

## MANUFACTURER DOCUMENT PACKAGE

# Manufacturer's Manual

ET 200S

2AI U HIGH FEATURE ANALOG INPUT MODULE

Reference package for procurement and maintenance review

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SIEMENS

**6ES7134-4LB02-0AB0****SIMATIC ET 200S 2AI U HIGH FEATURE**

Two-channel voltage analog input electronic module.

## REFERENCE PACKAGE

Selected official pages follow this cover with source pagination retained.

## OFFICIAL DOCUMENT

ET 200S 2AI U High Feature

# SIEMENS

## SIMATIC

ET 200S distributed I/O  
2AI U HF analog electronic module  
(6ES7134-4LB02-0AB0)

Manual

Preface

---

Properties

---

1

Parameters

---

2

Diagnostics

---

3

Analog value representation

---

4

Connecting

---

5

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## Safety Guidelines

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# Preface

## Purpose of the manual

This manual supplements the *ET 200S Distributed I/O System* Operating Instructions. General functions for the ET 200S are described in the *ET 200S Distributed I/O System* Operating Instructions.

The information in this document along with the operating instructions enables you to commission the ET 200S.

## Basic knowledge requirements

To understand these operating instructions you should have general knowledge of automation engineering.

## Scope of the manual

This manual applies to this ET 200S module. It describes the components that are valid at the time of publication.

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- Your local contact for Automation & Drives in our contact database.
- Information about on-site services, repairs, spare parts. Lots more can be found on our "Services" pages.

# Table of contents

|          |                                                                                   |           |
|----------|-----------------------------------------------------------------------------------|-----------|
|          | <b>Preface .....</b>                                                              | <b>3</b>  |
| <b>1</b> | <b>Properties .....</b>                                                           | <b>7</b>  |
| 1.1      | 2AI U HF analog electronic module (6ES7134-4LB02-0AB0) .....                      | 7         |
| <b>2</b> | <b>Parameters .....</b>                                                           | <b>13</b> |
| 2.1      | Parameters.....                                                                   | 13        |
| 2.2      | Parameter description.....                                                        | 14        |
| <b>3</b> | <b>Diagnostics .....</b>                                                          | <b>15</b> |
| 3.1      | Diagnostics using LED display.....                                                | 15        |
| 3.2      | Error types.....                                                                  | 16        |
| <b>4</b> | <b>Analog value representation .....</b>                                          | <b>17</b> |
| 4.1      | Introduction .....                                                                | 17        |
| 4.2      | Analog value representation for measuring range with SIMATIC S7 .....             | 17        |
| 4.3      | Effect on analog value representation .....                                       | 19        |
| 4.3.1    | Effect of the supply voltage and the operating state on analog input values ..... | 19        |
| 4.3.2    | Effect of the value range on the 2AI U HF analog input .....                      | 20        |
| <b>5</b> | <b>Connecting .....</b>                                                           | <b>21</b> |
| 5.1      | Connecting measuring sensors .....                                                | 21        |
| 5.2      | Wiring unused channels on analog input modules .....                              | 24        |
| 5.3      | Using the shield connection .....                                                 | 24        |
|          | <b>Index.....</b>                                                                 | <b>25</b> |



## Properties

### 1.1 2AI U HF analog electronic module (6ES7134-4LB02-0AB0)

#### Properties

- 2 inputs for measuring voltage
- Input ranges:
  - $\pm 5$  V, resolution 15 bits + sign
  - $\pm 10$  V, resolution 15 bits + sign
  - 1 V to 5 V, resolution 15 bits
- Isolated from the load voltage L+
- Permitted common-mode voltage between the channels 100 VAC
- Supports isochronous operation
  - Minimum time for the isochronous DP cycle ( $T_{DPmin}$ ): 0.7 ms
  - Minimum conversion time of the input modules ( $T_{WEmin}$ ): 0.5 ms
- Supports I&M functions

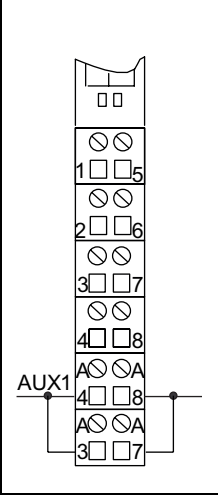
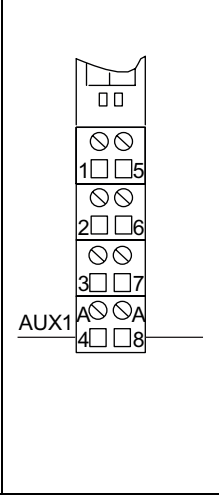
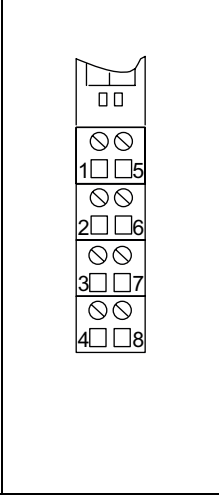
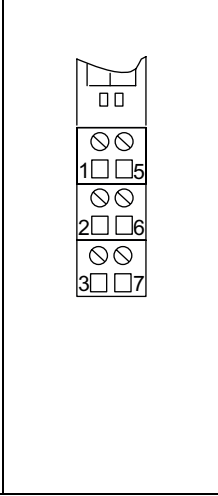
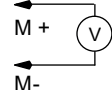
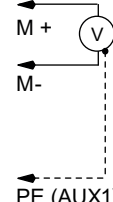
#### General terminal assignment

