

4 Binary input module 07 DI 90-S, safety-related, 24 V DC, 8 inputs, electrically isolated from the CS31 system bus

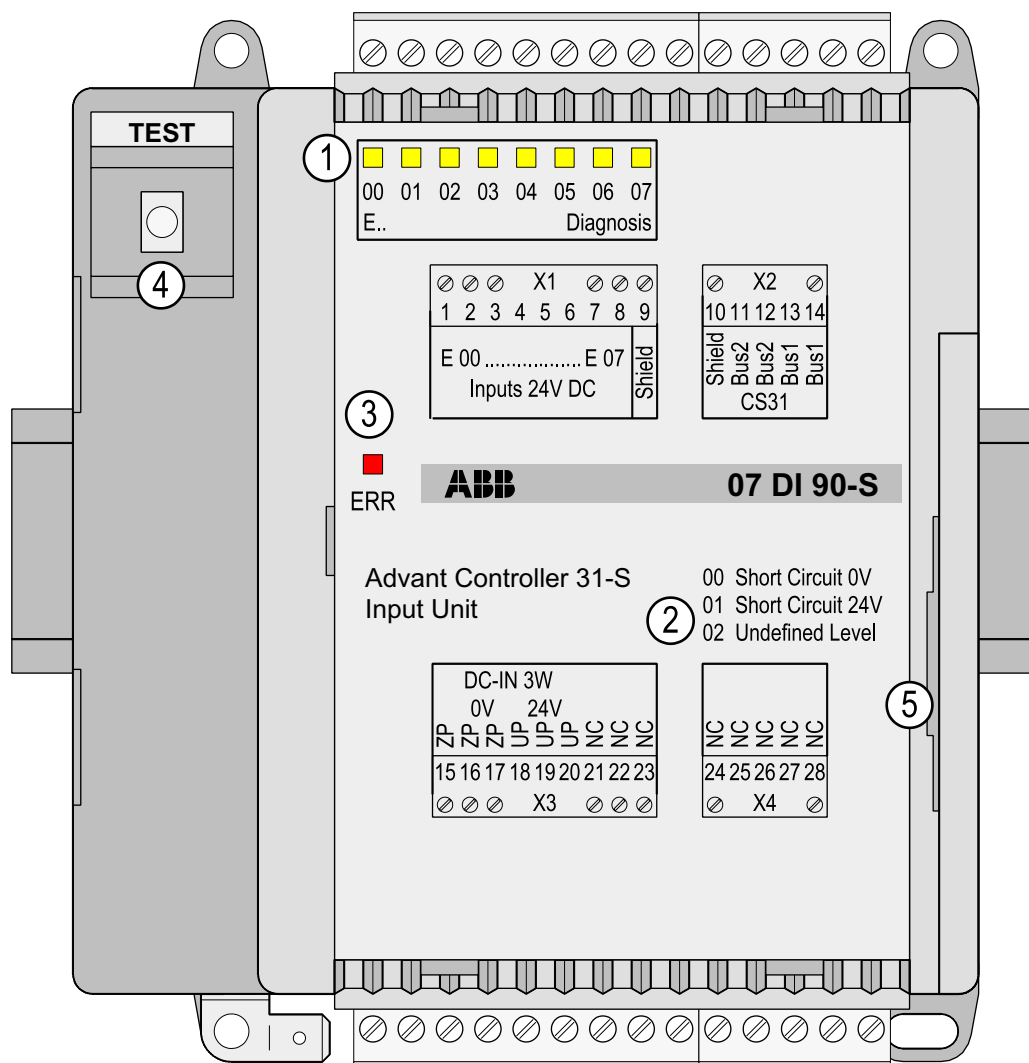


Figure 4-1: Safety-related binary input module 07 DI 90-S

Contents

Intended purpose	4-1
Indicators and operating elements on the front panel	4-2
Functional description	4-2
Principle of function	4-3
Electrical connection	4-3
Addressing (setting the module address)	4-6
Auxiliary and diagnosis functions	4-7
Start-up behaviour	4-7
Diagnosis at the module	4-7
Technical data	4-8
Installation and dimensions	4-9

Intended purpose

The module 07 DI 90-S is a binary input module with 8 input channels for 24 V DC safety-related sensors.

