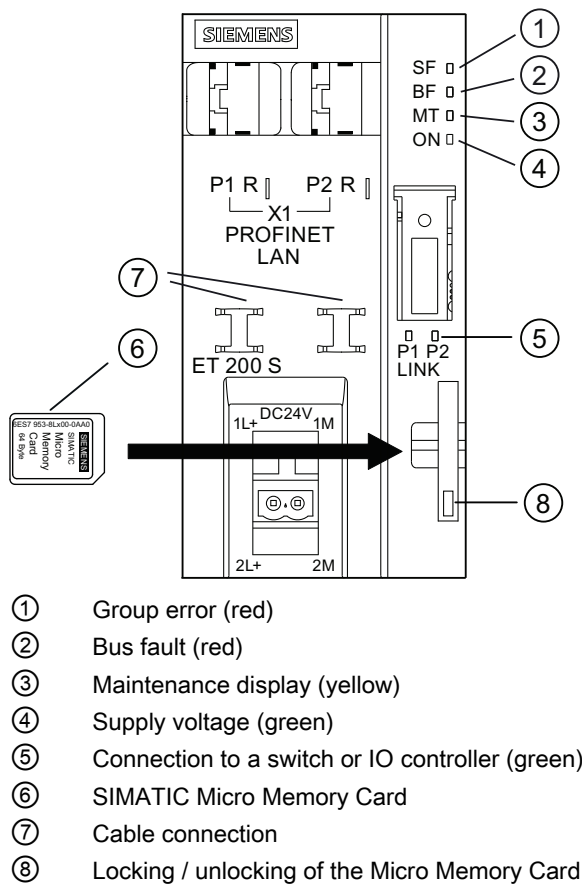
1.3 SIMATIC Micro Memory Card

SIMATIC Micro Memory Card (MMC) as memory medium

A SIMATIC Micro Memory Card is used as a memory medium for the IM151-3 PN HIGH SPEED.

A SIMATIC Micro Memory Card 64 KB is sufficient for storing the name of the device. An SIMATIC Micro Memory Card of at least 4 MB is required for a firmware update.

Position of the module slot for the SIMATIC 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 Updating firmware

Updating firmware

The firmware of an IM151-3 PN HIGH SPEED can be updated:

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

Additional information can be found in the Internet

(<http://support.automation.siemens.com/WW/view/en/19241998/133100>).

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

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

Requirements

In order to update the firmware of an IM151-3 PN HIGH SPEED you require:

- *STEP 7*, V5.3 or higher, SP 2
- A SIMATIC Micro Memory Card
- A PC or PD 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" option. In this case, you can delete the "Prioritized startup" parameter with "Reset to factory settings". You can then update the firmware again with the SIMATIC Micro Memory Card.

Parameters

2.1 Parameters for the IM151-3 PN HIGH SPEED interface module

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

IM151-3	Value range	Default setting	Applicability
Interference frequency suppression	50 Hz / 60 Hz	50 Hz	ET 200S
Reference junction slot	None / 2 to 32	None	ET 200S
Reference junction input	RTD on channel 0 / RTD on channel 1	0	ET 200S

2.2 Parameter description

2.2.1 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 all 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.

2.2.2 Reference junction slot

This parameter allows you to assign a slot (none, 2 to 32) 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.

2.2.3 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.

Functions

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	

3.1 Identification data for PROFINET IO

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.

Extension of the response time

The identification data operations can result in the extension of the response time during process data traffic and should be carried out with priority in the STOP of the controller.

3.2 Isochronous mode

Requirement

If you set IO devices for IRT communication with the "high performance" option, you also have to configure their topology.

Isochronous mode of process data

Process data, transfer cycle via PROFINET IO and user program are synchronized with each other to achieve the highest deterministic. The input and output data of distributed I/O devices in the system are detected and output simultaneously. The constant-bus-cycle-time PROFINET IO cycle is the clock generator for it.

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.

Acyclic services

To guarantee a fault-free isochronous operation, we recommend avoiding acyclic services (for example reference junction consideration at RTD) and keeping diagnostic interrupts to a minimum.

Note

An isochronous operation is only possible if all the configured modules are available and all the power modules are supplied with load voltage. If this is not the case, then the IM151-3 PN HIGH SPEED interface module will not change to data exchange or will abort it (e.g. if the load voltage fails).

