Legal information

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

⚠️ DANGER
indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠️ WARNING
indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠️ CAUTION
indicates that minor personal injury can result if proper precautions are not taken.

NOTICE
indicates that property damage can result if proper precautions are not taken.

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

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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

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 [http://support.automation.siemens.com/WW/view/en/1144348]. 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 this manual and do not find the answers in this document, please contact your local Siemens representative [http://www.siemens.com/automation/partners].

A guide to the technical documentation for the various SIMATIC products and systems is available on the Internet [http://www.siemens.com/simatic-docu].

The online catalog and ordering systems are available on the Internet [http://www.siemens.com/automation/mall].

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 [http://www.siemens.com/sitrain].
Technical Support


Additional information about Siemens Technical Support is available on the Internet [http://www.siemens.com/automation/csi_en_WW/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/csi_en_WW/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.
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Properties

The IM151-1 STANDARD interface module has the following properties:

- It connects the ET 200S with PROFIBUS DP via the RS485 interface.
- On SIMATIC S7 (in DPV1 mode), the maximum parameter length is 240 bytes per slot.
- The maximum address space is 244 bytes for inputs and 244 bytes for outputs.
- Operation as a DPV0 or DPV1 slave
- A maximum of 63 modules can be operated with the IM151-1 STANDARD.
- The maximum bus length is 2 m.
- Extended temperature range from 0 to 55°C with vertical installation.
- It supports option handling and the status byte for power modules.
- Firmware update over PROFIBUS DP with STEP 7
- Identification data (with DS248 or DS255)
- Direct data exchange (publisher)

The IM151-1 STANDARD interface module (6ES7151-1AA06-0AB0) replaces the predecessor interface modules 6ES7151-1AA00-0AB0 to 6ES7151-1AA05-0AB0.

Installation constraints

- For every 2DO AC24..230V electronic module used, the number of connectable I/O modules in this station is reduced by one.
Terminal assignment

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

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

<table>
<thead>
<tr>
<th>View</th>
<th>Signal name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>RxD/TxD-P</td>
<td>Data line B</td>
</tr>
<tr>
<td>4</td>
<td>RTS</td>
<td>Request to send</td>
</tr>
<tr>
<td>5</td>
<td>M5V2</td>
<td>Data reference potential (from station)</td>
</tr>
<tr>
<td>6</td>
<td>P5V2</td>
<td>Supply plus (from station)</td>
</tr>
<tr>
<td>7</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>RxD/TxD-N</td>
<td>Data line A</td>
</tr>
</tbody>
</table>

Up to 6ES7151-1AA04-0AB0, product release 6

| 1L+  | 24 V DC    |
| 2L+  | 24 V DC (for loop through) |
| 1M   | Ground     |
| 2M   | Ground (for loop through)  |

As of 6ES7151-1AA04-0AB0, product release 7 or as of 6ES7151-1AA05-0AB0
Properties

Block diagram

![Block diagram for the IM151-1 STANDARD interface module](image)

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

Technical specifications of IM151-1 STANDARD (6ES7151-1AA06-0AB0)

<table>
<thead>
<tr>
<th>Dimensions and weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension B (mm)</td>
</tr>
<tr>
<td>Weight</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module-specific data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission rate</td>
</tr>
<tr>
<td>Bus protocol</td>
</tr>
<tr>
<td>Interface</td>
</tr>
<tr>
<td>SYNC capability</td>
</tr>
<tr>
<td>FREEZE capability</td>
</tr>
<tr>
<td>Manufacturer ID</td>
</tr>
<tr>
<td>Direct data exchange</td>
</tr>
<tr>
<td>Isochronous operation</td>
</tr>
<tr>
<td>Parameter length</td>
</tr>
<tr>
<td>Address space</td>
</tr>
<tr>
<td>Option handling</td>
</tr>
<tr>
<td>With reserve module</td>
</tr>
<tr>
<td>Without reserve module</td>
</tr>
<tr>
<td>I&amp;M data</td>
</tr>
<tr>
<td>Firmware update</td>
</tr>
<tr>
<td>Max. output current of the PROFIBUS DP interface (5, 6)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Voltages, currents, potentials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated supply voltage of the electronic components (1L+)</td>
</tr>
</tbody>
</table>
**Properties**

### Dimensions and weight

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reverse polarity protection</td>
<td>Yes</td>
</tr>
<tr>
<td>Voltage failure backup</td>
<td>Min. 20 ms</td>
</tr>
</tbody>
</table>

### Electrical isolation

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between backplane bus and electronics</td>
<td>No</td>
</tr>
<tr>
<td>Between PROFIBUS DP and electronics</td>
<td>Yes</td>
</tr>
<tr>
<td>Between supply voltage and electronics</td>
<td>No</td>
</tr>
<tr>
<td>Permissible potential difference (to mounting rail)</td>
<td>75 V DC / 60 V AC</td>
</tr>
</tbody>
</table>

### Insulation tested with

500 V DC

### Current consumption from rated supply voltage (1L+)

Approx. 200 mA

### Power loss of the module

Typically 3.3 W

### Status, interrupts, diagnostics

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interrupts</td>
<td>Yes</td>
</tr>
<tr>
<td>Diagnostics function</td>
<td>Yes</td>
</tr>
<tr>
<td>Group error</td>
<td>Red &quot;SF&quot; LED</td>
</tr>
<tr>
<td>PROFIBUS DP bus monitoring</td>
<td>Red &quot;BF&quot; LED</td>
</tr>
<tr>
<td>Monitoring of the power supply voltage of the electronics</td>
<td>Green &quot;ON&quot; LED</td>
</tr>
</tbody>
</table>

### Updating the firmware of the IM151-1 STANDARD

The IM151-1 STANDARD firmware can be updated starting with *STEP 7* V5.1, SP 3 (via accessible nodes).

To update the firmware, you receive files (*.UPD) with the current firmware.

The following requirements must be met:

- The IM151-1 STANDARD in the station whose firmware is to be updated must be accessible online.
- The files with the current firmware version must be available in the file system of your programming device or PC.

You can find information on this procedure in the *STEP 7* online help.

### Note

Make sure that the correct firmware version for the interface module in question is used for the update. An interface module with an older order number cannot be updated with the firmware version for an interface module with a more recent order number and vice versa.
Configuration with more than 244 bytes of parameter data

For configurations with *STEP 7* V5.4, it is possible to operate the IM151-1 STANDARD from 6ES7151-1AA05-0AB0 in DPV1 mode with more than 244 bytes of parameter data. Configuration with the GSD file does not offer this option.

