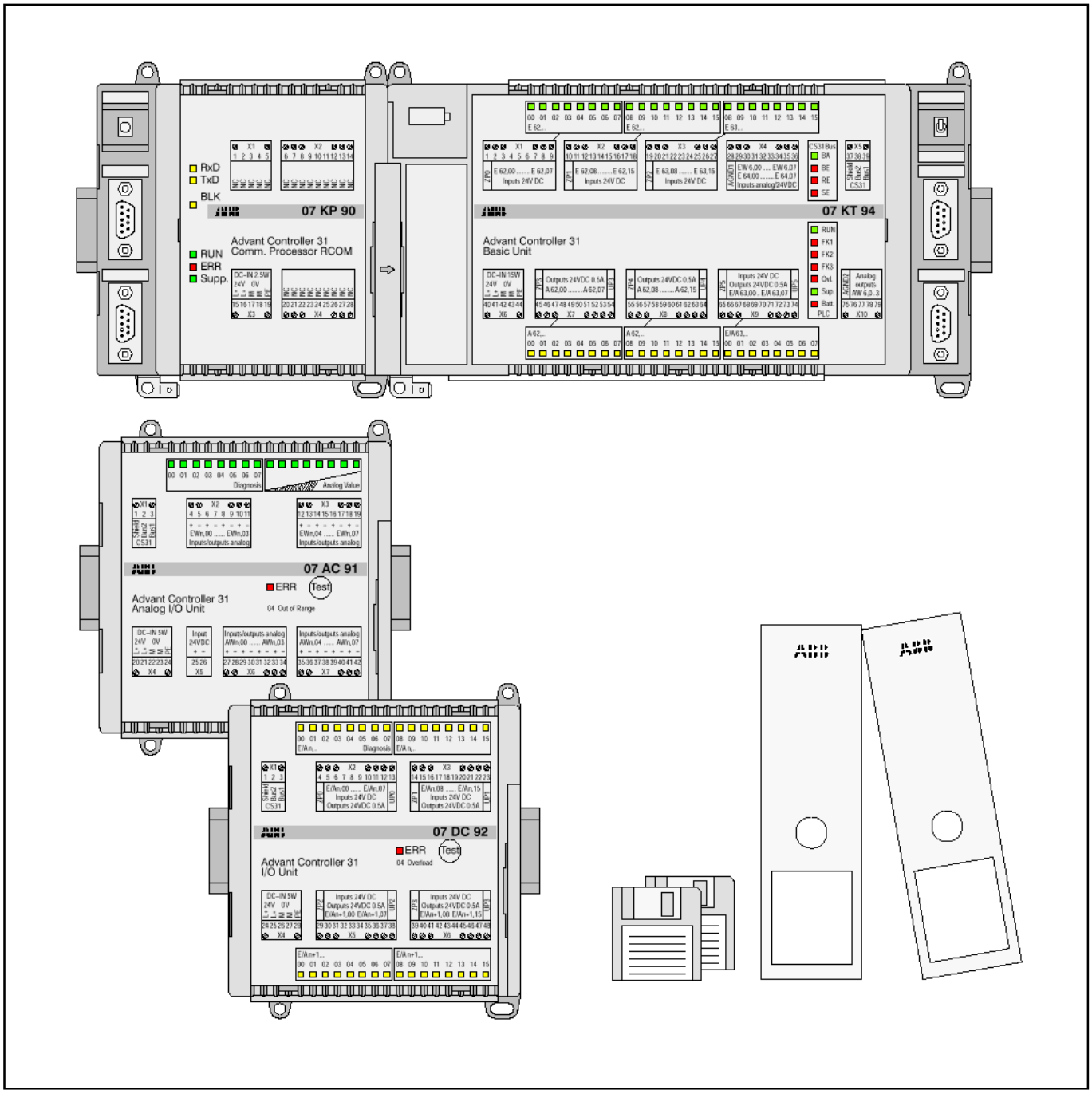
System Description

Advant Controller 31

Intelligent Decentralized Automation System

Hardware



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Regulations
Concerning the Setting up of Installations

Apart from the basic "Regulations for the Setting up of Power Installations" DIN VDE* 0100 and for "The Rating of Creepage Distances and Clearances" DIN VDE 0110 Part 1 and Part 2, the regulations "The Equipment of Power Installations with Electrical Components" DIN VDE 0160 in conjunction with DIN VDE 0660 Part 500 have to be taken into consideration.

Further attention has to be paid to DIN VDE 0113 Part 1 and Part 200 in case of the control of working and processing machines. If operating elements are to be mounted near parts with dangerous contact voltage DIN VDE 0106 Part 100 is additionally relevant.

If the protection against direct contact according to DIN VDE 0160 is required, this has to be ensured by the user (e.g. by incorporating the elements in a switch-gear cabinet). The devices are designed for pollution severity 2 in accordance with DIN VDE 0110 Part 1. If higher pollution is expected, the devices must be installed in appropriate housings.

The user has to guarantee that the devices and the components belonging to them are mounted following these regulations. For operating the machines and installations, other national and international relevant regulations, concerning prevention of accidents and using technical working means, also have to be met.

Devices of Advant Controller 31 Series (AC31) are designed according to IEC 1131 Part 2. Meeting this regulation, they are classified in overvoltage category II which is in conformance with DIN VDE 0110 Part 2.

For the direct connection of AC31 devices, which are powered with or coupled to AC line voltages of overvoltage category III, appropriate protection measures corresponding to overvoltage category II according to IEC-Report 664/1980 and DIN VDE 0110 Part 1 are to install.

Equivalent standards:

DIN VDE 0110 Part 1 ⇔ IEC 664
DIN VDE 0113 Part 1 ⇔ EN 60204 Part 1
DIN VDE 0660 Part 500 ⇔ EN 60439–1 ⇔ IEC 439–1

* VDE stands for "Association of German Electrical Engineers".

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Contents

1 System Data and System Configuration

The relevant product standard for the Advant Controller 31 control system is EN 61131-2 ⇔ IEC 1131-2.

1.1 System data

Operating and environmental conditions

Voltages

24 V DC	Process and supply voltage	24 V DC (+ 20 %, - 15 %, without ripple)
	absolute limits	19.2 V ... 30 V incl. ripple
	ripple	≤ 5 %
120 V AC	Line voltage	120 V AC (+ 10 %, - 15 %)
	frequency	50 Hz (+ 5 %, - 5 %) or 60 Hz (+ 5 %, - 5 %)
230 V AC	Line voltage	230 V AC (+ 10 %, - 15 %)
	frequency	50 Hz (+ 5 %, - 5 %) or 60 Hz (+ 5 %, - 5 %)

Allowed interruptions of power supply

DC supply	interruption ≤ 10 ms, time between 2 interruptions ≥ 1 s
AC supply	interruption ≤ 0.5 periods, time between 2 interruptions ≥ 1 s

Temperature

operating	0 °C ... + 55 °C
storage	- 25 °C ... + 75 °C
transport	- 25 °C ... + 75 °C

Humidity		50...95 %, without condensation
Air pressure	operation	≥ 800 hPa/≤ 2000 m
	storage	≥ 660 hPa/≤ 3500 m

Creepage distances and clearances

The creepage distances and clearances meet	Overvoltage category II, pollution degree 2

Insulation test voltages

230 V circuits (mains, 230 V inputs/outputs) against other circuitry	2500 V
120 V circuits (mains) against other circuitry	1500 V
24 V circuits (supply, 24 V inputs/outputs), when electrically isolated against other circuitry	500 V
CS31 bus against other circuitry	500 V

Electromagnetic compatibility

- Immunity
  against electrostatic discharge (ESD) — according to EN 61000-4-2
  - electrostatic voltage in case of air discharge — 8 kV
  - electrostatic voltage in case of contact discharge — 4 kV
- Immunity against
  the influence of radiated interference (CW radiated) — according to EN 61000-4-5
  - test field strength — 10 V/m

- Immunity
  against transient interference voltages (burst) — according to EN 61000-4-4
  - supply voltage units (AC/DC) — 2 kV
  - digital inputs/outputs (24 V DC) — 1 kV
  - digital inputs/outputs (120/230 V AC) — 2 kV
  - analog inputs/outputs — 1 kV
  - CS31-system bus — 2 kV
  - serial interfaces (COM) — 0.5 kV
  - ARCnet — 0.5 kV

- Immunity against the influence of
  line-conducted interferences (CW conducted) — according to EN 61000-4-6
  - test voltage — 10 V

- Radio disturbance — according to EN 55011 radio interference level A and according to EN 55022 radio interference level A (only for communication modules)

Mechanical data

Wiring method / terminals

for plug-in base ECZ	screw-type terminals for normal and Phillips-head screwdrivers, conductor cross section max. 2 x 2.5 mm^2
for removable terminal blocks (big)	screw-type terminals for normal screwdrivers, conductor cross section max. 2.5 mm^2
for removable terminal blocks (small)	screw-type terminals for normal screwdrivers, conductor cross section max. 1.5 mm^2

Degree of protection — IP 20

Housing — according to UL 94

Vibration resistance — all three axes

10 Hz...57 Hz	continuous	0.0375 mm
	peak	0.075 mm
57 Hz...150 Hz	continuous	0.5 g
	peak	1.0 g

Shock test — all three axes
15 g, 11 ms, half-sinusoidal

Mounting of the modules

DIN rail according to DIN EN 50022, only for plug-in base ECZ:	width 35 mm, depth 15 mm depths 7.5 mm and 15 mm
mounting with screws	screws with a diameter of 4 mm

Interfaces

between the basic unit and the input/output modules,	EIA RS-485 (CS31 system bus)
for the programming units and the connection to a terminal, 9-pole D-SUB, female	EIA RS-232

1.2 CS31 system bus

Wiring

Bus line

construction	2 cores, twisted, **with** common **shield**
conductor cross section	≥ 0.22 mm² (24 AWG)
recommendation	0.5 mm², corresponds to Ø 0.8 mm
twisting rate	> 10 per meter (symmetrically twisted)
core insulation	polyethylene (PE)
resistance per core	≤ 100 Ω / km
characteristic impedance	approx. 120 Ω (100...150 Ω)
Capacitance between the cores	< 55 nF / km (if higher, the max. bus length must be reduced)
terminating resistors	120 Ω ¼ W at both line ends
bus length	max. 500 m

Remarks

Commonly used telephone cables with PE insulation and a core diameter of ≥ 0.8 mm are normally good.

Cables with PVC core insulation and a core diameter of ≥ 0.8 mm can be used up to a length of approx. 250 m. In this case, the bus terminating resistor is approx. 100 Ω.

Bus configurations

A CS31 system bus always contains only one bus master (basic unit or coupler) which controls all actions on the bus. Up to 31 slaves can be connected to the bus, e.g. remote modules or slave-configured basic units.

Besides the wiring instructions shown below, the wiring and earthing instructions provided with the descriptions of the modules are valid additionally.

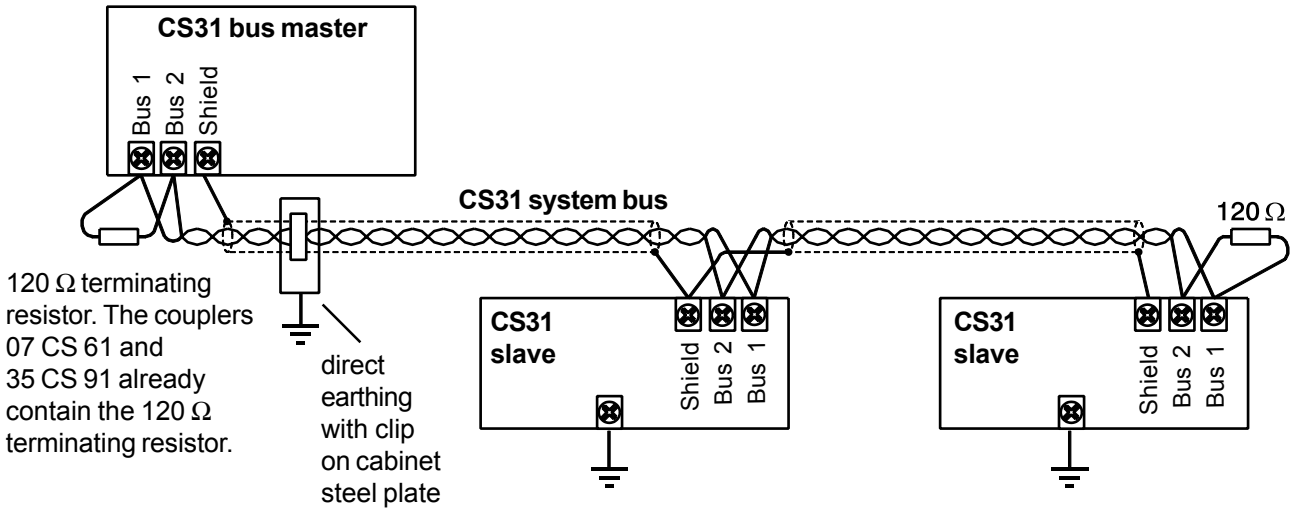


Fig. 1.2-1: Bus configuration for CS31 system bus (bus master at one end of the bus line)

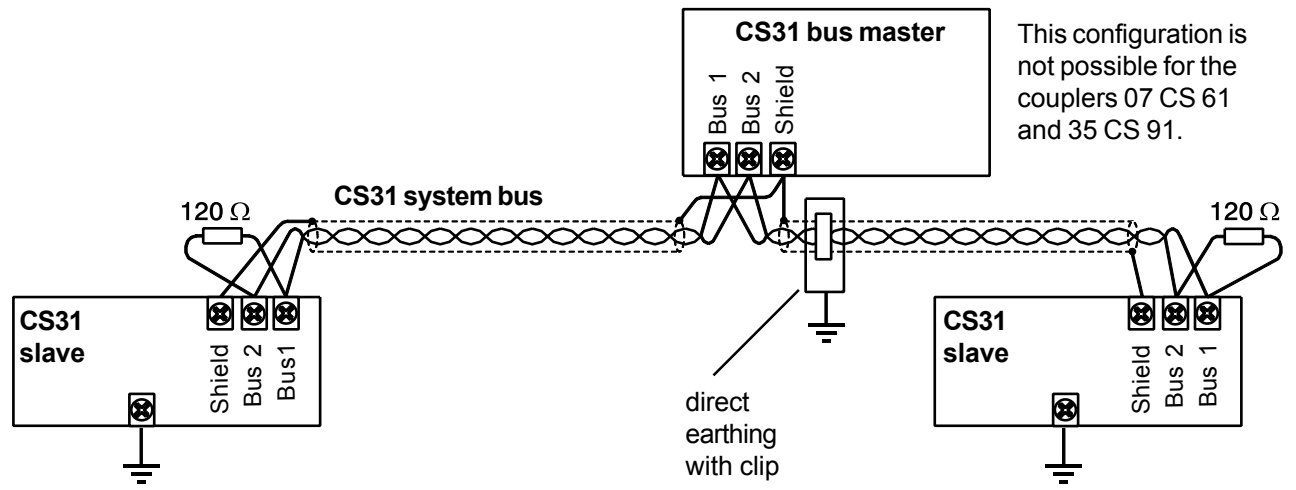


Fig. 1.2-2: Bus configuration for CS31 system bus (bus master within the bus line)

This configuration is only possible for bus masters that do not contain internal bus terminating resistors. Therefore, this configuration is not allowed with the couplers 07 CS 61 and 35 CS 91.

Wiring with spur lines is not allowed.

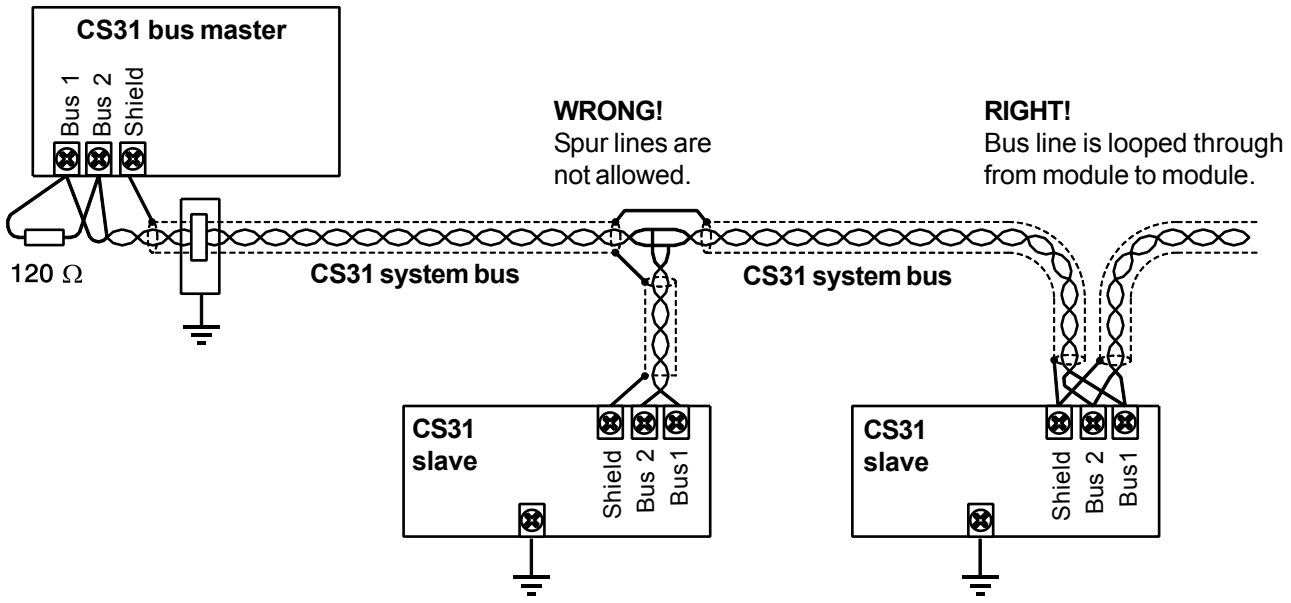


Fig. 1.2-3: Wiring with spur lines is not allowed.

Earthing

In order to avoid disturbance, the cable shields must be earthed directly.

Case a:
Several switch-gear cabinets: If it can be guaranteed that no potential differences can occur between the switch-gear cabinets by means of current-carrying metal connections (earthing bars, steel constructions etc.), the direct earthing is chosen.

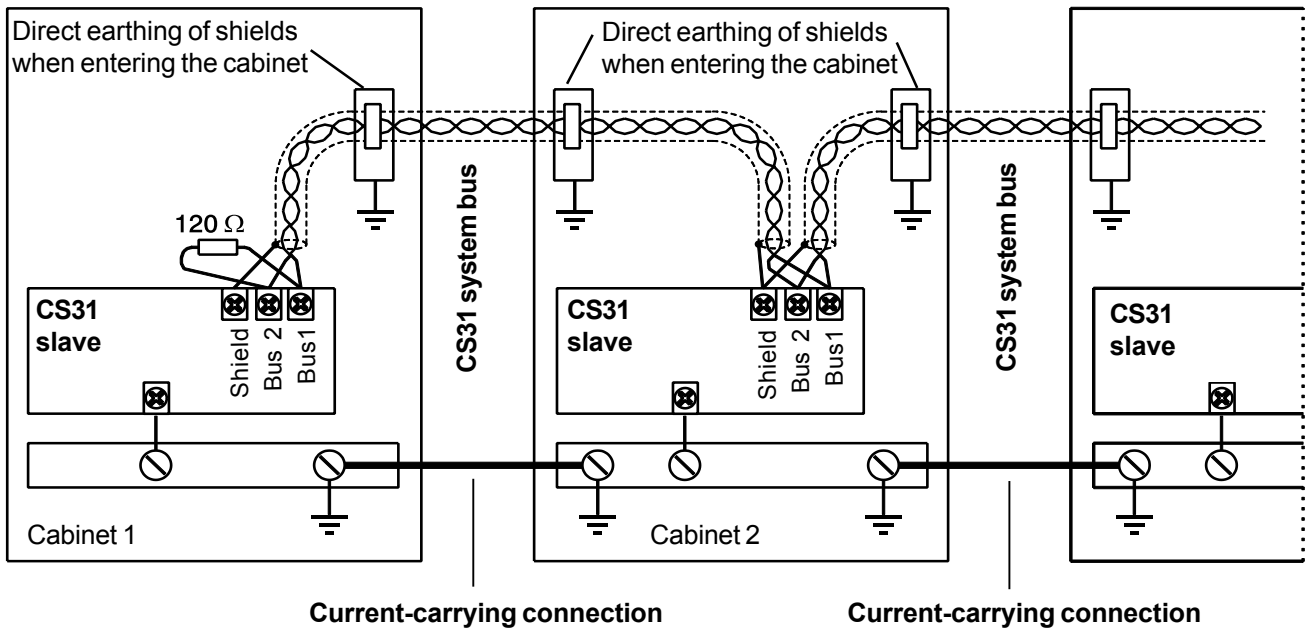


Fig. 1.2-4: Direct earthing

Case b:
Several switch-gear cabinets: If potential differences can occur between the switch-gear cabinets, the capacitive earthing is chosen in order to avoid circulating currents on the cable shields.

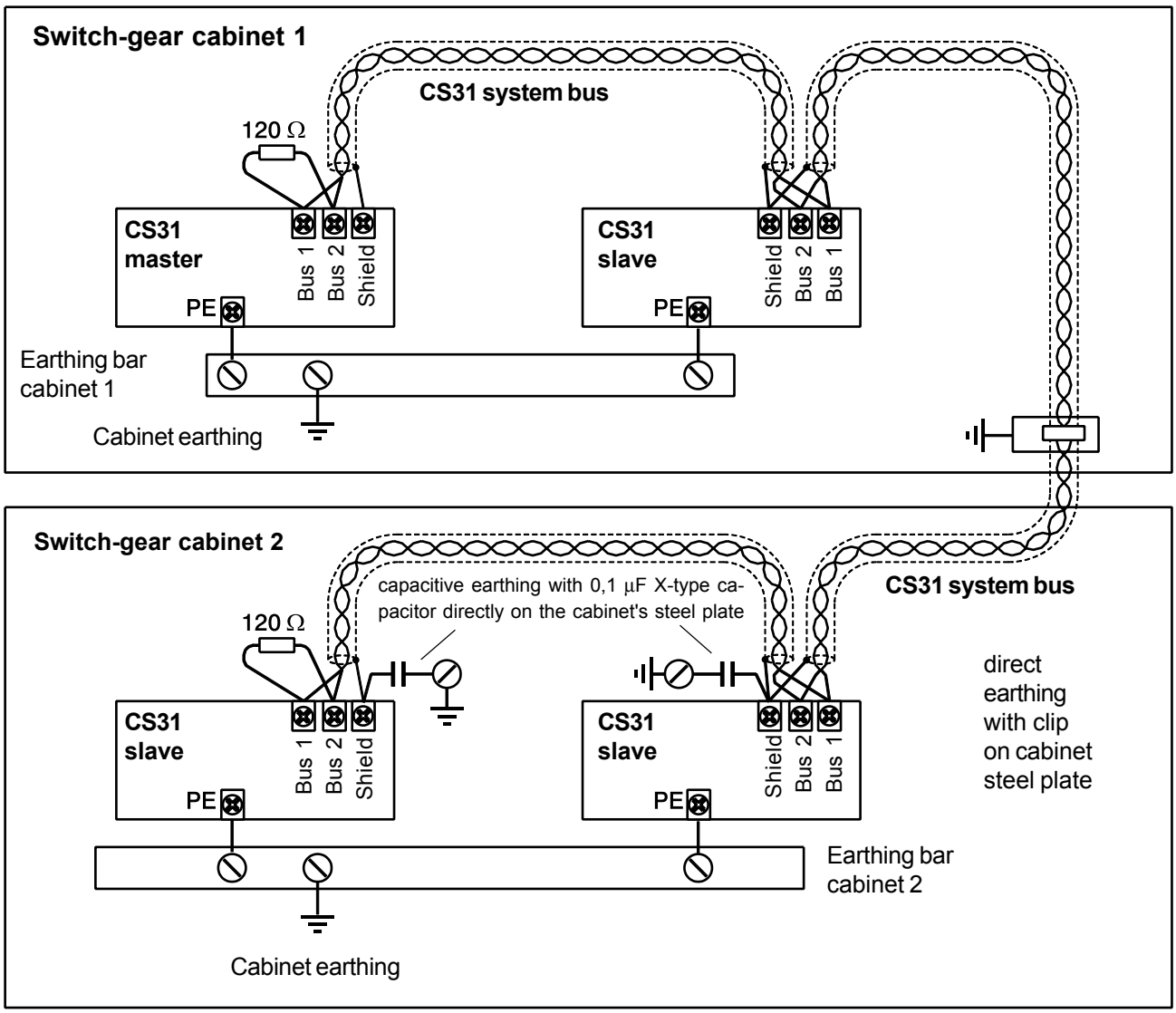


Fig. 1.2-5: Earthing concept with several switch-gear cabinets: direct earthing of cable shields when cables enter the first switch-gear cabinet (containing the master), and capacitive earthing at the modules

Note: The total length of the earthing connections shield-module and module-earthing bar must be as short as possible (max. 25 cm). The conductor cross section must be at least 2.5 mm^2.

VDE 0160 requires, that the shield must be earthed directly at least once per system.

1.3 Hints for project planning

see volume 5

1.4 Bus cycle time and data security

Bus cycle time

In the following, the bus cycle time t_B is introduced. The reaction time from terminal to terminal is the sum of several delays and is described with the basic units. The bus cycle time consist of:

- Base time 2 ms
  During this time the basic unit performs a diagnosis and looks for new remote modules.
- Bus transmission time per module, depends on the type of module (see next page).
- Equation for the bus cycle time of the AC31 modules:

  Bus cycle time t_B = sum of the bus transmission times of the modules + base time (2 ms)

Module	Bus transmission time in µs
Digital input modules	
ICSI 08 D1	323
ICSI 08 E1	323
ICSI 08 E3	323
ICSI 08 E4	323
ICSI 16 D1	387
ICSI 16 E1	387
Digital output modules	
ICSO 08 R1	260
ICSO 08 Y1	260
ICSO 16 N1	340
Digital input/output modules	
ICSC 08 L1	387
ICFC 16 L1	516
ICSK 20 F1	452
ICSK 20 N1	452
07 DC 91 / ICDG 32 L1	516/590 (depending on configuration)
07 DI 92	516
07 DC 92	750/516 (depending on configuration)
IP65-I/O modules	
07 DK 93-I	387
07 DO 93-I	260
07 DI 93-I	387
Analog modules	
ICSM 06 A6	1162
ICSE 08 A6	1355
ICSE 08 B5	1355
ICSA 04 B5	700
ICST 08 A8	1355
ICST 08 A9	1355
07 AI 91 / ICDT 08 B5	1355
07 AC 91	2500
Couplers	
ICBG32L7	516
ICBG64L7	750
High-speed counter	
ICSF 08 D1	1300
Safety-related modules	
07 DI 90-S / 07 EB 90-S	590
07 DO 90-S / 07 AB 90-S	750
07 AI 90-S / 07 EA 90-S	1050

Module	Bus transmission time in µs
Keyboard/LED controller module	
07 TC 90/91, TCK 64 16 E/A	387
32 E/A	750
Basic units as slaves	
07 KR 31 / 07 KT 31	516 * 1)
07 KR 91 / KT 92 / KT 93 / KT 94	750 * 2)
* = default	
Typ. settings	
1) Send 2 bytes + receive 2 bytes (1 word)	516
2) Send 4 bytes + receive 4 bytes (2 words)	750
Send 8 bytes + receive 8 bytes (4 words)	1300
Send 12 bytes + receive 12 bytes (6 words)	1850
Send 8 words + receive 8 words	2500

For system bus-compatible modules from other companies, the bus cycle times are provided with the modules.

Example: 8 modules of 07 DI 92 are used. For one 07 DI 92 a bus transmission time of 516 µs is given in the table. The bus cycle time is now calculated as
t_B = 8 • 516 µs + 2 ms = 6.1 ms.

Data security

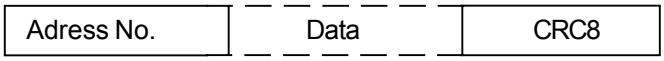
The transmission protocol serves for max. 31 slaves (remote I/O modules) plus one master - the basic unit.

During the initialization cycle the bus master searches for all the slaves and gets in this way the number and types of the found modules.

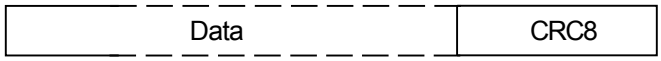
All telegrams terminate with a CRC8 check word. Error security of the bus is Hamming distance 4.

All the messages have the following format:

Request of the basic unit:



Answer of an I/O module:



In every cycle, the bus master addresses all existing modules one after the other, performs diagnostic functions and checks for new installed modules. In this way diagnosis is carried out continuously, the networking is always checked for correct function and new installed modules are detected quickly.

If a basic unit or a module detects a difference between a received CRC and its self-calculated CRC, the concerned telegram is ignored.

A bus error exists when 10 messages are wrong in sequence. For reactions see the descriptions of the the basic units and the couplers.

1.5 Replacing modules on the CS31 system bus

- Check the DIL switch settings.
- After replacing a module, the new module will be adopted into the bus cycle by the basic unit or by the coupler automatically. If a module is replaced while the system is running, some error flags may remain set. They can, for instance, be reset with power off/on of the basic unit.

1.6 Number of user data

The following table shows, how many user data (in **bytes**) the modules **send to the master** or r**eceive from the master**.

Module		sends	receives	type
ICSI 08...		1	0	0
ICSI 16...		2	0	0
ICSO 08...		0	1	2
ICSO 16...		0	2	2
ICSC 08...		1	1	4
ICSC 16...		2	2	4
ICSK 20...		2	1	4
07 DC 91 (ICDG 32 L1)	*	2	2	4
		3	2	4
07 DI 92		4	0	0
07 DC 92	*	4	4	4
		0	4	2
07 DK 93 -I		1	1	4
07 DO 93 -I		0	1	2
07 DI 93 -I		2	0	0
07 TC 91 / 07 TC 90 (TCK 64)	*	2	2	4
		4	4	4
ICSE 08...		16	0	1
ICST 08...		16	0	1
07 AI 91 (ICDT 08 B5)		16	0	1
ICSA 04 B5		0	8	3
ICSM 06 A6		8	4	5
07 AC 91 12 bits	*	16	16	5
8 bits		16	16	5
		16	0	1
		0	16	3
ICSF 08 D1		10	6	5
07 AI 90-S (07 EA 90-S)		12	0	1
07 DO 90-S (07 AB 90-S)		4	4	4
07 DI 90-S (07 EB 90-S)		5	0	0

* depends on configuration

Types: 0 = Digital input
1 = Analog input word
2 = Digital output
3 = Analog output word
4 = Digital input/output
5 = Analog input/output word

4 Digital modules

4.1.1 Digital Input Module 07 DI 92

32 digital inputs 24 V DC, electrically isolated in groups, CS31 system bus

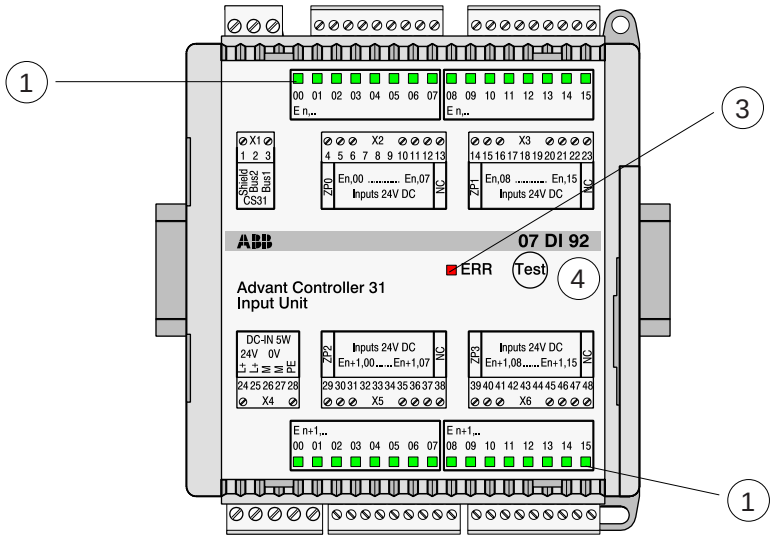


Fig. 4.1.1-1: Digital Input Module 07 DI 92

Contents

Intended purpose

The digital input module 07 DI 92 is used as a remote module on the CS31 system bus. It contains 32 inputs, 24 V DC, in 4 groups with the following features:

- The 4 groups of the inputs are electrically isolated from each other and from the rest of the unit.
- The module occupies two digital addresses for inputs on the CS31 system bus.

The unit works with a supply voltage of 24 V DC.

The system bus connection is electrically isolated from the rest of the unit.

Display and operating elements on the front panel

① 32 green LEDs to indicate the signal status of the inputs

③ Red LED for error messages

④ Test button

Electrical connection

The module can be mounted on a DIN rail (15 mm high) or with 4 screws. The following illustration shows the electrical connection of the input module.

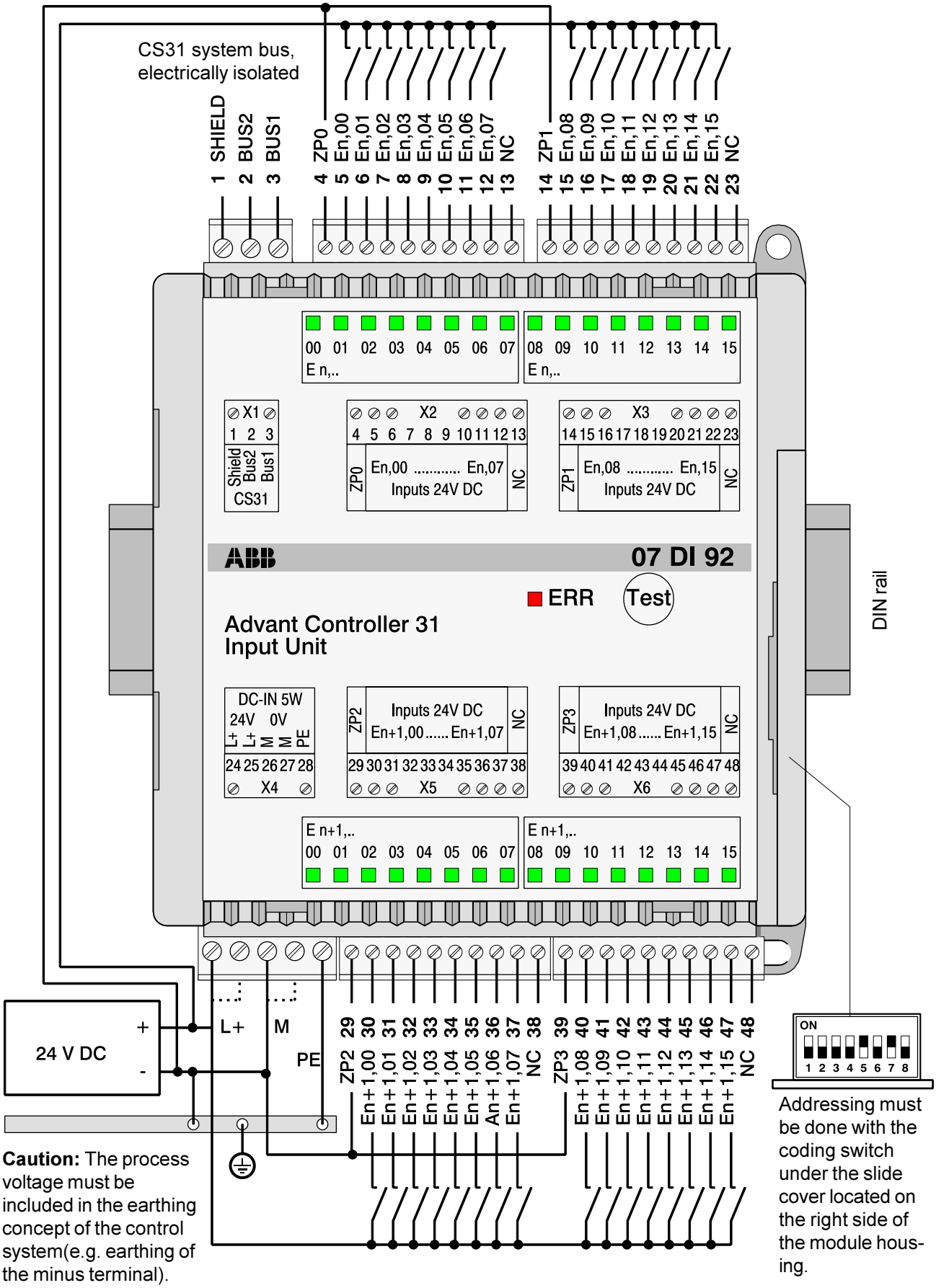


Fig. 4.1.1-2: Electrical connection of the digital input module 07 DI 92

Addressing

An address must be set for each module to enable the basic unit to correctly access the inputs and outputs.

A detailed description about "Addressing" can be found in the chapter "Addressing" of the basic units and couplers.

The address setting is accomplished with the DIL switch located under the slide cover on the right side of the module housing.

When using basic units 07 KR 91, 07 KT 92 to 07 KT 94 as bus master, the following address assignments apply:

Basic units 07 KR 91 / 07 KT 92/93/94

Terminal	Input	Terminal	Input
5	E n,00	30	E n+1,00
6	E n,01	31	E n+1,01
7	E n,02	32	E n+1,02
8	E n,03	33	E n+1,03
9	E n,04	34	E n+1,04
10	E n,05	35	E n+1,05
11	E n,06	36	E n+1,06
12	E n,07	37	E n+1,07
15	E n,08	40	E n+1,08
16	E n,09	41	E n+1,09
17	E n,10	42	E n+1,10
18	E n,11	43	E n+1,11
19	E n,12	44	E n+1,12
20	E n,13	45	E n+1,13
21	E n,14	46	E n+1,14
22	E n,15	47	E n+1,15

n: Module address, can be set with address DIL switch with switches 2...7.
Recommended module addresses for 07 KR 91 / 07 KT 92/93/94 as bus master: 08, 10, 12....60 (even-numbered addresses)

The module occupies **two** addresses on the CS31 system bus for inputs.

Switches 1 and 8 of the address DIL switch must be set to OFF.

Fig 4.1.1-3: Addresses of the channels

Note:

Module 07 DI 92 reads the position of the address switch **only** during the initialization after the power was switched on, which means, that changes of the setting during operation will remain ineffective until the next initialization.

Input/output configuration

No configuration data are required for the 07 DI 92.

Normal operation

- The module automatically initializes after the power has been switched on. During that time, all LEDs are switched on.
- When the CS31 system bus does not run, LED ③ flashes
- The LED ③ goes out again after the system bus runs correctly and the unit does not detect any error.
- The 32 green LEDs ① show the signal status of the 32 inputs.

Displays

By pressing the test button, an LED test is initiated. All LEDs must light up. Following that, the position of the address switch is displayed for about 3 seconds by LEDs 00 to 07 which was set by module 07 DI 92 during the initialization. In this case LED 00 shows the setting of switch 1 (LEDs 0...7 are assigned to switches 1...8).

Technical data 07 DI 92

In general, the technical system data listed under "System data and system configuration" in chapter 1 of volume 2 of the Advant Controller 31 system description are valid. Additional data or data which are different from the system data are listed as follows.

Technical data for the complete unit

Permissible temperature range during operation		0...55 °C
Rated supply voltage		24 V DC
Nominal signal voltage at inputs		24 V DC
Max. current consumption		0.15 A
Max. nominal load capacity for supply terminals		4.0 A
Max. power dissipation inside the unit		10 W
Protection against incorrect polarity of supply voltage		yes
Conductor cross section		
for removable connectors		
power supply		max. 2.5 mm^2
CS31 system bus		max. 2.5 mm^2
signal terminals		max. 1.5 mm^2
reference potentials ZP0, ZP1, ZP2, ZP3		max. 1.5 mm^2
Number of inputs		32
Electrical isolation	CS31 system bus	from the rest of the unit
	inputs	group from group, all groups from the rest of the unit
Reference potential for inputs		each group has a separate reference potential see Fig. 4.1.1–2
Number of interfaces		1 CS31 system bus interface
Address setting		Coding switch under the cover located on the right side of the housing
Operation and error displays		a total of 33 LEDs

Technical data for the digital inputs

Number of channels per module		32
Division of channels into groups		4 groups with 8 channels each, channels En,00...En,07 and En,08...En,15 channels En+1,00...En+1,07 and En+1,08...En+1,15
Reference potentials for the inputs		ZP0, ZP1, ZP2 and ZP3
Electrical isolation		group from group, all groups from the rest of the unit
Input signal delay		typ. 7 ms
Signalization of the input signals		one green LED per channel, LEDs activated according to the input signal
Input signal voltage		24 V DC
0 signal		- 30 V...+ 5 V
1 signal		+ 13 V...+ 30 V
residual ripple	for 0 signal	within - 30 V...+ 5 V
	for 1 signal	within + 13 V...+ 30 V

Input current per channel	
input voltage = + 24 V	typ. 7.0 mA
input voltage = + 5 V	≥ 0.2 mA
input voltage = + 13 V	≥ 2.0 mA
input voltage = + 30 V	≤ 9.0 mA
Conductor cross section	
for the removable terminal blocks	max. 1.5 mm^2 (distance between terminals 3.81 mm)

Connection to the CS31 system bus

Interface standard	EIA RS-485
Electrical isolation	against supply voltage, inputs and outputs
Conductor cross section	
for the removable terminal blocks	max. 2.5 mm^2 (grid space 5.08 mm)

Mechanical data

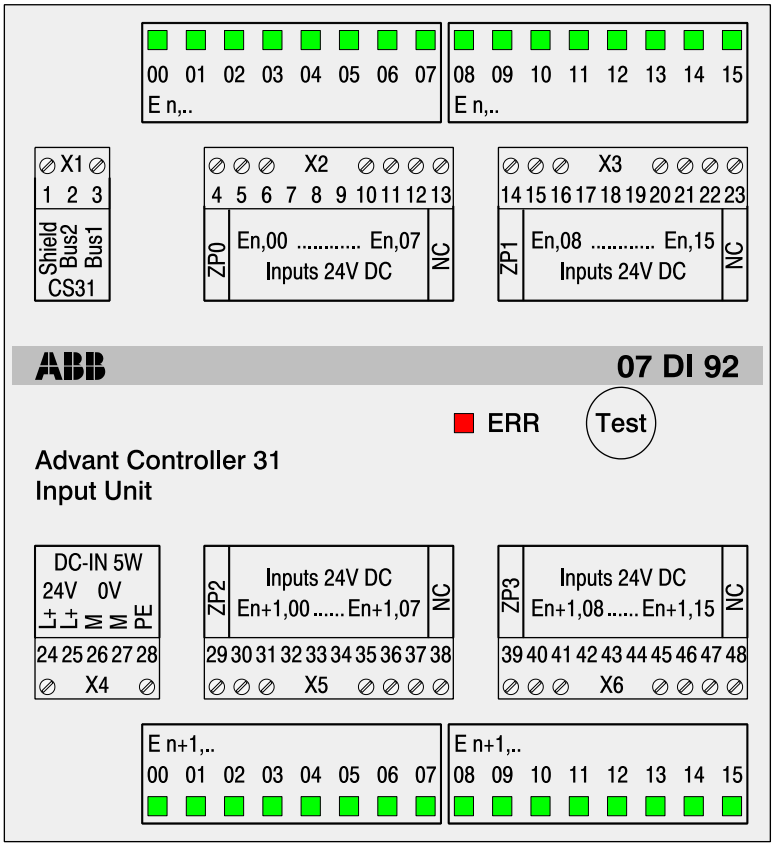
Mounting and DIN rail	according to DIN EN 50022–35, 15 mm deep. The DIN rail is centrally positioned between upper and lower edge of the module.
Mounting with screws	4 screws M4
Width x height x depth	120 x 140 x 85 mm
Connection method	removable connectors with screw-type terminals
cross section	max. 2.5 mm^2 (grid space 5.08 mm) max. 1.5 mm^2 (grid space 3.81 mm)
Weight	450 g
Dimensions for installation	see illustration on next page

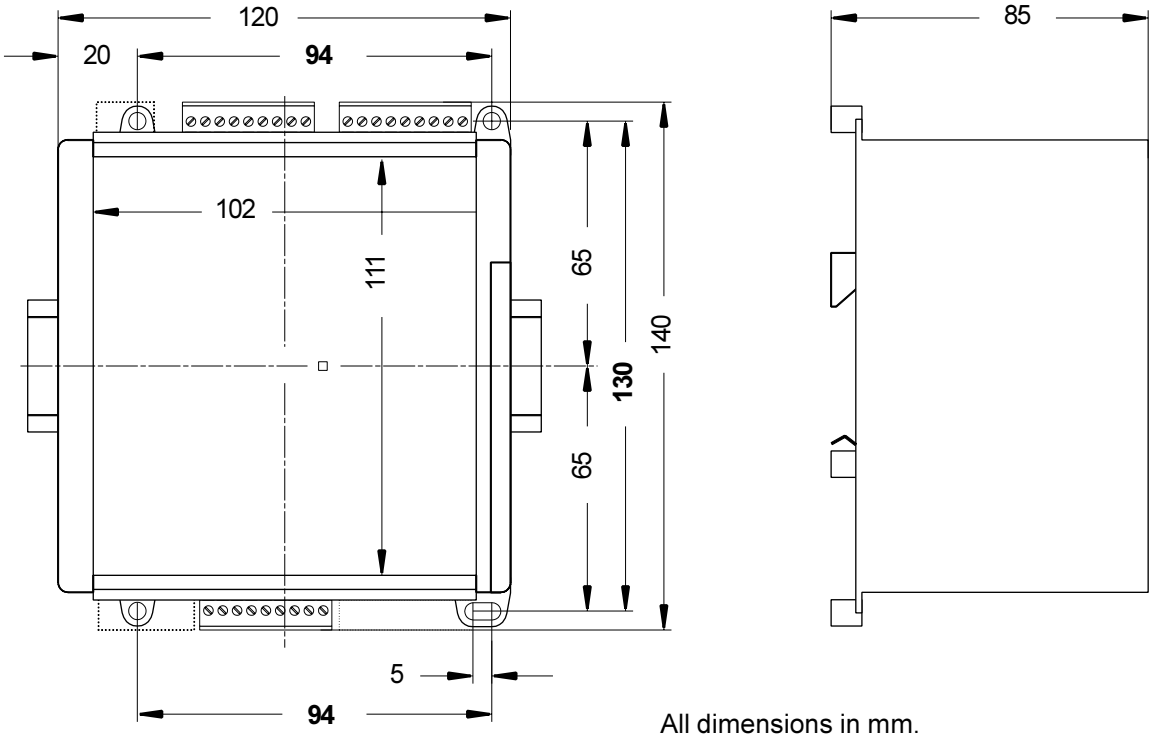
Installation instructions

Mounting position	vertical, connectors must point upward and downward
Cooling	The natural convection cooling must not be obstructed by cable ducts or other components in the cabinet

Ordering data

Module 07 DI 92	Order No. GJR5 2524 00 R0101
Scope of delivery	Digital input module 07 DI 92 1 5-pin connector (grid space 5.08 mm) 1 3-pin connector (grid space 5.08 mm) 4 10-pin connectors (grid space 3.81 mm)





All dimensions in mm.

The depth of the unit is 85 mm. If a DIN rail is used for the installation, the installation depth increases by the depth of the DIN rail.

Fig. 4.1.1-4: 07 DI 92, Front panel and outline dimensions
Dimensions for the installation holes are shown in bold print

4.3.1 Digital Input/Output Module 07 DC 91

16 digital inputs, 8 digital outputs, 8 configurable inputs/outputs, 24 V DC, CS31 system bus

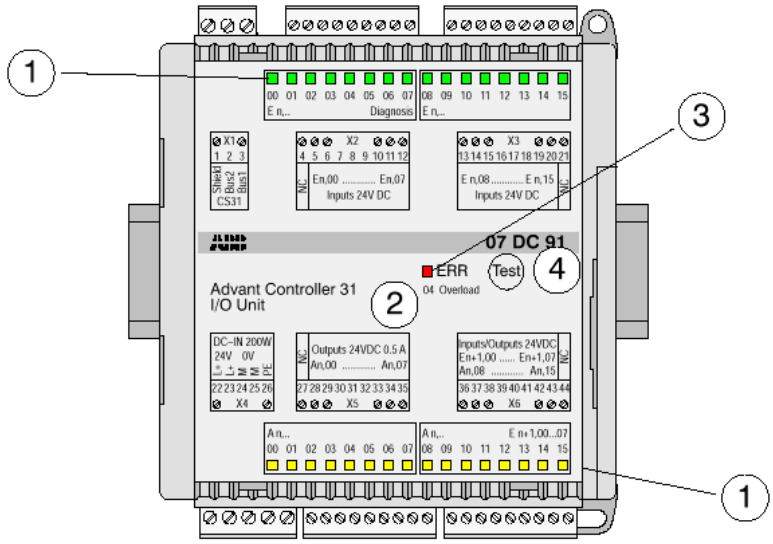


Fig. 4.3.1-1: Digital input/output module 07 DC 91

Contents

Intended purpose

The digital input/output module 07 DC 91 is used as a remote module on the CS31 system bus. It has 32 channels with the following features:

- 16 inputs, 24 V DC, in two groups.
- 8 outputs, 24 V DC, in one group.
  The outputs
  - work with transistors,
  - have a rated load capacity of 0.5 A and
  - are protected against overload and short circuits.
- 8 inputs/outputs, each of which can be addressed
  - as input,
  - as output or
  - as re-readable output
    (combined input/output)

  The technical data are identical with the normal inputs and outputs.

The operating voltage of the module is 24 V DC.

The system bus connection is electrically isolated from the rest of the unit.

The module offers a number of diagnosis functions (see chapter "Diagnosis and displays").

Displays and operating elements on the front panel

① 16 green LEDs to indicate the signal status at the inputs,
16 yellow LEDs to indicate the signal status at the outputs or at the configurable inputs/outputs

② List of diagnosis information related to the LEDs, when used for diagnosis display

③ Red LED for error message

④ Test button

Electrical connection

The module is mounted on a DIN rail (15 mm high) or with 4 screws. The following illustration shows the electrical connection of the input/output module.

