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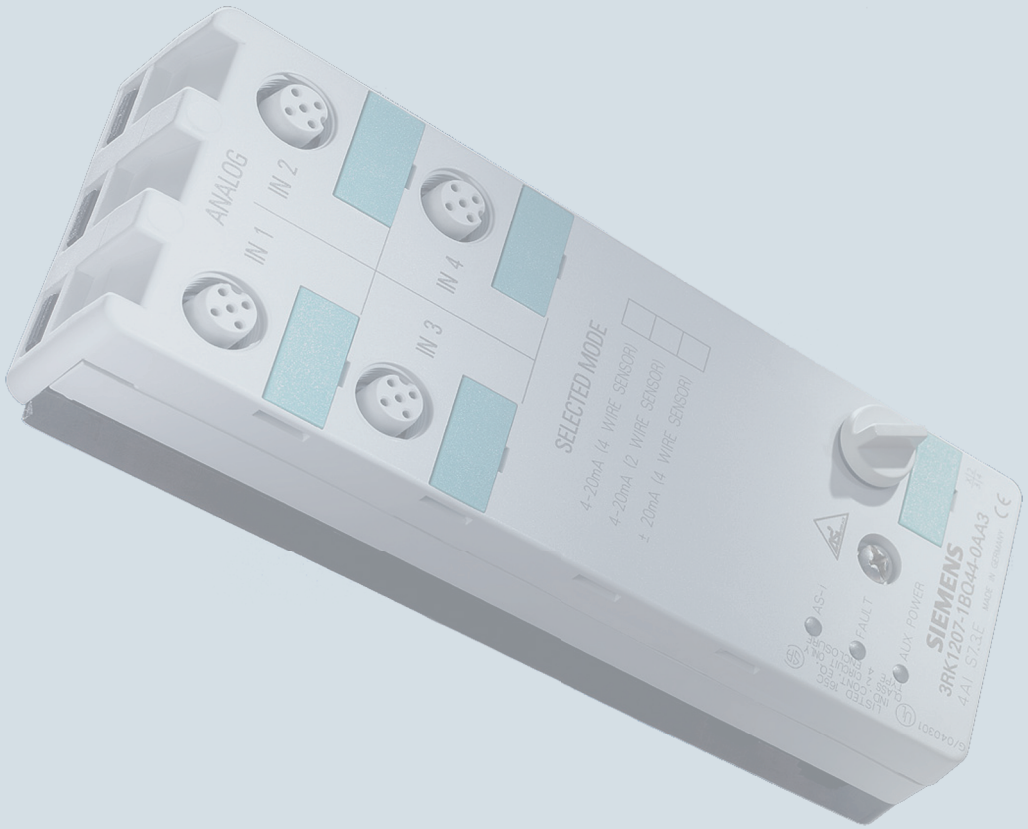

Manual

Industrial Communication

AS-Interface

Analog Modules
Profile 7.3
Profile 7.A.9

Edition 11/2016

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3RK1701-2BB40-0AA0
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Preface

This manual contains comprehensive information regarding the analog input modules and analog output modules for the actuator-sensor interface according to the slave profile 7.3. or slave profile 7.A.9.

The following modules are described:

- for current measurement
  - for 1, 2 inputs 3RK1207-1BQ40-0AA3 [1)]
    3RK2207-1BQ50-0AA3 [2)]
  - for 4 inputs 3RK1207-1BQ44-0AA3 [1)]
- for voltage measurement
  - for 1, 2 inputs 3RK1207-2BQ40-0AA3 [1)]
    3RK2207-2BQ50-0AA3 [2)]
  - for 4 inputs 3RK1207-2BQ44-0AA3 [1)]
- for resistance / thermal-resistance measurement
  - for 1, 2 inputs 3RK1207-3BQ40-0AA3 [1)]
  - for 4 inputs 3RK1207-3BQ44-0AA3 [1)]
- for current output 3RK1107-1BQ40-0AA3 [1)]
- for voltage output 3RK1107-2BQ40-0AA3 [1)]

Modules according to slave profile 7.2 are described in the manual *AS-Interface analog modules* with order no.: 3RK1701-2AB01-0AA0.

The manual is intended for system planners and for the technicians who install the analog modules and perform startup in the field.

1) according to slave profile 7.3
2) according to slave profile 7.A.9

Content

The manual contains:

- a general description of the modules
- a description of the procedure for quick and easy startup of the analog modules
- detailed information on:
  - the nominal ranges of the individual module variants and their block diagrams
  - the parameterization possibilities
  - programming in SIMATIC S7

Note

You must be adequately versed in the STEP 7 programming language and in the details of the actuator-sensor interface system.

The term "actuator-sensor interface" is abbreviated to "AS-i" in this manual.

When connecting sensors (e.g. BEROs with analog outputs) or actuators with M 12 connectors, note the differences in pin assignment between sensor or actuator and analog module.

Manual Structure

The manual consists of the following main sections:

- **Chapter 1** Contains a general description of the modules.
- **Chapter 2** Describes installation and the quick and easy way of starting the modules.
- **Chapter 3** Describes the analog input modules and contains the tables for the measurement ranges.
- **Chapter 4** Describes the analog output modules and contains the tables for the ranges.
- **Chapter 5** Describes the parameterization and programming.
- **Appendix A** Contains the order numbers of the modules and accessories.
- **Appendix B** Contains the technical data of all the modules.
- **Glossary** Contains explanatory notes on important terms
- **Index**

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Table of contents

Module description

1

The modules that can be switched or parameterized to 1 or 2 inputs or the modules with 4 inputs register or deliver analog signals on site.

These modules are linked to the higher-level control system via:

- an AS-i master complying with AS-i specification 2.1
- a PROFIBUS-DP / AS-i link complying with AS-i specification 2.1

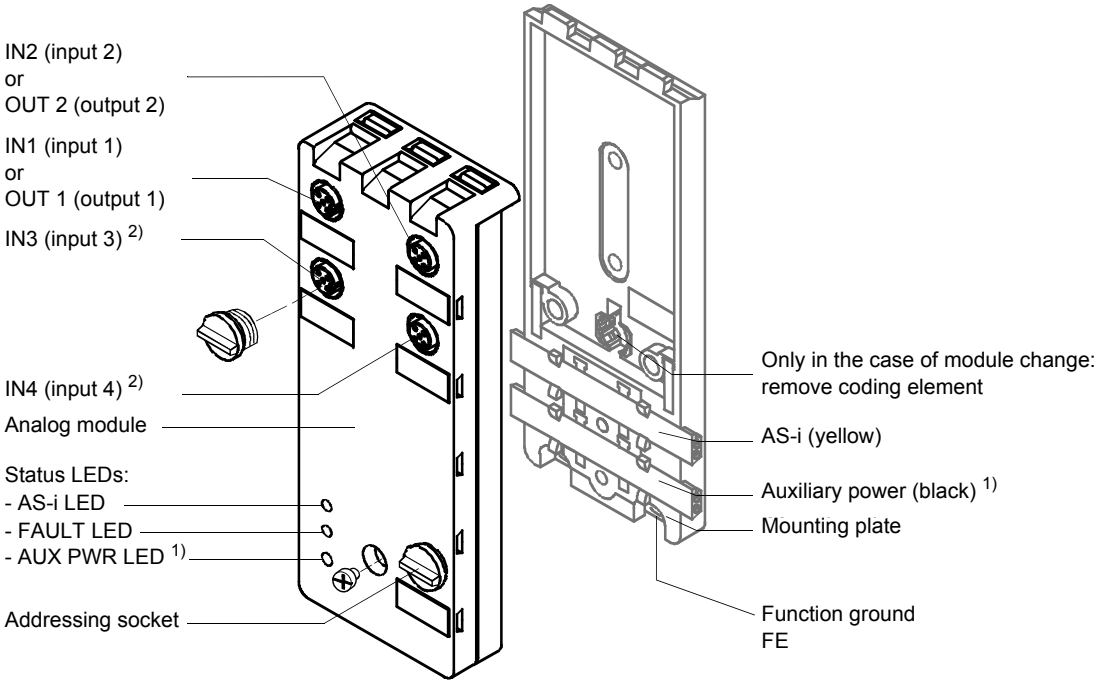
The analog modules belong to the AS-i product family and comply with the SIMATIC S7 standard.

The modules work according to the AS-i slave profile 7.3 or 7.A.9.

Notice

Modules according to the slave profile 7.A.9 can only run with "V3 Extended Masters" with profile M4.

1.1 Function Overview



1) Only on input modules for current and voltage
2) only present with input modules 3RK1207-.BQ44-0AA3

Figure 1-1 Elements on the Module

AS-Interface

The actuator-sensor interface is connected to the analog module by means of an AS-i ribbon cable (yellow) with penetration technique.

Auxiliary power

The auxiliary-power cable (black ribbon cable) with penetration technique has to be connected to the analog module if total current required for the sensors of the analog input modules for current and voltage modules is in excess of 46 mA. When the auxiliary power is connected, the sensor supply is short-circuit-protected (max. 500 mA).
The **green AUX PWR LED** is on when auxiliary power is applied.

On the output and resistance / thermal resistance modules, no auxiliary power is required. The auxiliary-power cable can, however, be connected through for other modules.

Status LEDs

The LEDs indicate the operating mode of the module. The following combinations are possible:

Table 1-1 Status LEDs

AS-i LED (green)	FAULT LED (red)	Operating status	Remedy
OFF	OFF	No voltage at the module (AS-i power fail) Incorrect polarity at AS-i cable	Connect AS-i voltage Check polarity
ON	OFF	Module is being polled by the AS-i master.	Communication OK
ON	ON	No data traffic Hardware error	Connect or configure the AS-i master Replace module
Flashing	ON	Module has slave address "0"	Assign slave address between "1" and "31"

Inputs, outputs

The modules have 1, 2 or 4 analog inputs and/or 2 outputs.

Sealing cap

For protection type IP67 to be preserved, unused inputs and outputs must be covered with sealing caps.

Shielding / function grounding

The modules can be function-grounded by means of their mounting plates.

The shield of the connected line at the analog input or output can be connected via pin 5 of the M 12 socket as function ground with the system ground.

Operation

The requirements for operating the analog modules are:

- A higher-order PLC (for example S7 series)
- An AS-i master complying with AS-i specification 2.1 that matches the higher-level control system
- An analog module suitable for the application requirements, complete with mounting plate

1.1.1 Module variants

A distinction is made between input and output modules.

Input modules

Modules are available for the following types of measuring:

- Current measurement
- Voltage Measurement
- Resistance/Thermal-Resistance Measurement

Output modules

Modules are available for the following output types:

- Current output
- Voltage output

Installation - startup procedure

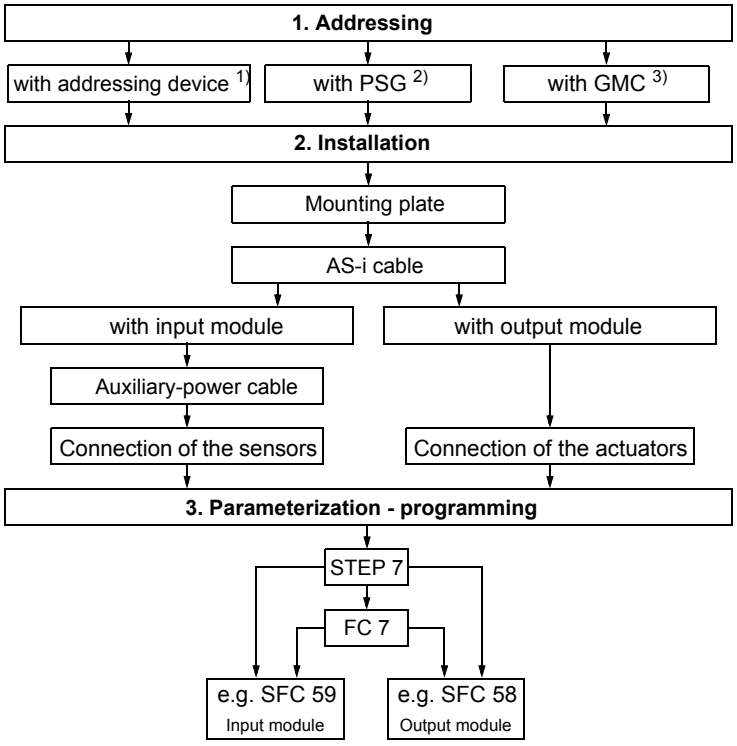
2

This chapter is intended primarily for technicians who install and start up the analog modules.

Startup consists of the following steps:

- Addressing
- Installation
- Programming in STEP 7
- Function Test

The flowchart below illustrates a practical, step-by-step startup procedure.



1) Addressing device, MLFB: 3RK1 904-2AB01
2) Programming and service device with AS-i voltage already connected
3) GOSSEN GMC Metratest 36 AS-i
4) if total draw for sensors is more than 46 mA (max. 500 mA)

Figure 2-1 Startup Procedure

2.1 Addressing

Each module must be assigned **one** individual address at the actuator-sensor interface. Each address may only be used once per AS-i master.

The following addresses can be set for the modules:

- Modules with the order numbers 3RK1207 and 3RK1107 work according to the slave profile 7.3 and occupy a full address. Other A / B modules on the same address are not permitted. Addresses from 1 ... 31 can be set.
- Modules with order number 3RK2207 work according to the slave profile 7.A.9 and are A / B modules. This means that a maximum of 62 analog modules are possible at one AS-i master. If only the A or B address is used, the analog value transfer is faster.

The requirements for addressing the analog modules are (see order numbers in Appendix A.2):

- An addressing device
  or
  programming and service device (PSG) via yellow cable and connected AS-i mains adapter
  or
  GOSSEN GMC Metratest 36 AS-i
- A connecting cable between addressing device and analog module

The addressing socket is concealed by a removable screw cap.

The illustration below shows the position of the addressing socket, the connecting cable and the addressing device.

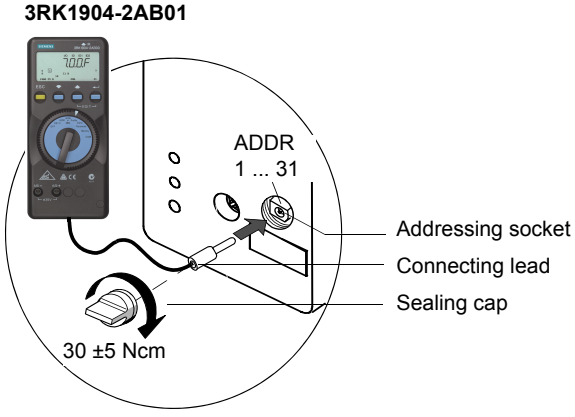


Figure 2-2 Setting the Address

See the User Guide (of the addressing device or PSD, as applicable) for instructions on how to set the address.

Note

Remember to reinstall the screw cap after addressing, in order to maintain IP67 protection. A module's address can be changed any number of times.

2.2 Installation

The procedure for installing the analog modules is as follows:

Table 2-1 Installation

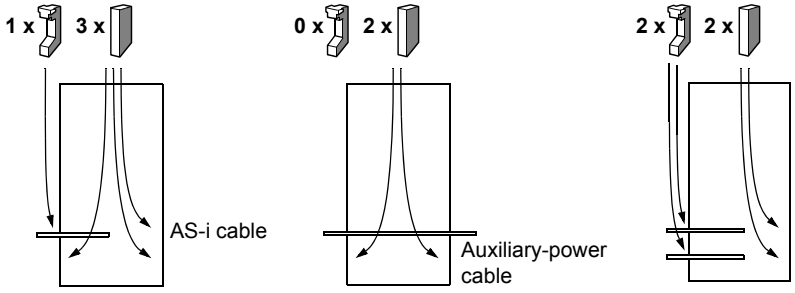
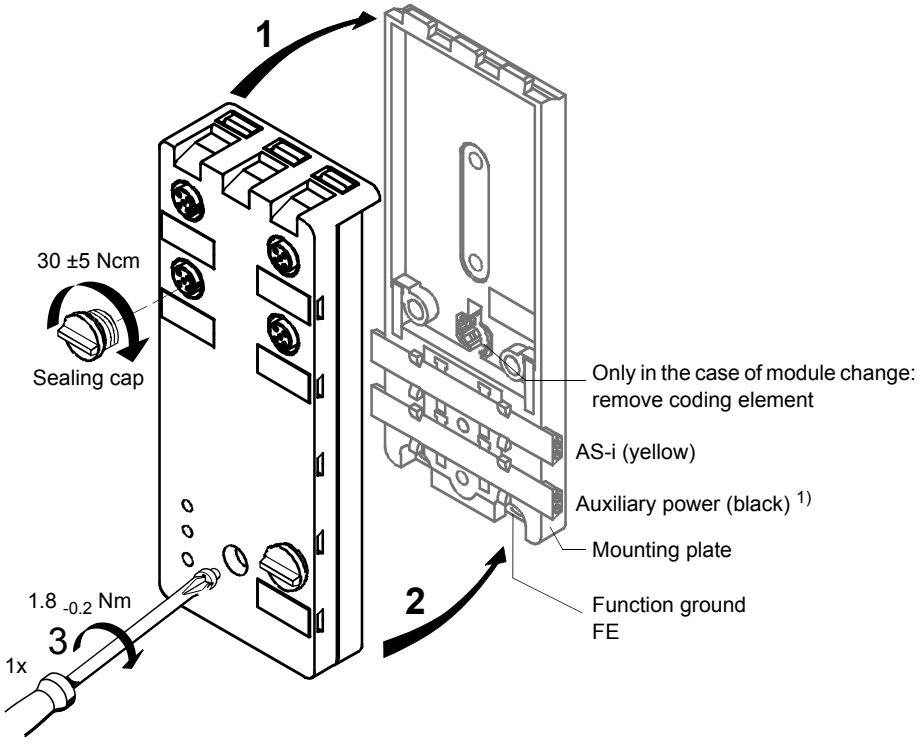
Step	Procedure
1	Before installation: Set the address of the analog module between 1 and 31.
2	• Mount the mounting plate 3RK1901-0CA00 on a level area with 3 M4x16 screws (dimensions, see Appendix B.4). • Secure the mounting plate 3RK1901-0CB00 on the top hat rail.
3	Position the yellow AS-i cable and the black auxiliary-power cable [1)] in the guides in the mounting plate.
4	In order to maintain IP67 protection: • Unused M 12 sockets must be covered with sealing caps 3RK1901-1KA00 • Seals and stoppers 3RK1902-0AR00 must be inserted in the conduit subways in which ribbon cables end.  Seals and stoppers have to be ordered separately. The number of seals and stoppers required depends on the individual configuration with AS-i cables and auxiliary-power cable.  **No** seals are necessary for guides in which ribbon cables are passed through. **Note** It is recommended to insert stoppers in unused conduit subways.