The module is part of the safety-related PLC (Advant Controller 31-S). It is used in safety-relevant automation systems to be classified under requirement classes 1...4 according to DIN V 19250.

It is used as a remote module and linked to the central unit 07 KT 94-S via the CS31 system bus.

The CS31 system bus interface is electrically isolated from the other circuitry of the module.

The input signals of the module 07 DI 90-S are read in by the AC31 central unit using special safety-related connection elements (CEs).

- ⑤ DIL switch for address setting below the cover

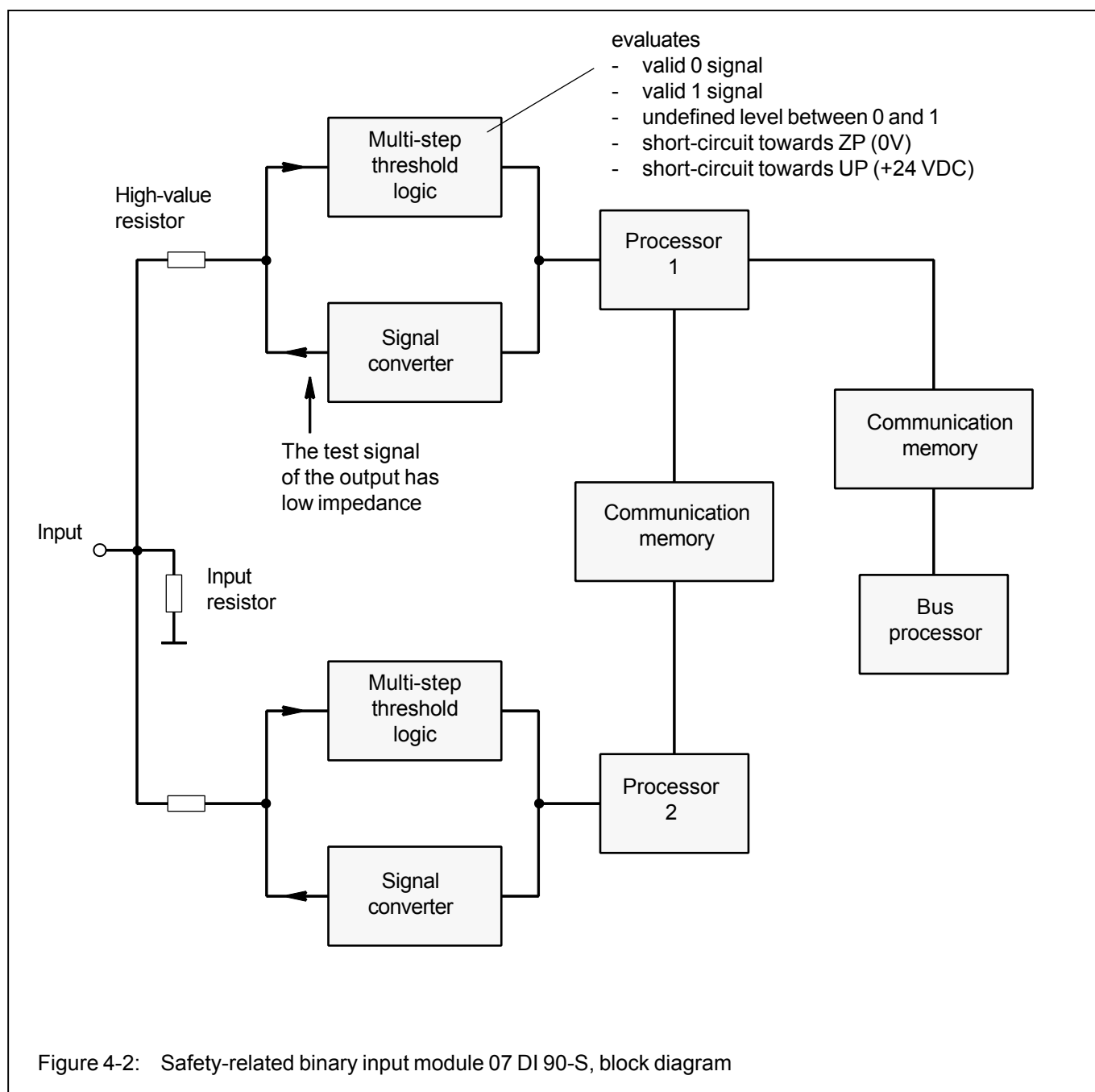
Indicators and operating elements on the front panel