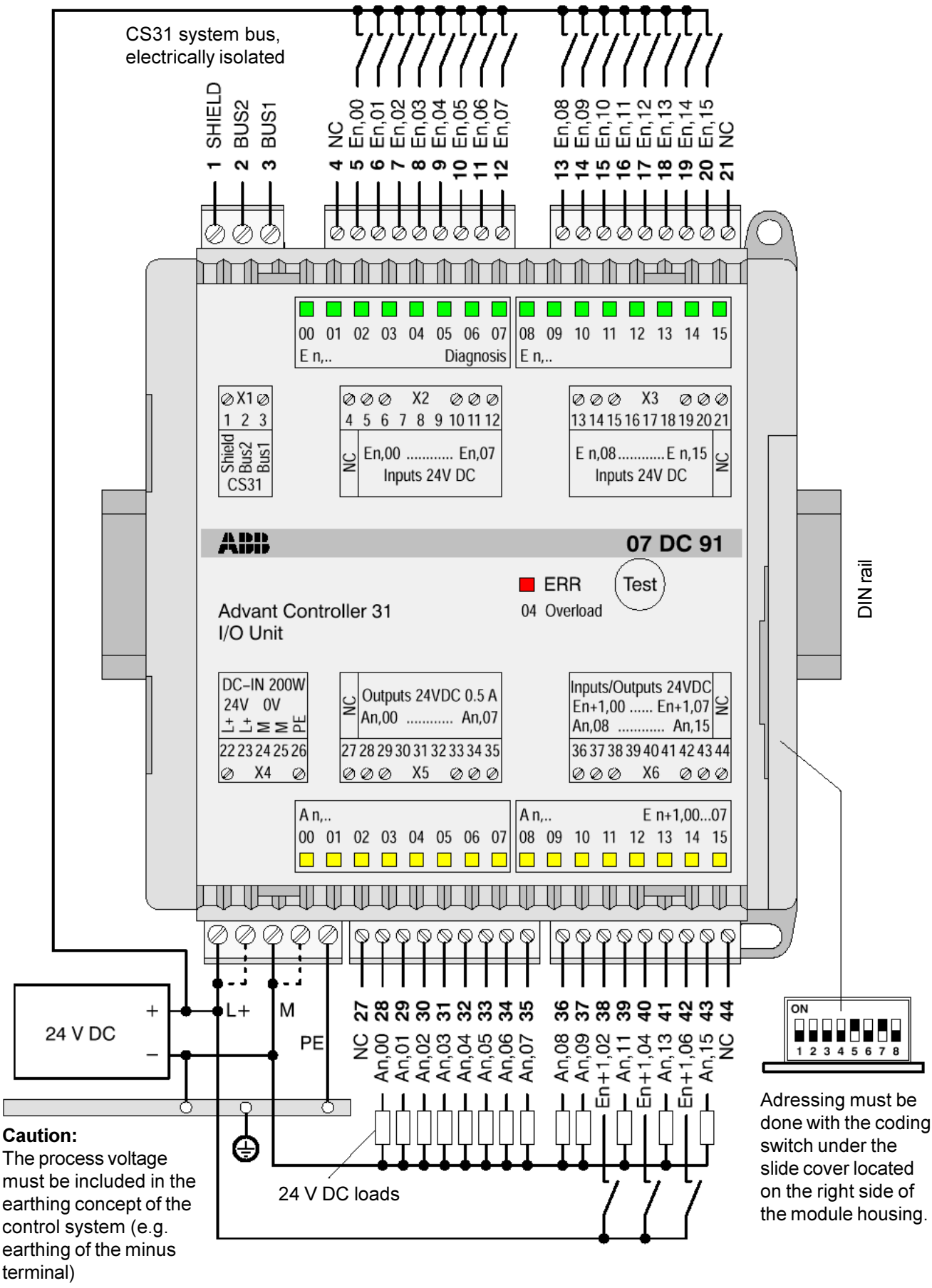


Fig. 4.3.1-2: Electrical connection of the digital input/output module 07 DC 91.
The example shows 19 channels used as inputs and 13 channels used as outputs.

Adressing

An address must be set for each module to enable the central unit to correctly access the inputs and outputs.

A detailed description about "Addressing" can be found in the chapter "Addressing" for the central processing unit and coupler.

The address must be set at the DIL switch, located under the slide cover on the right side of the module.

When using the central units 07 KR 91, 07 KT 92 to 07 KT 94 as bus master, the following **operating modes** (address allocations) apply, depending on the position of the address DIL switch No.1:

Central units 07 KR 91 / 07 KT 92/93/94

When the address DIL switch **No. 1** is set to **ON**, it means that 16 inputs an 16 outputs are **permanently** allocated. In this case all configurable channels are outputs.

Address DIL switch **No. 8** is not used.

Terminal/Input		Terminal/Output	
5	E n,00	28	A n,00
6	E n,01	29	A n,01
7	E n,02	30	A n,02
8	E n,03	31	A n,03
9	E n,04	32	A n,04
10	E n,05	33	A n,05
11	E n,06	34	A n,06
12	E n,07	35	A n,07
13	E n,08	36	A n,08
14	E n,09	37	A n,09
15	E n,10	38	A n,10
16	E n,11	39	A n,11
17	E n,12	40	A n,12
18	E n,13	41	A n,13
19	E n,14	42	A n,14
20	E n,15	43	A n,15

n: The group number can be set at address DIL switch with switches 2...7.
Recommended module addresses for 07 KR 91 / 07 KT 92/93/94 as bus master are 08, 10, 12...60 (even-numbered addresses)

With this setting, the module uses **only one** group number on the CS31 system bus.
In this case 16 inputs and outputs are available.

Fig. 4.3.1-3: Addresses of the channels when DIL switch No. 1 is set to ON

Central units 07 KR 91 / 07 KT 92/93/94

When the address DIL switch **No. 1** is in the **OFF** position (factory setting), it means that 16 inputs and 8 outputs are **permanently** set. The 8 configurable channels can be addressed individually as inputs or outputs.

Address DIL switch **No. 8** is not used.

Terminal/Input		Terminal/Output		Input
5	E n,00	28	A n,00	
6	E n,01	29	A n,01	
7	E n,02	30	A n,02	
8	E n,03	31	A n,03	
9	E n,04	32	A n,04	
10	E n,05	33	A n,05	
11	E n,06	34	A n,06	
12	E n,07	35	A n,07	
13	E n,08	36	A n,08	E n+1,00
14	E n,09	37	A n,09	E n+1,01
15	E n,10	38	A n,10	E n+1,02
16	E n,11	39	A n,11	E n+1,03
17	E n,12	40	A n,12	E n+1,04
18	E n,13	41	A n,13	E n+1,05
19	E n,14	42	A n,14	E n+1,06
20	E n,15	43	A n,15	E n+1,07

n: The group number can be set at address DIL switch with switches 2...7.
Recommended module addresses for 07 KR 91 / 07 KT 92/93/94 as bus master: 08, 10, 12...60 (even-numbered addresses)

With this setting, the module uses **two** group numbers on the CS31 system bus occupying 24 binary input channels and 16 binary output channels. 16 inputs, 8 outputs and 8 configurable inputs/outputs are available.
An +1,00...15 and En1,08...15 are not used. They can be used for other modules if needed.

Fig. 4.3.1-4: Addresses of channels when DIL switch No. 1 is set to OFF

Note:
Module 07 DC 91 reads the setting of the address switch **only** during the initialization, after switching on the power supply, meaning that changes of the setting during operation remain ineffective until the next initialization process.

Input/output configuration

Module 07 DC 91 does not store any configuration data. The 8 configurable channels are defined as inputs or outputs by the user program, e.g. by reading or writing data in the user program. Every configurable input/output channel can be used as input or output (or re-readable output). When used as input, the channel must not be assigned a 1 signal (see Fig. 4.3.1-3 and 4.3.1-4 for setting of the address DIL switch and address assignment).

Normal operation

- The module initializes automatically after power is switched on. During this time all LEDs are switched on.
- If the CS31 system bus does not run, the LED ③ flashes
- LED ③ goes out again after the bus operation runs correctly and the module does not detect an error.
- The 16 green and the 16 yellow LEDs ① indicate the signal status of the 32 channels.

Diagnosis and display

In case of an overload or a short-circuit, the output switches off and then performes re-starting attempts. An acknowledgement of the output is therefore not necessary. However, the error message is displayed by the LED.

Diagnosis functions:

- Short-circuit / overload of outputs (I > 0.7 A)
- Reporting of a short-circuit or overload condition to the central unit
- Storing and making this information available when recalled (kind of error and error location)
- Error inside of module
- Error on CS31 system bus

If one of these errors occur, the red LED ③ lights up. **The error is transmitted to the central unit or the coupler.** For additional information see instructions supplied there under "Diagnosis".

Using test button ④ and the LED displays ① a diagnosis interrogation can be performed directly at the unit.

Pressing the test button for the first time, En,**00** is selected: the status LED of the selected input flashes, all other status displays are switched off during this test. After releasing the test button, the diagnosis information for this channel is displayed for about 3 seconds by the green LEDs 00 to 07.

Explanation of LEDs:

00 not used
01 not used
02 not used
03 not used
04 Overload or
short circuit, only for outputs
05 not used
06 not used
07 not used

The explanation for the LEDs ② is also printed on the front panel in English.

With every successive pressing and releasing of the test button, the process is repeated for the other input and output channels (I/O channels).

After calling up the last channel and pressing the test button once again, an LED test is performed. All LEDs must light up. Then the setting of the address switch is displayed for about 3 seconds by LEDs 00 to 07 which the 07 DC 91 module has set during initialization. In this case LED 0 shows the setting of switch 1 (LEDs 0...7 are assigned to switches 1...8).

The error messages in the I/O module and central unit are deleted, as soon as the errors have been corrected, if no further errors exist **and** when the error correction has been acknowledged.

Acknowledgement of an error after error correction:

- by pressing the test button for about 5 seconds, or
- by the PLC program, or
- by the PC.

Note:

The short-circuit and overload message indicates which channel has got the error.

The error message refers to a group of 4 outputs. This means, a short-circuit on one single channel (channel 0, 1, 2 or 3) is indicated as an error for all 4 channels (the whole group). The diagnosis message sent to the PLC always contains the first channel of the channel group, in this case channel 0.

After conclusion of the diagnosis interrogation, the 32 green and yellow LEDs again show the signal status of the channels.

Technical Data for 07 DC 91

In general, the technical system data listed under "System data and system configuration" in chapter 1 of volume 2 of the "Advant Controller 31" system description are valid. Additional data or data which are different from the system data are listed as follows.

Technical data of the complete unit

Permissible temperature range during operation	0...55 °C
Rated supply voltage	24 V DC
Rated signal voltage for inputs and outputs	24 V DC
Max. current consumption without load	0.15 A
Max. rated load for supply terminals	4.0 A
Max. power dissipation in module (outputs without load)	5 W
Max. power dissipation in module (outputs under load)	10 W
Protection against reversed polarity of power connection	yes
Conductor cross section	
for removable connectors	
power input	max. 2.5 mm^2
CS31 system bus	max. 2.5 mm^2
signal terminals	max. 1.5 mm^2
Number of binary inputs	16
Number of binary transistor outputs	8
Number of configurable inputs and outputs	8
Reference potential for all inputs and outputs	Terminals 24/25 (minus pole of supply voltage, terminal M)
Number of interfaces	1 CS31 system bus interface
Electrical isolation	CS31 system bus interface against the rest of the unit
Address setting	Coding switch under the slide cover located on the right side of the housing
Diagnosis	see chapter "Diagnosis and displays"
Operation and error messages	a total of 33 LEDs

Technical data of the digital inputs

Number of channels per unit	16
Distribution of channels in groups	2 groups of 8 channels each, channels En,00...En,07, and En,08...En,15
Reference potential for all inputs	Terminals 24/25 (minus pole of supply voltage, terminal M)
Electrical isolation	from CS31 system bus
Input delay	typ. 7 ms
Signalization of input signals	one green LED per channel, LED activated according to the input signal
Input signal voltage	24 V DC
0 signal	- 30 V...+ 5 V
1 signal	+ 13 V...+ 30 V
residual ripple at 0 signal	within - 30 V...+ 5 V
at 1 signal	within + 13 V...+ 30 V

Input current per channel	
Input voltage = + 24 V	typ. 7.0 mA
Input voltage = + 5 V	≥ 1.0 mA
Input voltage = + 13 V	≥ 2.0 mA
Input voltage = + 30 V	≤ 9.0 mA
Conductor cross section	
for removable connectors	max. 1.5 mm^2 (grid space 3.81 mm)

Technical data of digital outputs

Number of channels per unit	8 transistor outputs
Distribution of channels in groups	1 group of 8 channels channels An,00...An,07
Reference potential for all inputs	Terminals 24/25 (minus pole of supply voltage, terminal M)
Common voltage supply terminals for all outputs	Terminals 22/23 (plus pole of supply voltage, terminal L+)
Electrical isolation	from CS31 system bus
Signalization of output signals	one yellow LED for each channel, LED activated according to output signal
Output current	
nominal value	500 mA at L+ = 24 V
maximum value	4 A total current per group
leakage current at 0 signal	< 0.5 mA
De-magnitization during inductive load	via internal varistor
Switching frequency at inductive load	max. 0.5 Hz
Switching frequency with lamps	max. 11 Hz at max. 5 W
Protection against short-circuit/overload	yes
overload message (I ≥ 0.7 A)	yes, after approx. 100 ms
limiting of output current	yes
reactivation after short-circuit/overload	automatically
Resistance to feedback against 24V signals	yes
Total load current (including output current of configured inputs and outputs)	max. 8 A
Conductor cross section for removable connectors	max. 1.5 mm^2 (grid space 3.81 mm)

Technical data of configurable inputs and outputs

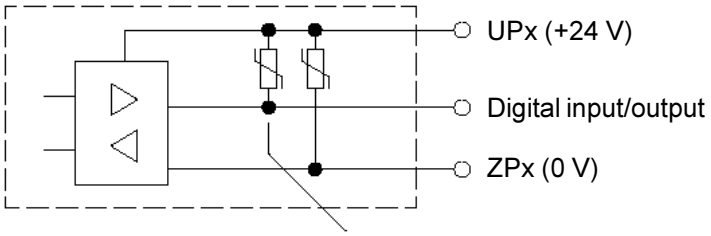
The configuarable channels are defined individually by the user program as either inputs or outputs. This is done by reading or writing data to/from the respective channel.

Number of channels per unit	8 inputs / transistor outputs
Distribution of channels in groups	1 group of 8 channels
when using channels as inputs	channels En+1,00...En+1,07
when using channels as outputs	channels An,08...An,15
Signalization of input and output signals	one yellow LED per channel, LED activated according to binary signal
Technical data when used as outputs	refer to digital outputs

Technical data when used as inputs

Input current per channel	refer to digital inputs
Input signal voltage	24 V DC
0 signal	- 6 V...+ 5 V *
1 signal	+ 13 V...+ 30 V
residual ripple at 0 signal	within - 6 V...+ 5 V *
at 1 signal	within + 13 V...+ 30 V

* Due to the direct connection to the output, the demagnetizing varistor is also effective at the input when disconnecting inductive loads (see figure). This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Following this, the input voltage must range from - 12 V to + 30 V when UPx = 24 V and from - 6 V to + 30 V when UPx = 30 V.
The following figure shows the circuit arrangement of a digital input/output.



For demagnetization when switching off inductive loads

Connection to the CS31 system bus

Interface standard	EIA RS-485
Electrical isolation	against voltage supply, input and output
Conductor cross section for removable 3-pole connector	max. 2.5 mm^2

Mechanical data

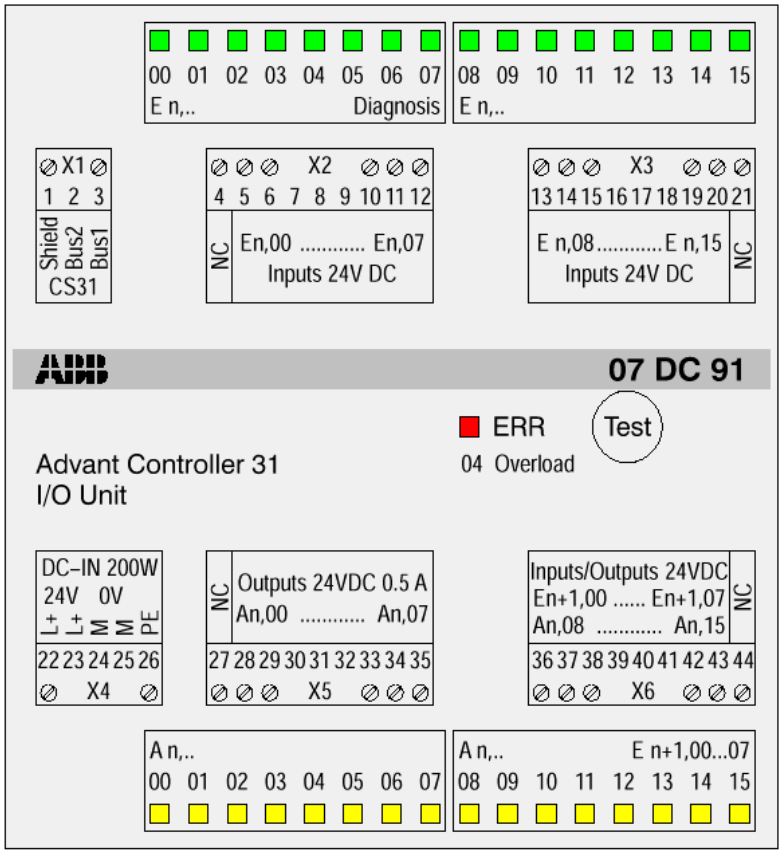
Mounting to DIN rail	according to DIN EN 50022-35, 15 mm deep. The DIN rail is centrally positioned between upper and lower edges of the module.
Mounting with screws	by 4 screws M4
Width x height x depth	120 x 140 x 85 mm
Connector	removable connectors with screw-type terminals
conductor cross section	max. 2.5 mm^2 (grid space 5.08 mm) max. 1.5 mm^2 (grid space 3.81 mm)
Weight	450 g
Dimensions for installation	refer to figure on next page

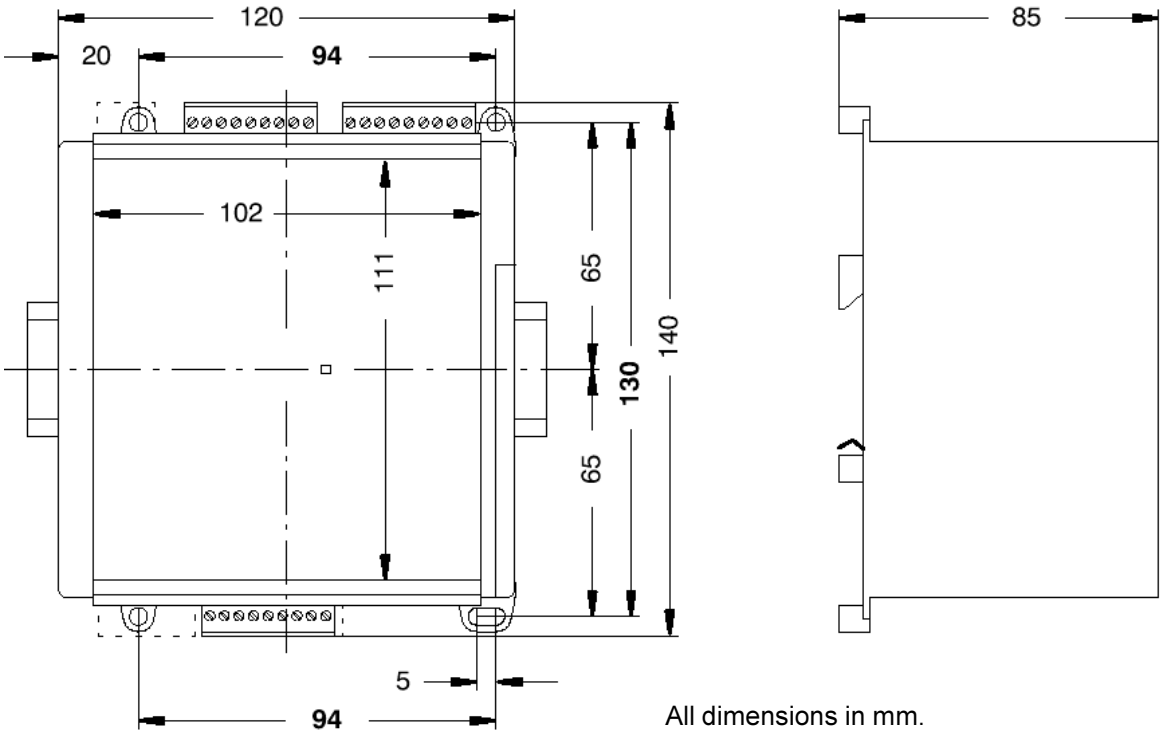
Installation instructions

Installation position	vertical with connectors pointing up and down
Cooling	The natural convection cooling must not be hindered by cable ducts or other additional components installed in the cabinet.

Ordering data

Module 07 DC 91	Order No. GJR5 2514 00 R0202
Scope of delivery	Digital input/output module 07 DC 91 1 5-pin connector (grid space 5.08 mm) 1 3-pin connector (grid space 5.08 mm) 4 9-pin connectors (grid space 3.81 mm)





All dimensions in mm.

The depth of the module is 85 mm. If a DIN rail is used, the installation depth must be increased by the dimension of the rail.

Fig. 4.3.1-5: 07 DC 91, Front panel foil and outside dimension
Dimensions for installation holes are shown in bold print

4.3.2 Digital Input/Output Module 07 DC 92

32 configurable digital inputs/outputs, 24 V DC, electrically isolated in groups, outputs can be loaded with 500 mA, CS31 system bus

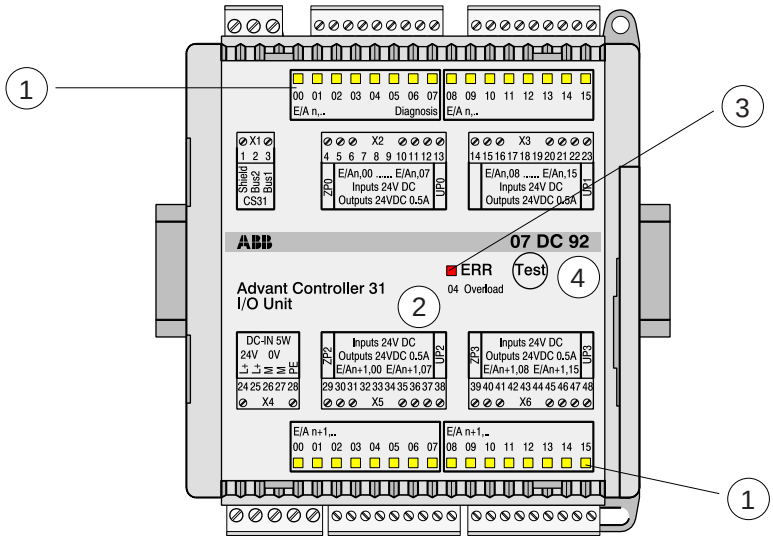


Fig. 4.3.2-1: Digital input/output module 07 DC 92

Contents

Intended purpose

The digital input/output module 07 DC 92 is used as a remote module on the CS31 system bus. It contains 32 inputs/outputs, 24 V DC, in 4 groups with the following features:

- The inputs/outputs can be accessed individually
  - as input,
  - as output or
  - as re-readable output (combined input/output)
- The outputs
  - work with transistors,
  - have a nominal load rating of 0.5 A and
  - are protected against overload and short circuit.
- The 4 groups of inputs/outputs are electrically isolated from each other and from the rest of the unit.
- The module occupies two digital addresses for inputs and outputs on the CS31 system bus. It is possible to configure the unit solely as an output module. In this case, the addresses for the inputs are not needed.

The unit works with a supply voltage of 24 V DC.

The system bus connection is electrically isolated from the rest of the unit.

The module offers a number of diagnosis functions (see chapter "Diagnosis and displays").

Displays and operating elements on the front panel

① 32 yellow LEDs to indicate the signal status of the configurable inputs and outputs

② List of diagnosis information concerning the LEDs when they are used for diagnosis display

③ Red LED for error message

④ Test button

Electrical connection

The module can be mounted on a DIN rail (height 15 mm) or with 4 screws. The following figure shows the electrical connection of the input/output module.

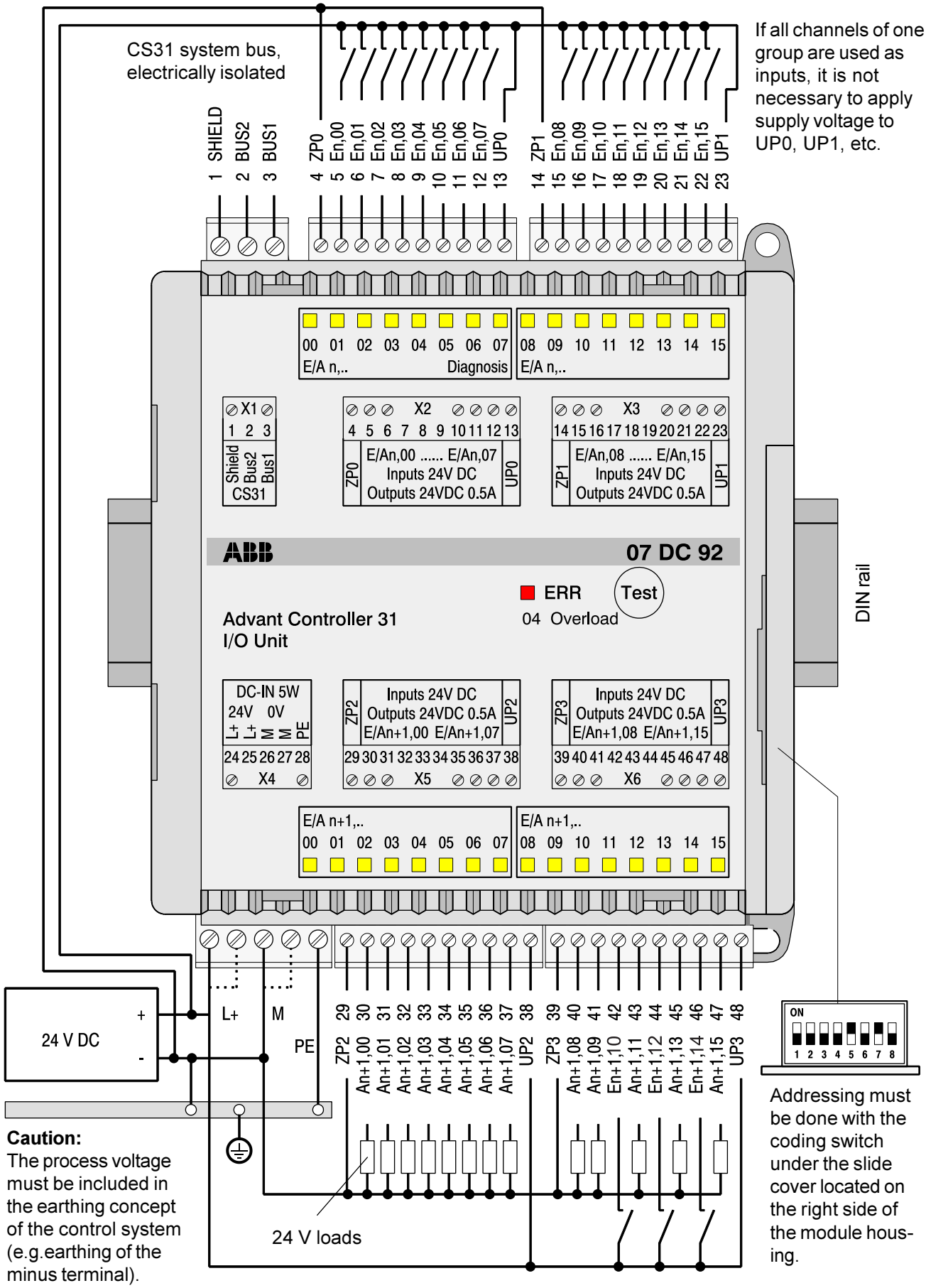


Fig. 4.3.2-2: Electrical connection of the digital input/output module 07 DC 92. The example shows 19 channels as inputs and 13 as outputs.

Addressing

An address must be set for each module to enable the central unit to correctly access the inputs and outputs.

A detailed description about "Addressing" can be found in the chapter "Addressing" for the central processing unit and coupler.

The address setting is accomplished with the DIL switch located under the slide cover on the right side of the module housing.

When using cental units 07 KR 91 or 07 KT 92 to 07 KT 94 as bus master, the following **possibilities** (address assignments) are offered, depending on the setting of the address DIL switch No. 1:

Central units 07 KR 91 / 07 KT 92/93/94

If the address DIL switch **No. 1** is set to **OFF**, all 32 channels can be used individually as inputs or outputs.
DIL switch 8 is not used.

Terminal	Input	Output
5	E n,00	A n,00
6	E n,01	A n,01
7	E n,02	A n,02
8	E n,03	A n,03
9	E n,04	A n,04
10	E n,05	A n,05
11	E n,06	A n,06
12	E n,07	A n,07
15	E n,08	A n,08
16	E n,09	A n,09
17	E n,10	A n,10
18	E n,11	A n,11
19	E n,12	A n,12
20	E n,13	A n,13
21	E n,14	A n,14
22	E n,15	A n,15
30	E n+ 1,00	A n+1,00
31	E n+ 1,01	A n+1,01
32	E n+ 1,02	A n+1,02
33	E n+ 1,03	A n+1,03
34	E n+ 1,04	A n+1,04
35	E n+ 1,05	A n+1,05
36	E n+ 1,06	A n+1,06
37	E n+ 1,07	A n+1,07
40	E n+ 1,08	A n+1,08
41	E n+ 1,09	A n+1,09
42	E n+ 1,10	A n+1,10
43	E n+ 1,11	A n+1,11
44	E n+ 1,12	A n+1,12
45	E n+ 1,13	A n+1,13
46	E n+ 1,14	A n+1,14
47	E n+ 1,15	A n+1,15

Fig. 4.3.2-3: Addresses of channels (channel numbers) when the DIL switch No. 1 is switched to OFF

Item **n** in the table designates the module address that can be set with the address DIL switch with switches 2...7.

When using 07 KR 91 / 07 KT 92/93/94 as bus master, we recommend to use even-numbered module addresses (08, 10, 12.....60).

In this setting, (**DIL switch 1 in OFF position** = factory setting) the module occupies **two** addresses for inputs and outputs.

If the **DIL switch 1 is set to ON**, the unit is configured solely as an output module. In this case, the addresses for inputs are not needed.

Note:
Module 07 DC 92 reads the setting of the address switch **only** during initialization, after switching on the power supply, meaning that changes of the setting during operation remain ineffective until the next initialization process.

Acknowledging outputs after a short-circuit

When an overload or short-circuit occurs, the output limits the current and thermically switches it off. The LED of the overloaded output is flashing.

After the overload or short-circuit is corrected, the outputs are switched on again automatically. A manual acknowledgement or one initiated by the user program is not necessary. The error message has to be acknowledged.

I/O configuration

Module 07 DC 92 does not store configuration data. The 32 configurable channels are defined by the user program as inputs or outputs, which means that through reading and writing data in the user program, each configurable input/output channel can be used as input, output, or re-readable output.

Normal operation

- The module automatically initializes after the power has been switched on. During that time, all LEDs are switched on.
- When the CS31 system bus does not run, LED ③ flashes.
- LED ③ goes out again when the bus operation runs correctly and the module does not recognize an error.
- The 32 yellow LEDs ① show the signal status of the 32 channels.

Diagnosis and displays

Diagnosis functions:

- Short-circuit/overload of outputs (I > 0.7 A)
- Reporting of a short-circuit or overload condition to the central unit and flashing of the corresponding LED
- Storing and making this information available for recall (kind of error and location of error)
- Error inside of module
- Error on CS31 system bus

If one of these errors occur, the red LED ③ will light up. **The error message will be reported to the central unit or to the coupler.** For additional information refer to chapter "Diagnosis" for these devices.

A direct diagnosis inquiry can be made with the test button ④ and the upper LED displays ①.

By pressing the test button once, the channel E/A n, **00** is selected: the status LED of the selected input flashes while all other status indicators are switched off during the test. After releasing the test button, the diagnosis information for this channel is displayed for about 3 seconds by the upper yellow LEDs 00 to 07.

Explanation of the lit LEDs:

00 not used
01 not used
02 not used
03 not used
04 Overload or short-circuit, only for outputs
05 not used
06 not used
07 not used

The explanation of the LEDs ② is also printed on the front panel.

The procedure is repeated for the other input and output channels with each successive pressing and releasing of the test button.

After accessing the last channel, another pressing of the test botton initiates an LED test. All LEDs must light up. Following that, the position of the address switch is displayed by LEDs 00 to 07 for about 3 seconds which was set by module 07 DC 92 during the initialization. In this case LED 00 shows the setting of switch 1 (LEDs 0...7 are assigned to switches 1...8).

The error messages at the I/O module and at the central control unit go out as soon as the errors have been corrected, no new errors exist **and** the error correction has been acknowledged.

Acknowledging an error after error correction:

- by pressing the test button for about 5 seconds or
- by the PLC program, or
- by the PC.

Notes:

The short-circuit and overload display can indicate in which group of 8 cannels the error has occured.

The error message to the PLC is as follows:

Overload in group 00...07	Channel 00 is reported
Overload in group 08...15	Channel 08 is reported
Overload in group 16...23	Channel 15 is reported
Overload in group 24...31	Channel 15 is reported

After the diagnosis interrogation has finished, the 32 yellow LEDs again show the signal status of the channels.

Technical Data for 07 DC 92

In general, the technical system data listed under "System data and system configuration" in chapter 1 of volume 2 of the "Advant Controller 31" system description are valid. Additional data or data which are different from the system data are listed as follows.

Technical data of the complete unit

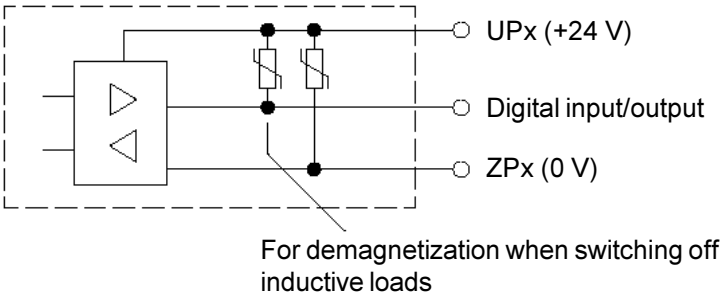
Permissible temperature range during operation	0...55 °C
Rated supply voltage	24 V DC
Rated signal voltage for inputs and outputs	24 V DC
Max. current consumption without load	0.15 A
Max. rated load for supply terminals	4.0 A
Max. power dissipation in module (outputs without load)	5 W
Max. power dissipation in module (outputs under load)	10 W
Protection against reversed polarity of power connection	yes
Conductor cross section	
for the removable connectors	
power supply	max. 2.5 mm^2
CS31 system bus	max. 2.5 mm^2
signal terminals	max. 1.5 mm^2
supply for I/O groups	max. 1.5 mm^2
Number of configurable inputs/outputs	32 (the configurable channels are defined individually by the user program to be either inputs or outputs. This is accomplished by interrogating or assigning the appropriate channel).
Electrical isolation CS31 system bus	from the rest of the unit
inputs/outputs	group from group, all groups from the rest of the unit
Supply of the I/O groups	each group is supplied individually, see Fig. 4.3.2-2
Number of interfaces	1 CS31 system bus interface
Address setting	Coding switch located under the slide cover at the right side of the housing
Diagnosis	see chapter "Diagnosis and display"
Operation and error displays	a total of 33 LEDs

Technical data of the I/O channels as binary inputs

Number of channels per unit	32
Division of channels into groups	4 groups with 8 channels each, channels En,00...En,07 and En,08...En,15 channels En+1,00...En+1,07 and En+1,08...En+1,15
Reference potential for inputs	ZP0, ZP1, ZP2 and ZP3
Electrical isolation	group from group, all groups from the rest of the unit
Input delay	typ. 7 ms
Signalization of the input signals	one yellow LED per channel, LED activated according to the input signal

Input signal voltage		24 V DC
0 signal (when UPx connected)		- 6 V...+ 5 V *
0 signal (when UPx not connected)		- 30 V...+ 5 V
1 signal		+ 13 V...+ 30 V
residual ripple	at 0 signal (UPx connected)	within - 6 V...+ 5 V *
	at 0 signal (UPx not connected)	within - 30 V...+ 5 V
	at 1 signal	within + 13 V...+ 30 V

* Due to the direct connection to the output, the demagnetizing varistor is also effective at the input when disconnecting inductive loads (see figure). This is why the difference between UPx and the input signal may not exceed the clamp voltage of the varistor. The varistor limits the voltage to approx. 36 V. Following this, the input voltage must range from - 12 V to + 30 V when UPx = 24 V and from - 6 V to + 30 V when UPx = 30 V.
When all 8 channels of the group are used as inputs and terminal UPx is not wired-up, there are no restrictions to the input signals. In this case, the input voltage can range from - 30 V to + 30 V. The following figure shows the circuit arrangement of a digital input/output.



Input current per channel	
input voltage = + 24 V	typ. 7.0 mA
input voltage = + 5 V	≥ 0.2 mA
input voltage = + 13 V	≥ 2.0 mA
input voltage = + 30 V	≤ 9.0 mA
Conductor cross section	
for the removable connectors	max. 1.5 mm^2 (grid space 3.81 mm)

Technical data of I/O channels as digital outputs

Number of channels per unit	32 transistor-outputs
Division of channels in groups	4 groups with 8 channels each, channels An,00...An,07 and An,08...An,15 channels An+1,00...An+1,07 and An+1,08...An+1,15
Reference potentials for outputs	ZP0, ZP1, ZP2 and ZP3
Voltage supply for outputs	UP0, UP1, UP2 and UP3
Electrical isolation	group from group, all groups from the rest of the unit
Signalization of output signals	one yellow LED per channel, LED activated according to the input signal
Output current	
nominal value	500 mA at L+ = 24 V
max. value	4 A total current for each group
leakage current at 0 signal	< 0.5 mA
Demagnetization at inductive load	via internal varistor
Switching frequency for inductive load	max. 0.5 Hz
Switching frequency for lamp load	max. 11 Hz at max. 5 W

Protection against short-circuit/overload	yes
overload message ($I \geq 0{,}7$ A)	yes, after approx. 100 ms
limitation of output current	yes
reactivation after short-circuit/overload	automatically
Resistance to feedback against 24V signals	yes
Load current (total)	max. 4 A for each group
Conductor cross section for the removable connectors	max. 1.5 mm^2 (grid space 3.81 mm)

Connection to the CS31 system bus

Interface standard	EIA RS-485
Galvanic separation	from supply voltage, inputs and outputs
Conductor cross section for the removable 3-pole connector	max. 2.5 mm^2

Mechanical data

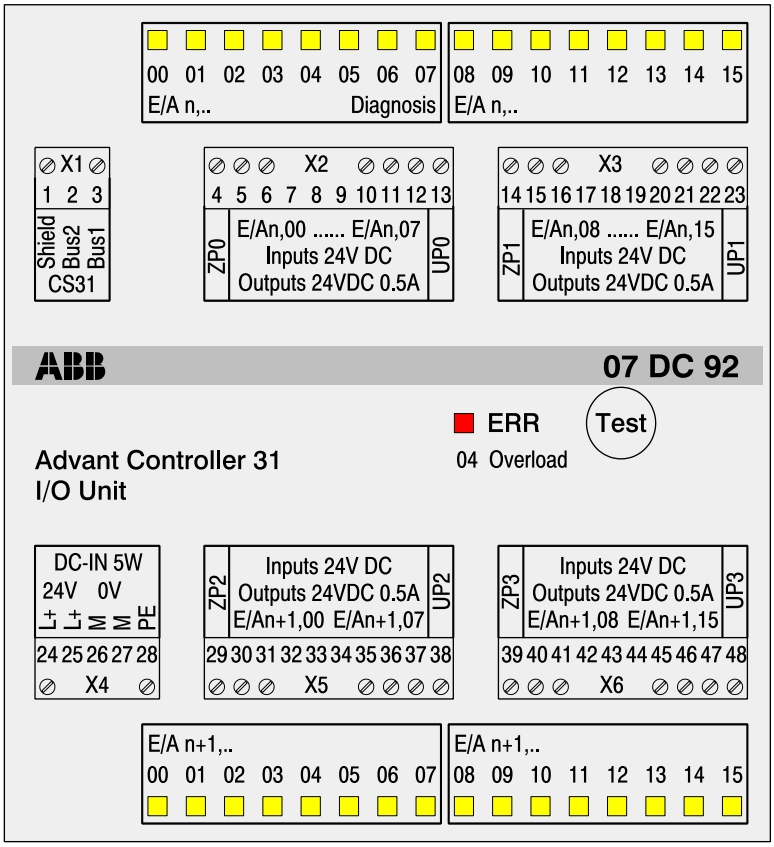
Mounting to DIN rail	according to DIN EN 50022-35, 15 mm deep. The DIN rail is centrally positioned between upper and lower edges of the module.
Mounting with screws	by 4 screws M4
Width x height x depth	120 x 140 x 85 mm
Connector	removable connectors with screw-type terminals
conductor cross section	max. 2.5 mm^2 (grid space 5.08 mm) max. 1.5 mm^2 (grid space 3.81 mm)
Weight	450 g
Dimensions for installation	see figure on next page

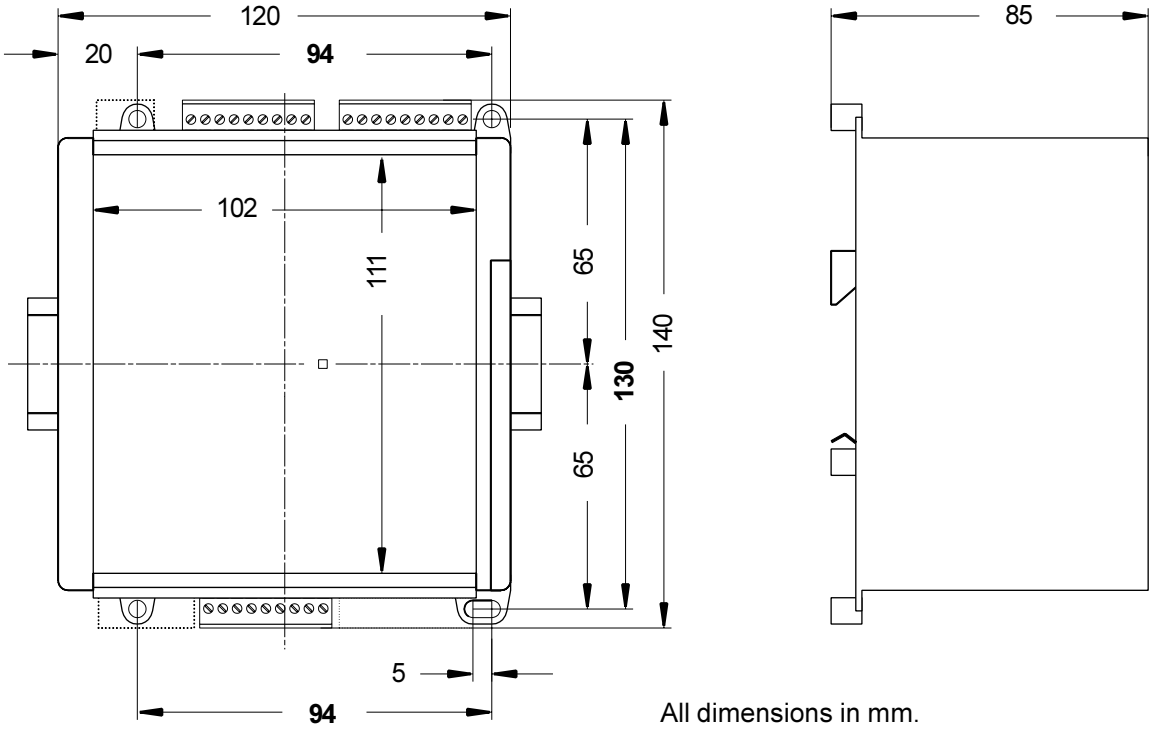
Installation instructions

Installation position	vertical with connectors pointing up and down
Cooling	The natural convection cooling must not be hindered by cable ducts or other additional components installed in the cabinet.

Ordering data

Module 07 DC 92	Order No. GJR5 2522 00 R0101
Scope of delivery	Digital Input and output module 07 DC 92 1 5-pin connector (grid space 5.08 mm) 1 3-pin connector (grid space 5.08 mm) 4 10-pin connectors (grid space 3.81 mm)





All dimensions in mm.

The depth of the module is 85 mm. If a DIN rail is used, the installation depth must be increased by the dimension of the rail.

Fig. 4.3.2-5: 07 DC 92, Front panel foil and outside dimensions.
Dimensions for installation holes are shown in bold print

4.3.3 Keyboard Controller 07 TC 90

32 switches/keys and 32 LEDs controllable

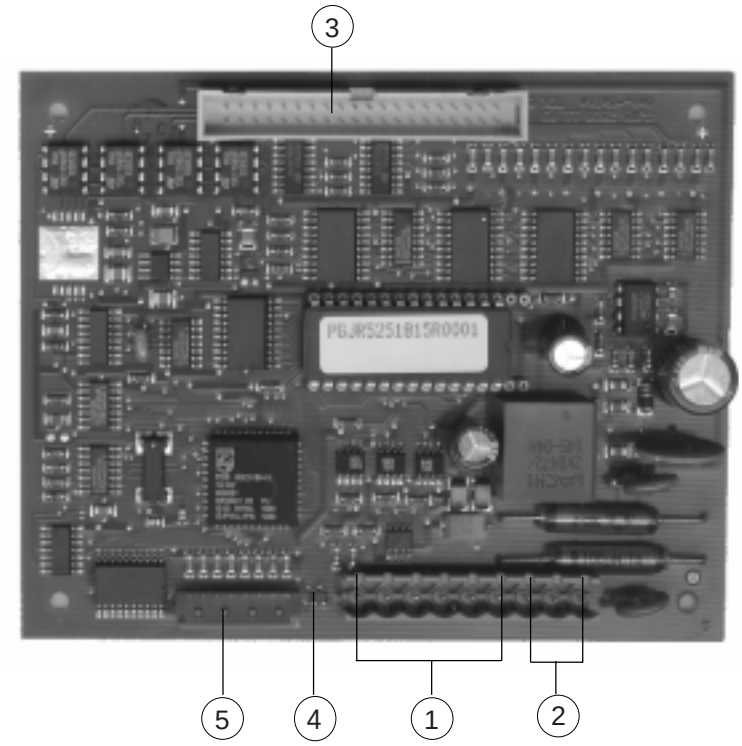


Fig. 4.3.3-1: Keyboard controller 07 TC 90

Contents

Intended purpose

The module 07 TC 90 is used for coupling control panels consisting of pushbuttons or switches and LEDs to the CS31 system bus. These control panels should be connectable to the CS31 system bus without large expenditure of wiring and software in the PLC.

The pushbuttons/switches and LEDs should preferably be connected via a printed circuit board (printed circuit board of the control panel manufacturer). The device 07 TC 90 is connected to this printed circuit board via a flat cable or a direct connector. The mechanical connection can be made by means of the four mounting holes on the device.

The device 07 TC 90 can input or control up to 32 switches/pushbuttons and 32 LEDs which are arranged in 4x8 matrix. In the PLC software one digital input is assigned to every pushbutton/switch and one digital output to every LED. Multiplexing is carried out by the 07 TC 90.

The device behaves like a combined I/O module on the CS31 system bus. It presents all keys and LEDs as individual digital signals.

Displays and components on the printed circuit board

① Interface to the CS31 system bus (basic housing for 6-pole plug-in type terminal)

② Power supply (basic housing for 3-pole plug-in type terminal)

③ Multiplex interface (40-pole pin block) for connecting the switches/pushbuttons and LEDs

④ Red LED for displaying the CS31 system bus status

⑤ Address switch

Electrical connection

The 24 V DC power supply is carried out via 3 plug-in type poles on a 9-pole connector housing.

