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SIEMENS

Add 7
AddFEM (Front End Module)

Manual **Version 01 / 2003**

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Automation & Drives Group
Systems Engineering
D-76181 Karlsruhe

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Order No. C79000–G8076–C900
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SIEMENS

Add 7

AddFEM
Front **E**nd **M**odule

Manual

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Front Connector Pin Assignment A

C79000–G8076-C900-04

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Safety Guidelines

This document contains information which you have to observe for your personal safety as well as in order to avoid damage to property. The information on your personal safety are highlighted by a warning triangle. Information on general damage to property do not have a warning triangle. Depending on the degree of danger they are indicated as follows:



Danger

Means that death, serious injury or considerable damage to property **will** result if the corresponding precautionary measures are not taken.



Warning

Means that death or serious injury **can** result if the corresponding precautionary measures are not taken.



Caution

With warning triangle means that minor injury can result if the corresponding precautionary measures are not taken.

Caution

Without warning triangle means that damage to property can result if the corresponding precautionary measures are not taken.

Notice

Means that undesired results or states can occur if the corresponding information is not observed.

Qualified Personnel

Commissioning and operation of a device may only be carried out by **qualified personnel.** Qualified personnel in the sense of the safety instructions in this manual are persons who are entitled to commission, ground and identify devices, systems and circuits in accordance with the standards of safety technology.

Normal Use

Please note the following:



Warning

The device may only be used for the applications described in the catalog and in the technical description and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens.

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Exclusion of liability

We have checked the contents of this manual for agreement with the hardware and software described. Since deviations cannot be precluded entirely, we cannot guaranteefull agreement. However, the data in the manual are reviewed regularly and any necessary corrections included in subsequent editions. Suggestions for improvement are welcomed.

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Preface

Add 7 Product Family

The Add 7 product family provides add–on products which allow the inexpensive realization of high or specific requirements from process control and automation technology. These products are based on many years of experience in process control technology as well as extensive knowledge of the current system generation 7 in the Siemens automation program “Totally Integrated Automation”.

As a member of the Add 7 product family, the AddFEM front end module is designed specifically for the special task of controlling turbines rapidly (different signal types, redundancy, rapid detection and preprocessing, etc.).

Extensions

6DL3100–8AB provides the possibility to use the AddFEM redundantly (module redundancy) and/or to edit preprocessing functions on the AddFEM.With 6DL3100–8AC it is possible to parameterize the AddFEM during current operation with DPV1 services.

Further Support

Should you have any questions on the products described which are not answered in this documentation, please contact your local Siemens partner.

CE Approval



Our products fulfill the requirements of the EU guideline 89/336/EEC “Electromagnetic Compatibility” and the EU guideline 73/23/EEC “Low voltage guideline” as well as the harmonized European standards (EN) listed in these guidelines.

In accordance with the above–mentioned EU guidelines the EU declaration of conformity are held available for the responsible authorities at:

Siemens Aktiengesellschaft

Automation and Drive Technology Division

A&D SE S21

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Area of Application

1

Overview

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1.1 Categorization and Features

The Add 7 product family provides add–on products which allow the implementation of high or specific requirements from process control and automation technology.

As a member of the Add 7 product family, the front end module is designed specifically for the special task of controlling turbines rapidly (different signal types, redundancy, rapid detection and preprocessing, etc.). AddFEM can be used to implement gas, steam, industrial and water turbine control systems. AddFEM can furthermore be used to implement automation and control applications which require short system reaction times.

1.1.1 AddFEM

The technical combination possibilities of the AddFEM are manifold. It can be used with SIMATIC M7 and SIMATIC S7 as well as with SIMADYN D.
The AddFEM is controlled by the higher–level host (SIMATIC M7, SIMATIC S7 or SIMADYN D) via the PROFIBUS–DP bus system. The control and automation function is realized in the automation processor.

Signal Inputs and Outputs

The AddFEM has analog and digital inputs and outputs as well as counting pulse inputs for speed detection.
The number of the different signal types is structured so that one AddFEM module is sufficient for small applications due to the optimally designed signal mix, whereas several modules can naturally be used for more complex solutions.

The following signal inputs and outputs are available per AddFEM on the individual signal types:

- 12 analog inputs of which 6 can be used as current inputs and 6 optionally as current or voltage inputs (configurable via the SIMATIC Manager or COM PROFIBUS)
- 8 analog outputs
- 15 digital inputs, of which 3 can be used as counting pulse inputs for speed detection with and without recognition of the direction of rotation
- 16 digital outputs which can also be used as digital inputs.

The measuring ranges of the analog inputs and analog outputs are designed so that no additional signal measuring transducers have to be used when the AddFEM is used for turbine control systems. In addition to the measuring ranges of 0 to 20 mA, 4 to 20 mA and ±20 mA common for current inputs and outputs, a measuring range of ±30 mA mA is also available. An additional current range ±50 mA at the analog outputs means that actuating elements with a higher current consumption, such as fuel control valves, can also be controlled without an additio-

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nal signal amplifier.

Both analog and digital outputs are resistant to short circuits. All the outputs are monitored and can be connected in parallel with other outputs. The analog and digital areas are isolated from each other.

Please also refer to Chapter 4 for further technical data of the inputs and outputs.

Increasing the Availability through Redundancy

Redundancy in this context means the implementation of a ”1–of–2” structure, whereby the availability is increased by the parallel use of two AddFEM units. If an AddFEM fails due to a fault, the second AddFEM takes over the function. In the case of an AddFEM 6DL3100–8AA the redundancy is configured to the automation processor. In the case of an AddFEM 6DL3100–8AB/–8AC the redundancy control is implemented as a system utility of the AddFEM. To this purpose a redundancy coupling via optical–fiber cable is used to transfer status and update information. Extensive redundancy mechanisms and self–diagnostic functions which are integrated in the AddFEM ensure automatic error recognition and changeover without any manual interventions being required.

Redundancy of PROFIBUS DP Connection

The AddFEM has two PROFIBUS DP interfaces (DP A and DP B) which operate in parallel. This allows redundant system structures to be implemented. As a rule the process input information is transferred in parallel via both PROFIBUS DP interfaces. By contrast only the process output information of the DP interface which is currently active is transferred to the output pins. The process output information of the currently passive DP interface is analyzed for monitoring purposes. The master–reserve status of the two DP interfaces, meaning which DP interface is active with regard to the output information and which interface is passive, can be specified by the automation processor.

Preprocessing Functions

The AddFEM offers the possibility of relocating automation subfunctions, such as the positioner at turbine control systems, as preprocessing functions on the AddFEM module. These preprocessing functions are called Front End Functions (FEF).

GSD File

If the AddFEM is used with SIMATIC S7, the PROFIBUS DP parameters as well as the properties of the AddFEM inputs and outputs (for example, measuring ranges, filtering, etc.) are configurable by means of HW Config in the SIMATIC Manager. The corresponding settings are carried out by means of the COM–PROFIBUS software package when used under SIMADYN D. In both cases the so–called GSD file of the AddFEM has to be linked before configuration begins. The GSD file describes the possibilities for setting the AddFEM and is called either

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SIEM80A3.GSE (English) or SIEM80A3.GSG (German) for 6DL3100–8AA/–8AB. For the variant 6DL3100–8AC the GSD file is called SIxx80A3.GSG or SIxx80A3.GSE (xx = version, e.g. 01).

Module Supply

The module supply of the AddFEM is designed for the nominal voltage of 24 V DC. The typical wattage amounts to 20 W. Voltage dips of up to 10 ms are overwritten. The making current is limited to 3 A.
The 24 V DC load supply for the analog outputs is supplied by the AddFEM. The 24 V DC load supply for the digital outputs must be generated externally and fed via the X7 connector.

Structure

The AddFEM housing consists of stainless steel and is prepared for screw as well as for DIN rail mounting.

The signal states of the digital inputs and outputs are indicated via signal LEDs.

The operating and error status of the AddFEM are indicated by 12 separate LEDs. The operating status is set via a key–operated switch and a slide switch.

There are 8 connectors with 10 pins each (total of 80 I/O pins) on the front of the AddFEM. These can be used to connect the process input and output signals.

Approvals

In addition to a CE approval the AddFEM also has a UL/CSA certification.

1.1.2 Applications of the variants 6DL3100–8AC

The extension of the AddFEM with DPV1 services is particularly suitable to supply front end functions (FEF) with parameter data as required (acyclically). With this extension configuration changes can also be carried out during running operation (Configuration in RUN). CiR allows the AddFEM to be reparameterized in order, for example, to activate unused channels or to reparameterize channels already used for spare–part applications when a sensor with a different specification is used. It is furthermore possible to signals alarms with an implicit acknowledgment mechanism. This functionality can be used by front–end functions.

PROFIBUS DPV1

The variant 6DL3100–8AC (DPV1 slave) supports DPV1 services in accordance with IEC 61158, Part 3–6. The DP master must naturally also fulfill these requirements (refer to the documentation of the DP master).

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PROFIBUS DPV2

The variant 6DL3100–8AC accepts the PrmCommand for changing over the communication redundancy (changeover between DPV1 Channel A and DPV1Channel B) in accordance with PROFIBUS Guideline 2.212 and makes the redundancy status available as a diagnosis.

The following table lists the new functions of the AddFEM DPV1 slave:

Function	DPV0 slave 6DL3100–8AA/–8AB	DPV1 slave 6DL3100–8AC	Remark
Cyclic data traffic	X	X	
Acyclic data traffic (read/write record). DP Master Class 1 service (parameterize master). Class 2 services are not supported (e.g. programming device)	–	X	Parameterization of the AddFEM during running. This means in particular that parameter values can be supplied to the front–end function.
Diagnostics			
· Device–specific diagnostics	X	–	
· Identifier–specific diagnostics	–	X	One alarm can be signaled per diagnostic message.
· Module status	–	X	
· Channel–specific diagnostics	–	X	
Alarms			
· Manufacturer–specific alarms	–	X	This alarm can be used by a front–end function.
Redundancy changeover Changeover of the communication redundancy of DPV1 Channel A and DPV1 Channel B.	–	X	Changeover with PrmCommand and signal the redundancy status as the diagnosis.

Further information on configuration in the host system can be found in the manual of the respective FEF. The manuals of the FEFs are stored on the AddFEM CD in the directory of the corresponding order number.

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1.1.3 Driver Blocks

Depending on the automation processor used the AddFEM can be controlled via driver blocks or – as in the case of turbine applications with SYMADYN D – supplied via PROFIBUS user messages directly from the user program.

Driver blocks are available for the SIMATIC S7:

Distribution via:

Siemens Aktiengesellschaft
Automation and Drive Technology Division
A&D SE S21 V
Siemensallee 84
D-76187 Karlsruhe

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Design

2

Overview

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2.2	Operating and Display Elements	2-3
2.3	Connection Elements	2-7

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2.1 Structure of the AddFEM

The AddFEM encompasses the following units in a stainless–steel housing: Power supply unit, processors, PROFIBUS DP interfaces, interfaces for process input and output signals, redundancy and service interface as well as switches and status displays.

All the connection elements are covered with a cover on which the connection designations are printed.

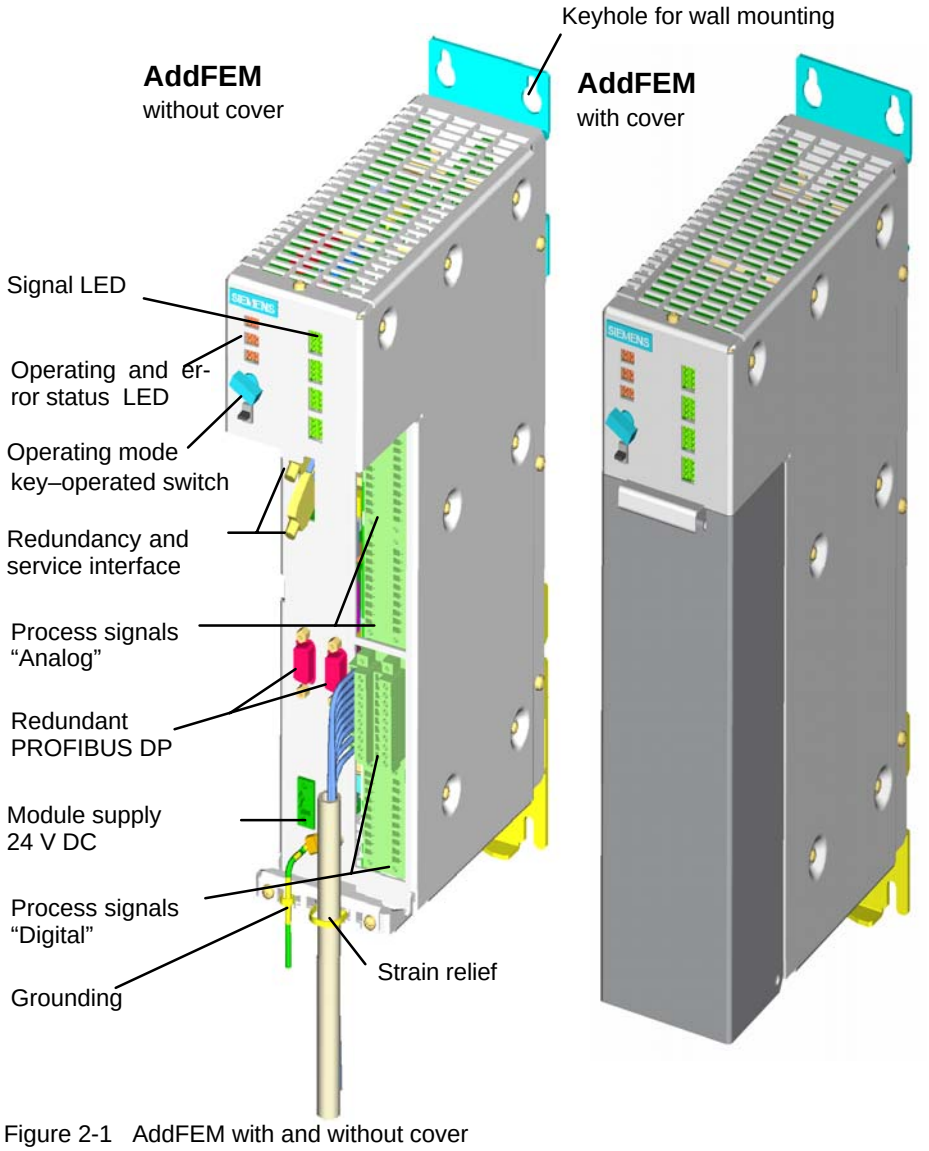


Figure 2-1 AddFEM with and without cover

The AddFEM module can be mounted optionally on mounting rails or via fastening sheets to the wall.

The overall dimensions without fixing elements are (W x H x D):
75 x 290 x 190 mm

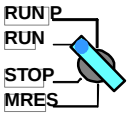
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2.2 Operating and Display Elements

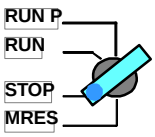
All the operating and display elements are positioned on the front of the AddFEM above the cover.

Operating Elements

The AddFEM can be operated by means of a key–operated switch and a slide switch on the front. The individual switch settings are explained in the following table.



Regular operation
Outputs are enabled
Preprocessing function (FEF) is processed.
The key can be removed in this position so that unauthorized changing of the operating mode is not possible.



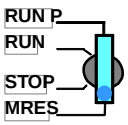
STOP:
The outputs are disabled.
Procedures for setting the PROFIBUS DP addresses and for re-setting the AddFEM can be executed.
The key can be removed in this position so that unauthorized changing of the operating mode is not possible.
Only for 6DL3100–8AB/–8AC:
Preprocessing function (FEF) is executed.
In case of module redundancy a master/reserve changeover is forced, the module becomes a “forced reserve”.



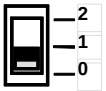
Warning

The following point is to be observed if the redundancy control is carried out by the automation processor (AP) (this is for example the case if the optical–fiber cables are defective or missing):
If a redundancy changeover was forced by setting the master briefly to STOP by means of the key–operated switch, this module cannot take over the master state again until 8 seconds has passed. If a further changeover in the master state is attempted during this period by setting the second module to STOP, this causes a double reserve, i.e. failure of the automation function.

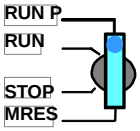
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Momentary–contact position of the key–operated switch.
Is used during the setting procedure for the bus addresses.



Position 0 – Momentary–contact position spring–loaded:
The PROFIBUS–DP–station addresses are displayed via the DI signal LEDs in hexadecimal forms. The least significant bit is at the top! The display is activated for approx. 5 seconds.
Position 1 – Latched position: Position of rest
Position 2 – Latched position: No function



Note:

Reserved for function extensions.
The key cannot be withdrawn in this position.

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LED

Above the key–operated switch there are 3 LED units with 4 LEDs each for error displays (left) and status displays (right). The logical states of the digital inputs and outputs are displayed by means of 32 operating state LEDs, which are positioned on the right, next to the error/status LEDs and the two switches.

Positioning of the LEDs and operating elements

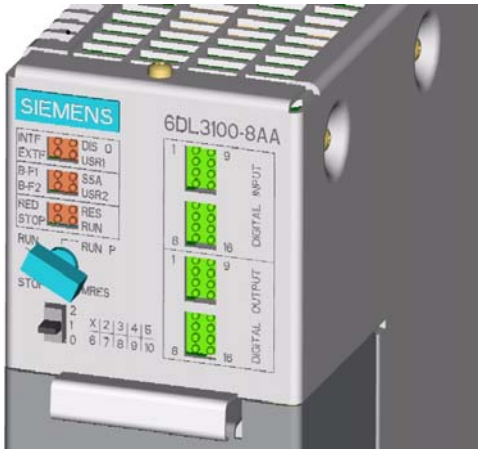
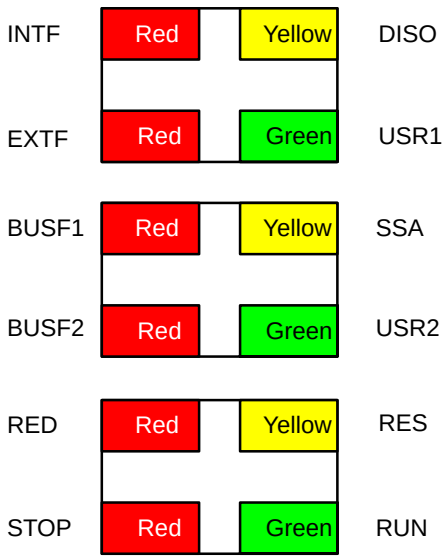


Figure 2-2 AddFEM operating elements

Meaning of the Error/Status LEDs

The error/status LEDs are divided into 3 LED units with 4 LEDs each.
The error LEDs are position on the left, the status LEDs are on the right.



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Table 2-1 Explanation of the Error/Status LEDs

Designation	Error type/Status	Explanation
INTF	Internal error	Display of internal errors, meaning that the self–diagnosis has recognized errors (e.g. voltage monitoring, CPU or memory self–diagnosis, etc.).
EXTF	External error	Display of external errors (e.g. short–circuiting at outputs, life–zero, etc.)
BUSF1	Bus error 1	Display of PROFIBUS–DP errors (for example, no message traffic) for PROFIBUS–DP connection X3A
BUSF2	Bus error 2	Display of PROFIBUS–DP errors (for example, no message traffic) for PROFIBUS–DP connection X3B
RED	Redundancy error	Display of serious errors at the redundant AddFEM unit
STOP	Off–line (stop)	The outputs are disabled. Procedures for setting the PROFIBUS DP addresses and for resetting the AddFEM can be executed. The key can be removed in this position so that unauthorized changing of the operating mode is not possible. Only for 6DL3100–8AB/–8AC: Preprocessing function (FEF) is executed. In the case of a module redundancy a master/reserve changeover is forced, so that the module becomes a ”forced reserve”.
DISO	Output disable	Outputs are de–activated due to commissioning or maintenance work. AddFEM is in the state STOP or, in the case of a module redundancy, the AddFEM is the reserve (passive).
USR1	User status 1	”USER–LED”: Can be used application–specifically in the preprocessing function (FEF) (are controlled like outputs).
SSA	Set Slave Address	Slave address (PROFIBUS–DP A and B) is set via switch operation (input procedure). The selected address is displayed via a signal LED (DI).
USR2	User status 2	”USER-LED”: Can be used application–specifically in the preprocessing function (are controlled like outputs).
RES	AddFEM is reserve	AddFEM is a reserve unit at present in case of module redundancy.
RUN	On–line (run)	Execution of the preprocessing functions

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2.3 Connection Elements

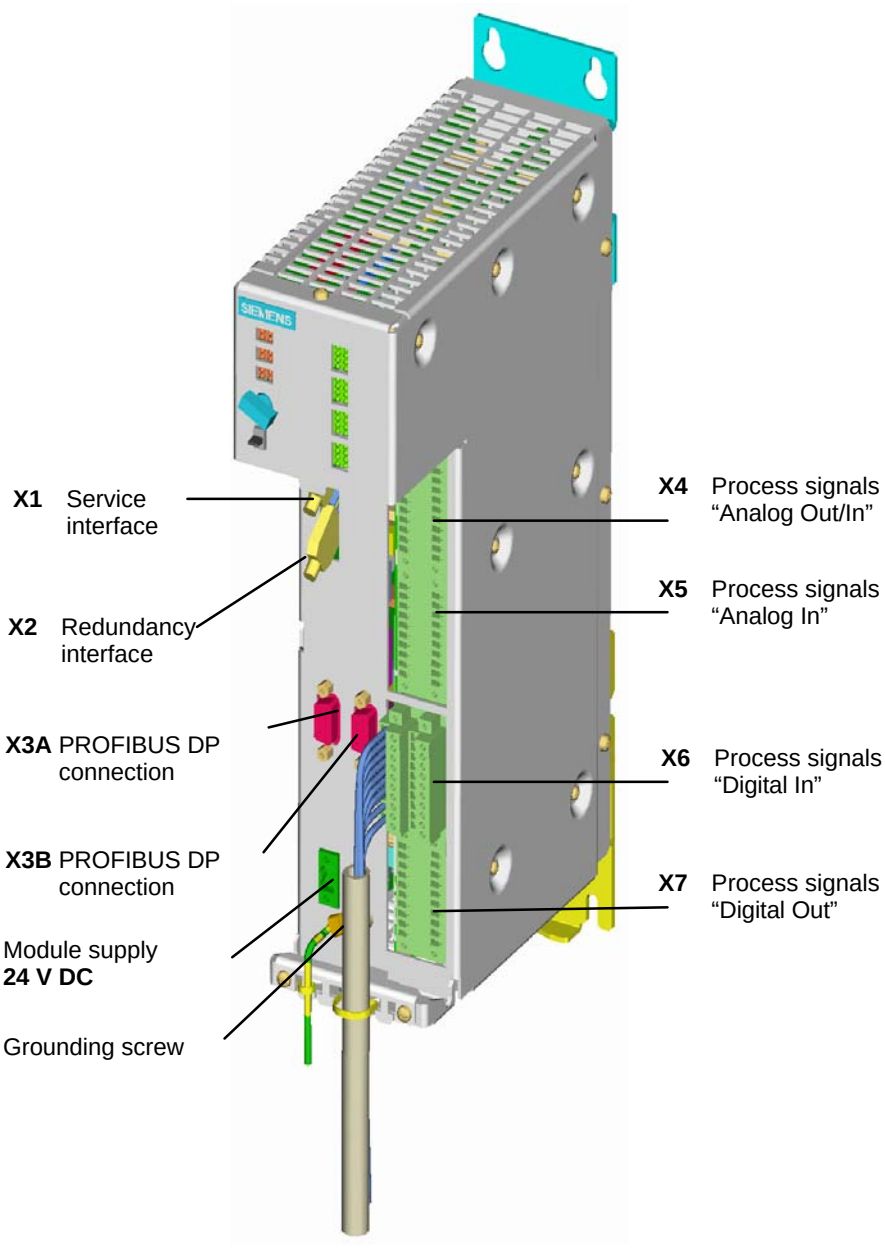
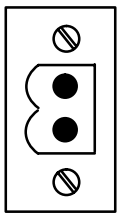


Figure 2-3 Connection elements

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Module Supply

The AddFEM is supplied with 24 V DC via a plug–in connector on the front.



M: Signal common

L+: Power supply +24 V

Figure 2-4 Module supply 24 V DC

The supply input of the module is limited electronically. In addition it is fused with F 2.5A (internal fuse element for protection against damage – cannot be replaced). The AddFEM can be operated with a direct voltage of 19.2 to 30 V.
The lower limit (19.2 V) is monitored.

Load Supply

The 24 V DC load supply for the analog outputs is supplied by the AddFEM. The 24 V DC load supply for the digital outputs must be generated externally and fed via the X7 connector (Fig. 2–3).

Grounding and Control–to–load Isolation

There is a grounding screw on the front panel below the module supply. If the AddFEM is mounted on an underground which is not conductive or not grounded, the module housing has to be grounded via this grounding screw (EMC shielding measure).

The following function areas are isolated from each other:

- Micro controller area including the analog inputs and outputs
- Module supply 24 V DC
- Digital inputs and outputs

4 of the 12 digital inputs each as well as the 3 counting pulse inputs have a signal common. The 16 digital outputs are distributed amongst two signal commons.

Interfaces X1 and X2

- Redundancy interface X2
  For the redundant operation of two AddFEMs.
- Service interface X1
  For maintenance work and commissioning.

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PROFIBUS–DP Connection X3A and X3B

The AddFEM disposes of two PROFIBUS connections which are used for communication with the automation processor.

Front Connectors X4 – X7

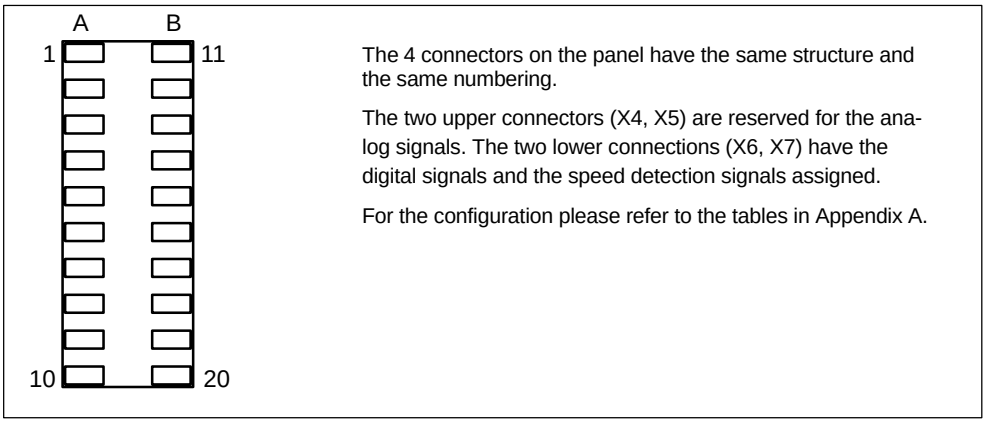


Figure 2-5 Front connector

Of the 12 analog inputs 6 can be used optionally as power inputs or as voltage inputs. The remaining 6 analog inputs can only be used as current inputs.

The 16 digital outputs can also be used as digital inputs.

Of the 15 digital inputs 3 can be used as counting pulse inputs for speed detection with/without recognition of the direction of rotation. In the case of speed detection with recognition of the direction of rotation counting pulse input 1 detects the leading signal while counting pulse input 2 detects the lagging signal.

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Mode of Operation

3

Overview

Section	Contains	Page
3.1	Functional Features	3-2
3.2	Operating Modes	3-7
3.3	Redundancy Functions with AddFEM	3-10
3.4	Preprocessing Functions with AddFEM (applies only for 6DL3100–8AB/–8AC)	3-22

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3.1 Functional Features

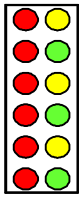
3.1.1 Operating States

☼ LED flashing

Introduction

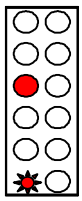
Operating states from POWER ON to productive operation determine the behavior of the AddFEM and are displayed at the operating and error status LED (see Fig. 2–1).
Operating states which only occur in redundant operation (only possible at 6DL3100–8AB/–8AC) are also listed to complete the picture. The states are listed in their sequence during starting up.

Power–On RESET



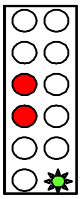
LED–Test. All the error and status LEDs are switched on for approx. 2 seconds after the power supply has been switched on or after a reset.

INIT



The following steps are carried out during the initialization phase:
Setting the hardware
Test for complete firmware
Execution of the ”Run–Up–Self–Test” (RUST)
Error reactions
If grave errors occur through the RUST, the AddFEM is reset and branches to the state RESET. If no PROFIBUS DP message has been received yet, the module waits for approx. 4 seconds for valid messages. The currently set address for DP–A (left LED 1...8) is displayed in binary form at the 16 signal LEDs for digital inputs.
Note:
This display is only visible if the PROFIBUS DP master is not yet ready or if the PROFIBUS line is not yet plugged, is defective or is not yet terminated.

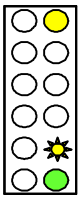
START–UP



No PROFIBUS DP message has been received yet. Initialization is completed. Module is waiting for valid messages.
PROFIBUS DP master not yet ready or the PROFIBUS line is not yet plugged, is defective or is not terminated.
Note: Please check termination switch in PROFIBUS–Plug.

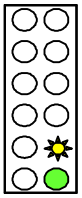
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LINK–UP PASSIVE



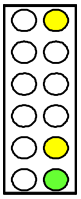
M/R state at module redundancy: Module is the RESERVE. It receives the start–up update from the MASTER module via the optical–fiber coupling.

LINK–UP ACTIVE



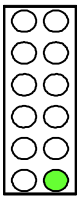
M/R state at module redundancy: Module is the MASTER. It sends the start–up update to the RESERVE module via the optical–fiber coupling.

RUN PASSIVE



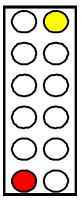
Output disable, FEF (preprocessing function) is executed.
M/R state at module redundancy: Module is the RESERVE. It receives the update data from the MASTER module via the optical–fiber coupling.

RUN ACTIVE



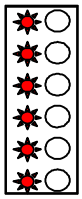
Outputs are active, FEF (preprocessing function) is executed.
M/R state at module redundancy: Module is the MASTER. It sends the update data to the RESERVE module via the optical–fiber coupling.

STOP



The STOP operating state can only be set via the key–operated switch. The output disable is activated.
M/R state at module redundancy: The module becomes the RESERVE (forced reserve). The partner module becomes the MASTER (master transfer).
In STOP state the operating switch can be used to set the bus address and reset the AddFEM.

FAULT



Internal error
No regular operation possible.