##### Note

Terminals 4, 8, A4, A8, A3 and A7 are only available at specified terminal modules.

| Terminal assignment for 2AI U HF (6ES7134-4LB02-0AB0) |                 |          |                 |                                                                                                                                                                                                                                                                                                                     |
|-------------------------------------------------------|-----------------|----------|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Terminal                                              | Assignment      | Terminal | Assignment      | Notes                                                                                                                                                                                                                                                                                                               |
| 1                                                     | M <sub>0+</sub> | 5        | M <sub>1+</sub> | <ul style="list-style-type: none"> <li>• M<sub>n+</sub>: Input signal "+", channel n</li> <li>• M<sub>n-</sub>: Input signal "-", channel n</li> <li>• n.c.: Not connected (max. 30 V DC can be connected)</li> <li>• AUX1: Protective-conductor terminal or potential bus (freely usable up to 230 VAC)</li> </ul> |
| 2                                                     | M <sub>0-</sub> | 6        | M <sub>1-</sub> |                                                                                                                                                                                                                                                                                                                     |
| 3                                                     | n.c.            | 7        | n.c.            |                                                                                                                                                                                                                                                                                                                     |
| 4                                                     | n.c.            | 8        | n.c.            |                                                                                                                                                                                                                                                                                                                     |
| A4                                                    | AUX1            | A8       | AUX1            |                                                                                                                                                                                                                                                                                                                     |
| A3                                                    | AUX1            | A7       | AUX1            |                                                                                                                                                                                                                                                                                                                     |

Usable terminal modules

| Usable terminal modules for 2AI U HF (6ES7134-4LB02-0AB0)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                      |                                      |                                      |                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|-----------------------|
| TM-E15C26-A1<br>(6ES7193-4CA50-0AA0)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | TM-E15C24-A1<br>(6ES7193-4CA30-0AA0) | TM-E15C24-01<br>(6ES7193-4CB30-0AA0) | TM-E15C23-01<br>(6ES7193-4CB10-0AA0) | ← Spring terminal     |
| TM-E15S26-A1<br>(6ES7193-4CA40-0AA0)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | TM-E15S24-A1<br>(6ES7193-4CA20-0AA0) | TM-E15S24-01<br>(6ES7193-4CB20-0AA0) | TM-E15S23-01<br>(6ES7193-4CB00-0AA0) | ← Screw-type terminal |
| TM-E15N26-A1<br>(6ES7193-4CA80-0AA0)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | TM-E15N24-A1<br>(6ES7193-4CA70-0AA0) | TM-E15N24-01<br>(6ES7193-4CB70-0AA0) | TM-E15N23-01<br>(6ES7193-4CB60-0AA0) | ← Fast Connect        |
| <div><div></div><div></div><div></div><div></div><div><div>Wiring examples</div><div></div><div></div></div></div> |                                      |                                      |                                      |                       |