**Note**

If the parameter length exceeds 244 bytes, a longer station startup time is to be expected.
# 2.1 Parameters for the IM151-1 STANDARD interface module

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

<table>
<thead>
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<th></th>
<th>Range of values</th>
<th>Default setting 5</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>DP interrupt mode</td>
<td>DPV0/DPV1</td>
<td>DPV0</td>
<td>ET 200S</td>
</tr>
<tr>
<td>Bus length</td>
<td>≤ 1 m/&gt; 1 m</td>
<td>≤ 1 m</td>
<td>ET 200S</td>
</tr>
<tr>
<td>Operation at set &lt; &gt;</td>
<td>Disable/enable</td>
<td>Disable</td>
<td>ET 200S</td>
</tr>
<tr>
<td>configuration 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diagnostic interrupt</td>
<td>Disable/enable</td>
<td>Disable</td>
<td>ET 200S</td>
</tr>
<tr>
<td>Process interrupt</td>
<td>Disable/enable</td>
<td>Disable</td>
<td>ET 200S</td>
</tr>
<tr>
<td>Remove/insert module</td>
<td>Disable/enable</td>
<td>Disable</td>
<td>ET 200S</td>
</tr>
<tr>
<td>interrupt 2 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identifier-related diagnostics</td>
<td>Disable/enable</td>
<td>Enable</td>
<td>ET 200S</td>
</tr>
<tr>
<td>Module status</td>
<td>Disable/enable</td>
<td>Enable</td>
<td>ET 200S</td>
</tr>
<tr>
<td>Channel-specific diagnostics</td>
<td>Disable/enable</td>
<td>Enable</td>
<td>ET 200S</td>
</tr>
<tr>
<td>Option handling in general</td>
<td>Disable/enable</td>
<td>Disable</td>
<td>ET 200S</td>
</tr>
<tr>
<td>Option handling</td>
<td>with / without reserve module</td>
<td>with reserve module</td>
<td>ET 200S</td>
</tr>
<tr>
<td>Option handling:</td>
<td>Slots 2 to 63</td>
<td>Disable</td>
<td>ET 200S</td>
</tr>
<tr>
<td>Analog value format</td>
<td>SIMATIC S7/</td>
<td>S7</td>
<td>ET 200S</td>
</tr>
<tr>
<td></td>
<td>SIMATIC S5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interference frequency suppression</td>
<td>50 Hz/60 Hz</td>
<td>50 Hz</td>
<td>ET 200S</td>
</tr>
<tr>
<td>Reference junction slot</td>
<td>None /2 to 63</td>
<td>None</td>
<td>ET 200S</td>
</tr>
<tr>
<td>Reference junction input</td>
<td>RTD on channel 0/</td>
<td>RTD on channel 1</td>
<td>ET 200S</td>
</tr>
</tbody>
</table>

1 See also the "option handling" parameter.
2 The default setting of the parameter in the GSD file is "disable".
3 Only parameterizable in DPV1 operation.
4 The parameter only exists when configuring via the GSD file.
5 The default settings apply to the default startup (if no other parameters have been assigned by the DP master).
2.2 Parameter description

2.2.1 DP interrupt mode
This parameter can be used to enable or disable ET 200S DPV1 operation. Data records and interrupts (can be assigned parameters) are supported by class 1 and class 2 services after DPV1 mode is enabled.

Requirements:
• The DP master must also support DPV1.

2.2.2 Bus length
\[ \leq 1 \text{ m}: \text{The default setting for the maximum bus length is 1 m.} \]
\[ > 1 \text{ m}: \text{The bus length of the ET 200S is > 1 m and can be up to 2 m. However, this setting will increase the response time of the ET 200S.} \]

2.2.3 Enable startup for set <> actual configuration
When this parameter is enabled:
• Removing and inserting modules during operation will not lead to an ET 200S station failure.
• If the actual configuration differs from the expected configuration, data exchange between the ET 200S and the DP master will continue.

When this parameter is disabled:
• Removing and inserting modules during operation will lead to an ET 200S station failure.
• If the actual configuration differs from the expected configuration, data exchange between the ET 200S and the DP master will cease.
Exception: Option handling

2.2.4 Option handling in general
This parameter can be used as a general means of enabling or disabling option handling for the entire ET 200S.

See also
Assigning parameters for option handling with RESERVE modules (Page 20)
2.2.5 **Option handling: Slot 2 to 63 (with RESERVE module)**

This parameter can be used to enable or disable checking of the configuration.

- Slots 2 to 63 are enabled: Instead of the configured electronic module you can also insert a RESERVE module into the relevant slot without generating a diagnostics message.
- Slots 2 to 63 are disabled: Only the configured module can be located on the relevant slot. RESERVE modules are treated as incorrect modules. Depending on the setting of the "Enable startup for set <> actual configuration" parameter, the ET 200S will either terminate or continue data exchange.

2.2.6 **Diagnostic interrupt**

This parameter can be used to enable or disable diagnostic interrupts. Diagnostic interrupts are supported

- on PROFIBUS DP, if the ET 200S is in DPV1 mode.

2.2.7 **Process interrupt**

This parameter can be used to enable or disable process interrupts. Process interrupts are supported.

- On PROFIBUS DP, if the ET 200S is in DPV1 mode.

2.2.8 **Insert/remove-module interrupt**

This parameter can be used to enable or disable remove/insert module interrupts. Remove/insert module interrupts are supported

- On PROFIBUS DP, if the ET 200S is in DPV1 mode.

2.2.9 **Analog-value format**

You set the number format for all analog electronic modules here.

2.2.10 **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.
2.2.11 Reference junction slot

This parameter can be used to assign a slot (none, 2 to 12/2 to 63) 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.

2.2.12 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.
3.1 Option handling with RESERVE modules

3.1.1 Principle of operation of option handling with RESERVE modules

Principle

With option handling with RESERVE modules, the configuration of ET 200S Slots 2 to 63 is checked. If a slot is enabled for option handling, the RESERVE module (option) can occupy this slot instead of the configured electronic module without triggering a diagnostic interrupt. If the slot is disabled, only the configured electronic module can occupy this slot. Any other module will trigger a diagnosis. You can also control the configuration of Slots 2 to 63 and monitor the configuration of Slots 1 to 63 using the control and feedback interface in the process input image (PII) and process output image (PIQ).
3.1 Option handling with RESERVE modules

![Flowchart of option handling with RESERVE modules](image)

Figure 3-1  Principle of operation of option handling with RESERVE modules

- Yes
  - The setting of the parameter "Operation at Preset <-> Actual configuration" is not relevant for the process illustrated.
  - No error
  - Bit in PII* = 1
- No
  - Bit in PII = 0
  - Slot enabled (configuration in HWCONFIG)?
    - No
      - Preset <-> actual configuration
      - Diagnosis is reported
    - Yes
      - Slot enabled in PIQ (bit in PIQ**=0)?
        - No
          - Incorrect module
          - Removed module
        - Yes
          - Is the RESERVE module inserted or is there an empty slot at the right-hand end of the ET 200S station?
            - No
              - Incorrect module
              - Removed module
            - Yes
              - No error
              - No diagnosis

* PII = process input image
** PIQ = process output image
3.1 Option handling with RESERVE modules

3.1.2 Prerequisites for option handling with RESERVE modules

Requirements

For option handling with RESERVE modules you require:

- An interface module that supports option handling with a RESERVE module.
- A power module PM-E 24 to 48 V DC (6ES7138-4CB50-0AB0 and higher) or PM-E 24 to 48 V DC/24 to 230 V AC (6ES7138-4CB10-0AB0 and higher).

