5.4 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

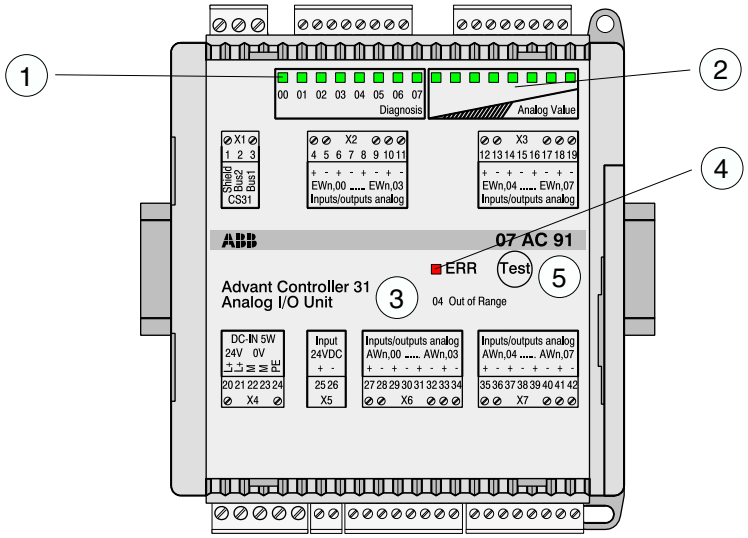


Fig. 5.4-1:
Analog input/output module 07 AC 91

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

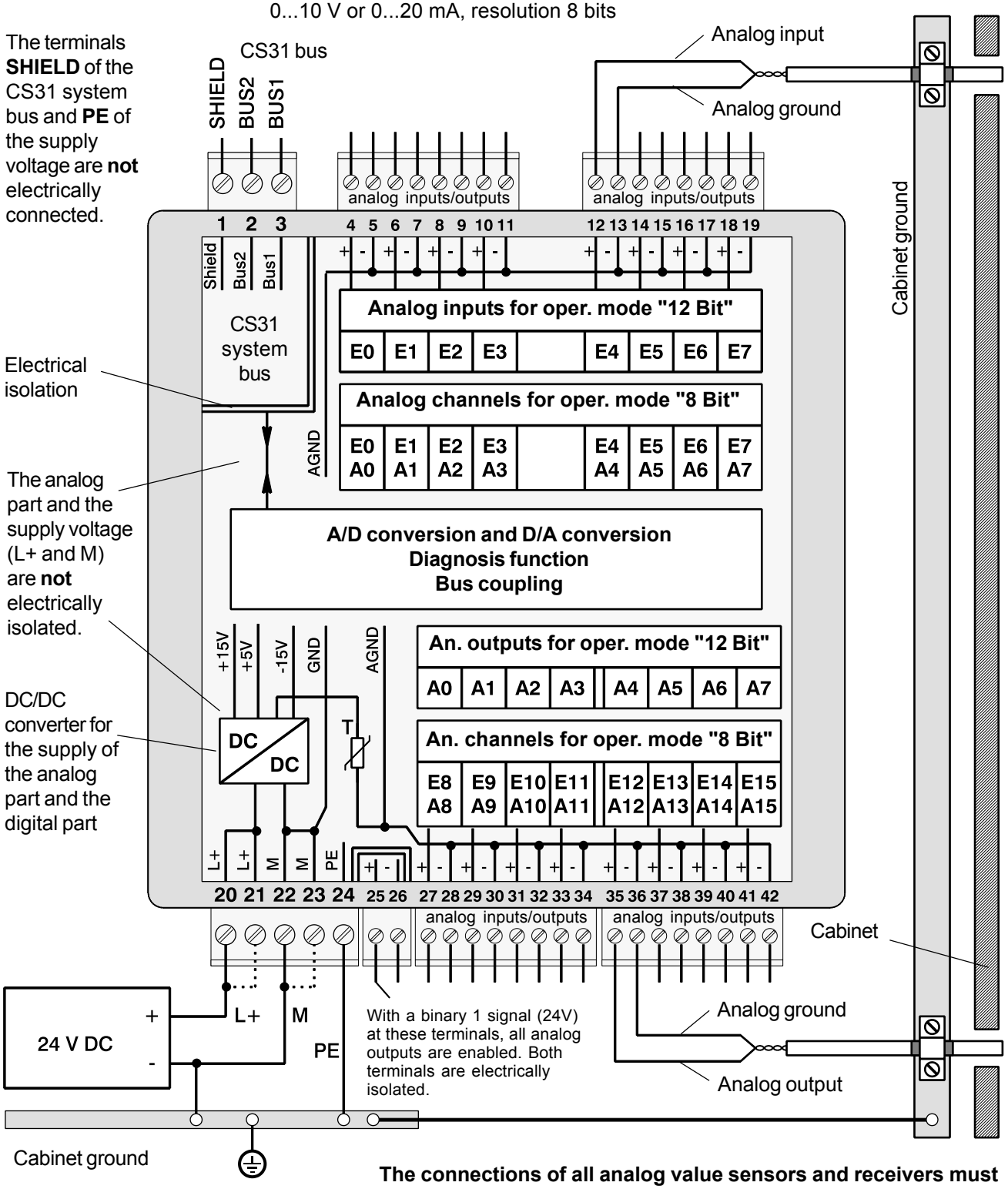
⑤ Test button

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 5.4-2: 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

