



SIMATIC S7-1500 Analog input/output module AI 4x U/I/R/RTD/TC ST; 4 channels in groups of 4; Hardware interrupts; Diagnostics AQ 2x U/I ST; 2 channels in groups of 2; Substitute value; Diagnostics Common mode voltage approx. 10 V 16 bit; Accuracy 0.3%; Delivery including push-in front connector, infeed element, shield bracket and shield terminal

| General information | |
|---|--|
| Product type designation | AI 4xU/I/RTD/TC /AQ 2xU/I ST |
| HW functional status | FS01 |
| Firmware version | V1.0.0 |
| <ul style="list-style-type: none"> FW update possible | Yes |
| Product function | |
| <ul style="list-style-type: none"> I&M data Isochronous mode Prioritized startup Measuring range scalable Scalable measured values Adjustment of measuring range Output range scalable | Yes; I&M0 to I&M3 No No No No No No |
| Engineering with | |
| <ul style="list-style-type: none"> STEP 7 TIA Portal configurable/integrated from version STEP 7 configurable/integrated from version PROFIBUS from GSD version/GSD revision PROFINET from GSD version/GSD revision | V13 / V13.0.2 V5.5 SP3 / - V1.0 / V5.1 V2.3 / - |

| Operating mode | |
|----------------|-----|
| • Oversampling | No |
| • MSI | Yes |
| • MSO | Yes |

| CiR - Configuration in RUN | |
|------------------------------------|-----|
| Reparameterization possible in RUN | Yes |
| Calibration possible in RUN | Yes |

| Supply voltage | |
|-------------------------------------|--------|
| Type of supply voltage | DC |
| Rated value (DC) | 24 V |
| permissible range, lower limit (DC) | 20.4 V |
| permissible range, upper limit (DC) | 28.8 V |
| Reverse polarity protection | Yes |

| Input current | |
|---------------------------|-----------------------------|
| Current consumption, max. | 200 mA; with 24 V DC supply |

| Encoder supply | |
|----------------------------|---|
| 24 V encoder supply | |
| • Short-circuit protection | Yes |
| • Output current, max. | 20 mA; Max. 47 mA per channel for a duration < 10 s |

| Power | |
|--|-------|
| Power available from the backplane bus | 0.7 W |

| Power loss | |
|------------------|-------|
| Power loss, typ. | 3.3 W |

| Analog inputs | |
|---|---|
| Number of analog inputs | 4 |
| • For current measurement | 4 |
| • For voltage measurement | 4 |
| • For resistance/resistance thermometer measurement | 2 |
| • For thermocouple measurement | 4 |
| permissible input voltage for voltage input (destruction limit), max. | 28.8 V |
| permissible input current for current input (destruction limit), max. | 40 mA |
| Constant measurement current for resistance-type transmitter, typ. | 150 Ohm, 300 Ohm, 600 Ohm, Pt100, Pt200, Ni100: 1.25 mA; 6 000 Ohm, Pt500, Pt1000, Ni1000, LG-Ni1000: 0.625 mA; PTC: 0.472 mA |
| Technical unit for temperature measurement adjustable | Yes; °C/°F/K |
| Analog input with oversampling | No |
| Standardization of measured values | No |

| Input ranges (rated values), voltages | |
|--|--|
| • 0 to +5 V | No |
| • 0 to +10 V | No |
| • 1 V to 5 V | Yes |
| — Input resistance (1 V to 5 V) | 100 kΩ |
| • -1 V to +1 V | Yes |
| — Input resistance (-1 V to +1 V) | 10 MΩ |
| • -10 V to +10 V | Yes |
| — Input resistance (-10 V to +10 V) | 100 kΩ |
| • -2.5 V to +2.5 V | Yes |
| — Input resistance (-2.5 V to +2.5 V) | 10 MΩ |
| • -25 mV to +25 mV | No |
| • -250 mV to +250 mV | Yes |
| — Input resistance (-250 mV to +250 mV) | 10 MΩ |
| • -5 V to +5 V | Yes |
| — Input resistance (-5 V to +5 V) | 100 kΩ |
| • -50 mV to +50 mV | Yes |
| — Input resistance (-50 mV to +50 mV) | 10 MΩ |
| • -500 mV to +500 mV | Yes |
| — Input resistance (-500 mV to +500 mV) | 10 MΩ |
| • -80 mV to +80 mV | Yes |
| — Input resistance (-80 mV to +80 mV) | 10 MΩ |
| Input ranges (rated values), currents | |
| • 0 to 20 mA | Yes |
| — Input resistance (0 to 20 mA) | 25 Ω; Plus approx. 42 ohms for overvoltage protection by PTC |
| • -20 mA to +20 mA | Yes |
| — Input resistance (-20 mA to +20 mA) | 25 Ω; Plus approx. 42 ohms for overvoltage protection by PTC |
| • 4 mA to 20 mA | Yes |
| — Input resistance (4 mA to 20 mA) | 25 Ω; Plus approx. 42 ohms for overvoltage protection by PTC |
| Input ranges (rated values), thermocouples | |
| • Type B | Yes |
| — Input resistance (Type B) | 10 MΩ |
| • Type C | No |
| • Type E | Yes |
| — Input resistance (Type E) | 10 MΩ |
| • Type J | Yes |
| — Input resistance (type J) | 10 MΩ |
| • Type K | Yes |
| — Input resistance (Type K) | 10 MΩ |
| • Type L | No |
| • Type N | Yes |

