

# SIEMENS

## SIMATIC

### Heating Controller HS 724i

Description

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Note the following:



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# Foreword

## Purpose of the description

This description provides you with a reference work in which you can look up information on installation, commissioning and operation of the HS 724i heating controller and on data communication between S7-CPU and HS 724i.

## Road map

The description offers the following access aids to enable you to find special information quickly.

- You will find a complete table of contents at the beginning of the description as well as a list of figures and tables contained in the description.
- In each chapter you will find information in the left-hand column of each page giving you an overview of the contents of the section.
- At the end of the description you will find a detailed index which will help you to find the information you need quickly.

## Special notes

For how to operate the HS 724i on the PROFIBUS-DP fieldbus and how to design your user program using the *STEP 7* programming software, see the respective manuals.

- Manual for PROFIBUS networks
- Manual on *programming with STEP 7, V5.x*

You will also need the manual of your DP master.

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## Product overview

This chapter introduces you to the components of the heating controller and describes the scope of the system.

## 1.1 Description of the HS 724i Heating Controller

The HS 724i heating controller is used to control radiant heaters in industrial applications. The preferred application area of the HS 724i is the control of radiant heaters for thermoforming and blow molding. Other applications include paint drying for the automotive industry, welding of plastics, and extrusion.

In principle, the HS 724i can be used for all applications where ohmic loads must be switched and monitored.

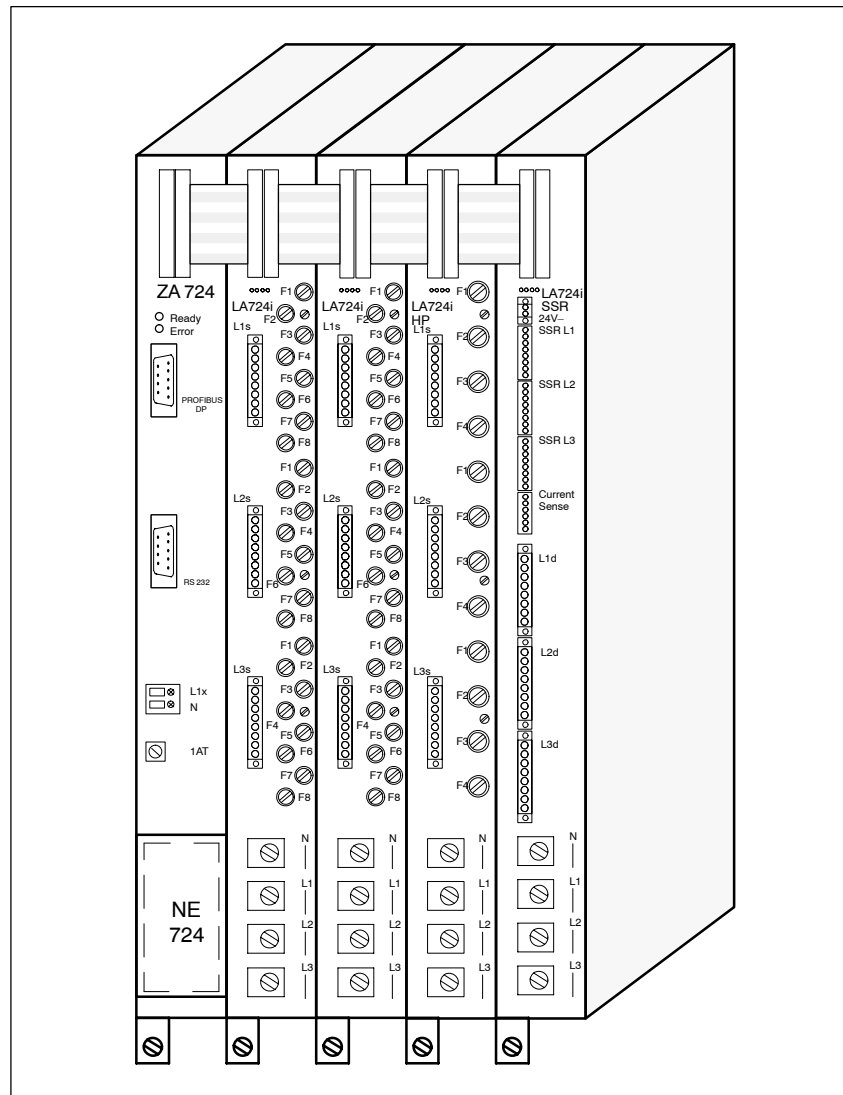


Figure 1-1 Setup of the HS 724i

The heart of the product is the central interface (ZA 724) which can handle up to 16 power outputs/load controllers (LA 724i xx). Three types of power outputs/load controllers are available for the different power classes.

- LA 724i for control of 24 channels with a capacity of up to 1000 W per channel
- LA 724i HP for control of 12 channels with a capacity of up to 2300 W (230 V)/4000 W (400 V) per channel
- LA 724i SSR with 24 channels for the control of solid state relays (SSR, external power switch) with a capacity of up to 20 kW at 230 V/36 kW at 400 V per channel

As the DP slave the ZA 724 communicates via the PROFIBUS-DP fieldbus with the host controller (DP master).

---

#### **Note**

Several HS 724i devices can be operated in a network on one DP master.

The channels are counted consecutively.

The size of the HS 724i network primarily depends on the resources of the DP master. The included S7 program limits the number of HS 724i devices to 17 (with the appropriate S7-CPU).

---

The control information generated by the ZA 724 is transmitted between the components with a parallel bus and the status of the power outputs is returned to the ZA 724. As an option, a system power acquisition device (NE 724) can be integrated to perform voltage compensation.

The individual components are each installed in a metalized housing and mounted on a plate in the switching cabinet.

Customized solutions without metalized housings are available on request.

## 1.2 System Overview

The following components make up a complete system.

- Host controller as PROFIBUS-DP master (SIMATIC S7 – with CPU 315-2 DP or CPU 414-2 DP, for instance)
- Central interface ZA 724 as PROFIBUS-DP slave with integrated  $\mu$ P system for control of power outputs/load controllers LA 724i xx
- 1 to 16 power outputs/load controllers LA 724i xx
- System power acquisition device NE 724 (optional)
- Current measuring module SM 724i (optional)
- Operator panel (optional)
- Radiant heater field/radiant heater

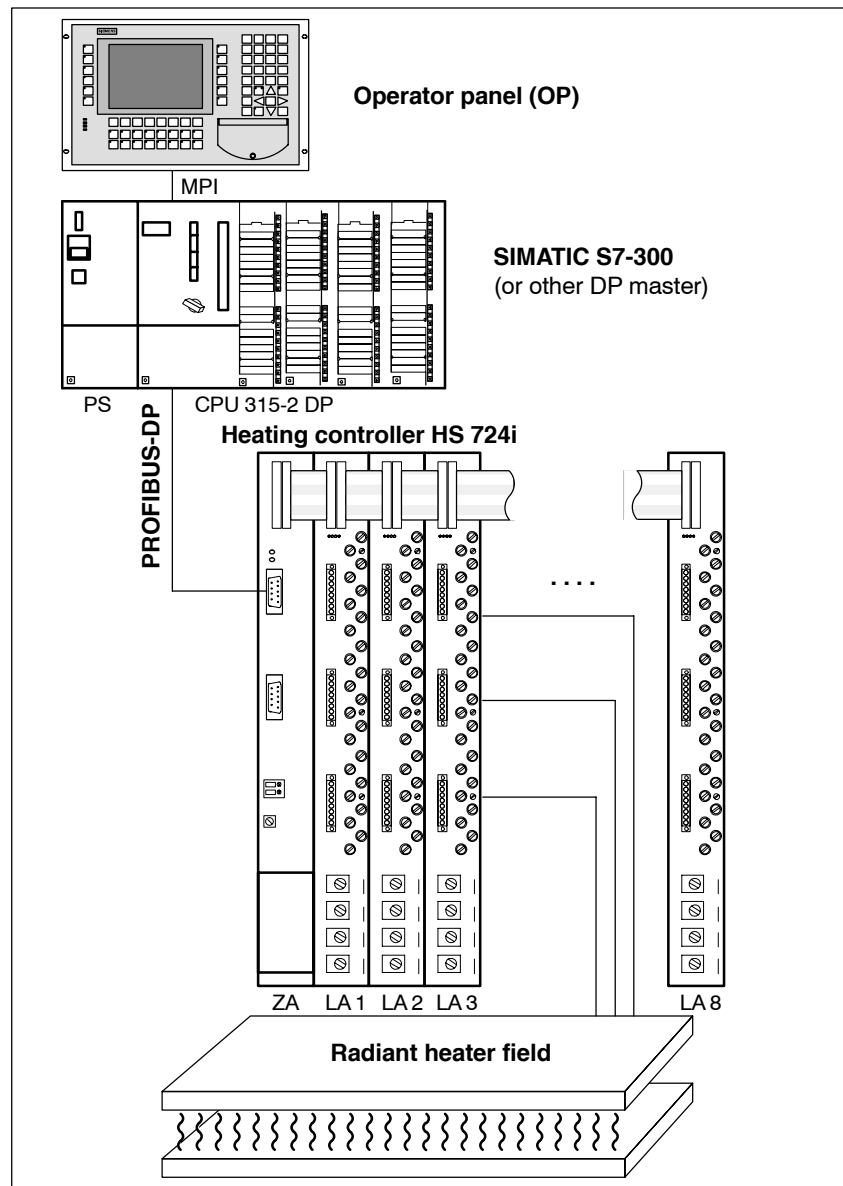


Figure 1-2 System components of the heating controller

## Network of HS 724i

Several HS 724i devices with 1 ZA 724 each and up to 16 LA 724i devices each can be connected to one PROFIBUS-DP master.

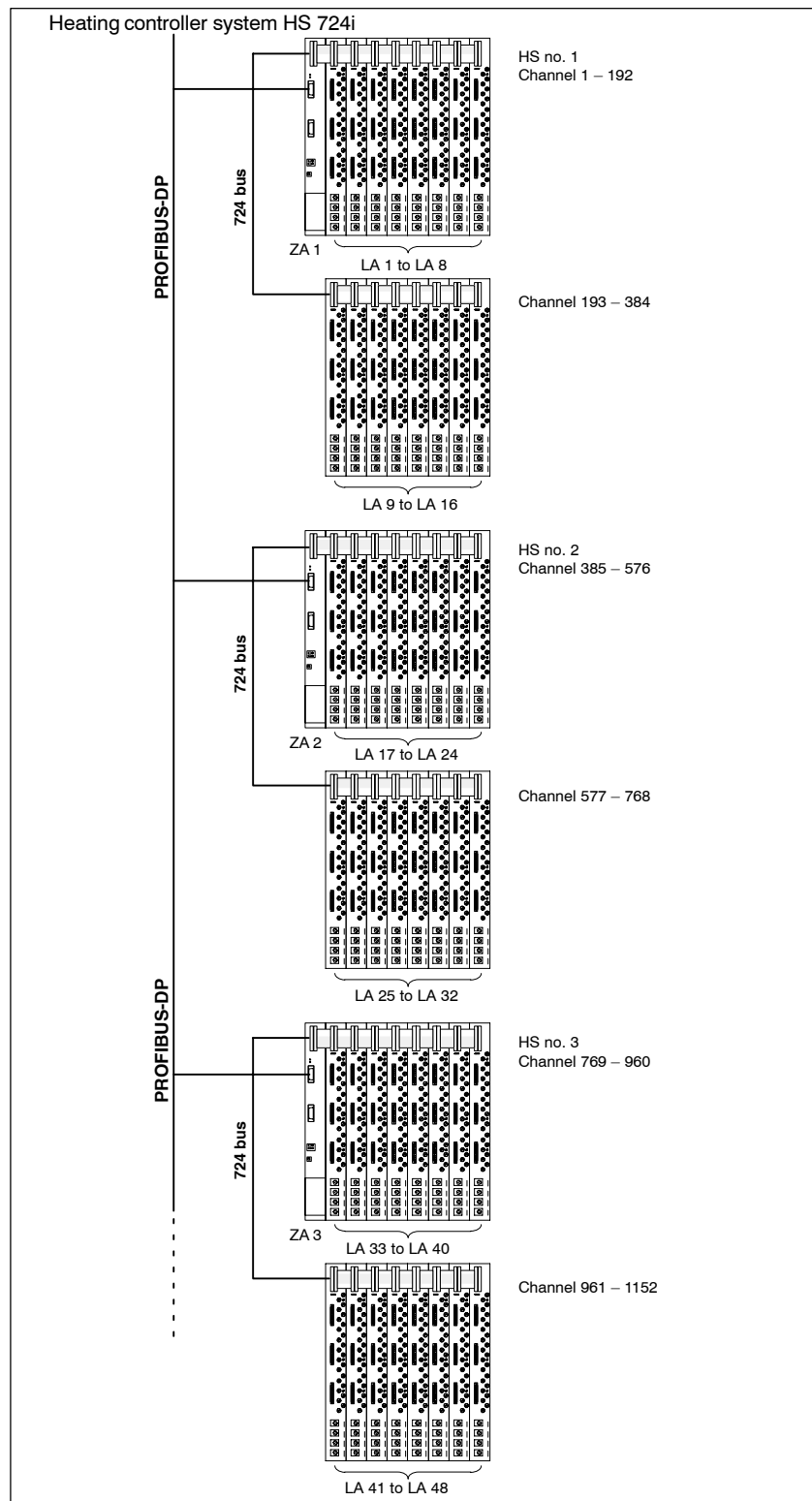


Figure 1-3 Example of operation of a network of HS 724i

## The HS 724i Heating Controller

This chapter discusses the setup and function of the following components.

- Central interface
- Power outputs/load controllers
- System power acquisition device
- Fan module
- Current measuring module

## 2.1 Central Interface ZA 724

### Product features

The ZA 724 central interface is characterized by the following features.

- Module installed in a metalized housing
- Connections for up to 16 power outputs/load controllers. LA 724i, LA 724i HP and LA 724i SSR can be connected in any combination.
- $\mu$ P system 80C165
- Communication with host system via PROFIBUS-DP interface
- Adjustable PROFIBUS-DP address area from 00 to 99 with rotary type switches
- Bus transmission speeds up to 12 MBaud
- Optional: Expansion with NE 724 system power acquisition device for compensation of fluctuations of the network power and power calculation
- Automatic recognition of the power frequency
- Controllers of up to 384 channels in half and full-wave mode
- Uniform load distribution over all channels and over all HS 724i devices in the network
- Control of the outputs without zero-frequency quantity
- Monitoring of all power outputs and all connected LAs
- Parameterization of channel control and diagnosis

## 2.1.1 Setup of the Module

### Front view of the ZA 724

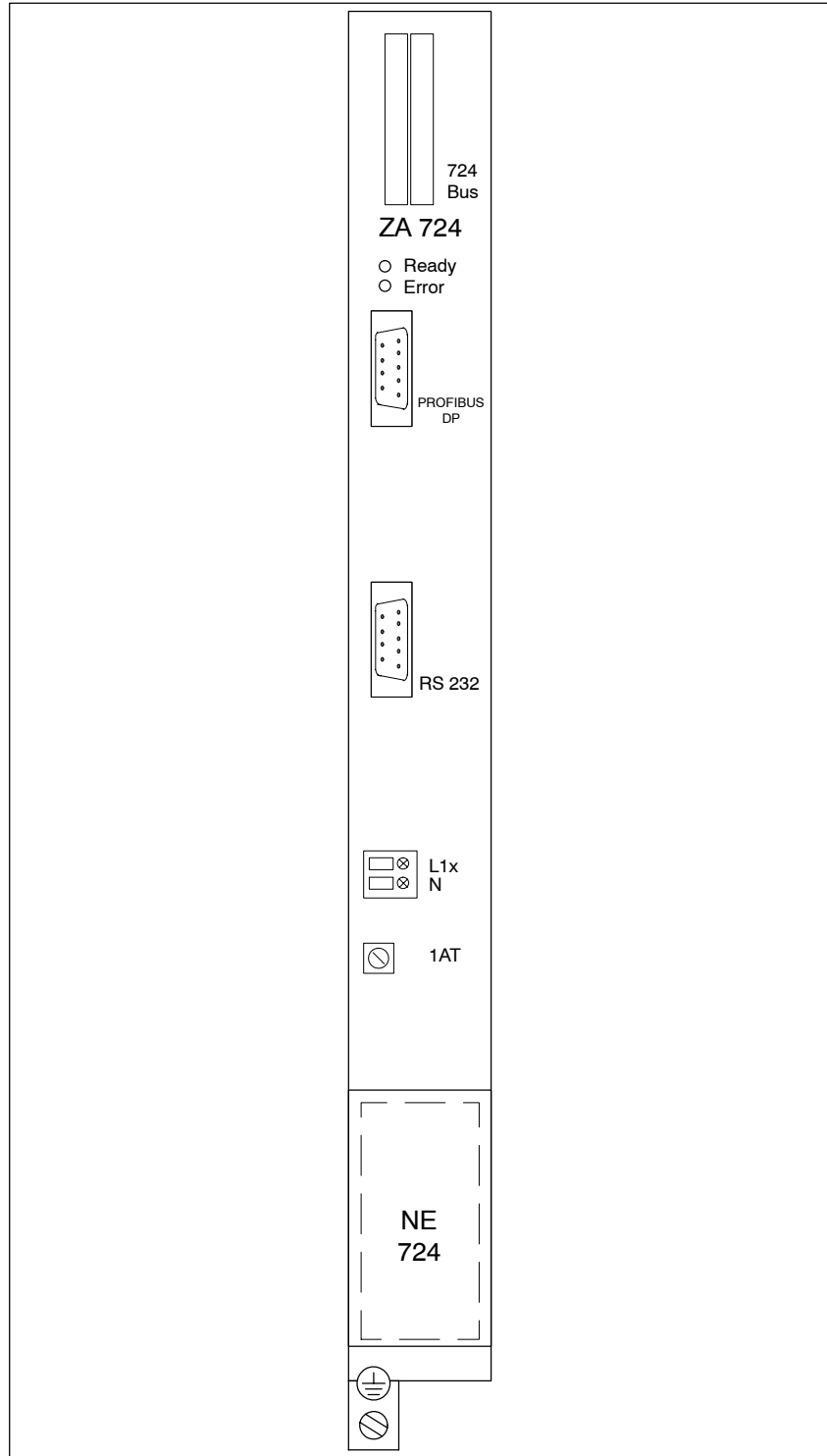


Figure 2-1 Front view of the ZA 724

Figure 2-1 shows a view of the front of the central interface (ZA). The ZA contains the following components.

- LED indicators for station status
- PROFIBUS-DP slave interface (floating via optocoupler)
- Rotary type switch for setting the PROFIBUS-DP address (see chap. 3.2)
- $\mu$ P system 80C165 with memory for controlling the power outputs
- Serial interface RS 232 (non-floating) for firmware update
- Parallel bus interface for the power outputs/load controllers
- Terminals for power connection
- Hardware for power synchronization of a phase
- Internal voltage supply for the power outputs/load controllers
- Floating voltage supply for the PROFIBUS-DP slave interface

### **Voltage supply**

The input alternating voltage of 230 V (min. of 187 V, max. of 264 V) is transformed into an alternating voltage of 24 V with the aid of an integrated transformer. A stabilized direct voltage of 5 V is then generated from this for the module's logic.

When the power is turned on, an automatic reset signal is generated for the  $\mu$ P system. This resets both the power outputs and the processor to a defined state.

A floating voltage supply is available for PROFIBUS-DP which is generated from the stabilized 5 V voltage.

### **Power synchronization**

To ensure synchronization of the power outputs/load controllers with the connected power, the  $\mu$ P 80C165 is synchronized to phase L1.

## 2.1.2 Plug Connections

The ZA 724 has five plug connections (see table 2-1) and On insert slot for the optional system power acquisition device NE 724 (see also figure 2-1) all of which are listed below.

Table 2-1 Plug connectors on the ZA 724

| Label                                                                             | Function                                                                                                            |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| 724 Bus                                                                           | Connection of LA 724 to the parallel bus<br>LA 1 to LA 8: Right plug (1st row)<br>LA9 to LA 16: Left plug (2nd row) |
| PROFIBUS-DP                                                                       | Connection to host system via PROFIBUS-DP                                                                           |
| RS 232                                                                            | Sub D plug for connection to RS 232 interface                                                                       |
| L1x                                                                               | Terminal for connection of phase L1                                                                                 |
| N                                                                                 | Terminal for connection of the neutral conductor                                                                    |
|  | Connection of the protective conductor via a bus bar                                                                |

### 2.1.3 Indicator Elements

The ZA 724 has 2 LEDs for indicating the current state.

- Ready LED (green)
- Error LED (red)

Table 2-2 gives you information on the LEDs for the various states of the ZA 724.

Table 2-2      Meaning of the LEDs of the ZA 724

| Error LED | Ready LED | Meaning                                                                                                  |
|-----------|-----------|----------------------------------------------------------------------------------------------------------|
| On        | Off       | Startup<br>Fatal error, HS 724i won't run.                                                               |
| On        | Flashing  | Startup<br>HS 724i is starting the DP communication.                                                     |
| On        | On        | Startup<br>HS 724i is waiting for configuration parameters.                                              |
| Off       | On        | Normal operation<br>No errors                                                                            |
| Off       | Flashing  | Normal operation<br>DP communication was lost. HS 724i is waiting for re-establishment by the DP master. |

## 2.1.4 Technical Data

Table 2-3 Technical data of the ZA 724

|                                                                                                                                            |                                                                                   |
|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| Supply voltage<br>Permissible range                                                                                                        | 230 V AC<br>187 V to 264 V                                                        |
| Nominal frequency<br>Permissible range                                                                                                     | 50/60 Hz<br>47 Hz to 63 Hz                                                        |
| Non-cyclic overvoltage<br>(in acc. w. EN 60204, part 1)<br>Limit value<br>Duration<br>Rise/drop time                                       | $2 \times U_{\text{Nom}}$<br>1.5 msec (single pulse)<br>500 nsec to 500 $\mu$ sec |
| Brief voltage interruption (output state: lower limit of nominal voltage = 187 V)<br>Interruption time<br>Recovery time<br>Events per hour | Maximum of 20 msec<br>At least 1 sec<br>Maximum of 10                             |
| Power consumption                                                                                                                          | 35 W, typical<br>Maximum of 46 W                                                  |
| Dimensions of the ZA 724<br>(W x H x D)<br>Weight, approx.                                                                                 | 50 mm x 480 mm x 210 mm<br>4.2 kg                                                 |

## 2.2 Power Output LA 724i

### Product features

The power output LA 724i is characterized by the following features.

- Module integrated in a metalized housing
- 24 power channels with a maximum of 1000 W switching capacity per output with 230 V AC, grouping of 8 outputs per phase
- Accessible from the outside, 5 A fuse for each power channel
- Internal fuse for each phase with 32 A

---

### Note

The total current per phase of 32 A may not be exceeded.

---

- Connection of the phases via bus bars
- Connection of the radiant heaters via front plugs
- No settings necessary on the module
- Diagnostic functions for recognition of internal and external errors
- Diagnostic functions for recognition of heater failure with parallel heaters via current measurement
- Two-stage temperature monitoring via thermistor (warning stage, switch-off stage)
- LED indicators for channel error and temperature monitoring

## 2.2.1 Setup of the Module

### Front view of the LA 724i

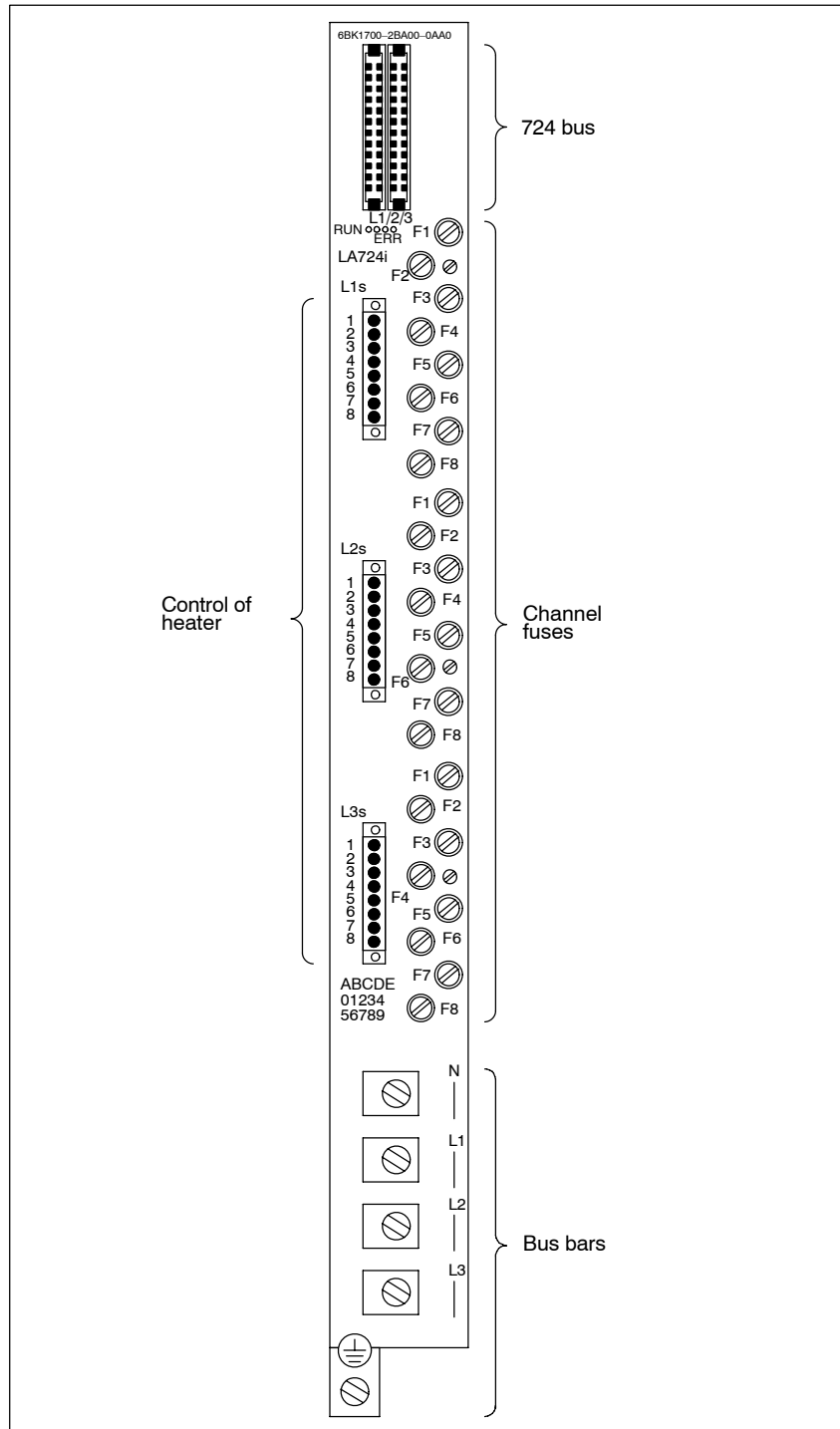


Figure 2-2 Front view of the LA 724i

**Protective circuitry** Triac and Opto-Triac are protected by Transil diodes against overvoltage of the electrical network. In addition, the Triac is protected with a fuse against short-circuit or overload.

**Isolation** The control current circuits all use safety extra low voltage (SELV) and are securely isolated from the power and load current circuits as required by EN 50178.

**Temperature monitoring** To monitor its temperature, a thermistor is located on the heat dissipater. This temperature-dependent resistor sends a message to the S7-CPU via the ZA 724 when the temperature is  $92\text{ }^{\circ}\text{C} (\pm 3\text{ }^{\circ}\text{C})$ .  
A second switching threshold at  $100\text{ }^{\circ}\text{C} (\pm 3\text{ }^{\circ}\text{C})$  switches off the power outputs of the module.

## 2.2.2 Plug Connections

The power output is equipped with the following plug connections.

Table 2-4 Plug connectors on the LA 724i

| Label                                                                               | Function                                                                                             |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| 724 Bus                                                                             | Connection to the next LA (right socket) and the previous LA or ZA (left socket) on the parallel bus |
| L1s                                                                                 | Connection to radiant heaters 1 to 8 on phase L1                                                     |
| L2s                                                                                 | Connection to radiant heaters 9 to 16 on phase L2                                                    |
| L3s                                                                                 | Connection to radiant heaters 17 to 24 on phase L3                                                   |
| N                                                                                   | Connection of the neutral conductor via a bus bar                                                    |
| L1                                                                                  | Connection of phase L1 via a bus bar                                                                 |
| L2                                                                                  | Connection of phase L2 via a bus bar                                                                 |
| L3                                                                                  | Connection of phase L3 via a bus bar                                                                 |
|  | Connection of the protective conductor via a bus bar                                                 |

### 2.2.3 Indicator Elements

The LA 724i has 4 LEDs for indication of the current state.

- RUN LED (green)
- ERR L1/L2/L3 LEDs (red)

Table 2-5 gives you information on the LEDs for the various states of the LA 724i.

