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ET 200S distributed I/O IM151-1 BASIC interface module (6ES7151-1CA00-0AB0)

Manual

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Preface

Purpose of the manual

This manual supplements the *ET 200S Distributed I/O System* Operating Instructions. General functions for the ET 200S are described in the *ET 200S Distributed I/O System* 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

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

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 these operating instructions, and do not find the answers in this document, please contact your local Siemens representative.

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- Information about on-site services, repairs, spare parts. Lots more can be found on our "Services" pages.

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Properties

1

Properties

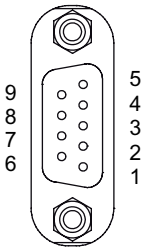
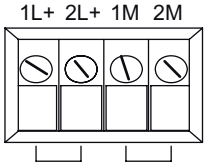
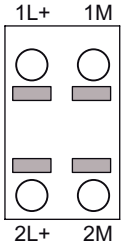
The IM151-1 BASIC interface module has the following features:

- It connects the ET 200S with PROFIBUS DP via the RS 485 interface.
- The maximum parameter length is 198 bytes.
- The maximum address space is 88 bytes for inputs and 88 bytes for outputs.
- Operation as a DPV0 slave
- A maximum of 12 modules can be operated with the IM151-1 BASIC.
- The maximum bus length is 2 m.

Terminal assignment

The following table shows the terminal assignment of the IM151-1 BASIC interface module for the 24 VDC voltage supply and PROFIBUS DP:

Table 1- 1 Terminal assignment of the IM151-1 BASIC interface module

View	Signal name		Name
	1	-	-
	2	-	-
	3	RxD/TxD-P	Data line B
	4	RTS	Request To Send
	5	M5V2	Data reference potential (station)
	6	P5V2	Supply plus (station)
	7	-	-
	8	RxD/TxD-N	Data line A
	9		
as of product version 5  product release 6 or later 	1L+		24 VDC
	2L+		24 VDC (for loop through)
	1M		Chassis ground
	2M		Ground (for loop through)

Block diagram

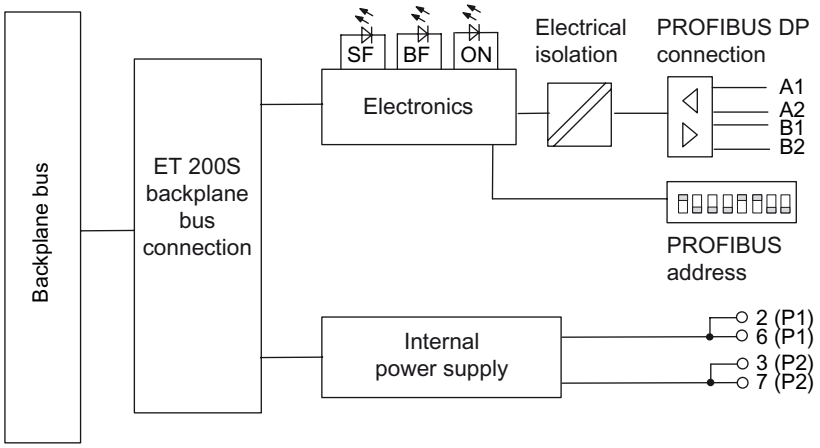


Figure 1-1 Block diagram for the IM151-1 BASIC interface module

Technical data IM151-1 BASIC (6ES7151-1CA00-0AB0)

Dimensions and weight	
Dimension B (mm)	45
Weight	Approx. 150 g
Module-specific data	
Data transmission rate	9.6; 19.2; 45.45; 93,75; 187.5; 500 kBaud, 1.5; 3; 6; 12 Mbit/s
Bus protocol	PROFIBUS DP
Interface	RS 485
SYNC capability	yes
FREEZE capability	yes
Manufacturer ID	$80F3_H$
Direct data exchange	yes
Cycle synchronization	No
Parameter length • IM • Maximum	 19 bytes 198 bytes per station
Address space	88 bytes I/O
Bus length	Max. 2 m
Number of modules that can be operated	Max. 12
Option handling	No
I&M data	No
Firmware update	No
Max. output current of the PROFIBUS DP interface (5, 6)	80 mA

