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Industrial Automation Components

# TECHNICAL DOCUMENTATION

## SYSTEM INTEGRATION & REPLACEMENT SUPPORT GUIDE

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# 5 Binary output module 07 DO 90-S, safety-related, 24 V DC, 8 outputs, electrically isolated

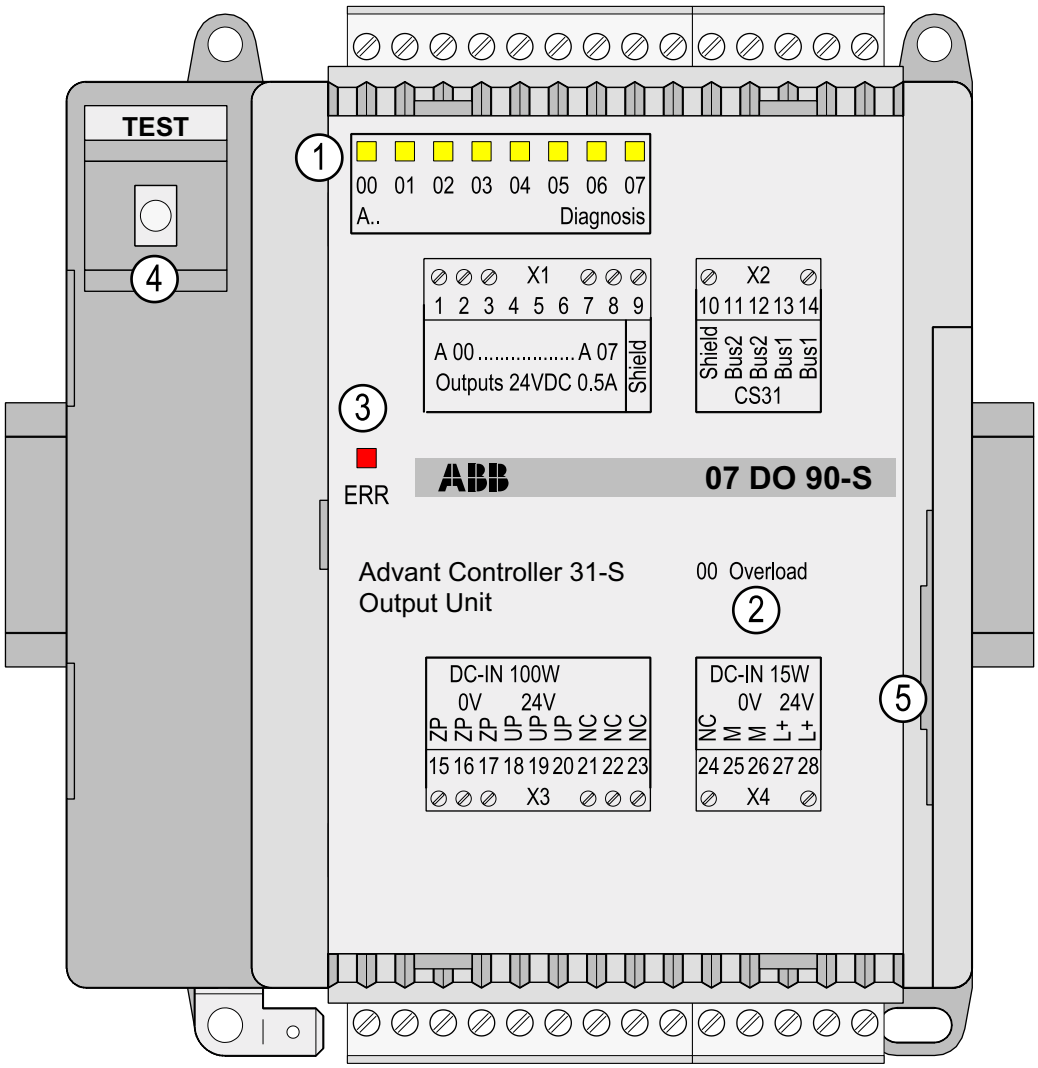



Figure 5-1: Safety-related binary output module 07 DO 90-S

## Contents



## Intended purpose

The module 07 DO 90-S is a binary output module with 8 electrically isolated output channels for 24 V DC.

