

DATA SHEET - ORIGINAL INSTRUCTIONS

AI531

Analog Input Module



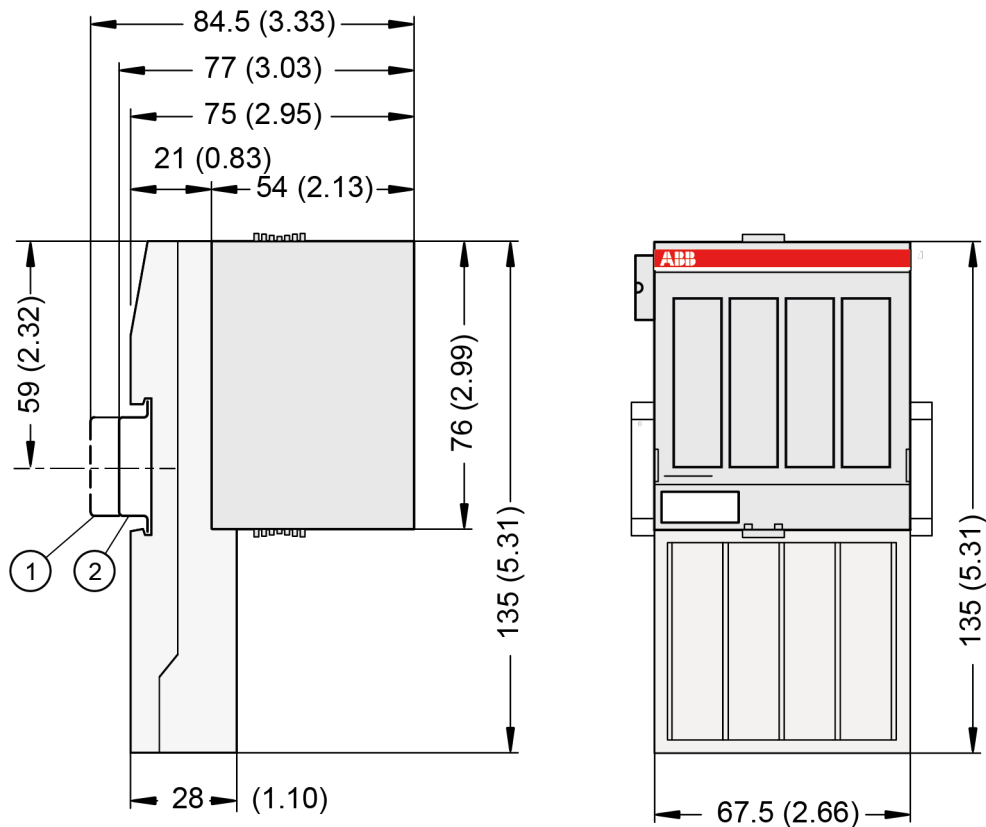
1 Ordering data

Part no.	Description	Product life cycle phase *)
1SAP 250 600 R0001	AI531, analog input module, 8 AI, U/I/Pt100, TC, 16 bits including sign, 4-wires	Active
1SAP 450 600 R0001	AI531-XC, analog input module, 8 AI, U/I/Pt100, TC, 16 bits including sign, 4-wires, XC version	Active



*) Modules in lifecycle Classic are available from stock but not recommended for planning and commissioning of new installations.

2 Dimensions



- 1 Din rail 15 mm
- 2 Din rail 7.5 mm



The dimensions are in mm and in brackets in inch.

3 Technical data

3.1 Technical data of the module

The system data of AC500 and S500 is applicable to the standard version.

🔗 Chapter 4 “System data AC500” on page 5

The system data of AC500-XC is applicable to the XC version.

🔗 Chapter 5 “System data AC500-XC” on page 9

Only deviating specifications are therefore described here.

The technical data is also applicable to the XC version.

Parameter	Value
Process voltage	
Connections	Terminals 1.8, 2.8, 3.8 and 4.8 for +24 V (UP) as well as 1.9, 2.9, 3.9 and 4.9 for 0 V (ZP)
Rated value	24 V DC

Parameter	Value
Max. ripple	5 %
Protection against reversed voltage	Yes
Rated protection fuse on UP	10 A fast
Galvanic isolation	Yes, per module
Current consumption	
From 24 V DC power supply at the terminals UP/L+ and ZP/M of the CPU/communication interface module	Ca. 2 mA
Current consumption from UP in normal operation	130 mA
Inrush current from UP (at power up)	0.056 A ² s
Max. length of analog cables, conductor cross section > 0.14 mm ² *)	100 m
Weight	130 g
Mounting position	Horizontal mounting or Vertical mounting with derating (max. temperature 40 °C)
Cooling	The natural convection cooling must not be hindered by cable ducts or other parts in the control cabinet.
*) Please note that an additional current of approx. 3µA flows out of the input for the wire break detection. Depending on the internal resistance of the signal source and the wire, this can lead to a higher measured value due to the voltage drop.	