Note

One of these power modules must be included in the configuration at least once, together with one of the aforementioned interface modules.

- RESERVE modules as replacements for future electronic modules
- For the purpose of configuring the IM151-1 STANDARD
  - DPV0/DPV1 mode: As of 07/2003 (V1.0 or higher), GSD file SI03806A.GSx.
  - DPV0 mode: GSD file SI02806A.GSx.

Note

In STEP 7, you do not require a GSD file for option handling with the:

- IM151-1 STANDARD of STEP 7 V5.4 or higher
- The current HW update for the interface and power modules. Use the menu command "Options > Install HW Updates" in HW Config to link the HW update. The HW updates can be downloaded from Customer Support on the Internet.

You can find the options handling description in the STEP 7 Online Help.

Note

If the actual configuration of an ET 200S station does not match the set configuration, a diagnostics report is generated if the check for the relevant slots is not enabled for option handling.
3.1.3 Example for using RESERVE modules

Configuration variants

1st version: Preparation using RESERVE modules and prewiring

2nd version: Preparation using RESERVE modules and prewiring. The RESERVE modules at the right-hand end of the station are not present.

Figure 3-2 Example for using RESERVE modules
3.1 Option handling with RESERVE modules

3.1.4 Assigning parameters for option handling with RESERVE modules

**Introduction**

In *STEP 7* or *COM PROFIBUS* you assign the parameters for the electronic modules which you want to use in future applications, e.g. 4DI H, on the RESERVE module slots (or the expansion modules on the right-hand end of the station):

- Drag the electronic module to the configuration table
- Assign the parameters

**Procedure**

1. Drag a PM-E 24..48 VDC or PM-E 24..48 VDC/24..230 VAC power module with one of the following entries into the configuration table:
   - ...O (option handling) or
   - ...SO (status byte + option handling)

   **Note**

   Entry of the power module with the ending ...O or ...SO can only be made once in the ET 200S configuration!

2. Assign parameters to the interface module as follows:

<table>
<thead>
<tr>
<th>Interface module</th>
<th>Parameter</th>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IM151-1 STANDARD or IM151-1 FO STANDARD or IM151-1 HIGH FEATURE</td>
<td>Option handling, general</td>
<td>enable</td>
<td>Option handling is activated for the entire ET 200S.</td>
</tr>
<tr>
<td></td>
<td>Option handling: Slots 2 to 63</td>
<td>Enable (all the slots where RESERVE modules can be located)</td>
<td>There are RESERVE modules or a configured electronic module on the slot. A diagnostic is not signaled.</td>
</tr>
<tr>
<td></td>
<td>Option handling: With/without RESERVE modules</td>
<td>With RESERVE modules</td>
<td>Selects option handling with RESERVE modules</td>
</tr>
</tbody>
</table>

**Note**

If "Operation for set < > actual installation" is blocked for parameter assignment,
- the ET 200S does not start up if a module is missing or if an incorrect module is plugged in. The diagnostic "No module" or "Incorrect module" is signaled.
- The ET 200S starts up if you enable option handling for the slot where a RESERVE module is plugged in. A diagnostic is not signaled.
Substitute values

If you have assigned an electronic module for the RESERVE module, the following substitute values are signaled:

- Digital input modules: 0
- Analog input modules: 7FFFH
- Function module: 0

See also

Option handling in general (Page 13)

3.1.5 Controlling and monitoring options with RESERVE modules

Introduction

You can use the control interface (PIQ) and feedback interface (PII) to control and monitor options by means of the user program.

Recommendation: Before working with the ET 200S optional enhancements, check whether all the configured electronic modules are plugged in using the feedback interface (refer to the table below).

Note

SFCs 14/15 can be used to consistently access the control and feedback interface.
3.1 Option handling with RESERVE modules

Principle

The control and feedback interface is located in the input and output process image of the PM-E 24..48 VDC or PM-E 24..48 VDC/24..230 VAC power module. It can only be accessed if entries ending in ...O or ...SO for that power module were selected in the configuration software.

One bit is available for each ET 200S electronic or RESERVE module slot.

- Control interface: Slot 2 to 63
- Feedback interface: Slot 1 to 63

<table>
<thead>
<tr>
<th>Slot</th>
<th>Value of the bit</th>
<th>Reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 to 63</td>
<td>0</td>
<td>Parameter assignment for option handling applies. RESERVE modules are allowed:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The station is engaged in data exchange.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• A diagnostic is not signaled.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The SF LED on the interface module is off.</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>Parameter assignment for option handling is cancelled. RESERVE modules are not accepted on this slot:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The station is engaged in data exchange.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The diagnostic &quot;Incorrect module&quot; is signaled.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The SF LED on the interface module is on.</td>
</tr>
</tbody>
</table>

(*) not relevant

Control interface PIQ (AB x to AB x+7):

You can use these bytes (8 bytes) to control the diagnostic behavior of the slots that you enabled for option handling in the HW Config.

Only the slot bits enabled at parameter assignment for option handling are evaluated. They are marked with "0".

Figure 3-3 Control (PIQ) and feedback interface (PII)
3.1 Option handling with RESERVE modules

Feedback interface PII (EB x to EB x+7):

The feedback interface (8 bytes) tells you which module is actually located on which slot. All slots are reported. Even slots that were not enabled for option handling.

Table 3-2 Feedback interface

<table>
<thead>
<tr>
<th>Slot</th>
<th>Value of the bit</th>
<th>Reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>Option handling is inactive</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Option handling is active</td>
</tr>
<tr>
<td>1 to 63</td>
<td>0</td>
<td>The RESERVE module, an incorrect module, or a removed module is on the slot.</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>The configured module is on the slot.</td>
</tr>
</tbody>
</table>

3.1.6 Troubleshooting for option handling with RESERVE modules

Troubleshooting for option handling

Table 3-3 Troubleshooting option handling

<table>
<thead>
<tr>
<th>Event</th>
<th>Cause</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>ET 200S does not start up; configuration error</td>
<td>There are multiple entries in the ET 200S configuration for power modules ending in ...O or ...SO.</td>
<td>Check and correct the configuration in HW Config.</td>
</tr>
<tr>
<td></td>
<td>There are no entries of power modules ending in ...O or ...SO in the ET 200S configuration.</td>
<td>Use a power module entry ending in ...O or ...SO in HW Config.</td>
</tr>
</tbody>
</table>
3.1.7 Address area for option handling and status byte with RESERVE modules

**Address area for option handling and status byte**

You can control and monitor option handling and evaluate the status byte of the power module using the control (PIQ) and feedback (PII) interface.

The address range in the control (PIQ) and feedback interface (PII) depends on the configuration, i.e. the selection of the corresponding entry in the configuration software.

This table shows the PII feedback interface and the PIQ control interface for various entries.