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 outputs of the module 07 DO 90-S are set by the AC31 central unit via special safety-related connection elements (CEs).

## Indicators and operating elements on the front panel

1. 8 yellow LEDs for indication of the signal state at the outputs 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
5. DIL switch for address setting under the cover

## Functional description

see block diagram on the next page

### Principle of the safety-related outputs

The safety-related output module is configured in a way that even in case of errors the safe states at the outputs are granted. The safe state is defined as the off-state of the outputs.

The output channels are organized in two groups with 4 outputs each. Each group disposes of an additional power transistor as second independent switch-off path besides the 4 short-circuit-proof output drivers.

The signal state of each output channel is read back via an input channel. The connection element (CE) S_LAB compares the sent signal with the signal which is read back at the input channel. If the signals are not equal, a message is generated.

### Partially two-channel configuration

The module is largely configured in dual-channel technique. Two processors control and monitor the output drivers. An output driver is only activated if it is addressed by both processors simultaneously.

### External and internal errors of the output module

Overload (or short-circuit towards ZP) is an external error and leads to a safe shut-down of the affected group. All other errors are internal errors and cause the shut-down of all outputs (RESET).

The correct function of the output drivers and the power transistors responsible for the group shut-down is checked cyclically as to their switch on/off capacity during the operation. For this purpose, the switching states are temporarily changed (duration < 1 msec). Any relays or other loads controlled by the output drivers must be designed in a way that they do not react to these short pulses.

The changing of the output signal states are detected and transferred to both processors for checking. By checking just one output at the same time, a possible cross-talk to neighboring channels can also be detected.

### Power supply for the output circuitry

The output drivers are supplied by ZP and UP (24 V DC). This supply voltage is electrically isolated from the CS31 system bus and also from the 24 V DC supply voltage (M, L+) for controlling and monitoring the outputs.

### Power supply for the CS31 bus coupling

The supply voltage for the bus coupling is provided internally using an electrically isolated DC/DC converter supplied from 24 V DC (L+, M).

### Electrical isolation

All signals, which are to be led via electrically isolated barriers, are transmitted with optocouplers.