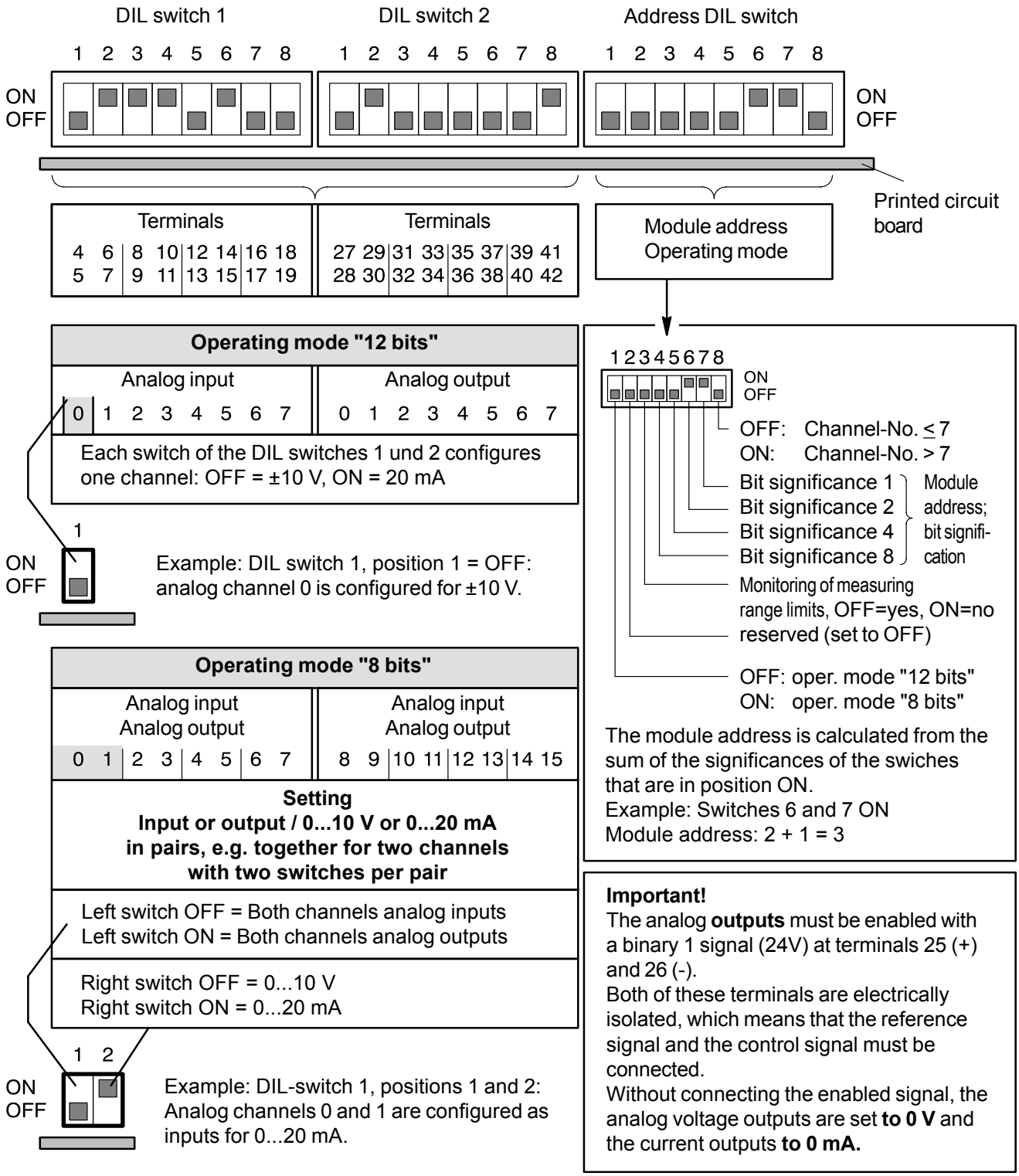


Fig. 5.4-3: Configuration of the analog channels and setting of the module address on the CS31system bus