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3.1.2 General Features

Introduction

Faults or errors have to be recognized, localized and signaled as soon as possible. The self test of the AddFEM is carried out completely (Run Up Self Test) after a POWER ON and section–by–section (Cycle Self Test) during cyclic normal operation. (see “Technical Data” Section 4.1)

Self Tests / Self Monitoring

The following components and functions are tested:
– Memory test RAM
– Checksum test RAM (calibration data, program code)
– Checksum test FEPROM (calibration data, program code)

Self Tests in Cyclic Operation

Some error evaluations have to be synchronized with the I/O cycle and are therefore part of the I/O cycle
Self tests in the I/O cycle:
– PROFIBUS functionality
– Data transfer between Host and AddFEM
– Data transfer between the redundant AddFEMs
– Cycle runtimes
– Supply voltage
– Channel error of the process inputs or process outputs
– Co–processor monitoring by the main processor

Delayed Shutoff

In case of a brief failure of the Host unit or a failure of the communication via the PROFIBUS DP the process outputs are switched off in graded form after a tolerance period which can be parameterized.
The tolerance period can be set within a range of 10 ms to 3 s.
The default is 0.5 seconds.
(refer to Section 4.3.1 “Parameterization Telegram”)

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Signal Filters for Analog Inputs

The analog input signals can be filtered digitally. There are mains filters for 50 Hz, 60 Hz and $16^{2/3}$ Hz. The parameter telegram is used to set the filtering for every analog input individually (channel–specifically). The following can be set:
– No filtering
– 50 Hz
– 60 Hz
– $16^{2/3}$ Hz
The default setting is “de–activated”, meaning that filtering does not take place.

3.1.3 Operating principle of the 2–channel speed detection with sense of rotation recognition

As from Version 8 of 6DL3100–8AA or Version 7 of 6DL3100–8AB/–8AC Channel 1 and 2 can be used for counting frequency detection with sense of rotation recognition. A suitable (2–channel) sensor has to be connected to Channels 1 and 2 to this purpose. The leading signal is connected to Channel 1 and the lagging signal to Channel 2.

Channel 3 can be used independently as a single channel (meaning without sense of rotation recognition).

Displaying of the (signed) frequency detected on 2 channels is carried out on the two Channels 1 and 2 as follows:

The value of the displayed frequency is calculated for each channel individually directly from the pulses of the connected sensor. The sign (for the sense of rotation) is determined from the phase offset of the two channels and assigned to the two channels.

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Behavior if one of the two sensors fails

If one of the two signals fails, the value of the speed of the failed channel is reduced step–by–step to 0, as in single–channel detection (refer to Chapter 4, Technical Data. The sign is frozen with the state which it had before the fault occurred. This ensures that speed recognition is still possible on one channel. However, changes in the sense of rotation are no longer recognized.

Recognition of a wire break can be carried out by, for example, comparing the two√ channels for equality of values. However, when the two changes are checked for equality of values take into account that natural differences between the two channels can arise through inaccuracies in the speed sensor (tooth flanks) as well as through acceleration processes (refer to the following chapter). In view of the multitude of possible applications, channel–specific wire–break recognition is therefore not carried out on the module, but rather has to be configured plant–specifically on the host system.

Information on updating and possible speed differences between the two channels

Module–internal calculation of the frequency is always coupled to a signal change (for the measurement of the period of oscillation) and is therefore carried out at different moments at the 2 ”phase–offset” sensors.
When there are changes in the speed this therefore results in slight deviations in the displays of Channels 1 and 2, since one of the two channels always (alternatively) supplies the more recent value. The precision and relevance can thus be increased in particular at lower speeds if the values of both channels are determined.

The speed difference (Δf) in the two channels arising through the acceleration processes which has to be taken into account at the minimum when the two channels are monitored, lies in the following range

$\Delta f = \sqrt{(f^2 + a)} - f$ (for frequencies $\leq$ 125 Hz) (a = acceleration, f = frequency)

$\Delta f = a * 2msec$ (for frequencies > 125 Hz)

Remark: Simplified formulae for sensors with recognition of the sense of rotation at which the two channels operate with a phase offset of 90°.

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3.2 Operating Modes

System Configurations

The AddFEM can be configured singularly or redundantly with one or two PROFIBUS DP channels, depending on the respective application. There are four system configurations available. There is no automatic recognition and adaptation by the AddFEM. Depending on the desired system configuration the operating mode is set on the AddFEM via the PROFIBUS DP parameter telegram.

Note:

The default setting for the redundancy operating modes of the AddFEM is selected so that no configuration changeover is required when the 6DL3100–8A**A** is replaced by the 6DL3100–8A**B**/–8A**C**.

Setting the Operating Mode

When SIMATIC S7 is used the PROFIBUS DP parameters can be set by means of the HW Config in the SIMATIC Manager. The corresponding settings are carried out by means of the COM–PROFIBUS software package when another system is used.

Operating mode	Host	AddFEM	PROFIBUS
0	Single–channel	Single–channel	1 PROFIBUS distributed I/O device line
1	Redundant	Single–channel	2 PROFIBUS distributed I/O device lines
2	Single–channel	Redundant	1 PROFIBUS distributed I/O device line
3	Redundant	Redundant	2 PROFIBUS distributed I/O device lines

Note

After POWER ON the AddFEM remains in the state START–UP (LED RUN flashes) until the operating mode is set by means of parameterization (refer to Section 5.2.1).

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System Configurations

AddFEM in Operating Mode 0

Host: Single–channel

AddFEM: Single–channel – PROFIBUS interface A activated

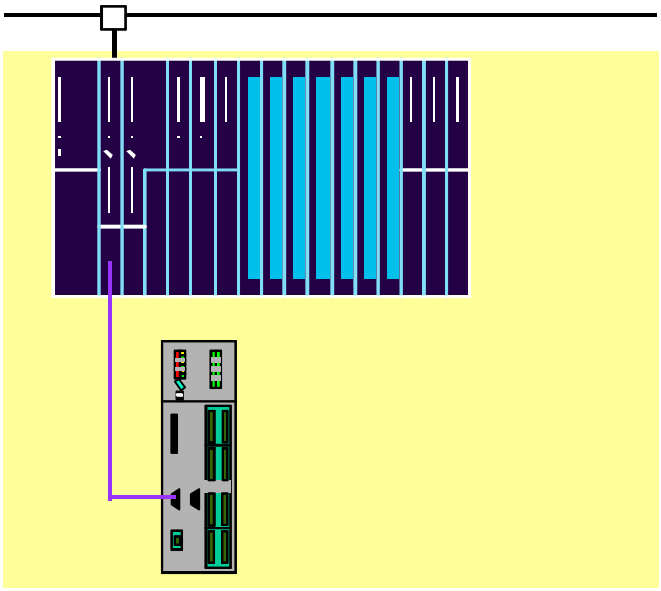


Fig. 3-1 Configuration with operating mode 0

AddFEM in Operating Mode 1

Host: Redundant

AddFEM: Single–channel

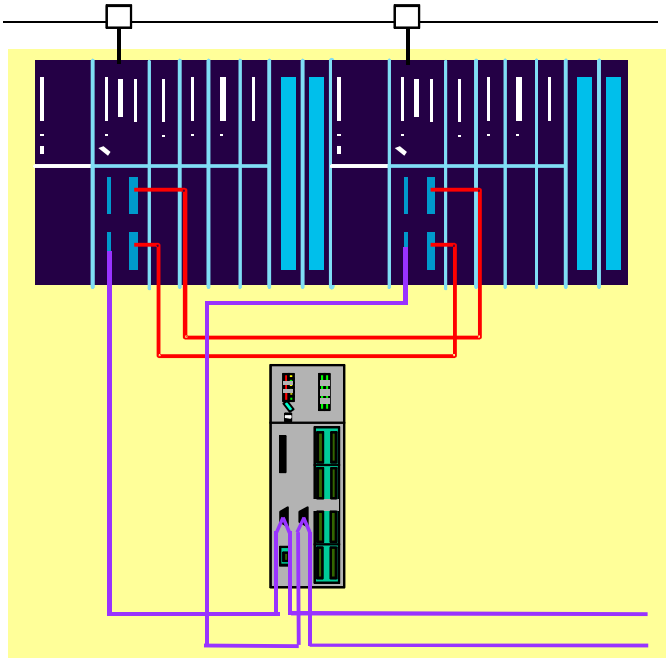


Fig. 3-2 Configuration with operating mode 1

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AddFEM in Operating Mode 2

Host: Single–channel

AddFEM: Redundant with optical–fiber cable redundancy coupling

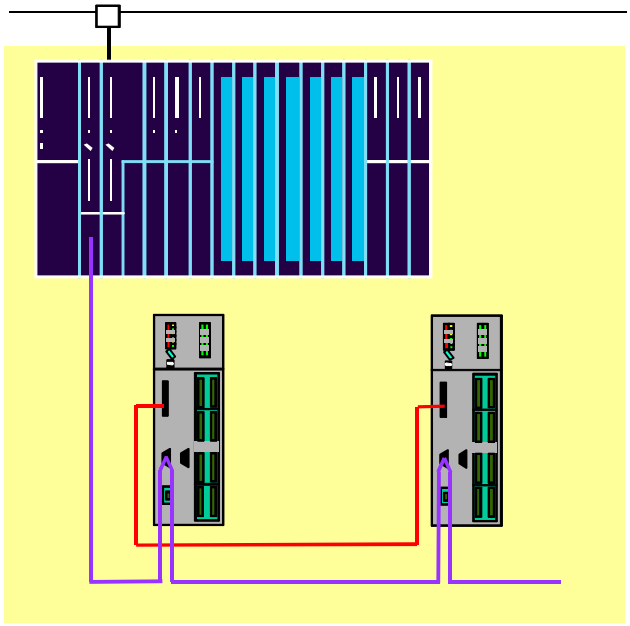


Fig. 3-3 Configuration with operating mode 2

AddFEM in Operating Mode 3

Host: Redundant

AddFEM: Redundant with optical–fiber cable redundancy coupling

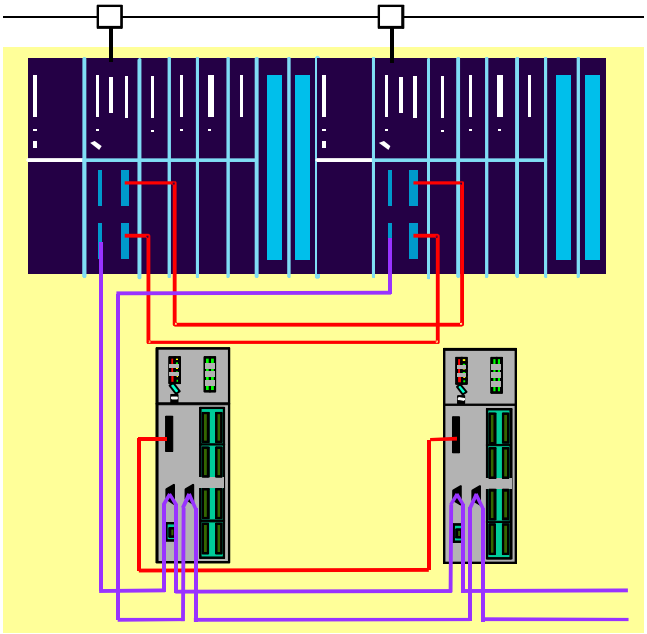


Fig. 3-4 Configuration with operating mode 3

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3.3 Redundancy Functions with AddFEM

Increasing the Availability through Redundancies

Redundancy in this context means the implementation of a “1–out–of–2” structure. The availability is increased by the parallel use of two identical components. If a component fails due to a fault, the second component takes over the function bumplessly. Extensive redundancy mechanisms and self–diagnostic functions which are integrated in the AddFEM ensure automatic error recognition and changeover without any manual interventions being required.

Master/Reserve

The terms “Master” and “Reserve” are used in order to identify the two AddFEMs in the following sections. The reserve operates simultaneously with the master and not only in case of errors. The process outputs of the reserve are, however, passive, meaning that no signals are output.

Features of Redundant AddFEMs

When an AddFEM fails the system changes over automatically to the redundant unit (”1–out–of–2” structure). Smooth taking over of the master state by coupling via the optical–fiber cable redundancy interface.
The changeover in the master state initiated by the AddFEM after error recognition, meaning the switching–off of the outputs of the previous master and switching–on of the outputs of the previous reserve is carried out quasi smoothly.
(for tolerance–specific changeover gap refer to “Technical Data” Section 4.1)

Optical–fiber Cable Coupling

Between redundant AddFEMs there is a serial bi–directional “redundancy” communication by means of optical–fiber cable through which the error status, redundancy status and update data are exchanged.

Master/Reserve Specification

In case of error equilibrium of the redundant AddFEMs specification is carried out by the AP. This soft specification is also used for the cyclic M/R changeover (every 24 hours).

Forced Reserve Specification

In case of a missing or faulty optical–fiber cable redundancy coupling the master/reserve assignment is carried out by the AP.

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Master/Reserve Changeover

The master module has the control until it recognizes an error in itself after which it hands the master state over to the reserve module.

Master/Reserve Changeover without Optical–fiber Cable

When the optical–fiber cable coupling fails the master/reserve assignment is decided by the Host. The current error weighting of the modules is decisive for the assignment.

Process Inputs and Outputs

Redundant AddFEMs have to assigned absolutely symmetrically with I/O signals.

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Redundancy Nodes

Redundancy nodes represent the fault tolerance of systems with components which are available several times. The independence of a redundancy node is given when the failure of a component does not cause any limitations in reliability in other nodes or in the complete system. In a “1–out–of–2” system a component of the redundancy node can fail without impairing the functional capability of the complete system.

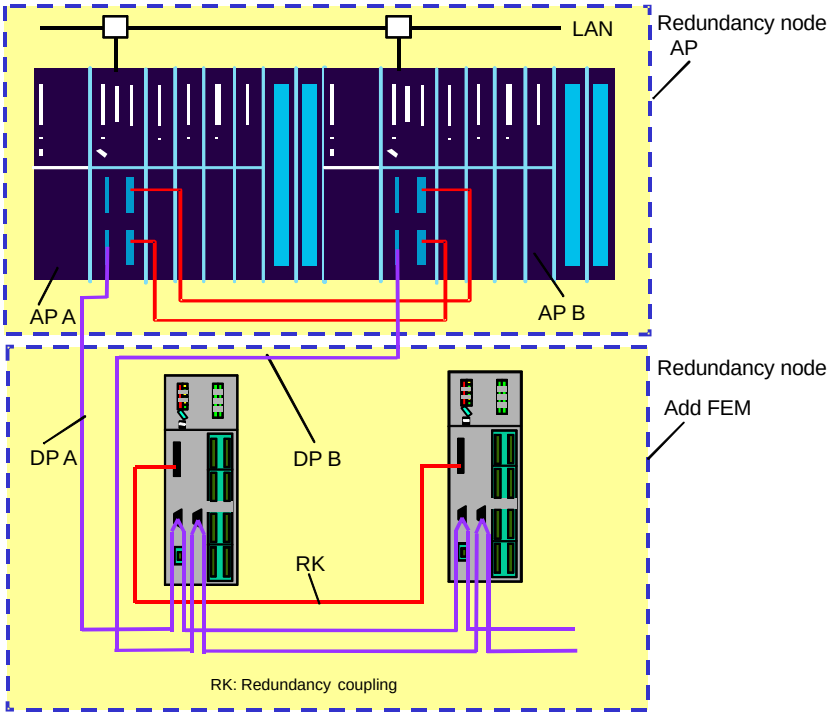


Fig. 3-5 System configuration with two redundancy nodes

The two automation processors (AP A and AP B) in Fig. 3–5 execute the same application software, for example, the turbine control function, synchronously and cyclically. One system (AP A or AP B) is the “master” and actively controls the outputs. When faults occur in the master system, a changeover takes place automatically and smoothly to the reserve system. The redundancy status and additionally update information are exchanged between AddFEM A and AddFEM B via the redundancy coupling (RED coupling).

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3.3.1 Redundancy of PROFIBUS DP Connection

The PROFIBUS DP channels are absolutely equivalent. The AddFEM changes the channels at the recognition of a DP error, sign–of–life change/error or at the receipt of a GCCL (Global Control Clear) message. The changeover of the DP channels from the AP is always carried out via the sign of life. The variant 6DL3100–8AC accepts the PrmCommand for changing over the DP channels in accordance with PROFIBUS Guideline 2.212 and makes the redundancy status available as a diagnosis.

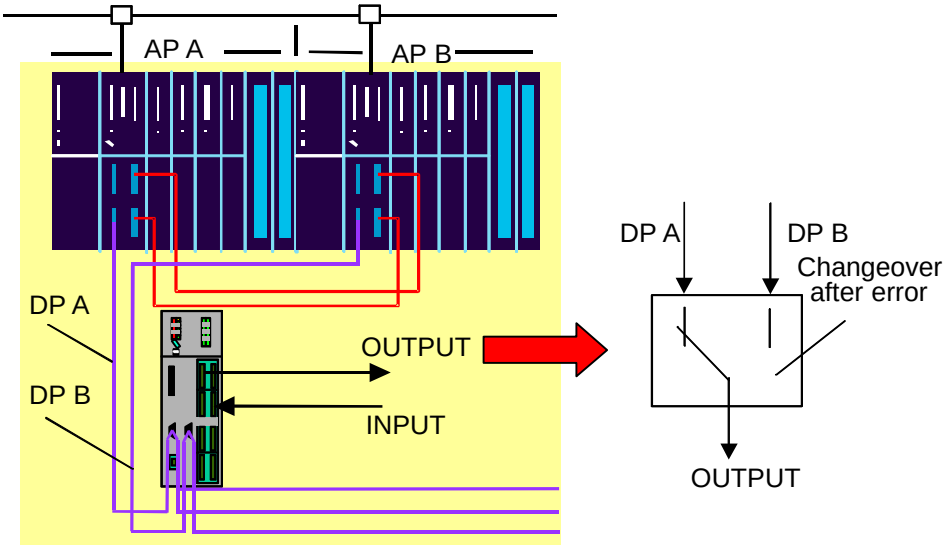


Fig. 3-6 Redundant PROFIBUS DP connection

The connection between AddFEM and the AP is configured redundantly as PROFIBUS DP A and PROFIBUS DP B. Each AddFEM has two PROFIBUS DP connections. The two busses operate in parallel.

The input information (Input) is always transferred in parallel to both automation processors. The outputs of the AddFEM can theoretically only ”obey” one of the two automation processors (AP A or AP B). Either the output data of the AP A or the output data of the AP B are output by the AddFEM. For this reason a master–reserve changeover with regard to the outputs is necessary on the AddFEM. The output information of the passive AP is analyzed for monitoring purposes and then rejected.

There are various changeover criteria for the output–specific changeover. As a reaction to a coupling failure the system always changes over to the intact interface. In case of a total failure, meaning that messages are not received on either of the two interfaces, zero signals are output (safety–oriented control).

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Note

In addition to the bus changeover by the AddFEM the automation processor AP can change over to active. The AP can specify actively which interface (DP A or DP B) is to be used.

Table 3-1 Monitoring criteria

No.	Criteria	Monitored by...
1	Serious fault in the transmission link, for example, PROFIBUS DP connector pulled off.	Bus ASIC of the AddFEM
2	Due to a hardware fault the AP sends a global–control–clear message.	Controller of the AddFEM
3	The sign of life of the AP fails to materialize (simultaneous monitoring and changeover mechanism for AP and AddFEM). Note: When operated with SIMADYN D the algorithm for generating the signs of life has to be configured (refer to Section 3.3.2).	Controller of the AddFEM
4	PrmCommand with new assignment of primary and backup channel. Note: DPV1_Status_3 Bit 7 (PrmCmd) has to be set in the parameterization message.	Firmware of the AddFEM

3.3.2 Monitoring and Changeover by Means of Signs of Life

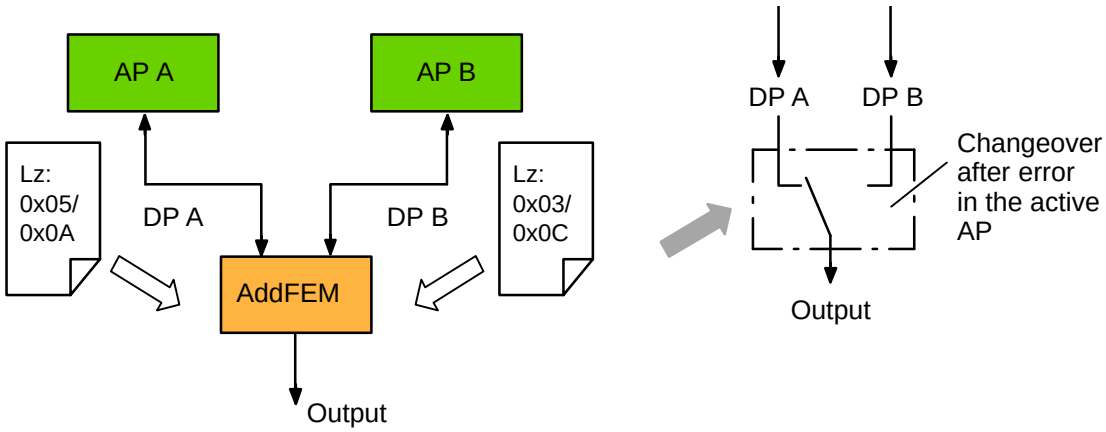


Figure 3-7 Sign of life from Host to AddFEM

The Host sends the sign of life (SoL) cyclically with the period of the program cycle time of its fastest application t = tcyc to the AddFEM **within the regular data message.** The SoL consists alternatively of the Code 1 (hexadecimal value: 0x05

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or 0x03) and Code 2 (hexadecimal value: 0x0A or 0x0C).

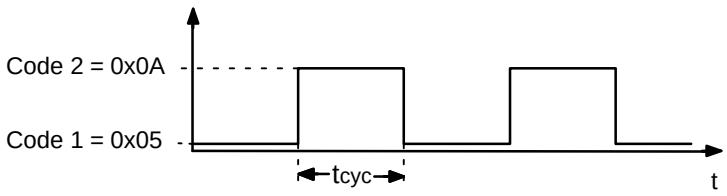


Figure 3-8 Changing the sign of life

For the AddFEM an Host is considered functional, if Code 1 and Code 2 are transferred alternatively as a SoL within a typical period of t_{cyc}! If a sign of life freezes in a state, an error has occurred and the system changes directly to the redundant interface!

The sign of life with the code 0x05/0x0A is evaluated higher by definition by the AddFEM than the SoL with the code 0x03/ 0x0C. The changeover controller for the output data follows the higher–value sign of life. The system always transfers those messages which contain the “higher–value” SoL code. If the current master CPU or the master transmission link fails, the AddFEM also accepts the message which contains the code 0x03/0x0C.

The master changeover can be initiated actively by the AP by changing the two sign–of–life codes between AP A and AP B. If equivalent signs of life (occurring only temporarily) occur, the old state is retained.

The AddFEM is changed over in accordance with the following algorithm:

Table 3-2 Changeover of the AddFEM

Bus interface A supplies...	Bus interface B supplies...	Reaction of the AddFEM
SoL 0x05/0x0A	SoL 0x03/0x0C	Use data from bus interface A!
SoL 0x05/0x0A	SoL 0x05/0x0A	Retain old state because duplicate master!
SoL 0x05/0x0A	– None –	Use data from bus interface A!
SoL 0x03/0x0C	SoL 0x03/0x0C	Retain old state because duplicate master!
SoL 0x03/0x0C	SoL 0x05/0x0A	Use data from bus interface B!
SoL 0x03/0x0C	– None –	Use data from bus interface A!
– None –	SoL 0x03/0x0C	Use data from bus interface B!
– None –	SoL 0x05/0x0A	Use data from bus interface B!
– None –	– None –	**Double fault! Set outputs to a safety–oriented state, meaning zero signals!**

Exceeding of a specified monitoring time is decisive for the changeover.
The monitoring time is not a fixed setting and does not have to be configured on the AddFEM. It is “learned” automatically by the AddFEM as described below.

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3.3.3 Self–learning Sign of Life Cycle Time

The self–learning function of the AddFEM expects an alternating sign of life with code 0x05/0x0A or 0x03/0x0C. The sign–of–life change is sent with the program cycle time of the fastest application of the AP. The AddFEM calculates the AP cycle time on the basis of the sign–of–life change and defines it as the monitoring time with a tolerance surplus of 100%. An AP cycle time of 4 ms calculated by the AddFEM thus results in a monitoring time of 8 ms. The learning time amounts to approx. 2 s per PROFIBUS DB channel. If the AddFEM does not determine a sign–of–life change, the self–learning function is not executed and life–of–time monitoring is not carried out.

3.3.4 Status Information from AddFEM to the AP

The AddFEM returns the received sign of life with the ORed active DP channel (A/B) and the own “error weighting”, i.e. the error status to the AP. The active DP channel is returned ORed with the received sign of life in the most significant bit on byte offset 48.

- DP channel A active: Byte in the message at byte offset 48 = Sign of life | 0x00
- DP channel B active: Byte in the message at byte offset 48 = Sign of life | 0x80

The own error weighting (corresponds to the own error status) is transmitted on byte offset 49 to the AP.

Monitoring and evaluation of the returned sign of life by the AP allows monitoring of the AddFEM by the AP.

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3.3.5 Redundant AddFEMs

Operating States at Module Redundancy

Generally both AddFEMs have equal rights so that each AddFEM can be either the master or the reserve. In the following figure it is assumed that AddFEM(1) takes over the master state.

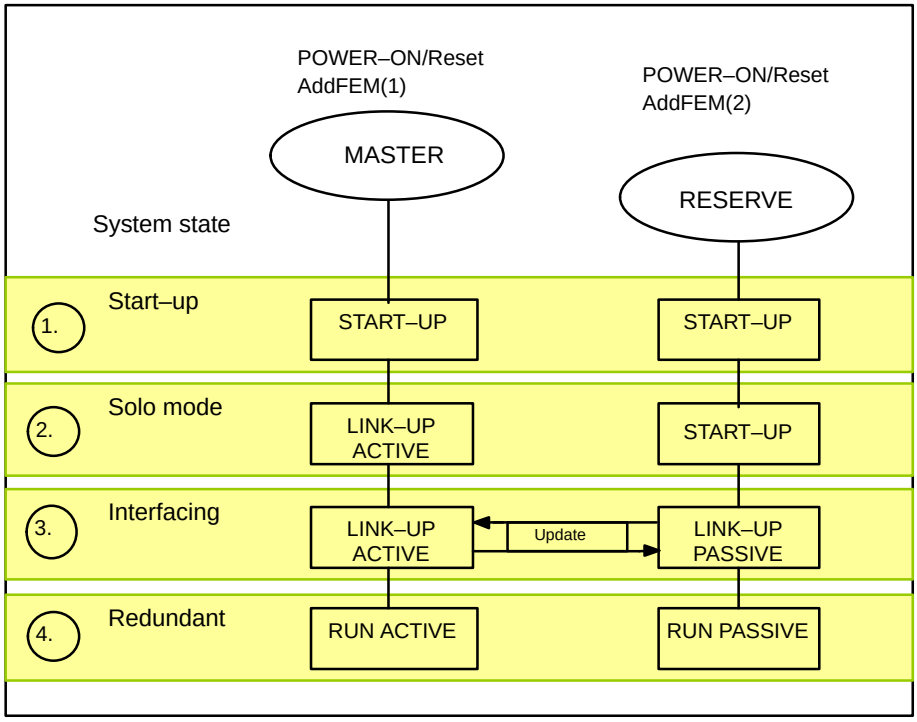


Figure 3-9 Operating states from POWER–ON to RUN

Table 3-3 Explanations on the operating states

Item	Description
1.	After the supply voltage has been switched on or after a hardware reset the AddFEM is in the START–UP state after an initialization phase.
2.	If the start–up is successfully, the master AddFEM(1) changes to solo mode. AddFEM(2) has not yet exited to START–UP state.
3.	Checking and updating the reserve AddFEM(2) is carried out again.
4.	After the LINK–UP coupling the master and reserve AddFEMs are in the RUN state.

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Master–Reserve Logic

Transfer of the master state is always carried out via the error weight. A numerical comparison of the error weighting is carried out to this purpose:

IF OWN_ERROR_STATUS < PARTNER_ERROR_STATUS

THEN MASTER

ELSE RESERVE

If redundancy communication via the optical–fiber cable interface fails, the higher–level system decides on the master state.

Master–Reserve Assignment

The master–reserve assignment is changed by:

- Specification (MRV) of a desired master by the AP if the error weighting of the redundant AddFEMs is the same
- Specification of a forced reserve (ZRV) by the AP if the redundancy communication fails
- Failure or STOP of the master AddFEM
- A greater error weighting at the master than at the reserve

Error Weighting

The own error status is sent back to the AP with the channel error weighting as the “error weighting”. The error weighting is defined as follows:

Error weighting = Error status + Channel error weighting

Channel Error Weighting

The lower–level channel error weighting is formed by the sum of the individual channel errors. All the channel errors (analog input, analog output and digital output) are weighted equally. The weighting of a channel error is 1. If an external power supply for the binary outputs fails, the weighting is 8 (since eight binary outputs are affected by a failure).

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Signals for Controlling The Redundancy Logic

Signals for controlling the redundancy logic are exchanged via the PROFIBUS DP user data messages. A driver block with implemented redundancy logic is available for SIMATIC S7.

Note:
The redundancy logic has to be configured for operation with other Hosts.

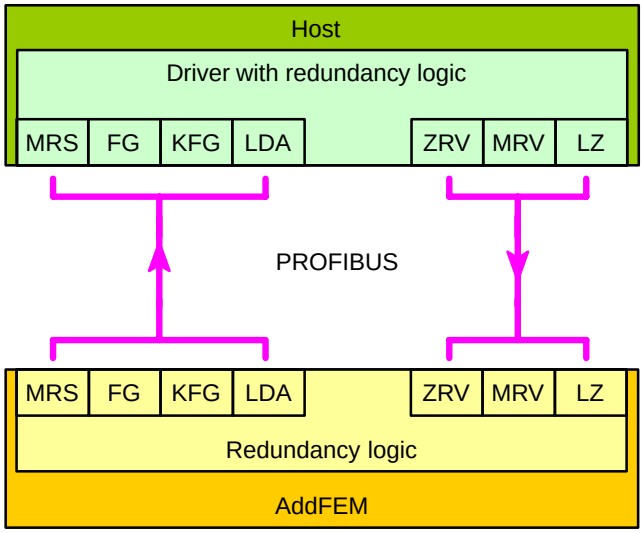


Figure 3-10 Signals for controlling the redundancy logic

Signals from the AddFEM to the Host

Signal name	Meaning	Value
FG	Error weighting	For structure refer to Chapter 4
KFG	Channel error weighting	Number of faulty I/O channels
LDA	Sign of life + active PROFIBUS DP channel	Bit 0 – 3: Return SoL to Host Bit 4 – 6: Reserve Bit 7: 0 = DP channel A is active 1 = DP channel B is active
MRS	Master/Reserve status	0 = Reserve; 1 = Master

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Signals from the Host to the AddFEM

Signal name	Meaning	Value
LZ	Sign of life	0x5/0xA = Active channel 0x3/0xC = Passive channel
MRV	Master/Reserve specification	0 = Master; 1 = Reserve
ZRV	Forced reserve specification	0 = Irrelevant; 1 = Forced reserve

3.3.6 Interconnection of Redundant Inputs and Outputs

In order to implement redundant control of actuating elements all the analog and digital outputs of one AddFEM can be connected in parallel with the outputs of the same type of another AddFEM. The same procedure can be applied to analog voltage inputs and digital inputs.

Redundant analog current inputs, on the other hand, have to be connected in series. Note that external Zener diodes (for types see Fig. 3-12) have to be connected parallel to the inputs, so that the current can continue to flow (via these external Zener diodes) when an AddFEM is replaced.

Note:
Redundant AddFEMs have to assigned absolutely symmetrically with I/O signals.