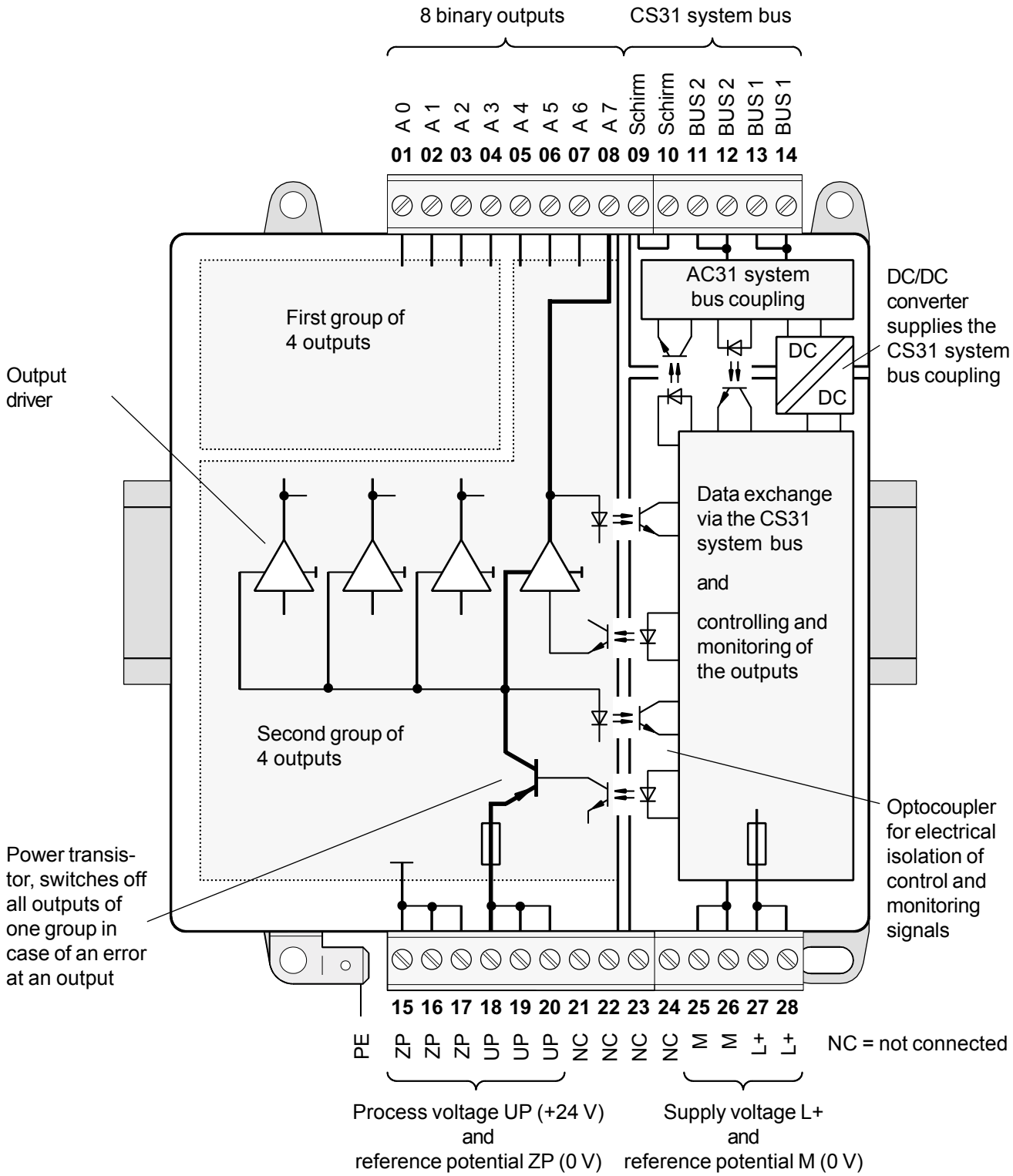


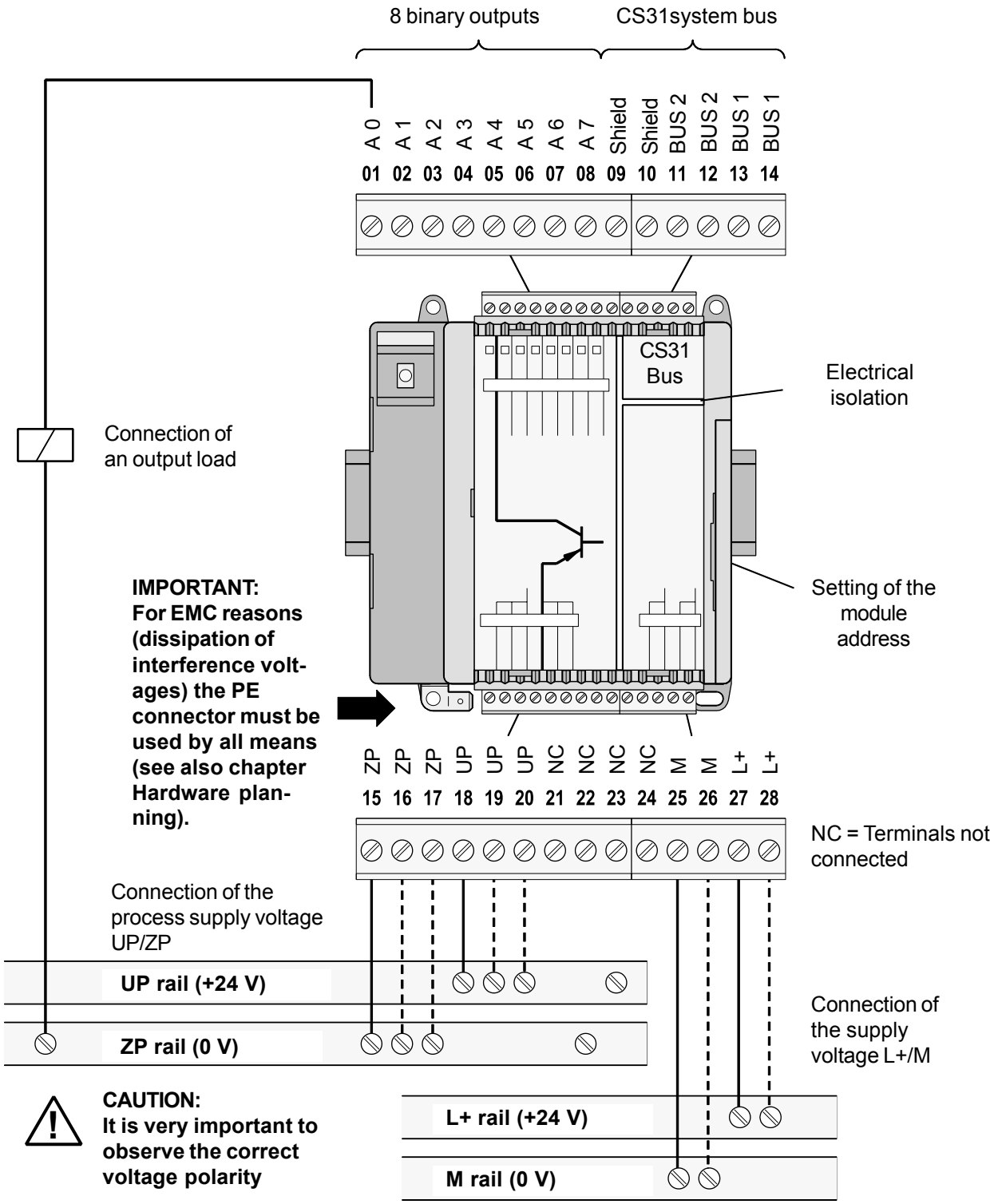

Figure 5-2: Block diagram 07 DO 90-S

## 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 established via pluggable terminal blocks. All terminal blocks must be plugged even those which are not used.

The figure on the next page shows the terminal assignment of the module.

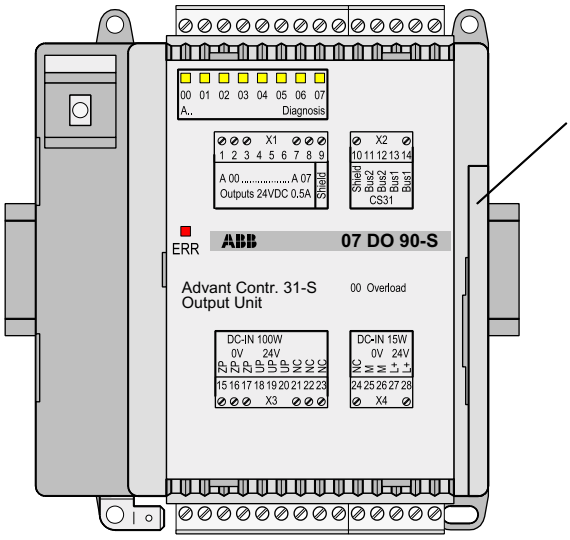



The terminals ZP and UP are intended for the supply of the module's outputs. The terminals M and L+ (electrically isolated from ZP and UP) supply the module's internal circuitry. If ZP and UP or M and L+ are looped through from module to module, the following points must be observed:

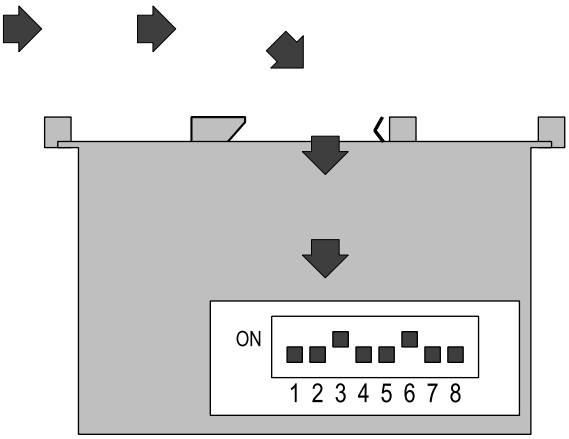
- When unplugging the terminal block, the power supply to the modules connected in series is switched off.
- At the terminals (and the plug-in connections) a total current of 4 A must not be exceeded.