Table 2-5 Meaning of the LEDs of the LA 724i

| <b>RUN LED</b> | <b>ERR L1 LED</b> | <b>ERR L2 LED</b> | <b>ERR L3 LED</b> | <b>Meaning</b>                                                                   |
|----------------|-------------------|-------------------|-------------------|----------------------------------------------------------------------------------|
| Off            | Off               | Off               | Off               | LA is not running.<br>It was not recognized by the ZA during <b>startup</b> .    |
| Off            | 1                 | 1                 | 1                 | The upper temperature threshold has been exceeded. Power outputs are turned off. |
| Flashing       | 1                 | 1                 | 1                 | LA is running.<br>The temperature warning threshold has been exceeded.           |
| On             | Off               | Off               | Off               | LA is running.<br>No channel errors                                              |
| On             | On                | 1                 | 1                 | LA is running.<br>Error on at least 1 channel of phase L1                        |
| On             | 1                 | On                | 1                 | LA is running.<br>Error on at least 1 channel of phase L2                        |
| On             | 1                 | 1                 | On                | LA is running.<br>Error on at least 1 channel of phase L3                        |

1 State irrelevant

## 2.2.4 Technical Data

Table 2-6 Technical data of the LA 724i

|                                                                                                                         |                                                                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Outputs per power output (LA 724i)                                                                                      | 24                                                                                                                                    |
| Isolation to control section                                                                                            | Via Opto-Triac and optocoupler which are specified as per VDE 0884                                                                    |
| Isolation voltage<br>Opto-Triac<br>Optocoupler                                                                          | 5 kV<br>5.3 kV                                                                                                                        |
| Potential isolation of the power outputs among each other                                                               | No                                                                                                                                    |
| Load voltage (for Y connection)<br>Nominal value<br>Permissible range<br>Frequency                                      | 230 V AC<br>187 V to 264 V (TN network)<br>50/60 Hz (47 Hz to 63 Hz)                                                                  |
| Total current per phase and module                                                                                      | Max. of 32 A                                                                                                                          |
| Current per bus bar                                                                                                     | Max. of 120 A                                                                                                                         |
| Output voltage                                                                                                          | Full or half-waves circuited at zero crossing                                                                                         |
| Output current<br>Maximum value<br>Residual current                                                                     | 5 A<br>Max. of 7 mA                                                                                                                   |
| Power loss                                                                                                              | Typ. $P_V = 0.7 \text{ W/A} \cdot I + 0.18 \text{ W/A}^2 \cdot I^2$<br>(I = control current on channel)                               |
| Switching capacity (simultaneity 100%)                                                                                  | Max. of 1000 W per channel at 230 V<br>Note:<br>The total current per phase of 32 A may not be exceeded.<br>Min. of 75 W per channel  |
| Parallel circuiting of heaters to one channel<br>Number<br>Minimum capacity per heater                                  | Typ. 5<br>200 W                                                                                                                       |
| Total switching capacity per LA 724i ( $T_U = 40 \text{ }^\circ\text{C}$ )<br>Without external fan<br>With external fan | 14.4 kW<br>22 kW                                                                                                                      |
| Type of load                                                                                                            | Ohmic loads with max. of 15 times the cold current in the 1st half-wave (if necessary, flash heaters can be measured at Siemens)      |
| Overload                                                                                                                | 5 times the nominal current for 20 msec                                                                                               |
| Thermal protection                                                                                                      | Yes, with thermistor<br>92 °C $\pm$ 3 °C: Warning to host controller via PROFIBUS-DP<br>100 °C $\pm$ 3 °C: Power outputs switched off |
| Short circuit protection                                                                                                | One 5 A/250 V F fuse per output                                                                                                       |

Table 2-6 Technical data of the LA 724i

|                                         |                                                                   |
|-----------------------------------------|-------------------------------------------------------------------|
| Overvoltage protection                  | With Transil diodes                                               |
| Connection line                         | $R_{\max} = 14 \, \Omega$<br>(to ensure short-circuit protection) |
| Dimensions of the LA 724<br>(W x H x D) | 50 mm x 480 mm x 210 mm                                           |
| Weight, approx.                         | 5.3 kg                                                            |

## 2.2.5 Performance Profile

Figure 2-3 shows the performance profile of the LA 724i.

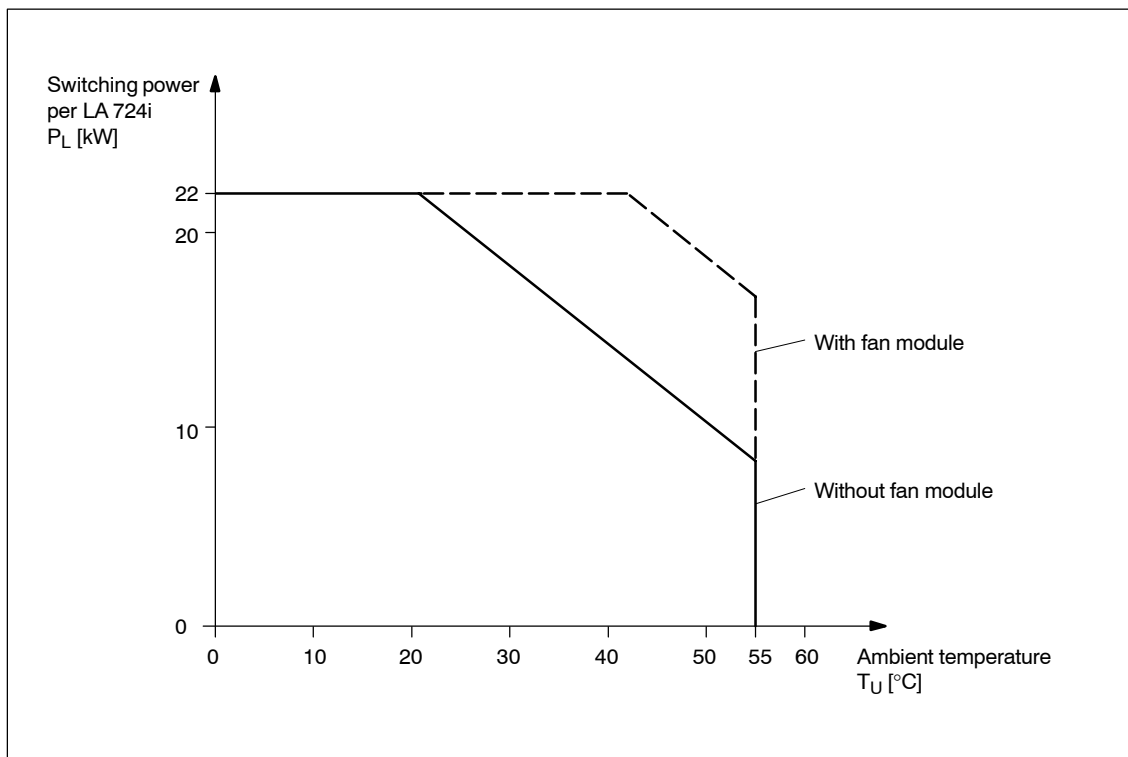


Figure 2-3 Performance profile of the LA 724i

## Examples of use

### Example 1

Prerequisites:

- Ambient temperature:  $T_U = 40\text{ }^{\circ}\text{C}$
- Operation without fan module
- 24 heaters (channels)
- Running production mode at 100% simultaneity

What is the maximum permissible heater capacity?

Figure 2-3 shows us:

At  $T_U = 40\text{ }^{\circ}\text{C}$  the switching capacity of the LA 724i  $P_L \approx 14.5\text{ kW}$ .

$$P_{\text{Heater}} = \frac{P_L}{24} = 604\text{ W}$$

### Example 2

Prerequisites:

- Ambient temperature:  $T_U = 55\text{ }^{\circ}\text{C}$
- Operation without fan module
- 24 heaters (channels)
- Production : standby = 4 : 1
- 85% simultaneity

Can we use 500 W heaters?

Figure 2-3 shows us:

At  $T_U = 55\text{ }^{\circ}\text{C}$  the switching capacity of the LA 724i  $P_L \approx 8.5\text{ kW}$ .

$$P_{\text{Heater}} = \frac{P_L}{24} \cdot \frac{1}{0.85} \cdot \frac{5}{4} = 520\text{ W}$$

Answer: We can use 500 W heaters.

## 2.3 Power Output LA 724i HP

### Product features

The LA 724i HP power output is characterized by the following features.

- Module is integrated in a metalized housing.
- 12 power channels with a maximum of 2300 W switching capacity at 230 V AC or 4000 W switching capacity at 400 V AC per output  
Grouping of 4 outputs per phase
- One 10 A fuse per power channel, can be accessed from outside
- Internal fuse per phase with 40 A

---

### Note

The total current of 40 A per phase may not be exceeded.

---

- Connection of the phases via bus bars
- Connection of the radiant heaters via front plug connector
- No settings necessary on the module
- Diagnostic function for recognition of internal and external errors
- Diagnostic function for recognition of a heater failure when heaters are connected parallel via current measurement
- Two-stage temperature monitoring with thermistor (warning stage, switch off stage)
- LED indicators for channel errors and temperature monitoring

## 2.3.1 Setup of the Module

### Front view of the LA 724i HP

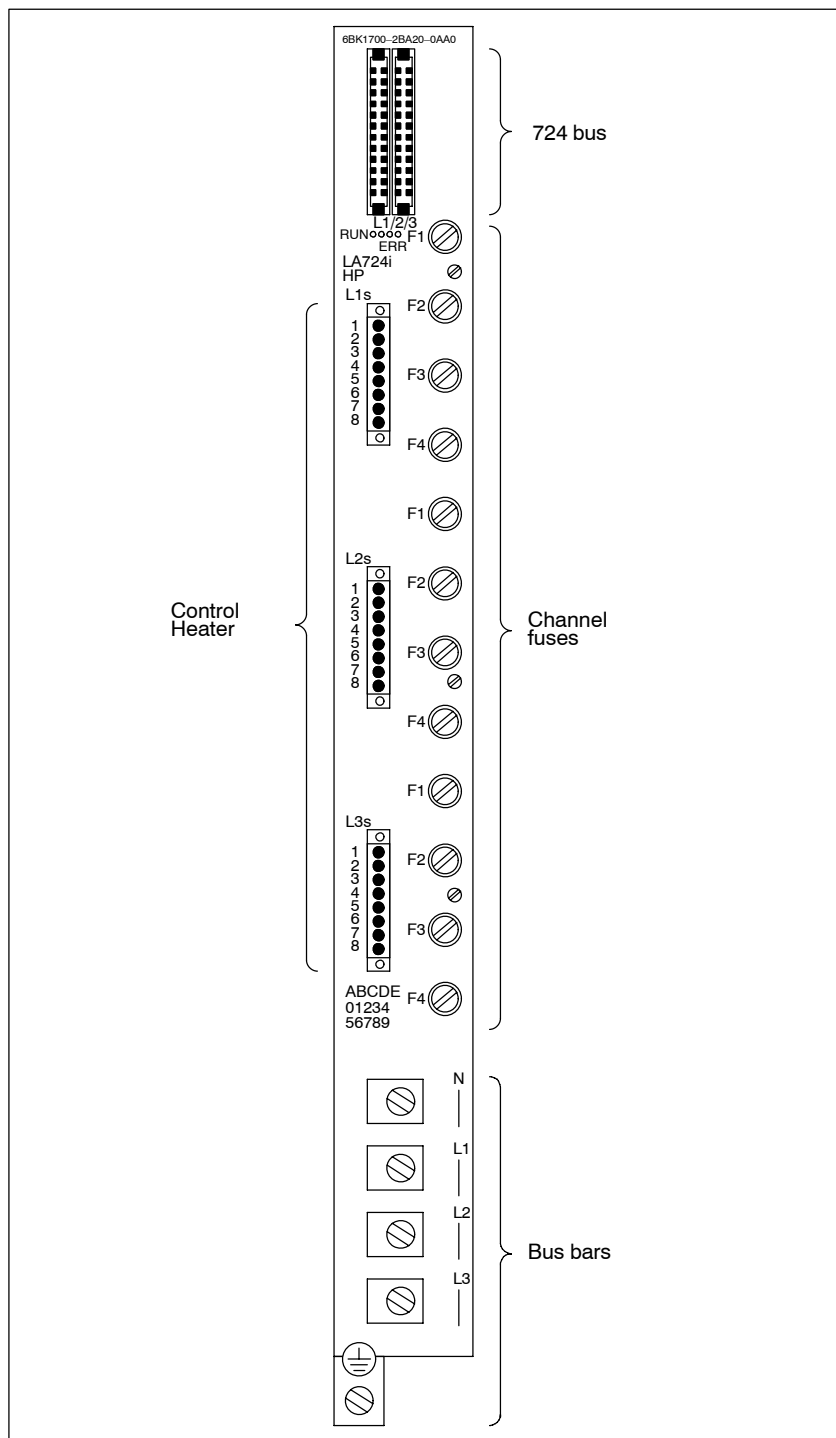


Figure 2-4 Front view of the LA 724i HP

|                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Protective circuitry</b>   | Triac and Opto-Triac are protected by Transil diodes against overvoltage of the electrical network. In addition, the Triac is protected with a fuse against short-circuit or overload.                                                                                                                                                                                                                                                                              |
| <b>Isolation</b>              | The control current circuits all use safety extra low voltage (SELV) and are securely electrically isolated from the power and load current circuits as required by EN 50178.                                                                                                                                                                                                                                                                                       |
| <b>Temperature monitoring</b> | <p>To monitor its temperature, a thermistor is located on the heat dissipater.</p> <p>This temperature-dependent resistor sends a message to the S7-CPU via the ZA 724 when the temperature is <math>92\text{ }^{\circ}\text{C}</math> (<math>\pm 3\text{ }^{\circ}\text{C}</math>).</p> <p>A second switching threshold at <math>100\text{ }^{\circ}\text{C}</math> (<math>\pm 3\text{ }^{\circ}\text{C}</math>) switches off the power outputs of the module.</p> |

### 2.3.2 Plug Connections

The power output is equipped with the following plug connections.

Table 2-7 Plug connectors on the LA 724i HP

| Label                                                                               | Function                                                                                             |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| 724 Bus                                                                             | Connection to the next LA (right socket) and the previous LA or ZA (left socket) on the parallel bus |
| L1s                                                                                 | Connection to radiant heaters 1 to 4 on phase L1                                                     |
| L2s                                                                                 | Connection to radiant heaters 5 to 8 on phase L2                                                     |
| L3s                                                                                 | Connection to radiant heaters 9 to 12 on phase L3                                                    |
| N                                                                                   | Connection of the neutral conductor via a bus bar                                                    |
| L1                                                                                  | Connection of phase L1 via a bus bar                                                                 |
| L2                                                                                  | Connection of phase L2 via a bus bar                                                                 |
| L3                                                                                  | Connection of phase L3 via a bus bar                                                                 |
|  | Connection of the protective conductor via a bus bar                                                 |

### 2.3.3 Indicator Elements

The LA 724i HP has 4 LEDs for indication of the current state.

- RUN LED (green)
- ERR L1/L2/L3 LEDs (red)

Table 2-8 gives you information on the LEDs for the various states of the LA 724i HP.

Table 2-8 Meaning of the LEDs of the LA 724iHP

| RUN LED       | ERR L1 LED | ERR L2 LED | ERR L3 LED | Meaning                                                                          |
|---------------|------------|------------|------------|----------------------------------------------------------------------------------|
| Off           | Off        | Off        | Off        | LA is not running.<br>It was not recognized by the ZA during <b>startup</b> .    |
| Off           | 1          | 1          | 1          | The upper temperature threshold has been exceeded. Power outputs are turned off. |
| Flash-<br>ing | 1          | 1          | 1          | LA is running.<br>The temperature warning threshold has been exceeded.           |
| On            | Off        | Off        | Off        | LA is running.<br>No channel errors                                              |
| On            | On         | 1          | 1          | LA is running.<br>Error on at least 1 channel of phase L1                        |
| On            | 1          | On         | 1          | LA is running.<br>Error on at least 1 channel of phase L2                        |
| On            | 1          | 1          | On         | LA is running.<br>Error on at least 1 channel of phase L3                        |

1 State irrelevant

## 2.3.4 Technical Data

Table 2-9 Technical data of the LA 724i HP

|                                                                                                                   |                                                                                                                                                             |
|-------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Outputs per power output (LA 724i HP)                                                                             | 12                                                                                                                                                          |
| Isolation to control section                                                                                      | Via Opto-Triac and optocoupler which are specified as per VDE 0884                                                                                          |
| Isolation voltage<br>Opto-Triac<br>Optocoupler                                                                    | 5 kV<br>5.3 kV                                                                                                                                              |
| Potential isolation of the power outputs among each other                                                         | No                                                                                                                                                          |
| Load voltage (for Y and Delta connection)<br>Nominal value<br>Permissible range<br>Frequency                      | 230 V AC / 400 V AC<br>187 V to 264 V / 340 V to 460 V (TN network)<br>50/60 Hz (47 Hz to 63 Hz)                                                            |
| Total current per phase and module                                                                                | Max. of 40 A                                                                                                                                                |
| Current per bus bar                                                                                               | Max. of 120 A                                                                                                                                               |
| Output voltage                                                                                                    | Full or half-waves circuited at zero crossing                                                                                                               |
| Output current<br>Maximum value<br>Residual current                                                               | 10 A<br>Max. of 7 mA                                                                                                                                        |
| Power loss                                                                                                        | Typ. $P_V = 0.7 \text{ W/A} \cdot I + 0.16 \text{ W/A}^2 \cdot I^2$<br>(I = control current on channel)                                                     |
| Switching capacity (simultaneity 100%)                                                                            | 2300 W per channel at 230 V<br>4000 W per channel at 400 V<br>Note:<br>The total current per phase of 40 A may not be exceeded.<br>Min. of 75 W per channel |
| Parallel circuiting of heaters to one channel<br>Number<br>Minimum capacity per heater                            | Typ. 5<br>200 W                                                                                                                                             |
| Total switching capacity per LA 724i HP ( $T_U = 40^\circ\text{C}$ )<br>Without external fan<br>With external fan | 13 kW<br>21 kW                                                                                                                                              |
| Type of load                                                                                                      | Ohmic loads with max. of 15 times the cold current in the 1st half-wave (if necessary, flash heaters can be measured at Siemens)                            |
| Overload                                                                                                          | 5 times the nominal current for 20 msec                                                                                                                     |
| Thermal protection                                                                                                | Yes, with thermistor<br>92 °C ± 3 °C: Warning to host controller via PROFIBUS-DP<br>100 °C ± 3 °C: Power outputs switched off                               |

Table 2-9 Technical data of the LA 724i HP

|                                             |                                                                |
|---------------------------------------------|----------------------------------------------------------------|
| Short circuit protection                    | One 10 A/250 V F fuse per output                               |
| Overvoltage protection                      | With Transil diodes                                            |
| Connection line                             | $R_{\max} = 14 \Omega$<br>(to ensure short-circuit protection) |
| Dimensions of the LA 724i HP<br>(W x H x D) | 50 mm x 480 mm x 210 mm                                        |
| Weight, approx.                             | 5.3 kg                                                         |

### 2.3.5 Performance Profile

Figure 2-5 shows the performance profile of the LA 724i HP with Y connection.

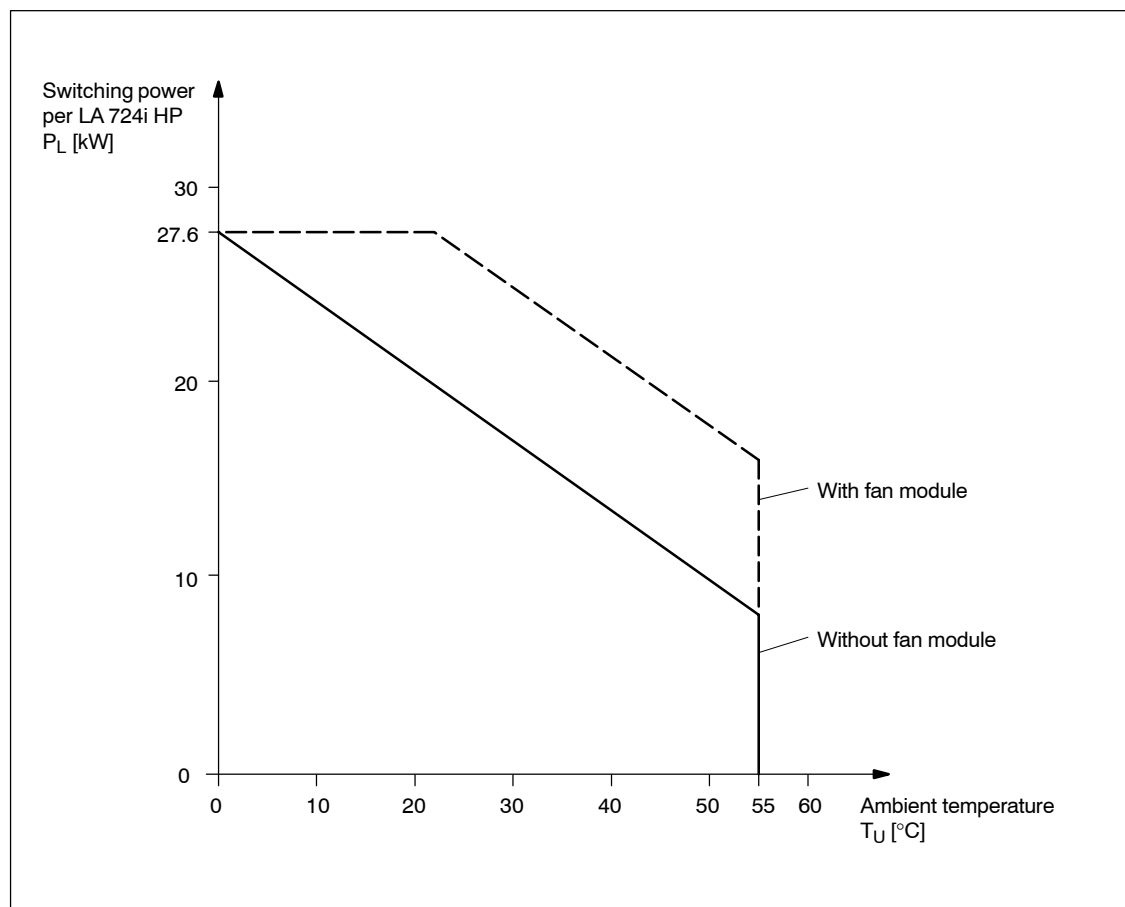


Figure 2-5 Performance profile of the LA 724i HP with Y connection

**Examples of use****Example 1**

Prerequisites:

- Ambient temperature:  $T_U = 40\text{ °C}$
- Operation without fan module
- Y connection
- Production : standby = 4 : 1
- 100% simultaneity

Can five 250 W heaters be connected in parallel?

Figure 2-5 shows us:

At  $T_U = 40\text{ °C}$  the switching capacity of the LA 724i HP  $P_L \approx 13\text{ kW}$ 

$$P_{\text{Channel}} \leq \frac{P_L}{12} \cdot \frac{5}{4} = 1354\text{ W}$$

$$P_{\text{Heater}} = \frac{1}{5} \cdot P_{\text{Channel}} = 270\text{ W}$$

Answer: Five 250 W heaters can be connected in parallel.

**Example 2**

Prerequisites:

- Ambient temperature:  $T_U = 50\text{ °C}$
- Operation with fan module
- Delta connection
- Running production mode at 100% simultaneity

What is the maximum heater capacity?

Figure 2-5 shows us:

At  $T_U = 50\text{ °C}$  and Y connection, the switching capacity of the LA 724i HP with fan module is  $P_{L,Y} \approx 17.5\text{ kW}$ 

$$P_{L,\Delta} = \frac{400\text{ V}}{230\text{ V}} \cdot 17.5\text{ kW} = 30.4\text{ kW}$$

$$P_{\text{Heater}} \leq \frac{P_{L,\Delta}}{12} = \frac{30.4}{12} = 2.54\text{ kW}$$

Answer: The maximum heater capacity is 2.54 kW

## 2.4 Load Controller LA 724i SSR

- Product features**      The LA 724i SSR load controller is characterized by the following features.
- Module is integrated in a metalized housing.
  - 24 power channels with one digital control signal of 24 V per output for controlling external solid state relays (SSR)  
Maximum of 20 kW switching capacity at 230 V or 36 kW at 400 V per output  
Grouping of 8 outputs per phase
  - Protection of each channel must be provided externally.

---

**Note**

The total current of 400 A per phase may not be exceeded.

---

- Connection of the SSR via front plug
- Optional
  - Connection for feedback from the heaters for diagnostic purposes.  
Voltage measurement for recognition of external errors.
  - Connection of the phases via bus bars
- Optional  
Connection of the current measuring module for diagnostic purposes  
Current measurement for recognition of external errors and for power monitoring with parallel heaters
- No settings necessary on the module
- Monitoring of the 24 V voltage supply
- LED indicators for channel errors and errors of the 24 V voltage supply

## 2.4.1 Setup of the Module

### Front view of the LA 724i SSR

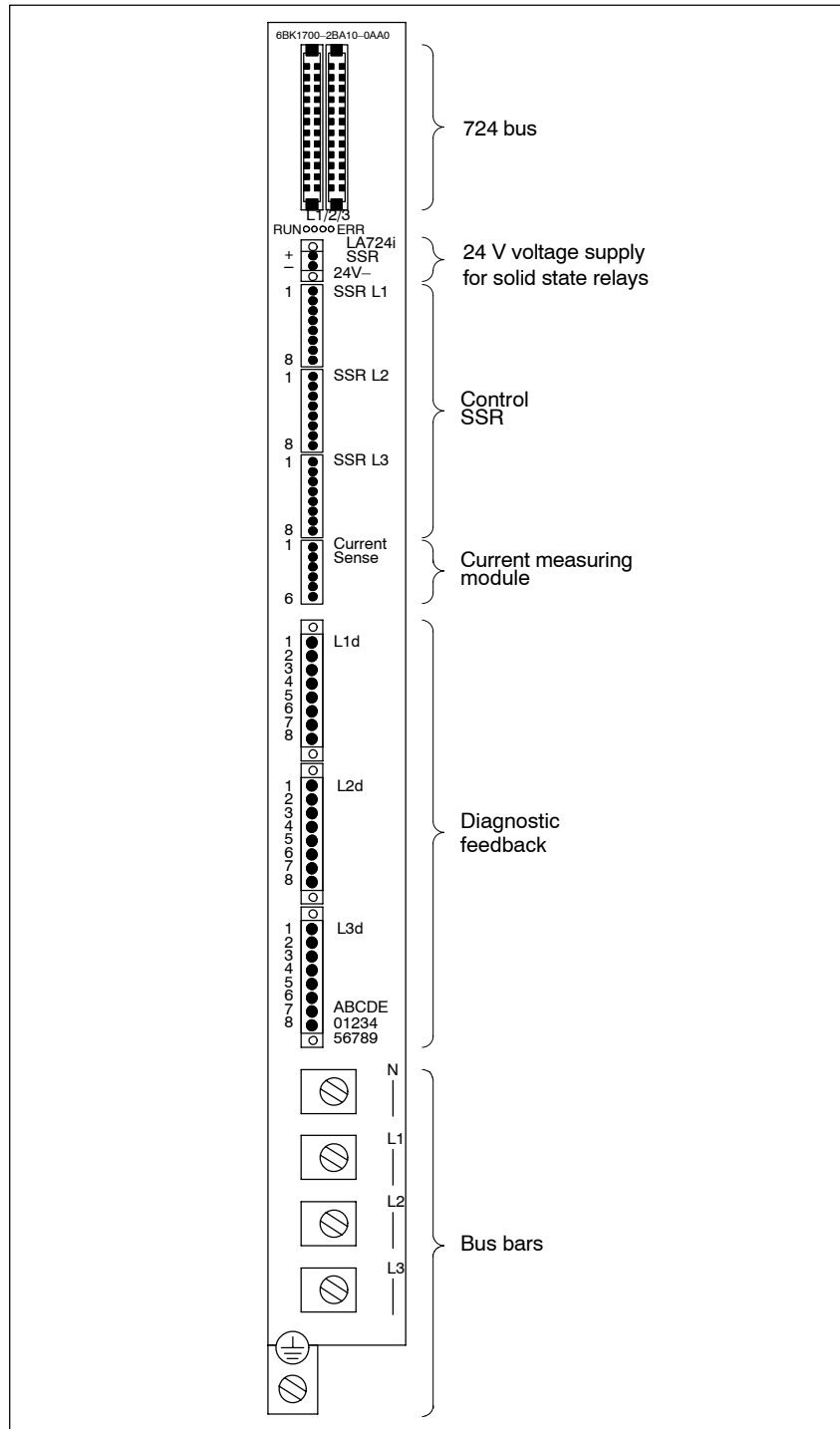


Figure 2-6 Front view of the LA 724i SSR

**Potential isolation** The control current circuits all use safety extra low voltage (SELV) and are securely electrically isolated from the power and load current circuits as required by EN 50178.

**24 V monitoring** The 24 V voltage connection is monitored for failure.  
If a failure occurs, the outputs to the SSR are switched off.

## 2.4.2 Plug Connections

The load controller is equipped with the following plug connections.

Table 2-10 Plug connectors on the LA 724i SSR

| Label                                                                               | Function                                                                                             |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| 724 Bus                                                                             | Connection to the next LA (right socket) and the previous LA or ZA (left socket) on the parallel bus |
| +/- 24 V-                                                                           | 24 V voltage for the solid state relays                                                              |
| SSR L1                                                                              | Connection SSR 1 to 8 on phase L1                                                                    |
| SSR L2                                                                              | Connection SSR 9 to 16 on phase L2                                                                   |
| SSR L3                                                                              | Connection SSR 17 to 24 on phase L3                                                                  |
| Current Sense                                                                       | Connection for current measuring module                                                              |
| L1d                                                                                 | Voltage monitoring SSR 1 to 8 for phase L1                                                           |
| L2d                                                                                 | Voltage monitoring SSR 9 to 16 for phase L2                                                          |
| L3d                                                                                 | Voltage monitoring SSR 17 to 24 for phase L3                                                         |
| N                                                                                   | Connection of the neutral conductor via a bus bar                                                    |
| L1                                                                                  | Connection of phase L1 via a bus bar                                                                 |
| L2                                                                                  | Connection of phase L2 via a bus bar                                                                 |
| L3                                                                                  | Connection of phase L3 via a bus bar                                                                 |
|  | Connection of the protective conductor via a bus bar                                                 |

### 2.4.3 Indicator Elements

The LA 724i SSR has 4 LEDs for indication of the current state.

- RUN LED (green)
- ERR L1/L2/L3 LEDs (red)

Table 2-11 gives you information on the LEDs for the various states of the LA 724i SSR.

