



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	From FS01
Firmware version	V1.0.0
<ul style="list-style-type: none"> <li>FW update possible</li> </ul>	Yes
Product function	
<ul style="list-style-type: none"> <li>I&amp;M data</li> <li>Isochronous mode</li> <li>Prioritized startup</li> <li>Measuring range scalable</li> <li>Scalable measured values</li> <li>Adjustment of measuring range</li> <li>Output range scalable</li> </ul>	Yes; I&M0 to I&M3 No No No No No No
Engineering with	
<ul style="list-style-type: none"> <li>STEP 7 TIA Portal configurable/integrated from version</li> <li>STEP 7 configurable/integrated from version</li> <li>PROFIBUS from GSD version/GSD revision</li> <li>PROFINET from GSD version/GSD revision</li> </ul>	V13 / V13.0.2 V5.5 SP3 / - V1.0 / V5.1 V2.3 / -
Operating mode	
<ul style="list-style-type: none"> <li>Oversampling</li> <li>MSI</li> <li>MSO</li> </ul>	No Yes Yes
CiR - Configuration in RUN	
Reparameterization possible in RUN	Yes
Calibration possible in RUN	Yes
Supply voltage	
Rated value (DC)	24 V
permissible range, lower limit (DC)	19.2 V
permissible range, upper limit (DC)	28.8 V
Reverse polarity protection	Yes
Input current	
Current consumption, max.	200 mA
Encoder supply	
24 V encoder supply	
<ul style="list-style-type: none"> <li>Short-circuit protection</li> <li>Output current, max.</li> </ul>	Yes 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
<ul style="list-style-type: none"> <li>● For current measurement</li> <li>● For voltage measurement</li> <li>● For resistance/resistance thermometer measurement</li> <li>● For thermocouple measurement</li> </ul>	4 4 2 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
<b>Input ranges (rated values), voltages</b>	
<ul style="list-style-type: none"> <li>● 0 to +5 V</li> <li>● 0 to +10 V</li> <li>● 1 V to 5 V <ul style="list-style-type: none"> <li>— Input resistance (1 V to 5 V)</li> </ul> </li> <li>● -1 V to +1 V <ul style="list-style-type: none"> <li>— Input resistance (-1 V to +1 V)</li> </ul> </li> <li>● -10 V to +10 V <ul style="list-style-type: none"> <li>— Input resistance (-10 V to +10 V)</li> </ul> </li> <li>● -2.5 V to +2.5 V <ul style="list-style-type: none"> <li>— Input resistance (-2.5 V to +2.5 V)</li> </ul> </li> <li>● -25 mV to +25 mV</li> <li>● -250 mV to +250 mV <ul style="list-style-type: none"> <li>— Input resistance (-250 mV to +250 mV)</li> </ul> </li> <li>● -5 V to +5 V <ul style="list-style-type: none"> <li>— Input resistance (-5 V to +5 V)</li> </ul> </li> <li>● -50 mV to +50 mV <ul style="list-style-type: none"> <li>— Input resistance (-50 mV to +50 mV)</li> </ul> </li> <li>● -500 mV to +500 mV <ul style="list-style-type: none"> <li>— Input resistance (-500 mV to +500 mV)</li> </ul> </li> <li>● -80 mV to +80 mV <ul style="list-style-type: none"> <li>— Input resistance (-80 mV to +80 mV)</li> </ul> </li> </ul>	No No Yes 100 kΩ Yes 10 MΩ Yes 100 kΩ Yes 10 MΩ No Yes 10 MΩ Yes 100 kΩ Yes 10 MΩ Yes 10 MΩ Yes 10 MΩ
<b>Input ranges (rated values), currents</b>	
<ul style="list-style-type: none"> <li>● 0 to 20 mA <ul style="list-style-type: none"> <li>— Input resistance (0 to 20 mA)</li> </ul> </li> <li>● -20 mA to +20 mA <ul style="list-style-type: none"> <li>— Input resistance (-20 mA to +20 mA)</li> </ul> </li> <li>● 4 mA to 20 mA <ul style="list-style-type: none"> <li>— Input resistance (4 mA to 20 mA)</li> </ul> </li> </ul>	Yes 25 Ω; Plus approx. 42 ohms for overvoltage protection by PTC Yes 25 Ω; Plus approx. 42 ohms for overvoltage protection by PTC Yes 25 Ω; Plus approx. 42 ohms for overvoltage protection by PTC
<b>Input ranges (rated values), thermocouples</b>	
