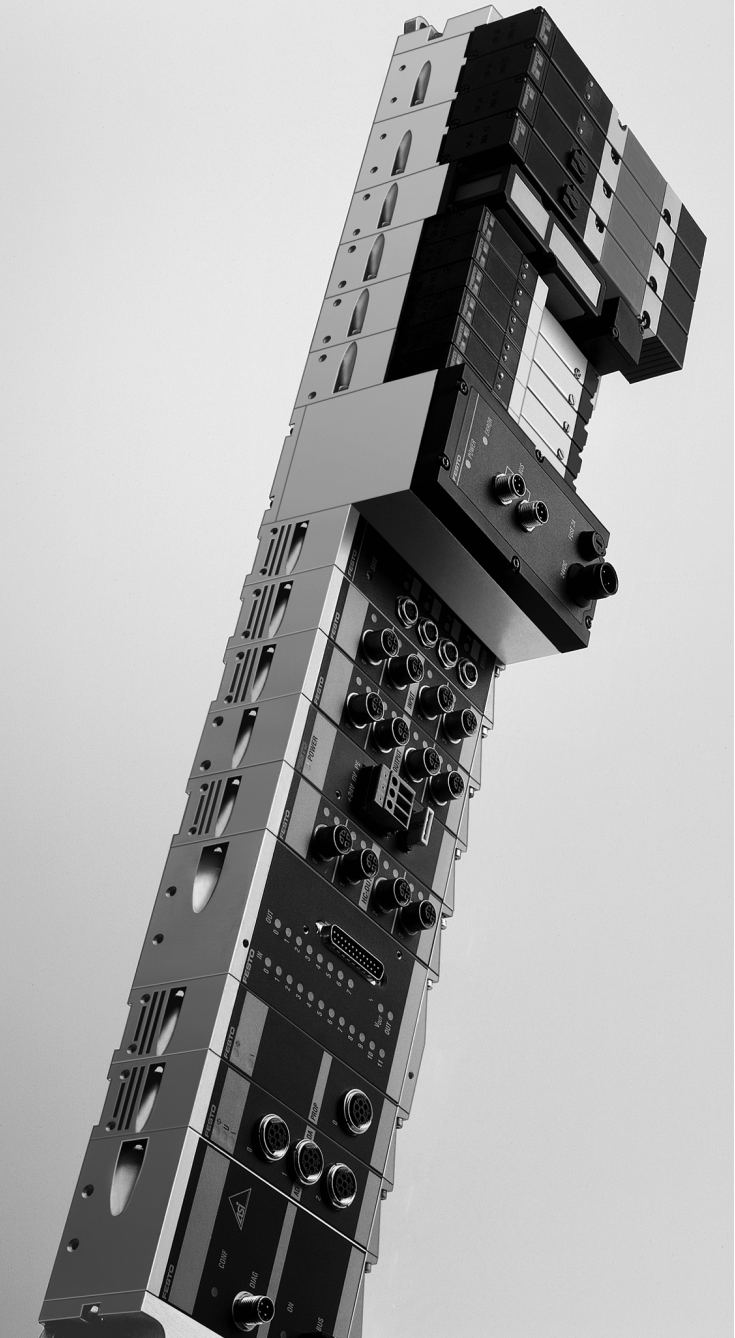
Valve terminals types 03/04-B

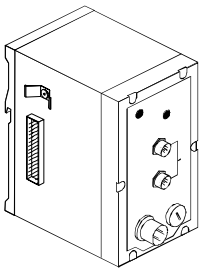


FESTO

Manual
Electronics

Valve terminal with
field bus connection
Type IFB05-03

Field bus protocol:
- Festo field bus
- ABB (CS31)
- Klöckner-Moeller
  SUCOnet K



Manual
152 765
en 0503e

Authors ..... U. Reimann, E. Klotz, H. Hohner

Editors ..... H.-J. Drung, M.Holder

Original ..... de

Translation ..... transline Deutschland GmbH

Layout ..... Festo AG & Co., Dept. KG-GD

Typesetting ..... DUCOM

Edition ..... en 0503e

Title ..... MANUAL-EN

Designation P.BE-VIFB6-03-EN

Order-no. 152 765

Internet: http://www.festo.com
E-mail: service_international@festo.com

Contents

Intended use

The valve terminal described in this documentation is intended exclusively for use as follows:

– for controlling pneumatic and electric actuators (valves and output modules)

– for interrogating electric sensor signals through the input modules.

Please use the valve terminal only as follows:

– as intended

– in faultless technical condition

– without undertaking any modifications.

In conjunction with additional commercially available components, such as sensors and actuators, the specifiedlimits for pressures, temperatures, electrical data, torques etc. must be observed.

Please observe the standards specified in the relevant chapters and comply with national and localsafety laws and regulations.

Target group

This manual is directed exclusively at personnel trained in control and automation technology and who have experience in installing, commissioning, programming and diagnosing programmable logic controllers (PLC) and field bus systems.

Service

If you have any technical problems, please contact your local Festo Service.

Important user instructions

Danger categories

This manual contains instructions on the dangers which may occur if the product is not used correctly. These instructions are marked with a heading (Warning, Caution, etc.), printed on a shaded background and accompanied by a pictogram. A distinction is made between the following danger categories:

Warning
This means that there is a danger of serious human injury and damage to property if these instructions are not observed.

Caution
This means that there is a danger of human injury and damage to property if these instructions are not observed.

Please note
This means that there is a danger of damage to property if these instructions are not observed.

In addition, the following pictogram marks passages in the text which describe activities involving electrostatically sensitive components:

Electrostatically sensitive components: Incorrect handling may result in damage to the components.

Marking special information

The following pictograms mark passages in the text containing special information.

Pictograms

Information:
recommendations, tips and references to other sources of information.

Accessories:
information on necessary or useful accessories for the Festo product.

Environment:
information on the environmentally-friendly use of Festo products.

Text markings

- The bullet denotes activities which can be carried out in any sequence.

1. Figures denote activities which must be carried out in the order specified.

– Hyphens denote general activities.

Abbreviations

The following product-specific abbreviations are used in this manual:

Abbreviation	Meaning
Terminal or valve terminal	Valve terminal type 03 or type 04-B with or without electric I/Os
Node	Field bus node/control unit
Sub-base	Type 03: Pneumatic sub-base for two valves Type 04-B Manifold sub-base with Intermediate solenoid plate MUH and pneumatic valve with hole pattern as per ISO 5599-2 size 1, 2 or 3 incl.
Single solenoid sub-base	Sub-base for single-solenoid valves
Double solenoid sub-base	Sub-base for double-solenoid valves or mid-position valves
I O I/O	Input Output Input and/or output
P-module	General pneumatic module
I/O module	Module with digital inputs or outputs in general
PLC	Programmable logic controller; in brief: controller
FO	Fibre-optical waveguide

Fig. 0/1: Index of abbreviations

Please note
For most of the drawings in this manual, we have used a simplified representation of a type 03 valve terminal with four pneumatic sub-bases and four input/output modules (standard fitting).

1 Input/output modules

2 Field bus node

3 Valves

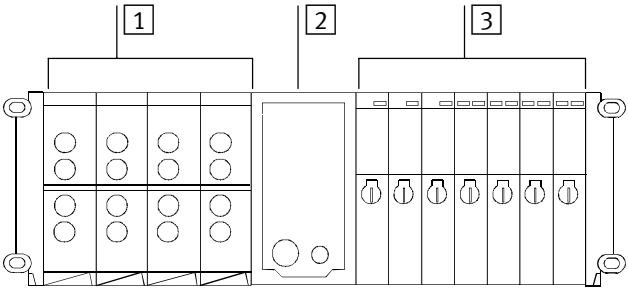


Fig. 0/2: Standard fitting for the drawings

Manuals for this valve terminal

Depending on your order and on the equipment to be fitted on your system, you will require the following Festo manuals for the complete documentation of the modular valve terminal:

Festo designation	Title/product
P.BE-MIDI/MAXI-03-...	Pneumatics manual – Valve terminal type 03, MIDI/MAXI
P.BE-VIISO-04-B-...	Pneumatics manual – Valve terminal type 04-B, ISO 5599-2
P.BE-VIEA-03/04B-..	Supplementary manual for the I/O modules (digital I/O modules 4I, 8I, 4O, high-current output modules, multi I/O modules)
P.BE-VIEA-03/04B-..	Analogue I/O manual
P.BE-VIEA-03/04B-..	Electronics manual – FB5 field bus connection (this manual)

Fig. 0/3: Manuals for this valve terminal

Additional modules for this valve terminal

The multifunctional valve terminal can be extended with the following modules:

I/O modules	
Type designation	**Name**
VIGE-03-FB-...	Input module with 4 or 8 inputs, PNP or NPN, 4-pin or 5-pin, with or without electronic fuse.
VIGA-03-FB-...	Output module with 4 outputs, PNP or NPN, 4-pin or 5-pin
VIGV-03-FB-...	Additional power supply module (24 V/25 A) for high-current outputs.
VIGA-03-FB-...	Multi I/O module with 12 inputs and 8 outputs, PNP
VIAP-03-FB	Analogue I/O module with 1 input and 1 output
VIGV-03-FB-...	Analogue I/O module with 3 inputs and 1 output Type voltage (-V) or current (-I)

Fig. 0/4: Additional modules

The valve terminals can be connected to the controllers of various manufacturers. This manual deals with the configuration of the PLC and the addressing of the terminals for the following control systems:

Controller manufacturer	Controller (PLC)	field bus module	Field bus
Festo	– FPC 405 – SF-202 types 02...05 – SF3 types 02...05	– E.CFA – integrated – integrated	Festo field bus
ABB	ABB Procontic CS31 (connected directly to the central unit) ABB Procontic T200	Central unit 07KR91 Central unit 07KR31 Central unit 07KT92 Central unit 07KT93 Coupler 07CS61	ABB CS31 system bus
Klöckner-Moeller	SUCOS PS 30 series e. g. – PS 416 – PS 4-201	Serial bus interface integrated integrated	SucoNet K

Fig. 0/5: Automation systems/field bus protocols which can be connected

Please note
– ABB
The address range of 64 I/Os can be used as from software version 1.3 (SW 23.01.95 or later).
– Klöckner-Moeller
The protocol for use on the SUCOnet K can be used as from software version 1.4 (SW 21.03.96 or later).

See type plate of valve terminal

Summary of components

Chapter 1

Contents

1.1 Summary of multifunctional Festo valve terminals

The multifunctional valve terminal is composed of individual modules and components.

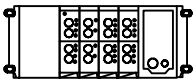
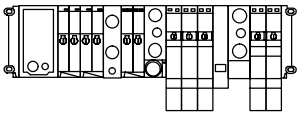
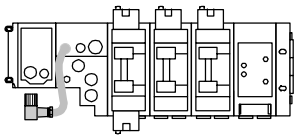
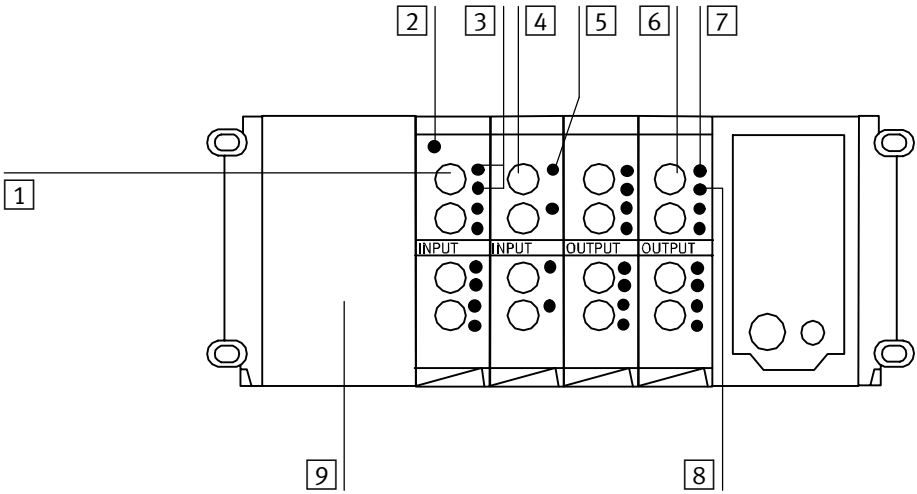
Valve terminal	Description of the modules
Type 03 Electric modules 	Electric modules suited to types 03/04B (PNP or NPN), fitted with: – digital inputs (modules with 4, 8 or 16 inputs) – digital outputs (modules with 4 outputs) 0.5 A – high-current outputs 2 A – multi-I/Os (module with 12 inputs/8 outputs) 0.5 A – analogue I/Os, AS-i master (not possible with all nodes)
Type 03: Pneumatic modules 	Pneumatic modules type 03, fitted with: – Sub-bases (MIDI and MAXI) fitted with 5/2-way single-solenoid valves, 5/2-way double-solenoid valves, 5/3-way mid-position valves (with auxiliary pilot air) or cover plates – Special modules for pressure supply, for forming pressure zones
Type 04-B ISO pneumatic modules 	Pneumatic modules type 04-B, fitted with: – Adapter plate for manifold sub-bases as per ISO 5599-2 in sizes 1, 2 and 3 – Manifold sub-bases for intermediate solenoid plates with hole pattern as per ISO 5588-2, fitted with pneumatic valves (single-solenoid, double-solenoid, mid-position) or cover plates – Components for high-level sub-bases (pressure regulator intermediate plates, restrictor plates etc.)

Fig. 1/1: Summary of modules for the multifunctional Festo valve terminals

1.2 Description of components

1.2.1 Types 03/04-B: Electric modules

The following connecting and display elements can be found on the electric modules:



1 Input socket for two electric inputs (PNP or NPN)

2 Red LED (error display per input module with electronic fuse)

3 Two green LEDs (one LED per input)

4 Input socket for one electric input (PNP or NPN)

5 Green LED (per input)

6 Output socket for electric output (PNP)

7 Yellow LED (status display per output)

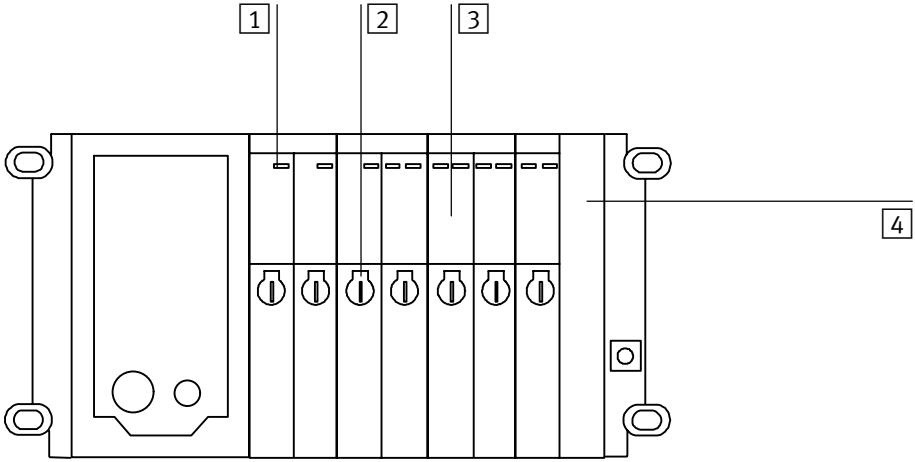
8 Red LED (error display per output)

9 Further modules (e.g. additional power supply, high-current outputs PNP/NPN)

Fig. 1/2: Connecting and display elements on the electric modules

1.2.2 Type 03: MIDI pneumatic modules

The following display and operating elements can be found on the pneumatic MIDI modules type 03:



1 Yellow LEDs (per valve solenoid coil)

2 Manual override (per valve solenoid coil), either locking or non-locking

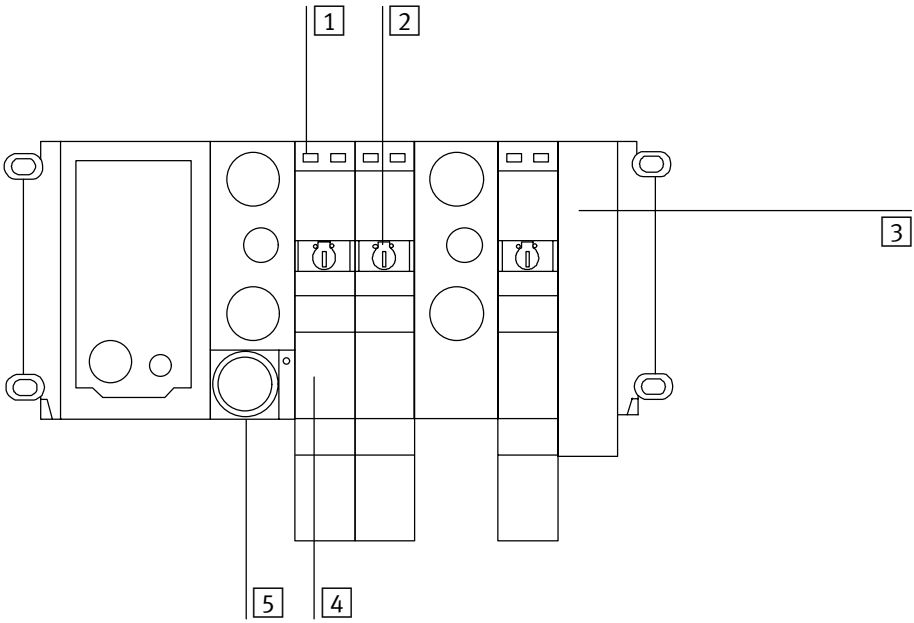
3 Valve location inscription field (designation signs)

4 Unused valve location with cover plate

Fig. 1/3: Display and operating elements on the MIDI modules type 03

1.2.3 Type 03: MAXI pneumatic modules

The following display and operating elements can be found on the pneumatic MAXI modules type 03:



1 Yellow LED (per valve solenoid coil)

2 Manual override (per valve solenoid coil), either locking or non-locking

3 Unused valve location with cover plate

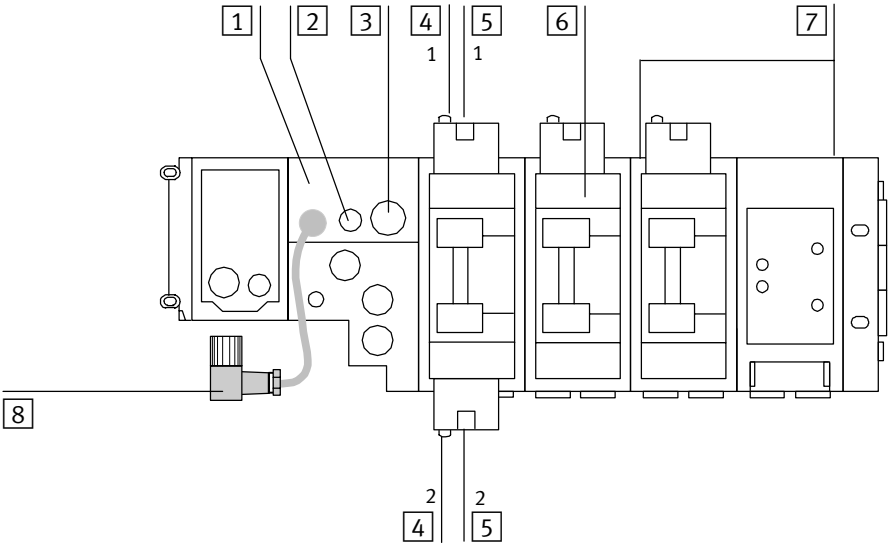
4 Valve location inscription field (designation signs)