Table 2-1 Installation (cont.)

Step	Procedure
5	Seat the module on its mounting plate and tighten the securing screws. Tightening the screws establishes contact to the cables. The following illustration shows the installation (example of module with 4 inputs).  Ground the module via the metal plate in the mounting plate.
6	After installation: Set the address between 1 and 31 if step 1 was not performed.
7	Run the parameterization and programming (see Chapter 5)

1) Needed only if the total current draw of all sensors connected to the analog input modules for current or voltage is more than 46 mA.

2.3 Wiring of the Modules

The illustrations below show the wiring arrangements of the individual module variants:

2.3.1 Input module for current measurement

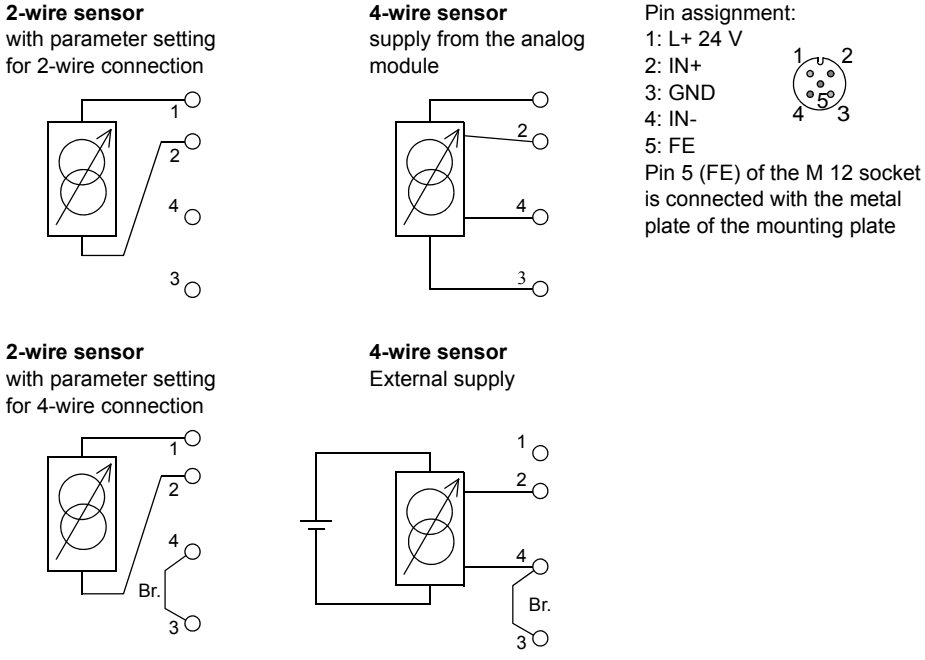


Figure 2-3 Circuit design for input module current measurement

2.3.2 Input module for voltage measurement

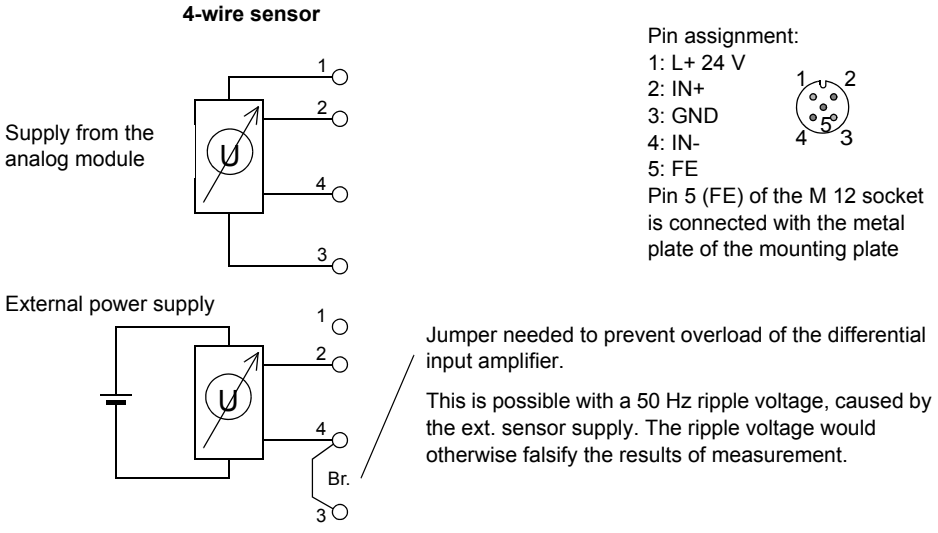


Figure 2-4 Circuit design for input module voltage measurement

2.3.3 Input module for resistance / thermal-resistance measurement

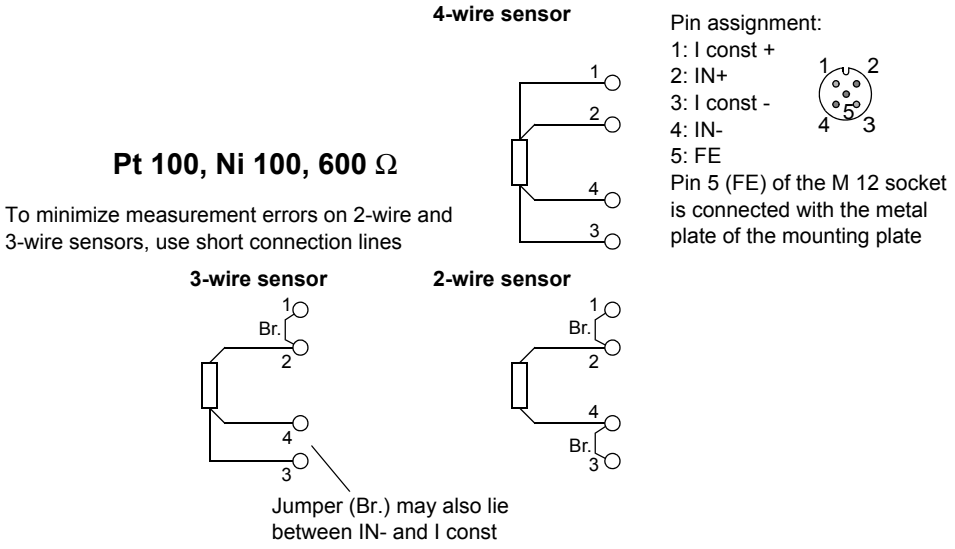


Figure 2-5 Circuit design for input module resistance / thermal-resistance measurement

2.3.4 Output modules for power and voltage

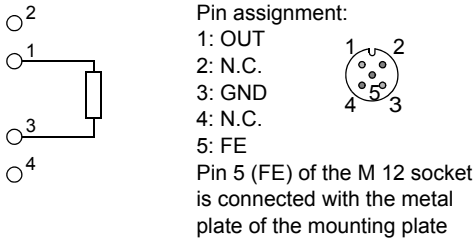


Figure 2-6 Circuit design of the output modules for power and voltage

2.4 Diagnosis of the operating mode via status LEDs

The LEDs indicate the operating mode of the module. The following combinations are possible:

Table 2-2 Diagnosis of the operating mode via status LEDs

AS-i LED (green)	**FAULT LED (red)**	**Operating status**	**Remedy**
OFF	OFF	No voltage at the module (AS-i power fail) Incorrect polarity at AS-i cable	Connect AS-i voltage Check polarity
ON	OFF	Module is being polled by the AS-i master.	Communication OK
ON	ON	No data traffic Hardware error	Connect or configure the AS-i master Replace module
Flashing	ON	Module has slave address "0"	Assign slave address between "1" and "31"

The **green AUX PWR LED** is on when auxiliary voltage is applied.

Only input modules for current and voltage have this LED.

Description of input modules

3

3.1 Overview of modules

Module variants and order MLFB

Table 3-1 Module overview, input modules

Type of measuring	Number of inputs	Order number	Slave profile	Description in chapter
Current measurement	1, 2 4 1, 2	3RK1207-1BQ40-0AA3 3RK1207-1BQ44-0AA3 3RK2207-1BQ50-0AA3	S7.3 S7.3 7.A.9	3.2 3.2 3.3
Voltage measurement	1, 2 4 1, 2	3RK1207-2BQ40-0AA3 3RK1207-2BQ44-0AA3 3RK2207-2BQ50-0AA3	S7.3 S7.3 7.A.9	3.2 3.2 3.3
Resistance / thermal-resistance measurement	1, 2 4	3RK1207-3BQ40-0AA3 3RK1207-3BQ44-0AA3	S7.3 S7.3	3.2 3.2

Notice

Modules according to the slave profile 7.A.9 can only run with "V3 Extended Masters" with profile M4.

3.2 Modules with profile S7.3

3.2.1 General module properties

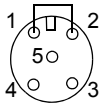
Circuit design of the 2-channel input modules with 1 input

The modules with order numbers 3RK1207-.BQ40-0AA3 with 2 inputs with conventional transfer rates can also be operated with increased transfer rate of the input signal. The usable inputs are thus reduced from 2 inputs to 1 input.

Note

To achieve this, pin 1 and pin 2 must be interconnected.

The jumper 3RK1901-1AA00 can also be used for this purpose.



The unused socket 2 (IN 2) must be fitted with a sealing cap.

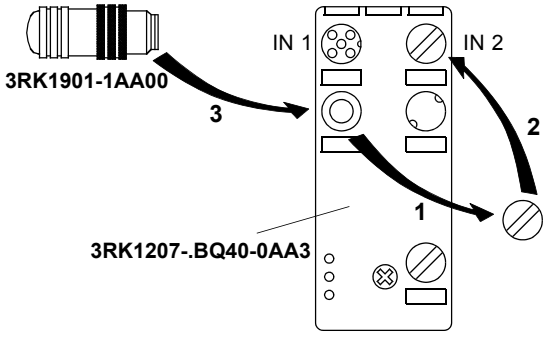


Figure 3-1 Operation with 1 input

Watchdog

The red FAULT LED on the slave module lights up if the module does not receive a data frame from the AS-i master for longer than 50 ms.

Peripheral fault

If the sensor supply is overloaded (only with input modules for current and voltage measurement) or if there is no data transfer according to profile S7.3 with the module, peripheral fault bit S1 is set in the status register of the slave.

Interference-frequency suppression

You must parameterize interference-frequency suppression for the analog input modules for 50 or 60 Hz line frequency, as appropriate.

Wire-break detection

In the ranges 4 ... 20 mA and 1 ... 5 V, the value for overflow / underflow is read in the event of a wire break (32 767 / -32 768 $_{dec}$, see also Table 3-5 in Chapter 3.2.2.5 or Table 3-9 in Chapter 3.2.3.5).

Common mode voltage

The common mode voltage U_{GL} is measured between IN- (pin 4) and GND (pin 3) with the sensor connected and must not exceed ±2 V. At the same time, the measured-value signal must not exceed the maximum input voltage of the module variant in question.

Correct representation of the measured value is ensured only within these range limits.

Equipotential Bonding

Equipotential bonding is necessary between the individual machines and sensors if two or more analog modules are operated in a common AS-i network.

The maximum permissible voltage between sensor and AS-i network is ±50 V. The formula for calculating this voltage is as follows:

$$\left|U_{S1} - U_1\right| \leq |50V|$$

The following is a block circuit diagram illustrating the layout.

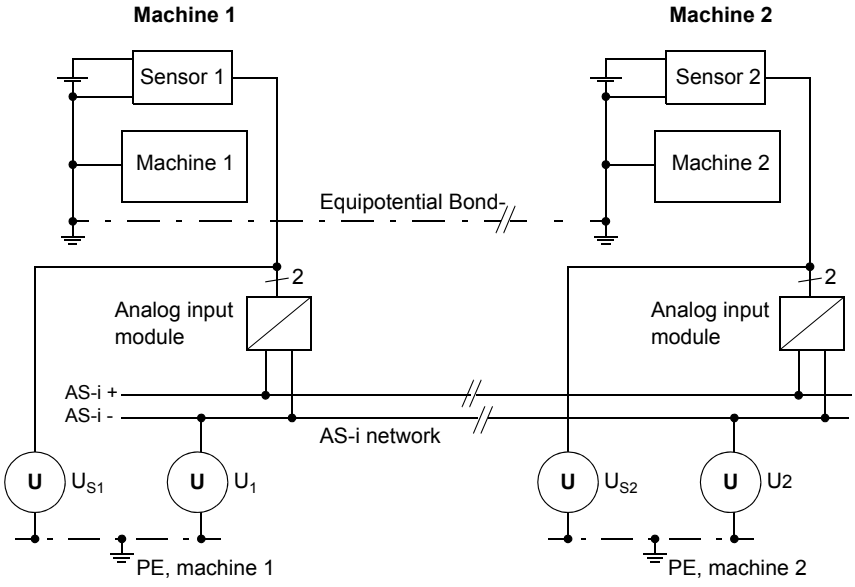


Figure 3-2 Equipotential Bonding

Updating the measured values

The measured values of the analog modules are read out in cycles.

Resolution

The resolution of the A / D converter is 15 bits + sign bit

Smoothing the measured values

The individual measured values are smoothed by digital filtering.
This is a digital low-pass filter of the 1st order.

Smoothing can be enabled or disabled using a parameter:

- Parameter bit P3 = 1: without smoothing *k* = 1 module scan cycle
- Parameter bit P3 = 0: with smoothing *k* = 8 module scan cycles

The formula for calculating time response for a given step of measured value *x* and a smoothing factor *k* is as follows:

$$y_n = \frac{x_n + (k-1)y_{n-1}}{k}$$

y_n = Value passed to the system in the current cycle n

The following illustration shows the step response with smoothing factor *k* = 8 depending on the number of module scan cycles.

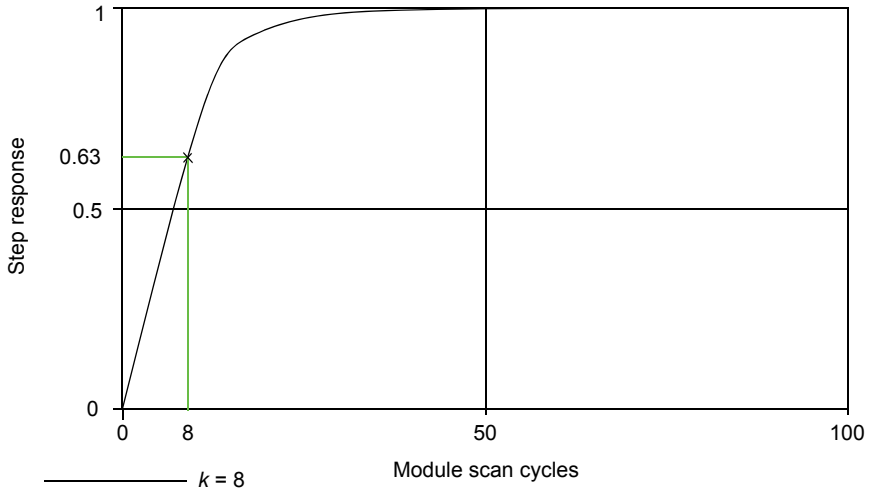


Figure 3-3 Step response with smoothing enabled (k = 8)

A module scan cycle with 2 inputs and 50 Hz interference-frequency suppression is approx. 130 ms (see also Figure 3-3).

Analog / digital converters

The analog/digital converter in the modules operates on the sigma-delta principle. The sigma-delta converter calculates the mean value over a defined measuring period (reset time) of 20 ms. The 20 ms value is applicable for 50 Hz interference-frequency suppression; the corresponding measuring period for 60 Hz is 16.6 ms.

The mean of a 50 Hz or 60 Hz interference voltage and its harmonics thus approaches zero.

The digital measured value is formed from the 3 individual measuring periods and output in the converter (does not apply with 1 input).

The conversion time t_c for a module scan cycle is thus

- t_c = 1 input * (1 * 20 ms + 5 ms) = 25 ms (for 50 Hz) [1)]
- t_c = 1 input * (1 * 16.6 ms + 5 ms) = 21.6 ms (for 60 Hz) [1)]
- t_c = 2 inputs * (3 * 20 ms + 5 ms) = 130 ms (for 50 Hz)
- t_c = 2 inputs * (3 * 16.6 ms + 5 ms) = 110 ms (for 60 Hz)
- t_c = 4 inputs * (3 * 20 ms + 5 ms) = 260 ms (for 50 Hz)
- t_c = 4 inputs * (3 * 16.6 ms + 5 ms) = 219.2 ms (for 60 Hz)

Time response - input step (conversion time t_c)

As a function of

- interference-frequency suppression (e.g. 50 Hz, in other words a period time of 20 ms)
- smoothing factor (e.g. *k* = 1, in other words no smoothing)
- with 2 active inputs

the time response of the module scan cycle for an input step is as follows.

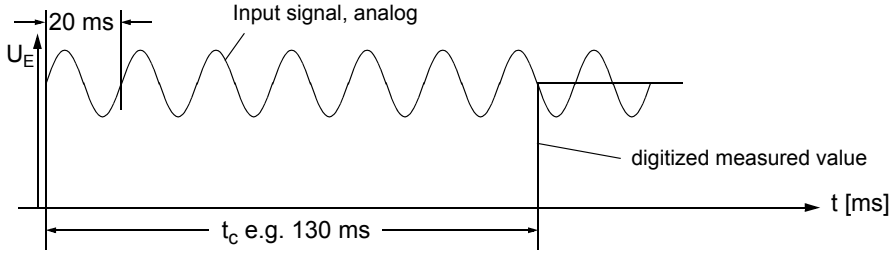


Figure 3-4 Time response for an input step (without smoothing)

1) With 1 input, the internal conversion time is eliminated, thus only 1 times 20 ms. The 5 ms are due to internal processes in the A/D converter.

Transfer time - analog value

The transfer time for a new analog value from the analog module to the AS-i master in the worst case for 4 inputs is 35 AS-i cycles.

The transfer time for the 4 inputs can be calculated as follows:

$t_{Transfer} \leq 35 * t_{AS-i} + t_{PLC}$

Where: t_{AS-i} = max. 5 ms
t_{PLC} = transfer time between PLC and master.
With a locally connected CP343-2, this example applies:
typ. 250 µs, max. 650 µs

The 4 inputs are transferred as multiplexed (alternating).