Connector assignment of the multiplex interface

Terminal		Terminal	
1	Column input 0	2	Column input 1
3	Column input 2	4	Column input 3
5	Column input 4	6	Column input 5
7	Column input 6	8	Column input 7
9	unused	10	unused
11	unused	12	unused
13	unused	14	unused
15	unused	16	unused
17	unused	18	unused
19	unused	20	unused
21	Column driver 0	22	Column driver 1
23	Column driver 2	24	Column driver 3
25	Column driver 4	27	Column driver 5
27	Column driver 6	28	Column driver 7
29	unused	30	used (+ 24 V, for internal use)
31	used (+ 24 V, for internal use)	32	unused
33	Line driver 4	34	Line driver 4
35	Line driver 3	36	Line driver 3
37	Line driver 2	38	Line driver 2
39	Line driver 1	40	Line driver 1

Fig. 4.3.3-2: Connector assignment of the multiplex interface

Connection diagram, connection of the switches/pushbuttons

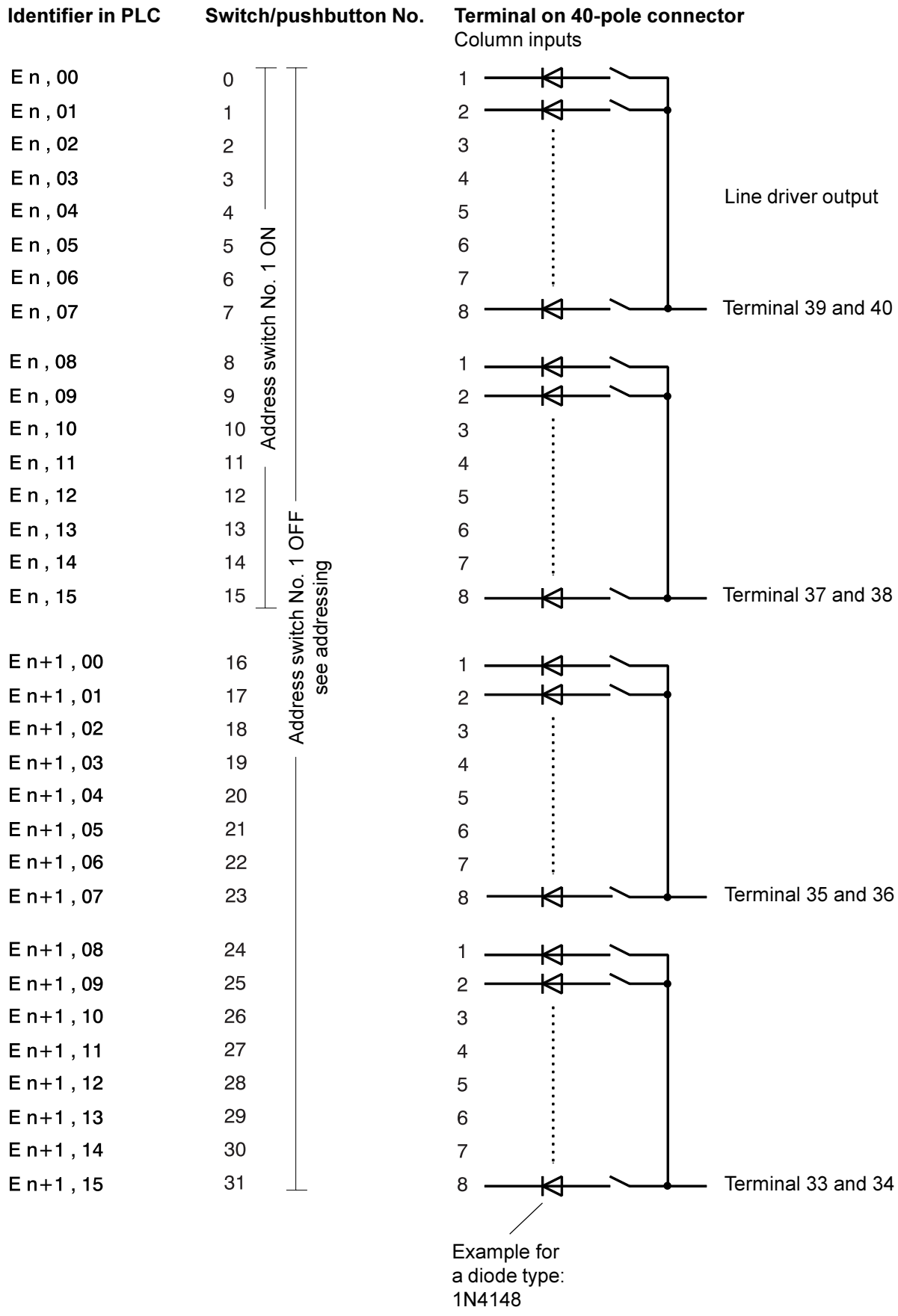


Fig. 4.3.3-3: Connection diagram 07 TC 90, connection of the switches/pushbuttons

Connection diagram, connection of the LEDs

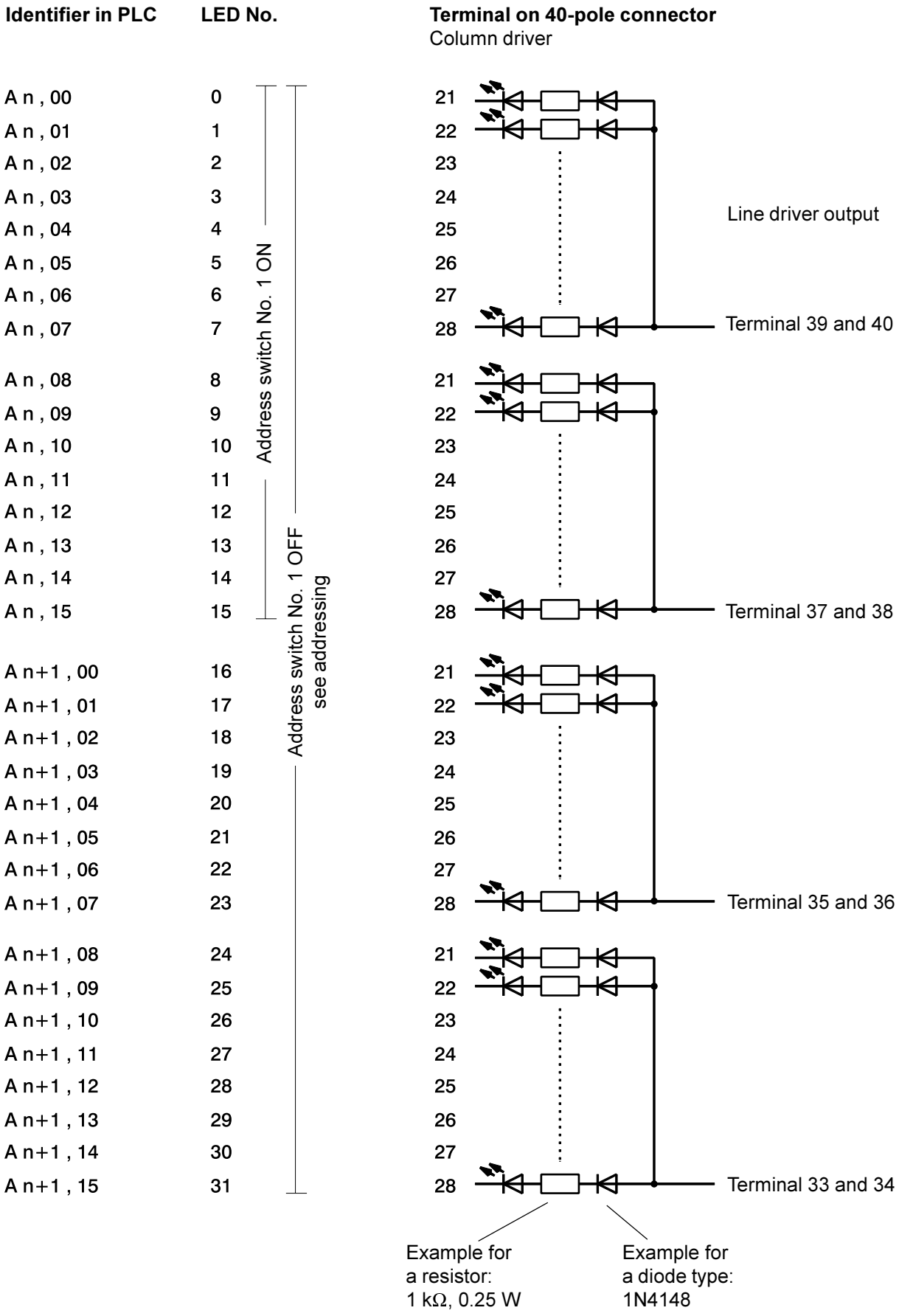


Fig. 4.3.3-4: Connection diagram 07 TC 90, connection of the LEDs

Timing diagram for multiplex controlling of the LEDs and switches

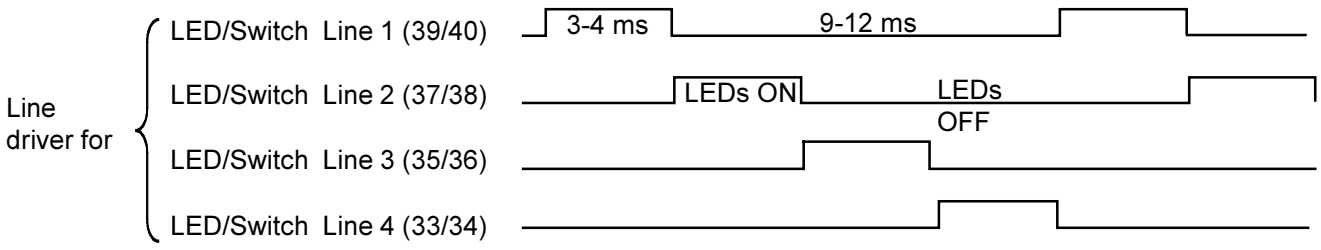


Fig. 4.3.3-5: Timing diagram for multiplex controlling of the LEDs and switches

Addressing

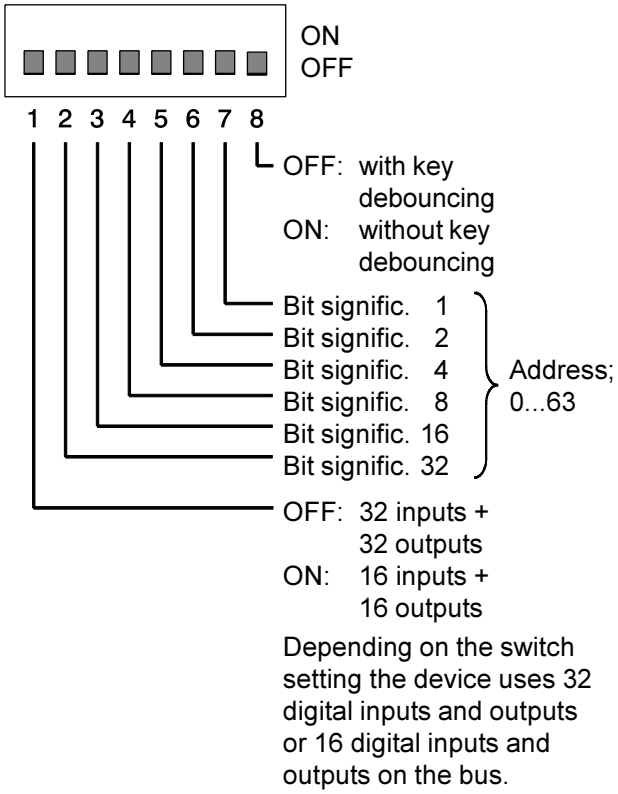


Fig. 4.3.3-6: Address setting

Diagnosis

Red LED

- OFF: CS31 system bus is running
- flashes: CS31 system bus is not running, CS31 system bus not connected
- ON: Initialization phase after switching on the supply voltage

There are no other diagnosis and configuration possibilities via the CS31 system bus.

Technical data

As far as possible, the AC31 system data are valid.

Exceptions:

- Open construction system, degree of protection IP00.
- The user is responsible for the appropriate installation and observance of the necessary degree of protection.
- The device cannot be used as I/O module for standard applications because of the multiplex method for the I/O signals.

  Principally it should be taken into consideration that the EMC behaviour can be affected by the LED and key module connected via the flat cable.

Power supply

Device rated supply voltage	24 V DC
Max. current consumption	600 mA (including key and LED controlling)
Connector	Basic housing for 3-pole plug-in type terminal

CS31 System bus interface

Interface standard	RS-485
Connector	Basic housing for 6-pole plug-in terminal for 2 x BUS1, 2 x BUS2, 2 x Shield

Multiplex interface

Line driver	24 V DC 500 mA per line, short-circuit proof Remark: The line current consists of the current for the LEDs via the column driver and the input current via the pushbuttons.
Column driver	max. 80 mA, "Open Collector" Sum < 500 mA (because of the line driver)
Column inputs	24 V DC, 7 mA (typical) no input delay, but key debouncing by the software, can be disabled by switch, see figure 4.3.3-6 "Address setting". Debounce time: approx. 40 ms, without key debouncing the updating time is 1 multiplex cycle (approx.13 ms)
Min. high-signal	$UH_{min.}$ = 3.5 V referred to internal 0 V, corresponds to 1 mA input current
Max. low-signal	$UL_{max.}$ = 0.9 V referred to internal 0 V, corresponds to 270 µA input current
Matrix	4 lines with 8 columns for pushbuttons/switches and 8 columns for LEDs
Multiplex frequency	approx. 75 Hz; 3-4 ms pulse / 9-12 ms interval
Connector	40-pole pin block with twisting protection, suitable for flat cable; grid spacing 2.54 mm; according to DIN 41651

General mechanical data

Displays	Red LED for CS31system bus status
Temperature range	0...55 °C
Reverse-connect protection for supply voltage	yes
Electrical isolation	CS31 system bus against the rest of the unit

Mechanical dimensions, connector arrangement

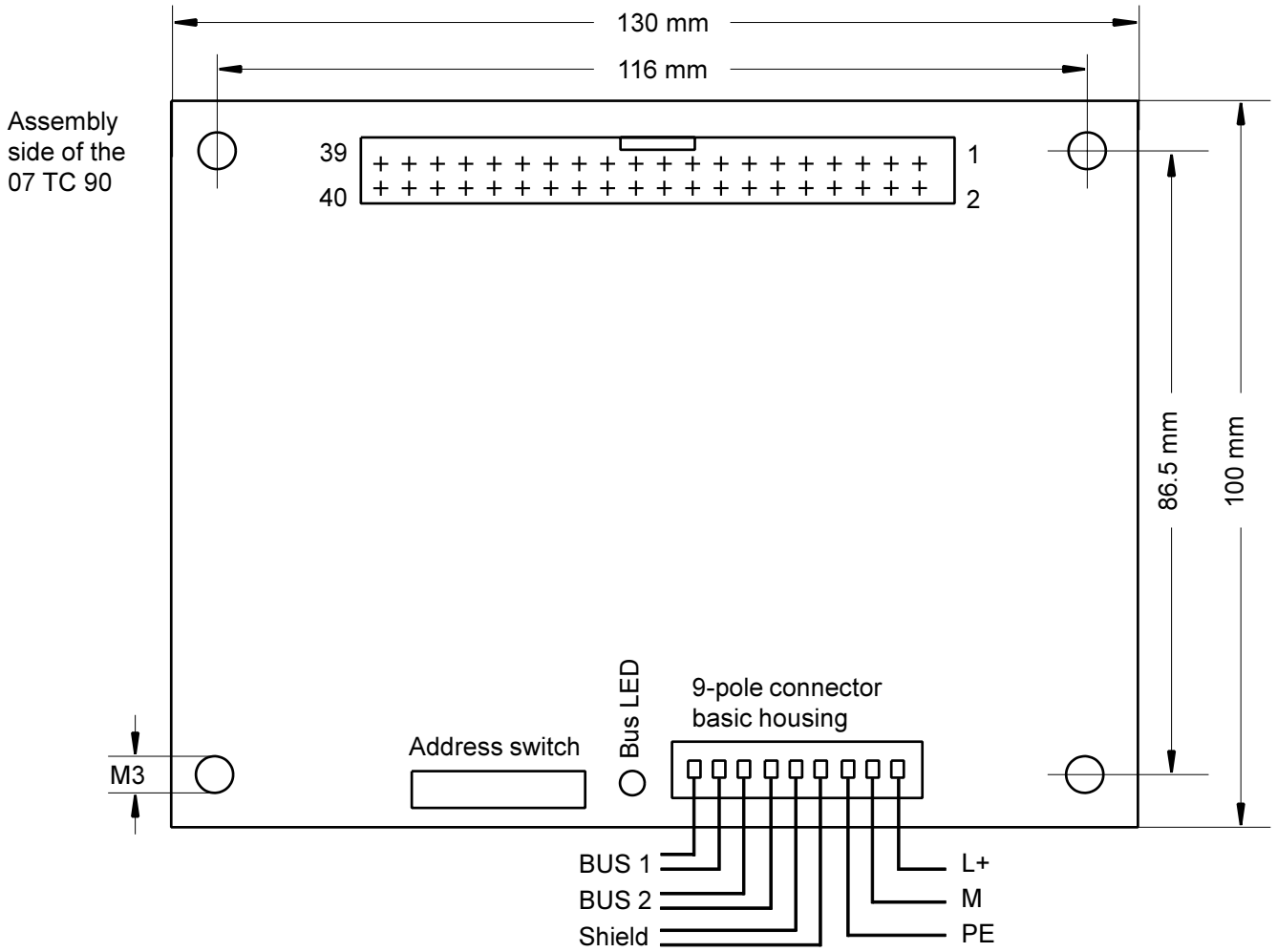


Fig. 4.3.3-7: Connector arrangement, mechanical dimensions

Dimensions	130 mm x 100 mm x 30 mm (length x width x height)
Weight	approx. 0.1 kg

Ordering data

07 TC 90	GJR5251800R101

Note:

A corresponding counterpart is required for the 9-pole connector basic housing (not supplied as standard accessory). Several manufacturers, e.g. Phönix, Wago, Weidmüller, offer this plug-in component in various versions (straight or bended, as screw-type terminal or cage tension spring terminal).

The Phönix name for the 9-pole connector basic housing (pin grid space 5.08 mm) used for the keyboard controller 07 TC 90 is:
COMBICON basic housing MSTBV 2,5/9-G-5,08

The corresponding screw-type terminal would be e.g.: Phönix MSTB 2,5/9-ST-5,08, Part No. 1757 080.

Appendix:
Calculation of the LED resistors

- The typical current in the column input is 7 mA, maximum 10 mA.
- The line driver is loaded via the switches/pushbuttons with max. 8 column inputs simultaneously.
- The maximum load-carrying capacity of a line driver is 500 mA. If the load caused by the column inputs is subtracted (80 mA max.), max. 420 mA remain for controlling the LEDs.
- A line driver must be able to drive max. 8 LEDs at the same time. For this purpose,
  420 mA/8 = 52.5 mA per LED are vailable.
- The voltage drops (LED + diode + saturation voltage of the drivers) are approx. 4 V. The maximum supply voltage is 30 V. The maximum voltage at the resistor is 30 V - 4 V = 26 V.
- Thus, the minimum LED resistor is

$$R_{LEDmin} = \frac{26\ V}{52.5\ mA} = \underline{\underline{0.495\ k\Omega}}$$

- Due to the multiplex method, the effective LED current is only ¼ of the impulse current of 52.5 mA max. The maximum brightness of the LEDs corresponds with the brightness of LEDs which are continuously operated with 52.5 mA/4 = 13.125 mA.
- The maximum power dissipation at the 495 Ω resistor is calculated with the following formula

$$P_V = \frac{U_{max} \cdot I_{max}}{4}$$

$$= \frac{26\ V \cdot 52{,}5\ mA}{4} = \underline{\underline{341\ mW}}$$

- The following table shows the calculation results for different resistors:

R_{LED}	510 Ω	680 Ω	1 kΩ	1,5 kΩ	2.2 kΩ
Rated impulse current L+ = 24 V	39.2 mA	29.4 mA	20 mA	13.3 mA	9.1 mA
Active LED-current L+ = 24 V	9.8 mA	7.4 mA	5 mA	3.3 mA	2.3 mA
Max. impulse current L+ = 30 V	51 mA	38.2 mA	26 mA	17.3 mA	11.8 mA
Max. power dissipation L+ = 30 V	331 mW	249 mW	169 mW	113 mW	77 mW
Resistor type	≥0.5 W	≥0.33 W	≥0.25 W	≥0.25 W	>0.125 W

Formulas for calculating the table values:

- Rated impulse current, L+ = 24 V

$$I_{imp} = \frac{24\ V - 4\ V}{R_{LED}}$$

- Active LED current, L+ = 24 V

$$I_{wirk} = \frac{I_{imp}}{4}$$

- Maximum impulse current, L+ = 30 V

$$I_{imp,max} = \frac{30\ V - 4\ V}{R_{LED}}$$

- Maximum power dissipation

$$P_{max} = \frac{I_{imp,max} \cdot (30\ V - 4\ V)}{4}$$

- Resistor type

  selected

4.3.4 Keyboard Controller 07 TC 91

32 switches/keys and 32 LEDs controllable

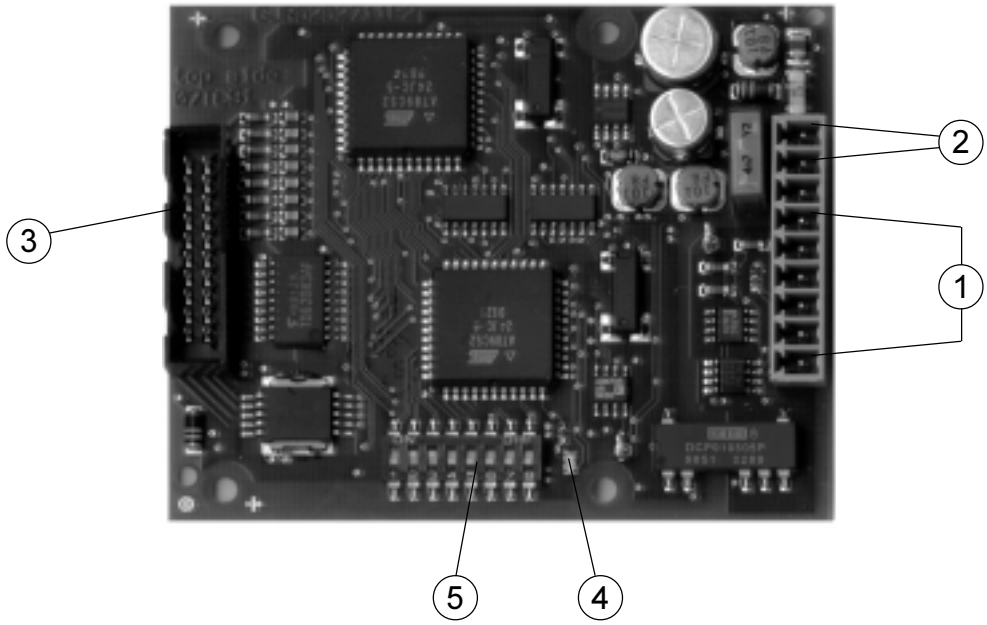


Fig. 4.3.4-1: Keyboard controller 07 TC 91

Contents

Intended purpose

The module 07 TC 91 is used for coupling control panels consisting of pushbuttons or switches and LEDs to the CS31 system bus. These control panels should be connectable to the CS31 system bus without large expenditure of wiring and software in the PLC.

The pushbuttons/switches and LEDs should preferably be connected via a printed circuit board (printed circuit board of the control panel manufacturer). The device 07 TC 91 is connected to this printed circuit board via a flat cable or a direct connector.

The mechanical connection can be made by means of the four mounting holes on the device.

The device 07 TC 91 can input or control up to 32 switches/pushbuttons and 32 LEDs which are arranged in 4x8 matrix. In the PLC software one digital input is assigned to every pushbutton/switch and one digital output to every LED. Multiplexing is carried out by the 07 TC 91.

The device behaves like a combined I/O module on the CS31 system bus. It presents all keys and LEDs as individual digital signals.

Displays and components on the printed circuit board

① Interface to the CS31 system bus (basic housing for 9-pole plug-in type terminal)

② Power supply (basic housing for 9-pole plug-in type terminal)

③ Multiplex interface (20-pole pin block) for connecting the switches/pushbuttons and LEDs

④ Red LED for displaying the CS31 system bus status

⑤ Address switch

Electrical connection

The 24 V DC power supply is carried out via 3 plug-in type poles on a 9-pole connector housing.

Connector assignment of the multiplex interface

Terminal		Terminal	
1	Column input 7	2	Column input 6
3	Column input 5	4	Column input 4
5	Column input 3	6	Column input 2
7	Column input 1	8	Column input 0
9	Column driver 7	10	Column driver 6
11	Column driver 5	12	Column driver 4
13	Column driver 3	14	Column driver 2
15	Column driver 1	16	Column driver 0
17	Line driver 3	18	Line driver 2
19	Line driver 1	20	Line driver 0

Fig. 4.3.4-2: Connector assignment of the multiplex interface X2

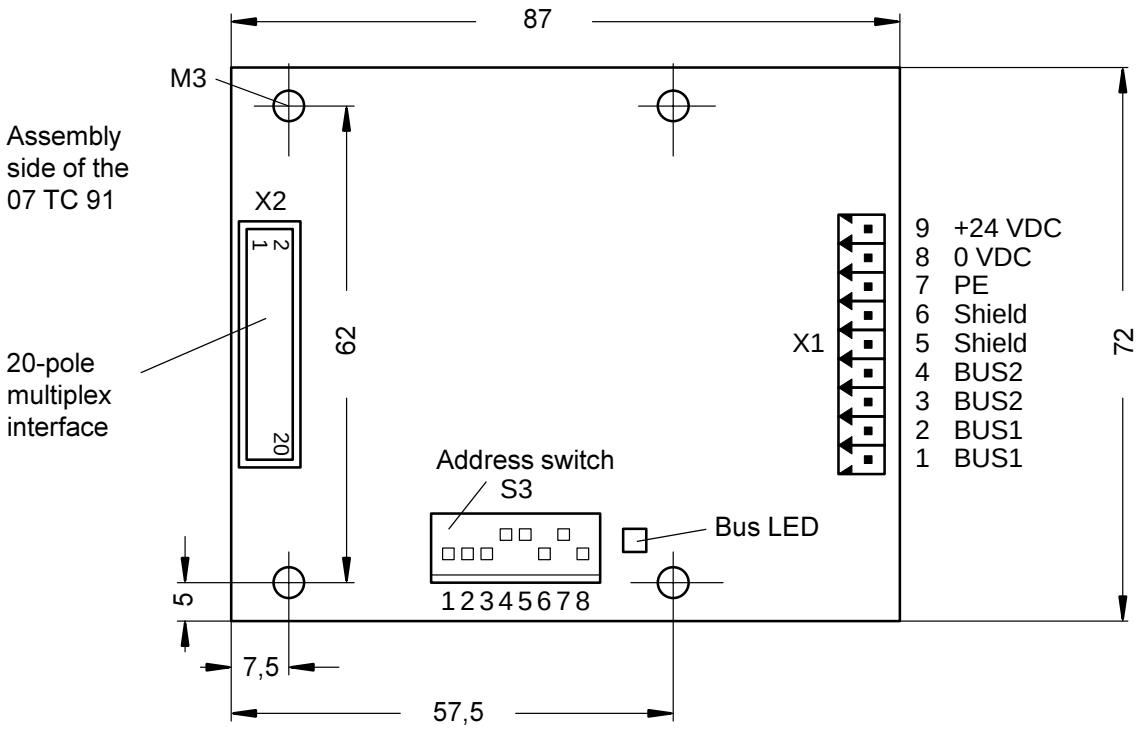


Fig. 4.3.4-3: Connector assignment of X1 (power supply and CS31 bus), mechanical dimensions

Connection diagram, connection of the switches/pushbuttons

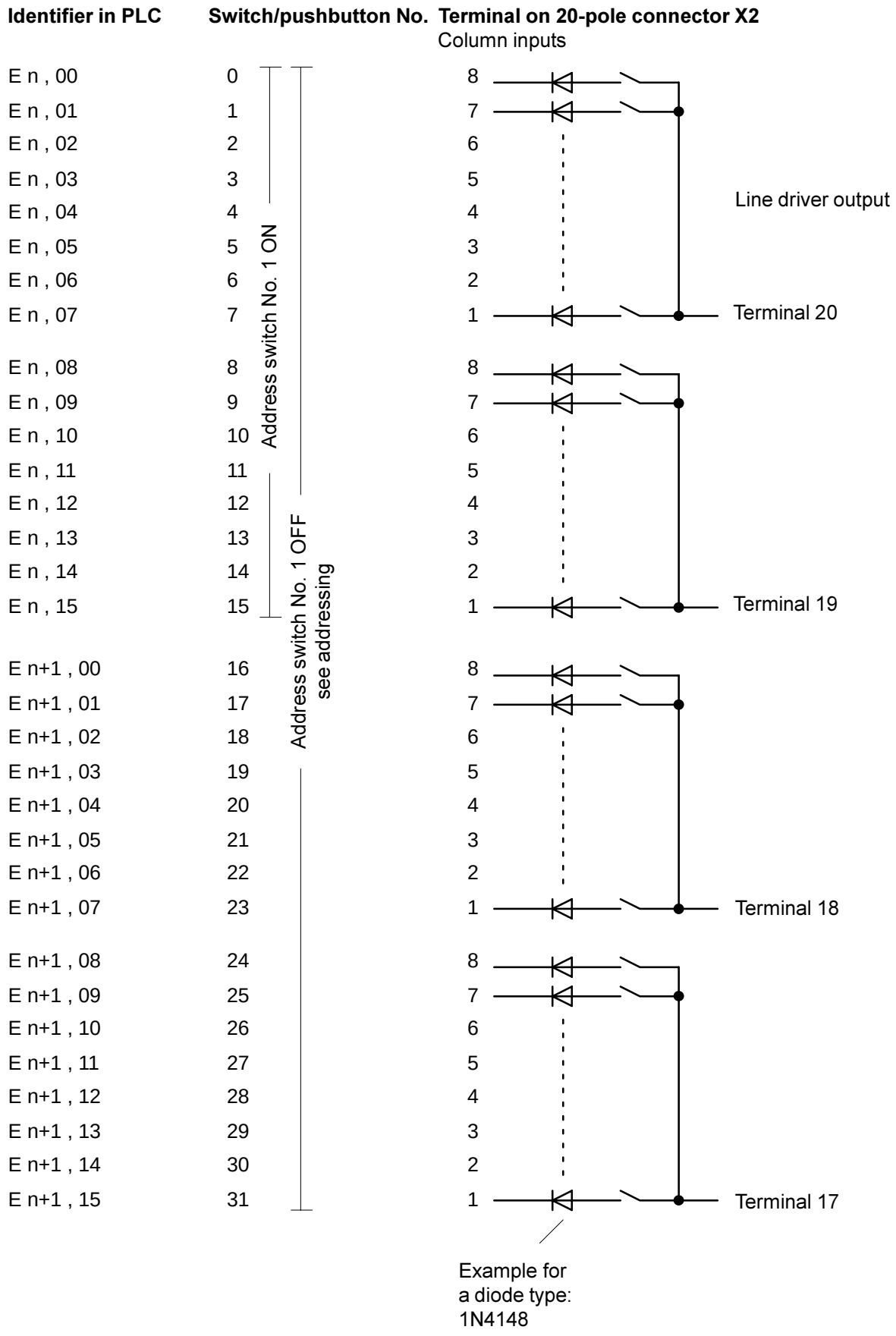


Fig. 4.3.4-4: Connection diagram 07 TC 91, connection of the switches/pushbuttons

Connection diagram, connection of the LEDs

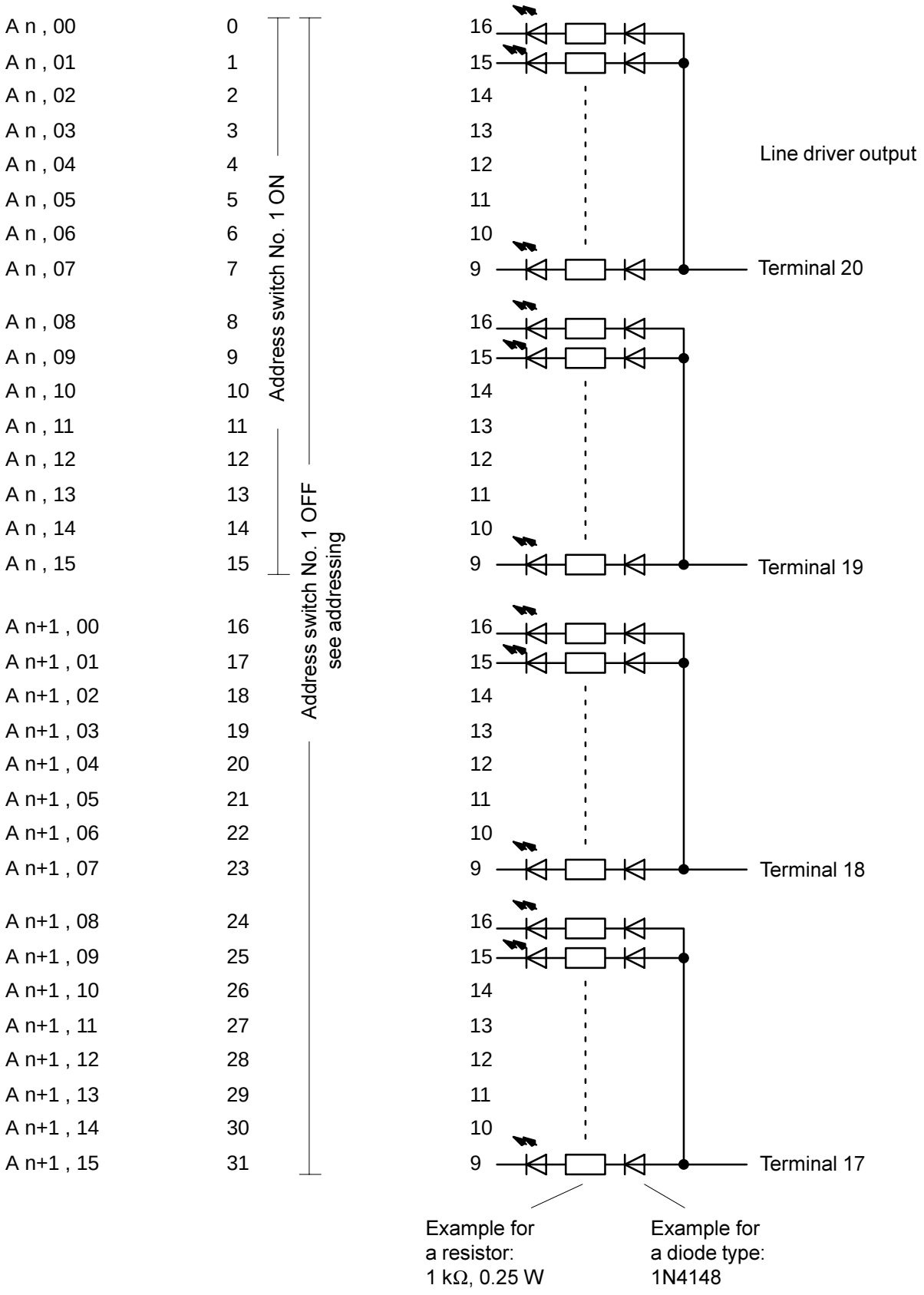


Fig. 4.3.4-5: Connection diagram 07 TC 91, connection of the LEDs

Timing diagram for multiplex controlling of the LEDs and switches

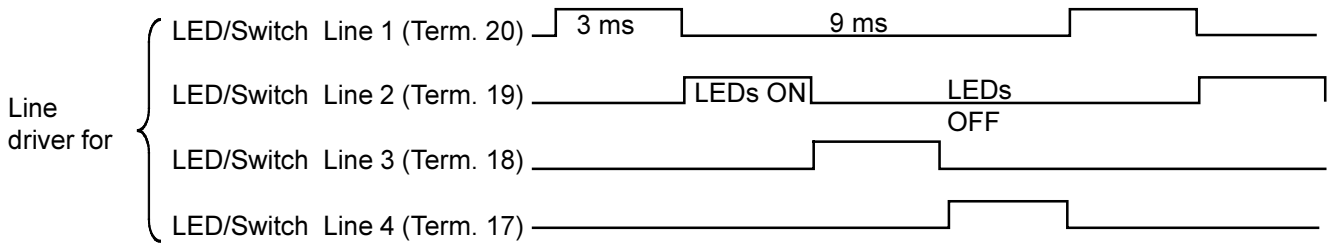


Fig. 4.3.4-6: Timing diagram for multiplex controlling of the LEDs and switches

Addressing

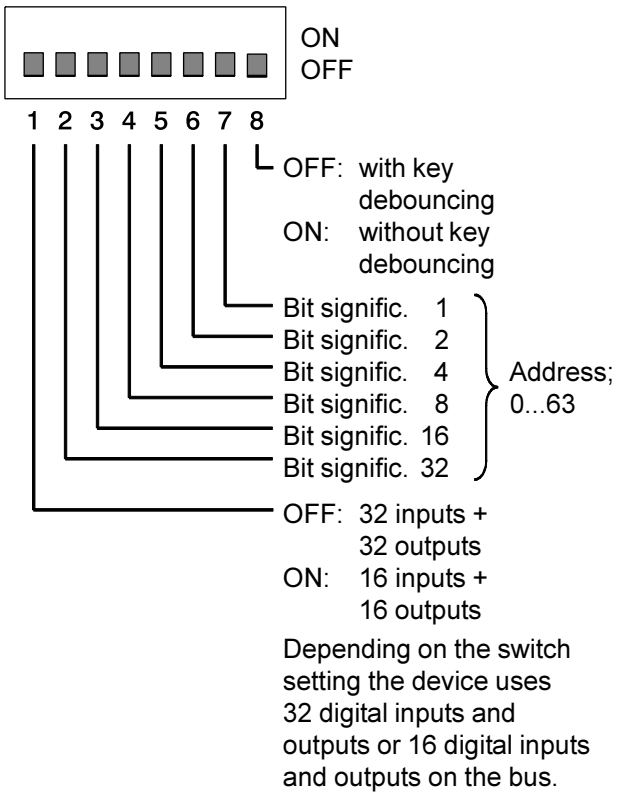


Fig. 4.3.4-7: Address setting

Diagnosis

Red LED

- OFF: CS31 system bus is running
- flashes: CS31 system bus is not running, CS31 system bus not connected
- ON: Initialization phase after switching on the supply voltage

There are no other diagnosis and configuration possibilities via the CS31 system bus.

Technical data

As far as possible, the AC31 system data are valid.

Exceptions:

- Open construction system, degree of protection IP00.
- The user is responsible for the appropriate installation and observance of the necessary degree of protection.
- The device cannot be used as I/O module for standard applications because of the multiplex method for the I/O signals.

  Principally it should be taken into consideration that that the EMC behaviour can be affected by the LED and key module connected via the flat cable.

  After each reset function, the module performs a lamp test for a period of ca. 250 ms.

Power supply

Device rated supply voltage	24 V DC
Max. current consumption	600 mA (including key and LED controlling)
Connector	Basic housing for 9-pole plug-in terminal see Fig. 4.3.4-8
Protection against reversed connected supply voltage	yes

CS31 system bus interface

Interface standard	RS-485
Connector	Basic housing for 9-pole plug-in terminal see Fig. 4.3.4-8
Electrical isolation	CS31 system bus against the rest of the unit

Multiplex interface

Line drivers	24 V DC 500 mA per line, short-circuit proof Remark: The line current consists of the current for the LEDs via the column drivers and the input currents via the pushbuttons.
Column drivers	max. 50 mA, "Open Collector" Sum <500 mA (because of the line drivers)
Column inputs	24 V DC, 7 mA (typical), no input delay, but key debouncing by the software, can be disabled by switch, see Fig. 4.3.4-7 "Address setting"; debounce time: ca. 40 ms, without key debouncing the updating time is 1 multiplex cycle (approx. 12 ms)
Min. high signal (at 24 V DC supply voltage)	$UH_{min.}$ = 16 V referred to internal 0 V, corresponds to 3.4 mA input current
Max. low signal (at 24 V DC supply voltage)	$UL_{max.}$ = 6 V referred to internal 0 V, corresponds to 1.3 mA input current
Matrix	4 lines with 8 columns for pushbuttons/switches and 8 columns for LEDs
Multiplex frequency	approx. 83 Hz; 3 ms pulse / 9 ms interval
Connector	20-pole pin block with twisting protection, suitable for flat cable; grid spacing 2.54 mm; according to DIN 41651
Displays	red LED for CS31 system bus status

Mechanical dimensions, connector assignment

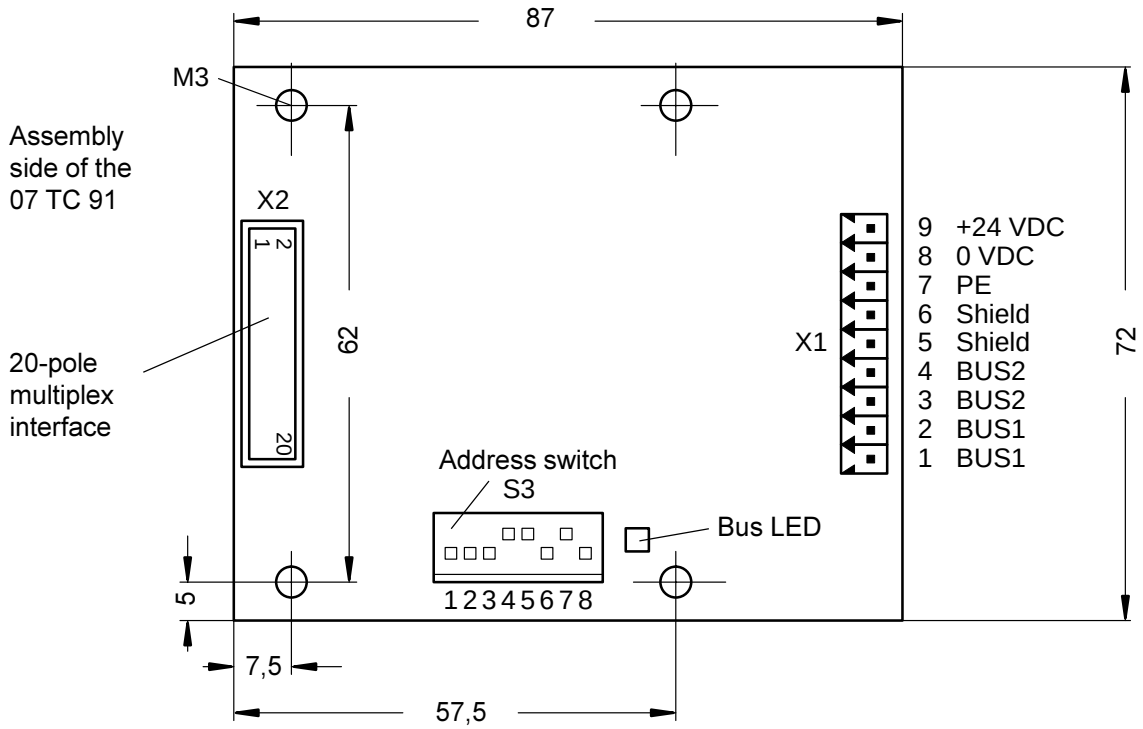


Fig. 4.3.4-8: Mechanical dimensions, connector assignment

Dimensions	87 mm x 72 mm x 30 mm (length x width x height)
Weight	ca. 0.1 kg

Ordering data

07 TC 91	GJR5 2527 00 R0101

Note:

A corresponding counterpart is required for the 9-pole connector basic housing (not supplied as standard accessory). Several manufacturers, e.g. Phönix, Wago, Weidmüller, offer this plug-in component in various versions (straight or bended, as screw-type terminal or cage tension spring terminal).

The Phönix name for the 9-pole connector basic housing (pin grid space 3.81 mm) used for the keyboard controller 07 TC 91 is:
COMBICON basic housing EMCV 1,5/9-G-3,81
Part No. 1860 715

The corresponding screw-type terminal would be e.g.:
Phönix MC 1,5/9-ST-3,81GY, Part No. 1883 666.

Appendix:
Calculation of the LED resistors

- The typical current in the column input is 7 mA, maximum 10 mA.
- The line driver is loaded via the switches/pushbuttons with max. 8 column inputs simultaneously.
- The maximum load-carrying capacity of a line driver is 500 mA. If the load caused by the column inputs is subtracted (80 mA max.), max. 420 mA remain for controlling the LEDs.
- A line driver must be able to drive max. 8 LEDs at the same time. For this purpose,
  420 mA/8 = 52.5 mA per LED are available. The 8 column drivers are loadable with max. **50 mA** each.
- The voltage drops (LED + diode + saturation voltage of the drivers) are approx. 4 V. The maximum supply voltage is 30 V. The maximum voltage at the resistor is 30 V - 4 V = **26 V**.
- Thus, the minimum LED resistor is

$$R_{LEDmin} = \frac{26\ V}{50\ mA} = \underline{\underline{0.520\ k\Omega}}$$

- The next higher value of a standard resistor is **560** Ω. When switched on, the current flowing through this resistor is

$$I_{LEDmax} = \frac{26\ V}{560\ \Omega} = \underline{\underline{46.4\ mA}}$$

- Due to the multiplex method, the effective LED current is only ¼ of the impulse current of 46.4 mA max. The maximum brightness of the LEDs corresponds with the brightness of LEDs which are continuously operated with 46.4 mA/4 = 11.6 mA.
- The maximum power dissipation at the 560 Ω resistor is calculated with the following formula

$$Pv = \frac{U_{max} \cdot I_{max}}{4}$$

$$Pv = \frac{26\ V \cdot 46.4\ mA}{4} = \underline{\underline{302\ mW}}$$

- The following table shows the calculation results for different resistors:

R_{LED}	560 Ω	680 Ω	1 kΩ	1,5 kΩ	2.2 kΩ
Rated impulse current L+ = 24 V	35.7 mA	29.4 mA	20 mA	13.3 mA	9.1 mA
Active LED-current L+ = 24 V	8.9 mA	7.4 mA	5 mA	3.3 mA	2.3 mA
Max. impulse current L+ = 30 V	46.4 mA	38.2 mA	26 mA	17.3 mA	11.8 mA
Max. power dissipation L+ = 30 V	302 mW	249 mW	169 mW	113 mW	77 mW
Resistor type	≥0.5 W	≥0.33 W	≥0.25 W	≥0.25 W	>0.125 W

Formulas for calculating the table values:

- Rated impulse current, L+ = 24 V

$$I_{imp} = \frac{24\ V - 4\ V}{R_{LED}}$$

- Active LED current, L+ = 24 V

$$I_{wirk} = \frac{I_{imp}}{4}$$

- Maximum impulse current, L+ = 30 V

$$I_{imp,max} = \frac{30\ V - 4\ V}{R_{LED}}$$

- Maximum power dissipation

$$P_{max} = \frac{I_{imp,max} \cdot (30\ V - 4\ V)}{4}$$

- Resistor type

  selected

4.4.1 Digital Input Module 07 DI 93-I

16 input channels 24 V DC, **degree of protection IP67**, electrically isolated CS31 system bus connection

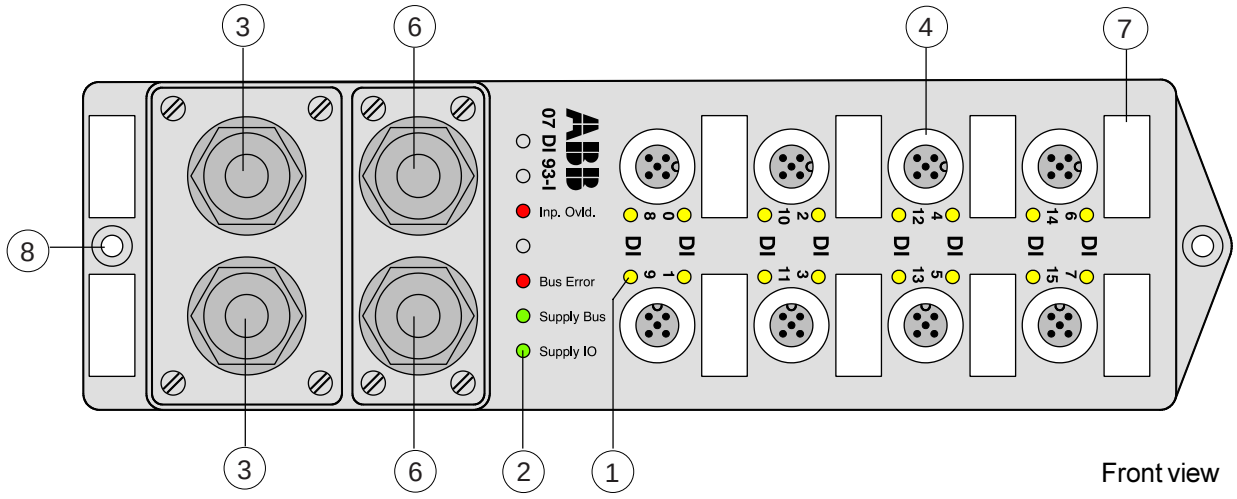


Fig. 4.4.1-1: Digital input module 07 DI 93-I

Contents

Intended purpose

The digital input module 07 DI 93-I is a remote module on the CS31 system bus. It has 16 input channels with the following features:

- Housing and connection according to IP67 degree of protection.
- The CS31 bus line is looped through from module to module (one PG9 screwed conduit entry each for input and output).
- Each pair of inputs have their own connector and thus can be unplugged individually.
- The inputs
  - allow you to connect sensors with 2-pole and 3-pole technique (switching contacts, initiators etc.)
  - provide a short-circuit/overload-proof supply voltage for the sensors, with can be loaded with max. 50 mA by each sensor
  - have a rated signal current of approx. 8 mA each

The module is mounted with screws.

The CS31 system bus connection is electrically isolated from remaining module components.

The module offers diagnosis functions.

Displays and connections at the module housing

① 16 yellow LEDs to indicate the signal status of the inputs

② LEDs "Bus Error", "Input Overload", "Supply Bus" and "Supply I/O" indicating operating conditions and errors

③ CS31 bus connector

④ 8 connectors for 16 inputs

⑥ 24 V DC power supply

⑦ Labelling fields

⑧ Bore holes for mounting

Electrical connection

The following pages show all details necessary for the electrical connection.

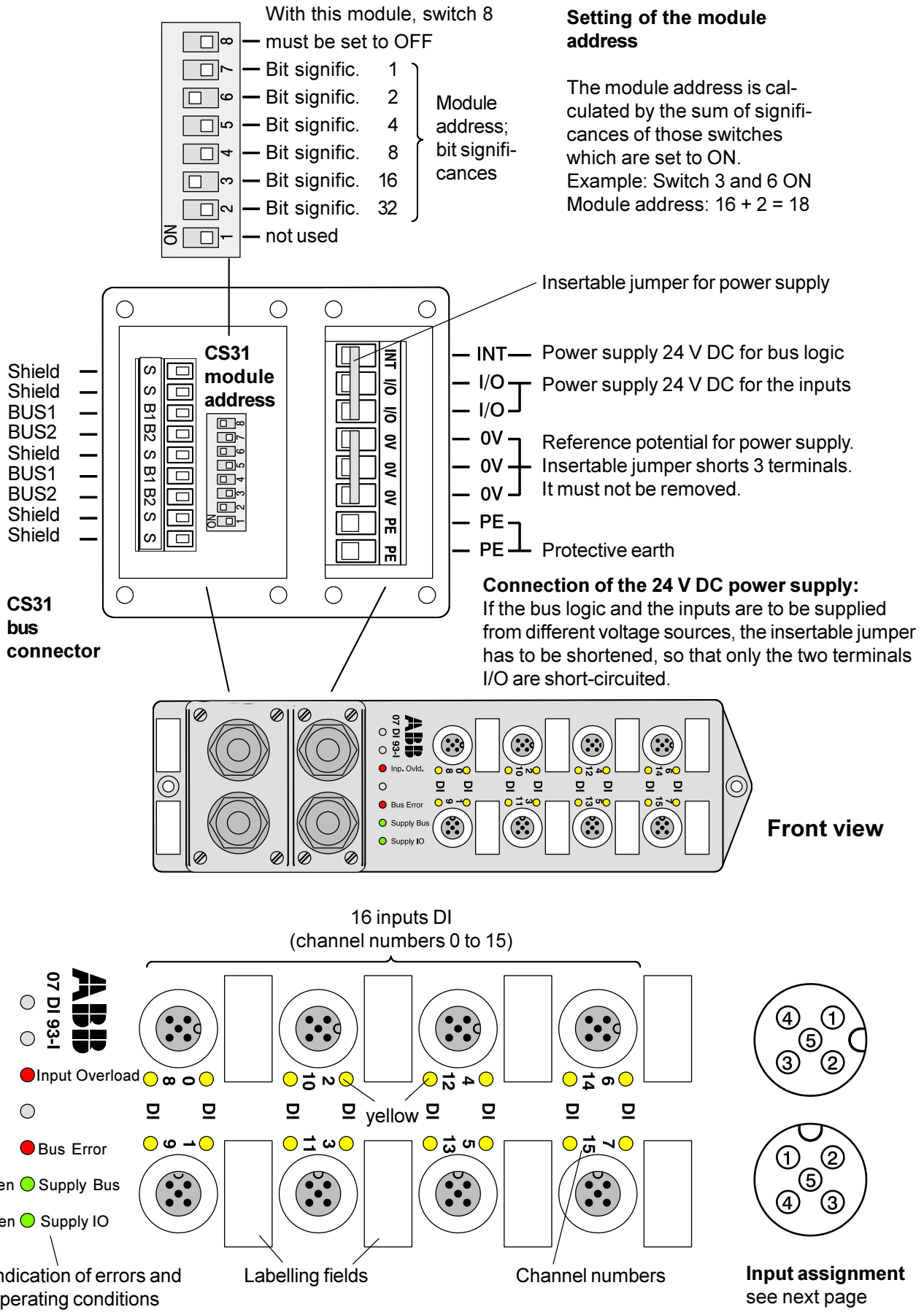
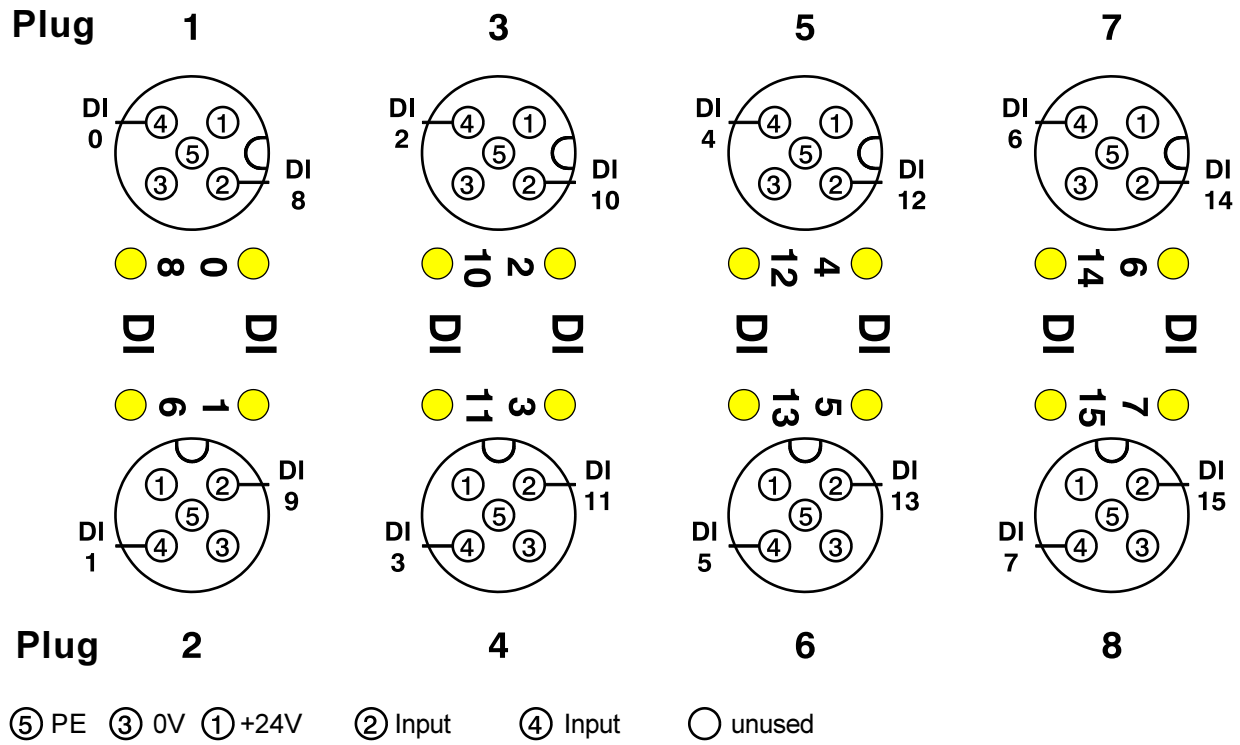
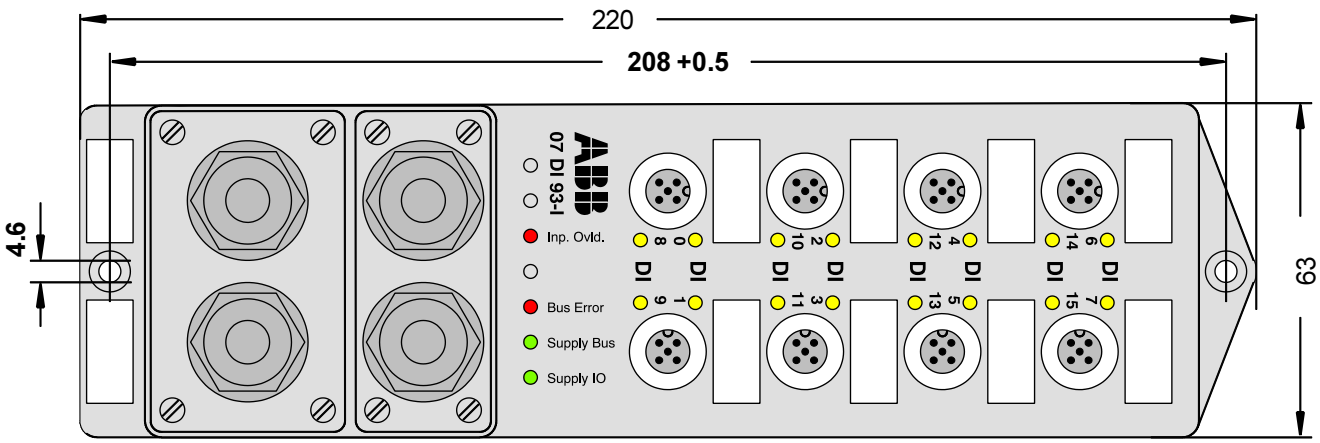


Fig. 4.4.1-2: Details for the electrical connection of the input module 07 DI 93-I



07 DI 93-I

Fig. 4.4.1-3: Detailed pin assignment of the inputs of the module 07 DI 93-I



Front view

The height is 70.5 mm

The dimensions for mounting with screws (assembly holes) are printed in **bold**.
The height of the module is **70.5 mm.**

Fig. 4.4.1-4: Outline dimensions of the input module 07 DI 93-I

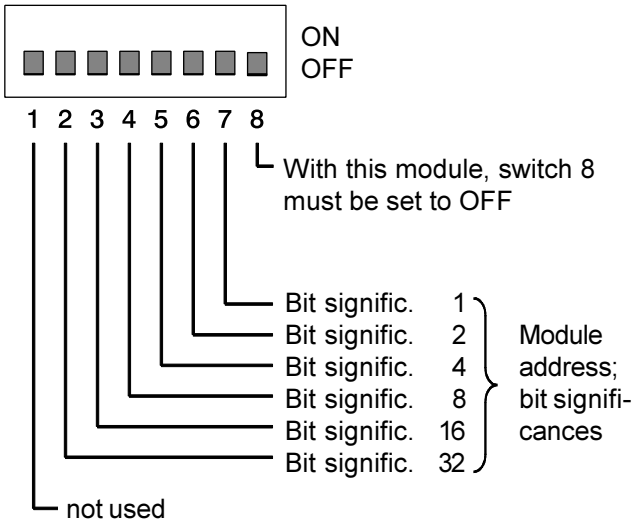
Addressing

An address has to be set on each module, so that the central unit can access the inputs correctly.