<table>
<thead>
<tr>
<th>In STEP 7/HW Config or COM PROFIBUS or other configuration software</th>
<th>Feedback interface PII</th>
<th>Control interface PIQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usual entry for the power module</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Ends in ...S</td>
<td>IBx</td>
<td>Status byte</td>
</tr>
<tr>
<td>Ends in ...O</td>
<td>IBx</td>
<td>Option handling</td>
</tr>
<tr>
<td></td>
<td>IBx+7</td>
<td>OBx</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OBx+7</td>
</tr>
<tr>
<td>Ends in ...SO</td>
<td>EBx</td>
<td>Option handling</td>
</tr>
<tr>
<td></td>
<td>EBx+7</td>
<td>ABx</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ABx+7</td>
</tr>
<tr>
<td></td>
<td>IBx+8</td>
<td>Status byte</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OBx+8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not applicable</td>
</tr>
</tbody>
</table>
Option handling in PIO/PII

<table>
<thead>
<tr>
<th>Slot 2 to 63:</th>
<th>0</th>
<th>Parameter assignment for option handling applies. RESERVE modules are allowed:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>• The station is engaged in data exchange.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• A diagnostic is not signaled.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The SF LED on the interface module is off.</td>
</tr>
<tr>
<td>Slot 1 to 63:</td>
<td>0</td>
<td>The configured module is on the slot.</td>
</tr>
<tr>
<td>Slot 1 to 63:</td>
<td>1</td>
<td>The RESERVE module, an incorrect module, or a removed module is on the slot.</td>
</tr>
</tbody>
</table>

(*) Not applicable
3.2 Option handling without reserve modules

3.2.1 Principle of operation of option handling without RESERVE modules

Principle

In the case of option handling without RESERVE modules, the configuration data are insufficient to compare the preset configuration with the actual configuration. In addition, information about the existing options is still required. This must be sent via the user data to the IM151-1. In order to be able to receive the user data, the IM151-1 initially goes formally into cyclic data exchange after the configuration data have been received. However, direct I/O access does not yet take place. Output data are rejected, the input data are zero. The IM151-1 only responds to the output data that you have to connect to a power module (O or SO). A preset-actual test isn't possible until this option information is available. Only after this can the I/O devices be operated.

Since the option information is stored retentively in the IM151-1, this intermediate state only exists during the first commissioning or reconfiguration/retrofitting.

Please note the following:

- Data record requests to option slots that do not exist induce a fault (80B0).
- If the IM151-1 is operated without configuration or without a CPU (DP master), it supplies the configuration as it exists. This is relevant for wiring test tools, since the actual slot numbers, without gaps from 1 to n, are used there for status/control.
- There are no limitations when "packing" digital modules. Theoretically, the module to which the byte address is assigned in the preset configuration can be missing in the structure.

Note

The configured slot numbers (slot numbers in data records, and for events such as diagnostics and interrupts) always apply for slot addressing.
3.2 Option handling without reserve modules

3.2.2 Prerequisites for option handling without RESERVE modules

Prerequisites
For option handling without RESERVE modules you require:

- IM151-1 STANDARD interface module (6ES7151-1AA05-0AB0 or higher)
- Power module PM E-24..48 VDC or PM E-24..48 VDC/24..230 VAC
  One of these power modules must be included in the configuration at least once.
- For configuring the GSD file SI04806A.GSx date 06/2008 or later.

Note
You do not require a GSD file for option handling in STEP 7 as from:
- STEP 7 V5.4 with HSP2035

You can find the description for option handling in the STEP 7 Online Help.
3.2 Option handling without reserve modules

3.2.3 Example for use without RESERVE modules

Configuration variants

Below is an example of the use of option handling without RESERVE modules.

Note: A "0" in the control interface means that this slot number is deactivated in the configuration and thus does not exist.

Figure 3-5 Example for use without RESERVE modules
3.2.4 Configuring option handling without RESERVE modules

Introduction

You configure option handling without RESERVE modules as described below.

Procedure

1. Drag a PM-E 24..48 VDC or PM-E 24..48 VDC/24..230 VAC power module with one of the following entries into the configuration table:
   - ...O (option handling) or
   - ...SO (status byte + option handling)

   Note
   You may only enter the power module with the ending ...O or ...SO once in the ET 200S configuration! We recommend configuring the power module to slot 1.

2. Assign parameters to the interface module as follows:

<table>
<thead>
<tr>
<th>Interface module</th>
<th>Parameter</th>
<th>Setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IM151-1 STANDARD (6ES7151-1AA06-0AB0 or higher)</td>
<td>Option handling, general</td>
<td>Enable</td>
<td>Option handling is activated for the entire ET 200S.</td>
</tr>
<tr>
<td></td>
<td>Option handling: With/without RESERVE modules</td>
<td>Without RESERVE modules</td>
<td>Selects option handling without RESERVE modules</td>
</tr>
</tbody>
</table>

Note

If "Operation for set < > actual installation" is blocked for parameter assignment, the ET 200S does not start up if a module is missing or if an incorrect module is plugged in. If an incorrect module is inserted, then the ET 200S will function but the I/O will not be enabled.

The diagnostic "No module" or "Incorrect module" is signaled.

If the IM151-1 does not start up in this state, the SF LED lights up at the IM151-1 and at the deactivated electronic module of the ET 200S.
3.2 Option handling without reserve modules

Note

In the case of option handling without RESERVE modules, incorrect filling in of the control interface can result in too many plugged modules with a slot number greater than 63 are reported from the point of view of the interface module. Since there is only room for 63 modules in the diagnostics message (module status), the highest-value bit is set in the "Identifier-related diagnostics" in this case. This produces the following results:

- The SF LED on the IM lights up
- Bit 3 in status byte 1 of the diagnostics message is set (external diagnosis exists)
- The "Slot 64 faulty" error message is indicated in STEP7.

Behavior during the first start-up

In the case of option handling without RESERVE modules, the IM151-1 always goes into cyclic data exchange during the first start-up. However, the I/O device input/output is not activated until valid information about the options is available from the module. No fault is indicated externally in this state (BF LED does not light up). The input/output of the I/O devices is not active in this state. Evaluate the data of the feedback interface in order to assess this state.

Behavior during a warm restart

Valid information about the options is stored retentively in the IM151-1. During the warm restart, the IM151-1 goes into cyclic data exchange and the input/output of the I/O devices is activated immediately. Has the configuration changed since the last startup (e.g.: incorrect module plugged in or information about options is incorrect), the input/output of the I/O devices is deactivated (irrespective of the parameter "Mode with set <> actual setup") until the real configuration agrees again with the configured one.
3.2 Option handling without reserve modules

3.2.5 Controlling and monitoring options without RESERVE modules

Introduction

You can use the control interface (PIQ) and feedback interface (PII) to control and monitor options by means of the user program.

Recommendation: Before working with the ET 200S optional enhancements, check whether all the required electronic modules are plugged in using the feedback interface (refer to the table below). The contents of the feedback interface have to agree with the specifications of the control interface.