Voltages, currents, potentials	
Rated supply voltage of the electronics (1L+)	24 VDC
• Incorrect polarity protection	Yes
• Power failure bypass	No
Galvanic isolation	
• Between the backplane bus and electronic components	No
• Between the PROFIBUS DP and electronic components	Yes
• Between the supply voltage and electronic components	No
Permitted potential difference (to the rail)	75 VDC, 60 VAC
Insulation test voltage	500 VDC
Current consumption from rated supply voltage (1L+)	Approx. 70mA
Power dissipation of the module	Typically 1.5 W
Status, interrupts, diagnostics	
Interrupts	None
Diagnostic function	Yes
• Group error	Red "SF" LED
• PROFIBUS DP bus monitoring	Red "BF" LED
• Monitoring of the power supply voltage of the electronics	Green "ON" LED

Parameters 2

2.1 Parameters for the IM151-1 BASIC interface module

Table 2- 1 Parameters for the IM151-1 BASIC interface module

IM151-1 BASIC	Value range	Default setting	Applicability
Operation at set < > actual configuration	disable/enable	disable	ET 200S
Identifier-related diagnostics	disable/enable	enable	ET 200S
Module status	disable/enable	enable	ET 200S
Channel-specific diagnostics	disable/enable	enable	ET 200S
Analog-value format [1]	SIMATIC S7/ SIMATIC S5	S7	ET 200S
Interference frequency suppression	50 Hz / 60 Hz	50 Hz	ET 200S
Reference junction slot	None / 2 to 12	None	ET 200S
Reference junction input	RTD on channel 0/RTD on channel 1	0	ET 200S
[1] The parameter only exists when configuring using the GSD file.			

2.2 Parameter description

2.2.1 Enable startup for set <> actual configuration

When this parameter is enabled, and

- Modules removed and inserted during operation will not lead to a ET 200S station failure.
- The actual configuration differs from the expected configuration, the ET 200S remains engaged in data transfer with the DP master.

When this parameter is disabled, and

- Modules removed and inserted during operation will lead to an ET 200S station failure.
- The actual configuration differs from the expected configuration, there is no data transfer between the DP master and the ET 200S.

2.2.2 Analog-value format

Here you set the number format for all analog electronic modules.

2.2.3 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. Here, enter the mains frequency in your system (50 Hz or 60 Hz).

The interference frequency suppression parameter applies to all analog electronic modules. With this parameter, you also specify the integration and conversion time of the various modules. See the technical data for the analog electronic modules.

2.2.4 Reference junction slot

This parameter allows you to assign a slot (none or 2 to 12) with a channel for measuring the reference temperature (calculation of the compensation value).

Reference

For information on connecting thermocouples, refer to the *manuals* for the *analog electronic modules*.

2.2.5 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

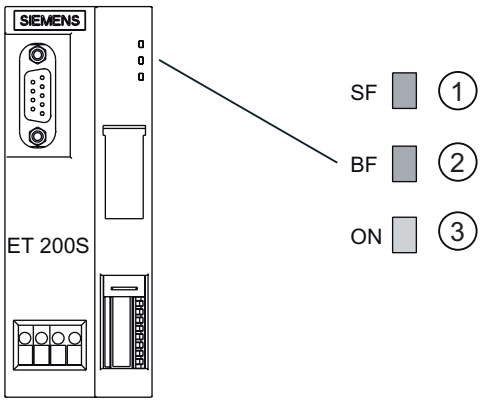
For information on connecting thermocouples, refer to the *manuals* for the *analog electronic modules*.

Error and system messages

3

3.1 LED displays on the interface module

LED display



① Group error (red)
② Bus fault (red)
③ Supply voltage (green)

Status and error displays

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

Event (LEDs)			Cause	Remedy
SF	BF	ON		
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, or replace the interface module.
*	*	On	There is voltage at the interface module.	---
*	Flashing	On	The interface module is not configured or is configured incorrectly. No data exchange is taking place between the DP master and the interface module. Causes: • The PROFIBUS address is incorrect. • Configuration error • Parameter assignment error	• Check the interface module. • Check the configuration and parameter assignment. • Check the PROFIBUS address.