A detailed description concerning the item "Addressing" is contained in the chapters "Addressing" of the central units and couplers.

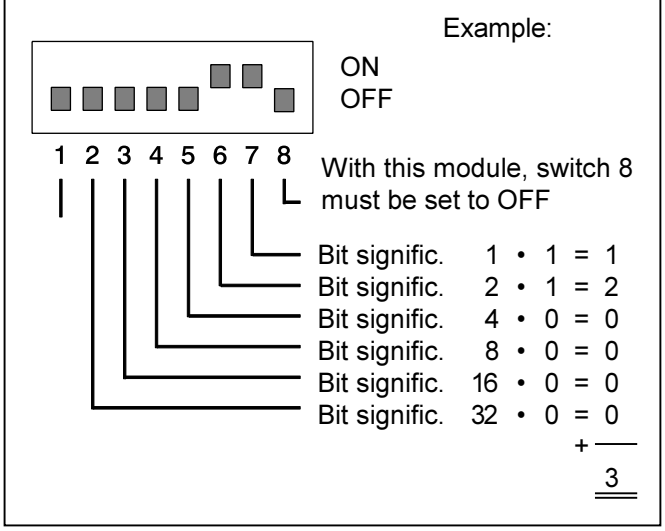
The module address is set on the DIL switch located under the cover at the top side of the module.

Meaning of the address switches:



Setting of the module address:

The module address is calculated by the sum of significances of those switches which are set to ON (see the following example).



When using the central units 07 KR 91, 07 KT 92 or 07 KT 93, the possible module addresses range from

0...61.

In connection with the central units 07 KR 91 and 07 KT 92/KT93 as bus masters, the following address allocations are valid:

Central units 07 KR 91 / 07 KT 92 / 93

The DIL switch No. 8 is set to:

Chan.	OFF	
DI 0	E xx,00	With this module the DIL switch No. 8 must be set to OFF.
DI 1	E xx,01	
DI 2	E xx,02	
DI 3	E xx,03	
DI 4	E xx,04	
DI 5	E xx,05	
DI 6	E xx,06	
DI 7	E xx,07	
DI 8	E xx,08	
DI 9	E xx,09	
DI 10	E xx,10	
DI 11	E xx,11	
DI 12	E xx,12	
DI 13	E xx,13	
DI 14	E xx,14	
DI 15	E xx,15	

xx: Group number of the address, set on the DIL switch with the switches 2...7.

The module uses 16 inputs on the CS31 system bus.

I/O configuration

With this module, an I/O configuration is not necessary.

Normal operation

- The module initializes itself after power ON. During initialization process all four LEDs ② are ON.
- After the initialization process, the two red LEDs ② go out again, if the bus is running correctly and the module does not detect any error. The green LEDs "Supply Bus" and "Supply I/O" light up.
- The 16 yellow LEDs ① indicate the signal status of the inputs and outputs.

Diagnosis and displays

Diagnosis functions:

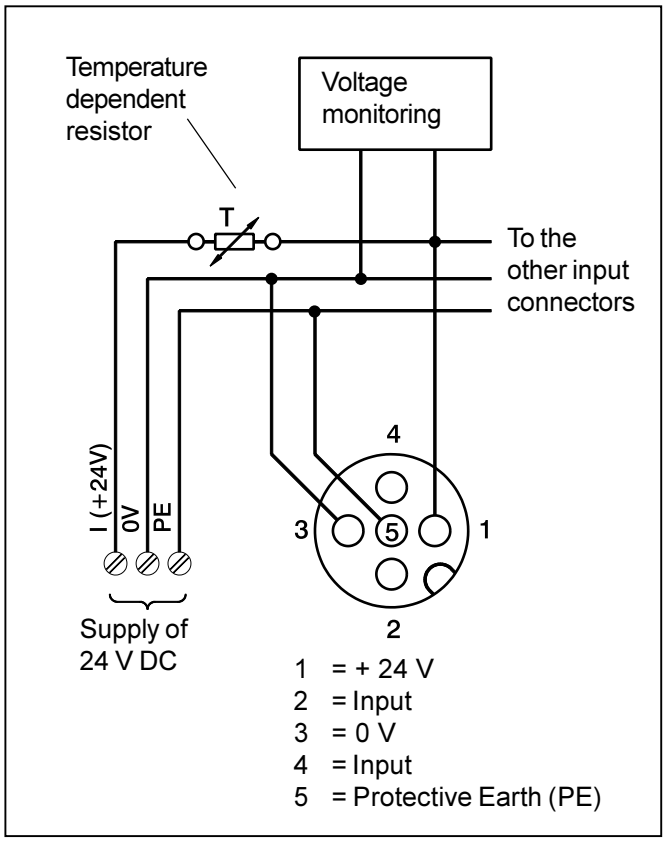
- Bus Error (on the CS31 system bus)
- Input Overload (overload or short-circuit at the power supply of the sensors)
- Supply Bus (power supply of the bus logic)
- Supply I/O (power supply for the inputs and outputs)

Diagnosis and error table:

Bus Error	Input Overload	Supply Bus	Supply IO	◪ LED flash. ■ LED ON □ LED OFF Explanation
□	□	□	□	The module is not connected at all, or the 24 V DC power supply is OFF.
□	□	■	■	Power is ON, the bus is running, no error.
□	■	■	■	Power is ON, there is a short-circuit/overload on at least one +24 V DC power supply connection of an input, the bus is running.
◪	□	■	■	Power is ON, the bus does not run.
◪	■	■	■	Power is ON, there is a short-circuit/overload on at least one +24 V DC power supply connection of an input, the bus does not run.
■	■	■	■	Initialization phase after power ON.

Behaviour in case of short-circuit or overload at sensors:

The supply connections at the sensor input connectors are connected via a temperature-dependent resistor (PTC thermistor) to the + 24 V DC input of the screw-type terminals. If an overload or a short-circuit occurs with a sensor, the PTC will work as an overload protection. A voltage monitoring circuitry generates an error message in case of undervoltage (the LED "Overload" lights up). The following figure demonstrates the function.



After the short-circuit or overload has been eliminated, the module can operate correctly again. The red LED "Input Overload" goes out.

Error message to the master:

In case of a short-circuit or an overload, an error message is sent to the master, along with the error code No. 4. In each case, the channel No. 0 is given as faulty, independent of the really involved channel. The error message is kept up for a period of at least 5 seconds, even if the short-circuit or overload has been remedied in a shorter time.

Fur further information concerning diagnosis, see the descriptions of the central units and couplers used as bus masters.

Technical Data 07 DI 93-I

In general, the technical system data listed under "System data and system configuration" in chapter 1 of volume 2 of the "Advant Controller 31" system description are valid. Additional data or data which are different from the system data are listed as follows.

Connectors and terminals

Power supply 24 V DC	Screw-type terminals 1.5 mm^2 inside the housing, PG9 gland for cable
CS31bus line	Screw-type terminals 1.5 mm^2 inside the housing, PG9 gland for cable
16 inputs	8 x 5-pole M12 connectors (female) 2 inputs per connector

Power supply

Rated supply voltage	24 V DC
Current consumption, without output loads	max. 80 mA
Conductor cross section	max. 1.5 mm^2 (with inserted jumper) max. 2.5 mm^2 (without inserted jumper)

Inputs

Number of inputs per module		16
Signal level of the inputs	with signal 1 with signal 0	11 - 30 V 0 - 5 V
Signal input current with signal 1		approx. 8 mA
Input signal delay		approx. 1 ms
Short-circuit protection for sensors		PTC, $I_K \geq 1.6$ A

Interfaces

Transmission standard between the central unit and input/output modules	EIA RS-485 (CS31 system bus)
Bus transmission time	387 µs

LED indicators

Input signals	1 yellow LED per channel
Bus Error	1 red LED
Input Overload (short-circuit or overload)	1 red LED (lights up, when there is an overload or a short-circuit at the supply voltage for the sensors)
Supply Bus (power supply for bus logic)	1 green LED (lights up, when the supply voltage is ≥ 18 V)
Supply IO (power supply for inputs/outputs)	1 green LED (lights up, when the supply voltage is ≥ 18 V)

Mechanical data

Degree of protection according to DIN 40040, IEC 529	IP 67
Dimensions (length x width x height)	220 x 63.0 x 70.5 mm
Mounting dimension	208 mm (+0.5 mm)
Weight	approx. 470 g

Ordering data	Order No.
Input/output module 07 DI 93-I	GJV3 0756 13 R0202
Accessories:	
5-pole M12 plug, male, "straight"	GJV3 0756 17 R0001
5-pole M12 plug, male, "bended"	GJV3 0756 18 R0001
4-pole M12 plug, male, "straight"	GJV3 0756 24 R0001
M12 filler plug (4 plugs are provided with the module)	GJV3 0756 19 R0001

Note:
In order to meet the degree of protection IP67, suitable cables with certain diameters must be used at the cable glands (bus, I/O connectors, supply voltage): cable diameters for I/O 4.5 mm to 6.5 mm, for supply voltage and CS31 system bus 5 mm to 10 mm. The electrical specifications for the bus cables can be found under the Advant Controller 31 system data.
Unused cable glands have to be sealed with filler plugs.

4.4.2 Digital Output Module 07 DO 93-I

8 output channels 24 V DC/2A, **degree of protection IP67,** electrically isolated CS31 system bus connection

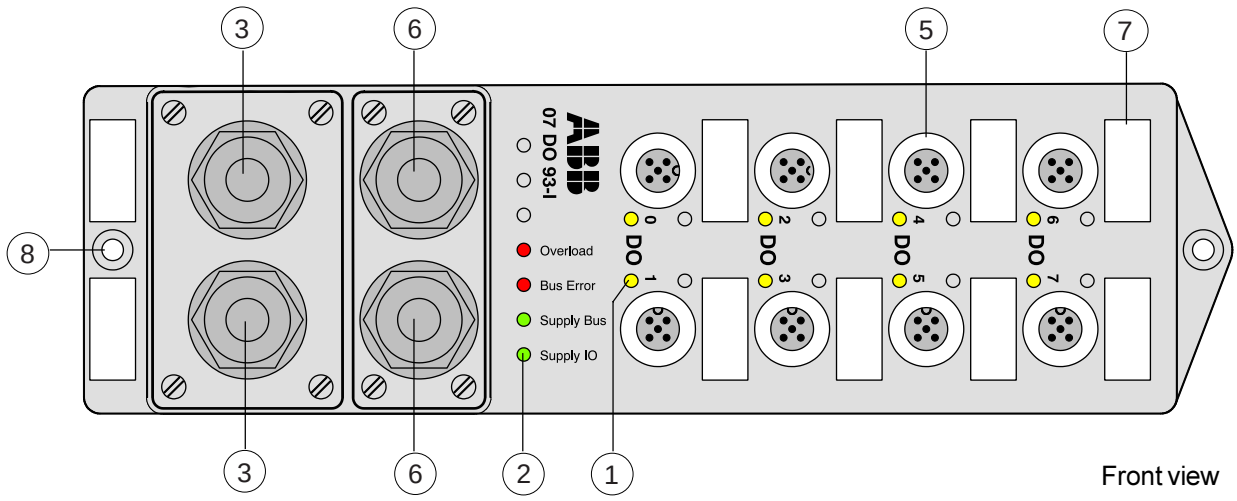


Fig. 4.4.2-1: Digital output module 07 DO 93-I

Contents

Intended purpose

The digital output module 07 DO 93-I is a remote module on the CS31 system bus. It has 8 output channels with the following features:

- Housing and connection according to IP67 degree of protection.
- The CS31 bus line is looped through from module to module (one PG9 screwed conduit entry each for input and output).
- Each output has its own connector and thus can be unplugged individually.
- The outputs
  - employ semiconductors,
  - have a rated load capability of 2 A and
  - are overload and short-circuit proof.

The module is mounted with screws.

The CS31 system bus connection is electrically isolated from remaining module components.

The module offers diagnosis functions.

Displays and connections at the module housing

① 8 yellow LEDs to indicate the signal status of the outputs

② LEDs "Bus Error", "Overload", "Supply Bus" and "Supply I/O" indicating the operating conditions and errors

③ CS31 bus connector

⑤ 8 connectors for 8 outputs

⑥ 24 V DC power supply

⑦ Labelling fields

⑧ Bore holes for mounting

Electrical connection

The following pages show all details necessary for the electrical connection.

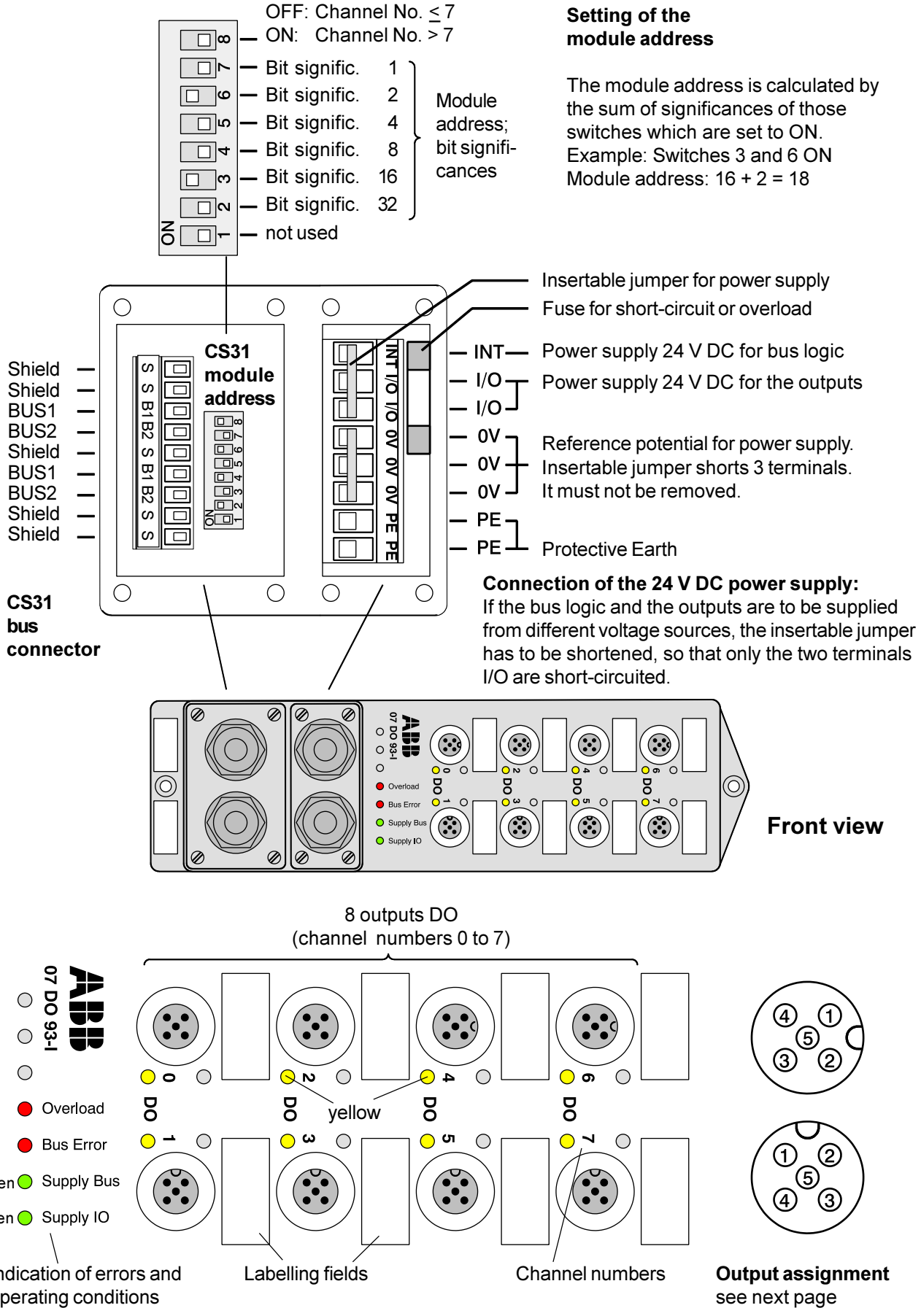


Fig. 4.4.2-2: Details for the electrical connection of the output module 07 DO 93-I

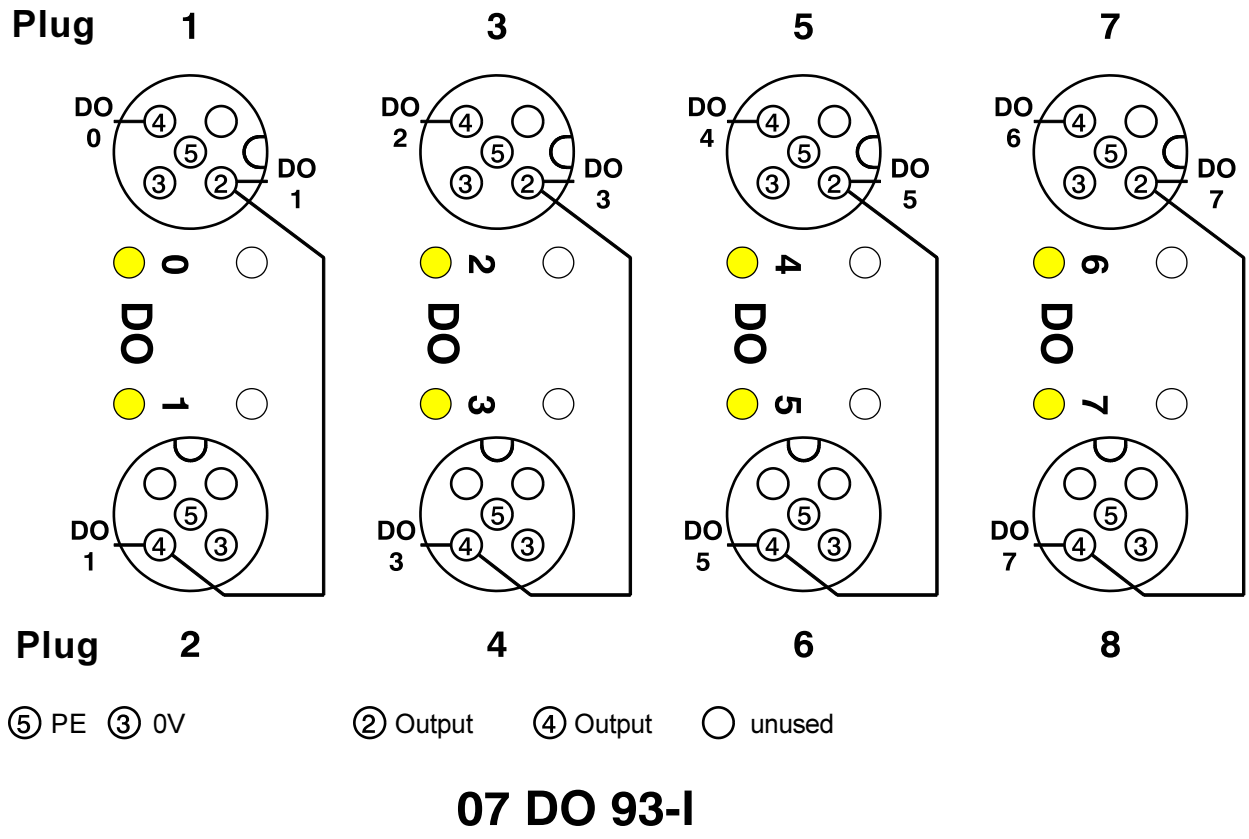
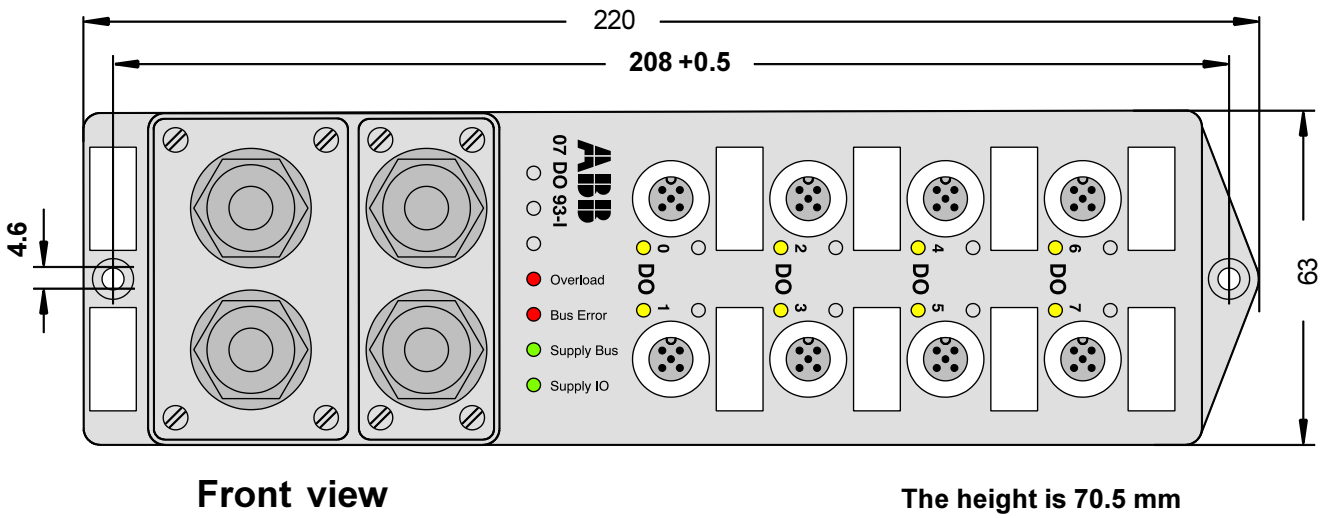


Fig. 4.4.2-3: Detailed pin assignment of the outputs of the module 07 DO 93-I



The dimensions for mounting with screws (assembly holes) are printed in **bold**.
The height of the module is **70.5 mm**.

Fig. 4.4.2-4: Outline dimensions of the output module 07 DO 93-I

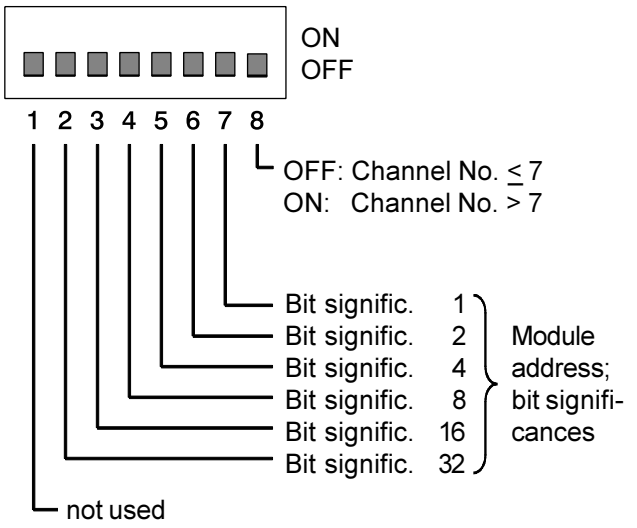
Addressing

An address has to be set on each module, so that the central unit can access the outputs correctly.

A detailed description concerning the item "Addressing" is contained in the chapters "Addressing" of the central units and couplers.

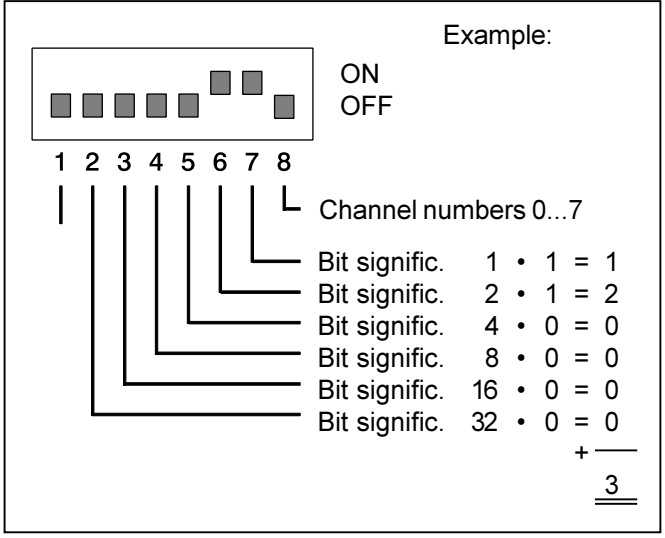
The module address is set on the DIL switch located under the cover at the top side of the module.

Meaning of the address switches:



Setting of the module address:

The module address is calculated by the sum of significances of those switches which are set to ON (see the following example).



When using the central units 07 KR 91, 07 KT 92 or 07 KT 93, the possible module addresses range from

0...61.

In connection with the central units 07 KR 91 and 07 KT 92/KT93 as bus masters, the following address allocations are valid:

Central units 07 KR 91 / 07 KT 92 / 93

The DIL switch No. 8 is set to:

Chan.	OFF	Chan.	ON
DO 0	A xx,00	DO 0	A xx,08
DO 1	A xx,01	DO 1	A xx,09
DO 2	A xx,02	DO 2	A xx,10
DO 3	A xx,03	DO 3	A xx,11
DO 4	A xx,04	DO 4	A xx,12
DO 5	A xx,05	DO 5	A xx,13
DO 6	A xx,06	DO 6	A xx,14
DO 7	A xx,07	DO 7	A xx,15

xx: Group number of the address, set on the DIL switch with the switches 2...7.

The module uses 8 outputs on the CS31 system bus.

I/O configuration

With this module, an I/O configuration is not necessary.

Normal operation

- The module initializes itself after power ON. During initialization process all four LEDs ② are ON.
- After the initialization process, the two red LEDs ② go out again, if the bus is running correctly and the module does not detect any error. The green LEDs "Supply Bus" and "Supply I/O" light up.
- The 8 yellow LEDs ① indicate the signal status of the outputs.

Diagnosis and displays

Diagnosis functions:

- Bus Error (on the CS31 system bus)
- Overload (overload or short-circuit at an output)
- Supply Bus (power supply of the bus logic)
- Supply I/O (power supply for the inputs and outputs)

Diagnosis and error table:

Bus Error	Overload	Supply Bus	Supply IO	◪ LED flash. ■ LED ON □ LED OFF Explanation
□	□	□	□	The module is not connected at all, or the 24 V DC power supply is OFF.
□	□	■	■	Power is ON, the bus is running, no error.
□	■	■	■	Power is ON, there is a short-circuit/overload on at least one output, the bus is running.
◪	□	■	■	Power is ON, the bus does not run.
◪	■	■	■	Power in ON, there is a short-circuit/overload on at least one output, the bus does not run.
■	■	■	■	Initialization phase after power ON.

Behaviour in case of short-circuit or overload at outputs:

If a short-circuit or an overload has occurred on an output channel, the involved channel will be switched off as a reaction on a high temperature of the switching transistor. In certain intervals, the module then tries to switch on the channel again. Before every switching-on trial, the signal at all channels will be interrupted for a period of approx. 20 μs. This is also valid for those channels which are not involved in the overload or short-circuit event.

After the short-circuit or overload has been eliminated, the involved channel can operate immediately again. The red LED "Overload" goes out.

Error message to the master:

In case of a short-circuit or an overload, an error message is sent to the master, along with the error code No. 4. In each case, the channel No. 0 is given as faulty, independent of the really involved channel. The error message is kept up for a period of at least 5 seconds, even if the short-circuit or overload has been remedied in a shorter time.

For further information concerning diagnosis, see the descriptions of the central units and couplers used as bus masters.

Technical Data 07 DO 93-I

In general, the technical system data listed under "System data and system configuration" in chapter 1 of volume 2 of the "Advant Controller 31" system description are valid. Additional data or data which are different from the system data are listed as follows.

Connectors and terminals

Power supply 24 V DC	Screw-type terminals 1.5 mm^2 inside the housing, PG9 gland for cable
CS31 bus line	Screw-type terminals 1.5 mm^2 inside the housing, PG9 gland for cable
8 outputs	8 x 5-pole M12 connectors (female)

Power supply

Rated supply voltage	24 V DC
Current consumption, without output loads	max. 80 mA
Supply current for the outputs	max. 10 A
Conductor cross section	max. 1.5 mm^2 (with inserted jumper) max. 2.5 mm^2 (without inserted jumper)
Internal fuse (under the cover)	16 A, slow-acting, 5 x 20 mm

Outputs

Number of outputs per module	8 (overload and short-circuit proof, electrically not isolated)
Signal level of the outputs at signal 1	like L+, max. internal voltage loss 0.1 V
Output load capability	
max. current per output	2 A, 100 % ED
lamp load per output	max. 50 W
total switching current (all outputs together)	max. 10 A
Switching frequency with inductive load	max. 1 Hz
with resistive load	max. 100 Hz
Short-circuit and overload protection	electronically
Short-circuit indication	yes, with a red LED
Limitation of output voltage, if an inductive load is switched off	by an integrated suppressor diode

Interfaces

Transmission standard between the central unit and input/output modules	EIA RS-485 (CS31 system bus)
Bus transmission time	323 μs

LED indicators

Output signals	1 yellow LED per channel
Bus Error	1 red LED
Overload (short-circuit or overload)	1 red LED (lights up when at least one output is short-circuited or overloaded)
Supply Bus (power supply for bus logic)	1 green LED (lights up when the supply voltage is ≥ 18 V)
Supply IO (power supply for inputs/outputs)	1 green LED (lights up when the supply voltage is ≥ 18 V)

Mechanical data

Degree of protection according to DIN 40040, IEC 529	IP 67
Dimensions (length x width x height)	220 x 63.0 x 70.5 mm
Mounting dimension	208 mm (+0.5 mm)
Weight	approx. 470 g

Ordering data	Order No.
Input/output module 07 DO 93-I	GJV3 0756 11 R0202
Accessories:	
5-pole M12 plug, male, "straight"	GJV3 0756 17 R0001
5-pole M12 plug, male, "bended"	GJV3 0756 18 R0001
4-pole M12 double plug, male, "straight"	GJV3 0756 24 R0001
M12 filler plug (4 plugs are provided with the module)	GJV3 0756 19 R0001

Note:
In order to meet the degree of protection IP67, suitable cables with certain diameters must be used at the cable glands (bus, I/O connectors, supply voltage): cable diameters for I/O 4.5 mm to 6.5 mm, for supply voltage and CS31 system bus 5 mm to 10 mm. The electrical specifications for the bus cables can be found under the Advant Controller 31 system data.
Unused cable glands have to be sealed with filler plugs.

4.4.3 Digital Input/Output Module 07 DK 93-I

8 input channels 24 V DC, 4 output channels 24 V DC/2A, **degree of protection IP67**, electrically isolated CS31 system bus connection

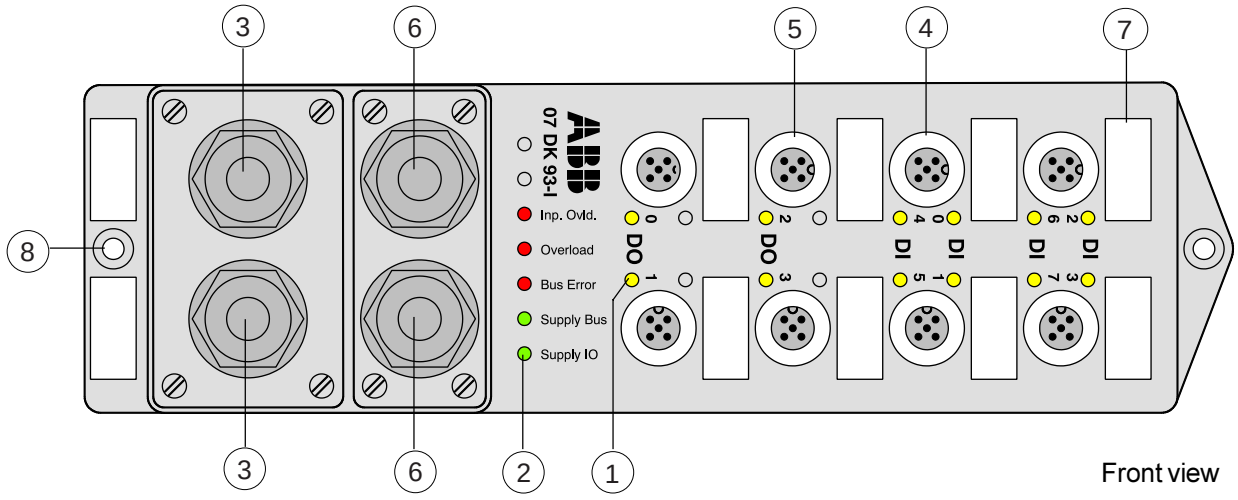


Fig. 4.4.3-1: Digital input/output module 07 DK 93-I

Contents

Intended purpose

The digital input/output module 07 DK 93-I is a remote module on the CS31 system bus. It has 8 input and 4 output channels with the following features:

- Housing and connection according to IP67 degree of protection.
- The CS31 bus line is looped through from module to module (one PG9 screwed conduit entry each for input and output).
- Each output and each pair of inputs have their own connector and thus can be unplugged individually.
- The inputs
  - allow you to connect sensors with 2-pole and 3-pole technique (switching contacts, initiators etc.)
  - provide a short-circuit/overload-proof supply voltage for the sensors, which can be loaded with max. 100 mA per channel
  - have a rated signal current of approx. 8 mA each
- The outputs
  - employ semiconductors,
  - have a rated load capability of 2 A and
  - are overload and short-circuit proof.

The module is mounted with screws.

The CS31 system bus connection is electrically isolated from remaining module components.

The module offers diagnosis functions.

Displays and connections at the module housing

① 12 yellow LEDs to indicate the signal status of the inputs and outputs

② LEDs "Bus Error", "Overload", "Input Overload", "Supply Bus" and "Supply I/O" indicating the operating conditions and errors

③ CS31 bus connector

④ 4 connectors for 8 inputs

⑤ 4 connectors for 4 outputs

⑥ 24 V DC power supply

⑦ Labelling fields

⑧ Bore holes for mounting

Electrical connection

The following pages show all details necessary for the electrical connection.

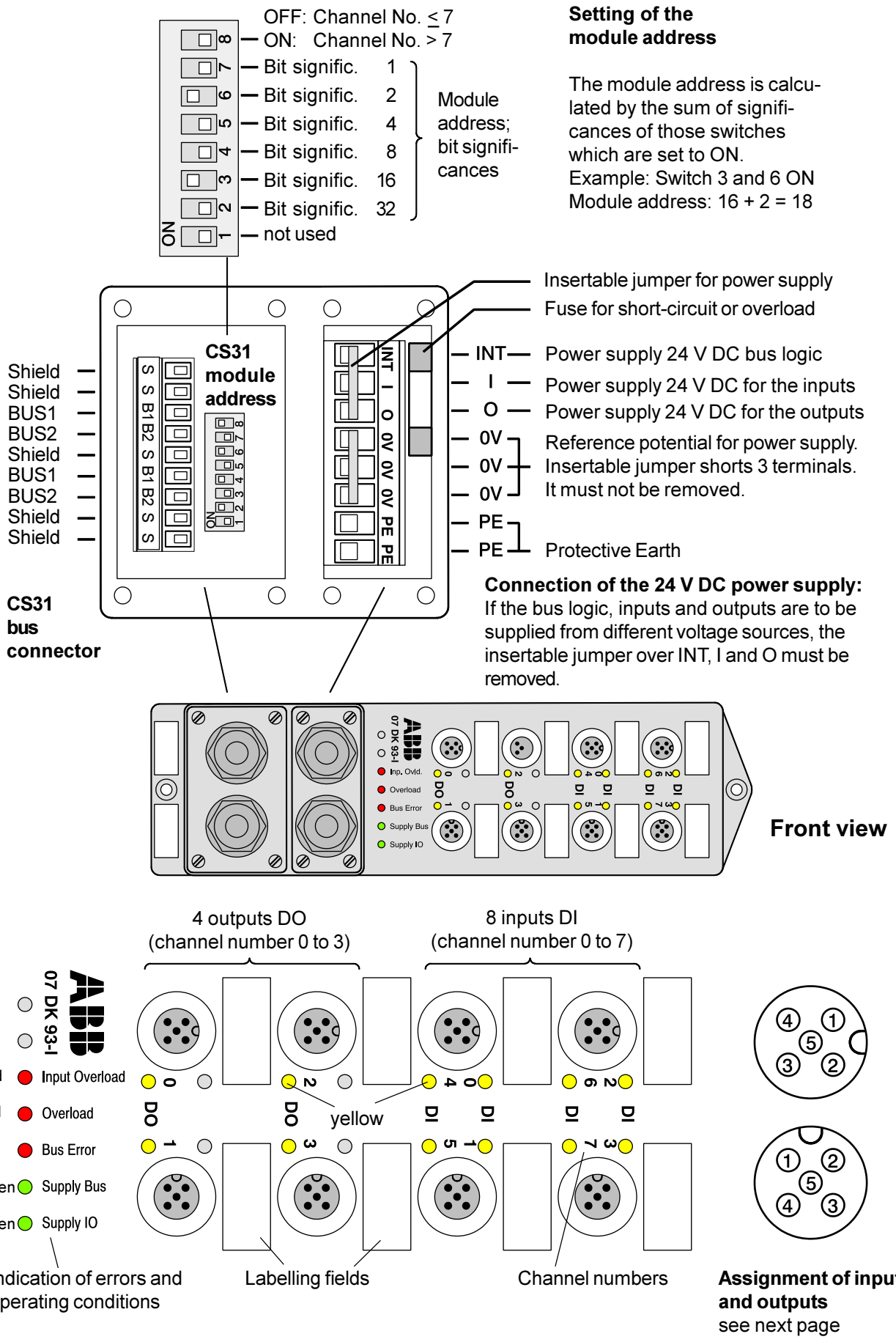


Fig. 4.4.3-2: Details for the connection of the input/output module 07 DK 93-I

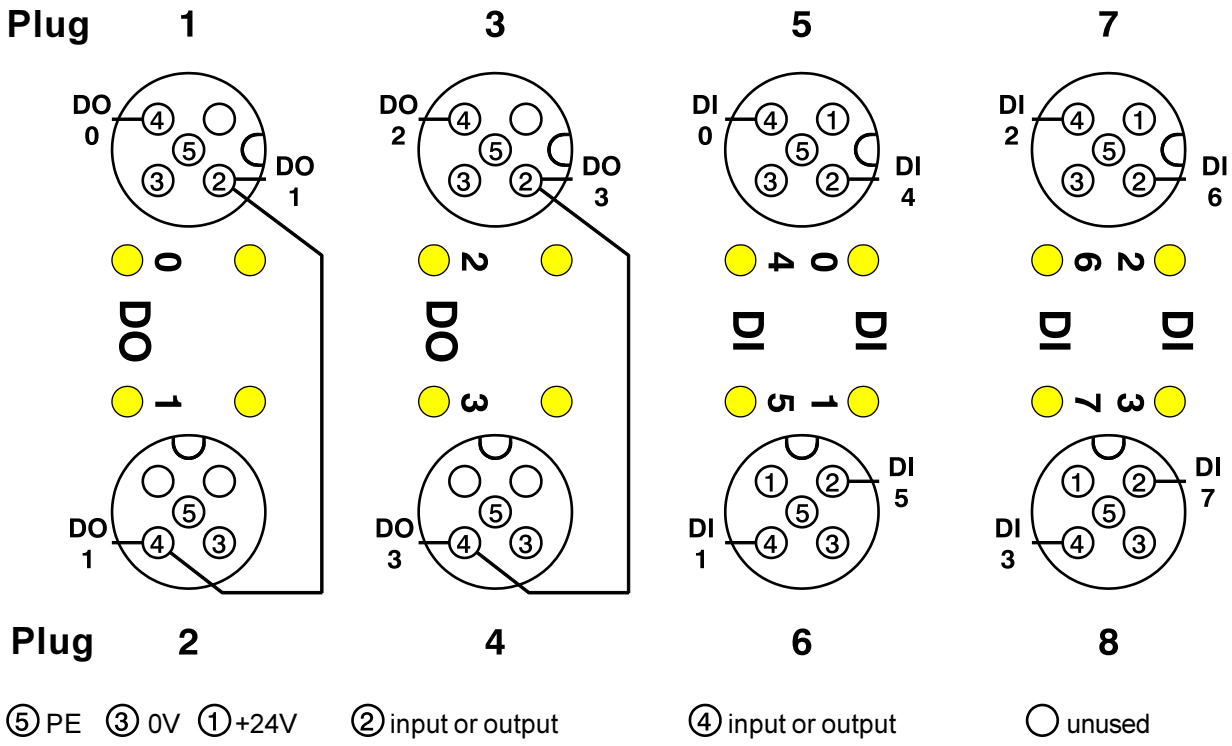
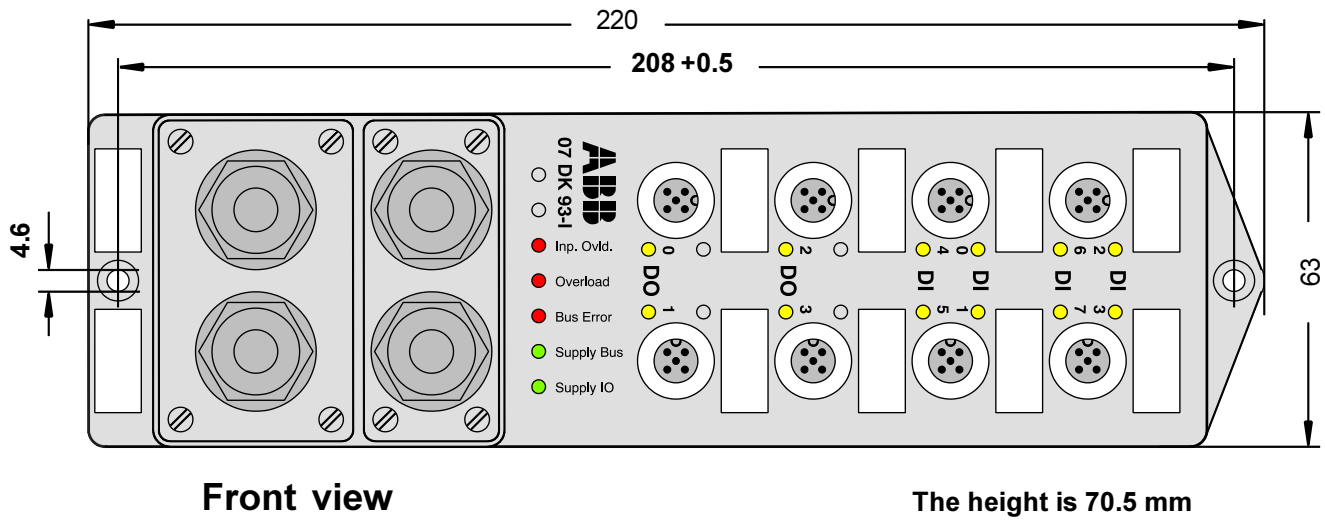


Fig. 4.4.3-3: Detailed pin assignment of the inputs and outputs of the module 07 DK 93-I



The dimensions for mounting with screws (assembly holes) are printed in **bold**.
The height of the module is **70.5 mm.**

Fig. 4.4.3-4: Outline dimensions of the input/output module 07 DK 93-I

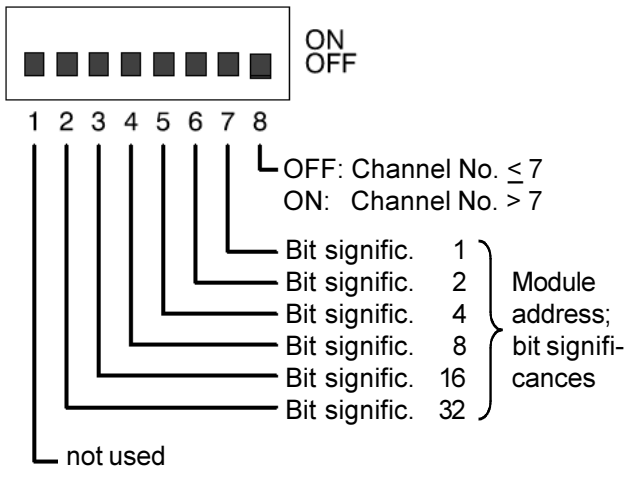
Addressing

An address has to be set on each module, so that the central unit can access the inputs and outputs correctly.

A detailed description concerning the item "Addressing" is contained in the chapters "Addressing" of the central units and couplers.

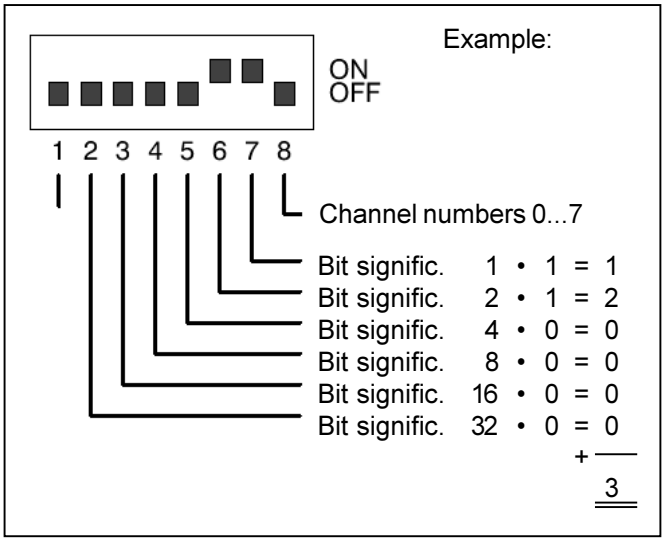
The module address is set on the DIL switch located under the cover at the top side of the module.

Meaning of the address switches:



Setting of the module address:

The module address is calculated by the sum of significances of those switches which are set to ON (see the following example).



When using the central units 07 KR 91, 07 KT 92 or 07 KT 93, the possible module addresses range from 0...61.

In connection with the central units 07 KR 91 and 07 KT 92/KT93 as bus masters, the following address allocations are valid:

Central units 07 KR 91 / 07 KT 92 / 93

The DIL switch No. 8 is set to:

Chan.	OFF	Chan.	ON
DI 0	E xx,00	DI 0	E xx,08
DI 1	E xx,01	DI 1	E xx,09
DI 2	E xx,02	DI 2	E xx,10
DI 3	E xx,03	DI 3	E xx,11
DI 4	E xx,04	DI 4	E xx,12
DI 5	E xx,05	DI 5	E xx,13
DI 6	E xx,06	DI 6	E xx,14
DI 7	E xx,07	DI 7	E xx,15
DO 0	A xx,00	DO 0	A xx,08
DO 1	A xx,01	DO 1	A xx,09
DO 2	A xx,02	DO 2	A xx,10
DO 3	A xx,03	DO 3	A xx,11

xx: Group number of the address, set on the DIL switch with switches 2...7.

The module uses 8 inputs and 8 outputs on the CS31 system bus.

I/O configuration

With this module, an I/O configuration is not necessary.

Normal operation

- The module initializes itself after power ON. During initialization process all five LEDs ② are ON.
- After the initialization process, the three red LEDs ② go out again, if the bus is running correctly and the module does not detect any error. The green LEDs "Supply Bus" and "Supply I/O" light up.
- The 12 yellow LEDs ① indicate the signal status of the inputs and outputs.