- ① 8 yellow LEDs for indication of the signal state at the inputs or for error and diagnosis indication
- ② List of the diagnosis information referred to the LEDs if these are used for diagnosis indication
- ③ Red LED for error indication
- ④ Test button

Functional description

As shown in the following Figure 4-2, the signal processing is mainly realized by means of dual-channel technique. In this way, the following tasks can be handled:

- Signal states are safely detected, wire cuts and short-circuits of signals are safely differentiated. Open inputs or wire cuts are interpreted as a short-circuit against ZP.
- Single faults are detected and lead to a safe shut-down.



Principle of function

The input current flowing through the input resistor generates a voltage drop which is led to two identically configured evaluation channels via high-value resistors. The high-resistivity of the resistors guarantees a non-interacting between both channels.

Both channels mutually supervise each other, by

- their processors comparing the evaluated input signals to each other;
- their processors generating multi-step binary signals in check cycles via signal converters and by comparing the values derived from this by the threshold switch to the expected value;
- their processors mutually checking each other for their function ability.

The dual-channel principle terminates at the bus processor with a specially safety-related telegram.

System bus interface

The CS31 system bus interface, which is electrically isolated, provides for the data exchange via the bus.

Process supply voltage UP

There is no electrical isolation between the process supply voltage and the binary inputs.

It must be observed by any means that the binary safety-related sensors are supplied by the same UP rail as the module itself. Only in this way, the 5 possible states of the module input signals can be correctly differentiated:

- valid 0 signal
- valid 1 signal
- undefined level between 0 and 1
- short-circuit towards ZP (0V) and
- short-circuit towards UP (+24 V).

Electrical connection

For the planning of the AC31-S, the safety manual for the AC31-S (this file) must be observed. Here, both the architecture of the PLC program and the construction of the hardware components and their wiring are described in detail.

The module is either snapped-on to a DIN rail or directly screwed on the control cabinet's rear wall. The electrical connection is realized via pluggable terminal blocks. All terminal blocks must be installed even those which are not used.

Figure 4-4 on page 4-5 shows the terminal assignment of the module with a wiring example for a safety-related sensor.

In this example it is assumed that the resistors for the open-circuit monitoring are integrated into the safety-related sensors. However, this is not the case for all of them.

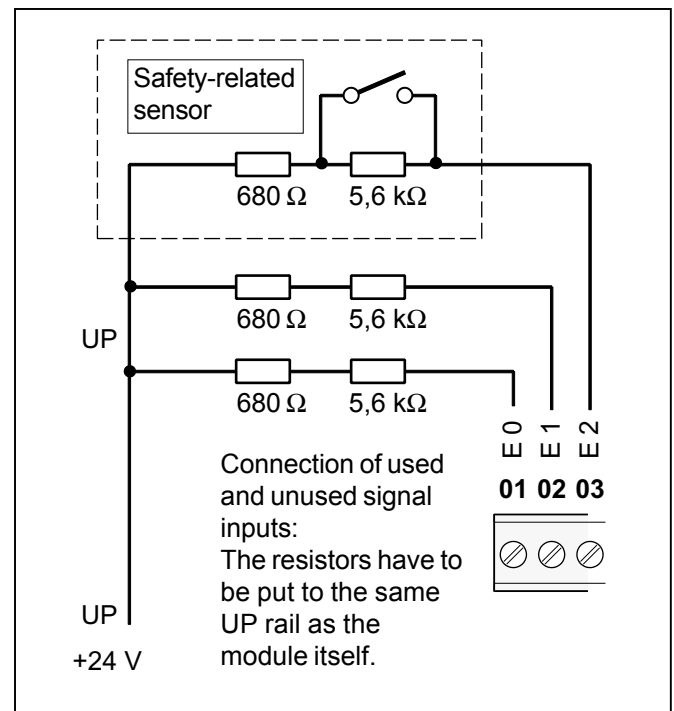
If safety-related sensors without integrated resistors are to be connected to the module 07 DI 90-S, there are two options:

- The wiring of the cables is completed according to the valid VDE regulations and for instance the fault exclusion according to VDE 0116 chapter 8.7.4.1 is used, which means that the short-circuiting of a conductor can be excluded as possible error source. Furthermore, if the planning is made according to the closed-circuit principle, the module detects any wire cut. In this case, the resistors may be mounted directly to the terminals of the module 07 DI 90-S.
- However, a higher safety level is achieved if the resistors are directly connected to the terminals of the safety-related sensor as this guarantees a complete cable monitoring.