Table 2-11 Meaning of the LEDs of the LA 724iSSR

| RUN LED | ERR L1 LED | ERR L2 LED | ERR L3 LED | Meaning                                                                        |
|---------|------------|------------|------------|--------------------------------------------------------------------------------|
| Off     | Off        | Off        | Off        | LA is not running.<br>It was not recognized by the ZA during <b>start-up</b> . |
| Off     | 1          | 1          | 1          | 24 V voltage failed                                                            |
| On      | Off        | Off        | Off        | LA is running.<br>No channel errors                                            |
| On      | On         | 1          | 1          | LA is running.<br>Error on at least 1 channel of phase L1                      |
| On      | 1          | On         | 1          | LA is running.<br>Error on at least 1 channel of phase L2                      |
| On      | 1          | 1          | On         | LA is running.<br>Error on at least 1 channel of phase L3                      |

1 State irrelevant

## 2.4.4 Technical Data

Table 2-12 Technical data of the LA 724i SSR

|                                                               |                                                      |
|---------------------------------------------------------------|------------------------------------------------------|
| Outputs per load controller (LA 724i SSR)                     | 24                                                   |
| Isolation to control section                                  | Via optocoupler which are specified as per VDE 0884  |
| Isolation voltage of the optocouplers                         | 5.3 kV                                               |
| Potential isolation of the diagnostic inputs among each other | No                                                   |
| Diagnostic voltage (for Y and delta connection)               |                                                      |
| Nominal value                                                 | 230 V AC / 400 V AC                                  |
| Permissible range                                             | 187 V to 264 V / 340 V to 460 V                      |
| Frequency                                                     | 50/60 Hz (47 Hz to 63 Hz)                            |
| Total current per phase and module                            | See current measuring module                         |
| Current per bus bar                                           | Max. of 120 A                                        |
| 24 V voltage for controlling the SSRs                         |                                                      |
| Nominal value                                                 | 24 V                                                 |
| Permissible range                                             | 20.4 V to 28.8 V                                     |
| Fuse                                                          | 1.5 A/250 V rapid action (external)                  |
| Control voltage                                               | 24 V                                                 |
| For nominal voltage                                           | Typ. 23.3 V<br>Min. of 22 V                          |
| Control current                                               | Max. of 50 mA per control output                     |
| Cable lengths                                                 |                                                      |
| Control cable to SSR                                          | Max. of 30 m                                         |
| Connection cable, SM 724i                                     | Max. of 30 m                                         |
| 24 V voltage                                                  | Max. of 10 m                                         |
|                                                               | Note:<br>Do not install cables outside of buildings. |
| Dimensions of LA 724i SSR<br>(W x H x D)                      | 50 mm x 480 mm x 210 mm                              |
| Weight, approx.                                               | 3.3 kg                                               |

### Note

Cables carrying low voltage (control cables for SSR, diagnostic cables for current measuring module) must be installed separately from the diagnostic cables for the voltage measurement (e.g., in a separate cable duct). Another method is to use shielded cables for the low voltage connections. All cables can then be installed in a common cable duct.

### Note

For ordering data on recommended solid state relays, see appendix A.

## 2.5 System Power Acquisition Device NE 724

The system power acquisition device is a separate module which can be used optionally in the ZA 724 when power fluctuations must be offset. The module is inserted from the front in the slot of the ZA 724. The slot is located near the bus bar. In case the NE 724 is not used, the opening is closed with the bus bar cover. When the system power acquisition device is used, the cover is used as protection against accidental touch.

---

### Note

Central interfaces are delivered from the plant without the system power acquisition device. If you want to acquire the system power and equalize fluctuations, order the module and the device (NE 724 and ZA 724) and put them together yourself (see chap. 3.9).

---

### Function

#### Compensation of system power fluctuations

Implementation of this function requires at least one NE 724 installed in a network of several HS 724i devices on a ZA 724. The offset factors are calculated there and transferred to the DP master. The DP master distributes these data to all slaves.

#### Power acquisition for power calculation

One NE 724 for each ZA 724 is required for this function. The NE 724 is needed to calculate the current in strongly fluctuating networks.

### Product features

The system power acquisition device NE 724 is characterized by the following features.

- Measurement of the voltage on phases L1, L2 and L3
- Connection of phases L1, L2, L3 and the neutral conductor via cable with Teflon insulation
- Potential isolation by a transmitter
- Bus interface to the ZA 724
- Evaluation of the system power and calculation of the offset factors with the aid of  $\mu$ P 80C165 on the ZA 724

## 2.5.1 Setup of the Module

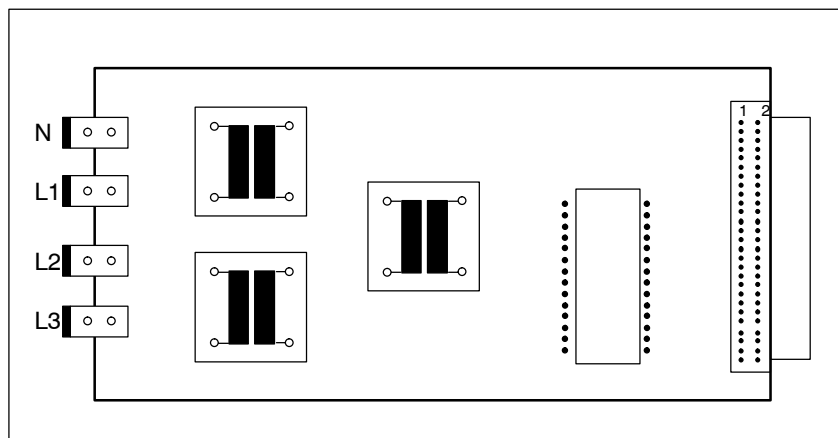


Figure 2-7 Setup of the NE 724

Figure 2-7 shows the setup of the PCB of the system power acquisition device. The NE contains the following components.

- Three voltage adjusters and filter units on the 230 V side
- Three transmitters as potential isolation and voltage adjustment
- Three precision rectifiers with filter connected afterwards
- One 4-channel A/D converter
- One –5 V voltage supply for the converter
- One connection plug to the ZA 724

The module is approx. 180 mm in length and approx. 80 mm in width.

## 2.5.2 Plug Connections

The system power acquisition device is equipped with the following plug connectors.

Table 2-13 Plug connectors on the NE 724

| Label | Function                            |
|-------|-------------------------------------|
| N     | Connection of the neutral conductor |
| L1    | Connection of phase L1              |
| L2    | Connection of phase L2              |
| L3    | Connection of phase L3              |
| None  | Plug connection for ZA 724          |

## 2.6 Fan Module LM 724

### Product features

The LM 724 fan module is characterized by the following features.

- Standard fan in IP 00 housing
- Hung under 2 modules of the HS 724i (see chap. 3.4)
- Use is optional. Depends on the required switching capacity (see chap. 2.2.5 and 2.3.5)

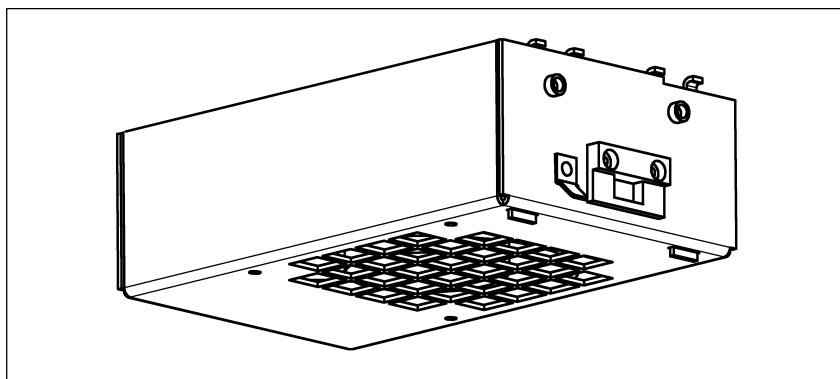


Figure 2-8 LM 724 fan module

Table 2-14 Technical data of the LM 724

|                        |                                                                                      |
|------------------------|--------------------------------------------------------------------------------------|
| Installation           | 1 fan module for 2 modules each<br>(2 x LA 724i xx or 1 x ZA 724 and 1 x LA 724i xx) |
| Voltage                |                                                                                      |
| Nominal value          | 230 V AC                                                                             |
| Permissible range      | 187 V to 264 V                                                                       |
| Frequency              | 50/60 Hz (47 Hz to 63 Hz)                                                            |
| Dimensions (W x H x D) | 100 mm x 50 mm x 162 mm                                                              |
| Weight, approx.        | 0.8 kg                                                                               |

## 2.7 Current Measuring Module SM 724i

### Product features

The SM 724i current measuring module is required when a diagnosis is to be performed via current measurement with an LA 724i SSR. This diagnosis is recommended when parallel connected heaters are used so that the failure of an individual heater can be detected.

The SM 724i must be mounted in the switching cabinet.

- Directly on a stable mounting surface (recommended)  
or
- A top hat rail

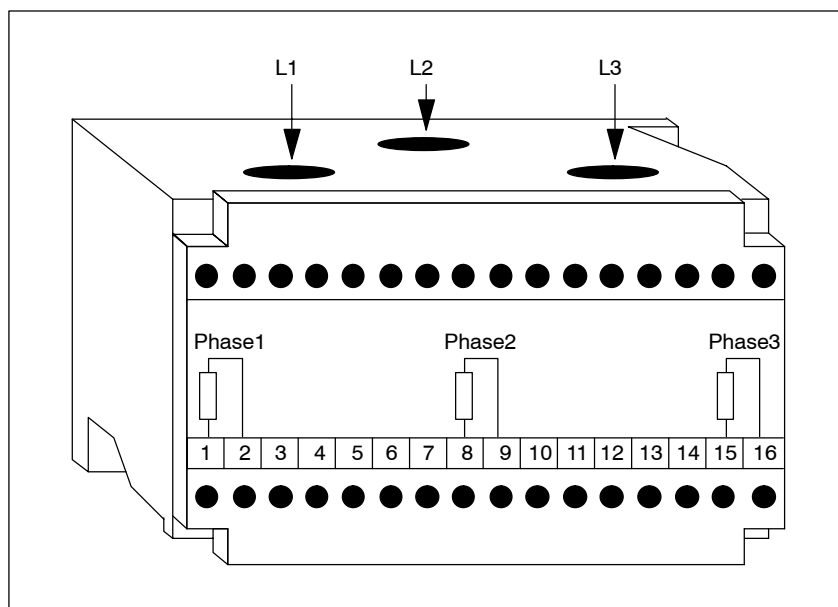


Figure 2-9 Current measuring module SM 724i

Table 2-15 Technical data of the SM 724i

|                             |                 |
|-----------------------------|-----------------|
| Nominal current             |                 |
| Primary                     | 3 x 400 A       |
| Secondary                   | 3 x 200 mA      |
| Accuracy                    | Approx. 1%      |
| Frequency range             | 50 Hz to 400 Hz |
| Cable introduction openings | Ø 22 mm         |

## 2.8 Ambient Conditions for All HS 724i Components

Table 2-16 Climatic ambient conditions

|                                                                                                                                                                   |                                                                                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Operating temperature <ul style="list-style-type: none"> <li>• Permissible range</li> <li>• Relative humidity at 25 °C</li> <li>• Temperature gradient</li> </ul> | 0 °C to 55 °C<br>95%<br>10 K/h                                                         |
| Storage temperature <ul style="list-style-type: none"> <li>• Permissible range</li> <li>• Relative humidity at 25 °C</li> <li>• Temperature gradient</li> </ul>   | −40 °C to 70 °C<br>95%<br>20 K/h                                                       |
| Air pressure during operation <ul style="list-style-type: none"> <li>• Minimum</li> <li>• Maximum</li> </ul>                                                      | 860 hPa (= 1500 m. a. s. l.) (restricted cooling when air pressure is low)<br>1080 hPa |
| Air pressure during storage <ul style="list-style-type: none"> <li>• Minimum</li> <li>• Maximum</li> </ul>                                                        | 660 hPa (= 3500 m. a. s. l.)<br>1080 hPa                                               |
| Ventilation                                                                                                                                                       | Own or external ventilation                                                            |

Table 2-17 Physical ambient conditions

|                                                                                                                                                               |                                                                                                                             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| Oscillations during operation (stationary use) <ul style="list-style-type: none"> <li>• 10 Hz to 58 Hz</li> <li>• 58 Hz to 150 Hz</li> </ul>                  | IEC 60068-2-6 test FC (10 cycles per axis)<br>0.075 mm amplitude<br>9.8 m/s <sup>2</sup> (= 1 g constant acceleration)      |
| Oscillations during transportation/storage (in shipping packaging) <ul style="list-style-type: none"> <li>• 5 Hz to 9 Hz</li> <li>• 9 Hz to 500 Hz</li> </ul> | IEC 60068-2-6 test FC (10 cycles per axis)<br>3.5 mm amplitude<br>9.8 m/s <sup>2</sup> (= 1 g constant acceleration)        |
| Shock during operation (stationary use)                                                                                                                       | IEC 60068-2-27 test EA<br>150 m/s <sup>2</sup> ≈ 15 g, half-sine<br>Duration: 11 msec<br>3 impacts per axis and direction   |
| Shock during transportation/storage (in shipping packaging)                                                                                                   | IEC 60068-2-29 test EB<br>250 m/s <sup>2</sup> ≈ 25 g, half-sine<br>Duration: 6 msec<br>1000 impacts per axis and direction |

Table 2-18 Electromagnetic compatibility

|                                                                                                                                                                                                                                                                                  |                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| HS 724i is installed in the switching cabinet                                                                                                                                                                                                                                    |                                                                                                  |
| Radio interference suppression (interference emission)                                                                                                                                                                                                                           | Limit value class A in acc. w. EN 55011, group 1                                                 |
| Interference immunity against line-conducted interference (bursts)                                                                                                                                                                                                               | In acc. w. EN 61000-4-4                                                                          |
| <ul style="list-style-type: none"> <li>• Alternating voltage supply lines</li> <li>• Signal lines which leave the device</li> </ul>                                                                                                                                              | 2 kV with coupling network<br>2 kV with snap-on connector                                        |
| Interference immunity against line-conducted interference (HF electrification)                                                                                                                                                                                                   | In acc. w. EN 61000-4-6<br>10 V (0.15 MHz to 80 MHz)                                             |
| Interference immunity against discharge of static electricity (ESD)                                                                                                                                                                                                              | In acc. w. EN 61000-4-2                                                                          |
| <ul style="list-style-type: none"> <li>• Contact discharge</li> <li>• Air discharge</li> </ul>                                                                                                                                                                                   | 4 kV<br>8 kV                                                                                     |
| Interference immunity against high-frequency emission                                                                                                                                                                                                                            | EN 61000-4-3 or ENV 50204<br>10 V/m (80 MHz to 1000 MHz)<br>10 V/m pulse-modulated (900 ± 5 MHz) |
| Interference immunity against high-energy impulses (surge)                                                                                                                                                                                                                       | In acc. w. EN 61000-4-5                                                                          |
| <ul style="list-style-type: none"> <li>• Power supply lines               <ul style="list-style-type: none"> <li>– Symmetric</li> <li>– Asymmetric</li> </ul> </li> <li>• PROFIBUS line               <ul style="list-style-type: none"> <li>– Asymmetric</li> </ul> </li> </ul> | 1 kV<br>2 kV<br>1 kV                                                                             |

# Installation

# 3

This chapter shows you the necessary installation steps prior to commissioning.

## 3.1 General Requirements

The HS 724i heating controller is designed for stationary installation in a switching cabinet.

---

### Note

- The components of the HS 724i have a protection rating of IP 00. The switching cabinet in which the HS 724i is installed must provide the necessary protection against accidental touch.
  - The EMC guidelines must be adhered to during installation.
  - The HS 724i must be powered by a separate medium voltage network transformer (industrial power network). It is not designed for connection to the public low voltage network.
- 



---

### Warning

- Since voltages greater than 60 V occur in the switching cabinet, suitable safety precautions against touch must be taken during commissioning and maintenance work.
  - Use of an FI protective device as a general protection against indirect touch is forbidden.
  - Do not touch the metalized housing of the modules with your bare fingers. → Danger of burn due to hot surfaces!
- 

### Requirements on the switching cabinet

To eliminate potential danger to operator control personnel, the switching cabinet must meet the following requirements.

- Closed cabinet
- Grounded cabinet
- Interface connections and ribbon cables on the devices may not be touched by lines which only have simple insulation and carry power inside the switching cabinet.

## 3.2 Setting the Bus Address

Communication between the heating controller and the master (e.g., S7-CPU) is handled by the PROFIBUS-DP fieldbus. This means that the bus address (slave address) must be set on the ZA which has two rotary switches for this purpose. The address area from 00 to 99 can be set with these switches.

### How to set the address

1st rotary switch S2 Set ones position of the PROFIBUS-DP address

2nd rotary switch S3 Set tens position of the PROFIBUS-DP address

The rotary switches are positioned so that they can be accessed from above through the ventilation slits of the ZA housing.

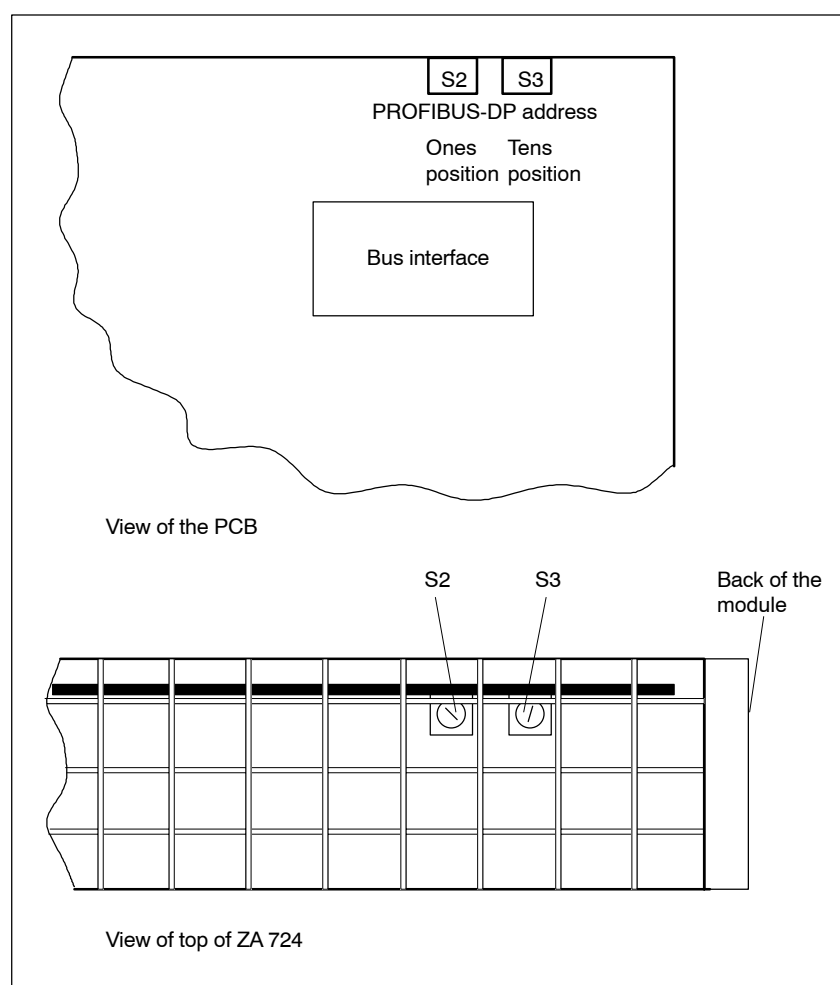


Figure 3-1 Setting the bus address

### 3.3 Mounting the Components on the Carrier Plate

The central interface and the power outputs/load controllers of the HS 724i are installed in metalized housings. These housings are mounted on a carrier plate in the switching cabinet.

#### How to mount the components

1. Isolate the switching cabinet from the power.
2. Trace bored hole template (figure 3-2) on carrier plate and drill holes.

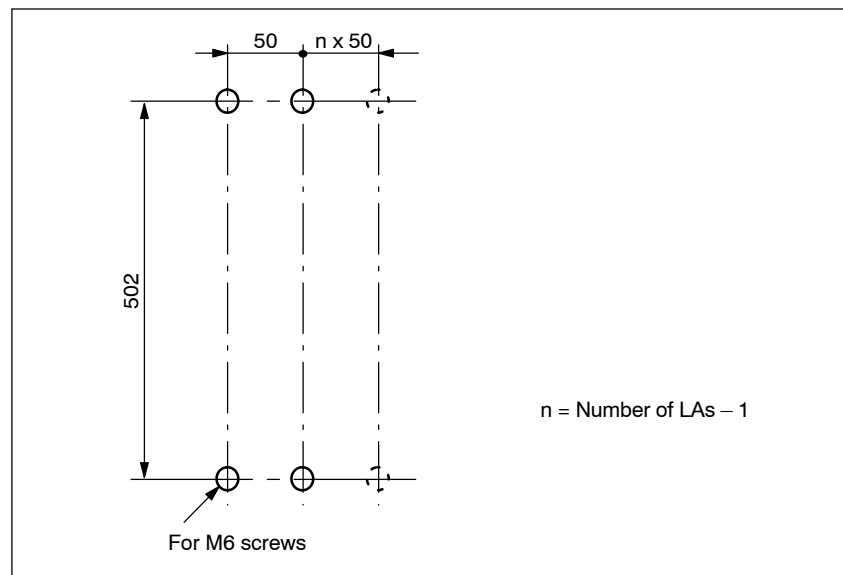


Figure 3-2 Template for components of the HS 724i

3. With M6 screws, connect housing to the mounting tabs on the carrier plate.

#### Note

When a **two-row setup of the HS 724i** is used and the two rows are positioned on top of each other, the temperature of the top row is increased by the warm air from the bottom row.

If higher switching capacities are required or when optional fan modules are used, we recommend providing an air conductor plate between the two rows when necessary.

The two rows can also be positioned next to each other. This prevents them from heating each other up.

**Distances for installation**

When installing the HS 724i in a switching cabinet, the minimum distances to cabinet walls, cable ducts and so on as shown in figure 3-3 must be adhered to.

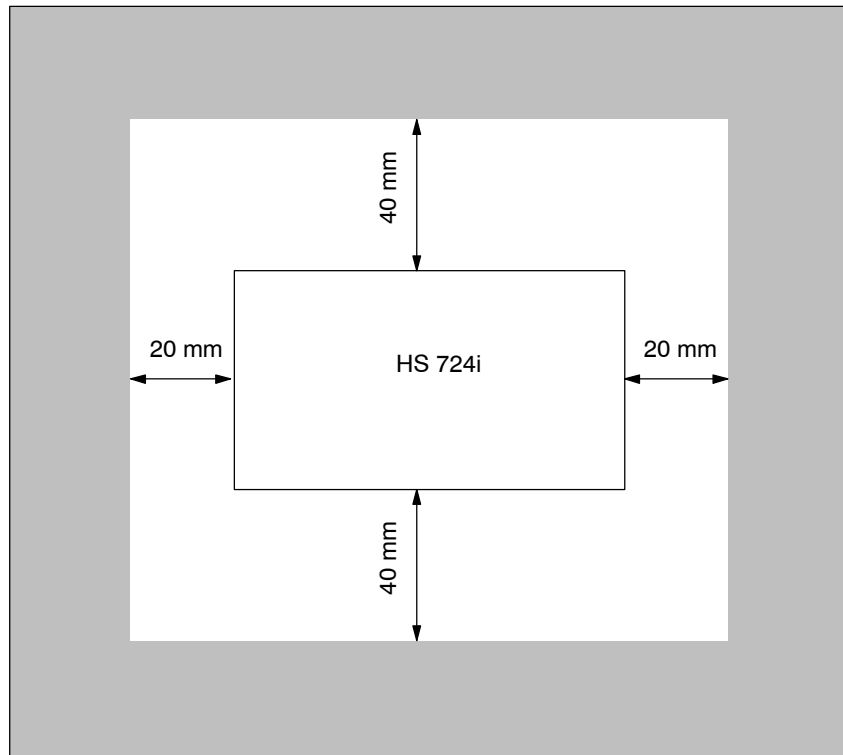


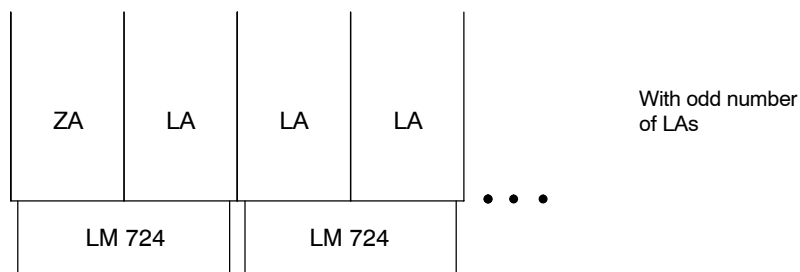
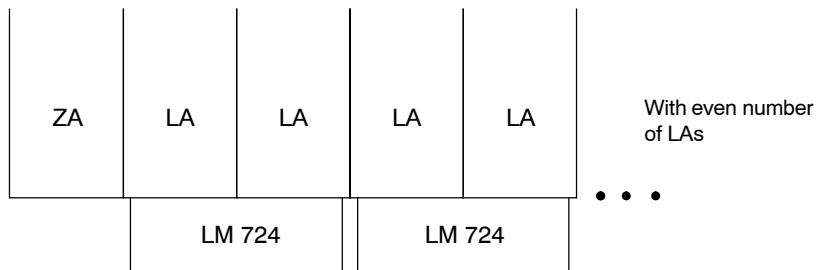
Figure 3-3 Distances for installation of an HS 724i

## 3.4 Installing the Optional Fan Module

Depending on the switching capacity required (see chapters 2.2.5 and 2.3.5), the LA 724i/LA 724i HP must be retrofitted with the optional fan module.

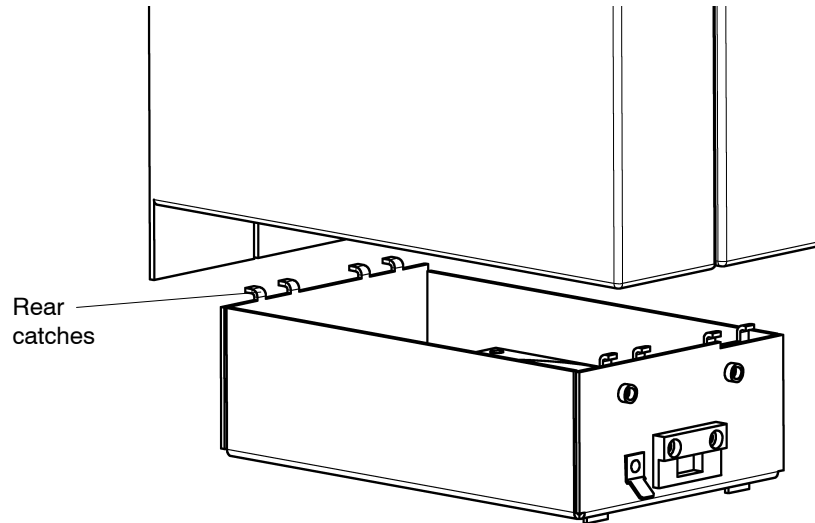
### Installation

The fan module is hung under 2 LA 724i modules or also under the ZA 724 and 1 LA 724i xx module.

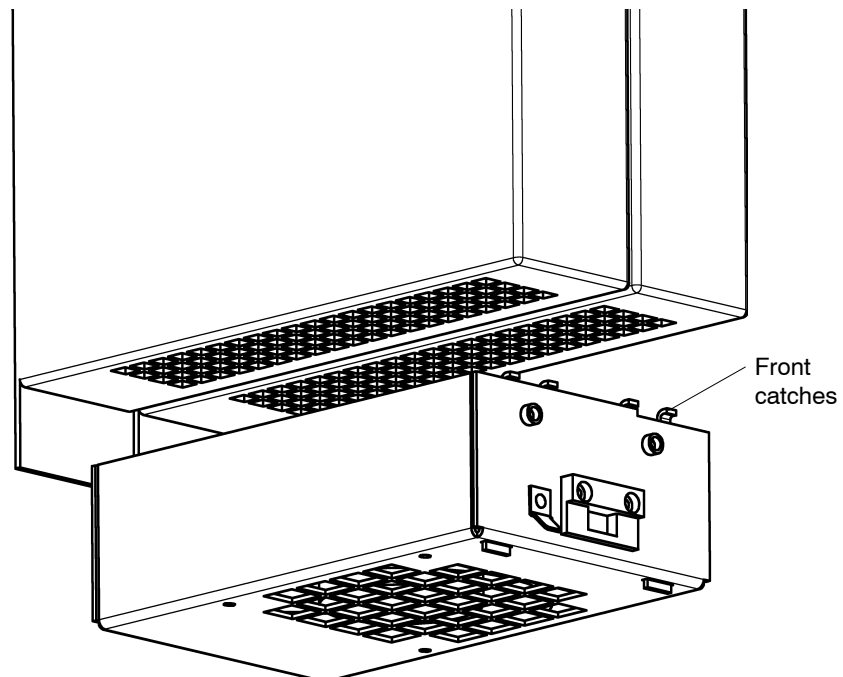


## How to install

1. Loosen terminal plate on the front of the fan module (loosen but not completely remove 2 oval head screws and then press towards rear).
2. Snap in fan module catches first in the back on the mesh plates of the modules.

