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Heater controller SIPLUS HCS716I

Operating Instructions

<u>Introduction</u>	1
<u>Safety notes</u>	2
<u>Description</u>	3
<u>Mounting</u>	4
<u>Connection</u>	5
<u>Commissioning</u>	6
<u>Functions</u>	7
<u>Alarm, error and system messages</u>	8
<u>Service and maintenance</u>	9
<u>Technical data</u>	10
<u>Order numbers</u>	11
<u>Appendix</u>	A

Legal information

Warning notice system

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

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

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

⚠ CAUTION
with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

CAUTION
without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

NOTICE
indicates that an unintended result or situation can occur if the relevant information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, 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.

Table of contents

1	Introduction	5
2	Safety notes	7
3	Description	9
3.1	Applications.....	9
3.2	Design.....	9
3.2.1	Rack hinged frame.....	9
3.2.2	Rack mounting frame.....	10
3.2.3	Rack mounting frame slim-line version.....	12
3.2.4	Expansion rack slim-line version.....	13
3.3	Components of the HCS716I heater controller.....	14
3.4	System components.....	15
3.5	Performance profile of the power output modules.....	16
3.5.1	Performance profile of the LA716.....	16
3.5.2	Performance profile of the LA716I.....	17
3.5.3	Performance profile of the LA716I HP.....	18
3.5.4	Sample calculation of ambient temperature.....	19
3.5.5	Sample calculation of the switching capacity.....	19
4	Mounting	21
4.1	Installing rack.....	21
4.2	Integrating HCS716I into the system.....	26
4.3	Setting the bus address.....	27
4.4	Plugging in power output modules.....	27
5	Connection	31
5.1	Connecting the PROFIBUS DP fieldbus.....	32
5.2	Connecting the supply voltage.....	33
5.3	Connecting the heat emitter and three-phase line supply.....	35
6	Commissioning	39
6.1	Hardware requirements.....	39
6.2	Software requirements.....	39
6.3	Integrating the GSD file.....	40
7	Functions	41
7.1	Initialization (start-up).....	41
7.2	Operation of the HCS716I.....	42
7.3	Monitoring functions of the HCS716I.....	43

7.3.1	Outputs of the power output modules	44
7.3.2	Temperature of the power output modules	45
7.3.3	Transfer of the diagnostic messages	45
7.4	Data exchange between an S7-DP master and the HCS716I.....	47
7.4.1	Installing the software	48
7.4.2	Software structure	49
7.4.3	Data blocks	50
7.4.4	Functions and their call interfaces	52
7.4.4.1	FC_ZYKL.....	53
7.4.4.2	FC_REST	53
7.4.4.3	FC_DIAG.....	54
7.5	Data exchange between a non S7-DP master and the HCS716I.....	55
7.5.1	Buffer format	55
7.5.2	Job types.....	56
7.5.2.1	No job.....	57
7.5.2.2	Transmission of the group assignment.....	58
7.5.2.3	Transfer of basic values.....	59
7.5.2.4	Transfer of override values	60
7.5.2.5	Transfer of test commands	61
7.5.2.6	Reporting of existing power output modules.....	62
7.5.3	Assignment of the output data	64
7.5.4	Data transfer	65
7.5.5	Error codes in the input buffer.....	66
8	Alarm, error and system messages	67
8.1	Error during startup or during operation.....	68
8.2	Faults on the power output modules.....	70
8.3	Reaction to interruption of the supply voltage.....	72
9	Service and maintenance	73
9.1	Loading the firmware for the HCS716I.....	73
10	Technical data	75
10.1	Technical data for rack.....	75
10.2	Technical data of the power output module	77
10.2.1	Technical data of the power output module LA716	77
10.2.2	Technical data for LA716I power output module	79
10.2.3	Technical data for LA716I HP power output module	81
10.3	Ambient conditions for all HCS716I components	83
11	Order numbers.....	87
11.1	Components of the SIPLUS HCS716I heater controller	87
11.2	Accessories.....	87
A	Appendix.....	89
A.1	Recycling and disposal	89
A.2	Service & support.....	89
	Index.....	91

Introduction

Purpose of the operating instructions

The information provided in these operating instructions will enable you to put the SIPLUS HCS716I heater controller into service on the PROFIBUS DP as a DP slave and to control it via an S7 DP master. You will find information on

- the installation
- the operation of the SIPLUS HCS716I heater controller
- possible faults
- technical specifications
- ordering options for individual components

Required basic knowledge

- These operating instructions require prior knowledge of programming an S7 controller or SIMOTION.
- Knowledge of working with the PROFIBUS DP fieldbus is also necessary.

Range of validity of these operating instructions

These operating instructions apply to the SIPLUS HCS716I heater controller.

Target group

The documentation is intended for qualified personnel. Specifically this includes:

- Installation personnel
- Electricians
- Programmers
- Plant owners

Registered trademarks

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Safety notes

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 WARNING
--

Before working on the heater controller or the connected components, ensure the system is disconnected.

 WARNING
--

- | |
|--|
| <ul style="list-style-type: none">• In the control cabinet, voltages of > 60 V occur. Suitable safety precautions must therefore be taken before commissioning and maintenance work.• The use of a residual current protective device as the sole protection against indirect touching is forbidden.• Do not touch the metal housing of the modules with bare fingers. Danger of burning due to hot surfaces! |
|--|

Fuse replacement

 WARNING
--

Before changing a fuse, you must isolate the load circuit from the supply.
--

CAUTION

Use only the prescribed fuse types. If you operate a power output module with unapproved fuses, the device could be destroyed.
--

Description

Overview

This section contains information on the modules of the heater controller and their position within the overall system.

3.1 Applications

The HCS716I heater controller is used for controlling heat emitters used in industry. One preferred application of the HCS716I is to control heat emitters in the areas of thermoforming and blow molding. It is also used for paint dryers in the automotive industry, for plastics welding and for extrusion.

In principle, the HCS716I can be used wherever resistive loads have to be switched and monitored.

3.2 Design

3.2.1 Rack hinged frame

Design

The following two diagrams show the design of the SIPLUS HCS716I heater controller for installation in a control cabinet with:

- Hinged frame
- 19" uprights

The CPU module and the control module are located at the rear of the rack. A ribbon cable connects the CPU module and the control module to the bus module.

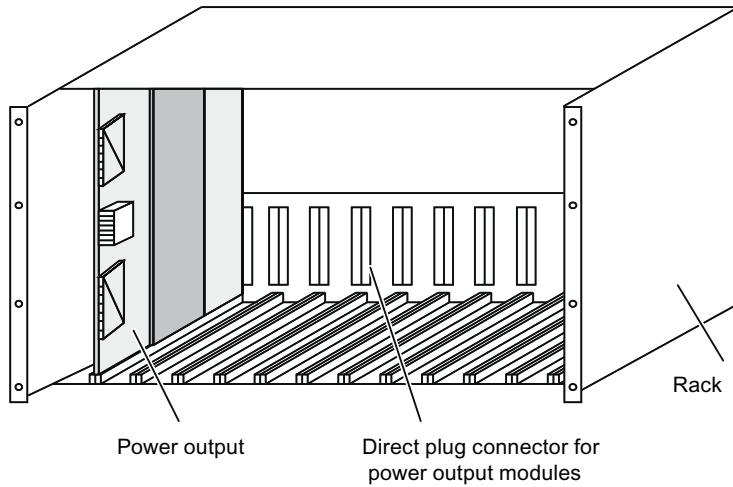


Figure 3-1 Front view of rack hinged frame

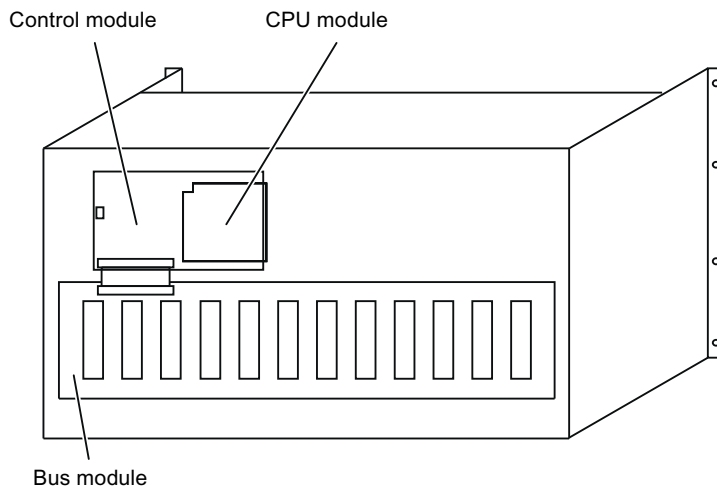


Figure 3-2 Rear view of rack hinged frame

3.2.2 Rack mounting frame

Design

The following two diagrams show the design of the SIPLUS HCS716I heater controller for installation in a control cabinet.

The CPU module and the control module are located at the side of the rack. A ribbon cable connects the CPU module and the control module to the bus module.

The rack mounting frame is available in two versions:

- With flange
- Without flange

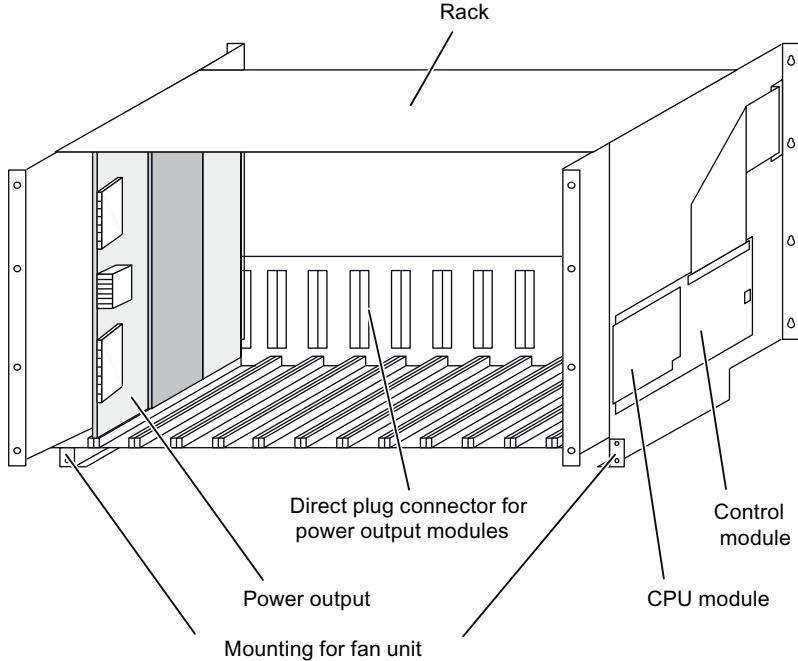


Figure 3-3 Front view of rack mounting frame

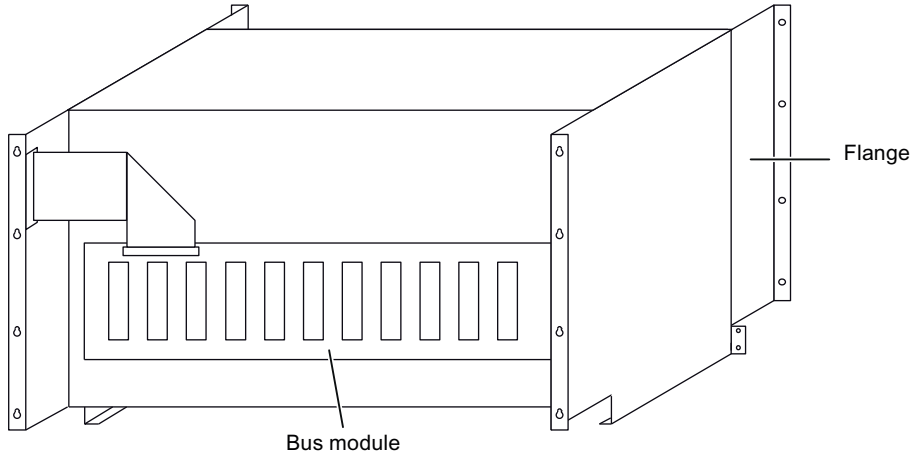


Figure 3-4 Rear view of rack mounting frame

3.2.3 Rack mounting frame slim-line version

Design

The following two figures show the design of the SIPLUS HCS716I heater controller (rack HCS716I mounting frame slim-line version) for direct installation in a control cabinet.

The CPU module and the control module are located at the side of the rack. A ribbon cable connects the CPU module and the control module to the bus module.

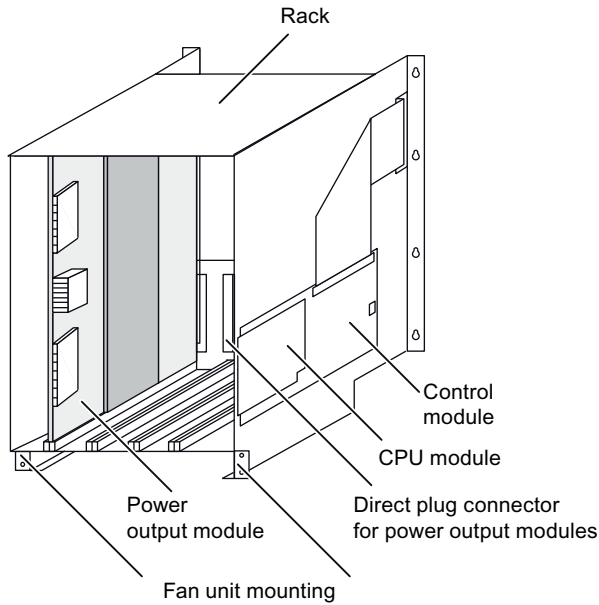


Figure 3-5 Front view of rack mounting frame slim-line version

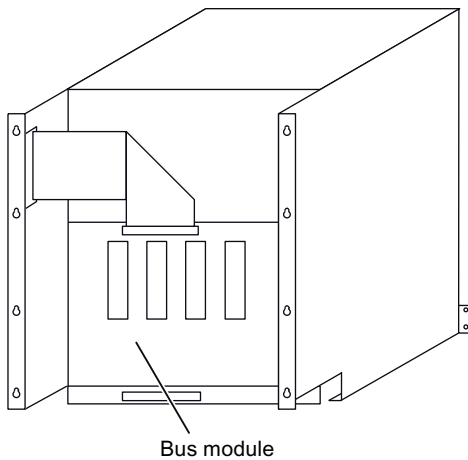


Figure 3-6 Rear view of rack mounting frame slim-line version

3.2.4 Expansion rack slim-line version

Design

The following two figures show the design of the SIPLUS HCS716I heater controller (expansion rack slim-line version) for direct installation in a control cabinet.

Expansion rack HCS716I slim-line version can be connected to rack HCS716I mounting frame slim-line version using a pre-assembled ribbon cable.