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)

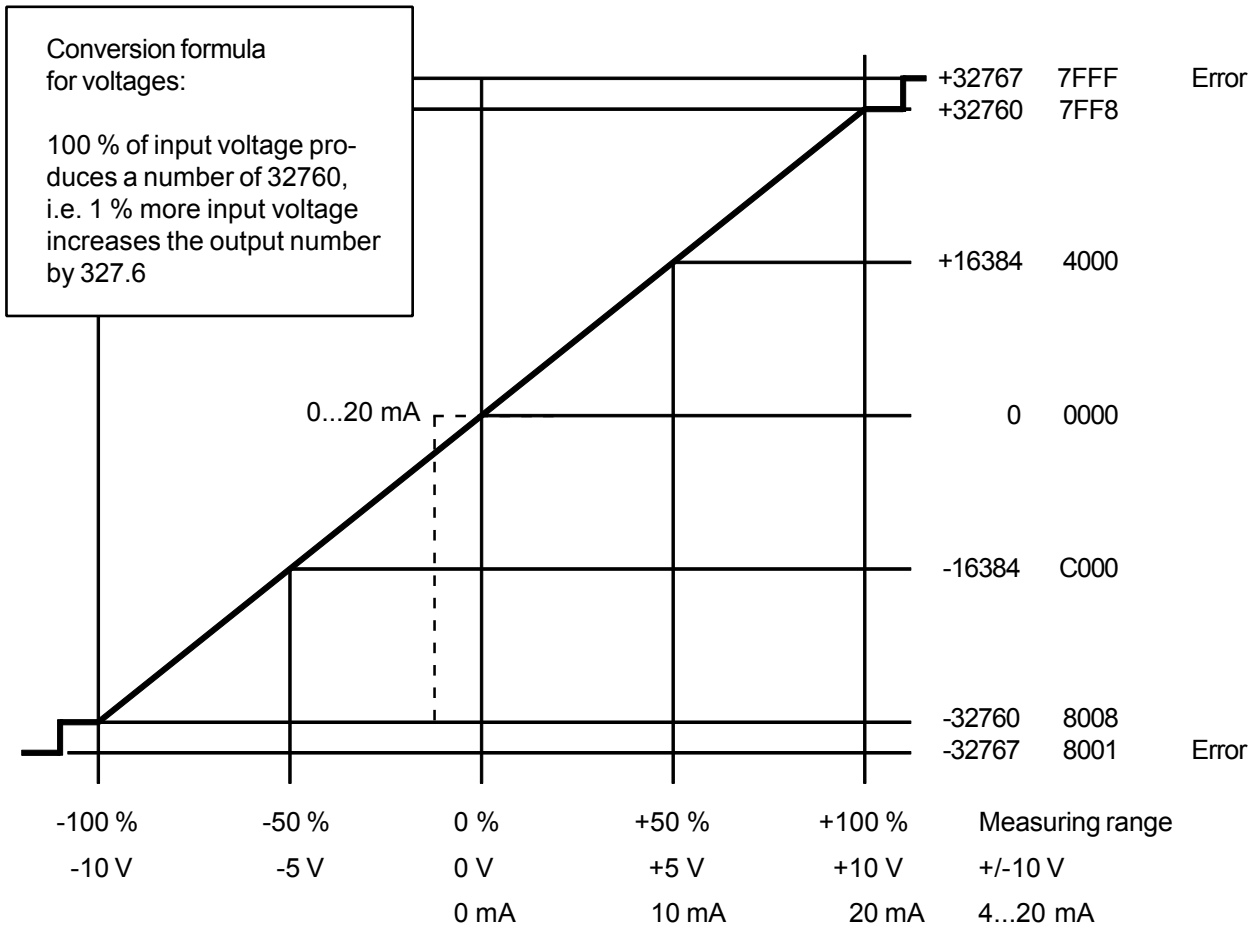


Fig. 5.4-4: Relationship between analog value and numerical value and position of bits in the word