- Input resistance (Type N) 10 MΩ
- Type R Yes
- Input resistance (Type R) 10 MΩ
- Type S Yes
- Input resistance (Type S) 10 MΩ
- Type T Yes
- Input resistance (Type T) 10 MΩ
- Type U No
- Type TXK/TXK(L) to GOST No

Input ranges (rated values), resistance thermometer

- Cu 10 No
- Cu 10 according to GOST No
- Cu 50 No
- Cu 50 according to GOST No
- Cu 100 No
- Cu 100 according to GOST No
- Ni 10 No
- Ni 10 according to GOST No
- Ni 100 Yes; Standard/climate
- Input resistance (Ni 100) 10 MΩ
- Ni 100 according to GOST No
- Ni 1000 Yes; Standard/climate
- Input resistance (Ni 1000) 10 MΩ
- Ni 1000 according to GOST No
- LG-Ni 1000 Yes; Standard/climate
- Input resistance (LG-Ni 1000) 10 MΩ
- Ni 120 No
- Ni 120 according to GOST No
- Ni 200 No
- Ni 200 according to GOST No
- Ni 500 No
- Ni 500 according to GOST No
- Pt 10 No
- Pt 10 according to GOST No
- Pt 50 No
- Pt 50 according to GOST No
- Pt 100 Yes; Standard/climate
- Input resistance (Pt 100) 10 MΩ
- Pt 100 according to GOST No
- Pt 1000 Yes; Standard/climate
- Input resistance (Pt 1000) 10 MΩ

| | |
|---|--|
| • Pt 1000 according to GOST | No |
| • Pt 200 | Yes; Standard/climate |
| — Input resistance (Pt 200) | 10 M Ω |
| • Pt 200 according to GOST | No |
| • Pt 500 | Yes; Standard/climate |
| — Input resistance (Pt 500) | 10 M Ω |
| • Pt 500 according to GOST | No |
| Input ranges (rated values), resistors | |
| • 0 to 150 ohms | Yes |
| — Input resistance (0 to 150 ohms) | 10 M Ω |
| • 0 to 300 ohms | Yes |
| — Input resistance (0 to 300 ohms) | 10 M Ω |
| • 0 to 600 ohms | Yes |
| — Input resistance (0 to 600 ohms) | 10 M Ω |
| • 0 to 3000 ohms | No |
| • 0 to 6000 ohms | Yes |
| — Input resistance (0 to 6000 ohms) | 10 M Ω |
| • PTC | Yes |
| — Input resistance (PTC) | 10 M Ω |
| Thermocouple (TC) | |
| Temperature compensation | |
| — parameterizable | Yes |
| — internal temperature compensation | Yes |
| — external temperature compensation via RTD | Yes |
| — Compensation for 0 °C reference point temperature | Yes; fixed value can be set |
| — Reference channel of the module | No |
| Cable length | |
| • shielded, max. | 800 m; for U/I, 200 m for R/RTD, 50 m for TC |
| Analog outputs | |
| Number of analog outputs | 2 |
| Voltage output, short-circuit protection | Yes |
| Voltage output, short-circuit current, max. | 24 mA |
| Current output, no-load voltage, max. | 22 V |
| Cycle time (all channels), min. | 3.2 ms; ± 0.5 ms, regardless of the number of activated channels |
| Output ranges, voltage | |
| • 0 to 10 V | Yes |
| • 1 V to 5 V | Yes |
| • -5 V to +5 V | No |
| • -10 V to +10 V | Yes |
| Output ranges, current | |