Restriction

If the load voltage fails, the data communication is not sustained in isochronous mode.

Send clock

In isochronous operation, PROFINET IO and I/O modules are synchronized.

This means that output data from the current PROFINET message frame will be issued by the output modules to the terminals within a send clock (e.g. 250 μ s), . Almost simultaneously, the input modules will detect the input values at the terminals within the send clock and send these to the controller in the next send clock.

Maximum output data

The maximum output data in isochronous mode can be achieved under the following conditions:

- Three identical IM151-3 PN HIGH SPEED stations in the "Line" topology exclusively on the SIMOTION controller P350-3, V4.1 and later
- Maximum I/O address space of 70 bytes per station
- 250 µs send clock for IRT communication when "high performance" option is set.
- No other network components or no other data traffic on the SIMOTION controller P350-3, V4.1 and later

3.3 Configuring port 1 and port 2

Introduction

The interface module IM 151-3 PN HIGH SPEED 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 relevant port.
- Topology tab:
You can specify a "Port interconnection".
- "Options" tab:
To enable port diagnostics, select the following "Connection" setting at "Transmission Medium/Duplex": "Automatic settings (monitor)".

Reference

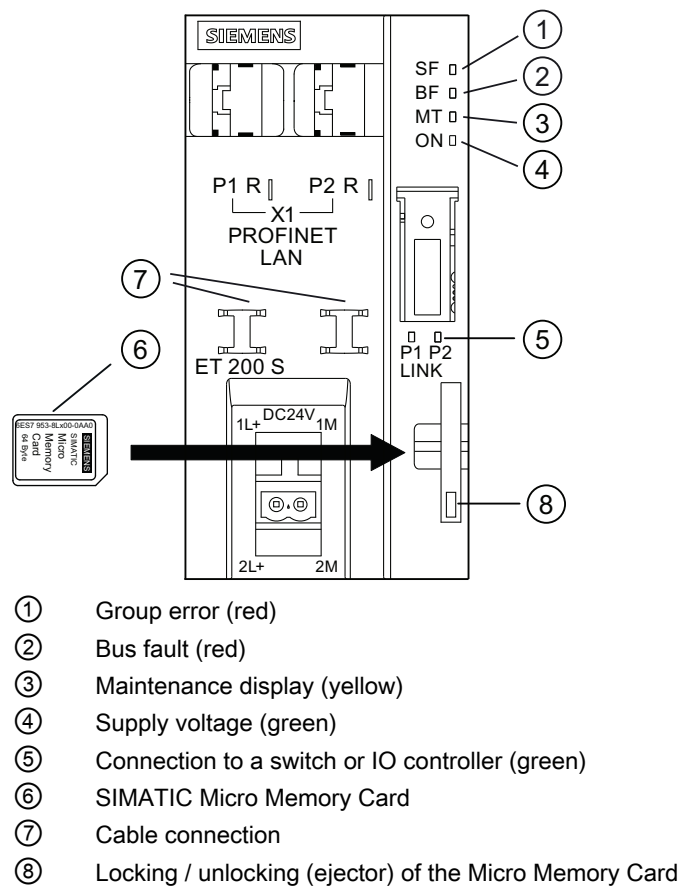
For more information about configuring, refer to the PROFINET system description (<http://support.automation.siemens.com/WW/view/en/19292127>) and the *STEP 7* online help.

Interrupt, error, and system messages

4.1 Diagnostics using LED display

LED display

LED display on the IM151-3 interface module:



Status and error displays

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

LEDs				Meaning	Remedy
SF	BF	MT	ON		
off	off	off	off	There is no voltage at the interface module, or the interface module has a hardware defect.	<ul style="list-style-type: none"> Switch on the 24 V DC supply voltage at the interface module.
*	*	*	on	There is voltage at the interface module.	–
*	flashes at 0.5 Hz	*	on	Incorrect or no connect message frame. Data communication is not taking place between the IO controller and the interface module (IO device). Causes: <ul style="list-style-type: none"> Incorrect device name Error in configuration Parameter assignment error The IO controller is disconnected/defective or the bus cable to the controller is missing. 	<ul style="list-style-type: none"> 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 backplane bus is correctly configured (all modules plugged, terminating resistor installed).
*	on	*	on	The IO device is not connected with the PROFINET IO system.	<ul style="list-style-type: none"> Establish a connection to the IO controller (via a switch). Assign a valid device name to the interface module. Check the bus installation. Check that the bus connector is correctly inserted. Check whether the bus cable to the IO controller is interrupted.
on	*	*	on	<ul style="list-style-type: none"> The configured structure of the ET 200S does not match the actual structure of the ET 200S. 	<ul style="list-style-type: none"> Check the structure of the ET 200S for missing or defective modules or whether an unconfigured module is inserted. Check the configuration (e.g. with HW Config), and correct any parameter assignment errors.
				<ul style="list-style-type: none"> There is an error in an I/O module, or the interface module is defective. Incoming diagnostics 	<ul style="list-style-type: none"> Replace the interface module, or contact your Siemens representative. Correct error (e.g. wire break)
on	off	*	on	Data communication is taking place between the IO controller and the ET 200S - diagnostics or maintenance are demanded.	–
on	on	*	on	A brand new SIMATIC Micro Memory Card is being formatted.	<ul style="list-style-type: none"> 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	MT	ON		
off	off	*	on	Data exchange is taking place between the IO controller and the ET 200S. The set configuration and actual configuration of the ET 200S match.	–
on	on	*	off	FW update (with Micro Memory Card) is running	–
off	flashes at 0.5 Hz	*	off	FW update (with Micro Memory Card) has been carried out successfully	–
on	flashes at 0.5 Hz	*	off	External error during FW update (with Micro Memory Card) (incorrect FW, for example)	<ul style="list-style-type: none"> Use the correct FW for the update.
on	flashes at 2 Hz	*	off	Internal error during FW update (with Micro Memory Card) (read/write error, for example)	<ul style="list-style-type: none"> Repeat the FW update.
*	*	on	on	<ul style="list-style-type: none"> Loss of synchronization 	See also Maintenance alarms (Page 34)
*) not relevant					

LEDs P1/P2	Meaning	Remedy
off	No connection to switch/IO controller.	
on	Connection to switch/IO controller.	

LED display of the configuration error

Properties

The configuration 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 6ES7151-3BA60-0AB0, firmware version 3.0:

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 32 (slot)	<p>Communication interruption</p> <p>Displays the first slot at which no I/O module is recognized.</p> <ul style="list-style-type: none"> • 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 <p>If the termination module is missing, the number of inserted I/O modules + 1 is output (if there is no set configuration)</p>	Check the configuration of the ET 200S.

4.2 Diagnostic messages of the electronic modules

Actions after a diagnostics message

Each diagnostic message triggers the following actions:

- The SF LED of the interface module lights up.
- Several simultaneous diagnostic messages are possible.
- Diagnostics data are reported as diagnostics interrupts and can be read from data records.
- Occurring interrupts are listed in the diagnostics buffer of the IO controller (CPUs). They can be read from data records with the respective system function.
- OB 82 is called in SIMATIC controllers (e.g. CPU 3xx or CPU4xx). If OB 82 is not available, the I/O controller goes into STOP.
- PeripheralFaultTask is called in the SIMOTION controller. If there is no PeripheralFaultTask, the SIMOTION controller goes to STOP operating state.
- Acknowledgment of the diagnostic interrupt (thereafter a new interrupt is possible).

Error types

The error types of the diagnosis messages are described in chapter "Channel diagnostics".

See also

Channel diagnostics (Page 30)

4.3 Substitute value behavior

Substitute value behavior

The substitute value behavior is defined slot-by-slot depending on the controller in the IM 151-3 PN HIGH SPEED station.

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
- Resetting to factory settings
- Failure of at least one module 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 Diagnostics readout

Introduction

Diagnostics data are saved in controllers (CPUs) via the device diagnostics in the diagnostic buffer.

