MOELLER

Hardware and Engineering

LE 4-206-AA1
Analog LE for Voltage Signals

06/99 AWB 27-1262 GB

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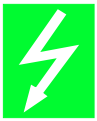


Caution!

Dangerous electrical voltage!

Before commencing the installation

- Disconnect the power supply of the device.
- Ensure that the device cannot be accidentally restarted.
- Verify isolation from the supply.
- Earth and short circuit.
- Cover or enclose neighbouring units that are live.
- Follow the engineering instructions (AWA) of the device concerned.
- Only suitably qualified personnel may work on this device/system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference do not impair the automation functions.
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation.
- Suitable safety hardware and software measures should be implemented for the I/O interface so that a line or wire breakage on the signal side does not result in undefined states in the automation devices.
- Ensure a reliable electrical isolation of the low voltage for the 24 volt supply. Only use power supply units complying with IEC 60 364-4-41 or HD 384.4.41 S2.
- Deviations of the mains voltage from the rated value must not exceed the tolerance limits given in the specifications, otherwise this may cause malfunction and dangerous operation.
- Emergency stop devices complying with IEC/EN 60 204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency-stop devices must not cause uncontrolled operation or restart.
- Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have been installed with the housing closed. Desktop or portable units must only be operated and controlled in enclosed housings.
- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency-stop devices should be implemented.

Contents

06/99 AWB 27-1262 GB

About This Manual

This manual is written for engineers and technicians with PLC experience.

It provides the specific information required for connecting the module correctly, as well as for configuring and programming it with Sucosoft S 40 programming software.

To use this manual, a knowledge of the following is required:

the master used;

the programming software.

You will find the required information in:

the “Hardware and Engineering” manual of your master

“Sucosoft S 40, User Interface” (AWB 2700-1305 GB)

“Sucosoft S 40, Language Elements for PS 4-... and PS 416” (AWB 2700-1306 GB)

The symbols used in this manual have the following meaning:

Draws your attention to useful tips and additional information.

▶ Indicates actions to be taken.

Note
Warns of the possibility of damage to products, adjacent equipment or data.

Caution!
Warns of the possibility of serious damage to products, adjacent equipment or data and risk of serious or fatal personal injury.

06/99 AWB 27-1262 GB

1 About the LE 4-206-AA1

Application range

The LE 4-206-AA1 converts analog ±10 V voltage signals to digital values, and digital values to analog ±10 V voltage signals.

In HVAC applications and in process engineering, it can be used to process analog signals from sensors that record physical values such as pressure, temperature, and flow rate. The analog output currents can then be used to regulate these variables.

The LE 4-206-AA1 can be used to expand the analog I/O of the PS 4-200 and PS 4-300 compact PLCs and the EM 4-204-DX1 expansion module.

Two modules can be used with each PLC or expansion module. They are fitted directly to the side of the PLC/expansion module in the first or second position.

Special features

Type of inputs/outputs	analog, ±10 V
Number of I/O	4 inputs/2 outputs
Resolution	10/12 bit; configurable
Error detection	Out-of-range value

06/99 AWB 27-1262 GB

Setup

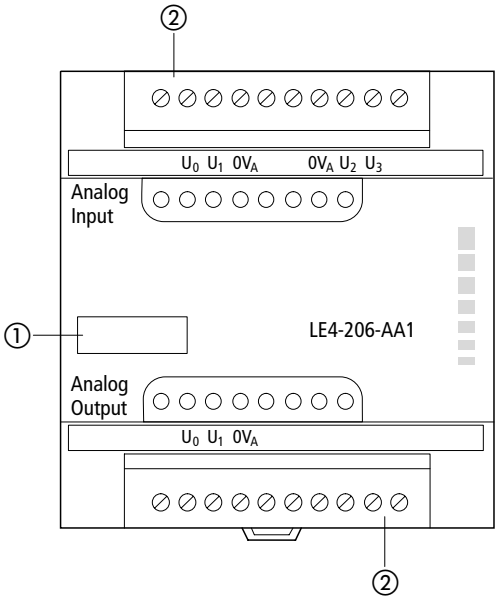


Figure 1: Setup of the LE 4-206-AA1

① Device designation with HAEG 18 × 6.5
② Plug-in screw terminal for inputs and outputs

2 Mounting

The LE 4-206-AA1 can be mounted on a top-hat rail or on a mounting plate using mounting feet. The relevant dimensions are given in the Appendix.