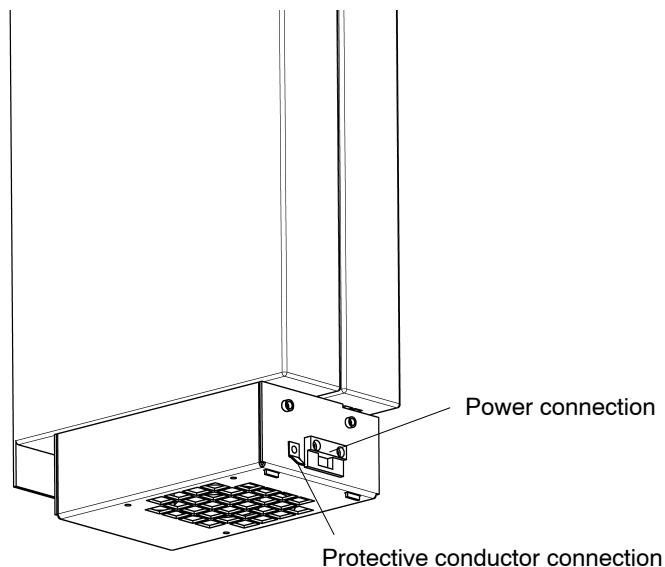


3. Snap in the front terminal plate on the mesh plates of the modules and secure with 2 M3 x 8 oval head screws.



4. Making the protective conductor connection

The protective conductor must have a cross section of  $0.75 \text{ mm}^2$  and be slipped on the Faston tab with a lockable,  $6.3 \times 0.8$  Faston plug. You must ensure that the connection cannot be disconnected.



5. Connect power supply for the fan.

Operation of the fan requires 230 V AC.



---

**Warning**

The power line must be without power while the fan is being connected.

---

The power line ( $0.75 \text{ mm}^2$ ) must be connected to the included plug and slipped on the leadthrough terminal on the front of the fan module. Secure the plug with 2 screws.

---

**Note**

Secure the feeder lines to the fan so that their protection complies with EN 60204, part 1 or EN 50178.

---



---

**Caution**

Do not reach through the bottom mesh plate and touch the fan blades while the fan module is running.

---

### 3.5 Connecting the PROFIBUS-DP Fieldbus

For communication of the ZA with the host controller (master), both components must be connected to the PROFIBUS-DP fieldbus.

#### How to connect

1. Connect the plug of the bus cable to the 9-pin, sub D, “PROFIBUS-DP” socket.
2. Secure plug to socket.

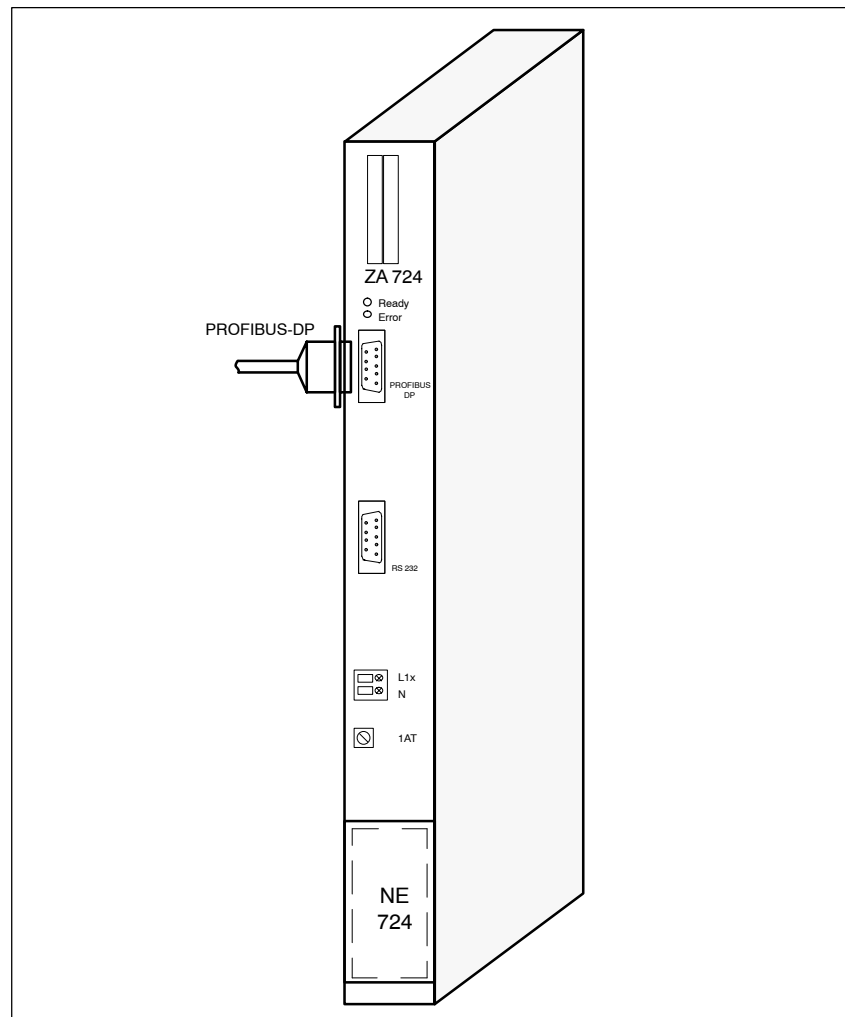


Figure 3-4 Connection to PROFIBUS-DP

## 3.6 Connecting the Parallel Bus

The power outputs/load controllers are connected to the central interface with a parallel bus. This is looped through via a ribbon cable.

Each ZA 724 offers 2 bus links on which up to 8 LA 724i xx devices can be connected.

### How to connect

1. Press plug of the ribbon cable on the right “724 Bus” socket of the central interface until it snaps in.
2. Slip the plug of the ribbon cable on the first power output/load controller into the left “724 Bus” socket until it snaps in.

Only when **several power outputs/load controllers per ZA** are used:

3. Press plug of an additional ribbon cable in the right “724 Bus” socket of the last connected power output/load controller until it snaps in.
4. Press plug of the ribbon cable in the left “724 Bus” socket of the next power output/load controller until it snaps in.

To connect each additional LA, repeat steps 3 and 4 (see figure 3-5).

Arrangement of the **LAs in two rows**:

5. Press plug of the ribbon cable for the 2nd row in the left “724 Bus” socket on the ZA until it snaps in.
6. Slip plug of the ribbon cable on the first LA of the second row into the left “724 Bus” socket until it snaps in.

To connect each additional LA, repeat steps 3 and 4 (see figure 3-6).

---

### Note

The ribbon cable for connecting a 2nd row must be ordered separately.  
For the order number, see appendix A.

---

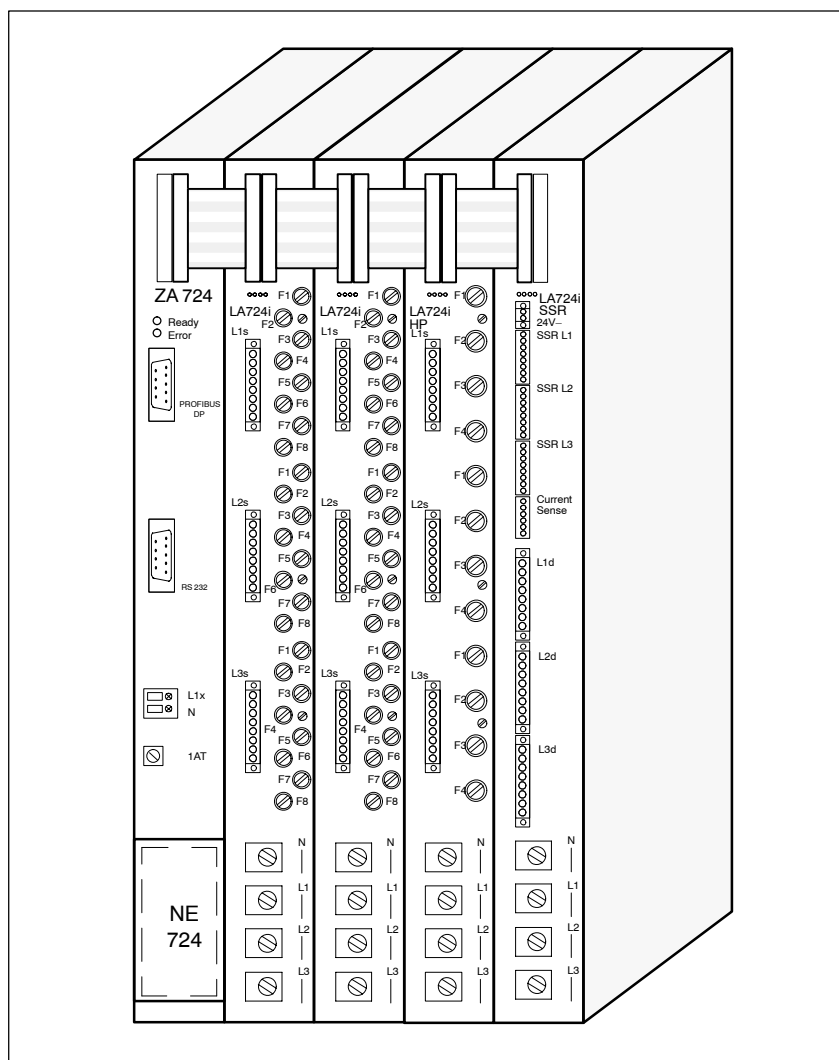


Figure 3-5 Connecting the parallel bus

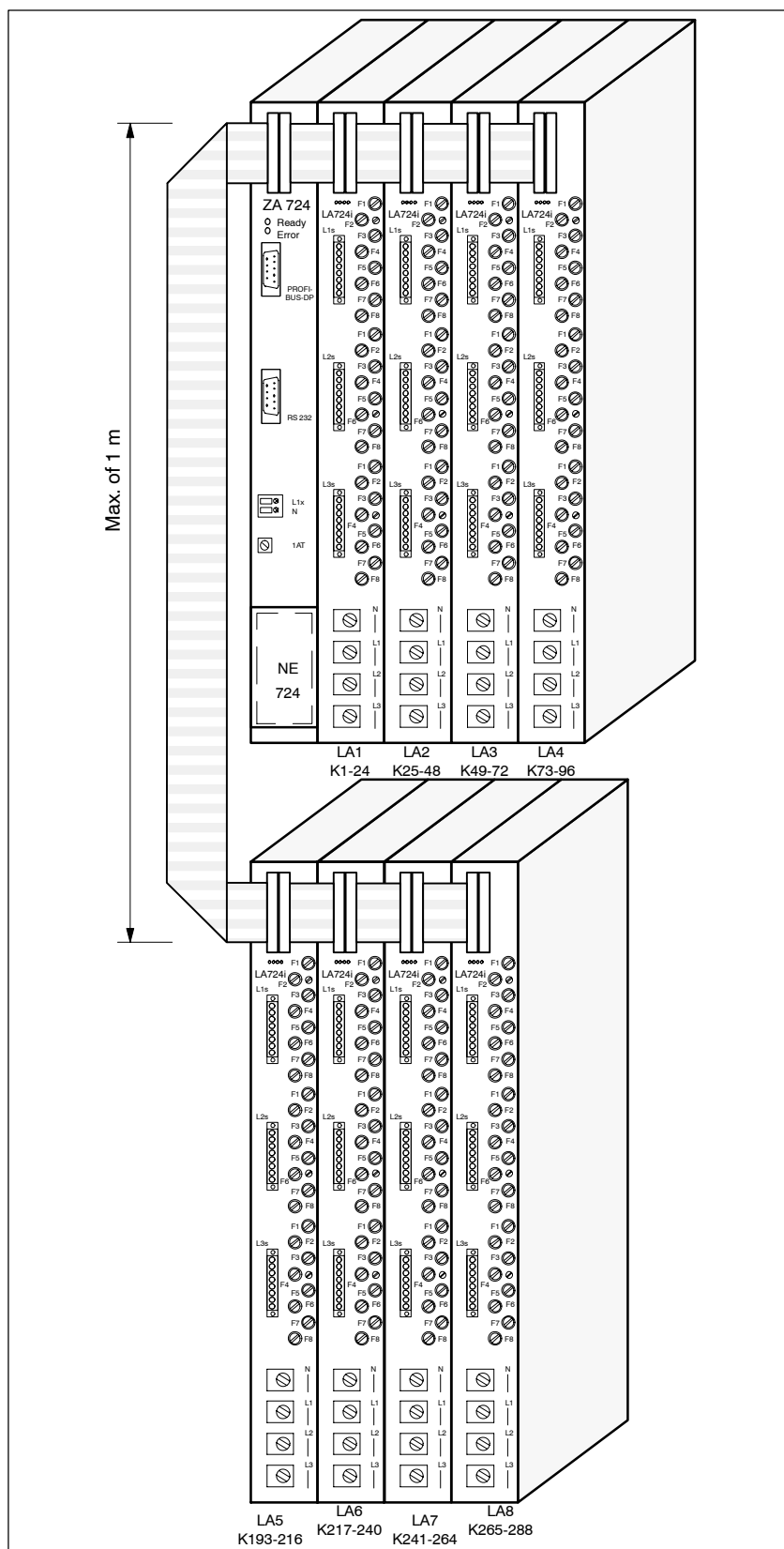


Figure 3-6 Connecting the parallel bus with 2-row setup

### 3.7 Connecting System Voltage to the ZA 724

The module is supplied with operational voltage with a power pack integrated on the ZA.

#### How to connect

1. Connect protective conductor to bus bar “PE.”
2. Bare power connection line.
3. Connect phase L1 to the screw terminal labeled “L1x.” The HS 724 is not designed for connection to the public low-voltage network and must be powered by a separate medium-voltage transformer (industrial power network).

---

#### Note

L1x must have the same phase as the L1 bus bar.

---

4. Connect the neutral conductor to the screw terminal labeled “N.”

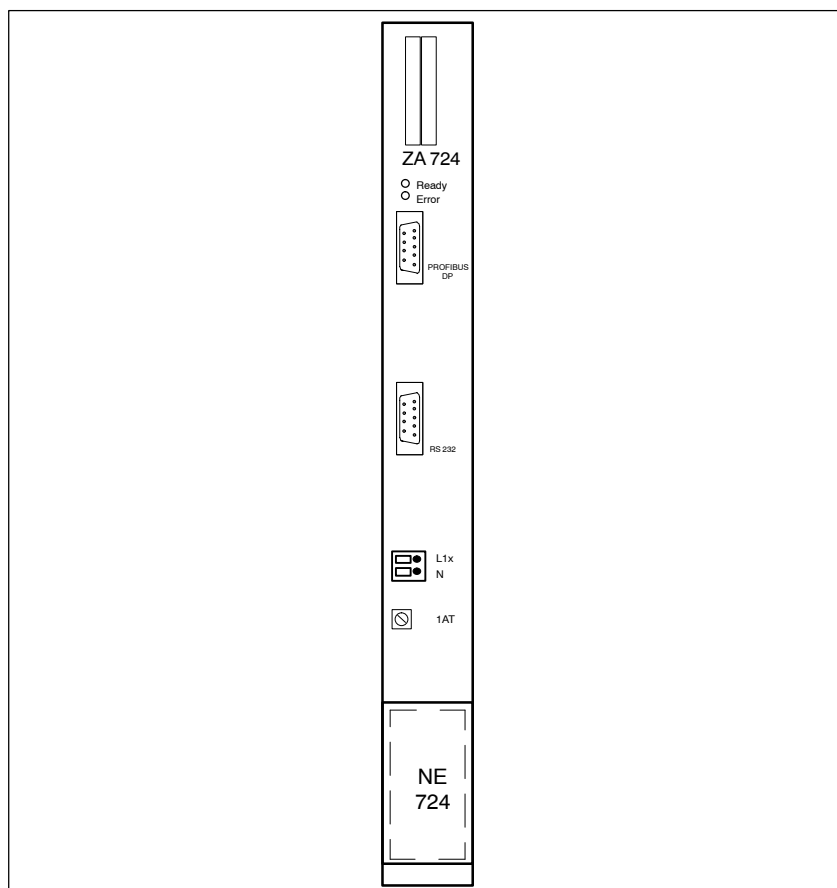


Figure 3-7 Location of the power connection terminals on the ZA 724

## 3.8 Connecting the Radiant Heaters

### 3.8.1 LA 724i/LA 724i HP

The radiant heaters are connected via three 8-pin strips with screw terminals to the socket strips on the front of the power outputs. The three-phase current network is provided via five bus bars (three phases + one neutral conductor + one Protective Earth).



---

#### Warning

- Only connect or remove pin strips for the radiant heaters to/from the socket strips when the power is off. When the three-phase current network is connected to the bus bars, the power lines must be disconnected from the current.
  - Messages from the DP master (e.g., HS 724i station failure or interruption of DP communication) must be evaluated by the user and appropriate reactions provided for system safety (e.g., radiant heater monitoring, also shutdown as appropriate during certain situations).
- 

#### How to connect

1. Connect protective conductor to “PE” bus bar.
2. Bare lines of the radiant heaters and secure in the screw terminals of the 8-pin strip.
3. Connect pin strips of radiant heaters 1 to 8 to socket strip L1s.
4. Connect pin strips of radiant heaters 9 to 16 to socket strip L2s.
5. Connect pin strips of radiant heaters 17 to 24 to socket strip L3s.
6. Connect neutral conductor to “N” bus bar.
7. Connect phase L1 to “L1” bus bar.
8. Connect phase L2 to “L2” bus bar.
9. Connect phase L3 to “L3” bus bar.

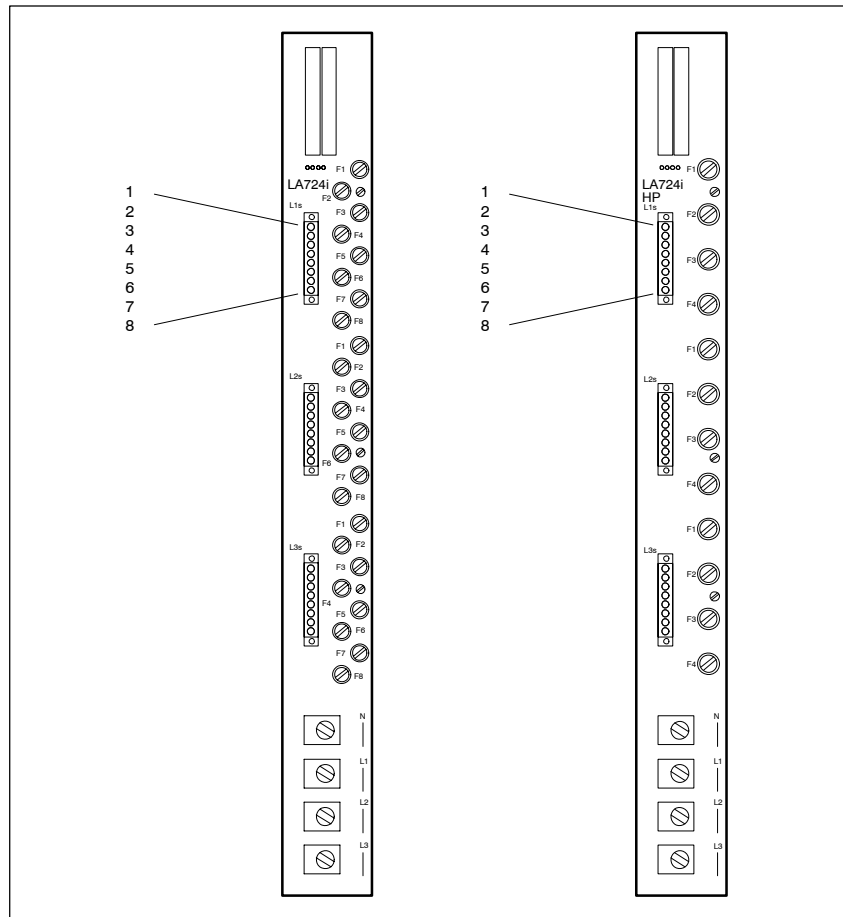


Figure 3-8 Front view of the LA 724i/724i HP with the sockets for radiant heater connection

Table 3-1 Allocation of the radiant heaters to the pins of the socket strips

| Socket Strip | Pin | Channel Number |            |
|--------------|-----|----------------|------------|
|              |     | LA 724i        | LA 724i HP |
| L1s          | 1   | 1              | 1          |
|              | 2   | 2              |            |
|              | 3   | 3              | 3          |
|              | 4   | 4              |            |
|              | 5   | 5              | 5          |
|              | 6   | 6              |            |
|              | 7   | 7              | 7          |
|              | 8   | 8              |            |
| L2s          | 1   | 9              | 9          |
|              | 2   | 10             |            |
|              | .   |                |            |
|              | .   |                |            |
|              | .   |                |            |
|              | 7   | 15             | 15         |
| 8            | 16  |                |            |
| L3s          | 1   | 17             | 17         |
|              | 2   | 18             |            |
|              | .   |                |            |
|              | .   |                |            |
|              | .   |                |            |
|              | 7   | 23             | 23         |
| 8            | 24  |                |            |



### Danger

After the bus bars have been connected, the covers of the bus bars must be installed again to provide protection against accidental touch.

After the power is connected to the switching cabinet, the bus bars carry voltage (230 V AC).

Installation or service work may only be performed when the system is disconnected from the power.

**Y circuit**

Figure 3-9 shows the connection of radiant heaters to the LA 724i/ LA 724i HP in a Y circuit.

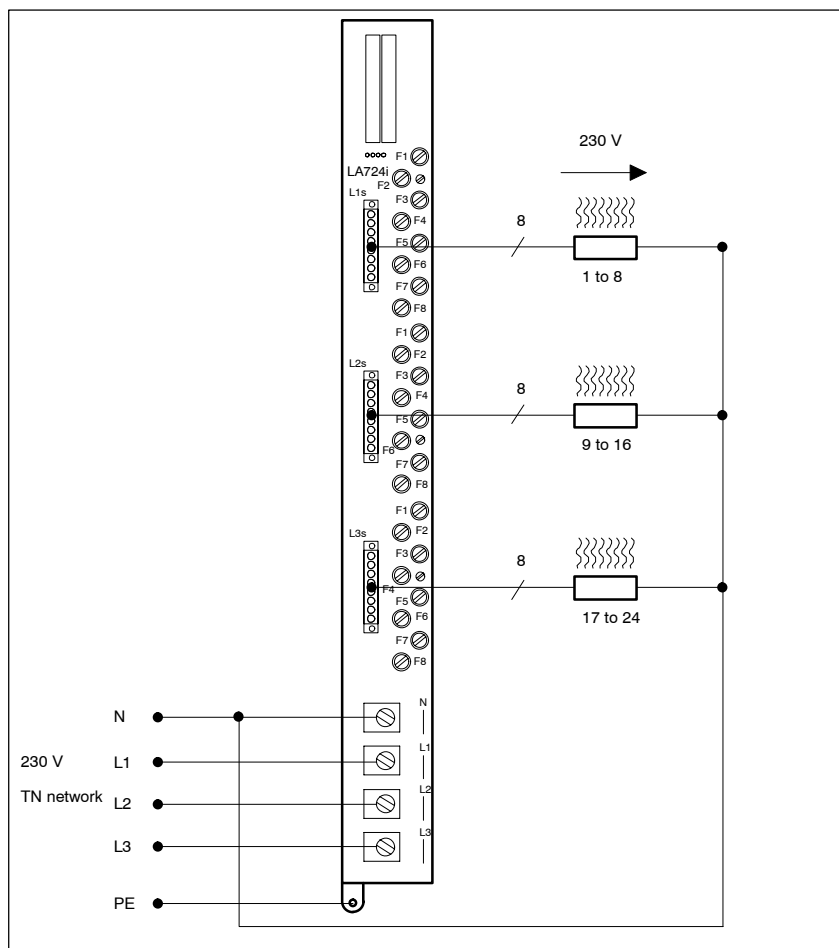


Figure 3-9 Y circuit of the radiant heaters on the LA 724i/LA 724i HP

**Note**

Heaters for 230 V and 400 V may not be combined on one HS 724i network.

## Delta circuit

Figure 3-10 shows the connection of radiant heaters to the LA 724i HP in a Delta circuit ( $\Delta$  circuit).

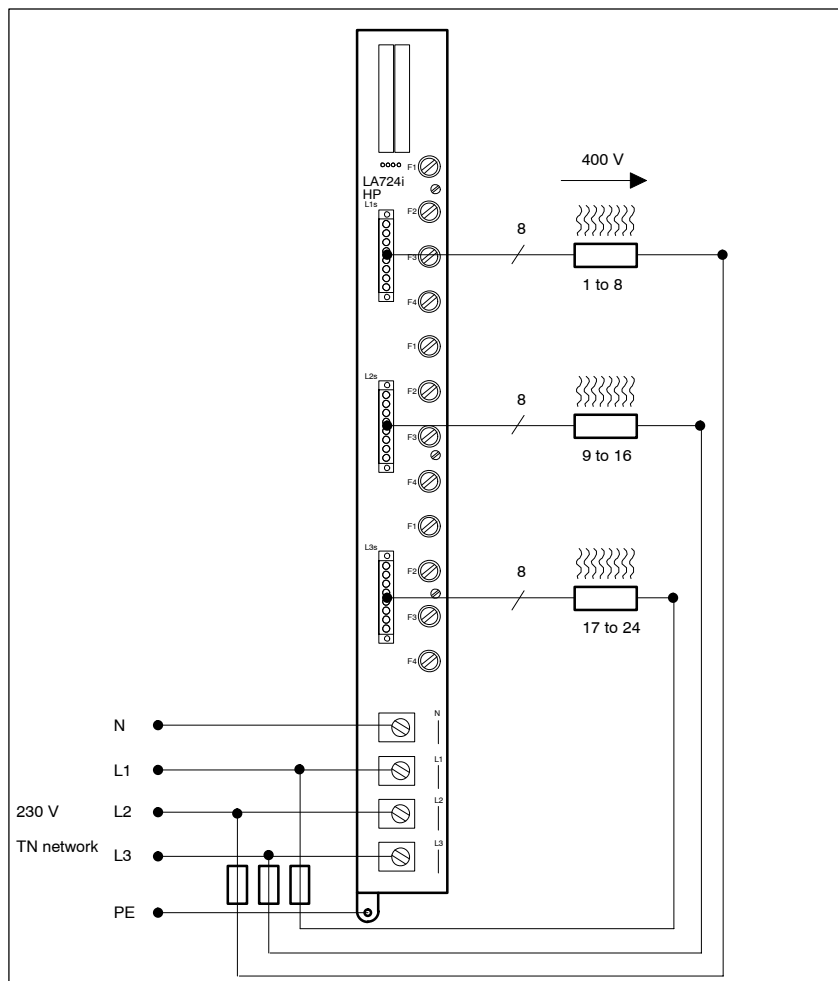


Figure 3-10 Delta circuit of the radiant heaters on the LA 724i HP

### Note

Protect the return lines of the radiant heaters so that line protection complies with EN 60204, part 1 or EN 50178. The plant engineer is responsible for ensuring correct protection.

### Note

Heaters for 230 V and 400 V may not be combined on one HS 724i network.

## Multiple power input

The HS 724i must be equipped with multiple power inputs when the maximum phase current would be exceeded on the bus bar with one-sided power input. Figure 3-11 shows an example for two-sided power input.

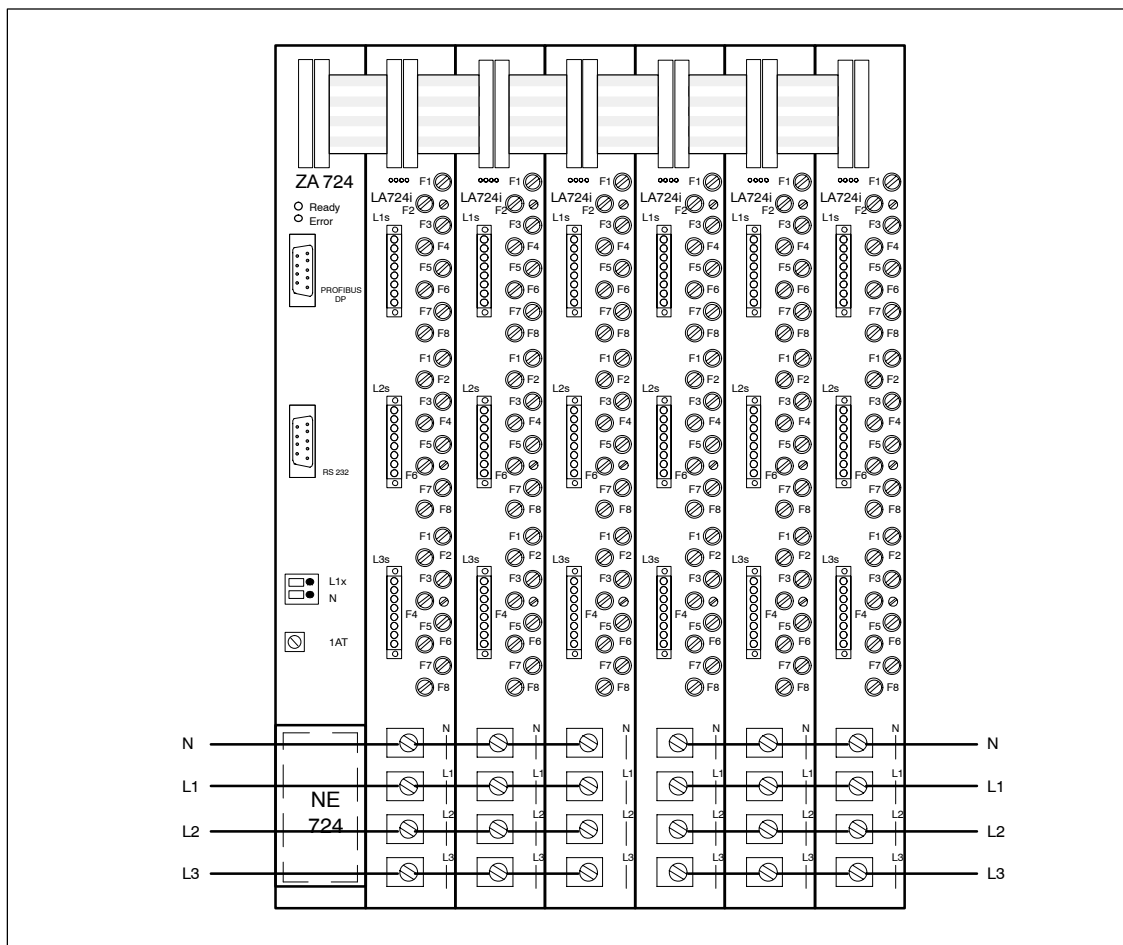


Figure 3-11 Example of two-sided power input for an HS 724i

### Note

When configuring, remember that the maximum current of 120 A per bus bar may not be exceeded.