The resistors used for the safety-related sensors must come up to the following requirements:

- Use of metal-film resistors in order to exclude a self-short-circuit of a resistor
- Resistor specifications:
680 Ω , 1 %, 0,33 W at 70 °C, TK 50 ppm/K and
5,6 k Ω , 1 %, 0,33 W at 70 °C, TK 50 ppm/K
or better. See also Figure 4-4.

Caution: Unused signal inputs have to be put to UP (+24 V) using two resistors of 680 Ω and 5,6 k Ω . Open inputs cause an external error display at the module.



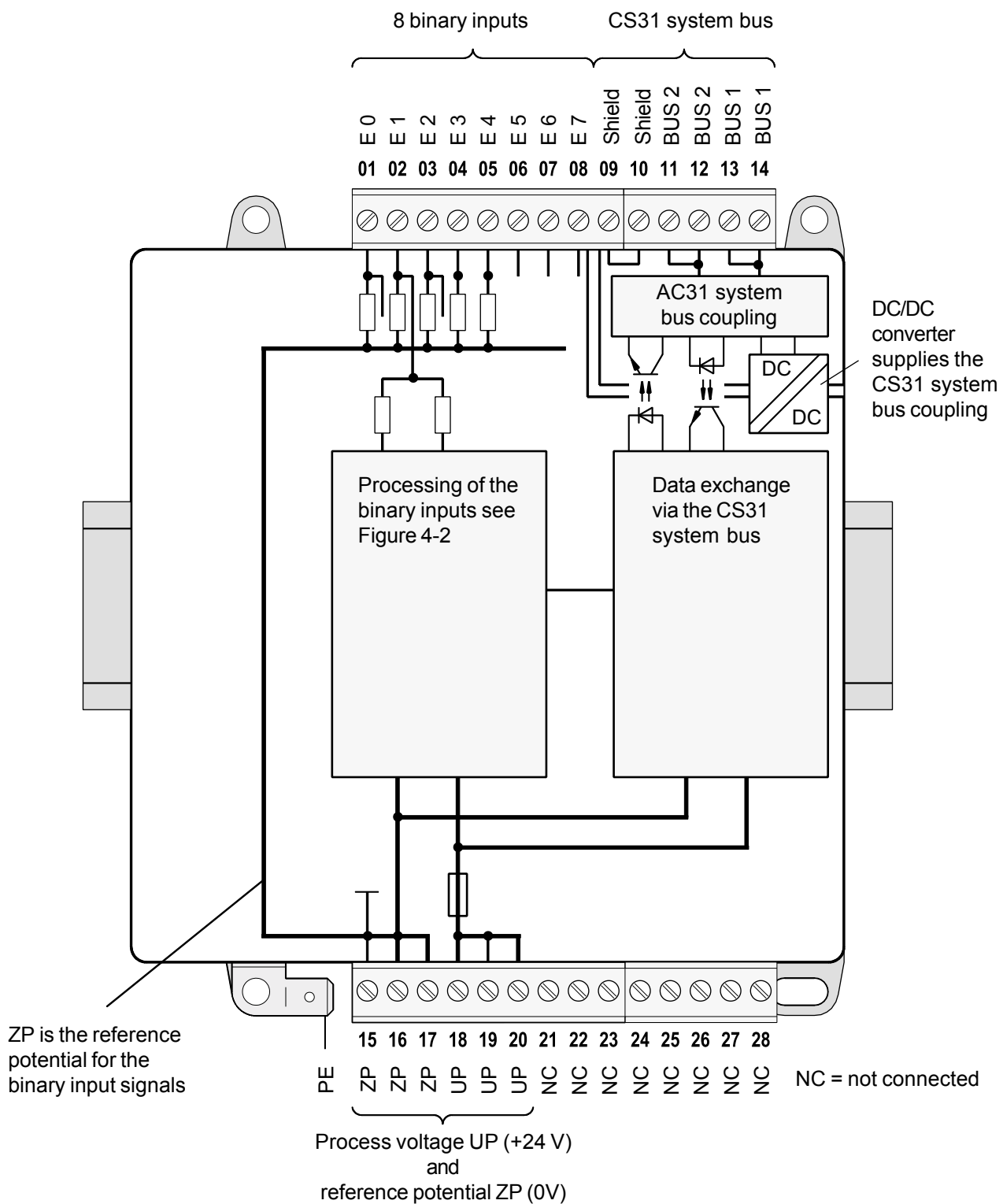
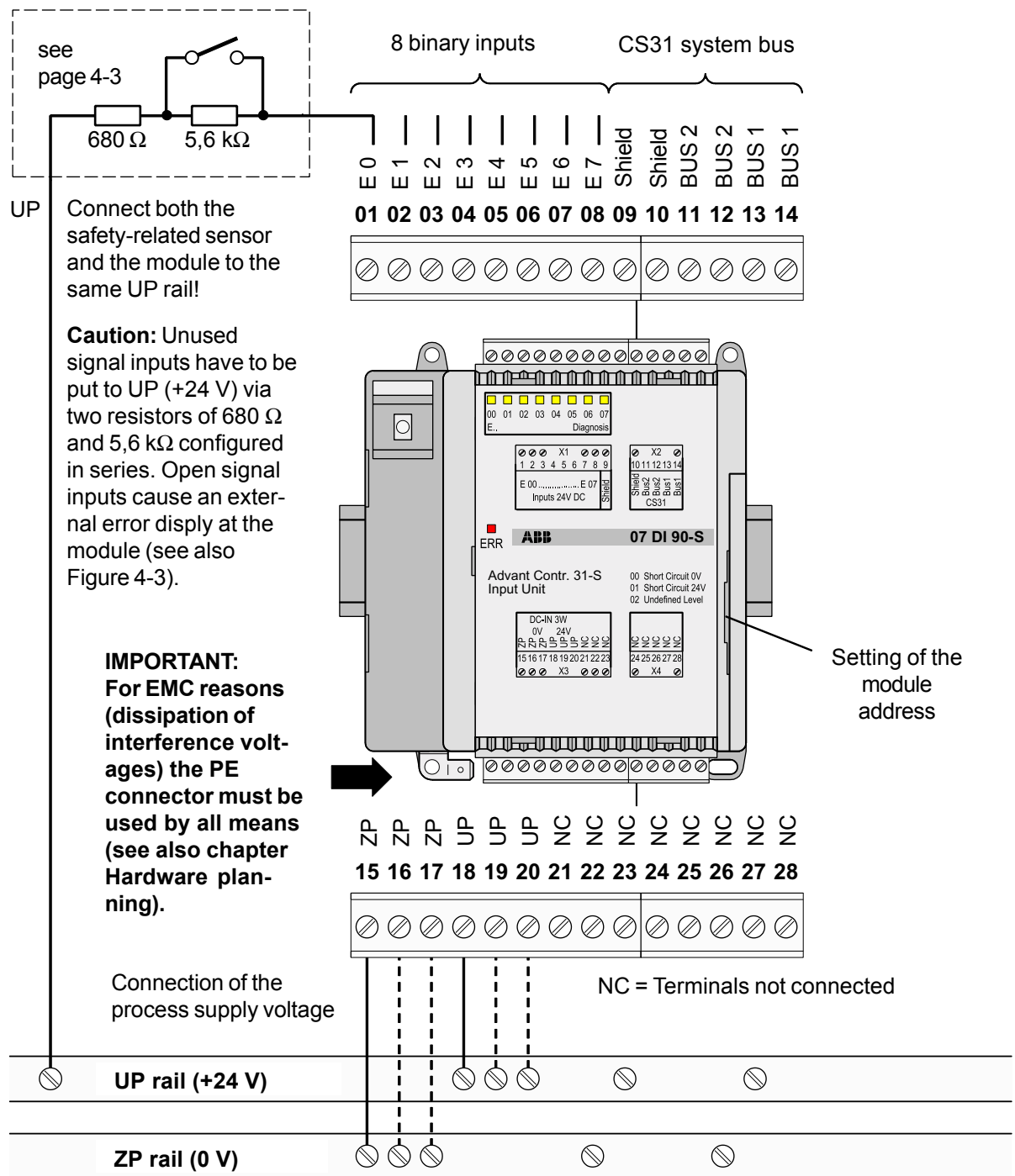