Mounting on top-hat rail

- ▶ Mount the device on the top-hat rail so that the upper edge of the rail engages in the slot.
- ▶ Insert a screwdriver ① into the slot of the spring-loaded clip and pull the clip downwards ②.
- ▶ Push the device fully onto the top-hat rail ③.
- ▶ Remove the screwdriver. The spring-loaded clip should snap back into position and hold the device securely.
- ▶ Check that the device is securely attached.

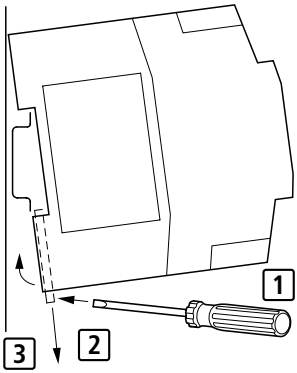


Figure 2: Mounting on top-hat rail

Mounting on mounting plate using mounting feet

- ▶ Turn the module over. Its reverse side contains the the slots provided for the mounting feets ①.
- ▶ Push the mounting feets into the slots until the lugs ② engage.
- ▶ Ensure that all mounting feet are snapped securely into position.
- ▶ Using M4 screws, fasten each mounting foot to the mounting plate ③.

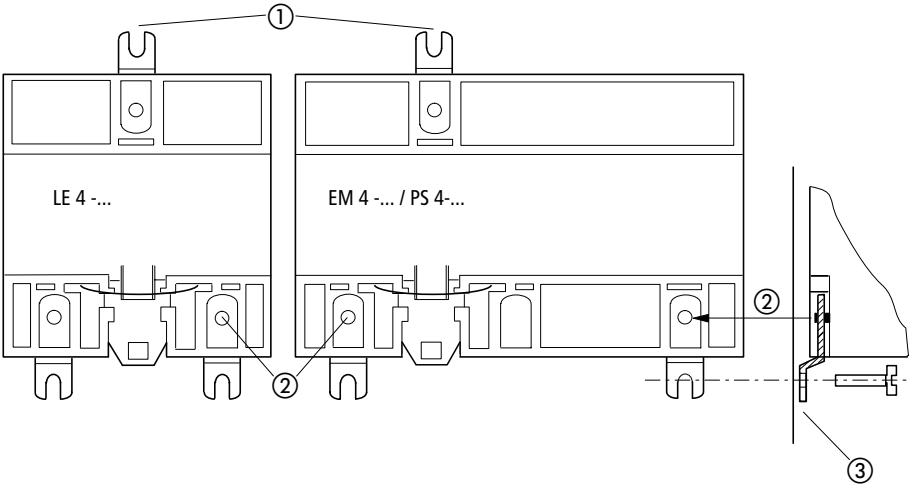


Figure 3: Mounting on mounting plate

Installing in the control cabinet

Ensure the following points when installing in a control cabinet:

- ▶ Attach the modules horizontally in the control cabinet.

Proceed as follows to prevent electromagnetic interference from impairing the function of the electronic circuitry:

06/99 AWB 27-1262 GB

- ▶ Ensure that a spacing of at least 5 cm (2") is maintained between the cable duct ①and the module.
- ▶ Arrange the control ③ and power sections ② separate from each other.

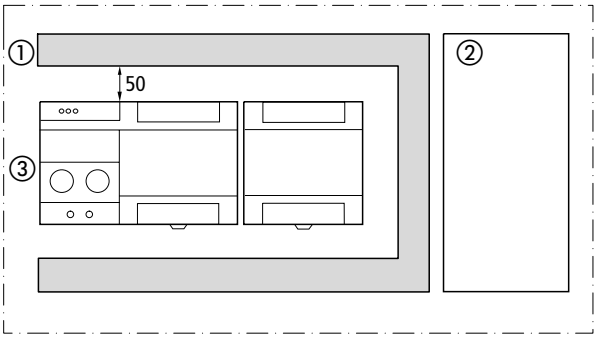


Figure 4: Arrangement in a control cabinet

Fitting/ removing the terminal strip

Caution!
Electrostatic charge can destroy the equipment. Make sure you are free of electrostatic charge before working on the input terminals.