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

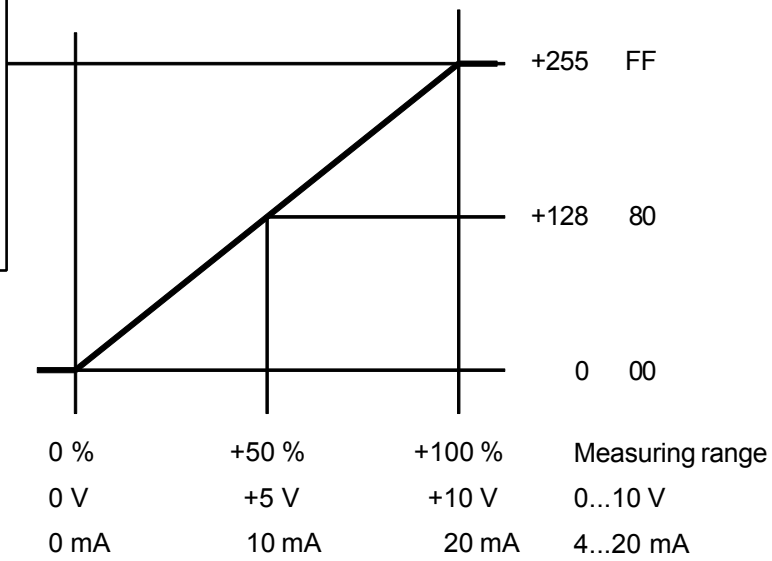


Fig. 5.4-5: Relationship between analog value and numerical value and position of bits in the word

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. 5.4-3). When using central units 07 KR 91, 07 KT 9x as bus master, the following address allocations result:

Central units 07 KR 91 / 07 KT 9x

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 9x, 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 5.4-6 and 5.4-7).

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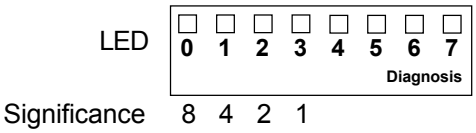
* 01 if only inputs are configured
03 if only outputs are configured
05 if inputs and outputs are configured

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. 5.4-6: 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

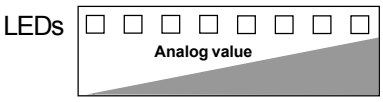


Fig. 5.4-7: Display LEDs for an analog value

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. 5.4-8: 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. 5.4-2).

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

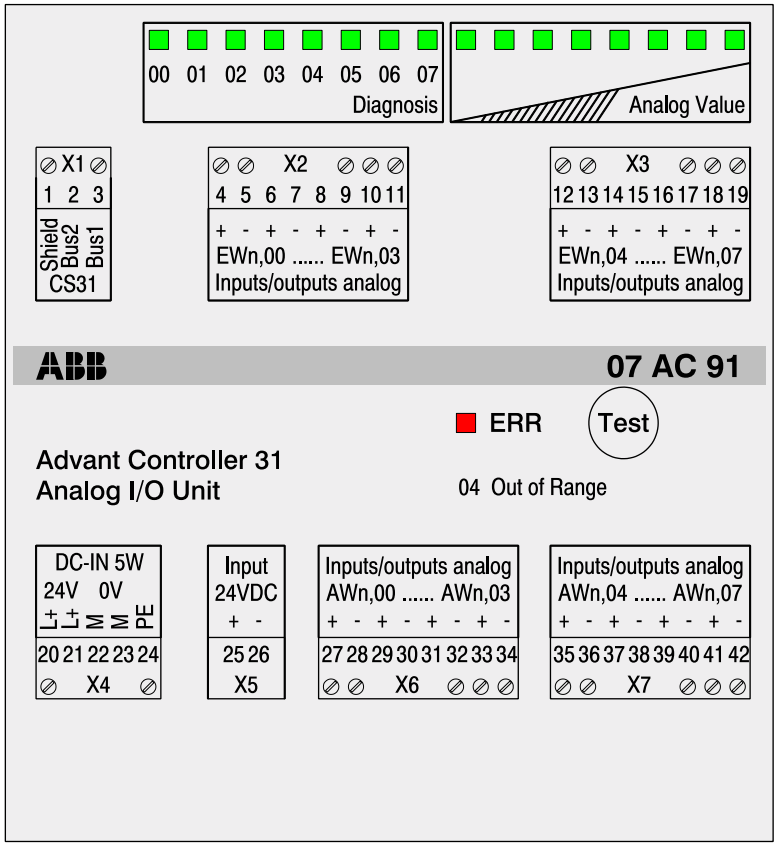
Mounting on DIN rail	according to DIN EN 50022-35, 15 mm deep. The DIN rail is positioned centrally between the upper and the lower edges of the module.
Mounting with screws	by 4 screws M4
Width x height x depth	120 x 140 x 85 mm
Wiring method supply terminals, CS31 system bus all other terminals	removable 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. 5.4-9

