



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 	Yes; I&M0 to I&M3
<ul style="list-style-type: none"> • Isochronous mode 	No
<ul style="list-style-type: none"> • Prioritized startup 	No
<ul style="list-style-type: none"> • Measuring range scalable 	No
<ul style="list-style-type: none"> • Scalable measured values 	No
<ul style="list-style-type: none"> • Adjustment of measuring range 	No
<ul style="list-style-type: none"> • Output range scalable 	No
Engineering with	
<ul style="list-style-type: none"> • STEP 7 TIA Portal configurable/integrated from version 	V13 / V13.0.2
<ul style="list-style-type: none"> • STEP 7 configurable/integrated from version 	V5.5 SP3 / -
<ul style="list-style-type: none"> • PROFIBUS from GSD version/GSD revision 	V1.0 / V5.1
<ul style="list-style-type: none"> • PROFINET from GSD version/GSD revision 	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 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)
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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 |
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Dimensions

Width	25 mm
Height	147 mm
Depth	129 mm

Weights

Weight, approx.	250 g
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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

last modified: 09/03/2020