Block diagram

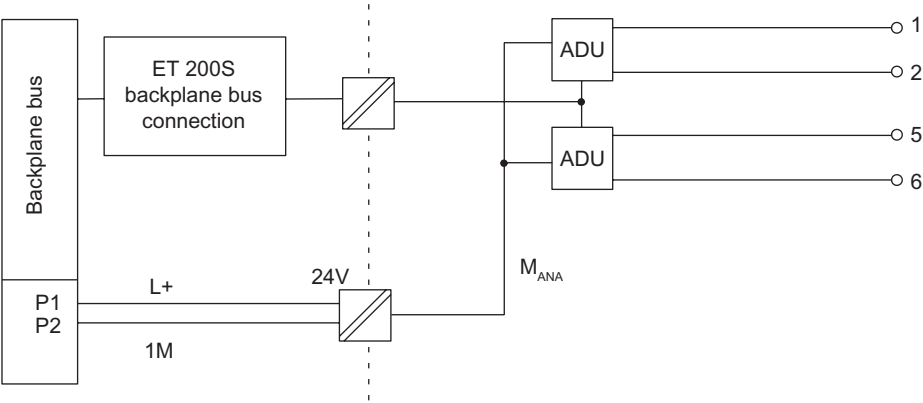


Figure 1-1 Block diagram of the 2AI U HF

## 2AI U HF technical data (6ES7134-4LB02-0AB0)

| Dimensions and weight                                                                                |                                                   |
|------------------------------------------------------------------------------------------------------|---------------------------------------------------|
| Width (mm)                                                                                           | 15                                                |
| Weight                                                                                               | Approx. 45 g                                      |
| Module-specific data                                                                                 |                                                   |
| Supports isochronous operation <sup>1</sup>                                                          | Yes                                               |
| Supports I&M functions                                                                               | Yes                                               |
| Number of inputs                                                                                     | 2                                                 |
| Cable length                                                                                         |                                                   |
| • Shielded                                                                                           | Max. 200 m                                        |
| Parameter length                                                                                     | 12 bytes                                          |
| Address space                                                                                        | 4 bytes                                           |
| Analog value representation                                                                          | S5 and S7 format                                  |
| <sup>1</sup> Supported if no interference frequency suppression or smoothing is configured.          |                                                   |
| Voltages, currents, potentials                                                                       |                                                   |
| Rated load voltage L+ (from the power module)                                                        | 24 VDC                                            |
| • Reverse polarity protection                                                                        | Yes                                               |
| • Supply of the transmitters                                                                         | No                                                |
| Electrical isolation                                                                                 |                                                   |
| • Between the channels and backplane bus                                                             | Yes                                               |
| • Between the channels and load voltage L+                                                           | Yes                                               |
| • Between the channels                                                                               | No                                                |
| Permissible potential difference                                                                     |                                                   |
| • Between channels ( $U_{CM}$ )                                                                      | 140 VDC / 100 VAC                                 |
| • Between $M_{ANA}$ and the central grounding point ( $U_{iso}$ )                                    | 75 V DC, 60 V AC                                  |
| Insulation tested                                                                                    | 500 VDC                                           |
| Current consumption                                                                                  |                                                   |
| • From load voltage L+                                                                               | Max. 55 mA                                        |
| Power dissipation of the module                                                                      | Typically 0.85 W                                  |
| Status, interrupts, diagnostics                                                                      |                                                   |
| Diagnostics function                                                                                 |                                                   |
| • Group error                                                                                        | Red "SF" LED                                      |
| • Diagnostic functions readable                                                                      | Yes                                               |
| • Hardware interrupts <sup>2</sup>                                                                   | Configurable, violation of upper and lower limits |
| <sup>2</sup> Hardware interrupts are only sent if the process interrupt mechanism is not overloaded. |                                                   |

## Properties

### 1.1 2AI U HF analog electronic module (6ES7134-4LB02-0AB0)

| Analog value generation                                                                                          |                                                                                                    |                 |      |
|------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|-----------------|------|
| Measuring principle                                                                                              | Sigma-Delta                                                                                        |                 |      |
| Conversion and cycle time                                                                                        |                                                                                                    |                 |      |
| • Integration time can be assigned parameters                                                                    | Yes                                                                                                |                 |      |
| • Interference frequency suppression in Hz                                                                       | 60                                                                                                 | 50              | No   |
| • Conversion time in ms (per channel)                                                                            | 17                                                                                                 | 20              | 0,04 |
| • Cycle time in ms (per module)                                                                                  | 18                                                                                                 | 21              | 0,5  |
| • Resolution (including overshoot range)                                                                         | ±10 V/15 bits + sign<br>±5 V/15 bits + sign<br>1 to 5 V/15 bits                                    |                 |      |
| Suppression of interference, limits of error                                                                     |                                                                                                    |                 |      |
| Interference voltage suppression for<br>f = n x (f1 ± 0.5 %), (f1 = interference frequency)                      |                                                                                                    |                 |      |
| • Common-mode interference (U <sub>ss</sub> )                                                                    | Min. 100 dB                                                                                        |                 |      |
| • Series-mode interference<br>(peak interference value < rated value of input range)                             | min. 90 dB                                                                                         |                 |      |
| • Crosstalk between the inputs                                                                                   | min. -100 dB                                                                                       |                 |      |
| Operational limit<br>(entire temperature range with reference to input range; calibration enabled <sup>1</sup> ) | ±0.1% with interference frequency suppression<br>±0.2% without interference frequency suppression  |                 |      |
| Operational limit<br>(operational limit at 25°C)                                                                 | ±0.05% with interference frequency suppression<br>±0.1% without interference frequency suppression |                 |      |
| Temperature error (with reference to the input range)                                                            | ± 0.003 %/K                                                                                        |                 |      |
| Linearity error (with reference to the input range)                                                              | ± 0,01 %                                                                                           |                 |      |
| Repeatability<br>(in steady state at 25°C with reference to input range)                                         | ± 0,01 %                                                                                           |                 |      |
| Data for selecting a sensor                                                                                      |                                                                                                    |                 |      |
| Input range (rated value)/input resistance                                                                       |                                                                                                    |                 |      |
| • Voltage                                                                                                        | ±10 V/min. 0.8 MΩ<br>±5 V/min. 0.8 MΩ<br>1 to 5 V/min. 0.8 MΩ                                      |                 |      |
| Permitted input voltage (destruction limit)                                                                      | 35 V continuous<br>75 V for 1 ms max., pulse-duty factor 1:20                                      |                 |      |
| Smoothing of the measured values                                                                                 | Yes, can be assigned parameters in 4 steps by means of digital filtering                           |                 |      |
|                                                                                                                  | Step                                                                                               | Time constant   |      |
|                                                                                                                  | None                                                                                               | 1 x cycle time  |      |
|                                                                                                                  | Weak                                                                                               | 4 x cycle time  |      |
|                                                                                                                  | Medium                                                                                             | 16 x cycle time |      |
|                                                                                                                  | Strong                                                                                             | 32 x cycle time |      |