Figure 4-3: 07 DI 90-S, internal design



CAUTION: It is very important to observe the correct voltage polarity:
UP = +24 V, ZP = 0 V (reference potential)

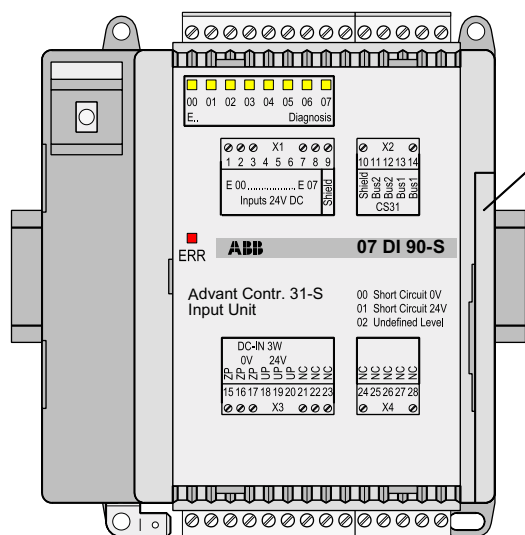
The terminals ZP and UP are intended for the module's supply (see above).

If ZP and UP are looped through from module to module, the following points must be observed:

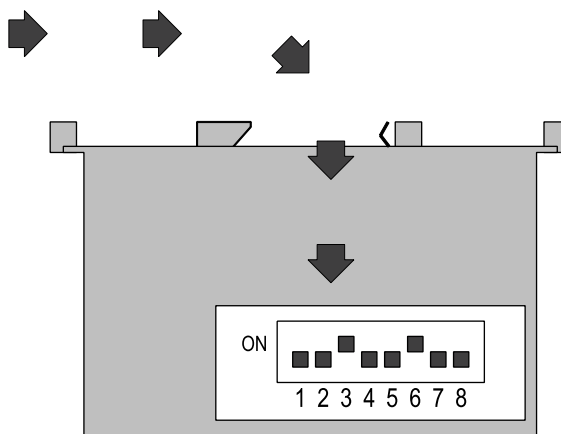
- When unplugging the terminal block, the power supply to the modules connected in series is switched off.
- At the terminals (and the plug-in connections) a total current of 4 A must not be exceeded.

Figure 4-4: 07 DI 90-S, terminal assignment and connection example for a safety-related sensor

Addressing (setting the module address)



Setting the module address (0...31) is done using a DIL switch. The switch is accessible after removing the lateral cover. Pull the cover towards the front while tilting it lightly to the right. The switch is provided with a lid.



Meaning of the 8 switches:

Switch 1: must always be set to OFF
Switch 2: must always be set to OFF

Switch 3: Module address bit 4, significance 16
Switch 4: Module address bit 3, significance 8
Switch 5: Module address bit 2, significance 4
Switch 6: Module address bit 1, significance 2
Switch 7: Module address bit 0, significance 1

Switch 8: must always be set to OFF

The sum of the significance values of the switches in ON position is the set module address, e.g.: switch 3 = ON, significance = 16 and switch 6 = ON, significance = 2 results in module address 18.

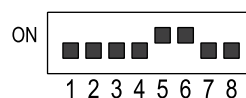
Examples: Module address 0
E 00,00 *



Module address 2
E 02,00 *



Module address 6
E 06,00 *



* Address entry at connection element S_LSB

Figure 4-5: 07 DI 90-S, setting of module address at the DIL switch (see also chapter 3.3 "Configuration data for the I/O modules")

Auxiliary and diagnosis functions

Start-up behaviour

After switching the power supply (UP) on, the LED 'ERR' will light up for approx. 10 sec. during the switch-on self-test of the module.

After that, the LED 'ERR' flashes until the module has been adopted in the CS31 bus cycle.

After the 'ERR' signal has gone out, this shows the correct self-test as well as the end of the initialization and adoption in the CS31 system bus.

If, however, the LED 'ERR' is lighting permanently (>15 sec) after switching on the power supply, an internal error has been detected.

The LEDs for channel indication remain off until the initialization is completed. After that, they show the state of the corresponding input channel.

Further diagnosis information are included in the Advant Controller 31 System Description (AC31 error flags).