Note

The use of SFCs 14/15 enables consistent access to the control and feedback interface.

Principle

The control and feedback interface is located in the input and output process image of the PM-E 24..48 VDC or PM-E 24..48 VDC/24..230 VAC power modules. It can only be accessed if entries ending in ...O or ...SO for that power module were selected in the configuration software.

One bit is available for each ET 200S electronic module slot:

- Control interface: Slots 1 to 63
- Feedback interface: Slots 1 to 63

<table>
<thead>
<tr>
<th>EB/AB x</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>EB/AB x+1</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>EB/AB x+2</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>23</td>
</tr>
<tr>
<td>EB/AB x+3</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>29</td>
<td>30</td>
<td>31</td>
</tr>
<tr>
<td>EB/AB x+4</td>
<td>32</td>
<td>33</td>
<td>34</td>
<td>35</td>
<td>36</td>
<td>37</td>
<td>38</td>
<td>39</td>
</tr>
<tr>
<td>EB/AB x+5</td>
<td>40</td>
<td>41</td>
<td>42</td>
<td>43</td>
<td>44</td>
<td>45</td>
<td>46</td>
<td>47</td>
</tr>
<tr>
<td>EB/AB x+6</td>
<td>48</td>
<td>49</td>
<td>50</td>
<td>51</td>
<td>52</td>
<td>53</td>
<td>54</td>
<td>55</td>
</tr>
<tr>
<td>EB/AB x+7</td>
<td>56</td>
<td>57</td>
<td>58</td>
<td>59</td>
<td>60</td>
<td>61</td>
<td>62</td>
<td>63</td>
</tr>
</tbody>
</table>

Figure 3-6 Control (PIQ) and feedback interface (PII)
Functions

3.2 Option handling without reserve modules

Control interface PIQ (AB x to AB x+7):
You must inform the IM151-1 via the control interface about which modules actually exist and which slots have been left out. The IM151-1 cannot evaluate the configuration until it has received this information.

Table 3-5 Control interface

<table>
<thead>
<tr>
<th>Slot</th>
<th>Value of the bit</th>
<th>Reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>Content of the bitspur is not relevant</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Bitspur is valid</td>
</tr>
<tr>
<td>1 to 63</td>
<td>0</td>
<td>Slot does not exist in the actual configuration</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Slot exists in the actual configuration</td>
</tr>
</tbody>
</table>

Feedback interface PII (EB x to EB x+7):
The feedback interface (8 bytes) tells you which module is actually located on which slot.

Table 3-6 Feedback interface

<table>
<thead>
<tr>
<th>Slot</th>
<th>Value of the bit</th>
<th>Reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>Option handling is inactive</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Option handling is active</td>
</tr>
<tr>
<td>1 to 63</td>
<td>0</td>
<td>Slot belongs to an option that does not exist or the module status is not OK</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Slot exists and is OK</td>
</tr>
</tbody>
</table>

If the feedback result of the feedback interface is identical with the specification of the control interface, the configuration is correct.

Procedure

In order to start testing the options, set Bit0=1 in the first byte (AB x).

Proceed as follows in order to ensure the consistency of the 8 bytes:

- Write the first byte (AB x) last (for direct access with T PAB)

or

- First write the complete information of the control interface in the first byte (AB x) with Bit0=0 and then set Bit0=1 in this byte in the subsequent OB1 cycle.

Alternatively you can use the SFC15 in order to achieve consistent transfer.

Note
Whenever any change in the 8 bytes of the control interface takes place, this information is stored and used, even if non-relevant bits were changed (bits outside the preset configuration).
3.3 Identification data

Definition

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

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

Identification data enable modules to be uniquely identified online.

In STEP 7, the identification data are displayed in the "Module Information - IM 151" and "Properties - DP Slave" tabs (see STEP 7 online help).

Reading the identification data with DS 255

As of 6ES7151-1AA05-0AB0, the IM 151-1 STANDARD also supports the standardized access to the identification data via the DS 255 (index 65000 to 65003). For further information on the data structure of the DS 255, refer to the PROFIBUS Guideline - Order No. 3.502, Version 1.1.1 dated March 2005.

Reading the identification data with DS 248

Users can directly access specific identification data by selecting Read data record. This requires a two-stage access:

1. Data record 248 contains a folder that holds the data records associated with the various indexes (see the table below.)

<table>
<thead>
<tr>
<th>Table 3-7</th>
<th>DS 248 structure for the ET 200S</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>List of contents</td>
</tr>
<tr>
<td><strong>Header information</strong></td>
<td></td>
</tr>
<tr>
<td>ID of content directory</td>
<td>2</td>
</tr>
<tr>
<td>Index of content directory</td>
<td>2</td>
</tr>
<tr>
<td>Length of successive blocks in bytes</td>
<td>2</td>
</tr>
<tr>
<td>Number of blocks</td>
<td>2</td>
</tr>
<tr>
<td><strong>Block information for Identification data</strong></td>
<td></td>
</tr>
<tr>
<td>SSL associated data record number</td>
<td>2</td>
</tr>
<tr>
<td>Length of the data record</td>
<td>2</td>
</tr>
<tr>
<td>Index</td>
<td>2</td>
</tr>
<tr>
<td>SSL associated data record number</td>
<td>2</td>
</tr>
<tr>
<td>Length of the data record</td>
<td>2</td>
</tr>
<tr>
<td>Index</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>
Functions

3.3 Identification data

<table>
<thead>
<tr>
<th>List of contents</th>
<th>Length (bytes)</th>
<th>Coding (hex)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSL</td>
<td>2</td>
<td>F1 11</td>
</tr>
<tr>
<td>associated data record number</td>
<td>2</td>
<td>00 E9</td>
</tr>
<tr>
<td>Length of the data record</td>
<td>2</td>
<td>00 40</td>
</tr>
<tr>
<td>Index</td>
<td>2</td>
<td>00 03</td>
</tr>
<tr>
<td>SSL</td>
<td>2</td>
<td>F1 11</td>
</tr>
<tr>
<td>associated data record number</td>
<td>2</td>
<td>00 EA</td>
</tr>
<tr>
<td>Length of the data record</td>
<td>2</td>
<td>00 40</td>
</tr>
<tr>
<td>Index</td>
<td>2</td>
<td>00 04</td>
</tr>
</tbody>
</table>

8 bytes of block information for additional data record objects

Σ: 48

1. The relevant index assigned to a particular section of the ID data is found in the associated data record number (see the ID data table below.)
   - All data records which contain ID data have a length of 64 bytes.
   - The data record structure is based on the principle shown in the table below.

Table 3- 8 Basic structure of data records which contain ID data.