This results in the following maximum transfer time:

$t_{Transfer} \leq 175 \text{ ms} + t_{PLC}$

Total processing time

The total processing time t_{Total} for the complete transfer of 1, 2, and 4 inputs is composed of:

- Conversion time t_c
- AS-i transfer time $t_{Transfer}$
- PLC transfer time t_{PLC}

This results in the following maximum total transfer time (with locally connected CP 343-2) for 1, 2 and 4 inputs:

- 1 input: $t_{Total} \leq 25 \text{ ms } (t_c) + 70 \text{ ms } (t_{Transfer}) + t_{PLC} \sim 95 \text{ ms}$
- 2 inputs: $t_{Total} \leq 130 \text{ ms } (t_c) + 105 \text{ ms } (t_{Transfer}) + t_{PLC} \sim 235 \text{ ms}$
- 4 inputs: $t_{Total} \leq 260 \text{ ms } (t_c) + 175 \text{ ms } (t_{Transfer}) + t_{PLC} \sim 435 \text{ ms}$

Parameter

The parameters are set together for the inputs and are sent automatically by the AS-i master to the analog module after a voltage failure.

The modules can be re-parameterized in the field.

The parameters in **bold print** are parameterized by the AS-i master if no changes have been made in the configured slave parameters in the AS-i master (factory setting of the AS-i master).

Parameterization, see Chapter 5.

Note

If a non-permitted parameterization is sent to the module, the parameterization in **bold** print is set.

3.2.2 Current Measurement

3.2.2.1 Parameter settings

The following parameters can be set:

Table 3-2 Setting parameter - current measurement

Parameter	**Parameter bit P3 - P0**	**Possible settings**
Filter	**1** X X X 0 X X X	**50** Hz 60 Hz
Smoothing	X **1** X X X 0 X X	**without** smoothing with smoothing
Measurement ranges 4-wire 4-wire 2-wire [1]	X X 0 1 X X **1 1** X X 1 0	±20 mA (±23.52 mA max.) **4 ... 20 mA** [2] (+22.81 mA max.) 4 ... 20 mA [2] (+22.81 mA max.)

1) Sensor receives power supply from the analog module, so in 2-wire mode measuring range starts at 4 mA
2) with wire-break detection

3.2.2.2 Technical specifications

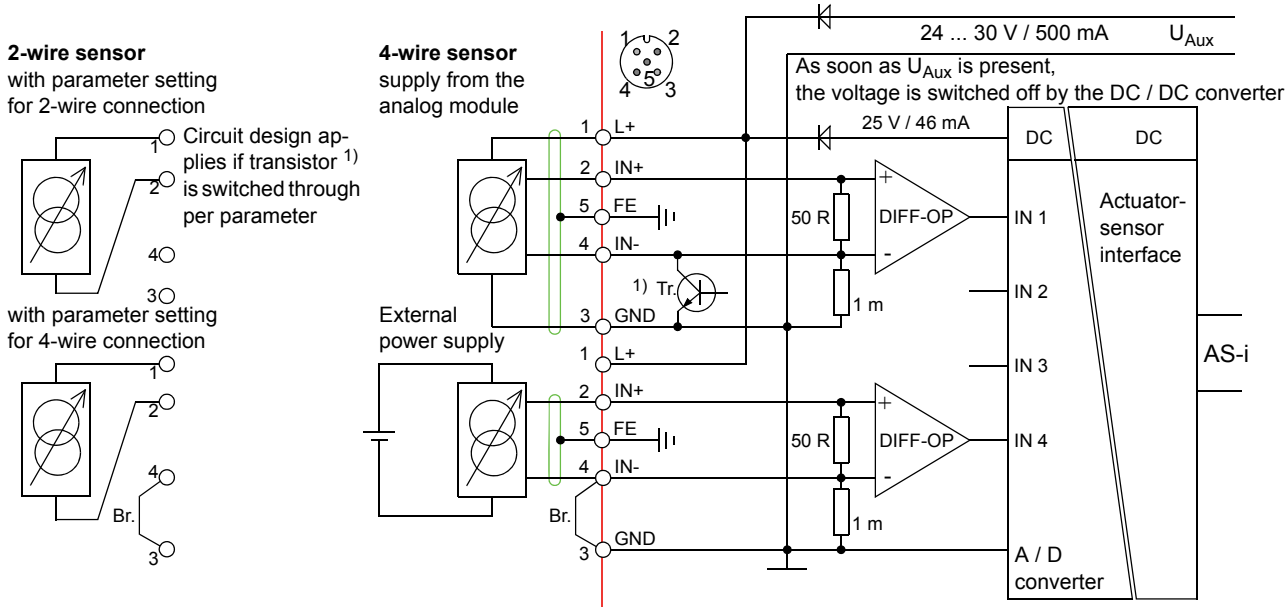
Table 3-3 Technical data - current measurement

Input resistance	50 Ω
Max. input current (Destruction limit)	50 mA[1]
Common mode voltage	
U_{GL} (IN- to GND) from input to input	max. ±2 V
Sensor supply (total current for all inputs)	
without U_{Aux}	46 mA (short-circuit-protected)
with U_{Aux}	500 mA (short-circuit-protected)

1) **Attention**
If the input current exceeds the destruction limit of 50 mA, the input will be damaged. This may result in no values or incorrect values being displayed. Devices up to product version E16 switch off the sensor supply if the input current of 26 mA is exceeded. As this may lead to problems in the case of 2-wire sensors that require a higher current during startup, this function will no longer be available from product version E17 onwards. Make sure that the input current does not exceed the destruction limit in order to rule out any damage to the device.

3.2.2.3 Block diagram

The block diagram below shows the internal layout of the input module for current measurement.



Pin 5 (FE) of the M 12 socket is connected with the metal plate of the mounting plate.
The internal transistor (Tr.) is switched through with parameter setting XX10 (for 2-wire connection) (only with input IN 1 and 2).

1) Tr. only present with input IN 1 and 2; with input IN 3 and 4, the jumper must be set

Figure 3-5 Block diagram - current measurement

3.2.2.4 Circuit design

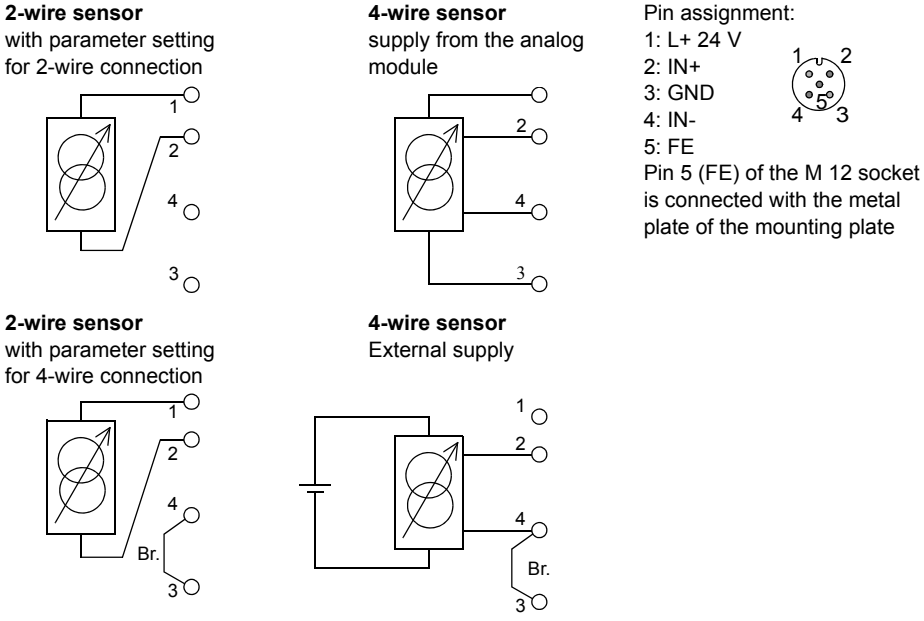


Figure 3-6 Circuit design for input module current measurement

3.2.2.5 Current measurement ranges

Range ±20 mA

(Parameter setting XX01)

Table 3-4 Current measurement ±20 mA

Measured value		Steps		Range
±20 mA	**in %**	**dec.**	**hex.**	
>23.52 mA	>117.589	32767	7FFF	overflow
23.52 mA	117,589	32511 27649	7EFF 6C01	Overrange
20 mA 723.4 nA 0 mA -723.4 nA -20 mA	100 0,003617 0 -0,003617 -100	27648 1 0 -1 -27648	6C00 0001 0000 FFFF 9400	nominal range
-23.51 mA	-117.593	-27649 -32512	93FF 8100	underrange
<-23.51 mA	< -117.593	-32768 (+32767)	8000 (7FFF)	Underflow (for some AS-i masters)

Range 4 ... 20 mA

(Parameter setting XX11 for 4-wire connection)
(Parameter setting XX10 for 2-wire connection)

Table 3-5 Current measurement 4 ... 20 mA

Measured value		Steps		Range
4 ... 20 mA	**in %**	**dec.**	**hex.**	
>22.81 mA	>117.589	32767	7FFF	overflow
22.81 mA	117,589	32511 27649	7EFF 6C01	Overrange
20 mA 4 mA + 578.7 nA 4 mA	100 0,003617 0	27648 1 0	6C00 0001 0000	nominal range
1.185 mA	-17,593	-1 -4864	FFFF ED00	underrange
<1.185 mA	< -17.593	32767	7FFF	wire break

3.2.3 Voltage measurement

3.2.3.1 Parameter settings

The following parameters can be set:

Table 3-6 Setting parameter - voltage measurement

Parameter	**Parameter bit P3 - P0**	**Possible settings**
Filter	**1** X X X 0 X X X	**50** Hz 60 Hz
Smoothing	X **1** X X X 0 X X	**without** smoothing with smoothing
Measurement ranges4-wire	X X **1 1** X X 1 0	**±10 V** (± 11.759 V max.) 1 ... 5 V [1] (+ 5.704 V max.)

1) with wire-break detection

3.2.3.2 Technical specifications

Table 3-7 Voltage measurement - technical data

Input resistance	100 kΩ
Max. input voltage against GND (destruction limit)	± 25 V
Max. input voltage differential (destruction limit)	± 50 V
Common mode voltage	
U_{GL} (IN- to GND) from input to input	max. ±2 V
Sensor supply (total current for all inputs)	
without U_{Aux}	46 mA (short-circuit-protected)
with U_{Aux}	500 mA (short-circuit-protected)

3.2.3.3 Block diagram

The block diagram below shows the internal layout of the input module for voltage measurement.

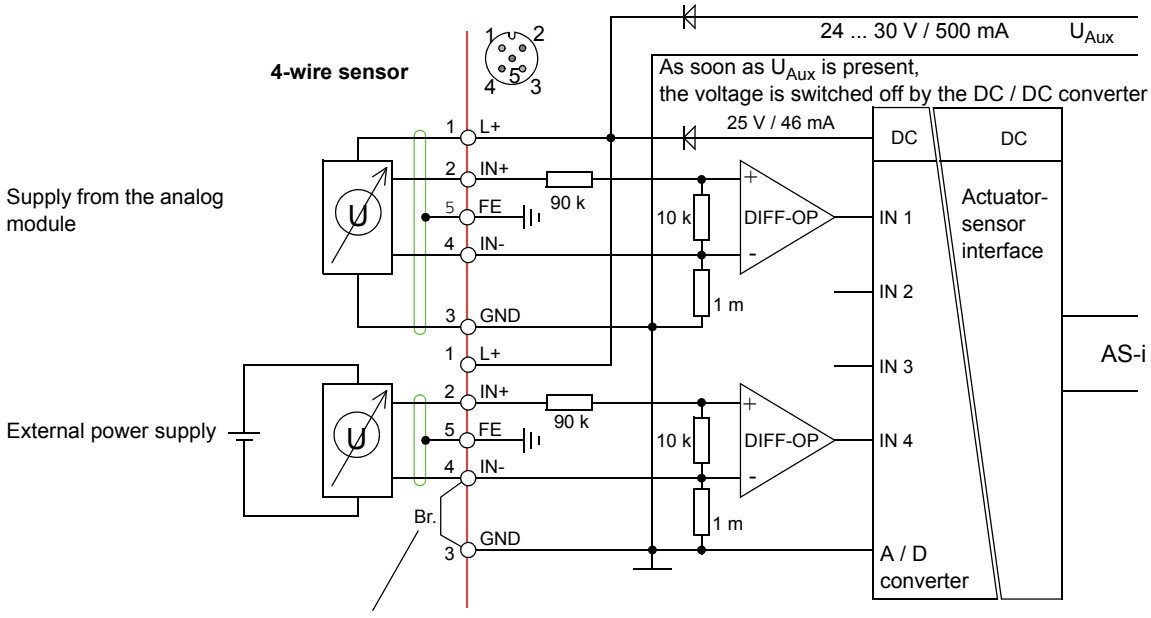


Figure 3-7 Block diagram - voltage measurement

3.2.3.4 Circuit design

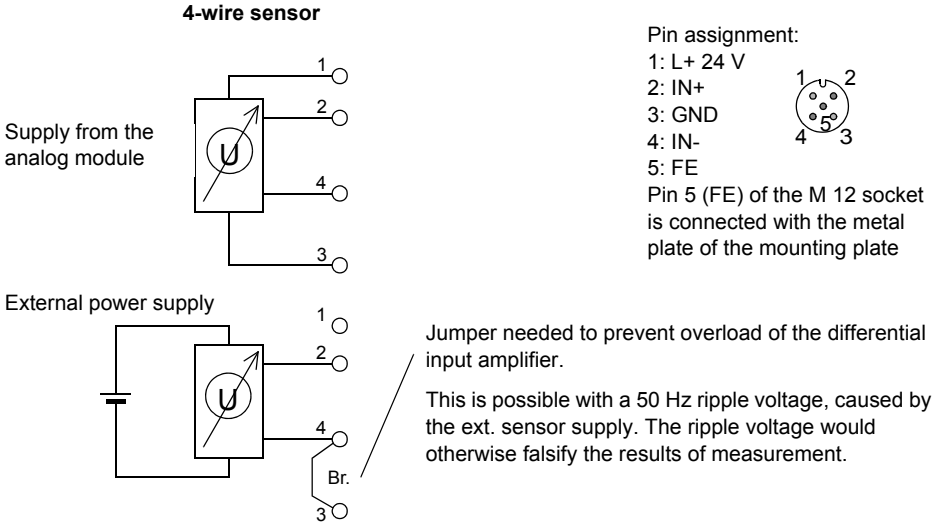


Figure 3-8 Circuit design for input module voltage measurement

3.2.3.5 Voltage measurement ranges

Range ±10 V

(Parameter setting XX11)

Table 3-8 Voltage measurement ±10 V

Range		Steps		Range
±10 V	**in %**	**dec.**	**hex.**	
> 11.759 V	>117.589	32767	7FFF	overflow
11.759 V	117,589	32511 27649	7EFF 6C01	Overrange
10 V 361.7 µV 0 V -361.7 µV -10 V	100 0,003617 0 -0,003617 -100	27648 1 0 -1 -27648	6C00 0001 0000 FFFF 9400	nominal range
 module -11,759 V	 -117,593	-27649 -32512	93FF 8100	underrange
< -11.759 V	< -117.593	-32768 (+32767)	8000 (7FFF)	Underflow (for some AS-i masters)

Range 1 ... 5 V

(Parameter setting XX10)

Table 3-9 Voltage measurement 1 ... 5 V

Range		Steps		Range
1 ... 5 V	**in %**	**dec.**	**hex.**	
> 5.704 V	>117.589	32767	7FFF	overflow
5.704 V	117,589	32511 27649	7EFF 6C01	Overrange
5 V 1 V + 144.7 µV 1 V	100 0,003617 0	27648 1 0	6C00 0001 0000	nominal range
 module 0,296 V	 -17,593	-1 -4864	FFFF ED00	underrange
<0.296 V	< -17.593	32767	7FFF	wire break

3.2.4 Resistance/Thermal-Resistance Measurement

3.2.4.1 Parameter settings

The following parameters can be set:

Table 3-10 Setting parameters - resistance measurement

Parameter	**Parameter bit P3 - P0**	**Possible settings**
Filter	**1** X X X 0 X X X	**50** Hz 60 Hz
Smoothing	X **1** X X X 0 X X	**without** smoothing with smoothing
Measurement ranges		
• Thermal resistance Pt 100 4-wire [1] linear standard linear climatic	 X X **1 1** X X 0 1	 **-200 ... +850 °C** -120 ... +130 °C
• Thermal resistance Ni 100 4-wire [1] linear standard	 X X 0 0	 -60 ... +250 °C
• Resistance measurement 4-wire [1]	 X X 1 0	 0 ... 600 Ω

1) 2-wire and 3-wire simulated with 4-wire.

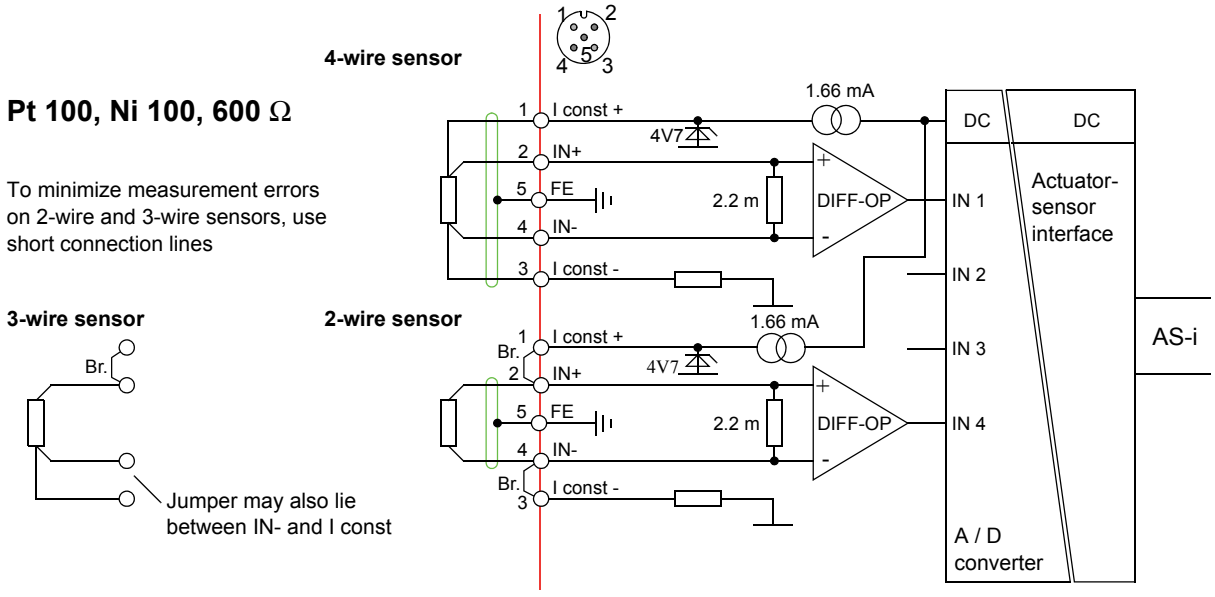
3.2.4.2 Technical specifications

Table 3-11 Technical data - resistance measurement

Input resistance	2 MΩ
Max. input voltage against GND (destruction limit)	± 10 V
Max. input voltage differential (destruction limit)	± 20 V
Measurement current	1.667 mA
Connection type	floating
Common mode voltage	
U_{GL} (IN- to GND) from input to input	max. ±2 V

3.2.4.3 Block diagram

The block diagram below shows the internal layout of the input module for resistance/thermal-resistance measurement.