Diagnosis and displays

Diagnosis functions:

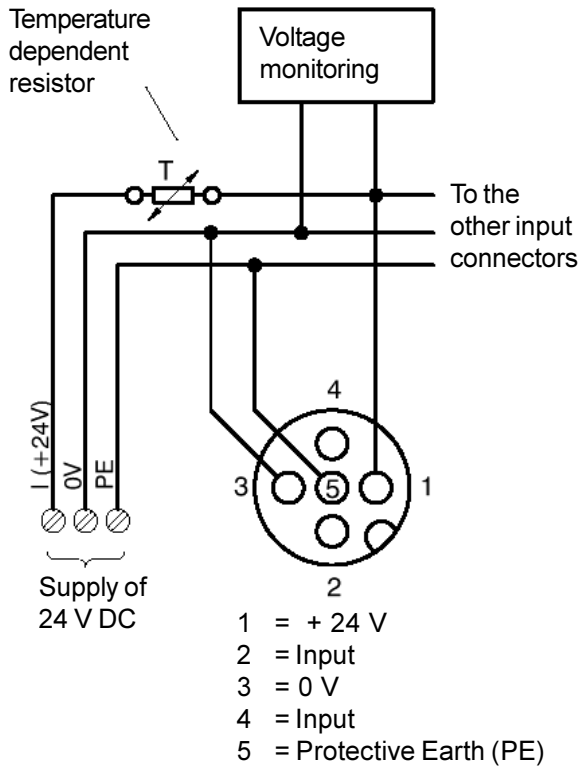
- Bus Error (on the CS31 system bus)
- Overload (overload or short-circuit at an output)
- Input Overload (overload or short-circuit at the power supply of the sensors)
- Supply Bus (power supply of the bus logic)
- Supply I/O (power supply for the inputs and outputs)

Diagnosis and error table:

Bus Error	Overload	Input Overload	Supply Bus	Supply IO	◪ LED flash. ■ LED ON □ LED OFF Explanation
□	□	□	□	□	The module is not connected at all, or the 24 V DC power supply is OFF.
□	□	□	■	■	Power is ON, the bus is running, no error.
□	■	□	■	■	Power is ON, there is a short-circuit/overload on at least one output, the bus is running.
□	□	■	■	■	Power is ON, there ist a short-circuit/overload on at least one +24 V DC power supply connection of an input, the bus is running.
◪	□	□	■	■	Power is ON, the bus does not run.
◪	■	□	■	■	Power is ON, there is a short-circuit/overload on at least one output, the bus does not run.
■	■	■	■	■	Initialization phase after power ON.

Behaviour in case of short-circuit or overload at sensors:

The supply connections at the sensor input connectors are connected via a temperature-dependent resistor (PTC thermistor) to the +24 V DC input of the screw-type terminals. If an overload or a short-circuit occurs with a sensor, the PTC will work as an overload protection. A voltage monitoring circuitry generates an error message in case of undervoltage (the LED "Input Overload" lights up). The following figure demonstrates the function.



After the short-circuit or overload has been eliminated, the module can operate correctly again. The red LED "Input Overload" goes out.

Behaviour in case of short-circuit or overload at outputs:

If a short-circuit or an overload has occurred on an output channel, the involved channel will be switched off as a reaction on a high temperature of the switching transistor. In certain intervals, the module then tries to switch on the channel again. Before every switching-on trial, the signal at all channels will be interrupted for a period of approx. 20 µs. This is also valid for those channels which are not involved in the overload or short-circuit event.

After the short-circuit or overload has been eliminated, the involved channel can operate immediately again. The red LED "Overload" goes out.

Error message to the master:

In case of a short-circuit or an overload, an error message is sent to the master, along with the error code No. 4. In each case, the channel No. 0 is given as faulty, independent of the really involved channel. The error message is kept up for a period of at least 5 seconds, even if the short-circuit or overload has been remedied in a shorter time.

For further information concerning diagnosis, see the descriptions of the central units and couplers used as bus masters.

Technical Data 07 DK 93-I

In general, the technical system data listed under "System data and system configuration" in chapter 1 of volume 2 of the "Advant Controller 31" system description are valid. Additional data or data which are different from the system data are listed as follows.

Connectors and terminals

Power supply 24 V DC	Screw-type terminals max. 1.5 mm^2 inside the housing, PG9 gland for cable
CS31 bus line	Screw-type terminals max. 1.5 mm^2 inside the housing, PG9 gland for cable
8 inputs	4 x 5-pole M12 connectors (female), 2 inputs per connector
4 outputs	4 x 5-pole M12 connectors (female)

Power supply

Rated supply voltage	24 V DC
Current consumption, without output loads	max. 80 mA
Supply current for the outputs	max. 8 A
Conductor cross section	max. 1.5 mm^2 (with inserted jumper) max. 2.5 mm^2 (without inserted jumper)
Internal fuse (under the cover)	10 A, slow-acting, 5 x 20 mm

Inputs

Number of inputs per module		8
Signal level of the inputs	with signal 1 with signal 0	11 - 30 V 0 - 5 V
Signal input current with signal 1		approx. 8 mA
Input signal delay		approx. 1 ms
Short-circuit protection for sensors		PTC, $I_K \geq 1.6$ A

Outputs

Number of outputs per module		4 (overload and short-circuit proof, electrically not isolated)
Signal level of the outputs at signal 1		like L+, max. internal voltage loss 0.1 V
Output load capability		
max. current per output		2 A, 100 % ED
lamp load per output		max. 50 W
total switching current		max. 8 A
Switching frequency	with inductive load with resistive load	max. 1 Hz max. 100 Hz
Short-circuit and overload protection		electronically
Short-circuit indication		yes, with a red LED
Limitation of output voltage, if an inductive load is switched off		by an integrated suppressor diode

Interfaces

Transmission standard between the central unit and input/output modules	EIA RS-485 (CS31 system bus)
Bus transmission time	387 µs

LED indicators

Input signals	1 yellow LED per channel
Output signals	1 yellow LED per channel
Bus Error	1 red LED
Overload (short-circuit or overload)	1 red LED (lights up when at least one output is short-circuited or overloaded)
Input Overload (short-circuit or overload)	1 red LED (lights up when there is an overload or a short-circuit at the supply voltage for the sensors)
Supply Bus (power supply for bus logic)	1 green LED (lights up when the supply voltage is ≥ 18 V)
Supply IO (power supply for inputs/outputs)	1 green LED (lights up when the supply voltage is ≥ 18 V)

Mechanical data

Degree of protection according to DIN 40040, IEC 529	IP 67
Dimensions (length x width x height)	220 x 63.0 x 70.5 mm
Mounting dimension	208 mm (+0.5 mm)
Weight	approx. 470 g

Ordering data	Order No.
Input/output module 07 DK 93-I	GJV3 0756 23 R0202
Accessories:	
5-pole M12 plug, male, "straight"	GJV3 0756 17 R0001
5-pole M12 plug, male, "bended"	GJV3 0756 18 R0001
4-pole M12 double plug, male, "straight"	GJV3 0756 24 R0001
M12 filler plug (4 plugs are provided with the module)	GJV3 0756 19 R0001

Note:
In order to meet the degree of protection IP67, suitable cables with certain diameters must be used at the cable glands (bus, I/O connectors, supply voltage): cable diameters for I/O 4.5 mm to 6.5 mm, for supply voltage and CS31 system bus 5 mm to 10 mm. The electrical specifications for the bus cables can be found under the Advant Controller 31 system data.
Unused cable glands have to be sealed with filler plugs.

5 Analog modules

5.1 General information for the use of analog modules

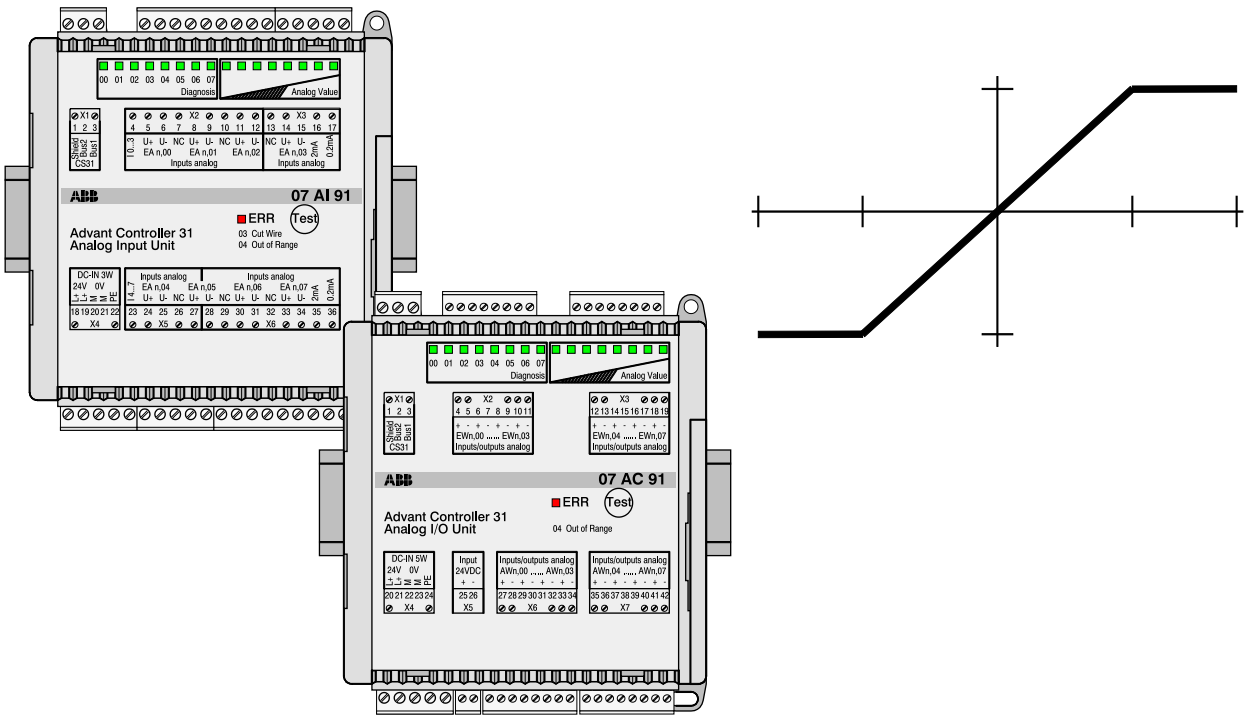


Fig. 5.1-1: Analog modules

Contents

5.1.1 Analog input/output modules

All analog input modules perform an internal analog-digital conversion. After the conversion, the analog value is represented with 8 or 12 bits, depending on the resolution. For processing and storing this relevant bits (bits which contain the analog information), a 16-bit word is available.

All analog output modules perform an internal digital-analog conversion. The digital value before the conversion (consisting of 8 or 12 relevant bits) is stored in a 16-bit word.

5.1.2 Position of the relevant data bits in the 16-bit word

The figure on the next page shows the position of the relevant data bits of modules with a resolution of 8 or 12 bits.

The 50 % value means either

- Analog value 5 V in the range of 0...10 V or -10 V...+10 V
- Analog value 10 mA in the range 0...20 mA
- Analog value 12 mA in the range 4...20 mA (The distance between 4 and 20 mA is 16 mA. 50 % of 16 mA is 8 mA. The real analog input or output value is then 12 mA, after adding the offset of 4 mA.)

The following pages show in detail:

- the conversion characteristics of the analog inputs and outputs referring to
  - the resolution (8 bits or 12 bits)
  - the analog signal range
- tables showing the significances of the bits in the 16-bit word

Bit No. in the 16-bit word

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
-100 %	50 %	25 %	12.5 %	6.25 %	3.13 %	1.56 %	0.78 %	0.39 %	0	0	0	0	0	0	0

8-bit resolution, value range 0...+ 100 %,
in the range of - 100...+ 100 % bit 7 is 0, the sign is assigned to bit 15

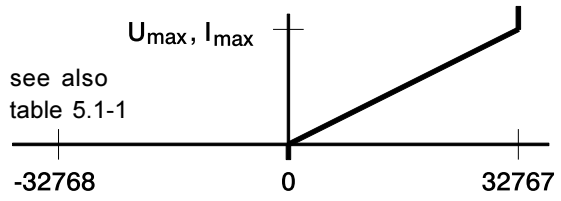
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
-100 %	50 %	25 %	12.5 %	6.25 %	3.13 %	1.56 %	0.78 %	0.39 %	0.20 %	0.10 %	0.05 %	0.02 %	0	0	0

12-bit resolution, value range 0...+ 100 % and -100...+100 %,
the sign is assigned to bit 15

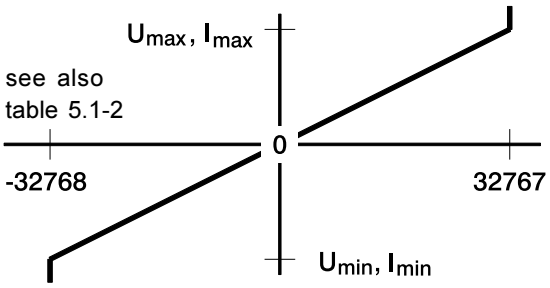
Fig.: Position of the relevant bits in the 16-bit word with a resolution of 8 bits and 12 bits

5.1.3 Conversion characteristics for analog modules

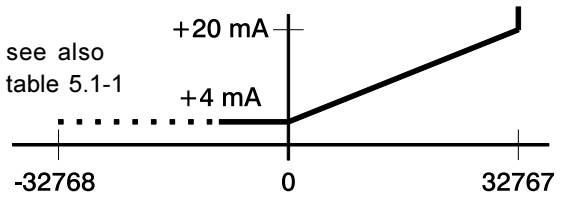
Input modules



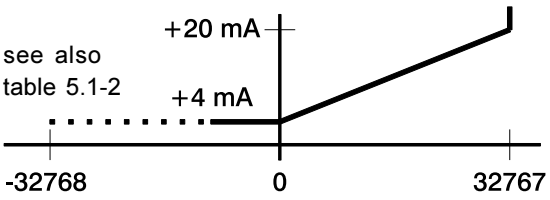
Input 0...10 V, 0...5 V, 0...20 mA, 8 bits



Input ±10 V, ±5 V, ±20 mA, 12 bits

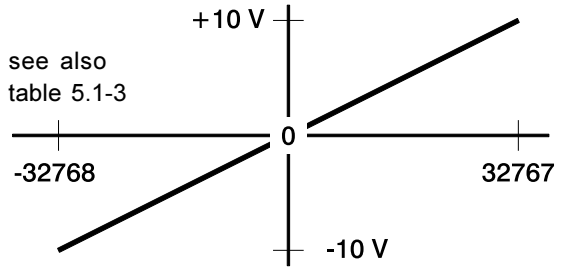


Input 4...20 mA, 8 bits

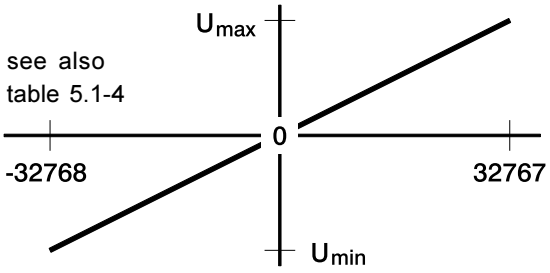


Input 4...20 mA, 12 bits

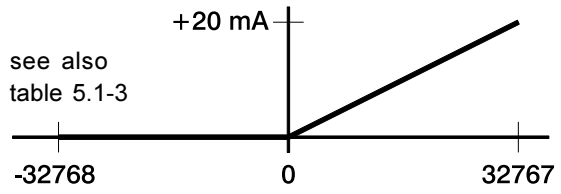
Output modules



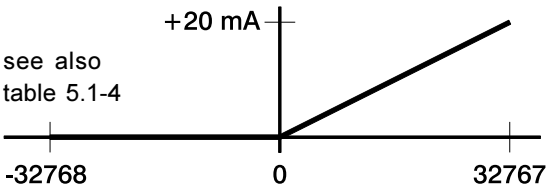
Output ±10 V, 8 bits



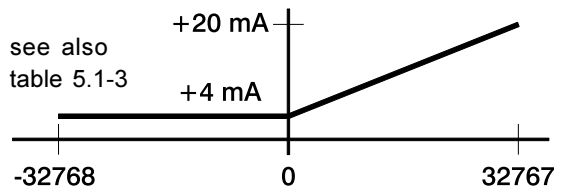
Output ±10 V and ±12,5 V, 12 bits



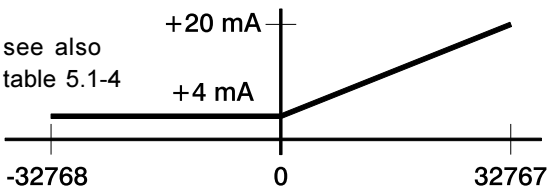
Output 0...20 mA, 8 bits



Output 0...20 mA, 12 bits



Output 4...20 mA, 8 bits



Output 4...20 mA, 12 bits

Meas. range	0 V...+10 V	0...5 V	0...20 mA	4...20 mA
Resolution	40 mV	20 mV	+ 0.08 mA	+ 0.062 mA
Max. value	+ 9.96 V	+ 4.98 V	+ 19.92 mA	+ 19.94 mA
Min. value	0 V	0 V	0 mA	4.0 mA
Offset	0 V	0 V	0 mA	4.0 mA
16-bit word				
Bit 15	0 V	0 V	0 mA	0 mA *)
Bit 14	+ 5 V	+ 2.5 V	+ 10 mA	+ 8 mA
Bit 13	+ 2.5 V	+ 1.25 V	+ 5 mA	+ 4 mA
Bit 12	+ 1.25 V	+ 0.62 V	+ 2.5 mA	+ 2 mA
Bit 11	+ 0.62 V	+ 0.31 V	+ 1.25 mA	+ 1 mA
Bit 10	+ 0.31 V	+ 0.15 V	+ 0.62 mA	+ 0.5 mA
Bit 09	+ 0.15 V	+ 0.08 V	+ 0.31 mA	+ 0.25 mA
Bit 08	+ 0.08 V	+ 0.04 V	+ 0.15 mA	+ 0.125 mA
Bit 07	+ 0.04 V	+ 0.02 V	+ 0.08 mA	+ 0.062 mA
Bit 06	0 V	0 V	0 mA	0 mA
Bit 05	0 V	0 V	0 mA	0 mA
Bit 04	0 V	0 V	0 mA	0 mA
Bit 03	0 V	0 V	0 mA	0 mA
Bit 02	0 V	0 V	0 mA	0 mA
Bit 01	0 V	0 V	0 mA	0 mA
Bit 00	0 V	0 V	0 mA	0 mA

Table 5.1-1 Significances of the bits in the 16-bit word for analog **input** modules with a **8-bit** resolution, 07 KR 91, 07 KT 92, 07 KT 93, 07 KT 94 as master

Meas. range	±10 V	±5 V	±20 mA	4...20 mA
Resolution	5 mV	2.5 mV	0.010 mA	+ 0.008 mA
Max. value	+ 10 V	+ 5 V	+ 20 mA	+ 20 mA
Min. value	- 10 V	- 5 V	- 20 mA	+ 4.0 mA
Offset	0 V	0 V	0 mA	+ 4.0 mA
16-bit word				
Bit 15	- 10 V	- 5 V	- 20 mA	0 mA *)
Bit 14	+ 5 V	+ 2.5 V	+ 10 mA	+ 8 mA
Bit 13	+ 2.5 V	+ 1.25 V	+ 5 mA	+ 4 mA
Bit 12	+ 1.25 V	+ 0.62 V	+ 2.5 mA	+ 2 mA
Bit 11	+ 0.62 V	+ 0.31 V	+ 1.25 mA	+ 1 mA
Bit 10	+ 0.31 V	+ 0.15 V	+ 0.62 mA	+ 0.5 mA
Bit 09	+ 0.15 V	+ 0.08 V	+ 0.31 mA	+ 0.25 mA
Bit 08	+ 0.08 V	+ 0.04 V	+ 0.15 mA	+ 0.125 mA
Bit 07	+ 0.04 V	+ 0.02 V	+ 0.08 mA	+ 0.062 mA
Bit 06	+ 0.02 V	+ 0.01 V	+ 0.04 mA	+ 0.031 mA
Bit 05	+ 0.01 V	+ 0.005 V	+ 0.02 mA	+ 0.015 mA
Bit 04	+ 0.005 V	+ 0.0025 V	+ 0.01 mA	+ 0.008 mA
Bit 03	0 V	0 V	0 mA	0 mA
Bit 02	0 V	0 V	0 mA	0 mA
Bit 01	0 V	0 V	0 mA	0 mA
Bit 00	0 V	0 V	0 mA	0 mA

Tabelle 5.1-2 Significances of the bits in the 16-bit word for analog **input** modules with a **12-bit** resolution, 07 KR 91, 07 KT 92, 07 KT 93, 07 KT 94 as master

*) For input modules the most significant bit is 0, if $I \geq 4$ mA and 1, if $I < 4$ mA.

Meas. range	±10 V	0...20 mA	4...20 mA
Resolution	80 mV	0.08 mA	+ 0.062 mA
Max. value	+ 9.92 V	+ 19.92 mA	+ 19.94 mA
Min. value	- 10 V	0 mA	+ 4.0 mA
Offset	0 V	0 mA	+ 4.0 mA
16-bit word			
Bit 15	- 10 V	- 20 mA [4])	- 16 mA [5])
Bit 14	+ 5 V	+ 10 mA	+ 8 mA
Bit 13	+ 2.5 V	+ 5 mA	+ 4 mA
Bit 12	+ 1.25 V	+ 2.5 mA	+ 2 mA
Bit 11	+ 0.62 V	+ 1.25 mA	+ 1 mA
Bit 10	+ 0.31 V	+ 0.62 mA	+ 0.5 mA
Bit 09	+ 0.15 V	+ 0.31 mA	+ 0.25 mA
Bit 08	+ 0.08 V	+ 0.15 mA	+ 0.125 mA
Bit 07	0 V	+ 0.08 mA	+ 0.062 mA
Bit 06	0 V	0 mA	0 mA
Bit 05	0 V	0 mA	0 mA
Bit 04	0 V	0 mA	0 mA
Bit 03	0 V	0 mA	0 mA
Bit 02	0 V	0 mA	0 mA
Bit 01	0 V	0 mA	0 mA
Bit 00	0 V	0 mA	0 mA

Table 5.1-3 Significances of the bits in the 16-bit word for analog **output** modules with a **8-bit** resolution, 07 KR 91, 07 KT 92, 07 KT 93, 07 KT 94 as master

Meas. range	±10 V	±12,5 V	0...20 mA	4...20 mA
Resolution	5 mV	6 mV	0.01 mA	+ 0.008 mA
Max. value	+ 9.995 V	+ 12.49 V	+ 19.99 mA	+ 19.99 mA
Min. value	- 10 V	- 12.5 V	0 mA	+ 4.0 mA
Offset	0 V	0 V	0 mA	+ 4.0 mA
16-bit word				
Bit 15	- 10 V	- 12.5 V	- 20 mA [4])	- 16 mA [5])
Bit 14	+ 5 V	+ 6.25 V	+ 10 mA	+ 8 mA
Bit 13	+ 2.5 V	+ 3.12 V	+ 5 mA	+ 4 mA
Bit 12	+ 1.25 V	+ 1.56 V	+ 2.5 mA	+ 2 mA
Bit 11	+ 0.62 V	+ 0.77 V	+ 1.25 mA	+ 1 mA
Bit 10	+ 0.31 V	+ 0.39 V	+ 0.62 mA	+ 0.5 mA
Bit 09	+ 0.15 V	+ 0.19 V	+ 0.31 mA	+ 0.25 mA
Bit 08	+ 0.08 V	+ 0.1 V	+ 0.15 mA	+ 0.125 mA
Bit 07	+ 0.04 V	+ 0.05 V	+ 0.08 mA	+ 0.062 mA
Bit 06	+ 0.02 V	+ 0.025 V	+ 0.04 mA	+ 0.031 mA
Bit 05	+ 0.01 V	+ 0.012 V	+ 0.02 mA	+ 0.015 mA
Bit 04	+ 0.005 V	+ 0.006 V	+ 0.01 mA	+ 0.008 mA
Bit 03	0 V	0 V	0 mA	0 mA
Bit 02	0 V	0 V	0 mA	0 mA
Bit 01	0 V	0 V	0 mA	0 mA
Bit 00	0 V	0 V	0 mA	0 mA

Table 5.1-4 Significances of the bits in the 16-bit word for analog **output** modules with a **12-bit** resolution, 07 KR 91, 07 KT 92, 07 KT 93, 07 KT 94 as master

[4]) If bit 15 = 1, the output current is 0 mA.
[5]) If bit 15 = 1, the output current is 4 mA.

5.2.1 Analog Input Module 07 AI 91

8 inputs, configurable for temperature sensors or as voltage inputs, 24 V DC, CS31 system bus

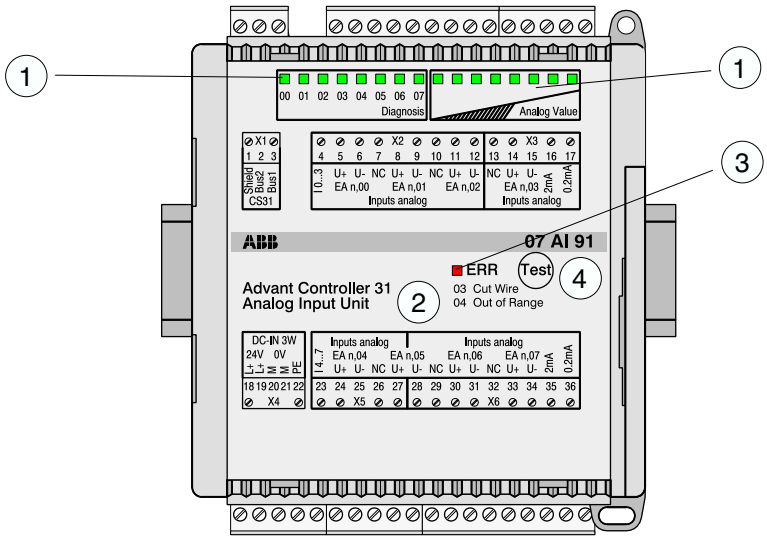


Fig. 5.2.1-1: Analog input module 07 AI 91

Contents

Intended purpose

The analog input module 07 AI 91 is used as a remote module at the CS31 system bus. It has 8 analog input channels with the following features:

- The channels can be configured in pairs for the connection of the following temperature or voltage sensors:
  - ± 10 V / ± 5 V / ± 500 mV / ± 50 mV
  - 4...20 mA (with external 250 Ω resistor)
  - Pt100 / Pt1000 with linearization
  - Thermocouples types J, K and S with linearization
  - Only electrically isolated sensors may be used.
- The range of ± 5 V can also be used for measuring 0..20 mA with an additional external 250 Ω resistor.
- The configuration of the input channels as well as the setting of the module address are performed with the DIL switches.

The 07 AI 91 uses **one** module address (group number) in the word input range. Each of the 8 channels use 16 bits.

The unit is powered with 24 V DC. The CS31 system bus connection is electrically isolated from the rest of the unit.

The module offers a number of diagnosis functions (see chapter "Diagnosis and displays"). The diagnosis functions perform a self-calibration for all channels.

Displays and operating elements on the front panel

① 8 green LEDs for channel selection and diagnosis, 8 green LEDs for analog value display of one channel

② List of diagnosis information relating to the LEDs, when used for diagnosis display

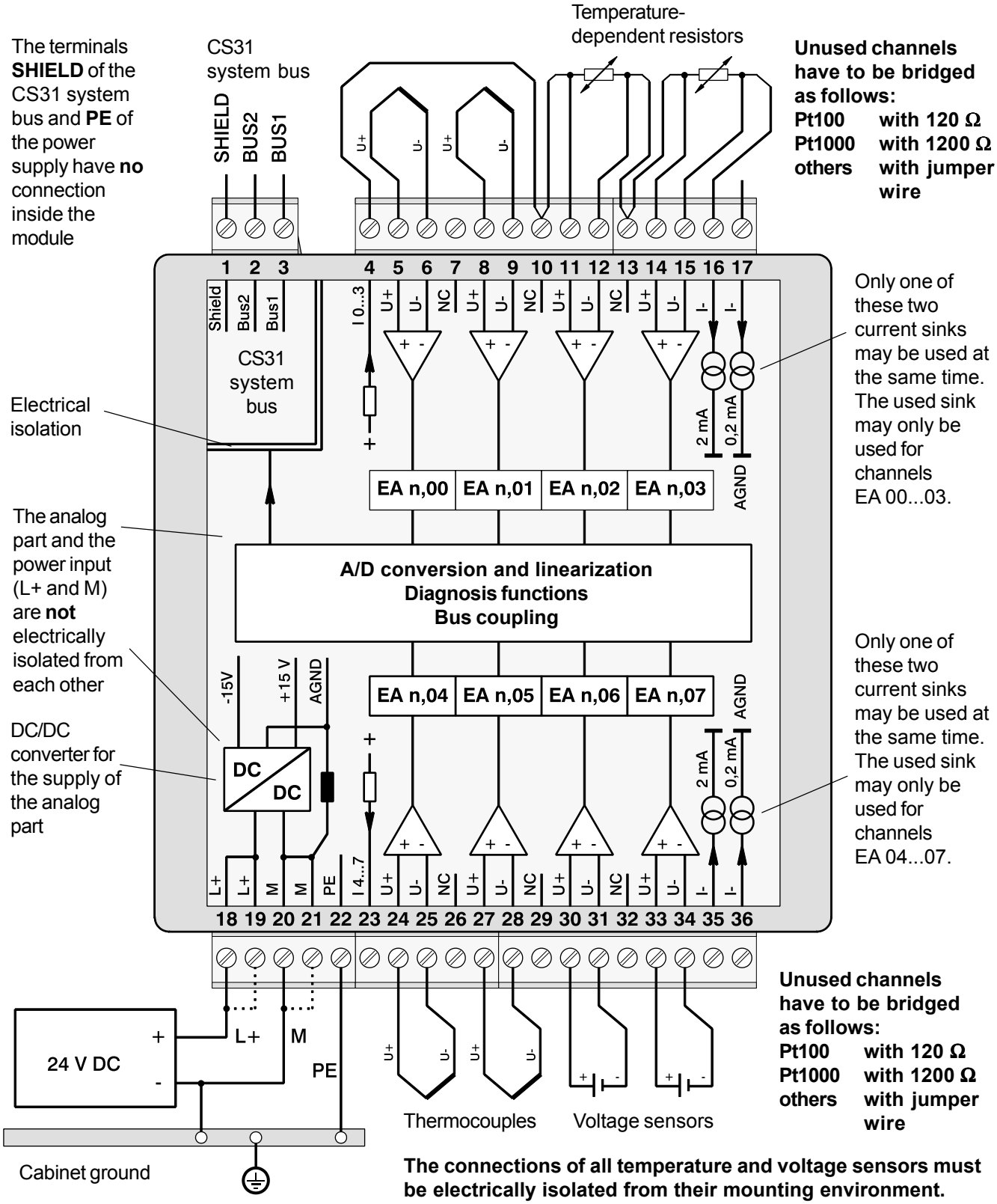
③ Red LED for error messages

④ Test button

Electrical connection

The module is mounted on a DIN rail (15 mm high) or with 4 screws. The following figure shows the electrical connection of the input module.

Connection examples for temperature sensors



Caution: The process supply voltage must be included in the grounding concept of the control system (e.g. grounding of the minus terminal)

The connections of all temperature and voltage sensors must be electrically isolated from their mounting environment.
The cable shields of the temperature sensors are grounded to the cabinet at the entry into the cabinet.

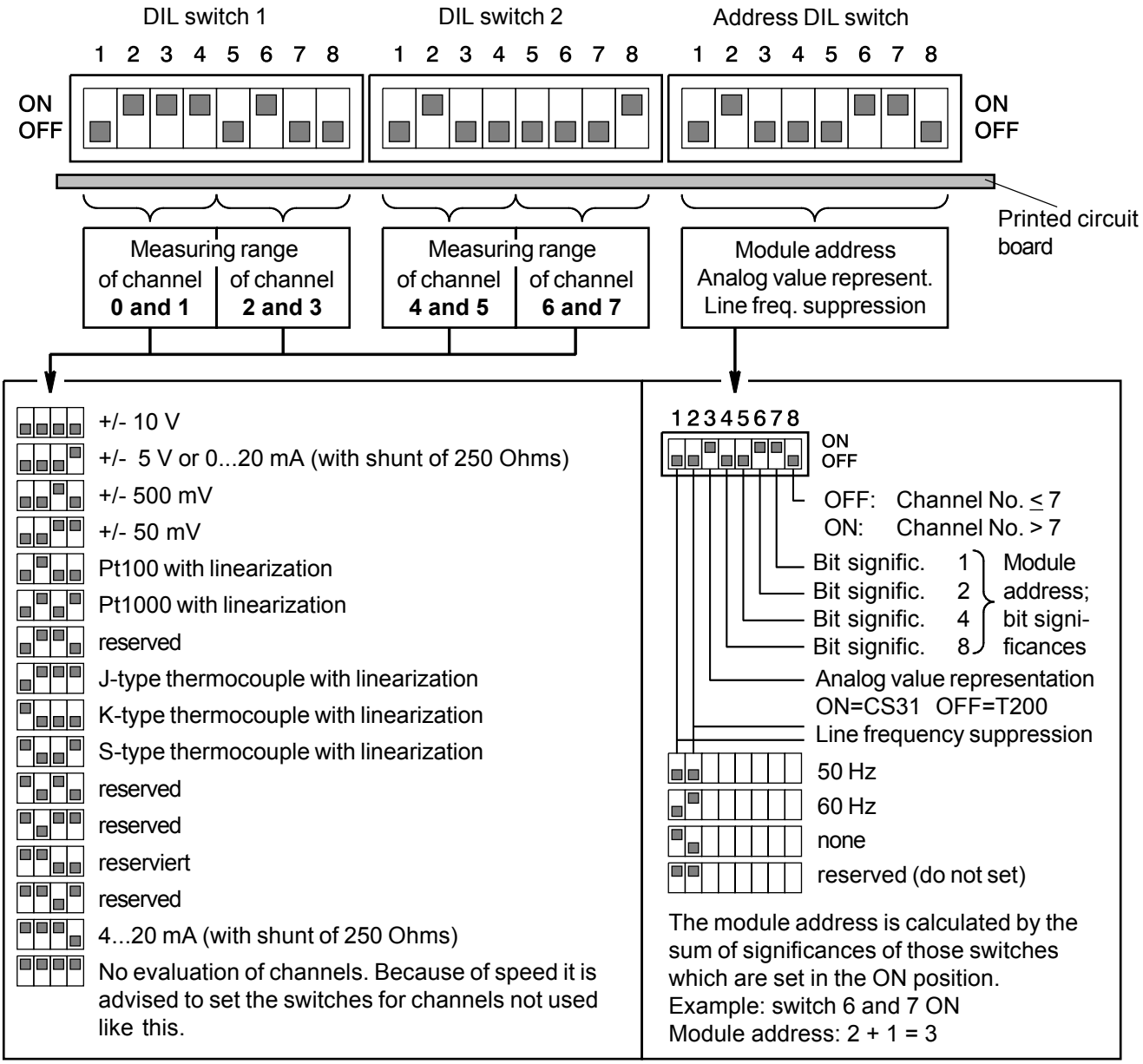
The setting of the module address as well as the configuration of the analog channels are performed with the DIL switches (see next page).

Fig. 5.2.1-2: Electrical connection of the analog input module 07 AI 91

Configuration of input channels and setting of the module address at the CS31 bus

The measuring ranges for the analog channels are set in pairs (i.e. always for two channels together) using DIL switches 1 and 2. The setting of address DIL switch determines the module address, the analog value representation and the line frequency suppression (50 Hz, 60 Hz or none).

The switches are located under the slide cover on the right side of the module housing. The following figure shows the possible settings.



Specifications for the platinum temperature sensors are:

Pt100	= platinum 100 Ω at 0 °C	measuring range -50...400 °C	constant current 2 mA
Pt1000	= platinum 1000 Ω at 0 °C	measuring range -50...400 °C	constant current 0.2 mA

Specifications for the thermocouples are:

Type **J = Fe-CuNi**	0...1200 °C	iron / copper-nickel	+ = Fe	- = CuNi
Type **K = NiCr-NiAl**	0...1372 °C	nickel-chromium / nickel-aluminium	+ = NiCr	- = NiAl
Type **S = Pt10Rh-Pt**	0...1600 °C	platinum-10% rhodium / platinum	+ = Pt10Rh	- = Pt

Fig. 5.2.1-3: Configuration of the input channels and setting of module address at the CS31 system bus

Measuring ranges of the input channels

All input signals are evaluated as differential signals. The sensor signal is connected with two poles to the inputs U+ and U- (example see Fig. 5.2.1-2). The relationship between input signal and the output numerical value is shown in figs. 5.2.1-7 and 5.2.1-8. All channels not used must be short-circuited (see also bridging of unused channels at Pt100/Pt1000 channels).

± 10 V / ± 5 V / ± 500 mV / ± 50 mV

The set measuring range resulting from the A/D conversion is displayed in the following number range:

-32760 ... 0 ... +32760

If input voltages overflow the measuring range, the overflow number of +32767 is output. If the input voltage underflows the measuring range, the underflow number of -32767 is output. In both cases, an error message is sent via the CS31 system bus.

All unused channels must be short-circuited.

4...20 mA / 0...20 mA

The following configurations must be set:

Measuring range	Setting
4...20 mA	4...20 mA
0...20 mA	± 5 V

Both channel input terminals must be externally bridged with a shunt of 250 Ω.

Unused inputs for 0...20 mA must be short-circuited. In this case, they do not need a shunt. Unused inputs for 4...20 mA can be circuited in parallel with another 4...20 mA input channel without requiring an extra shunt. In this way, error messages (underflow) can be avoided.

Pt 100 / Pt 1000

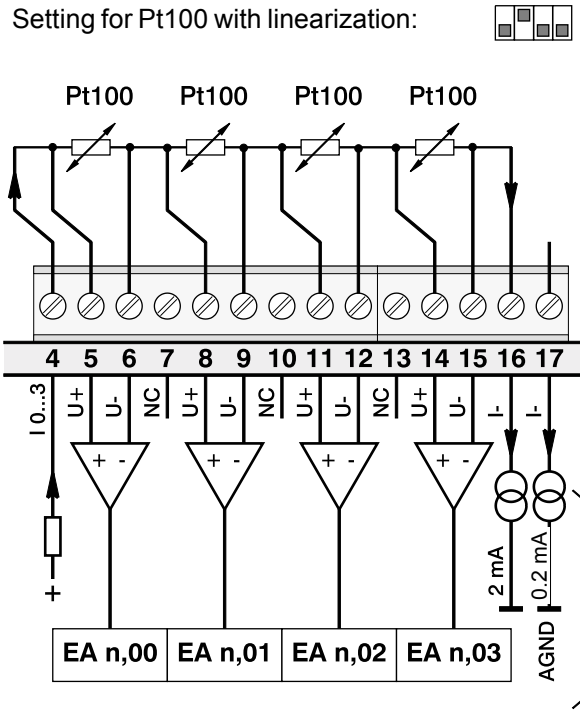
When resistance thermometers are used, a constant current must flow through the shunt to build the necessary voltage drop for the evaluation. For this purpose the module provides two constant current sinks.

The two following figures show the connection of Pt100 and Pt1000 resistance thermometers. In these configurations the module performs a linearization of the Pt100/ Pt1000 characteristic curves. The integrated current sinks of 2 mA and 0.2 mA is also considered in these measuring circuits. This way their tolerances are compensated.

The following allocation applies to the constant current sinks:

For resistance thermometers connected to terminals 5 to 15 (channels EA n,00 to EA n,03), only one of the two sinks may be used on terminals 16 **or** 17 (2 mA **or** 0.2 mA).

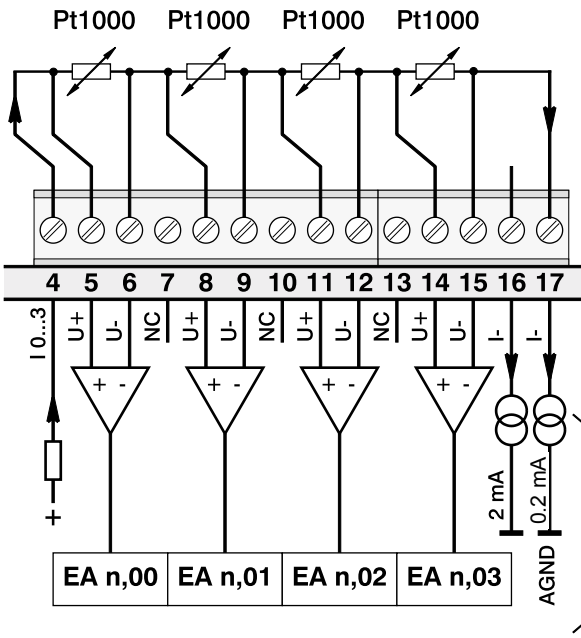
Setting for Pt100 with linearization:



Only one of the two sinks may be used at the same time. The used sink may only be used for channels EA 00...03.

Fig. 5.2.1-4: Connection of Pt100 sensors

Setting for Pt1000 with linearization:



Only one of the two sinks may be used at the same time. The used sink may only be used for channels EA 00...03.

Fig. 5.2.1-5: Connection of Pt1000 sensors

For resistance thermometers connected to terminals 24 to 34 (channels EA n,04 to EA n,07), only one of the two sinks may be used for terminals 35 **or** 36 (2 mA **or** 0.2 mA).

Simultaneous operation of Pt100 and Pt1000 sensors is possible when one group (i.e. Pt100) is connected to the upper terminal bank and the other (i.e. Pt1000) is connected to the lower terminal bank.

Terminals 7, 10, 13, 26, 29 and 32 (marked NC) can be used as connecting points for the current loop (see also Fig. 5.2.1-2).

The measuring range of **-50°C...400°C** is assigned linearly to the number range of **-1022...+8190** (see also Figs. 5.2.1-7 and 5.2.1-8).

If input voltages overflow the measuring range, the overflow number of +32767 is output. If the input voltage underflows the measuring range, the underflow number of -32767 is output. In both cases, an error message is sent via the CS31 system bus.

In case of open circuit (wire break in the current loop), the numeric value of -32767 is displayed. In case of wire breakage (in a sensor circuit), the numeric value +32767 is displayed. Both cases cause an error message via the CS31 system bus.

If unused Pt100/Pt1000 channels are bridged, the wire bridge simulates 0 Ω, the measuring value for very low temperature. This causes the error message "range underflow". To avoid such error messages, bridge unused Pt100/Pt1000 channels as follows:

Pt 100 with a resistor of 120 Ω
Pt 1000 with a resistor of 1200 Ω

Connection of other temperature-dependent resistors

Basically all temperature-dependent resistors can be connected in place of the Pt100/Pt1000 sensors. For a configuration you can use the settings ± 5 V, ± 500 mV and ± 50 mV. If necessary, the linearization of the resistance characteristic must be performed in the PLC user program. The integrated current sinks can be used, however, consider the following:

- The voltage drop of all resistors connected in series must not exceed

  7 V (when using the current sink of 0.2 mA),

  2,5 V (when using the current sink of 2 mA)

- The tolerance of the integrated current sinks of ± 1.5 % must be considered in the tolerance calculations for the temperature measurement (no compensation as for Pt100/Pt1000).

Thermocouples types J, K, and S

Thermocouples are connected to terminals U+ and U-, either directly or via compensating wires to both poles. Be sure to observe polarity.

The reference junction temperature sensor is integrated in the module near the terminals. When evaluating the absolute temperature, the terminals are considered as the reference junction.

Configuration (see Fig. 5.2.5-3)

Type J with linearization

Type K with linearization

Type S with linearization

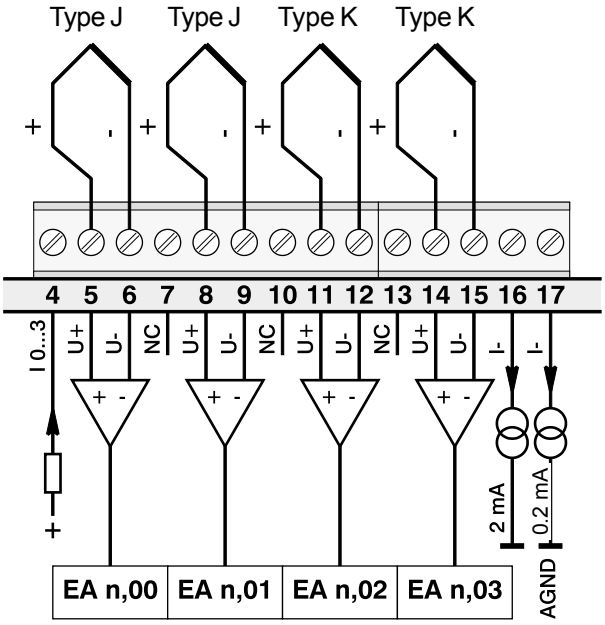


Fig. 5.2.1-6: Connection of two type J and two type K sensors

The thermoelectric voltage generated by the thermocouples is converted into binary values inside the module and then linearized according to the thermocouple type. In order to get the absolute temperature, the temperature of the reference junction is added.

The measuring value is allocated linearly to the numeric values as follows (see also Figs. 5.2.1-7 and 5.2.1-8):

Type J: **0°C...1200°C** number range **0...24576**
Type K: **0°C...1372°C** number range **0...28096**
Type S: **0°C...1600°C** number range **0...32760**

If input voltages overflow the measuring range, the overflow number of +32767 is output. If the input voltage underflows the measuring range, the underflow number of -32767 is output. In both cases, an error message is sent via the CS31 system bus. Temperatures below 0°C are considered as "underflow".

A wire break will cause the numerical value of -32767 as well as an error message via the CS31 system bus.

All channels not used must be short-circuited.

Note:

Since L type thermocouples (iron/constantan, Fe-CuNi according to DIN 43710) are similar to J type thermocouples, they also can be used in the temperature range of 0...900 °C. The slightly greater thermo emf generated by the L type thermocouple, however, pretends a little higher temperature. The following table illustrates this fact (all temperature data is referred to a reference temperature of 0 °C):

Temperature at the measuring point	Temperature evaluated by the module, if an L type thermocouple is used instead of a J type thermocouple
25 °C	25.63 °C
50 °C	51.23 °C
100 °C	101.89 °C
200 °C	203.13 °C
400 °C	405.69 °C
600 °C	609.78 °C
900 °C	920.41 °C

Configuration of unused channels

No evaluation of the channels 

Compare with configuration, Fig. 5.2.1-3

If the channels (in pairs) are not needed, we suggest to exclude them from the evaluation (acquisition of measuring values and processing within the software). The processing of the remaining channels is then faster. Unused channels must be short-circuited.

Relationship between measuring values and the location of bits in a 16 bit word

The measuring ranges for analog channels are configured in pairs (always together for two channels, see Fig. 5.2.1-3). When above or below a measuring range (out of range) or when recognizing an open circuit, the numerical values +32767 or -32767 respectively will be displayed.

The following two illustrations show the evaluation functions of the module.

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-100 %	50 %	25 %	12.5 %	6.25 %	3.13 %	1.56 %	0.78 %	0.39 %	0.20 %	0.10 %	0.05 %	0.02 %	0	0	0
	Sign															
±10 V	-10V	5V	2.5V	1.25V	625mV	313mV	156mV	78mV	39mV	20mV	10mV	5mV	2mV	0	0	0
±5 V	-5V	2.5V	1.25V	625mV	313mV	156mV	78mV	39mV	20mV	10mV	5mV	2mV	1mV	0	0	0
±0.5 V	-500mV	250mV	125mV	63mV	31mV	16mV	7.8mV	3.9mV	2mV	1mV	0.5mV	0.2mV	0.1mV	0	0	0
±50 mV	-50mV	25mV	12.5mV	6.3V	3.1mV	1.6mV	0.8mV	0.4mV	0.2mV	0.1mV	50µV	20µV	10µV	0	0	0
Bit values	-32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1

Measuring ranges ±10 V, ±5 V, ±500 mV, ±50 mV, 12 bit resolution plus sign:
The meas. range of -100...+100 % corresponds with the num. values 8008_H...$7FF8_H$ (-32760...+32760), range overflow: $7FFF_H$ (32767), range underflow: 8001_H (-32767)

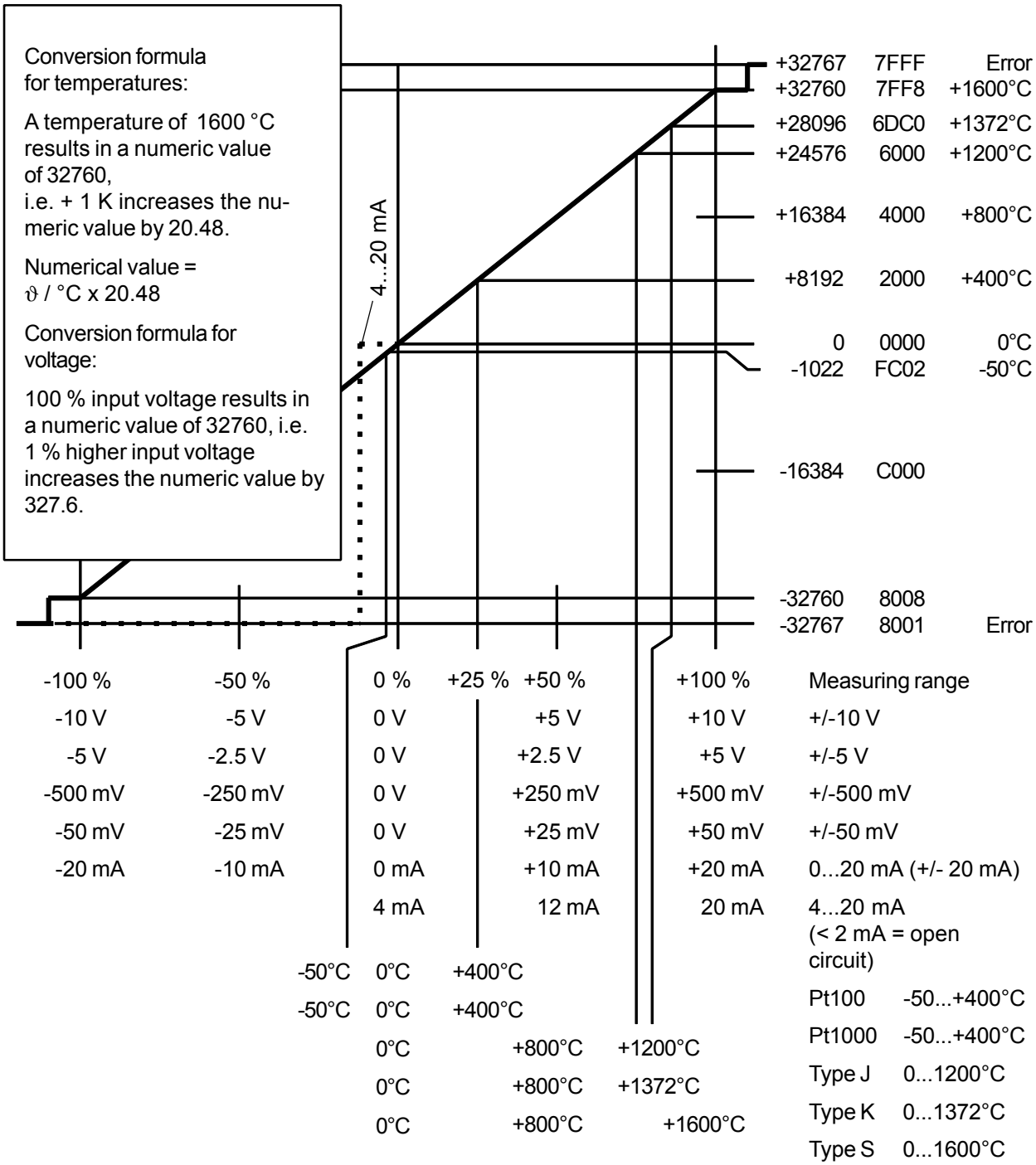
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-100 %	50 %	25 %	12.5 %	6.25 %	3.13 %	1.56 %	0.78 %	0.39 %	0.20 %	0.10 %	0.05 %	0.02 %	0.01 %	0.005 %	0
	Sign															
Pt100 Pt1000	-1600°C	800°C	400°C	200°C	100°C	50°C	25°C	12.5°C	6.25°C	3.13°C	1.56°C	0.78°C	0.39°C	0.2°C	0.1°C	0
Thermo-couple	0	800°C	400°C	200°C	100°C	50°C	25°C	12.5°C	6.25°C	3.13°C	1.56°C	0.78°C	0.39°C	0	0	0
Bit values	-32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1

Measuring ranges for Pt100/Pt1000 with 12 bit resolution plus sign:
The meas. range of -50...+400 °C corresponds with the num. values of $FC02_H$...$1FFE_H$ (-1022...+8190), range overflow / wire break in the sensor wiring: $7FFF_H$ (32767), range underflow / wire break in the sensor wiring: 8001_H (-32767)

Measuring range for thermocouples with 12 bit resolution without sign:
Measuring range of 0...+1600 °C corresponds with the num. values of 0_H...$7FF8_H$ (0...+32760), range overflow: $7FFF_H$ (32767), range underflow / wire break: 8001_H (-32767)

Fig. 5.2.1-7: Relationship between measuring values and arrangement of bits in the 16 bit word

Relationship between measuring value and numerical value, voltage and temperature inputs



Specifications for platinum resistance thermometers are:

Pt100	= platinum 100 Ω bei 0 °C	measuring range -50...400 °C	constant current 2 mA
Pt1000	= platinum 1000 Ω bei 0 °C	measuring range -50...400 °C	constant current 0.2 mA

Specifications for thermocouples (pairs) are:

Type **J =**	**Fe-CuNi**	0...1200 °C	iron / copper-nickel	+ = Fe	- = CuNi
Type **K =**	**NiCr-NiAl**	0...1372 °C	nickel-chromium / nickel-aluminium	+ = NiCr	- = NiAl
Type **S =**	**Pt10Rh-Pt**	0...1600 °C	platinum-10% rhodium / platinum	+ = Pt10Rh	- = Pt

Fig. 5.2.1-8: Relationship between measuring value and numerical value

Addressing

Each module must have an address installed to enable the central unit to correctly access the inputs and outputs.