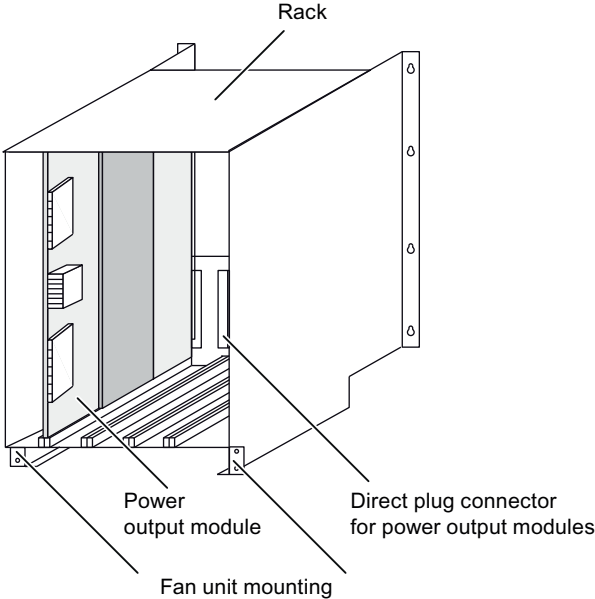


Figure 3-7 Front view of expansion rack slim-line version

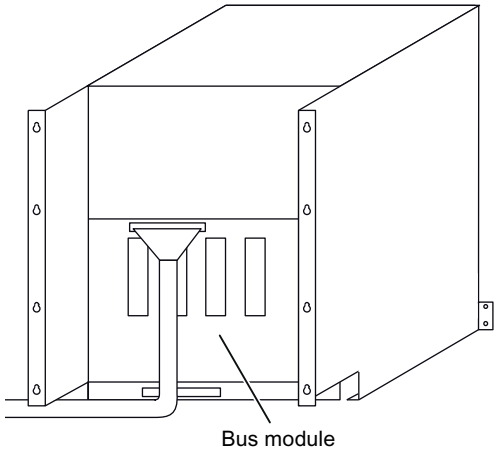


Figure 3-8 Rear view of expansion rack slim-line version

3.3 Components of the HCS716I heater controller

Table 3- 1 Components of the heater controller

Component	Description
Rack	19" frame with <ul style="list-style-type: none">• CPU module, control module and bus module• Holders for 4¹⁾, 8²⁾, or 12³⁾ power output modules• Isolation plate
Power output modules	<ul style="list-style-type: none">• Provide 8/16 channels for switching heat emitters on and off• Front panel if necessary• Mating connector, power supply connection, if necessary
Control module	<ul style="list-style-type: none">• Power supply for the modules of the heater controller• Decoding for control of the power output modules
CPU module	<ul style="list-style-type: none">• Connection as a slave device to the PROFIBUS DP fieldbus• Communication at 12 MBaud on PROFIBUS DP• Control of the power output modules• Automatic detection of the line frequency
Bus module	Contains 4 ¹⁾ , 8 ²⁾ , or 12 ³⁾ direct-connectors for the connection from the control module to the power output modules

- 1) Rack mounting frame slim-line version
- 2) Rack mounting frame slim-line version with expansion rack slim-line version
- 3) Rack hinged frame/rack mounting frame

3.4 System components

List of the system components

The heater controller SIPLUS HCS716I is a distributed I/O device, also referred to as a slave. It communicates via the PROFIBUS DP fieldbus with a DP master.

A complete system includes the following components:

- Heater controller with between 1 and 12 power output modules
- Higher-level control by DP master

For example, SIMATIC S7-300/400 automation system with integrated interface for PROFIBUS DP or SIMOTION

- PROFIBUS DP
- Cabling
- Heat emitter array
- HMI panel or IPC

Interaction of the system components

The following diagram shows an example of the interaction between the system components described:

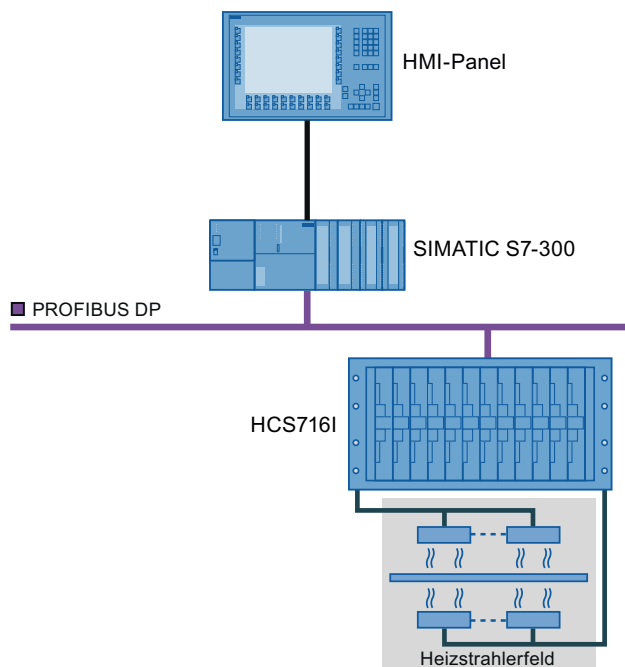


Figure 3-9 System components of the SIPLUS HCS716I heater controller

3.5 Performance profile of the power output modules

Use the performance profile to check whether your heater emitter field corresponds to the specifications of the SIPLUS HCS716I heater controller.

3.5.1 Performance profile of the LA716

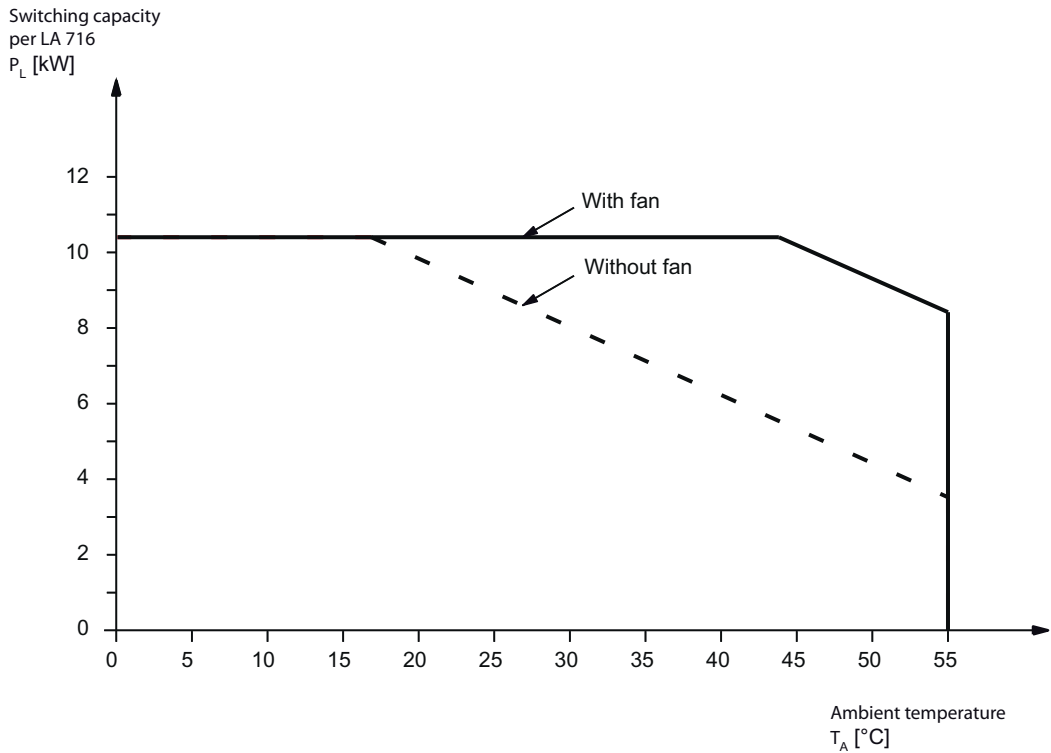


Figure 3-10 Performance profile of the LA716

3.5.2 Performance profile of the LA716I

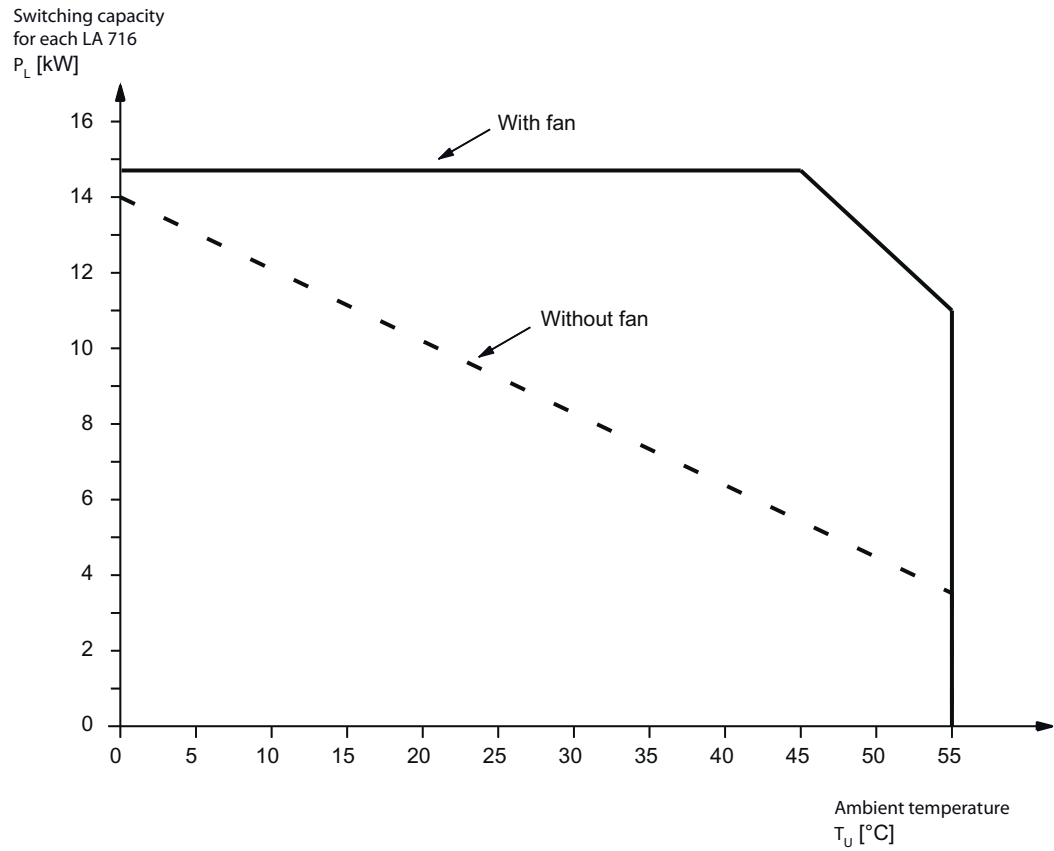


Figure 3-11 Performance profile of the LA716I

3.5.3 Performance profile of the LA716I HP

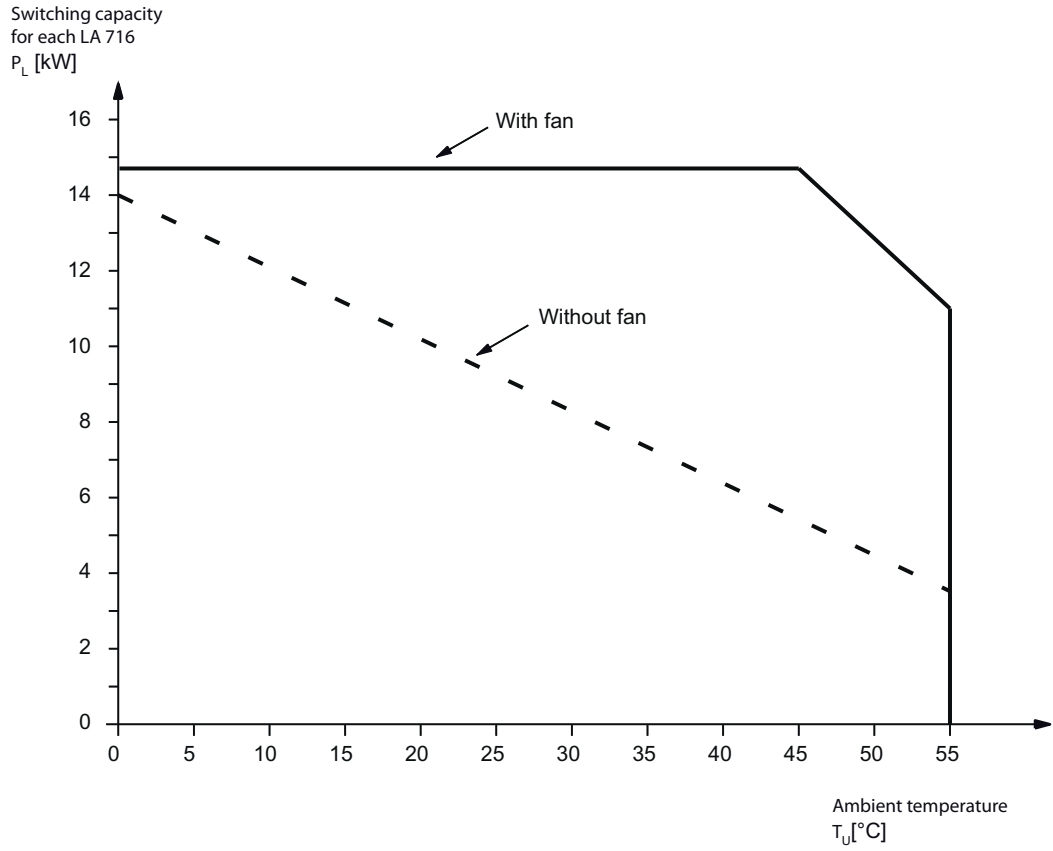


Figure 3-12 Performance profile of the LA716I HP

3.5.4 Sample calculation of ambient temperature

Prerequisites

- Emitter power output $P_S = 1000 \text{ W}$
- 16 emitters (channels) $\rightarrow A = 16$
- Heating ON / total cycle time $V = 0.7$
e.g. heating ON = 7 s; entire cycle time = 10 s
- Simultaneity $G = 0.85$
i.e. all emitters always heat at 85%

Calculation of the necessary ambient temperature

We calculate the effective switching capacity per LA716 using the formula

$$\begin{aligned} P_{\text{Leff}} &= P_S \times A \times V \times G \\ &= 700 \text{ W} \times 16 \times 0.7 \times 0.85 \\ &= 9520 \text{ W} \end{aligned}$$

Read from the characteristic curve the permissible ambient temperature for the calculated switching capacity.

Result

- The permissible ambient temperature without a fan is 22°C.
- The permissible ambient temperature with a fan is 49°C.

3.5.5 Sample calculation of the switching capacity

Prerequisites

- 16 emitters (channels) $\rightarrow A = 16$
- Heating ON / total cycle time $V = 0.8$
e.g. heating ON = 80 s; entire cycle time = 100 s
- Simultaneity $G = 1.0$
i.e. all emitters always heat at 100%

Can 700 W emitters be operated on the LA716, with fan, $T_a = 40^\circ\text{C}$?

We calculate the effective switching capacity per LA716 using the formula

$$\begin{aligned} P_{\text{Leff}} &= P_S \times A \times V \times G \\ &= 700 \text{ W} \times 16 \times 0.8 \times 1.0 \\ &= 8960 \text{ W} \end{aligned}$$

The maximum switching capacity per LA716 is

$$\begin{aligned} P_{\text{Lmax}} &= P_{\text{Lchannel}} \times A \\ &= 650 \text{ W} \times 16 \\ &= 10400 \text{ W} \end{aligned}$$

Result

$P_{\text{Leff}} < P_{\text{Lmax}}$, i.e. 700 W emitters can be operated on the LA716.

Mounting

Introduction

This section contains information on the following topics:

- Requirements for the control cabinet
- Installation of the SIPLUS HCS716I heater controller
- Assigning the address for the PROFIBUS DP

4.1 Installing rack

The heater controller is designed for stationary installation in a 19" control cabinet. The rack forms the "outer frame" of the heater controller that you install in the control cabinet.

 WARNING
--

The SIPLUS HCS716I heater controller is designed with IP00 degree of protection. You must ensure that the supply voltage for the heater controller is switched off when you open the cabinet.

Installation location requirements

In order to reliably prevent hazards for the operating personnel, the control cabinet must satisfy the following requirements:

- Closed cabinet
- Grounded cabinet
- It must be ensured that interface connections and ribbon cables at the devices are not touched by live cables which only have a single layer of insulation and pass through the control cabinet.

 **WARNING**

Danger of electric shock due to incorrect installation or damaged components.

The safety notes provided in this description must be observed in order that the device can be installed without danger and subsequently operated safely.

If the device shows signs of external damage, it must not be connected.

 **WARNING**

The use of a residual current protective device as the sole protection against indirect contact is forbidden.

NOTICE

The heater controller is designed with IP00 degree of protection. For operation the rack must therefore be installed in a closed control cabinet or the rack must be protected against physical contact at the front.

Boards and components on the reverse side of the rack must not come into contact with cables that have only single insulation and are routed through the control cabinet.