**I&M functions**

The I&M data can be read from the module using interface modules with the following order numbers or firmware/product versions (or higher):

| Interface module        | Order Number       | Firmware version | Product version |
|-------------------------|--------------------|------------------|-----------------|
| IM151-1 HIGH FEATURE    | 6ES7151-1BA01-0AB0 | V2.0             | 02              |
| IM151-3 PN              | 6ES7151-3AA20-0AB0 | V4.0             | 01              |
| IM151-3 PN HIGH FEATURE | 6ES7151-3AA20-0AB0 | V4.0             | 01              |
| IM151-3 PN FO           | 6ES7151-3BB21-0AB0 | V4.0             | 01              |



## Parameters

### 2.1 Parameters

Table 2-1 Parameters for analog input module

| 2AI U HF                                                       | Range of values                                                                                                                                      | Default setting | Applicability |
|----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---------------|
| Group diagnostics (parameter assignment error, internal error) | <ul style="list-style-type: none"> <li>• Disable</li> <li>• Enable</li> </ul>                                                                        | Disable         | Module        |
| Diagnostics: Overflow/underflow                                | <ul style="list-style-type: none"> <li>• Disable</li> <li>• Enable</li> </ul>                                                                        | Disable         | Module        |
| Smoothing <sup>1</sup>                                         | <ul style="list-style-type: none"> <li>• None</li> <li>• Weak</li> <li>• Medium</li> <li>• Strong</li> </ul>                                         | None            | Channel       |
| Type/range of measurement                                      | <ul style="list-style-type: none"> <li>• Deactivated</li> <li>• <math>\pm 5</math> V</li> <li>• <math>\pm 10</math> V</li> <li>• 1 to 5 V</li> </ul> | $\pm 10$ V      | Channel       |
| Interference frequency suppression <sup>1</sup>                | <ul style="list-style-type: none"> <li>• Disable</li> <li>• Enable</li> </ul>                                                                        | Disable         | Module        |
| Diagnostics: Wire break <sup>2</sup>                           | <ul style="list-style-type: none"> <li>• Disable</li> <li>• Enable</li> </ul>                                                                        | Disable         | Channel       |
| <sup>1</sup> Not with isochronous mode                         |                                                                                                                                                      |                 |               |
| <sup>2</sup> Only in the measuring range 1 V to 5 V            |                                                                                                                                                      |                 |               |

## 2.2 Parameter description

### Smoothing

The individual measured values are smoothed by digital filtering. The smoothing can be adjusted in four steps, in which the smoothing factor  $k$  multiplied with cycle time of the electronic module equals the time constant of the smoothing filter. The greater the smoothing, the greater the time constant of the filter.

The figure below shows the step response with the various smoothing factors in relation to the number of subassembly cycles.