5 Regulator for limiting the pressure of the auxiliary pilot air

Fig. 1/4: Display and operating elements on the MAXI modules type 03

1.2.4 Type 04-B: ISO pneumatic modules

The following connecting, display and operating elements can be found on the pneumatic ISO modules type 04-B:



1 Adapter plate type 04-B

2 Fuses for the valves

3 Power supply connection

4 [1] Yellow LEDs (per pilot solenoid 14)
[2] Yellow LEDs (per pilot solenoid 12)

5 [1] Manual override (per pilot solenoid 14, non-locking)
[2] Manual override (per pilot solenoid 12, non-locking)

6 Valve location inscription field

7 0.135 A fuse (per pilot solenoid)

8 Adapter cable for power supply to the node and the I/O modules

Fig. 1/5: Operating, display and connecting elements on the ISO modules type 04-B

1.3 Method of operation

The node controls the following functions:

- it connects the valve terminal to the appropriate field bus and to the power supply.
- it performs the system settings of the valve terminal. An automatic valve test and further node-dependent functions can be set.
- it controls data transfer to/from the field bus module of your control system
- Internal control of the valve terminal

1 Incoming field bus

2 Continuing field bus

3 Node

4 Compressed air

5 Work air (2, 4)

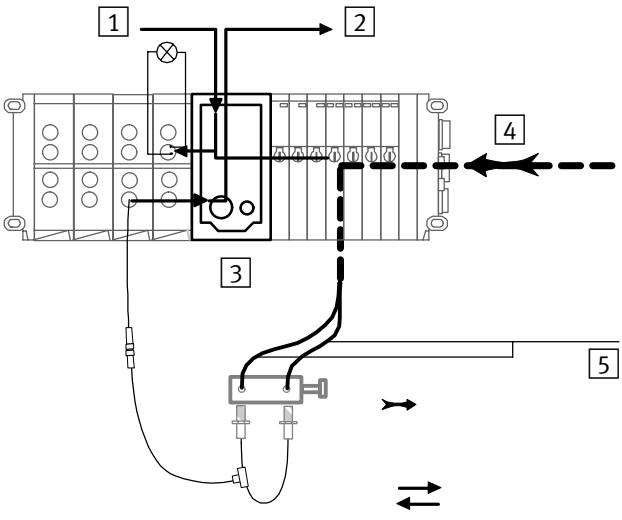


Fig. 1/6: Summary of the functions of a valve terminal

The input modules process input signals (e.g. from sensors) and transmit these signals via the field bus to the controller.

The output modules are universal electric outputs and control low-current consuming devices with positive logic, e.g. further valves, bulbs, etc.).

Additional I/O modules for special applications are also available.

Further information on the use of all I/O modules can be found in the "Supplementary description of the I/O modules" for your valve terminal.

The pneumatic modules perform the following functions:

– they form the common channels for supply and exhaust air

– they supply electric signals from all the valve solenoid coils

Work connections 2 and 4 are provided for each valve location on the individual pneumatic modules.

The valves are supplied with compressed air via the common channels on the pneumatic end plate or via special supply modules. The exhaust air and pilot exhaust are also vented via these channels/modules. Further modules for pressure supply are also available, e.g. for working with different pressures or for fitting either MIDI/MAXI valves or ISO valves on a node.

Further information on their use can be found in the "Pneumatics manual" for your valve terminal.

Fitting

Chapter 2

Contents

2.1 Fitting the modules and components

The valve terminal is supplied from the factory ready fitted. If you wish to supplement or replace individual modules or components, please follow the instructions in the following manuals:

– “Supplementary description of the I/O modules” for fitting the electric I/O modules

– “Pneumatics manual” for fitting the pneumatic modules

– Fitting instructions supplied with the product in the case of modules and components ordered at a later date.

Please note
Handle all modules and components of the valve terminal with the utmost care. Pay particular attention to the following:

– Make sure that screws are not distorted and not subjected to mechanical stress. Make sure that screws are correctly aligned (otherwise their threads may be damaged).

– Make sure that the specified torques are not exceeded.

– Avoid misalignment between the modules (IP 65).

– Make sure that connecting surfaces are clean (avoid leakage and contact faults).

– The contacts of type 03 valve solenoid coils must not be bent (they are not resistant to bending, i.e. they will break off if bent backwards).

– Electrostatically sensitive components
Do not touch the contact surfaces of the plug connectors on the sides of the modules and components.

2.1.1 Earthing the end plates

The valve terminal possesses both a left-hand and a right-hand end plate as a mechanical termination of the valve terminal. These end plates fulfil the following requirements:

– they comply with protection class IP 65.

– they contain connections/contacts for earthing.

– they contain holes for fitting the valve terminal onto a wall and, in the case of type 03, also for the hat-rail clamping unit.

Please note
When supplied from the factory, the end plates of the valve terminal are earthed internally. If you wish to extend/convert the type 03 valve terminal, earth the end plates of the valve terminal as described below.

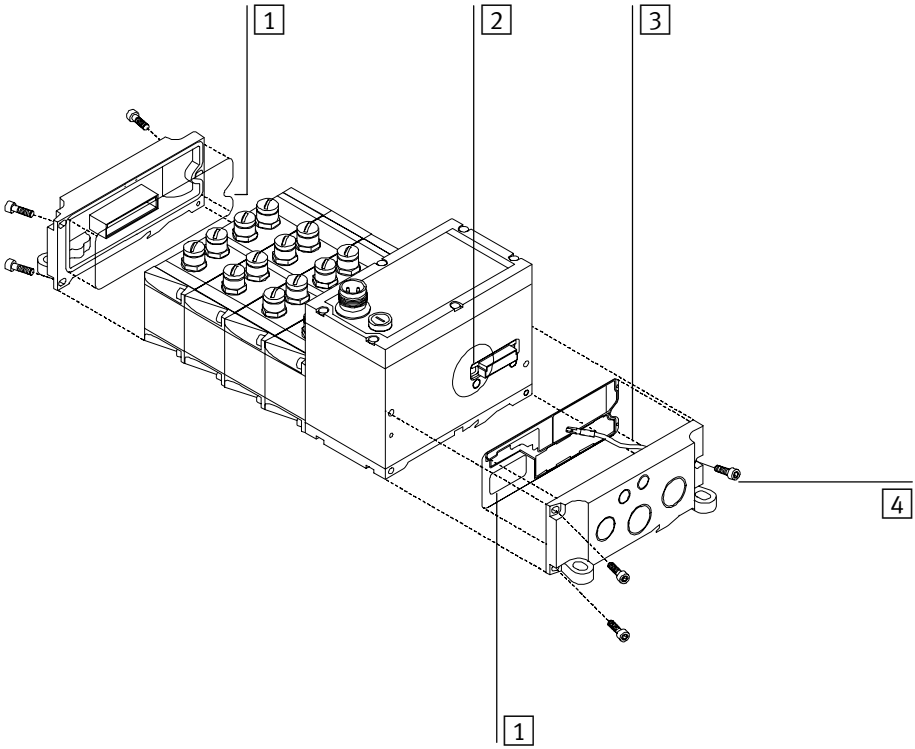
You thereby avoid faults caused by electromagnetic influences.

Earth the end plates after extension/conversion as follows:

1. Right-hand end plate (type 03):
   In order to earth the right-hand end plate, connect the ready-fitted cable on the inside to the appropriate contacts on the pneumatic modules or on the node (see diagram below).

2. Left-hand end plate:
   The left-hand end plate is connected conductively to the other components by means of the ready-fitted spring contacts.

Remark:
Instructions on earthing the complete valve terminal can be found in the chapter “Installation”.
The diagram below shows how the end plates are fitted using as an example a type 03 valve terminal.



1 Seals

2 Contact for the earth cable

3 Ready-fitted earth cable

4 Fastening screws max. 1 Nm

Fig. 2/1: Fitting the end plates (example of type 03 valve terminal)

2.2 Fitting onto a hat rail (type 03)

The valve terminal is suitable for fitting onto a hat rail (support rail as per EN 50022). For this purpose there is a guide groove on the rear of all modules in order that they can be hung on a hat rail (see Fig. 2/3).

Caution
- Fitting the valve terminal onto a hat rail without a hat-rail clamping unit is not permitted.
- If the valve terminal is fitted in a sloping position or if it is subject to vibration, secure the hat-rail clamping unit additionally:
  - against sliding down and use the locking screws (item 3) to protect it against unintentional loosening/ opening.

Please note
- If the valve terminal is fitted in a horizontal position and if the load is at rest, the hat-rail clamping unit can be used without locking screws (item 3).
- If you do not have a hat-rail clamping unit for your valve terminal, you can order this and fit it at a later stage.
- The use of MIDI or MAXI clamping units depends on the end plates available (MIDI/MAXI).

Hat-rail clamping unit (type 03)

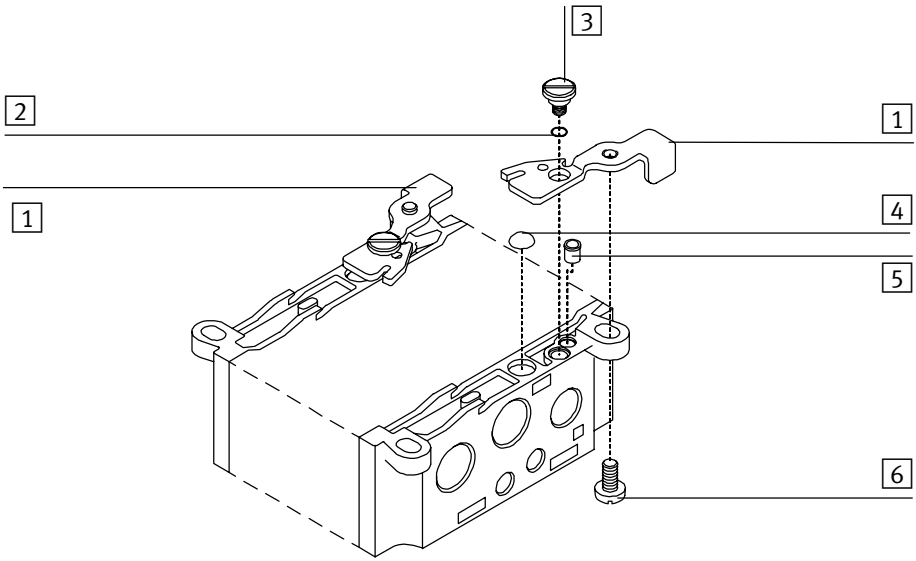
In order to fit the valve terminal onto a hat rail, you will require a hat-rail clamping unit. This must be fitted on the rear of the end plates as shown in the diagram below. Pay particular attention to the following:

Before fitting:

- Make sure that the surfaces for glueing on the rubber feet are clean (cleaned with spirit).
- Make sure that the flat-head screws (item 3) are tightened.

After fitting:

- Fasten the lever with a locking screw (item 7).



1	Lever*)	4	Self-adhesive rubber foot
2	O-ring	5	Clamping elements
3	Flat-head screw	6	Locking screw

*) Different lever lengths with MIDI and MAXI

Fig. 2/2: Fitting the hat-rail clamping unit

Proceed as follows:

1. Ascertain the weight of your valve terminal as described in chapter 2.3
2. Make sure that the mounting surface can support this weight.
3. Fit a hat rail (support rail as per EN 50022 - 35x15; width 35 mm, height 15 mm).
4. Fasten the hat rail to the fastening surface at least every 100 mm.
5. Hang the valve terminal onto the hat rail. Fasten the valve terminal on both sides with the hat-rail clamping unit to prevent it from tilting or sliding (see Fig. 2/3).
6. If the hat-rail clamping unit is subject to vibration or if it is fitted in a sloping position, fasten it with two locking screws (item 3) against unintentional loosening/opening.

[1] Hat-rail clamping unit unlocked

[2] Hat-rail clamping unit locked

[3] Locking screw

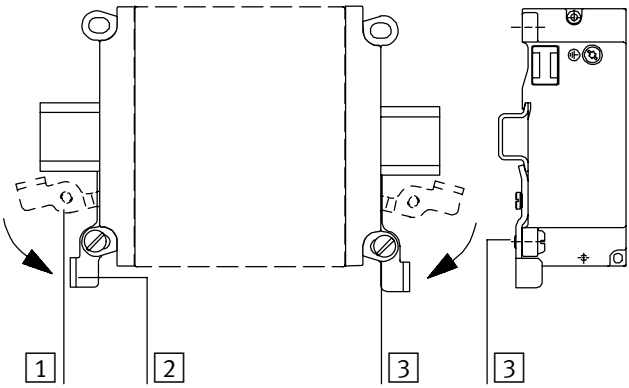


Fig. 2/3: Fitting the type 03 valve terminal to a hat rail

2.3 Fitting the valve terminal onto a wall

Caution
In the case of long valve terminals with several I/O modules, use additional support brackets for the modules (approximately every 200 mm). You can thereby avoid:
- overloading the fastening eyes on the left-hand end plate
- the terminal sagging (I/O side)
- natural resonance

Proceed as follows:

1. Ascertain the weight of your valve terminal (weigh or calculate). Reference values:

Valve terminal module			
type 03 *) – per pneumatic module (incl. valves)	**MIDI** 0.8 kg	**MAXI** 1.2 kg	
Type 04-B manifold sub-bases*) – Adapter plate and right-hand end plate – per pneumatic module (incl. manifold sub-base, intermediate solenoid plate and valve)	**ISO size 1** 3.0 kg 1.2 kg	**ISO size 2** 3.2 kg 1.6 kg	**ISO size 3** 4.1 kg 2.4 kg
Node	1 kg	1 kg	1 kg
I/O module	0.4 kg	0.4 kg	0.4 kg
*) Components for high-level linking: Weight see Pneumatics manual			

2. Make sure that the mounting surface can support this weight. Check to see if you require support brackets for the I/O modules.

3. If necessary, use spacers.

4. Fasten the valve terminal, depending on the type, as shown in the following table. The valve terminal can be fitted in any desired position.

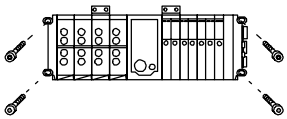
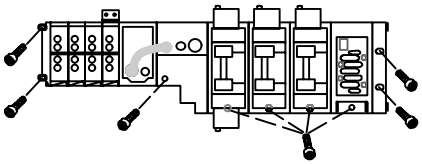
Type of valve terminal	Fastening methods
Type 03 	– with four M6 screws on the left-hand and right-hand end plate. In the case of valve terminals with several I/O modules, use additional support brackets for the modules (approximately every 200 mm).
Type 04-B 	– with two M6 screws on the left-hand end plate – with three M6 screws (ISO sizes 1 and 2) or M8 (ISO size 3) on the adapter plate and on the right-hand end plate. If required, use the following additional methods of fastening: – a fastening screw per manifold sub-base – the hole on the bottom of the manifold sub-base (“blind hole”, see Pneumatics manual) – In the case of valve terminals with several I/O modules, use additional support brackets for the modules (approximately every 200 mm).

Fig. 2/4: Possibilities for fitting onto a wall

Installation

Chapter 3

Contents

3.1 General connection methods

Warning
Switch off the following before undertaking installation and/or maintenance work:

– the compressed air supply
– the operating voltage supply for the electronics (pin 1)
– the load voltage supply for the outputs/valves (pin 2).

You can thereby avoid:

– sudden uncontrolled movements of loose tubing
– unexpected movements of the connected actuators
– non-defined switching states of the electronic components.

3.1.1 Selecting the field bus cable

Please note
Please observe the cable specifications

During the exchange of data, transmission errors, signal reflections and signal attenuation occur, especially with high baud rates. Both can lead to transmission faults.

The causes of reflections may be:
– missing or incorrect terminating resistor
– branches.

The causes of signal attenuation may be:
– transmission over long distances
– unsuitable cables.

ABB (CS31)/Klöckner-Moeller SucoNet K

A twisted screened two-core cable must be used as the field bus cable. Please refer to the manual for your controller for information on the cable type to be used. Take into account the distance and the field bus baud rate set.

Festo

The cables listed can be used for data transmission over the distances mentioned. The relevant matchingsocket (PG) is specified in brackets.

1. Universally usable for distances up to 1000 m (note electric strength):

   BELDEN 9841: twisted in pairs, double screened cable (wire 24AWG; 30 V)

2. Recommended cable types depend on the baud rate and distance (see also the table below):
   A coaxial paired cable (socket PG 9)
   (Twinax; wire 20AWG, 600 V):
   BICC H8106
   Belden 8227 or 1162A
   Helektra HE-TW-K 105 part no. 1107304

   B Coaxial, screened paired cable
   (socket PG 7)
   (wire 25AWG, 300 V)
   Belden 9271

   C Paired twisted cable with screening
   (socket PG 7)
   (wire 25AWG, 250 V)
   Kabelmetal DUE4001 part no. 444101
   Helektra HE-DUE 4CY AWG20
   part no. 1109401

   D Paired twisted, screened control cable
   (socket PG 13)
   Belden 9860
   Siemens L-2Y2YcY 2*1*1,
   (1.5 mm^2, 900 V) 5kf40
   part no. V45551-F21-B5

Baud rate [kBd]	**Cable type for distances [m]**			
	500	**1000**	**2000**	**4000**
375	AB	—	—	—
187,5	AB	A	—	—
62,5	ABCD	ACD	ACD	—
31,25	ABCD	ACD	ACD	D

Available from

BICC Deutschland GmbH
Düsseldorfer Str. 186
41460 Neuss

Belden Electronics GmbH
Fuggerstr. 2
41468 Neuss

Helektra GmbH
Boschweg 12-16
12057 Berlin 44

kabelmetal electro GmbH
Schafhofstr. 35
90411 Nürnberg

Siemens AG
UB NK
Kistlerhofstr. 170
81379 München 70

3.1.2 Selecting the operating voltage cable

Several parameters must be taken into consideration when the operating voltages are connected. Further information can be found in the following chapters:

Chapter 3.4: Installation section “Connecting the power supply ”
- calculating the current consumption
- design of the power unit
- cable cross section and length (orientation values)

Appendix A.2: Cable length and cross-sectional area
- determining the cross-sectional area and length by means of tables
- calculating with a formula.