Options for reading out the diagnostics

Table 4- 2 Reading out the diagnostics with STEP 7 and SCOUT

Automation system with IO controller	Block or tab in STEP 7	Application	Reference
SIMATIC S7	Open in HW Config with the menu command "Station > Online"	Device diagnostics in form of plain text on STEP 7 interface (in the Quick View, Diagnostics View, or Module Status windows)	"Diagnosing hardware" in <i>STEP 7 online help</i>
	SFB 52 "RDREC"	Read data sets from the I/O device	SFB see <i>STEP 7 online help</i> (system functions/-function blocks)
	SFB 54 "RALRM"	Receiving interrupts from the IO Device	SFB see <i>STEP 7 online help</i> (system functions/-function blocks)
SIMOTION SCOUT	System function _ReadRecord	The system function effects 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).

Error types of the other modules

The error types for the power modules, digital electronic modules, analog electronic modules, and technology modules can be found in the relevant manual.

Structure of diagnostic data records

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

The standard can be downloaded free of charge from the homepage of the Homepage for PROFIBUS user organization (<http://www.profinet.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 block versions apply to the IM151-3 PN HIGH SPEED interface module:

IM151-3 PN HIGH SPEED interface module	BlockVersion
As of 6ES7151-3xx6x-0AB0	W#16#0101

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

The following manufacturer-specific diagnostics are signaled in the USI for the IM151-3 PN HIGH SPEED interface module.

- Interruption of the ET 200S backplane 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	Comment	Bytes
USI	W#16#0001	Manufacturer-specific diagnostics for interruption of the ET 200S backplane bus	2
3 reserved bytes follow			
	Reserved		1
	Reserved		1
	Reserved		1
Slot number starting at which the backplane 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	Comment	Bytes
USI	W#16#0002	Manufacturer-specific diagnostics for incorrect module combinations	2
The slot number at which the combination was configured incorrectly.			
	SlotNumber	B#16#00 to B#16#11	1

4.4.3 Incorrect module configurations of ET 200S on the PROFINET IO

Incorrect module configuration states

The following incorrect ET 200S module configurations will cause the ET 200S IO device to fail or prevent data communication.

- a missing module
- terminating module missing
- number of modules exceeds maximum configuration
- backplane bus fault (for example, defective terminal module)

Note

The I/O 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 23)

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 user data communication is interrupted, it may be caused by the following:

- a missing module
- 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 on the topic of diagnostics:

You will find additional information in the From PROFIBUS DP to PROFINET IO (<http://support.automation.siemens.com/WW/view/en/19289930>) programming instructions and in the chapter Diagnostics using LED display (Page 23).

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:

- No output for output modules.
- Substitute values are generated for input modules.

CAUTION**Switching off load voltage**

Switching off the load voltage in isochronous mode will cause the station to fail.

The station will return once all the load voltages on the respective power modules have been switched on.

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.

Note**Switching of load voltage in non-isochronous mode**

Diagnostics and insert/remove module interrupts may occur if you switch off the load voltage in non-isochronous mode.

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 do not trigger the start of corresponding OBs after the restart of the IO Controller. To obtain an overview of the device state, call OB 100 (SIMATIC controller) or StartUpTask or ShutdownTask (SIMOTION controller) .

Diagnostics after recovery of the IO device

After the recovery of an IO device, call SFB 52 (SIMATIC controller) or _readRecord (SIMOTION controller) to read the E00C_H data record. 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	<ul style="list-style-type: none"> No synchronization message frame received <p>After parameter assignment or during operation, the sync master did not receive a synchronization message frame within the timeout period.</p> <ul style="list-style-type: none"> 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 IO device generates interrupts as a reaction to specific error events. Interrupts are evaluated based on the IO controller used.

The ET 200S supports the following interrupts:

- Diagnostic interrupts
- Hardware interrupts
- Maintenance interrupts

Evaluating interrupts with IO controller

Occurring interrupts are listed with the corresponding EventID in the diagnostics buffer of SIMOTION or SIMATIC controllers. They can be read from the SFB 52 data (SIMATIC controller) or the data records with the `_ReadRecord` system function (SIMOTION controller).

Initiating a Diagnostics Interrupt

With an event (e.g. wire break) the module triggers a diagnostic interrupt upon "Release: Diagnostic Interrupt" (submodule-defined).

The CPU interrupts user program execution, and executes diagnostic interrupt OB 82 (SIMATIC controller) or `PeripheralFaultTask` (SIMOTION controller). The event which led to the triggering of the interrupt is entered in the start information of the `PeripheralFaultTask`.

Note

In isochronous mode, restrict diagnostics interrupts to the minimum.