Analog Outputs

Analog outputs of redundant AddFEMs are activated or passivated in accordance with the module status (master or reserve).

There is no load distribution for redundant analog outputs – so that a subdivision 50%/50% to both redundant AddFEMs is not possible.

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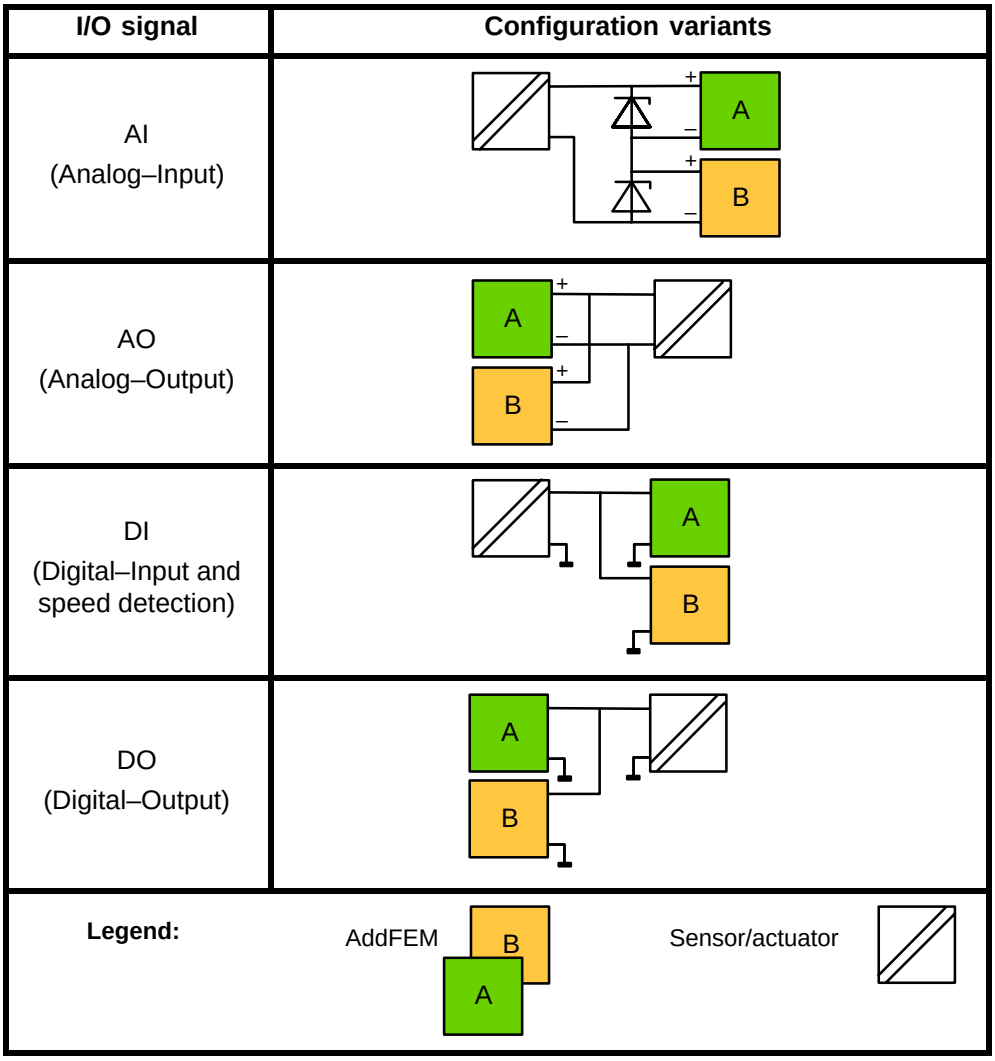
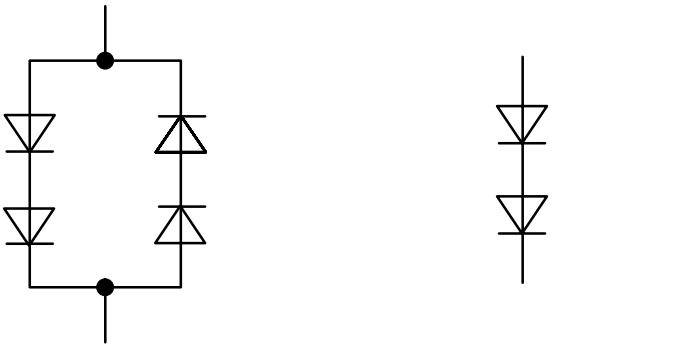


Figure 3-11 Possible redundancy configurations



1.6 V bi–directional,
e.g. 4 x BZX55 COV8
for ±20 mA or ±30 mA

1.6 V uni–directional,
e.g. 2 x BZX55 COV8
for 0..20 mA or 4..20 mA

Figure 3-12 Applicable diodes

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3.4 Preprocessing Functions with AddFEM (applies only for 6DL3100–8AB/–8AC)

The AddFEM 6DL3100–8AB/–8AC provides the possibility of executing subfunctions of the automation, such as the positioner at turbine control systems, as preprocessing functions. This allows time–critical functions which require short cycle times to be relocated from the higher–level automation system to the AddFEM so that less time–critical tasks remain on the higher–level automation system. These preprocessing functions are called Front End Functions (FEF).

The FEF functions are made available as prepared functions which are configured specifically by the user by means of parameters so that they can be adapted optimally to the respective process.

Selection of the FEF Function via Configuration

A minimum of three different FEFs are available on or can be loaded to an AddFEM in addition to the standard I/O. The FEF type can be set via the configuration (for example, HW Config). The selection is carried out in the GSD file by means of a numerical code (1, 2, 3, etc.) so that the GSD file does not have to be adapted at every new FEF. Invalid basic settings (for example, default setting 0) activate the basic function, i.e. only the I/O function.

Changes in Values of Parameters

For example, characteristic curve adaptation, controller parameters Kp, Tn, Tv, etc.
In the case of 6DL3100–8AB the parameters for setting functions are provided by the automation processor (SIMATIC AS 400 H or SIMADYN) and transferred cyclically via the PROFIBUS–DP. At the SIMATIC AS 400 the parameters are saved in a data block. At 6DL3100–8AC parameters are transferred acyclically with DPV1 services.

PROFIBUS DP Messages

In the case of preprocessing on the AddFEM configuration information and further intermediate results have to be transferred additionally with a higher signal dynamic. In order to transfer this extensive information, an extended PROFIBUS DP message is used in case of preprocessing on the AddFEM.

Documentation

Further detailed information on the FEF functions can be found in the instructions on the respective preprocessing functions.

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New FEF Functions

The range of available FEF functions can be extended. In as far as customer–specific applications exist which can only be solved with great effort and cost or not at all with the existing automation components, you can have user–specific solutions created as loadable FEF functions.

Contact for the creation of further customer–specific FEF applications:

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Technical Data

4

Overview

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4.3	PROFIBUS–DP Message Structure	4-18

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4.1 AddFEM

General Data	
Dimensions (Height x Width x Depth)	295 mm x 75 mm x 209 mm
Mass	2.8 kg
Input voltage, Nominal value Valid range	 24 V DC static: 19.2 to 30 V DC dynamic: 18.5 to 30.2 V
Nominal input current Module supply Load supply	 0.8 A 8 A
Starting current Peak value Half–value width	 3 A limited 100 ms
Overriding of power failures	At least 10 ms (at input voltage 19.2 to 30 V DC)
Power loss arising in the AddFEM – Module supply – Power input at the digital inputs – Power input at the analog inputs – Switching and transmission losses of the digital outputs supplied via the load supply	max. 33 W (sum) max. 20 W max. 4 W max. 1 W max. 8 W
Module supply fuse	F 2.5 A (internal as protection against damage, cannot be replaced)
Load supply fuse	2 x F 7 A (internal as protection against damage, cannot be replaced)

Control–to–load isolation

The module consists of several function groups which are isolated from each other. In operation the max. permitted potential difference between these function groups amounts to 50 V. The signals/connections are assigned to the individual function groups as follows:

a) Analog inputs and outputs (plug connections X4/1 to X4/20 and X5/1 to X5/20) including internal micro controller area
b) Counting pulse inputs (plug connections X6/1 to X6/4)
c) Digital inputs 5 to 8 (plug connections X6/6 to X6/10)
d) Digital inputs 9 to 12 (plug connections X6/11 to X6/15)
e) Digital inputs 13 to 16 (plug connections X6/16 to X6/20)
f) Digital outputs 1 to 8 (plug connections X7/1 to X7/10)
g) Digital outputs 9 to 16 (plug connections X7/11 to X7/20)
h) PROFIBUS DP connection to connector X3A
i) PROFIBUS DP connection to connector X3B
j) Module supply 24 V DC
k) Housing

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PROFIBUS DP Interfaces	
Number of interfaces	2
Baud rate	9.6 Kbauds to 12 Mbauds
Max. line length of a bus segment with both ends terminated	100 m
Permissible load of the 5–V bus supply to connect further loads without own supply	Max. 80 mA per interface
For detailed information on the PROFIBUS please refer to SIMATIC NET, Manual for PROFIBUS Networks, Order No. 6GK1970–5CA20–0AA0!	

Cycle Times Input/Output (PROFIBUS and Connector X4 – X7)	
Analog signal detection	666.667 µs
Analog signal output	666.667 µs
Digital signal detection[1)]	666.667 µs
Digital signal output	666.667 µs
Counting pulse input	2 ms

1) Update every 666.667 µs. Due to signal filtering there is an additional dead time of 666.667 µs between the detection and passing on.

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Digital Inputs	
Number of inputs	12
Type of input to IEC IEC 61131–2	Type 1
Voltage range	–30 V...+30 V DC
0-signal level	–30 V...+5 V
1-signal level	+11 V...+30 V
48-V contact voltage	No
Connection of BEROs possible	Yes
Minimum current at input voltage	5 mA at 11 V (refer to Fig. 4-1)
Delay time (TID)	50 µs for signal transitions from 0 to 1 50 µs for signal transitions from 1 to 0
Display	The converted values read by the internal micro controller unit are displayed at the LEDs on the front.
Configuration of the terminals	Refer to Appendix A, connector X6, Page A-2

Input characteristic curve of digital inputs

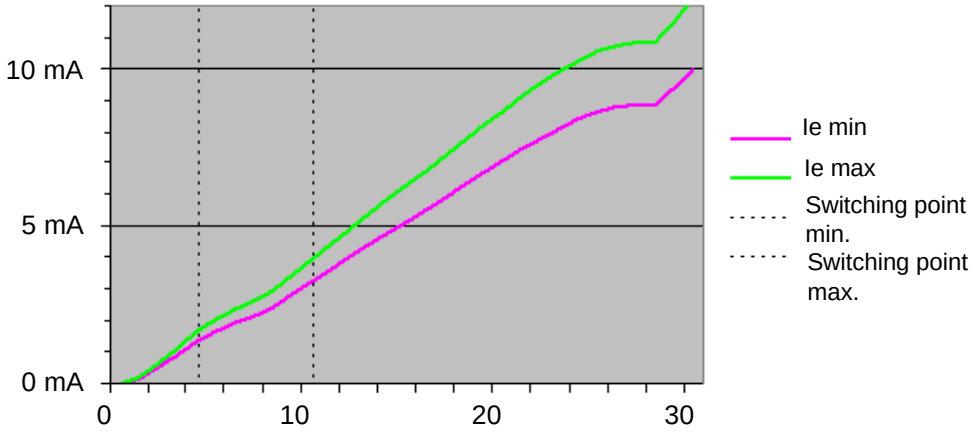


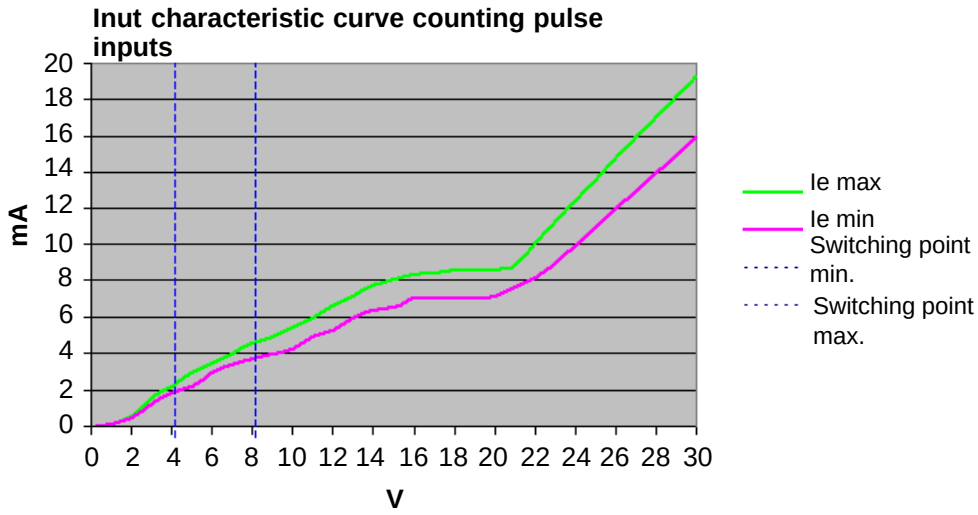
Figure 4-1 Characteristic curve image for digital inputs

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Counting Pulse Inputs [1]	
Number of inputs	3
Type of input to IEC 61131–2	Type 1/2
Voltage range	–28...+28 V DC
0-signal level	–28...+3 V
1-signal level	+8...+28 V
Coincidence factor at operation with voltage > 26 V	The counting pulse inputs are also specially designed for low input voltage (high recognition from 8 V). In order to limit the power dissipation the input voltage has to remain limited to 26 V or a pulse duty factor of 60% with a maximum pulse length of 1 minute or only 2 of 3 inputs may be switched to 1 at the same time.
Load impedance	1 kΩ to 3 kΩ
Current/voltage characteristic across the entire operating range	Refer to Fig. 4-1!
Delay time (TID)	50 µs for signal transitions from 0 to 1 50 µs for signal transitions from 1 to 0
Cyclic signal evaluation every	2 ms Disturbing pulses smaller than 10.667 µs are filtered out. Additional hardware evaluation by counter.
Input frequency (f_{in})	0...20 kHz
Counter resolution	32 bits
Measuring precision	Better than 10^{-4}
Updating interval	2 ms
Integration period at frequencies < 800 Hz	20 ms
Filter	During every updating instant the frequency is recalculated as the mean of the counting pulses detected during the last 20 ms.
Sense of rotation recognition	Sense of rotation recognition possible by interconnecting channel 1 and channel 2. Refer to Chapter 3.1.3 (Possible from Version 8 of 6DL3100–8AA, Version 7 of 6DL3100–8AB, all Versions of 6DL3100–8AC)
Display	The converted values read by the internal micro controller unit are displayed at the LED on the front.
Configuration of the terminals	Refer to Appendix A, connector X6, Page A–2

[1] Counting pulse inputs can also be used as digital inputs!

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Current/Voltage curve across the entire operating range, including tolerances for input current Ie

Figure 4-2 Characteristic curve image for counting pulse inputs

Behavior of the counting pulse / speed detection at interruption of the pulses (e.g. through wire break)

A) Single–channel operation (without sense of rotation recognition)
(applies for 6DL3100–8AA/–8AB as from Version 7, all 6DL3100–8AC)

If no more counting pulses arrive, the frequency output is limited in accordance with the period which has passed since the last detected pulse. The limit frequency F results from the period T since the last pulse as follows F= 1/(T–dead_time) * 1,5 The dead time results from the cycle time of the detection and amounts to 0 to max. 2 msec.

In practice the following limit frequencies result to which the output is reduced (in as far as the original frequency measured before the pulses stopped was higher).

The value is set to 0 after 10 seconds. (Frequencies under 0.1 Hz are not detected).

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Period T since the last pulse	Limiting of the frequency output to following values
0..to max. 2 msec	Old frequency is retained. Since the cycle time for the detection amounts to 2 msec, a missing pulse can no longer be detected.
2 to max. 4 msec	Limitation to max. 750 Hz
4 to max. 6 msec	Limitation to max. 375 Hz
8 to max. 10 msec	Limitation to max. 187.5 Hz
18 to max. 20 msec	Limitation to max. 83.3 Hz
48 to max. 50 msec	Limitation to max. 31.3 Hz
98 to max. 100 msec	Limitation to max. 15.3 Hz
0.998 to max. 1 sec	Limitation to max. 1.5 Hz
9.998 to max. 10 sec	Limitation to max. 0.15 Hz
> 10 sec	Output is set to 0 (i.e. frequencies under 0.1 Hz are not detected or always set to 0)

Further information on the counting pulse inputs at wire breaks at 6DL3100–8AA/–8AB with versions below 7 can be found in the product information which is contained on the same document CD.

B) Behavior of the two–channel counting pulse/speed detection (with sense of rotation recognition) if one of the channels fails:
(applies for 6DL3100–8AA as from Version 8, 6DL3100–8AB as from Version 7, all 6DL3100–8AC)

If one of the two channels fails, the value of the speed of the failed channel is reduced step–by–step to 0, as in single–channel detection. The sign is frozen with the state which it had before the fault occurred. This ensures that speed recognition is still possible on one channel. However, changes in the direction of rotation are no longer recognized.

Note

For a configuration suggestion on monitoring for wire breaks please refer to Section 3.1.3 ”Operating principle of the 2–channel speed detection with recognition of the sense of rotation”

Caution

Operation of the counting pulse/speed detection with sense of rotation recognition (for use at water turbines) with versions below those specified above is not permitted, since the speed and sense of rotation are sporadically no longer recognized correctly when a sensor fails or a wire breaks (jumps in the values).

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Digital Outputs [1]	
Number of outputs	16 digital semiconductor outputs
Nominal output voltage	24 V DC
Output voltage at 0 signal	< 1 V
Output voltage at 1 signal	Supply voltage –2 V
Max. output current	500 mA Parallel connection of outputs for higher currents is possible.
Output current at 100% coincidence factor	500 mA
Total output current	8 A
Effects of multiple overloads on multiple circuit modules	None
Short–circuit to ground monitoring	Yes
Short–circuit strength	Yes
Max. lamp load per output	5 W
Inductive loads Typical values: Maximum inductivity at I ≤ 500 mA and f ≤ 1 Hz Maximum inductivity at I < 250 mA and any f Maximum inductivity at external suppressor diode	Connection of inductive loads is possible. Integrated suppressor diodes with a higher extinction voltage of 39 V than the normal free–wheeling diode lead to rapid disconnection of the current and thus of the actuating element. However, the maximum extinction current (1 W) may not be exceeded. 8 H (without external suppressor diode) Unlimited Unlimited
Output delay time (TQD, dead time) from command output to response of the output (beginning of the current rise)	20 µs for signal transitions from 0 to 1 20 µs for signal transitions from 1 to 0
Output response time (TQT) from command output until the full output current is reached at 500 mA	50 µs for signal transitions from 0 to 1 50 µs for signal transitions from 1 to 0
Behavior of the outputs at interruption of the operation controlled by the main processing unit	The outputs are de–activated
Behavior of the outputs at collapsing and interruptions of the supply voltage L1+ resp. L2+ at X7/1 resp. X7/11	The output voltage of the outputs follows the supply voltage.
Display	The voltage level of the digital outputs are detected via additional module–internal digital inputs, converted and read by the internal micro controller unit. The micro controller unit displays these read–back states at the LED on the front.
Configuration of the terminals	Refer to Appendix A, connector X7, Page A-2

[1] Digital outputs can also be used as digital inputs!

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Analog Inputs	
Input impedance in signal range	
At current measurement	41.8 Ω
At voltage measurement	100 kΩ
Measuring error	
Greatest error at 25°C	± 0.12% at 0 V common–mode voltage
Temperature coefficient	± 25 ppm/K
Greatest error across the complete temperature range	± 0.2% related to an upper limit of effective range at 2 V maximum common–mode voltage
Digital resolution of the digital–analog converter	13 bits + preceding sign
Value of the least significant bit (LSB)	
At current measurement	4 µA
At voltage measurement	2 mV
Highest permitted continuous overload (without damage)	60 V
Output of the digital value under overload conditions	118%
Input type	Differential
Common–mode voltage range	± 6 V
Common–mode voltage suppression	
Direct voltage	–0.05%/V
50 Hz	55 dB
60 Hz	55 dB
Total system input transfer time interval (TAID + TAIT)	52 µs
Sampling time including transient recovery time	20 µs
Sampling repeat time	104.167 µs
First order input filter	
Transition frequency	880 Hz
Mean–value generation across 4 measurements each	
Transition frequency including input filter	700 Hz
Greatest short–time deviation during each specified electrical disturbance test	Refer to EMC data (Section 4.2)
Conversion method	Successive approximation / parallel conversion of 4 channels each
Operating mode	Self–sampling
Calibration	Not required
Configuration of the terminals	Refer to Appendix A, connector X5, Page A-1!

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Analog Inputs (continued)	
Measuring ranges of the current inputs / overflow range	0...20 mA / –3.511 mA to 23.7 mA 4...20 mA / –1.185 mA to 22.96 mA ± 20 mA / ± 23.7 mA ± 30 mA / ± 35.55 mA
Measuring range of the voltage inputs Only with the channels 1 to 6	0...10 V / –1.755 V to 11.85 V ± 10 V / ± 11.85 V
Number and classification of the inputs	6 inputs measuring current, 6 inputs measuring either current or voltage
Feedthrough between the channels at Direct voltage 50 Hz 60 Hz	 ≤ 60 dB ≤ 60 dB ≤ 60 dB
Non–linearity	< 0.01%

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Analog Outputs	
Number of analog outputs	8
Greatest error at 25°C	±0.15%
Temperature coefficient	±100 ppm/K
Greatest error across the complete temperature range	±0.4%
Digital resolution of the digital–analog converter	13 bits + preceding sign
Value of the least significant bit (LSB)	8 µA
Total system transfer time interval (TAQD +TAQT)	1 ms
Transient recovery time at changes across the entire range	0.6 ms
Overshoot	0.2%
Greatest temporary deviation during each specified electrical disturbance test	Refer to EMC data (Section 4.2)
Configuration of the terminals	Refer to Appendix A, connector X4, Page A-1
Permissible inductive load	1 H
Shutdown cycles of the power supply	Up to 10 ms a buffer overrides. In case of longer failures the starting operation depends on the software
Conversion process	Parallel conversion of all 8 output channels
Power output range unipolar / overflow range / load impedance	0...20 mA/±23.5 mA/500 Ω 4...20 mA/–4.96 to +22.96 mA/500 Ω
Power output range bipolar / overflow range / load impedance	±20 mA/±23.5 mA/500 Ω ±30 mA/±35.55 mA/300 Ω
Power output bipolar (only channels 1 to 4) [1)]	±50 mA/±59.26 mA/180 Ω
Monitoring tolerance of the output current	4%
Feedthrough between the channels at: Direct voltage 50 Hz 60 Hz	 ≤ 60 dB ≤ 60 dB ≤ 60 dB
Non–linearity	< 0.1%
Output ripple	< 0.1%

1) The analog outputs 1 to 4 are limited to a mean load of 40 mA in order to protect the module. The extension of the current range of these outputs to 50 mA / 59.26 mA is only intended for controlling integral–action actuating elements. To this purpose a max. current of 59.26 mA is provided for a limited period.
The current is monitored by software and is limited as follows:
Mean–value limitation: At a power output configured to ±50 mA a first–order time delay with a time constant of 10 seconds is used to form the mean value of the output current. It the mean value exceeds a current of 40 mA, the output current and thus also the mean value of the output current is limited to ±40 mA.

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Cause for Redundancy Changeover at Module Redundancy (Only 6DL3100–8AB/–8AC)	
By priority (error weighting)	**Cause**
Forced reserve specification	–Signal ZRV from the automation processor at failure of the optical–fiber cable redundancy coupling –Operating mode switch to STOP
Module fault	–Memory test of the RAM data range –Check sum across the program code in the FEPROM/RAM –Failure of the supply voltage/undervoltage
Central unit failure	–Failure of the PROFIBUS DP –Failure of the sign of life from the automation processor
Channel error	–Channel error analog input, analog output, digital output or failure of the 24 V DC load supply for the digital outputs
Channel error weighting	–Sum of the individual channel errors. All channel errors have the same weighting

Response Times of the Error Recognition for Central Unit Failure	
PROFIBUS–DP	At activated response monitoring the monitoring time is calculated from the corresponding values in the parameterization telegram (refer to the PROFIBUS standard).
Sign of life	2 x automation processor cycle

Response Times of the Error Recognition for Channel Errors [1)]	
Analog inputs Max. delay of the qualifier QU (Bit 0 of the respective analog value AI 1...12) in the input message	42.00 ms
Analog outputs Max. delay of the qualifier AO 1 ... 8 in the input message	12.667 ms 28.667 ms (at 6DL 3100–8AA till Version 6)
Digital outputs or undervoltage load supply Max. delay of the qualifier DO 1 ... 16 in the input message	2.00 ms

1) The error recognition times from the signal evaluation are a multiple of the cycle time due to error filtering. The error filtering function ensures that disturbing pulses or the unique occurrence of an error do not cause an error message.

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Cycle Times of Memory Tests (Only 6DL3100–8AB/–8AC)	
–Memory test of the RAM: Check for ”stuck–at–zero” and ”stuck–at–one” faults	24.5 seconds
–Check sum across the program code in the RAM	1.2 seconds
–Check sum across the program code in the FEPROM	2.5 seconds
Note: The program code of the RAM is used in cyclic operation	

PROFIBUS–DP Channel Changeover	
Changeover gap when changing over between the PROFIBUS DP channels	No changeover gap

Changeover Gaps at Module Redundancy (Only 6DL3100–8AB/–8AC)	
Changeover gap at intact optical–fiber cable redundancy coupling	
–Digital outputs	0 – 100 µs
–Analog outputs	0 – 300 µs
Changeover gap at missing or faulty optical–fiber cable redundancy coupling [2)]	1 Automation processor cycle
–Digital and analog outputs	+ 1 PROFIBUS DP token + 1 AddFEM cycle

[2)] When the optical–fiber cable redundancy coupling fails the master/reserve assignment is decided by the automation processor. The current error weighting of the modules is decisive for the assignment.

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4.2 Safety, Environmental Conditions and EMC

Approvals:

6DL3100–8AA/–8AB/–8AC has the following approvals:

- UL-Recognition-Mark: Underwriters Laboratories (UL) to Standard UL 508
- CSA-Certification-Mark: Canadian Standard Association (CSA) to Standard C 22.2 No. 142

CE Approval

6DL3 100–8AA/–8AB/–8AC fulfills the requirements of the EC guideline 89/336/EEC ”Electromagnetic compatibility” and the EC guideline 73/23/EEC ”Low–voltage guideline”.