Event (LEDs)			Cause	Remedy
SF	BF	ON		
*	On	On	Transmission rate detection, illegal PROFIBUS address, or bottom DIP switch (PROFIBUS address) not in the OFF position. Causes: • The response monitoring interval has elapsed. • Bus communication to the interface module via PROFIBUS DP is interrupted.	Set a valid PROFIBUS address (1 to 125) on the interface module or check the bus configuration. • Check that the bus connector is correctly inserted. • Check whether the connecting cable to the DP master has been disconnected. • Switch the 24 V DC supply voltage on and off again at the interface module.
On	*	On	The configured structure of the ET 200S does not match the actual structure of the ET 200S.	Check the structure of the ET 200S for missing or defective modules or whether an unconfigured module is inserted. Check the configuration (using COM PROFIBUS or STEP 7, for example) and correct the parameter assignment error.
			There is an error in an I/O module, or the interface module is defective.	Replace the interface module, or contact your Siemens representative.
Off	Off	On	Data exchange is taking place between the DP master and the ET 200S. The set configuration and actual configuration of the ET 200S match.	---
* Not applicable				

3.2 Diagnostic messages of the electronic modules

Actions following a diagnostic message in DPV0 mode

The error is entered in the diagnostics frame in the channel-specific diagnostics:

- The SF LED on the interface module lights up.
- Several diagnostic messages can be output simultaneously.

3.3 Diagnostics with STEP 7

3.3.1 Diagnostics readout

Introduction

The slave diagnostics comply with IEC 61784-1:2002 Ed1 CP 3/1. Depending on the DP master, slave diagnostics can be read out with *STEP 7* for all DP slaves that comply with the standard.

Length of the diagnostics frame

- For the ET 200S with the IM151-1 BASIC, the maximum frame length is 43 bytes.
- The minimum frame length is
  - 6 bytes (identifier-related diagnostics, module status, and channel-specific diagnostics disabled via parameter assignment).

Options for reading out the diagnostics

The table below shows the options for reading out the diagnostics with *STEP 7* on PROFIBUS DP.

Table 3- 2 Reading out the diagnostics with STEP 7 on PROFIBUS DP

Automation system with DP master	Block or tab in *STEP 7*	Application	Reference
SIMATIC S7/M7	"DP Slave Diagnostics" tab	Slave diagnostics in plain text on the STEP 7 user interface	"Diagnosing hardware" in *STEP 7* Online Help
	SFC 13 "DP NRM_DG"	Reading out slave diagnostics (store in the data area of the user program)	SFC see *STEP 7 Online Help*

Example of reading out S7 diagnostics using SFC 13 "DP NRM_DG"

Here, you will find an example of how to use SFC 13 to read out the slave diagnostics for a DP slave in the STEP 7 user program.

For the purpose of this STEP 7 user program, the following is assumed:

- The diagnostic address of the ET 200S is 1022 ($3FE_H$).
- The slave diagnostics are to be stored in DB 82: Starting from address 0.0, length = 43 bytes.
- The slave diagnostics can be up to 43 bytes long.

STEP 7 user program

```
STL                                          Description

CALL SFC 13

REQ       :=TRUE                             Read request
LADDR     :=W#16#3FE                         Diagnostic address of the ET 200S
RET_VAL   :=MW0                              RET_VAL of SFC 13
RECORD    :=P#DB82.DBX 0.0 BYTE 43           Data record for the diagnostics in DB 82
BUSY      :=M2.0                             The read process runs through several OB 1 cycles
```

3.3.2 Structure of the slave diagnostics

Structure of the slave diagnostics

The figure below shows the structure of the IM151-1 BASIC slave diagnostics.