Procedure for hinged frame/mounting frame

Install the rack in the following sequence:

1. Disconnect the control cabinet from the power supply.
2. Place the rack in the control cabinet.
3. Secure the rack for installation
 - in the hinged frame on the front
 - in the mounting frame at the back

Use the pre-fabricated mounting holes that are shown in the hole diagram below:

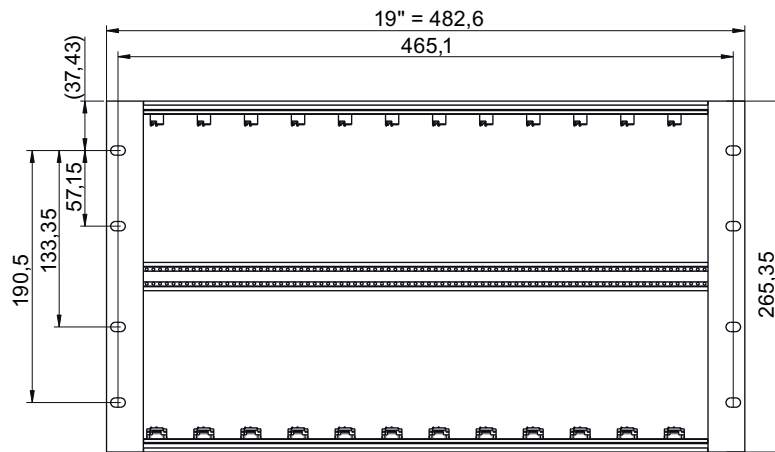


Figure 4-1 Front: Distance between holes for installation in hinged frame

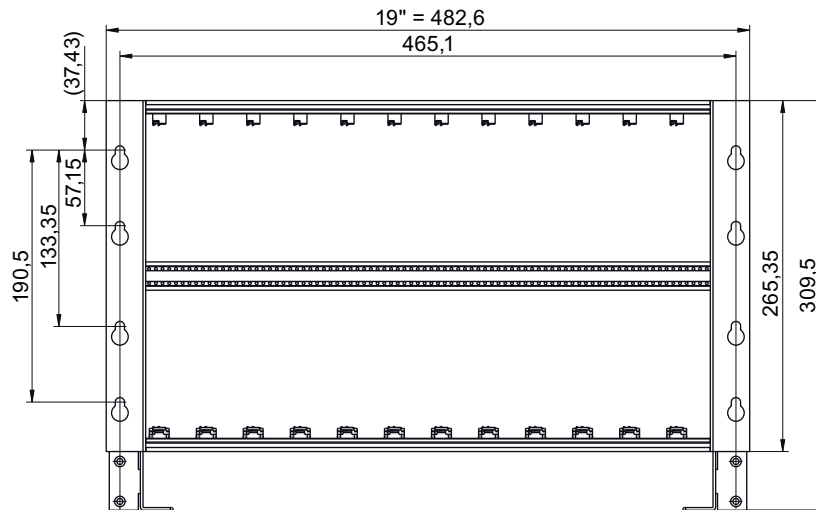


Figure 4-2 Back: Distance between holes for installation on mounting plate (mounting frame)

Procedure for mounting frame and expansion rack slim-line version

Install the rack in the following sequence:

1. Disconnect the control cabinet from the power supply.
2. Place the rack in the control cabinet.
3. Secure the rack for installation at the back.

Use the pre-fabricated mounting holes that are shown in the hole diagram below:

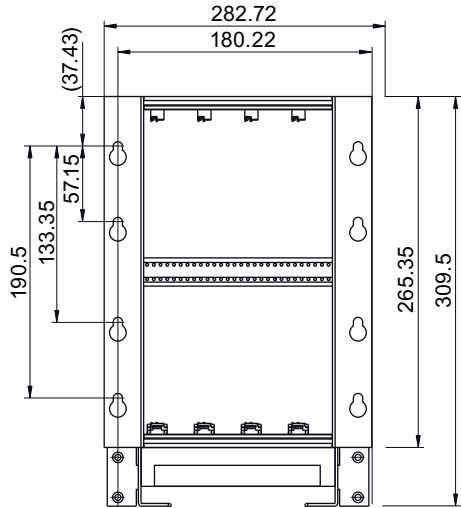


Figure 4-3 Back: Distance between holes for installation on mounting plate (mounting frame/extension rack slim-line version)

Expansion rack HCS716I slim-line version is placed to the left of the mounting frame slim-line version at a maximum distance of 50 mm and at the same height. The expansion rack HCS716I slim-line version is connected to the mounting frame slim-line version using the supplied ribbon cable.

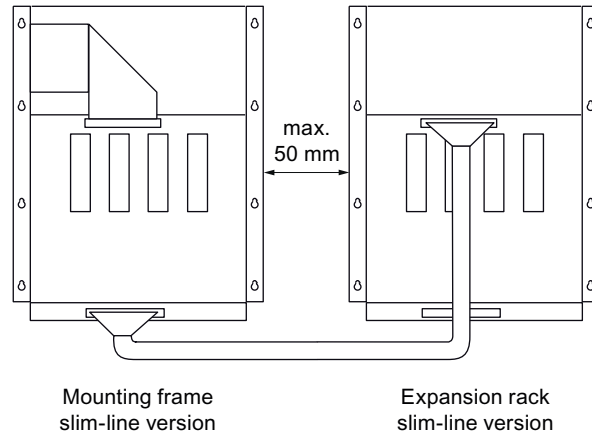


Figure 4-4 Design: Mounting frame and expansion rack slim-line version

Clearances for installing an HCS716I

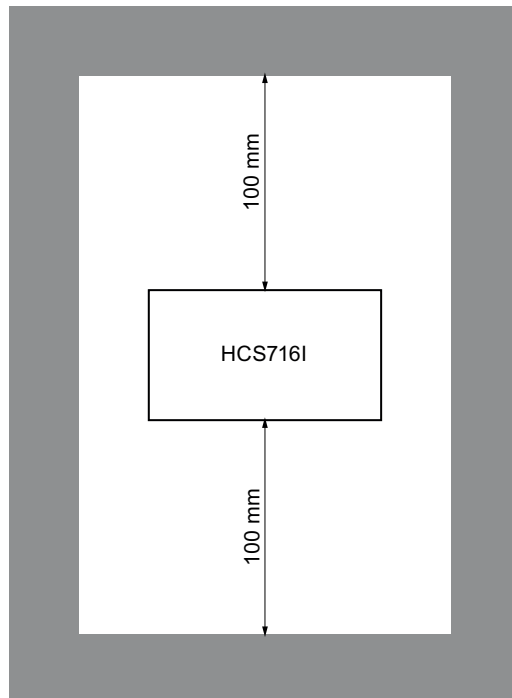


Figure 4-5 Clearances for installing an HCS716I

4.2 Integrating HCS716I into the system

Perform the settings and connections on the CPU module and the control module.

Design

The modules have the following design:

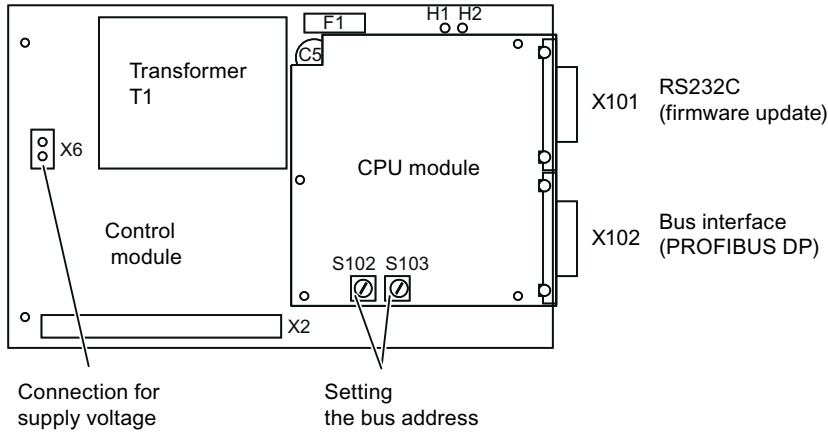


Figure 4-6 Control module and CPU module

The function of the LEDs (H1, H2) for displaying the operating state can be found at Error during startup or during operation (Page 68).

Procedure

The following settings must be performed and connections made on the modules. You can view the details in the following sections.

1. Set bus address via S102 and S103
2. Connect PROFIBUS DP fieldbus via X102 (see Connecting the PROFIBUS DP fieldbus (Page 32))
3. Connect supply voltage at X6 (see Connecting the supply voltage (Page 33))

4.3 Setting the bus address

To enable communication between S7-300/SIMOTION and the heater controller via the PROFIBUS DP fieldbus, set the bus address on the CPU module.

Procedure

Set the bus address using the rotary switches S102 and S103.

1. Select an address between 0 and 99.
2. Set the address on the CPU module.
3. Use the
 - S102 switch for the tens position of the PROFIBUS DP address
 - S103 switch for the units position of the PROFIBUS DP address

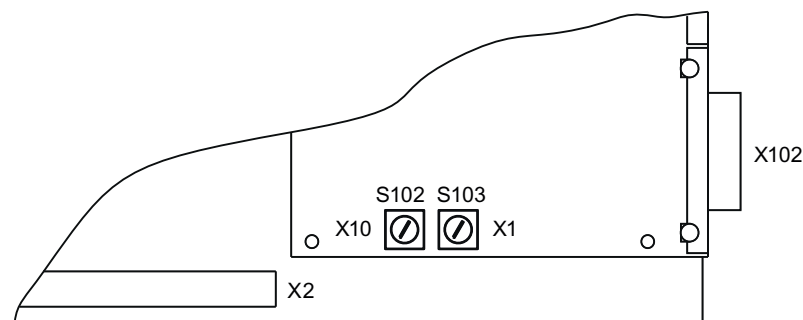


Figure 4-7 Rotary switch for setting the bus address

Note


The default address is 20.

4.4 Plugging in power output modules

The power output module is designed in double European format. Its length of 237 mm differs from the standard. A power output module consists of 8/16 identically structured output channels. On the front are located two 8-pin female connectors for connecting the heat emitters and a 3-pin screw terminal or a 3-pin connector for the line connection.

At the front, the subrack has 12 slots for the power output modules. Each slot has:

- a lower and an upper guide rail for the power output module
- a fastening clip for locking the module
- a direct plug-in connection on the bus module

 WARNING
Danger of electric shock from live heater controller or heat emitters!
Cables to the heat emitters can be live during operation. You are at risk of an electric shock. Insert or remove the power output modules only when the power is switched off!

Procedure for hinged frame/mounting frame

Install the power output modules in the following order:

1. Insert the power output module in the top and bottom guide rails. Push the module back.
2. Press the plug-in contact into the direct plug-in connection until the module engages on the guide rail.

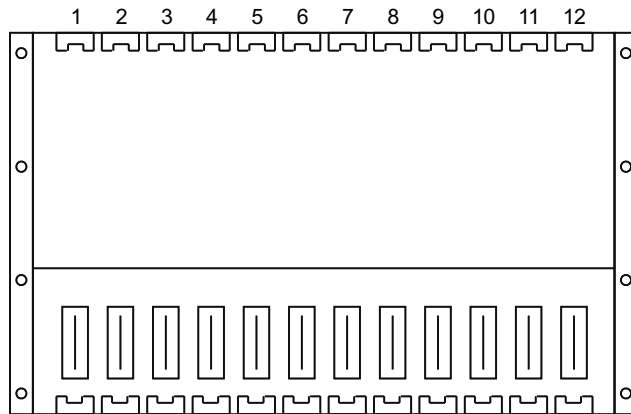


Figure 4-8 Slots for power output module (hinged frame/mounting frame)

3. Repeat this process for additional power output modules.
4. Mount the front panels for LA716I or LA716I HP.
5. If there are fewer than 12 power output modules, insert the supplied isolation plate into the slot to the right of the last power output module.

Note

If you do choose not to use the shock-hazard protection, you can insert the power output modules in any slots.

Procedure for mounting frame and expansion rack slim-line version

Install the power output modules in the following order:

1. Insert the power output module in the top and bottom guide rails. Push the module back.
2. Press the plug-in contact into the direct plug-in connection until the module engages on the guide rail.

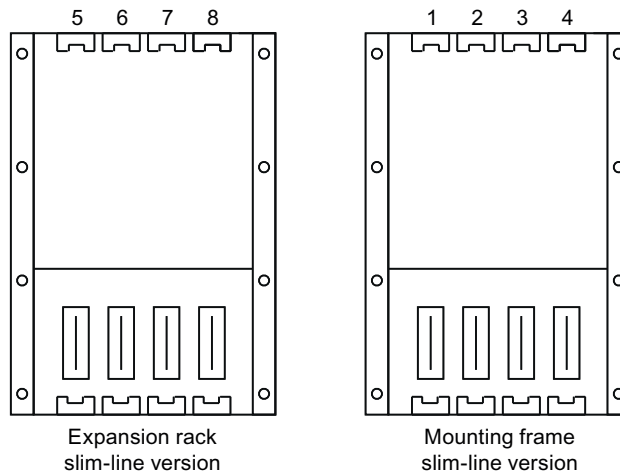


Figure 4-9 Slots for power output module (mounting frame and expansion rack slim-line version)

3. Repeat this process for additional power output modules.
4. Mount the front panels for LA716I or LA716I HP.
5. If there are fewer than 4 or 8 power output modules, insert the supplied isolation plate into the slot to the right of the last power output module.

Note

If you do choose not to use the shock-hazard protection, you can insert the power output modules in any slots.

Connection

Introduction

In the following section you will see how the components of the heater controller are assembled and connected to create the overall system. The documentation deals in detail with the following:

- PROFIBUS DP fieldbus
- Supply voltage
- Power output modules
- Heat emitters
- Three-phase system

5.1 Connecting the PROFIBUS DP fieldbus

To enable communication between S7-300/SIMOTION and the heater controller and the DP master, connect the PROFIBUS DP to the CPU module.

Procedure

Connect the bus cable in the following sequence:

1. Insert the bus cable connector into the 9-pin Sub D socket X102.

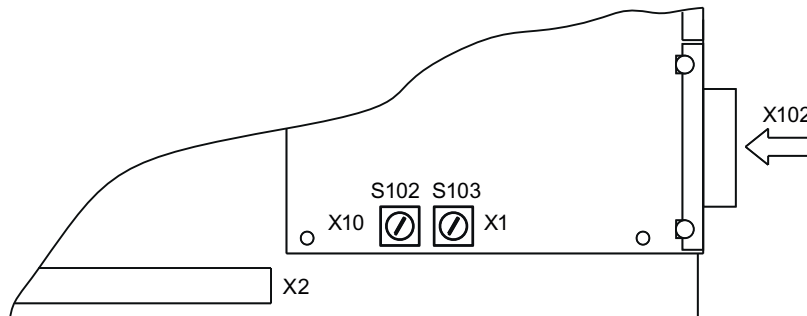


Figure 5-1 Connection socket for the PROFIBUS DP

2. Latch the connector onto the socket.
3. If the bus connector is located at the start or the end of a bus segment, you must enable the terminating resistor ("ON" position).

Make sure that stations with an activated terminating resistor are always supplied with power during startup and operation.

CAUTION

Plug-in connections can be pulled out under tension.

In order that the PROFIBUS plug-in connection on the CPU-module is not subjected to mechanical loading, the PROFIBUS cable must be secured accordingly to the rear of the rack.

5.2 Connecting the supply voltage

The modules of the SIPLUS HCS716I heater controller are powered from a power supply unit mounted on the control module. The 2-pin connector X6 for the line connection is also mounted on the module.

Procedure

Connect the supply voltage cable in the following sequence:

1. Strip the insulation from the end of the mains supply lead and fit the protective conductor with a tab receptacle. The protective conductor must have a cross-section of at least 4 mm².
2. Connect phase L1 and the neutral conductor to the connector X6.