| | |
|--|---|
| • 0 to 20 mA | Yes |
| • -20 mA to +20 mA | Yes |
| • 4 mA to 20 mA | Yes |
| Connection of actuators | |
| • for voltage output two-wire connection | Yes |
| • for voltage output four-wire connection | Yes |
| • for current output two-wire connection | Yes |
| Load impedance (in rated range of output) | |
| • with voltage outputs, min. | 1 k Ω ; 0.5 k Ω m at 1 to 5 V |
| • with voltage outputs, capacitive load, max. | 1 μ F |
| • with current outputs, max. | 750 Ω |
| • with current outputs, inductive load, max. | 10 mH |
| Cable length | |
| • shielded, max. | 800 m; for current, 200 m for voltage |
| Analog value generation for the inputs | |
| Integration and conversion time/resolution per channel | |
| • Resolution with overrange (bit including sign), max. | 16 bit |
| • Integration time, parameterizable | Yes |
| • Integration time (ms) | 2,5 / 16,67 / 20 / 100 ms |
| • Basic conversion time, including integration time (ms) | 9 / 23 / 27 / 107 ms |
| — additional conversion time for wire-break monitoring | 9 ms |
| — additional conversion time for resistance measurement | 150 ohm, 300 ohm, 600 ohm, Pt100, Pt200, Ni100: 2 ms, 6000 ohm, Pt500, Pt1000, Ni1000, LG-Ni1000, PTC: 4 ms |
| • Interference voltage suppression for interference frequency f1 in Hz | 400 / 60 / 50 / 10 |
| • Time for offset calibration (per module) | Basic conversion time of the slowest channel |
| Smoothing of measured values | |
| • parameterizable | Yes |
| • Step: None | Yes |
| • Step: low | Yes |
| • Step: Medium | Yes |
| • Step: High | Yes |
| Analog value generation for the outputs | |
| Integration and conversion time/resolution per channel | |
| • Resolution with overrange (bit including sign), max. | 16 bit |
| • Conversion time (per channel) | 0.5 ms |
| Settling time | |
| • for resistive load | 1.5 ms |

| | |
|-----------------------|--------|
| • for capacitive load | 2.5 ms |
| • for inductive load | 2.5 ms |

Encoder

Connection of signal encoders

| | |
|--|--|
| • for voltage measurement | Yes |
| • for current measurement as 2-wire transducer — Burden of 2-wire transmitter, max. | Yes 820 Ω |
| • for current measurement as 4-wire transducer | Yes |
| • for resistance measurement with two-wire connection | Yes; Only for PTC |
| • for resistance measurement with three-wire connection | Yes; All measuring ranges except PTC; internal compensation of the cable resistances |
| • for resistance measurement with four-wire connection | Yes; All measuring ranges except PTC |

Errors/accuracies

| | |
|--|--|
| Linearity error (relative to input range), (+/-) | 0.02 % |
| Temperature error (relative to input range), (+/-) | 0.005 %/K; With TC type T 0.02 ± % / K |
| Crosstalk between the inputs, max. | -80 dB |
| Repeat accuracy in steady state at 25 °C (relative to input range), (+/-) | 0.02 % |
| Output ripple (relative to output range, bandwidth 0 to 50 kHz), (+/-) | 0.02 % |
| Linearity error (relative to output range), (+/-) | 0.15 % |
| Temperature error (relative to output range), (+/-) | 0.002 %/K |
| Crosstalk between the outputs, max. | -100 dB |
| Repeat accuracy in steady state at 25 °C (relative to output range), (+/-) | 0.05 % |
| Temperature error of internal compensation | ±6 °C |

Operational error limit in overall temperature range

| | |
|--|--|
| • Voltage, relative to input range, (+/-) | 0.3 % |
| • Current, relative to input range, (+/-) | 0.3 % |
| • Resistance, relative to input range, (+/-) | 0.3 % |
| • Resistance thermometer, relative to input range, (+/-) | 0.3 %; Ptxxx standard: ±1.5 K, Ptxxx climate: ±0.5 K, Nixxx standard: ±0.5 K, Nixxx climate: ±0.3 K |
| • Thermocouple, relative to input range, (+/-) | 0.3 %; Type B: > 600 °C ±4.6 K, type E: > -200 °C ±1.5 K, type J: > -210 °C ±1.9 K, type K: > -200 °C ±2.4 K, type N: > -200 °C ±2.9 K, type R: > 0 °C ±4.7 K, type S: > 0 °C ±4.6 K, type T: > -200 °C ±2.4 K |
| • Voltage, relative to output range, (+/-) | 0.3 % |
| • Current, relative to output range, (+/-) | 0.3 % |