3.2 Field bus node

3.2.1 Opening and closing the node

Warning
Switch off the following before undertaking installation and/or maintenance work:

- the compressed air supply
- the operating voltage supply for the electronics (pin 1)
- the operating voltage supply for the outputs/valves (pin 2).

You can thereby avoid:

– sudden uncontrolled movements of loose tubing

– unexpected movements of the connected actuators

– non-defined switching states of the electronic components.

Please note
The node contains electrostatically sensitive components.

- Do not therefore touch any contacts.
- Please observe the regulations for handling electrostatically sensitive components.

You can thereby prevent the electronics of the node from being damaged.

The following connecting and display elements can be found on the cover of the node:

1 Green LED

2 Red LED

3 Plug for field bus cable

4 Fuse for the operating voltage of the inputs

5 Operating voltage connection

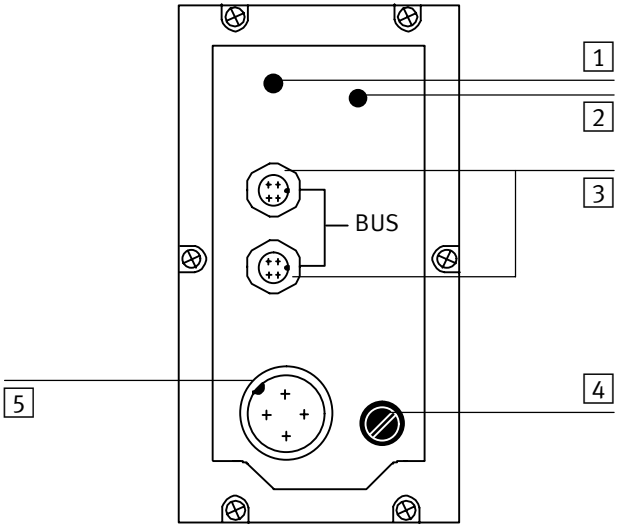


Fig. 3/1: Cover of the node

Please note
The cover is connected to the internal printed circuit boards by means of the cables for the power supply and cannot therefore be removed completely.

Opening
Unscrew and remove the 6 Philips screws in the cover. Carefully lift up the cover. Do not damage the cable as a result of mechanical stress.

Closing
Replace the cover. Push the cables for the operating voltage connection back into the housing, so that the cables are not squashed. Tighten the Philips screws of the cover in diagonally opposite sequence.

3.2.2 Configuring the valve terminal

There are four printed circuit boards in the node. There is an LED and two plugs for the field bus cables on board 2; on board 3 there is an LED and switches for setting the configuration.

1 Green LED

2 Red LED

3 Address selector switch (station no.)

4 DIL switches

5 Board 4

6 Board 3

7 Flat plug for the operating voltage connection

8 Board 2

9 Screening plate

10 Board 1

11 Plug for field bus cable

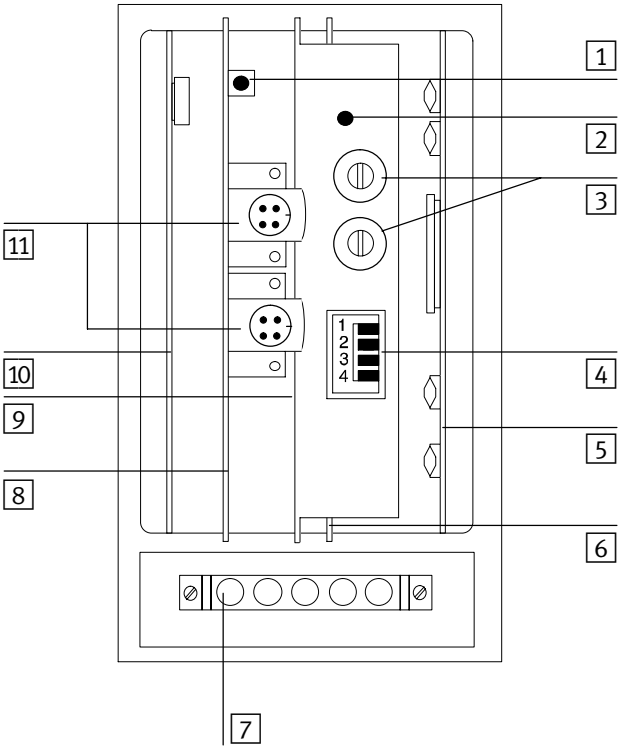


Fig. 3/2: Connecting, display and operating elements on the node

3.2.3 Setting the field bus address

You can set the field bus address of the valve terminal with the two address selector switches on board 3. The switches are numbered from 0...9. The arrow on the address selector switches shows the tens or units figure of the field bus address set.

1 Address selector switch for UNITS figure

2 Address selector switch for TENS figure

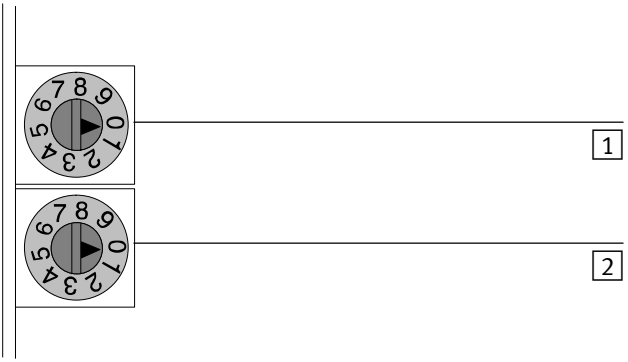


Fig. 3/3: Address selector switch

Please note
Field bus addresses may only be assigned once per field bus module.

Recommendation:
Assign the field bus addresses in ascending order. Assign the field bus addresses, if necessary, to suit the machine structure of your system.

Possible field bus addresses

PLC	Address designation	Addresses
Festo	Field bus address	1; 2; 3; ...; 99
ABB Procontic	CS31 module address	0; 1; 2; ...; 60*)
Klöckner-Moeller	-	1; ...; 99

*) also less, depending on the controller and the size of the valve terminal (see chapter 4.4)

Proceed as follows:

1. Switch off the operating voltage.
2. Assign an unused field bus address to the valve terminal.
3. Use a screwdriver to set the arrow of the relevant address selector switch to the tens or units figure of the desired field bus address.

Example

1 Setting with field bus address: 05

2 Setting with field bus address: 38

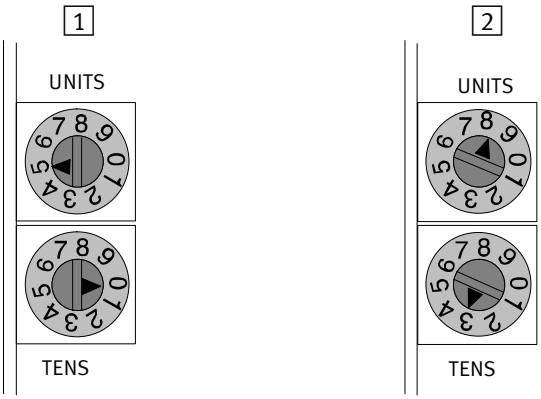


Fig. 3/4: Function of the address selector switch

Besides the address selector switch, there is a DIL switch in the node with which you can set the following functions:

– the field bus baud rate

– Field bus protocol.

The DIL switch consists of four switch elements. These switch elements are numbered from 1...4. The position ”ON” is marked.

1 Field bus baud rate

2 Field bus protocol

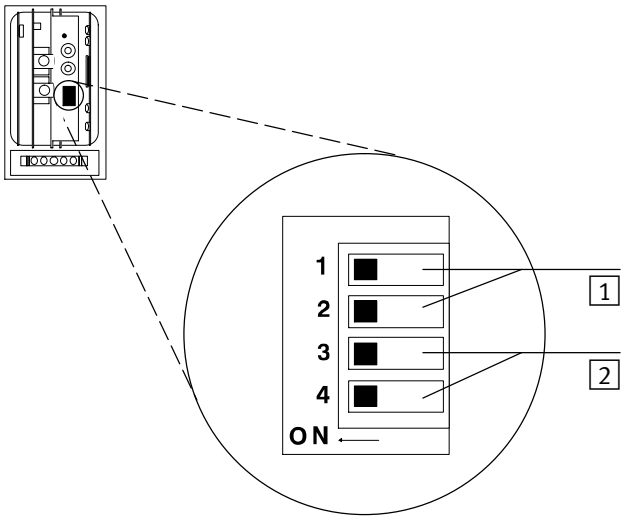


Fig. 3/5: Position of the DIL switch

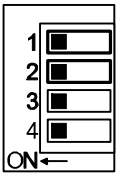
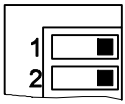
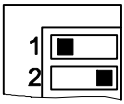
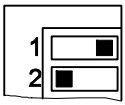
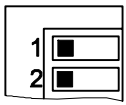
3.2.4 Setting the field bus baud rate

Please note

- Set the field bus baud rate of the valve terminal so that it corresponds to the setting of the field bus module (master) of the control system.

– Klöckner-Moeller controllers require the use of a baud rate of 187.5 kBaud or 375 kBaud. The baud rate setting is carried out automatically.

– ABB controllers (ABB CS31 and others) require the use of a baud rate of 187.5 kBaud.

DIL switches	Field bus baud rate [kBaud]			
	31,25	62,5	187,5	375
			 ABB Klöckner-Moeller*)	

*) The DIL switches must be set at baud rate 187.5, the field bus node then sets itself automatically to the baud rate set by the master.

Fig. 3/6: Setting the field bus baud rate

3.2.5 Setting the field bus protocol

The setting depends on the control system used.

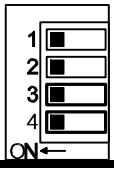
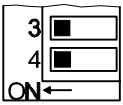
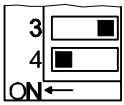
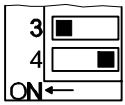
DIL switches	Control system		
	Festo	Klöckner-Moeller	ABB
			

Fig. 3/7: Setting the field bus protocol

3.3 Switching on the power supply

Warning

- Use only PELV **circuits** as per IEC/DIN EN 60204-1 (Protective Extra-Low Voltage, PELV) for the electrical supply. Consider also the general requirements for PELV circuits in accordance with IEC/DIN EN 60204-1.
- Use power **supplies** which guarantee reliable electrical isolation of the operating voltage as per IEC/DIN EN 60204-1.

By the use of PELV circuits, protection against electric shock (protection against direct and indirect contact) is guaranteed in accordance with IEC/EN 60204-1 (Electrical equipment for machines, General requirements).

Caution

The load voltage supply for the outputs/valves must be fused externally with maximum 10 A (slow blowing). With the external fuse you can avoid functional damage to the valve terminal in the event of a short circuit.

Before connecting the power supply, please note the following:

- Avoid long distances between the power unit and the valve terminal. If necessary, calculate the maximum permitted distance as described in Appendix A.
- The following apply as orientation values for your valve terminal.

Cross-sectional area of cable	**Distance**
1.5 mm^2 2.5 mm^2	$\leq$ 8 m $\leq$ 14 m
Current consumption (at V_B = 24 V): Operating voltage (pin 1) = 2.2 A Operating voltage (pin 2) = 10 A	

- If necessary, calculate the complete current consumption as shown in the table below and then select a suitable power unit and suitable cable cross-sectional area.

3.3.1 Calculating the current consumption

The table below shows you how to calculate the complete current consumption for the valve terminal. The values specified have been rounded up. If you wish to use other valves or modules, please refer to the relevant technical specifications for their current consumption.

Current consumption for electronics and inputs (Pin 1 on the node, 24 V ± 25 %)		
Node	0,200A	
Number of simultaneously assigned sensor inputs ____ x 0.010 A	+ Σ A	
Power supply for sensors (see manufacturer specifications) ____ x _____ A	+ Σ A	
Current consumption for electronics and inputs (pin 1 on the node) max. 2.2 A	= Σ A	A
Current consumption of valves and outputs (pin 2 on the node, 24 V ± 10 %)		
Number of valve coils (simultaneously actuated): Type 03: MIDI: ____ x 0.055 A MAXI: ____ x 0.100 A Type 04: MIDI: ____ x 0.140 A	Σ A	
Number of simultaneously actuated electric outputs: ____ x 0.010 A	+ Σ A	
Load current of simultaneously actuated electric outputs ____ x _____ A	+ Σ A	
Current consumption of outputs (Pin 2 on the node) max. 10 A	= Σ A	+ A
Current consumption on the node		= Σ A
Current consumption of high-current outputs*) (Pin 1 of additional supply*) 24 V/25 A)		
Number of high-current output modules fitted ____ x 0.100 A	Σ A	
Load current of simultaneously actuated high-current output modules ____ x _____ A	+ Σ A	
Current consumption of high-current outputs*) *) per additional supply module max. 25 A	= Σ A	Σ A

Fig. 3/8: Calculating the complete current consumption

3.3.2 Connecting the power supply

The following separate supplies of +24 V DC are provided via the power supply connection:

– the operating voltage for the internal electronics and the inputs of the input modules (pin 1: +24 V DC , tolerance ±25 %, external fuse M3.15 A recommended).

– the load voltage for valve outputs and outputs of the output modules (pin 2: +24 V DC , tolerance ±10 %, external fuse max. 10 A (slow blowing) required).

1 Power supply for type 03

2 Power supply for type 04B

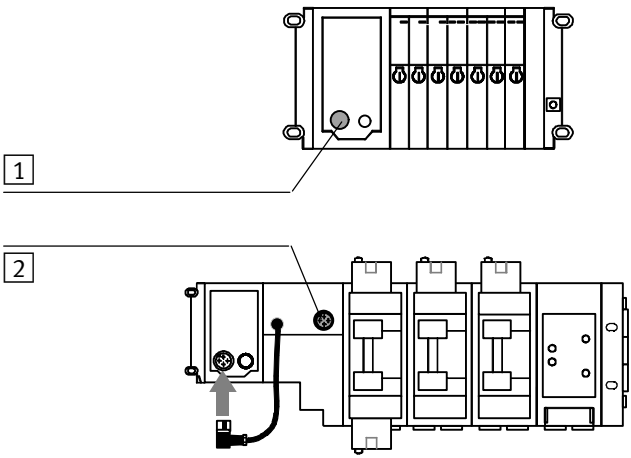


Fig. 3/9: Type-specific power supply connection

Please note
Check within the framework of your EMERGENCY STOP circuit, to ascertain which measures are required for putting your machine/system in a safe state in the event of an EMERGENCY STOP (e.g. switching off the load voltage for the valves and output modules, switching off the pressure).

The pin assignments of the power supply connection on the node (type 03) and on the adapter block (type 04-B) are identical.

1 24 V supply for electronics and inputs

2 24 V load voltage supply for valves and outputs

3 0 V

4 Earth connection

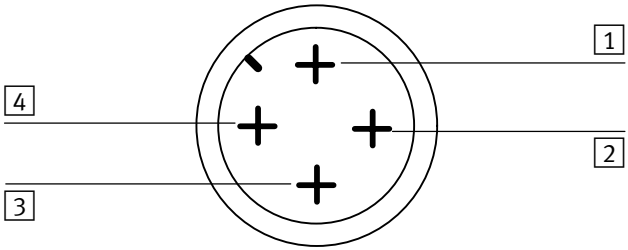


Fig. 3/10: Pin assignment of the power supply connection for types 03/04-B

Please note
Common operating and load voltage supplies for pin 1 (electronics and inputs) and pin 2 (outputs/valves):

- In this case, note that the lower tolerance of ±10 % for both current circuits must be observed.

Check the 24 V load voltage of the outputs while your system is operating. Make sure that the load voltage of the outputs lies within the permitted tolerance even during operation at full load.

Recommendation:
Use a closed-loop power unit.

Potential equalization

The valve terminal has two earth connections for potential equalization.

– on the load voltage connection (pin 4 incoming socket).

– on the left-hand end plate (M4 thread).

Please note

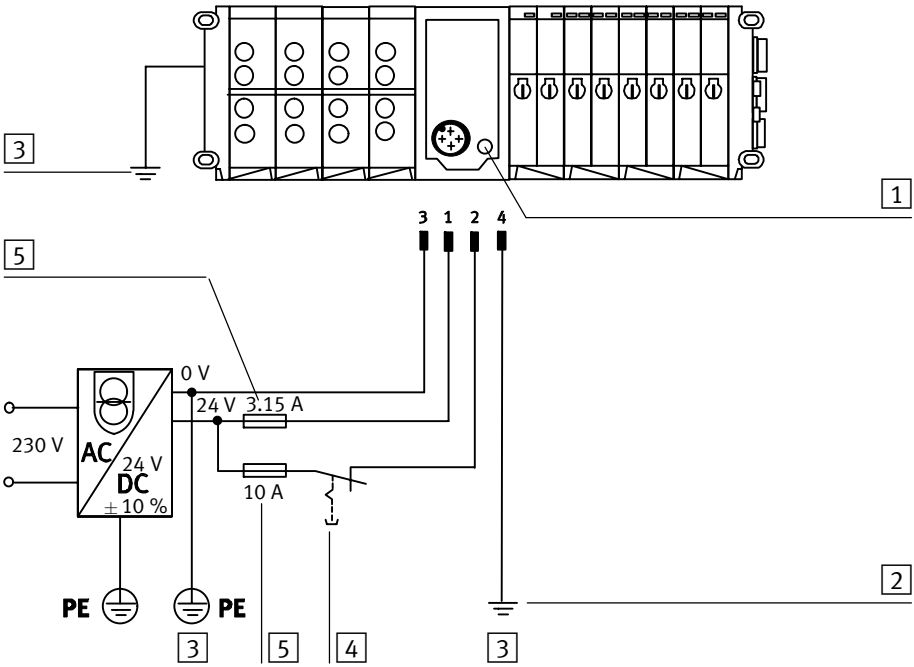
- Always connect the earth potential to pin 4 of the voltage connection.
- Connect the earth connection of the left-hand end plate to the earth potential with low impedance (short cable with large cross-sectional area).
- By means of low-impedance connections, you can be sure that the housing of the valve terminal and the earth connection at pin 4 have the same potential and that there are no equalizingcurrents.

You can thereby avoid interference due to electromagnetic influences and you can ensure electromagnetic compatibility in accordance with the EMC guidelines.

Example of connection

The diagram below shows as an example the connection of a common 24 V power supply for pin 1 and pin 2. Please note here that:

- the load voltage supply for the outputs/valves must be protected with an external fuse of maximum 10 A (slow blowing) against short circuit/overload.
- the power supply for the electronics and the inputs should be protected with an external fuse of 3.15 A against short circuit/overload (recommendation).
- the power supply for the sensors is also protected with the fuse fitted (2 A).
- the common tolerance of 24 V DC $\pm$ 10 % must be observed.
- both connections are connected for potential equalization and that equalizing currents are avoided.
- the load voltage at pin 2 (valves/electric outputs) can be switched off separately.