Fuses

The module has an integrated solder-in-type micro-fuse for the supply voltage UP. If this fuse blows, the following error indication takes place:

- The module has no function any more.
- All LEDs are off.

The module has to be replaced.

Diagnosis at the module

The module distinguishes between 2 different error types:

- External errors:
 - Short-circuit of a sensor line towards 0 V or cut of a sensor line
 - Short-circuit of a sensor line towards UP
 - Input signal has exceeded the permissible input level ranges
- Internal errors:
 - all other errors

Reaction to external errors:

- The LED 'ERR' starts flashing.
- The channel state of the faulty channel is frozen.
- The error can be requested via the test button of the module.
- The error-free input channels continue the signal processing.
- The channel is marked as faulty via the CE 'S_LEB' for the AC31 central unit.
- After error recovery, the error can be acknowledged with the test button.

Reaction to internal errors:

- The LED 'ERR' and all input channel LEDs are lighting permanently.
- The module stops the processing of all input signals.
- The entire module is marked as faulty via the CE 'S_LEB' for the AC31 central unit.
- After error recovery, the error can be acknowledged by switching the power OFF and then ON again.
- Refer to chapter "Diagnosis and troubleshooting" in volume 7 for further diagnosis information.

Diagnosis of external errors:

- By pressing the "TEST" pushbutton, the channels are selected subsequently. After pressing this key, the LED of the selected channel starts flashing. After releasing the pushbutton, the error indication of the selected channel (e.g. LED 01 for short-circuit towards 0 V) is displayed in the channel LEDs for approx. 2 seconds. After that, the module switches back to the status indication of the input channels. Now, the next channel can be selected.
- After selecting and querying channel 7, an LED test will be carried out after pressing the test pushbutton (all channel LEDs light up). After releasing the pushbutton, the set module address is displayed for approx. 2 seconds.
- The acknowledgement of external errors is made by pressing the test pushbutton somewhat longer (approx. 5 seconds).

Technical data

Process and supply voltage UP
(power supply according to VDE 0551 is necessary)

rated voltage
upper limit value
lower limit value

24 V DC $\pm$ 5 % ripple
24 V DC + 20 % = 28,8 V ($\pm$ 5 % ripple)
24 V DC - 15 % = 20,4 V ($\pm$ 5 % ripple)

The supply voltage must rise to at least 19 V
within 0 to 40 msec after being switched on.

Buffered voltage interruption time

> 10 ms

Reference potential ZP

0 V for process voltage UP

Protection against reversed polarity (UP $\leftrightarrow$ 0V)

yes

Number of inputs per module

8 (for safety-related sensors)

Signal levels of the inputs (nominal values)

short-circuit towards ZP

0 signal

undefined level

1 signal

short-circuit towards UP

0%... 15% of UP (0 V... 3,6 V for UP = 24 V)
15%... 35% of UP (+3,6 V... 8,4 V for UP = 24 V)
35%... 65% of UP (+8,4 V... 15,6 V for UP = 24 V)
65%... 85% of UP (+15,6 V... 20,4 V for UP = 24 V)
85%... 100% of UP (+20,4 V... 24,0 V for UP = 24 V)

Input resistance

approx. 2,2 k Ω

Input current at 24 V DC

approx. 10 mA

Input signal delay (edges 0 $\rightarrow$ 1 and 1 $\rightarrow$ 0)

typ. 5 ms, monitoring to 20 ms

Input frequency

max. 20 Hz (higher input frequency leads to an external
or an internal error)

Input signal transition time (edges 0 $\rightarrow$ 1 and 1 $\rightarrow$ 0)

0 ms...5 ms

Cable lengths with cables laid in parallel

shielded

unshielded

max. 1000 m

max. 600 m

Conductor cross section of process terminals
tightening torque

max. 1 x 2,5 mm²

max. 0.5 Nm

Electrical isolation

from the CS31 system bus

Rated insulation voltage, process terminals
from CS31 system bus:

acc. to VDE 0160, rated direct voltage
test voltage for reinforced insulation

0...50 V

800 V DC

Current consumption (UP)

110 mA

Total power dissipation

max. 3 W

Address setting

see page 4-5

Indication of input signals

one yellow LED per channel

Error indication

one red LED (ERR)

Safety-related sensor (snap-action contact element)

resistance, if contact is open
contact is closed

5,6 k Ω + 680 Ω ($\pm$ 1 %)