A detailed description about "Addressing" can be found in the chapter "Addressing" for the central processing unit and couplers.

The address setting must be performed at the DIL switch under the slide cover on the right side of the module housing (see Fig. 5.2.1-3). If central units 07 KR 91, 07 KT 92, 07 KT 93 and 07 KT 94 are used as bus master, the following address allocations apply:

Central units: 07 KR 91 / 07 KT 92 / 07 KT 93 / 07 KT 94...

The address switch DIL No. 8 is set to **OFF**:

Channel	Address in PLC program	Channel	Address in PLC program
EA n,00	EW n,00	EA n,04	EW n,04
EA n,01	EW n,01	EA n,05	EW n,05
EA n,02	EW n,02	EA n,06	EW n,06
EA n,03	EW n,03	EA n,07	EW n,07

The address switch DIL No. 8 is set to **ON:**

Channel	Address in PLC program	Channel	Address in PLC program
EA n,00	EW n,08	EA n,04	EW n,12
EA n,01	EW n,09	EA n,05	EW n,13
EA n,02	EW n,10	EA n,06	EW n,14
EA n,03	EW n,11	EA n,07	EW n,15

n: Group number of address, set with address DIL switch with switches 5...8. Addresses for 07 KR 91 / 07 KT 92 / 07 KT 93 as bus master: 00...05, as of 07 KT 94: 00...05 and 08...15.

The module uses 8 analog inputs at the CS31 system bus.

Normal operation

- The module initializes automatically after the power has been switched on. During this time all LEDs are switched on.
- If the CS31 system bus does not yet run, the red error LED will flash. Should an error occur during initialization, the error LED will also light up.

Diagnosis and displays

Module 07 AI 91 offers the following diagnosis functions:

- Detection of open circuit at connection for Pt100/ Pt1000 resistance thermometers or thermocouples
- Storing and making this information available when recalled (kind of error and error location)
- Recognition of an internal module error
- Recognition of a transmission error

If one of these errors occur, the red Error LED will light up. **The error message is then sent to the central unit or to the coupler.**

For central units 07 KR 91 / 07 KT 92 / 07 KT 93 / 07 KT 94 the errors will be displayed as follows:

- Open circuits (cut wire)

Error class 4	(FK4)		M 255.14
Error number:	09	->	MW 255.08
Unit type:	01	->	MW 255.09
Group number:		->	MW 255.10
Channel number:		->	MW 255.11

- Range exceeded (out of range)

Error class 4	(FK4)		M 255.14
Error number:	10 dec.	->	MW 255.08
Unit type:	01	->	MW 255.09
Group number:		->	MW 255.10
Channel number:		->	MW 255.11

Using the test button, all diagnosis functions can be separately selected for each channel. Pressing the test button for the first time selects channel 0 and LED 0 will flash.

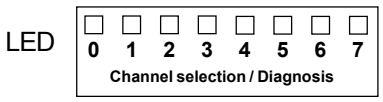


Fig. 5.2.1-9: LEDs for dislaying channel selection and diagonsis

When releasing the test button, the error information for this channel is displayed by the green LEDs 0 to 7 for about 3 seconds.

Explanation of LEDs when lighting up:
0 not used
1 not used
2 not used
3 Open circuit (cut wire)
4 Range exceeded (out of range)
5 not used
6 not used
7 not used

Explanations for the LEDs ② are also printed on the front panel.

The error messages at the module and at the central unit go out as soon as the error has been corrected, when no more faults have been detected **and** when the error correction has been acknowledged.

Acknowledgement of an error after error correction:

- by pressing the test button for about 5 seconds, or
- using the PC, or
- using the PLC program of the central unit.

With each pressing and releasing of the test button, the procedure is repeated for the other input channels.

After checking the last channel by again pressing the test button, an LED test is performed. All LEDs of the module must light up. After that, the setting of the address DIL switch (module address at the CS31 system bus) is displayed for about 5 seconds. LED 0 shows the position of switch 1 (LEDs 0...7 are assigned to switches 1...8).

Display of an analog value

When the test button is not pressed, 8 LEDs display the analog value of the selected channel.
Explanation:

all LEDs OFF -> minimum value
all LEDs ON -> maximum vallue

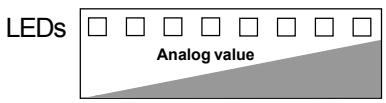


Fig. 5.2.1-10: Display of an analog value with LEDs

Minimum and maximum values are:

Configuration	Min. value all LEDs OFF	Max. value all LEDs ON
+/- 10 V	-10 V	+10 V
+/- 5 V	-5 V	+5 V
+/- 500 mV	-500 mV	+500 mV
+/- 50 mV	-50 mV	+50 mV
+/- 20 mA	-20 mA	+20 mA
0 V / 0 mA = 4 LEDs ON		
4...20 mA	4 mA	20 mA
12 mA = 4 LEDs ON		
Pt100	-50 °C	+400 °C
Pt1000	-50 °C	+400 °C
0 °C = 1 LED ON		
Thermoc. type J	0 °C	+1600 °C
Thermoc. type K	0 °C	+1600 °C
Thermoc. type S	0 °C	+1600 °C
800 °C = 4 LEDs ON		

Fig. 5.2.1-11: Min. and max. values for analog display

Technical Data for 07 AI 91

In general, the technical system data listed under "System data and system configuration" in chapter 1 of volume 2 of the "Advant Controller 31" system description are valid. Additional data or data which are different from the system data are listed as follows.

Technical data for the complete module

Permissible temperature range during operation	0...55 °C
Rated supply voltage	24 V DC
Max. current consumption	max. 0.15 A
Max. power dissipation	max. 3 W
Protection against reversed polarity of power connection	yes
Conductor cross section for the removable connectors	max. 2.5 mm^2
Number of analog input channels	8
Electrical isolation	CS31 system bus interface from the rest of the unit
Addressing and configuration	Coding switch under right housing cover
Diagnosis	see chapter "Diagnosis and displays"
Operation and error displays	total of 17 LEDs, see chapter "Diagnosis and displays"

Technical data for analog inputs (applies to all settings)

Number of channels per module	8 (each configurable in pairs)
Electrical isolation	from CS31 system bus
Line frequency suppression	can be configured for 50 Hz, 60 Hz, or none
Input delay	0 (no RC combination)
Line frequency hum suppression (software filter)	20.0 ms at 50-Hz suppression 16.7 ms at 60-Hz suppression
Permissible input overvoltage	max. +/- 30 V
Updating period per channel incl. input delay and conversion time	
- suppression 50/60 Hz	typ. 100 ms
- no suppression	typ. 30 ms
- when using thermocouples and suppression 50/60 Hz	typ. 150 ms

The total updating time is reduced when not all channels are used (configuration see Fig. 5.2.1-3).

Voltage inputs

Input resistance	> 1 MΩ
Measuring ranges (nominal values)	+/- 10 V, +/- 5 V, +/- 500 mV, +/- 50 mV
Resolution	12 bit + sign
Total error	≤ ±0.5 % of full scale
Channels not used	must be bridged

Current inputs 0...20 mA / 4...20 mA

By bridging the input terminals with a shunt, the voltage input can also be used for input currents. The following specifications are valid:

Current range	0...20 mA	4...20 mA
Selected measuring range	+/- 5 V	4...20 mA
Required external shunt	250 Ω	250 Ω
Destruction limits of the shunt	depends on its load capabilities	
Total error	≤ ±0.5 % of full scale ± tolerance of the shunt	
Channels not used	must be bridged	

Pt100/Pt1000 input

Evaluation range with linearization	-50°C...+400°C	
Resistance of the sensors within the evaluation range		
Pt100	80.31 Ω...247.04 Ω	
Pt1000	803.1 Ω...2470.4 Ω	
Resolution	12 bit + sign (1 LSB = 0.1°C)	
Permissible total line resistance of both current-carrying lines	max. 50 Ω per sensor (in 4-wire configuration)	
Evaluation error within the range of -50...+400°C (linearity, linearization, temperature range, resolution, adjustment)	Pt100: +/- 0.5 % of full scale Pt1000: +/- 1.0 % of full scale	
Constant current sinks for the sensors		
Pt100	2 mA	
Pt1000	0.2 mA	
Power dissipation in the sensor		
Pt100 meas. value = 0°C	0.4 mW	
Pt100 meas. value = 400°C	1.0 mW	
Pt1000 meas. value = 0°C	0.04 mW	
Pt1000 meas. value = 400°C	0.1 mW	
No-load voltage of the current output	< +15 V	
Permissible total voltage drop at the sensors and lines circuited in series	max. 7.0 V (current sink 0.2 mA is used) max. 2.5 V (current sink 2.0 mA is used)	
Cable length, if cables have been laid in parallel		
shielded	max. 50 m	
two-core shielded and cross section ≥ 0.5 mm²	max. 200 m	

Unused input channels:

If unused Pt100/Pt1000 channels are bridged, the wire bridge with 0 Ω simulates the measuring value of a very low temperature. This will cause the error message "range underflow". To avoid such error messages, bridge unused Pt100/Pt1000 channels as follows:

Pt 100	with a resistor of 120 Ω
Pt 1000	with a resistor of 1200 Ω

Connection of other temperature-dependent resistors:

Basically all temperature-dependent resistors (PTC, NTC) can be connected instead of Pt100/Pt1000 sensors. For the configuration use the settings ± 5 V, ± 500 mV and ± 50 mV. If necessary, the linearization of the resistor curves must be performed in the PLC user program. The installed current sinks can be used, however, note the following:

- The voltage drop of all series connected resistors must not exceed

  7 V (when using current sinks of 0.2 mA),

  2.5 V (when using current sinks of 2 mA).

- The tolerance of the installed current sinks (± 1.5 %) must be added in the tolerance calculation for the temperature measurements (no compensation as for Pt100/Pt1000).

Input by thermocouples

Possible thermocouples		types J, K and S		
Evaluation range with linearization				
Type J	Fe-CuNi	0°C...+1200°C	at	0....57.942 mV
Type K	NiCr-NiAl	0°C...+1372°C	at	0....41.269 mV
Type S	Pt10Rh-Pt	0°C...+1600°C	at	0.... 9.585 mV

The module has an internal reference junction. The temperature value of this junction is added to the temperature measured by the thermocouple.

Resolution	12 bit + sign (1 LSB = 0.4°C)
Evaluation error within the range of 0...+1600°C (linearity, linearization, temperature range, resolution, adjustment)	+/- 0.5 % of full scale
Cable length, if cables have been laid in parallel	
shielded	max. 50 m
two-core shielded and cross section $\geq$ 0.5 mm^2	max. 200 m
Unused channels	have to be short-circuited

Connection to the CS31 system bus

Interface standard	EIA RS-485
Electrical isolation	versus supply voltage and inputs

Mechanical data

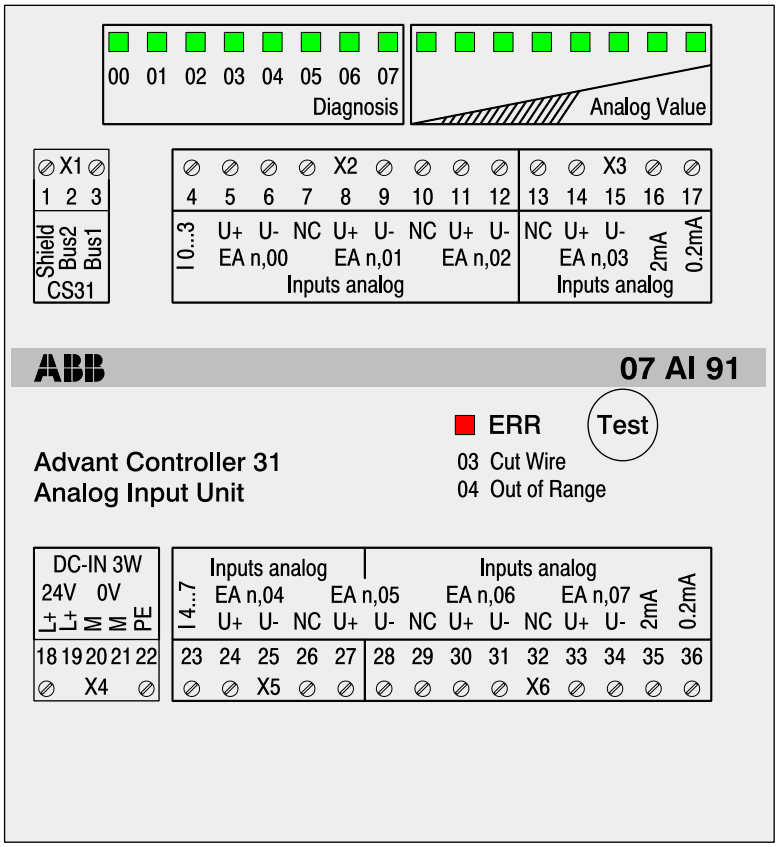
Mounting on DIN rail	according to DIN EN 50022-35, 15 mm deep. The DIN rail is positioned centrally between the upper and the lower edges of the module.
Mounting with screws	by 4 screws M4
Width x height x depth	120 x 140 x 85 mm
Wiring method	removable terminal blocks with screw-type terminals
conductor cross section	max. 2.5 mm^2
Weight	450 g
Installation dimensions	see Fig. 5.2.1-13

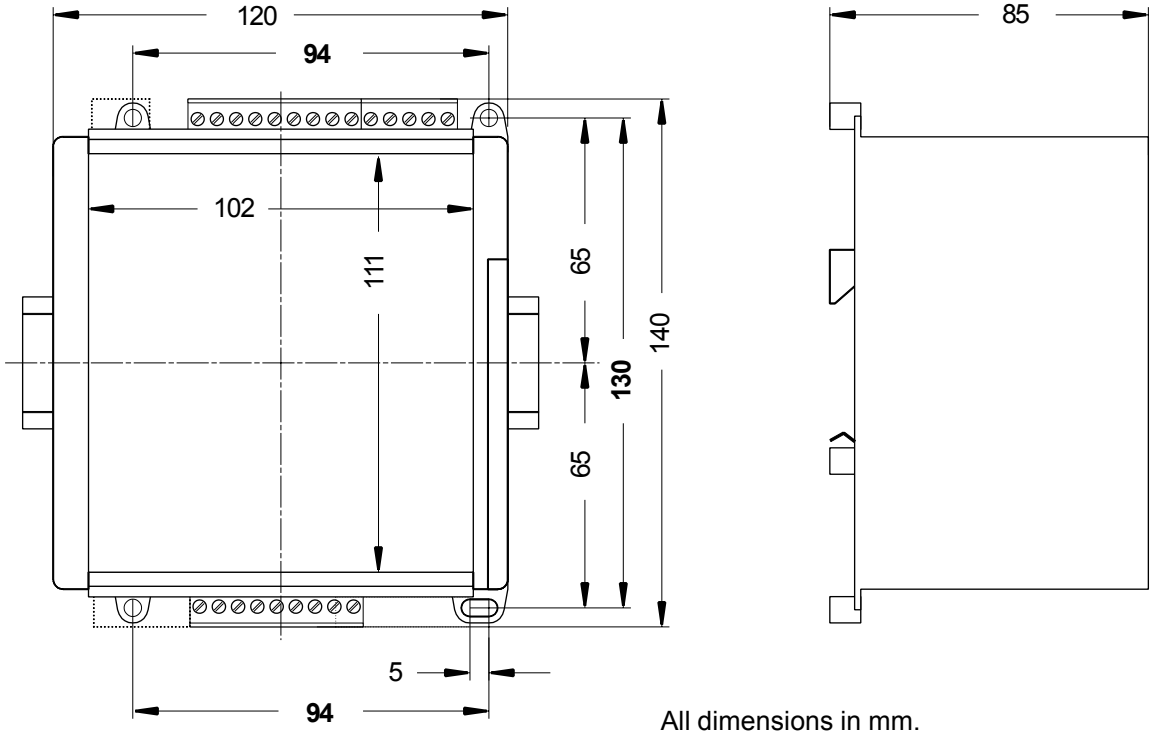
Installation instructions

Installation position	vertical, connector terminals must point upward and downward
Cooling	The natural convection cooling must not be blocked by cable ducts or other components installed in the cabinet.

Ordering data

Module 07 AI 91	Order No. GJR5 2516 00 R0202
Scope of delivery:	Analog input module 07 AI 91 1 3-pole terminal block 3 5-pole terminal blocks 2 9-pole terminal blocks





All dimensions in mm.

The depth of the device is 85 mm. If a DIN rail is used for the installation, the depth must be increased by the depth of the rail.

Fig. 5.2.1-13: 07 AI 91, Front panel foil, **dimensions for installation holes are in bold print**

5.4.1 Analog Input/Output Module 07 AC 91

16 inputs/outputs, configurable for ±10 V, 0...10 V, 0...20 mA, 8/12 bit resolution, 2 operating modes, CS31 system bus

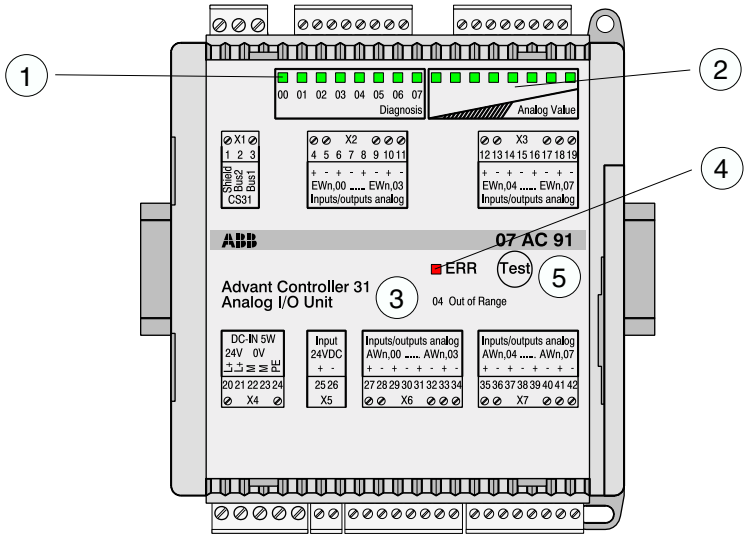


Fig. 5.4.1-1:
Analog input/output module 07 AC 91

Contents

Intended purpose

The analog input/output module 07 AC 91 is used as a remote module on the CS31 system bus. It contains 16 analog input/output channels that can be configured in two operating modes:

- Operating mode "12 bits":
  8 input channels, individually configurable ±10 V or 0...20 mA, 12 bit resolution plus 8 output channels, individually configurable ±10 V or 0...20 mA, 12 bit resolution
- Operating mode "8 bits":
  16 channels, configurable in pairs as inputs or outputs, 0...10 V oder 0...20 mA, 8 bit resolution
- The configuration is set with DIL switches.
- The PLC offers an interconnection element ANAI4_20 for measuring signals of 4...20 mA (refer to 907 PC 331, connection element library).

The module 07 AC 91 uses up to **eight** input words on the CS31 system bus plus up to **eight** output words. In the operating mode "8 bits", 2 analog values are packed into one word.

The operating voltage of the unit is 24 V DC. The CS31 system bus connection is electrically isolated from the rest of the module.

The module offers a number of diagnosis functions (see chapter "Diagnosis and displays").

Displays and operating elements on the front panel

① 8 green LEDs for channel selection and diagnosis

② 8 green LEDs for analog value display of a channel

③ List of diagnosis information relating to the LEDs, when they are used for diagnosis display

④ Red LED for error messages

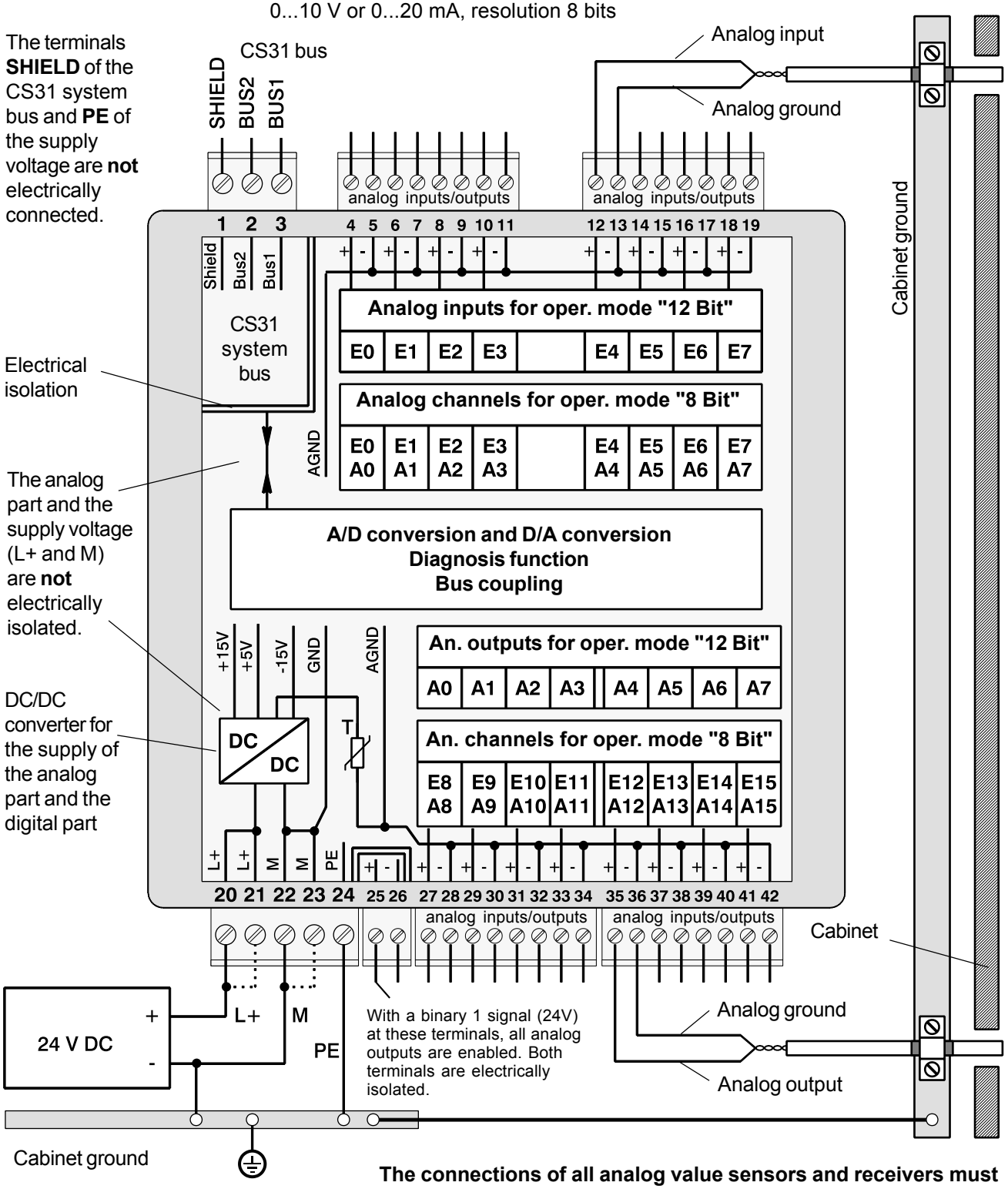
⑤ Test button

Electrical connection

The module can be installed on a DIN rail (15 mm high) or with 4 screws. The figure on the next page shows the electrical connection for the input/output module.

Operating mode "12 bits": 8 analog inputs (terminals 4 to 19) and 8 analog outputs (terminals 27 to 42), configurable for ±10 V or 0...20 mA, resolution 12 bits

Operating mode "8 bits": 16 analog channels configurable in pairs as inputs or outputs for 0...10 V or 0...20 mA, resolution 8 bits



Caution: The process voltage must be included in the grounding concept of the control system (e.g. grounding of the minus terminal).

The connections of all analog value sensors and receivers must be electrically isolated from their installation environment.
The cable shields of the analog wiring must be connected to cabinet ground where they enter the cabinet.

Setting of the module address and configuration of the analog channels is done with the DIL switches (see next page).

Bild 5.4.1-2: Electrical connection of the analog input/output module 07 AC 91

Configuration of analog channels and settings of the module address on the CS31 bus

The 16 analog channels can be configured in two operating modes with DIL switches (located under the slide cover on the right side of the module housing (see following figure):

Operating mode "12 bits": 8 analog inputs (terminals 4 to 19) plus 8 analog outputs (term. 27 to 42), configurable for ±10 V or 0...20 mA, solution 12 bits

Operating mode "8 bits": 16 analog channels configurable in pairs as inputs or outputs for 0...10 V or 0...20 mA, solution 8 bits

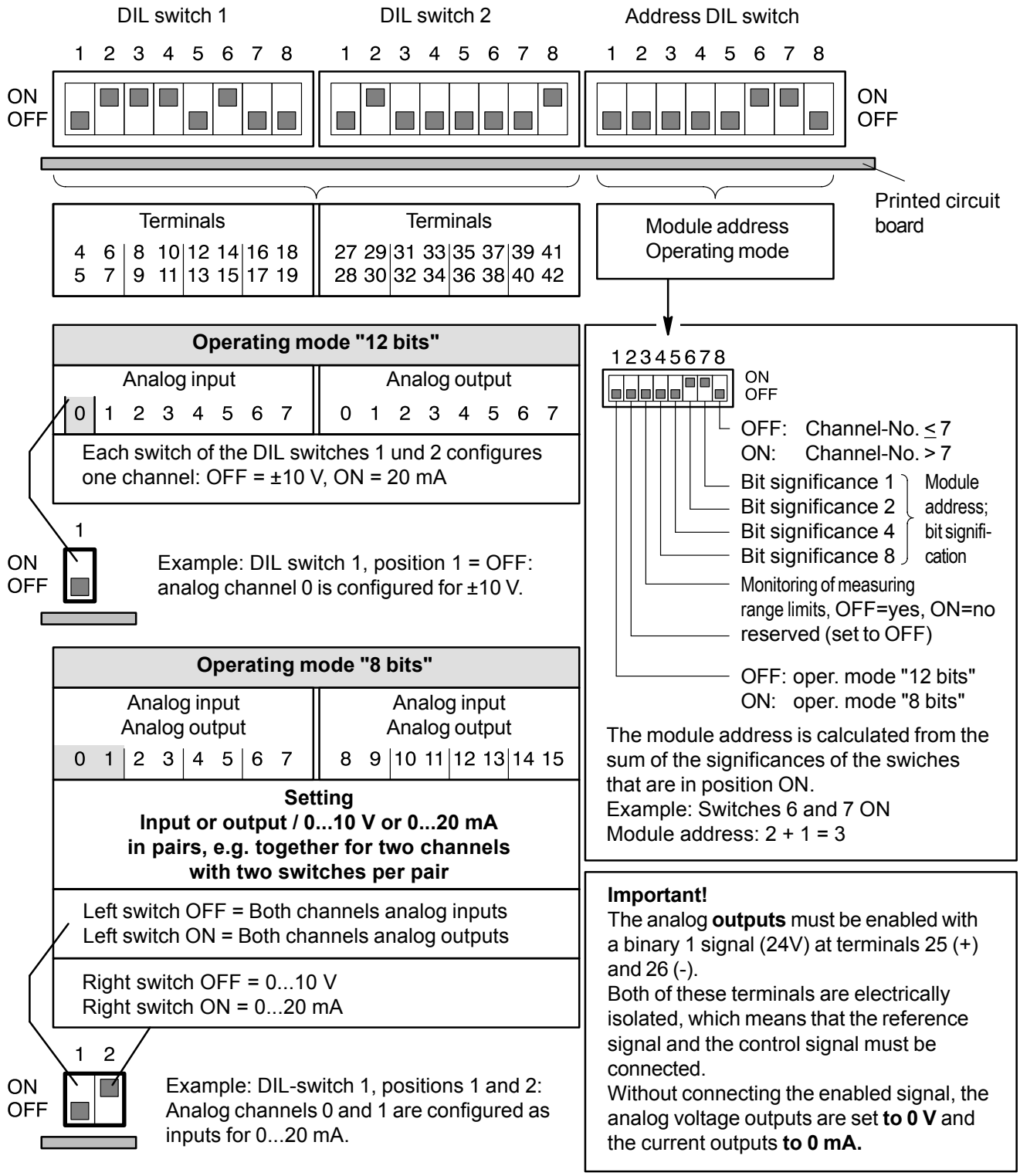


Fig. 5.4.1-3: Configuration of the analog channels and setting of the module address on the CS31system bus

Operating mode "12 bits":

For configuration see preceding page. If input values overflow or underflow the measuring range, the values 32767 or -32767 are output.

Resolution in the control system:
All measured values will be converted with a resolution of 12 bits which are either 11 bits + sign or 12 bits without sign.

Examples:

Measuring range	Range of numerical display
-10 V...0...10 V	-32760_D....0....32760_D 8008_H...0000_H...$7FF8_H$
0...20 mA	0...32760_D 0000...$7FF8_H$

The relationship between analog signal and converted numerical value is shown in the following figure.

Bit in word	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-100 %	50 %	25 %	12.5 %	6.25 %	3.13 %	1.56 %	0.78 %	0.39 %	0.20 %	0.10 %	0.05 %	0.02 %	0	0	0
	Sign															
±10 V	-10V	5V	2.5V	1.25V	625mV	313mV	156mV	78mV	39mV	20mV	10mV	5mV	2mV	0	0	0
0...20 mA		10mA	5mA	2.5mA	1.25mA	625µA	313µA	156µA	78µA	39µA	20µA	10µA	5µA	0	0	0
Bit values	-32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1

Measuring range ±10 V: 11 bit resolution plus sign, measuring range 0...20 mA: 12 bit resolution without sign, the value range of -100...+100 % corresponds to the numerical values of 8008_H...$7FF8_H$ (-32760...+32760), overflow: $7FFF_H$ (32767), underflow: 8001_H (-32767)

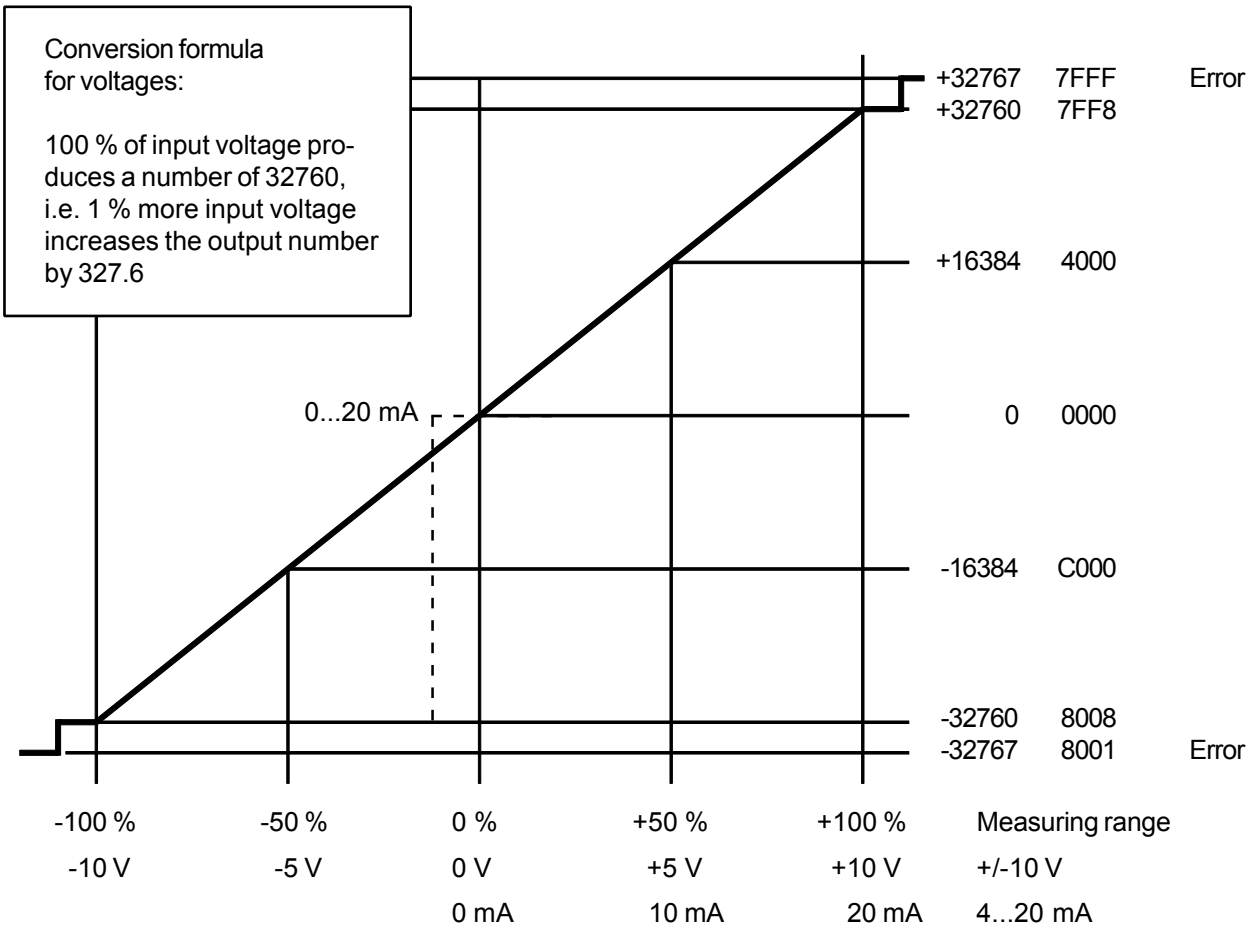


Fig. 5.4.1-4: Relationship between analog value and numerical value and position of bits in the word

Operating mode "8 bits":

For configuration please see second preceding page.

Resolution in the control system:

The converted analog values of two analog channels are packed into a word with 8 bit each (low byte and high byte).

The smallest difference that can be detected on the analog side (e.g. 40 mV in the range of 0...10 V) results in a change of the numeric value by 1 in the PLC program.

Examples:

0...10 V	0_D....255_D
	00_H...FF_H
0...20 mA	0_D....255_D
	00_H...FF_H

The relationship between analog signal and converted numerical value is shown in the following figure.

Bits in the word

	High Byte							Low Byte							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
50 %	25 %	12.5 %	6.25 %	3.13 %	1.56 %	0.78 %	0.39 %	50 %	25 %	12.5 %	6.25 %	3.13 %	1.56 %	0.78 %	0.39 %
0...10 V															
5V	2.5V	1.25V	625mV	313mV	156mV	78mV	39mV	5V	2.5V	1.25V	625mV	313mV	156mV	78mV	39mV
0...20 mA															
10mA	5mA	2.5mA	1.25mA	625µA	313µV	156µA	78µA	10mA	5mA	2.5mA	1.25mA	625µA	313µA	156µA	78µA
Bit values															
128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1

Measuring ranges 0...10 V, 0...20 mA, 8 bit resolution
The value range of 0...+100 % corresponds with the numerical values 00_H...FF_H (0...+255)

Conversion formula for voltages:

100 % of input voltage produces a number of 255, i. e. 1 % more input voltage increases the output number by 2.55

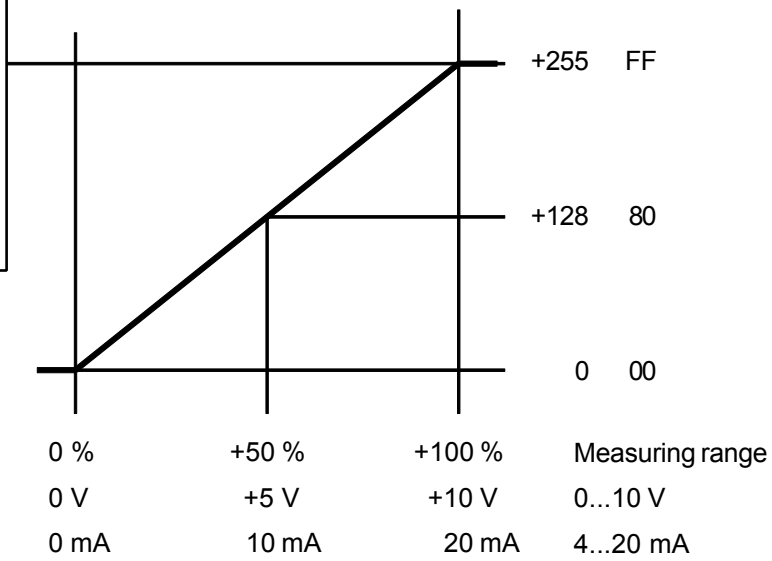


Fig. 5.4.1-5: Relationship between analog value and numerical value and position of bits in the word

Addressing

Each module must have an address installed to enable the central unit to correctly access the inputs and outputs.

A detailed description about "Addressing" can be found in the chapter "Addressing" for the central processing unit and couplers.

The setting of the address must be done with the DIL switch located under the slide cover on the right side of the module housing (see Fig. 5.4.1-3). When using central units 07 KR 91, 07 KT 92, 07 KT 93 and 07 KT 94 as bus master, the following address allocations result:

Central units 07 KR 91 / 07 KT 92 / 07 KT 93 / 07 KT 94...

Operating mode "12 bits",
Address DIL switch **No. 1** in **OFF** position

Channel	Address in PLC program	Channel	Address in PLC program
E0	EW n,00	A0	AW n,00
E1	EW n,01	A1	AW n,01
E2	EW n,02	A2	AW n,02
E3	EW n,03	A3	AW n,03
E4	EW n,04	A4	AW n,04
E5	EW n,05	A5	AW n,05
E6	EW n,06	A6	AW n,06
E7	EW n,07	A7	AW n,07

Operating mode "8 bits",
Address DIL switch **No. 1** in **ON** position

Channel	Address in PLC program	Channel	Address in PLC program
E00	EW n,00 Lo	A00	AW n,00 Lo
E01	EW n,00 Hi	A01	AW n,00 Hi
E02	EW n,01 Lo	A02	AW n,01 Lo
E03	EW n,01 Hi	A03	AW n,01 Hi
E04	EW n,02 Lo	A04	AW n,02 Lo
E05	EW n,02 Hi	A05	AW n,02 Hi
E06	EW n,03 Lo	A06	AW n,03 Lo
E07	EW n,03 Hi	A07	AW n,03 Hi
E08	EW n,04 Lo	A08	AW n,04 Lo
E09	EW n,04 Hi	A09	AW n,04 Hi
E10	EW n,05 Lo	A10	AW n,05 Lo
E11	EW n,05 Hi	A11	AW n,05 Hi
E12	EW n,06 Lo	A12	AW n,06 Lo
E13	EW n,06 Hi	A13	AW n,06 Hi
E14	EW n,07 Lo	A14	AW n,07 Lo
E15	EW n,07 Hi	A15	AW n,07 Hi

n: Group number of the address, set at address DIL switch with switches 5...8. Addresses for 07 KR 91 / 07 KT 92 / 07 KT 93 as bus master: 00...05, as of 07 KT 94 also 08...15. Lo = low byte, Hi = high byte

As shown in the table, the module occupies 8 analog inputs and 8 analog outputs on the CS31 system bus.

If the module is confiugured in operating mode "8 bits" only for inputs or only for outputs, only 8 analog inputs or 8 analog outputs are used on the CS31 system bus. In this case, not occupied input or output addresses can be used by other modules.

If the address DIL switch **No. 8** is switched to **ON,** all channel numbers change by 08, i.e. address AW n,00 changes to AW n,08, etc. This applies for the address assignments for inputs and outputs in both operation modes.

Normal operation

- After the supply voltage was switched on, the module initializes automatically. During initialization process all LEDs are switched on.
- If the CS31 system bus does not (yet) run, the red error LED will light up. If an error occurs during the initialization process, the red error LED will also light up.

Diagnosis and displays

The module 07 AC 91 offers the following diagnosis functions:

- Analog value is out of measuring range
- Storing this information and possibility for recall (kind of error and location of error)

If an error occurs, the red LED lights up. **The error message will be transmitted to the central unit or the coupler.**

In the central units 07 KR 91 / 07 KT 92 / 07 KT 93 / 07 KT 94, the errors are displayed as follows:

- Out of range

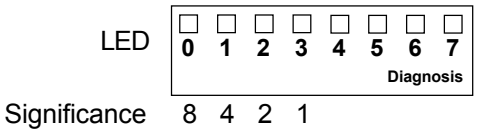
Error classification 4		(FK4)		M 255.14
Error recognition:		10 dec.	->	MW 255.08
Module type:	*	01/03/05	->	MW 255.09
Group number:			->	MW 255.10
Channel number:			->	MW 255.11

In the initial state after initialization, channel 0 is selected and the corresponding analog value ist displayed (see also figures 5.4.1-6 and 5.4.1-7).

---

* 01 if only inputs are configured
03 if only outputs are configured
05 if inputs and outputs are configured

Diagnosis functions can be selected individually for each channel with the test button. The initial actuation of the test button selects channel 0. The diagnosis LEDs 0 to 3 display the channel number in hexadecimal code.



The channel address results from the sum of the bit significances of the LEDs that light up.
Example: LEDs 0 and 1 are lit
Channel address: 8 + 4 = 12

Fig. 5.4.1-6: Display LEDs for channel selection and diagnosis

After releasing the test button, the diagnosis information of this channel is displayed for about 3 seconds by the green LEDs 0 to 7.

Explanation of lit LEDs:

0 not used
1 not used
2 not used
3 not used
4 Out of range
5 not used
6 not used
7 not used

Explanations for the LEDs are also printed in English on the front panel.

The error messages on the module and on the central unit go out again as soon as the error has been corrected, no new errors have been recognized **and** the error correction was acknowledged.

Acknowledging an error after error correction:

- by pressing the test button for about 5 seconds, or
- with the PC, or
- with the PLC program in the central unit

The current input has a self-protecting feature for the measuring range 0...20 mA. If the current gets too high, the current input shunt is switched off and the value for "overflow" is output. Re-activation is attempted again in increments of approx. 1 second to facilitate the correct measurement as soon as the current regains acceptable limits.

With each successive pressing and releasing of the test button, the process is repeated for the other channels.

After interrogating the last channel and pressing the test button once more, an LED test is initiated. All LEDs of the module must light up. Following this, the position of the DIL address switch is displayed for about 3 seconds (module address on the CS31 system bus). In this case, LED 0 shows the position of switch 1 (LEDs 0...7 are assigned to switches 1...8).

Display of an analog value

When the test button is not pressed, the analog value of the selected channel is displayed with 8 LEDs.

Explanation:

all LEDs OFF -> minimum value
all LEDs ON -> maximum value

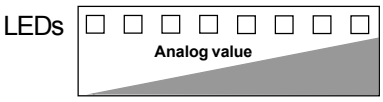


Fig. 5.4.1-7: Display LEDs for an analog value

Minimum and maximum values are:

Configuration	Min. value all LEDs OFF	Max. value all LEDs ON
+/- 10 V	-10 V	+10V
0...10 V	0 V	+10 V
0...20 mA	0 mA	+20 mA

Fig. 5.4.1-8: Minimum and maximum values for the analog display

Example:

Configuration ±10 V and 0 V at E0

Display: ■ ■ ■ ■ □ □ □ □

Technical data for 07 AC 91

In general, the technical system data listed under "System data and system configuration" in chapter 1 of volume 2 of the "Advant Controller 31" system description are valid. Additional data or data which are different from the system data are listed as follows.

Technical data for the complete unit

Permissible temperature range during operation	0...55 °C
Rated supply voltage	24 V DC
Max. current consumption	0.2 A
Max. power dissipation	5 W
Protection against reversed polarity of power connection	yes
Number of binary inputs	1 as enabling input for the analog outputs
Number of analog input channels	8 or 16, depending on the operating mode
Number of analog output channels	8 or 16, depending on the operating mode
Electrical isolation	CS31 system bus interface from the rest of the unit, 1 binary input from the rest of the unit
Address setting and configuration	Coding switch under the cover located on the right side of the housing
Diagnosis	see chapter "Diagnosis and displays"
Operation and error displays	a total of 17 LEDs, see chapter "Diagnosis and displays"
Method of connections supply terminals, CS31 system bus all other terminals	removable screw-type terminal blocks max. 1 x 2.5 mm^2 or max. 2 x 1.5 mm^2 max. 1 x 1.5 mm^2
Max. length of the analog cables, two-core shielded and cross section $\geq$ 0.5 mm^2	100 m
Conversion error of the analog values (non-linearity, factory calibration and resolution)	typ. 0.5 %, max. 1 %
Max. permissible potential difference between terminal M (minus of the supply voltage) and terminals AGND (minus of analog inputs and outputs)	± 1 V
Common reference potential for all analog signals	AGND (minus terminal of analog inputs and outputs)
Electrical isolation of analog signals	none (see also Fig. 5.4.1-2).

Technical data of the binary input (enabling input for analog outputs)

The analog outputs must be enabled by a binary 1 signal (24V) at terminals 25 (+) and 26 (-).

Signal level	0 signal (-30...+5 V)	voltage outputs are at 0 V, current outputs are at 0 mA
	1 signal (+13...+30 V)	analog outputs are active
Electrical isolation		yes, i.e. the reference potential and the control signal must be connected

Technical data of analog inputs

Number of channels per module,	oper. mode"12 bits"	8
Number of channels per module,	oper. mode "8 bits"	up to 16
Configurability	oper. mode "12 bits"	±10 V, 0...20 mA (each channel can be configured individually)
Configurability pairs)	oper. mode "8 bits"	0...10 V, 0...20 mA (channels can be configured in
Signalization of input signals		see diagnosis
Input resistance per channel	voltage input current input	> 100 kΩ approx. 330 Ω

The current input has a self-protecting feature. If the current gets too high, the current input shunt is switched off and the value for "overflow" is output. Re-activation is attempted again in increments of approx. 1 second to facilitate the correct measurement as soon as the current regains acceptable limits.

Time constant of the input filter			470 µs for voltage, 100 µs for current	
Conversion cycle (over 8 inputs + 8 outputs)			8 ms	
Resolution	range ±10 V range 0...20 mA	oper. mode "12 bit" oper. mode "12 bit"	5 mV 5 µA	(11 bit plus sign) (12 bit without sign)
Resolution	range 0...10 V range 0...20 mA	oper. mode "8 bit" oper. mode "8 bit"	40 mV 80 µA	(8 bit without sign) (8 bit without sign)
Relationship between input signal and hexcode operating mode "12 bits"			-100 %...0...100 % =	8008_H...0000_H...$7FF8_H$ (-32760...0...32760 decimal)
Relationship between input signal and hexcode operating mode "8 bits"			0...100 % =	00_H...FF_H (0...255 decimal)
Voltage inputs not used			can be bridged to increase noise immunity	
Current inputs not used			are low in ohms, can remain open	

Technical data of analog outputs

Number of channels per unit,	oper. mode "12 bits"	8
Number of channels per unit,	oper. mode "8 bits"	up to 16
Configurability	oper. mode "12 bits"	±10 V, 0...20 mA (each channel can be configured individually)
Configurability pairs)	oper. mode "8 bits"	0...10 V, 0...20 mA (channels can be configured in
Signalization of output channels		see diagnosis
Output loadability as voltage output output)		max. +20 mA (source, current flows out of the max. -10 mA (sink, current flows into the output)
Output load resistance (burden), if current output		0...500 Ω
Resolution		see "analog inputs"
Relationship between output signal and hexcode		see "analog inputs"
Outputs not used		remain open

Connection to the CS31 system bus

Interface standard	EIA RS-485
Electrical isolation	from the rest of the unit

Mechanical data

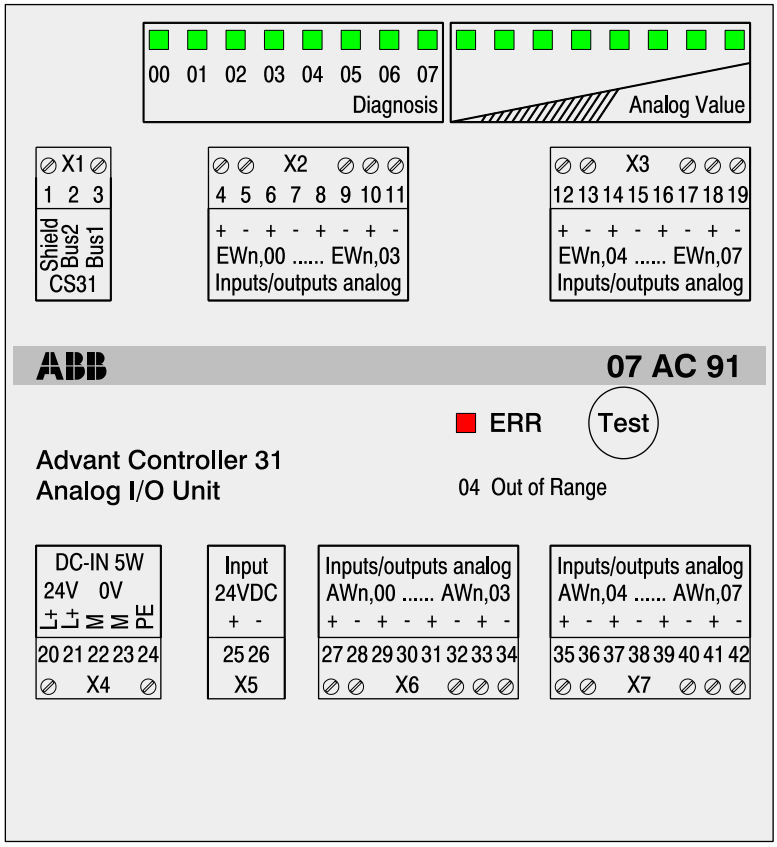
Mounting on DIN rail	according to DIN EN 50022-35, 15 mm deep. The DIN rail is positioned centrally between the upper and the lower edges of the module.
Mounting with screws	by 4 screws M4
Width x height x depth	120 x 140 x 85 mm
Wiring method supply terminals, CS31 system bus all other terminals	removable terminal blocks with screw-type terminals max. 1 x 2.5 mm^2 or max. 2 x 1.5 mm^2 max. 1 x 1.5 mm^2
Weight	450 g
Installation dimensions	see Fig. 5.4.1-9

Installation instructions

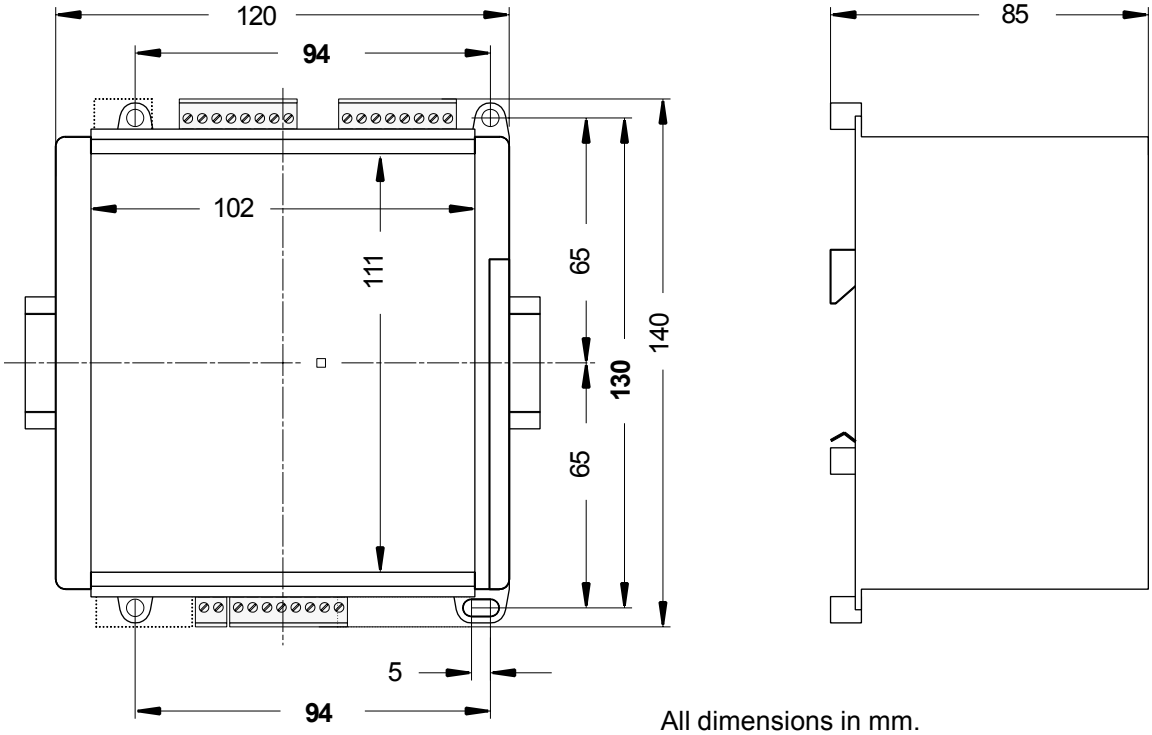
Installation position	vertical, connector terminals must point upward and downward
Cooling	The natural convection cooling must not be blocked by cable ducts or other components installed in the cabinet.