1 Fuse for sensor inputs (2 A)

2 Earth connection pin 4 designed for 12 A

3 Potential equalization

4 Load voltage can be switched off separately.

5 External fuses

Fig. 3/11: Example – connection of a common 24 V power supply and the potential equalization(example for type 03)

3.4 Connecting the field bus interface

There are two field bus plugs on the node for connecting the valve terminal to the field bus. One of these connections is intended for the incoming cable; the other is for the continuing bus cable. The signal cables of both plugs are connected with each other internally.

This permits two types of connections.

– looping the field bus cable from valve terminal to valve terminal. Both field bus plugs are required here.

– connecting the field bus cable with a T-adapter. Only one field bus plug is required here.

Caution
Branches (e.g. T-adapters) cause signal reflections with high baud rates. This can lead to “telegram faults” with brief “failure” of the valves.

Recommendation:

- Do not exceed the maximum permitted distance of 15 cm between the T-adapter and the field bus plug, in order to avoid signal reflections.
- Use the Festo T-adapter FB-TA for this purpose.

1 Incoming field bus

2 Continuing field bus

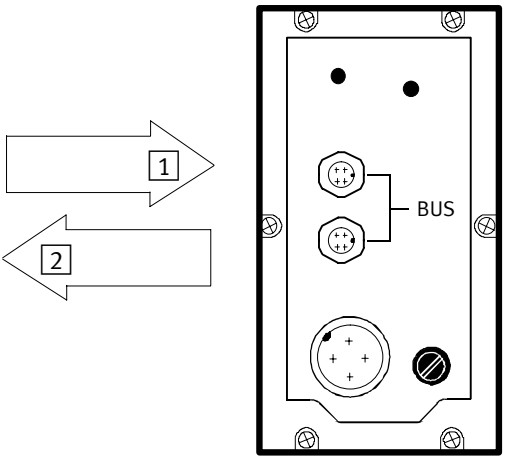


Fig. 3/12: Connection variant for the field bus (looping the field bus cable through)

1 Incoming field bus

2 T-adapter (e. g. Festo FB-adapter)

3 Continuing field bus

4 Branch line max. 15 cm

5 Seal with a protective cap (IP 65)

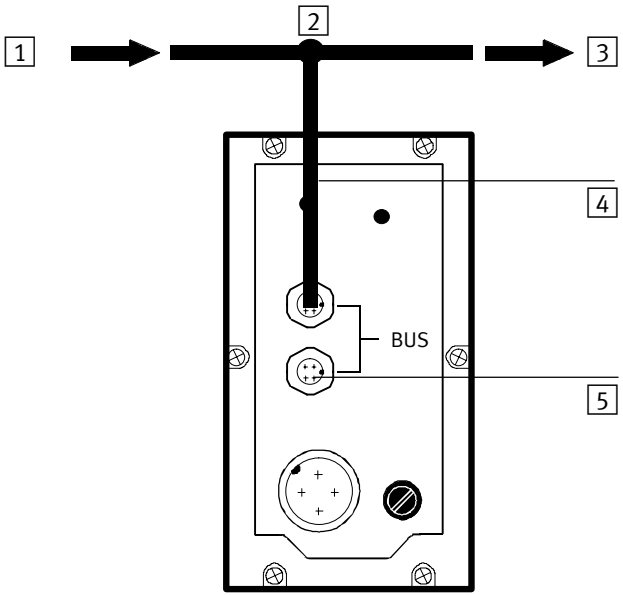


Fig. 3/13: Connection variant for the field bus (connecting with a T-adapter)

Caution
- Please observe the correct polarity before connecting the field bus interface.
- Connect the screening.

The diagram below shows the pin assignment of the field bus interface. Connect the field bus cables to the pins of the bus cable socket. Note also the connection instructions in further diagrams, as well as in the PLC manual for your controller.

1 Screening/shield

2 Internal network

3 Housing of node

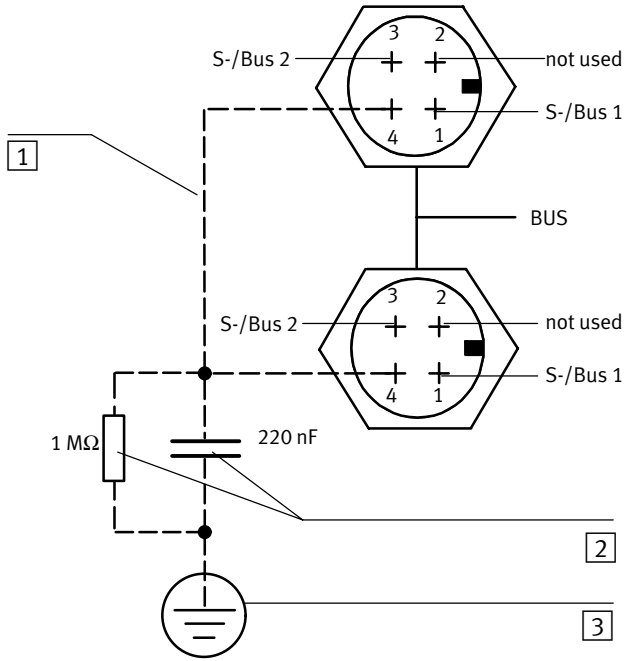


Fig. 3/14: Pin assignment of the field bus interface

3.4.1 Connection instructions for Festo and ABB

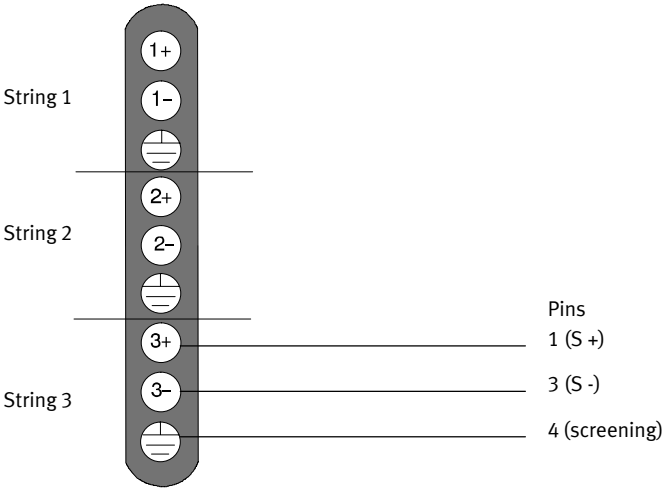
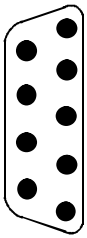
<table>
<tr><th>Manufacturer</th><th>Field bus module
Plug/pin assignment</th><th>Field bus cable</th><th>Valve terminal
Pin assignment of field bus interface</th></tr>
<tr><td>Festo</td><td colspan="3">Field bus module E.CFA
Festo field bus
 
</td></tr>
<tr><td>ABB
Procontic
CS31
T200</td><td colspan="3">The geometrical arrangement of the connecting pins for the central unit differs from that for the coupler. The designation of the pins is the same.
ABB Procontic
Pins
Bus 1 — 1 (S +)
Bus 2 — 3 (S -)
Screening/shield — 4 (screening)
Check the assignment in the PLC manual</td></tr>
</table>

Fig. 3/15: Connection instructions for Festo and ABB CS31

3.4.2 Connection instructions for Klöckner-Moeller

<table>
<tr><th>Manufacturer</th><th>Field bus module
Plug/pin assignment</th><th>Field bus cable</th><th>Valve terminal
Pin assignment of field bus interface</th></tr>
<tr><td>Klöckner-Moeller</td><td colspan="3">Serial bus interface SucoNet K1

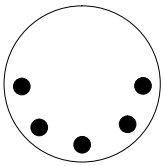
With 9-pin subminia-
ture D-plug
(DIN 41652/ISO 4902)

Pins Pins
3 ——— (T_A/R_A) ——— 1 (S +)
7 ——— (T_B/R_B ——— 3 (S -)
4 ——— 4 (screening)

Check the assignment in the PLC manual</td></tr>
<tr><td>Klöckner-Moeller</td><td colspan="3">Serial bus interface

With 5-pin
DIN plug (DIN 41512)

Pins Pins
4 ——— (T_A/R_A) ——— 1 (S +)
1 ——— (T_B/R_B ——— 3 (S -)
Housing ——— 4 (screening)

Check the assignment in the PLC manual</td></tr>
</table>

Fig. 3/16: Connection instructions for Klöckner-Moeller

3.4.3 Terminating resistor

If the valve terminal to be connected is at the end of a field bus string, a terminating resistor (120 Ohm, 0.25 Watt) must be fitted in the socket of the incoming field bus cable (adaption necessary). The unused field bus plug must be sealed with a protective cap (protection class IP 65).

Proceed as follows (see diagram below).

1. Crimp the wires of the resistor together with those of the incoming field bus cable between the cores S+ (pin 1) and S- (pin 3) of the bus cable socket.

   In order to guarantee reliable contact, we recommend that you crimp together the wires of the resistor and those of the incoming field bus cable in common end sleeves.

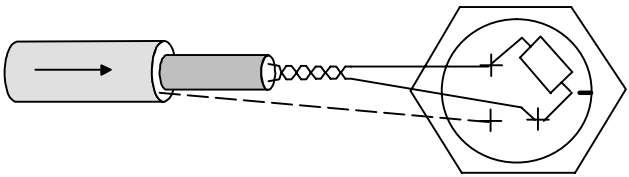


Fig. 3/17: Fitting the terminating resistor

2. Fit the bus cable socket onto one of the field bus plugs.
3. Seal the unused field bus plug with a protective cap.

Commissioning

Chapter 4

Contents

4.1 Addressing and configuring the valve terminal

4.1.1 Ascertaining the configuration data

Before configuring, ascertain the exact number of available inputs/outputs. A multifunctional valve terminal consists of a varying number of I/Os, depending on what you have ordered.

Please note

- The status bits must be treated like inputs and occupy four additional input addresses.
- The maximum possible extension of the valve terminal is limited by the addressing limits of the relevant field bus protocol and the mechanical limits of the valve terminal.
- Type 04-B
  With this valve terminal, the assignment of the valve addresses can be set fixed by means of a DIL switch in the adapter block. This manual valve terminal configuration (“Address reserving”) is described in the Appendix of the Pneumatics manual for type 04-B.

The table below shows the number of I/Os required per module for configuration.

Type of module	**Number of I/Os assigned*)**
MIDI/MAXI manifold (type 03)	
– Single solenoid sub-base	2A
– Double solenoid sub-base	4A
ISO manifold (type 04-B)	
– Single solenoid sub-base	1A
– Double solenoid sub-base	2A
4-output module (4 digital outputs)	4A
4-input module (4 digital inputs)	4E
8-input module (8 digital inputs)	8E
16-input module (16 digital inputs)	16E
Multi I/O module	
Status bits**)	12E + 8A
	4E

*) The I/Os are assigned automatically within the valve terminal, irrespective of whether an input/output is actually used.
**) The status bits are assigned automatically within the terminal, as soon as there are input modules.

Fig. 4/1: Number of assigned I/Os per module

Copy the following table for further calculations.

Calculating the number of inputs/outputs

Inputs		
1. Number of 4-input modules	_____ x 4	Σ E
2. Number of 8-input modules	_____ x 8	+ Σ E
3. Number of 16-input modules	_____ x 16	+ Σ E
4. Number of other inputs, e. g. multi I/O module		+ Σ E
5. The 4 status bits are assigned internally automatically by the valve terminal.		+ 4 E
Total number of inputs to be configured		= Σ E

Outputs		
6. Number of single-solenoid sub-bases MIDI/MAXI	_____ x 2	Σ A
7. Number of double-solenoid sub-bases MIDI/MAXI	_____ x 4	+ Σ A
8. Number of type 04-B single-solenoid sub-bases*)	_____ x 1	+ Σ A
9. Number of type 04-B double-solenoid sub-bases*)	_____ x 2	+ Σ A
*) Note the possible address reservations with type 04-B		
Intermediate sum 6. – 9.		= Σ A
10. Check to see if the sum of 6. – 9. is divisible by four without remainder. This check is necessary because of the 4-bit-orientated internal addressing of the terminal. The following distinction is made: a) if divisible by four without remainder: continue with point 11. b) If not: round up to the next half byte (+1...3).		+ 2 A
11. Number of 4-output electric modules	_____ x 4	+ Σ A
12. Number of other outputs, e. g. multi I/O module		+ Σ A
Total number of outputs to be configured		= Σ A

4.1.2 Address assignment of the valve terminal

The address assignment of the outputs of a multifunctional valve terminal depends on the equipment fitted on the valve terminal. A distinction is made between the following equipment fitted:

– valves and digital I/O modules.

– only valves.

– only digital I/O modules.

The basic rules described below apply to the address assignment of these fitting variants. A detailed example is given after each of these basic rules.

Please note
If two addresses are assigned for one valve location, the following assignment applies:
– lower-value address: pilot solenoid 14
– higher-value address: pilot solenoid 12

Information on reserving addresses of the valves on the type 04-B valve terminal can be found in the Pneumatics manual for type 04-B.

Basic rules of addressing

With mixed fitting, the address assignment of the valves, digital I/O modules and status bits is taken into account.

Outputs

1. The address assignment of the outputs does not depend on the inputs.

2. Address assignment of the valves:
   - Assign the addresses in ascending order without gaps.
   - Counting begins on the node from **left to right**.
   - Maximum 26 valve solenoid coils can be addressed.

   Type 03:
   - Single-solenoid sub-bases always occupy 2 addresses
   - Double-solenoid sub-bases always occupy 4 addresses

   Type 04-B
   - Single-solenoid sub-bases always occupy 1 address
   - Double-solenoid sub-bases always occupy 2 addresses

3. Round up to 4 bits: The following distinction is made:
   a) If the number of valve addresses can be divided by 4 without remainder, continue with point 4.
   b) If the number of valve addresses cannot be divided by 4 without remainder, you must round up to 4 bits because of the 4-bit orientated addressing. The bits thus rounded up in the address range cannot be used.

4. Address assignment of the output modules:
   After the (4-bit rounded) addresses of the valves the digital outputs must be addressed.
   – Assign the addresses in ascending order without gaps.
   – Counting begins on the node from **right to left**.
   – Counting on the individual modules is made from the top to the bottom.
   – Digital output modules occupy 4 or 8 addresses.

Inputs

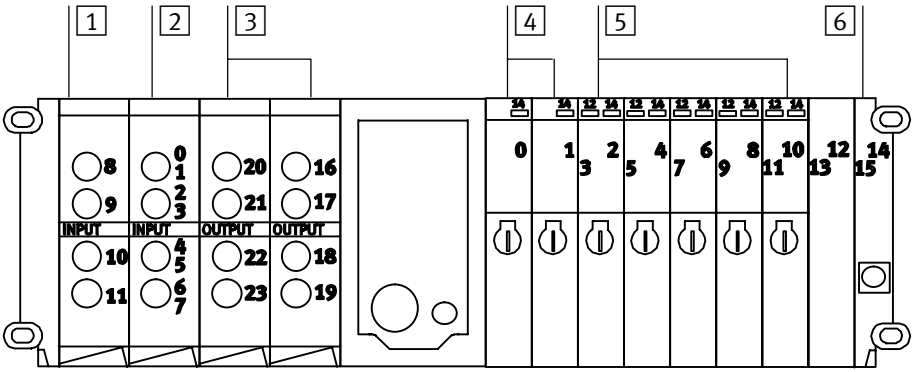
1. The address assignment of the inputs does not depend on the outputs.

2. Address assignment of the input modules:
   – Assign the addresses in ascending order without gaps.
   – Counting begins on the node from right to left.
   – On the individual modules from the top to the bottom.
   – Input modules occupy 4, 8, 12 or 16 addresses.

3. Status bits:
   The address assignment of the status bits depends on the fitting variants of the inputs and the configuration.

   The following always applies:
   – The status bits are only available if input modules are connected to the valve terminal and are configured
   – Addressing
     The status bits are transmitted to the four highest-value positions of the configured address range.

When the power supply is switched on, the valve terminal automatically recognizes all available pneumatic modules and digital input/output modules and assigns the appropriate addresses. If a valve location is not used (cover plate) or if an input/output is not connected, the relevant address will still be assigned. The diagram below shows the address assignment as an example.



1	4-input module	4	Single sub-base
2	8-input module	5	Double sub-base
3	4-output module	6	Round up

Fig. 4/2: Address assignment of a valve terminal with digital I/Os (example type 03)

Remarks on the diagram

- If single-solenoid valves are fitted onto double-solenoid sub-bases of valve terminal type 03 (MIDI/MAXI), four addresses will be reserved for valve solenoid coils; the higher address in each case will then remain unused (see address 3 or Fig. 4/1).
- if unused valve locations are fitted with cover plates, the addresses will still be assigned (see addresses 12, 13).

– Due to the 4-bit orientated addressing of the modular valve terminal, rounding up to the full four bits is always made on the last valve location (if the fitting does not already use the full four bits). This means that two addresses cannot perhaps be used (see addresses 14, 15).

Additional notes on valve terminals without I/O modules

If only valves are used, the address assignment will always be as described in the section “Basic rules for addressing”.

Please note
– Maximum 26 valve solenoid coils can be addressed.
– The last two locations on the valve side are not rounded up.
– Valve terminals without input modules do not require a configuration for the inputs. The status bits are not therefore available.

Additional instructions for valve terminals without valves

If only electric I/Os are used, the address assignment will always be as described in the section “Basic rules for addressing”.

Please note
– Counting begins immediately to the left of the node.
– The last two locations on the valve side are not rounded up.
– The maximum possible amount of equipment which can be fitted on the valve terminal is limited by the addressing limits of the relevant field bus protocol and the mechanical limits of the valve terminal (max. 96 inputs or 48 outputs).

4.1.3 Address assignment after extension/conversion

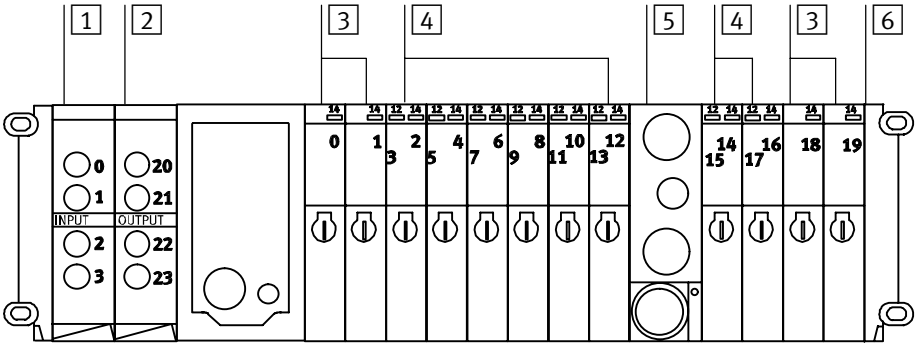
A special feature of the multifunctional valve terminal is its flexibility. If the demands made to the machine change, the equipment fitted on the valve terminal can also be changed.