To prewire a circuit or to change a module, remove the plug-in screw terminal from the module.

- ▶ Fully open the cover of the plug-in screw terminal.
- ▶ Pull the plug-in screw terminal out by its cover.

▶ Use the same procedure for the other plug-in screw terminal.

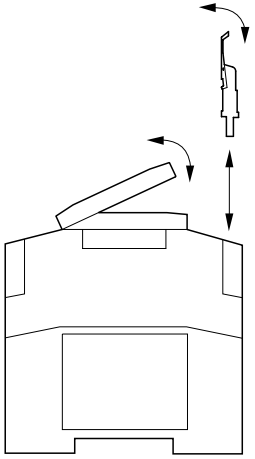


Figure 5: Fitting/removing the plug-in screw terminal

To fit the plug-in screw terminal into the module:

▶ Fully open the cover of the plug-in screw terminal.

▶ Place the plug-in screw terminal into the slot and press it into position.

06/99 AWB 27-1262 GB

3 Engineering

Connection overview

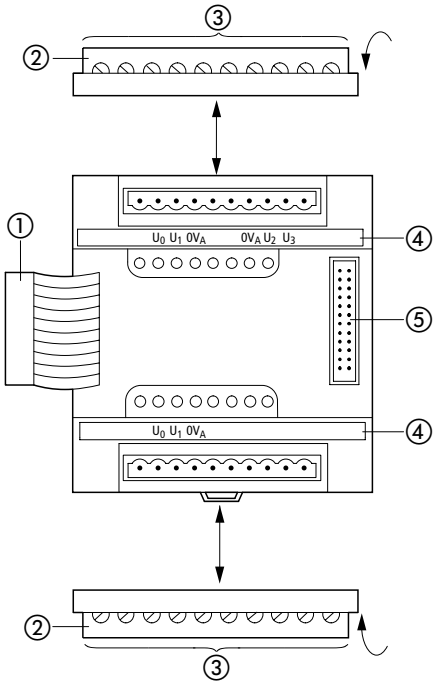


Figure 6: Connection overview

① Female connector

② Plug-in screw terminal

③ Connection cross-sections:
flexible with ferrule 0.22 to 1.5 mm^2
(AWG 23 to AWG 16)
solid 0.22 to 2.5 mm^2(AWG 23 to AWG 13)

④ Designation strips

⑤ Plug connector for local expansion modules

Connecting analog cables

The following example shows the connection of the analog cables to the LE 4-206-AA1:

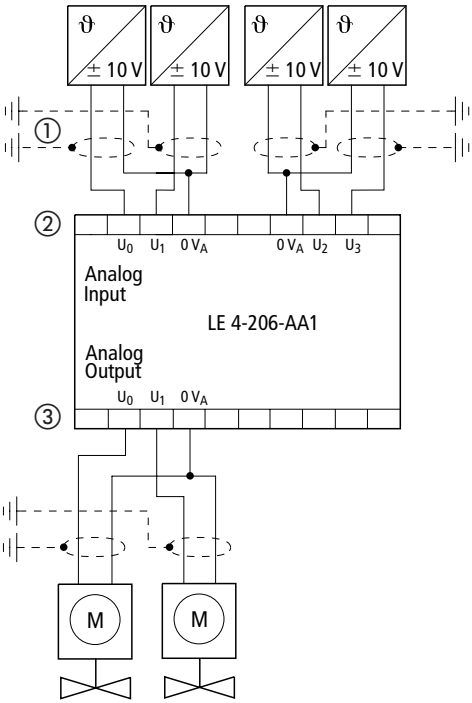


Figure 7: Connecting the analog cables

① Screening the analog cables (see Page 14)

② Sensor connections

③ Actuator connections

06/99 AWB 27-1262 GB

Electromagnetic compatibility (EMC)

The following engineering measures must be observed in order to meet the requirements of the EMC regulations and comply with the following European EMC standards:

EN 50 081-2 (Emission)
EN 50 082-2 (Immunity)

Other engineering instructions are given in the manual “EMC Guidelines for Automation Systems”, AWB 27-1287-GB and the EMC manual “Electromagnetic Compatibility of Machines”, TB 02-022 GB.