**NOTICE!**

All I/O channels (digital and analog) are protected against reverse polarity, reverse supply, short circuit and temporary overvoltage up to 30 V DC.

3.2 Technical data of the analog inputs

Parameter	Value
Number of channels per module	8
Distribution of channels into groups	1 group of 8 channels
Connections of the channels I0 ... I3	Terminals 1.0 ... 1.7 and terminals 2.0 ... 2.7
Connections of the channels I4 ... I7	Terminals 3.0 ... 3.7 and terminals 4.0 ... 4.7
Input type	Bipolar (not with current or Pt100/ Pt1000/ Ni1000/ Cu50/ resistor)
Galvanic isolation	Against internal supply and other modules
Common mode input range	± 20 V DC plus signal voltage

Parameter		Value
Configurability		Digital input, -50 mV ... +50 mV, -500mV ... +500 mV, -1 V ... +1 V, -5 V ... +5 V, -10 V ... +10 V, 0 V ... +5 V, 0 V ... +10 V, -20 mA ... +20 mA, 0 mA ... 20 mA, 4 mA ... 20 mA, Pt100, Pt1000, Ni1000, Cu50, resistor, thermo-couple types J, K, N, S, T (each input can be configured individually)
Channel input resistance		Voltage: > 100 k Ω , current: ca. 330 Ω
Time constant of the input filter		Line-frequency suppression 50 Hz, 60 Hz, none
Indication of the input signals		1 yellow LED per channel, the brightness depends on the value of the analog signal
Conversion time		1 ms (none), 100 ms (50 Hz / 60 Hz) per channel
Resolution		16 bits including sign
Conversion error of the analog values caused by non-linearity, adjustment error at factory and resolution within the normal range	Typ.	$\pm 0.1\%$ (voltage) $\pm 0.3\%$ (current, resistor) at 25 °C
	Max	$\pm 0.7\%$ (voltage) $\pm 0.9\%$ (current, resistor) $\pm 0.5\%$ (thermocouple type J, N, S, T; thermocouple type K > -220 °C) 1.0 K (resistance temperature detectors) at 0 °C ... 60 °C or EMC disturbance
Maximum permanent allowed overload (no damage)		
	Current input	When the input current exceeds the overflow value of the measurement range, the input impedance is switched to high impedance for protection. The maximum allowed overload is then 30 V. The digital value corresponds to the overflow value. Periodically, the input impedance is switched to the normal value and the input current is measured. If the input current is within the measurement range, the input impedance remains at the normal level and the digital value corresponds to the measured current.
	Voltage input	30 V
Relationship between input signal and hex code		
Unused voltage inputs		Are configured as "unused"
Unused current inputs		Have a low resistance, can be left open-circuited
Overvoltage protection		Yes

3.3 Technical data of the analog inputs if used as digital inputs

Parameter	Value
Number of channels per module	Max. 8
Distribution of channels into groups	1 group of 8 channels
Connections of the channels I0+ to I3+	Terminals 2.0, 2.2, 2.4, 2.6
Connections of the channels I4+ to I7+	Terminals 4.0, 4.2, 4.4, 4.6
Reference potential for the inputs	Terminals 1.9, 2.9, 3.9 and 4.9 (ZP)
Input delay	Typ. 2 ms
Indication of the input signals	1 LED per channel
Input signal voltage	24 V DC
Signal 0	-30 V ... +5 V
Undefined signal	+5 V ... +13 V
Signal 1	+13 V ... +30 V
Input current per channel	
Input voltage +24 V	Typ. 5 mA
Input voltage +5 V	Typ. 1 mA
Input voltage +15 V	Typ. 3.1 mA
Input voltage +30 V	< 7 mA
Input resistance	Ca. 4.8 kΩ

4 System data AC500

4.1 Environmental conditions

Table 1: Process and supply voltages

Parameter	Value
24 V DC	
Voltage	24 V (-15 %, +20 %)
Protection against reverse polarity	Yes
100 V AC...240 V AC wide-range supply	
Voltage	100 V ... 240 V (-15 %, +10 %)
Frequency	50/60 Hz (-6 %, +4 %)
Allowed interruptions of power supply, according to EN 61131-2	
DC supply	Interruption < 10 ms, time between 2 interruptions > 1 s, PS2
AC supply	Interruption < 0.5 periods, time between 2 interruptions > 1 s



NOTICE!