Ordering data

Module 07 AC 91	Order No. GJR5 2523 00 R0101
Scope of delivery	Analog input and output module 07 AC 91 1 2-pole terminal block (grid space 3.81 mm) 1 3-pole terminal block (grid space 5.08 mm) 1 5-pole terminal block (grid space 5.08 mm) 4 8-pole terminal blocks (grid space 3.81 mm)



The imprint on the front panel foil shows the address assignment in operating mode "12bits"



All dimensions in mm.

The depth of the device is 85 mm. If a DIN rail is used for the installation, the depth must be increased by the depth of the rail.

Fig. 5.4.1-9: 07 AC 91, Front panel foil and outside dimensions,
dimensions for mounting holes are shown in bold print

6 Special Modules

6.1 CS31 System Bus Module NCB

CS31 system bus amplifier, system bus electrically isolated

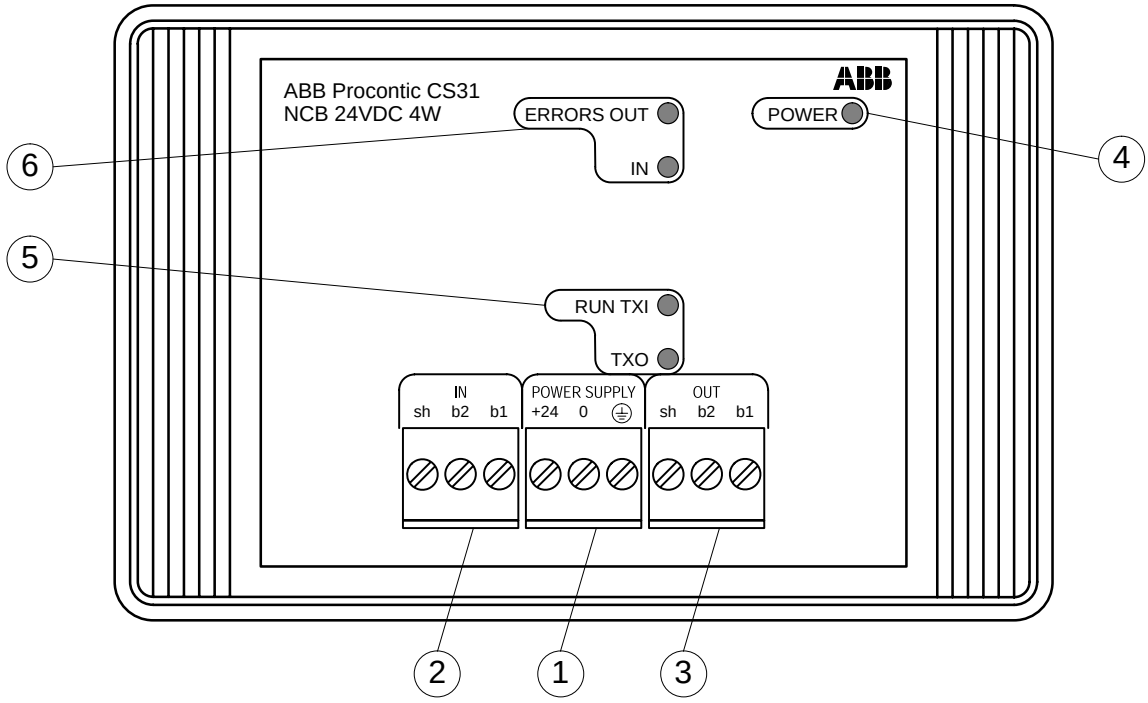


Fig. 6.1-1: CS31 system bus amplifier NCB

Contents

Intended purpose

The NCB is an amplifier for the CS31 system bus. Using up to 3 NCBs, a total length of 3 km can be obtained for the CS31 system bus.

The use of NCBs is entirely transparent. A diagnosis is possible for every part of the bus system on both the basic unit and the NCB.

Display and operating elements on the front panel

(1) Removable connector for the 24 V DC power supply

(2) Removable connector for the CS31 system bus input

(3) Removable connector for the CS31 system bus output

(4) A green LED indicates that the power supply is ON

(5) TXI: communication is running from the CS31 bus master to the NCB
TXO: communication is running from the CS31 remote module to the NCB

(6) 2 red LEDs ”OUT” and ”IN” indicate the CS31 system bus status

Electrical connection

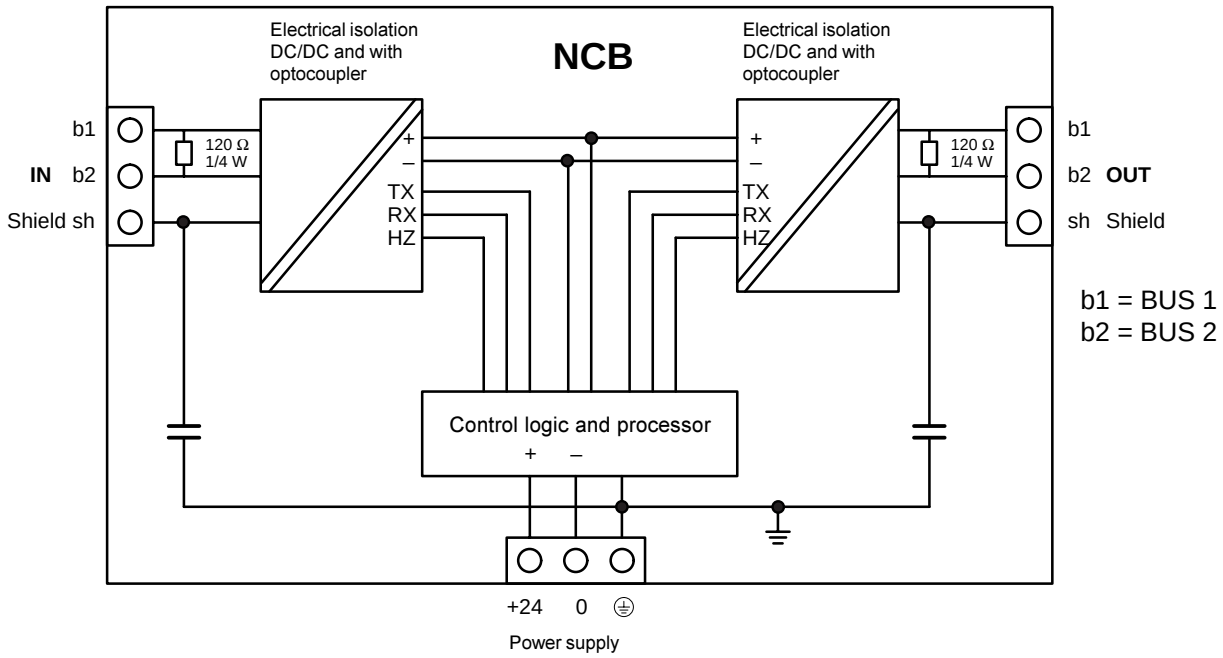


Fig. 6.1-2: Electrical connection of the CS31 system bus amplifier NCB

Installation

All EMC standards have to be met (see also AC31 system data)

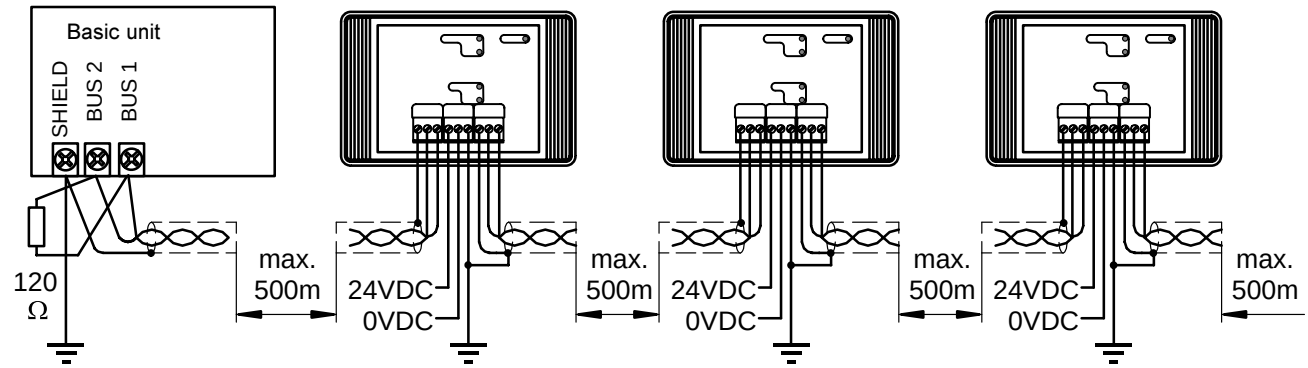


Fig. 6.1-3: Installation of a CS31 bus line with 3 NCB bus amplifiers

The bus terminating resistor of 120 Ω 1/4 W is already integrated in the NCB.

In order to guarantee a correct diagnosis function, the terminals "IN" have to be connected to the CS31 master's side.

For a safe and error-free data transmission over long distances, the selection of an appropriate bus cable is very important.

The following figure shows a typical configuration.

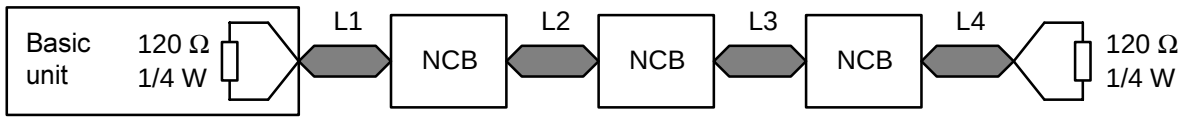


Fig 6.1-4: Typical configuration

The cable can be selected according to the following rules:

L1 + L2 + L3 + L4 < 1200 m

A standard cable (twisted pair) can be used.

1200 m < L1 + L2 + L3 + L4 < 1500 m

Cable specifications:
- Twisted pair, twisting rate > 10/m
- Cable capacitance < 100 nF/km (100 pF/m)
- Cable impedance 80...120 Ω (= √L/C)
- **Transmission speed (= 1/√LC) > 55 % of light velocity (55 % of 300 000 km/s)**

1500 m < L1 + L2 + L3 + L4 < 2000 m

Cable specifications:
- Twisted pair, twisting rate > 10/m
- Cable capacitance < 100 nF/km (100 pF/m)
- Cable impedance 80...120 Ω (= √L/C)
- **Transmission speed (= 1/√LC) > 66 % of light velocity (66 % of 300 000 km/s)**

Diagnosis and displays

Both an open-circuit and a short-circuit on the CS31 system bus is detected by the NCB. The defective part of the bus line and all parts behind it are out of order. The other bus segments work properly.

In case of an error, the red LEDs ”OUT” or ”IN” light up.

In the basic unit, an error is indicated as ”Remote Unit Error” (FK3).

The access to the error is different with the different types of basic units.

07 KR 31 / 07 KT 31

- Access to the error with the function block COPY to the memory address
  SEG: 0h and OFFSET: 8660h

  If the value of 2Ah is found, one of the NCBs is in the error state. (The red LED on the basic unit remains OFF.)

  Using the function block COPY, the error is reset in the basic unit by writing the value 0h to the memory address 0:8660h.
- Access to the error as FK3 error number 17d with versions produced after April 1996 (07 KR 31 index J and 07 KT 31 index B).

07 KR 91 / 07 KT 92 / 07 KT 93

- Access to the error with the function block COPY to the memory address
  SEG: C000h and OFFSET: 0100h

  If the value of 2Ah is found, one of the NCBs is in the error state. (The red LED on the basic unit lights up.)

  Using the function block COPY, the error is reset in the basic unit by writing the value 0h to the memory address 0C00:0100h.

07 CS 61 (for T200)

- Version index c R202

  The error is seen as a bus error with no remote modules connected.
- Version index d R202 and the following:

  The error is set in bit 4 of the word
  MW 4104,03 for the first CS31 line,
  MW 4105,11 for the second CS31 line,
  MW 4107,03 for the third CS31 line and
  MW 4108,11 for the fourth CS31 line.

07 CS 91 (for T300 and UCZA/UCZB)

- A diagnosis is not available.

Error detection

– Check all CS31 system bus connections. The bus connectors BUS1 and BUS2 must not be reversed.

– Check the CS31 system bus.

  In case of a short-circuit, all remote modules in the concerned bus segment do not work.

  The NCB only can detect an open-circuit if it is between the NCB and the first remote module. In this case, the basic unit will detect a disconnected remote module.

After the error has been remedied, the NCB acknowledges it automatically. The red LED goes out again.

Under normal conditions, a remote unit error is always detected by the basic unit.

Technical data

General data

Rated supply voltage	24 V DC
Max. power dissipation inside the module	4 W
Max. delay between input and output signals	< 2 µs

Technical data of the system bus terminals ”IN”

Interface standard	EIA RS-485
Terminating resistor 120 Ω, 1/4 W	integrated
Electrical isolation	yes
Isolation IN/OUT and IN/power supply	1000 V AC

Technical data of the system bus terminals ”OUT”

Interface standard	EIA RS-485
Terminating resistor 120 Ω, 1/4 W	integrated
Electrical isolation	yes
Isolation OUT/IN and OUT/power supply	1000 V AC

LED displays

Indication of the power supply voltage		1 green LED
Indication of communication	TXI	1 yellow LED ”Communication is running from the CS31 bus master to the NCB”
	TXO	1 yellow LED ”Communication is running from the CS31 remote module to the NCB"
Indications CS31 system bus		2 red LEDs ”OUT” and ”IN”

Mechanical data

Dimensions, width x height x depth	120 x 80 x 85 mm
Weight	340 g
Mounting on DIN rail	yes

Ordering data

Order No.	NCB	FPR3471200R1002

6.2 CS31 System Bus Module NCBR

CS31 system bus amplifier with redundancy,
system bus electrically isolated

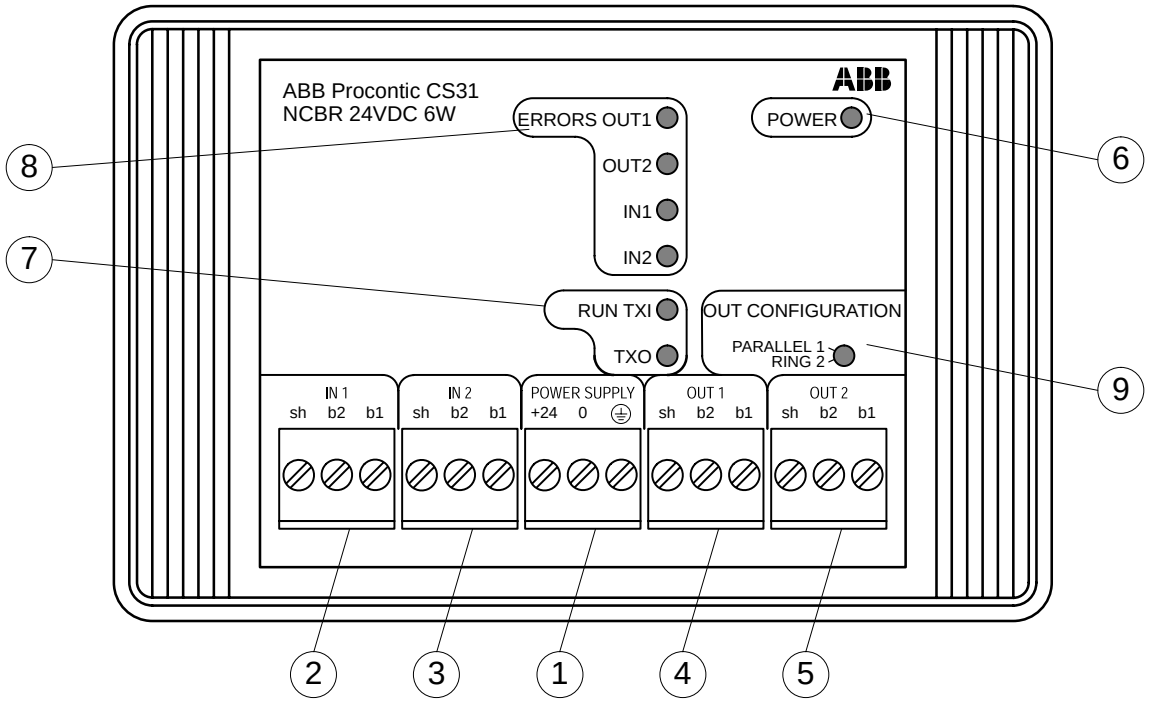


Fig. 6.2-1: CS31 system bus amplifier NCBR with redundancy

Contents

Intended purpose

The NCBR is an amplifier for the CS31 system bus with integrated redundancy functions.

The NCBR allows two types of configuration:

– **Reliable installation**
In this case, NCBRs are used to build up redundant data transmission systems.

– **Extended installation**
In this case, NCBRs are used to build up star-type configurations which cover wide areas of application.

The redundancy is performed with two parallel buses between two NCBRs or with one bus using one NCBR in ring configuration.

Due to the integrated amplifier function, a maximum bus length of up to 1800 m is possible with the installation of 3 NCBRs.

The use of NCBRs is entirely transparent. A diagnosis is possible for every part of the bus system on both the basic unit and the NCBR.

Display and operating elements on the front panel

(1) Removable connector for the 24 V DC power supply

(2) Removable connector for the CS31 system bus input 1

(3) Removable connector for the CS31 system bus input 2

(4) Removable connector for the CS31 system bus output 1

(5) Removable connector for the CS31 system bus output 2

(6) A green LED indicates that the power supply is ON

(7) 2 yellow LEDs ”TXI” and ”TXO” to display the communication between the basic unit and the NCBR

(8) 4 red LEDs ”OUT1”, ”OUT2”, ”IN1” and ”IN2” to display of errors on the different CS31 bus segments

(9) Selection of parallel or ring configuration

Electrical connection

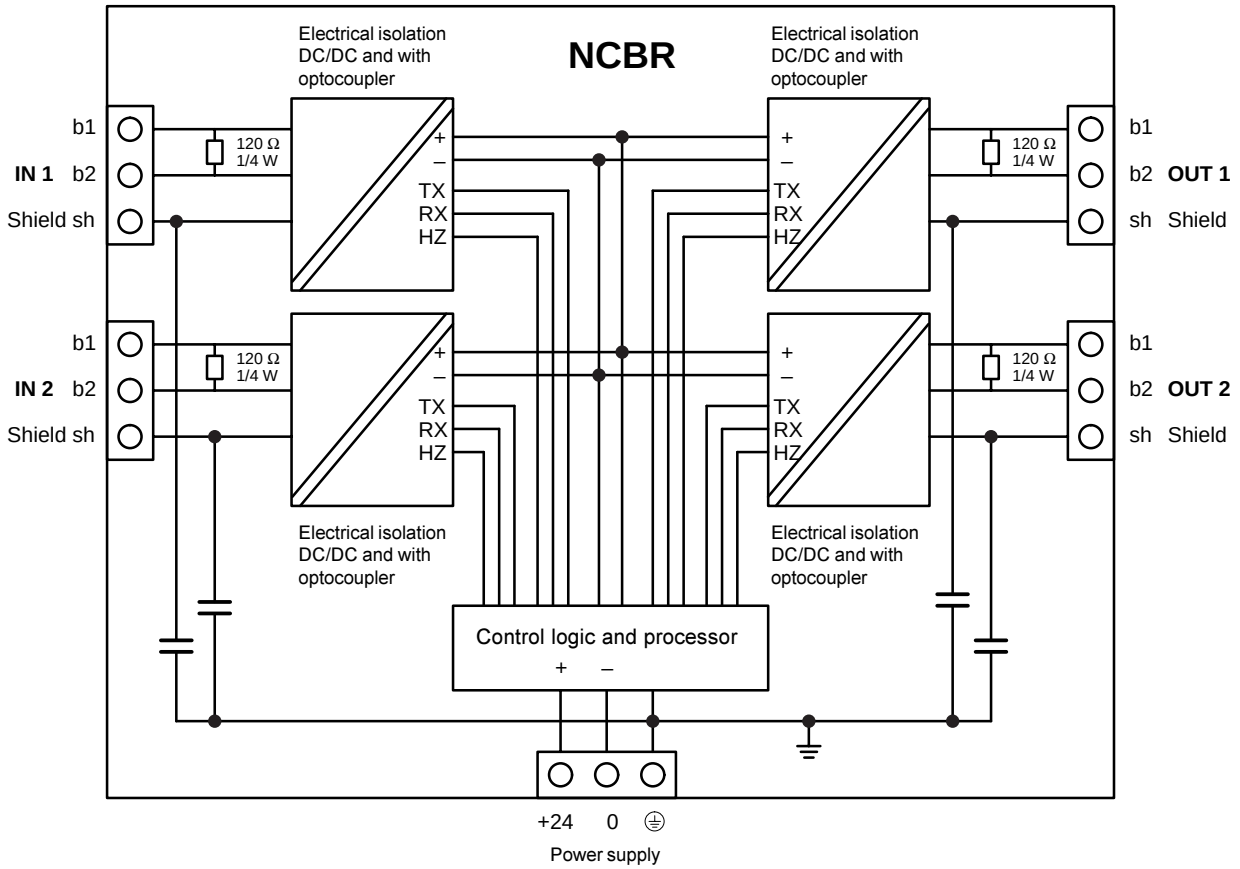


Fig. 6.2-2: Electrical connection of the CS31 system bus amplifier NCBR

b1: BUS 1
b2: BUS 2
IN1 and OUT1: Segment 1
IN2 and OUT2: Segment 2

Installation

All EMC standards have to be met (see also AC31 system data).

Parallel configuration

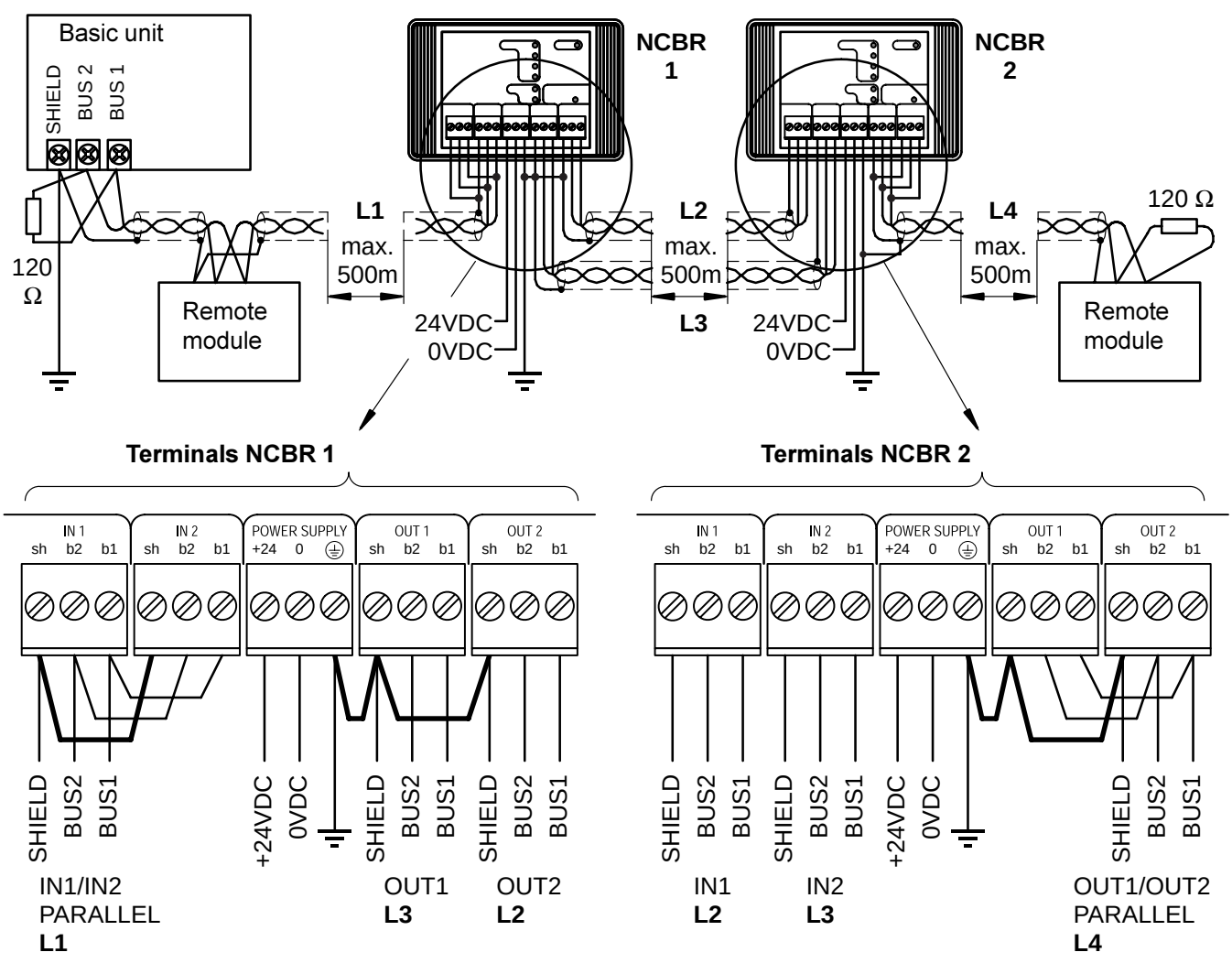


Fig. 6.2-3: Parallel configuration with 2 NCBR bus amplifiers, L1 to L4 = CS31 system bus lines

The bus terminating resistor of 120 Ω 1/4 W is already integrated in the NCBR.

The maximum length of each CS31 bus segment is 500 m.

The maximum length in one direction (e.g. L1 + L2 + L4) depends on the cable specifications (see also chapter ”Cable selection”).

In case of an error on L2 (resp. L3) the remote modules connected on L2 (resp. L3) between the failure location and the preceding NCBR lose their communication with the basic unit.

Ring configuration

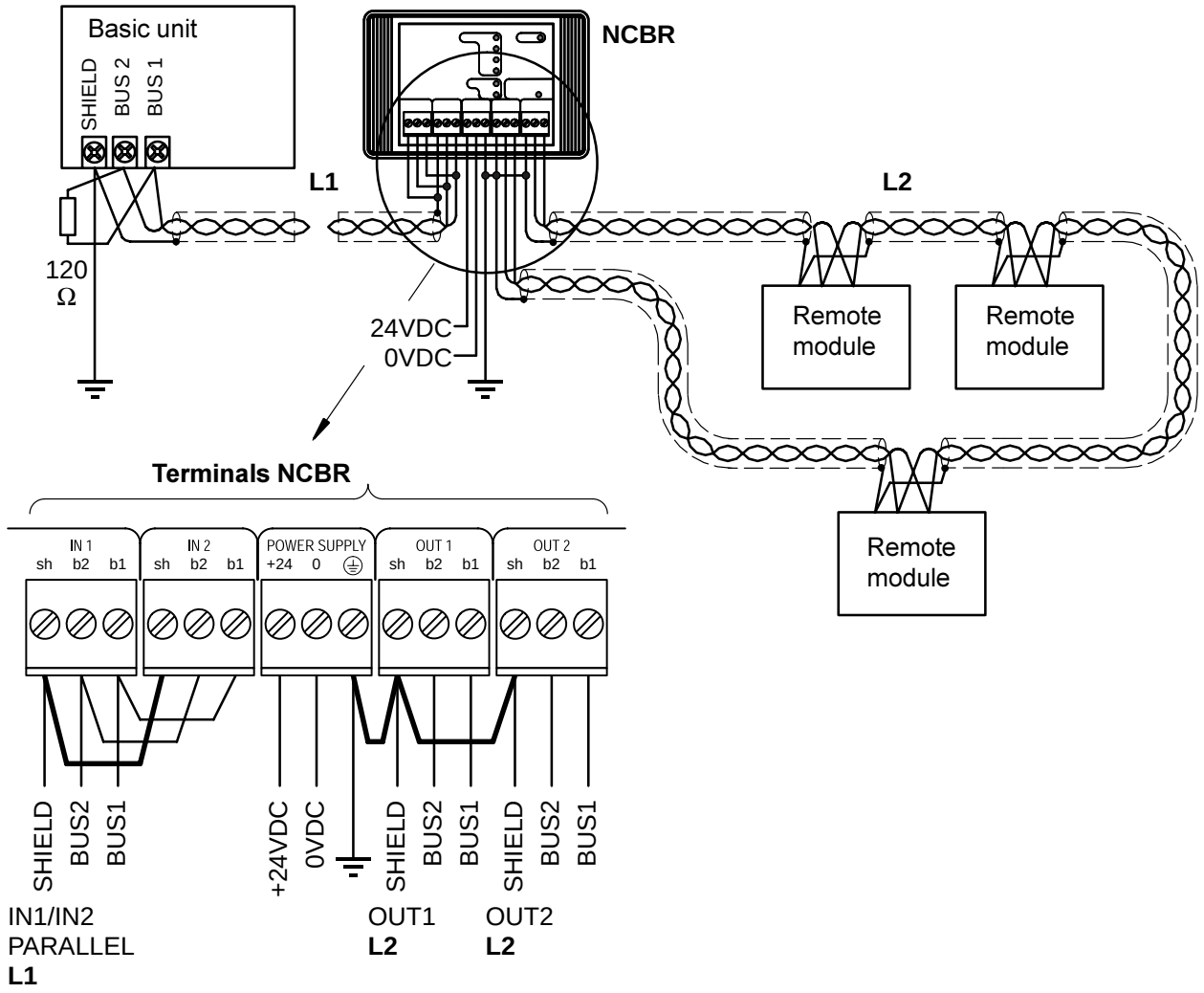


Fig. 6.2-4: Ring configuration with one NCBR bus amplifier

The maximum length of each CS31 bus segment is 500 m.

The maximum length in one direction (e.g. L1 + L2) depends on the cable specifications (see also chapter ”Cable selection”).

Star configuration

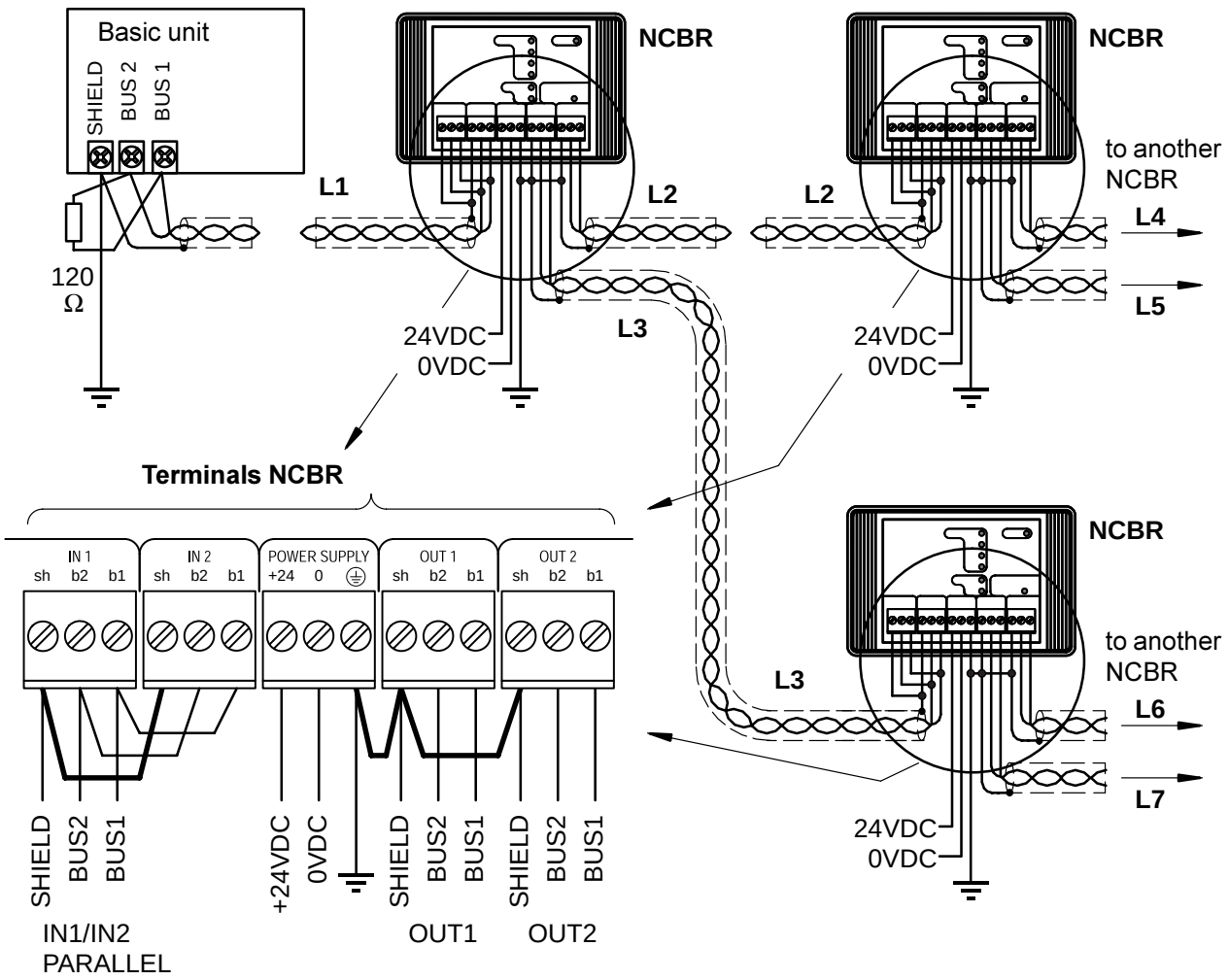


Fig. 6.2-5: Star configuration with several NCBR bus amplifiers

In this configuration, up to 7 NCBRs can be used.

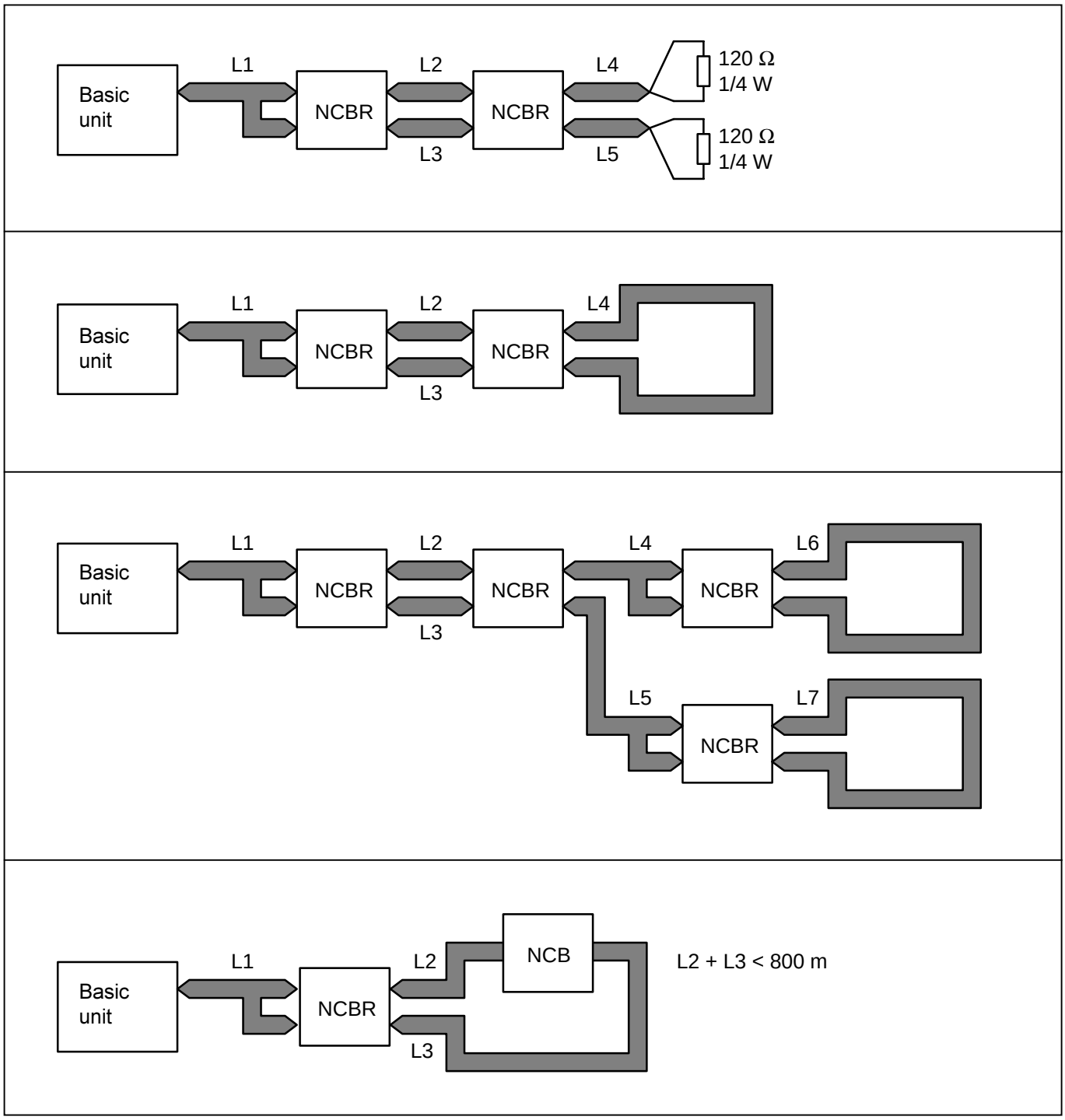
The maximum length of each CS31 bus segment is 500 m.

For correct function with the maximum length in one direction (e.g. L1 + L3 + L6 = 1500 m) the use of a suitable cable is very important (see also chapter ”Cable selection” on the following pages).

The 3 possible configurations can be combined with each other.

In one direction, a maximum of 3 NCBRs can be used. The entire configuration must not contain more than 31 remote modules. NCBRs do not use a bus address here.

Examples for other configurations:



Cable selection

For a safe and error-free data transmission over long distances, the selection of an appropriate bus cable is very important.

The maximum length of each CS31 bus segment is 500 m.

- **If the total length is less than 1200 m,** a standard cabele (twisted pair) can be used.

- **If the cable length is between 1200 m and 1500 m,** a cable with the following specifications can be used:

Cable specifications:
– Twisted pair, twisting rate > 10/m
– Cable capacitance < 100 nF/km (100 pF/m)
– Cable impedance 80...120 Ω (= √L/C)
– **Transmission speed (= 1/√LC) > 55 % of light velocity (55 % of 300 000 km/s)**

- **If the cable length is between 1500 m and 1800 m,** a cable with the following specifications can be used:

Cable specifications:
– Twisted pair, twisting rate > 10/m
– Cable capacitance < 100 nF/km (100 pF/m)
– Cable impedance 80...120 Ω (= √L/C)
– **Transmission speed (= 1/√LC) > 66 % of light velocity (66 % of 300 000 km/s)**

Function

The NCBR is waiting for a character at the inputs IN1 and IN2.

When the first character of a frame is received on one of the two buses, the corresponding line becomes valid and the characters on the other bus line are ignored then.

After the complete frame has been received (delay > 20 µs) the NCBR waits for a new frame on both buses.

- **Redundancy and star configuration**

The switch **"OUT CONFIGURATION"** has to be in the position **PARALLEL**.
Frames are sent from both bus outputs now.

- **Ring configuration**

The switch **"OUT CONFIGURATION"** has to be in the position **RING**.
After initialization, the electrical signal on OUT1 is changed, and the NCBR checks whether the signal on OUT2 follows this change.

– If yes, the ring is closed. The data frame is sent only from OUT1 now.

– If no, the ring is open. The data frame is sent from both outputs (OUT1 and OUT2) now.

The red LEDs are alternatively ON.

The NCBR checks for each character if it arrives at OUT2.

If the ring is closed again, the two frames are overlapping each other.

If a transmission error occurs, the telegram currently sent is ignored and will be sent again.

After Power ON the red LEDs go out and the yellow ones indicate the communication process.

Diagnosis and displays

Both an open-circuit and a short-circuit on the CS31 system bus is detected by the NCBR.

These errors are displayed on the basic unit.

In case of a bus error, the red LEDs "OUT1", "OUT2", "IN1" or "IN2" light up.

The access to the errors is different with the different types of basic units:

07 KR 31 / 07 KT 31

– Access to the error with the function block COPY to the memory address
SEG: 0h and OFFSET: 8660h

  If the value of 2Ah is found, one of the NCBRs is in the error state. (The red LED on the basic unit remains OFF.)

  Using the function block COPY, the error is reset in the basic unit by writing the value 0h to the memory address 0:8660h.

– Access to the error as FK3 error number 17d with versions produced after April 1996 (07 KR 31 index J and 07 KT 31 index B).

07 KR 91 / 07 KT 92 / 07 KT 93 / 07 KT 94

– Access to the error with the function block COPY to the memory address
SEG: C000h and OFFSET: 0100h

  If the value of 2Ah is found, one of the NCBRs is in the error state. (The red LED on the basic unit lights up.)

  Using the function block COPY, the error is reset in the basic unit by writing the value 0h to the memory address 0C00:0100h.

07 CS 61 (for T200)

– Version index c R202

  The error is seen as a bus error with no remote modules connected.

– Version index d R202 and the following:

  The error is set in bit 4 of the word
  MW 4104,03 for the first CS31 line,
  MW 4105,11 for the second CS31 line,
  MW 4107,03 for the third CS31 line and
  MW 4108,11 for the fourth CS31 line.

07 CS 91 (for T300 and UCZA/UCZB)

– A diagnosis is not available.

Error detection

– Check all CS31 system bus connections. The bus connectors BUS1 and BUS2 must not be reversed.

– Check the CS31 system bus.

  In case of a short-circuit, all remote modules in the concerned bus segment do not work.

  The NCBR only can detect an open-circuit if it is between the NCBR and the first remote module of the last segment between two NCBRs (in parallel or ring configuration).

After the error has been remedied, the NCBR acknowledges it automatically. The red LED goes out again.

Under normal conditions, a remote unit error is always detected by the basic unit.

Technical data

General data

Rated supply voltage	24 V DC
Max. power dissipation inside the module	6 W
Max. delay between input and output signals	< 2 µs
Isolation IN1 / IN2 / OUT1 / OUT2 and power supply (see Electrical Connection)	1000 V AC

Technical data of the system bus terminals ”IN1/IN2”

Interface standard	EIA RS-485
Terminating resistor 120 Ω, 1/4 W	integrated
Electrical isolation	yes

Technical data of the system bus terminals ”OUT1/OUT2”

Interface standard	EIA RS-485
Terminating resistor 120 Ω, 1/4 W	integrated
Electrical isolation	yes

LED displays

Indication of the power supply voltage		1 green LED
Indication of communication	TXI	1 yellow LED
	TXO	1 yellow LED
Indications CS31 system bus		4 red LEDs ”OUT1”, "OUT2", "IN1" and ”IN2”

Mechanical data

Dimensions, width x height x depth	120 x 80 x 85 mm
Weight	340 g
Mounting on DIN rail	yes

Ordering data

Order No.	NCBR	FPR3471300R1002

10 Interface Cables

Interface cables for connection between peripheral units and the 9-pole serial interfaces of the basic units 07 KR 91, 07 KT 92, 07 KT 93 and 07 KT 94 (AC31) and the communication processors 07 KT 62 and 07 KP 64 (ABB Procontic T200):

Type	Order number
07 SK 90 R1	GJR5 2502 00 R0001
07 SK 91 R1	GJR5 2503 00 R0001
07 SK 92 R1	GJR5 2504 00 R0001

10.1 Interface Cables 07 SK 90 R1, 07 SK 91 R1 and 07 SK 92 R1

for connection of peripheral units to the 9-pole serial interfaces of the basic units 07 KR 91, 07 KT 92, 07 KT 93 and 07 KT 94 (Advant Controller 31) and the communication processors 07 KP 62 and 07 KP 64 (ABB Procontic T200) and 07 KP 90 (Advant Controller 31)

10.1.1 Survey table

The following table shows, which interface cables can be used for connections between peripheral units and the 9-pole interfaces of the AC31 basic units and the T200 communication processors.

Connection from the processor unit interface	**via** the system cable (interface cable)	**to the peripheral unit**
07 KR 91 COM1 07 KT 9x COM1 07 KP 62 COM1	07 SK 90	PC programming unit with 907 PC 331
07 KR 91 COM1 07 KT 9x COM1 07 KP 62 COM1	07 SK 90	Operating station in active mode
07 KR 91 COM1 07 KT 9x COM1 07 KP 62 COM1 07 KP 64 CONSOLE 07 KP 90 CONSOLE	07 SK 90	Terminal
07 KR 91 COM1 07 KT 9x COM1 07 KT 9x COM2 07 KP 62 COM1 07 KP 62 COM2	07 SK 91	Operating station in passive mode
07 KR 91 COM1 07 KT 9x COM1 07 KT 9x COM2 07 KP 62 COM1 07 KP 62 COM2 07 KP 64 RCOM 07 KP 90 RCOM	07 SK 92	Modem with a standard interface, for signal names and pin assignment see chapter 10.4

10.2 Interface Cable 07 SK 90 R1 with adaptor

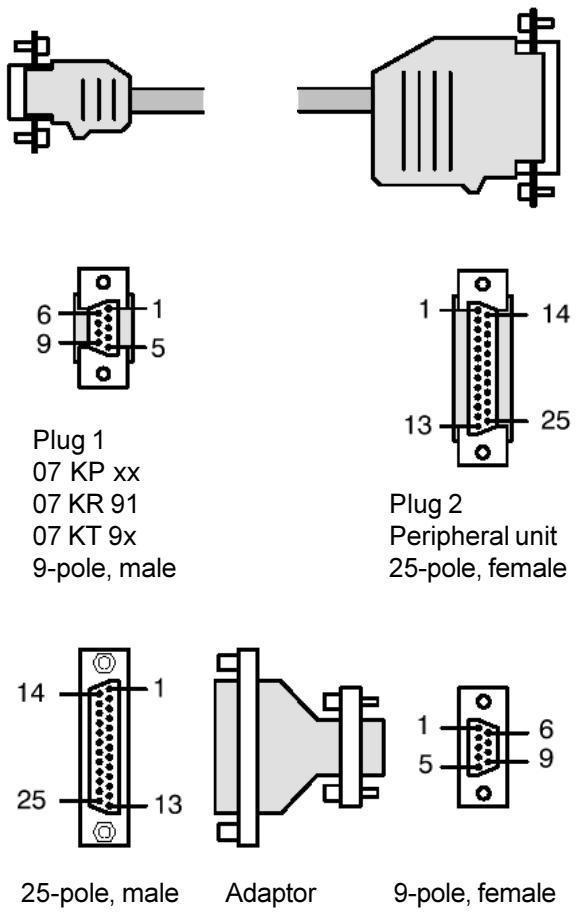


Fig. 10.2-1:
Interface cable 07 SK 90 R1 with adaptor

Intended purpose

The cable 07 SK 90 is used to connect a 9-pole interface connector of AC31 basic units or T200 communication processors with a peripheral unit in order to operate in programming or active mode (see 10.1.1 Survey table). If the peripheral has a 9-pole interface, the adaptor provided with (25-pole to 9-pole) can be employed for adaption.

Mechanical design

Plug 1

SUB-D plug, 9-pole male on the side of 07 KP 6x, 07 KR 91, 07 KT 9x. The housing is metal-plated, the shield is connected to the metal plate.

Plug 2

SUB-D plug, 25-pole female, on the side of the peripheral unit. The plugs are mounted to both interfaces by means of screws.

Cable type

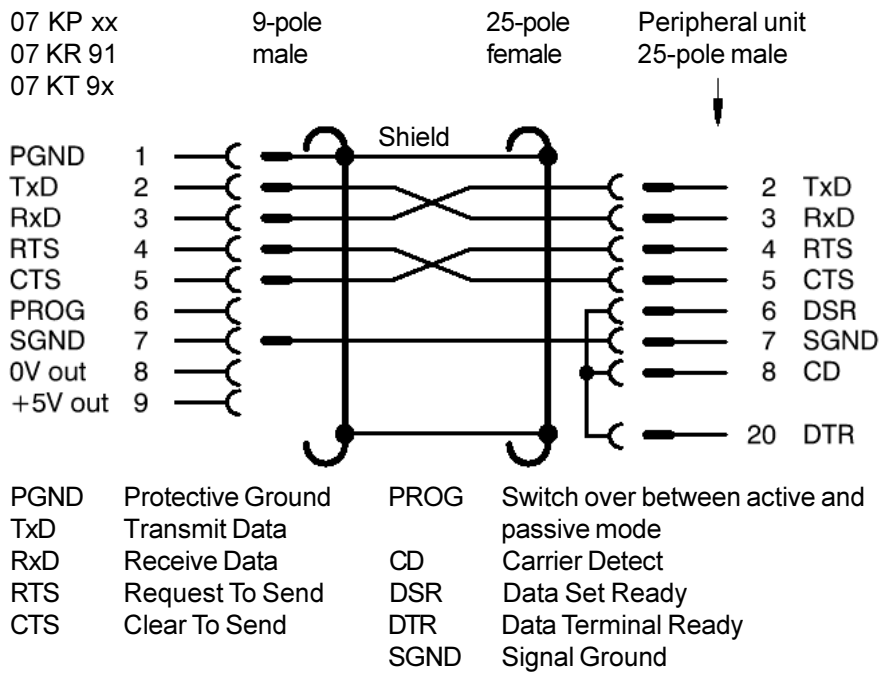
LICYCY 5 x 0.14/15

Adaptor provided

25-pole male/9-pole female for connection of peripheral units with 9-pole interfaces (male).