### 3.8.2 LA 724i SSR

The solid state relays are connected via three 8-pin socket strips to the pin strips on the front of the load controllers. If necessary, the three-phase current network is supplied via four bus bars (three phases + one neutral conductor).



---

#### Warning

- Only connect or remove socket strips for the solid state relays to/from the pin strips when the power is off. When connecting the three-phase current network to the bus bars, the incoming power lines must not be carrying current.
  - Messages from the DP master (e.g., HS 724i station failure or interruption of DP communication) must be evaluated by the user who must then provide an appropriate reaction to ensure the safety of the system (e.g., monitor the radiant heaters or shut down specific heaters if necessary).
- 

#### How to connect

1. Connect protective conductor to “PE” bus bar.
2. Bare lines to the solid state relays and insert in the screw-type terminals of the 8-pin, orange socket strips.
3. Insert socket strip of SSR 1 to 8 in the SSR L1 pin strip.
4. Insert socket strip of SSR 9 to 16 in the SSR L2 pin strip.
5. Insert socket strip of SSR 17 to 24 in the SSR L3 pin strip.
6. Connect 24 V voltage to 2-pin socket strip and insert this in the “24V–” pin strip.  
Caution: Make sure poles are not reversed!

---

#### Note

Diagnosis via voltage measurement and diagnosis via current measurement cannot both be performed at the same time.

---

The following additional steps must be performed for **diagnosis via voltage measurement**.

7. Connect neutral conductor to “N” bus bar.
8. Connect phase L1 to bus bar “L1.”
9. Connect phase L2 to bus bar “L2.”
10. Connect phase L3 to bus bar “L3.”
11. Connect lines of output of the SSRs to the green 8-pin pin strips.  
Note: Feedback from the SSRs for the voltage measurement must be performed on the same channel as the controller.
12. Insert pin strip of SSRs 1 to 8 in socket strip L1d.
13. Insert pin strip of SSRs 9 to 16 in socket strip L2d.
14. Insert pin strip of SSRs 17 to 24 in socket strip L3d.

The following additional steps must be performed for **diagnosis via current measurement**.

7. Connect lines of the current measuring module to the orange 6-pin socket strip.
8. Insert socket strip of the measuring cables in the “Current Sense” pin strip.

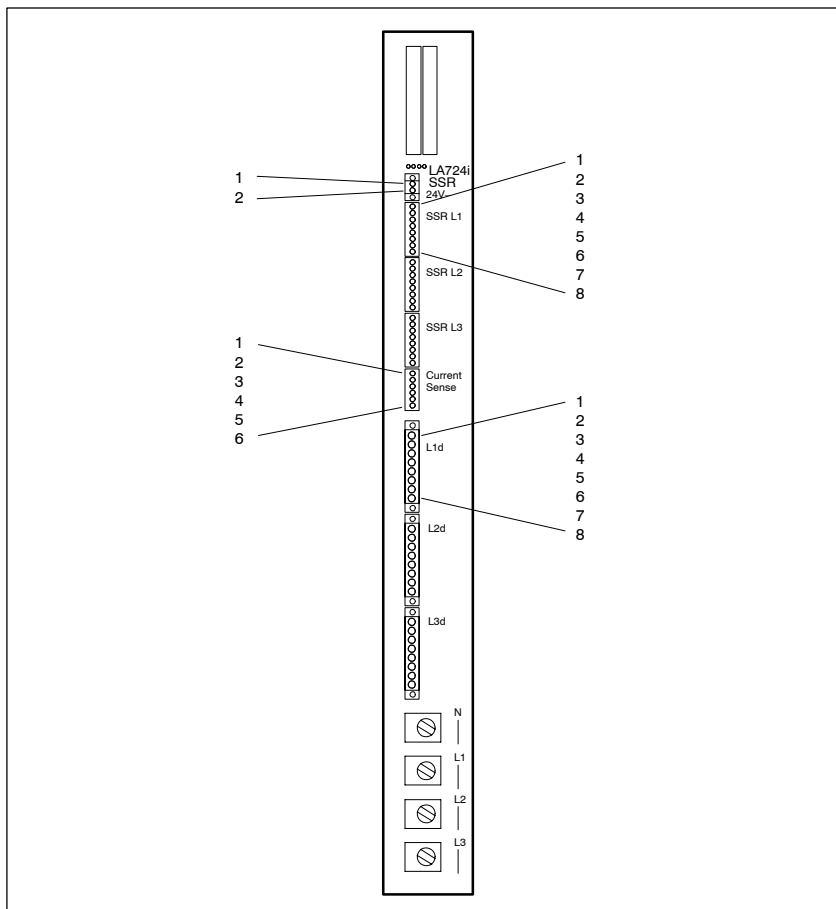


Figure 3-12 Front view of the LA 724i SSR with sockets for SSR connection

Table 3-2 Allocation of the SSRs to the pins of the pin/socket strips

| Pin/Socket Strip | Pin | SSR (Channel) |
|------------------|-----|---------------|
| SSR L1 and L1d   | 1   | 1             |
|                  | 2   | 2             |
|                  | :   | :             |
|                  | 8   | 8             |
| SSR L2 and L2d   | 1   | 9             |
|                  | 2   | 10            |
|                  | :   | :             |
|                  | 8   | 16            |
| SSR L3 and L3d   | 1   | 17            |
|                  | 2   | 18            |
|                  | :   | :             |
|                  | 8   | 24            |

Table 3-3 Allocation of the current measuring module to the pins of the pin strip

| Pin Strip     | Pin | Terminal on<br>Current Measuring Module |
|---------------|-----|-----------------------------------------|
| Current Sense | 1   | 1                                       |
|               | 2   | 2                                       |
|               | 3   | 8                                       |
|               | 4   | 9                                       |
|               | 5   | 15                                      |
|               | 6   | 16                                      |

Table 3-4 Allocation of the 24 V voltage supply to the pins of the pin strip

| Pin Strip | Pin | Signal |
|-----------|-----|--------|
| 24V–      | 1   | +24 V  |
|           | 2   | 0 V    |

**Danger**

After the bus bars have been connected, the covers of the bus bars must be reinstalled as protection against accidental touch.

After the operational voltage is turned on in the switching cabinet, the bus bars carry voltage (230 V AC).

Installation or service work may only be performed when the system is disconnected from the power.

## Y circuit

Figure 3-13 shows the connection of the radiant heaters to the LA 724i SSR with a Y circuit.

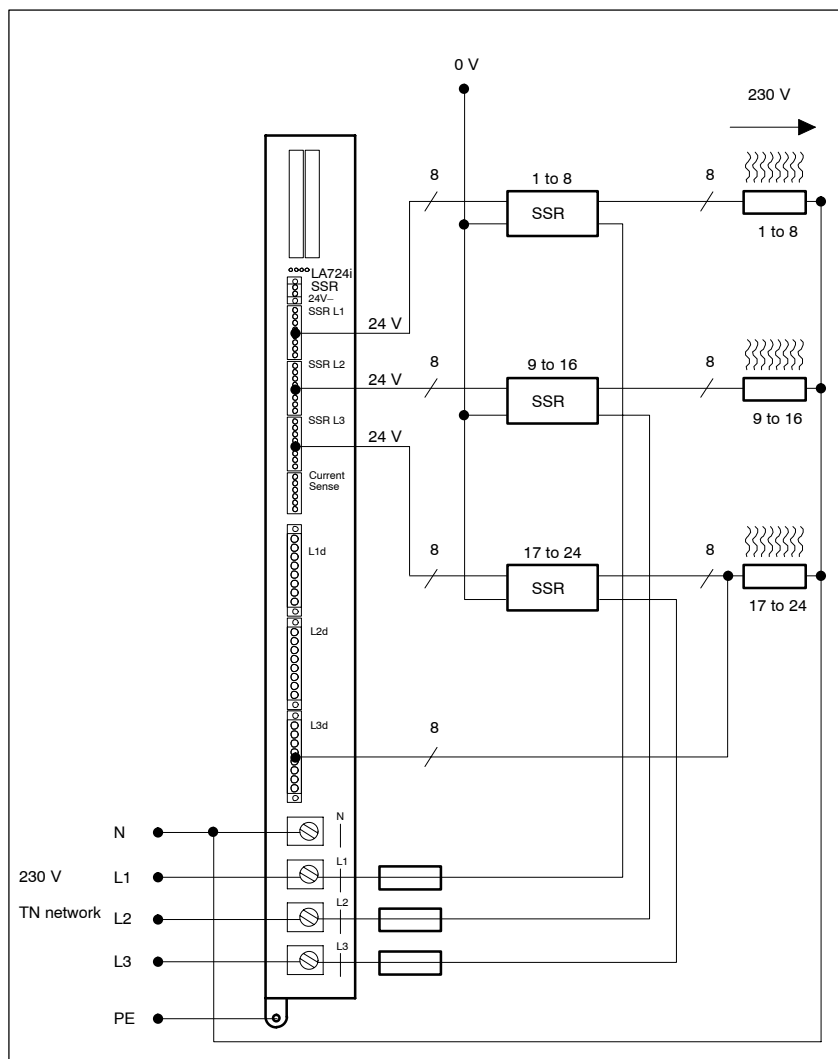


Figure 3-13 Y circuit of the radiant heaters on the LA 724i SSR (example with voltage feedback for diagnosis)

## Note

Radiant heaters for 230 V and 400 V may not be combined in one HS 724i network.

## Delta circuit

Figure 3-14 shows the connection of the radiant heaters to the LA 724i SSR in a Delta circuit ( $\Delta$  circuit).

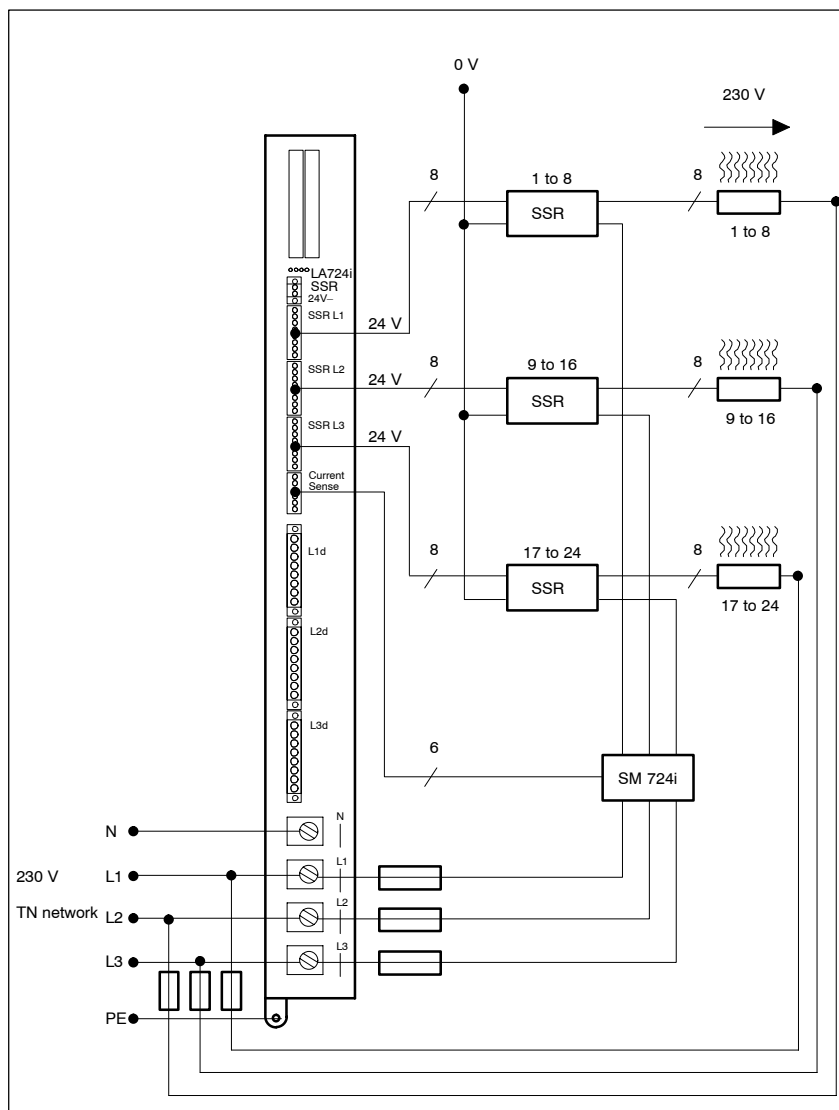


Figure 3-14 Delta circuit for radiant heaters to LA 724i SSR (example with current measurement for diagnosis)

### Note

The return lines of the radiant heaters must be protected so that line protection complies with EN 60204, part 1 or EN 50178. The plant engineer is responsible for ensuring correct protection.

### Note

Heaters for 230 V and 400 V may not be combined on one HS 724i network.

### 3.9 Connecting the NE 724

The NE 724 module is slid into the compartment of the ZA 724 from the front and pressed into the plug connector. The cables on the module are connected to the 3 phases and the neutral conductor on the adjacent LA 724i xx.

#### How to connect

1. Remove bus bar cover from ZA 724 and LA 724i xx.
2. Push NE 724 module with the plug connector from the front into the compartment of the ZA 724.  
Make sure that the PCB is positioned in the grooves of the guide bolts (see figure 3-15).
3. Snap in plug connector.
4. Connect cables of the NE 714 module to the bus bar connections of the adjacent LA 724i xx (see figure 3-15).

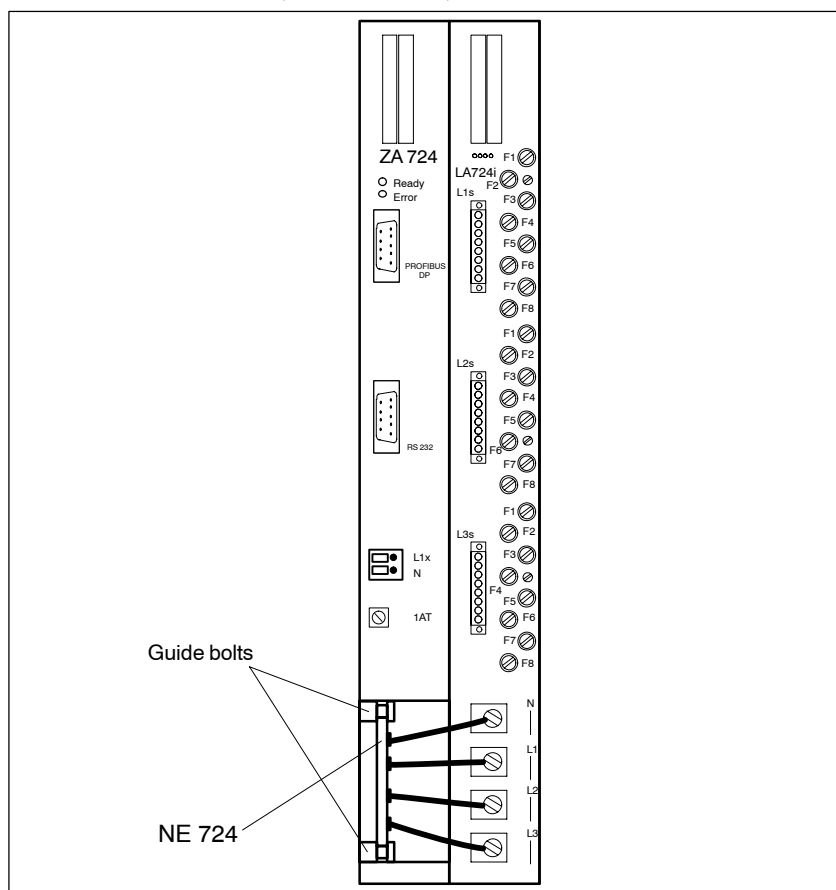


Figure 3-15 Location and connection of the NE 724

5. Re-install bus bar covers on ZA 724 and LA 724i.

#### Note

The bus bar covers will only snap onto the front plate when the bus bars and the NE 724 are correctly connected.

# Operation

# 4

This chapter explains the functions, commissioning, initialization and normal operation of the HS 724i heating controller.

You will learn how the power outputs/load controllers are monitored and how the system reacts when a malfunction occurs. Suggestions are also offered on how to correct errors on the power outputs/load controllers.

## 4.1 Commissioning

### 4.1.1 Hardware Prerequisites

|                           |                                                                                                                                                                                                                                                                                                              |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Controller</b>         | <p>Required, for example:</p> <ul style="list-style-type: none"> <li>• A SIMATIC S7 CPU 3xx or CPU 4xx with integrated PROFIBUS-DP interface</li> <li>• Or a DP standard master</li> </ul>                                                                                                                   |
| <b>Heating controller</b> | <p>A heating controller consists of:</p> <ul style="list-style-type: none"> <li>• 1 ZA 724 central interface</li> <li>• 1 to 16 LA 724i xx power output(s)/load controller(s)</li> <li>• NE 724 system power acquisition device (optional)</li> <li>• SM 724i current measuring module (optional)</li> </ul> |

### 4.1.2 Software Prerequisites

#### Contents of the CD

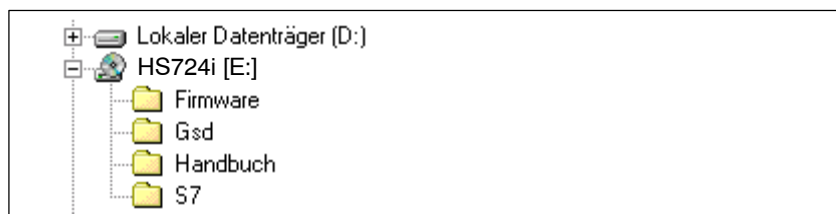


Figure 4-1 Contents of the CD

|                           |                                                                                                                |
|---------------------------|----------------------------------------------------------------------------------------------------------------|
| <b>Directory\firmware</b> | Contains the flash loader and the current firmware                                                             |
| <b>Directory\Gsd</b>      | <p>SIEM80FF.gsd</p> <p>GSD file of the HS 724i for installation in the configuration tool of the DP master</p> |
| <b>Directory\Handbuch</b> | Contains this description in electronic format                                                                 |
| <b>Directory\S7</b>       | Archive with the current STEP 7 program (for transmission of projects to the SIMATIC Manager)                  |

### 4.1.3 Integrating the HS 724i in the PROFIBUS-DP Configuration

A GSD file for configuration is included so that the HS 724i can be run on a PROFIBUS-DP master.

The GSD file (so-called device master file) includes all the properties of a DP slave which the DP master must “know.”

The HS 724i is entered for the PNO under ID 80FF and the GSD file is thus called SIEM80FF.GSD.

- Operation on S7 CPU  
The GSD file of the HS 724i must be integrated in the module catalog. To do this, proceed as shown below.
  1. First, create a new project or open an already existing one.
  2. Open the hardware configuration of your project and select “Extras → Neue GSD installieren ...”
  3. Select the file SIEM80FF.GSD.
- Operation on a non S7 DP master  
Install the GSD file as described in the guidelines of the DP master.

**Configuration limits of the DP slave:**

32 bytes of output data, consistent

32 bytes of input data, consistent

64 bytes of diagnostic data (not yet used)

Baud rates up to 12 Mbaud

Supported standard: PROFIBUS-DP

#### 4.1.4 (Standard) Commissioning Procedure

##### How to commission

1. Set PROFIBUS address with rotary switches S2 and S3 on the central interface (see chapter 3.2).
2. Mount the components in the switching cabinet (see chapters 3.3 and 3.4).
3. Connect parallel bus (see chapter 3.6).
4. Install and connect system power acquisition NE 724 (optional). See chapter 3.9.
5. Connect system voltage (see chapter 3.7).
6. Connect PROFIBUS-DP (see chapter 3.5).
7. Connect radiant heater (see chapter 3.8).
8.
  - With operation on the S7 master  
Load S7 sample project and adjust to your application.  
For description of the S7 interface, see chapter 5.
  - With operation on non S7 master  
User program for use of the HS 724i  
For description of the DP interface, see chapter 6.

### 4.1.5 Loading the Firmware for the HS 724i

#### Status on delivery of the ZA 724 central interface

When the ZA 724 central interface is delivered, the current firmware status has already been loaded to the module.

In case of error or a necessary update, the firmware can be loaded via the included program called HSSETUP.EXE.

#### How to load the firmware of the HS 724i

##### Notice

The standard ZA 724 is delivered with the current firmware version and is ready for operation.

The steps described below are only required when the ZA 724 must be updated with another firmware version.

To load the firmware, you will need a “null modem” cable. If such a cable is not available, a cable with the following allocation will be sufficient.

```
RxD 2—————3 TxD
TxD 3—————2 RxD
Gnd 5—————5 Gnd
```

##### Note

If you are using a 25-pin plug connector, use pin 7 for ground (Gnd) instead of pin 5!

To load the firmware, proceed as shown below.

1. Turn off the ZA 724.
2. Connect serial interface RS 232 of the ZA 724 with interface cable to COM1 or COM2 on the PC.
3. Call HSSETUP.EXE and enter the PC interface which you used (COM1 or COM2).
4. Turn on the ZA 724.

All other steps are performed automatically. You can watch programming progress on the PC.

After the firmware download is finished, the ZA 724 performs a new start.

##### Note

The load voltage must be off while the firmware is being loaded.

##### Note

The flash loader on the FEPR0M of the ZA 724 is usually not overwritten. If the voltage supply or the serial connection was interrupted before the end of the loading procedure, the procedure can be repeated.

## 4.2 Initialization

### Startup reactions

- The firmware checks approx. 1 second long whether a request for the firmware update via serial interface exists. If so, a branch is made to the flash loader procedure.
- The firmware then checks the system. The system halts during startup if there is an error (e.g., fatal error: flash not loaded).
- During the initialization phase, data communication between DP master and ZA 724 is started (see also chapters 5.3.1 and 5.4.1).
  - Information on the state of the HS 724i
  - Transmission of the configuration data to the HS 724i
  - Performance of startup checks

---

#### Note

For a detailed description of the jobs and the contents for initialization, see chapters 5 and 6.

---

### Startup tests

During the initialization phase, the power frequency and the phase sequence of the HS 724i can be checked. The tests are selected in one of the initialization telegrams and performed on the HS 724i.

The result must be checked by the user on the DP master. For a description of storage of the data required for the test, see chapter 5 or 6.

#### Power frequency test

This test must be performed during startup. It returns to you the determined frequency (50/60 Hz).

If the frequency could not be determined, an invalid value is returned but the HS 724i starts up anyway.

#### Phase sequence test

This test can be performed during startup and to support commissioning. Since multiple powering is necessary for higher switching capacities, the LA 724i xx devices can be selected with whose channels the phase sequence is to be checked.

The first channel of a phase of each LA must be wired for the phase sequence test (i.e., channels 1, 9 and 17). The test is performed with the channels switched off. Only with the LA 724i SSR with connected current measuring module SM 724i must the channels be activated for the duration of one full wave during the test.

## 4.3 Normal Operation

### Introduction

After successful initialization, the HS 724i heating controller must be switched to “heating mode” with the appropriate control bits. The ZA 724s cyclically monitor the data for changes and the power outputs/load controllers. The radiant heaters are activated with the current manipulated values.

### Operation cycle

The following is performed cyclically during normal operation.

- The temperature of the LA 724i/LA/724i HP power outputs is checked.
- The 24 V supply of the LA 724i SSR load controller is monitored.
- Data communication with the DP master is performed.
- The power outputs are controlled and monitored.

The ZA 724 central interfaces behave as DP slaves on PROFIBUS-DP.

Data communication between DP master and HS 724i uses cyclic PROFIBUS-DP data. Output data are data which are transferred from the DP master to the HS 724i. Input data are data which are sent from the HS 724i to the DP master.

These data are divided into two areas.

The first 4 bytes contain “real” cyclic data: Selection of the operating mode by the DP master, group message of errors by the HS 724i and communication of offset data for the voltage offset.

The other 28 bytes are used for telegram communication between the DP master and the HS 724i. This route is used to parameterize the HS 724i by the DP master and to send detailed diagnostic information and information on commissioning from the HS 724i to the DP master. The diagnostic routine via PROFIBUS-DP is not used.

---

### Note

For a detailed description of the data, see chapter 5 or 6.

---

### 4.3.1 Calculating the Manipulated Values

After valid radiant heater setpoints and field factors have been transferred, the heating controller calculates the manipulated values for the individual channels of the LA 724i xx power outputs. Voltage offsets can also be included in this.

#### Definition of setpoint

Up to three setpoints can be specified for various operating modes for each channel.

Table 4-1 Values for setpoint calculation

| Value                                          | Description                                                                     | Range    | Dimension |
|------------------------------------------------|---------------------------------------------------------------------------------|----------|-----------|
| Channel setpoint for startup                   | Setpoint for a channel which is to be used for “startup” mode                   | 0 to 100 | 1% *      |
| Channel setpoint for production with profile 1 | Setpoint for a channel which is to be used for “production with profile 1” mode | 0 to 100 | 1% *      |
| Channel setpoint for production with profile 2 | Setpoint for a channel which is to be used for “production with profile 2” mode | 0 to 100 | 1% *      |

\* Increments of 0.5% can be achieved with the set configuration parameter (see also chap. 4.3.3 on accuracy).

#### Definition of field factor

Up to two factors with which the current channel setpoint can be multiplied can be parameterized for each field.

Table 4-2 Values for setpoint calculation

| Value                 | Description                                                                                                                                      | Range    | Dimension |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|----------|-----------|
| Factor for production | Field factor with which the setpoints can be multiplied for profile 1 and profile 2 for “production” mode for all channels of the related field. | 0 to 255 | 0.01%     |
| Factor for standby    | Field factor with which the setpoints can be multiplied for profile 1 for “standby” mode for all channels of the related field.                  | 0 to 255 | 0.01%     |

At least 1 field must be configured on each HS 724i.

#### Definition of voltage offset

For determination of the offset value per phase, see chapter 4.3.2.

### Definition of the manipulated values for the operating modes

The manipulated value of a channel depends on the parameterized channel manipulated value, the parameterized field factors and the operating mode used.

#### Standby mode

$$\text{Manipulated variable} = \frac{\text{Standard channel setpoint} \times \text{field factor for standby mode}}{100}$$

#### Production mode, profile 1

$$\text{Manipulated variable} = \frac{\text{Standard channel setpoint} \times \text{field factor for production mode}}{100}$$

#### Production mode, profile 2

$$\text{Manipulated variable} = \frac{\text{Channel setpoint for profile 2} \times \text{field factor for prod. mode}}{100}$$

#### Startup mode

$$\text{Manipulated variable} = \text{Channel setpoint for startup}$$

### Manipulated value calculation

Figure 4-2 illustrates manipulated value calculation in graphical format.

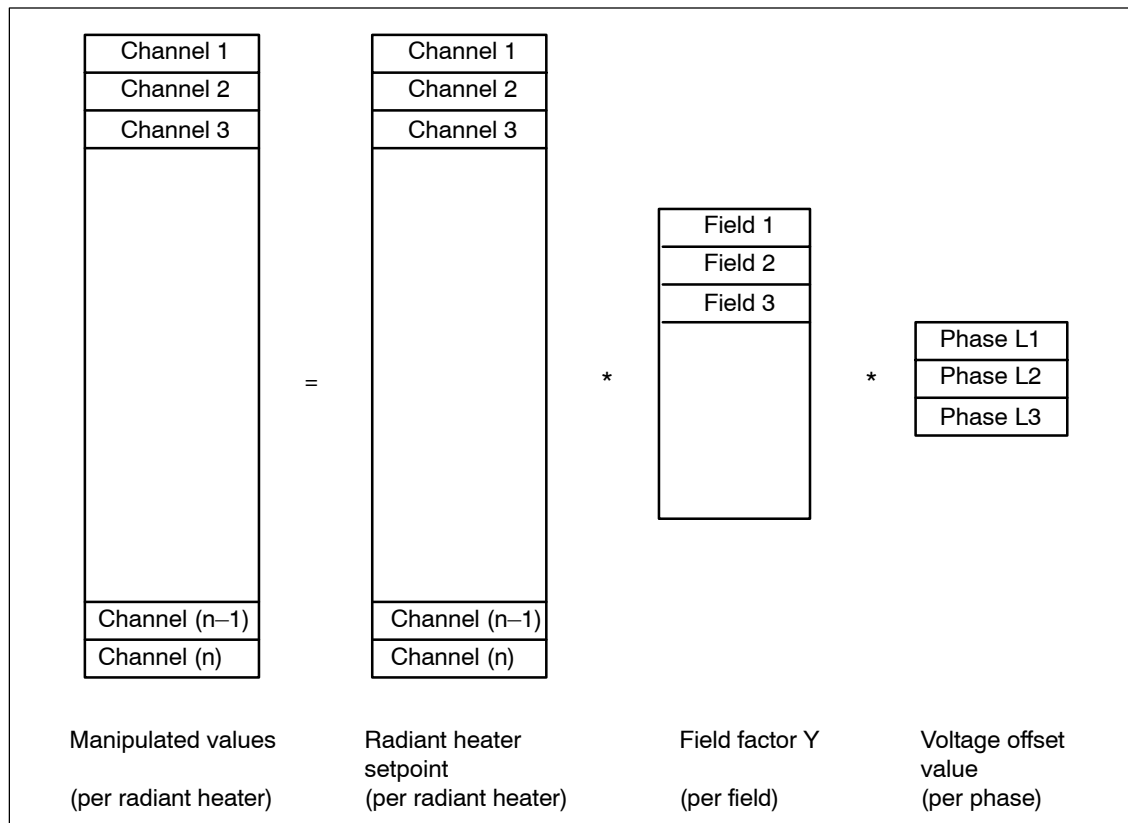


Figure 4-2 Principle of manipulated value calculation

**Updating the manipulated values**

When new data arrive from the S7 (radiant heater setpoints and field factors), the manipulated values are recalculated.