Safety	
Device standard	DIN EN 61131-2 ≙ IEC 61131-2 ≙ VDE 0411, Part 500
Self–heating	The overtemperature of the metal housing amounts to approx. 20 K under full load. At 60°C ambient temperature the limiting temperature of 70°C is thus exceeded. Above this temperature safe contact (to DIN EN 61131–2) is not possible without protection.
Power supply	Only extra low voltage separated safely from the system may be used for the 24 V DC supply. Safe separation can be realized in accordance with the requirements e.g. in VDE 0100 Part 410 ≙ HD 384-4-41 ≙ IEC 364-4-41 (as functional extra–low voltage with safety separation PELV) or in VDE 0805 ≙ EN 60950 ≙ IEC 950 (as safety extra–low voltage SELV) or in VDE 0106 Part 101.
Mounting safety requirements	6DL3100–8AA/–8AB/–8AC is an ”open device” in accordance with DIN IEC 61131–2 and an ”open type” in accordance with the UL/CSA certification In order to fulfill the requirements for safe operation with regard to mechanical strength, flame retardance, stability and shock protection the following alternative installation types are prescribed: – Installation in a suitable cabinet – Installation in a suitable housing – Only permitted in accordance with DIN EN 61131–2: Installation in a correspondingly equipped closed operating area
Control–to–load isolation	The control–to–load isolation for the areas described in Section 4.1 is designed to 50 V in nominal operation. In the routine test the dielectric test is carried out in accordance with UL 508 (test voltage / test duration 707 V DC / 1 min or alternatively 849 V DC / 1 s at de–activated test specimen).
Protection again foreign bodies and water	Degree of protection IP 20 in accordance with IEC 529, i.e. protection against contact with standard probes. There is no protection against ingressing water.
Noise emission	None

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Reliability	
MTBF Value to SN 29500	23 years at 40 °C module ambient temperature

Electromagnetic Compatibility (EMC) The specified values apply for the use of shielded process cables for analog signals. Digital signal cables can be laid without shielding. The values apply without the shielding effect of a cabinet and without additional external protecting elements.	
Stress	**Test values**
Emitted interference	Limit class A to VDE 60875, T11 ≙ EN 55011
RF effect on cables and cable shields to ENV 50141	10 V 9 kHz to 80 MHz (with 80% amplitude modulation of 1 kHz) Possible deviations for the analog input signals < 3%
RF effect on cables and cable shields To ENV 50140 To ENV 50204	 10 V/m 80 MHz to 1 GHz to IEC 801–3 (with 80% amplitude modulation of 1 kHz) 10 V/m 900 MHz (with 50% pulse modulation)
Burst pulses (rapid transient disturbances) to IEC 1000–4–4	±2 kV on power supply cables and signal cables
High–energy single pulse (1.2/50 ms pulse, surge) to IEC 1000-4-5 Asymmetric interference Symmetric interference	 ±2 kV On supply cables ±2 kV On signal lines Type of crosstalk: At the unshielded binary signals on the cable. On the shielded analog signals and PROFIBUS DP on the cable shielding ±1 kV On the supply cables and signal cables <u>Information for 1.2/50 ms pulse/surge test:</u> The surge test simulates high–energy interference signals which, depending on the ambient conditions (corresponding to the standard) can be launched from cable lengths of approx. 10 m on and then superimpose themselves on the useful signals. Since in the case of a surge the individual disturbing pulse already lies within the sample frequency/cycle time of the module, it is not possible to filter the interference signals sufficiently by hardware means in the case of the very short cycle times. Otherwise the corresponding useful signals would also be filtered. Therefore the 50– or 60–Hz filter should be activated at the analog inputs if crosstalk from surge interference is to be expected on the signal cables due to the ambient conditions and the cable lengths. When the filter is activated, the deviation at the analog signals is reduced to less than 2% when surge interference occurs. Without a filter brief individual deviations of up to 60% are possible at the analog inputs.
Immunity to interference against discharge of static electricity on housing and structural parts	±6 kV Contact discharge to IEC 1000-4-2 ±8 kV Air discharge to IEC 1000-4-2

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Climatic Conditions	
Temperature (ambient temperature) Operation	Tested to DIN EN 60068–2–1, DIN EN 60068–2–2, UL 508 and DIN EN 61131–2: 0°C to +50°C At nominal load (refer to Section 4.1) 0°C to +55°C At nominal load. However max. of 200 mA possible at digital outputs 5, 6, 7, 8 as well as 13, 14, 15 and 16 0°C to +60°C At nominal load. However, max. of 120 mA 11 possible at digital outputs 3 to 8 and 11 to 16. Max. input voltage at the binary inputs ±28 V. PROFIBUS normal operation without load of the additional PROFIBUS supply for 90 mA (i.e. no users without own supply, e.g. optical fiber converter, connectable). Maximum temperature gradient 10°C/hour
Storage/transportation (packed for dispatch)	Tested to DIN EN 60068-2-1 and DIN EN 60068-2-2: –40°C to +70°C Maximum temperature gradient 5°C/hour (Danger of moisture condensation at higher temperature gradients. Moisture condensation is not allowed). In case of long–term storage it is advisable to take the modules into operation for an hour each at regular intervals in order to form the electrolytic capacitors: At a storage temperature of up to 40°C: Within the first 10 years every 5 years, afterwards every 3 years. At a storage temperature over 40°C: Every 2 years.
Relative humidity Operation	Max. 95% at + 25°C. Moisture condensation is not allowed. Corresponds to RH degree of stress 2 to IEC 61131–2. Tested to IEC 60068–2–3: 95% at 30°C
Storage/transportation (packed for dispatch)	Max. 95% at + 25°C. Moisture condensation is not allowed. Tested to IEC 60068–2–30: 95% at 25°C to 55°C
Air pressure	Storage: 1080...660 hPa (–1000 to + 3500 m) Operation: 1080...900 hPa (–1000 to + 1000 m) At greater heights the cooling decreases so that the upper operating temperature has to be reduced. (Reference value: 10 K/1000 m height as from 1000 m above mean sea level).
Pollutant concentration	$S0_2$ < 0.5 ppm, rel. humidity < 60%, no condensation H_2S < 0.1 ppm, rel. humidity < 60%, no condensation

Mechanical Ambient Conditions	
Vibration In operation, mounted by means of screw fixing device or on DIN rails (see Section 5.1)	Tested to DIN EN 60068-2-6: 10 to 58 Hz: Amplitude 0.075 mm 58 to 500 Hz: Acceleration 1 g (10 m/s^2) Excitation signal: Sliding sine Frequency modification speed: 1 octave/min, 10 cycles per axis
Packed for dispatch	Tested to DIN EN 60068-2-6: 5 to 8.5 Hz: Amplitude 3.5 mm 8.5 to 500 Hz: Acceleration 1 g (10 m/s^2) Excitation signal: Sliding sine Frequency modification speed: 1 octave/min 10 cycles per axis

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Mechanical Ambient Conditions (continued)	
Bumping	
In operation, mounted by means of screw fixing device or on DIN rails (see Section 5.1)	Tested to DIN EN 60068-2-29: Half–sine: 10 g (100 m/s^2) for 16 ms 100 shocks per axis Note: DIN rail design corresponding to DIN EN 50022 (min. material thickness 2.2 mm). At a rail length of 19” a middle fastening is required in addition to the side fastening in order to achieve the rigidity of the rails required to hold the module firmly.
Packed for dispatch	Tested to DIN EN 60068-2-27: Half–sine: 25 g (250 m/s^2) for 6 ms 1000 shocks per axis

Dust Endangering The Functionality	
Conductive and corrosive components must be kept away from the AddFEM. The conditions of use specified in DIN IEC 721 Part 3 Class 3S1 apply for other dust and sand.	
Particular points	
Quality assurance	Conforming to ISO 9001

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4.3 PROFIBUS DP Telegram Structure

4.3.1 Parameterization Telegram

The first 7 bytes of the parameterization telegram are determined by the PROFIBUS standard. The user–specific parameters for the process inputs and outputs are defined as follows:

Byte number	Range	Value (hex)
0	Reserved by the COM PROFIBUS	00
1 – 6	Analog input Channel 1 – 6	x0 = ”Current 4 ... 20 mA” x1 = ”Current 0 ... 20 mA” x2 = ”Current +/– 20 mA” x3 = ”Current +/–30 mA” x4 = ”Voltage +/– 10 V” x5 = ”Voltage 0...10 V”
		0x = ”No filtering” 1x = ”Filtering 50Hz” 2x = ”Filtering 60Hz” 3x = ”Filtering 16 2/3Hz”
7 – 12	Analog input Channel 7 – 12	x0 = ”Current 4 ... 20 mA” x1 = ”Current 0 ... 20 mA” x2 = ”Current +/– 20 mA” x3 = ”Current +/–30 mA”
		0x = ”No filtering” 1x = ”Filtering 50Hz” 2x = ”Filtering 60Hz” 3x = ”Filtering 16 2/3Hz”
13 – 20	Analog output Channel 1 – 8	00 = ”Current 4 ... 20 mA” 01 = ”Current 0 ... 20 mA” 02 = ”Current +/– 20 mA” 03 = ”Current +/–30 mA” 04 = ”Current +/–50 mA”
21	Counter input Channel 1	00 = ”Sense of rotation recognition off” 01 = ”Sense of rotation recognition on” (Channel 1 is the leading signal, Channel 2 the lagging one)
22	Delayed shutoff	00 = ”0 ms” 01 = ”10 ms” 02 = ”20 ms” 05 = ”50 ms” 0A = ”100 ms” 14 = ”200 ms” 32 = ”500 ms” (default) 64 = ”1 s” C8 = ”2 s” FF = ”3 s”

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Byte number	Range	Value (hex)
23	Configuration of the FEF	00 = ”Basic functionality” 01 = ”Positioner 8 channels” 02 = ”NoName0” 03 = ”NoName1”
24	Configuration of the operating mode	00 = ”Standard 1–channel” 01 = ”AS red. AddFEM 1–channel ” 02 = ”AS 1–channel AddFEM red. ” 03 = ”AS red. AddFEM red.

Note

At 6DL3100–8AC parameterization contains further setting possibilities. Information on further parameterization can be found in the manuals of the FEFs. The manuals of the FEFs are stored on the AddFEM CD in the directory of the corresponding order number.

4.3.2 Input Telegram

The input telegram for using the AddFEM without preprocessing function encompasses 52 bytes. When the AddFEM is operated with preprocessing function (FEF, only possible as from variant 6DL3100–8AB), an extended telegram structure with 122 bytes is used. At variant 6DL3100–8AC the length of the extended message depends of the configured FEF.

		Bit 15...	**Bit 8... Bit 7...**	**...Bit 0**
Word No.	**Byte address offset**	**Meaning of ”high” byte (Address + 1)**		**Meaning of ”low” byte (Address +0)**
1	1/0	DIO 16...	**[DI 1–16 – combined with DO 1–16]**	...DIO 1
2	3/2	Qualifier DO 16...	**[Qualifier DO]**	...Qualifier DO 1
3	5/4	Reserve		Qualif. AO 8 .[Qualif.AO] .Qualif. AO 1
4	7/6	DI 16...	**[DI 1–16]**	...DI 1
5	9/8	**AI 1**		
6	11/10	**AI 2**		
7	13/12	**AI 3**		
8	15/14	**AI 4**		
9	17/16	**AI 5**		
10	19/18	**AI 6**		
11	21/20	**AI 7**		
12	23/22	**AI 8**		
13	25/24	**AI 9**		
14	27/26	**AI 10**		
15	29/28	**AI 11**		

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16	31/30	**AI 12**													
17	33/32	**Z 1 [IEEE 754]**													
18	35/34														
19	37/36	**Z 2 [IEEE 754]**													
20	39/38														
21	41/40	**Z 3 [IEEE 754]**													
		Bit 15...							**Bit 8...**	**Bit 7...**					**...Bit 0**
Word No.	**Byte address offset**	**Meaning of "high" byte (Address + 1)**								**Meaning of "low" byte (Address +0)**					
22	43/42														
23	45/44	Range ID AI 12... ...Range ID AI 9								Range ID AI 8... ...Range ID AI 1					
24	47/46	Start–up ID 0xA5								Range ID AO 8... ...Range ID AO 1					
25	49/48	Error weighting								Sign of life + active DP channel					
26	51/50	**MRS**		**RPM**						Channel error weighting					
27 – 58	115/52	Additional dynamic FEF signals													
59 – 61	116/121	Reserve													

Legend: In case of 6DL3100–8AB the extensions for the use with FEF function have a gray background.
In case of 6DL3100–8AC the extensions depend of the configured FEF.

Information on the Input Telegram:	
Word No.	**Meaning**
1	**Signal states** at the **binary inputs (DI)** which can be used optionally as binary outputs at the front connector **X7A/ X7B.** Bit 15 corresponds to DI/DO 16 (pin X719) – Bit 0 corresponds to DI/DO 1 (pin X72)
2	**Qualifier of the digital outputs (DO)** In the case of discrepancies between the specified and the actual output signal state of the DO the respective channel–specific qualifier is set to "1".
3	Low byte: **Qualifier of the analog outputs (AO)** In the case of discrepancies between the specified and the actual output current of the AO the respective channel–specific qualifier is set to "1".
4	**Signal states of the binary inputs (DI) at the front connectors X6A/ X6B.** Bit 0 corresponds to DI 1 (pin X6–2) – The input is simultaneously counter input K 1. Bit 1 corresponds to DI 2 (pin X6–3) – The input is simultaneously counter input K 2. Bit 2 corresponds to DI 3 (pin X6–4) – The input is simultaneously counter input K 3. Bit 3 is not assigned at present (reserve). Bit 4 corresponds to DI 5 (pin X6–6) : Bit 15 corresponds to DI 16 (pin X6–19)
5–16	**Analog inputs AI 1 to AI 12:** The analog values are transferred in fixed–point format. The representation corresponds to the SIMATIC format. Measuring range, see below. Bit 15 is the preceding sign (1 = negative). Bit 0 is the qualifier. The qualifier is set when the specified measuring–range limits are exceeded or the detection hardware of the analog input is faulty.

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Information on the Input Telegram (continued):	
Word No.	**Meaning**
17–22	**Counter inputs Z1 to Z3** The detected counter values are represented in IEEE 754 format, single–precision, (32 bits – 4 bytes). Refer to the description below.
23	**Area ID AI** Identifies the polarity of the analog inputs (0 = unipolar; 1 = bipolar). The individual bits are set channel–specifically. Bit 0 (least significant bit) corresponds to analog input 1. Bit 11 corresponds to analog input 12.
24	Low–Byte: **Area ID AO** Identifies the polarity of the analog outputs (0 = unipolar; 1 = bipolar). The individual bits are set channel–specifically. Bit 0 (least significant bit) corresponds to analog output 1. Bit 7 corresponds to analog output 8. High–Byte: **Start–up ID** The start–up ID is fixed to 0xA5.
25	Low–Byte: **Sign of life + active DP channel** Mirrored sign of life with ORed active DP channel Bit 0 – 3: Sign of life Bit 4 –6: Reserve Bit 7 = DP_AKT DP_AKT = 0 = DP channel A is active. DP_AKT = 1 = DP channel B is active. High-Byte: **Error weighting (FG)** Current error weighting of the AddFEM
26	Low–Byte: **Channel error weighting (KFG)** I/O channel errors (analog/digital / output/input) have the same weighting. High byte: Bit 0 – 4, 6 **Reserve** Not used at present Bit 5 **RPM** Run Passiv Master Bit 7: **MRS** AddFEM is reserve = 0. AddFEM is master = 1.
27 – 58	32 words for additional dynamic FEF signals in case of 6DL3100–8AB. In case of 6DL3100–8AC it depends of configured FEF
59 – 62	3 words reserve only in case of 6DL3100–8AB

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Error Weighting Structure		
Bit Pos.	**Signal**	**Meaning**
7	ZRV	**Forced reserve specification manual** Is set when operating mode switch = STOP e.g. due to repairs.
6	BGF	**Module fault** Grave fault. Hardware fault e.g.: power failure, memory error, etc. Restart of the AddFEM
5	ZTA	**Central unit failure** Higher–level fault. E.g. central unit or PROFIBUS DP failure.
4	KF	**Channel error** Lower–level or externally initiated channel fault. The number of channel errors is supplied in the additional byte **"Channel error weighting"**.
3	RES	**Reserve**
2	RES	**Reserve**
1	RES	**Reserve**
0	MRV*	**Master state specification request** The automation processor specifies the master state of the AddFEM as the "higher–level referee". =1 –> Automation processor requests: AddFEM is reserve =0 –> Automation processor requests: AddFEM is master

Legend: * Is not set in the error weighting via the PROFIBUS DP telegram

Floating–point Representation of the Counter Values in IEEE 754 Format (32 Bits = 4 Bytes):				
Byte address	**+3**	**+2**	**+1**	**+0**
Meaning	SEEE EEEE	EMMM MMMM	MMMM MMMM	MMMM MMMM

Meaning of the individual bits:

S Preceding sign bit
0: Positive / 1: Negative

E Exponent
Two's–complement representation with a fixed offset of 127

M Mantissa 24 bits
The most significant bit is always 1 and is not represented. The least significant bit of the exponent is displayed at the corresponding bit position.

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4.3.3 Output Telegram

The output telegram for using the AddFEM without preprocessing function encompasses 22 bytes. When the AddFEM is operated with preprocessing function (FEF), an extended telegram structure with 122 bytes is used. At variant 6DL3100–8AC the length of the extended message depends of the configured FEF.

		Bit 15...	**Bit 8...**	**Bit 7**	**.....Bit 0**
Word No.	**Byte address offset**	**Meaning of “high” byte (Address + 1)**		**Meaning of “low” byte (Address +0)**	
1	1/0	DO 16...	**[DO 1–16]**		...DO 1
2	3/2	**AO 1**			
3	5/4	**AO 2**			
4	7/6	**AO 3**			
5	9/8	**AO 4**			
6	11/10	**AO 5**			
7	13/12	**AO 6**			
8	15/14	**AO 7**			
9	17/16	**AO 8**			
10	19/18	**Reserve**		**ZRV** **MRV** **RES** **RES** **LZ**	
11	21/20	**Reserve**			
12 – 43	22 – 85	Additional dynamic FEF signals			
44	87/86	Reserve		Parameter block address 1	
45 – 60	88 – 119	16 parameters			
61	121/120	Reserve		Parameter block address 2	

Legend: In case of 6DL3100–8AB the extensions for the use with FEF function have a gray background.
In case of 6DL3100–8AC the extensions depend of the configured FEF.

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Information on the Output Telegram:	
Word No.	Meaning
1	Signal states at the usable binary output (DO) at the front connector X7A/ X7B. Bit 15 corresponds to DO 16 (pin X719) – Bit 0 corresponds to DO 1 (pin X72)
2–9	**Analog outputs AO 1 to AO 8** The analog values are transferred in fixed–point format. The representation corresponds to the SIMATIC format. Measuring range, see below.
10	Low byte: Bit 0 – 3: **LZ** Sign of life changing with the contents. Code: 0x05/0x0A or 0x03/0x0C. Bit 4: **RES** Reserve bit Bit 5: **RPM** Run Passive Master Bit 6: **MRV** Master–state specification Bit 7: **ZRV** Forced reserve specification High byte: **Reserve**
11	**Reserve**
12 – 43	**In case of 6DL3100–8AB 32 words additional dynamic FEF signals** **In case of 6DL3100–8AC it depends of configured FEF**
44	Low byte: **Parameter block address 1 (only for 6DL3100–8AB)** Address of the parameter block (1 – 255). Address 0 is invalid. High byte: **Reserve**
45 – 60	**16 words parameters (only for 6DL3100–8AB)**
61	Low byte: **Parameter block address 2 (only for 6DL3100–8AB)** Repetition of parameter block address 1 as a backup measure. High byte: **Reserve**

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4.3.4 Coding of the Analog Values and Measured Value Ranges

Analog value representation for asymmetric (unipolar) measuring ranges:

System			Measuring range		
Value	**Dec.**	**Hex.**	**0...20 mA**	**0...10 V**	**Remark**
118.507%	32764	7FFC	23.696 mA	11.848 V	Overflow
117.596%	32512	7F00			
117.582%	32508	7EFC	23.511 mA	11.756 V	Overrange
	27652	6C04			
100%	27648	6C00	20 mA	10 V	Nominal range
0.014468%	4	4	0.002893 mA	0.0014468 V	
0%	0	0	0 mA	0 V	
	–4	FFFC			Underrange
–17.593%	–4864	ED00	–3.511 mA	–1.756 V	
	–4868	ECFC			Underflow
–118.522%	–32768	8000			

System			Meeasuring range	
Value	**Dec.**	**Hex.**	**4...20 mA**	**Remark**
118.507%	32764	7FFC	22.96 mA	Overflow
117.593%	32512	7F00		
117.589%	32508	7EFC	22.81 mA	Overrange
	27652	6C04		
100%	27648	6C00	20 mA	Nominal range
0.014468%	4	4	0.002315 mA	
0%	0	0	4 mA	
	–4	FFFC	3.998 mA	Underrange
–17.593%	–4864	ED00	1.185 mA	
≤ 17.607%	–4868	ECFC		Wire break

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Analog value representation for symmetrical (bipolar) measuring ranges:

System			**Measuring range**				
Value	**Dec.**	**Hex.**	**±20 mA**	**±30 mA**	**±50 mA**	**±10 V**	**Re-mark**
118.507%	32764	7FFC	23.70 mA	35.549 mA	59.25 mA	11.85 V	Over-flow
117.596%	32512	7F00					
117.582%	32508	7EFC	23.52 mA	35.271mA	58.80 mA	11.76 V	Over-range
	27652	6C04					
100%	27648	6C00	20 mA	30 mA	50 mA	10 V	Nomi-nal range
0.014468%	4	4	0.002893 mA	0.00434 mA	0.00723 mA	0.014468 V	
0 %	0	0	0 mA	0 mA	0 mA	0 V	
–0.014468%	–4	–4	–0.002893mA	–0.00434mA	–0.00723mA	–0.014468V	
–100%	–27648	9400	–20 mA	–30 mA	–50 mA	–10 V	
	–27652	93FC					Under-range
–17.596%	–32512	8100	–23.52 mA	–35.276 mA	–58.80 mA	–11.76 V	
	–32516	80FC					Under-flow
–118.521%	–32768	8000	–23.70 mA	–35.55 mA	–59.25 mA	–11.85 V	

Value	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
Bit No.	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
As-sign.	**PS**	x	x	x	x	x	x	x	x	x	x	x	x	x	x	**QU**

Meaning:

PS = Preceding sign : 0 →Positive
1 → Negative

x = Analog value as fixed–point number (13 bits)

QU = Qualifier : 0 → Analog value OK
1 → Analog value faulty

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4.3.5 Diagnostic Message

Qualifiers are assigned to the analog and binary input and output data, which are also transferred within the user data messages.
For masters which can be diagnosed device–specific diagnostic messages are transferred under consideration of the PROFIBUS DP diagnostic possibilities.
The previously single–stage diagnostic concept DPV1–Slave 6DL3100–8AC has been extended to the three–stage diagnostic concept of PROFIBUS–DP, consisting of the device–specific diagnostics, identifier– or module–specific diagnostics and the channel–specific diagnostics. In addition the alarm model according to DPV1 can be used by preprocessing functions. Further information on diagnostics at 6DL3100–8AC can be found in the manuals of the FEFs. The manuals of the FEFs are stored on the AddFEM CD in the directory of the corresponding order number.

The diagnostic buffer is byte–oriented. The first 6 bytes have a default assignment. The remaining bytes (7 to 18) have the following assignments for 6DL3100–8AA/–8AB:

		Bit 7							**Bit 0**
Byte No.	Contents	7	6	5	4	3	2	1	0
7	Header byte	Device–specific diagnostics		Length of the external diagnostic data					
		0	0	0	0	1	1	0	0
8	Reserve	0	0	0	0	0	0	0	0
9	Group status	BSV BAR 2	BSV BAR 1	0	0	0	EXT	INT	BUS
10	Group status	0	0	0	0	0	BOF	AOF	AIF
11	AI status	AI_8F	AI_7F	AI_6F	AI_5F	AI_4F	AI_3F	AI_2F	AI_1F
12	AI status	0	0	0	0	AI_12F	AI_11F	AI_10F	AI_9F
13	AO status	AO_8F	AO_7F	AO_6F	AO_5F	AO_4F	AO_3F	AO_2F	AO_1F
14	AO status	0	0	0	0	0	0	0	0
15	BO/BI status	BO_8F	BO_7F	BO_6F	BO_5F	BO_4F	BO_3F	BO_2F	BO_1F
16	BO/BI status	BO_16F	BO_15F	BO_14F	BO_13F	BO_12F	BO_11F	BO_10F	BO_9F
17	Internal error	SV_P24V	CP_F	S2_RAST	S2_TAST	S1_RUN_P	S1_RUN	S1_STOP	S1_MRES
18	Internal error	KORR-DAT_F	PROM_F	RAM_F	RSS_F	SV_P20V	SV_N20V	SV_N15V	SV_P15V

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Information in the Diagnostic Message:		
Set error state		1
Unset error state		0
Group status	(byte 9, 10)	Group display – Combination by ORing individual errors
AI status	(byte 11, 12)	Individual status of the analog inputs
AO status	(byte 13, 14)	Individual status of the analog outputs
BO/BI status	(byte 15, 16)	Individual status of the combined binary outputs and outputs
Internal error	(byte 17, 18)	Individual status of the internal error messages
Individual signal	**Forms the group display**	**Description**
BUS[1)]	–	Corresponding to BUSF (... at S7) display of PROFIBUS DP errors
INT	–	Corresponding to INTF display of internal errors
EXT	–	Corresponding to EXTF display of external faults (channel faults) – ORing of AIF, AOF, BOF, etc.
AIF	EXT	Group error analog inputs – ORing of AI_1F to AI_12F
AOF	EXT	Group error analog outputs – ORing of A0_1F to AO_8F
BOF	EXT	Group error binary outputs – ORing of DO_1F to DO_16F
BSV BAR 1	–	External supply voltage DO 1 ... 8 missing
BSV BAR 2	–	External supply voltage DO 9 ... 16 missing
AI_1F..AI_12F	AIF	Individual error / qualifier of the analog inputs – are set or reset directly by the acquisition part.
AO_1F..AO_8F	AOF	Individual error / qualifier of the analog outputs (see above)
BO_1F..BO_12F	BOF	Individual error / qualifier of the binary outputs (see above)
S1_MRES[2)]	INT	Key switch in position MRES
S1_STOP[2)]	INT	Key switch in position STOP
S1_RUN	INT	Key switch in position RUN
S1_RUN_P[2)]	INT	Key switch in position RUN P
S2_TAST[3)]	INT	Slide switch in jogging position (Position 0)
S2_RAST[3)]	INT	Slide switch in notched position (Position 2)
CP_F	INT	Co–processor fault occurred
SV_P24V	INT	Monitoring of the external supply voltage +24 V has been triggered
SV_P15V	INT	Monitoring of the internal supply voltage +15 V has been triggered
SV_N15V	INT	Monitoring of the internal supply voltage –15 V has been triggered
SV_P20V	INT	Monitoring of the internal supply voltage +20 V has been triggered
SV_N20V	INT	Monitoring of the internal supply voltage –20 V has been triggered
RSS_F	INT	Fault at the optical fiber redundancy interface
RAM_F	INT	Check sum correction factors in the RAM invalidated

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Information in the Diagnostic Message (continued):		
PROM_F	INT	Check sum program code in the FLASH–EPROM invalidated
KORRDAT_F	INT	Check sum correction factors in the FLASH–EPROM invalidated

1) The failure of the redundancy partner is signaled at the operating mode with redundant PROFIBUS DP

2) The diagnostic message is removed in the key switch position RUN (going diagnosis).

3) The diagnostic message is removed in the slide switch position 1 Rest (going diagnosis).

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Commissioning / Operation / Maintenance 5

Overview

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5.4	Configuring the AddFEM	5-26
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5.1 Mounting the AddFEM

The fastening elements of the AddFEM can be modified. This means that the AddFEM can be mounted alternatively on DIN rails or with screws to a wall.

Both the cables for the 24 V DC supply of the module as well as the process cables are to be clamped to the strain relief.

Mounting in Accordance with DIN EN 61131–2

6DL3100–8AA/–8AB/–8AC is an ”open device” in accordance with DIN EN 61131–2 and an “open type” in accordance with the UL/CSA certification
In order to fulfill the requirements for safe operation with regard to mechanical strength, flame retardance, stability and shock protection the following alternative installation types are prescribed:
– Installation in a suitable cabinet
– Installation in a suitable housing
– Only permitted in accordance with DIN EN 61131–2:
Installation in a correspondingly equipped closed operating area.



Caution

The overtemperature of the metal housing amounts to approximately 20 K under full load. At 60°C ambient temperature the limit temperature of 70°C is exceeded, below which completely harmless contact (according to DIN EN 61131–2) is possible without protection.

Fastening Possibilities

The following fastening possibilities are prepared:

- DIN rail mounting on twin DIN rail (standard configuration at delivery)
- Direct wall mounting with screws

DIN Rail Mounting

165.1 mm are specified for the distance from the upper to the lower rail (center–to–center) (refer to dimensioned drawing for DIN rail mounting).
In order to ensure that the module is held securely the DIN rail construction must have a minimum strength. We therefore recommend that you use a DIN rail construction conforming to DIN EN 50022 (min. material thickness 2.2 mm) with a fastening spacing on less than 25 cm (this means that if a rail is 19” long, the DIN rail has to be fastened in the middle in addition to the fastening at the sides).

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Fastening of the AddFEM to the DIN rail:

- Slide the upper fixing bracket from above over the upper DIN rail and “hang in” the module.
- Press the lower attachment lightly against the lower DIN rail.
- There is a slot in the lower fastening element at the level of the housing base. Insert a flat–blade screwdriver at an angle from below into this slot (refer to dimensioned drawing for DIN rail mounting) and move it towards the housing bottom. This action pulls the lower fastening bow against the spring pressure downwards and the AddFEM can then be fastened onto the lower DIN rail.
- Remove the screwdriver. The AddFEM is now anchored firmly.

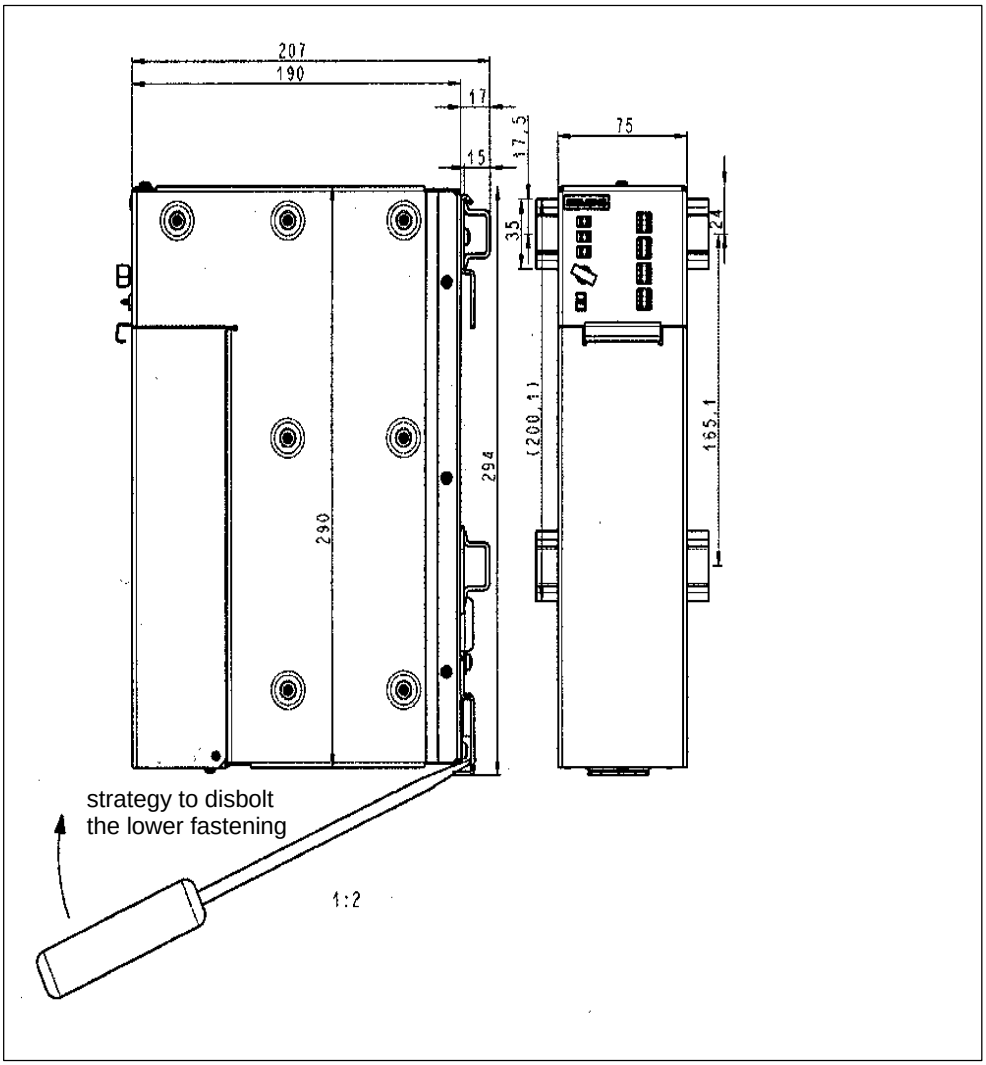


Figure 5-1 Dimensioned drawing for DIN rail mounting

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Screw Mounting

For direct mounting with screws the fastening elements on the module rear have to be removed, turned around and attached again. 4 screws M5 are used as fastening elements. The hole distances are indicated in the dimensioned drawing for screw mounting.

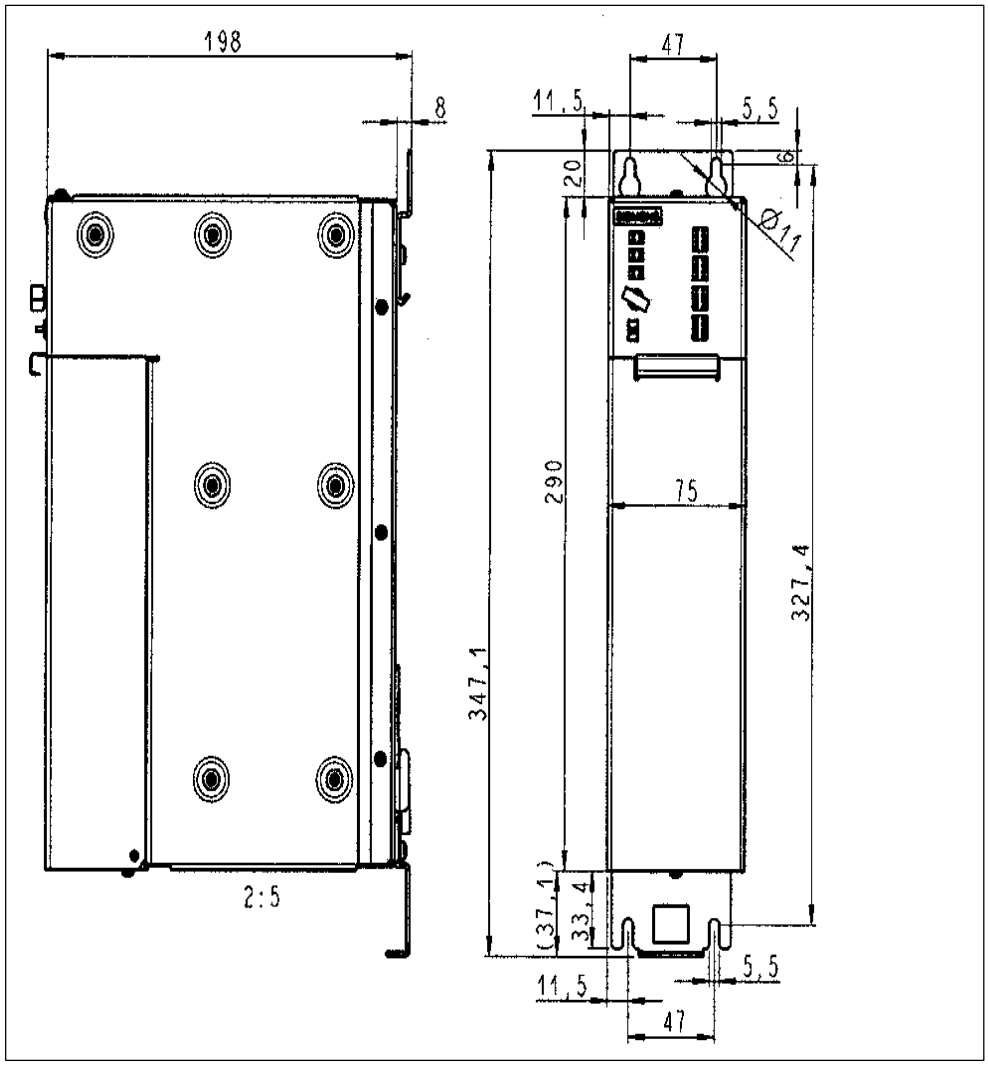
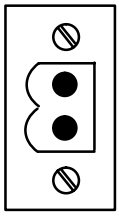


Figure 5-2 Dimensioned drawing for screw mounting

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Module Supply

The AddFEM is supplied with 24 V DC current via a connector with 2 screw terminals from the FEM connector set, Order No. 6DL9900–8AA. At 60°C ambient temperature the temperature in the area of the supply terminal can reach 70°C (approval of the cable insulation required for 75°C).