Figure 5-3: 07 DO 90-S, terminal assignment and connection example for an output

## 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

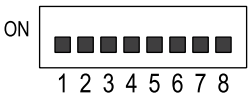
Switch 3: Module addresse bit 4, significance 16
Switch 4: Module addresse bit 3, significance 8
Switch 5: Module addresse bit 2, significance 4
Switch 6: Module addresse bit 1, significance 2
Switch 7: Module addresse bit 0, significance 1

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.

Switch 8: must always be set to OFF

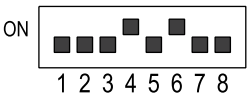
**Examples:**

Module address 0
A 00,00 *
E 00,00




Module address 2
A 02,00 *
E 02,00


Module address 10
A 10,00 *
E 10,00




* Address entry at connection element S_LAB, S_SAB

Figure 5-4: 07 DO 90-S, setting of the 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 on the power supply (L+), the LED 'ERR' will light up for approx. 10 sec. during the start-up selftest of the module. The process voltage UP must be switched on prior to or simultaneously with the supply voltage L+. Otherwise the start-up selftest of the outputs will cause the module's shut-down.

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 output channel (when activated by the AC31 control unit).

### Fuses

The module has three integrated solder-in-type micro-fuses (one for the supply voltage UP and one for each output group, see also Figure 5-2).

If the fuse for UP blows, the following error indication takes place:

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

If one of the fuses for the output groups blows, the affected output group indicates an external error.

The module has always to be replaced if a fuse has blown.

### Diagnosis at the module

The module distinguishes between internal and external errors.

Reaction to internal errors:

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

Reaction to external errors:

- The LED 'ERR' is flashing.
- The power supply of the affected driver group (there are two groups with 4 outputs each) is switched off.
- The error can be requested via the test button of the module.
- After error recovery, the error can be acknowledged by switching the supply voltage L+ OFF and then ON again.

Diagnosis pushbutton:

- 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 is displayed in the channel LEDs for approx. 2 seconds (no LED is lighting means that no error has occurred). After that, the module switches again to the status indication of the output 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.

## Technical data

| | |
|---|---|
| Process voltage **UP** (supplies the output channels) and supply voltage **L+** (supplies the module's circuitry) (power supplies according to VDE551 are necessary) | |
| rated voltage for UP and L+ | 24 V DC ± 5 % ripple |
| upper limit value | 24 V DC + 20 % = 28,8 V (± 5 % ripple) |
| lower limit value | 24 V DC - 15 % = 20,4 V (± 5 % ripple) |
| The supply voltages must rise to at least 19 V within 0 to 40 msec after being switched on. | |
| Buffered voltage interruption time, | |
| for L+ | > 10 ms |
| for Up | no interruption allowed (leads to an external error) |
| Reference potential ZP | 0 V for process voltage UP |
| Reference potential M | 0 V for supply voltage L+ |
| Protection against reversed polarity for L+ | yes |
| Number of outputs per module | 8 |
| Load current | |
| Maximum value | 0.5 A |
| Leakage current at 0 signal | max. 0.3 mA |
| Lamp load | max. 5 W |
| Total current at all 8 outputs | max. 4 A |
| Switching frequency for inductive loads | max. 0.5 Hz |
| Limiting of inductive interrupt voltages | yes, with diode |
| Switching capacitive loads | not allowed (leads to an external error) |
| Short-circuit protection | yes, electronically |
| Output signal delay of the module | |
| signal edge 0 -> 1 and 1 -> 0 | 8 ms, monitoring to 8 ms |
| Duration of test signal | < 1 ms<br>During this time the output has the inverted signal state, see also page 5-2. |
| Output level | |
| 0 signal | 0 V...3 V |
| 1 signal | > UP-2.5 V |
| monitoring the 0 signal | An output level > 8 V (5 V nom.) leads to an internal error, if the output state is 0 (0 signal) (the module will be switched off). |
| Cable lengths with cables laid in parallel | |
| shielded | max. 1000 m |
| unshielded | max. 600 m |
| Conductor cross section of process terminals | max. 1 x 2.5 $mm^2$ |
| tightening torque | max. 0.5 Nm |
| Electrical isolation | against CS31 bus and outputs (as group) |
| Rated insulation voltage, | |
| process terminals from CS31 system bus: | |
| acc. to VDE 0160, rated direct voltage | 0...50 V |
| test voltage for reinforced insulation | 800 V DC |
| outputs: | |
| acc. to VDE 0160, rated direct voltage | 0...50 V |
| test voltage for basis and additional insulation | 500 V DC |