Triggering of a Hardware Interrupt

If a process interrupt occurs, the CPU interrupts user program execution and executes OB 40 (SIMATIC controller) or `PeripheralFaultTask` (SIMOTION controller). The event which led to the triggering of the interrupt is entered in OB 82 (SIMATIC controller) or in the start information of `PeripheralFaultTask` (SIMOTION controller).

Note

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

Diagnosis "Process interrupt lost"

The "Process interrupt lost" diagnostics are not currently available for the 4DI DC24V HF (6ES7131-4BD01-0AB0) module.

Response times

5.1 Response times of PROFINET IO

Calculation of the response time for this IM151-3 PN HIGH SPEED

The following equation enables you to make an approximate calculation of the ET 200S response time:

Response time [μ s]: 25

+ 15 (m/2 + 1) + maximum from [(6.5do + 9.5ao + 13.5t); (0.8m)] + maximum from [(7di + 10.5ai + 14.5t); (18)]

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.

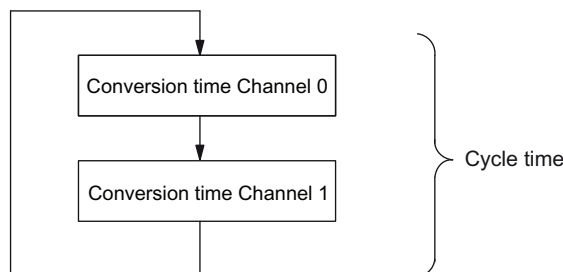


Figure 5-1 Cycle time of the analog input module

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.

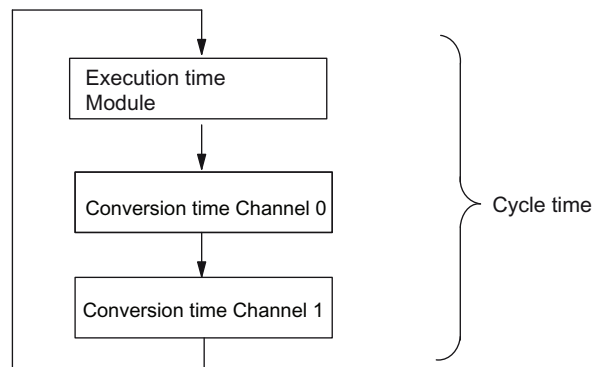


Figure 5-2 Cycle time of the analog output module

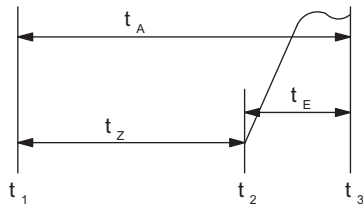
Settling time

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 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*.

Index

A

Applicability
Manual, 3

B

Block diagram, 12

C

Changes compared to the previous version, 3
Channel diagnostics, 30
Configuring
Ports, 22
Conversion time, 39
Cycle time, 38, 39

D

Device replacement without exchangeable
media/programming device, 9
Diagnostics, 29
After IO Controller STOP, 34
After recovery of the IO Device, 34
Disposal, 3

I

Identification data, 19
Internet
Service & Support, 4
IO Controller STOP, 34
Isochronous mode, 21
Isochronous real time communication, 8

L

LED display, 23
Configuration and parameter assignment errors, 25
Status and error indicator, 24

M

Maintenance interrupts
Loss of synchronization, 34
Network error, 34
Media redundancy, 10
Module
Not usable, 11

P

PeripheralFaultTask
Diagnostics, 34
Pin assignment, 11
Ports, 22
Prioritized startup, 9
Properties, 7
Properties via PROFINET IO, 8

R

Reading diagnostics data, 29
Recycling, 3
Required basic knowledge, 3
Response time, 40
Response times
analog input modules, 38
analog output modules, 39
digital input modules, 37
digital output modules, 38
Technological modules, 40

S

Service & Support, 4
Settling time, 39
Shared Device, 11
Shutdown task (shutdown), 34
SIMATIC Micro Memory Card, 14
Service life, 15
SIMATIC Micro Memory Cards
Order numbers, 15
SNMP, 13
Startup task (restart), 34

T

Technical data, 12
Technical Support, 4
Training center, 4

U

Updating firmware, 16