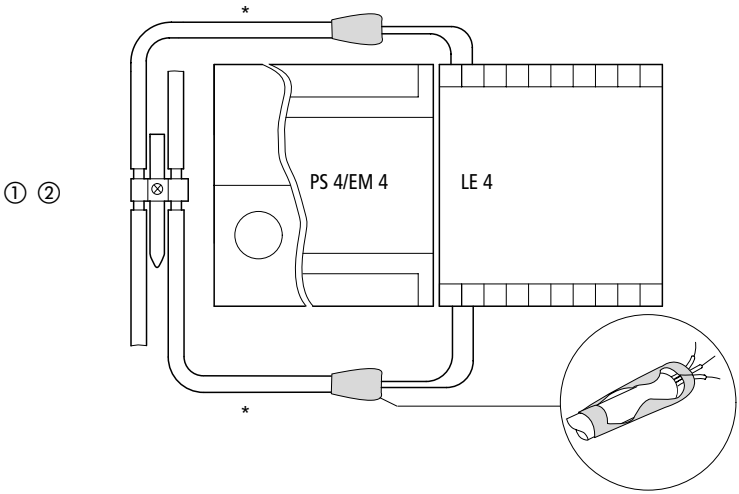
Analog cables

Only shielded cables must be used for analog lines (see Page 15).

Note
Electromagnetic interference
Interference and line-conducted interference according to ENV 50 140 and ENV 50 141 can corrupt your readings by up to 20 %.
An improper connection of the module may produce interference in other components.

Terminating the analog cables

- ▶ Pull back the screen at the ends of the analog input cables.
- ▶ Isolate the screen with suitable material such as heat-shrinkable tubing.



① ②

* Schematic connection; for connection assignment of the LE 4-206-AA1 see section “Connecting analog cables” on page 12.

① Installation with top-hat rail on mounting plate

② Installation on mounting plate

Grounding the analog lines

- ▶ Strip the cable sheathing near the contact clip.
- ▶ Place a contact clip around the stripped section of each analog line or press the stripped section into the snap-on mounting of the terminal clip.

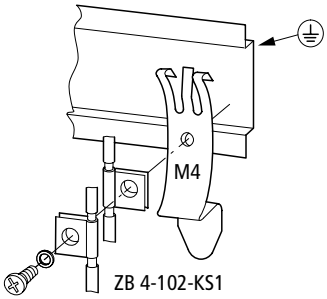
06/99 AWB 27-1262 GB

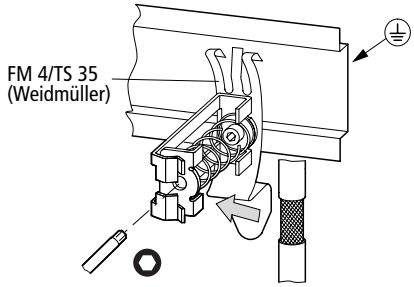
- ▶ Make a low-impedance connection between the clip or the terminal clip and the top-hat rail or the mounting plate.
- ▶ Fit the top-hat rail to the mounting plate.

Ensure that all connections are corrosion proof and that the paint is removed from the connection point of mounting plates.

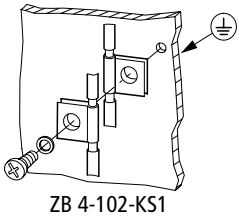
- ▶ Ground the top-hat rail, ensuring a large contact area.

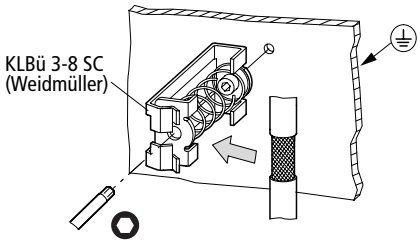
①





②





Connecting to the PS 4-200/300, EM 4-204-DX1

The LE 4-206-AA1 must be mounted on the top-hat rail or secured to the mounting plate before it can be connected to the 4-200/300, EM 4-204-DX1.