<table>
<thead>
<tr>
<th>List of contents</th>
<th>Length (bytes)</th>
<th>Coding (hex)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Header information</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SSL</td>
<td>2</td>
<td>F1 11</td>
</tr>
<tr>
<td>Index</td>
<td>2</td>
<td>00 0x</td>
</tr>
<tr>
<td>Length of identification data</td>
<td>2</td>
<td>00 38</td>
</tr>
<tr>
<td>Number of blocks which contain ID data.</td>
<td>2</td>
<td>00 01</td>
</tr>
<tr>
<td>Identification data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Index</td>
<td>2</td>
<td>00 0x</td>
</tr>
<tr>
<td>Identification data for the respective index (see table below)</td>
<td>54</td>
<td></td>
</tr>
</tbody>
</table>

The identification data are assigned to the indices corresponding to the table below.

The data structures of data records 231 to 234 are compliant with the PROFIBUS Guideline - Order No. 3.502, Version 1.1.1 dated March 2005.
## Reading of identification data

### Table 3-9 Identification data

<table>
<thead>
<tr>
<th>Identification data</th>
<th>Access</th>
<th>Default setting</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MANUFACTURER_ID</td>
<td>read (2 Byte)</td>
<td>2A hex (= 42 dec)</td>
<td>The name of the manufacturer is stored here. (42 dec = SIEMENS AG)</td>
</tr>
<tr>
<td>ORDER_ID</td>
<td>Read (20 bytes)</td>
<td>Depends on the module</td>
<td>Order number of the module</td>
</tr>
<tr>
<td>SERIAL_NUMBER</td>
<td>Read (16 bytes)</td>
<td>Not relevant</td>
<td></td>
</tr>
<tr>
<td>HARDWARE_REVISION</td>
<td>read (2 Byte)</td>
<td>Not relevant</td>
<td></td>
</tr>
<tr>
<td>SOFTWARE_REVISION</td>
<td>Read (4 bytes)</td>
<td>Firmware version</td>
<td>This indicates the firmware version of the module.</td>
</tr>
<tr>
<td>REVISION_COUNTER</td>
<td>read (2 Byte)</td>
<td>-</td>
<td>Provides information on parameter modifications on the module.</td>
</tr>
<tr>
<td>PROFILE_ID</td>
<td>read (2 Byte)</td>
<td>F600 hex</td>
<td>Generic Device</td>
</tr>
<tr>
<td>PROFILE_SPECIFIC_TYPE</td>
<td>read (2 Byte)</td>
<td>0003 hex</td>
<td>On electronic modules</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0005 hex</td>
<td>on interface modules</td>
</tr>
<tr>
<td>IM_VERSION</td>
<td>read (2 Byte)</td>
<td>0101 hex</td>
<td>Provides information on the ID data version (0101 hex = version 1.1)</td>
</tr>
<tr>
<td>IM_SUPPORTED</td>
<td>read (2 Byte)</td>
<td>000E hex</td>
<td>Provides information on existing identification data (index 2 to 4)</td>
</tr>
</tbody>
</table>

### Maintenance data 1: Index 2 (Data record 232)

| TAG_FUNCTION       | Read/write (32 bytes) | - | Define a unique identifier for the module in this record.                                       |
| TAG_LOCATION        | Read/write (22 bytes)  | - | Enter the installation location of the module here.                                              |

### Maintenance data 2: Index 3 (data record 233)

| INSTALLATION_DATE  | Read/write (16 bytes) | - | Enter the installation date of the module here.                                                  |
| RESERVED            | Read/write (38 bytes)  | - | Reserved                                                                                         |

### Maintenance data 3: Index 4 (data record 234)

| DESCRIPTOR          | Read/write (54 bytes) | - | Enter a comment on the module here.                                                              |
Interrupt, error, and system messages

4.1 LED displays on the interface module

LED display

1. Group error (red)
2. Bus fault (red)
3. Supply voltage (green)
### 4.1 LED displays on the interface module

#### Status and error displays

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

<table>
<thead>
<tr>
<th>Event (LEDs)</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SF</strong></td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>*</td>
<td>*</td>
<td>On</td>
</tr>
<tr>
<td>* Flashing</td>
<td>On</td>
<td>On</td>
</tr>
<tr>
<td>*</td>
<td>On</td>
<td>On</td>
</tr>
<tr>
<td>On</td>
<td>*</td>
<td>On</td>
</tr>
<tr>
<td>Off</td>
<td>Off</td>
<td>On</td>
</tr>
<tr>
<td>Off</td>
<td>Off</td>
<td>On</td>
</tr>
</tbody>
</table>

* Not relevant
4.2 Process interrupt lost

"Process interrupt lost" Diagnostics

Modules with a controller use the "Process interrupt lost" diagnostics.

The "Process interrupt lost" diagnostics are not currently available for the 2DI 24 V DC High Feature and 4DI 24 V DC High Feature modules.

Note

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

If more than approximately 90 process interrupts are generated per second, process interrupts may be lost.

4.3 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.
- OB 82 is called. If OB 82 is not available, the CPU goes into STOP.

Actions Following a Diagnostic Message in DPV1 mode

Each diagnostic message triggers the following actions:

- Diagnostics can be reported as diagnostic interrupts in DPV1 mode.
- After a diagnostic message is signaled, the message is:
  - Entered in the diagnostic frame as a diagnostic interrupt block (always limited to one interrupt)
  - Written to the diagnostic buffer of the CPU
- The SF LED on the interface module lights up.
- OB 82 is called. If OB 82 is not available, the CPU goes into STOP mode.
- Acknowledgment of the diagnostic interrupt (thereafter a new interrupt is possible).
4.4 Diagnostics with STEP 7

4.4.1 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

- The maximum frame length for the ET 200S is as follows:
  - IM151-1 STANDARD (DPV0 mode): 62 bytes
  - IM151-1 STANDARD (DPV1 mode): 110 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>
<thead>
<tr>
<th>Automation system with DP master</th>
<th>Block or tab in STEP 7</th>
<th>Application</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIMATIC S7/M7</td>
<td>&quot;DP Slave Diagnostics&quot; tab</td>
<td>Slave diagnostics in plain text on the STEP 7 user interface</td>
<td>&quot;Diagnosing hardware&quot; in STEP 7 Online Help</td>
</tr>
<tr>
<td>SFC 13 &quot;DP NRM_DG&quot;</td>
<td></td>
<td>Reading out slave diagnostics (store in the data area of the user program)</td>
<td>SFC see STEP 7 Online Help</td>
</tr>
<tr>
<td>SFC 59 &quot;RD_REC&quot;</td>
<td></td>
<td>Reading out data records of the S7 diagnostics (store in the data area of the user program)</td>
<td>See the system and standard functions reference manual</td>
</tr>
<tr>
<td>SFB52 &quot;RDREC&quot;</td>
<td></td>
<td>Read data records from the DP slave</td>
<td>SFB see STEP 7 Online Help (system functions/function blocks)</td>
</tr>
<tr>
<td>SFB 54 &quot;RALRM&quot;(^1)</td>
<td></td>
<td>Receiving interrupts from the interrupt OBs</td>
<td>SFB see STEP 7 Online Help (system functions/function blocks)</td>
</tr>
</tbody>
</table>

\(^1\) only for S7-400 from V3.0 and CPU 318 from V3.0
### 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 (3FEH).
- The slave diagnostics are to be stored in DB 82: Starting from address 0.0, length = 64 bytes.
- The slave diagnostics consist of a maximum of 64 bytes (IM151-1 STANDARD in DPV0 mode).