<ul style="list-style-type: none"> <li>● Type B <ul style="list-style-type: none"> <li>— Input resistance (Type B)</li> </ul> </li> <li>● Type C</li> <li>● Type E <ul style="list-style-type: none"> <li>— Input resistance (Type E)</li> </ul> </li> <li>● Type J <ul style="list-style-type: none"> <li>— Input resistance (type J)</li> </ul> </li> <li>● Type K <ul style="list-style-type: none"> <li>— Input resistance (Type K)</li> </ul> </li> <li>● Type L</li> <li>● Type N <ul style="list-style-type: none"> <li>— Input resistance (Type N)</li> </ul> </li> <li>● Type R <ul style="list-style-type: none"> <li>— Input resistance (Type R)</li> </ul> </li> <li>● Type S <ul style="list-style-type: none"> <li>— Input resistance (Type S)</li> </ul> </li> <li>● Type T</li> </ul>	Yes 10 MΩ No Yes 10 MΩ Yes 10 MΩ No Yes 10 MΩ Yes 10 MΩ Yes 10 MΩ Yes

— Input resistance (Type T)	10 MΩ
• Type U	No
• Type TXK/TXK(L) to GOST	No
<b>Input ranges (rated values), resistance thermometer</b>	
• 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 MΩ
• Pt 200 according to GOST	No
• Pt 500	Yes; Standard/climate
— Input resistance (Pt 500)	10 MΩ
• Pt 500 according to GOST	No
<b>Input ranges (rated values), resistors</b>	
• 0 to 150 ohms	Yes
— Input resistance (0 to 150 ohms)	10 MΩ
• 0 to 300 ohms	Yes
— Input resistance (0 to 300 ohms)	10 MΩ
• 0 to 600 ohms	Yes
— Input resistance (0 to 600 ohms)	10 MΩ
• 0 to 3000 ohms	No
• 0 to 6000 ohms	Yes
— Input resistance (0 to 6000 ohms)	10 MΩ
• PTC	Yes
— Input resistance (PTC)	10 MΩ
<b>Thermocouple (TC)</b>	
<b>Temperature compensation</b>	
— 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

<b>Cable length</b>	
<ul style="list-style-type: none"> <li>shielded, max.</li> </ul>	800 m; for U/I, 200 m for R/RTD, 50 m for TC
<b>Analog outputs</b>	
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
<b>Output ranges, voltage</b>	
<ul style="list-style-type: none"> <li>0 to 10 V</li> <li>1 V to 5 V</li> <li>-5 V to +5 V</li> <li>-10 V to +10 V</li> </ul>	<ul style="list-style-type: none"> <li>Yes</li> <li>Yes</li> <li>No</li> <li>Yes</li> </ul>
<b>Output ranges, current</b>	
<ul style="list-style-type: none"> <li>0 to 20 mA</li> <li>-20 mA to +20 mA</li> <li>4 mA to 20 mA</li> </ul>	<ul style="list-style-type: none"> <li>Yes</li> <li>Yes</li> <li>Yes</li> </ul>
<b>Connection of actuators</b>	
<ul style="list-style-type: none"> <li>for voltage output two-wire connection</li> <li>for voltage output four-wire connection</li> <li>for current output two-wire connection</li> </ul>	<ul style="list-style-type: none"> <li>Yes</li> <li>Yes</li> <li>Yes</li> </ul>
<b>Load impedance (in rated range of output)</b>	
<ul style="list-style-type: none"> <li>with voltage outputs, min.</li> <li>with voltage outputs, capacitive load, max.</li> <li>with current outputs, max.</li> <li>with current outputs, inductive load, max.</li> </ul>	<ul style="list-style-type: none"> <li>1 kΩ; 0.5 kΩ at 1 to 5 V</li> <li>1 μF</li> <li>750 Ω</li> <li>10 mH</li> </ul>
<b>Cable length</b>	
<ul style="list-style-type: none"> <li>shielded, max.</li> </ul>	800 m; for current, 200 m for voltage
<b>Analog value generation for the inputs</b>	
<b>Integration and conversion time/resolution per channel</b>	