▶ Connect the LE 4-206-AA1 to the PS 4-200/300, EM 4-204-DX1 via the plug connector.

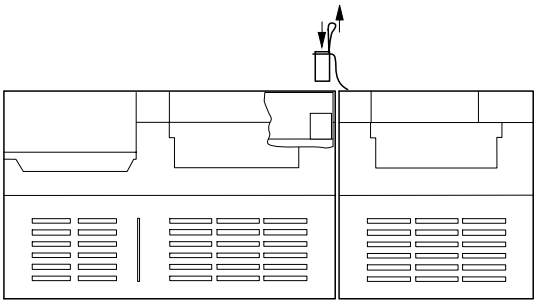


Figure 8: Connecting to the PS 4-200/300, EM 4-204-DX1

4 Configuration and Setting Parameters

The LE 4-206-AA1 is configured with the Sucosoft S 40 Topology Configurator:

- ▶ In the Topology Configurator choose ‹Edit → ‹Local Expansion›.
- ▶ Select LE 4-206-AA1 from the device list. When selected, the LE 4 will be highlighted.
- ▶ Choose ‹Edit → Parameters› and set the input and output parameters of the device.

Setting the input and output parameters

To cover applications that require only a few or no analog inputs, a variety of configurations are available for selection in the parameter editor. Input and output scan times are defined for each configuration. These are listed in the table below. The resolution applies both to inputs and to outputs.

Scan times

In the specified period, the input signals are read and converted to a digital value, and signals are applied to the outputs.

If each change of the digital value is to be output, the PLC cycle time must be greater than the scan time.

Table 1: Input and output configuration

Configuration	Scan time [ms]
4 inputs (U_0–U_3) 2 outputs 12 Bit	60
4 inputs (U_0–U_3) 2 outputs 10 bit	35
2 inputs (U_0, U_1) 2 outputs 12 Bit	32
2 inputs (U_0, U_1) 2 outputs 10 bit	22
1 input (U_0) 2 outputs 12 Bit	17
1 input (U_0) 2 outputs 10 bit	10
0 inputs 2 outputs 12 Bit	2

Parameter settings for the PROFIBUS-DP network

If the LE 4-206-AA1 is used as a local expansion module for the EM 4-204-DX1, the inputs and outputs can be configured with the PROFIBUS-DP configurator according to Table 1.

5 Addressing/Operation/Diagnostics

Addressing

Addressing the inputs and outputs of the LE 4-206-AA1 is described in the manual “Hardware and Engineering“ for the selected master. The data type of the analog values is always “Integer”. The operands are addressed as follows:

```
VAR
AnlgIn  AT%IAW0.0.x.y:INT; (*Scan an input*)
AnlgOut AT%QAW0.0.x.y:INT; (*Addressing an output*)
END_VAR

LD AnlgIn
ST AnlgOut
```

x = 1, 2: Module number
y = 0, 2, 4, 6: I/O number

Table 2: Overview of operands

Input designation	Input number	Operand
U_0	0	IAW0.0.x.0
U_1	2	IAW0.0.x.2
U_2	4	IAW0.0.x.4
U_3	6	IAW0.0.x.6

Output designation	Output number	Operand
U_0	0	QAW0.0.x.0
U_1	2	QAW0.0.x.2

Operation

Startup behaviour

Once the power supply has been switched on, the PLC sends the user-defined parameters to the LE 4-206-AA1 and starts the exchange of process data. No process data is exchanged if the PLC is in HALT after being switched on. All outputs of the LE 4-206-AA1 remain at 0 V.

Diagnostics

The diagnostics data of the LE 4 is stored in one diagnostics byte. If the input voltage exceeds the specified range and rises above +10.5 V or falls below –10.5 V, the digital value is set to 7530 hex, irrespective of the resolution.

In this case, the “DLS” bit in the diagnostics byte of the PS 4 is set, as is the corresponding error bit in the diagnostics byte of the LE 4.