#### STEP 7 user program

<table>
<thead>
<tr>
<th>STL</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALL</td>
<td>SFC 13</td>
</tr>
<tr>
<td>REQ</td>
<td>:=TRUE</td>
</tr>
<tr>
<td>LADDR</td>
<td>:=W#16#3FE</td>
</tr>
<tr>
<td>RET_Val</td>
<td>:=MW0</td>
</tr>
<tr>
<td>RECORD</td>
<td>:=P#DB82.DBX 0.0 BYTE 64</td>
</tr>
<tr>
<td>BUSY</td>
<td>:=M2.0</td>
</tr>
</tbody>
</table>
4.4.2 Structure of the slave diagnostics

The figure below shows the structure of the slave diagnostics.

Figure 4-1 Structure of the slave diagnostics

* These diagnostics can be disabled or enabled using parameters. If you disable them, they will be removed from this diagnostics frame.

** Only for IM151-1 STANDARD (6ES7151-1AA04-0AB0 or higher) in DPV1 mode.
Note

The length of the diagnostics frame varies depending on the parameter assignment:
- Between 6 and 62 bytes in DPV0 mode
- Between 6 and 110 bytes in DPV1 mode

You can identify the length of the last received diagnostics frame in *STEP 7* by referring to the RET_VAL parameter of the SFC 13.
4.4.3 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 4-3 Structure of station status 1 (byte 0)

<table>
<thead>
<tr>
<th>Bit</th>
<th>Meaning</th>
<th>Cause/Remedy</th>
</tr>
</thead>
</table>
| 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?  
• Is the DP slave connected to the voltage supply?  
• Is the RS-485 repeater set correctly?  
• Has the DP slave been 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 does not match the slave configuration. | • Has the correct station type or the correct DP slave configuration been entered in the configuration software? |
| 3   | 1: External diagnostics information is pending. (Group diagnostics display) | • Evaluate the ID-specific diagnostics information, the module status, and/or the channel-specific diagnostics 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 diagnostics 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. | • Has the correct station type been 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" diagnostics byte. |
### Structure of station status 2 (byte 1)

<table>
<thead>
<tr>
<th>Bit</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1: The DP slave parameters need to be reassigned.</td>
</tr>
<tr>
<td>1</td>
<td>1: A diagnostics message is pending. The DP slave will not operate until the problem is eliminated (static diagnostics message).</td>
</tr>
<tr>
<td>2</td>
<td>1: The bit on the DP slave is always &quot;1&quot;.</td>
</tr>
<tr>
<td>3</td>
<td>1: The watchdog is activated for this DP slave.</td>
</tr>
<tr>
<td>4</td>
<td>1: The DP slave has received the &quot;FREEZE&quot; control command.</td>
</tr>
<tr>
<td>5</td>
<td>1: The DP slave has received the &quot;SYNC&quot; control command.</td>
</tr>
<tr>
<td>6</td>
<td>0: Bit is always &quot;0&quot;.</td>
</tr>
</tbody>
</table>
| 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 diagnostics message changes also.

### Structure of station status 3 (byte 2)

<table>
<thead>
<tr>
<th>Bit</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 6</td>
<td>0: Bits are always set to &quot;0&quot;.</td>
</tr>
</tbody>
</table>
| 7   | 1:  

- There are more diagnostics messages pending than the DP slave is able to store.  
- The DP master cannot enter all the diagnostics messages sent by the DP slave in its diagnostics buffer (channel-specific diagnostics).

### 4.4.4 Master PROFIBUS address

**Definition**

The Master PROFIBUS address diagnostics byte contains the PROFIBUS address of the DP master:

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

The master PROFIBUS address is located in byte 3 of the slave diagnostics.
4.4.5 Identifier-related diagnostics

Definition

The identifier-related diagnostics indicate whether or not modules of the ET 200S have errors/faults. Identifier-related diagnostics start at byte 6 and are 9 bytes long.

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

**Figure 4-2** Structure of the identifier-related diagnostics for the ET 200S with IM151-1 STANDARD
4.4.6 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. The module status starts after the identifier-related diagnostics and consists of 20 bytes.

The module status for the ET 200S with the IM151-1 STANDARD is structured as follows:

![Module status structure diagram]

* Always "00"
4.4.7 Channel-specific diagnostics

Definition

Channel-specific diagnostics provide information about channel errors in 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 the slave diagnostics, i.e., 62 bytes in DPV0 mode or 110 bytes in DPV1 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).

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

![Diagram](image)

Figure 4-4 Structure of the channel-specific diagnostics for the ET 200S with the IM151-1 STANDARD
Note
The module slot coding is contained in byte 35, 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 bits 6/7 of byte 36, 00B is output if a power module reports channel-specific diagnostics.

4.4.8 Interrupts

Definition
The interrupt section of the slave diagnostics indicates the interrupt type and the event that led to an interrupt being triggered. The interrupt part consists of a maximum of 48 bytes.

Position in the diagnostic frame
The interrupt section comes after the channel-specific diagnostics (only in DPV1 mode).
Example: If 3 channel-specific diagnostics are pending, then the interrupt section starts at byte 44.

Data records
The diagnostic data of a module can be up to 44 bytes in length and is located in data records 0 and 1:
- Data record 0 contains 4 bytes of diagnostic data describing the current status of an automation system. DS0 is part of the header information of OB 82 (local data bytes 8 to 11).
- Data record 1 contains the 4 bytes of diagnostic data that is also contained in data record 0 and, in addition, up to 40 bytes of module-specific diagnostic data.
DS0 and DS1 can be read out with SFC 59 "RD_REC."

Contents
The contents of the interrupt information depend on the interrupt type:
- In the case of diagnostic interrupts, diagnostic data record 1 (up to 44 bytes) is sent as the interrupt status information (starting from byte x+4).
- The status information for process interrupts is 4 bytes in length.
- In the case of insert/remove module interrupts, the interrupt status information is 0 bytes long.
Structure of interrupts

Once configuration with *STEP 7* is complete, the interrupt data is evaluated and transferred to the relevant organization blocks (OBs).