M: Reference potential

L+: +24 V power supply

Figure 5-3 Module supply 24 V DC

Only full–wire cables or litz wires with wire end ferrules may be used for the module supply with 24 V DC (stripping length: 7 mm).
Tightening torque of the screws when connecting the wires to the connector:
0.5 to 0.6 Nm



Warning

Only an extra–low voltage separated safely from the power supply may be used for the 24 V DC module supply. Safety separation can be implemented for example in accordance with the requirements in
VDE 0100 Part 410 ≙ HD 384-4-41 ≙ IEC 364-4-41
(as functional extra–low voltage with safety separation PELV) or in
VDE 0805 ≙ EN 60950 ≙ IEC 950
(as safety extra–low voltage SELV) or in
VDE 0106, Part 101.

Load Supply of the Digital Outputs

The 24 V DC load supply for the analog outputs is supplied by the AddFEM. The 24 V DC load supply for the digital outputs must be generated externally and fed via the X7 connector.

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Connection of the Process Signals

Cable type: Shielded cables are to be used for analog signals in order to achieve the corresponding protection against interference (refer to ”Supplementary Technical Data on Safety, Environmental Conditions and EMC”). Unshielded cables can be used for the digital signals.

In accordance with the UL/CSA approval for the front connectors which fit the sokkets X4 to X7 (connector with 10 screw terminals from the AddFEM connector set, Order No. 6DL9900–8AA) connection of the process signals may only be realized by means of copper full–wire cables or litz wires with wire end ferrules (stripping length 9 mm). At 60^{o}C ambient temperature the temperature in the area of the supply terminal can reach 70^{o}C (approval of the cable insulation required for 75^{o}C).

Tightening torque of the screws when connecting the wires: 0.22 to 0.25 Nm.



Warning

Please note that in the process transients or faulty connections can cause dangerous contact voltages to arise which are connected via the connectors to the module. These voltages can become dangerous for the user through the following connection points:

Lock screws:

The lock screws used to screw the cables onto the process connector can be touched when connecting the cables or handling the cable connectors.

Contact pins on the module front connector:

If the process connector is only plugged partially onto the module front connector, dangerous contact voltages can be transferred from the adapted contacts via the module to the open contact pins not yet adapted.

The shrouding cover must therefore be closed after the process connector has been connected and the cables have been clamped.
Before opening the shrouding cover either disconnect the connection to the process or take the required precautionary measures to prevent contact to the open contact pins or to the lock screws.

Strain Relief of the Cables

At the front end of the AddFEM there is a metal comb for clamping all the cables and wires with cable ties. When a module is replaced, the metal comb (including the cables and wires fixed to it) can be removed after loosening two screws and then mounted on the new module.

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Shielding

Cable shields: The shields of the cables for the analog signals as well as the shields of the PROFIBUS DP cables are to be clamped and grounded suitably directly before the module. If grounding is not carried out until the strain relief, any high interference currents possible are discharged via the housing, thus impairing the immunity to interference of the module.

Unshielded cables can be used for the digital process signals.

Housing: The module housing must be grounded in order to achieve EMC protection. For grounding it is sufficient if the module is mounted on grounded DIN rails (DIN rail mounting) or on a grounded sheet (screw mounting).
If there are not sufficient grounded mounting possibilities, implement the grounding separately. To this purpose there is a grounding screw on the front (below the module power supply) by means of which a grounded cable can be connected.

For further information on configuring and implementing an overall system (lightning protection, grounding, etc.) please refer to the SIMATIC PCS 7 overall documentation on CD–ROM (see ST PCS 7 catalog).

Cabinet Technique

The AddFEM can be installed in cabinets together with other distributed peripheral devices or higher–level units from the spectrum of SIMATIC M7, SIMATIC S7, SIMATIC PCS 7 or SIMADYN D. A special cabinet design technique of Siemens has been optimized specifically for these system families.

The cabinets consisting of system–specific and system–neutral modules conform to the CE requirements. This means they conform to the guidelines for electromagnetic compatibility specified in the EMC act. They offer secure protection against unauthorized access, mechanical influences, impurities and corrosion.

They can be adapted excellently to different plant types and sizes thanks to their modularity and the resulting variability.

For information on configuring and structuring customer–specific cabinets:

Siemens AG
A&D SE SP3
Mr. Rieder
Tel: +49 721 595–2528
Fax: +49 721 595–4711
Siemensalle 84
D– 76187 Karlsruhe
Germany

Hardware Maintenance

The AddFEM cannot be repaired on site at the customer (delivery to the supply works required). Cleaning is only possible in a dry state.

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Accessories (Cables and Connectors)

1. **AddFEM connector set for process cable connection and module supply**
   (1 set is required per AddFEM), Order No. 6DL9900–8AA,
   consisting of:
   - 8 connectors with 10 screw terminals each for connecting the process cables of a module to X4 A/B to X7 A/B
   - 1 connector with 2 screw terminals for connecting the cables to the module power supply with 24 V DC
2. **Cables and connectors for the PROFIBUS DP connection of the AddFEM:**
   The current order numbers for these accessories can be found either in the Siemens catalog IC 10, Industrial Communication, or in the Internet under http://www.ad.siemens.de –> Products and Solutions –> Automation Systems –> Industrial Communications SIMATIC NET.
3. **Optical–fiber cable for redundancy connection**
   Length 1,6 meter
   Order number 6DL9 901-8AA

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5.2 Setting the PROFIBUS–DP Address

A unique address must be assigned in order to address each user at a PROFIBUS DP. This PROFIBUS DP address can be selected from the range ”1” to ”125”. The PROFIBUS DP address of the AddFEM can be set either by means of key–operated and slide switches or via the SIMATIC Manager. Both possibilities are described below. In case of a redundant application it is advisable to assign the same address to both PROFIBUS DPs – the two addresses can, however, also be set differently. An address which has been set once is retained after a power failure, since they are saved in the Flash EPROM storage of the AddFEM. In order to simplify the procedure of setting the adresses, possibly low addresses, for example ”2”, ”3”, ”4”, or ”5”, should be assigned to the three or four AddFEMs per PROFIBUS DP line (typical configuration at the turbine control systems).

5.2.1 Setting the PROFIBUS DP Address for Bus A via Key–operated and Slide Switches

The following section describes the procedure step–by–step to be carried out when setting the PROFIBUS–DP address for Bus A (connector X3A at AddFEM) by the maintenance/repair personnel with the operating elements of the AddFEM (key–operated and slide switches).

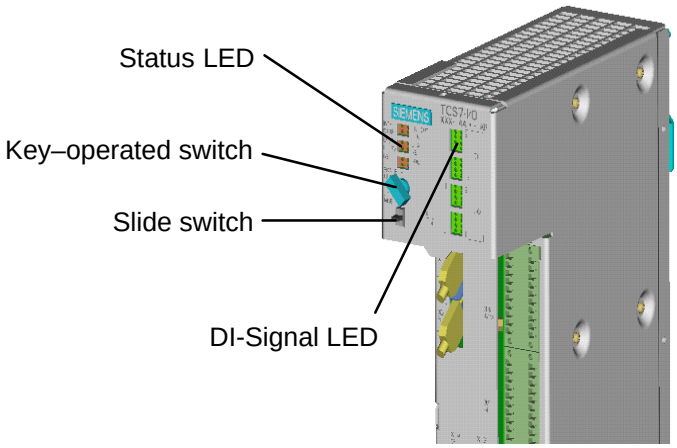
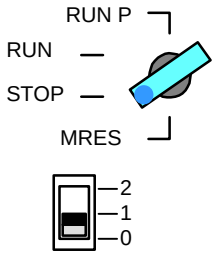
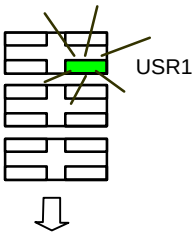
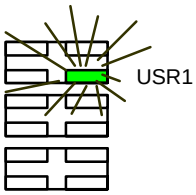
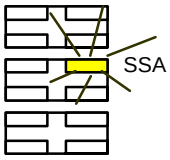
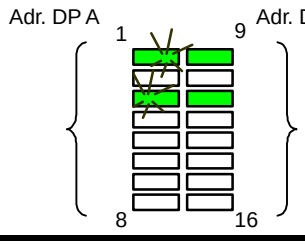


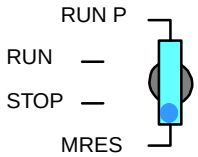
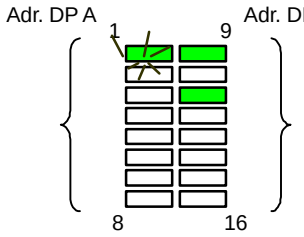
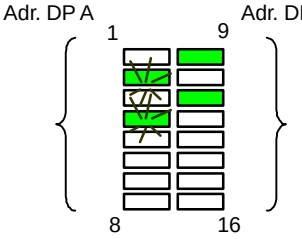
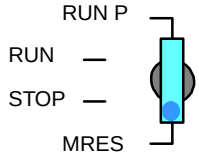
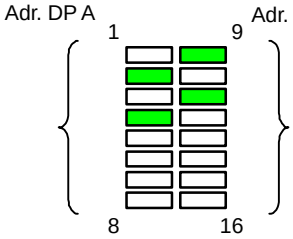
Figure 5-4 Operating elements of the AddFEM

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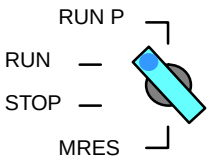
Table 5-1 Setting the PROFIBUS–DP Address for Bus A via Key–operated and Slide Switches

Seq. No.	**Operation**	**Handling (key–operated and slide switches)**	**Display/Reaction**	**Next step, if ...**
1	Preparation of AddFEM for adjustment procedures.	Turn key–operated switch to the ”STOP” position and press slide switch to spring position 0. 	Status–LED ”USR1” flashes.  Status-LED ”USR1” flickers. 	...wait until status LED ”USR1” flickers! Then proceed with Step 2.
2	Function mode 1, set ”DP address A”.	Release the slide switch The slide switch springs back to Position 1 	Status LED “SSA” flashes.  The currently set addresses for DP A (left LEDs 1 to 8 flashing) and DP B (right LEDs 9 to 16 static) are indicated at the 16 signal LEDs in binary form. LED 1 has the value 2^0. LED 2 has the value 2^1. etc. The address 5 is set respectively for DP A and DP B in the following example: 	Continue with Step 3 ...

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Seq. No.	Operation	Handling (key–operated and slide switches)	Display/Reaction	Next step, if ...
3	Function mode 1, confirm ”DP address A”.	Turn the key–operated switch to the position ”MRES” and release it again. 	The default address 1 is displayed at the 16 signal LEDs. 	Continue with Step 4 ...
4	”Set ”DP–Address A”.	Set the desired address for DP A with the slide switch in Position ”0”. The address is increased by “1” whenever the button is pressed.  If the slide switch remains pressed for longer than 3 seconds, the station address is increased automatically.	The 16 signal LEDs display the current/new address. The address 10 is set for DP A in the example below. 	Hold the slide switch in Position 1 until the address is set. Then proceed with Step 5 ....
5	Confirm the new address for Bus DP A.	Turn the key–operated switch to the position ”MRES” and release it. The new address is then saved. 	The 16 signal LEDs display the desired address statically for approx. 3 seconds. 	After approx. 3 seconds the status of the DI displays change. The state of the digital inputs is displayed again. Continue with Step 6.

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Seq. No.	Operation	Handling (key–operated and slide switches)	Display/Reaction	Next step, if ...
6	Set the regular ”RUN” mode again.	Turn the key–operated switch to ”RUN” or ”RUN P”. 		Setting has been completed.

5.2.2 Setting the PROFIBUS–DP Address for Bus B via Key–operated and Slide Switches

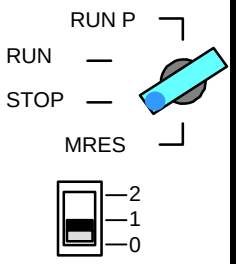
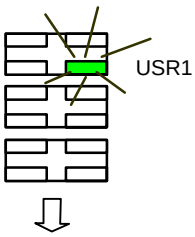
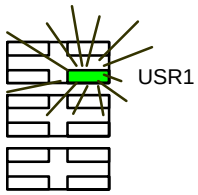
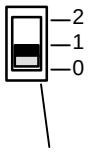
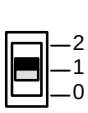
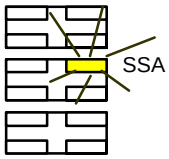
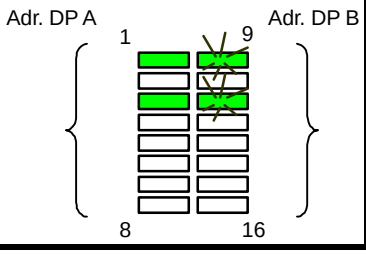
The following section describes the procedure step–by–step to be carried out when setting the PROFIBUS DP address for Bus B (connector X3B at AddFEM) by the maintenance/repair personnel with the operating elements of the AddFEM (key–operated and slide switches).

Notice

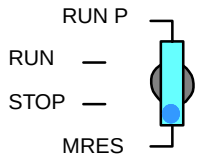
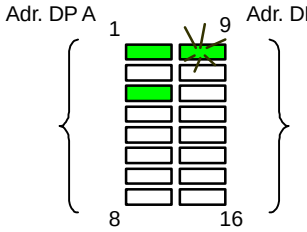
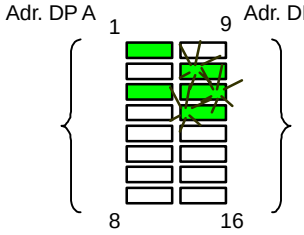
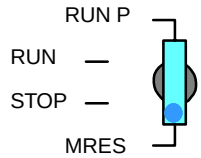
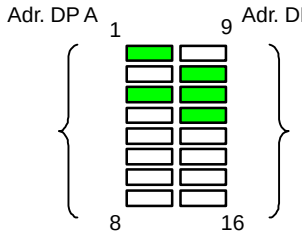
The procedure corresponds essentially to the procedure for setting the PROFIBUS DP address for Bus A. However, the operating mode Function Mode 2, “Set DP Address B” has to be set at Step 2 by pressing the slide switch 2 once more!

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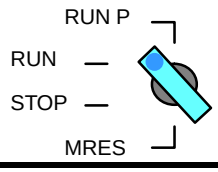
Table 5-2 Setting the PROFIBUS–DP Address for Bus B via Key–operated and Slide Switches

Seq. No.	Operation	Handling (key–operated and slide switches)	Display/Reaction	Next step, if ...
1	Preparation of AddFEM for adjustment procedures.	Turn key–operated switch to the ”STOP” position and press slide switch to spring position 0. 	Status–LED ”USR1” flashes.  Status–LED ”USR1” flickers. 	...wait until status LED ”USR1” flickers! Then proceed with Step 2.
2	Function mode 2, set ”DP address B”.	Release the slide switch. The slide switch springs back to Position 1. Function Mode 2 is set by pressing the slide switch once more to the spring position 0 !  **Move once more to Position 0!** Release the slide switch! 	Status LED ”SSA” flashes.  The currently set addresses for DP A (left LEDs 1 to 8 static) and DP B (right LEDs 9 to 16 flashing) are indicated at the 16 signal LEDs in binary form. LED 9 has the value 2^0. LED 10 has the value 2^1. etc. The address 5 is set respectively for DP A and DP B in the following example: 	Continue with Step 3 ...

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Seq. No.	Operation	Handling (key–operated and slide switches)	Display/Reaction	Next step, if ...
3	Function mode 2, confirm ”DP address B”.	Turn the key–operated switch to the position ”MRES” and release it again. 	The 16 signal LEDs display the default address 1 für DP B. 	Continue with Step 4 ...
4	Set ”DP–Address B”.	Set the desired address for DP B with the slide switch in Position ”0”. The address is increased by “1” whenever the button is pressed.  If the slide switch remains pressed for longer than 3 seconds, the station address is increased automatically.	The 16 signal LEDs display the current/new address. The address 14 is set for DP B in the example below. 	Hold the slide switch in Position 0 until the address is set. Then proceed with Step 5 ....
5	Confirm the new address for Bus DP B.	Turn the key–operated switch to the position ”MRES” and release it. The new address is then saved. 	The 16 signal LEDs display the desired address statically for approx. 3 seconds. 	After approx. 3 seconds the status of the DI displays change. The state of the digital inputs is displayed again. Continue with Step 6.

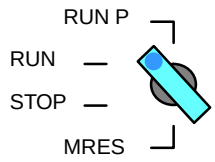
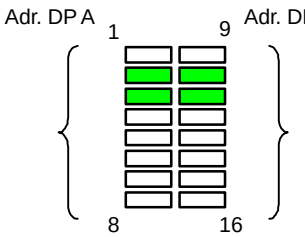
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Seq. No.	Operation	Handling (key–operated and slide switches)	Display/Reaction	Next step, if ...
6	Set the regular ”RUN” mode again.	Turn the key–operated switch to ”RUN” or ”RUN P”. 		Setting has been completed.

5.2.3 Checking the Setting of the PROFIBUS–DP Address

The set PROFIBUS DP addresses can be displayed during operation in order to check them. To this purpose the following settings must be carried out at the AddFEM.

Table 5-3 Checking the Setting of the PROFIBUS–DP Address

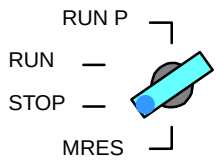
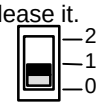
Seq. No.	Operation	Handling (key–operated and slide switches)	Display/Reaction	Next step, if ...
1	Display DP addresses.	The key–operated switch is in the Position ”RUN”, ”RUN P” or “STOP”.  Push the slide switch to the Position 0 and release it. 	The 16 signal LEDs display the desired address statically for approx. 3 seconds . LED 1 or 9 has the value 2^0. LED 2 or 10 has the value 2^1 etc.. The address 6 is set for DP A and DP B in the following example: 	Setting has been completed.

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5.2.4 Resetting the AddFEM

The AddFEM is reset by means of the following switching procedure:

Table 5-4 Resetting the AddFEM

Seq. No.	Operation	Handling (key–operated and slide switches)	Display/Reaction	Next step, if ...
1	Reset the AddFEM.	Turn the key–operated switch to ”STOP”.  Hold the slide switch in the Position 0 for **at least 10 seconds** and release it.  	The AddFEM is reset after approx. 10 seconds. During the subsequent restart all the status are activated for approx. 1 second.	Setting has been completed.

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5.2.5 Setting the PROFIBUS–DP Address via the SIMATIC–Manager

Alternatively to the procedure described above (with slide and key–operated switches) the PROFIBUS DP address can also be set by means of a SIMATIC programming device. In the process the SSA message
(SSA : SET SLAVE ADDRESS), which contains the new PROFIBUS DP address is sent via the PROFIBUS DP to the AddFEM. After the message has been received the new address is saved automatically in the Flash EPROM Storage of the AddFEM and is thus available permanently. The setting procedure must be carried out separately twice, for PROFIBUS DP A and DP B .

The programming device (PG 740, PG 760 etc.) must be connected via an MPI cable to the AddFEM in order for the PROFIBUS DP address to be set. The MPI cable is connected to the PROFIBUS DP interface X3A or X3B at the AddFEM.

After the SIMATIC–Manager has been started and the ”PLC” –>
”Assign PROFIBUS Address” menu has been selected a new address can be assigned directly. The old currently valid address is displayed additionally.

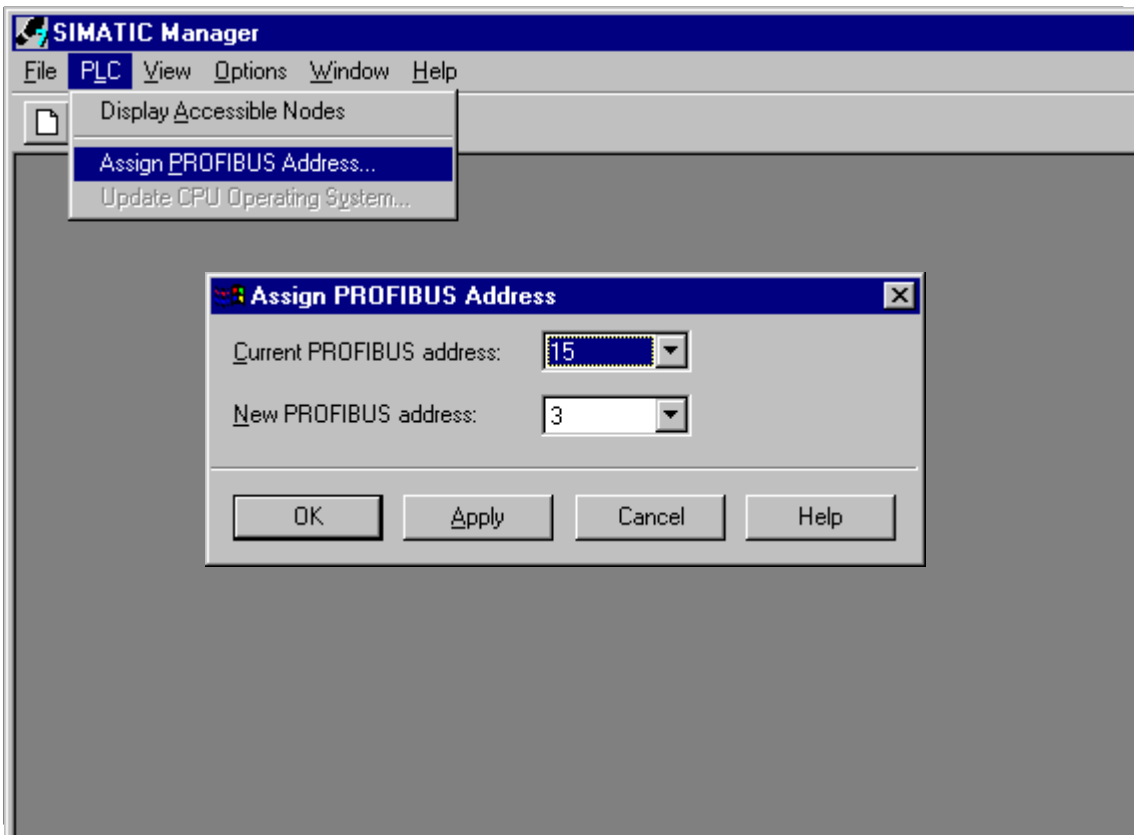


Figure 5-5 Assignment of the PROFIBUS–DP address via the SIMATIC–Manager

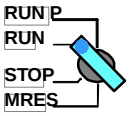
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5.3 Operating and Display Elements

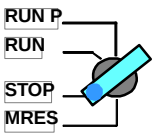
All the operating and display elements are positioned on the front of the AddFEM above the cover.

Operating Elements

The AddFEM can be operated by means of a key–operated switch and a slide switch on the front. The individual switch settings are explained in the following table.



Regular operation
Outputs are enabled
Preprocessing function (FEF) is processed.
The key can be removed in this position so that unauthorized changing of the operating mode is not possible.



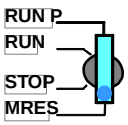
STOP:
The outputs are disabled.
Procedures for setting the PROFIBUS DP addresses and for re-setting the AddFEM can be executed.
The key can be removed in this position so that unauthorized changing of the operating mode is not possible.
Only for 6DL3100–8AB/–8AC:
Preprocessing function (FEF) is executed.
In the case of a module redundancy a master/reserve changeover is forced, so that the module becomes a ”forced reserve”.



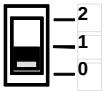
Warning

The following point is to be observed if the redundancy control is carried out by the automation processor (AP) (this is for example the case if the optical–fiber cables are defective or missing):
If a redundancy changeover was forced by setting the master briefly to STOP by means of the key–operated switch, this module cannot take over the master state again until 8 seconds have passed. If a further changeover in the master state is attempted during this period by setting the second module to STOP, this causes a double reserve, i.e. failure of the automation function.

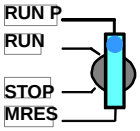
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Momentary–contact position of the key–operated switch.
Is used during the setting procedure for the bus addresses.



Position 0 – Momentary–contact position spring–loaded:
The PROFIBUS DP station addresses are displayed via the DI signal LEDs in hexadecimal forms. The least significant bit is at the top! The display is activated for approx. 5 seconds.
Position 1 – Latched position: Position of rest
Position 2 – Latched position: No function



Note:

Reserved for function extensions.
The key cannot be withdrawn in this position.

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LED

Above the key–operated switch there are 3 LED units with 4 LEDs each for error displays (left) and status displays (right). The logical states of the digital inputs and outputs are displayed by means of 32 operating state LEDs, which are positioned on the right, next to the error/status LEDs and the two switches.

Positioning of the LEDs and operating elements

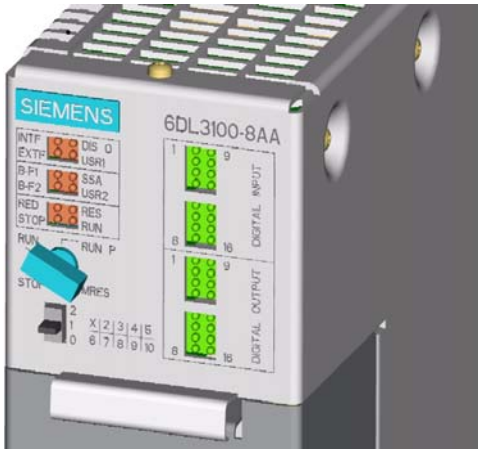
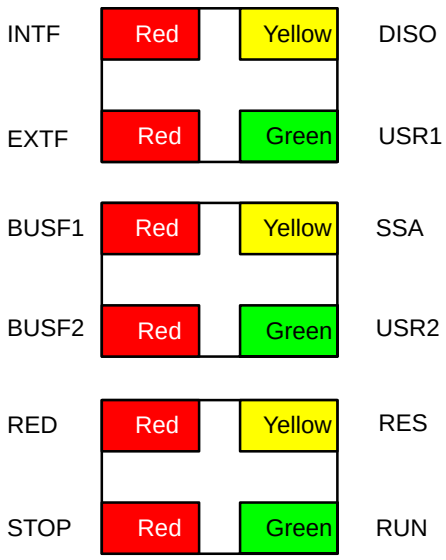


Figure 5-6 AddFEM operating elements

Meaning of the Error/Status LEDs

The error/status LEDs are divided into 3 LED units with 4 LEDs each.
The error LEDs are position on the left, the status LEDs are on the right.



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Table 5-5 Explanation of the Error/Status LEDs

Designation	Error type/Status	Explanation
INTF	Internal error	Display of internal errors, meaning that the self–diagnosis has recognized errors (e.g. voltage monitoring, CPU or memory self–diagnosis, etc.).
EXTF	External error	Display of external errors (e.g. short–circuiting at outputs, life–zero, etc.)
BUSF1	Bus error 1	Display of PROFIBUS–DP errors (for example, no message traffic) for PROFIBUS–DP connection X3A
BUSF2	Bus error 2	Display of PROFIBUS–DP errors (for example, no message traffic) for PROFIBUS–DP connection X3B
RED	Redundancy error	Display of serious errors at the redundant AddFEM unit
STOP	Off–line (stop)	The outputs are disabled. Procedures for setting the PROFIBUS DP addresses and for resetting the AddFEM can be executed. The key can be removed in this position so that unauthorized changing of the operating mode is not possible. Only for 6DL3100–8AB/–8AC: Preprocessing function (FEF) is executed. In the case of a module redundancy a master/reserve changeover is forced, so that the module becomes a ”forced reserve”.
DISO	Output disable	Outputs are de–activated due to commissioning or maintenance work. AddFEM is in the state STOP or, in the case of a module redundancy, the AddFEM is the reserve (passive).
USR1	User status 1	”USER–LED”: Can be used application–specifically in the preprocessing function (FEF) (is controlled like outputs).
SSA	Set Slave Address	Slave address (PROFIBUS–DP A and B) is set via switch operation (input procedure). The selected address is displayed via a signal LED (DI).
USR2	User status 2	”USER–LED”: Can be used application–specifically in the preprocessing function (is controlled like outputs).
RES	AddFEM is reserve	AddFEM is a reserve unit at present in case of module redundancy.
RUN	On–line (run)	Execution of the preprocessing functions

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Display of the Operating Modes

LEDs				Operating state	Meaning
All LEDs ☀				POWER ON	LED–Test. All the error and status LEDs are switched on for approx. 2 seconds after the power supply has been switched on.
STOP ☼		**BUSF1** ☀		INIT “WAITING FOR BUS”	No PROFIBUS DP message received yet. Module waits approx. 4 seconds for valid message. The currently set address for DP–A (left LED 1...8) is displayed in binary form at the 16 signal LEDs for digital inputs. PROFIBUS DP master not yet ready or the PROFIBUS line is not yet plugged, is defective or is not terminated.
STOP ○	**RUN** ☼	**DISO** ○	**RES** ○	START–UP	No PROFIBUS DP message has been received yet. Initialization is completed. Module is waiting for valid messages. PROFIBUS DP master not yet ready or the PROFIBUS line is not yet plugged, is defective or is not terminated.
○	☀	☀	☼	LINK–UP PASSIVE	M/R state at module redundancy: Module is the RESERVE. It receives the start–up update from the MASTER module via the optical–fiber coupling.
○	☀	○	☼	LINK–UP ACTIVE	M/R state at module redundancy: Module is the MASTER. It sends the start–up update to the RESERVE module via the optical–fiber coupling.
○	☀	☀	☀	RUN PASSIVE	Output disable, FEF (preprocessing function) is executed. M/R state at module redundancy: Module is the RESERVE. It receives the update data from the MASTER module via the optical–fiber coupling.
○	☀	☼	☀	RUN PASSIVE PARALLEL	Only for 6DL3100–8AC: This operating state is only used when an FEF (preprocessing function) is activated, which supports a load distribution of the analog outputs at module redundancy. Further information can be found in the manual of the corresponding FEF.