- Change in radiant heater setpoint → The related channel manipulated value is calculated again.
- Change in field factor → All channel manipulated values of the affected field are calculated again.
- Change in voltage offset value → The manipulated values of all channels of the affected phase are calculated again.

### 4.3.2 Voltage Offset

To eliminate power fluctuations, the HS 724i can be equipped with the optional NE 724 system power acquisition module.

The ZA then polls the voltages cyclically and integrated them in the integration time transmitted during initialization.

#### Configuration

The function can be enabled/disabled with a parameter.

- Function is active and NE 724 exists.  
→ Offset values are calculated and sent to the DP master.
- Function is active.  
→ Offset values are accepted by the DP master.

When system power acquisition is activated, the DP master must distribute the offset values to all HS 724i devices in the network.

#### Determining the offset value

The ZA calculates a phase-related voltage offset value from the determined voltages and the standardized value (setpoint voltage) specified during initialization.

$$\text{Offset value} = \left( \frac{\text{Standardized value}}{\text{Network voltage}} \right)^2 \times 100$$

When the network voltage corresponds to the specified setpoint voltage (standardized value), the offset value is 100% (i.e., the setpoints are multiplied with the factor 1).

The offset values for all three phases are transferred in the cyclic data to the DP master via PROFIBUS-DP. The DP master then sends the current voltage offset values to all connected ZAs for calculation of the manipulated values.

### Sample calculation

The following examples show the calculation of the offset value as well as the resulting change in the radiant heater setpoint for voltage which is less than or greater than the standardized value.

The standardized value should be 230 V.

1. Power voltage = 210 V (< standardized value)

$$\text{Offset value} = \left( \frac{230}{210} \right)^2 \times 100 = 120\%$$

The parameterized radiant heater setpoint is multiplied with this offset value.

Radiant heater setpoint before the offset: 80%

Radiant heater setpoint after the offset: 96%

2. Power voltage = 240 V (> standardized value)

$$\text{Offset value} = \left( \frac{230}{240} \right)^2 \times 100 = 92\%$$

The parameterized radiant heater setpoint is multiplied with this offset value.

Radiant heater setpoint before the offset: 80%

Radiant heater setpoint after the offset: 73%

### Standardized values

The standardized values are phase-related and permanently assigned to the channels.

The following applies to every LA 724i xx.

Channels 1 to 8 Phase L1

Channels 9 to 16 Phase L2

Channels 17 to 24 Phase L3

### Errors

When the NE 724 determines a power voltage below 80% of the entered standardized value, it is assumed that the system power acquisition module has made an error. The offset value is set to 1 and a message is sent to the S7 CPU.

### 4.3.3 Controlling the Power Outputs/Load Controllers

Control of the power outputs/load controllers with the manipulated values is synchronized by phase L1.

All subsequent zero crossings for L1, L2 and L3 are generated from this signal. Control of the applicable phase occurs at each zero crossing signal.

#### **New data**

If new data (radiant heater setpoints, production or voltage offset values) from the S7 arrive during normal operation, processing of the outputs is not terminated. The new values are processed gradually (for manipulated value calculation, see chap. 4.3.1) and used to control the power outputs.

#### **Control**

The channels can be run with half-wave or full-wave control. With half-wave control, each time a zero crossing occurs, the channel is controlled based on the parameterized manipulated value. With full-wave control, this only occurs once per network cycle

The manipulated variable is set in values from 0 to 100%.

With half-wave control, the reference basis is 1 second. With full-wave control, the basis is 2 seconds.

Example: 1% with half-wave control

⇒ Control of radiant heater with 1 of 100 half-waves

#### **Accuracy**

The manipulated variables are calculated from various variables (see chapter 4.3.2). The value is rounded to the next whole-number percent value.

An “overlaid” cycle can be configured with a configuration parameter. This is then rounded to the next 0.5% value. In this case, the cycle length is increased to 2 seconds with half-wave mode. With full-wave mode, the cycle length is increased to 4 seconds.

Example: At 50.5%, a cycle is controlled with 50% and the next cycle with 51%.

---

#### **Note**

A channel control with 0.5% is only useful when slow radiant heaters (e.g., quartz heaters or heating cartridges) are used. Results with flash heaters are not satisfactory.

---

**Load distribution**

Using a static control table, an even load distribution over all outputs of a phase is achieved. This also applies to operation of several HS 724i devices in a network with one DP master.

The user must ensure that all three phases are loaded evenly.

**Zero frequency quantity**

With half-wave control, the channels are controlled without zero frequency quantity.

## 4.4 Monitoring Functions

### Description

The heating controller monitors:

- The outputs of the power outputs/load controllers
- The temperature of the power outputs LA 724i and LA 724i HP
- The 24 V voltage of the LA 724i SSR load controller

When an error occurs, an error message is prepared for the DP master.

Each power output can be enabled for the test either directly or via the assigned field.

Communication between DP master and HS 724i is monitored on PROFIBUS-DP.

---

### Note

The temperature of the radiant heaters is not monitored by the HS 724i.

---

### 4.4.1 Temperature on the Power Outputs

### Description

The temperature of the heat dissipater is continuously monitored on the power outputs LA 724i and LA 724i HP.

When an excess temperature occurs ( $T \geq \text{approx. } 92^\circ\text{C}$ ), this is reported to the DP master.

Exceeding the warning stage does not interrupt the heating cycle.



---

### Warning

A reaction to this warning message must be provided on the DP master. For example, the user must provide suitable cooling measures (use fan).

---

If the temperature of the heat dissipater continues to rise, the power outputs of the module are shut down at approx.  $100^\circ\text{C}$ . This error message is also sent to the DP master.

---

### Note

When both errors have been corrected, the operating mode must be selected again via the DP master for resumption of heating.

---

#### 4.4.2 24 V on the Load Controllers

**Description** The 24 V voltage on the LA 724i SSR load controller is continuously monitored.

If the 24 V voltage fails, this is reported to the DP master.

This deactivates the control outputs of the module.

---

**Note**

When the error has been corrected, the operating mode must be selected again via the DP master for resumption of heating.

---

#### 4.4.3 Communication

**Description** The connection between DP master and DP slave is monitored with PROFIBUS-DP routines.

The DP master recognizes the failure of a slave and reports this to the user who may then provide an appropriate reaction.

The HS 724i recognizes a failure of the DP master or the communication. The reaction of the HS 724i varies depending on the configuration.

The current status of the outputs is either retained or all outputs are deactivated.

---

**Note**

When the error has been corrected, the operating mode must be selected again via the DP master for resumption of heating.

---

#### 4.4.4 Cyclic Monitoring of the Outputs of the LA 724i xx

##### Introduction

During normal operation, the outputs are monitored with the software. An output is monitored if both the channel and the related field have been enabled for the test.

##### Test types

The test distinguishes between the standard diagnosis and the expanded diagnosis with current measurement.

- **Standard diagnosis**  
With operation of one radiant heater on a channel, the emphasis is on error localization (either an error on the module or an external error). The diagnosis is performed with voltage measurement.  
For precise differentiation of the error, current measurement is performed afterwards.
- **Expanded diagnosis**  
With operation of several radiant heaters on a channel, it is particularly important to determine whether one heater has failed or several heaters. A current measurement with power calculation is performed. The power calculation is made with the voltage values of the NE 724 or with the parameterized data.

---

##### Note

The expanded diagnosis with current measurement is only recommended for operation of heaters which are switched in parallel.

---

---

##### Note

An external SM 724i current measuring module is required for the current measurement with the LA 724i SSR. The diagnosis assumes that, when the standard diagnosis is used, the signals of the load circuit are returned to the LA 724i SSR and that, when expanded diagnosis with current measurement is used, only the current measuring module is connected and there is no return from the load circuit.

---

**Test cycles**

The following figure shows a flow chart which is applicable when all outputs are enabled for the test.

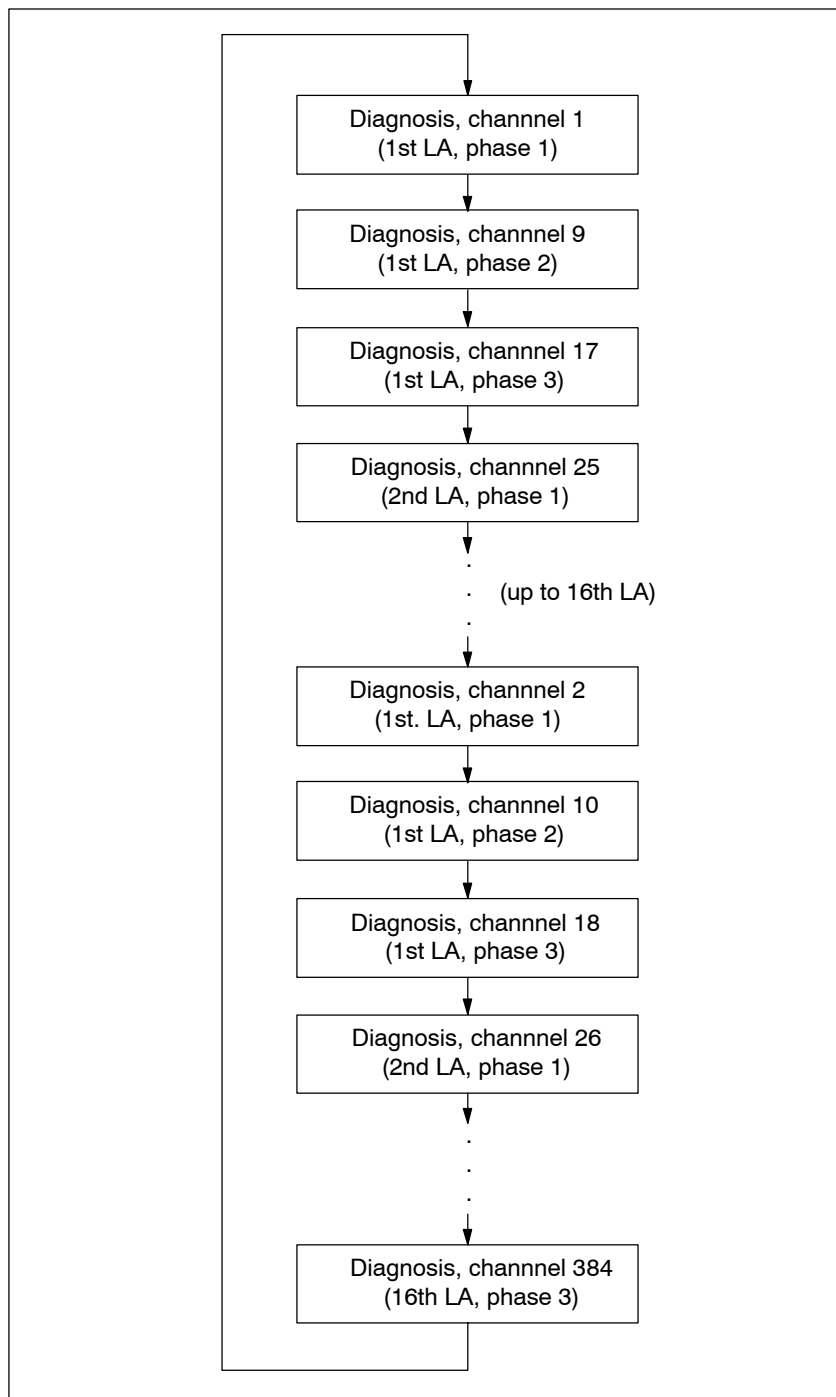


Figure 4-3 Channel sequence for diagnostic cycle

If a channel is not enabled for the test, it is not considered during the procedure.

**Test parameters**

The control signal of the channel must be changed for the test cycle. This distorts the control signal.

- **Standard diagnosis**  
The measuring cycle covers two full waves. During one full wave, the channel is activated and for one full wave the channel is deactivated. Only when an error occurs are all channels of the current phase deactivated for one full wave so that the external error can be recognized.
- **Expanded diagnosis**  
The measuring cycle covers two full waves. During one full wave, the channel is deactivated and for one full wave the test channel is activated and the other channels of the phase are deactivated. The current measurement requires this.

A diagnostic cycle always covers all channels enabled for the test.

The following configuration features are available for optimal adjustment of the diagnostic cycle to the process.

1. Channels can be excluded from the test via channel parameter or field parameter. The channel is only checked when the channel is enabled for the test with both types of parameters.
2. Each channel can be parameterized to permit a current measurement or not. If standard diagnosis is selected, a current measurement is only performed when an error is detected to localize the error. In the other case, a current measurement with evaluation is performed for the channel during each test cycle.
3. The diagnostic cycle is only performed in the modes standby and production.
4. It can be configured how many repeat measurements are to be performed before a detected error is reported to the DP master or is shown on the LED.
5. A pause can be set between the test of two channels. This means a configured pause (number x) of x channels is inserted between two tests before the next channel is tested.
6. A pause between two diagnostic cycles can be configured. Normally, after the last channel is tested, the test starts over with the first channel to be tested again. When a pause is configured (number x), x diagnostic cycles are omitted before the test starts over again with the first channel to be tested.

**Cycle duration**

A test cycle for 384 channels takes approx. 20 seconds.

**Types of errors,  
LA 724i and  
LA 724i HP**

The diagnosis distinguishes between the following errors during the standard diagnostic cycle.

- **Module error 1** (error type 1)

- The power switch cannot be turned on (Triac is high ohmic).
- The module fuse has blown.

These errors cannot be further specified by the diagnostic function of the HS 724i.

- **Module error 2** (error type 2)

The power switch cannot be turned off (Triac has shorted out).

- **External error** (error type 2, external)

The heating current circuit is interrupted by one or more of the following.

- External fuse blown
- Cable break
- Radiant heater break

With expanded diagnosis, the following errors are also recognized.

- **Nominal power on channel is exceeded** (error type 4).

One or more heaters are being operated on the output with too much power. The nominal power and the difference can be parameterized.

- **Nominal power on channel is dropped below** (error type 3).

Either heaters with too little power are being run on the output or at least one heater has failed. The nominal power and the difference can be parameterized.

**Error types,  
LA 724i SSR**

The diagnosis distinguishes between the following errors during the standard diagnostic cycle. Further distinction for multiple causes is not possible.

- **Module error** (error type 5)

- The output driver is defective. The SSR cannot be correctly activated.

- **External error 1** (error type 1)

- SSR is defective and cannot be turned on.
- The feeder line to the SSR is interrupted.
- The external channel fuse has blown.

- **External error 2** (error type 2)

- SSR is defective and cannot be turned off.
- Heater break
- Line break

With the expanded diagnosis, the following errors can also be recognized.

- **Nominal power on channel is exceeded** (error type 4).

One or more heaters are being operated on the output with too much power. The nominal power and the difference can be parameterized.

- **Nominal power on channel is dropped below** (error type 3).

Either heaters with too little power are being run on the output or at least one heater has failed. The nominal power and the difference can be parameterized.

#### 4.4.5 Monitoring the Outputs of the LA 724i Via Job

Particularly for testing and commissioning, the outputs can also be monitored with a separate job.

This job triggers a diagnostic cycle on the HS 724i for the channels of all existing LA 724i xx devices. There is no evaluation of parameterized pauses or measurement repetitions as described in the previous chapter.

The type of channel diagnosis entered determines the test. The standard setting is a standard diagnosis for each channel (diagnosis via voltage measurement).

The results of the diagnosis are transmitted directly to the DP master. They are not stored on the HS 724i.

For a description of the job, see chapter 5 or 6.

---

##### Note

This job can also be used during operation when a diagnostic cycle is to be performed explicitly at certain times.

Remember that the cyclic diagnosis must be disabled. This must be implemented by disabling the diagnosis for all used fields.

---

#### 4.4.6 Manipulated Variables of the LA 724i xx

The manipulated variables are calculated by multiplying the channel setpoint with the field factor and the factor from the network voltage offset.

If the product exceeds 100%, the manipulated variable is limited to 100% and a warning message is output. Heating continues.

## 4.5 LED Indicators on the ZA 724

The following LED states are shown on the ZA 724 during initialization and operation.

Table 4-3 LED indicators on the ZA 724

| Error LED (Red) | Ready LED (Green) | Description                                                                                                                                                                                                                                                                                                                                                      |
|-----------------|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| On              | Off               | Firmware detected a fatal error (FEPROM contents not valid) or received the request for a firmware update via the serial interface and is now located in the flash loader.                                                                                                                                                                                       |
|                 |                   | After establishment of the PROFIBUS connection, the HS 724i sends zeros in the cyclic data to show that an initialization by the DP master is necessary. The DP master (S7-CPU) must send the three initialization jobs (i.e., jobs 01, 02 and 03). If S7 software is used, these jobs are executed by the FC_INIT function.                                     |
| On              | Flashing          | Initialization of the hardware and the firmware and the PROFIBUS connection. The firmware waits until the DP master has detected the HS 724i and integrated it in the PROFIBUS cycle.                                                                                                                                                                            |
| Off             | On                | After the initialization jobs have been received, the HS 724i concludes the initialization phase and reports this back in the cyclic bits (i.e., finished with or without errors). The HS 724i is now ready for normal operation. Data communication with the DP master is possible. Parameter/diagnosis via jobs, operating mode selection via the cyclic data. |
| Off             | Flashing          | When communication with the DP master fails, the HS 724i assumes the configured state and waits for communication to resume. The configured and parameterized data are retained. The DP master does not perform a new initialization when communication is resumed.                                                                                              |

## 4.6 Error Handling and Correction

### Introduction

Two categories of errors can occur when the HS 724i heating controller is used.

- Errors during startup (initialization)
- Errors during normal operation

Error on power outputs/load controllers which occur during normal operation can be avoided or corrected with specific measures.

### Errors during normal operation

The reactions of the heating controller to errors during normal operation are shown in table 4-4 below.

Table 4-4 Errors during normal operation

| Error                                                                                 | Reaction                                                                                                                           |
|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| Fatal error                                                                           | Automatic hardware reset with new start-up of the ZA 724 (initialization)<br>The user must send all jobs to the ZAs again.         |
| Bus error<br>For example, timeout due to defective bus cable or failure of the S7-CPU | Depending on the parameterization, the outputs are reset or retain their values.<br>The user must select the operating mode again. |
| Channel error (module error, Triac short circuit, external error)                     | Message to the DP master                                                                                                           |
| Excess temperature, 1st stage (92 °C)                                                 | Message to the DP master                                                                                                           |
| Excess temperature, 2nd stage (100 °C)                                                | Power outputs are switched off.<br>The user must select the operating mode again.                                                  |
| 24 V voltage for LA 724i missing                                                      | Relay outputs are switched off.<br>The user must select the operating mode again.                                                  |
| Value error<br>The manipulated value has exceeded the 100% value                      | Message to the S7-CPU<br>Processing is continued with the manipulated value 100%.                                                  |

### Excess temperature

Excess temperature can occur on an LA 724i/LA 724i HP power output when the ambient temperature or the switching capacity is too high (see chap. 2.2.5 and 2.3.5).

## Fuse blown

Each standard channel of the LA 724i/LA 724i HP power output is equipped with a 5/10 A F fuse which blows when an output short circuits, for instance.

These channel fuses are located on the power output directed on the front (see figure 4-4).

The three phase feeder lines are protected with a 32/40 A fuse.

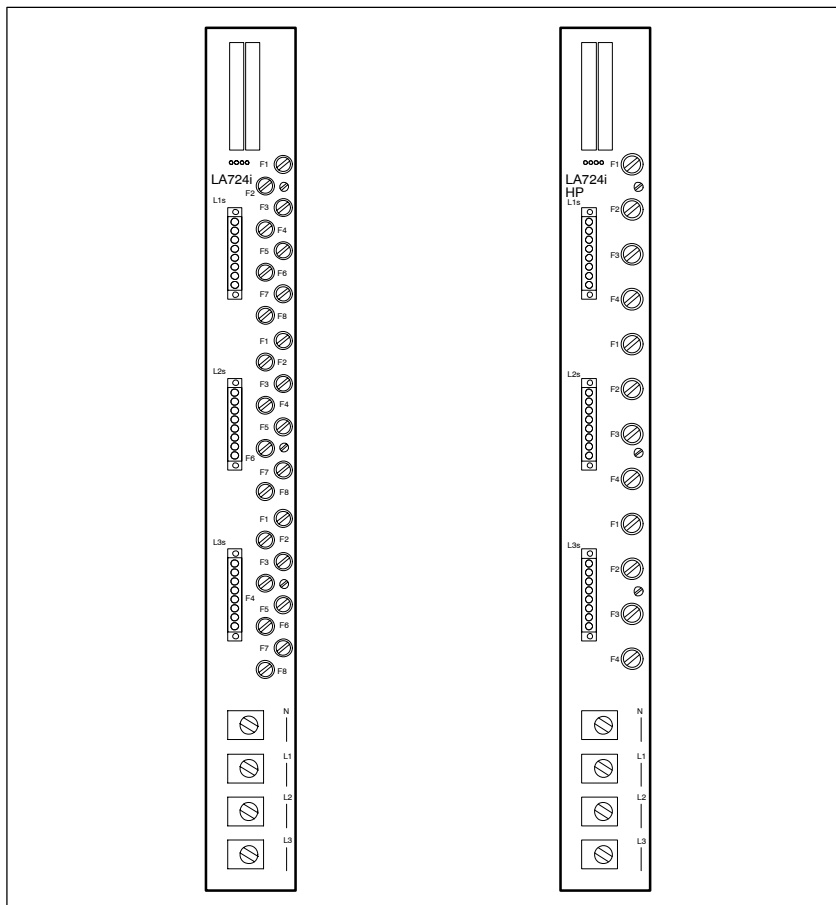


Figure 4-4 Location of the channel fuses on the LA 724i/LA 724i HP power output

### Replacing defective channel fuses



---

#### Warning

Before changing the fuses, the load circuit must be de-energized.

---

1. Release the cap of the fuse holder.
  2. Replace defective fuse with same type fuse.
  3. Mount cap again.
- 

#### Note

For the ordering data of the fuses, see appendix A.

---

### Defective phase fuses

When a phase fuse is defective, the LA 724i/LA 724i HP must be sent to the manufacturer for repair.

### Reaction to interruption of the voltage

An interruption of the voltage lasting longer than 20 msec triggers a restart of the HS 724i heating controller via a reset.

The outputs of the LA 724i xx power outputs/load controllers are reset when power returns.

The HS 724i must be parameterized again.



# Data Transmission from/to an S7 DP Master

# 5

This chapter explains how data communication between S7-CPU (user program) and HS 724i is organized when the included S7 functions are used.

You will learn about the structure of the software and the organization of the data blocks.

A knowledge of *STEP 7* programming is required.

## 5.1 Installing the Software

The STEP 7 project HS724i.zip stored on the included CD contains all necessary functions and data required for operation of one or more HS 724i devices on PROFIBUS-DP.

The project is copied to the hard drive with “Datei – Dearchivieren...” and loaded to the STEP 7 Manager.

In addition to the functions, function blocks and data blocks described in the following sections, a sample application is included.

- **DB\_PLC\_TEST**  
This data block contains all necessary test data.
- **OB1**  
Cyclic program which controls the HS 724i
- **OB100**  
Sample program for reaction to startup/restart in an S7-300 CPU

The following configuration is implemented in the project as an example.

- CPU 316-2 DP
- 3 HS 724i devices

The hardware configuration can be changed with HW-Config. The CPU can be replaced by another. The number of HS 724i devices must be adjusted (delete/add).

The included data blocks have also been preassigned for operation of three HS 724i devices in a network. The applicable structures in the data blocks must be adjusted to the desired number of HS 724i devices. If, for example, only one HS 724i with 100 channels is used, the excess structures can simply be deleted.

Numbers have been assigned for the data blocks, functions and function blocks. These can be renamed (exception: DB\_HS\_WORK). If for some reason the numbers of DB\_HS\_WORK have to be changed, check with HS 724i support.

## 5.2 Structure of the Software

### Overview

The S7 software for operation of the HS 724i offers an interface of data blocks and function blocks/functions which makes it relatively easy for an application to access one or more HS 724i devices

The data required for execution are managed in data blocks. The structure of these blocks is permanently specified.

Access to the HS 724i via jobs in the PROFIBUS-DP data is performed with functions.

Since the entire PROFIBUS data area of an HS 724i with 32 bytes of input data and 32 bytes of output data must be consistent, accesses to the I/O image are performed via the SFC14 "DPRD\_DAT" and SFC15 "DPWR\_DAT." These SFCs are available on every S7-CPU.

If more than 384 radiant heaters must be controlled, several HS 724i devices can be run as a network via the S7 interface. For the common management, the HS 724i devices and their channels are simply numbered consecutively as shown below.

- First HS 724i, channel numbers 1 to 384
- Second HS 724i, channel numbers 385 to 768

The numbers which can be managed are indirectly limited by the amount of available memory space on the S7-CPU as well as the time required to provide the HS 724i with data.

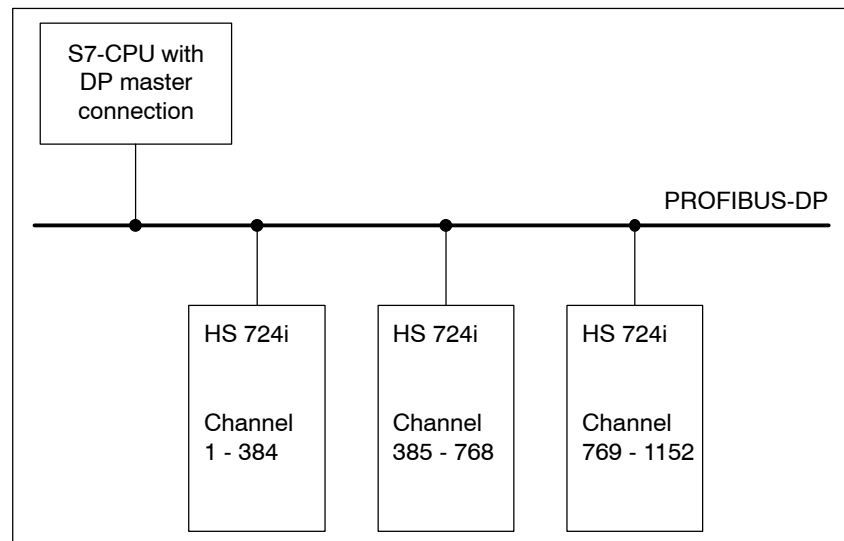


Figure 5-1 Several HS 724i devices on one S7-CPU

## Block structure

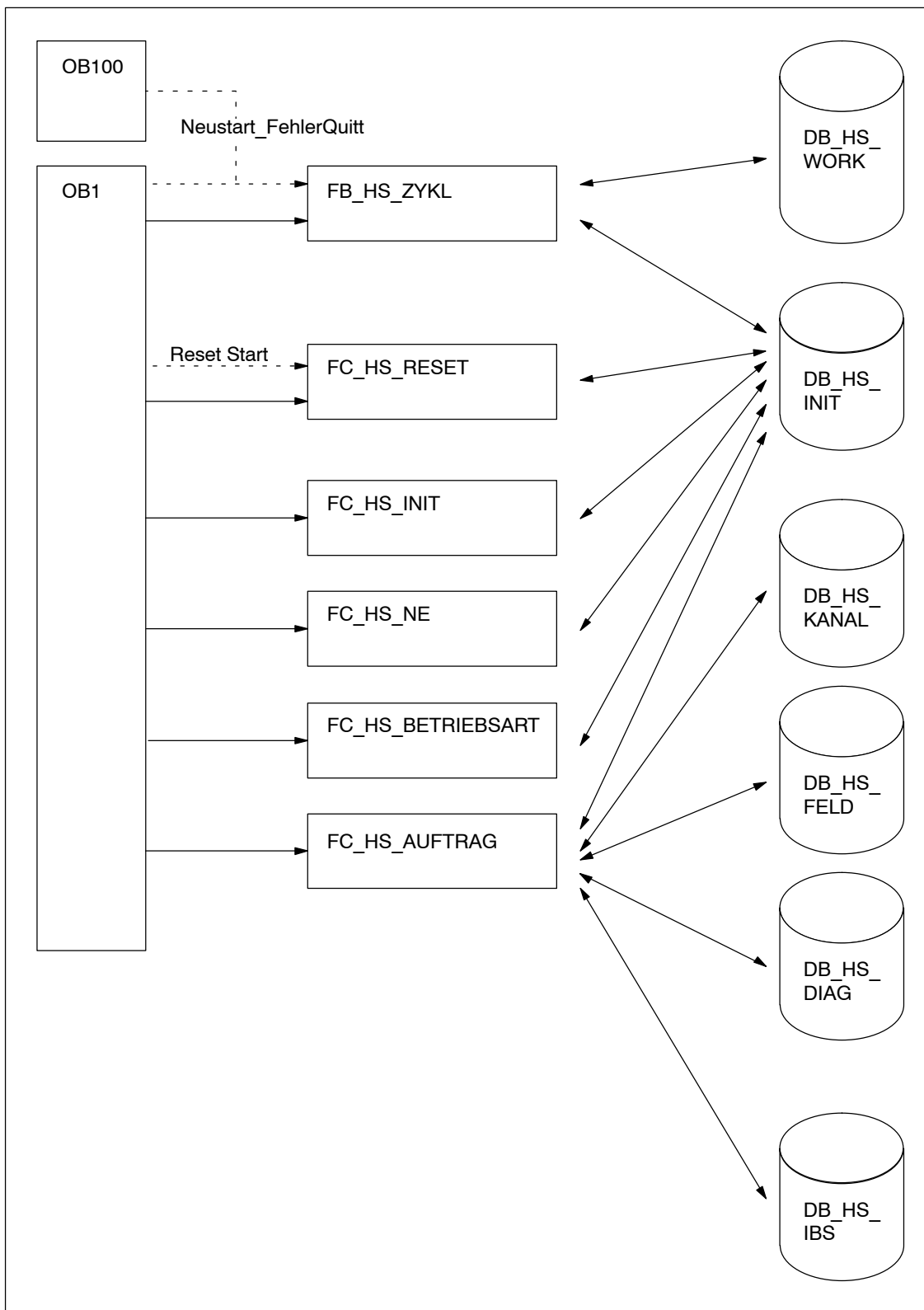


Figure 5-2 Structure of an S7-program

The S7 software for the HS 724i is divided into the following primary areas which will be described in detail in the next few sections.