| | |
|---|---|
| Current consumption (UP) | max. 0.2 A + load current at the outputs |
| Current consumption (L+) | 100 mA |
| Total power dissipation | max. 15 W |
| Address setting | see page 5-4 |
| Indication of output signals<br>Error indication | one yellow LED per channel<br>one red LED (ERR) |
| Safety-related CE (S-CE) in the PLC software | S_LAB : Read binary S-output module<br>S_SAB: Write binary S-output module |
| Module-specific CS31 bus transmission time | 750 µs |
| Dimensions (width x height x depth) in mm | 120 x 140 x 85 mm (see next page) |
| Weight | 400 g |
| Order number 07 DO 90-S | GJR5 2508 00 R202 |

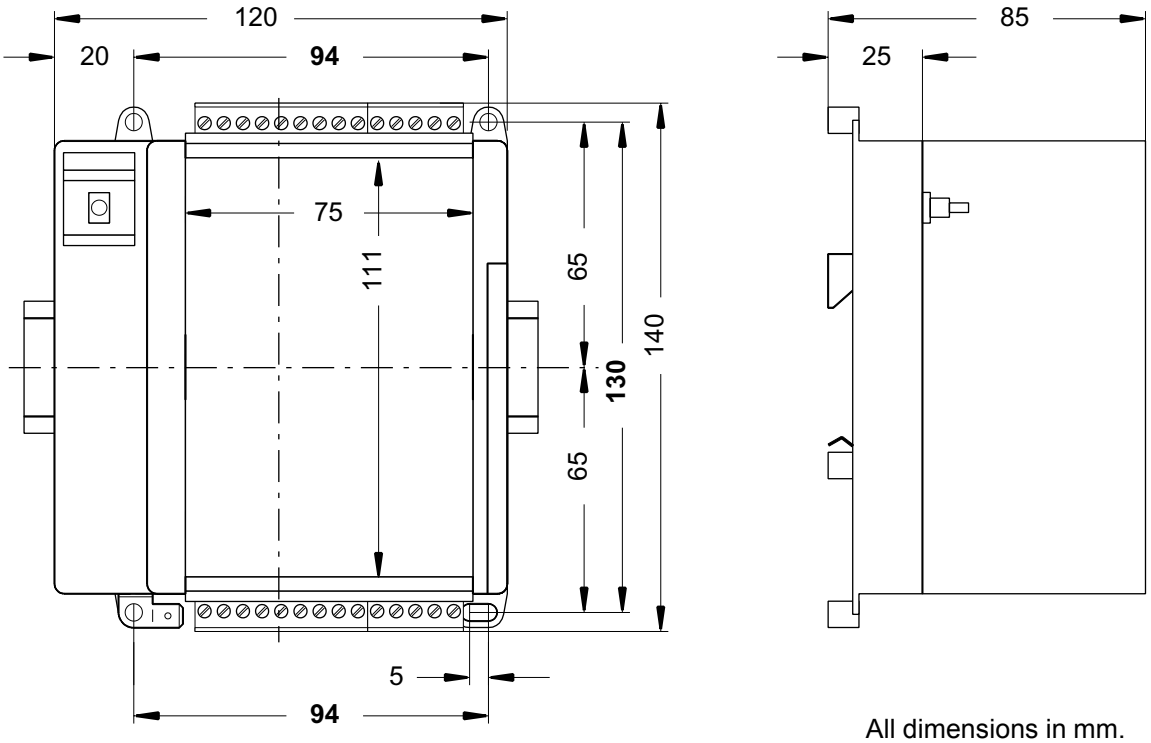
## Installation and dimensions

### 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.




All dimensions in mm.

**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 5-5: 07 DO 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. |

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