<ul style="list-style-type: none"> <li>Resolution with overrange (bit including sign), max.</li> <li>Integration time, parameterizable</li> <li>Integration time (ms)</li> <li>Basic conversion time, including integration time (ms) <ul style="list-style-type: none"> <li>— additional conversion time for wire-break monitoring</li> <li>— additional conversion time for resistance measurement</li> </ul> </li> <li>Interference voltage suppression for interference frequency f1 in Hz</li> <li>Time for offset calibration (per module)</li> </ul>	<ul style="list-style-type: none"> <li>16 bit</li> <li>Yes</li> <li>2,5 / 16,67 / 20 / 100 ms</li> <li>9 / 23 / 27 / 107 ms <ul style="list-style-type: none"> <li>9 ms</li> <li>150 ohm, 300 ohm, 600 ohm, Pt100, Pt200, Ni100: 2 ms, 6000 ohm, Pt500, Pt1000, Ni1000, LG-Ni1000, PTC: 4 ms</li> </ul> </li> <li>400 / 60 / 50 / 10</li> <li>Basic conversion time of the slowest channel</li> </ul>
<b>Smoothing of measured values</b>	
<ul style="list-style-type: none"> <li>parameterizable</li> <li>Step: None</li> <li>Step: low</li> <li>Step: Medium</li> <li>Step: High</li> </ul>	<ul style="list-style-type: none"> <li>Yes</li> <li>Yes</li> <li>Yes</li> <li>Yes</li> <li>Yes</li> </ul>
<b>Analog value generation for the outputs</b>	
<b>Integration and conversion time/resolution per channel</b>	
<ul style="list-style-type: none"> <li>Resolution with overrange (bit including sign), max.</li> <li>Conversion time (per channel)</li> </ul>	<ul style="list-style-type: none"> <li>16 bit</li> <li>0.5 ms</li> </ul>
<b>Settling time</b>	
<ul style="list-style-type: none"> <li>for resistive load</li> <li>for capacitive load</li> <li>for inductive load</li> </ul>	<ul style="list-style-type: none"> <li>1.5 ms</li> <li>2.5 ms</li> <li>2.5 ms</li> </ul>
<b>Encoder</b>	
<b>Connection of signal encoders</b>	
<ul style="list-style-type: none"> <li>for voltage measurement</li> <li>for current measurement as 2-wire transducer <ul style="list-style-type: none"> <li>— Burden of 2-wire transmitter, max.</li> </ul> </li> <li>for current measurement as 4-wire transducer</li> <li>for resistance measurement with two-wire connection</li> </ul>	<ul style="list-style-type: none"> <li>Yes</li> <li>Yes <ul style="list-style-type: none"> <li>820 Ω</li> </ul> </li> <li>Yes</li> <li>Yes; Only for PTC</li> </ul>

<ul style="list-style-type: none"> <li>• for resistance measurement with three-wire connection</li> </ul>	Yes; All measuring ranges except PTC; internal compensation of the cable resistances
<ul style="list-style-type: none"> <li>• for resistance measurement with four-wire connection</li> </ul>	Yes; All measuring ranges except PTC
<b>Errors/accuracies</b>	
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
note regarding accuracy	at temperatures below 0 °C, the figures for operating error and temperature error are doubled
<b>Operational error limit in overall temperature range</b>	
<ul style="list-style-type: none"> <li>• Voltage, relative to input range, (+/-)</li> <li>• Current, relative to input range, (+/-)</li> <li>• Resistance, relative to input range, (+/-)</li> <li>• Resistance thermometer, relative to input range, (+/-)</li> </ul>	0.3 %
<ul style="list-style-type: none"> <li>• Thermocouple, relative to input range, (+/-)</li> </ul>	0.3 %
<ul style="list-style-type: none"> <li>• Voltage, relative to output range, (+/-)</li> <li>• Current, relative to output range, (+/-)</li> </ul>	0.3 %
<ul style="list-style-type: none"> <li>• Resistance, relative to input range, (+/-)</li> <li>• Resistance thermometer, relative to input range, (+/-)</li> </ul>	0.3 %; Ptxxx standard: ±1.5 K, Ptxxx climate: ±0.5 K, Nixxx standard: ±0.5 K, Nixxx climate: ±0.3 K
<ul style="list-style-type: none"> <li>• Thermocouple, relative to input range, (+/-)</li> </ul>	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
<b>Basic error limit (operational limit at 25 °C)</b>	
<ul style="list-style-type: none"> <li>• Voltage, relative to input range, (+/-)</li> <li>• Current, relative to input range, (+/-)</li> <li>• Resistance, relative to input range, (+/-)</li> <li>• Resistance thermometer, relative to input range, (+/-)</li> </ul>	0.1 %