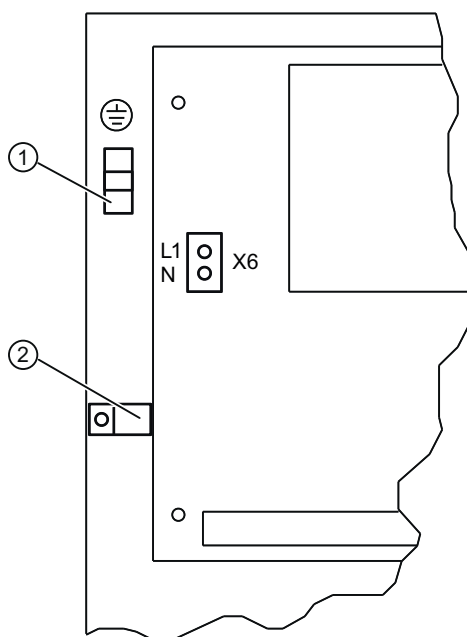


Figure 5-2 Connecting the power supply

3. Push the protective conductor onto the flat connector ① at the top left of the rack.
4. Secure the power supply cable with the cable clamp ②.

Fuse

The power supply for the modules of the heater controller is protected against overload by a miniature, medium time-lag 0.63 A fuse. The position of the fuse on the control module is shown in the diagram below:

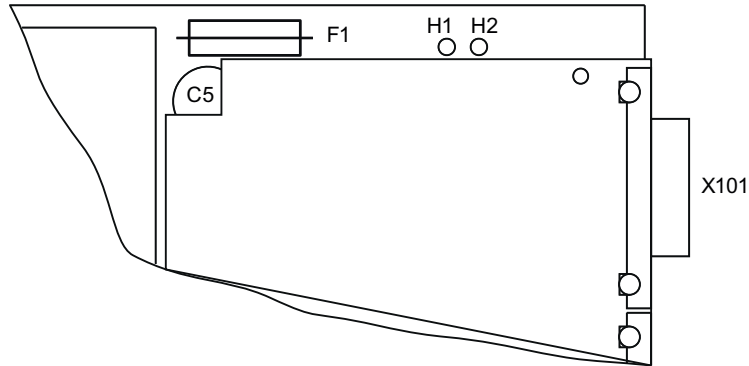


Figure 5-3 Control module fuse

If the fuse F1 has tripped, send the complete module for fault diagnosis and repair to the relevant Siemens Repair Center. See also Service & support (Page 89)

5.3 Connecting the heat emitter and three-phase line supply

The heat emitters are connected to the female connectors on the front of the power output modules by means of two 8-pin plug connectors with screw-type terminals.

The connection to the three-phase power system is made at the 3-pin screw-type terminal or the 3-pin connector on the power output module.

Note

The male connectors to the heat emitters are not included in the scope of delivery of the heater controller. The male connectors must be ordered separately (see Accessories (Page 87)).

 WARNING
--

Danger of electric shock from live heater controller or heat emitters!

Male connectors may only be inserted in or removed from the female connectors in the de-energized state. The power supply cables must be de-energized on connection to the 3-pin screw terminal or the 3-pin connector.

Procedure

In order to connect the heat emitters to the three-phase system and to the power output modules, the following steps must be performed:

1. Strip the insulation from the heat emitter cables. Secure the cables in the screw-type terminals of the 8-pin male connectors.

The connecting cables must have a resistance of at least 14 Ω .

2. Plug the male connectors of heat emitters 1 to 8 into the female connectors X1.

3. Plug the male connector of heat emitters 9 to 16 into the female connector X3.

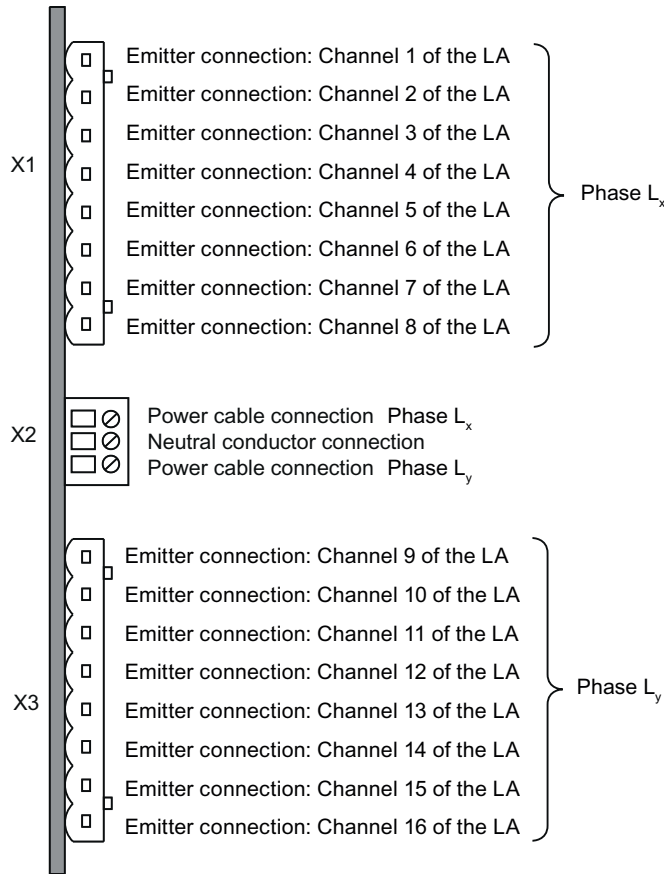


Figure 5-4 Assignment of the male connectors and the screw-type terminal on the power output module (LA)

- Strip the power supply cables and neutral conductors for connection to the three-phase line supply.
- Connect the neutral conductor to the 3-pin screw terminal or the 3-pin plug X2.
- Connect the phases L_x and L_y to the 3-pin screw terminal or the 3-pin plug X2.

NOTICE

In order to achieve the most even possible loading of the three-phase system, 8 channels at a time of the power output modules are to be connected consecutively to the phases L1, L2 and L3.

NOTICE

Compliance with the respective wiring diagrams is essential for the diagnostics to function.

5.3 Connecting the heat emitter and three-phase line supply

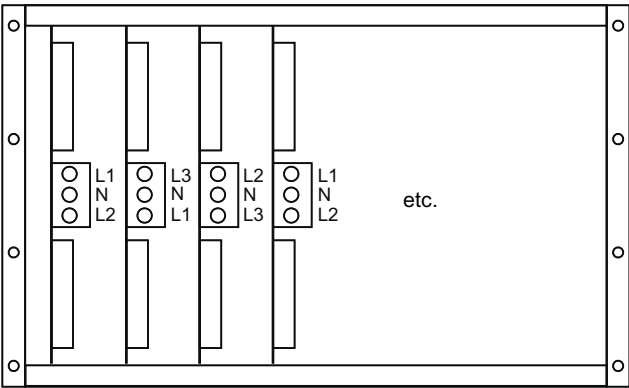


Figure 5-5 Wiring diagram for three-phase current (hinged frame/mounting frame)

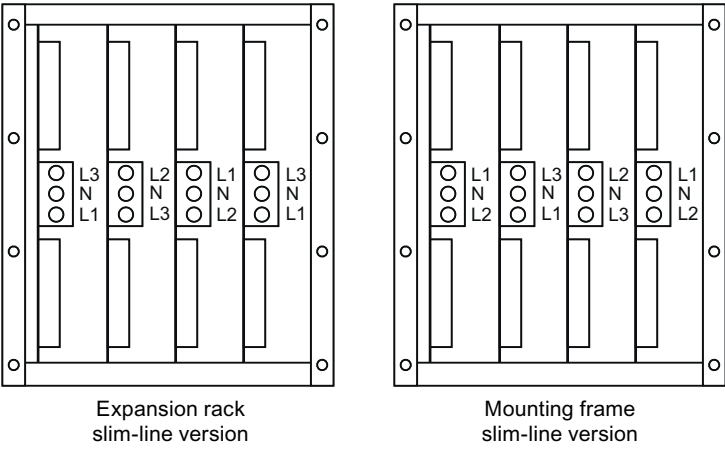


Figure 5-6 Wiring diagram for three-phase current (mounting frame and expansion rack slim-line version)

Note

When expansion rack slim-line version is used, the sequence of the phases continues from the mounting frame slim-line version with Phase L3 in slot 5.

Note

In the power output module LA724I HP only every other channel is used after channel 1.

Commissioning

6.1 Hardware requirements

Controller

The following is necessary:

- a SIMATIC S7 CPU/SIMOTION with PROFIBUS DP interface
- PROFIBUS DP
- SIPLUS HCS716I heater controller

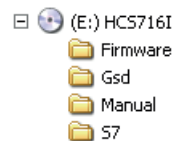
Heater controller

A heater controller includes the following components:

- A SIPLUS HCS716I rack
- between one and twelve power output modules LA716, LA716I, LA716I HP

6.2 Software requirements

CD contents



Directory\ Firmware

contains the Flash loaders and the current firmware

Directory\ Gsd

contains the language-specific GSD files for the HCS716I for installation in the planning tool of the DP master.

Directory\ Manual

contains the description in this document in electronic form.

Directory\ S7

Archive with the current *STEP 7* program (for transferring projects to the SIMATIC Manager)

6.3 Integrating the GSD file

For heater control, use the language-specific GSD file "SIEM8113.GSx ". The file contains the configuration of the DP slave. The GSD file can be found on the supplied CD in the directory\Gsd.

You need this file in order to perform the PROFIBUS configuration. It is included in the scope of delivery of STEP 7 or COM PROFIBUS.

Procedure

If this GSD file is not yet available in the version of your configuration software, integrate the GSD file into STEP 7 or COM PROFIBUS according to the table below.

Table 6- 1 Integrating the GSD file in your configuration software

Step	STEP 7, as of V5.0, Service Pack 3
1	Start STEP 7 and then select Options > Install New GSD File in HW Config.
2	Select the GSD file to install from the next dialog box, then confirm with OK. Result: The heater controller appears in the hardware catalog in the PROFIBUS DP folder (other field devices - general).
3	Configure the heater controller using STEP 7 (refer to the STEP 7 Online Help).

If a DP master is used which is not an S7 DP master, install the GSD file as described in the instructions for the DP master.

Features of the DP slave

- 32 bytes of output data, consistent
- 4 bytes of input data, consistent
- 60 bytes of diagnostic data
- Baud rates up to 12 Mbaud
- Supported standard: PROFIBUS DP

Functions

Introduction

This section familiarizes you with the initialization and operation of the heater controller.

The data structure is presented for communication between the PROFIBUS master and the heater controller.

You will learn how the power output modules are monitored and how to control the device via the S7 DP master.

7.1 Initialization (start-up)

When you switch on the system, the initialization of the SIPLUS HCS716I heater controller starts automatically.

Startup characteristics

During the initialization phase the heater controller exchanges data between the DP master and power output modules on a step-by-step basis according to the following table:

Table 7- 1 Initialization steps

Level	Description
1	CPU module and PROFIBUS DP are initialized. Default for the control of the channels <ul style="list-style-type: none"> • Basic values for all channels are "zero" • Override values for all the groups are "zero" • Test commands for all groups are "zero"
2	The connection to the DP master is established.
3	The heater controller reports the available power output modules to the DP master.
4	The DP master transfers the group assignments of the channels to the CPU module.

The initialization is complete. All channels of the power output modules output "zero" and the power outputs are not checked.

In the next step, the basic and override values can be transferred.

7.2 Operation of the HCS716I

After successful initialization, the SIPLUS HCS716I heater controller operates the "normal heating mode". It checks the data cyclically for changes and monitors the power output modules. The power output modules are controlled with the current output values.

Operating cycle

During operation, the following procedures are carried out cyclically:

- the temperature of the power output modules is checked
- the output buffer is queried for changes and the channels controlled accordingly
- channels are checked, provided they have been enabled for testing
- Input and diagnostics data is provided, if new data exists.

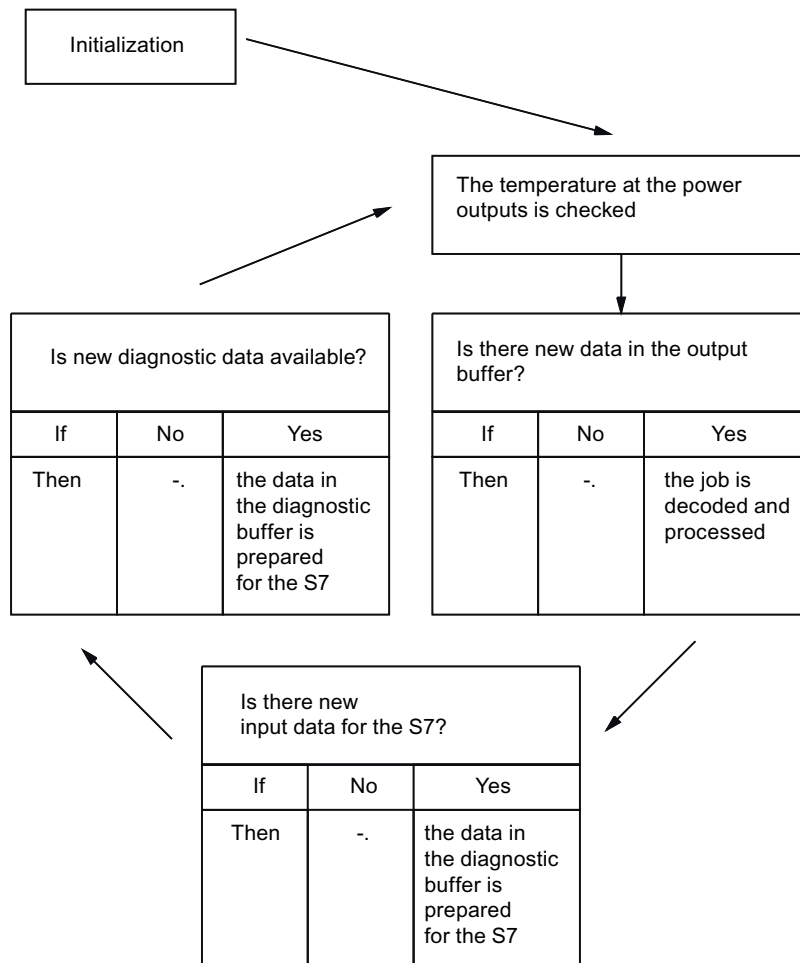


Figure 7-1 Operating cycle

Output value for the power output modules

Following the transfer of valid basic and override values, the heater controller calculates the output values for the individual channels of the power output modules.

$$\text{Output value}_{\text{channel } x} = \text{Basic value}_{\text{channel } x} \times \frac{\text{Group override}_{\text{channel } x}}{100}$$

Channel x is controlled with this output value.

If new data (basic or override values) arrives from the DP master, the HCS716I calculates the output values again as follows:

- a basic value has been changed → a channel output value is recalculated
- an override value has been changed → all channel output values of the respective group are recalculated

You can adjust the power of the heat emitters with a resolution of 1%. In this case, note the following:

- The reference value is 2 seconds.
- Only full waves are switched.
- Synchronization with Phase L1 takes place on the control module.

7.3 Monitoring functions of the HCS716I

Description

The heater controller monitors

- the outputs of the power output modules
- the output temperature of the power output modules.

If an error occurs, the HCS716I provides a diagnostic message for the DP master.

If power outputs of one group have not been enabled for testing, they are not monitored.

7.3.1 Outputs of the power output modules

Description

During operation, the software monitors the outputs of all groups released for testing.

Types of fault

The monitoring distinguishes between two types of fault:

- Fault type 1
 - The circuit breaker does not close (Triac has a high resistance).
- Fault type 2
 - The circuit breaker does not open (Triac short-circuit).
 - The module fuse has blown.
 - If there is a short-circuit at the output, the fuse only blows if the output is controlled (\cong case of the module fuse).
 - The heating circuit has been interrupted due to:
 - ◇ blown external fuse
 - ◇ broken cable
 - ◇ heat emitter defect.

Test cycle

A test cycle lasts approximately 8 seconds.

If an error is detected, this will not be signaled until a repeated measurement also detects the error. In other words, the error message is signaled to the DP master after at least 16 seconds.

7.3.2 Temperature of the power output modules

Description

At the power output modules, the temperature of the heat sink is monitored permanently.

If the temperature exceeds the set limit, it is reported to the DP master. An active heating cycle must be aborted.

Information on avoiding overtemperature can be found in section Faults on the power output modules. (Page 70).