Pin 5 (FE) of the M 12 socket is connected with the metal plate of the mounting plate.

Figure 3-9 Block diagram - resistance / thermal-resistance measurement

3.2.4.4 Circuit design

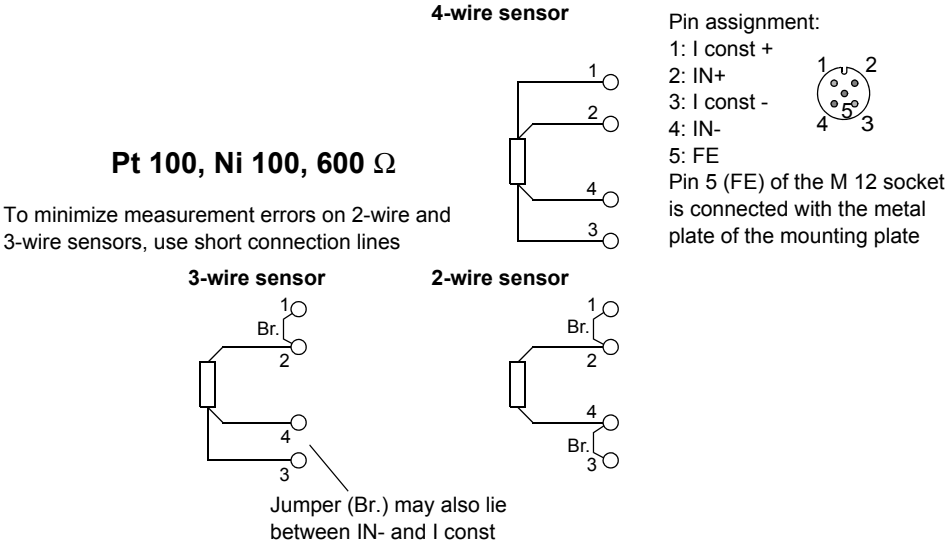


Figure 3-10 Circuit design for input module resistance / thermal-resistance measurement

3.2.4.5 Response to wire break

The module either shows a digital value of max. +50 and -50 or goes to overflow or underflow, depending on how the wire break occurs.

The possibilities for a wire break are illustrated below.

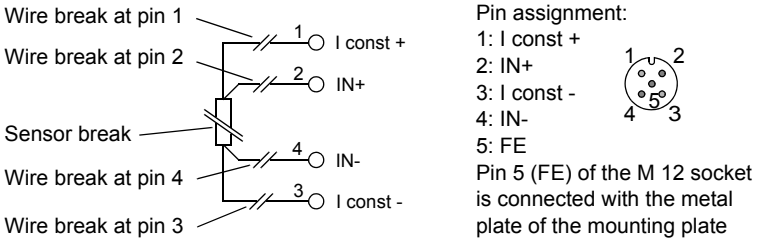


Figure 3-11 Possibilities of a Wire Break

The table below shows how the module's digital value responds to a wire break at these various points:

Table 3-12 Response to Wire Break

Wire break at pin	**Digital value (dec.)** with thermal-resistance measurement Pt 100 / Ni 100	**Digital value (dec.)** with resistance measurement 0 ... 600 Ω
1	-32768 (underflow) or +32767 (for some AS-i masters)	approx. 0
2		approx. 0 ... 50
3		approx. 0 ... 20
4		approx. -50 ... 0
Sensor break	+32767 (overflow)	+32767 (overflow)

3.2.4.6 Thermal resistance Pt 100

Standard Range Linear -200 ... +850 °C

(Parameter setting XX11)

Table 3-13 Thermal resistance Pt 100 standard range -200 ... +850 °C

Range	Steps		Range
-200 ... +850 °C	**dec.**	**hex.**	
> 1000 °C	32767	7FFF	overflow
1000 °C [1]	8501	2135	Overrange
850 °C ... 0.1 °C 0 °C -0.1 °C ... -200 °C	8500 1 0 -1 -2000	2134 0001 0000 FFFF F830	nominal range
-243 °C [1]	-2001	F82F	underrange
<-243 °C	-32768 (+32767)	8000 (7FFF)	Underflow (for some AS-i masters)

1) In underrange and overrange, the characteristic retains the gradient at its point of excursion from the linearized nominal range.

Climatic Range Linear -120 ... +130 °C

(Parameter setting XX01)

Table 3-14 Thermal resistance Pt 100 climatic range -120 ... +130 °C

Range	Steps		Range
-120 ... +130 °C	**dec.**	**hex.**	
> 155 °C	32767	7FFF	overflow
155 °C [1]	13001	32C9	Overrange
130 °C ... 0.01 °C 0 °C -0.01 °C ... -120 °C	13000 1 0 -1 -12000	32C8 0001 0000 FFFF D120	nominal range
-145 °C [1]	-12001	D11F	underrange
<-145 °C	-32768 (+32767)	8000 (7FFF)	Underflow (for some AS-i masters)

1) In underrange and overrange, the characteristic retains the gradient at its point of excursion from the linearized nominal range.

3.2.4.7 Thermal resistance Ni 100

Standard Range Linear -60 ... +250 °C

(Parameter setting XX00)

Table 3-15 Thermal resistance Ni 100 standard range -60 ... +250 °C

Range	Steps		Range
-60 ... +250 °C	**dec.**	**hex.**	
> 295 °C	32767	7FFF	overflow
295 °C [1]	2501	9C5	Overrange
250 °C ... 0.1 °C 0 °C -0.1 °C ... -60 °C	2500 1 0 -1 -600	9C4 0001 0000 FFFF FDA8	nominal range
-105 °C [1]	-601	FDA7	underrange
<-105 °C	-32768 (+32767)	8000 (7FFF)	Underflow (for some AS-i masters)

1) In underrange and overrange, the characteristic retains the gradient at its point of excursion from the linearized nominal range.

3.2.4.8 Resistance measurement

Range 0 ... 600 Ω

(Parameter setting XX10)

Table 3-16 Resistance measurement

Range		Steps		Range
0 ... 600 Ω	**in %**	**dec.**	**hex.**	
> 705.53 Ω	>117.589	32767	7FFF	overflow
705,53 Ω	117,589	32511 27649	7EFF 6C01	Overrange
600 Ω ... 21.7 mΩ 0 Ω	100 0,003617 0	27648 1 0	6C00 0001 0000	nominal range
1) 1)	 -17,593	-1 -4864	FFFF ED00	underrange
1)	< -17.593	-32768 (+32767)	8000 (7FFF)	Underflow (for some AS-i masters)

1) Polarity reversal of constant current IC+, IC-

3.3 Modules with profile S7.A.9

3.3.1 General module properties

Analog modules according to the slave profile 7.A.9 are A / B modules, i.e., a maximum of 62 analog modules according to the slave profile 7.A.9 are possible at each AS-i master.

With profile 7.A.9, it is possible to transfer 12/14-bit data from the slave to the master in the extended address mode. If only the A or B address is used, the analog value transfer is faster.

Notice

Modules according to the slave profile 7.A.9 can only run with "V3 Extended Masters" with profile M4.

Coding

I/O code [HEX]: 7
ID code [HEX]: A
ID2 code [HEX]: 9
ID1 code [HEX], see table:

Table 3-17 ID1 code

ID1	IN 1	IN 2	14 Bit	12 Bit
0	X	—	X	—
1	X	—	—	X
2	X	—	X	—
3	X	—	X	—
4	X	X	X	—
5	X	X	X	—
6	X	X	—	X
7	X	X	X	—

Operation with 1 input

The modules with order numbers 3RK2207-.BQ50-0AA3 with 2 inputs can also be operated with 1 input. This increases the transfer rate of the input signal.

Watchdog

The red FAULT LED on the slave module lights up if the module does not receive a data frame from the AS-i master for longer than 50 ms.

Peripheral fault

If the sensor supply is overloaded (only with input modules for current and voltage measurement) or if there is no data transfer according to profile S7.A.9 with the module, peripheral fault bit S1 is set in the status register of the slave.

Wire-break detection

In the ranges 4 ... 20 mA and 1 ... 5 V, the value for overflow / underflow is read in the event of a wire break (32 767 / -32 768 $_{dec}$, see also Table 3-5 in Chapter 3.2.2.5 or Table 3-9 in Chapter 3.2.3.5).

Common mode voltage

The common mode voltage U_{GL} is measured between IN- (pin 4) and GND (pin 3) with the sensor connected and must not exceed ±2 V. At the same time, the measured-value signal must not exceed the maximum input voltage of the module variant in question.

Correct representation of the measured value is ensured only within these range limits.

Equipotential Bonding

Equipotential bonding is necessary between the individual machines and sensors if two or more analog modules are operated in a common AS-i network.

The maximum permissible voltage between sensor and AS-i network is ±50 V. The formula for calculating this voltage is as follows:

$$|U_{S1} - U_1| \leq |50V|$$

The following is a block circuit diagram illustrating the layout.

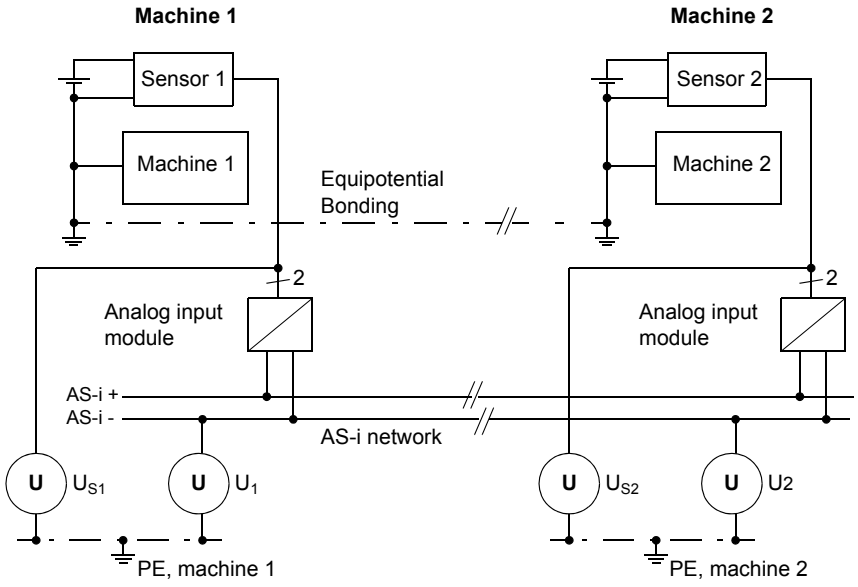


Figure 3-12 Equipotential Bonding

Updating the measured values

The measured values of the analog modules are read out in cycles.

Resolution

The resolution of the A / D converter is 13 bits + sign bit

Analog / digital converters

The analog/digital converter in the modules operates on the sigma-delta principle. The sigma-delta converter forms the mean value over a measuring period.

Total processing time

The total processing time t_{Total} for the complete transfer of 1 or 2 inputs is composed of:

- Conversion time t_c
- AS-i transfer time $t_{Transfer}$ (with cycle times of 5 ms or 10 ms)
- PLC transfer time t_{PLC}

With standard transfer, this results in the following total transfer time for 1 or 2 inputs:

12-bit
1 input : $t_{Total} \leq 25$ ms (t_c) + 30 ms ($t_{Transfer}$) + t_{PLC} ~ 55 ms
2 inputs : $t_{Total} \leq 100$ ms (t_c) + 45 ms ($t_{Transfer}$) + t_{PLC} ~ 145 ms

14-bit
1 input : $t_{Total} \leq 25$ ms (t_c) + 40 ms ($t_{Transfer}$) + t_{PLC} ~ 65 ms
2 inputs : $t_{Total} \leq 100$ ms (t_c) + 60 ms ($t_{Transfer}$) + t_{PLC} ~ 160 ms

With AB/technology, this results in the following total transfer time for 1 or 2 inputs:

12-bit
1 input : $t_{Total} \leq 25$ ms (t_c) + 60 ms ($t_{Transfer}$) + t_{PLC} ~ 85 ms
2 inputs : $t_{Total} \leq 100$ ms (t_c) + 90 ms ($t_{Transfer}$) + t_{PLC} ~ 190 ms

14-bit
1 input : $t_{Total} \leq 25$ ms (t_c) + 80 ms ($t_{Transfer}$) + t_{PLC} ~ 105 ms
2 inputs : $t_{Total} \leq 100$ ms (t_c) + 120 ms ($t_{Transfer}$) + t_{PLC} ~ 220 ms

Parameter

The parameters are set together for the inputs and are sent automatically by the AS-i master to the analog module after a voltage failure.

The modules can be re-parameterized in the field.

The parameters in **bold print** are parameterized by the AS-i master if no changes have been made in the configured slave parameters in the AS-i master (factory setting of the AS-i master).

Parameterization, see Chapter 5.

Note

If a non-permitted parameterization is sent to the module, the parameterization in **bold** print is set.

3.3.2 Current Measurement

3.3.2.1 Parameter settings

The following parameters can be set:

Table 3-18 Setting parameter - current measurement

Parameter	**Parameter bit P2 - P0**	**Possible settings**
Smoothing	**1** X X 0 X X	**without** smoothing with smoothing
Measurement ranges 4-wire 4-wire 2-wire [1]	X 0 1 X **1 1** X 1 0	±20 mA (±23.52 mA max.) **4 ... 20 mA** [2] (+22.81 mA max.) 4 ... 20 mA [2] (+22.81 mA max.)

1) Sensor receives power supply from the analog module, so in 2-wire mode measuring range starts at 4 mA
2) with wire-break detection

3.3.2.2 Technical specifications

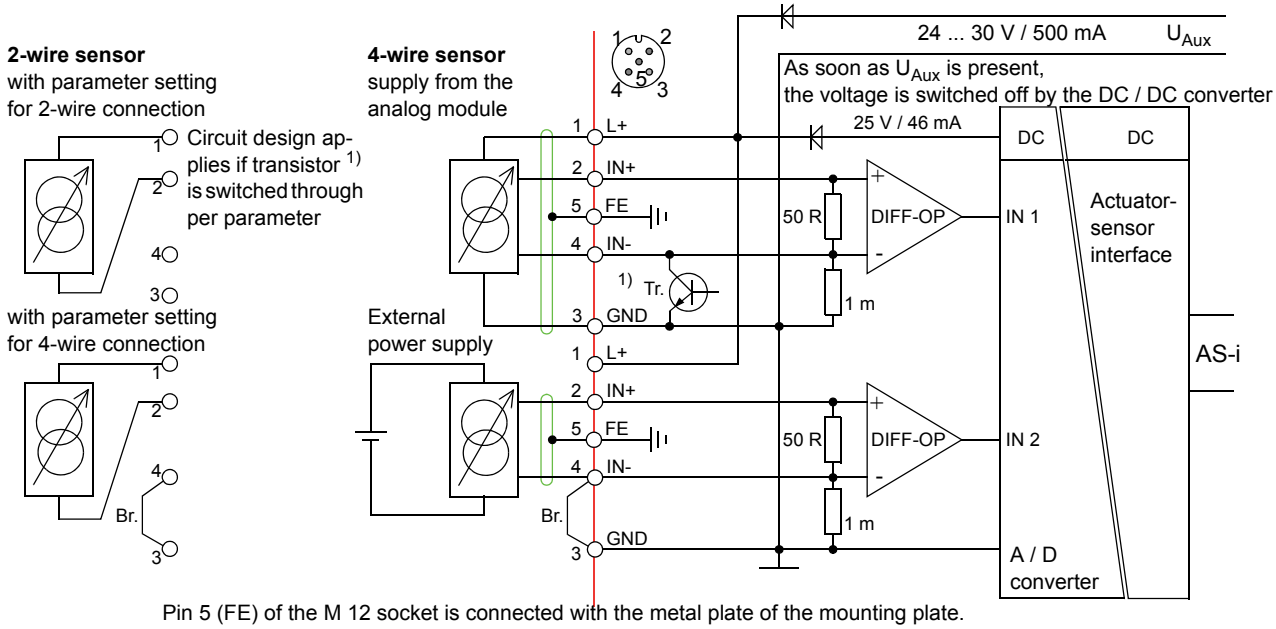
Table 3-19 Technical data - current measurement

Input resistance	50 Ω
Max. input current (Destruction limit)	50 mA[1]
Common mode voltage	
U_{GL} (IN- to GND) from input to input	max. ±2 V
Sensor supply (total current for all inputs)	
without U_{Aux}	46 mA (short-circuit-protected)
with U_{Aux}	500 mA (short-circuit-protected)

1) **Attention**
If the input current exceeds the destruction limit of 50 mA, the input will be damaged. This may result in no values or incorrect values being displayed. Devices up to product version E03 switch off the sensor supply if the input current of 26 mA is exceeded. As this may lead to problems in the case of 2-wire sensors that require a higher current during startup, this function will no longer be available from product version E04 onwards. Make sure that the input current does not exceed the destruction limit in order to rule out any damage to the device.

3.3.2.3 Block diagram

The block diagram below shows the internal layout of the input module for current measurement.



Pin 5 (FE) of the M 12 socket is connected with the metal plate of the mounting plate.
The internal transistor (Tr.) is switched through with parameter setting XX10 (for 2-wire connection) (only with input IN 1 and 2).