Technical data

Length	5 m
Weight	220 g
Order number	GJR5 2502 00 R1



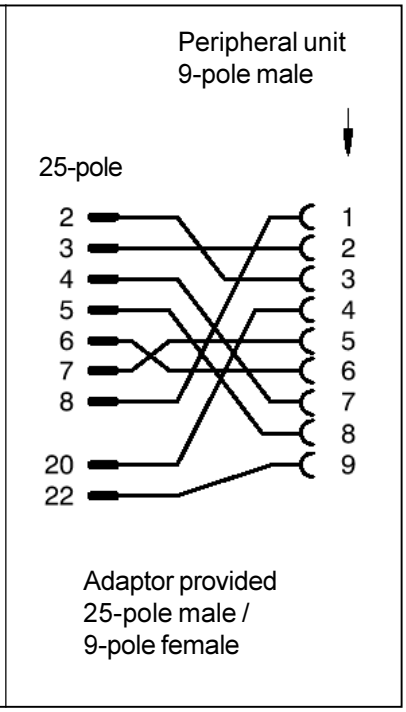


Fig. 10.2-2: Terminal assignment of the 07 SK 90 interface cable and the adaptor provided with

10.3 Interface cable 07 SK 91 R1 with adaptor

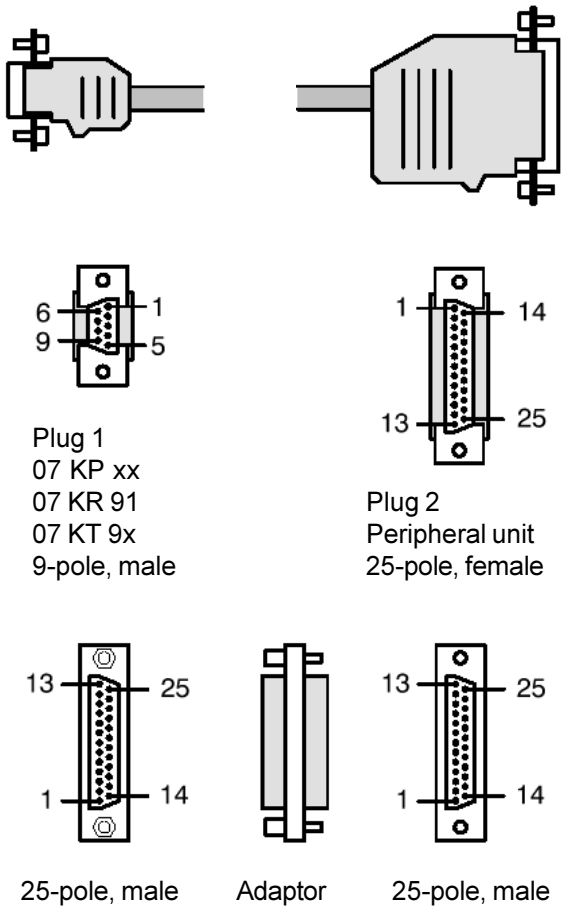


Fig. 10.3-1:
Interface cable 07 SK 91 R1 with adaptor

Intended Purpose

The cable 07 SK 91 is used to connect a 9-pole interface connector of AC31 basic units or T200 communication processors with a peripheral unit in order to operate in MMC mode or passive mode (see 10.1.1 Survey table). If the peripheral unit has a 9-pole connector, a commercially available adaptor (25-pole to 9-pole) has to be employed for adaption.

Mechanical design

Plug 1

SUB-D plug, 9-pole male on the side of 07 KP 6x, 07 KR 91, 07 KT 9x. The housing is metal-plated, the shield is connected to the metal plate.

Plug 2

SUB-D plug, 25-pole female on the side of the peripheral unit. The plugs are mounted to both interfaces by means of screws.

Cable type

LICYCY 5 x 0.14/15

Adaptor provided

25-pole male/25-pole male for connection of peripheral units with 25-pole interfaces (female).

Technical data

Length	5 m
Weight	220 g
Order number	GJR5 2503 00 R1

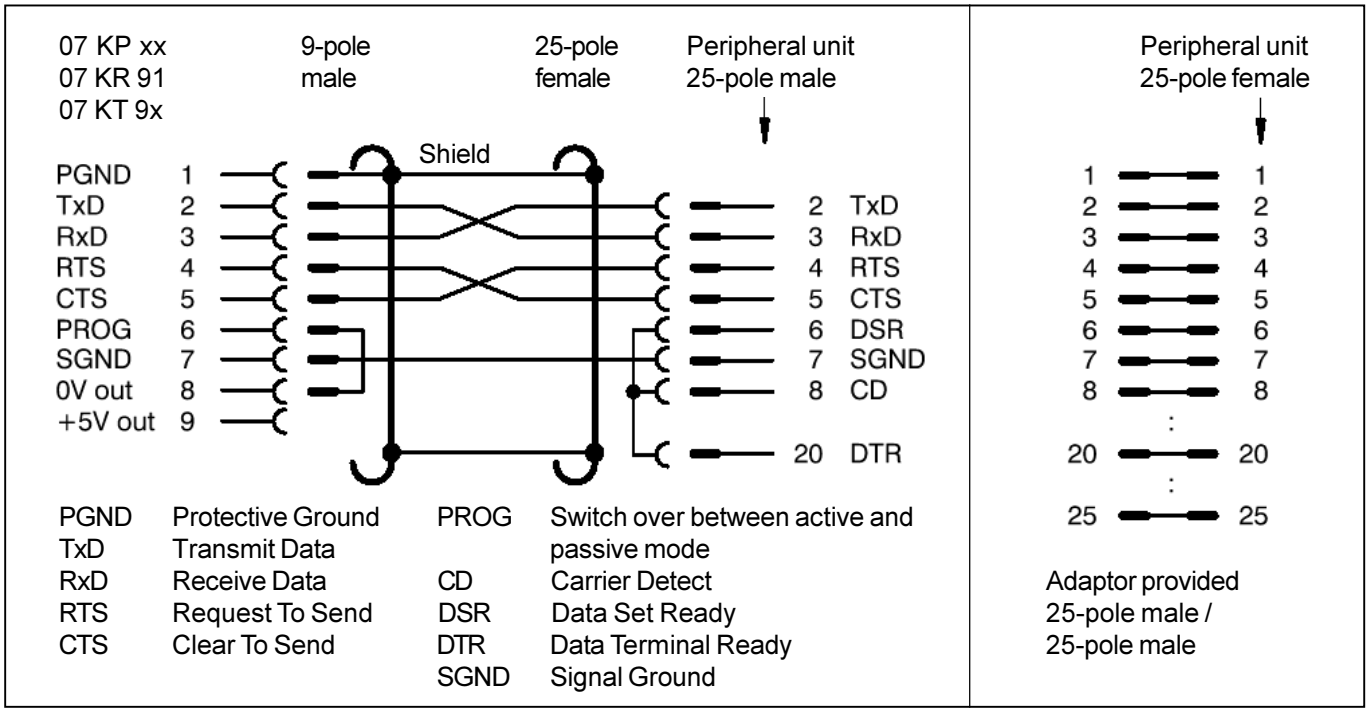


Fig. 10.2-3: Terminal assignment of the 07 SK 91 interface cable and the adaptor provided with

10.4 Interface cable 07 SK 92 R1

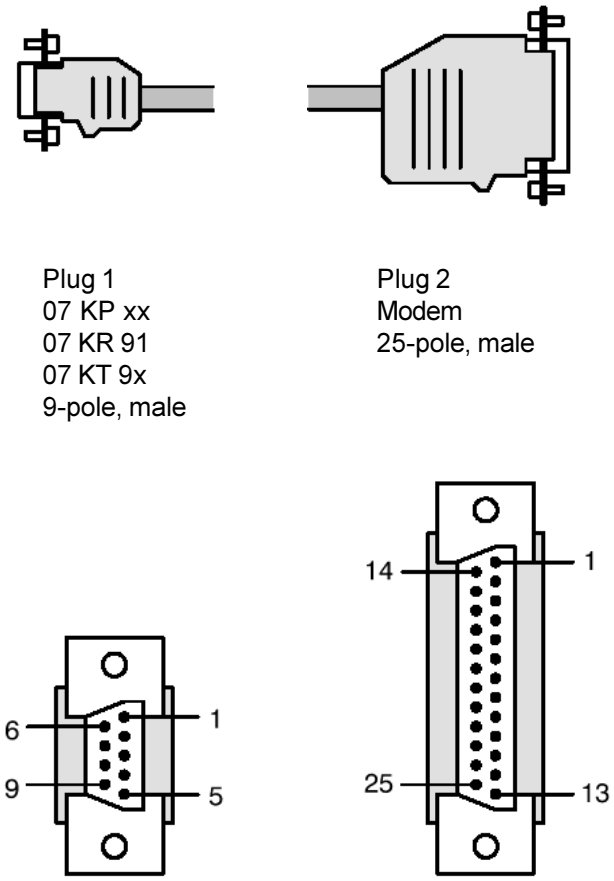


Fig. 10.4-1:
Interface cable 07 SK 92 R1

Intended purpose

The cable 07 SK 92 is used to connect a 9-pole interface connector of AC31 basic units or T200 communication processors to a modem with a standard interface (see 10.1.1 Survey table). If another modem has to be connected, the cable has to be modified possibly.

Mechanical design

Plug 1

SUB-D plug, 9-pole male on the side of 07 KP 6x, 07 KR 91, 07 KT 9x. The housing is metal-plated, the shield is connected to the metal plate.

Plug 2

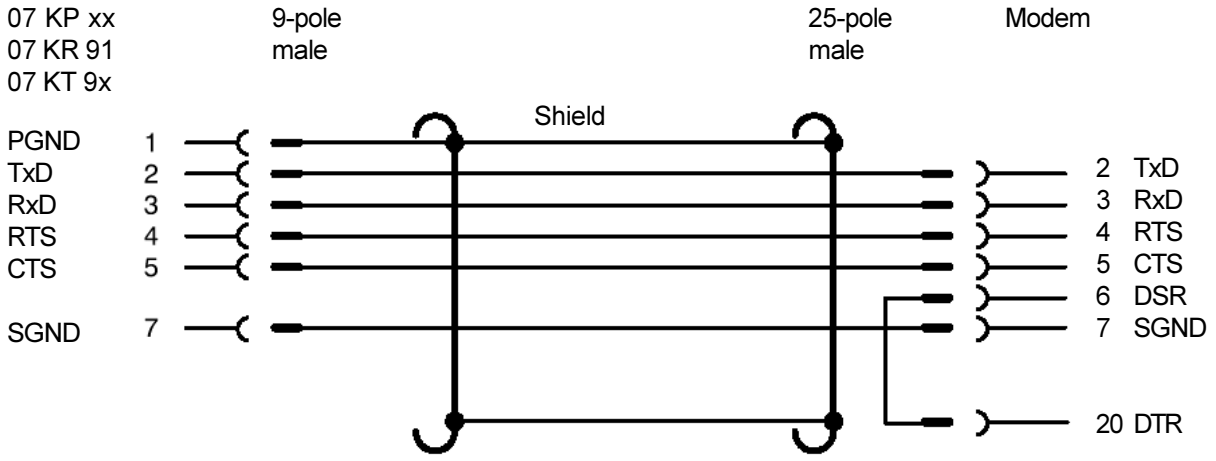
SUB-D plug, 25-pole male on the side of the modem.
The plugs are mounted to both interfaces by means of screws.

Cable type

LICYCY 5 x 0.14/15

Technical data

Length	5 m
Weight	220 g
Order number	GJR5 2504 00 R1



PGND	Protective Ground
TxD	Transmit Data
RxD	Receive Data
RTS	Request To Send
CTS	Clear To Send
DSR	Data Set Ready
DTR	Data Terminal Ready
SGND	Signal Ground

Fig. 10.2-4: Terminal assignment 07 SK 92

11 Accessories

Type	Order number
Power Supply Unit 07 NG 32, 24 V DC, 2,5 A	**GJV3 0756 01 R1**
Power Supply Unit 07 NG 34, 24 V DC, 5 A	**GJV3 0756 02 R1**
Power Supply Unit 07 NG 35, 24 V DC, 10 A	**GJV3 0756 03 R1**
Power Supply Unit 07 NG 36, 24 V DC, 20 A	**GJV3 0756 04 R1**
Lithium Battery Module 07 LE 90 R1 for use in processsor units	**GJR5250700R1**

11.1 Power Supply Unit 07 NG 32 R1
primary voltage: 115/230 V AC, secondary voltage: 24 V DC, 2.5 A

The 07 NG 32 R1 power supply unit generates a 24 V DC voltage from a single-phase mains voltage of 115 V AC or 230 V AC. For applications in electronic control systems, the output voltage is smoothed by electrolytic capacitors. The power supply unit has a load capability of 2.5 A. A green LED indicates that the output voltage is present.

The primary and the secondary voltage are protected by built-in miniature fuses (5 x 20 mm). The electrical connections are made via screw-type terminals (see Fig. 11.1-1, Top view with circuit diagram imprint and terminal assignment). Cable grips fasten the cables. There is an electrical isolation between the primary and the secondary voltage according to VDE 0551 (safety electrical isolation).

The power supply unit has a mounting base which allows the user to snap the unit onto a DIN rail (EN 50022). If this mounting base is removed, the unit can be fastened by 4 screws M4 (see Fig. 11.1-2, drilling pattern).

The power supply unit must be mounted so that the convection air current is not disturbed.

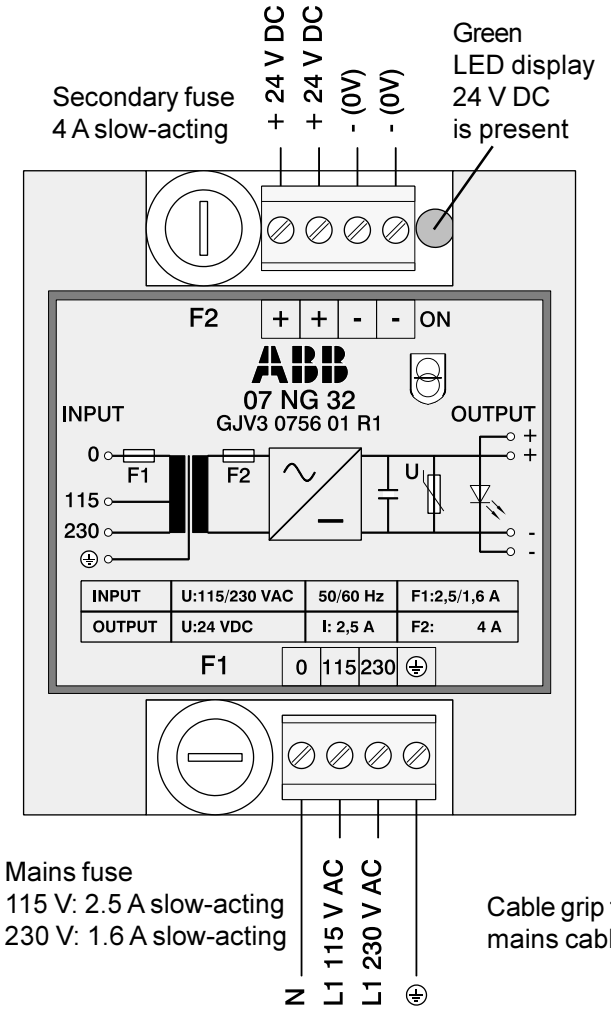


Fig. 11.1-1: Top view with circuit diagram imprint and terminal assignment

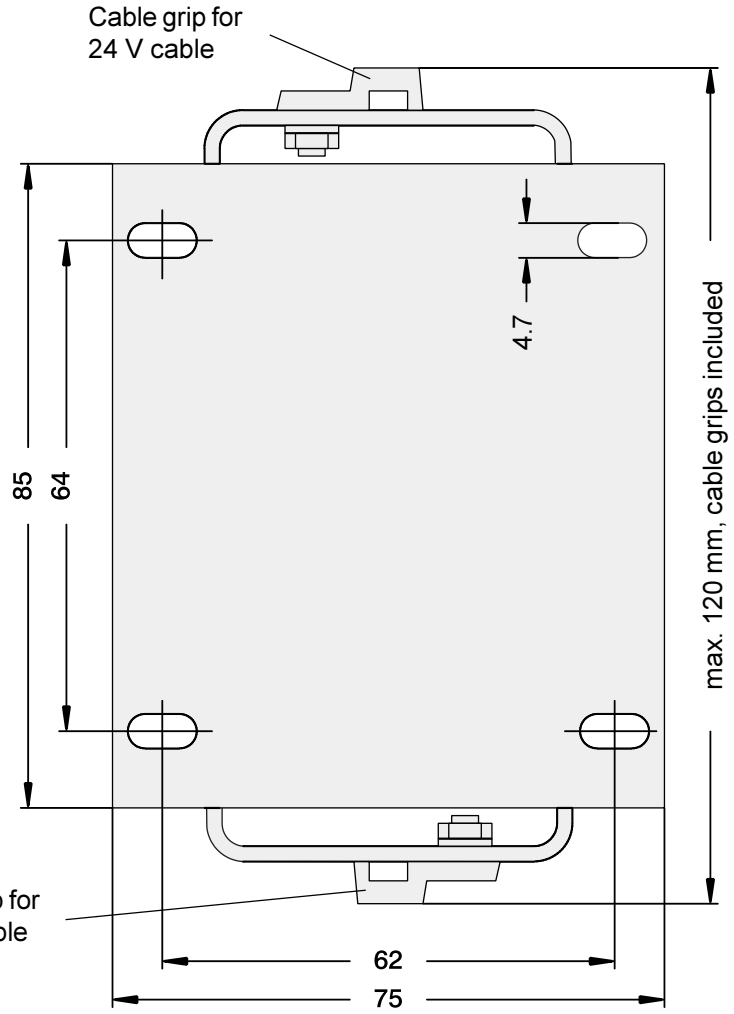


Fig. 11.1-2: Drilling pattern and outline dimensions of the power supply unit

The power supply unit has a height (depth if mounted on rear panel) of approx. 145 mm

Technical data

Electrical data, input specifications

Primary voltage **115 V AC**		
Rated voltage		115 V AC
Limiting values		103.5...126.5 V AC
Mains frequency		50 or 60 Hz
Current consumption	with no load	approx. 180 mA
	with rated load	approx. 900 mA
Miniature fuse primary		2.5 A slow-acting, sand-filled
Primary voltage **230 V AC**		
Rated voltage		230 V AC
Limiting values		207...253 V AC
Mains frequency		50 or 60 Hz
Current consumption	Leerlauf	approx. 90 mA
	Nennlast	approx. 450 mA
Miniature fuse primry		1.6 A slow-acting, sand- filled (inserted by factory)
Max. conductor cross section of the terminals		2.5 mm^2

Electrical data, output specifications

Secondary voltage (output voltage)	
Rated voltage	24 V DC
Limiting values	19.2...30 V DC
Max. ripple content	≤ 5 %
Indication "voltage present"	by green LED
Output load capability	
Rated current (permitted continuous load)	2.5 A
Miniature fuse, secondary	4.0 A medium time-lag, sand-filled
Max. conductor cross section of the terminals	2.5 mm^2, plus and minus poles are assigned to two terminals each (in parallel)

Mechanical data

Mounting	onto a DIN rail or with 4 screws M4
Mechanical dimensions	
Mounting base	85 x 75 mm (120 mm), see Fig. 11.1-2, Drilling pattern
Height (depth if mounted on rear panel)	145 mm
Weight	2.2 kg
Cooling	The power supply unit must be mounted so that the convection air current is not disturbed.
Ambient temperature	max. 55 °C (at 100 % load)
Standards, regulations	VDE 0160, transformer according to VDE 0551

Ordering data

Order number	07 NG 32 R1	GJV3 0756 01 R1

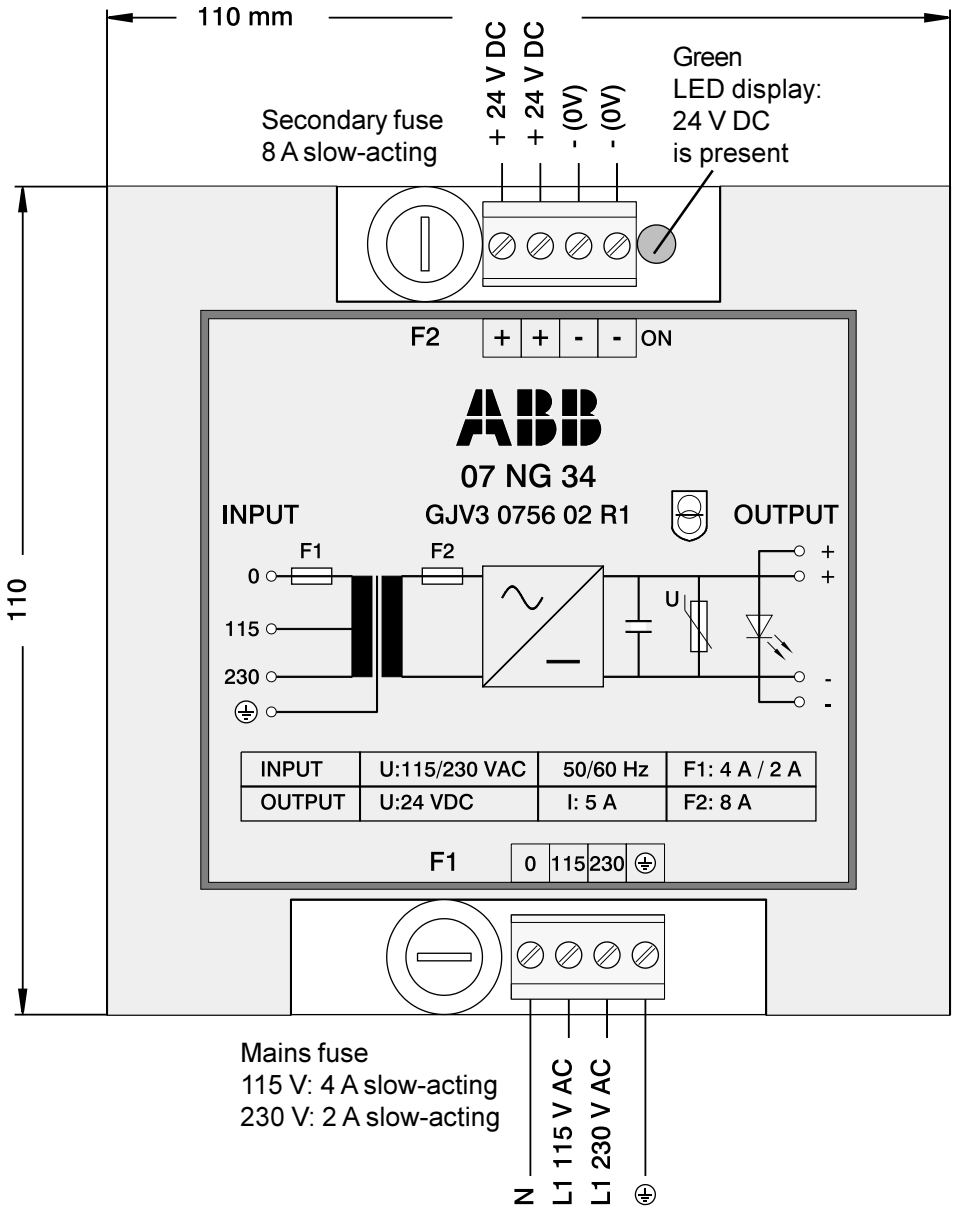
11.2 Power Supply Unit 07 NG 34 R1
primary voltage: 115/230 V AC, secondary voltage: 24 V DC, 5 A

The 07 NG 34 R1 power supply unit generates a 24 V DC voltage from a single-phase mains voltage of 115 V AC or 230 V AC. For applications in electronic control systems, the output voltage is smoothed by electrolytic capacitors. The power supply unit has a load capability of 5 A. A green LED indicates that the output voltage is present.

The primary and the secondary voltage are protected by built-in miniature fuses (5 x 20 mm). The electrical connections are made via screw-type terminals (see Fig. 11.2-1, Top view with circuit diagram imprint and terminal assignment). Cable grips fasten the cables. There is an electrical isolation between the primary and the secondary voltage according to VDE 0551 (safety electrical isolation).

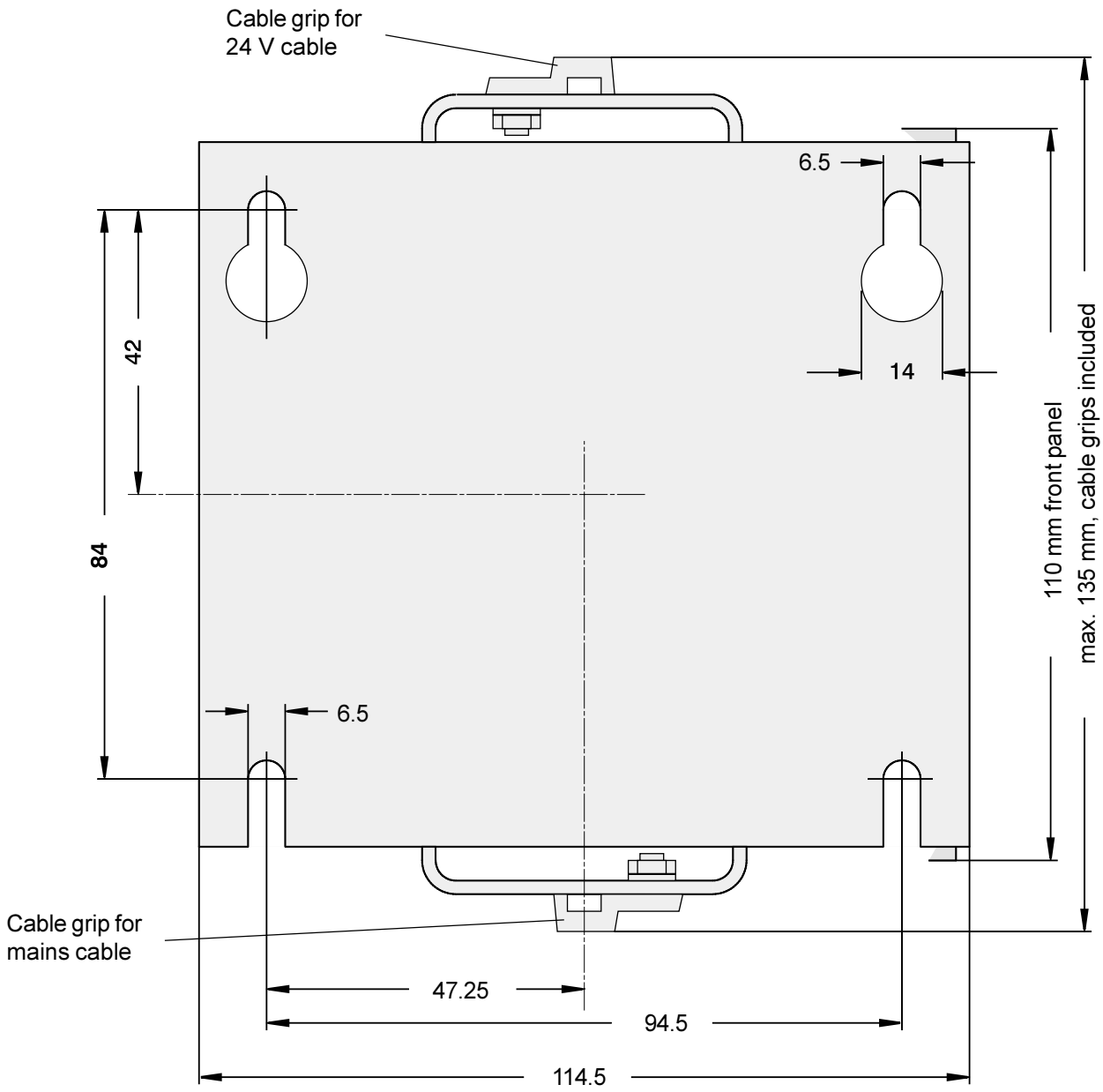
The power supply is fastened by 4 screws M5 (see Fig. 11.2-2, drilling pattern).

The power supply unit must be mounted so that the convection air current is not disturbed.



The power supply unit has a height (depth if mounted on rear panel) of approx. 145 mm

Fig. 11.2-1: Top view with circuit diagram imprint and terminal assignment



The power supply unit has a height (depth if mounted on rear panel) of approx. 145 mm

Fig. 11.2-2: Drilling pattern and outline dimensions of the power supply unit

Technical data

Electrical data, input specifications

Primary voltage **115 V AC**		
Rated voltage		115 V AC
Limiting values		103.5...126.5 V AC
Mains frequency		50 or 60 Hz
Current consumption	with no load	approx. 0.35 A
	with rated load	approx. 1.60 A
Miniature fuse primary		4 A slow-acting, sand-filled
Primary voltage **230 V AC**		
Rated voltage		230 V AC
Limiting values		207...253 V AC
Mains frequency		50 or 60 Hz
Current consumption	with no load	approx. 0.17 A
	with rated load	approx. 0.85 A
Miniature fuse, primary		2 A slow-acting, sand-filled (inserted by factory)
Max. conductor cross section of the terminals		2.5 mm^2

Electrical data, output specifications

Secondary voltage (output voltage)	
Rated voltage	24 V DC
Limiting values	19.2...30 V DC
Max. ripple content	≤ 5 %
Indication "voltage present"	by green LED
Output load capability	
Rated current (permitted continuous load)	5 A
Miniature fuse, secondary	8 A medium time-lag, sand-filled
Max. conductor cross section of the terminals	2.5 mm^2, plus and minus poles are assigned to two terminals each (in parallel)

Mechanical data

Mounting	by 4 screws M5
Mechanical dimensions	
Mounting base	110 x 110 mm (135 mm), see Fig. 11.2-2, Drilling pattern
Height (depth if mounted on rear panel)	145 mm
Weight	4 kg
Cooling	The power supply unit must be mounted so that the convection air current is not disturbed.
Ambient temperature	max. 55 °C (at 100 % load)
Standards, regulations	VDE 0160, transformer according to VDE 0551

Ordering data

Order number	07 NG 34 R1	GJV3 0756 02 R1

11.3 Power Supply Unit 07 NG 35 R1

primary voltage: 230/400 V 3-phase AC, secondary voltage: 24 V DC, 10 A

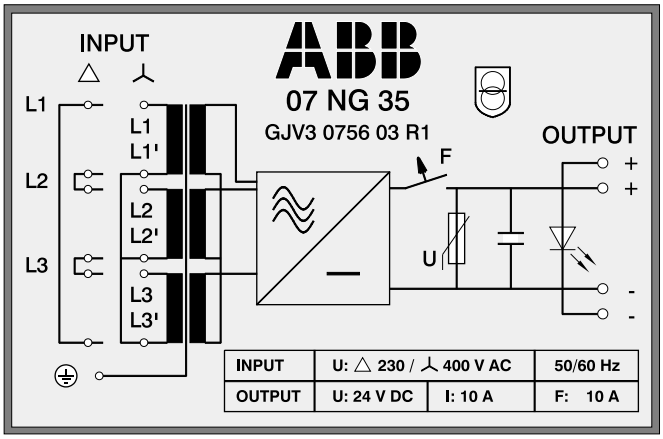
The 07 NG 35 R1 power supply unit generates a 24 V DC voltage from a three-phase mains voltage of 230 V AC or 400 V AC. The output voltage is gained by using a 3-phase bridge-connected rectifier. Together with a filter capacitor, this guarantees a small ripple content of the voltage. The power supply unit has a load capability of 10 A. It is suitable for applications in electronic control systems. A green LED indicates that the output voltage is present.

The secondary voltage is protected by a built-in automatic circuit-breaker. The primary voltage (mains) has to be protected by external fuses.

The electrical connections are made via screw-type terminals. With 3-phase mains voltage of 230 V, the primary windings of the transformer are delta-connected, with 3-phase mains voltage of 400 V, the windings are star-connected (see Fig. 11.3-1). Cable grips fasten the cables. There is an electrical isolation between the primary and the secondary voltage according to VDE 0551 (safety electrical isolation).

The power supply is fastened by 4 screws M5 (see Fig. 11.3-2, Drilling pattern).

The power supply unit must be mounted so that the convection air current is not disturbed.



Configuration set by the factory:

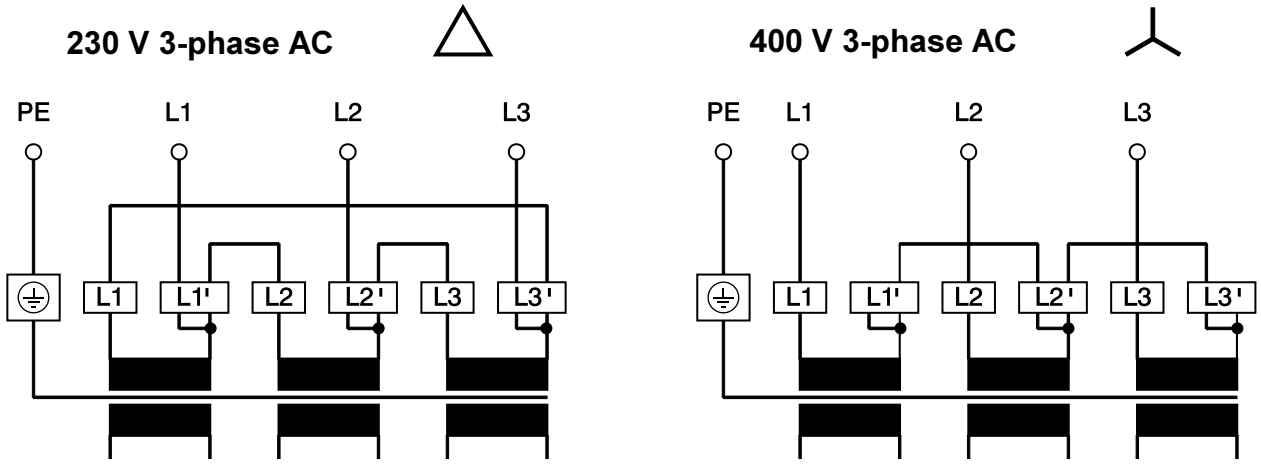
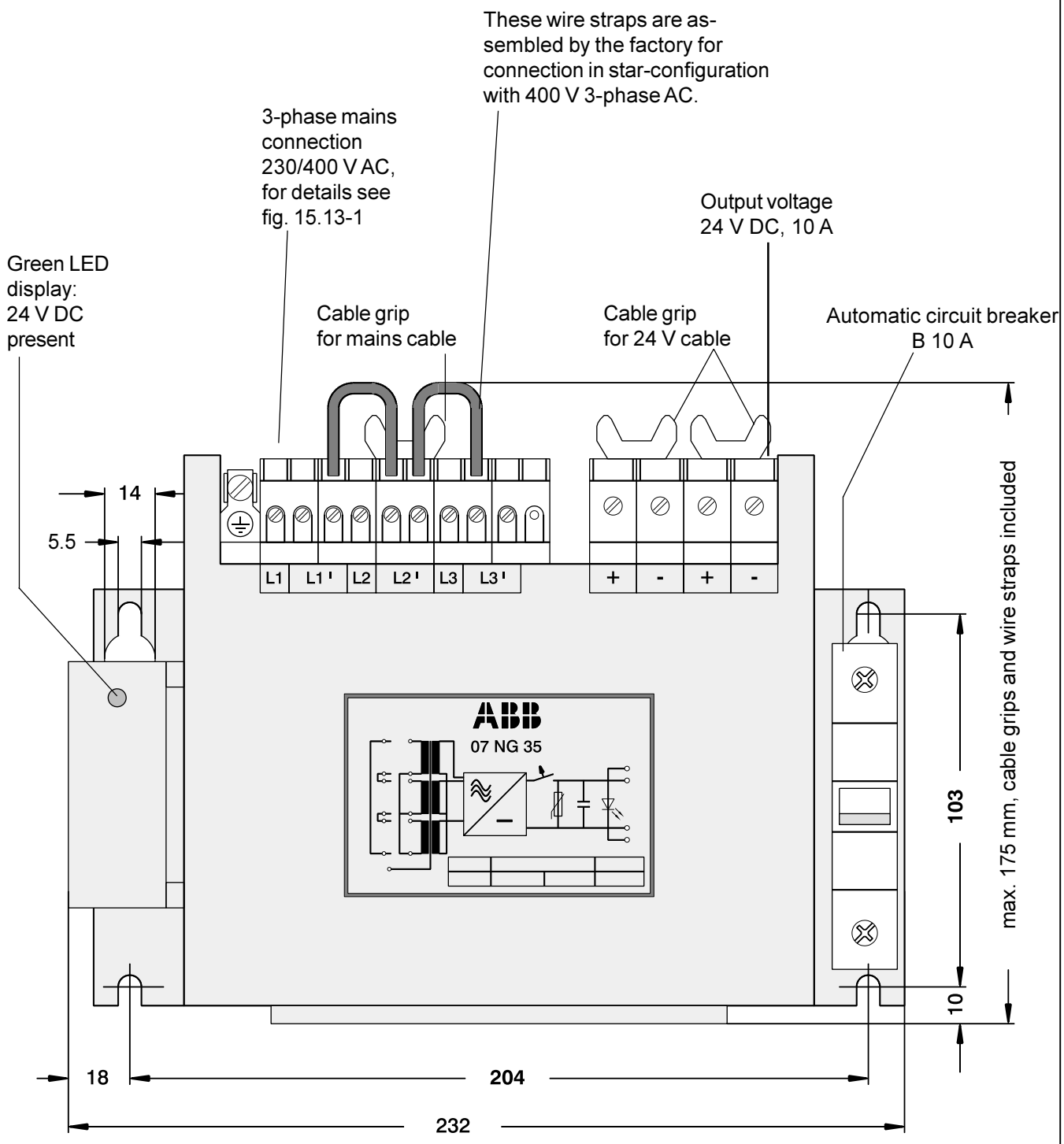


Fig. 11.3-1: Imprinted circuit diagram and terminal diagrams for 230 V und 400 V 3-phase AC



The power supply unit has a height (depth if mounted on rear panel) of approx. 145 mm

Fig. 11.3-2: Drilling pattern and outline dimensions of the power supply unit

Technical data

Electrical data, input specifications

Primary voltage **230 V 3-phase AC**		
Rated voltage		230 V 3-phase AC
Limiting values		207...253 V AC
Mains frequency		50 or 60 Hz
Current consumption	with no load	approx. 0.22 A
	with rated load	approx. 0.85 A
Fusing, primary		external
Primary voltage **400 V 3-phase AC**		
Rated voltage		400 V 3-phase AC
Limiting values		360...440 V AC
Mains frequency		50 or 60 Hz
Current consumption	with no load	approx. 0.15 A
	with rated load	approx. 0.50 A
Fusing, primary		external
Max. conductor cross section of the terminals		2 x 1.5 mm^2

Electrical data, output specifications

Secondary voltage (output voltage)	
Rated voltage	24 V DC
Limiting values	19.2...30 V DC
Max. ripple content	≤ 2 %
Indication "voltage present"	by green LED
Output load capability	
Rated current (permitted continuous load)	10 A
Fusing, secondary	automatic circuit-breaker B 10 A
Max. conductor cross section of the terminals	2 x 4 mm^2, plus and minus poles are assigned to two terminals each (in parallel)

Mechanical data

Mounting	by 4 screws M5
Mechanical dimensions	
Mounting base	232 x 175 mm, see Fig. 11.3-2, Drilling pattern
Height (depth if mounted on rear panel)	125 mm
Weight	6 kg
Cooling	The power supply unit must be mounted so that the convection air current is not disturbed.
Ambient temperature	max. 55 °C (at 100 % load)
Standards, regulations	VDE 0160, transformer according to VDE 0551

Ordering data

Order number	07 NG 35 R1	GJV3 0756 03 R1

11.4 Power Supply Unit 07 NG 36 R1

primary voltage: 230/400 V 3-phase AC, secondary voltage: 24 V DC, 20 A

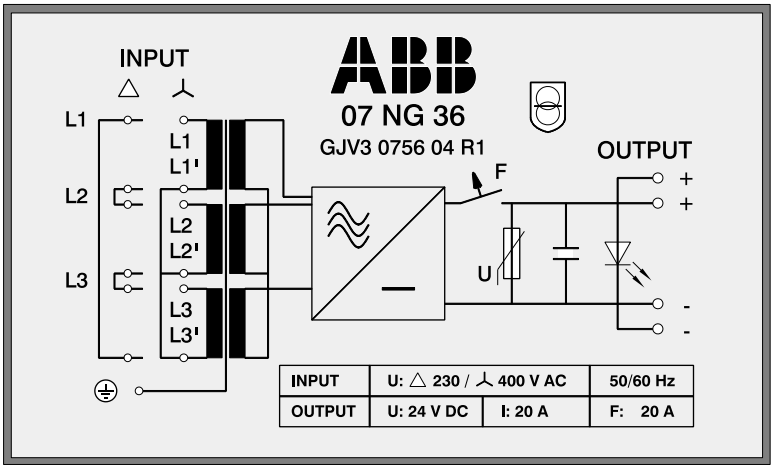
The 07 NG 36 power supply unit generates a 24 V DC voltage from a three-phase mains voltage of 230 V AC or 400 V AC. The output voltage is gained by using a 3-phase bridge-connected rectifier. Together with a filter capacitor, this guarantees a small ripple content of the voltage. The power supply unit has a load capability of 20 A. It is suitable for applications in electronic control systems. A green LED indicates that the output voltage is present.

The secondary voltage is protected by a built-in B-type automatic circuit-breaker. The primary voltage (mains) has to be protected by external fuses.

The electrical connections are made via screw-type terminals. With 3-phase mains voltage of 230 V, the primary windings of the transformer are delta-connected, with 3-phase mains voltage of 400 V, the windings are star-connected (see Fig. 11.4-1). Cable grips fasten the cables. There is an electrical isolation between the primary and the secondary voltage according to VDE 0551 (safety electrical isolation).

The power supply is fastened by 4 screws M6 (see Fig. 11.4-2, Drilling pattern).

The power supply unit must be mounted so that the convection air current is not disturbed.



Configuration set by the factory:

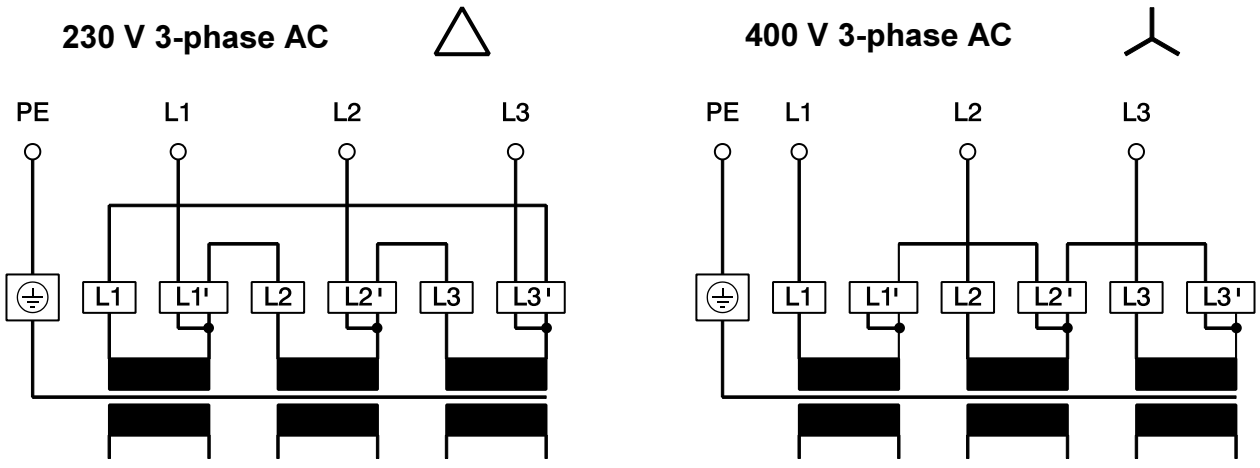
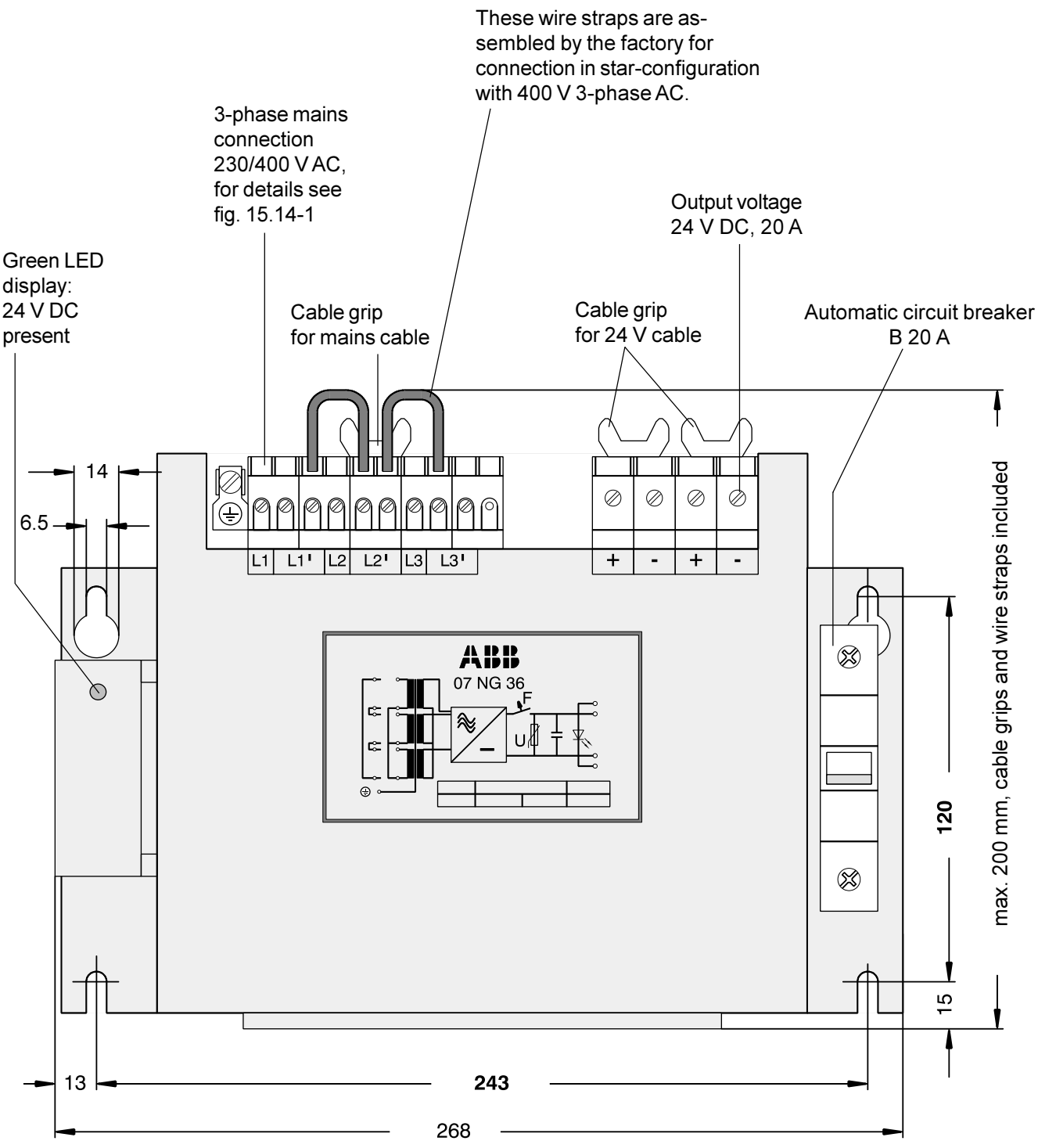


Fig. 11.4-1: Imprinted circuit diagram and terminal diagrams for 230 V and 400 V 3-phase AC



The power supply unit has a height (depth if mounted on rear panel) of approx. 136 mm

Fig. 11.4-2: Drilling pattern and outline dimensions of the power supply unit

Technical data

Electrical data, input specifications

Primary voltage **230 V 3-phase AC**		
Rated voltage		230 V 3-phase AC
Limiting values		207...253 V AC
Mains frequency		50 or 60 Hz
Current consumption	with no load	approx. 0.35 A
	with rated load	approx. 1.70 A
Fusing, primary		external
Primary voltage **400 V 3-phase AC**		
Rated voltage		400 V 3-phase AC
Limiting values		360...440 V AC
Mains frequency		50 or 60 Hz
Current consumption	with no load	approx. 0.25 A
	with rated load	approx. 1.00 A
Fusing, primary		external
Max. conductor cross section of the terminals		2 x 1.5 mm^2

Electrical data, output specifications

Secondary voltage (output voltage)	
Rated voltage	24 V DC
Limiting values	19.2...30 V DC
Max. ripple content	≤ 2 %
Indication "voltage present"	by green LED
Output load capability	
Rated current (permitted continuous load)	20 A
Max. conductor cross section of the terminals	2 x 4 mm^2, plus and minus poles are assigned to two terminals each (in parallel)

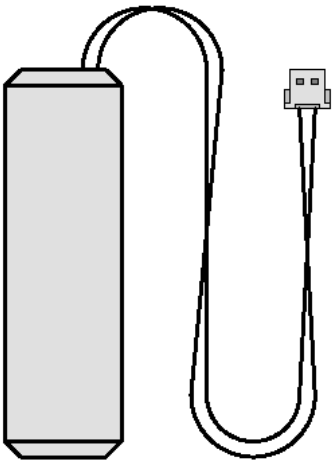
Mechanical data

Mounting	by 4 screws M6
Mechanical dimensions	
Mounting base	268 x 200 mm, see Fig. 11.4-2, Drilling pattern
Height (depth if mounted on rear panel)	136 mm
Weight	15 kg
Cooling	The power supply unit must be mounted so that the convection air current is not disturbed.
Ambient temperature	max. 55 °C (at 100 % load)
Standards, regulations	VDE 0160, transformer according to VDE 0551

Ordering data

Order number	07 NG 36 R1	GJV3 0756 04 R1

11.5 Lithium Battery Module 07 LE 90 R1
for use in processor units



Lithium battery module 07 LE 90

The 07 LE 90 R1 lithium battery module is used for RAM data back-up in several processor units of programmable control systems. It is equipped with a 2-pole plug and two soldered wires.

The following handling advice has to be taken into consideration:

- Use only genuine ABB lithium battery modules.
- At the end of lifetime, replace the battery module by a new one.
- **Do not short-circuit battery!** It may cause overheating or explosion. Prevent accidental short-circuit. Therefore, do not put battery into metallic boxes or on metallic surfaces.
- **Do not try to charge battery!** It may cause overheating or explosion!
- **Replace battery only during the power is on.** Otherwise you can loose data.
- **Dispose of the battery environmentally acceptable!**
- **Pay attention to the battery monitoring facilities on the devices, e.g.,**

  LED indications, whether a battery is exhausted or missing. The battery lifetime depends on the unit where it is installed.

Battery Lifetime

The value of the battery lifetime says how long the battery is able to back-up the stored data while the unit is not supplied by the internal voltages.

If the internal voltages are switched on, the battery is only discharged by its own leakage current.

Type of unit, where the battery is installed	Battery lifetime t (guaranteed values at 25°C)
07 KP 62 R101 (ABB Procontic T200)	min. 5 000 h
07 KP 63 R101 (ABB Procontic T200)	min. 5 000 h
07 KR 91 (Advant Controller 31)	min. 4 200 h
07 KT 9x (Advant Controller 31)	min. 4 200 h

Technical Data

Capacity	1000 mAh
No-load voltage	3.6 V
Rated voltage	3.5 V
Temperature coefficient of rated voltage	approx. – 1 mV/K
Temperature coefficient of capacity	< – 1.5 % at 0...70 °C
Self discharge	< 3.0 % per year at 25 °C < 6.0 % per year at 40 °C < 25.0 % per year at 70 °C
Weight	20 g
Dimensions	18 mm x 53 mm
Order number	GJR5250700R1

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