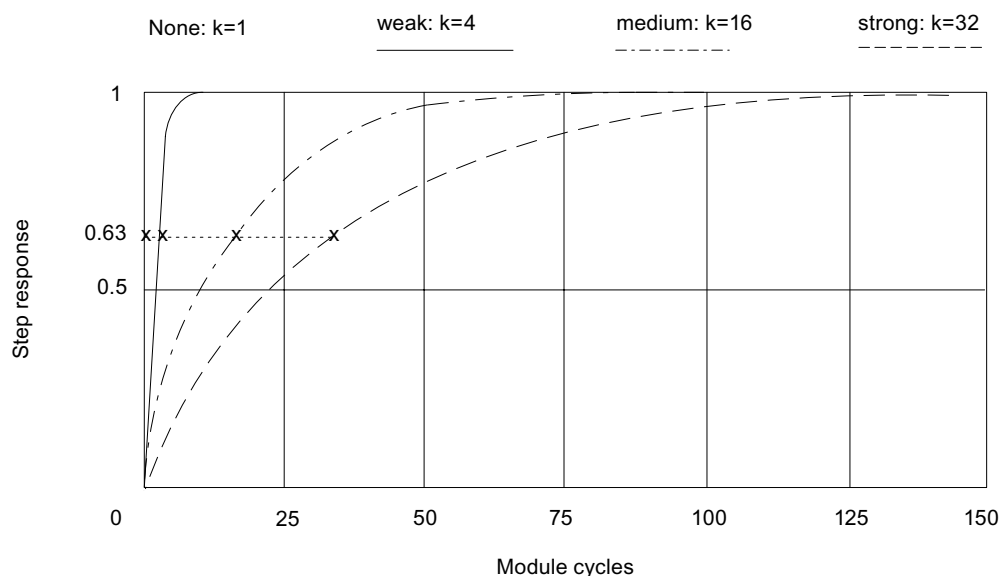


Figure 2-1 Smoothing with the 2AI U HF

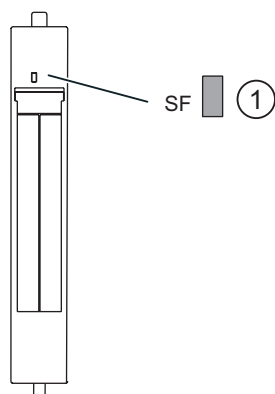
### Interference frequency suppression

The 2AI U HF analog input module supports the setting of interference frequency suppression (50 Hz or 60 Hz) on the interface module. This analog input module (HIGH FEATURE) also enables the interference frequency suppression to be disabled; i.e., this setting will be ignored on the interface module. Disabling interference suppression reduces the conversion and cycle times in this module.

## Diagnostics

### 3.1 Diagnostics using LED display

#### LED display



① Batch error (red)

#### Status and error displays

| Event (LED) | Cause                                                                                                    | Remedy                                                                            |
|-------------|----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| <b>SF</b>   |                                                                                                          |                                                                                   |
| On          | No configuration or incorrect module plugged in. No load voltage present. There is a diagnostic message. | Check the parameter assignment. Check the load voltage. Evaluate the diagnostics. |

## 3.2 Error types

### Analog input module error types

Table 3-1 Error types

| Error type      |                                    | Meaning                                                                                                                                   | Remedy                                                                                                                                                                              |
|-----------------|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16 <sub>D</sub> | 10000: Parameter assignment error  | Module cannot use the parameter for the channel:<br>Inserted module does not match the one configured.<br>Incorrect parameter assignment. | Correct the configuration (align actual and set configuration).<br>Correct the parameter assignment (wire break diagnostics only parameterized for the permitted measuring ranges). |
| 9 <sub>D</sub>  | 01001: Error                       | Internal module error (diagnostic message at channel 0 applies to the entire module)                                                      | Replace the module.                                                                                                                                                                 |
| 7 <sub>D</sub>  | 00111: Upper limit exceeded        | Value is above the overshoot range.                                                                                                       | Correct the module/final controlling element tuning.                                                                                                                                |
| 8 <sub>D</sub>  | 01000: Lower limit value undershot | Value is below the underrange.                                                                                                            | Correct the module/final controlling element tuning.                                                                                                                                |
| 6 <sub>D</sub>  | 00110: Open circuit                | Line to the encoder interrupted.                                                                                                          | Correct the process wiring.                                                                                                                                                         |

## Analog value representation

### 4.1 Introduction

#### Electronic modules with analog outputs

With the electronic module with analog inputs, continuously variable signals, such as those occurring in temperature measurement and resistance measurement, can be acquired, evaluated, and converted to digital values for further processing.

### 4.2 Analog value representation for measuring range with SIMATIC S7

#### Analog value representation

With the same nominal range, the digitized analog value is the same for input and output values. Analog values are represented in two's complement.

The following table shows the analog value representation of the analog electronic modules.

Table 4-1 Analog value representation (SIMATIC S7 format)

| Resolution               | Analog value |          |          |          |          |          |       |       |       |       |       |       |       |       |       |       |
|--------------------------|--------------|----------|----------|----------|----------|----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Bit number               | 15           | 14       | 13       | 12       | 11       | 10       | 9     | 8     | 7     | 6     | 5     | 4     | 3     | 2     | 1     | 0     |
| Significance of the bits | S            | $2^{14}$ | $2^{13}$ | $2^{12}$ | $2^{11}$ | $2^{10}$ | $2^9$ | $2^8$ | $2^7$ | $2^6$ | $2^5$ | $2^4$ | $2^3$ | $2^2$ | $2^1$ | $2^0$ |

#### Sign

The sign (S) of the analog value is always in bit number 15:

- "0" → +
- "1" → –

## Output value

The following table shows the representation of the binary analog values and the corresponding decimal and hexadecimal representation of the units of the analog values.