CAUTION

With the higher-level DP master system you must ensure that the next heating cycle is only started if there is no longer an overtemperature.
--

7.3.3 Transfer of the diagnostic messages

Description

If the heater controller has detected an error, it sends the diagnostic buffer to the DP master. This comprises 60 bytes. The first 6 bytes are reserved by the DP software. The device-related diagnosis, including header, is 54 bytes long.

This buffer offers the advantage that the DP master only retrieves it in the event of a change. This procedure considerably relieves the load on the data traffic between DP master and heater controller.

Access to diagnosis

The diagnostic data is transferred as a PROFIBUS DP standard diagnosis to the DP master.

The access, for example in an S7 CPU, is via the SFC 13 "DPNRM_DG".

Buffer allocation

The diagnostic buffer contains an up-to-date image of the status of the power output modules. It indicates errors at the outputs and supplies temperature information. Outputs (channels) and slots are coded bit-wise.

The states are indicated as follows:

- Error type 1 (24 bytes for 192 channels)
 - Bit = 0: Output faulty
 - Bit = 1: Fault-free output
- Error type 2 (24 bytes for 192 channels)
 - Bit = 0: Output faulty
 - Bit = 1: Fault-free output
- Temperature monitoring (2 bytes for 12 power output modules)
 - Bit = 0: Overtemperature
 - Bit = 1: Standard temperature

Byte	Contents	
0	Standard DP diagnostics (comprises 6 bytes)	Station Status 1
...		Station Status 2
		Station Status 3
		Master PROFIBUS address
...		Manufacturer ID = 81 _H (high byte)
5		Manufacturer ID = 13 _H (low byte)
6	Manufacturer-specific diagnostic data	Length = 36 _H
...		Type = 81 _H
...		Slot number = 00 _H
9		Specifier = 00 _H
10	Buffer for error type 1 (Triac has high resistance)	Distribution of the bytes and bits in accordance with the following graphic
...		
33		
34	Buffer for error type 2 (Triac short-circuit, fuse tripped, external error)	Distribution of the bytes and bits in accordance with the following graphic
...		
57		
58	Temperature monitoring	Distribution of the bytes and bits in accordance with the following graphic
59		

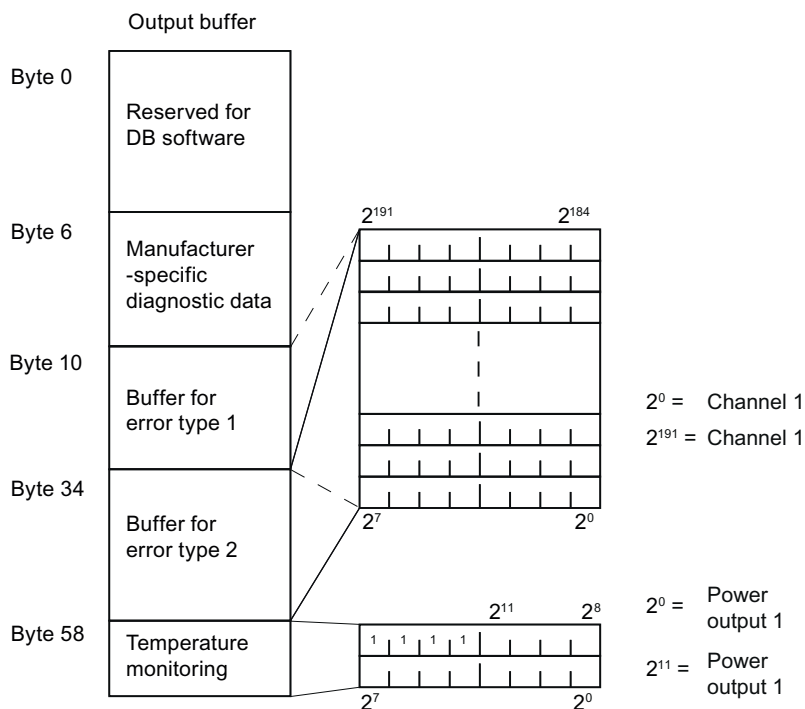


Figure 7-2 Structure of the diagnostic buffer

7.4 Data exchange between an S7-DP master and the HCS716I

Introduction

In this section you will learn how the data exchange between the user program S7-CPU and the HCS716I is organized when using the supplied S7 functions.

The documentation deals with the following topics in particular:

- Software structure
- Setup of data blocks

The chapter assumes programming knowledge in STEP 7.

Note

After each interruption time on the PROFIBUS DP or due to a CPU STOP, the parameterization must again be transferred to the HCS716I.

7.4.1 Installing the software

Installation of STEP 7

The supplied CD includes the STEP 7 project "HCS716I.zip". This project contains all the functions and data needed for operating one or more HCS716I controllers on the PROFIBUS DP.

1. Open the "S7" folder on the supplied CD.



2. Unzip the STEP 7 project "HCS716I.zip" using the "File - Retrieve" option.
The project is then copied to the hard drive and loaded into the STEP 7 Manager.

3. You can now use following example programs:

- OB1
Example program for a cyclic sequential program that controls the HCS716I
- OB100
Example program for the reaction to start/restart in an S7-300 CPU
- OB82
Example program for the diagnosis

4. Integrate the blocks into your STEP 7 project.

Numbers have been assigned to the data blocks and functions. You can change these numbers to names of your choice. A description of the functions can be found in the project under "Sources".

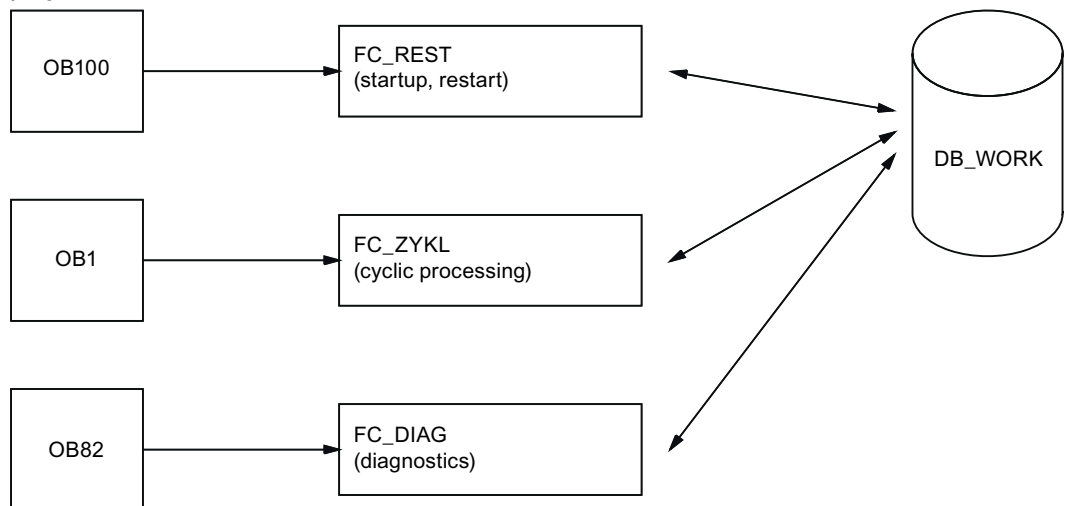


Figure 7-3 Structure of S7 program

7.4.2 Software structure

Overview

The STEP 7 software for operating the HCS716I is an interface comprising data blocks and functions that allow a program easy access to one or more HCS716I controllers.

STEP 7 manages the data necessary for the sequence in data blocks. The structure of these blocks has been permanently defined:

- The HCS716I controllers are accessed via jobs by means of functions.
- Accesses to the I/O image take place via
 - SFC14 "DPRD_DAT"
 - SFC15 "DPWR_DAT"

These SFCs exist in each S7 CPU. They are used, because the entire PROFIBUS data area must be consistent across 32-byte output data and 4-byte input data (see also Buffer format (Page 55)).

If the software is to control more than 192 heat emitters, the functions are to be called several times. All configuration parameters must be assigned separately for each HCS716I.

- First HCS716I, channel numbers 1 to 192
- Second HCS716I, channel numbers 1 to 192

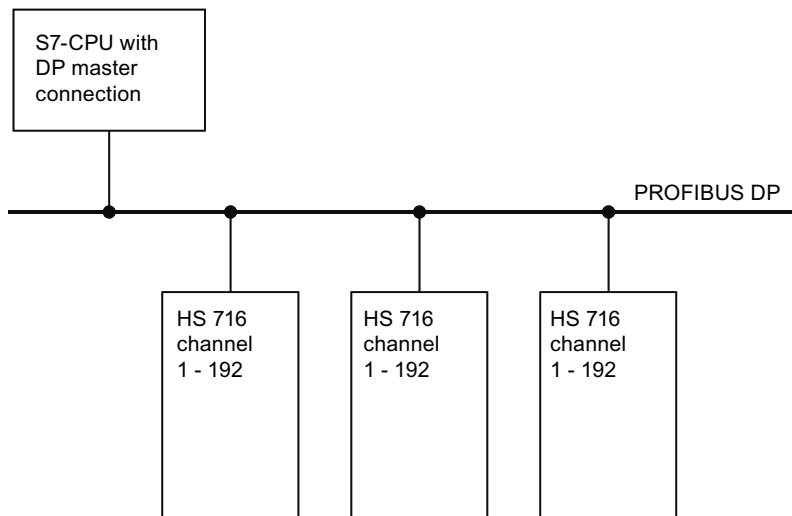


Figure 7-4 Several HCS716I modules connected to one S7 CPU

With rack HCS716I mounting frame slim-line version, channels 1-64 can be addressed. With the expansion rack HCS716I slim-line version, channels 65-128 can also be addressed.

7.4.3 Data blocks

STEP 7 manages data in the data block DB_WORK. This data block contains all the data necessary for configuring and operating an HCS716I:

- Data for the initialization
- Configuration data
- All data for job management
- Error reports

The following table shows the structure of the data block:

Table 7-2 Structure of the DB_WORK

Name	Type	Date	Description
Messages to the user			
BIT.SYNC	BOOL	0.0	HCS716I is synchronized and ready for the data exchange
BIT.active	BOOL	0.1	Message that the data exchange with the HCS716I is active
BIT.WSYNC	BOOL	0.2	Wait for startup message
BIT.Lein	BOOL	0.3	Power can be switched on
BIT.SFe	BOOL	0.6	A serious error has occurred; no further communication to the HCS716I until the error has been rectified and acknowledged.
BIT.Fe	BOOL	0.7	An error has occurred.
Messages from the user to the function FC_ZYKL			
BIT.eOB1	BOOL	1.0	First OB1 cycle (only if the FC_REST is not used; the user must set the bit)
FE.FeQ	BOOL	1.7	Error acknowledgment
Jobs from the user to the HCS716I			
SOLL.Anfo.oF00	BOOL	2.0	Not used
SOLL.Anfo.TG04	BOOL	2.1	Request job 04: Transfer test commands. The test status is transmitted for all active groups.
SOLL.Anfo.KS [n] n = 1 – 8	BOOL	3.0 to 3.7	Transmit basic value of a channel <ul style="list-style-type: none"> • Channel number is in SOLL.KS_Nr[n] • Setpoint is in SOLL.K_Wert[SOLL.KS_Nr[n]]
SOLL.Anfo.GS[n] n = 1 – 16	BOOL	4.0 to 5.7	Transmit override of a group Value is in SOLL.G_Wert[1..16]
SOLL.Anfo.KG[n] n = 1 – 16	BOOL	6.0 to 7.7	Transmit all basic values of a group Value is in SOLL.K_Wert[INI.GR[n].K_An to INI.GR[n].K_En] (all channel values from first channel to last channel).

7.4 Data exchange between an S7-DP master and the HCS716I

Name	Type	Date	Description
SOLL.Quitt.TG04	BOOL	8.1	Acknowledgment for SOLL.Anfo.TG04 <ul style="list-style-type: none"> If the job is not acknowledged, it is processed again after execution of all pending jobs. All acknowledgments are pending for one cycle only.
SOLL.Quitt.KS [n] n = 1 – 8	BOOL	9.0 to 9.7	Acknowledgment for SOLL.Anfo.KS [n]
SOLL.Quitt.GS[n] n = 1 – 16	BOOL	10.0 to 11.7	Acknowledgment for SOLL.Anfo.GS[n]
SOLL.Quitt.KG[n] n = 1 – 16	BOOL	12.0 to 13.7	Acknowledgment for SOLL.Anfo.KG[n]
Channel number for SOLL.Anfo.KS			
SOLL.KS_Nr[n] n = 1 – 8	INT	14 to 28	Channel numbers 1..192
Basic/override values			
SOLL.K_Wert[n] n = 1 – 192	INT	30 to 412	Basic values for channel [n]
SOLL.G_Wert[n] n = 1 – 16	INT	414 to 444	Override for group [n]
HCS716I initialization data			
INI.LIZT	INT	446	Life monitoring time After this inactive time a job 00 is generated to determine whether the HCS716I is still waiting for jobs.
INI.EByte	WORD	448	Input byte from HW Config
INI.AByte	WORD	450	Output byte from HW Config
Group data 1-16			
INI.GR[n].GR_Typ n = 1 – 16	BOOL	452.0 + [n-1×(6)]	Group type <ul style="list-style-type: none"> 0 = all channels are active 1 = every other channel is active
INI.GR[n].GR_iO n = 1 – 16	BOOL	452.1 + [n-1×(6)]	Group OK <ul style="list-style-type: none"> Channel number > 0 K_An ≤ K_En
INI.GR[n].GR_pr n = 1 – 16	BOOL	452.2 + [n-1×(6)]	Check group Activate/deactivate diagnostics
INI.GR[n].GR_Fe n = 1 – 16	BOOL	452.3 + [n-1×(6)]	Group has not been parameterized or has been wrongly parameterized. There is no data exchange for this group.
INI.GR[n].GR_K_An n = 1 – 16	INT	454 + [n-1×(6)]	First channel number in this group
INI.GR[n].GR_K_En n = 1 – 16	INT	456 + [n-1×(6)]	Last channel number in this group

Name	Type	Date	Description
INI.HZ	INT	548	Determined frequency
INI.DIAGon	BOOL	602.0	Activate the diagnosis for the HCS716I The diagnosis is evaluated only if INI.DIAGon=1.
INI.DIAGaddr	INT	604	Diagnostic address (from HW Config)
Error			
FE.FeNr	WORD	606	Error number
FE.Fe_fein	WORD	608	Fine coding of error: Additional information about the error
FE.T_BG[n] n = 1 – 16	BOOL	610.0 to 611.3	Module fault: Temperature error
FE.T1[n] n = 1 – 192	BOOL	612.0 to 635.7	Channel fault type 1: e.g. Triac has high resistance
FE.T2[n] n = 1 – 192	BOOL	636.0 to 659.7	Channel fault type 2: e.g. Triac short-circuit, fuse blown

7.4.4 Functions and their call interfaces

Introduction

The communication between the HCS716I and the DP master is based on the following functions:

FC_ZYKL	Control of the HCS716I
FC_REST	Initialization of the HCS716I
FC_DIAG	Diagnosis of the HCS716I

The tasks of the functions can be found in the following sections.

7.4.4.1 FC_ZYKL

Controller

The actual control of the HCS716I is performed by the FC_ZYKL function. It executes the following sequence:

1. FC_ZYKL processes the jobs or new data that FC_REST has previously saved in DB_WORK.
2. FC_ZYKL compares the configuration data from the DB_WORK with the actually existing configurations and returns any errors.
3. After evaluating the startup message 05 (Page 62) FC_ZYKL compares the parameterized data with the actual state.
4. FC_ZYKL executes a plausibility check of the channel data. It determines, for example, whether a channel is already being used.

The DP master calls FC_ZYKL for the HCS716I cyclically once in the OB 1. If you use more than one HCS716I, the DP master calls the function again with modified parameters.

Call interface

Parameter	Declaration	Data type	Description
DB_WORK	INPUT	INT	Number of the data block which contains the configuration data.

7.4.4.2 FC_REST

Initialization

When the HCS716I starts up, it first initializes itself. The initialization is performed by the FC_REST function. The function saves the ascertained data in DB_WORK.