Basic error limit (operational limit at 25 °C)

| | |
|---|-------|
| • Voltage, relative to input range, (+/-) | 0.1 % |
| • Current, relative to input range, (+/-) | 0.1 % |

| | |
|--|--|
| • Resistance, relative to input range, (+/-) | 0.1 % |
| • Resistance thermometer, relative to input range, (+/-) | 0.1 %; Ptxxx standard: ±0.7 K, Ptxxx climate: ±0.2 K, Nixxx standard: ±0.3 K, Nixxx climate: ±0.15 K |
| • Thermocouple, relative to input range, (+/-) | 0.1 %; Type B: > 600 °C ±1.7 K, type E: > -200 °C ±0.7 K, type J: > -210 °C ±0.8 K, type K: > -200 °C ±1.2 K, type N: > -200 °C ±1.2 K, type R: > 0 °C ±1.9 K, type S: > 0 °C ±1.9 K, type T: > -200 °C ±0.8 K |
| • Voltage, relative to output range, (+/-) | 0.2 % |
| • Current, relative to output range, (+/-) | 0.2 % |

Interference voltage suppression for $f = n \times (f_1 \pm 1 \%)$, f_1 = interference frequency

| | |
|--|-------|
| • Series mode interference (peak value of interference < rated value of input range), min. | 40 dB |
| • Common mode voltage, max. | 10 V |
| • Common mode interference, min. | 60 dB |

Interrupts/diagnostics/status information

| | |
|--|---|
| Diagnostics function | Yes |
| Substitute values connectable | Yes |
| Alarms | |
| • Diagnostic alarm | Yes |
| • Limit value alarm | Yes; two upper and two lower limit values in each case |
| Diagnoses | |
| • Monitoring the supply voltage | Yes |
| • Wire-break | Yes; only for input type 1 ... 5 V, 4 ... 20 mA, TC, R, RTD and output type current |
| • Short-circuit | Yes; Only for output type "voltage" |
| • Overflow/underflow | Yes |
| Diagnostics indication LED | |
| • RUN LED | Yes; green LED |
| • ERROR LED | Yes; red LED |
| • Monitoring of the supply voltage (PWR-LED) | Yes; green LED |
| • Channel status display | Yes; green LED |
| • for channel diagnostics | Yes; red LED |
| • for module diagnostics | Yes; red LED |

Potential separation

| | |
|--|-----|
| Potential separation analog inputs | |
| • between the channels | No |
| • between the channels, in groups of | 4 |
| • between the channels and backplane bus | Yes |
| • Between the channels and load voltage L+ | Yes |
| Potential separation analog outputs | |
| • between the channels | No |
| • between the channels, in groups of | 2 |

- between the channels and backplane bus
- Between the channels and load voltage L+

Yes
Yes

Permissible potential difference

| | |
|-----------------------------------|---------|
| between the inputs (UCM) | 20 V DC |
| Between the inputs and MANA (UCM) | 10 V DC |
| between S- and MANA (UCM) | 8 V DC |

Isolation

| | |
|-----------------------|----------------------|
| Isolation tested with | 707 V DC (type test) |
|-----------------------|----------------------|

Ambient conditions

Ambient temperature during operation

- | | |
|---------------------------------|-------|
| • horizontal installation, min. | 0 °C |
| • horizontal installation, max. | 60 °C |
| • vertical installation, min. | 0 °C |
| • vertical installation, max. | 40 °C |

Altitude during operation relating to sea level

- | | |
|---|--|
| • Installation altitude above sea level, max. | 5 000 m; Restrictions for installation altitudes > 2 000 m, see manual |
|---|--|

Dimensions

| | |
|--------|--------|
| Width | 25 mm |
| Height | 147 mm |
| Depth | 129 mm |

Weights

| | |
|-----------------|-------|
| Weight, approx. | 250 g |
|-----------------|-------|

Other

Note: Supplied incl. 40-pole push-in front connectors. Additional basic error and noise for integration time = 2.5 ms: Voltage: ± 250 mV ($\pm 0.02\%$), ± 80 mV ($\pm 0.05\%$), ± 50 mV ($\pm 0.05\%$); resistance: 150 Ohms ($\pm 0.02\%$); resistance thermometer: Pt100 climate: ± 0.08 K, Ni100 climate: ± 0.08 K; thermoelement: Type B, R, S: ± 3 K, type E, J, K, N, T: ± 1 K

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