The table below shows the resolutions 11, 12, 13, and 15 bit + sign. Each analog value is entered left aligned in the ACCU. The bits marked with "x" are set to "0".

Table 4-2 Output values (SIMATIC S7 format)

| Resolution in bits | Units   |                 | Analog value    |               |
|--------------------|---------|-----------------|-----------------|---------------|
|                    | Decimal | Hexadecimal     | High byte       | Low byte      |
| 11+S               | 16      | 10 <sub>H</sub> | S 0 0 0 0 0 0 0 | 0 0 1 x x x x |
| 12+S               | 8       | 8 <sub>H</sub>  | S 0 0 0 0 0 0 0 | 0 0 0 1 x x x |
| 13+S               | 4       | 4 <sub>H</sub>  | S 0 0 0 0 0 0 0 | 0 0 0 0 1 x x |
| 15 + sign          | 1       | 1 <sub>H</sub>  | S 0 0 0 0 0 0 0 | 0 0 0 0 0 0 1 |

## Introduction

The following tables contain the digitized analog values for the measuring ranges of the analog input modules.

Since the binary representation of the analog values is always the same, these tables only compare the measuring ranges with the units.

## Voltage measuring ranges: $\pm 5\text{ V}$ , $\pm 10\text{ V}$

Table 4-3 SIMATIC S7 format: Measuring ranges  $\pm 5\text{ V}$  and  $\pm 10\text{ V}$

| Measuring range $\pm 5\text{ V}$ | Measuring range $\pm 10\text{ V}$ | Units   |                   | Range           |
|----------------------------------|-----------------------------------|---------|-------------------|-----------------|
|                                  |                                   | Decimal | Hexadecimal       |                 |
| > 5,8794                         | > 11,7589                         | 32767   | 7FFF <sub>H</sub> | Overflow        |
| 5,8794                           | 11,7589                           | 32511   | 7EFF <sub>H</sub> | Overshoot range |
| :                                | :                                 | :       | :                 |                 |
| 5,0002                           | 10,0004                           | 27649   | 6C01 <sub>H</sub> |                 |
| 5,00                             | 10,00                             | 27648   | 6C00 <sub>H</sub> | Nominal range   |
| 3,75                             | 7,50                              | 20736   | 5100 <sub>H</sub> |                 |
| :                                | :                                 | :       | :                 |                 |
| -3,75                            | -7,50                             | -20736  | AF00 <sub>H</sub> |                 |
| -5,00                            | -10,00                            | -27648  | 9400 <sub>H</sub> |                 |
| -5,0002                          | -10,0004                          | -27649  | 93FF <sub>H</sub> | Underrange      |
| :                                | :                                 | :       | :                 |                 |
| -5,8796                          | -11,759                           | -32512  | 8100 <sub>H</sub> |                 |
| < -5,8796                        | < -11,759                         | -32768  | 8000 <sub>H</sub> | Underflow       |

## Voltage measuring ranges: 1 to 5 V

Table 4-4 SIMATIC S7 format: Measuring range 1 to 5 V

| Measuring range<br>1 to 5 V | Units   |                   | Range           |
|-----------------------------|---------|-------------------|-----------------|
|                             | Decimal | Hexadecimal       |                 |
| > 5,704                     | 32767   | 7FFF <sub>H</sub> | Overflow        |
| 5,704                       | 32511   | 7EFF <sub>H</sub> | Overshoot range |
| :                           | :       | :                 |                 |
| 5,000145                    | 27649   | 6C01 <sub>H</sub> |                 |
| 5,000                       | 27648   | 6C00 <sub>H</sub> | Nominal range   |
| 4,000                       | 20736   | 5100 <sub>H</sub> |                 |
| :                           | :       | :                 |                 |
| 1,000                       | 0       | 0 <sub>H</sub>    |                 |
| 0,999855                    | -1      | FFFF <sub>H</sub> | Underrange      |
| :                           | :       | :                 |                 |
| 0,296                       | -4864   | ED00 <sub>H</sub> |                 |
| < 0,296                     | -32768  | 8000 <sub>H</sub> | Underflow       |

## 4.3 Effect on analog value representation

### 4.3.1 Effect of the supply voltage and the operating state on analog input values

The input and output values of the analog modules are dependent on the power supply for electronics/sensors and on the operating state of the PLC (CPU of the DP master). This is illustrated by the table below.