1) Tr. present with input IN 1 and 2

Figure 3-13 Block diagram - current measurement

3.3.2.4 Circuit design

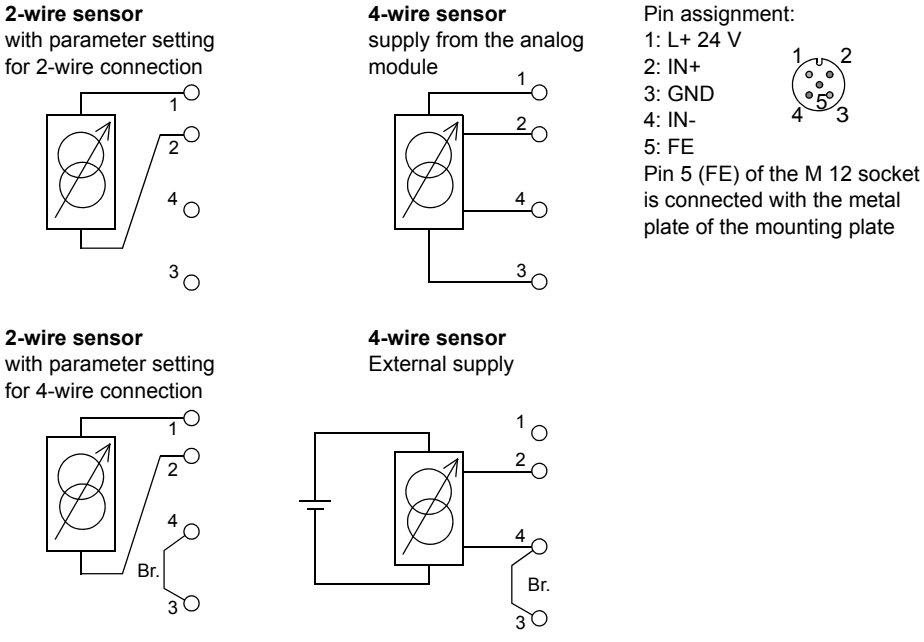


Figure 3-14 Circuit design for input module current measurement

3.3.2.5 Current measurement ranges

Range ±20 mA

(Parameter setting X01)

Table 3-20 Current measurement ±20 mA

Measured value		Steps		Range
±20 mA	**in %**	**dec.**	**hex.**	
>23.52 mA	>117.589	32767	7FFF	overflow
23.52 mA	117,589	32511 27649	7EFF 6C01	Overrange
20 mA 0 mA -20 mA	100 0 -100	27648 0 -27648	6C00 0000 9400	nominal range
 -23.51 mA	 -117,593	-27649 -32512	93FF 8100	underrange
<-23.51 mA	< -117.593	-32768 (+32767)	8000 (7FFF)	Underflow (for some AS-i masters)

Range 4 ... 20 mA

(Parameter setting X11 for 4-wire connection)
(Parameter setting X10 for 2-wire connection)

Table 3-21 Current measurement 4 ... 20 mA

Measured value		Steps		Range
4 ... 20 mA	**in %**	**dec.**	**hex.**	
>22.81 mA	>117.589	32767	7FFF	overflow
22.81 mA	117,589	32511 27649	7EFF 6C01	Overrange
20 mA 4 mA	100 0	27648 0	6C00 0000	nominal range
 1.185 mA	 -17,593	-1 -4864	FFFF ED00	underrange
<1.185 mA	< -17.593	32767	7FFF	wire break

3.3.3 Voltage measurement

3.3.3.1 Parameter settings

The following parameters can be set:

Table 3-22 Setting parameter - voltage measurement

Parameter	**Parameter bit P2 - P0**	**Possible settings**
Smoothing	**1** X X 0 X X	**without** smoothing with smoothing
Measurement ranges4-wire	X **1 1** X 1 0	**±10 V** (± 11.759 V max.) 1 ... 5 V [1] (+ 5.704 V max.)

1) with wire-break detection

3.3.3.2 Technical specifications

Table 3-23 Technical data - voltage measurement

Input resistance	100 kΩ
Max. input voltage against GND (destruction limit)	± 25 V
Max. input voltage differential (destruction limit)	± 50 V
Common mode voltage	
U_{GL} (IN- to GND) from input to input	max. ±2 V
Sensor supply (total current for all inputs)	
without U_{Aux}	46 mA (short-circuit-protected)
with U_{Aux}	500 mA (short-circuit-protected)

3.3.3.3 Block diagram

The block diagram below shows the internal layout of the input module for voltage measurement.

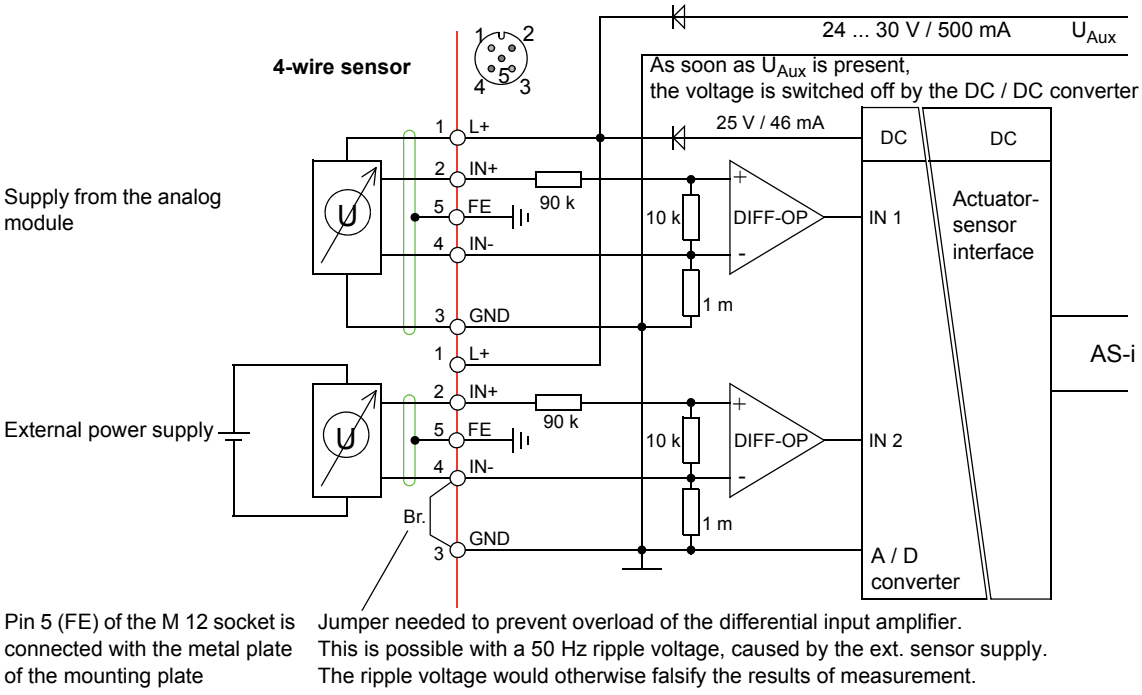


Figure 3-15 Block diagram - voltage measurement

3.3.3.4 Circuit design

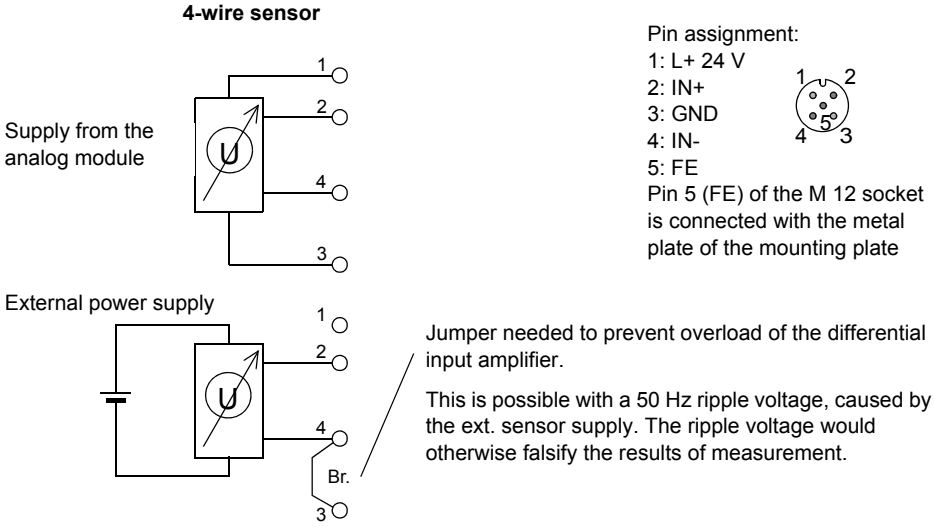


Figure 3-16 Circuit design for input module voltage measurement

3.3.3.5 Voltage measurement ranges

Range ±10 V

(Parameter setting X11)

Table 3-24 Voltage measurement ±10 V

Range		Steps		Range
±10 V	**in %**	**dec.**	**hex.**	
> 11.59 V	>117.589	32767	7FFF	overflow
11.759 V	117,589	32511 27649	7EFF 6C01	Overrange
10 V 0 V -10 V	100 0 -100	27648 0 -27648	6C00 0000 9400	nominal range
module -11,759 V	-117,593	-27649 -32512	93FF 8100	underrange
< -11.759 V	< -117.593	-32768 (+32767)	8000 (7FFF)	Underflow (for some AS-i masters)

Range 1 ... 5 V

(Parameter setting X10)

Table 3-25 Voltage measurement 1 ... 5 V

Range		Steps		Range
1 ... 5 V	**in %**	**dec.**	**hex.**	
> 5.704 V	>117.589	32767	7FFF	overflow
5.704 V	117,589	32511 27649	7EFF 6C01	Overrange
5 V 1 V	100 0	27648 0	6C00 0000	nominal range
module 0,296 V	-17,593	-1 -4864	FFFF ED00	underrange
<0.296 V	< -17.593	32767	7FFF	wire break

Description of output modules

4

4.1 General module properties

Module variants and order MLFB

Output module are available for the following output types:

- Current output MLFB: 3RK1107-1BQ40-0AA3
- Voltage output MLFB: 3RK1107-2BQ40-0AA3

Transfer time - analog value

The transfer time for an analog value from the analog module to the AS-i master in the worst case for 2 outputs is 21 AS-i cycles.

The transfer time for both outputs can be calculated as follows:

$t_{Transfer} = 21 * t_{AS-i} + t_{PLC}$

Where:

t_{AS-i} = max. 5 ms

t_{PLC} = Transfer time between PLC and master.
With a locally connected CP343-2, this example applies:
typ. 250 µs, max. 650 µs

The two outputs are transferred as multiplexed (alternating).

This results in the following maximum transfer time:

$t_{Transfer} = 105 \text{ ms} + t_{PLC}$ [ms]

Time response for output step (settling time t_t)

The settling time t_t for the analog output depends on the connected load. This time is

- 0.6 ms for resistive loads
- 6 ms for inductive/capacitive loads.

The analog output signal is stable at the end of the settling time.

Total processing time

The total processing time t_{Total} for the complete transfer of 2 outputs is composed of:

- PLC transfer time t_{PLC}
- AS-i transfer time $t_{Transfer}$
- Settling time t_t

This results in the following maximum total transfer time (with locally connected CP 343-2) for 2 outputs:

$t_{Total} \leq t_{PLC}$ + 105 ms ($t_{Transfer}$) + 6 ms (t_t) ~ 111 ms

Watchdog and peripheral faults

The outputs are pegged at 0 V or 7.3 mA, as applicable, if there is no exchange of data in accordance with slave profile 7.1 for longer than 5 s or if the analog module does not have a data frame call within 50 ms.

In other words, the watchdog is triggered and a peripheral fault is indicated if the analog module is connected to an AS-i master which, although it has included the analog module in cyclic data interchange, does not supply the analog module with analog output values in accordance with slave profile 7.3.

The red FAULT LED on the analog module lights up if the watchdog is triggered.

The watchdog signal is automatically reset as soon as the output module starts receiving analog output values.

The peripheral fault is reported by setting the peripheral fault bit S1 in the status register of the slave.

Parameter

The parameters are set together for both outputs and are sent automatically by the AS-i master to the analog module after a voltage failure.

The modules can be re-parameterized in the field.

The parameters in **bold** print are parameterized by the AS-i master if no changes have been made in the configured slave parameters in the AS-i master (factory setting of the AS-i master).

Parameterization, see Chapter 5.

Note

If a non-permitted parameterization is sent to the module, the parameterization in **bold** print is set.

Resolution

The resolution of the A / D converter is 11 bits + sign bit In the PLC, the value is processed with a resolution of 15 bits + sign bit.
The increment for a change in the output value at the analog module is thus 16 units. Changes in the lowest 4 bits (least significant bits) are ignored.

4.2 Current output

4.2.1 Parameter settings

The following parameters can be set:

Table 4-1 Setting parameter - current output

Parameter		Parameter bit P3 - P0	Setting options
Output ranges:	2-wire	1 1 1 0 1 1 **1 1** 1 1 0 1	±20 mA **4 ... 20 mA** 0 ... 20 mA

4.2.2 Technical specifications

Table 4-2 Technical data - current output

Load impedance	max. 500 Ω
with inductive load	max. 0.1 mH
No-load-protected (open output)	Yes
No-load voltage	approx. 15 V
Max. output current	24 mA per channel
Wire-break detection	No

4.2.3 Block diagram

The block diagram below shows the internal layout of the module for current output.

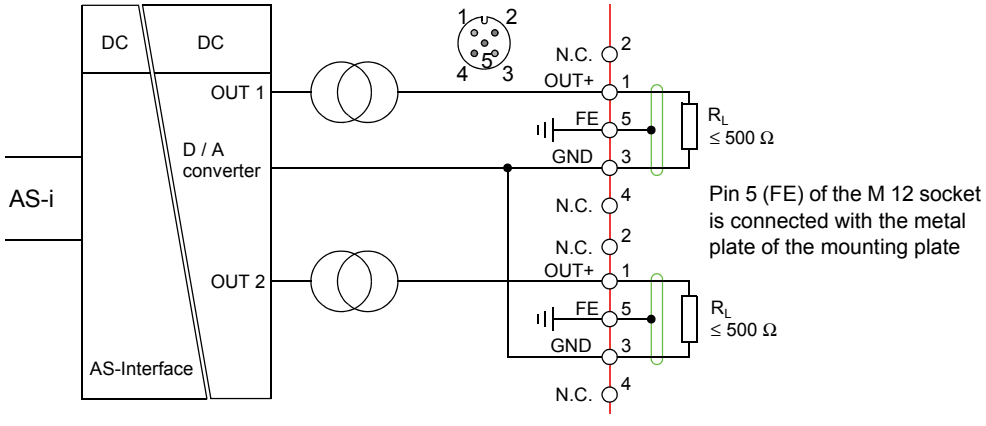
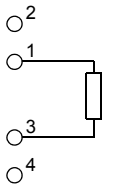


Figure 4-1 Block diagram - current output

4.2.4 Circuit design



Pin assignment:
1: OUT
2: N.C.
3: GND
4: N.C.
5: FE

Pin 5 (FE) of the M 12 socket is connected with the metal plate of the mounting plate

Figure 4-2 Circuit design for current output module

4.2.5 Current output ranges

Range ±20 mA

(Parameter setting 1110)

Table 4-3 Current output ±20 mA

Output value		Steps		Range
±20 mA	**in %**	**dec.**	**hex.**	
0 mA	118,5149 117,593	32767 32512	7FFF 7F00	overflow
23.52 mA	117,589	32511 27649	7EFF 6C01	Overrange
20 mA 723.4 nA 0 mA -723.4 nA -20 mA	100 0,003617 0 -0,003617 -100	27648 1 0 -1 -27648	6C00 0001 0000 FFFF 9400	nominal range
 -23.52 mA	 -117,593	-27649 -32512	93FF 8100	underrange
0 mA	-117,596 -118,519	-32513 -32768	80FF 8000	Underflow

Range 0 ... 20 mA

(Parameter setting 1101)

Table 4-4 Current output 0 ... 20 mA

Output value		Steps		Range
0 ... 20 mA	**in %**	**dec.**	**hex.**	
0 mA	118,5149 117,593	32767 32512	7FFF 7F00	overflow
23.52 mA	117,589	32511 27649	7EFF 6C01	Overrange
20 mA 723.4 nA 0 mA	100 0,003617 0	27648 1 0	6C00 0001 0000	nominal range
0 mA	-117,593	-1 -32512	FFFF 8100	Non-permitted range
0 mA	-117,596 -118,519	-32513 -32768	80FF 8000	Underflow

Range 4 ... 20 mA

(Parameter setting 1111)

Table 4-5 Current output 4 ... 20 mA

Output value		Steps		Range
4 ... 20 mA	**in %**	**dec.**	**hex.**	
0 mA	118,5149 117,593	32767 32512	7FFF 7F00	overflow
22.81 mA	117,589	32511 27649	7EFF 6C01	Overrange
20 mA 4 mA + 578.7 nA 4 mA	100 0,003617 0	27648 1 0	6C00 0001 0000	nominal range
4 mA - 578.7 nA 0 mA	-25	-1 -6912	FFFF E500	underrange
0 mA	-117,593	-6913 -32512	E4FF 8100	Non-permitted range
0 mA	-117,596 -118,519	-32513 -32768	80FF 8000	Underflow

Note

The D/A converter's smallest possible resolution is 11.57 µA.

This, in turn, means that the current which results from the steps received changes in a 11.57 µA matrix.

4.3 Voltage output

4.3.1 Parameter settings

The following parameters can be set:

Table 4-6 Setting parameter - voltage output

Parameter		Parameter bit P3 - P0	Setting options
Output ranges:	2-wire	1 1 **1 1** 1 1 0 0 1 1 1 0	**±10 V** 1 ... 5 V 0 ... 10 V

4.3.2 Technical specifications

Table 4-7 Technical data - voltage output

Load impedance	min. 1 kΩ
with capacitive load	max. 0.1 µF
Short-circuit-protected	Yes
Short-circuit current	30 mA
Max. output voltage	approx. 15 V
Wire-break detection	No

4.3.3 Block diagram

The block diagram below shows the internal layout of the module for voltage output.