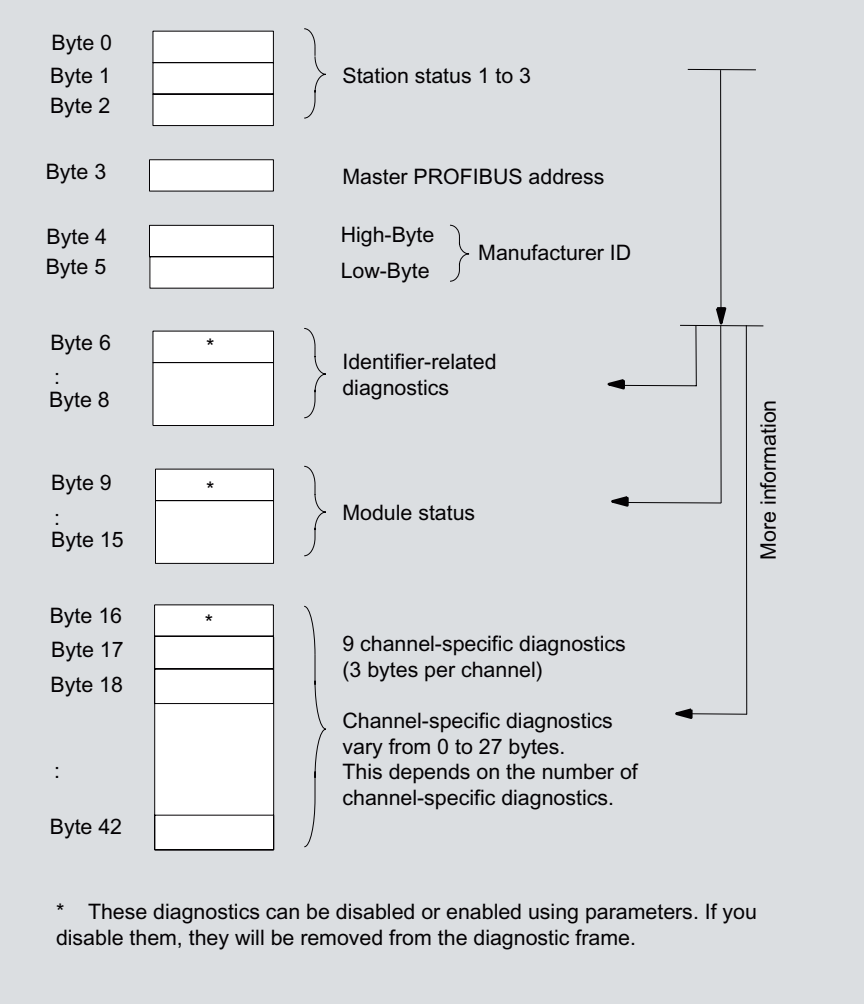


Figure 3-1 Structure of the IM151 BASIC slave diagnostics

Note

With the IM151-1 BASIC, the length of the diagnostics frame varies between 6 and 43 bytes.

You can see the length of the last received diagnostic frame in: *STEP 7* from the parameter RET_VAL des SFC 13.

3.3.3 Station statuses 1 to 3

Definition

Station statuses 1 to 3 provide an overview of the status of a DP slave.

Structure of station status 1 (byte 0)

Table 3- 3 Structure of station status 1 (byte 0)

Bit	Meaning	Cause/remedy
0	1: The DP slave cannot be accessed by the DP master.	• Is the correct PROFIBUS address set on the DP slave? • Is the bus connector plugged in? • Voltages on DP slave? • RS 485 repeater set correctly? • DP slave reset?
1	1: The DP slave is not yet ready to exchange data.	• Wait, the DP slave is currently starting up.
2	1: The configuration data transferred from the DP master to the DP slave do not match the slave configuration.	• Correct station type or correct configuration of the DP slave entered in the configuration software?
3	1: External diagnostic information exists. (Group diagnostic display)	• Evaluate the channel-related diagnostic information, the module status and/or the channel-related diagnostic information. As soon as all errors have been eliminated, bit 3 will be reset. The bit will be set again when there is a new diagnostic message in the bytes of the aforementioned diagnostics.
4	1: The required function is not supported by the DP slave (for example, changing the PROFIBUS address by means of software).	• Check the configuration.
5	1: The DP master cannot interpret the response of the DP slave.	• Check the bus configuration.
6	1: The DP slave type does not match the software configuration.	• Correct station type entered in the configuration software?
7	1: Parameters have been assigned to the DP slave by a different DP master (not the one that currently has access to the DP slave).	• The bit is always 1, for example, if you access the DP slave with the programming device or another DP master. • The PROFIBUS address of the DP master that assigned parameters to the DP slave is located in the "master PROFIBUS address" diagnostic byte.

Structure of station status 2 (byte 1)

Table 3- 4 Structure of station status 2 (byte 1)

Bit	Meaning	
0	1:	Parameters have to be reassigned to the DP slave.
1	1:	A diagnostic message exists. The DP slave will not operate until the problem is eliminated (static diagnostic message).
2	1:	The bit on the DP slave is always "1".
3	1:	The watchdog is activated for this DP slave.
4	1:	The DP slave has received the "FREEZE" control command [1].
5	1:	The DP slave has received the "SYNC" control command [1].
6	0:	Bit is always "0".
7	1:	The DP slave is disabled, that is, it has been removed from the processing in progress.
[1] The bit is updated only if another diagnostic message changes, too.		

Structure of station status 3 (byte 2)

Table 3- 5 Structure of station status 3 (byte 2)

Bit	Meaning	
0 to 6	0:	Bits are always "0".
7	1:	• There are more diagnostic messages than the DP slave can store. • The DP master cannot enter all the diagnostic messages sent by the DP slave in its diagnostic buffer (channel-specific diagnostics).