The DP master calls FC_REST for the HCS716I cyclically once in the OB 100. If you use more than one HCS716I, then the DP master calls the function again with modified parameters.

Call interface

Parameter	Declaration	Data type	Description
DB_WORK	INPUT	INT	Number of the data block which contains the configuration data.
LZU	INPUT	INT	Lifetime monitoring <ul style="list-style-type: none"> • Standard 1500 ms • Range of values: 500 ms to 20,000 ms In the event of a deviation, 1500 ms is entered After this time has elapsed (inactive) a job 00 is generated.
EinAdr	INPUT	INT	Input address (from HW Config)
AusAdr	INPUT	INT	Output address (from HW Config)
DIAGon	INPUT	BOOL	Enabling the diagnostics (for entire HCS716I)
DiaGAdr	INPUT	INT	Diagnostic address (from HW Config)
Data of groups 01 to 16 (GR = 01...16)			
GRxx_Typ	INPUT	BOOL	<ul style="list-style-type: none"> • FALSE = all channels are active • TRUE = only every second channel active
GRxx_pr	INPUT	BOOL	Group check (with diagnostics); activate/change by means of job 04 only operative if "DIAGon" = TRUE
GRxx_Kan	INPUT	INT	First channel in the group
GRxx_Kan	INPUT	INT	Last channel in the group

7.4.4.3 FC_DIAG

Creating diagnosis

FC_DIAG diagnoses any errors that occur in the HCS716I. The evaluation takes place in FC_ZYKL. The diagnostic data are saved in DB_WORK.

The DP master calls FC_REST for the HCS716I cyclically once in the OB 82. If you use more than one HCS716I, then the DP master calls the function again with modified parameters.

The function is only active if "DIAGon" has been set to TRUE.

Call interface

Parameter	Declaration	Data type	Description
DB_WORK	INPUT	INT	Number of the data block which contains the configuration data.

7.5 Data exchange between a non S7-DP master and the HCS716I

7.5.1 Buffer format

The DP master communicates with the heater controller via an output buffer and an input buffer. The size of the two buffers is stored in the GSD file.

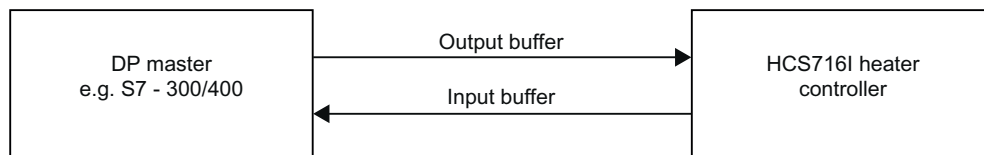


Figure 7-5 Communication directions of the buffers

Output buffer

In the header of the output buffer, the DP master specifies the current job together with type number and length of the net data. The DP master then sets a job bit. Job-specific statements are encrypted in the additional information.

The DP master stores the associated data in the data area.

Input buffer

If the job in the HCS716I heater controller has been processed successfully, the HCS716I provides the header with an acknowledged job bit in the input buffer. As soon as the input buffer reaches the DP master, the DP master checks whether the HCS716I has fulfilled the jobs placed.

In the event of an error, the job bit in the input buffer is set to 1. Byte 2 contains the error number.

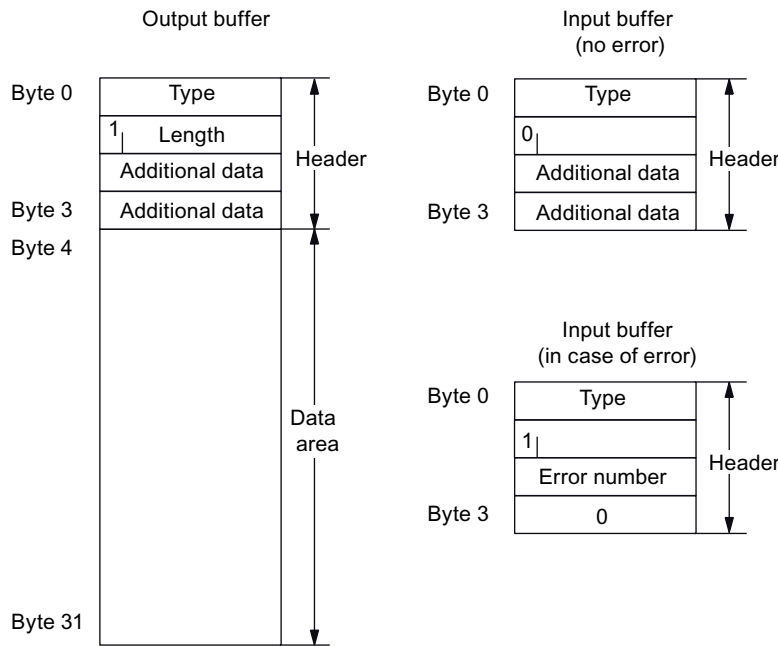


Figure 7-6 Structure of the data buffer for PROFIBUS DP

7.5.2 Job types

Possible jobs

The DP master sends jobs to the HCS716I heater controller. The following jobs are possible:

- 00 No job
- 01 Transmit the group assignment
- 02 Transmit basic values
- 03 Transmit override values
- 04 Transmit test commands
- 05 Report existing power output modules

In the following sections, you will find the structure and the bit-by-bit control of the individual jobs.

7.5.2.1 No job

Description

This job is necessary, as the output data is updated cyclically. It enables the HCS716I heater controller to recognize more promptly that it does not have to process any new data.

The job can be used as a sign of life between the DP master and the heater controller. The DP master can therefore occupy bytes 2 and 3 accordingly.

NOTICE
Send "No job"
"No job" is an assignment in the buffer and must be sent explicitly by the DP master as a job.

Buffer allocation

With the "Job 00", the data buffers are assigned as follows:

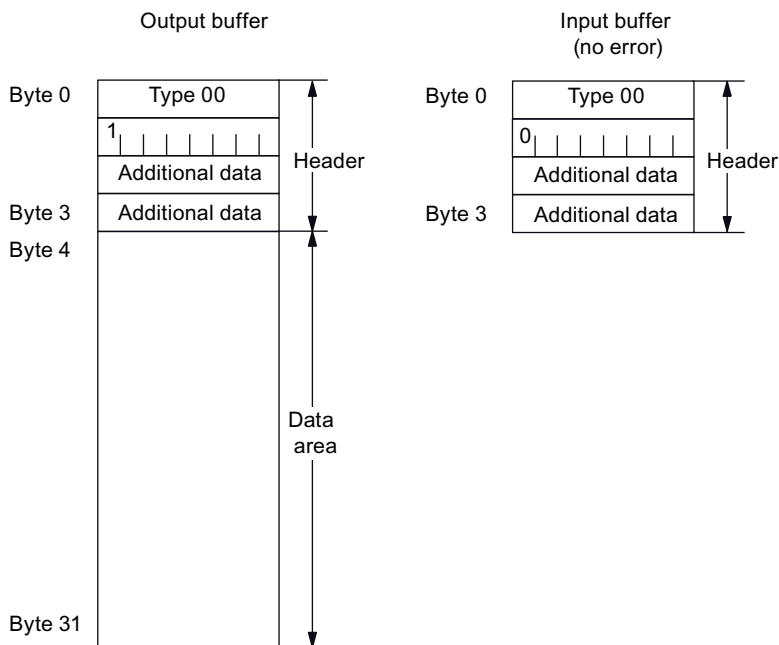


Figure 7-7 Buffer allocation for "no job"

7.5.2.2 Transmission of the group assignment

Description

The DP master can freely configure the assignment of the channels of the power output modules to groups.

Configuration rules

The DP master must take the following into consideration during configuration:

- Each channel used must be assigned to a group.
- A maximum of 16 groups may be specified.
- Two different types of group are permissible:
 - Type 0: The channels are consecutive.
 - Type 1: Every other channel is unassigned.
- The channels of a group must be consecutive.
- The DP master must place this job ahead of all subsequent jobs. The heater controller evaluates this job as being completed when the block number (byte 2) matches the number of blocks (byte 3).
- A job can be placed no more than once after start/restart.
- In one job, the DP master can transmit a maximum of 7 group assignments.

Buffer allocation

With the "Job 01", the data buffers are assigned as follows:

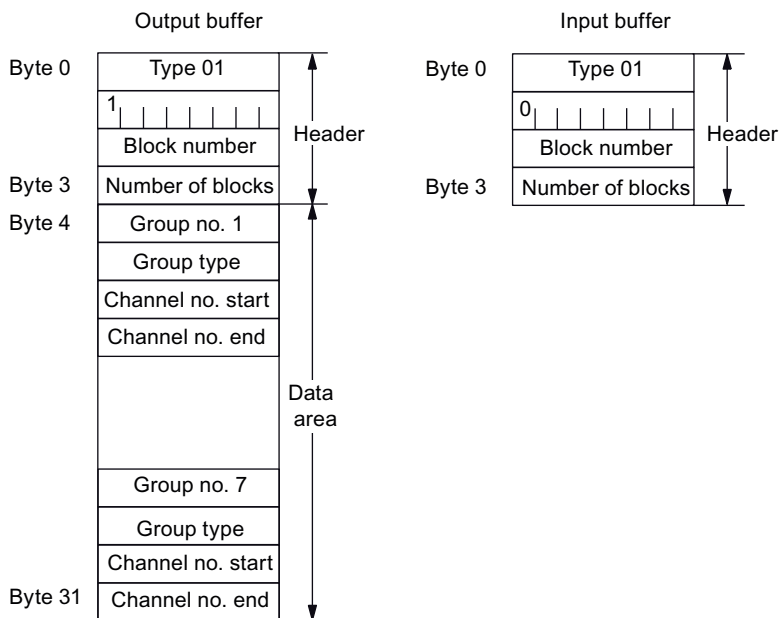


Figure 7-8 Buffer assignment for "Group allocation" job

7.5.2.3 Transfer of basic values

Description

The DP master assigns a power value in percent to each channel used. This value forms the basis for the output value with which the HCS716I controls the channel during the heating phase.

Configuration rules

The following must be taken into account during configuration:

- The job cannot be executed until Job 01 has been completed
- In one job, the DP master can transmit a maximum of 14 channels.

Buffer allocation

With the "Job 02", the data buffers are assigned as follows:

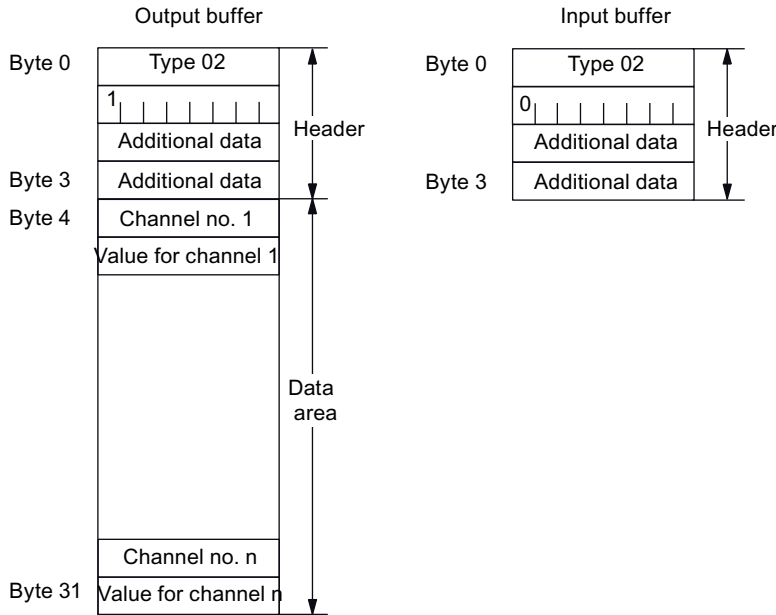


Figure 7-9 Buffer assignment for "Basic values" job

7.5.2.4 Transfer of override values

Description

The DP master assigns an override value in percent to each defined group.

The override value of a group is multiplied by the individual basic values of the channels belonging to the group to obtain the output values.

Configuration rules

The following must be taken into account during configuration:

- The job cannot be executed until job 01 has been completed
- In one override job, the DP master can transfer override values for a maximum of 14 groups.

Buffer allocation

With the "Job 03", the data buffers are assigned as follows:

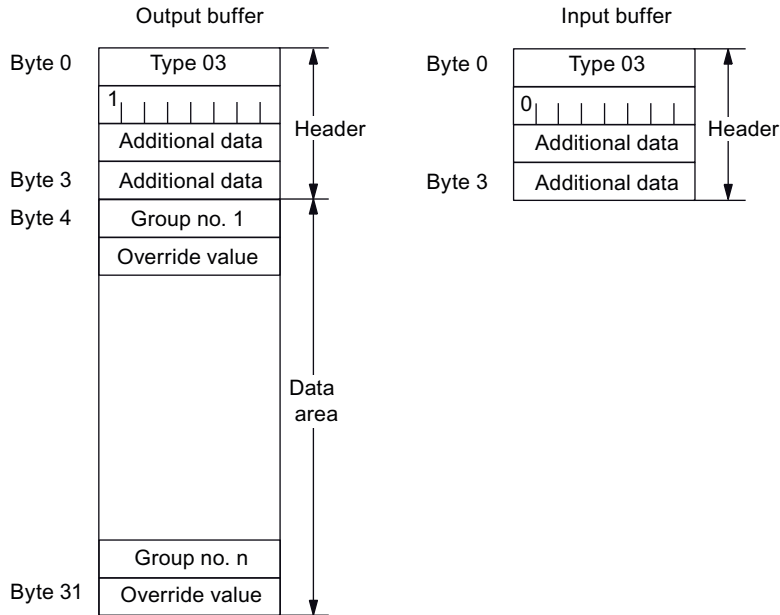


Figure 7-10 Buffer allocation for "Override values" job

7.5.2.5 Transfer of test commands

Description

By transmitting test commands, the DP master can include specific groups in the checking of the power outputs or exclude them from it.

The channels of the groups that are excluded from the test, are not checked. By default, following initialization, no groups are checked.

The test command is specified as follows:

- 0 Do not check group
- 1 Check group

Configuration rules

The following must be taken into account during configuration:

- The job cannot be executed until job 01 has been completed
- In one job, the DP master can transfer test commands for a maximum of 14 groups.

Buffer allocation

With the "Job 04", the data buffers are assigned as follows:

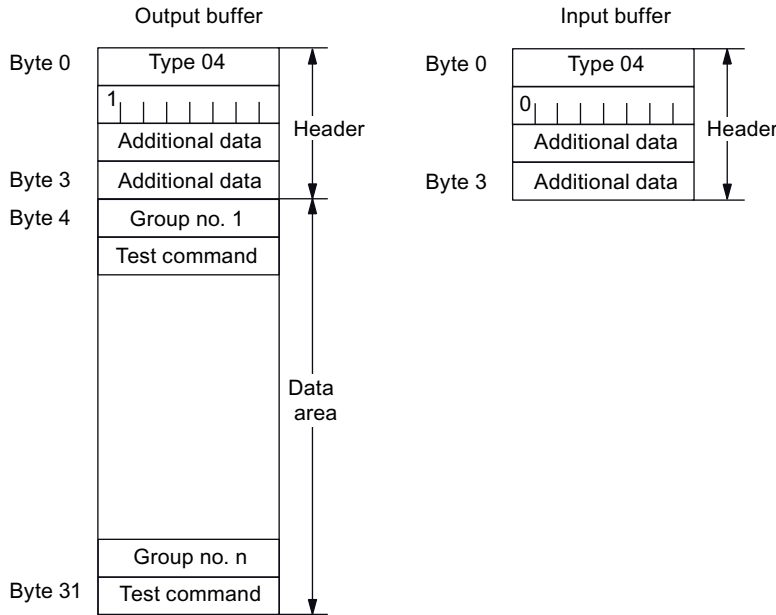


Figure 7-11 Buffer assignment for "Test commands" job

7.5.2.6 Reporting of existing power output modules

Description

During initialization, the heater controller creates a startup frame. The startup frame transfers

- the assigned slots in the subrack
- the applied line frequency

Rules

The following must be considered:

- The startup frame is issued by the heater controller:
 - after a startup or
 - after an interruption
 - ◊ to the DP master
 - ◊ due to a CPU STOP

Buffer allocation

With the "Job 05", the data buffers are assigned as follows:

- Byte 1 transfers the line frequency with the following assignments:
 - 50_D: 50 Hz
 - 60_D: 60 Hz
 - 0_D: not detected
- Bytes 2 and 3 consist of bits 0 to 15. For each slot, a bit is reserved with the following assignment:
 - Bit = 0: Power output module is available
 - Bit = 1: Power output module is not available

The bits are assigned to the slots consecutively:

Bit 0 = Slot 1
 Bit 1 = Slot 2
 ...