Caution
If the valve terminal is extended or converted at a later stage, the input/output addresses may be shifted. This applies in the following cases:

- when one or several pneumatic sub-bases are added or removed at a later stage (types 03/04-B).
- Type 03: when a pneumatic sub-base for two single-solenoid valves is replaced by a sub-base for two double-solenoid valves or vice versa.
- Type 04-B when a pneumatic sub-base for one single-solenoid valve is replaced by a sub-base for a double-solenoid valve or vice versa.
- when additional input/output modules are added between the node and the existing input/output modules.
- when existing input/output modules are removed or replaced by input/output modules which occupy fewer or more input/output addresses.

If the configuration of the inputs is modified, the addresses of the status bits may be shifted.

The diagram below shows, as an example, the modifications which occur to the address assignment when more equipment is added to the standard fitting of the previous diagram. 2 double-solenoid and 2 single-solenoid sub-bases have been added to the valve side. An 8-input module and a 4-output module have been removed from the electric I/Os.



1 4-input module

2 4-output module

3 Single sub-base

4 Double sub-base

5 Power supply

6 No rounding

Fig. 4/3: Address assignment of a valve terminal with digital I/Os after extension (example type 03)

Remarks on the diagram
Pressure supply modules and intermediate pressure supply modules do not occupy any addresses.

4.2 General commissioning instructions

Before commissioning or programming, please compile a configuration list of all the connected field bus slaves. On the basis of this list you can:

– carry out a comparison between the NOMINAL and the ACTUAL configurations in order to recognize connection faults

– access these specifications during the syntax check of a program in order to avoid addressing errors .

The configuration of the valve terminal requires an accurate procedure, as in certain circumstances different configuration specifications are required for each valve terminal on account of the modular structure. Please observe the instructions for this procedure in the following sections.

4.2.1 Switching on the power supply

Please note
Please observe also the instructions in the manual for your controller.

When the controller is switched on, it automatically carries out a comparison between the NOMINAL and the ACTUAL configurations. For this configuration run it is important that:

– the specifications for configuration are complete and correct.

– the power supplies for the PLC and the field bus slaves are switched on either simultaneously or in the sequence specified below.

Please note the following points when switching on the power supply:

– Common supply: If there is a common power supply for the control system and all the field bus slaves, the power should be switched on via a central power unit or switch.

– Separate supply: If the control system and the field bus slaves have separate power supplies, the power should be switched on in the following sequence:

1. the power supply for all the field bus slaves

2. the power supply for the controller.

4.3 Commissioning the Festo field bus

4.3.1 Configuration

The field bus configurator in the FST software will help you in creating the NOMINAL configuration. The menu control and operation of the FST software is described in the appropriate FST manual for your controller.

Configure your system as follows:

– Enter the field bus address of the field bus slave (valve terminal).

– Enter the string number (only FPC 405).

– Select and enter the type of the valve terminal from the field bus type file (“valve terminal 03” for types 03/04-B).

– Enter the calculated inputs/outputs byte-by-byte under IW and OW. The number of IWs may differ from the number of OWs.

Please note
The entry mask of the field bus configurator shows the IWs and OWs on the screen. This stands for input words and output words, therefore 16 bits each. If you select a type 03 valve terminal from the type file, the software will interpret all I/O entries as bytes, therefore 8 bits each. Optimum byte-by-byte configuration of the modular valve terminal is therefore possible.

Example
48 inputs ⇒ 6 IW (48 bits)
20 outputs ⇒ 3 OW (24 bits)

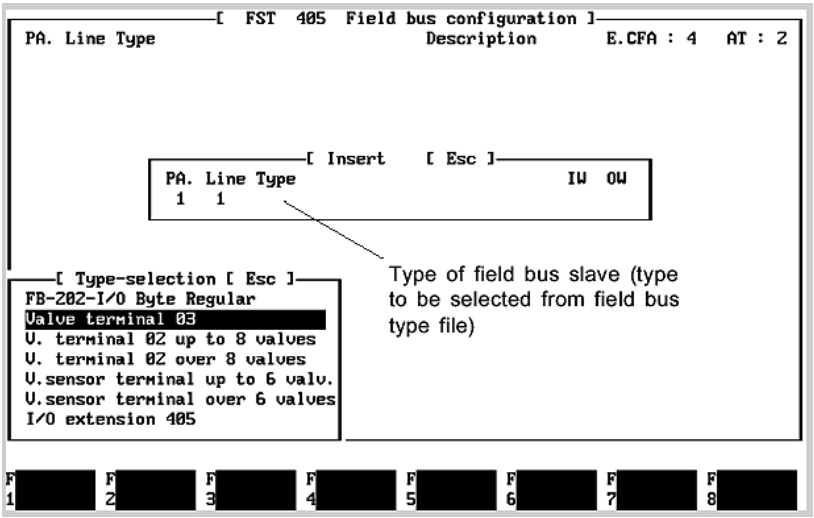


Fig. 4/4: Example Configure with FST 405, select the valve terminal from the type file

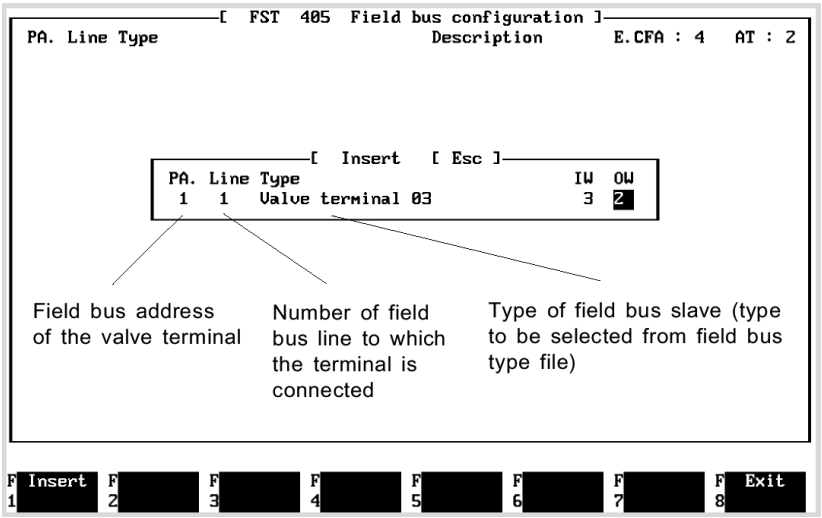


Fig. 4/5: Example Configure with FST 405, different number of IW/OW

4.3.2 Addressing

Inputs/outputs

Please note
The addressing of valve terminal type 03 is carried out byte-by-byte. Note the differences from the word-by-word addressing of other field bus slaves.

The diagram below shows the addressing of the inputs/outputs using the standard fittings as an example (master: SF-202, field bus address of the valve terminal: 3).

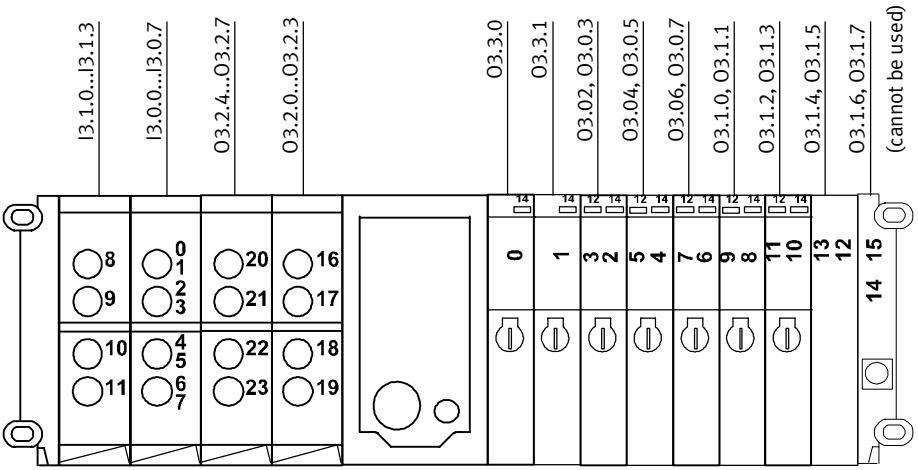


Fig. 4/6: Addressing the valve terminal with standard fittings

Addressing the status bits

The status bits always occupy the four highest-value addresses of the configured address range. If the inputs of the input addresses thereunder are not used, the valve terminal will set them to “logical zero”. The following diagram shows the addresses of the status bits in the address range of a valve terminal, depending on the configuration.

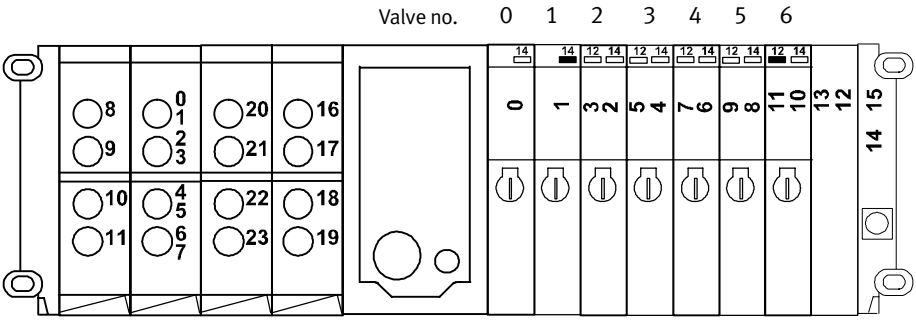
Configured inputs	**Available address range**	**Addresses of the status bits**
0EW	No address range for inputs	No status bits available
1EW	0...7	4, 5, 6, 7
2EW	0...15	12, 13, 14, 15
3EW	0...23	20, 21, 22, 23
4EW	0...31	28, 29, 30, 31
5EW	0...39	36, 37, 38, 39
6EW	0...47	44, 45, 46, 47
7EW	0...55	52, 53, 54, 55
8EW	0...63	60, 61, 62, 63

Fig. 4/7: The addresses of the status bits depend on the configuration

Example

Configuration
FPC405 system with:
processor system address E.CFA: 4
Field bus address of the valve terminal 16

With mixed fittings as shown in the diagram below, outputs 1, 11 and 20 are to be set and inputs 0, 10 are to be loaded.




```
Program extract


IF              E416.0.0   “input 0       (1st. input module, input 0)
       AND      E416.1.2   “input 10      (2nd. input module, input 2)
THEN   SET      A416.0.1   “output 1      (valve 1, upper coil)
       SET      A416.1.3   “output 11     (valve 6, lower coil)
       SET      A416.2.4   “output 10     (2nd. output module, output
0)
```

Fig. 4/8: Example Addressing the inputs/outputs

Further details on addressing and programming can be found in the PLC manual for your controller (e.g. Festo system manual FPC 405, chapter 7).

4.4 Commissioning the ABB CS31

4.4.1 General information

A valve terminal can be fitted with different numbers of inputs and outputs. This results in the number of bits. See also chapter “Basic principles of configuration and addressing”.

The addressing of the valve terminal is based in every case on the specifications for the CS31 system bus. The following applies for the valve terminal:
Every 16 bits require a CS31 bus address. A group of 16 which has been started also requires a full CS31 bus address.

The following applies if the CS31 system bus is connected to an ABB Protonic T200.

– The address designation of the inputs/outputs is different from that of a CS31 central unit.

– The appropriate module identifiers must be entered in the configuration table of the T200.

Please note
Select if possible the range n = 0...58 for the address to be set in the field bus node. n+3 ≤ 61 can also be addressed here.

If there are inputs on the valve terminal, 4 additional status bits will be reserved for diagnostic messages. The status bits always lie at the upper end of the highest group of 16.

Example
Valve terminal with 60 + 4 inputs on the CS31 system bus, set address 20, CS31 central unit:
Status bits I 23,12; I 23,13; I 23,14 and I 23,15.

The limits of the valve terminal are:

– max. 60 inputs and max. 64 outputs,

– max. 26 valve locations
(rounded up to groups of 4, these occupy 28 output signals)

– only valve terminal type 05 (ISO):
max. 12 valve coils may be switched on at the same time.

4.4.2 CS31 central unit as bus master

Summary of addresses

Valve terminal		Signal designations when a CS 31 central unit is used	
Inputs max.	**Outputs max.**	**Inputs**	**Outputs**
	16		O n,00 ... O n,15
	32		O n,00 ... O n,15 O n+1,00 ... O n+1,15
	48		O n,00 ... O n,15 O n+1,00 ... O n+1,15 O n+2,00 ... O n+2,15
	64		O n,00 ... O n,15 O n+1,00 ... O n+1,15 O n+2,00 ... O n+2,15 O n+3,00 ... O n+3,15
12 + 4		I n,00 ... I n,15	
28 + 4		I n,00 ... I n,15 I n+1,00 ... I n+1,15	
44 + 4		I n,00 ... I n,15 I n+1,00 ... I n+1,15 I n+2,00 ... I n+2,15	
60 + 4		I n,00 ... I n,15 I n+1,00 ... I n+1,15 I n+2,00 ... I n+2,15 I n+3,00 ... I n+3,15	
12 + 4	16	I n,00 ... I n,15	O n,00 ... O n,15
28 + 4	32	I n,00 ... I n,15 I n+1,00 ... I n+1,15	O n,00 ... O n,15 O n+1,00 ... O n+1,15
44 + 4	48	I n,00 ... I n,15 I n+1,00 ... I n+1,15 I n+2,00 ... I n+2,15	O n,00 ... O n,15 O n+1,00 ... O n+1,15 O n+2,00 ... O n+2,15
60 + 4	64	I n,00 ... I n,15 I n+1,00 ... I n+1,15 I n+2,00 ... I n+2,15 I n+3,00 ... I n+3,15	O n,00 ... O n,15 O n+1,00 ... O n+1,15 O n+2,00 ... O n+2,15 O n+3,00 ... O n+3,15

Fig. 4/9: Configuration possibilities and addresses for a CS31 central unit

The CS31 central unit ascertains the configuration of the CS31 system bus when it is switched on and does not require any settings for this.

Please note
With system flag KW 00,09, program processing can be stopped until the specified number of I/O modules (incl. valve terminals) exists on the CS31 system bus.

Example of addressing with the CS31 central unit

Address 20 is set in the field bus node. The valve terminal occupies 2 CS31 bus addresses (28 + 4 input signals and 32 output signals).

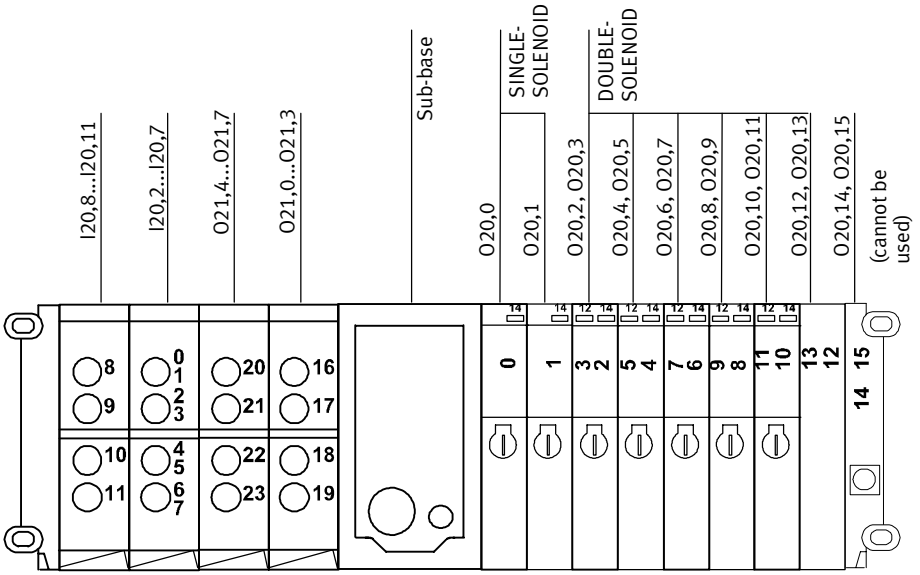


Fig. 4/10: Example Addressing with a CS31 central unit

4.4.3 T200 / 07CS61 as bus master

The T200 station offers the possibility of connecting 4 CS31 system busses. The coupler 07CS61 plugged in nearest to the T200 central unit has line no. 1, the next following have line numbers 2, 3 and 4.
The signal designation I1.20,05 means: line 1, address in the field bus node 20, input 05.

The max. scope of data for each line is 1024 bits, whereby the unused bits are also included.

In the example shown below with 12 + 4 inputs and 24 outputs a total of 64 bits are assigned.

When the program is created, the central unit must be informed how the lines are configured. With the 07 PC 332 programming system, enter here the appropriate module identifiers in the configuration table (see examples).

Examples Module identifiers

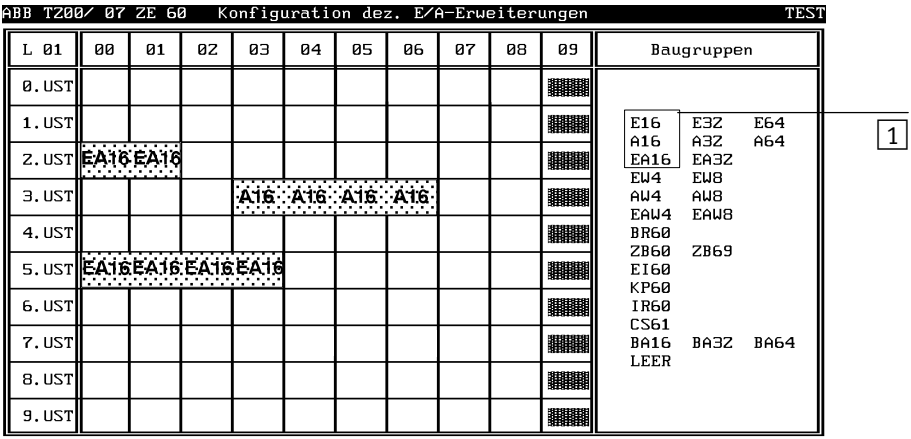
The configuration list shown applies to line 1.

Valve terminals entered:

– Address in the field bus node: 20
  28 + 4 inputs, 32 outputs
  The status bits are: I 21,12...I 21,15

– Address in the field bus node: 33
  64 outputs, this valve terminal does not supply any status bits

– Address in the field bus node: 50
  60 + 4 inputs, 64 outputs
  The status bits are: I 53.12...I 53.15



[1] Permitted configuration identifiers for Festo valve terminals

Fig. 4/11: Example Module identifiers

Remark:
Other identifiers could also be entered for the same signal numbers. However, this will result in completely different signal addresses.