The interrupt section for the ET 200S is structured as follows:

![Diagram of interrupt structure](image)

Figure 4-5 Structure of the interrupt status of the interrupt section
Diagnostic interrupt, byte x+4 to x+7

Figure 4-6 Structure of bytes x+4 to x+7 for diagnostic interrupt
Diagnostic interrupt from the modules, byte x+8 to byte x+11

Figure 4-7 | Structure of byte x+8 to byte x+11 for diagnostic frame
Diagnostic interrupt from the modules, byte x+12 to byte x+15

Figure 4-8 Structure of byte x+12 to byte x+15 for diagnostic frame
Example of a diagnostic interrupt

Example:
The 4DI electronic module reports the "short circuit" diagnostic interrupt on channel 2

Byte x

7 6 5 4 3 2 1 0
0 0 1 1 0 0 1 1

Length of the interrupt section = 27 bytes

Byte x+1

7 6 5 4 3 2 1 0
0 0 0 0 0 0 1

Diagnostics interrupt

Byte x+2

7 6 5 4 3 2 1 0
0 0 0 0 1 0 1 0

Slot number 10

Byte x+3

7 6 5 4 3 2 1 0
0 0 0 1 0 0 1

at least 1 error is pending
Interrupt sequence number = 1

Byte x+4

7 6 5 4 3 2 1 0
0 0 0 1 0 0 0

Channel error

Byte x+5

7 6 5 4 3 2 1 0
0 0 1 1 1 1 1

Digital electronic module
Channel information exists

Bytes x+6 and x+7 always "0"

Figure 4-9   Example of a diagnostic interrupt (Part 1)
4.4 Diagnostics with STEP 7

Figure 4-10  Example of a diagnostic interrupt (Part 2)
Process interrupt of digital input modules

<table>
<thead>
<tr>
<th>Byte x+4</th>
<th>7 6 5 4 3 2 1 0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rising edge on channel 0</td>
</tr>
<tr>
<td></td>
<td>Rising edge on channel 1</td>
</tr>
<tr>
<td></td>
<td>Rising edge on channel 2</td>
</tr>
<tr>
<td></td>
<td>Rising edge on channel 3</td>
</tr>
<tr>
<td></td>
<td>Bytes x+5, x+6 and x+7 always 00h</td>
</tr>
</tbody>
</table>

Figure 4-11 Structure as of byte x+4 for process interrupt (digital input)

Process interrupt of analog input modules

<table>
<thead>
<tr>
<th>Byte x+4</th>
<th>7 6 5 4 3 2 1 0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Upper limit exceeded: Channel 0</td>
</tr>
<tr>
<td></td>
<td>Upper limit exceeded: Channel 1</td>
</tr>
<tr>
<td>Byte x+5</td>
<td>7 6 5 4 3 2 1 0</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lower limit value undershot: Channel 0</td>
</tr>
<tr>
<td></td>
<td>Lower limit value undershot: Channel 1</td>
</tr>
<tr>
<td></td>
<td>Bytes x+6 and x+7 always 00h</td>
</tr>
</tbody>
</table>

Figure 4-12 Structure as of byte x+4 and byte x+5 for process interrupt (analog input)
4.4.9 Incorrect module configurations of ET 200S on the PROFIBUS DP

Invalid module configuration states

The following invalid ET 200S module configuration states lead to an ET 200S station failure 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
- Module missing in slot 1 (in the case of IM151-1 STANDARD, 6ES7151-1AA00-0AB0)
- Backplane bus fault (for example, defective terminal module)

Note

For IM151-1 STANDARD (6ES7151-1AA01-0AB0) and higher: The station will not start up if one module is missing (gap) and the ET 200S is switched on.

Diagnostics

You can identify any invalid module configuration states on the basis of the following diagnostics:

<table>
<thead>
<tr>
<th>Identifier-related diagnostics</th>
<th>Module status</th>
</tr>
</thead>
<tbody>
<tr>
<td>All 63 bits set</td>
<td>01b: &quot;Module error; invalid user data&quot; for all modules (slots) until the cause of the error is found</td>
</tr>
<tr>
<td></td>
<td>11b: &quot;No module; invalid user data&quot; once the cause of the error is found</td>
</tr>
</tbody>
</table>
4.5 Evaluating the interrupts of the ET 200S

Introduction

In the case of certain process states/errors, the DP slave saves one interrupt block for each process state or error, containing the relevant information, in the diagnostic frame (DPV1 interrupt mechanism). Regardless of this, the diagnostic status of the DP slave is tracked in the identifier-related diagnostics, the module status, and the channel-specific diagnostics.

Interrupts in DPV0 mode

For DPV0 mode, no interrupts are defined in accordance with the PROFIBUS standard. This means that interface modules do not trigger an interrupt in DPV0 mode.

Interrupts in DPV1 mode

The ET 200S supports the following interrupts:
- Diagnostic interrupts
- Process interrupts
- Remove/insert module interrupts

Requirements: Interrupts are only supported when you run the ET 200S with IM151-1 STANDARD interface modules (6ES7151-1AA04-0AB0 or higher) in DPV1 mode.

In the event of an interrupt, interrupt OBs are automatically executed in the CPU of the DP master (see information on program design in the System Software for S7-300/S7-400 Programming Manual).

Triggering a diagnostic interrupt

When an incoming or outgoing event (e.g., a 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.
Evaluating hardware interrupts with *STEP 7*

When a process interrupt occurs, the CPU interrupts the processing of the user program and processes the OB 40 process interrupt block.

The module channel that triggered the process interrupt is entered in the start information of OB 40, in the OB40_POINT_ADDR variable. The figures below show how the local data double word 8 is assigned to the bits.

**Process interrupts in electronic modules 2DI DC24V HF and 4DI DC24V HF:**

![Diagram showing OB 40 start information for digital input modules](image1)

Figure 4-13   OB 40 start information: The event that triggered the process interrupt for digital input modules

**Process interrupts for 2 AI U HS, 2 AI I 2WIRE HS and 2 AI I 4WIRE HS electronic modules:**

![Diagram showing OB 40 start information for analog input modules](image2)

Figure 4-14   OB 40 start information: The event that triggered the process interrupt for analog input modules

You will find a description of OB 40 in the *System and Standard Functions* Reference Manual.

**Triggering a insert/remove module interrupt**

Insert/remove-module interrupts are supported in DPV1 mode. The CPU interrupts processing of the user program and processes diagnostic block OB 83 instead. The event that triggered the interrupt is entered in the OB 83 start information.
Response times

5.1 Overview

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

Figure 5-1  Response times between DP Master and ET 200S
5.2 Response times for the ET 200S

Calculating the response time with the IM151-1 STANDARD

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

\[ \text{Response time [µs]} = 28 \cdot m + 9 \cdot b + 350 \]

Explanation of the parameters:

- \( m \): Sum total of all configured modules
- \( b \): Sum total of all input and output bytes (without bit granular modules)

**Example for calculating the ET 200S response time (as of 6ES7151-1AA05-0AB0)**

![Diagram of IM151-1 STANDARD configuration](image)

Calculation method:

\( m = 21; b = 16 \)

Response time = \( 28 \cdot m + 9 \cdot b + 350 \)

Response time = \( 28 \cdot 21 + 9 \cdot 16 + 350 \)

Response time = **1082 µs**
5.3 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.

5.4 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.
5.5 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.

![Cycle time of the analog input module](image)

Figure 5-3 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.
5.6 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.

![Diagram showing cycle time of the analog output module]

Settling time

The settling time (t₂ to t₃) 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 (t₁ to t₃) 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 5-5  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.

5.7 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.

5.8 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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