Off ○ Lighting ☀ Flashing ☼

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LEDs				Operating state	Meaning
○	✳	○	○	RUN ACTIVE	Outputs are active, FEF (preprocessing function) is executed. M/R state at module redundancy: Module is the MASTER. It sends the update data to the RESERVE module via the optical–fiber coupling.
○	✳	✳	○	RUN ACTIVE PARALLEL	Only for 6DL3100–8AC: This operating state is only used when an FEF (preprocessing function) is activated, which supports a load distribution of the analog outputs at module redundancy. Further information can be found in the manual of the corresponding FEF.
✳	○	✳	○	STOP	Output disable. Master transfer. Set bus address Reset AddFEM

Off ○ Lighting ✳ Flashing ✳

Note

All Error LEDs	FAULT	Internal error No regular operation possible
✳		
USR1 / USR2	START–UP	If a preprocessing function (FEF) is installed on the AddFEM, the LEDs USR1 and USR2 are triggered alternatively by the FEF with 0.5 Hz.
✳		

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Error Displays

LED	Error type	Display	Cause
INTF	Internal error	☀	Errors determined by self monitoring: • RAM memory test • Check sum of correction factors • Check sum of program code flash EPROM or RAM
EXTF	External error	☀	• Process signal “Analog Out” faulty • Process signal “Analog In” faulty • Process signal “Digital Out” faulty • The 24 V DC load supply for the digital outputs is missing
BUSF1	Bus error 1	☀	Errors determined by self monitoring at the PROFIBUS DP connection X3A: • Master monitoring has triggered • Sign of life has failed
		☼	Parameterization error via PROFIBUS DP connection X3A: • The received configuration message contains invalid parameter values. • At 2–channel configuration: The received parameter values deviate from the configuration via the PROFIBUS DP connection X3B.
BUSF2	Bus error 2	☀	Errors determined by self monitoring at the PROFIBUS DP connection X3B • Master monitoring has triggered • Sign of life has failed
		☼	Parameterization error via PROFIBUS DP connection X3B: • The received configuration message contains invalid parameter values. • At 2–channel configuration: The received parameter values deviate from the configuration via the PROFIBUS DP connection X3A.
RED	Redundancy error	☀	At module redundancy: The optical–fiber cable coupling between the redundant AddFEMs has failed.
		☼	Compatibility test at the module redundancy in the LINK–UP state: • The redundant AddFEMs were configured differently • The master and the reserve modules have different firmware version states

Lighting ☀ Flashing ☼

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Note

Redundant AddFEM: Errors in the process output signals are displayed with the LED **EXTF**. If a signal error occurs at the master module, the reserve module takes over the master function. The error display **EXTF** cannot be canceled until the module emits active signals again, i.e. takes over the master function.

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5.4 Configuring the AddFEM

Configuration of the AddFEM is carried out via the PROFIBUS DP in accordance with the procedure specified in the PROFIBUS standard.
Together with the AddFEM a GSD file is included on the supplied CD. This can be edited with the usual PROFIBUS configuration tools, for example the COM PROFIBUS tool.
The configuration tool creates a master parameter file from the GSD file. This is saved on the automation processor (AP) and is transferred respectively to the AddFEM during the initialization phase.
Further information can be obtained from the description on the respective configuration tool.

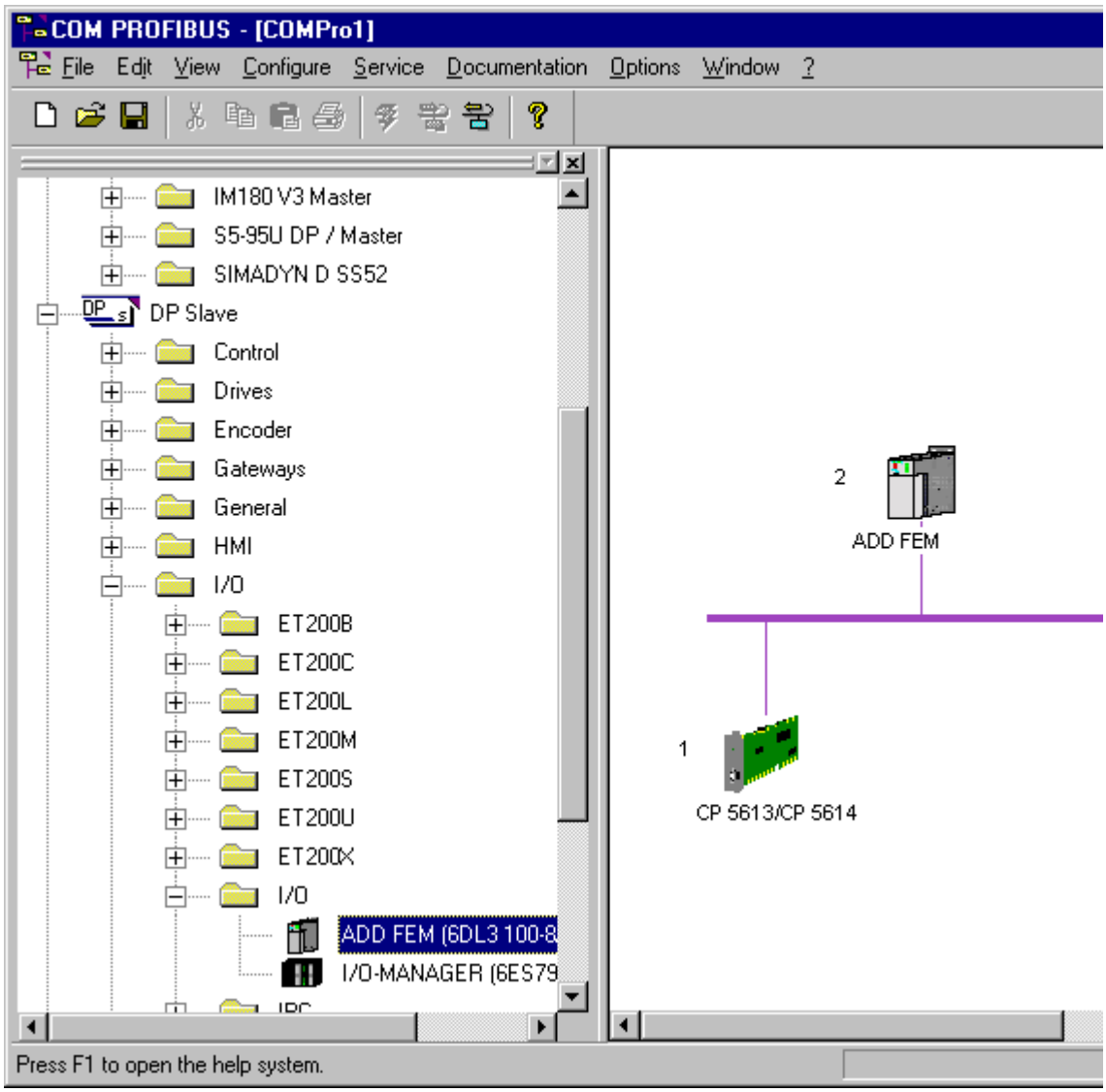


Figure 5-7 Configuring the AddFEM by means of the COM PROFIBUS configuration tool, overview

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Configuring the Operating Mode of the AddFEM:

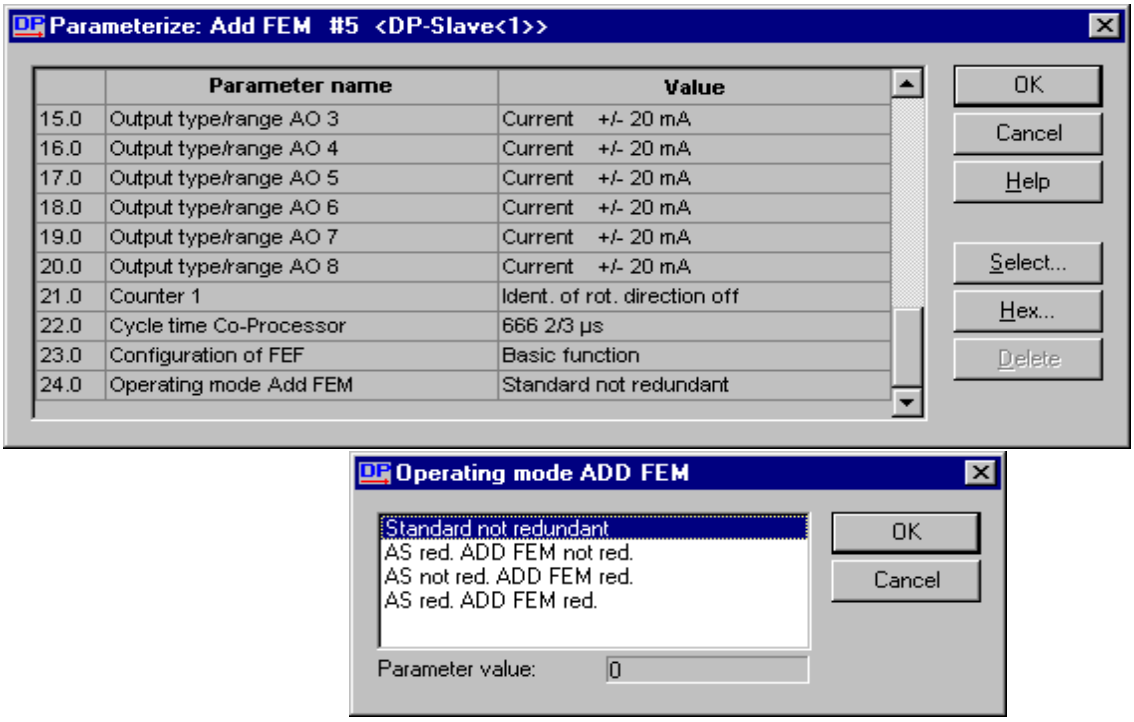


Figure 5-8 Configuring the operating mode

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Configuring the Analog Inputs:

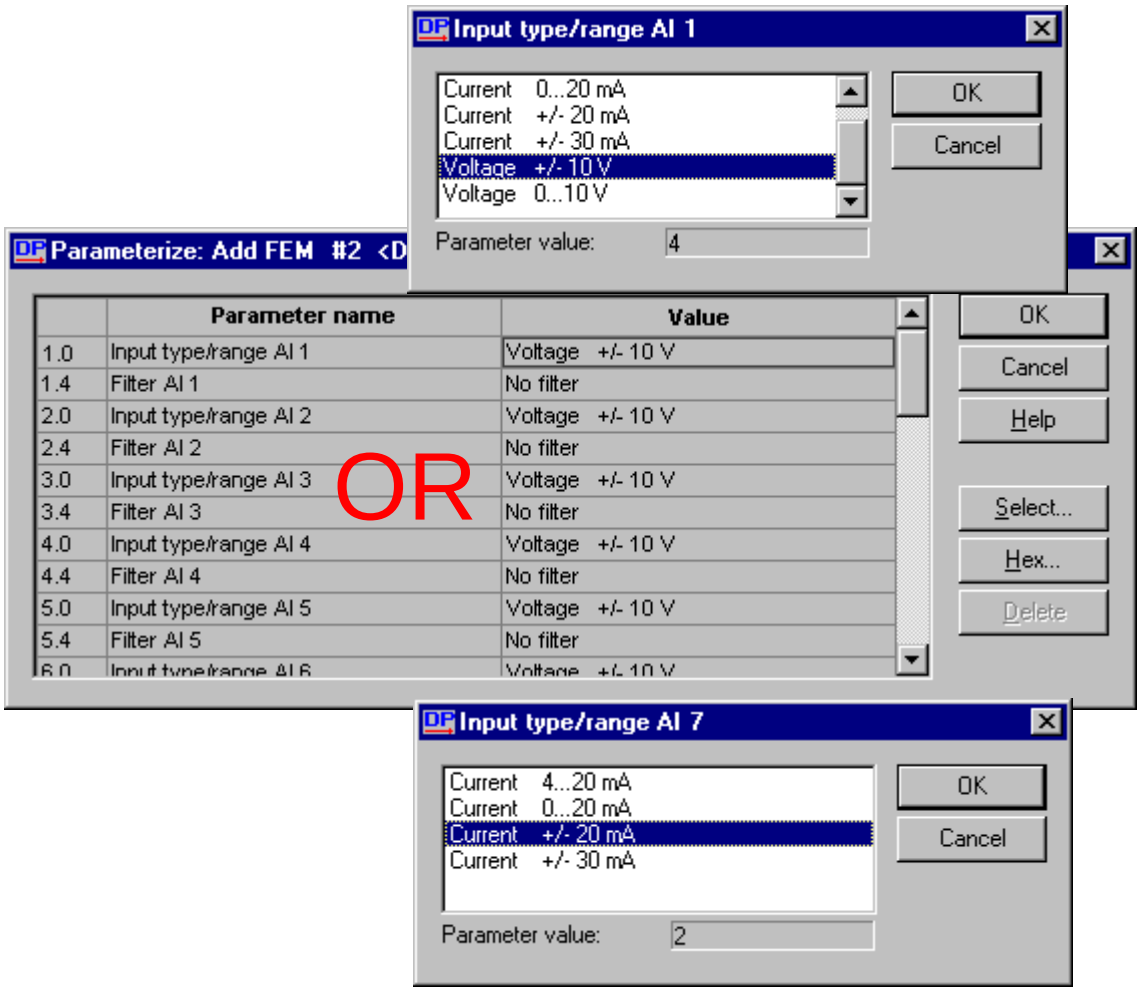


Figure 5-9 Configuring the analog inputs

The analog inputs 1 to 12 can be set selectively by the channels. The analog inputs 1 –6 can be configured as voltage or current inputs. The analog inputs 7 – 12 are pure current inputs.

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Configuring the Analog Outputs:

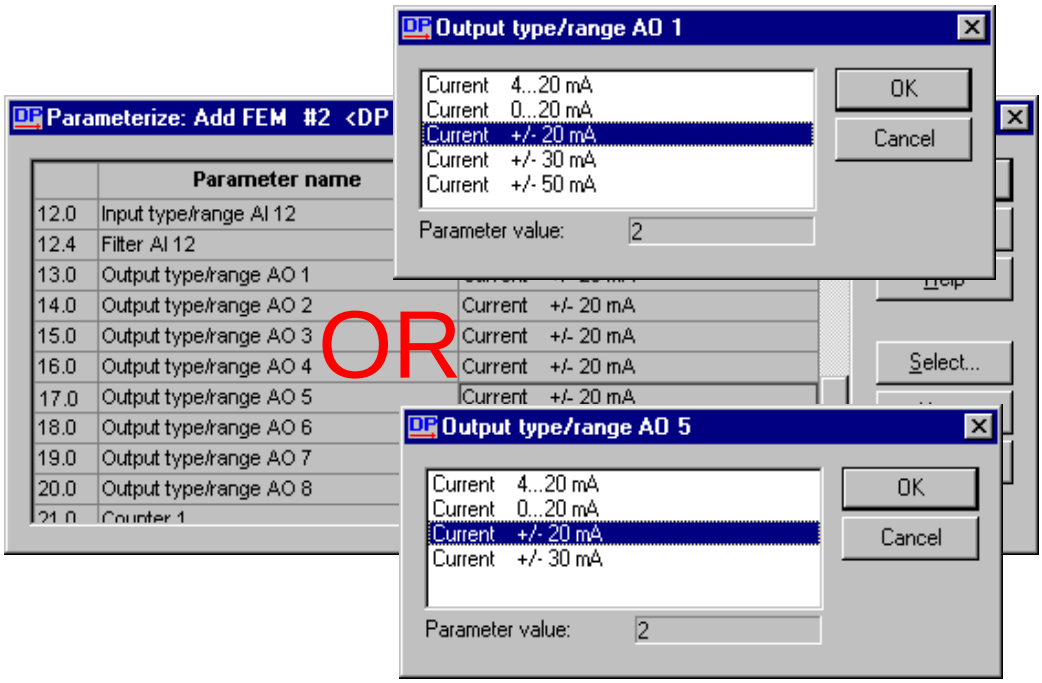


Figure 5-10 Configuring the analog outputs

The analog outputs 1 to 8 can be set selectively by the channels. They are all implemented as current outputs which can be configured in the range of ±30 mA.

Note

The analog outputs 1 – 4 can also be configured to ±50 mA for short–term loads.
The analog inputs 5 – 8 can be configured with the maximum value of ±30 mA.

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Configuring Counter 1:

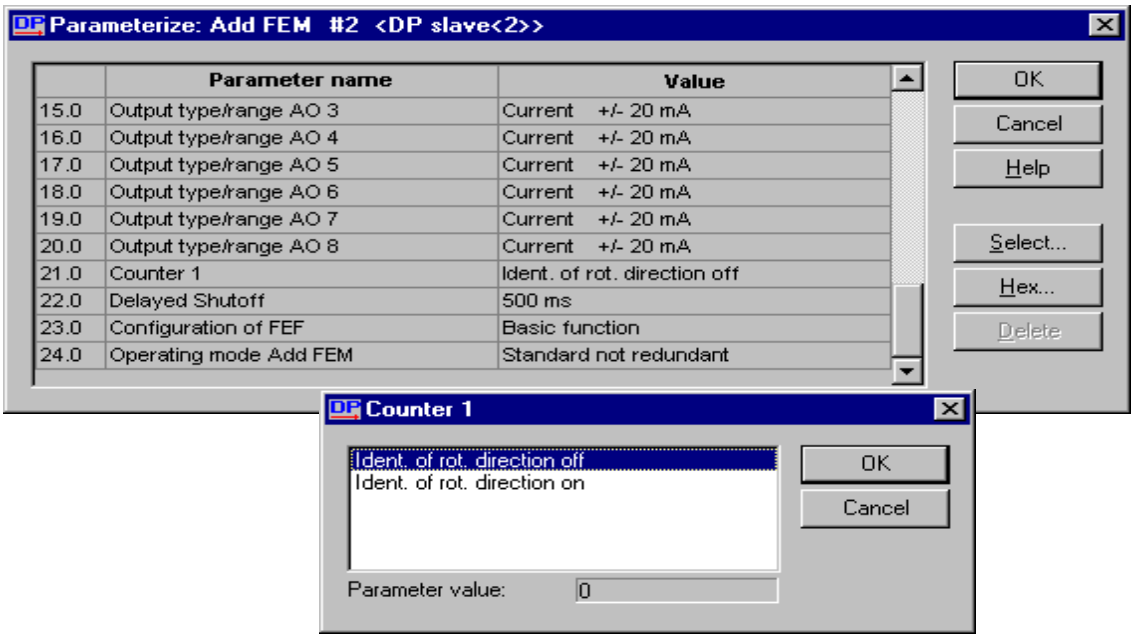


Figure 5-11 Configuring Counter 1

Counter 1 can be configured with or without a sense of rotation recognition function. For ”Sense of rotation recognition on” the leading or lagging signal must be assigned to the counting pulse inputs 1 and 2.

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Configuring the Filtering of the Analog Inputs:

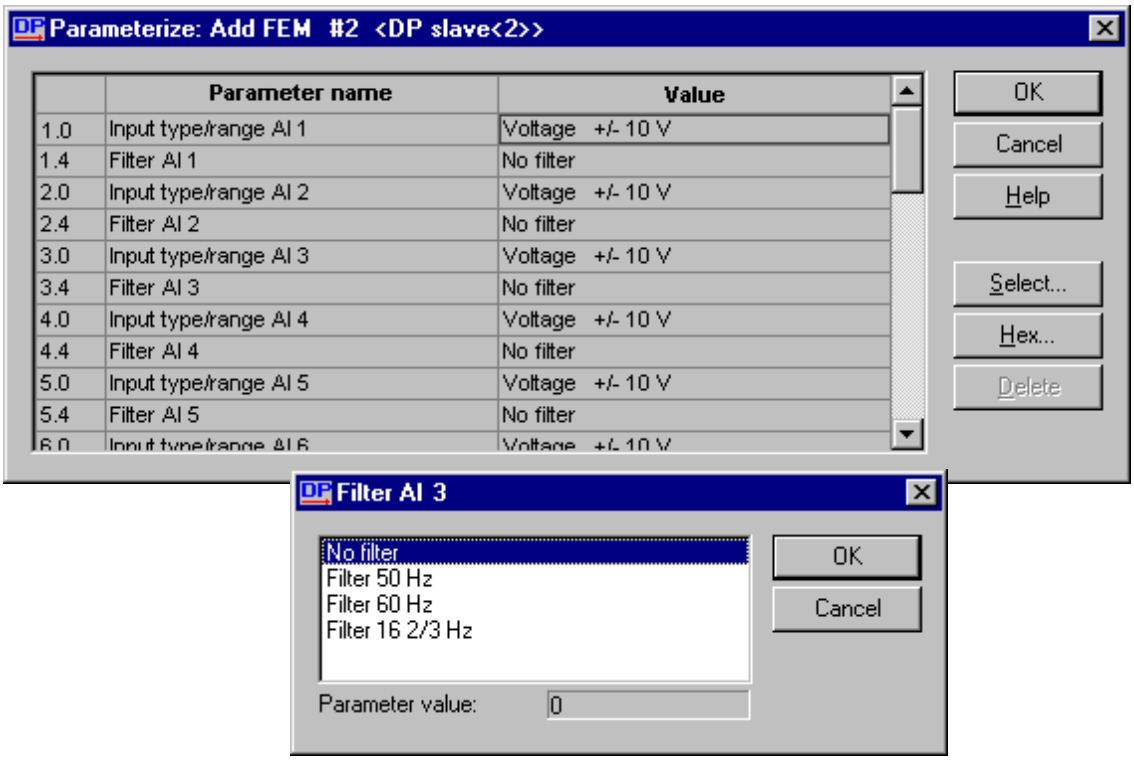


Figure 5-12 Configuring the filtering of the analog inputs

A filter can be configured for each analog input. Filtering results in a suppression of the respective mains frequency.

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Configuring the Delayed Disconnection:

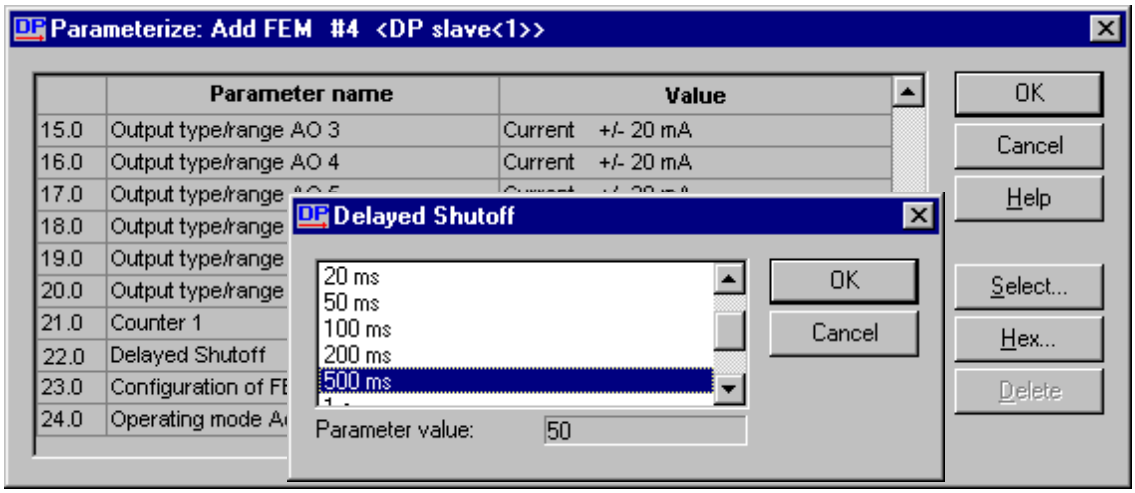


Figure 5-13 Configuring the delayed disconnection

Brief processing gaps in the automation processor – such as they occur when redundant APs are updated – can be bridged by the AddFEM. ”Hard” disconnection of the outputs is not carried out until the set tolerance time has expired.

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Configuring the Front–end Functions:

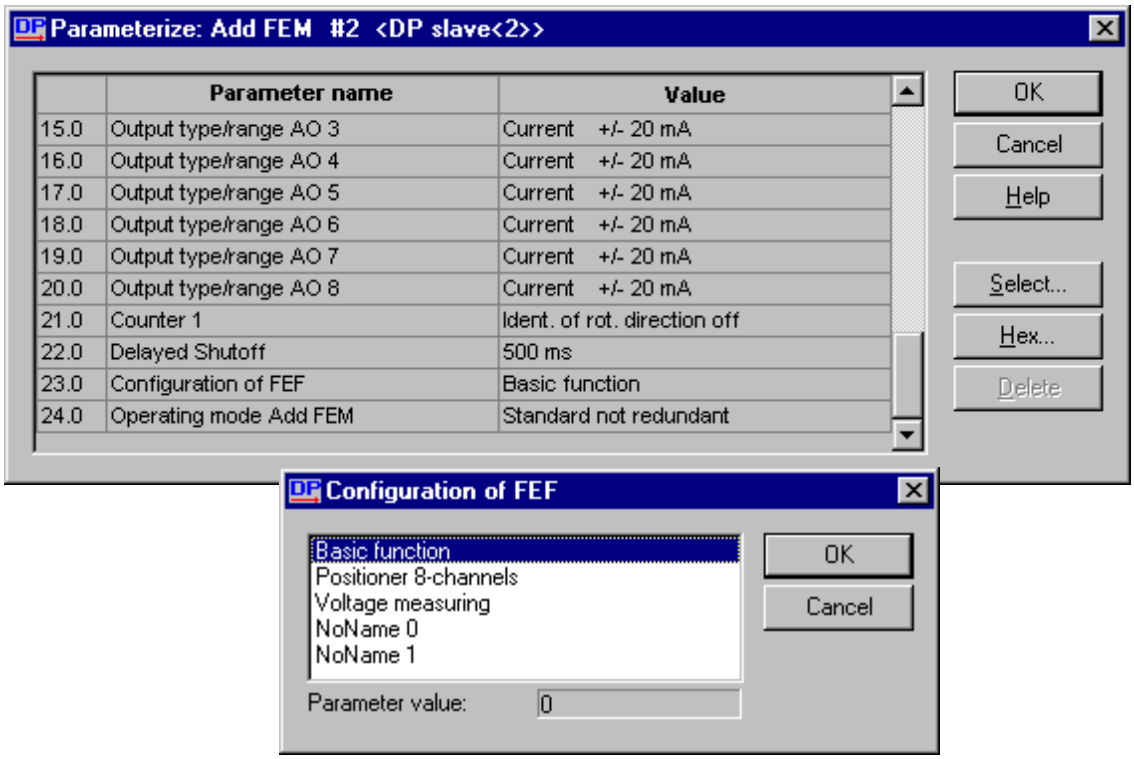


Figure 5-14 Configuring the front–end functions

Only for 6DL3100–8AB:

This parameter specifies the functionality of the AddFEM. Fixed but configurable front–end functions (FEF), for example positioners for gas or steam turbines, can be specified. At 6DL3100–8AC the AddFEM operates as a modular slave. The FEF is installed in the AddFEM as an additional module during the configuration.

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5.5 Function Blocks for SIMATIC S7–400 for 6DL3100–8AA/–8AB

The AddFEM is ”represented” by CFC function blocks (driver function blocks) in the S7 CPU. The driver takes over the format conversion, data transportation and monitoring of the AddFEM. The blocks can be used both for standard use (single operation) as well as for all the provided redundancy configurations. The redundancy operating modes are specified by the address configuration at the function blocks and by the configuration in HW Config. The input and output values are available at the block bars of the driver function blocks. In addition, parameters such as the upper and lower measuring range limits have to be configured. A complex of four individual driver function blocks are available for an AddFEM. The driver functions have been split so that...

–..the input and output bars of the blocks do not become too extensive and so that the function blocks fit well onto a single function chart sheet of the CFC.

–..shorter signal run times can be implemented by separating input and output blocks. To this purpose the processing sequence **I**nput, **P**rocessing, **O**utput has to be observed within the respective watchdog interrupt level.

5.5.1 Configuring the Driver Blocks

Despite the block subdivision, organizational information, such as the subnet ID (PROFIBUS DP line number) and rack number (PROFIBUS DP slave address) etc., have to be configured at a single driver function block, the FEM_AI. The internal communication of the drivers for the PROFIBUS DP is carried out for all the input and output data block–by–block, runtime–optimized and consistently. When configuring the driver function blocks the parameters BLOCKCON, BLOCKCNI and BLOCKCNO have to be used to create the internal connection between the function blocks.

The parameters BLOCKCON, BLOCKCNI and BLOCKCNO are of the data type STRUCT. The structure has a word–by–word structure and contains all the information relevant for the driver function blocks.

The parameter BLOCKCON is ”passed on” by the individual blocks. Starting from the FEM_AI block the parameter is interconnected to the BLOCKCNI input of the FEM_DI block. The BLOCKCNO output is interconnected to the BLOCKCNI input of the FEM_DO block. Its BLOCKCNO output is interconnected to the BLOCKCON input of the FEM_AO block.

In order to ensure consistent input and output data in a cycle, the blocks have to be installed in a watchdog–interrupt cycle in the following order:

1) FEM_AI

2) FEM_DI

3) FEM_DO

4) FEM_AO

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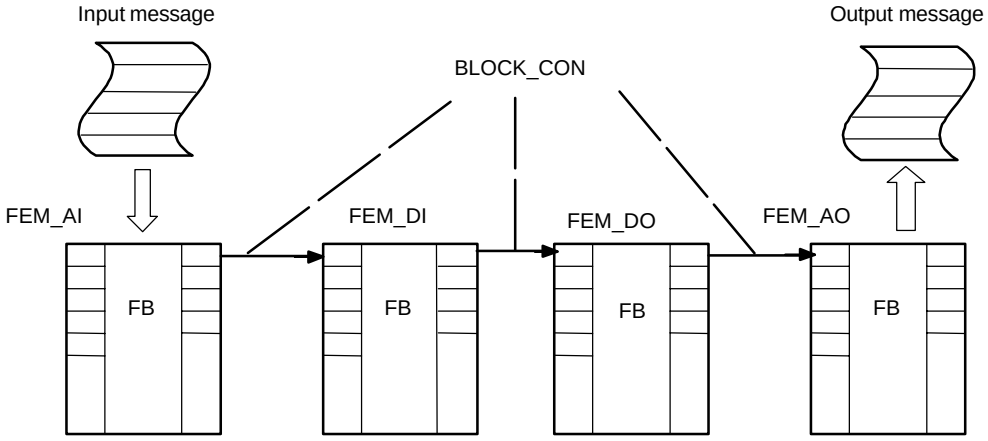


Figure 5-15 Installation sequence of the driver function blocks

The FEM_AI block must always be available in order to supply the AddFEM. The FEM_AO block has to be installed in order to output values to the AddFEM.

The two blocks for digital input and output, FEM_DI and FEM_DO, are not necessary, if digital inputs and outputs are not required. In this case the BLOCKCON output of the FEM_AI block has to be interconnected to the BLOCKCON input of the FEM_AO block.