Bits 12 to 15 are not required. Their default value is "1".

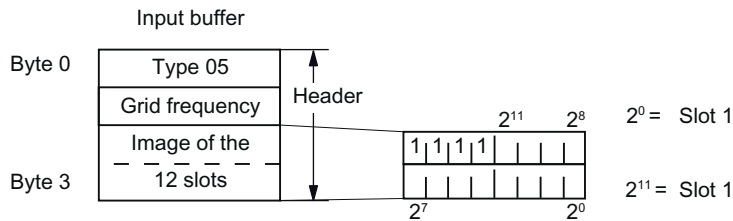


Figure 7-12 Assignment for "Startup frame" input buffer

7.5.3 Assignment of the output data

Channel assignment

The system transfers output data for all power output modules inserted in the rack. The numbering and number of slots for the power output module of the particular rack design can be found in Chapter "Plugging in power output modules (Page 27)". The following table lists the channel assignment to the slots:

Table 7- 3 Assignment of the channel numbers to the slots

Slot	Channel number
1	1 to 16
2	17 to 32
3	33 to 48
4	49 to 64
5	65 to 80
6	81 to 96
7	97 to 112
8	113 to 128
9	129 to 144
10	145 to 160
11	161 to 176
12	177 to 192

Note

Slots 5 to 8: Only for expansion racks in conjunction with mounting frame slim-line version.

Slots 9 to 12: Only for hinged frame/mounting frame.

7.5.4 Data transfer

Procedure

When the DP master provides new output data, the HCS716I processes this new data. After processing, the HCS716I acknowledges the job at the DP master. The DP master saves this input data.

The following two options exist for a smooth communication procedure between the DP master and heater controller:

1. After the execution and acknowledgment of a job by the heater controller, the DP master sends the job 00 "No order" and waits until the job is acknowledged by the HCS716I heater controller. Only then does the DP master send a new job.
2. After a job has been completed, the DP master immediately sends the next job and waits until this is acknowledged. If more than one job 02, 03 or 04 is sent consecutively, bytes 2 and 3 must be used for the control. Otherwise the DP master does not recognize which job a received acknowledgment is associated with.

Access to data

The cyclic input or output data involves one consistent data area.

7.5.5 Error codes in the input buffer

Error messages

The HCS716I checks the incoming jobs for plausibility. If the contents contain errors, an error code is returned in the acknowledgment.

The following table provides an overview of the error numbers and the associated errors:

Table 7- 4 Error messages during the data transmission

Error number	Description
1	During the initialization, memory could not be assigned for channel groups and channel description
2	Job type cannot be processed, as the job sequence has not been observed e.g. Job 02 (basic values) comes before Job 01 (group assignment)
3	Incorrect job type entered in byte 0 (Types 00 to 04 are permissible)
4	Incorrect frame length entered in byte 1 (max. 28 Bytes are permissible)
5	Incorrect group number is entered (Group numbers in the range from 1 to 16 are permissible)
6	Incorrect channel number is entered (Channel numbers in the range from 1 to 192 are permissible)
7	Incorrect group type is entered (Group types 0 and 1 are permissible)
8	Incorrect test command is entered for group (Group commands 0 and 1 are permissible)
9	Incorrect override value is entered for a group (max. permissible value is 100)
10	Incorrect basic value is entered for a channel (max. permissible value is 100)
11	New group from job type 01 cannot be inserted (max. 16 groups are permissible)
12	Specified channel cannot be processed, because it has not been assigned to a group
13	Specified group cannot be processed because the group has not been parameterized.
14	A channel can no longer be entered in the channel list. One or more channels have probably been assigned to several groups.

Alarm, error and system messages

Introduction

When using the heater controller, two categories of error can occur:

- Error during startup or during operation

For displaying the various operating modes, the heater controller has two LEDs (H1, H2). You will see the LEDs at two positions:

- at the rear or at the side of the CPU module
- at the front of the bus module

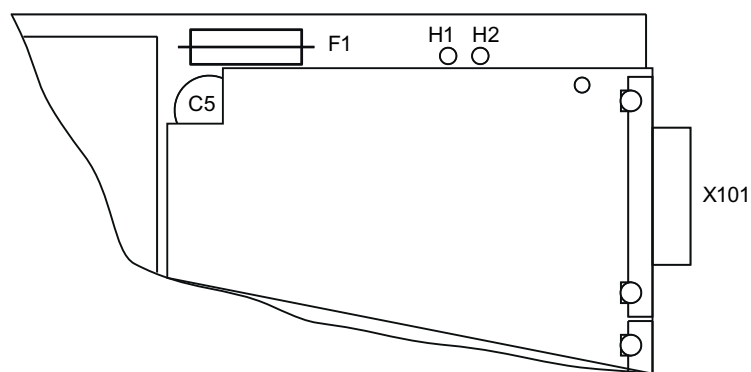


Figure 8-1 CPU module with LEDs H1, H2 for displaying the operating states

- Errors on the power output modules.

8.1 Error during startup or during operation

Operating states

The two LEDs on the heater controller indicate following operating states:

Table 8- 1 Operating states of the heater controller

LED red (H2)	LED green (H1)	Operating state of heater controller	Status of the PROFIBUS DP
On	On	CPU module is starting up. This display is only temporarily visible after a reset.	
On	Off	CPU module is in the initialization phase	
Off	Off	<ul style="list-style-type: none"> Heater controller is active Channels are switched off. 	No communication with the DP master (bus status STOP/CLEAR)
Off	On	<ul style="list-style-type: none"> Heater controller is active Channels are controlled by the master according to the job specification 	Communication with the DP master (bus status OPERATE)

NOTICE

- The PROFIBUS STOP state is adopted by the slave if no communication can take place.
 - No DP master or no connection to DP master is available.
 - The address is configured or set incorrectly.
 - Defective hardware.
- The PROFIBUS state CLEAR is adopted if the master CPU enters the STOP state. On resumption of the PROFIBUS communication, the heater controller sends the startup frame 05 and awaits new configuration data from the DP master.

Error during startup or during operation

If during startup or during operation a non-rectifiable error occurs, then it is a "Fatal" error. In this case, the channels of the power output modules are deactivated. The heater controller can no longer communicate with the DP master.

The two LEDs indicate an error number by flashing. The flashing frequency of the red LED varies and does not reveal information about the error that has occurred. The green LED flashes with a constant frequency. The following table shows the fault coding of the green LED:

Table 8- 2 LED displays for errors during startup or operation

LED green (H1) flashes [number]	Error
1 time	Error in internal RAM test DPC31
2 times	Error during initialization of the communication 1
3 times	Error during initialization of the communication 2
4 times	Error during initialization of the communication 3
5 times	Error during initialization of the communication 4
6 times	Error when setting up connection with Master 1
7 times	Error when setting up connection with Master 2
8 times	Error when setting up connection with Master 3
9 times	Error when querying output data
10 times	Error when updating the input data
11 times	Error when updating the diagnostics data
12 times	Error in communication layer

If a problem cannot be cleared by switching the supply voltage to the rack off and on again, the rack must be replaced.

8.2 Faults on the power output modules.

The device-internal monitoring mechanisms detect faults on the power output modules. The HCS716I heater controller provides a corresponding message in the diagnostic buffer (see Monitoring functions of the HCS716I (Page 43)).

NOTICE

If the testing of a channel is switched off during operation and a fault has previously been detected, the fault message remains in the diagnostic buffer. You can clear this fault by reinitializing.

Overtemperature

If an excessively high temperature occurs on a power output module, the power output module operates outside the performance profile (see also Performance profile of the LA716 (Page 16)).

Fuse tripped

Each channel of the power output module is fitted with a 5 A or 10 A quick-response fuse. This can trip, for example, if there is a short-circuit at the output.

The fuses are located on the power output module immediately behind the female connectors, as shown in the following diagram:

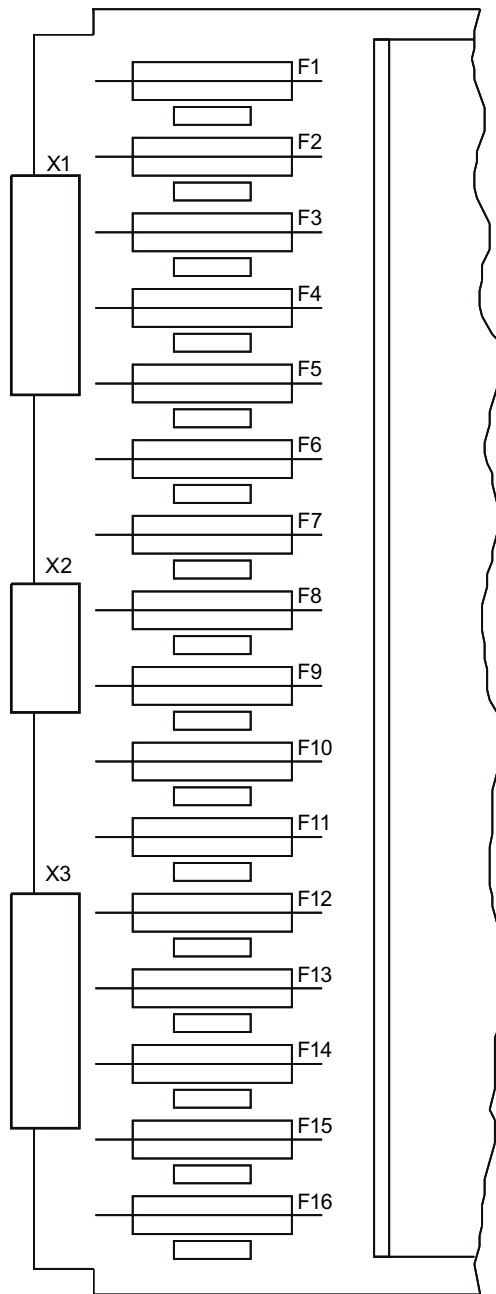


Figure 8-2 Position and arrangement of the fuses of the power output module

<p>CAUTION</p> <p>In order to prevent damage to the power output modules in the event of a fault, defective fuses must only be replaced with original 5 A or 10 A quick-response fuses (see also Accessories (Page 87)).</p>

8.3 Reaction to interruption of the supply voltage

An interruption of the supply voltage longer than 20 ms triggers a restart of the heater controller by means of a reset:

1. The outputs of the power output modules are automatically reset when the voltage is restored.
2. The initialization process is executed.
3. The DP master transfers all the necessary operating data to the heater controller.

Service and maintenance

9.1 Loading the firmware for the HCS716I

Delivery condition

The current firmware version is already loaded on the module when the HCS716I is shipped.

In the event of a fault or if an update is necessary, you can load the firmware by means of the HSSETUP.EXE program which is supplied with the product.

NOTICE
<p>The HCS716I is delivered as standard with the current firmware version and is ready to switch on.</p> <p>The steps described below only have to be performed if the HCS716I has to be updated with a different firmware version.</p>

Prerequisite for loading the firmware

You need a null modem cable (9-pin) for loading the firmware. If you do not have such a cable, a cable with the following pin assignment is sufficient:

RxD 2-----3 TxD

TxD 3-----2 RxD

Gnd 5-----5 Gnd

Note

If you use a 25-pin connector, Pin 7 is to be used for Gnd instead of Pin 5!

To install the firmware, proceed as follows:

1. Switch off the HCS716I.
2. Connect the RS232 serial interface of the HCS716I via an interface cable to COM1 or COM2 on the PC.
3. Start HSSETUP.EXE and enter the interface which is used on the PC (COM1 or COM2).
4. Switch on the HCS716I.
5. All the remaining steps are carried out automatically. The progress of the programming can be tracked on the PC.
6. After completing the firmware download, you must restart the HCS716I by switching the supply voltage off and on again.

Note

The load voltage must be disconnected when the firmware is being loaded.

Note

The flash loader in the FEPRM of the HCS716I is not normally overwritten. If the voltage supply or the serial connection is interrupted before the end of the loading process, the process can be repeated.

Technical data

10.1 Technical data for rack

Technical data for HCS716I rack

Table 10- 1 Power supply for rack

Input voltage	
• Rated value	• 230 V AC
• Permissible range	• 187 to 264 V
Frequency	
• Rated value	• 50/60 Hz
• Permissible range	• 47 to 63 Hz
Non-periodic overvoltage (acc. to EN 60204, Part 1)	
• Limit value	• $2 \times U_{\text{rated}}$
• Duration	• 1.5 ms (single pulse)
• Rise/fall time	• 500 ns to 500 μ s
Transient voltage interruption (Initial status: lower limit $U_{\text{rated}} = 187$ V)	
• Interruption time	• Maximum 20 ms
• Recovery time	• At least 1 s
• Events per hour	• Maximum 10
Power consumption of the control electronics	Max. 15 W
Total switching capacity ¹⁾ at $T_U \leq 45$ °C (hinged frame/mounting frame)	
• without ventilation	• Max. 67 kW
• with ventilation	• Max. 176 kW
(Rate of flow $\hat{=} 2$ m/s)	
Total switching capacity ¹⁾ at $T_U \leq 45$ °C (mounting frame slim-line version)	
• without ventilation	• Max. 22 kW
• with ventilation	• Max. 59 kW
(flow velocity $\hat{=} 2$ m/s)	
Total switching capacity ¹⁾ at $T_U \leq 45$ °C (mounting frame slim-line version incl. expansion rack slim-line version)	
• without ventilation	• Max. 45 kW
• with ventilation	• Max. 117 kW
(flow velocity $\hat{=} 2$ m/s)	

¹⁾ The total switching capacity depends on the output module used.

Table 10- 2 Mechanical data for rack

Dimensions (hinged frames)	
• Width	• 483 mm
• Height	• 265.5 mm
• Depth	• 350 mm
Dimensions (mounting frame)	
• Width	• 510 mm
• Height	• 310 mm
• Depth	• 330 mm (with flange) 290 mm (without flange)
Dimensions (mounting frame slim-line version)	
• Width	• 202.7 mm
• Height	• 309.5 mm
• Depth	• 287 mm
Dimensions (expansion frame slim-line version)	
• Width	• 202.7 mm
• Height	• 309.5 mm
• Depth	• 287 mm
Degree of protection	
• for device	• IP00
• for control cabinet	• at least IP20
Safety class for control cabinet	DIN EN 61140 safety class I

10.2 Technical data of the power output module

10.2.1 Technical data of the power output module LA716

Table 10- 3 LA716 supply voltage

For control section	Provided internally via the bus module
---------------------	--

Table 10- 4 LA716 power outputs

Number per power output module	16
Electrical isolation	
<ul style="list-style-type: none"> From the control section 	<ul style="list-style-type: none"> By means of opto-triac and optocoupler, specified according to EN 60747-5-2
<ul style="list-style-type: none"> Of power outputs from each other 	<ul style="list-style-type: none"> No
Load voltage	
<ul style="list-style-type: none"> Rated value 	<ul style="list-style-type: none"> 230 V AC
<ul style="list-style-type: none"> Permissible range 	<ul style="list-style-type: none"> 187 V to 264 V (TN system)
<ul style="list-style-type: none"> Frequency 	<ul style="list-style-type: none"> 50/60 Hz (47 to 63 Hz)
Output voltage	Full waves switched during the zero crossover
Output current per phase	Maximum 23 A
Output current per output	
<ul style="list-style-type: none"> Rated value 	<ul style="list-style-type: none"> 2.8 A
<ul style="list-style-type: none"> Permissible range 	<ul style="list-style-type: none"> 0.1 to 2.8 A
<ul style="list-style-type: none"> Residual current 	<ul style="list-style-type: none"> ≤ 10 mA
Switching capacity per channel	Maximum 650 W at 230 V
Resolution at the power outputs	1 %

10.2 Technical data of the power output module

Loads	
<ul style="list-style-type: none"> • Load type • Overload 	<ul style="list-style-type: none"> • Resistive loads with max. 15 times the cold current in the first half-wave¹⁾ • Five times the rated current for 20 ms
Protective measures	
<ul style="list-style-type: none"> • Thermal monitoring <ul style="list-style-type: none"> – Response threshold • Short-circuit protection • Overvoltage protection 	<ul style="list-style-type: none"> • Yes (by NTC thermistor) <ul style="list-style-type: none"> – 93 °C ± 5 K • One quick-response 5 A/ 250 V fuse per output • Yes
Connection cables	R _{max} = 14 Ω (this ensures short-circuit protection)

¹⁾ In the case of Flash emitters, this can lead to a reduction of the permissible switching capacity. These emitters can be measured at Siemens.