<ul style="list-style-type: none"> <li>• Thermocouple, relative to input range, (+/-)</li> </ul>	0.1 %
<ul style="list-style-type: none"> <li>• Voltage, relative to output range, (+/-)</li> <li>• Current, relative to output range, (+/-)</li> </ul>	0.1 %
<ul style="list-style-type: none"> <li>• Resistance, relative to input range, (+/-)</li> <li>• Resistance thermometer, relative to input range, (+/-)</li> </ul>	0.1 %; Ptxxx standard: ±0.7 K, Ptxxx climate: ±0.2 K, Nixxx standard: ±0.3 K, Nixxx climate: ±0.15 K
<ul style="list-style-type: none"> <li>• Thermocouple, relative to input range, (+/-)</li> </ul>	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
<ul style="list-style-type: none"> <li>• Voltage, relative to output range, (+/-)</li> <li>• Current, relative to output range, (+/-)</li> </ul>	0.2 %
<ul style="list-style-type: none"> <li>• Current, relative to output range, (+/-)</li> </ul>	0.2 %
<b>Interference voltage suppression for <math>f = n \times (f_1 \pm 1 \%)</math>, <math>f_1</math> = interference frequency</b>	
<ul style="list-style-type: none"> <li>• Series mode interference (peak value of interference &lt; rated value of input range), min.</li> </ul>	40 dB
<ul style="list-style-type: none"> <li>• Common mode voltage, max.</li> </ul>	10 V
<ul style="list-style-type: none"> <li>• Common mode interference, min.</li> </ul>	60 dB
<b>Interrupts/diagnostics/status information</b>	
Diagnostics function	Yes
Substitute values connectable	Yes
<b>Alarms</b>	
<ul style="list-style-type: none"> <li>• Diagnostic alarm</li> <li>• Limit value alarm</li> </ul>	Yes
	Yes; two upper and two lower limit values in each case
<b>Diagnoses</b>	
<ul style="list-style-type: none"> <li>• Monitoring the supply voltage</li> <li>• Wire-break</li> </ul>	Yes
<ul style="list-style-type: none"> <li>• Short-circuit</li> <li>• Overflow/underflow</li> </ul>	Yes; only for input type 1 ... 5 V, 4 ... 20 mA, TC, R, RTD and output type current
	Yes; Only for output type "voltage"
	Yes
<b>Diagnostics indication LED</b>	
<ul style="list-style-type: none"> <li>• RUN LED</li> <li>• ERROR LED</li> <li>• Monitoring of the supply voltage (PWR-LED)</li> <li>• Channel status display</li> <li>• for channel diagnostics</li> </ul>	Yes; green LED
	Yes; red LED
	Yes; green LED
	Yes; green LED
	Yes; red LED

• for module diagnostics	Yes; red LED
<b>Potential separation</b>	
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	Yes
• Between the channels and load voltage L+	Yes
<b>Permissible potential difference</b>	
between the inputs (UCM)	20 V DC
Between the inputs and MANA (UCM)	10 V DC
between S- and MANA (UCM)	8 V DC
<b>Isolation</b>	
Isolation tested with	707 V DC (type test)
<b>Ambient conditions</b>	
Ambient temperature during operation	
• horizontal installation, min.	-25 °C; From FS03
• horizontal installation, max.	60 °C
• vertical installation, min.	-25 °C; From FS03
• 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
<b>Dimensions</b>	
Width	25 mm
Height	147 mm
Depth	129 mm
<b>Weights</b>	
Weight, approx.	250 g
<b>Other</b>	
Note:	Supplied incl. 40-pole push-in front connectors. Additional basic error and noise for integration time = 2.5 ms: Voltage: $\pm 250$ mV ( $\pm 0.02\%$ ), $\pm 80$ mV ( $\pm 0.05\%$ ), $\pm 50$ mV ( $\pm 0.05\%$ ); resistance: 150 Ohms ( $\pm 0.02\%$ ); resistance thermometer: Pt100 climate: $\pm 0.08$ K, Ni100 climate: $\pm 0.08$ K; thermoelement: Type B, R, S: $\pm 3$ K, type E, J, K, N, T: $\pm 1$ K

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