The PROFIBUS addresses of the redundant PROFIBUS DP interfaces of the AddFEM have to be specified at the FEM_AI driver block.

The FEM_AI driver block receives the data from both respective PROFIBUS DP interfaces of one or both AddFEMs of a correspondingly configured redundancy operating mode. On the basis of the master/reserve identifier the block recognizes which interface is the master and outputs the values to the block outputs. The data received of the passive interfaces or of the AddFEM are rejected. By contrast, the output message is sent to all the AddFEM interfaces.

PROFIBUS Addressing

PROFIBUS addressing of the assigned AddFEMs is carried out at the four output parameters G_ADR_1A, G_ADR_1B, G_ADR_2A and G_ADR_2B in WORD format.

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Example: **W#16#0105** means ..
PROFIBUS number = 1 and
Slave number of the AddFEM interface = 5

The following configurations are to be carried out for the individual operating modes:

Table 5-6 Configuration of the PROFIBUS–DP addresses at the driver function block FEM_AI

Operating mode	Configuration at the driver block FEM_AI
0 (Single)	G_ADR_1A : <Address> (e.g. W#16#0105) G_ADR_1B : 16#0 G_ADR_2B : 16#0 G_ADR_2B : 16#0
1 (AS redundant)	G_ADR_1A : <Address Interface A> (e.g. W#16#0105) G_ADR_1B : <Address Interface B> (e.g. W#16#0205) G_ADR_2A : 16#0 G_ADR_2B : 16#0
2 (AddFEM redundant)	G_ADR_1A : <Address Interface A Module 1> (e.g. W#16#0105) G_ADR_1B : 16#0 G_ADR_2A : <Adress Interface A Module 2> (e.g. W#16#0106) G_ADR_2B : 16#0
3 (AS redundant and AddFEM redundant)	G_ADR_1A : <Address Interface A Module 1> (e.g. W#16#0105) G_ADR_1B : <Address Interface B Module 1> (e.g. W#16#0205) G_ADR_2A : <Address Interface A Module 2> (e.g. W#16#0106) G_ADR_2B : <Address Interface B Module 2> (e.g. W#16#0206)

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5.5.2 Additional Interfaces of the Driver Blocks for Front End Functions (FEF)

No additional driver blocks are required for the use of the AddFEM with FEF. The existing drivers can be changed over to the FEF functionality by means of configuration. Only two data blocks for the input and output data have to be created for the additional data exchange. The additional data blocks are used to exchange FEF–specific input and output data which cannot be exchanged via the input and output bars.

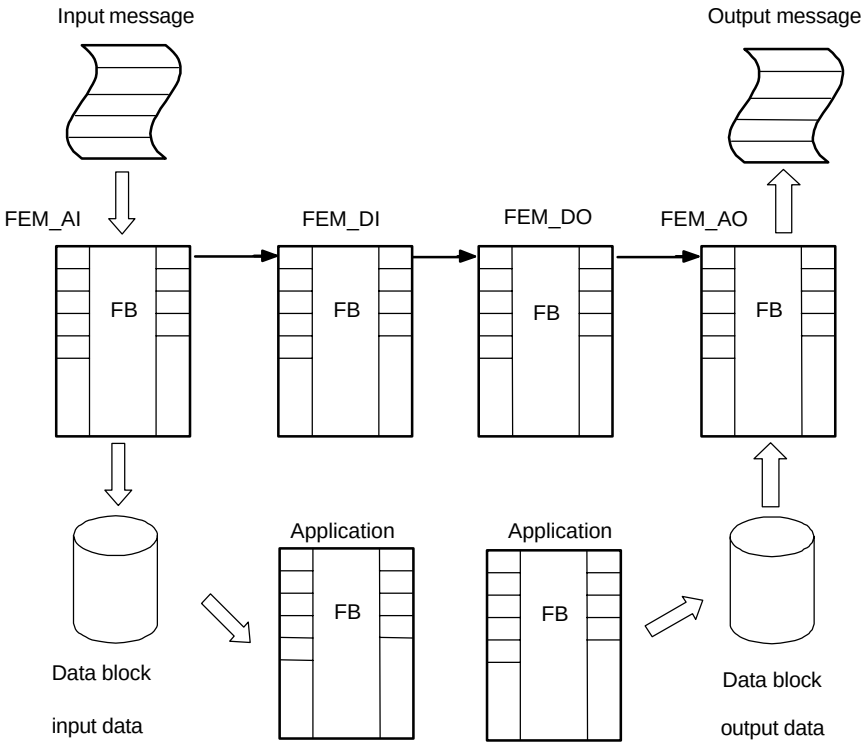


Figure 5-16 Overview of the driver blocks with FEF functionality

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5.5.3 Configuration of the AddFEM Driver Block with Continuous Function Chart (CFC)

Within the CFC in the SIMATIC–Manager the four AddFEM driver blocks, FEM AI, FEM AO, FEM DI and FEM DO, are placed in the corresponding function chart and connected to each other by means of the block connectors BLOCKCON, BLOCKNI and BLOCKCNO. In addition the further inputs and outputs of the driver function blocks are to be connected to the application function blocks.

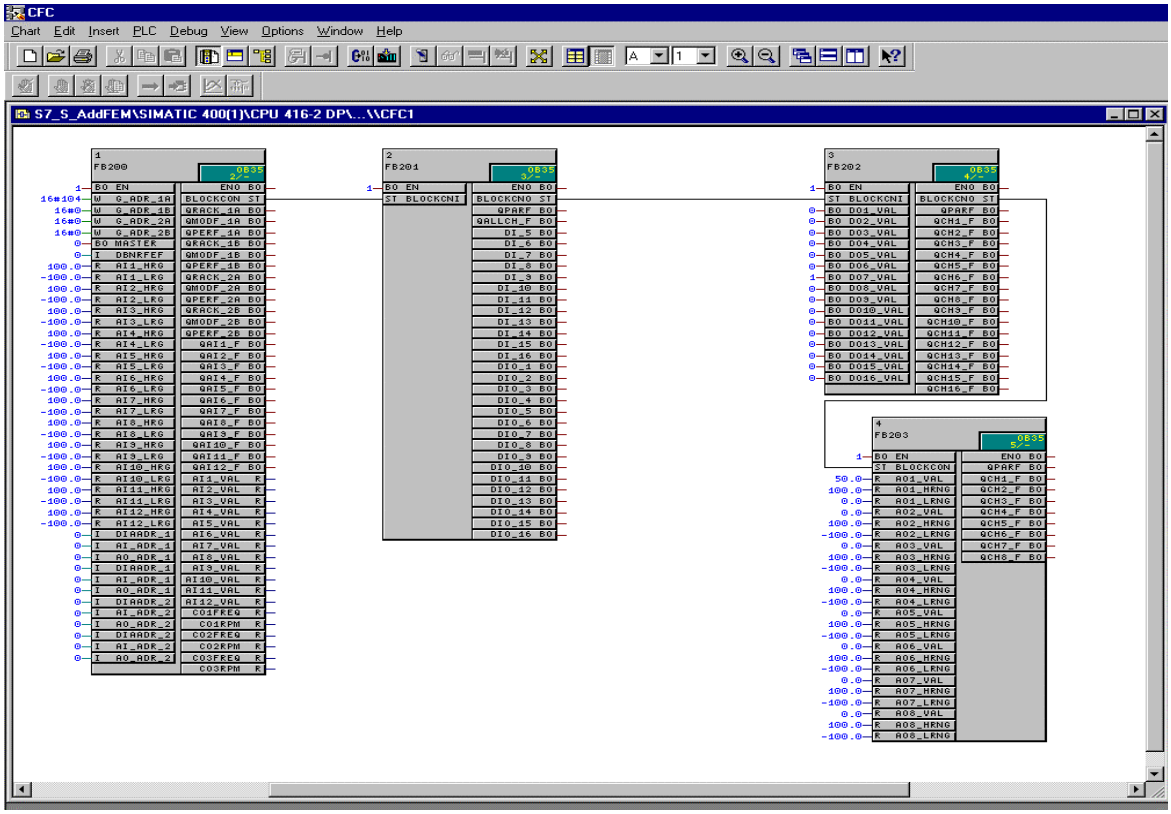


Figure 5-17 Representation of AddFEM driver blocks in CFC

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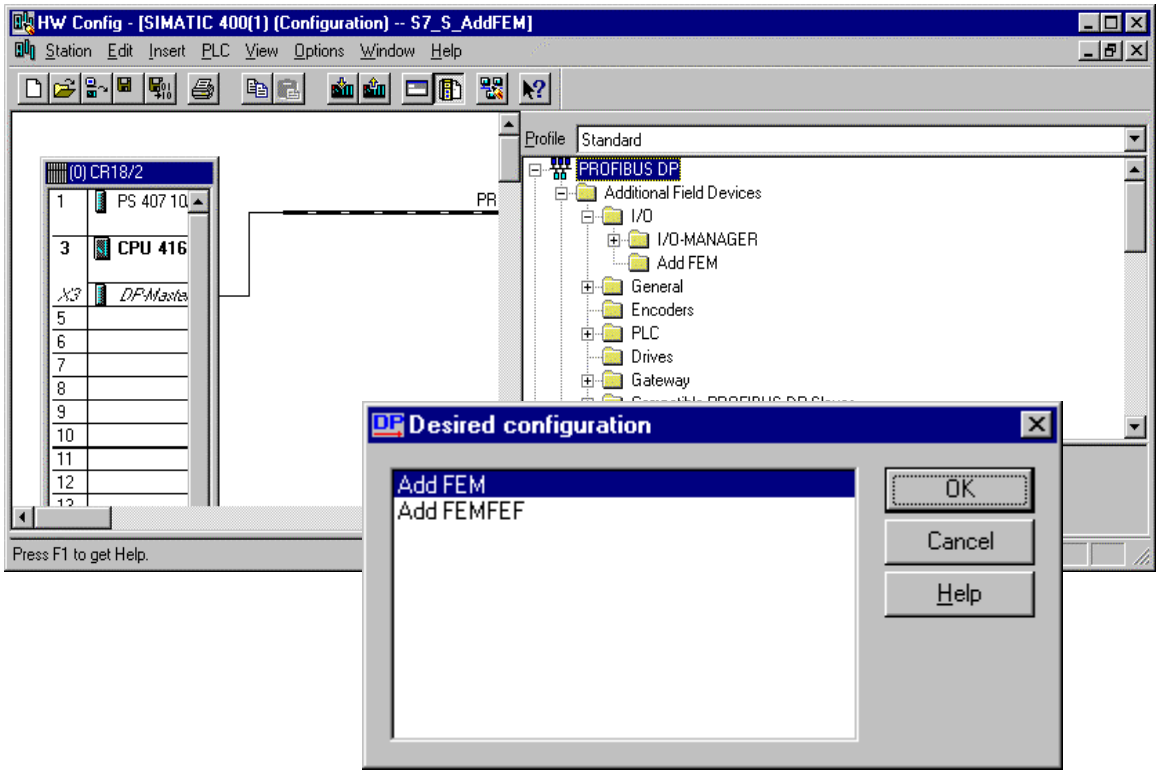
5.5.3.1 Hardware Configuration

The hardware configuration is carried out in the lower–level subfunction ”HW Config” of the SIMATIC Manager.

Note:

The configuration data of the AddFEM have to be included once in the database of the SIMATIC Manager before configuration is started. The GSD file of the AddFEM (SIEM80a3.gse, English or SIEM80a3.gsg, German) has to be copied into the directory “**...\step7\s7data\gsd**” to this purpose. Then the function ”**Options–>Update Catalog**” has to be carried out in HW Config. The AddFEM is then stored in the catalog “**PROFIBUS–DP\Additional Field Devices\I/O**”.

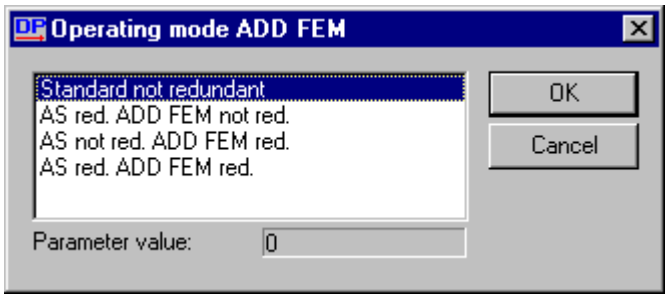
During the current configuration the AddFEM is attached to the PROFIBUS line of the master CPU by dragging–and–dropping it. When the AddFEM is ”docked onto” the PROFIBUS, the ”Select Setpoint Configuration” window is opened automatically. To this purpose either ”AddFEM” (normal configuration without FEF) or ”AddFEMFEF” (Front–end function) has to be selected.



After the selection the AddFEM is connected “virtually” to the PROFIBUS.

The “**Properties DP–Slave–>Parameter Assigment**” dialog box is used to specify the redundancy operating mode.

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5.5.3.1.1 Operating Mode 0 – Single Operation

At Operating Mode 0 the AddFEM is only connected with one channel to the PROFIBUS DP.

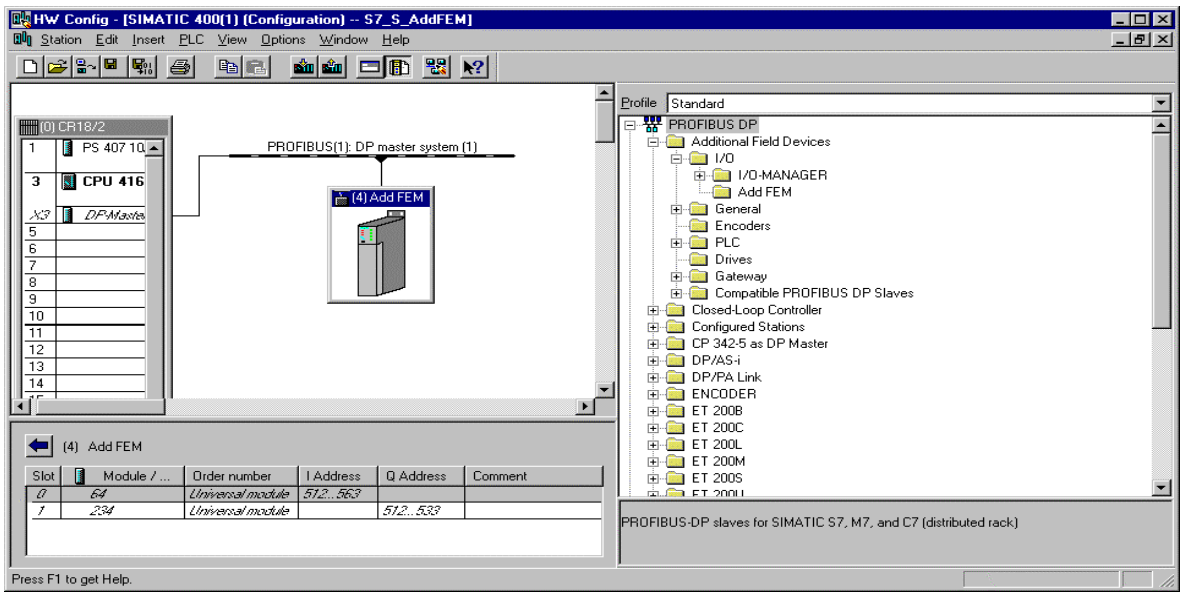


Figure 5-18 Configuration at single–channel use

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5.5.3.1.2 Redundant AS (Operating Mode 1)

At Operating Mode 1 the AddFEM is docked ”virtually” to both PROFIBUS DP lines of the redundant SIMATIC S7–400H.

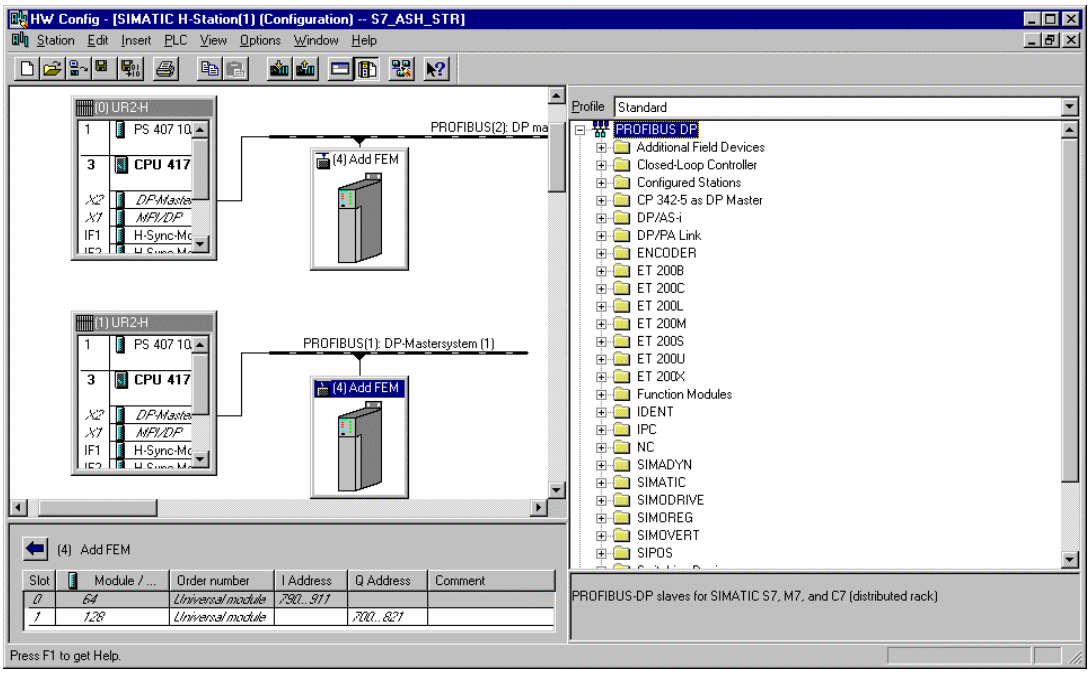


Figure 5-19 Redundant AS

An AddFEM is displayed at each of the PROFIBUS DP lines in HW Config. However, in reality only one AddFEM is installed as hardware with two PROFIBUS DP interfaces. A PROFIBUS DP address has to be assigned to each interface. Two ”modules” must therefore be configured **identically** in HW Config.

Note

Operating Mode 1 “**AS red. AddFEM not red.**” has to be set individually at each of the displayed modules.

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5.5.3.1.3 Redundant AddFEM (Operating Mode 2)

At Operating Mode 2 the two AddFEMs which exist physically are docked “virtually” to the PROFIBUS DP line of the SIMATIC S7–400.

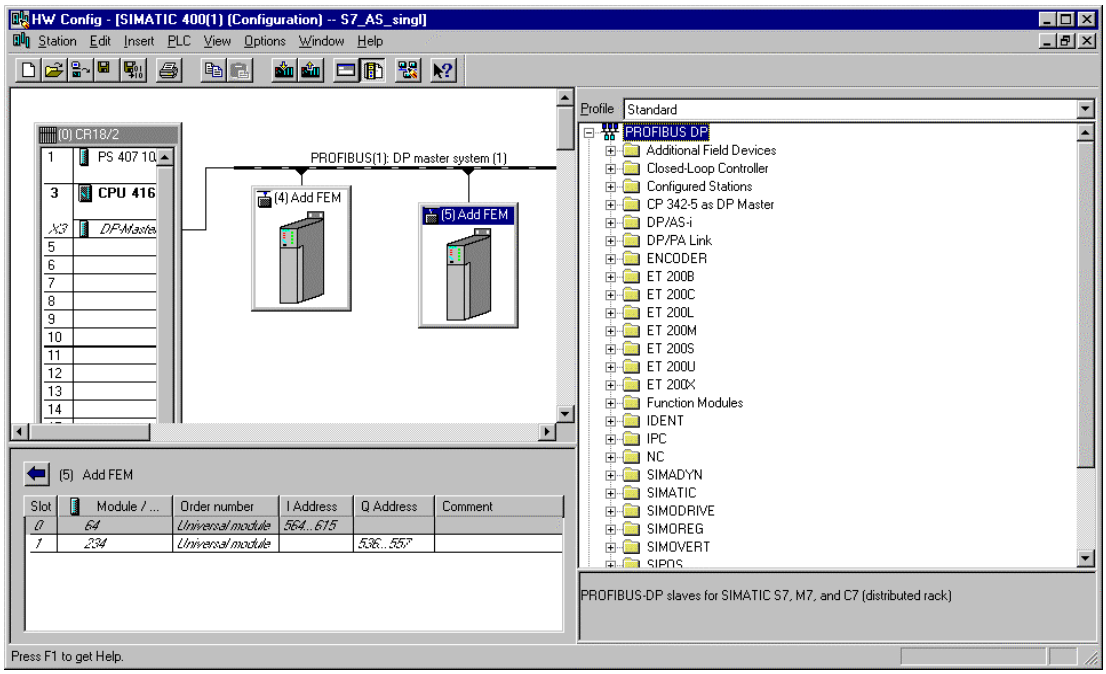


Figure 5-20 AddFEM redundant

The two AddFEMs have to be configured with different PROFIBUS DP addresses. Interface A is assigned at each module. The configuration of the two modules has to be absolutely identical, with the exception of the PROFIBUS DP address.

Note

Operating Mode 2 “**AS not red. AddFEM red.**” has to be set individually at each of the displayed modules.

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5.5.4 AS Redundant and AddFEM Redundant (Operating Mode 3)

At Operating Mode 3 the two AddFEMs which exist physically are docked “virtually” to both PROFIBUS DP lines of the SIMATIC S7–400H.

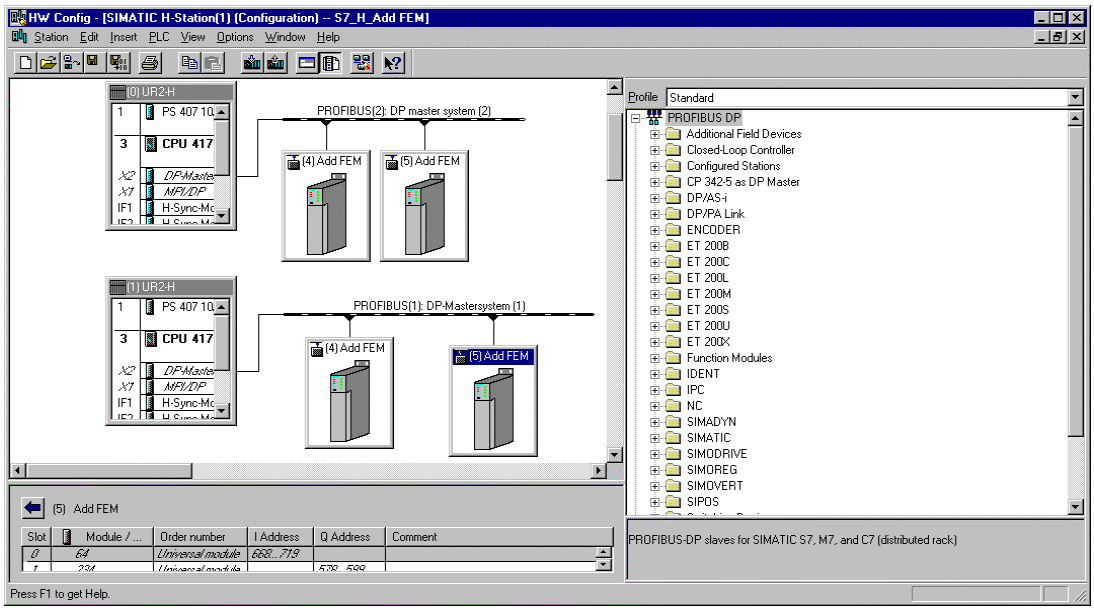


Figure 5-21 AS redundant and AddFEM redundant

At this operating mode there are two AddFEMs with a total of four DP interfaces. Four “modules” must therefore be configured in HW Config.

Two AddFEMs are displayed at each of the PROFIBUS DP lines in HW Config. However, in reality “only” two AddFEMs are installed as hardware with two PROFIBUS DP interfaces. A PROFIBUS DP address has to be assigned to each interface. Four “modules” must therefore be configured **identically** in HW Config.

Note

Operating Mode 3 “**AS red. AddFEM red.**” has to be set individually at each of the displayed modules.

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5.5.5 Processing Times for Driver Function Blocks

The driver function blocks for AddFEM require the following processing times, depending on the CPU used and on the redundancy operating mode.

Operating mode	Mean runtime
0	Approx. 2 ms (CPU 416–2DP)
1	Approx. 3 ms (CPU 417 H)
2	Approx. 2.5 ms (CPU 416–2DP)
3	Approx. 4 ms (CPU 417 H)

5.5.6 Required Memory Space

Basic Memory Requirement per AS:

Block	Download memory	Working memory
FEM_AI (FB200)	10526 bytes	9700 bytes
FEM_DI (FB201)	1756 bytes	1326 bytes
FEM_DO (FB202)	1672 bytes	1302 bytes
FEM_AO (FB203)	6758 bytes	5924 bytes

Memory Requirement per Instance:

Block	Download memory	Working memory
Instance DB of FEM_AI (FB200)	1548 bytes	716 bytes
Instance DB of FEM_DI (FB201)	546 bytes	150 bytes
Instance DB of FEM_DO (FB202)	482 bytes	146 bytes
Instance DB of FEM_AO (FB203)	900 bytes	400 bytes
Per OB call	100 bytes	60 bytes
Per FC at CFC	150 bytes	100 bytes

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5.6 Detailed Description of the Driver Function Blocks

The following sections describe the four driver function blocks FEM_AI, FEM_AO, FEM_DI, FEM_DO in detail.

Note

The driver function blocks can be configured optionally ..
a) ...with SIMATIC CFC (Continuous Function Chart) or ..
b) ...exclusively with SIMATIC S7 STL (statement list).
If you carry out configuration with CFC (Case a), installation in the various priority classes is carried out automatically by the configuration system.

5.6.1 FEM_AI – Analog Input

The following OBs must call the function block FEM_AI:

a) Watchdog interrupt OB for cyclic operation (for example OB 32).

b) In addition the block has to be called in the OB70, OB72, OB80, OB82, OB83, OB85, OB86, OB100 and OB121 in order to intercept special functions such as the start–up, peripheral errors, timeout, etc.

Area of Application

The block is the header block for the supply and disposal of the AddFEM.

Functional Description

The block detects the 12 analog inputs of the AddFEM module, converts the standardized fixed–point values, depending on the range limits, into REAL values and makes the values available at the output bar.

The block reads the standardized fixed–point values of the AddFEM module and maps these to the physical range.

The physical value is output in REAL format at the block output parameters.

If the switch SIMUAIx = 1, not the value of the AddFEM is output at the block output, but the simulation value AIx_SIM.

Note

SIMUAIx means SIMUAI<Channel Number 1 to 12> e.g. SIMUAI1.

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Two outputs are available for each counter value. The frequency in Hz is displayed at the first output. The rotational speed in revolutions per minute is displayed at the second output.

The counter values are represented in REAL format.

If ”Sense of rotation recognition on” is configured in HW Config of the SIMATIC Manager for the first counter value, the same value is displayed at the Counter Value 1 and Counter Value 2. If the leading pulse signal is interconnected to the binary counting input DI_1 of the AddFEM and the lagging signal to the counting input DI_2, this means a positive speed ”Clockwise”. A negative speed means ”Counterclockwise”.

Mode of Operation

The block reads the geographic addresses (bus number and slave number) entered at the inputs and converts these into the logical I/O addresses and the diagnostic address. The calculated addresses are made available via the output structure BLOCKCON for the remaining function blocks (FEM_AO, FEM_DI, FEM_DO). If the addresses are not configured or if there is a fault, this is signaled to the error outputs and saved additionally in the BLOCKCON structure.

Error Handling

The following cases are handled by the block algorithm:

- **QRACKF_1A** **= 1:** AddFEM device failure or no communication via PROFIBUS DP module 1A
- **QMODF_1A** **= 1:** Module error (e.g. AddFEM to Stop) Module 1A
- **QPERF_1A** **= 1:** I/O access error Module 1A
- **QPARF_1A** **= 1:** Configuration error (e.g. DP does not exist), Module 1A
- **QRACKF_1B** **= 1:** AddFEM device failure or no communication via PROFIBUS DP module 1B
- **QMODF_1B** **= 1:** Module error (e.g. AddFEM to Stop) Module 1B
- **QPERF_1B** **= 1:** I/O access error Module 1B
- **QPARF_1B** **= 1:** Configuration error (e.g. DP does not exist), Module 1B
- **QRACKF_2A** **= 1:** AddFEM device failure or no communication via PROFIBUS DP module 2A
- **QMODF_2A** **= 1:** Module error (e.g. AddFEM to Stop) Module 2A
- **QPERF_2A** **= 1:** I/O access error Module 2A
- **QPARF_2A** **= 1:** Configuration error (e.g. DP does not exist), Module 2A
- **QRACKF_2B** **= 1:** AddFEM device failure or no communication via PROFIBUS DP module 2B
- **QMODF_2B** **= 1:** Module error (e.g. AddFEM to Stop) Module 2B
- **QPERF_2B** **= 1:** I/O access error Module 2B
- **QPARF_2B** **= 1:** Configuration error (e.g. DP does not exist), Module 2B

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Start–up Characteristics

During an initial start–up or restart the logical address of the inputs and outputs and the diagnostic address are formed from the geographic AddFEM address. The range limits (AIx_HRG and AIx_LRG) are converted into factors and offsets in order to calculate the current input values. In case of incorrect error configuration, for example Upper limit <= Lower limit the input value is set to ”zero.

During start–up a factor for calculating the speed (rpm) is calculated for each counter value. The number of pulses per revolution (number of teeth) has to be configured at the Cox_NUM input parameters.

Time Response

Does not exist.

Message Characteristics

The block does not have message characteristics.

Operator Control and Monitoring

The block does not have a faceplate.