Table 4-5 Relationship between the analog input values for the operating state of the PLC (CPU of the DP master) and the supply voltage L+

| Operating state of the PLC (CPU of the DP master) |      | Supply voltage L+ on ET 200S (power module) | Input value of the electronic module with analog inputs (evaluation possible on the CPU of the DP master)              |
|---------------------------------------------------|------|---------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| POWER ON                                          | RUN  | L+ present                                  | Process values                                                                                                         |
|                                                   |      |                                             | 7FFF <sub>H</sub> until first conversion after startup, or after assignment of parameters for the module is completed. |
|                                                   |      | L+ missing                                  | 7FFF <sub>H</sub>                                                                                                      |
| POWER ON                                          | STOP | L+ present                                  | Process value                                                                                                          |
|                                                   |      | L+ missing                                  | 7FFF <sub>H</sub>                                                                                                      |
| POWER OFF                                         | -    | L+ present                                  | -                                                                                                                      |
|                                                   |      | L+ missing                                  | -                                                                                                                      |

### 4.3.2 Effect of the value range on the 2AI U HF analog input

The way electronic modules respond to analog inputs depends on where the input values fall within the value range. This is illustrated by the table below.

Table 4-6 Response of the analog modules, depending on where the analog input value falls within the range of values

| Measured value within ...                                        | Input value in SIMATIC S7 format | Input value in SIMATIC S5 format                |
|------------------------------------------------------------------|----------------------------------|-------------------------------------------------|
| Nominal range                                                    | Measured value                   | Measured value                                  |
| Over-/underrange                                                 | Measured value                   | Measured value                                  |
| Overflow                                                         | 7FFF <sub>H</sub>                | End of the overshoot range +1 plus overflow bit |
| Underflow                                                        | 8000 <sub>H</sub>                | End of the underrange -1 plus overflow bit      |
| Prior to parameter assignment, or incorrect parameter assignment | 7FFF <sub>H</sub>                | 7FFF <sub>H</sub>                               |

## Connecting

### 5.1 Connecting measuring sensors

#### Introduction

You can connect voltage encoders to the 2AI U HF analog input module

In this chapter you will find out how to connect the measuring encoders and what to watch out for when doing so.

#### Cables for analog signals

You should use shielded and twisted-pair cables for the analog signals. This reduces the effect of interference. You should ground the shield of the analog cables at both ends. If there are differences in potential between the cable ends, an equipotential bonding current that may interfere with the analog signals will flow across the shield. If this is the case, you should only ground the shield at one end of the cable.

#### Analog input modules

The analog input modules are electrically isolated:

- Between the logic and backplane bus
- Between the load voltage and the channels.
  - Electrical isolation: No link between  $M_{ANA}$  and the central grounding point ( $U_{ISO}$ )

---

#### Note

Ensure that this difference in potential  $U_{ISO}$  does not exceed the permitted value. If there is a possibility of exceeding the permitted value, establish a connection between terminal  $M_{ANA}$  and the central grounding point.

---

#### Connecting measuring encoders to analog inputs

There can be only a limited potential difference  $U_{CM}$  (common mode) between the measuring lines  $M-$  of the input channels and the reference point of the measuring circuit  $M_{ANA}$ . To ensure that the permitted value is not exceeded, you must take different steps depending on whether the encoders are isolated or non-isolated. The steps you have to take are described in this chapter.

### Abbreviations used

The meanings of the abbreviations in the figures below are as follows:

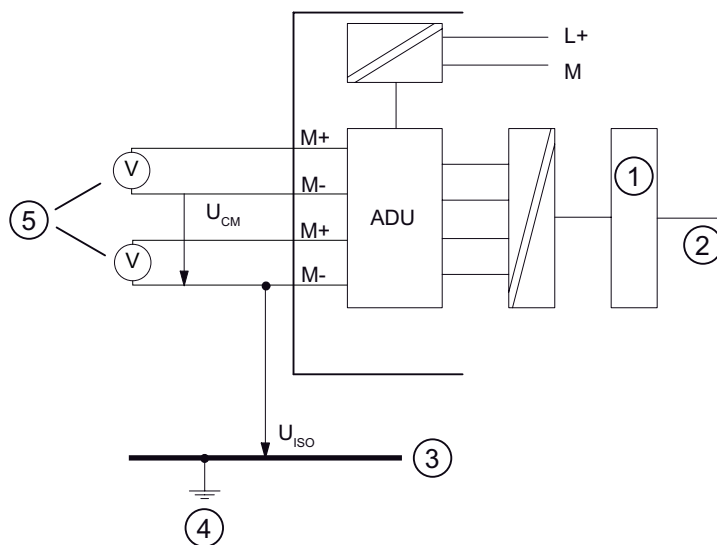
|                  |                                                                                                       |
|------------------|-------------------------------------------------------------------------------------------------------|
| M+:              | Measuring line (positive)                                                                             |
| M-               | Measuring line (negative)                                                                             |
| M <sub>ANA</sub> | Reference potential of the analog measuring circuit                                                   |
| M                | Ground connection                                                                                     |
| L+               | Rated load voltage 24 V DC                                                                            |
| U <sub>CM</sub>  | Potential difference between inputs and reference potential of the measuring circuit M <sub>ANA</sub> |
| U <sub>ISO</sub> | Potential difference between M <sub>ANA</sub> and central grounding point                             |