4.4.4 T200 / 07CS61 as bus master

Summary of addresses

Valve terminal		T200 module identifier	Signal designations when a T200/07CS61 central unit is used	
Inputs max.	Outputs max.		Inputs	Outputs
	16	O 16		O l.n,00 ...O l.n,15
	32	O 16 O 16		O l.n,00 ...O l.n,15 O l.n+1,00 ...O l.n+1,15
	48	O 16 O 16 O 16		O l.n,00 ...O l.n,15 O l.n+1,00 ...O l.n+1,15 O l.n+2,00 ...O l.n+2,15
	64	O 16 O 16 O 16 O 16		O l.n,00 ...O l.n,15 O l.n+1,00 ...O l.n+1,15 O l.n+2,00 ...O l.n+2,15 O l.n+3,00 ...O l.n+3,15
12 + 4		I 16	I l.n,00 ...I l.n,15	
28 + 4		I 16 I 16	I l.n,00 ...I l.n,15 I l.n+1,00 ...I l.n+1,15	
44 + 4		I 16 I 16 I 16	I l.n,00 ...I l.n,15 I l.n+1,00 ...I l.n+1,15 I l.n+2,00 ...I l.n+2,15	
60 + 4		I 16 I 16 I 16 I 16	I l.n,00 ...I l.n,15 I l.n+1,00 ...I l.n+1,15 I l.n+2,00 ...I l.n+2,15 I l.n+3,00 ...I l.n+3,15	
12 + 4		IO 16	I l.n,00 ...I l.n,15	O l.n,16 ...O l.n,15
28 + 4		IO 16 IO 16	I l.n,00 ...I l.n,15 I l.n+1,00 ...I l.n+1,15	O l.n,16 ...O l.n,15 O l.n+1,16 ...O l.n+1,15
44 + 4		IO 16 IO 16 IO 16	I l.n,00 ...I l.n,15 I l.n+1,00 ...I l.n+1,15 I l.n+2,00 ...I l.n+2,15	O l.n,16 ...O l.n,31 O l.n+1,16 ...O l.n+1,31 O l.n+2,16 ...O l.n+2,31
60 + 4		IO 16 IO 16 IO 16 IO 16	I l.n,00 ...I l.n,15 I l.n+1,00 ...I l.n+1,15 I l.n+2,00 ...I l.n+2,15 I l.n+3,00 ...I l.n+3,15	O l.n,16 ...O l.n,31 O l.n+1,16 ...O l.n+1,31 O l.n+2,16 ...O l.n+2,31 O l.n+3,16 ...O l.n+3,31
Explanation l = line, n = set address				

Fig. 4/12: Possibilities of configuration and addresses with T200 as CS31 bus master

Example of addressing with T200/07CS61 as central unit (line 1):

– Address 20 is set in the field bus node.

– The valve terminal occupies 2 CS31 bus addresses (28 + 4 input signals and 32 output signals).

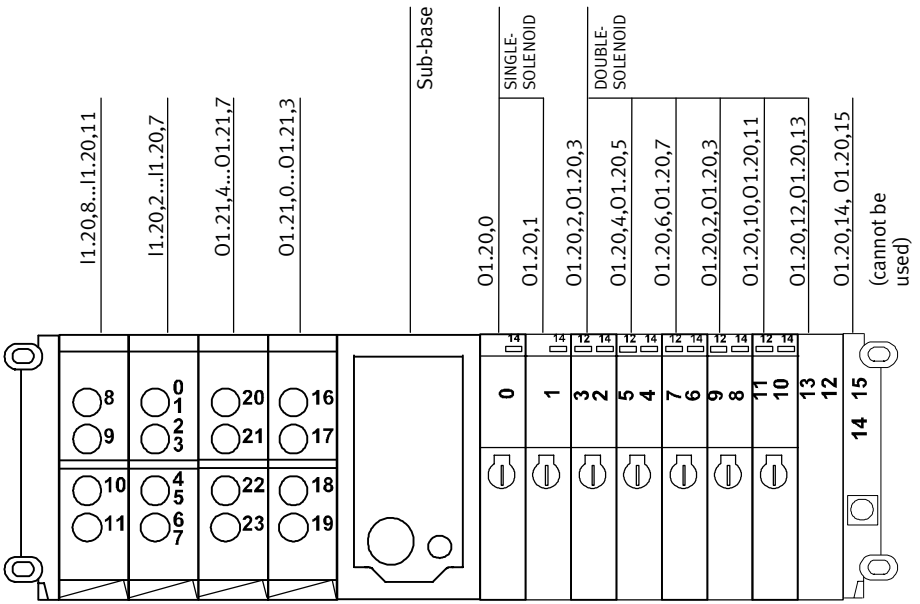


Fig. 4/13: Example Addressing with T200/07CS61 as central unit

4.4.5 Transmission times

Festo valve terminals react on the ABB-CS31 bus like a local module. The total transmission time is calculated from the CS31 basic transmission time (1.5 ms) and the transmission time of the individual local modules (ABB-CS31 local modules 323...1355 µs depending on scope of data, Festo valve terminals see table).

Valve terminal		Transmission time on the CS31 bus
Inputs max.	**Outputs max.**	
0	16	452 µs
0	32	582 µs
0	48	620 µs
0	64	712 µs
12 + 4	0	452 µs
28 + 4	0	582 µs
44 + 4	0	620 µs
60 + 4	0	712 µs
12 + 4	16	516 µs
28 + 4	32	772 µs
44 + 4	48	1000 µs
60 + 4	64	1284 µs

Fig. 4/14: Transmission times of the valve terminal

4.5 Commissioning Klöckner-Moeller

4.5.1 Configuration

If you are using the modular valve terminal in the SUCOnet K, please observe the following:

– The valve terminal may have maximum 60 inputs and 64 outputs.

– Use the following types of modules:
  - valve terminal with up to 28 inputs/32 outputs
    SIS-K-06/07
  - valve terminal with up to 60 inputs/64 outputs
    SIS-K-10/10

The following diagram shows the configuration entries for a valve terminal, using as an example a PS4-201 as master.

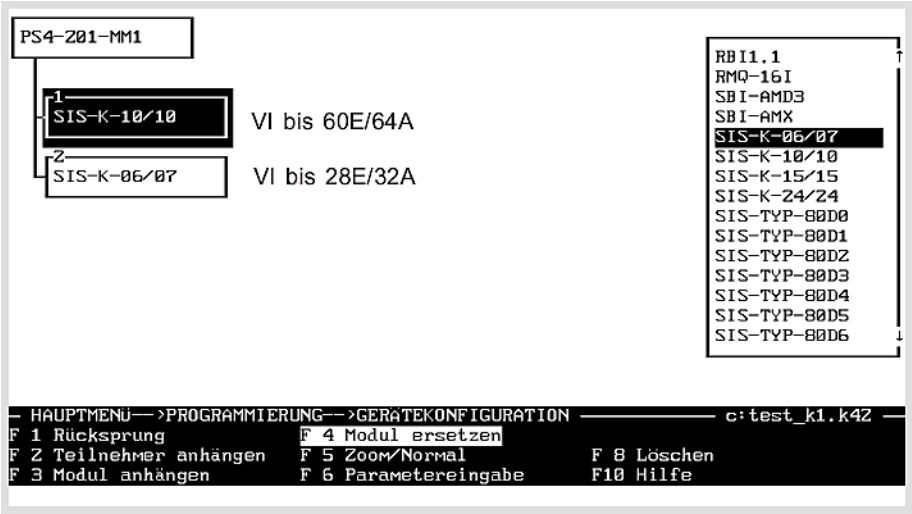


Fig. 4/15: Configuration on the SUCOnet K1

4.5.2 Addressing Klöckner-Moeller

Inputs/outputs

When addressing the inputs/outputs of a valve terminal, please observe the following:

The slave number or the number of the unit differs from the set station number by -1.

Example

Set field bus address of the valve terminal	Number of the unit or slave number
2	1
3	2
4	3
.	.
.	.

Fig. 4/16: Assignment of units

Status bits

Please note
The four status bits of the valve terminal are only available if there are electric input modules.

The status bits always occupy the **four highest-value addresses of the 4th. or 8th. input byte** (depending on equipment fitted). If the inputs of the addresses thereunder are not used, the valve terminal will set them to "logical zero". The following diagram shows the addresses of the status bits in the address range of a valve terminal, depending on the equipment fitted.

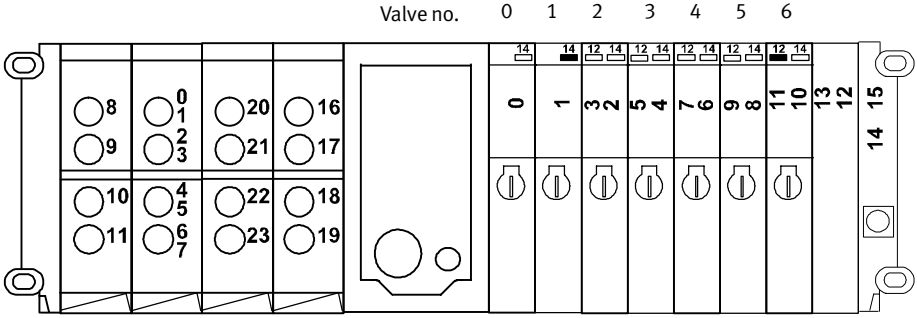
Module type	Number of inputs	Number of status bits
None	No address range for inputs	No status bits available
SIS-K-06/07	up to 28	28, 29, 30, 31
SIS-K-10/10	up to 60	60, 61, 62, 63

Fig. 4/17: Addresses of the status bits depending on the equipment fitted

Example

With mixed fittings as shown in the diagram below, outputs 1, 11 and 20 are to be set and inputs 0, 10 are to be loaded.

Configuration
Master: PS4-201
Field bus address 2 (= unit 1)




```
Program extract

156     L RD1.1.0.0.0      (input 0:      1st. input module, input 0)
157     A RD1.1.0.1.2      (input 10:     2nd. input module, input 2)
158     S SD1.1.0.0.1      (output 1      valve 1, upper coil)
159     S SD1.1.0.1.3      (output 11     valve 6, lower coil)
160     S SD1.1.0.2.4      (output 20:    couple flag for
                                          2nd. output module, output 0)
```

Fig. 4/18: Example Addressing the inputs/outputs with PS 4-201

Diagnosis and error treatment

Chapter 5

Contents

5.1 Summary of diagnostic possibilities

The modular valve terminal offers extensive and user-friendly possibilities of diagnosis and error treatment. The following possibilities are available depending on the fittings on the valve terminal.

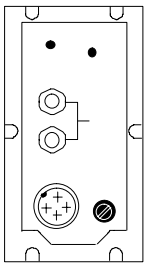
<table>
<tr><td></td><td colspan="3">Valve terminal with inputs</td></tr>
<tr><td></td><td></td><td colspan="2">Valve terminal without inputs</td></tr>
<tr><td>Diagnostic possibilities</td><td>Status bits
<table><tr><th>Bit 2^7</th><th>Bit 2^6</th><th>Bit 2^5</th><th>Bit 2^4</th></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>X</td><td>0</td><td>1</td><td>X</td></tr><tr><td>X</td><td>1</td><td>0</td><td>X</td></tr><tr><td>X</td><td>1</td><td>1</td><td>X</td></tr><tr><td>1</td><td>X</td><td>X</td><td>X</td></tr></table>X = not relevant</td><td>LEDs
  </td><td>Diagnostic byte
<table><tr><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr><tr><td>None</td><td>V_{out}</td><td>V_{val}</td><td>V_{sen}</td><td>None</td><td>sc/o</td><td>None</td><td>Cycle p.no.</td></tr></table></td></tr>
<tr><td>Brief description</td><td>The four status bits are transmitted to the module cyclically as “inputs” together with the normal inputs.</td><td>The LEDs show directly configuration errors, hardware errors, bus errors, etc.</td><td>The diagnostic byte must be read out and evaluated user-program controlled.</td></tr>
<tr><td>Advantages</td><td>fast access to error messages, irrespective of the module and the master</td><td>fast “on-the-spot” error recognition</td><td>Detailed error recognition, depending on the field bus protocol</td></tr>
<tr><td>Detailed description</td><td>chapter 5.3</td><td>chapter 5.2</td><td>chapter 5.4</td></tr>
</table>

Fig. 5/1: Possibilities of diagnosis and error treatment

5.2 On-the-spot diagnosis

5.2.1 LEDs on the bus node

The LEDs on the cover of the node indicate the operating status of the valve terminal.

1 Green LED (operating status display)

2 Red LED (error display)

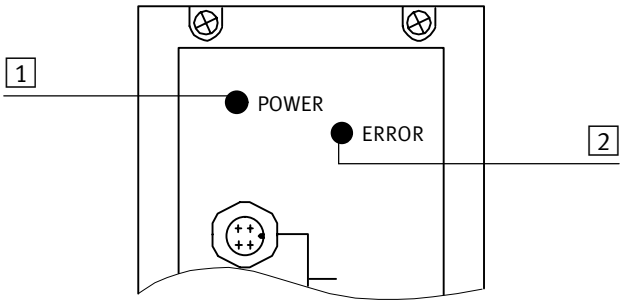


Fig. 5/2: LEDs on the field bus node

The following table explains how the various operating states are shown by the LEDs.

LEDs green	LEDs red	Operating status	Error treatment
☀	○	Operating status normal or: operating status normal but valves do not switch. Possible causes – Operating voltage of the outputs not in tolerance range or not applied. – Compressed air supply not correct. – Pilot exhaust blocked.	None Check the ... • operating voltage connection of the outputs (pin 2), tolerance range 21.6 V DC ... 26.4 V) • the compressed air supply • pilot exhaust channels
○	○	Operating voltage not applied	Check the operating voltage connection for the electronics (pin 1)
☀ (very fast)	☀	Baud rate setting and/or address selector switch setting are not permitted with the field bus protocol set	Check the address/baud rate settings
☀ (1 second i	☀	Field bus connection not correct. Possible causes – Address setting is not correct (e.g. address assigned twice) – The baud rates set on the valve terminal and on the field bus module are not the same. – Field bus protocol setting is not correct – Switched-off or defective field bus module – Interrupted, short-circuited or faulty field bus connection	Check the ... • setting of the address selector switch • baud rate setting on the valve terminal and on the field bus module • field bus protocol setting • field bus module • field bus connection

○ out ☀ flashes green ☀ flashes red ☀ lights up green ● lights up red

Fig. 5/3: LED display of operating status (part 1)

LEDs green	LEDs red	Operating status	Error treatment
	 (long out)	modules not fitted correctly – more than 12 I/O modules fitted – This number of I/Os is not supported by the protocol set – module type not permitted	Reduce the number of ... – I/O modules – Use only permitted module types
		Internal faults of the valve terminal – Short circuit/overload at an electric output – V_{valves} <21.6 V – $V_{outputs}$ <10 V – V_{sensor} < 10 V	• Eliminate the short circuit • or replace the fuse • Check the loading of the power unit
 out	 flashes green	 flashes red	 lights up green  lights up red

Fig. 5/4: LED display of operating status (part 2)

5.2.2 LEDs of the valves

There is a yellow LED for each valve solenoid coil on the valve terminal. This shows the switching status of the valve solenoid coil.

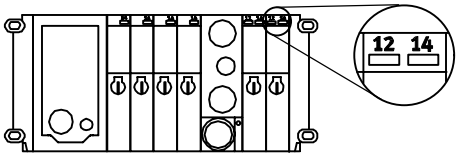
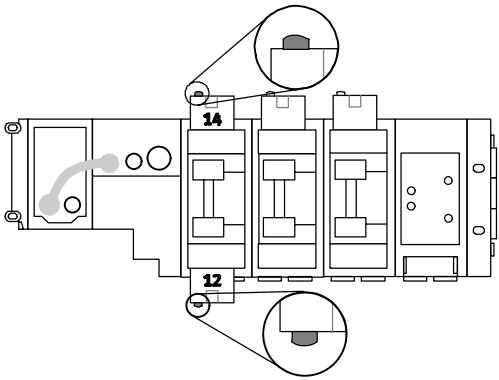
Valve terminal type	LEDs of the valve solenoid coils
Type 03	
Type 04-B	

Fig. 5/5: Positions of the valve solenoid coil LEDs

LED	Switching position of the valve solenoid coil	Meaning
yellow out	basic position	logical 0 (no signal)
yellow alight	– switch position or – basic position	logical 1 (signal present) logical 1 but – operating voltage of outputs lies below permitted tolerance range (21.6 V...26.4 V DC) or – compressed air supply not correct. or – pilot exhaust blocked. or – servicing required

Fig. 5/6: LEDs for the status display of the valve solenoid coils

Short circuit/overload (only type 04-B)

The valve solenoid coils of valve terminal type 04-B are fitted with special fuses for protection against short circuit or overload. The method of replacing these fuses is described in chapter 5.6.

5.2.3 LEDs of the input/output modules

Specific explanations on further I/O modules can be found in the “Supplementary description of the I/O modules”.

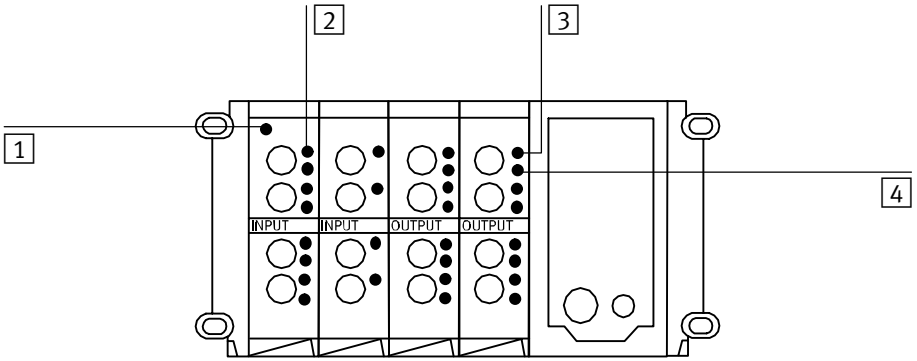
Next to the relevant connections on the input/output modules there are one or two LEDs (status displays) in the colours:

– green (status display of the digital inputs).

– yellow (status display of the digital outputs).

– red (error display of the digital outputs).

The signal currently at the relevant input or output is shown by means of the yellow and green LEDs. The red LEDs of the outputs display a short circuit/overload at the relevant output.