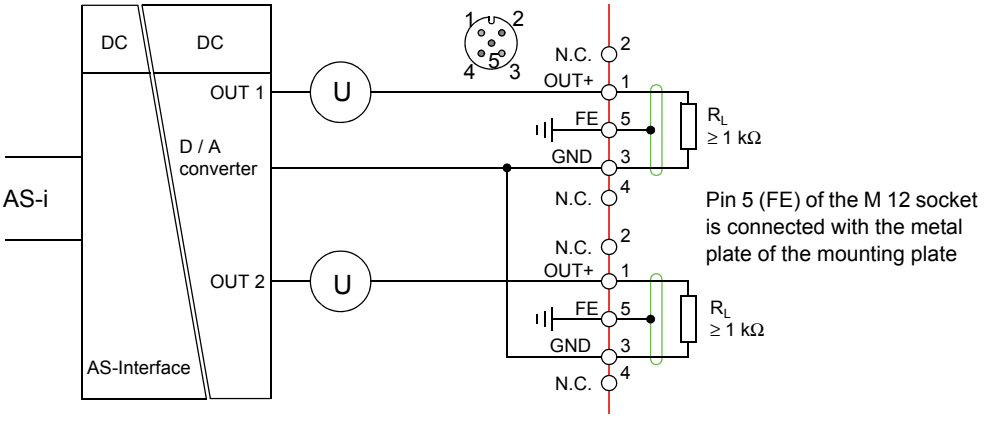
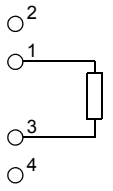


Figure 4-3 Block diagram - voltage output

4.3.4 Circuit design



Pin assignment:
1: OUT
2: N.C.
3: GND
4: N.C.
5: FE

Pin 5 (FE) of the M 12 socket is connected with the metal plate of the mounting plate

Figure 4-4 Circuit design for voltage output modules

4.3.5 Voltage output ranges

Range ±10 V

(Parameter setting 1111)

Table 4-8 Voltage output ±10 V

Output value		Steps		Range
±10 V	**in %**	**dec.**	**hex.**	
0 V	118,5149 117,593	32767 32512	7FFF 7F00	overflow
11.76 V	117,589	32511 27649	7EFF 6C01	Overrange
10 V 361.7 µV 0 V -361.7 µV - 10 V	100 0,003617 0 -0,003617 -100	27648 1 0 -1 -27648	6C00 0001 0000 FFFF 9400	nominal range
- 11.76 V	-117,593	-27649 -32512	93FF 8100	underrange
0 V	-117,596 -118,519	-32513 -32768	80FF 8000	Underflow

Range 0 ... 10 V

(Parameter setting 1110)

Table 4-9 Voltage output 0 ... 10 V

Output value		Steps		Range
0 ... 10 V	**in %**	**dec.**	**hex.**	
0 V	118,5149 117,593	32767 32512	7FFF 7F00	overflow
11.76 V	117,589	32511 27649	7EFF 6C01	Overrange
10 V 361.7 µV 0 V	100 0,003617 0	27648 1 0	6C00 0001 0000	nominal range
 0 V	 -117,593	-1 -32512	FFFF 8100	Non-permitted range
0 V	-117,596 -118,519	-32513 -32768	80FF 8000	Underflow

Range 1 ... 5 V

(Parameter setting 1100)

Table 4-10 Voltage output 1 ... 5 V

Output value		Steps		Range
1 ... 5 V	**in %**	**dec.**	**hex.**	
0 V	118,5149 117,593	32767 32512	7FFF 7F00	overflow
5.7 V	117,589	32511 27649	7EFF 6C01	Overrange
5 V 1 V +144.7 µV 1 V	100 0,003617 0	27648 1 0	6C00 0001 0000	nominal range
1 V -144.7 µV 0 V	 -25	-1 -6912	FFFF E500	underrange
 0 V	 -117,593	-6913 -32512	E4FF 8100	Non-permitted range
 0 V	-117,596 -118,519	-32513 -32768	80FF 8000	Underflow

Note

The D/A converter's smallest possible resolution is 5.787 mV.

This, in turn, means that the voltage which results from the steps received changes in a 5.787 mV matrix.

Configuring, parametrizing, programming

5

This chapter uses examples to show how you use AS-Interface analog modules and known AS-Interface Links and Masters to plan projects.

You will find more information to download on the internet at:

http://support.automation.siemens.com

or follow the link to the relevant document.

Table 5-1 Overview

Document title	Drawing number	Chapter / Page	Link
Manual DP/AS-Interface Link Advanced	C79000-G8976-C209-01		http://support.automation.siemens.com/WW/view/en/22710305
		4.2/S.43	Requirements and menu structure
		6.1	Configuring DP/AS-Interface LINK Advanced as DP slave in the DP master
		6.3	Configuration using a GSD file
		7.2.2	Addressing table CLASSIC (default setting)
		7.2.3	Addressing table LINEAR
Manual DP/AS-Interface Link 20E	C79000-G8976-C138-04		http://support.automation.siemens.com/WW/view/en/5281638
		1.9	Configuring DP/AS-i 20E as DP slave in the DP master
		1.9.2	Importing the GSD file
		2.4	Transferring AS-i analog values
		2.4.2	Programming
CP 343-2 / CP 343-2 P AS-Interface master	C79000-G8976-C149-02		http://support.automation.siemens.com/WW/view/en/5581657
		2.3	Transferring AS-i analog values
		2.3.1	Addressing the analog values of AS-i slaves
		3.2.1	Set_Permanent_Parameter
System manual AS-Interface/ ASIsafe	A5E01172290		http://support.automation.siemens.com/WW/view/de/26250840
		8.4.6	Analog input / output modules K60 - field IP67
		11.2.3	Analog data

5.1 LINK Advanced, F-Link

5.1.1 System with SIMATIC STEP 7 V5.4 or higher for LINK Advanced and F-Link

5.1.1.1 Configuring with Link Advanced as an example

Requirement

The AS-Interface Link Advanced is already configured at the PROFIBUS line.

Procedure

1. Click on the Link Advanced assembly to open the actuator-sensor interface assembly list.
2. Drag an AS-i slave from the assembly catalog in the directory DP-AS-i Link Advanced into this list, e.g. in row 1A for actuator-sensor interface address 1A. Open the object properties, e.g. by double-clicking on row 1A.
3. Switch to the 'Configuration' tab.
4. Here you will find the slave selection dialog using the **Selection…** button. The Siemens product order numbers can be selected under the corresponding headings.
   For analog modules, click on **K60 compact modules IP6X**.
   You can select the corresponding analog module at **AI** and **AO**.
5. Set the parameters.
6. Verify the ID1 value

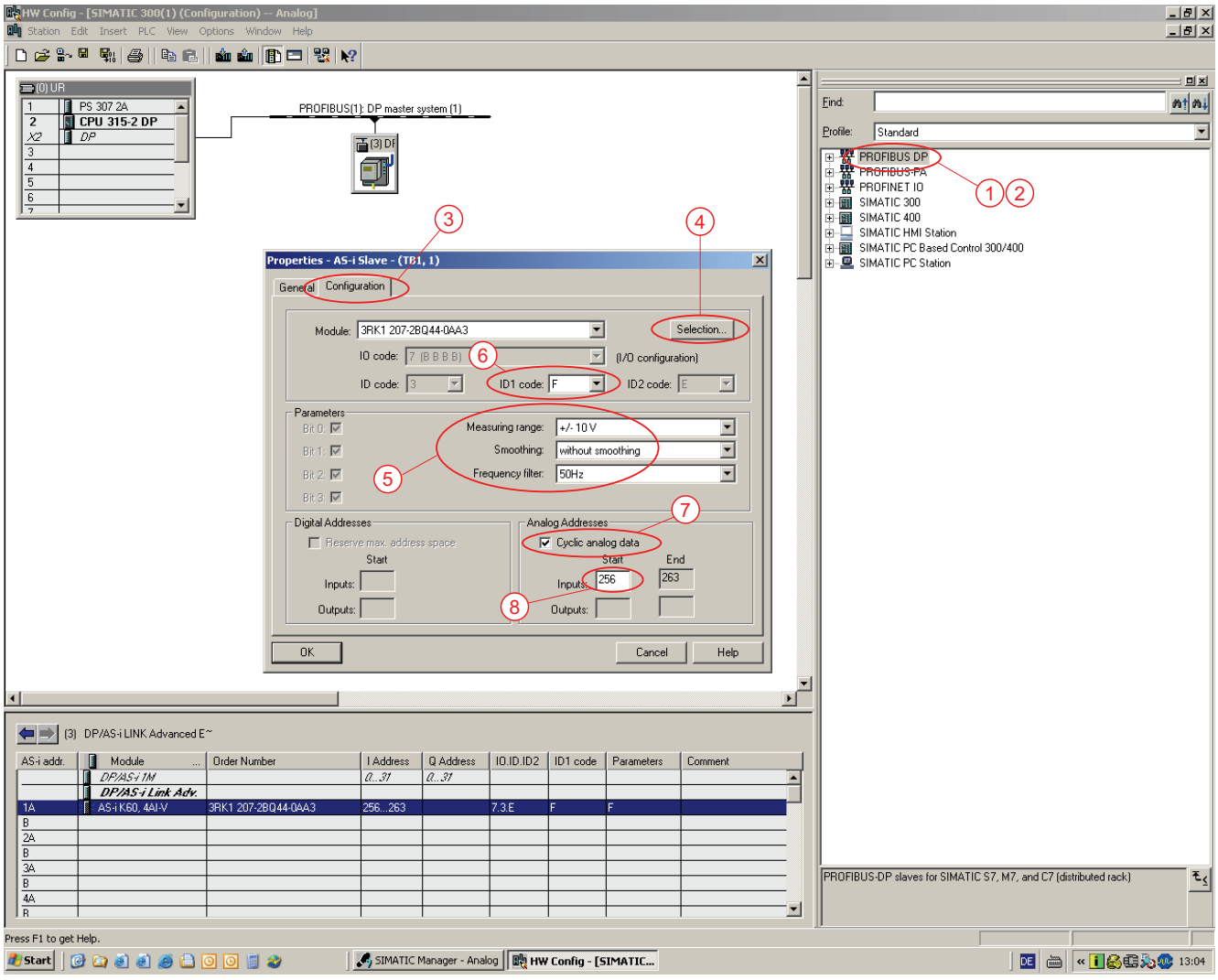
Note

The ID1 value must be set in the same way it is set at the module (e.g. via addressing device).

In the case of analog modules according to profile 7.A.9, the ID1 value influences the module properties.

Table 5-2 ID1 default values for analog modules

Default value ID1	Analog modules
F	**according to slave profile 7.3** 3RK1107-.BQ40-0AA3 (K60 2O) 3RK1207-.BQ00-0AA3 (K60 2I) 3RK1207-.BQ44-0AA3 (K60 4I)
7	**according to slave profile 7.A.9** 3RK2207-.BQ50-0AA3 (K60 2I)



Other information

You will find more information in the message box of the slave selection dialog.

For the ID1 value setting options, see also Chapter 3.3 *Modules with profile S7.A.9.*

5.1.1.2 Cyclical transfer of the I/O data

7. Select **Cyclical analog data**.
8. Enter the desired analog address, e.g. 256. The option box **Cyclical analog data** enables / disables access to analog data via peripheral commands.

In the program, you use the command LW256 to access the analog input value of the first channel for (IN1) or the command TW256 to access an analog output value (OUT1). The other channels of the module are on the subsequent addresses, e.g. 258, 260 etc.

5.1.1.3 Acyclical transfer of I/O data

If you deselect **cyclical analog data**, access to the analog values is via data records. The option box **Cyclical analog data** must not be disabled accordingly of the analog outputs of an AS-i slave are written via acyclical services.

Other information

More information on access to analog values via data records can be found in the manual SIMATIC NET DP/AS-Interface Link Advanced.

- Chapter 7.3.2 *Accessing AS-i analog data via acyclical services*.
  Consult Table 5-3, Representing the analog values in the data records.

Table 5-3 Representing the analog values in the data records

Address AS-i slave	Reserved byte addresses for analog values in the data record							
	DS 140	**DS 141**	**DS 142**	**DS 143**	**DS 144**	**DS 145**	**DS 146**	**DS 147**
	8C	8D	8E	8F	90	91	92	93
1	0							
2	8							
3	16							
4	24							
5	32	0						
6	40	8						
7	48	16						
8	56	24						
9	64	32	0					
10	72	40	8					
11	80	48	16					
12	88	56	24					
13	96	64	32	0				
14	104	72	40	8				
15	112	80	48	16				
16	120	88	56	24				
17	128	96	64	32	0			
18	136	104	72	40	8			
19	144	112	80	48	16			
20	152	120	88	56	24			
21	160	128	96	64	32	0		
22	168	136	104	72	40	8		
23	176	144	112	80	48	16		
24	184	152	120	88	56	24		
25	192	160	128	96	64	32	0	
26	200	168	136	104	72	40	8	
27	208	176	144	112	80	48	16	
28	216	184	152	120	88	56	24	
29	224	192	160	128	96	64	32	0
30	232	200	168	136	104	72	40	8
31		208	176	144	112	80	48	16

- And *Acyclical transfer of the I/O data* in Chapter 5.2.1 *System with SIMATIC STEP 7 V5.0 SP3 or higher with Link 20E*.

5.1.2 System integration via GSD (only applies to Link Advanced)

You need system integration via a GSD file as an alternative configuration for older STEP 7 versions or for non-SIMATIC systems and always when STEP 7 V5.4 or higher is unavailable.

5.1.2.1 Configuring

You can call up the GSD file on the internet at

`http://support.automation.siemens.com/WW/view/en/113250`

The integration is described in detail in the manual SIMATIC NET DP / AS-Interface Link.

With configuration (project planning) using a GSD file, the inputs and outputs of the AS-i slaves are activates in accordance with CLASSIC sorting in the peripherals space (cyclical transfer of I/O data).

Other information

You will find more information in the manual SIMATIC NET DP/AS-Interface Link Advanced

- Chapter 6.1 *Configuring DP/AS-Interface LINK Advanced as DP slave in the DP master*
- Chapter 6.3 *Configuration using a GSD file*
- Chapter 7.2.2 *Addressing table CLASSIC*.

Note

In addition to configuration using a GSD file, parameterization of the AS-i configuration is required using the keyboard and display or via WBM.

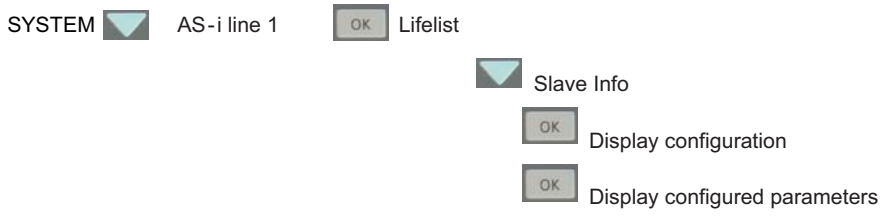


Figure 5-1 Parameterization via display

Relevant parameters

Table 5-4 Relevant parameters for power and voltage input

Parameter bit [1] P3 P2 P1 P0	**Current input**	**Voltage input**	**Resistance [2]**
X X 1 1	4... 20 mA, 4-wire	±10 V, 4-wire	Pt 100 standard, 4-wire
X X 1 0	4... 20 mA, 2-wire	1... 5 V, 4-wire	0... 600 Ω, 4-wire
X X 0 1	±20 mA, 4-wire	reserved [3]	Pt 100 climatic, 4-wire
X X 0 0	reserved [3]	reserved [3]	Ni 100 standard, 4-wire
X 1 X X	without smoothing		
X 0 X X	with smoothing		
1 X X X	Filter 50 Hz [1]		
0 X X X	Filter 60 Hz [1]		

1) In the case of modules with order number 3RK2207, Fast analog modules according to Spec. 3.0, the parameter P3 is no longer required; the modules are firmly set to filter 50 Hz.
2) 2-wire and 3-wire simulated with 4-wire.
3) With this parameter combination, the default range is set as with X X 1 1.

Table 5-5 Relevant parameters for power and voltage output

Parameter bit P3 P2 P1 P0	**Current output**	**Voltage output**
1 1 1 1	4... 20 mA	±10 V
1 1 1 0	±20 mA	0 ... 10 V
1 1 0 1	0 ... 20 mA	reserved [1]
1 1 0 0	reserved [1]	1... 5 V

1) With this parameter combination, the default range is set as with 1 1 1 1.

5.1.2.2 Cyclical transfer of I/O data (use of 'slot mechanism')

The GSD offers various modules.

Example of an analog input module

1. Select e.g. an **ASi-1: 4 Word In** module.
2. Open the 'Properties' dialog of this module
3. At the parameter **AS-i Slave Address**, select the AS-i address that has been set at the analog module
4. Select the input address under which the CPU accesses the analog data.

For an analog output module, select e.g. module **ASi-1: 4 Word Out** and proceed accordingly.

Note

For each AS-i line you want to use, exactly one binary module (e.g. **ASi-1:Binary Array 32 bytes**) must be placed under the modules used.
For a 2-channel analog input slave, a module **ASi-1: 2 Word In** can be selected instead of the **ASi-1: Binary Array 32 bytes**.
If a dual master is used, the corresponding modules (e.g. **ASi-2: Binary Array 32 bytes**) are also to be selected for the second AS-i line.

5.1.2.3 Acyclical transfer of the I/O data

Access to analog values via data records applies here; the 'slot mechanism' is not used. See Chapter 5.1.1.3.

5.2 Link 20E

Notice

The Link 20E does not support any Fast analog modules according to profile 7.A.9 (3RK2207-.BQ50-0AA3 (K60 2I)). This means they must not be selected in the assembly catalogs.

5.2.1 System with SIMATIC STEP 7 V5.0 SP3 or higher with Link 20E

5.2.1.1 Configuring

Requirement

The AS-Interface Link is already configured at the PROFIBUS line.

Procedure

1. Click on the Link20E assembly to open the actuator-sensor interface assembly list.
2. Drag an AS-i standard slave from the assembly catalog in the directory DP-AS-i Link 20E into this list, e.g. in row 1 for actuator-sensor interface address 1. Open the object properties, e.g. by double-clicking on row 1.
3. Switch to the 'Configuration' tab.
4. Here you will find the slave selection dialog using the **Selection…** button. The Siemens product order numbers can be selected under the corresponding headings. For analog modules, click on **K60 compact modules IP6X**. You can select the corresponding analog module at **AI** and **AO**. Bear in mind the constraint described in Chapter 5.2.
5. Set the parameters.
6. Verify the ID1 value

Note

The ID1 value must be set in the same way it is set at the module (e.g. via addressing device).