3.3.4 Master PROFIBUS address

Definition

The diagnostic byte master PROFIBUS address contains the PROFIBUS address of the DP master:

- that assigned parameters to the DP slave and
- that has read and write access to the DP slave.

The master PROFIBUS address is in byte 3 of the slave diagnostic information.

3.3.5 Identifier-related diagnostics

Definition

The identifier-related diagnostics indicate whether or not modules of the ET 200S have errors/faults. In the case of the IM151-1 BASIC, identifier-related diagnostics start at byte 6 and are 3 bytes long.

Structure of the identifier-related diagnostics

The identifier-related diagnostics for the ET 200S with the IM151-1 BASIC are structured as follows:

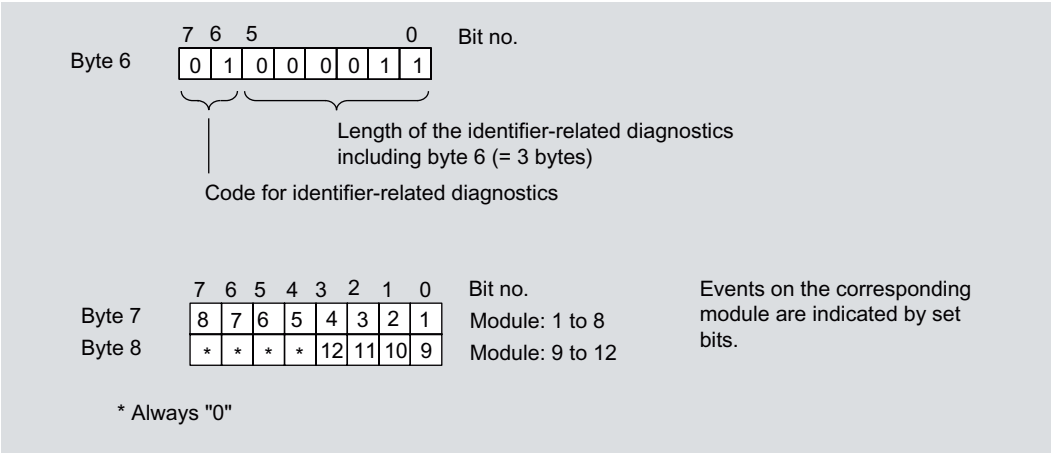


Figure 3-2 Structure of the identifier-related diagnostics for the IM151-1 BASIC

3.3.6 Module status

Definition

The module status indicates the status of the configured modules and provides more information on the identifier-related diagnostics with respect to the configuration. With the IM151-1 BASIC, the module status starts after the identifier-related diagnostics and consists of 7 bytes.

Structure of the module status

With the IM151-1 BASIC, the module status for the ET 200S is:

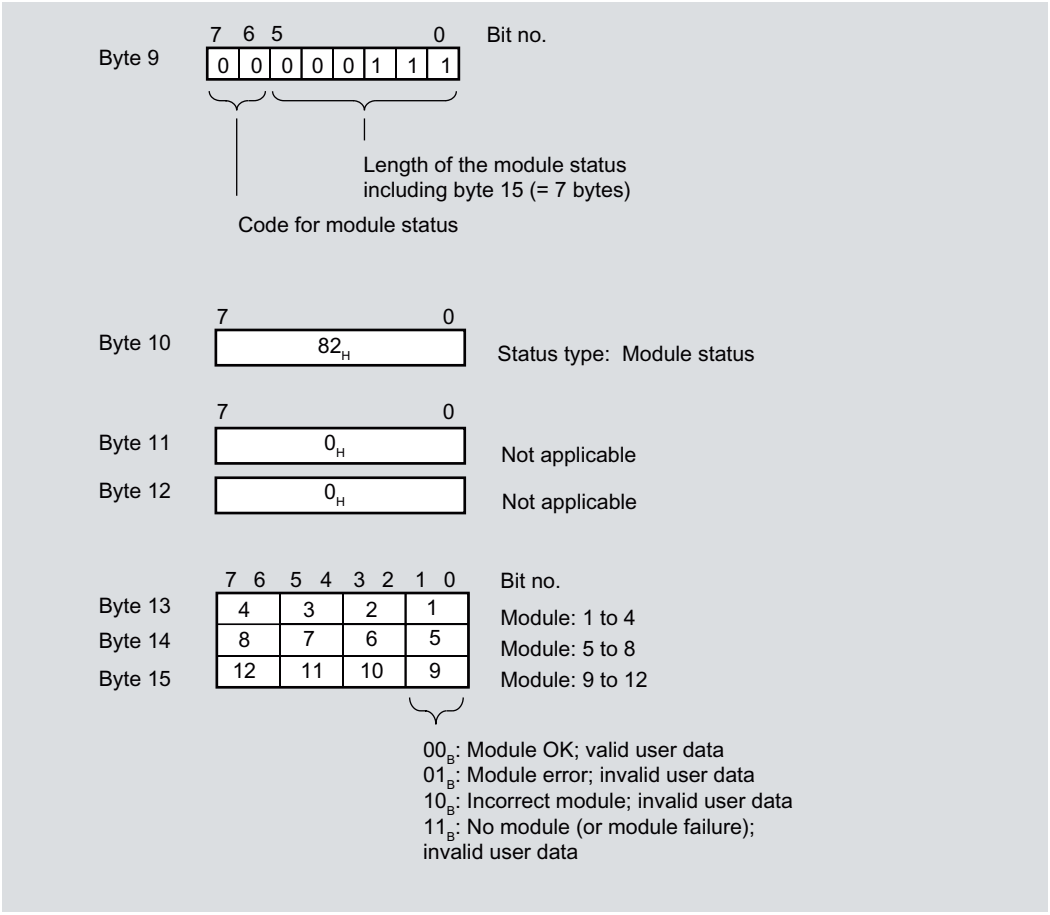


Figure 3-3 Structure of the module status for the ET 200S with the IM151-1 BASIC

3.3.7 Channel-specific diagnostics

Definition

Channel-specific diagnostics provide information about channel errors of modules and details of the identifier-related diagnostics. The channel-specific diagnostics start after the module status (if parameters are preset accordingly). The maximum length is limited by the maximum total length of slave diagnostics, i.e., 43/44/62 bytes in DPV0 mode. Channel-specific diagnostics do not affect the module status.

A maximum of 9 channel-specific diagnostic messages are possible (in DPV0 mode/DPV1 mode).

Structure of the channel-specific diagnostics

The channel-specific diagnostics for the ET 200S with the IM151-1 BASIC are structured as follows:

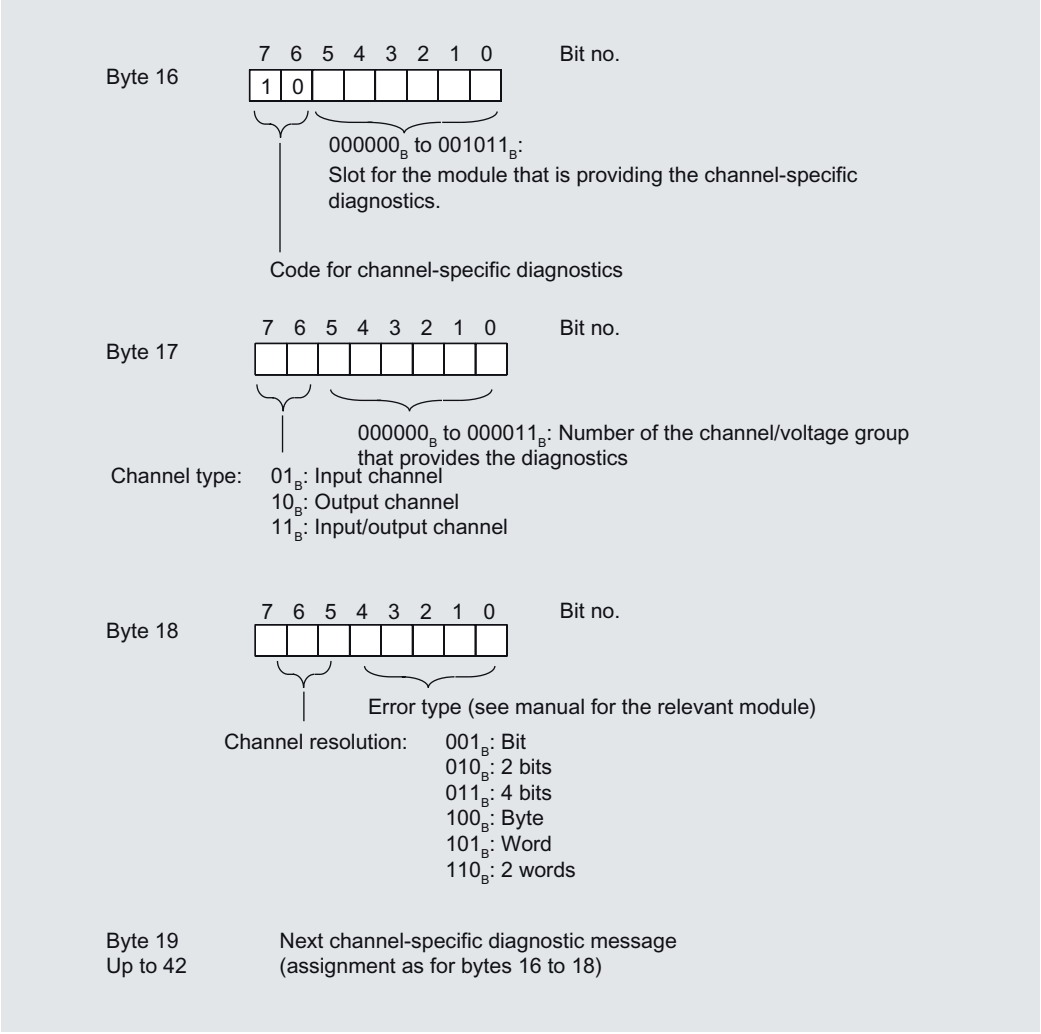


Figure 3-4 Structure of channel-specific diagnostics for the ET 200S with the IM151-1 BASIC

Note

The module slot coding is contained in byte 16, bits 0 to 5. The following applies: Displayed number +1 = Slot of the module (0 ≙ Slot 1; 1 ≙ Slot 2; 3 ≙ Slot 4, etc.)

In byte 17, bit 6 and bit 7, 00_B is output if a power module reports channel-specific diagnostics.

3.3.8 Incorrect module configurations of ET 200S on the PROFIBUS DP

Invalid module configuration states

The following incorrect module configurations of ET 200S lead to station failure of the ET 200S or prevent entry into data exchange. These responses occur regardless of whether the IM parameters "Operation at set <> actual configuration", "Replace modules during operation", and "Startup at set <> actual configuration" have been enabled.

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

Note

The station will not start up if **one** module is missing (gap) and the ET 200S is switched on.

Diagnostics

You can recognize all faulty module configuration states based on the following diagnostic information:

Identifier-related diagnostics	Module status
All 12 bits set	• 01_B: "Module error; invalid user data" for all modules (slots) until the cause of the error is found • 11_B: "No module; invalid user data" once the cause of the error is found

Response times

4

4.1 Overview

The figure below shows the various response times between DP Master and ET 200S.