Parameters

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The **FEM_AI** has the following input parameters:

Table 5-7 Input parameters of the FEM_AI

Parameter	Comment	Data type	Visible	Default
G_ADR_1A	Geografical Address Interface A Unit 1	INT	Yes	0
G_ADR_1B	Geografical Address Interface B Unit 1	INT	Yes	0
G_ADR_2A	Geografical Address Interface A Unit 2	INT	Yes	0
G_ADR_2B	Geografical Address Interface B Unit 2	INT	Yes	0
MASTER	Set Master (no failure state) 0 = Unit 1 is master 1 = Unit 2 is master	BOOL	Yes	0
FEF_EN	1 = Front End Function enabled	BOOL	Yes	0
DBNRFEF	Data Block Number FEF Input Parameter	INT	Yes	0
AI1_HRG	Analog Input 1 High Range	REAL	Yes	100.0
AI1_LRG	Analog Input 1 Low Range	REAL	Yes	–100.0
AI1_SIM	Simulation Value Analog Input 1	REAL	No	0.0
SIMUAI1	1 = Simulation on	BOOL	No	0
AI2_HRG	Analog Input 2 High Range	REAL	Yes	100.0
AI2_LRG	Analog Input 2 Low Range	REAL	Yes	–100.0
AI2_SIM	Simulation Value Analog Input 2	REAL	No	0.0
SIMUAI2	1 = Simulation on	BOOL	No	0
AI3_HRG	Analog Input 3 High Range	REAL	Yes	100.0
AI3_LRG	Analog Input 3 Low Range	REAL	Yes	–100.0
AI3_SIM	Simulation Value Analog Input 3	REAL	No	0.0
SIMUAI3	1 = Simulation on	BOOL	No	0
AI4_HRG	Analog Input 4 High Range	REAL	Yes	100.0
AI4_LRG	Analog Input 4 Low Range	REAL	Yes	–100.0
AI4_SIM	Simulation Value Analog Input 4	REAL	No	0.0
SIMUAI4	1 = Simulation on	BOOL	No	0
AI5_HRG	Analog Input 5 High Range	REAL	Yes	100.0
AI5_LRG	Analog Input 5 Low Range	REAL	Yes	–100.0
AI5_SIM	Simulation Value Analog Input 5	REAL	No	0.0
SIMUAI5	1 = Simulation on	BOOL	No	0
AI6_HRG	Analog Input 6 High Range	REAL	Yes	100.0
AI6_LRG	Analog Input 6 Low Range	REAL	Yes	–100.0
AI6_SIM	Simulation Value Analog Input 6	REAL	No	0.0
SIMUAI6	1 = Simulation on	BOOL	No	0
AI7_HRG	Analog Input 7 High Range	REAL	Yes	100.0
AI7_LRG	analog Input 7 Low Range	REAL	Yes	–100.0
AI7_SIM	Simulation Value Analog Input 7	REAL	No	0.0
SIMUAI7	1 = Simulation on	BOOL	No	0
AI8_HRG	Analog Input 8 High Range	REAL	Yes	100.0
AI8_LRG	Analog Input 8 Low Range	REAL	Yes	–100.0

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The **FEM_AI** has the following input parameters (continued):

Parameter	Comment	Data type	Visible	Default
AI8_SIM	Simulation Value Analog Input 8	REAL	No	0.0
SIMUAI8	1 = Simulation on	BOOL	No	0
AI9_HRG	Analog Input 9 High Range	REAL	Yes	100.0
AI9_LRG	Analog Input 9 Low Range	REAL	Yes	–100.0
AI9_SIM	Simulation Value Analog Input 9	REAL	No	0.0
SIMUAI9	1 = Simulation on	BOOL	No	0
AI10_HRG	Analog Input 10 High Range	REAL	Yes	100.0
AI10_LRG	Analog Input 10 Low Range	REAL	Yes	–100.0
AI10_SIM	Simulation Value Analog Input 10	REAL	No	0.0
SIMUAI10	1 = Simulation on	BOOL	No	0
AI11_HRG	Analog Input 11 High Range	REAL	Yes	100.0
AI11_LRG	Analog Input 11 Low Range	REAL	Yes	–100.0
AI11_SIM	Simulation Value Analog Input 11	REAL	No	0.0
SIMUAI11	1 = Simulation on	BOOL	No	0
AI12_HRG	Analog Input 12 High Range	REAL	Yes	100.0
AI12_LRG	Analog Input 12 Low Range	REAL	Yes	–100.0
AI12_SIM	Simulation Value Analog Input 12	REAL	No	0.0
SIMUAI12	1 = Simulation on	BOOL	No	0
CO1_NUM	Number of Teeth for Counter 1	INT	No	60
CO1_SIM	Simulation Value Counter 1	REAL	No	0.0
SIMCO1	1 = Simulation on	BOOL	No	0.0
CO2_NUM	Number of Teeth for Counter 2	INT	No	60
CO2_SIM	Simulation Value Counter 2	BOOL	No	0.0
SIMUCO2	1 = Simulation on	BOOL	No	0
CO3_NUM	Number of Teeth for Counter 3	INT	No	60
CO3_SIM	Simulation Value Counter 3	REAL	No	0.0
SIMUCO3	1 = Simulation on	BOOL	No	0

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The **FEM_AI** has the following output parameters:

Table 5-8 Output parameters of the FEM_AI

Parameter	Comment	Data type	Default
BLOCKCON	Block connector	STRUCT	0
QRACKF_1A	1 = Rack Failure Channel A Unit 1	BOOL	0
QMODF_1A	1 = Modul Failure Channel A Unit 1	BOOL	0
QPERF_1A	1 = I/O Access Failure Channel A Unit 1	BOOL	0
QPARF_1A	1 = Parameter Assignment Failure Channel A Unit 1	BOOL	0
QRACKF_1B	1 = Rack Failure Channel B Unit 1	BOOL	0
QMODF_1B	1 = Module Failure Channel B Unit 1	BOOL	0
QPERF_1B	1 = I/O Access Failure Channel B Unit 1	BOOL	0
QPARF_1B	1 = Parameter Assignment Failure Channel A Unit 1	BOOL	0
QRACKF_2A	1 = Rack Failure Channel A Unit 2	BOOL	0
QMODF_2A	1 = Modul Failure Channel A Unit 2	BOOL	0
QPERF_2A	1 = I/O Access Failure Channel A Unit 2	BOOL	0
QPARF_2A	1 = Parameter Assignment Failure Channel A Unit 2	BOOL	0
QRACKF_2B	1 = Rack Failure Channel B Unit 2	BOOL	0
QMODF_2B	1 = Modul Failure Channel B Unit 2	BOOL	0
QPERF_2B	1 = Access Failure Channel B Unit 2	BOOL	0
QPARF_2B	1 = Parameter Assignment Failure Channel A Unit 2	BOOL	0
QCH1_F	1 = Channel Failure AI1	BOOL	0
QCH2_F	1 = Channel Failure AI2	BOOL	0
QCH3_F	1 = Channel Failure AI3	BOOL	0
QCH4_F	1 = Channel Failure AI4	BOOL	0
QCH5_F	1 = Channel Failure AI5	BOOL	0
QCH6_F	1 = Channel Failure AI6	BOOL	0
QCH7_F	1 = Channel Failure AI7	BOOL	0
QCH8_F	1 = Channel Failure AI8	BOOL	0
QCH9_F	1 = Channel Failure AI9	BOOL	0
QCH10_F	1 = Channel Failure AI10	BOOL	0
QCH11_F	1 = Channel Failure AI11	BOOL	0
QCH12_F	1 = Channel Failure AI12	BOOL	0
AI1_VAL	Analog Input 1 Value	REAL	0
AI2_VAL	Analog Input 2 Value	REAL	0
AI3_VAL	Analog Input 3 Value	REAL	0
AI4_VAL	Analog Input 4 Value	REAL	0
AI5_VAL	Analog Input 5 Value	REAL	0
AI6_VAL	Analog Input 6 Value	REAL	0
AI7_VAL	Analog Input 7 Value	REAL	0
AI8_VAL	Analog Input 8 Value	REAL	0
AI9_VAL	Analog Input 9 Value	REAL	0

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The FEM_AI has the following output parameters (continued):

Parameter	Comment	Data type	Default
AI10_VAL	Analog Input 10 Value	REAL	0
AI11_VAL	Analog Input 11 Value	REAL	0
AI12_VAL	Analog Input 12 Value	REAL	0
CO1FREQ	Counter 1 Frequency [Hz]	REAL	0
CO1RPM	Counter 1 Revolutions Per Minute	REAL	0
CO2FREQ	Counter 2 Frequency [Hz]	REAL	0
CO2RPM	Counter 2 Revolutions Per Minute	REAL	0
CO3FREQ	Counter 3 Frequency [Hz]	REAL	0
CO3RPM	Counter 3 Revolutions Per Minute	REAL	0

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5.6.2 FEM_AO – Analog Output

The following OBs must call the function block FEM_AO:

a) Watchdog interrupt OB for cyclic operation (for example OB 32).

b) In addition the block has to be called in the OB 100 for the start–up processing.

Area of Application

The block writes the output data to the AddFEM.

Functional Description

The FEM_AO block converts the 8 analog values in REAL format at the input bar which are to be output into standardized fixed–point values and transfers these to the analog outputs of the AddFEM. If the switch SIMULx = 1 is set, the simulation value AOx_SIM is output.

Note

SIMUAIx means SIMUAI<Channel Number 1 to 12> e.g. SIMUAI1.

If the range is exceed, the output value is limited to approx. 18% over the physical limit.

Mode of Operation

The block reads the logic addresses entered in the **BLOCKCON** input structure and writes all the output data (analog and digital outputs) consistently to all the connected AddFEMs.

Error Handling

If there is a fault at a channel (Qualifier Bit=1), the corresponding channel fault output QCHx_F is set to 1.

In case of configuration errors all the channel faults outputs are set. The outputs cannot be simulated in this case.

If there is a configuration error (incorrect address), this is signaled at the output QPARF = 1.

Start–up Characteristics

The range limits (AIx_HRG and AIx_LRG) are converted into factors and offsets in order to calculate the current input values during the initial start–up or restart. In case of incorrect error configuration (for example Upper limit <= Lower limit) the output value is set to zero.

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Time Response

Does not exist.

Message Characteristics

The block does not have message characteristics.

Operator Control and Monitoring

The block does not have a faceplate.

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Parameters

The **FEM_AO** has the following input parameters:

Table 5-9 Input parameters of the FEM_AO

Parameter	Comment	Data type	Visible	Default
BLOCKCON	Block connector	STRUCT	Yes	0
AO1_VAL	Analog Output 1 Value	REAL	Yes	0.0
AO1_HRNG	Analog Output 1 High Range	REAL	Yes	100.0
AO1_LRNG	Analog Output 1 Low Range	REAL	Yes	–100.0
AO1_SIM	Simulation Value Analog Output 1	REAL	No	0.0
SIMUL1	1 = Simulation on	BOOL	No	0
AO2_VAL	Analog Output 2 Value	REAL	Yes	0.0
AO2_HRNG	Analog Output 2 High Range	REAL	Yes	100.0
AO2_LRNG	Analog Output 2 Low Range	REAL	Yes	–100.0
AO2_SIM	Simulation Value Analog Output 2	REAL	No	0.0
SIMUL2	1 = Simulation on	BOOL	No	0
AO3_VAL	Analog Output 3 Value	REAL	Yes	0.0
AO3_HRNG	Analog Output 3 High Range	REAL	Yes	100.0
AO3_LRNG	Analog Output 3 Low Range	REAL	Yes	–100.0
AO3_SIM	Simulation Value Analog Output 3	REAL	No	0.0
SIMUL3	1 = Simulation on	BOOL	No	0.0
AO4_VAL	Analog Output 4 Value	REAL	Yes	0.0
AO4_HRNG	Analog Output 4 High Range	REAL	Yes	100.0
AO4_LRNG	Analog Output 4 Low Range	REAL	Yes	–100.0
AO4_SIM	Simulation Value Analog Output 4	REAL	No	0.0
SIMUL4	1 = Simulation on	BOOL	No	0
AO5_VAL	Analog Output 5 Value	REAL	Yes	0.0
AO5_HRNG	Analog Output 5 High Range	REAL	Yes	100.0
AO5_LRNG	Analog Output 5 Low Range	REAL	Yes	–100.0
AO5_SIM	Simulation Value Analog Output 5	REAL	No	0.0
SIMUL5	1 = Simulation on	BOOL	No	0
AO6_VAL	Analog Output 6 Value	REAL	Yes	0.0
AO6_HRNG	Analog Output 6 High Range	REAL	Yes	100.0
AO6_LRNG	Analog Output 6 Low Range	REAL	Yes	–100.0
AO6_SIM	Simulation Value Analog Output 6	REAL	No	0.0
SIMUL6	1 = Simulation on	BOOL	No	0
AO7_VAL	Analog Output 7 Value	REAL	Yes	0.0
AO7_HRNG	Analog Output 7 High Range	REAL	Yes	100.0
AO7_LRNG	Analog Output 7 Low Range	REAL	Yes	–100.0
AO8_SIM	Simulation value output 7	REAL	No	0.0
SIMUL7	1 = Simulation on	BOOL	No	0

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Parameter	Comment	Data type	Visible	Default
AO8_VAL	Analog Output 8 Value	REAL	Yes	0.0
AO8_HRNG	Analog Output 8 High Range	REAL	Yes	100.0
AO8_LRNG	Analog Output 8 Low Range	REAL	Yes	–100.0
AO8_SIM	Simulation Value Analog Output 8	REAL	No	0.0
SIMUL8	1 = Simulation on	BOOL	No	0

The **FEM_AO** has the following output parameters:

Table 5-10 Output parameters of the FEM_AO

Parameter	Comment	Data type	Default
QPARF	1 = Parameter Assignment Failure	BOOL	0
QCH1_F	1 = Channel Failure AO1	BOOL	0
QCH2_F	1 = Channel Failure AO2	BOOL	0
QCH3_F	1 = Channel Failure AO3	BOOL	0
QCH4_F	1 = Channel Failure AO4	BOOL	0
QCH5_F	1 = Channel Failure AO5	BOOL	0
QCH6_F	1 = Channel Failure AO6	BOOL	0
QCH7_F	1 = Channel Failure AO7	BOOL	0
QCH8_F	1 = Channel Failure AO8	BOOL	0

5.6.3 FEM_DI – Binary Input

The following OBs must call the function block FEM_DI:

Watchdog interrupt OB for cyclic operation (for example OB 32).

Area of Application

The block outputs the binary input data of the AddFEM to its output bar.

Functional Description

The block reads the binary inputs from the AddFEM. The inputs DI5 to DI12 are pure binary inputs. DI1 to DI3 are the pulse inputs of the counters. Input 4 is not assigned and is therefore also not specified in the block bar. The inputs DIO1 to DIO16 are combined inputs and outputs. They can be used both as inputs and as outputs. Each digital input can be switched to simulation by means of a simulation switch. If the switch SIMUDIx = 1, the simulation value DIx_SIM is output.

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Mode of Operation

The block reads the digital inputs stored in the BLOCKCNI input structure and outputs the conditioned values to the output bar.

Error Handling

In case of a configuration error (for example DP address does not exist) the output QPARF = 1 and the output QALLCH = 1 are set. In this case simulation is not possible.

The output QALLCH = 1 is set at a device failure.

Start–up Characteristics

Do not exist.

Time Response

Does not exist.

Message Characteristics

The block does not have message characteristics.

Operator Control and Monitoring

The block does not have a faceplate.

Parameters

The **FEM_DI** has the following input parameters:

Table 5-11 Input parameters of the FEM_DI

Parameter	Comment	Data type	Visible	Default
BLOCKCNI	Block Connector Input	STRUCT	Yes	0
DI1_SIM	Simulation Value DI1	BOOL	No	0
SIMUDI1	1 = Simulation on	BOOL	No	0
DI2_SIM	Simulation Value DI2	BOOL	No	0
SIMUDI2	1 = Simulation on	BOOL	No	0
DI3_SIM	Simulation Value DI3	BOOL	No	0
SIMUDI3	1 = Simulation on	BOOL	No	0
DI5_SIM	Simulation Value DI5	BOOL	No	0
SIMUDI5	1 = Simulation on	BOOL	No	0
DI6_SIM	Simulation Value DI6	BOOL	No	0
SIMUDI6	1 = Simulation on	BOOL	No	0

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The **FEM_DI** has the following input parameters (continued):

Parameter	Comment	Data type	Visible	Default
DI7_SIM	Simulation Value DI7	BOOL	No	0
SIMUDI7	1 = Simulation on	BOOL	No	0
DI8_SIM	Simulation Value DI8	BOOL	No	0
SIMUDI8	1 = Simulation on	BOOL	No	0
DI9_SIM	Simulation Value DI9	BOOL	No	0
SIMUDI9	1 = Simulation on	BOOL	No	0
DI10_SIM	Simulation Value DI10	BOOL	No	0
SIMUDI10	1 = Simulation on	BOOL	No	0
DI11_SIM	Simulation Value DI11	BOOL	No	0
SIMUDI11	1 = Simulation on	BOOL	No	0
DI12_SIM	Simulation Value DI12	BOOL	No	0
SIMUDI12	1 = Simulation on	BOOL	No	0
DI13_SIM	Simulation Value DI13	BOOL	No	0
SIMUDI13	1 = Simulation on	BOOL	No	0
DI14_SIM	Simulation Value DI14	BOOL	No	0
SIMUDI14	1 = Simulation on	BOOL	No	0
DI15_SIM	Simulation Value DI15	BOOL	No	0
SIMUDI15	1 = Simulation on	BOOL	No	0
DI16_SIM	Simulation Value DI16	BOOL	No	0
SIMUDI16	1 = Simulation on	BOOL	No	0
DIO1_SM	Simulation Value DIO1	BOOL	No	0
SIMDIO1	1 = Simulation on	BOOL	No	0
DIO2_SM	Simulation Value DIO2	BOOL	No	0
SIMDIO2	1 = Simulation on	BOOL	No	0
DIO3_SM	Simulation Value DIO3	BOOL	No	0
SIMDIO3	1 = Simulation on	BOOL	No	0
DIO4_SM	Simulation Value DIO4	BOOL	No	0
SIMDIO4	1 = Simulation on	BOOL	No	0
DIO5_SM	Simulation Value DIO5	BOOL	No	0
SIMDIO5	1 = Simulation on	BOOL	No	0
DIO6_SM	Simulation Value DIO6	BOOL	No	0
SIMDIO6	1 = Simulation on	BOOL	No	0
DIO7_SM	Simulation Value DIO7	BOOL	No	0
SIMDIO7	1 = Simulation on	BOOL	No	0
DIO8_SM	Simulation Value DIO8	BOOL	No	0
SIMDIO8	1 = Simulation on	BOOL	No	0
DIO9_SM	Simulation Value DIO9	BOOL	No	0
SIMDIO9	1 = Simulation on	BOOL	No	0
DIO10_SM	Simulation Value DIO10	BOOL	No	0

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The **FEM_DI** has the following input parameters (continued):

Parameter	Comment	Data type	Visible	Default
SIMDIO10	1 = Simulation on	BOOL	No	0
DIO11_SM	Simulation Value DIO11	BOOL	No	0
SIMDIO11	1 = Simulation on	BOOL	No	0
DIO12_SM	Simulation Value DIO12	BOOL	No	0
SIMDIO12	1 = Simulation on	BOOL	No	0
DIO13_SM	Simulation Value DIO13	BOOL	No	0
SIMDIO13	1 = Simulation on	BOOL	No	0
DIO14_SM	Simulation Value DIO14	BOOL	No	0
SIMDIO14	1 = Simulation on	BOOL	No	0
DIO15_SM	Simulation Value DIO15	BOOL	No	0
SIMDIO15	1 = Simulation on	BOOL	No	0
DIO16_SM	Simulation Value DIO16	BOOL	No	0
SIMDIO16	1 = Simulation on	BOOL	No	0

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The **FEM_DI** has the following output parameters:

Table 5-12 Output parameters of the FEM_DI

Parameter	Comment	Data type	Default
BLOCKCNO	Block Connector Output	STRUCT	0
QPARF	1 = Parameter Assignment Failure	BOOL	0
QALLCH	1 = All Channels Failure	BOOL	0
DI_1	Digital Input 1 (Counter Input)	BOOL	0
DI_2	Digital Input 2 (Counter Input)	BOOL	0
DI_3	Digital Input 3 (Counter Input)	BOOL	0
DI_5	Digital Input 5	BOOL	0
DI_6	Digital Input 6	BOOL	0
DI_7	Digital Input 7	BOOL	0
DI_8	Digital Input 8	BOOL	0
DI_9	Digital Input 9	BOOL	0
DI_10	Digital Input 10	BOOL	0
DI_11	Digital Input 11	BOOL	0
DI_12	Digital Input 12	BOOL	0
DI_13	Digital Input 13	BOOL	0
DI_14	Digital Input 14	BOOL	0
DI_15	Digital Input 15	BOOL	0
DI_16	Digital Input 16	BOOL	0
DIO_1	Digital Input/Output 1	BOOL	0
DIO_2	Digital Input/Output 2	BOOL	0
DIO_3	Digital Input/Output 3	BOOL	0
DIO_4	Digital Input/Output 4	BOOL	0
DIO_5	Digital Input/Output 5	BOOL	0
DIO_6	Digital Input/Output 6	BOOL	0
DIO_7	Digital Input/Output 7	BOOL	0
DIO_8	Digital Input/Output 8	BOOL	0
DIO_9	Digital Input/Output 9	BOOL	0
DIO_10	Digital Input/Output 10	BOOL	0
DIO_11	Digital Input/Output 11	BOOL	0
DIO_12	Digital Input/Output 12	BOOL	0
DIO_13	Digital Input/Output 13	BOOL	0
DIO_14	Digital Input/Output 14	BOOL	0
DIO_15	Digital Input/Output 15	BOOL	0
DIO_16	Digital Input/Output 16	BOOL	0

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5.6.4 FEM_DO – Binary Input

The following OBs must call the function block FEM_DO:

Watchdog interrupt OB for cyclic operation (for example OB 32).

Area of Application

The block outputs 16 binary outputs to the AddFEM module.

Functional description

The input values DO_x are output to the assigned digital outputs of the AddFEM. If the switch SIMUDOx = 1, the output channel is simulated, meaning that the value DIx_SIM is output to the AddFEM module.

Mode of Operation

The block combines the digital outputs into a word and passes it to the BLOCKCNO output structure for output by the FEM_AO block.

Error Handling

In case of a configuration error (for example DP address does not exist) the output QPARF = 1 and all the channel fault outputs are set. In this case simulation is not possible.

At channel faults the corresponding channel fault outputs are set = 1.

Start–up Characteristics

Do not exist.

Time Response

Does not exist.

Message Characteristics

The block does not have message characteristics.

Operator Control and Monitoring

The block does not have a faceplate.

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Parameters

The **FEM_DO** has the following input parameters:

Table 5-13 Input parameters of the FEM_DO

Parameter	Comment	Data type	Visible	Default
BLOCKCNI	Block Connector Input	STRUCT	Yes	0
DO1_VAL	Output Value DO1	BOOL	Yes	0
DO1_SIM	Simulation Value DO1	BOOL	No	0
SIMUDO1	1 = Simulation on	BOOL	No	0
DO2_VAL	Output Value DO2	BOOL	Yes	0
DO2_SIM	Simulation Value DO2	BOOL	No	0
SIMUDO2	1 = Simulation on	BOOL	No	0
DO3_VAL	Output Value DO3	BOOL	Yes	0
DO3_SIM	Simulation Value DO3	BOOL	No	0
SIMUDO3	1 = Simulation on	BOOL	No	0
DO4_VAL	Output Value DO4	BOOL	Yes	0
DO4_SIM	Simulation Value DO4	BOOL	No	0
SIMUDO4	1 = Simulation on	BOOL	No	0
DO5_VAL	Output Value DO5	BOOL	Yes	0
DO5_SIM	Simulation Value DO5	BOOL	No	0
SIMUDO5	1 = Simulation on	BOOL	No	0
DO6_VAL	Output Value DO6	BOOL	Yes	0
DO6_SIM	Simulation Value DO6	BOOL	No	0
SIMUDO6	1 = Simulation on	BOOL	No	0
DO7_VAL	Output Value DO7	BOOL	Yes	0
DO7_SIM	Simulation Value DO7	BOOL	No	0
SIMUDO7	1 = Simulation on	BOOL	No	0
DO8_VAL	Output Value DO8	BOOL	Yes	0
DO8_SIM	Simulation Value DO8	BOOL	No	0
SIMUDO8	1 = Simulation on	BOOL	No	0
DO9_VAL	Output Value DO9	BOOL	Yes	0
DO9_SIM	Simulation Value DO9	BOOL	No	0
SIMUDO9	1 = Simulation on	BOOL	No	0
DO10_VAL	Output Value DO10	BOOL	Yes	0
DO10_SIM	Simulation Value DO10	BOOL	No	0
SIMUDO10	1 = Simulation on	BOOL	No	0
DO11_VAL	Output Value DO11	BOOL	Yes	0
DO11_SIM	Simulation Value DO11	BOOL	No	0
SIMUDO11	1 = Simulation on	BOOL	No	0
DO12_VAL	Output Value DO12	BOOL	Yes	0
DO12_SIM	Simulation Value DO12	BOOL	No	0

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The **FEM_DO** has the following input parameters (continued):

Parameter	Comment	Data type	Visible	Default
SIMUDO12	1 = Simulation on	BOOL	No	0
DO13_VAL	Output Value DO13	BOOL	Yes	0
DO13_SM	Simulation Value DO13	BOOL	No	0
SIMUDO13	1 = Simulation on	BOOL	No	0
DO4_VAL	Output Value DO14	BOOL	Yes	0
DO14_SM	Simulation Value DO14	BOOL	No	0
SIMUDO14	1 = Simulation on	BOOL	No	0
DO15_VAL	Output Value DO15	BOOL	Yes	0
DO15_SM	Simulation Value DO15	BOOL	No	0
SIMUDO15	1 = Simulation on	BOOL	No	0
DO16_VAL	Output Value DO16	BOOL	Yes	0
DO16_SM	Simulation Value DO16	BOOL	No	0
SIMUDOO16	1 = Simulation on	BOOL	No	0

The **FEM_DO** has the following output parameters:

Table 5-14 Output parameters of the FEM_DO

Parameter	Comment	Data type	Default
BLOCKCNO	Block Connector Output	STRUCT	0
QPARF	1 = Parameter Assignment Failure	BOOL	0
QCH1_F	1 = Channel Failure DO1	BOOL	0
QCH2_F	1 = Channel Failure DO2	BOOL	0
QCH3_F	1 = Channel Failure DO3	BOOL	0
QCH4_F	1 = Channel Failure DO4	BOOL	0
QCH5_F	1 = Channel Failure DO5	BOOL	0
QCH6_F	1 = Channel Failure DO6	BOOL	0
QCH7_F	1 = Channel Failure DO7	BOOL	0
QCH8_F	1 = Channel Failure DO8	BOOL	0
QCH9_F	1 = Channel Failure DO9	BOOL	0
QCH10_F	1 = Channel Failure DO10	BOOL	0
QCH11_F	1 = Channel Failure DO11	BOOL	0
QCH12_F	1 = Channel Failure DO12	BOOL	0
QCH13_F	1 = Channel Failure DO13	BOOL	0
QCH14_F	1 = Channel Failure DO14	BOOL	0
QCH15_F	1 = Channel Failure DO15	BOOL	0
QCH16_F	1 = Channel Failure DO16	BOOL	0

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5.7 Fault Elimination

5.7.1 Failure and Exchange of Redundant AddFEMs during Operation

Exchanging modules during operation is decisive for non–interrupted operation of the AddFEMs at module redundancies.

Initial Situation

Failure	How do the AddFEMs react?
• One AddFEM fails	The partner module takes over the master function

Prerequisites for Replacing

The exchange described below is only possible if the ”new” AddFEM

- has the same version as the one which has failed and
- any existing preprocessing functions (FEF) have the same firmware version.

Procedure

Step	What is to be done?	How do the AddFEMs react?
1	Turn the key–operated switch at the corresponding module from RUN to STOP	The partner module takes over the master function and changes to the state LINK–UP (LED RES flashes)
2	Remove the optical–fiber cable for the redundancy connection [1)]	The two AddFEMs signal an error at the redundancy coupling (LED RED is on).
3	Disconnect the power supply	
4	Loosen the process signal cables and remove the module	
5	• Install the new module • Connect the process signal cables • Turn the key–operated switch to the STOP position [2)] • Plug the optical–fiber cable for the redundancy connection • Apply the supply voltage	
6	Turn the key–operated switch from STOP to RUN	The AddFEM carries out automatic a LINK–UP. The new installed module takes over the reserve function.

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1)

Note

If there is no optical–fiber cable redundancy coupling or if it is faulty, the automation processor decides the master/reserve assignment on the basis of the current error weighting.

2)

Notice

Please note that the key–operated switch has to be turned to the STOP position before plugging the optical–fiber redundancy connection during operation to the reserve module and that it may only be turned to the RUN position after the optical–fiber redundancy connection has been plugged.
If this point is not observed, untentional multiple master/reserve changes may occur after plugging, if both modules have errors with equal error weighting (for example, due to external errors at the process signals connected to both process signals).

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Front Connector Configuration

A

Overview

The following tables list the pin configuration of the connectors X4 to X7.

Connector X4

Pin No.	Name	Function	Pin No.	Name	Function
1	NC	Not assigned	11	NC	Not assigned
2	S1+	Analog output Channel 1	12	M1+	Analog input Channel 1+
3	S2+	Analog output Channel 2	13	M1–	Analog input Channel 1–
4	S3+	Analog output Channel 3	14	M2+	Analog input Channel 2+
5	S4+	Analog output Channel 4	15	M2–	Analog input Channel 2–
6	S5+	Analog output Channel 5	16	M3+	Analog input Channel 3+
7	S6+	Analog output Channel 6	17	M3–	Analog input Channel 3–
8	S7+	Analog output Channel 7	18	M4+	Analog input Channel 4+
9	S8+	Analog output Channel 8	19	M4–	Analog input Channel 4–
10	M	Signal common AO / AI	20	M	Signal common AI

Connector X5

Pin No.	Name	Function	Pin No.	Name	Function
1	NC	Not assigned	11	NC	Not assigned
2	M5+	Analog input Channel 5+	12	M9+	Analog input Channel 9+
3	M5–	Analog input Channel 5–	13	M9–	Analog input Channel 9–
4	M6+	Analog input Channel 6+	14	M10+	Analog input Channel 10+
5	M6–	Analog input Channel 6–	15	M10–	Analog input Channel 10–
6	M7+	Analog input Channel 7+	16	M11+	Analog input Channel 11+
7	M7–	Analog input Channel 7–	17	M11–	Analog input Channel 11–
8	M8+	Analog input Channel 8+	18	M12+	Analog input Channel 12+
9	M8–	Analog input Channel 8–	19	M12–	Analog input Channel 12–
10	M	Signal common AI	20	M	Signal common AI

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Connector X6

Pin No.	Name	Function	Pin No.	Name	Function
1	1N	Signal common Channel 1,2,3	11	3N	Signal common Channel 9,10,11,12
2	1	Counter digital input Channel 1	12	9	Digital input Channel 9
3	2	Counter digital input Channel 2	13	10	Digital input Channel 10
4	3	Counter digital input Channel 3	14	11	Digital input Channel 11
5	NC	Not assigned	15	12	Digital input Channel 12
6	5	Digital input Channel 5	16	13	Digital input Channel 13
7	6	Digital input Channel 6	17	14	Digital input Channel 14
8	7	Digital input Channel 7	18	15	Digital input Channel 15
9	8	Digital input Channel 8	19	16	Digital input Channel 16
10	2N	Signal common Channel 5,6,7,8	20	4N	Signal common Channel 13,14,15,16

Connector X7

Pin No.	Name	Function	Pin No.	Name	Function
1	1L+	Power input L+ Channel 1..8	11	2L+	Power input L+ Channel 9..16
2	1	Digital output Channel 1	12	9	Digital output Channel 9
3	2	Digital output Channel 2	13	10	Digital output Channel 10
4	3	Digital output Channel 3	14	11	Digital output Channel 11
5	4	Digital output Channel 4	15	12	Digital output Channel 12
6	5	Digital output Channel 5	16	13	Digital output Channel 13
7	6	Digital output Channel 6	17	14	Digital output Channel 14
8	7	Digital output Channel 7	18	15	Digital output Channel 15
9	8	Digital output Channel 8	19	16	Digital output Channel 16
10	1M	Signal common Channel 1..8	20	2M	Signal common Channel 9..16

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