The diagnostics byte of the LE 4 can be viewed in the “Test and commissioning - Topology Configurator” menu. If a limit value is exceeded, improved noise immunity measures must be implemented.

In general, the device status of the LE 4-206-AA1 in the “Test and Commissioning” menu shows four inputs, regardless of the number of configured inputs.

06/99 AWB 27-1262 GB

LE 4 diagnostics byte

The diagnostics data of the LE 4-206-AA1 is stored in the diagnostics byte. The diagnostics byte has the following structure:

Bit	7	6	5	4	3	2	1	0

Bit 0 = 0: device OK
= 1: no/incorrect module

Bit 1 to 3: not used

Bit 4 = 0: OK
= 1: out-of-range value U_0

Bit 5 = 0: OK
= 1: out-of-range value U_1

Bit 6 = 0: OK
= 1: out-of-range value U_2

Bit 7 = 0: OK
= 1: out-of-range value U_3

Scanning
The diagnostics byte is scanned by bit or by byte with the following syntax:

The variable declarations are not shown here. A general declaration is described in the manual “Language Elements for PS 4/PS 416” (AWB 2700-1306 GB).

Bit format	Byte format
LD %ISB0.0.x.0.y	LD %ISB0.0.x.0

x = 1 or 2 (module number)
y = 0 to 7 (bit number)

Diagnostics for the PROFIBUS-DP network

The LE 4-206-AA1 can be used as local expansion module for the EM 4-204-DX1 in a PROFIBUS-DP line.

For a detailed description for the diagnosis on a PROFIBUS-DP line, refer to the “Hardware and Engineering” manual for EM 4-204-DX1 (AWB 27-1315 GB) and the manuals for the master used.

Scanning and evaluation of the diagnostics bytes for master module PS 416-NET-400 is described in manual “Hardware and Engineering” (AWB 2700-1330 GB).

The scanning of the diagnostic byte with, for example, LD%ISB1.2.1.0, as used for Sucosoft K stations, is not possible with PROFIBUS-DP. If the instruction is used, it results in an error message.

In the diagnostics byte of the LE 4-206-AA1, an error message is generated for “Overrange”.

06/99 AWB 27-1262 GB

6 Analog Value Representation

Analog-to-digital conversion

The LE 4-206-AA1 converts analog signals to digital values and digital values to analog signals. Analog signals in the following ranges can be read:

Inputs; bipolar signals: ±10 V
Outputs; bipolar signals: ±10 V

Calculation example

In 10-bit resolution (decimal representation 0 to 1023), the individual values are determined as follows:

Calculation of step size:

$$\frac{\text{obere} - \text{untere Messgrenze}}{2^{10}} = 1 \text{ LSB Schrittweite}$$

A bipolar measuring range (±10 V) and a 10-bit resolution result in the following step size:

$$\frac{10\text{V} - (-10\text{V})}{2^{10}} = 0,02\text{V}$$

Calculation of the analog value:y

$$\frac{\text{MG}}{2^{10}} \times \text{Wert (dez)} - \text{MG}^{1)} = \text{Analogwert}$$

MR = measuring range (upper – lower measurement limit)

1) for a negative voltage range

Positive voltage range: A bipolar measuring range (±10 V), a 10-bit resolution and a decimal value of 1 result in the following analog value:

$$\frac{20\ V}{2^{10}} \times 1 = 0,02\ V$$

Negative voltage range: A bipolar measuring range (±10 V), a 10-bit resolution and a decimal value of 516 result in the following analog value:

$$\frac{20\ V}{2^{10}} \times 516 - 20\ V = -9,92\ V$$

To calculate the value for a given analog value, the equation is reversed:

$$(\text{Analogwert} + \text{MG}^{1)}) \times \frac{2^{10}}{\text{MG}} = \text{Wert (dez)}$$

1) for a negative voltage range

Example:
The analog value is –8 V

$$(-8 + 20) \times \frac{2^{10}}{20} = 614,4$$

The table below lists the analog value representation of the bipolar analog signals of the analog LE for 12- and 10- bit resolution:

Tabelle 3: Binary, decimal and hexadecimal representation of analog values with 12-bit resolution:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
Voltage (V)	**Binary**																**Dec.**	**Hex.**
9.995	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	2047	07FF
9.990	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	2046	07FE
0.010	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0002
0,005	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0001
0,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0000
–0.005	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	4095	0FFF
–0.010	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	0	4094	0FFE
–9.995	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	2049	0801
–10.000	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2048	0800

Table 4: Binary, decimal and hexadecimal representation of analog values with 10-bit resolution:

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
Voltage (V)	**Binary**																**Dec.**	**Hex.**
9.980	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	511	01FF
9.961	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	510	01FE
0.039	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0002
0.020	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0001
0.000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0000
–0.020	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1023	03FF
–0.039	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	1022	03FE
–9.980	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	513	0201
–10.000	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	512	0200

If the digital output value is increased beyond the highest possible 10-bit or 12-bit value, the higher-order bits are ignored by the digital-to-analog converter.

Example of a 10-bit resolution:

A value of 1026 is given by the user program.

1026 dec = 100 0000 0010 binary

Eleven bits are needed to represent this number. The eleventh bit is ignored by the converter, so that the number is converted to 00 0000 0010 (2 dec.).

A voltage of +0.039 V is applied to the voltage output!

Appendix

Technical Data

General	
Standards, regulations	IEC/EN 61 131-2/EN 50 178
Ambient temperature	0 to 55 °C
Storage temperature	–25 °C to +70 °C
Weight	approx. 440 g
Shock resistance	15 g, 11 ms
Vibration resistance	const. 1 g, f = 0 to 150 Hz
Device mounting	Snap-fit on top-hat rail or mounting plate
Rated insulation voltage	600 V AC
Degree of protection	IP 20
Terminals	Plug-in screw terminal
Terminal cross-section	
Flexible with ferrule	0.22 to 1.5 mm^2 (AWG 23 to 16)
solid	0.22 to 2.5 mm^2 (AWG 23 to 13)
Configuration	PS 4-200, PS 4-300, EM 4-204-DX1
max. number per PS 4-200/300, EM 4-204-DX1	2
Insulation	
LE bus to analog inputs/outputs	Yes
Inputs/outputs to each other	No
Analog inputs	
Input ranges	±10 V
Number of inputs	4
Transducer connection type	Two-wire connection to transducer
Resolution	12 bit (4096 units)/10 bit (1024 units) configurable
Inputs against central grounding point	see isolation voltage

Permissible input voltage	max. ±15 V
Error message on	
Out-of-range value	Yes
Wire breakage detection	No
Cumulative error	typ. 0.8 % of upper range value
Cable length, screened	max. 50 m at cable cross-section ≧014 mm²
Input resistance	40 kΩ per input
Analog outputs	
Output ranges	±10 V
Number of outputs	2
Load resistance per output	2 kΩ
Connection type	Two-wire connection
Resolution	configurable; 12 bit (4096 units)/ 10 bit (1024 units)
Short-circuit-proof	Yes
Short-circuit current	±32 mA
Permissible potential difference, to ground and between outputs	see isolation voltage
Cumulative error	normally 0.8 % of upper range value
Cable length, screened	max. 50 m at cable cross-section ≧0.14 mm²

06/99 AWB 27-1262 GB

General EMC specifications for automation equipment			
Emission	EN 55 011/22 Class A		
Interference immunity			
ESD	EN 61 000-4-2	Contact discharge Air discharge	4 kV 8 kV
RFI	EN 61 000-4-3	AM/PM	10 V/m
Burst	EN 61 000-4-4	Mains/digital I/O Analog I/O, fieldbus	2 kV 1 kV
Surge	EN 61 000-4-5	Digital I/O, asymmetrical Mains DC, asymmetrical Mains DC, symmetrical Mains AC, asymmetrical Mains AC, symmetrical	0.5 kV 1 kV 0.5 kV 2 kV 1 kV
Immunity to line-conducted interference	EN 61 000-4-6	AM	10 V

06/99 AWB 27-1262 GB

06/99 AWB 27-1262 GB

Index

06/99 AWB 27-1262 GB

06/99 AWB 27-1262 GB