680 Ω ($\pm$ 1 %)

Specifications for the resistors of the sensor

680 Ω , 1 %, 0,33 W at 70 °C, TK 50 ppm/K and
5,6 k Ω , 1 %, 0,33 W at 70 °C, TK 50 ppm/K
or better

Safety-related CE (S-CE) in the PLC software

S_LEB: Read binary S-input module

Module-specific CS31 bus transmission time	590 □s
Dimensions (width x height x depth) in mm	120 x 140 x 85 mm (see below)
Weight	400 g
Order number	07 DI 90-S
	GJR5 2509 00 R202

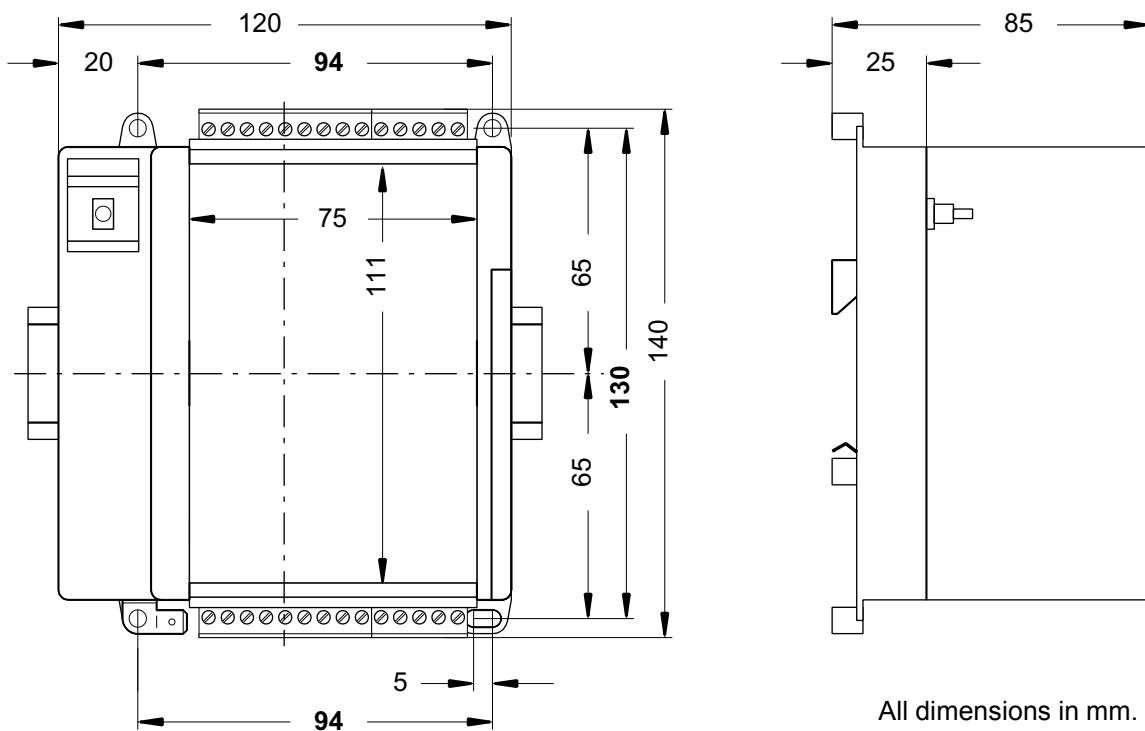
Installation and dimensions

Fixing the module on a DIN rail

The easiest and fastest way to install the module is to snap it on to a DIN rail (acc. to DIN EN 50022-35, 15 mm deep). Neither for the assembly nor for the disassembly, any tools are required. The DIN rail is centered between upper and lower edge of the module.

Fixing the module by screwing

Using 4 M4 screws, the module can be fastened on an assembly surface (e.g. rear wall of the control cabinet). The following drawing shows the position of the fixing holes as well as all important assembly dimensions.



The device is 85 mm deep. If a DIN rail is used, the mounting depth is increased by the overall depth of the rail.

Figure 4-6: 07 DI 90-S, outline dimensions, **dimensions for assembly holes are printed in bold**

Mounting hints

Mounting position

Vertical, terminals above and below

Cooling

The natural convection cooling must not be hindered by cable ducts or other material mounted in the control cabinet.