Table 10- 5 LA716 mechanical data

Dimensions	
<ul style="list-style-type: none"> • Depth • Width • Height 	<ul style="list-style-type: none"> • 250 mm (without mating connector) • 31 mm • 233.4 mm
Degree of protection according to DIN 40050	IP00

10.2.2 Technical data for LA716I power output module

Table 10- 6 LA716I supply voltage

For control section	Provided internally via the bus module
---------------------	--

Table 10- 7 LA716I power outputs

Number per power output module	16
Electrical isolation	
<ul style="list-style-type: none"> From the control section 	<ul style="list-style-type: none"> By means of opto-triac and optocoupler, specified according to EN 60747-5-2
<ul style="list-style-type: none"> Of power outputs from each other 	<ul style="list-style-type: none"> No
Load voltage	
<ul style="list-style-type: none"> Rated value 	<ul style="list-style-type: none"> 230 V AC
<ul style="list-style-type: none"> Permissible range 	<ul style="list-style-type: none"> 187 V to 264 V (TN system)
<ul style="list-style-type: none"> Frequency 	<ul style="list-style-type: none"> 50/60 Hz (47 to 63 Hz)
Output voltage	Full waves switched during the zero crossover
Output current per phase	Maximum 32 A
Output current per output	
<ul style="list-style-type: none"> Rated value 	<ul style="list-style-type: none"> 5 A
<ul style="list-style-type: none"> Permissible range 	<ul style="list-style-type: none"> 0.1 to 5 A
<ul style="list-style-type: none"> Residual current 	<ul style="list-style-type: none"> ≤ 10 mA
Switching capacity per channel	Maximum 1150 W at 230 V
Resolution at the power outputs	1 %

10.2 Technical data of the power output module

Loads	
<ul style="list-style-type: none"> • Load type 	<ul style="list-style-type: none"> • Resistive loads with max. 15 times the cold current in the first half-wave¹⁾
<ul style="list-style-type: none"> • Overload 	<ul style="list-style-type: none"> • Five times the rated current for 20 ms
Protective measures	
<ul style="list-style-type: none"> • Thermal monitoring <ul style="list-style-type: none"> – Response threshold • Short-circuit protection • Overvoltage protection 	<ul style="list-style-type: none"> • Yes (by NTC thermistor) <ul style="list-style-type: none"> – 93 °C ± 5 K • One quick-response 5 A/ 250 V fuse per output • Yes
Connection cables	R _{max} = 14 Ω (this ensures short-circuit protection)

¹⁾ In the case of Flash emitters, this can lead to a reduction of the permissible switching capacity. These emitters can be measured at Siemens.

Table 10- 8 LA716I mechanical data

Dimensions	
<ul style="list-style-type: none"> • Depth • Width • Height 	<ul style="list-style-type: none"> • 252 mm (without mating connector) • 31 mm • 233.4 mm
Degree of protection according to DIN 40050	IP00

10.2.3 Technical data for LA716I HP power output module

Table 10- 9 LA716I HP supply voltage

For control section	Provided internally via the bus module
---------------------	--

Table 10- 10 LA716I HP power outputs

Number per power output module	8
Electrical isolation	
<ul style="list-style-type: none"> From the control section 	<ul style="list-style-type: none"> By means of opto-triac and optocoupler, specified according to EN 60747-5-2
<ul style="list-style-type: none"> Of power outputs from each other 	<ul style="list-style-type: none"> No
Load voltage	
<ul style="list-style-type: none"> Rated value 	<ul style="list-style-type: none"> 230 V AC
<ul style="list-style-type: none"> Permissible range 	<ul style="list-style-type: none"> 187 V to 264 V (TN system)
<ul style="list-style-type: none"> Frequency 	<ul style="list-style-type: none"> 50/60 Hz (47 to 63 Hz)
Output voltage	Full waves switched during the zero crossover
Output current per phase	Maximum 32 A
Output current per output	
<ul style="list-style-type: none"> Rated value 	<ul style="list-style-type: none"> 10 A
<ul style="list-style-type: none"> Permissible range 	<ul style="list-style-type: none"> 0.1 to 10 A
<ul style="list-style-type: none"> Residual current 	<ul style="list-style-type: none"> ≤ 10 mA
Switching capacity per channel	Maximum 2300 W at 230 V
Resolution at the power outputs	1 %

10.2 Technical data of the power output module

Loads	
<ul style="list-style-type: none"> • Load type 	<ul style="list-style-type: none"> • Resistive loads with max. 15 times the cold current in the first half-wave¹⁾
<ul style="list-style-type: none"> • Overload 	<ul style="list-style-type: none"> • Five times the rated current for 20 ms
Protective measures	
<ul style="list-style-type: none"> • Thermal monitoring <ul style="list-style-type: none"> – Response threshold • Short-circuit protection • Overvoltage protection 	<ul style="list-style-type: none"> • Yes (by NTC thermistor) <ul style="list-style-type: none"> – 93 °C ± 5 K • One quick-response 10 A/ 250 V fuse per output • Yes
Connection cables	R _{max} = 14 Ω (this ensures short-circuit protection)

¹⁾ In the case of Flash emitters, this can lead to a reduction of the permissible switching capacity. These emitters can be measured at Siemens.

Table 10- 11 LA716I HP mechanical data

Dimensions	
<ul style="list-style-type: none"> • Depth • Width • Height 	<ul style="list-style-type: none"> • 252 mm (without mating connector) • 31 mm • 233.4 mm
Degree of protection according to DIN 40050	IP00

10.3 Ambient conditions for all HCS716I components

Table 10- 12 Climatic ambient conditions

Operating temperature	
• Permissible range	• 0 to 55 °C
• Relative humidity at 25 °C	• 95 %
• Temperature gradient	• ≤ 10 K/h
Storage temperature	
• Permissible range	• -40 to 70 °C
• Relative humidity at 25 °C	• 95 %
• Temperature gradient	• ≤ 20 K/h
Air pressure during operation	
• Minimum	• 860 hPa (= 1500 m above sea-level) (reduced cooling performance at lower air pressure)
• Maximum	• 1080 hPa
Air pressure during storage	
• Minimum	• 660 hPa (= 3500 m above sea level)
• Maximum	• 1080 hPa
Ventilation	
	Separate or forced ventilation

10.3 Ambient conditions for all HCS716I components

Table 10- 13 Mechanical ambient conditions

Vibration during operation (stationary use)	IEC 60068-2-6 Test FC (10 cycles per axis)
<ul style="list-style-type: none"> • 10 to 58 Hz • 58 to 500 Hz 	<ul style="list-style-type: none"> • 75 mm amplitude • 9.8 m/s² (= 1 g constant acceleration)
During transportation and storage (in shipping package)	IEC 60068-2-6 Test FC (10 cycles per axis)
<ul style="list-style-type: none"> • 5 to 9 Hz • 9 to 500 Hz 	<ul style="list-style-type: none"> • 3.5 mm amplitude • 9.8 m/s² (= 1 g constant acceleration)
Shock during operation (stationary use)	IEC 60068-2-27 Test EA
	<ul style="list-style-type: none"> • 150 m/s² ≈ 15 g, half sine • 11 ms duration • 3 shocks per axis and direction
Shock during transport/storage (in delivery packaging)	IEC 60068-2-29 EB test
	<ul style="list-style-type: none"> • 250 m/s² ≈ 25 g, half sine • 6 ms duration • 1000 shocks per axis and direction

Table 10- 14 Electromagnetic compatibility

Radio interference suppression (emitted interference)	Acc. to EN61000-6-4 Group 1, class A
Immunity to conducted interference (burst)	according to EN 61000-4-4
<ul style="list-style-type: none"> • AC voltage supply cables • Signal lines that exit the device 	<ul style="list-style-type: none"> • 2 kV with switching network • 1 kV with clamp
Immunity to conducted interference (HF irradiation)	acc. to EN 61000-4-6 10 V (0.15 MHz to 80 MHz)
Interference immunity against static electricity (ESD)	according to EN 61000-4-2
<ul style="list-style-type: none"> • Contact discharge • Air discharge 	<ul style="list-style-type: none"> • 4 kV • 8 kV
Immunity to RF interference	according to EN 61000-4-3 or ENV 50204
	<ul style="list-style-type: none"> • 10 V/m (80 MHz to 1000 MHz) • 3 V/m (1.4 GHz to 2.0 GHz) • 1 V/m (2.0 GHz to 2.7 GHz)
Immunity to high-energy pulses (surge)	according to EN 61000-4-5
	<ul style="list-style-type: none"> • Power supply lines, signal lines <ul style="list-style-type: none"> – symmetrical: 1 kV – asymmetrical: 2 kV • PROFIBUS cable <ul style="list-style-type: none"> – asymmetrical: 1 kV

Order numbers

11.1 Components of the SIPLUS HCS716I heater controller

Ordering data for components of the HCS716I

Description	Order No.
HCS716I rack, hinged frame	6BK1700-2AA00-0AA1
HCS716I rack, mounting frame	6BK1700-2AA10-0AA1
HCS716I rack, mounting frame (without flange)	6BK1700-2AA70-0AA0
Rack HCS716I mounting frame slim-line version	6BK1700-2AA80-0AA0
Expansion rack HCS716I slim-line version	6BK1700-3AA00-0AA0
LA716 power outputs	6BK1700-2BA70-0AA1
PCB power output module LA716I	6BK1700-4BA80-0AA0
PCB power output module LA716I HP	6BK1700-4CA00-0AA0

11.2 Accessories

Ordering data for fans

Description	Voltage (in V AC)	Voltage (in V DC)	Speed monitoring	Order No. Third-party company	Order No. Siemens
Fan unit with 3 fans	230	No	No	Rittal: SK 3342.230	-
Fan unit with 3 fans	115 to 230	24	Yes	Rittal: SK 3342.500	-
Fan unit with 1 fan (for slim-line version)	230	No	No	-	6BK1700-2GA10-0AA0

Ordering data for fuses

Description	Order No. Third-party company	Order No. Siemens
Replacement fuse for LA716 and LA716I 5A F / 250 V Ceramic housing 5 mm x 20 mm	Littlefuse: 216005.MXP	200021116
Spare fuse for LA716I HP 10A F / 250 V Ceramic housing 5x20 mm	Littlefuse: 216010.MXP	A5E00186303

Ordering data for mating connector

Description	Order No. Third-party company	Order No. Siemens
Mating connector for connecting heat emitters (X1, X3) Weidmüller: Type SLT 5.08/8B SN OR	Weidmüller: 1611770000	A5E00507233
Mating connector for line supply connection (X2) for LA716I or LA716I HP Phoenix Contact: SPC 5 / 3-STCL-7.62	Phoenix Contact: 1718494	A5E30280233
Mating connector for the power supply of the fan unit with 1 fan (for slim-line version) Phoenix Contact: MSTB 2.5 / 2-STF-5.08	Phoenix Contact: 1777989	A5E30564087

Appendix

A.1 Recycling and disposal

The HCS716I can be recycled owing to its low pollutant content. For ecologically compatible recycling and disposal of your old device, contact a certificated disposal service for electronic scrap.

A.2 Service & support

Contacts

Please talk to your Siemens contact (<http://www.siemens.com/automation/partner>) at one of our agencies or local offices if you have any questions about the products described here and do not find the answers in this manual.

Technical Support

You can access technical support for all IA/DT projects via the following:

- Phone: + 49 (0) 911 895 7222
- Fax: + 49 (0) 911 895 7223
- E-mail (<mailto:support.automation@siemens.com>)
- Internet: Online support request form: (<http://www.siemens.com/automation/support-request>)

Service & support for industrial automation and drive technologies

You can find various services on the Support homepage (<http://www.siemens.com/automation/service&support>) of IA/DT on the Internet.

There you will find the following information, for example:

- Our newsletter containing up-to-date information on your products.
- Relevant documentation for your application, which you can access via the search function in "Product Support".
- A forum for global information exchange by users and specialists.
- Your local contact for IA/DT on site.
- Information about on-site service, repairs, and spare parts. Much more can be found under "Our service offer".

Heater controller homepage

For general information about the Siemens AG heater controllers, visit Homepage (www.siemens.com/hcs).

Online catalog and ordering system

The online catalog and the online ordering system can also be found on the Industry Mall Homepage (<http://www.siemens.com/industrymall>).

Training center

We offer appropriate courses to get you started. Please contact your local training center or the central training center in

D-90327 Nuremberg.

Phone: +49 (0) 180 523 56 11

(€ 0.14 /min. from the German landline network, deviating mobile communications prices are possible)

For information about courses, see the SITRAIN homepage (<http://www.sitrain.com>).

FAQs

You can find the answers to frequently asked questions on the Internet FAQs (<http://support.automation.siemens.com/WW/view/en/10807371/133000>).

Index

A

Ambient temperature LA716, 19
Applications, 9

B

Basic values, 43, 59
Buffer format, 55
Bus address, 26, 27

C

CD, 48
Channel assignment, 64
Channel numbers, 64
Components
 Heater controller, 14
Connecting PROFIBUS DP, 32
Connecting the fieldbus, 32
Control cabinet, 21
Courses, 90

D

Data block, 50
DB_WORK, 50
Default diagnosis, 45
Design
 Expansion rack, 13
 Hinged frame, 9
 Mounting frame, 10, 12
Diagnostic buffer, 45
Diagnostic message, 45
Diagnostics function, 54
Disposal of old equipment, 89

E

Error code, 66, 69

F

Fan, 87
FC_DIAG, 54
FC_REST, 53
FC_ZYKL, 53
Fuse, 34, 88
Fuse tripped, 70

G

Group assignment, 58
GSD file, 40, 55

H

H1, 68
H2, 68
Heat emitters, 35
Hinged frame, 10

I

Initialization, 41
Initialization function, 53
Input buffer, 55
Installation of rack, 21
Installation of STEP 7, 48
Interaction of the system components, 15

J

Job 00, 57
Job 01:, 58
Job 02, 59
Job 03, 60
Job 04, 61
Job 05, 62
Job bit, 55
Job types, 56

L

LED, 68

M

Monitoring of the temperature, 45
Monitoring power output modules, 44
Mounting frame, 11

N

No job, 57

O

OB 1, 53
OB 100, 53
OB 82, 54
Operating cycle, 42
Operating states, 68
Ordering data, 87
Output buffer, 55
Output value, 43
Override values, 43, 60
Overtemperature, 70

P

Performance profile, 16, 17, 18
Power output modules, 27, 35, 62
PROFIBUS DP standard diagnosis, 45

R

Rack, 21
Recycling of old equipment, 89
Reporting of power output modules, 62

S

S102, 26, 27
S103, 26, 27
Sequence function, 53
Several HCS716I modules, 49
Startup characteristics, 41
Supply voltage, 33
Switching capacity LA716, 20
System components, 15

T

Technical data, 75
Technical Support, 89

Temperature monitoring, 45
Test command, 61
Training, 90
Transfer of basic values, 59
Transfer of override values, 60
Transfer of test commands, 61
Transmission of the group assignment, 58

X

X1, 35
X102, 26, 32
X3, 36
X6, 26, 33