Table 5-6 ID1 default values for analog modules

Default value ID1	Analog modules
F	**according to slave profile 7.3** 3RK1107-.BQ40-0AA3 (K60 2O) 3RK1207-.BQ00-0AA3 (K60 2I) 3RK1207-.BQ44-0AA3 (K60 4I)
7	**according to slave profile 7.A.9** 3RK2207-.BQ50-0AA3 (K60 2I)

5.2.1.2 Acyclical transfer of the I/O data

In the program, you use data record accesses to access the analog values.

Example of an analog input module at address 1 and an analog output module at address 5:

Create a data component for the input data, e.g. DB40 with 8 bytes length.
Create a data component for the output data, e.g. DB41 with 8 bytes length.

Insert the following lines in your program: [1].

```
L    0                                  //base address of the Link or CP
T MW 100                                //cache base address

L    140                                //data record number for inputs
T    MB   102                           //cache data record number

L    141                                //data record number for outputs
T    MB   103                           //cache data record number

CALL  "RD_REC"
REQ :=TRUE                              //always
IOID :=B#16#54                          //fixed value
LADDR  :=MW100                          //base address
RECNUM :=MB102                          //data record number inputs
RET_VAL:=MW104                          //return parameter
BUSY   :=M108.0                         //return parameter
RECORD :=P#DB40.DBX 0.0 BYTE 8          //reception buffer inputs

CALL  "WR_REC"
REQ :=TRUE                              //always
IOID :=B#16#54                          //fixed value
LADDR  :=MW100                          //base address
RECNUM :=MB103                          //data record number outputs
RECORD :=P#DB41.DBX 0.0 BYTE 8          //send buffer outputs
RET_VAL:=MW106                          //return parameter
BUSY   :=M108.1                         //return parameter
```

1) We are unable to guarantee that the specifications are correct.

In the remainder of the program, you use the command L DB40.DBW 0 to access the analog input value of the first channel (IN1 of AS-i address 1) or the command T DB41.DBW 0 to access the analog output value of the first channel (OUT1 of As-i address 5).

The other channels of the module are on the subsequent addresses, e.g. DBW 2, DBW 4 etc.

If other AS-i addresses are to be accesses, the data components might have to be extended accordingly and other data record numbers used.

Consult Table 5-3, Representing the analog values in the data records, on Page 63.

Other information

See also manual DP/AS-Interface Link 20E

- Chapter 2.4 *Transferring AS-i analog values*.
- Chapter 2.4.2 *Programming*

5.2.2 System integration via GSD

You need system integration via a GSD file as an alternative configuration for older STEP 7 versions or for non-SIMATIC systems and always when the path described at 5.2.1 V5. is unavailable.

5.2.2.1 Configuring

You can call up the GSD file on the internet at

http://support.automation.siemens.com/WW/view/en/113250

The integration is described in general in the manual DP/AS-Interface Link 20E, Chapter 1.9.2 *Importing the GSD file*.

Quick Guide for analog modules with Link 20E DPV1 GSD

Notice

DPV0 GSD does not support any data records for analog modules. For this reason, make sure that you use DPV1 GSD.

1. Select module 16/16Byte (AKF) or 32/32Byte (AKF).
2. Open the 'Properties' dialog of the DP/AS-i Link 20E, select the 'Parameterize' tab, and open the device-specific parameters. Here, you can set the parameter bits for each AS-i address, according to the following parameter description, see Chapter 5.1.2, Table 5-4 and Table 5-5.
3. Save the configuration of the AS-i slaves (save the AS-i target configuration) by pressing the SET button on the DP/AS-i Link 20E.

Other information

See also manual DP/AS-Interface Link 20E, Chapter 1.9 *Configuring DP/AS-i LINK 20E as DP slave in the DP master*.

5.2.2.2 Acyclical transfer of I/O data

In the program, you use data record accesses to access the analog values.

Example of an analog input module at address 1 and an analog output module at address 5, see Chapter 5.2.1.2.

5.3 CP343-2P

Notice

The CP343-2P does not support any Fast analog modules according to profile 7.A.9 (3RK2207-.BQ50-0AA3 (K60 2I)). This means they must not be selected in the assembly catalogs.

5.3.1 System with SIMATIC STEP 7 V5.4 or higher

5.3.1.1 Configuring

Requirement

The AS-Interface CP343-2P is already configured at the rack.

Procedure

1. Open the object properties of the assembly and select the 'Slave configuration' tab to open the actuator-sensor interface assembly list.
2. Double-clicking on an (empty) line opens the 'Properties' dialog of the AS-i slave, e.g. in line 1A for actuator-sensor interface address 1A.
3. Open the object properties, e.g. by double-clicking on row 1A.
4. In the 'Configuration' tab, you will find the slave selection dialog using the **Selection…** button. The Siemens product order numbers can be selected under the corresponding headings. For analog modules, click on **K60 compact modules IP6X**. You can select the corresponding analog module at **AI** and **AO**.
5. Set the parameters.
6. Verify the ID1 value

Note

The ID1 value must be set in the same way it is set at the module (e.g. via addressing device).

Table 5-7 ID1 default values for analog modules

Default value ID1	Analog modules
F	**according to slave profile 7.3** 3RK1107-.BQ40-0AA3 (K60 2O) 3RK1207-.BQ00-0AA3 (K60 2I) 3RK1207-.BQ44-0AA3 (K60 4I)
7	**according to slave profile 7.A.9** 3RK2207-.BQ50-0AA3 (K60 2I)

5.3.1.2 Transferring I/O data

Example of an analog input module at address 1 and an analog output module at address 5, see Chapter 5.2.1.2. In the program, you use data record accesses to access the analog values.

If other AS-i addresses are to be accesses, the data components might have to be extended accordingly and other data record numbers used, see
CP 343-2 / CP 343-2 P actuator-sensor interface Master, Chapter 2.3.1 *Addressing the analog values of AS-i slaves*.

Other information

See also Manual SIMATIC NET CP 343-2 / CP 343-2 P actuator-sensor interface master

- Chapter 2.3 *Transferring AS-i analog values*.
  Consult Table 5-8, Representing the analog values in the data records.

Table 5-8 Representing the analog values in the data records

Address AS-i slave	Reserved byte addresses for analog values in the data record							
	DS 140	DS 141	DS 142	DS 143	DS 144	DS 145	DS 146	DS 147
	8C	8D	8E	8F	90	91	92	93
1	0-7							
2	8-15							
3	16-23							
4	24-31							
5	32-39	0-7						
6	40-47	8-15						
7	48-55	16-23						
8	56-63	24-31						
9	64-71	32-39	0-7					
10	72-79	40-47	8-15					
11	80-87	48-55	16-23					
12	88-95	56-63	24-31					
13	96-103	64-71	32-39	0-7				
14	104-111	72-79	40-47	8-15				
15	112-119	80-87	48-55	16-23				
16	120-127	88-95	56-63	24-31				
17		96-103	64-71	32-39	0-7			
18		104-111	72-79	40-47	8-15			
19		112-119	80-87	48-55	16-23			
20		120-127	88-95	56-63	24-31			
21			96-103	64-71	32-39	0-7		
22			104-111	72-79	40-47	8-15		
23			112-119	80-87	48-55	16-23		
24			120-127	88-95	56-63	24-31		
25				96-103	64-71	32-39	0-7	
26				104-111	72-79	40-47	8-15	
27				112-119	80-87	48-55	16-23	
28				120-127	88-95	56-63	24-31	
29					96-103	64-71	32-39	0-7
30					104-111	72-79	40-47	8-15
31					112-119	80-87	48-55	16-23

5.4 CP343-2

Notice

The CP343-2 does not support any Fast analog modules according to profile 7.A.9 (3RK2207-.BQ50-0AA3 (K60 2I)). This means they must not be selected in the assembly catalogs.

5.4.1 System with SIMATIC STEP 7 V5.3 or higher

5.4.1.1 Configuring

With an actuator-sensor interface CP343-2, all that takes place in the hardware configuration is that the CP is inserted from the catalog into the rack. Other settings for the AS-i slaves are not possible in the hardware configuration.

Pressing the SET button adopts the existing configuration of the AS-i network as target configuration and saves it in the CP.

As default, all the parameters are set to **F**, **1111**. The command interface ASI_3422 (FC7) is used to change the parameters.

Call interface

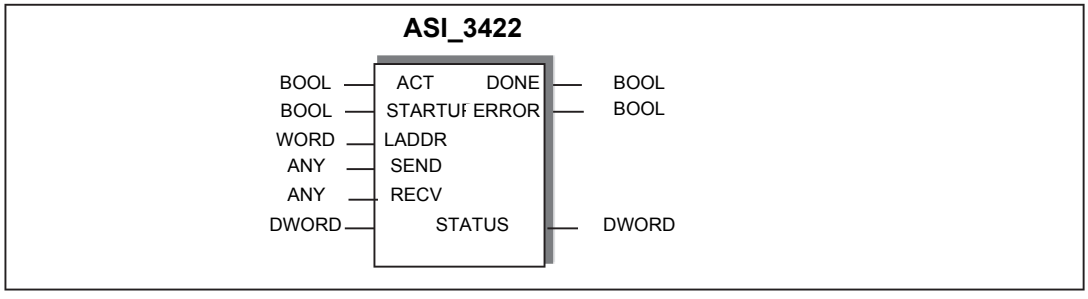


Figure 5-2 Call interface

On SIMATIC S7, the FC ASI_3422 is a convenient command interface. You use the component call-up FC ASI_3422 so transfer the commands and adopt response data. The FC ASI_3422 manages the call instructions "Write_data_record" and "Read_data_record" on its own.

Notice

Use version of the FC ASI_3422 2.0 or higher.
The FC ASI_3422 has no re-entrant capability! This means that FC call instructions may not be programmed in program run levels that interrupt one another (e.g. by means of call-up in OB 1 **and** in OB 35). If the CP 343-2 is used in the ET 200M, only a limited number of Read_Data_Record and Write_Data_Record jobs may be active simultaneously in the S7 CPU. The maximum permitted number depends on the S7 CPU. If more jobs are triggered, these are terminated with the error 80C3h (temporary resource bottleneck). The rejected job then has to be repeated.

Configure the parameter value for a slave with the command call-up **Set_Permanent_Parameter**.

Meaning

This call instruction configures a parameter value for the specified AS-i slave in the CP 343-2. The value is stored in nonvolatile form in the EEPROM of the CP 343-2.

The configured parameter is **not** transferred immediately by the CP 343-2 to the AS-i slave. Only after switching on the supply voltage at the CP 343-2 is the configured parameter value transferred on activation of the AS-i slave.

This call instruction is not permitted for AS-i slaves that comply with the AS-i slave standard profile 7.4. For these AS-i slaves, the AS-i master manages the AS-i slave parameterization itself. The configured parameters are always equal to F_H in this case.

Notice

If you configure the AS-i slaves using HW Config, it is usually superfluous t use the call instruction described here.

If you use the call instruction, it overwrites configuration data that comes from the key configuration or configuration via HW Config.

Structure of the job data in the send buffer

Table 5-9 Structure of the job data in the send buffer

Byte	Meaning			
	Bit 7	Bit 4	Bit 3	Bit 0
0	Command number: 00_H			
1	Slave address			
2	irrelevant		Parameters	

Programming example: [1)]

```
// Set M116.0 in the PLC start-up to initialize the FC
   L    0                    //base address of the CP or Link
   T MW 110                  //cache base address
   L    0                    // command number 0 = configure parameter value
   T    MB   120             //send buffer: Command
   L    1                    // AS-i address (1..31) of the analog module
   T    MB   121             //send buffer: Address
   L    2#1101               // set parameter bits P3-P2-P1-P0
   T    MB   122             //send buffer: Parameters
```

1) We are unable to guarantee that the specifications are correct.

```
// Set M130.0 here to enable the FC command
CALL  "ASi_3422"                  // open the command interface
ACT :=M130.0                      // enable command
STARTUP :=M116.0                  // initialize component
LADDR :=MW110                     // base address of the CP343-2
SEND :=P#M 120.0 BYTE 3           // send buffer (3 bytes)
RECV :=MB123                      // reception buffer (1 byte), not used here
DONE :=M130.1
ERROR :=M130.2
STATUS :=MD112                    // MW112 contains error code, MW114 must not be
                                  changed
U   M   130.1                     // command no. 0 executed successfully
U   M   130.0                     // and command no. 0 active
S   M   131.0                     // then activate command no. 2
O   M   130.1                     // command no. 0 executed successfully
O   M   130.2                     // or command no. 0 aborted with error
R   M   130.0                     // then deactivate command
L   2                             // command number 2 = write parameter value
T   MB  120                       //send buffer: Command
CALL  "ASi_3422"                  // open the command interface
ACT :=M131.0                      // activate command no. 2
STARTUP :=M116.0                  // initialize component
LADDR :=MW110                     // base address of the CP343-2
SEND :=P#M 120.0 BYTE 3           // send buffer (3 bytes)
RECV :=MB123                      // reception buffer (1 byte), not used here
DONE :=M131.1
ERROR :=M131.2
STATUS :=MD112                    // MW112 contains error code, MW114 must not be
                                  changed
O   M   131.1                     // command no. 2 executed successfully
O   M   131.2                     // or command no. 2 aborted with error
R   M   130.0                     // then deactivate command
```

Other information

See also Manual SIMATIC NET CP 343-2 / CP 343-2 P actuator-sensor interface master

- Chapter 3.1 *Description of the FC "ASI_3422"*
- Chapter 3.2.1 *Configuring the parameter value (Set_Permanent_Parameter)*

5.4.1.2 Transferring I/O data

See Chapter 5.3.1.2.

Order numbers

A

A.1 Analog modules

A.1.1 Input modules

Order numbers for input modules

Each module is shipped with two coding elements.

Table A-1 Order numbers for input modules

Module variant	MLFB	Coding setting
1, 2 inputs		
• Current measurement	3RK1207-1BQ40-0AA3 1)	B1
	3RK2207-1BQ50-0AA3 2)	B1
• Voltage Measurement	3RK1207-2BQ40-0AA3 1)	B2
	3RK2207-2BQ50-0AA3 2)	B2
• Thermal resistance measurement	3RK1207-3BQ40-0AA3 1)	B3
4 inputs		
• Current measurement	3RK1207-1BQ44-0AA3	B1
• Voltage Measurement	3RK1207-2BQ44-0AA3	B2
• Thermal resistance measurement	3RK1207-3BQ44-0AA3	B3

1) Operation with 1 input only possible with jumper 3RK1901-1AA00 (see Chapter 3.1)
2) Operation with 1, 2 inputs configurable via ID1 code

Mounting plates must be ordered separately (see Appendix A.2).

A.1.2 Output modules

Order numbers for output modules

Each module is shipped with two coding elements.

Table A-2 Order numbers for output modules

Module variant	MLFB	Coding setting
Current output	3RK1107-1BQ40-0AA3	B4
Voltage output	3RK1107-2BQ40-0AA3	B5

Mounting plates must be ordered separately (see Appendix A.2).

A.2 Accessories

Table A-3 Accessories and Order Numbers

Description	Order number
Long mounting plate for screwed connection	3RK1901-0CA00
Long mounting plate for screwed installation on top hat rail	3RK1901-0CB00
DIN rail adapter for mounting plate	3RX1660-0B
Rating plate 9 x 20, petrol (19 frame, 380 plate)	3RT1900-1SB50
Set of seals for mounting plate (pack with 5 straight seals and 5 profiled seals)	3RK1902-0AR00
Sealing cap M 12 (pack with 10 caps)	3RK1901-1KA00
M 12 coupler plug, straight, 5-pin. (unshielded)	3RX1667
M 12 coupler plug, angled, 5-pin. (unshielded)	3RX1668
Jumper for operation with 1 input (applies to modules: 3RK1207-1BQ40-0AA3 3RK1207-2BQ40-0AA3 3RK1207-3BQ40-0AA3)	3RK1901-1AA00
AS-Interface addressing and diagnosis device	3RK1904-2AB01

Technical specifications

B

B.1 Input modules

B.1.1 General Data and Properties

Table B-1 General Data and Properties

Dimensions L x W x H			153 x 60 x 29 mm		
Weight (with mounting plate)			approx. 230 g		
Actuator-sensor interface profile			3RK1207		3RK2207
I / O configuration	(hex)		7	7	7
ID code	(hex)		3	3	A
ID 2	(hex)		D	E	9
Number of inputs (channels)			1, 2	4	2
Types of measuring			Current measurement Voltage Measurement Thermal resistance Pt 100 / Ni 100 Resistance measurement 0 ... 600 Ω		
Cable length shielded			≤ 30 m		
Degree of protection			IP67		
Ambient temperature					
In operation					
• without auxiliary voltage		with load current from L+ >30 mA with load current < 30 mA	-20 ... +60 °C -20 ... +70 °C		
• with auxiliary voltage		with load current < 500 mA	-20 ... +70 °C		
In storage			-40 ... +85 °C		
Site altitude			max. 2000 m		
Installation position			any		
Connection of measurement transducer					
Current measurement, voltage measurement			any, but U_{GL} <±2V with 2 sensors of common module		
Resistance / thermal-resistance measurement			floating		

Table B-1 General Data and Properties (cont.)

Connection of sensors via M 12 socket		
Ground for shield		possible via pin 5 of the M 12 connector (see Chapter 1, Page 13)
Grounding the module		possible by mounting plate
Differential inputs		Yes
Processing bipolar input signals		possible
Parameterization of various measurement ranges		possible
AS-i interface		integral
Power supply from AS-i		Yes
Connection of an AS-i addressing device possible		Yes
Protection of the assembly against surges complying with IEC 60801-5		requires external protective devices in signal-carrying wires
Max. relative humidity		95% at +40 °C
EMC resistance		
IEC 61000-4-2 Level 3	contact discharge air discharge	6 kV, module grounded 8 kV
IEC 61000-4-3		10 V/m
IEC 61000-4-4		1 kV / 2 kV

B.1.2 Voltages, currents, potentials

Table B-2 Voltages, currents, potentials

Voltage supply			
Operating voltage		U_{AS-i}	26.5 ... 31.6 V DC
Polarity reversal protection		U_{AS-i}	Yes
Current draw from AS-i	at U_{AS-i} = 30 V	typ.	50 ... 60 mA + max. 46 mA for sensor supply
	at U_{AS-i} = 19 V [1]	max.	150 mA incl. sensor supply
Heat loss in module			approx. 1.7 W
Supply of external sensors (total of all inputs)			
from AS-i (25 V ±5%) short-circuit-protected			max. 46 mA [2]
from U_{aux} (24 ... 30 V) short-circuit-protected			max. 500 mA [3]
Electrical isolation			
Between AS-i and analog input	dielectric strength		max. 50 V
Common mode voltage UGL			
Between reference potential of the sensors and GND			max. ±2 V [4]

1) Non-permitted operating mode
2) In the case of overload, the output voltage L+ clocks
3) PELV mains adapter (protective extra-low voltage) prescribed
4) Particular attention required on connection of 2 electrically connected sensors to one module.