### Isolated measuring encoders

The isolated measuring encoders are not connected to the local ground potential. These can be potential-free. Depending on local conditions or interference, potential differences U<sub>CM</sub> (static or dynamic) can occur between the measuring lines M- of the input channels and the reference point of the measuring circuit M<sub>ANA</sub>.

The permitted value for U<sub>CM</sub> must not be exceeded, even in environments with strong EMC interference.

The following schematic representation illustrates the connection of isolated measuring encoders to the optically isolated analog input modules.



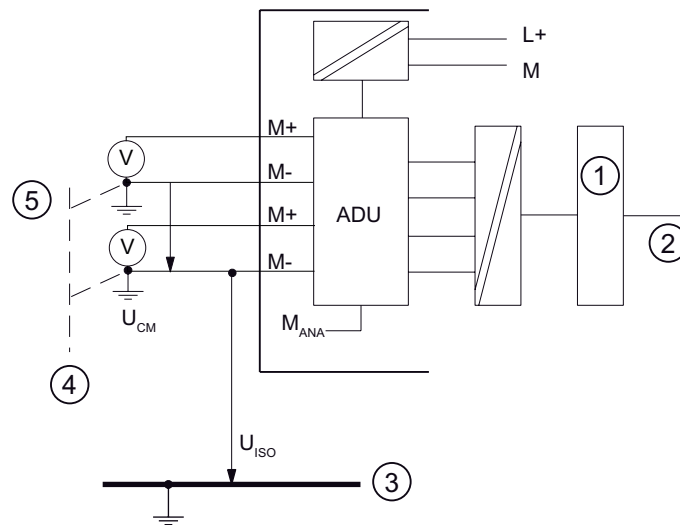
- ① Logic
- ② Backplane bus
- ③ Ground bus
- ④ Central grounding point
- ⑤ Isolated measuring encoders

### Non-isolated measuring encoders

The non-isolated measuring encoders are connected to the local ground potential. You must connect  $M_{ANA}$  to the ground potential. Depending on local conditions or interference, potential differences  $U_{CM}$  (static or dynamic) can occur between the locally distributed measuring points.

If the permitted value for  $U_{CM}$  is exceeded, there must be equipotential bonding conductors between the measuring points.

The following schematic representation illustrates the connection of non-isolated measuring encoders to an optically isolated analog input module.



- ① Logic
- ② Backplane bus
- ③ Ground bus
- ④ Equipotential bonding conductor
- ⑤ Non-isolated measuring encoders

## 5.2 Wiring unused channels on analog input modules

### Rules

Pay attention to the following instructions when wiring unused channels:

- "Deactivate" unused input channels when assigning parameters.
- A deactivated channel always returns the value 7FFF<sub>H</sub>.

## 5.3 Using the shield connection

### Rules

To prevent interference we recommend the following for analog electronic modules:

- Use shielded wires to the sensors and actuators.
- Lay out the wire shields on the shield connection.
- Connect the shield connection to the ground bus with low impedance.

# Index

## 2

2AI U HF analog electronic module  
Block diagram, 8  
Properties, 7  
Technical data, 9  
Terminal assignment, 7

## A

Analog input modules  
Error types, 16  
Analog value processing, 21

## B

Basic knowledge requirements, 3

## C

Cables for analog signals, 21  
Connecting, 21  
Connecting measuring encoders to analog inputs, 21

## D

Disposal, 3

## I

Interference frequency suppression, 14  
Internet  
Service & Support, 4  
Isolated measuring encoders, 22

## L

LED display, 15

## M

Measured value resolution, 18  
Measuring encoders, 21  
Measuring ranges with SIMATIC S7, 17

## N

Non-isolated measuring encoders, 23

## R

Recycling, 3  
Response of the analog modules, 19  
During operation, 19  
When faults occur, 19

## S

Scope  
Manual, 3  
Service & Support, 4  
Shield connection, 24  
Smoothing, 14

## T

Technical Support, 4  
Training center, 4