Installation instructions

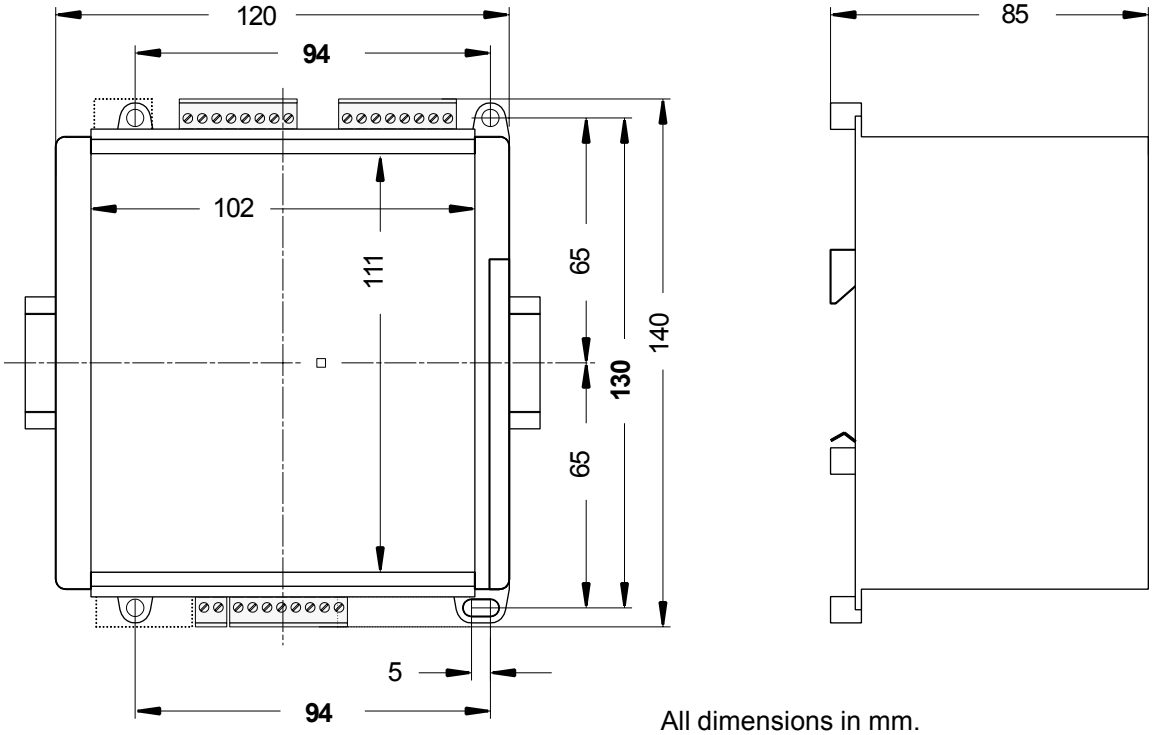
Installation position	vertical, connector terminals must point upward and downward
Cooling	The natural convection cooling must not be blocked by cable ducts or other components installed in the cabinet.

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. 5.4-9: 07 AC 91, Front panel foil and outside dimensions,
dimensions for mounting holes are shown in bold print