B.1.3 Adjustable Parameters

Table B-3 Adjustable Parameters

Signal filtering with notch frequency [1]	50 Hz 60 Hz
Smoothing consecutive measured values [1]	without 1 module scan cycle with 8 module scan cycles
Measurement ranges	
• Current measurement	see Chapter B.1.5
• Voltage Measurement	see Chapter B.1.6
• Resistance/Thermal-Resistance Measurement	see Chapter B.1.7

1) only for 3RK1207

B.1.4 Interference Suppression, Error Limits

Table B-4 Interference Suppression, Error Limits

Common mode interference (V_{ss} < 2 V)	> 70 dB
Push-pull interference	
Parameterized line frequency and multiple peak value of interference < nominal input range	> 90 dB
Cross-talk between the inputs	> 50 dB
Usage margin of error in the entire temperature range [1]	±1 %
Base margin of error at 25 °C [1]	±0.7%
Temperature fault [1]	±0.01 %/K
Linearity fault [1]	±0,05 %
Repeat accuracy, steady, at 25 °C [1]	±0,1 %

1) related to full scale of the input range

B.1.5 Current measurement

Table B-5 Current measurement

MLFB		
1, 2 inputs		3RK1207-1BQ40-0AA3
4 inputs		3RK1207-1BQ44-0AA3
2 inputs		3RK2207-1BQ50-0AA3
Parameterizable measurement ranges		
Four-wire connection with differential input		±20 mA (±23.52 mA max.) 4 ... 20 mA (+22.81 mA max.)
Two-wire connection		4 ... 20 mA [1] (+22.81 mA max.)
Data for selecting the sensor		
Input resistance of the module		50 Ω
Max. input current		26 mA
Wire break detection	7FFF (hex)	for range 4 ... 20 mA only
Coding element		Position B1

1) Sensor receives power supply from the analog module, so in 2-wire mode measuring range starts at 4 mA

B.1.6 Voltage measurement

Table B-6 Voltage Measurement

MLFB		
1, 2 inputs		3RK1207-2BQ40-0AA3
4 inputs		3RK1207-2BQ44-0AA3
2 inputs		3RK2207-2BQ50-0AA3
Parameterizable measurement ranges		
Four-wire connection with differential input		±10 V (± 11.759 V max.) 1 ... 5 V (+ 5.704 V max.)
Data for selecting the sensor		
Input resistance of the module		100 kΩ
Max. input voltage against GND (destruction limit)		module ±25 V
Max. input voltage differential (destruction limit)		module ±50 V
Wire break detection	7FFF (hex)	for range 1 ... 5 V only
Coding element		Position B2

B.1.7 Thermal resistance Pt 100 / Ni 100, resistance measurement

Table B-7 Thermal resistance Pt 100 / Ni 100, resistance measurement

MLFB	
1, 2 inputs	3RK1207-3BQ40-0AA3
4 inputs	3RK1207-3BQ44-0AA3
Parameterizable measurement ranges	
Four-wire connection	Pt 100 standard range Pt 100 climatic range Ni 100 Resistance measurement 0 ... 600 Ω
Data for selecting the sensor	
Input resistance of the module	2 MΩ
Max. input voltage against GND (destruction limit)	±10 V
Max. input voltage differential (destruction limit)	module ±20 V
Measurement current	1.667 mA
Connection type	floating
Coding element	Position B3

B.2 Output modules

B.2.1 General Data and Properties

Table B-8 General Data and Properties

Dimensions L x W x H		153 x 60 x 29 mm
Actuator-sensor interface profile		3RK1107
I / O configuration ID code ID 2	(hex) (hex) (hex)	7 3 5
Number of outputs (channels)		2
Output types		Current output
		Voltage output
Cable length shielded		≤ 30 m
Degree of protection		IP67
Ambient temperature		
In operation		-20 ... +60 °C
In storage		-40 ... +85 °C
Site altitude		max. 2000 m
Installation position		any
Connection of actuators via M 12 socket		
Ground for shield		possible via pin 5 of the M 12 connector (see Chapter 1, Page 13)
Output of bipolar analog values		possible
Parameterization of various measurement ranges		possible
AS-i interface		integral
Power supply from AS-i		Yes
Connection of an AS-i addressing device possible		Yes
Module protection against surges to IEC 60801-5		requires external protective devices in signal-carrying wires
Max. relative humidity		95% at +40 °C
EMC resistance		
IEC 61000-4-3		10 V/m
IEC 61000-4-4		1 kV / 2 kV

B.2.2 Voltages, currents, potentials

Table B-9 Voltages, currents, potentials

Voltage supply	
Operating voltage U_{AS-i}	26.5 ... 31.6 V DC
Polarity reversal protectionU_{AS-i}	Yes
Heat loss in module	max. 2 W
Electrical isolation	
Between AS-i and analog output dielectric strength	max. 50 V

B.2.3 Analog-Value Formation

Table B-10 Analog-Value Formation

Transfer time	7 AS-i cycles per output
Settling time tt	
For resistive load	0.6 ms
for inductive/capacitive loads	6.0 ms
Resolution (incl. overrange)	11 bits + signal bit
Resolution in steps	
in the nominal range (increment 16 = 1 unit)	1728
Response to reset	Outputs pegged at zero
Watchdog (outputs shut down if AS-i is faulty)	

B.2.4 Adjustable Parameters

Table B-11 Adjustable Parameters

Measurement ranges	
• Current Output	see Chapter B.2.6
• Voltage output	see Chapter B.2.7

B.2.5 Interference Suppression, Error Limits

Table B-12 Interference Suppression, Error Limits

Cross-talk between the outputs	> 50 dB
Usage margin of error in the entire temperature range [1)]	±1 %
Base margin of error at 25 °C [1)]	±0,8 %
Temperature fault [1)]	±0.01 %/K
Linearity fault [1)]	±0,08 %
Repeat accuracy, steady, at 25 °C [1)]	±0,1 %

1) related to full scale of the output range

B.2.6 Current output

Table B-13 Current output

MLFB		3RK1107-1BQ40-0AA3
Parameterizable output ranges		
Two-wire connection		±20 mA 0 ... 20 mA 4 ... 20 mA
Data for selecting the load		
Output ranges per channel:	Nominal values	±20 mA
	Maximum values	±23,50 mA
Load impedance		max. 500 Ω
with inductive load		max. 0.1 mH
No-load-protected (open output)		Yes
No-load voltage		approx. 15 V
Connection type		2-line connection
Wire-break detection		No
Coding element		Position B4

B.2.7 Voltage output

Table B-14 Voltage output

MLFB		3RK1107-2BQ40-0AA3
Parameterizable output ranges		
Two-wire connection		± 10 V 0 ... 10 V 1 ... 5 V
Data for selecting the load		
Output ranges:	Nominal values	±10 V
	Maximum values	module ±11,76 V
Load impedance		min. 1 kΩ
with capacitive load		max. 0.1 µF
Short-circuit-protected		Yes
Short-circuit current		30 mA
Connection type		2-line connection
Wire-break detection		No
Coding element		Position B5

B.3 Basic value tables

B.3.1 Basic values, Pt 100

The table below lists the basic values for Pt 100 temperature sensors.

Table B-15 Basic values, Pt 100

Temp in °C	R in Ω	Temp in °C	R in Ω	Temp in °C	R in Ω	Temp in °C	R in Ω
-200	18.52	100	138.51	400	247.09	700	345.28
-190	22.83	110	142.29	410	250.53	710	348.38
-180	27.10	120	146.07	420	253.96	720	351.46
-170	31.34	130	149.83	430	257.38	730	354.53
-160	35.34	140	153.58	440	260.78	740	357.59
-150	39.72	150	157.33	450	264.18	750	360.64
-140	43.88	160	161.05	460	267.56	760	363.67
-130	48.00	170	164.77	470	270.93	770	366.70
-120	52.11	180	168.48	480	274.29	780	369.71
-110	56.19	190	172.17	490	277.64	790	372.71
-100	60.26	200	175.86	500	280.98	800	375.70
-90	64.30	210	179.53	510	284.30	810	378.68
-80	68.33	220	183.19	520	287.62	820	381.65
-70	72.33	230	186.84	530	290.92	830	384.60
-60	76.33	240	190.47	540	294.21	840	387.55
-50	80.31	250	194.10	550	297.49	850	390.48
-40	84.27	260	197.71	560	300.75		
-30	88.22	270	201.31	570	304.01		
-20	92.16	280	204.90	580	307.25		
-10	96.09	290	208.48	590	310.49		
0	100.00	300	212.05	600	313.71		
10	103.90	310	215.61	610	316.92		
20	107.79	320	219.15	620	320.12		
30	111.67	330	222.68	630	323.30		
40	115.54	340	226.21	640	326.48		
50	119.40	350	229.72	650	329.64		
60	123.24	360	233.21	660	332.79		
70	127.08	370	236.70	670	335.93		
80	130.90	380	240.18	680	339.06		
90	134.71	390	243.64	690	342.18		

B.3.2 Basic values, Ni 100

The table below lists the basic values for Ni 100 temperature sensors.

Table B-16 Basic values, Ni 100

Temp in °C	R in Ω	Temp in °C	R in Ω	Temp in °C	R in Ω	Temp in °C	R in Ω
		10	105.6	110	168.8	210	249.8
		20	111.2	120	176.0	220	259.2
		30	117.1	130	183.3	230	268.9
-60	69.5	40	123.0	140	190.9	240	278.9
-50	74.3	50	129.1	150	198.6	250	289.2
-40	79.1	60	135.3	160	206.6		
-30	84.2	70	141.7	170	214.8		
-20	89.3	80	148.2	180	223.2		
-10	94.6	90	154.9	190	231.8		
0	100.0	100	161.8	200	240.7		

B.4 Dimensions

3RK1901-0CA00 **3RK1901-1AA00**

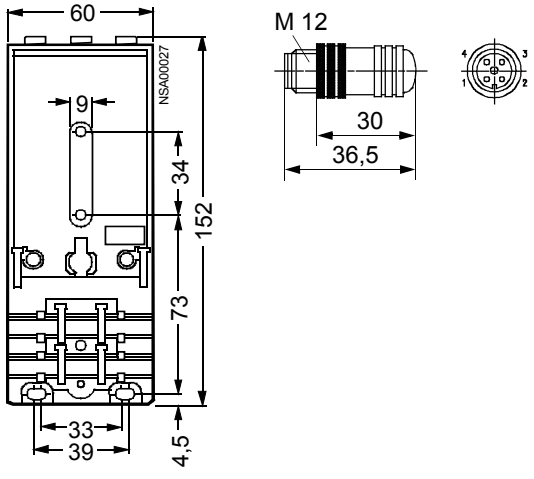


Figure B-1 Dimensions

Glossary

A / B address

According to AS-i spec. 2.1, a maximum of 62 so-called A / B modules can be connected to an AS-i master. Each address (1 ... 31) is subdivided into an A or B address.

Analog modules according to slave profile 7.3 are not A / B modules and this each require a full address, i.e., a maximum of 31 analog modules according to the slave profile 7.3 are possible at each AS-i master.

Analog modules according to the slave profile 7.A.9 are A / B modules, i.e., a maximum of 62 analog modules according to the slave profile 7.A.9 are possible at each "V3 Extended Master" with profile M4.

A / D converter

(analog/digital converter) Converts an analog signal into a digital bit pattern. Used in the analog input modules.

Actuator

Element which performs actions in response to commands (e.g. contactors, valves, analog control signals).

Address

Each ⇒ slave is assigned an individual address by which it is identified by the ⇒ master. This lies in the range from 1 - 31. The ⇒ address 0 has a special function ⇒ automatic addressing. The master addresses its slaves by means of their addresses.

Address 0

Address 0 has a special significance:

- It is the default address of each ⇒ slave when shipped.
- ⇒ Automatic addressing.

Analog

In contrast with binary signals, these are continuous values, such as temperature, pressure and so on. A given analog value can be assigned a given electrical current or voltage value.

Analog-Value Transfer

The development of a secure protocol for analog value transfer meant that the actuator-sensor interface could be used to transfer non time-critical analog values. The process is compatible with existing ⇒ masters and ⇒ slaves.

AS-i

Abbreviation used in this manual for the term ⇒ actuator-sensor interface.

AS-i cable

The AS-i cable is a specially shaped two-wire cable with polarity-reversal protection interconnecting the
⇒ slaves and the ⇒ master for the transfer of information and
⇒ auxiliary power.

AS-i power supply

The AS-i power supply unit supplies 30 V DC for the ⇒ master and all connected ⇒ slaves. The power supply unit is specially decoupled for the data-transfer streams superimposed on the voltage supply. The power supply unit is short-circuit proof and is complaint with the⇒ PELV requirements.

AS-Interface

The actuator-sensor interface is a networking system for the lowest automation levels. It is suitable for networking binary actuators and sensors.

AS-Interface master

⇒ Master

Automatic addressing

With the factory setting, a new ⇒ slave has the address 0. If it replaced with a defective slave, it is automatically assigned the address of the 'predecessor'.

Auxiliary power

Additional voltage supply for ⇒ actuators and for ⇒ sensors with high current consumption.

Binary

Two possible switching states: ON/OFF, 1 / 0.

Bit

Digital information carrier, state 1 / 0 corresponds to the OFF/ON switch signal.

Bus

(Actuator-sensor interface) 2-wire cable for serial data transfer between two or more stations.

Coding element

Mechanical component which prevents the insertion of some other ⇒ module variant. Each module variant has its own, variant-specific mechanical coding.

CP 243-2 V2

⇒ Master for deployment in a SIMATIC S7-200 according to AS-i specification 2.1. Automatic recognition and communication with analog slaves according to profile 7.3.

CP 343-2

⇒ Master for deployment in a SIMATIC S7-300 according to AS-i specification 2.1. Automatic recognition and communication with analog slaves according to profile 7.3.

D / A converter

(digital/analog converter) Converts a digital bit pattern into an analog signal. Used in the analog output modules.

Encoder

Another term for ⇒ sensor.

Ground

Ground is the entirety of all interconnected inactive parts of a resource which cannot assume a hazardous touch voltage even in the event of a fault.

HOST

A host is a system or device with at least one AS-Interface master, e.g. the ⇒ programmable logic controller with CPU is the host, the CP 343-2 is the actuator-sensor interface master.

I / O code

The I/O code defines the correlation between the inputs and outputs of the ⇒ slaves and the data bits. The I/O code defines 16 different input/output combinations.

ID code

Fixed ID code specified by the device manufacturer. It enables the AS-i master to identify the slave and also enables differentiated communication with the slave.

ID 1

Variable ID code that can be programmed by the system project planner. It enables extended identification of the devices in a system. In the case of modules according to the slave profile 7.A.9, it sets the number of channels and the data bit width.

ID 2

The ID2 code is an optional extra identifier which can be used for each ⇒ slave. The ID code is specified for each slave.

IP67

Protection type complying with DIN 40050: Complete protection against contact, protection against ingress of dust and protection against detrimental ingress of water at a certain pressure on immersion.

LED

Light-emitting diode, e.g. for operating mode indication.

LINK 20 E

Master according to AS-i specification 2.1 for deployment in a PROFIBUS-DP system, e.g. SIMATIC S7 or another PROFIBUS-DP V1 system. Automatic recognition and communication with analog slaves according to profile 7.3.

LINK Advanced

Master according to AS-i specification 3.0 for deployment in a PROFIBUS-DP system, e.g. SIMATIC S7 or another PROFIBUS-DP V1 system. A LINK Advanced is necessary when modules according to profile 7.A.9 are used.

Load

Another term for ⇒ actuator.

Master

The master is the controlling unit which monitors and coordinates data transfer from and to the slaves. It handles all aspects of organization on the ⇒ bus. The master regulates timeslice access to the bus and samples the ⇒ slaves.

Module variant

The following different types of analog module (module variants) are available:

- Input modules divided into:
  - Current input
  - Voltage input
  - Resistance/Thermal-Resistance Measurement
- Output modules divided into:
  - Current output
  - Voltage output

Mounting plate

Establishes the electromechanical connection between bus cable and compact module.

Ni 100

Temperature-sensitive resistor made of nickel (100 Ω at 0 °C).

Nominal range

Defined normal analog working range in which no overrange or underrange excursions occur.

Parameterize

Parameterization is the transfer of slave parameters from the master to the slave.

Participant

Another term for ⇒ slave.

PELV

Protective Extra-Low Voltage. A DIN VDE 0100 T410 protective measure against accidental contact.

PG

Programming device for ⇒ STEP 7 software.

PLC

Programmable logic control (e.g. SIMATIC S7-300). The PLC processes all programmed commands in accordance with the inputs and sends the results to the outputs.

Profile

⇒ Slave profile

Programmable logic controller

⇒ PLC

Pt 100

Temperature-sensitive resistor made of platinum (100 Ω at 0 °C).

Reference potential

Potential against which the voltages on the circuits in question is examined and/or measured.

Sensor

Element for registering signals (e.g. switches, proximity switches, temperature-sensitive resistors, metering devices, transducers).

SFC

System Function Call. Component in the operating system of the ⇒ PLC.

Slave

The slave is a passive station and responds only to requests from the ⇒ master. The slaves are the interfaces between the higher-order ⇒ master and the connected ⇒ actuators and ⇒ sensors. Slaves transfer data to the master only when requested to do so by the latter.

Slave profile

Operating mode with which master and slave exchange data. In the case of analog modules, slave profile 7.3 or 7.A.9 is used for analog value transfer.

STEP 7

The programming language for SIMATIC S7 programmable logic controllers.

Watchdog

Monitoring facility which ensures the correct operating status of the module.

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