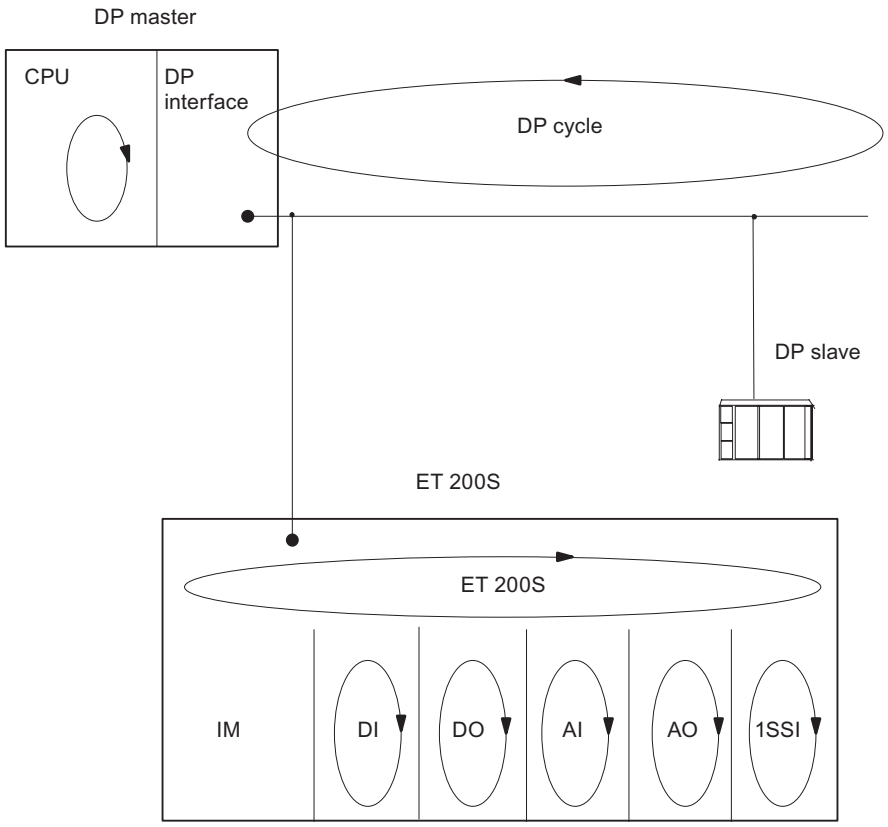


Figure 4-1 Response times between DP Master and ET 200S

4.2 Response times for the ET 200S

Calculation of the response time for IM151-1 BASIC

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

Response time [µs] = 156 *m* + 33 *do* + 486 *ai* + 374 *ao* + 1,633 *t* + 934

Description of the parameters:

- **m**: Total number of all modules (power modules, digital electronic modules, analog electronic modules, 4 IQ-SENSE electronic modules, 4POTDIS potential distribution module, RESERVE module, technological modules, and motor starters)
- **do**: Sum total of all digital output modules
- **ai**: Sum total of all analog input modules and 1SSI fast electronic modules
- **ao**: Sum total of all analog output modules
- **t**: Total number of technological modules (except 1SSI fast)

Example for calculating the ET 200S response time for IM151-1 BASIC

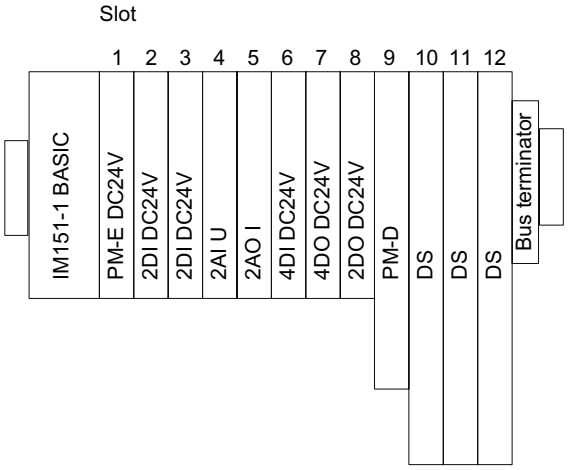


Figure 4-2 Example setup for calculating the response time of IM151-1 BASIC

Calculation method:

m = 12; do = 2; ai = 1; ao = 1; t = 0

Response time = 156 *m* + 33 *do* + 486 *ai* + 374 *ao* + 1,633 *t* + 934

Response time = 156 *12* + 33·*2* + 486 *1* + 374 *1* + 1,633 *0* + 934

Response time = **3732 µs**

4.3 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.

4.4 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.

4.5 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.

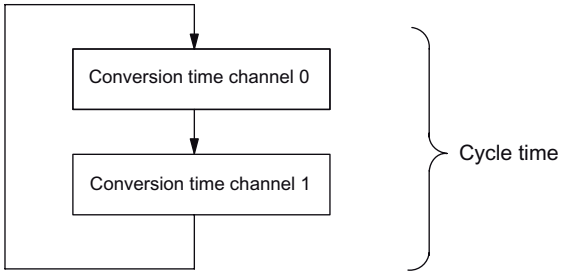


Figure 4-3 Cycle time of the analog input module

Reference

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

4.6 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.

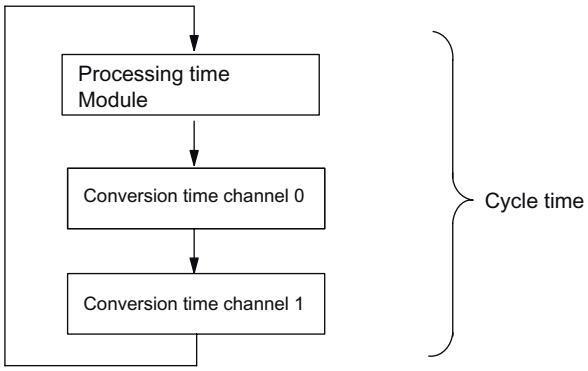


Figure 4-4 Cycle time of the analog output module

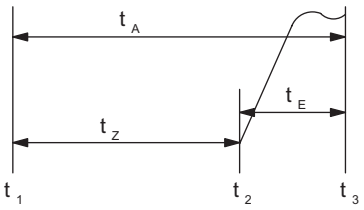
Settling time

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 4-5 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.

4.7 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.

4.8 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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