	Description	LED	Status
1	Short circuit/overload display of the sensor power supply (only input modules with electronic fuse)	Red LED out Red LED alight	Input without short circuit/overload Short circuit/overload at the relevant input *)
2	Switching status display of the inputs	green out green alight	logical 0 (no signal) logical 1 (signal present)
3	Switching status display of the outputs	yellow out yellow alight	Output without short circuit/overload Short circuit/overload at the relevant output or input (only input modules with electronic fuse*))
4	Short circuit/overload display of the outputs	red out red alight	logical 0 (no signal) logical 1 (signal present)
*) Treatment of short circuit/overload see “Supplementary description of the I/O modules”			

Fig. 5/7: LED displays of the input/output modules

5.2.4 Testing the valves

Warning
Before starting the test, switch off the compressed air supply to the valves.

You can thereby avoid unexpected or dangerous movements of the actuators.

Caution
- This test function runs automatically in the valve terminal. All valves will be switched on/off cyclically.
- None of the programmed interlockings or further switching conditions will be taken into account.

The valve terminal provides the following test routines with which all the valves are switched on/off cyclically.

Test routine	Meaning
Parallel	All valves will be switched on/off cyclically.
Serial	All the valves of an address byte will be switched on/off one after the other at 1 second intervals.

Fig. 5/8: Test routines which can be set

Starting the test routine

1. Switch off the operating and load voltage supplies (pins 1 and 2).
2. Open the node in accordance with chapter 3.2.1, “Opening and closing the node”.
3. Note the settings of the address selector switch and the DIL switch elements.
4. Set address 99 and DIL switch elements 1...4 to OFF.
5. Switch on the power supplies (pins 1 and 2).
6. Set the desired test routine on the address selector switches as follows:

Test routine	**Address to be set**
Parallel	0, 1 or 2
Serial	3

Fig. 5/9: Setting the test routines

7. Start: Set DIL switch elements 1 and 2 to ON.

If faults occur when the test routine is started, the red LED on the node will flash fast. The procedure must then be repeated.

Stopping the test routine

1. Switch off the operating and load voltage supplies to the valve terminal (pins 1 and 2).
2. Set the address selector switch and the DIL switch elements to their original positions.

Remark:
If the yellow LED on the valves does not light up, it may be due to one of the following causes:

– the LED or the solenoid coil is defective.

Only type 04-B:

– the internal 0.315 A fuse of the manifold sub-base is burnt through (see chapter 5.6).

5.3 Status bits

The valve terminal provides 4 status bits for diagnostic purposes irrespective of the protocol used.

Please note
The four status bits of the valve terminal are only available when the terminal is equipped with input modules.

The status bits are configured as inputs and always occupy the four highest value addresses in the available address space. If the inputs of the addresses underneath these are not used, the terminal sets them to “logic zero”.

The position of the 4 status bits within the address space of the valve terminal can be found in the following chapters on diagnosis with the relevant field bus protocol.

The 4 status bits provide coded diagnostic information with the following significance:

Status bits*)				**Diagnostic information**
2^7	**2^6**	**2^5**	**2^4**	
0	0	0	0	no error
X	0	1	X	Short circuit/overload at output
X	1	0	X	$V_{valves} < 21.6V$
X	1	1	X	$V_{outputs} < 10V$
1	X	X	X	$V_{Sensor} < 10$ V

X = not relevant
*) The status bits can always be addressed at the four highest value addresses of the configured address space.

Fig. 5/10: Coded diagnostic information of the 4 status bits

Diagnostic information	Description	Function
Short circuit/overload at output	Output short circuited or overloaded	Monitors of electrical outputs of output stages
V_{valves} <21.6V	Load voltage on pin 2 (valves and outputs) of the operating voltage connection < 21.6 V	Monitors the tolerance of the load voltage for valves and electrical outputs
$VU_{outputs}$ <10V	Load voltage on pin 2 (valves and outputs) of the operating voltage connection < 10 V	Monitors the load voltage for valves and electrical outputs (no voltage present, e.g. emergency stop)
V_{Sensor} < 10 V	Operating voltage on pin 1 (electronics and inputs) of the operating voltage connection < 10 V	Monitors the operating voltage for inputs (sensors). Shows whether internal fuse has been triggered (fuse on node or at least one electronic fuse on the input module[1)] VIGE-03-FB-8-S)
[1)] Electronic fusing of input module available since February 1999.		

Fig. 5/11: Diagnostic information

5.3.1 Short circuit/overload

During a short circuit or overload, the error code “Short circuit/overload” is entered in the 4 status bits of the node. Depending on the field bus protocol used, the terminal provides one or more diagnosis status registers (bytes, words). Most of the field bus protocols can therefore detect and evaluate a short circuit (see Chapter 5.4).

Short circuit/overload at an IO module

Valve terminals type 03 or 04-B can be equipped, amongst others, with the following IO modules:

- Output modules
- High-current output modules
- Multi-I/O modules
- Input modules
- Input modules with fuses

The behaviour of these modules during short circuit/overload is described in the “Supplementary description of the I/O modules”.

5.4 Diagnosis with the field bus

The modular valve terminal offers the two following possibilities of diagnosis via the field bus:

– with a diagnostic byte

– with four status bits

Diagnostic byte

The diagnostic byte is structured manufacturer-specific and contains the following diagnostic information, depending on the field bus system used:

SPS manufacturer		Valve terminal
Name	**Designation**	**Diagnostic information**
Festo	Status byte	Individual error message on: short circuit/overload of the outputs – operating voltage at pin 2 under 21.6 V (V_{VEN}) – operating voltage at pin 2 under 10 V (V_{OUT}) – supply to inputs (sensors) under 10 V (V_{ON})
ABB (CS31)	Remote status or error flag	
Klöckner-Moeller	Diagnostic byte	

Fig. 5/12: Diagnostic byte – manufacturer-specific diagnostic information

Status bits

The four status bits are interrogated like normal inputs. The contents are coded and contain the following information:

Status bits	Diagnostic information
the four highest-value addresses of the configured address range	Coded individual error message: – Short circuit/overload of the outputs – Operating voltage at pin 2 under 21.6 V (V_{VEN}) – Operating voltage at pin 2 under 10 V (V_{OUT}) – Power supply for inputs (sensors) under 10 V

Fig. 5/13: Status bits – manufacturer-independent diagnostic information

5.4.1 Diagnostic byte

The diagnostic information of a valve terminal is grouped into a diagnostic byte. The following error states are recognized with this diagnostic byte and communicated to the PLC:

Diagnostic information	**Meaning**	**Cause**
$V_{\mathbf{Val}ves}$ (V_{val})	Monitors the tolerance of the operating voltage of the valves and electric outputs	Operating voltage at pin 2 of the operating voltage connection < 21.6 V
$V_{\mathbf{Out}puts}$ (V_{out})	Monitors the operating voltage of the valves and electric outputs (no voltage applied, e.g. EMERGENCY STOP)	Operating voltage at pin 2 of the operating voltage connection < 10 V
$V_{\mathbf{Out}puts}$ (V_{out})	Monitors the supply voltage to the inputs (sensors).	Internal fuse triggered
Short circuit/ overload	Monitors the electric outputs of the output modules	Short circuit or overload

Fig. 5/14: Error states of the valve terminal

The diagnostic byte is transmitted to the PLC in accordance with the relevant field bus protocol. Please note in this respect the following information, depending on the manufacturer:

5.4.2 Festo field bus

All diagnostic information can be evaluated directly with a Festo PLC. An error list is created in the field bus module for this purpose. All diagnostic bytes are included and continually updated in this list.

Bit no.	7	6	5	4	3	2	1	0
Diagnostic information	None	V_{out}	V_{val}	V_{in}	None	Short circuit/ overload (sc/o)	None	None
Signal status	0 or 1							1
Meaning	Signal status 0: No faults Signal status 1: Faults							Cyclic field bus slave

Fig. 5/15: Structure of a diagnostic byte (status byte)

The diagnostic byte is interrogated with function module 44 or in the command interpreter (CI). Further information can be found in the PLC manual for your controller.

Example

Interrogation and evaluation of the diagnostic byte of a field bus slave.

Field bus address	23
Processor system address:	4
Interrogation:	With faults of V_{inputs} (Bit no. 4) is to be branched in the program.
Solution	With bit-by-bit masking of the return parameter, the contents will be evaluated (HEX10 = 0001.0000).

```
Program STL:

STEP                (1)
                                  “Read status byte terminal 23
IF                  NOP
THEN    CFM 54                    “Function module – call in CZE 4
          WITH      C44           “CFM 44 in CFA
          WITH      C23           “Address of field bus slave

STEP                (2)
                                  “Bit no. 4 set in status byte?
IF                  (FU32         “CFM return parameter
          AND       $10)          “Condition: Bit no. 4 = 1
          =         K$10
THEN      JMP TO    V_error (3)   “Jump to subprogram “Error”
OTHERWISE           NOP
```

```
Basic program

CALL       FN54 (44, 23)      :I  Read status byte terminal 23 via CFM
44
IF         @Q0 AND $10 THEN...:I  Condition: Bit no. 4 = 1
```

Fig. 5/16: Example of program with Festo field bus

5.4.3 Diagnosis via ABB CS31

The valve terminal reacts on the ABB CS31 system bus like a binary input/output module. All central units and couplers perform the general monitoring of the CS31 system bus, e.g. total failure of the local modules.

On the valve terminal, the central units and couplers also interrogate the available diagnostic messages (see section “Diagnostic byte” in this chapter). Depending on their performance ability, the diagnostic messages can be processed in detail and can be interrogated with test devices, etc. The displays on the central units and on the couplers indicate the status of the ABB CS31 system bus and the local modules.

The relevant ABB manuals apply to all the central units and couplers.
The following diagram shows as an example the diagnostic possibility in conjunction with

– central unit 07KR91

– coupler 07CS61

Example 1 central unit 07KR91

Diagnostic information	Meaning	Cause	Remote status/ error flag	LED display Coupler/central
V_{val} V_{val}	Monitors the operating voltage of the valves and electric outputs	Operating voltage at pin 2 of the operating voltage connection <21.5 V	Internal fault*)	remote unit error
$V_{Outputs}$ (V_{out})	Monitors the operating voltage of the valves and electric outputs (no voltage applied, e.g. EMERGENCY STOP)	Operating voltage at pin 2 of the operating voltage connection <10 V	Internal fault*)	remote unit error
$V_{Outputs}$ (V_{out})	Monitors the power supply to the inputs/ sensors on the valve terminal (e.g. fuse triggered)	Internal fuse triggered	Internal fault*)	remote unit error
Short circuit/ overload	Monitors the electric outputs of the valve terminal	Short circuit or overload	Overload*)	remote unit error
*) The exact meaning can be found in the diagram below				

Fig. 5/17: Diagnostic information – example 07KR91

The entries of the Festo valve terminals types 03/04-B in the error flag have the following meaning:

Structure of ABB error flag

FK3 = Simple fault	**FK4 = Warning**
M 255,10	
M 255.13	M 255.14
MW 255,00 [1]	MW 255.08 [4]
MW 255.01 [2]	MW 255.09 [2]
MW 255.02 [3]	MW 255.10 [3]
MW 255.03	MW 255.11 [5]
MW 255.04	MW 255.12
MW 255.05	MW 255.13
MW 255.06	MW 255.14
MW 255.07	MW 255.15

1 15_D= valve terminal not connected

2 Device type 0,2 or 4D
0_D = Binary entry (terminal only with inputs)
2D = Binary output (terminal only with outputs)
4D = Binary inputs/outputs (terminal with inputs/outputs)

3 Group no. (= set field bus address, decimal)

4 1_D = internal module error (terminal V_{VAL}, V_{SEN}, V_{OUT})
4_D = overload or short circuit (terminal short circuit/overload)

5 Channel no. in conjunction with the Festo valve terminals types 03/04-B is always 0.

Fig. 5/18: Example 07KR91: Error recognition of the Festo valve terminals

Example 2 coupler 07CS61

The diagnostic information of the terminals is entered in the following system flags:

– Line 1: MW 4104.02...10

– Line 2: MW 4105.10..15

– Line 3: MW 4107.02...10

– Line 4: MW 4108.10..15

Example for line 1:
(see next page)

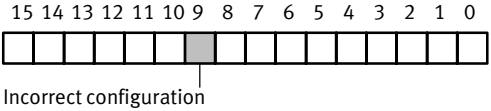
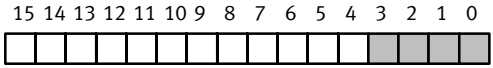
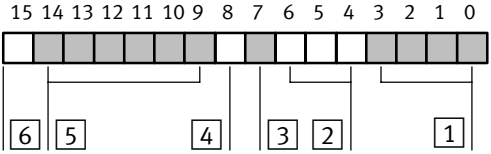
Meaning	**System flag**	
Configuration fault	MW 4104.02	
Status word	MW 4104.03	 Common message error code 1111 no error **1011 Remote Unit Error *)** 1101 Bus error 1110 Serial unit error
Error word 1 Error word 2 Error word 3 Error word 4 Error word 5 Error word 6 Error word 7	MW 4104.04 MW 4104,05 MW 4104.06 MW 4104.07 MW 4104.08 MW 4104.09 MW 4104.10	 1 Error code 0000 No error 1111 Module separated from bus, no longer responds 1000 Short circuit **0100 Overload** 0010 Wire fracture **D = internal module error (V_{VAL}, V_{OUT}, V_{SEN})*)** 2 Channel no. always 0 in conjunction with Festo valve terminals 3 0 = input module 1 = input/output module 4 1= **always 1 in conjunction with Festo valve terminals** 5 CS31 Module address (set field bus address) 6 0 = binary module (= Festo valve terminal) 1 = analogue module *) Will be modified by the valve terminal

Fig. 5/19: Example 07CS61 Error recognition of the Festo valve terminals

5.4.4 Diagnosis with Klöckner-Moeller SUCOnet K

The master receives the diagnostic byte from the SUCOnet K via the 5th. or 9th. input byte, depending on the equipment fitted on the valve terminal (up to 28 inputs, more than 28 inputs). Further information can be found in the example below and in the PLC manual for your controller.

Example
Load diagnostic byte.
Master: PS4-201
Field bus address of the valve terminal 2 (= unit no. 1)

```
Program extract

L RDB1.1.0.8   Status byte of valve terminal
no. 1
= MB 11
```

Fig. 5/20: Program example Klöckner-Moeller

Structure of diagnostic byte

Bit no.	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Diagnosis information	None	V_{out}	V_{val}	V_{in}	None	Short circuit/ over-load	None	None
Signal status	L or H							
Meaning	Signal status L: no error Signal status H: error							

Fig. 5/21: Structure of diagnostic byte

5.4.5 Position of the status bits

Position of the status bits within the available inputs (depending on equipment fitted)

Configured inputs	Available address range	Position of the status bits
Festo		No status bits available
None	—	
1 IW	0 ... 7	4, 5, 6, 7
2 IW	0 ... 15	12, 13, 14, 15
3 IW	0 ... 23	20, 21, 22, 23
4 IW	0 ... 31	28, 29, 30, 31
5 IW	0 ... 39	36, 37, 38, 39
6 IW	0 ... 47	44, 45, 46, 47
7 IW	0 ... 55	52, 53, 54, 55
8 IW	0 ... 63	60, 61, 62, 63
ABB		
None	—	
16 I	0 ... 15	12, 13, 14, 15
32 I	0 ... 31	28, 29, 30, 31
48 I	0 ... 47	44, 45, 46, 47
64 I	0 ... 63	60, 61, 62, 63
Klöckner-Moeller		
None	—	
32I (SIS type K06/07)	0 ... 31	28, 29, 30, 31
64I (SIS type K10/10)	0 ... 63	60, 61, 62, 63

Fig. 5/22: Position of the status bits depending on the equipment fitted

5.5 Error treatment

Reaction to faults in the control system

PLC manufacturer	Reaction of valve terminal		
	to a PLC stop	to field bus faults	to field bus interruptions
Festo	Valves and electric outputs will be reset immediately	Valves and electric outputs will be reset when the timeout time has expired	Valves and electric outputs will be reset immediately
ABB			
Klöckner-Moeller			

Fig. 5/23: Reaction of the control system to faults

Please note
If all outputs are reset after a PLC stop, a field bus interruption or a field bus fault, the following “pneumatic rules” must be observed.

– unilaterally actuated valves move to the basic position
– double-solenoid valves remain in the current position
– mid-position valves move to the mid-position and (depending on valve type) are pressurized, exhausted or blocked.

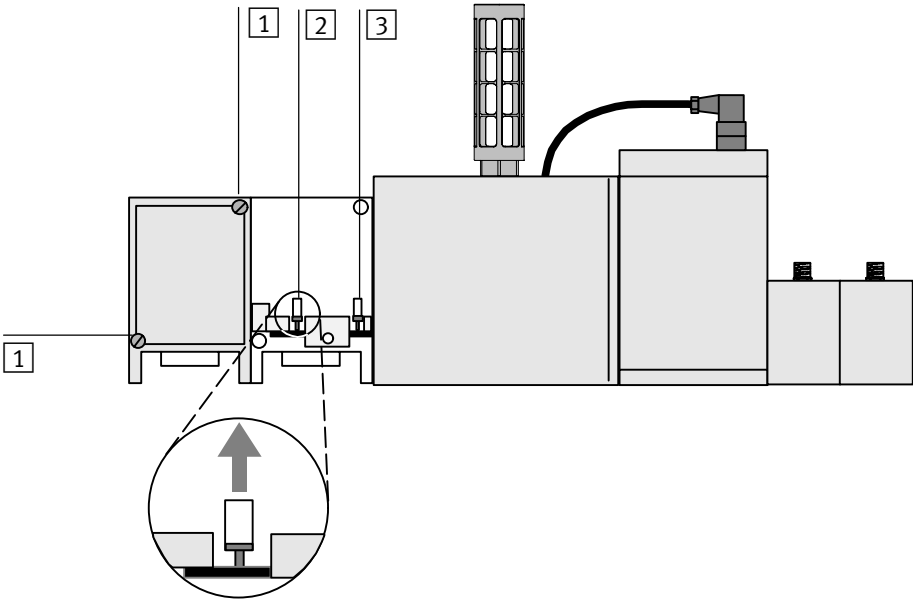
5.6 Type 04-B: fuses for the pilot solenoids

The pilot solenoid coils of the valve terminals of type 04-B are fused separately with (quick acting) 0.315 A fuses. These fuses are situated on the printed circuit board (behind a cover) in each manifold sub-base. Each single-solenoid manifold sub-base is fitted with one fuse; each double-solenoid manifold sub-base is fitted with two fuses.

Replacing defective/burnt through 0.315 A fuses

In order to replace burnt through fuses, proceed as follows (note also Fig. 5/8).