- Data blocks for the management of parameters and configuration data
- Data blocks for the storage of diagnostic or commissioning information
- Functions as user interface to the performance of various tasks
- Function block for communication with the HS 724i via PROFIBUS-DP

## **5.3 Data Blocks**

### **Overview**

Data blocks represent the actual user interface in the software.

The following data blocks are required for operation of the HS 724i.

- DB\_HS\_INIT (initialization data)
- DB\_HS\_KANAL (data for parameterization of the individual power outputs)
- DB\_HS\_FELD (data for management of the outputs in groups)
- DB\_HS\_DIAG (information on the state of the outputs and LA modules)

The following data blocks are optional for operation of the HS 724i.

- DB\_HS\_IBS (measured values from the HS 724i – primarily for commissioning)

The DB\_HS\_WORK data block in the structure contains working data. It is managed by the S7 DP master.

### 5.3.1 DB\_HS\_INIT

All data needed for the configuration of an HS 724i are collected in this data block. These data are required once for initialization and are then never changed again. In addition to the HS 724i configuration data, this includes the necessary S7 information for addressing one or more HS 724i devices. The data block also contains the information which is sent to the DP master during the initialization of the HS 724i.

The following table shows the structure of an entry in the data block. The number of structures corresponds to the number of HS 724i devices operated in one network. The data block contains an array from these structures.

The data marked with an asterisk are transferred to the S7 during the initialization phase of the HS 724i. This information should be checked by the user for correctness.

| Name           | Type         | Meaning                                                                                                                                                                              |
|----------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AnzHS          | WORD         | Number of existing HS 724i devices                                                                                                                                                   |
| EAdr           | INT          | Start address from the I area of the HS 724i, is specified with HW-Config in the DP configuration.                                                                                   |
| AAdr           | INT          | Start address from the Q area of the HS 724i, is specified with HW-Config in the DP configuration.                                                                                   |
| NrKanal        | INT          | Number of the first channel of the HS 724i. When one HS 724i is used, enter the number 1 here.<br>This channel number must always be an increment of 24 (e.g., 1, 25, ...).          |
| PrDrehfeld     | WORD         | Setting of the phase sequence test for each LA 724i xx (one bit exists for each LA 724i xx).<br>Bit = 0: Don't perform test<br>Bit = 1: Perform test                                 |
| Reserv         | BYTE         | –                                                                                                                                                                                    |
| ErgPrNetzfreq* | BYTE         | Results of the network frequency test<br>50: 50 Hz<br>60: 60 Hz<br>0xFF: Undefined                                                                                                   |
| ErgPrDrehfeld* | WORD         | Results of the phase sequence test (one bit exists for each LA 724i xx).<br>Bit = 0: Test without errors<br>Bit = 1: Error in the phase sequence test                                |
| LaInfo*        | ARRAY (BYTE) | Information on each LA 724i xx found<br>0x00: No module exists.<br>0x01: LA 724i exists.<br>0x02: LA 724i HP exists.<br>0x10: LA 724i SSR exists.<br>0xFF: Old LA 724 found (error). |
| NeInfo*        | BYTE         | Information on optional NE 724<br>0: NE 724 doesn't exist.<br>1: NE 724 does exist                                                                                                   |

| Name    | Type            | Meaning                                            |
|---------|-----------------|----------------------------------------------------|
| Reserv* | BYTE            | 0 (reserved for later information on ZA 724)       |
| ZaInfo* | ARRAY<br>(BYTE) | Firmware version of the ZA 724 in format Vxx.yy.zz |

### 5.3.2 DB\_HS\_KANAL

All parameters needed for a channel are collected in this data block. This data block must always exist.

The following table shows the structure of an entry in the data block. The number of structures corresponds to the number of existing channels. The data block contains an array from these structures.

#### Note

When an HS 724i network is used, all channels are entered here. There is only one DB.

| Name      | Type | Meaning                                                                                                                                                                                    |
|-----------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NrKanal   | INT  | Number of the configured channel. Value range 1 to xx (depends on the number of channels used).                                                                                            |
| Sollwert  | BYTE | Setpoint for production mode with profile 1 and for standby mode in (%). Value range 0 to 100.<br>With bit 7 = 1: 0.5% can be set.                                                         |
| SwAnlauf  | BYTE | Setpoint for startup in (%). Value range 0 to 100.<br>With bit 7 = 1: 0.5% can be set.                                                                                                     |
| Sollwert2 | BYTE | Setpoint for production mode with profile 2 in (%). Value range 0 to 100.<br>With bit 7 = 1: 0.5% can be set                                                                               |
| Diag      | BYTE | Test setting for the channel (see also error diagnosis).<br>0: Channel is not checked.<br>1: Channel is checked with standard diagnosis.<br>2: Channel is checked with expanded diagnosis. |
| Pnenn     | INT  | Nominal power to be expected on a channel in (W)<br>This parameter must have a valid value when the expanded diagnosis with current measurement is used.                                   |
| Pabw      | INT  | Permissible deviation greater than or less than the nominal power in (W).<br>This parameter must have a valid value when the expanded diagnosis with current measurement is used.          |

### 5.3.3 DB\_HS\_FELD

All parameters required for a field description are collected in this data block. This data block must always exist.

The following table shows the structures of possible entries in the data block. The number of structures corresponds to the number of required fields. The data block contains a string of various structures.

#### Note

When an HS 724i network is used, all fields are entered here. There is only one DB.

The minimum configuration for operation is one field per HS 724i.

| Name     | Type        | Meaning                                                                                                                                                         |                               |
|----------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| NrFeld   | BYTE        | Number of the field. Value range 1 to 127.                                                                                                                      |                               |
| Typ      | BYTE        | Field type<br>0: All channels between beginning and end<br>1: Every other channel between beginning and end<br>2: List with channels                            |                               |
| FakProd  | BYTE        | Field factor for production mode with profile 1 and profile 2 in (0,00). Value range 0 to 255.                                                                  |                               |
| FakStBy  | BYTE        | Field factor for standby mode in (0,00). Value range 0 to 255.                                                                                                  |                               |
| Diag     | BYTE        | Test setting for the field (see also channel diagnosis).<br>0: No channels of the field are checked.<br>1: All field channels enabled for the test are checked. |                               |
| Reserv   | BYTE        | 0                                                                                                                                                               |                               |
|          |             | Entries for field type 0 and 1                                                                                                                                  | Entries for field type 2      |
| AKanal   | INT         | Number of the first channel in the field                                                                                                                        | –                             |
| EKanal   | INT         | Number of the last channel in the field                                                                                                                         | –                             |
| AnzKanal | INT         | –                                                                                                                                                               | Number of subsequent channels |
| NrKanal  | ARRAY (INT) | –                                                                                                                                                               | Channel numbers in the field  |

Field type 2 with AnzKanal = 0 can be used to delete a field.

### 5.3.4 DB\_HS\_DIAG

All diagnostic information is collected in this data block. This includes both the module-specific and channel-specific error messages and warnings. This data block must always exist.

The following table shows the structures of the various entries in the data block. The number of structures corresponds to the number of HS 724i devices as well as with the number of channels. The data block contains arrays from these structures.

#### Note

When an HS 724i network is used, the error information of all power outputs/load controllers and channels is entered here. There may only be one DB.

| Name      | Type | Meaning                                                                                                                                                                                                                                |
|-----------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NrHS      | BYTE | Consecutive number of the HS 724i                                                                                                                                                                                                      |
| ErrNeL1   | BYTE | Error on system power acquisition L1<br>0: No error<br>xx: Measured value                                                                                                                                                              |
| ErrNeL2   | BYTE | Error on system power acquisition L2<br>0: No error<br>xx: Measured value                                                                                                                                                              |
| ErrNeL3   | BYTE | Error on system power acquisition L3<br>0: No error<br>xx: Measured value                                                                                                                                                              |
| ErrInitLa | BYTE | Error during initialization of the HS 724i<br>0x01: All power outputs found<br>0x02: Power output/load controller without ID found<br>0x04: Frequency couldn't be determined.<br>More than one error can be reported at the same time. |
| Reserv    | BYTE | 0                                                                                                                                                                                                                                      |
| ErrTemp1  | BYTE | Error message for first LA 724i xx (first row)<br>1: Temperature warning threshold exceeded (LA 724i/LA 724i HP)<br>2: Temperature switch-off threshold exceeded (LA 724i/LA 724i HP)<br>3: 24 V voltage failed (LA 724i SSR)          |
| .         |      |                                                                                                                                                                                                                                        |
| .         |      |                                                                                                                                                                                                                                        |
| .         |      |                                                                                                                                                                                                                                        |
| ErrTemp16 | BYTE | Error message for sixteenth LA 724i xx (second row)                                                                                                                                                                                    |

| Name     | Type | Meaning                                                                                                                                                                                                                  |
|----------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NrKanal  | INT  | Number of the channel                                                                                                                                                                                                    |
| ErrKanal | BYTE | Error information on the channel<br>0: Output is okay.<br>1: Error type 1<br>2: Error type 2<br>3: Error type 2, external<br>4: Error type 3<br>5: Error type 4<br>6: Error type 5<br>(For error types, see chap. 4.4.4) |
| WKanal   | BYTE | Warning which occurred for a channel<br>0: Manipulated variable is okay.<br>1: Wrong manipulated variable due to setpoint x field value<br>2: Wrong manipulated variable due to voltage offset                           |

### 5.3.5 DB\_HS\_IBS

All information from the commissioning jobs is collected in this data block. This includes both module-specific and channel-specific actual values. This data block must only exist when commissioning jobs are used.

The following table shows the structures of the various entries in the data block. The number of structures corresponds to the number of HS 724i devices as well as to the number of channels. The data block contains arrays from these structures.

---

#### Note

When an HS 724i network is used, the commissioning information of all power outputs/load controllers and channels is entered here. There is only one DB.

---

The values are not valid unless the HS 724i was initialized and an operating mode was selected. The channel measured values are not valid unless an expanded diagnosis with current measurement is parameterized for the channel.

| Name      | Type | Meaning                                                                                                   |
|-----------|------|-----------------------------------------------------------------------------------------------------------|
| NrHS      | BYTE | Consecutive number of the HS 724i                                                                         |
| ErrTemp1  | INT  | Temperature measured value for first LA (first row) in (C)<br>Enter 0 here if there is no measured value. |
| .         |      |                                                                                                           |
| .         |      |                                                                                                           |
| .         |      |                                                                                                           |
| ErrTemp16 | INT  | Temperature measured value for sixteenth LA (second row)                                                  |

| Name       | Type | Meaning                                                  |
|------------|------|----------------------------------------------------------|
| NrKanal    | INT  | Number of the channel                                    |
| Stellgröße | BYTE | Current manipulated variable of the channel in (%)       |
| Reserv     | BYTE |                                                          |
| Strom      | INT  | Current current measured value on the channel in 0.0 (A) |
| Leistung   | INT  | Current power measured value on the channel in (W)       |

## 5.4 Functions and Function Blocks

In addition to the central function block for managing the various HS 724i devices, several functions are available for controlling the cyclic data.

The tasks of the functions will now be discussed in the next few sections.

### 5.4.1 FC\_HS\_INIT

The heating controllers must be initialized once during startup. A function is available for this which must be called after the startup of an HS 724i. This function handles the initialization of the HS 724i.

In addition to the data from the DB\_INIT where each HS 724i may have different data, the data which are transferred here during a function call must be identical for all HS 724i devices.

---

#### Note

When an HS 724i network is used, the initialization of **all** HS 724i devices must have been successfully concluded before operation can begin.

---

The function can be called cyclically to perform automatic initialization after new start/restart of the DP master.

**Call interface**

| Parameter  | Declaration | Data Type | Description                                                                                                                                                                                                                                                     |
|------------|-------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NrDbInit   | INPUT       | BLOCK_DB  | Number of the data block containing the configuration data                                                                                                                                                                                                      |
| ErrDP      | INPUT       | BYTE      | Activation of the channels when an error occurs (PROFIBUS error):<br>0: No outputs are activated (setpoint 0%).<br>1: The outputs retain the last set value.                                                                                                    |
| NeFunktion | INPUT       | BYTE      | Voltage offset function:<br>0: Disabled<br>1: Enabled<br>This affects all existing HS 724i devices.                                                                                                                                                             |
| NeNennSpg  | INPUT       | INT       | Nominal value of the voltage (e.g., 230 V) is used<br><ul style="list-style-type: none"> <li>as standardized value for voltage offset</li> <li>to calculate power without NE 724</li> </ul>                                                                     |
| NeZeit     | INPUT       | BYTE      | Integration time for voltage offset in multiples of 300 msec<br>0: Measurement not repeated<br>1 to 254: Number of repetitions<br>Only required when the function is enabled.                                                                                   |
| DiagTZyk   | INPUT       | BYTE      | Diagnostic cycle:<br>Number of pause cycles between two diagnostic cycles 0 to x                                                                                                                                                                                |
| DiagTKanal | INPUT       | BYTE      | Diagnostic cycle:<br>Number of pause times between two channel diagnoses 0 to x                                                                                                                                                                                 |
| DiagRepeat | INPUT       | BYTE      | Diagnostic cycle:<br>Number of repetitions when error is detected before the error is actually reported to the master (0 to 10)                                                                                                                                 |
| LSControl  | INPUT       | BYTE      | Activation of the power outputs with:<br>0: Half-wave operation (time base = 1 sec)<br>1: Full-wave operation (time base = 2 sec)<br>2: Half-wave operation, 0.5% increments (time base = 2 sec)<br>3: Full-wave operation, 0.5% increments (time base = 4 sec) |
| BetStDr    | INPUT       | BYTE      | Radiant heaters are run with:<br>0: Y circuit (230 V)<br>1: Delta circuit (400 V) – only LA 724i HP/SSR                                                                                                                                                         |
| RetVal     | OUTPUT      | WORD      | Response message concerning execution                                                                                                                                                                                                                           |

### 5.4.2 FC\_HS\_AUFTRAG

This function can be used to transfer data changed in DB\_HS\_KANAL or DB\_HS\_FELD to the HS 724i or to read data in DB\_HS\_DIAG or DB\_HS\_IBS by the HS 724i. The appropriate bit can be set in the job code by the user.

The job code may contain more than one job. The cyclic function block executes all entered jobs based on the LSB (least significant bit) and does not send a response message until either all jobs have been executed or an error occurred.

#### Note

Data blocks DB\_HS\_INIT, DB\_HS\_KANAL, DB\_HS\_FELD and DB\_HS\_DIAG must exist. DB\_HS\_IBS, however, is only checked when an appropriate job was entered.

#### Call interface

| Parameter | Declaration | Data Type | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----------|-------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NrDbInit  | INPUT       | BLOCK_DB  | Number of the data block containing the configuration data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| NrDbKanal | INPUT       | BLOCK_DB  | Number of the data block containing the channel descriptions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| NrDbFeld  | INPUT       | BLOCK_DB  | Number of the data block containing the field descriptions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| NrDbDiag  | INPUT       | BLOCK_DB  | Number of the data block containing the diagnostic data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| NrDbIbs   | INPUT       | BLOCK_DB  | Number of the data block containing the commissioning data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| AuCode    | INPUT       | DWORD     | <p>Bit-coded entry of which data in the DBs have changed and must thus be transmitted or which data must be fetched for diagnostic purposes (e.g., new setpoints, new field values):</p> <p>0x00000008 Channel setpoints, profile 1/standby</p> <p>0x00000010 Channel setpoints, profile 2</p> <p>0x00000020 Channel setpoints, startup</p> <p>0x00000040 Field definition</p> <p>0x00000080 Field factor for production mode</p> <p>0x00000100 Field factor for standby mode</p> <p>0x00000200 Diagnostic setting, channels</p> <p>0x00000400 Diagnostic setting, fields</p><br><p>0x00080000 Read general diagnosis</p> <p>0x00100000 Read channel diagnosis</p> <p>0x00200000 Read channel warnings</p> <p>0x00400000 Trigger a diagnostic cycle with results</p><br><p>0x20000000 Current channel manipulated variable (during commissioning)</p> <p>0x40000000 Current channel measured values (during commissioning)</p> <p>0x80000000 Current temperature measured values (during commissioning)</p> <p>Several pieces of data can be entered.</p> |
| RetVal    | OUTPUT      | WORD      | Response message concerning job: Error/no error. It is also indicated here when the job is still being processed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

### 5.4.3 FC\_HS\_NE

The function is only required when offset values are needed for the system power acquisition.

This function can be used to distribute the voltage offset values. The data of the HS 724i are taken from the input data area with the NE 724 and transferred to all HS 724i devices.

#### Call interface

| Parameter | Declaration | Data Type | Description                                                                                                                                                                             |
|-----------|-------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NrDbInit  | INPUT       | BLOCK_DB  | Number of the data block containing the configuration data                                                                                                                              |
| ArtNe     | INPUT       | BOOL      | Voltage offset:<br>0: Values of the HS 724i with system power acquisition are transferred to all HS 724i devices.<br>1: Values calculated in S7 are transferred to all HS 724i devices. |
| WertNeL1  | INPUT       | BYTE      | Offset value for L1 calculated in S7 (only with ArtNe = 1)                                                                                                                              |
| WertNeL2  | INPUT       | BYTE      | Offset value for L2 calculated in S7 (only with ArtNe = 1)                                                                                                                              |
| WertNeL3  | INPUT       | BYTE      | Offset value for L3 calculated in S7 (only with ArtNe = 1)                                                                                                                              |
| RetVal    | OUTPUT      | WORD      | Response message concerning execution                                                                                                                                                   |

### 5.4.4 FC\_HS\_BETRIEBSART

This function can be used to control the operating mode of the HS 724i. The control covers all HS 724i devices. The new mode should not be selected until the previously selected mode has been acknowledged by all HS 724i devices.

Evaluation of the response message must be handled by the user.

#### Call interface

| Parameter   | Declaration | Data Type | Description                                                                                                                                         |
|-------------|-------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| NrDbInit    | INPUT       | BLOCK_DB  | Number of the data block containing the configuration data                                                                                          |
| Betriebsart | INPUT       | BYTE      | Modes available for selection:<br>1: Startup<br>2: Heating off<br>4: Standby mode<br>5: Production mode, profile 1<br>6: Production mode, profile 2 |
| RetVal      | OUTPUT      | WORD      | Response message concerning execution                                                                                                               |

### 5.4.5 FB\_HS\_RESET

This function can be used to execute a reset of the HS 724i. When a network is used, all HS 724i devices are reset.

The function is only executed when no jobs are running and “heating off” mode is selected. This function is intended for commissioning.

#### Call interface

| Parameter   | Declaration | Data Type | Description                                                |
|-------------|-------------|-----------|------------------------------------------------------------|
| Reset_Start | INPUT       | BOOL      | Start of execution (via edge is highly recommended)        |
| NrDbInit    | INPUT       | BLOCK_DB  | Number of the data block containing the configuration data |
| RetVal      | OUTPUT      | WORD      | Response message concerning execution                      |

## 5.4.6 FB\_HS\_ZYKL

This function block can be used to accept the actual controller of the HS 724i. It processes the jobs or new data which are transferred with the above described functions.

Each time it is called, the current status of each HS 724i is updated and transferred to the user. The information on “response message of the operating mode” as well as “error indication” must be checked by the user and evaluated.

The FB **must** be called **cyclically before** the already described functions in OB1.

### Call interface

| Parameter            | Declaration | Data Type | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------|-------------|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NrDbInit             | INPUT       | BLOCK_DB  | Number of the data block containing the configuration data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Neustart_FehlerQuitt | INPUT       | BOOL      | Signal for initialization of DB_HS_WORK. The signal must be activated <ul style="list-style-type: none"> <li>• after S7 new start/restart</li> <li>• for acknowledgment after a job error</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| HS724i_zust          | IN/OUT      | POINTER   | <p>Pointer to an area in which the cyclic input data of each HS 724i can be stored. 4 bytes per HS 724i.</p> <p><b>Byte 0:</b> Status of the HS 724i (several response messages at a time are possible)</p> <p>Bits 7 to 5: Error indication, diagnostic information present</p> <p>0x80 Channel warning message<br/>(→ job for reading channel warnings)</p> <p>0x40 Channel error message<br/>(→ job for reading channel errors)</p> <p>0x20 General error message<br/>(→ job for reading general diagnosis)</p> <p>Bits 4 to 2: Return message of the operating mode</p> <p>0x04 Return message of “startup” mode</p> <p>0x08 Return message of “heating off” mode</p> <p>0x10 Response message of “standby” mode</p> <p>0x14 Return message of “production, profile 1” mode</p> <p>0x1C Return message of “production, profile 2” mode</p> <p>0x00 Request for new selection of mode</p> <p>Bits 1 to 0: Return message for initialization – for information</p> <p>0x00 HS 724i must be initialized.</p> <p>0x03 HS 724i is initialized and ready for operation.</p> <p>0x01 Fatal error during startup of the HS 724i</p> <p>0x02 Fatal error during startup of the HS 724i</p> <p><b>Byte 1:</b> Voltage offset for L1 – for information</p> <p><b>Byte 2:</b> Voltage offset for L2 – for information</p> <p><b>Byte 3:</b> Voltage offset for L3 – for information</p> |
| RetVal               | OUTPUT      | WORD      | Return message for execution                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

## 5.5 Error Tables

The tables below list the identifiers of all errors which can be reported for communication with the HS 724i via the S7 software.

### 5.5.1 Error messages of the S7 software

Table 5-1 Error messages of the S7 software

| System Errors   |                                                                                                                                                                                                                                                                                                           |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 808x            | System error for external DP interface                                                                                                                                                                                                                                                                    |
| 8090            | For the specified logical base address <ul style="list-style-type: none"> <li>You didn't configure a module.</li> <li>You didn't comply with the restriction on the length of consistent data.</li> <li>You didn't use hexadecimal format to specify the start address in the LADDR parameter.</li> </ul> |
| 8092            | An ANY reference contains a type which is not BYTE.                                                                                                                                                                                                                                                       |
| 8093            | There is no DP module from which you can read consistent data for the logical address specified under LADDR.                                                                                                                                                                                              |
| 80A0            | An access error was detected while accessing the I/O (read-access).                                                                                                                                                                                                                                       |
| 80A1            | An access error was detected while accessing the I/O (write-access).                                                                                                                                                                                                                                      |
| 80B0            | Failure of the slave on external DP interface                                                                                                                                                                                                                                                             |
| 80B1            | The length of the specified destination area is not the user data length configured with <i>STEP 7</i> .                                                                                                                                                                                                  |
| 80B2            | System error with external DP interface                                                                                                                                                                                                                                                                   |
| 80B3            | System error with external DP interface                                                                                                                                                                                                                                                                   |
| 80C0            | The data were not yet read from the module.                                                                                                                                                                                                                                                               |
| 80C1            | The data of the previous write job have not yet been processed by the module.                                                                                                                                                                                                                             |
| 80C2            | System error with external DP interface                                                                                                                                                                                                                                                                   |
| 80Fx            | System error with external DP interface                                                                                                                                                                                                                                                                   |
| 87xy            | System error with external DP interface                                                                                                                                                                                                                                                                   |
| 85xy            | System error with external DP interface                                                                                                                                                                                                                                                                   |
| Programm errors |                                                                                                                                                                                                                                                                                                           |
| A001            | Invalid job code transferred to FC_HS_AUFTRAG                                                                                                                                                                                                                                                             |
| A002            | No channel exists or too few fields parameterized.                                                                                                                                                                                                                                                        |
| A003            | Channel number 0 is not permitted.                                                                                                                                                                                                                                                                        |
| A004            | DB_HS_DIAG or DB_HS_IBS contains an invalid number for the HS 724i.                                                                                                                                                                                                                                       |
| A005            | DB_HS_DIAG or DB_HS_IBS contains an erroneous channel number 0.                                                                                                                                                                                                                                           |
| A007            | FC_HS_RESET may only be called when "heating off" mode is selected and no more jobs are being processed.                                                                                                                                                                                                  |
| Notes           |                                                                                                                                                                                                                                                                                                           |
| AFFF            | FC_HS_INIT is required. At least one HS 724i is not initialized.                                                                                                                                                                                                                                          |

## 5.5.2 Error Messages of the HS 724i

Table 5-2 Error messages of the HS 724i

|      |                                                                                                         |
|------|---------------------------------------------------------------------------------------------------------|
| A081 | General: Wrong job code                                                                                 |
| A082 | General: Wrong telegram header in first telegram                                                        |
| A083 | General: Wrong telegram header in second telegram                                                       |
| A084 | General: Job may only be executed during INIT                                                           |
| A085 | General: Only reset job is permitted.                                                                   |
| A086 | General: Job may only be executed during INIT.                                                          |
| A08A | FC_HS_RESET job: Wrong job length                                                                       |
| A090 | FC_HS_INIT job: Wrong job length with DP job 02                                                         |
| A091 | FC_HS_INIT job: Error in parameters of the first channel number                                         |
| A092 | FC_HS_INIT job: Error in parameters of the substitute values                                            |
| A093 | FC_HS_INIT job: Error in parameters of "control" mode                                                   |
| A094 | FC_HS_INIT job: Error in parameters of number of diagnostic repetitions                                 |
| A095 | FC_HS_INIT job: Error in parameters of power connection                                                 |
| A09A | FC_HS_INIT job: Wrong job length for DP job 03                                                          |
| A09B | FC_HS_INIT job: Error in test setting                                                                   |
| A0A0 | Channel setpoint 1 job: Wrong job length                                                                |
| A0A1 | Channel setpoint 1 job: Wrong channel number                                                            |
| A0A2 | Channel setpoint 1 job: Wrong setpoint (0.5% setting is not permitted due to type of control)           |
| A0A3 | Channel setpoint 1 job: Wrong setpoint (> 100%)                                                         |
| A0AA | Channel setpoint 2 job: Wrong job length                                                                |
| A0AB | Channel setpoint 2 job: Wrong channel number                                                            |
| A0AC | Channel setpoint 2 job: Wrong setpoint (0.5% setting is not permitted due to type of control)           |
| A0AD | Channel setpoint 2 job: Wrong setpoint (> 100%)                                                         |
| A0B0 | Channel setpoint startup job: Wrong job length                                                          |
| A0B1 | Channel setpoint startup job: Wrong channel number                                                      |
| A0B2 | Channel setpoint startup job: Wrong setpoint (0.5% setting is not permitted due to type of control)     |
| A0B3 | Channel setpoint startup job: Wrong setpoint (> 100%)                                                   |
| A0C0 | Field definition job: Wrong field number                                                                |
| A0C1 | Field definition job: Wrong field type                                                                  |
| A0C2 | Field definition job: Wrong channel number                                                              |
| A0C3 | Field definition job: First channel number is greater than second channel number (field types 0 and 1). |
| A0CA | Field factor production job: Wrong job length                                                           |
| A0CB | Field factor production job: Wrong field number                                                         |
| A0DA | Field factor standby job: Wrong job length                                                              |
| A0DB | Field factor standby job: Wrong field number                                                            |
| A0BA | Job for diagnostic setting, channel: Wrong job length                                                   |

Table 5-2 Error messages of the HS 724i

|      |                                                                            |
|------|----------------------------------------------------------------------------|
| A0BB | Job for diagnostic setting, channel: Wrong setting for type of diagnosis   |
| A0D0 | Job for diagnostic setting, channel: Wrong job length                      |
| A0D1 | Job for diagnostic setting, field: Wrong field number                      |
| A0D2 | Job for diagnostic setting, field: Wrong setting for the type of diagnosis |

# Data Transmission from/to a Non S7 DP Master

# 6

This chapter shows you how data are communicated between a DP master and the ZA 724 when no S7 function blocks (see chapter 5) are used.

The HS 724i can be used with any DP master.

The prerequisite is that the master must be able to process 32-bit consistent I/O data.

## 6.1 PROFIBUS-DP Interface

### Overview

The HS 724i is a DP slave which can be described with a GSD file and operated on any DP master. Since the HS 724i requires more data than PROFIBUS-DP is equipped to handle, telegram communication based on cyclic DP data was introduced. Since telegram communication requires time, some of the cyclic data remain intact in the input/output area so that certain data can be transferred quickly.

An input/output area of 32 bytes each is provided for the HS 724i. This area cannot be increased since the data must be consistently read and written by the DP master (due to telegram communication).

### I/O data

Division into four bytes of cyclic data and 28 bytes for telegram communication also applies to the input and output area.

In general the following statements apply. Input data are data which are transferred from slave to master. Output data are data which are transferred from master to slave.

Table 6-1 PROFIBUS-DP input/output area

| Byte | Description |               |
|------|-------------|---------------|
| 0-3  | 4 bytes     | Cyclic data   |
| 4-31 | 28 bytes    | Telegram data |

## 6.2 Telegram Data

The last 28 bytes of the DP data are reserved for telegram communication between master and slave. Each telegram consists of a two-byte telegram header containing the job code, and the user data in which the job data including the entire length of the job are stored. The telegram data themselves are described in chapter 6.3.

Table 6-2 Telegram layout

| Data            | Byte | Bit  | Meaning                                                                                                                                                                                                           |
|-----------------|------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Telegram header | 0    |      | Job code, is acknowledged by the HS 724i.                                                                                                                                                                         |
|                 | 1    | 6–0  | Sequence number, is acknowledged by the HS 724i.<br>If errors occur during transmission, the field number is entered here by the HS 724i.                                                                         |
|                 |      | 7    | Errors in the job, message by the HS 724i<br>0: No errors<br>1: Errors                                                                                                                                            |
| User data       | 2–3  | Byte | The net user data of the entire job are entered here in the first job (telegram with sequence number 0).<br>The length of a total job may not exceed 2000 bytes. Big Endian applies to storage of the WORD value. |
|                 | 4    | Byte | Data 1, ...                                                                                                                                                                                                       |
|                 | ...  |      |                                                                                                                                                                                                                   |
|                 | 27   | Byte |                                                                                                                                                                                                                   |

## **6.3 Telegram Sequence**

The job in the read direction uses the same principle but the data are located in the acknowledgment telegram of the HS 724i and are received by the DP master and evaluated.