1. Switch off the compressed air supply and the power supply (connections 1 and 2).
2. Open the cover of the manifold sub-base.
3. Carefully remove the defective/burnt through fuse from its base (see diagram).
4. Insert a new (quick-acting) 0.315 A fuse.
5. Close the cover.



1 Fastening screws of the cover

2 Left-hand fuse for pilot solenoid coil 12

3 Right-hand fuse for pilot solenoid coil 14

Fig. 5/24: Replacing a fuse for a pilot solenoid coil

Further information can be found in the Pneumatics manual for valve terminal type 04-B.

Technical appendix

Appendix A

Contents

A.1 Technical specifications

General	
Protection class (as per EN 60529)	IP 65
Temperature during – operation – storage/transport	 - 5 °C ... +50 °C -20 °C +60 °C
Vibration (as per DIN/IEC68/EN 60068 part 2-6 and as per IEC 721/EN 60068 part 2-3) – Transport – Operation/use **Shock** (as per DIN/IEC 68/EN 60068 part 2-27 and IEC 721)	 3,5 mm path at 2-8 Hz 1 g acceleration at 8-25 Hz 0,35 mm path at 25-57 Hz 5 g acceleration at 57-150 Hz 1 g acceleration at 150-200 Hz 30 g at 11 ms duration
Protection against electric shock (protection against direct and indirect contact as per IEC/DIN EN 60204-1)	by means of PELV circuits (Protective Extra-Low Voltage)
Elektromagnetic compatibility – Interference emitted – Immunity against interference	 Tested as per DIN EN 61000-6-4 (industry)[1)] Tested as per DIN EN 61000-6-2 (industry)
[1)] The component is intended for industrial use.	

Operating voltage for electronics and inputs	
(pin 1 – operating voltage connection)	
– Rated value (protected against incorrect polarity)	24 V DC
– Tolerance	± 25 % (18 V DC ... 30 V)
– Residual ripple	4 Vpp
– Current consumption (at 24 V)	200 mA + sum of internal current consumption of inputs
– Fusing the power supply for the inputs/sensors	2 A, slow-blowing
Power consumption (P)	P[W] = (0.2 A + $\sum I_{inputs}$) · 24 V
– Calculation	
Bridging time (drop in logic voltage)	min. 20 ms

Load voltage for outputs/valves	
(pin 2 – load voltage connection)	External fuse required (typ. 10 A, see circuitry example chapter 3.2)
– Rated value (protected against incorrect polarity)	24 V DC
– Tolerance	±10 % (DC 21.6 V ... 26,4 V)
– Residual ripple	4 Vpp
– Current consumption (at 24 V)	10 mA + Sum of current consumption of outputs + Sum of current consumption of switched valve solenoid coils (e. g. per MIDI-valve solenoid coil 55 mA)
Power consumption (P)	P[W] = (0.01A
– Calculation	+$\sum I_{electric\ outputs}$ +$\sum I_{Solenoid\ coil}$) · 24 V

Field bus	
Design	RS 485, floating
Transmission type	serial asynchronous, half-duplex
Protocol – can be set with switch	– Festo field bus – ABB Procontic CS31 – Klöckner-Moeller SUCOnet K
Baud rate – can be set with switch	depends on protocol: 31.25 kBaud 62.5 kBaud 187.5 kBaud 375 kBaud
Cable length (depends on baud rate and cable type)	max. 4000 m
Cable type (depends on cable length and field bus baud rate set)	see manual for your controller

Technical specifications for the pneumatics and valves can be found in the Pneumatics catalogue.

Technical specifications for the I/O modules can be found in the Supplementary description of the I/O modules.

A.2 Cable length and cross-sectional area

Please note
It is assumed here that the user is already familiar with the information contained in the chapters “Installation” in this manual. The following information is therefore aimed exclusively at personnel trained in electro-technology.

A load-dependent drop in voltage occurs on all three cables of the power supply to a valve terminal. This can cause the voltage at pin 1 or pin 2 of the power supply connection to be outside the permitted tolerance.

Recommendation:

- Avoid long distances between the power unit and the valve terminal.
- Calculate suitable cable lengths and cross-sectional areas with the aid of the graphs or formulae below. When doing this please note the following:
  – the graphs provide approximate values for cross-sectional areas 1.5 mm^2 and 2.5 mm^2.
  – the formulae provide exact values for any cross-sectional area.

Please note
In the following graphs and formulae it is assumed that the cross-sectional areas of the power supply cables (pins 1, 2 and 3) are the same.

Calculating with the graph

Proceed as follows:

1. Calculate the maximum current consumption of the outputs/valves (I_2).

2. Calculate the lowest voltage to be expected during operation (VB_{min}) on thepower unit. When doing this, please note:
   – the load dependency of the power unit
   – the fluctuations in the primary mains voltage

3. Read off the permitted cable length for your cross-sectional area in the relevant table.
   Example for 1.5 mm^2:
   V_{Bmin} = 22.8 V, I_2 = 2 A; L_{max} = 25 m

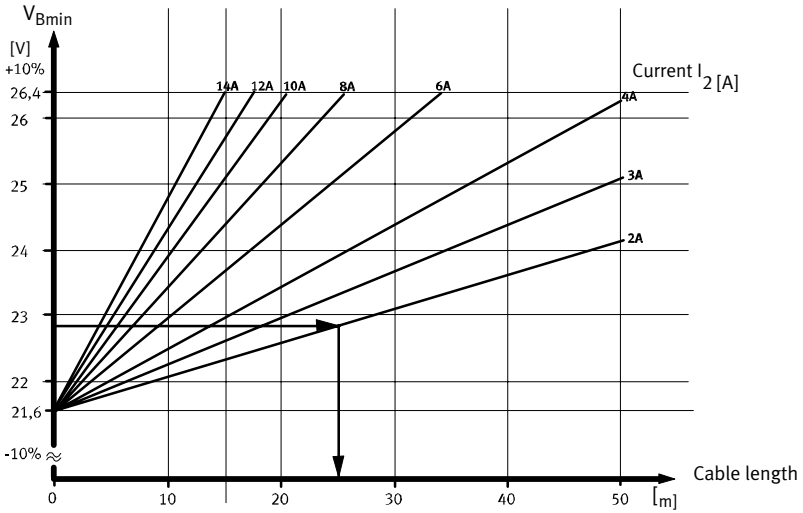


Fig. A/1: Calculating the maximum cable length for cross-sectional area 1.5 mm^2

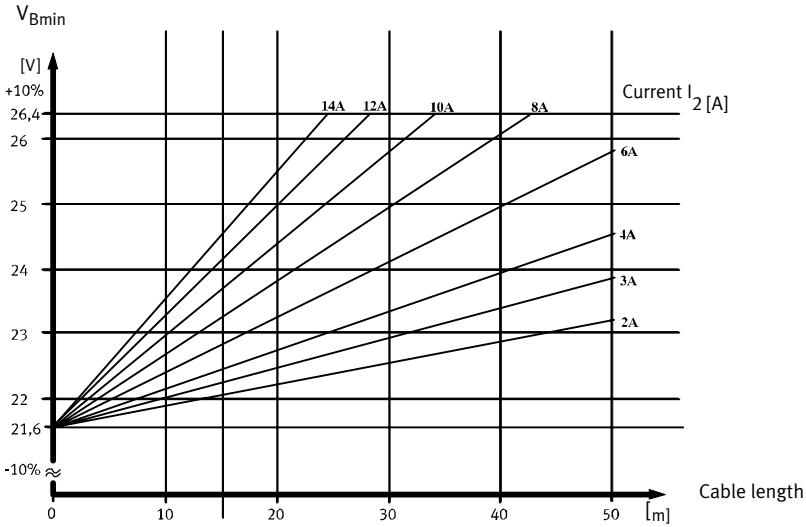


Fig. A/2: Calculating the maximum cable length for cross-sectional area 2.5 mm^2

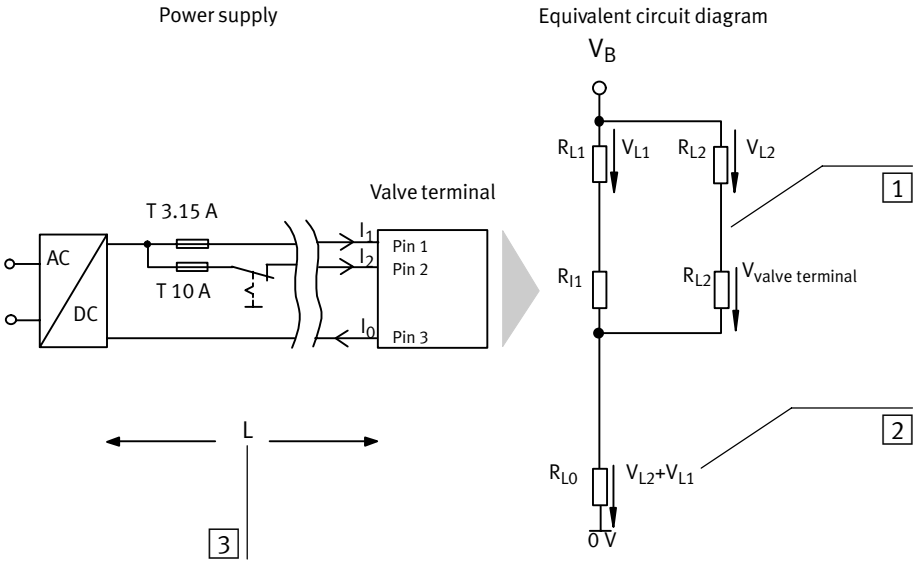
Calculating with a formula

Proceed as follows:

1. Calculate the maximum current consumption of the inputs and electronics (I_1) as well as of the outputs/valves (I_2).

2. Calculate the lowest voltage to be expected during operation (V_{min}) on the power unit. When doing this, please note:
   – – the load dependency of the power unit
   – – the fluctuations in the primary mains voltage

3. Enter the values in the formula below. The equivalent circuit diagram and the example explain the correlation.



1 Line resistance (outgoing) R_{L1} + RL2

2 Line resistance (incoming) R_{L0}

3 L = distance (cable length)

Fig. A/3: Equivalent circuit diagram for power supply

Formula for cable length:

$$L \leq \frac{(V_{Bmin} - 21.6\ V) \cdot A \cdot \kappa_{CU}}{2 \cdot I_2 + I_1}$$

.

This means:

- 21.6 V $V_{VALVE\ TERMINAL}$ = 24 V ± 10%, minimum: ≥ 21.6 V
- V_{Bmin} = minimum supply voltage (at the power unit)
- I_1 = current for electronics and inputs
- I_2 = current for outputs/valves
- A = cable cross-sectional area (uniform e. g. 1.5 mm^2)
- κ = conductance value of cables (uniform e. g. $\kappa_{Cu} = 56 \frac{m}{mm^2 \cdot \Omega}$

Example:

I_1 = 1 A
I_2 = 5 A
V_{Bmin} = 24 V
$V_{VALVE\ TERMINALmin}$ = 21.6 V
$\kappa_{Cu} = 56 \frac{m}{mm^2 \cdot \cong \Omega}$

Result of example:

L ≤ 18 m for A = 1.5 mm^2
L ≤ 30 m for A = 2.5 mm^2

A.3 Examples of circuitry

1 24 V supply for electronics and inputs

2 24 V load voltage supply for valves and outputs

3 0 V

4 Earth connection

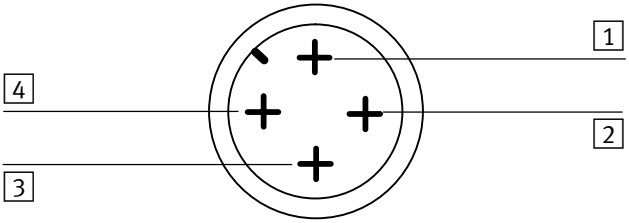


Fig. A/4: Pin assignment (node)

A.3.1 Power supply type 03 – internal layout

1 Electric outputs*)

2 Valves*)

3 Power supply connection of node type 03

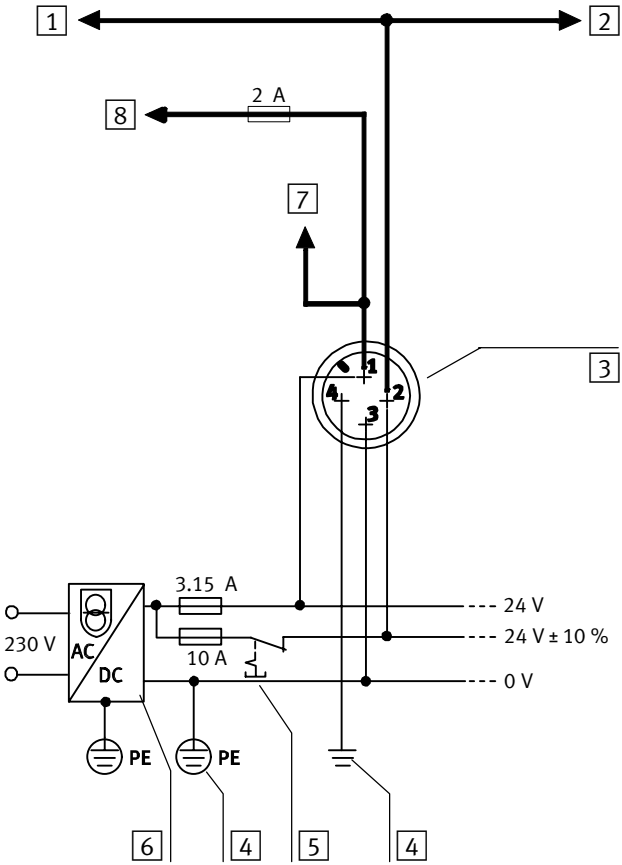
4 Potential equalization

5 Load voltage can be switched off separately.

6 Power unit (e. g. central power supply)

7 24V electronics (fused internally)

8 Electric inputs/ sensors (fused internally)



*) (must be fused externally)

Fig. A/5: Example of circuitry and internal layout of type 03

A.3.2 Power supply type 04-B – internal layout

1 Electric outputs (fused internally)

2 Adapter cable

3 Valves max. 50 % simultaneity (fused internally)

4 Power supply connection adapter plate (type 04-B)

5 Potential equalization

6 Load voltage can be switched off separately.

7 Power unit (e. g. central power supply)

8 24V electronics (fused internally)

9 Electric inputs/ sensors (fused internally)

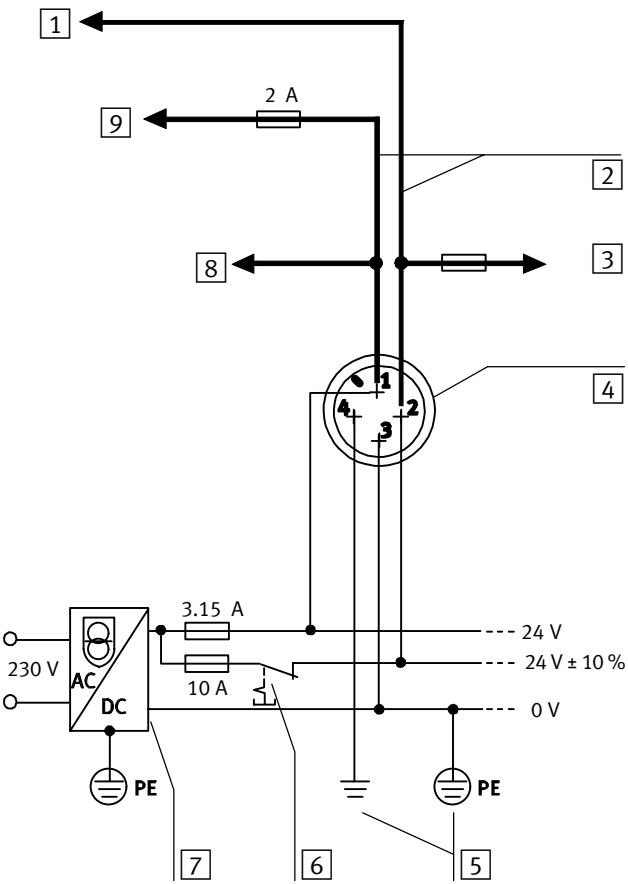


Fig. A/6: Example of circuitry and internal layout of type 04-B

Accessories

Appendix B

Contents

B.1 Connecting the cables to the plugs/sockets

Caution
The position of the pins on the plug is different from that on the socket.

– The connections of the input/output modules are in the form of sockets.
– The connections for the power supply are in the form of plugs.

Please see the following chapters for the pin assignment.

When you have selected suitable cables, connect them to the plugs/sockets in accordance with the steps listed below.

1. Open the Festo plugs/sockets as follows (see diagram):

   – Mains power supply socket
     Insert the power supply socket in the power supply connection of the valve terminal. Unscrew the housing of the socket.
     Then remove the connecting part of the socket which inserted in the power supply connection.

   – Sensor plug (for input/output modules):
     Loosen the centre knurled nut.

2. Open the strain relief on the rear of the housing. Pass the cable through as follows (see diagram).

Outer diameter of cable	
– PG7:	4.0 ... 6.0 mm
– PG9:	6.0 ... 8.0 mm
– PG13.5:	10.0 ... 12.0 mm

Plug/socket (straight or angled):	
– Power supply socket	PG7, 9 or 13.5
– Sensor plug	PG7
– Bus cable socket	PG7, 9 or 13.5

1 Cables
2 Strain relief
3 Housing
4 Connecting part
5 Plug
6 Socket

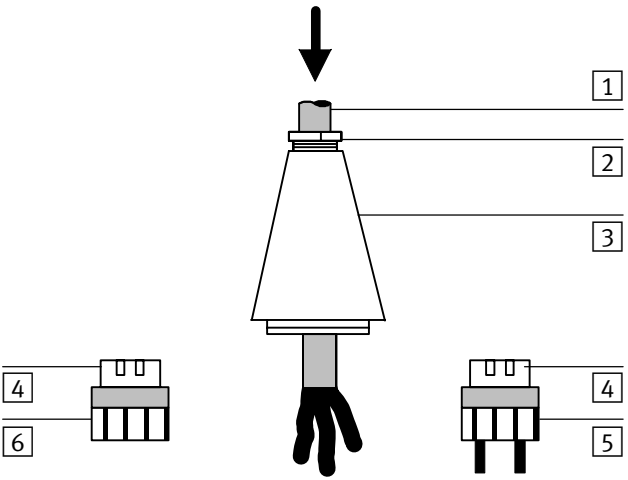


Fig. B/1: Individual plug/socket parts and cable routing

3. Remove 5 mm of insulation from the end of the conductors.
4. Fit end sleeves to the wires.
5. Connect the conductors.
6. Place the connecting part back on the housing of the plug and screw the two items together. Pull the cable back so that there are no loops inside the housing.
7. Tighten the strain relief.

Index

Appendix C

Contents

A

C

D

E

F

H

I

K

L

O

P

S

T

U

V