Combined read/write jobs use the same procedure. Both the job of the DP master and the acknowledgment response of the HS 724i contain user data.

To be able to recognize a new job, the first byte which contains the job code must be cyclically polled on the HS 724i and evaluated. In an idle state, this byte is set to 0 by the DP master. A new job is initiated and processed by entering a valid job code. After the last telegram of the job is acknowledged by the HS 724i, the DP master resets the job byte back to idle status 0. Two jobs are always separated by the idle status between DP master and HS 724i. In idle status, the remaining 27 bytes can be disregarded.

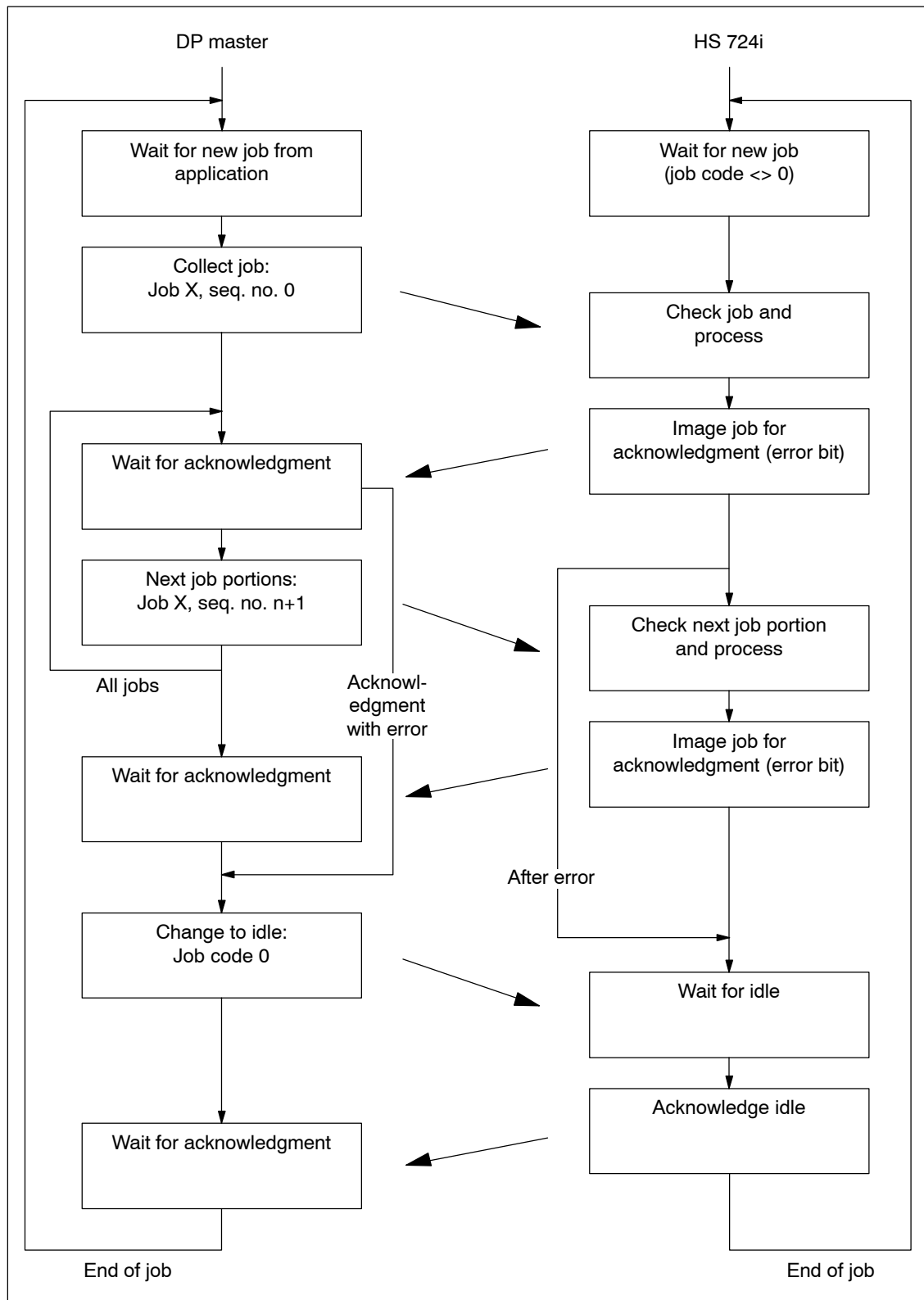


Figure 6-1 Flowchart of a telegram sequence

## 6.4 Cyclic Data

Cyclic data are used to exchange information between master and slave which should cause an immediate reaction. These are data which only exist once per HS 724i.

These cyclic data bytes are cyclically polled and evaluated both on the DP master and the HS 724i.

The following tables list and explain these data.

Table 6-3 Meaning of the cyclic input data

| Byte | Bit  | Meaning                                                                                                                                                                                                                                                                                                          |
|------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0    | 0–1  | Initialization phase (info via the HS 724i)<br>00: HS 724i is in the initialization phase.<br>11: Initialization phase concluded. HS 724i is ready.<br>01 or 10: Initialization phase concluded. HS 724i is not ready.                                                                                           |
|      | 4–2  | Return message of the operating mode (response to preselection of the master)<br>001: Startup<br>010: Heating off<br>100: Standby mode<br>101: Production mode, profile 1<br>111: Production mode, profile 2<br>Message of a change in mode by HS 724i (after error)<br>000: New selection of mode is necessary. |
|      | 5    | 1: General error occurred on HS 724i<br>The bit indicates changes and remains set until the info is fetched via job 20 (general diagnosis).                                                                                                                                                                      |
|      | 6    | 1: Channel error on HS 724i occurred<br>The bit indicates changes and remains set until the info is fetched via job 21 (channel diagnosis).                                                                                                                                                                      |
|      | 7    | 1: Channel warning on HS 724i occurred<br>The bit indicates changes and remains set until the info is fetched via job 22 (warning channel).                                                                                                                                                                      |
| 1    | Byte | Voltage offset value of NE 724 for L1                                                                                                                                                                                                                                                                            |
| 2    | Byte | Voltage offset value of NE 724 for L2                                                                                                                                                                                                                                                                            |
| 3    | Byte | Voltage offset value of NE 724 for L3                                                                                                                                                                                                                                                                            |

Table 6-4 Meaning of the cyclic output data

| Byte | Bit  | Meaning                                                                                                                                                             |
|------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0    | 0-1  | Reserved                                                                                                                                                            |
|      | 4-2  | Preselection of mode (by the master)<br>001: Startup<br>010: Heating off<br>100: Standby mode<br>101: Production mode, profile 1<br>111: Production mode, profile 2 |
|      | 5-7  | Reserved                                                                                                                                                            |
| 1    | Byte | Voltage offset value of master for L1                                                                                                                               |
| 2    | Byte | Voltage offset value of master for L2                                                                                                                               |
| 3    | Byte | Voltage offset value of master for L3                                                                                                                               |

Bits 2 to 4 in byte 0 of the cyclic data are used for the master control or slave response message bits which communicate with each other.

## 6.5 Jobs (Telegram Data)

Jobs in the data area of telegrams are used to transfer large amounts of data between DP master and HS 724i which, due to the amount, cannot be exchanged cyclically in the input/output area by PROFIBUS-DP.

Jobs 01, 02 and 03 are initialization jobs. They must be transferred in the right order. All other jobs can be transferred in any order and number.

### 6.5.1 Job 01: Read Module Information

This job is used to read the current status of the HS 724i during startup and evaluate it in the DP master application.

This is a read-only job.

Table 6-5 Reading module information

| Byte <sup>1</sup> | Meaning                                                                                                                                                                                                      |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0                 | Information via first module to ZA 724 (first module row)<br>0x00: No module exists.<br>0x01: LA 724i exists.<br>0x02: LA 724i HP exists.<br>0x10: LA 724i SSR exists.<br>0xFF: Old LA 724 found (error)     |
| ...               | ...                                                                                                                                                                                                          |
| 15                | Information on sixteenth module to ZA 724 (second module row)<br>0x00: No module exists.<br>0x01: LA 724i exists.<br>0x02: LA 724i HP exists.<br>0x10: LA 724i SSR exists.<br>0xFF: Old LA 724 found (error) |
| 16                | Information on NE 724<br>0: No module exists.<br>1: NE 724 exists.                                                                                                                                           |
| 17                | Information on ZA 724<br>0: Reserved                                                                                                                                                                         |
| 18–23             | Information on HS 724i firmware (length: 6 bytes)<br>Version xx.yy Build zz                                                                                                                                  |

- 1 The byte numbering of this and all following jobs refers to the telegram data area which begins in a telegram starting with byte 4. However, the first telegram of a job does not begin until byte 6 since the user data length is entered here.

## 6.5.2 Job 02: Load Configuration Parameters

This job is used to configure the HS 724i and, based on this, initializations are performed in the HS 724i firmware.

This job is a write-only job.

Table 6-6 Loading the configuration parameters

| Byte | Meaning                                                                                                                                                                                                                                            |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0,1  | Number of the first channel of the HS 724i when a network of HS 724i devices on one DP master is being used.                                                                                                                                       |
| 2    | Activation of the channels in case of error (PROFIBUS error)<br>0: Outputs are no longer activated (setpoint 0%).<br>1: All outputs retain the last set value.                                                                                     |
| 3    | Voltage offset function<br>0: Disabled<br>1: Enabled<br>This affects all existing HS 724i devices.                                                                                                                                                 |
| 4, 5 | Nominal value of voltage (e.g., 230 V) is used <ul style="list-style-type: none"> <li>as standardized value for voltage offset</li> <li>for power calculation without NE 724</li> </ul>                                                            |
| 6    | Parameter 2 for NE 724<br>Integration time for voltage offset in multiples of 300 msec                                                                                                                                                             |
| 7    | Configuration of diagnosis (1)<br>Length of pause between two diagnostic cycles in multiples of the duration of one diagnostic cycle<br>When 255 is entered, the diagnostic cycle is disabled.                                                     |
| 8    | Configuration of diagnosis (2)<br>Length of pause between the test of two channels in multiples of the duration of one channel test                                                                                                                |
| 9    | Number of repetitions until an error is sent to the DP master<br>0: Error is detected and reported.<br>1 to 10: Error must be detected in 1 to 10 consecutive diagnostic cycles.                                                                   |
| 10   | Selection for activation of the circuit breakers<br>0: Half-wave mode (time base: 1 sec)<br>1: Full-wave mode (time base: 2 sec)<br>2: Half-wave mode, 0.5% increments (time base: 2 sec)<br>3: Full-wave mode, 0.5% increments (time base: 4 sec) |
| 11   | Selection of mode for the connected radiant heaters<br>0: Operation on 230 V<br>1: Operation on 400 V                                                                                                                                              |
| ...  | Other required parameters or reserved for future expansions (e.g., operating phase cut)                                                                                                                                                            |

### 6.5.3 Job 03: Execution of Tests

This job can be used to trigger certain tests on the HS 724i. The results must then be evaluated by the DP master application. This means that this job involves both read and write accesses. The job must be executed since the HS 724i cannot exit the INIT state otherwise.

Table 6-7 Execution of tests

| Byte | Meaning                                                                                                                 |                                                                                                                                               |
|------|-------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| 0    | Power frequency test<br>1: Test is performed.                                                                           | Test results of HS 724i<br>50: 50 Hz<br>60: 60 Hz                                                                                             |
| 1    | Phase sequence test<br>0: Test is not performed.<br>1: Test is performed.                                               | Test results of HS 724i                                                                                                                       |
| 2, 3 | Setting of phase sequence test per LA 724i xx (one bit exists for each LA 724i xx)<br>Bit = 0: No test<br>Bit = 1: Test | Results of the phase sequence test (one bit exists for each LA 724i)<br>Bit = 0: Test without errors<br>Bit = 1: Error in phase sequence test |

### 6.5.4 Jobs 04, 05 and 06: Transfer Channel Setpoints

These jobs are used to transfer the setpoints for a channel. Depending on which operating modes are used, one job or all jobs must be transferred to the HS 724i.

If, for instance, the mode "startup" or "profile 2" is not needed, it is sufficient to transfer the setpoints for "production" (profile 1) via job 04 (mode as on HS 724i).

All setpoints can always be overwritten. As long as no setpoint was transferred, the initialization value 0% is used. The value range for the setpoint is 0 to 100 (basis of 1%).

A sub setting of 0.5% can be specified by setting bit 7 in the setpoint.

Table 6-8 Transferring the channel setpoints

| Byte | Bit | Meaning<br>Job 04                                   | Meaning<br>Job 05                       | Meaning<br>Job 06    |
|------|-----|-----------------------------------------------------|-----------------------------------------|----------------------|
| 0,1  | 0   | Channel number                                      |                                         |                      |
| 2    | 6–0 | Setpoint for standby and production mode, profile 1 | Setpoint for production mode, profile 2 | Setpoint for startup |
| 2    | 7   | 0: Setpoint,0<br>1: Setpoint,5                      |                                         |                      |
| 3,4  |     | Channel number                                      |                                         |                      |
| ...  | ... | ...                                                 | ...                                     | ...                  |

### 6.5.5 Job 07: Field Assignment

This job can be used to combine channels into fields so that the setpoints of the channels can be changed with a common field factor.

There are three field types.

- Specification of the first and last channel of a field using each channel or every other channel
- Specification of all channels

A maximum of 127 fields can be defined beginning with the number 1 (field 0 is reserved).

Table 6-9 Field assignment

| Byte          | Meaning                                                     |
|---------------|-------------------------------------------------------------|
| 0             | Field number                                                |
| 1             | Field type 0: All channels between beginning and end        |
| 2, 3          | Starting channel number                                     |
| 4, 5          | Ending channel number                                       |
| 6             | Field number                                                |
| 7             | Field type 1: Every other channel between beginning and end |
| 8, 9          | Starting channel number                                     |
| 10, 11        | Ending channel number                                       |
| 12            | Field number                                                |
| 13            | Field type 2: List with channels                            |
| 14, 15        | Number of subsequent channels                               |
| 16, 17        | Number of channel a                                         |
| 18, 19        | Number of channel b                                         |
| ...           | ...                                                         |
| 18+x,<br>19+x | Number of channel z                                         |
| ...           | ...                                                         |

### 6.5.6 Job 08: Field Factor for Production Mode

This job can be used to transfer the production value for each defined field. The value range for the production value is 0 to 255 (basic factor 0.01). If configured, this value applies to both profiles of production mode.

If the value 100% is exceeded when channel setpoint and field factor are multiplied, the value is set to 100% and a warning message is sent to the DP master.

Table 6-10 Field factor for production mode

| Byte | Meaning                      |
|------|------------------------------|
| 0    | Field number x               |
| 1    | Production value for field x |
| ...  | ...                          |

### 6.5.7 Job 09: Field Factor for Standby Mode

This job can be used to transfer the standby value for each defined field. The value range for the standby value is 0 to 255 (basic factor 0.01).

If the value 100% is exceeded when channel setpoint and field factor are multiplied, the value is set to 100% and a warning message is sent to the DP master.

Table 6-11 Field factor for standby mode

| Byte | Meaning                      |
|------|------------------------------|
| 0    | Field number x               |
| 1    | Production value for field x |
| ...  | ...                          |

### 6.5.8 Job 10: Channel Diagnosis

Each channel can be parameterized to specify how it is to be checked. There are two types of diagnosis: standard diagnosis and expanded diagnosis via current measurement.

Since the latter is only useful for the recognition of parallel radiant heaters, the following two values are defined per channel.

- The nominal power to be expected
- The maximum permissible deviation from this value

If there is no NE 724 in the system, a voltage of 230 V is assumed for the required current calculation.

After initialization, the channel check is always enabled. The host controller handles the field diagnosis.

Table 6-12 Channel diagnosis

| Byte     | Meaning                                                                              |
|----------|--------------------------------------------------------------------------------------|
| 0, 1     | Channel number x                                                                     |
| 2        | 0: Channel x is not checked.                                                         |
| ...      |                                                                                      |
| n, n+1   | Channel number y                                                                     |
| n+2      | 1: Channel y is checked with the standard diagnosis.                                 |
| ...      |                                                                                      |
| m, m+1   | Channel number z                                                                     |
| m+2      | 2: Channel z is checked with the expanded diagnosis.                                 |
| m+3, m+4 | Nominal power to be expected for the channel (in W), as related to 230 V             |
| m+5, m+6 | Permissible deviation from nominal power for the channel (in W), as related to 230 V |
| ...      |                                                                                      |

### 6.5.9 Job 11: Field Diagnosis

The standard setting is that all fields are disabled for the diagnosis. The diagnosis can be enabled for each field for all channels belonging to the field.

The type of diagnosis (standard diagnosis or diagnosis via current measurement) is set separately for each channel. A channel can only be checked when the diagnosis is enabled in both the channel description and the field description.

Table 6-13 Field diagnosis

| Byte | Meaning                                                                                                                                                  |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0    | Field number x                                                                                                                                           |
| 1    | Setting of the diagnosis for field x<br>0: No channels of field x are checked.<br>1: All channels of field x which are enabled for the test are checked. |
| ...  |                                                                                                                                                          |

### 6.5.10 Job 20: General Diagnosis

This job can be used to read general errors from the error buffer of the HS 724i. The job should be triggered when an error was indicated in the cyclic data. The error buffer is not cleared by reading the error.

The job is always transferred with a fixed length. If no error exists, the contents of all error bytes is 0.

Table 6-14 General diagnosis

| Byte | Meaning                                                                                                                                                                                                                           |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0    | Error with system power acquisition for phase L1                                                                                                                                                                                  |
| 1    | Error with system power acquisition for phase L2                                                                                                                                                                                  |
| 2    | Error with system power acquisition for phase L3                                                                                                                                                                                  |
| 3    | Error during initialization of the HS 724i<br>0x01: Old power output found<br>0x02: Power output/load controller without ID found<br>0x04: Frequency could not be determined.<br>Several errors can be reported at the same time. |
| 4    | Error on the first module (first module row)<br>1: Temperature warning threshold exceeded (LA 724i/LA 724i HP)<br>2: Temperature shutoff threshold exceeded (LA 724i/LA 724i HP)<br>3: 24 V voltage failed (LA 724i SSR)          |
| ...  | ...                                                                                                                                                                                                                               |
| 19   | Error on the sixteenth module (second module row)<br>1: Temperature warning threshold exceeded (LA 724i/LA 724i HP)<br>2: Temperature shutoff threshold exceeded (LA 724i/LA 724i HP)<br>3: 24 V voltage failed (LA 724i SSR)     |

### 6.5.11 Job 21: Channel Diagnosis

This job can be used to read channel errors from the error buffer of the HS 724i. The job should be triggered when an error is indicated in the cyclic data. The error buffer is not cleared by reading the error. Only changes are transferred. A response with the length 0 means that no new information is available.

Table 6-15 Channel diagnosis

| Byte | Meaning                                                                                                                                                                                                               |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0, 1 | Channel number                                                                                                                                                                                                        |
| 2    | Channel error<br>0: Output is okay.<br>1: Error type 1<br>2: Error type 2<br>3: Error type 2, external<br>4: Error type 3<br>5: Error type 4<br>6: Error type 5<br>(For information on error types, see chap. 4.4.4.) |
| 3, 4 | Channel number                                                                                                                                                                                                        |
| 5    | Channel error                                                                                                                                                                                                         |
| ...  | ...                                                                                                                                                                                                                   |

### 6.5.12 Job 22: Channel Warning

This job can be used to read warnings from the warning buffer of the HS 724i which are generated by the calculation of channel setpoints. The job should be triggered when a warning was indicated in the cyclic data. The warning buffer is not cleared when the warning is read. Only changes are transferred. A response with the length of 0 means that no new information is available.

Table 6-16 Channel warning

| Byte | Meaning                                                                                                                                                               |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0, 1 | Channel number                                                                                                                                                        |
| 2    | Channel warning<br>0: Output is okay.<br>1: Erroneous manipulated variable through setpoint x field value<br>2: Erroneous manipulated variable through voltage offset |
| 3, 4 | Channel number                                                                                                                                                        |
| 5    | Channel warning                                                                                                                                                       |
| ...  | ...                                                                                                                                                                   |

### 6.5.13 Job 23: Trigger Diagnostic Cycle

This job can be used to trigger a complete, one-time diagnostic cycle to test all channels. This is useful during commissioning or for heating processes which should not be affected cyclically by a diagnostic cycle. A diagnostic cycle can also be triggered by this job when no diagnostic cycle is configured. The results of this cycle are not entered in the error buffer of the HS 724i. Instead they are immediately transferred to the DP master application in the response telegrams.

The status is reported for all channels of all LA modules recognized during startup since the job has no way to tell which channels are actually connected.

For return message, see chapter 6.5.11

### 6.5.14 Job 30: Read Current Channel Manipulated Variable

Since the channel manipulated variable is generated from the channel set-point, the currently valid field factor and the offset value of the voltage offset, the current value can be read from the HS 724i.

The manipulated variable is between 0 and 100 (basis of 1%).

The manipulated variable is transferred for all channels of all LA modules recognized during startup.

Table 6-17 Reading the current channel manipulated variable

| Byte | Meaning                            |
|------|------------------------------------|
| 0, 1 | Channel number x                   |
| 2    | Manipulated variable for channel x |
| ...  | ...                                |

### 6.5.15 Job 31: Read the Current Actual Channel Values

This job is used to read the current and power value of the specified channel. The power value is not available unless an NE 724 is installed on the HS 724i. The measured values of all channels for all LA modules recognized during startup are transferred.

---

**Caution**

The value of the current is measured when this job is processed. This means that, when a channel is measured, it is turned on for one full wave and the other seven channels of the phase are turned off. Since this affects the process, it should only be used when commissioning takes place.

---

Table 6-18 Reading the current actual channel values

| Byte | Meaning                                                        |
|------|----------------------------------------------------------------|
| 0, 1 | Channel number x                                               |
| 2, 3 | Value of the current for channel x (in A, basis of 0, 1)       |
| 4, 5 | Power value for channel x (in W, basis of 1, only with NE 724) |
| ...  | ...                                                            |

### 6.5.16 Job 32: Read the Current Temperature Values

This job is used to read the current temperature value on the LA 724i/LA 724i HP. A measured value is transferred for all recognized LA modules. 0 is transferred for the slots in which an LA 724i SSR is installed.

The measured value is invalid when the maximum temperature threshold is exceeded.

Table 6-19 Reading the current temperature values

| Byte | Meaning                                            |
|------|----------------------------------------------------|
| 0    | Module numbers 1 to 16 (first and second row)      |
| 1, 2 | Temperature measured value (0 SSR, 0xFFFF invalid) |
| ...  | ...                                                |

### 6.5.17 Job 40: Reset

This job causes the HS 724i to perform a new start by executing an SW reset. From the DP master side, a new initialization of the HS 724i must be performed.

The job is acknowledged before the reset is performed.

Other than the job code, the job contains no data. It can always be executed.

## 6.6 Error Table

The following table lists the error numbers which can occur while jobs are being transferred. The error message occurs when the job is acknowledged as described in chapter 6.2.

Table 6-20 Error messages of the HS 724i when jobs are transferred

|      |                                                                               |
|------|-------------------------------------------------------------------------------|
| 0x80 | Everything okay                                                               |
| 0x81 | Wrong job code                                                                |
| 0x82 | Wrong telegram header in first telegram                                       |
| 0x83 | Wrong telegram header in subsequent telegram                                  |
| 0x84 | Job may only be executed during INIT.                                         |
| 0x85 | Only reset job is permitted.                                                  |
| 0x86 | Job may only be executed after INIT.                                          |
| 0x8A | Job 40: Wrong job length                                                      |
| 0x90 | Job 02: Wrong job length                                                      |
| 0x91 | Job 02: Error in parameter of first channel number                            |
| 0x92 | Job 02: Error in parameter of substitute values                               |
| 0x93 | Job 02: Error in parameter of activation mode                                 |
| 0x94 | Job 02: Error in parameter of number of diagnostic repetitions                |
| 0x95 | Job 02: Error in parameter of power connection                                |
| 0x9A | Job 03: Wrong job length                                                      |
| 0x9B | Job 03: Error in test setting                                                 |
| 0xA0 | Job 04: Wrong job length                                                      |
| 0xA1 | Job 04: Wrong channel number                                                  |
| 0xA2 | Job 04: Wrong setpoint (0.5% setting is not permitted due to activation type) |
| 0xA3 | Job 04: Wrong setpoint (> 100%)                                               |
| 0xAA | Job 05: Wrong job length                                                      |
| 0xAB | Job 05: Wrong channel number                                                  |
| 0xAC | Job 05: Wrong setpoint (0.5% setting is not permitted due to activation type) |
| 0xAD | Job 05: Wrong setpoint (> 100%)                                               |
| 0xB0 | Job 06: Wrong job length                                                      |

Table 6-20 Error messages of the HS 724i when jobs are transferred

|      |                                                                                          |
|------|------------------------------------------------------------------------------------------|
| 0xB1 | Job 06: Wrong channel number                                                             |
| 0xB2 | Job 06: Wrong setpoint (0.5% setting is not permitted due to activation type)            |
| 0xB3 | Job 06: Wrong setpoint (> 100%)                                                          |
| 0xC0 | Job 07: Wrong field number                                                               |
| 0xC1 | Job 07: Wrong field type                                                                 |
| 0xC2 | Job 07: Wrong channel number                                                             |
| 0xC3 | Job 07: First channel number is greater than second channel number (field types 0 and 1) |
| 0xCA | Job 08: Wrong job length                                                                 |
| 0xCB | Job 08: Wrong field number                                                               |
| 0xDA | Job 09: Wrong job length                                                                 |
| 0xDB | Job 09: Wrong field number                                                               |
| 0xBA | Job 10: Wrong channel number                                                             |
| 0xBB | Job 10: Wrong setting for the type of diagnosis                                          |
| 0xD0 | Job 11: Wrong job length                                                                 |
| 0xD1 | Job 11: Wrong field number                                                               |
| 0xD2 | Job 11: Wrong setting for the type of diagnosis                                          |

## Order numbers

### Components of the HS 724i

Table A-1      Order numbers of the components of the HS 724i

| Component                        | Order Number        |
|----------------------------------|---------------------|
| ZA 724 central interface         | 6BK1 700-2BA30-0AA0 |
| LA 724i power output             | 6BK1 700-2BA00-0AA0 |
| LA 724i HP power output          | 6BK1 700-2BA20-0AA0 |
| LA 724i SSR load controller      | 6BK1 700-2BA10-0AA0 |
| NE 724 system power acquisition  | 6ES7 171-1XX00-6AA0 |
| LM 724 fan module                | 6ES7 171-3AA00-0AA0 |
| SM 724i current measuring module | 6BK1 700-2BA40-0AA0 |

## Accessories

Table A-2 Order numbers of the accessories for the HS 724i

| Accessory                                                                                                        | Order Number                                                                                                                                                                                                                                                                       |
|------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ZA 724</b>                                                                                                    |                                                                                                                                                                                                                                                                                    |
| Heating controller ribbon cable for connection of 2nd row                                                        | 6ES7 171-1XX00-5AA0                                                                                                                                                                                                                                                                |
| <b>LA 724i / LA 724i HP</b>                                                                                      |                                                                                                                                                                                                                                                                                    |
| Counter plug for radiant heater connection (L1s, L2s, L3s)<br>Company: Phönix, IC 2.5/8STF-5.08                  | Siemens A&D SE: 40018384<br>Phönix: 1825378                                                                                                                                                                                                                                        |
| Fuses for LA 724i:<br>5 A, rapid-action/250 V<br>Ceramic casing, 5 x 20 mm                                       | Siemens A&D SE: 41760372<br>Wickmann: 19415000001                                                                                                                                                                                                                                  |
| Fuses for LA 724i HP:<br>10 A, rapid-action/500 V<br>Ceramic casing, 6.3 x 32 mm                                 | Siemens A&D SE: A5E00197323<br>SIBA: 7006563.10SA                                                                                                                                                                                                                                  |
| <b>LA 724i SSR</b>                                                                                               |                                                                                                                                                                                                                                                                                    |
| Counter plug for 24 V power<br>Company: Weidmüller, BL 3.5/2F                                                    | Siemens A&D SE: A5E00210675<br>Weidmüller: 160664                                                                                                                                                                                                                                  |
| Counter plug for connection of SSR (SSR L1, SSR L2, SSR L3)<br>Company: Weidmüller, BL 3.5/8                     | Siemens A&D SE: A5E00043661<br>Weidmüller: 159742                                                                                                                                                                                                                                  |
| Counter plug for connection of SM 724i current measuring module (Current Sense)<br>Company: Weidmüller, BL 3.5/6 | Siemens A&D SE: A5E00210670<br>Weidmüller: 159740                                                                                                                                                                                                                                  |
| Counter plug for voltage monitoring of phase Lx (L1d, L2d, L3d)<br>Company: Phönix, IC 2.5/8STF-5.08             | Siemens A&D SE: 40018384<br>Phönix: 1825378                                                                                                                                                                                                                                        |
| Solid State Relay (SSR)                                                                                          | Semi-conductor relay/contactor<br>SIRIUS SC<br>(e.g., 3RF2 350-1AA02):<br>Semi-conductor contactor, 50 A, 40 °C,<br>control voltage 24 V, screw connection<br>More information under:<br><a href="http://siemens.hl-studios.de/siriussc">http://siemens.hl-studios.de/siriussc</a> |

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