Risk of damaging the PLC due to improper voltage levels!

- Never exceed the maximum tolerance values for process and supply voltages.
 - Never fall below the minimum tolerance values for process and supply voltages.
- Observe the **system data** ↗ *Chapter 4 “System data AC500” on page 5* and the **technical data** of the module used.



NOTICE!

Improper voltage level or frequency range which cause damage of AC inputs:

- AC voltage above 264 V.
- Frequency below 47 Hz or above 62.4 Hz.



NOTICE!

Improper connection leads cause overtemperature on terminals.

PLC modules may be destroyed by using wrong cable type, wire size and cable temperature classification.

Parameter		Value
Temperature		
	Operating	0 °C ... +60 °C: Horizontal mounting of modules. 0 °C ... +40 °C: Vertical mounting of modules. Output load reduced to 50 % per group.
	Storage	-40 °C ... +70 °C
	Transport	-40 °C ... +70 °C
Humidity		Max. 95 %, without condensation
Air pressure		
	Operating	> 800 hPa / < 2000 m
	Storage	> 660 hPa / < 3500 m

4.2 Creepage distances and clearances

The creepage distances and clearances meet the requirements of the overvoltage category II, pollution degree 2.

4.3 Power supply units



AC500 and AC500-eCo PLC devices are Class II/Class III devices and do not require a Protective Earth (PE) connection.

For proper EMC performance, all metal parts, DIN rails, mounting screws, and cable shield connection terminals are connected to a common ground and provide Functional Earth (FE). This is typically connected to a common reference potential, such as equipotential bonding rails.

Signal Grounds (SGND or GND) are used for signal reference and must not be connected to cable shields, FE or other signals unless otherwise specified in the specific device description.

For the supply of the modules, power supply units according to SELV or PELV specifications must be used.



Safety Extra Low Voltage (SELV) and Protective Extra Low Voltage (PELV)

To ensure electrical safety of AC500/AC500-eCo extra low voltage circuits, 24 V DC supply, communication interfaces, I/O circuits, and all connected devices must be powered from sources meeting requirements of SELV, PELV, class 2, limited voltage or limited power according to applicable standards.



WARNING!

Improper installation can lead to death by touching hazardous voltages!

To avoid personal injury, safe separation, double or reinforced insulation and separation of the primary and secondary circuit must be observed and implemented during installation.

- Only use power converters for safety extra-low voltages (SELV) with safe galvanic separation of the primary and secondary circuit.
- Safe separation means that the primary circuit of mains transformers must be separated from the secondary circuit by double or reinforced insulation. The protective extra-low voltage (PELV) offers protection against electric shock.

4.4 Electromagnetic compatibility

Table 2: Electromagnetic compatibility

Parameter	Value
Device suitable only as <i>Control Equipment for Industrial Applications</i> , including marine applications. IEC 61131-2, zone B Chapter 4.6 “Approvals and certifications” on page 9	
Radiated emission according to IEC 61000-6-4 CISPR11, class A	Yes
Conducted emission according to IEC 61000-6-4 CISPR11, class A	Yes
Electrostatic discharge (ESD) according to IEC 61000-4-2, criterion B	Air discharge: 8 kV Contact discharge: 6 kV

Parameter	Value
Fast transient interference voltages (burst) according to IEC 61000-4-4, criterion B	Power supply (DC): 2 kV Digital inputs/outputs (24 V DC): 1 kV Digital inputs/outputs (240 V AC): 2 kV Analog inputs/outputs: 1 kV Communication lines shielded: 1 kV
High energy transient interference voltages (surge) according to IEC 61000-4-5, criterion B	Power supply (DC): - Line to ground: 1 kV - Line to line: 0,5 kV Digital inputs/outputs/relay: (24 V DC): - Line to ground: 1 kV (AC): - Line to ground: 2 kV - Line to line: 1 kV Analog inputs/outputs: - Line to ground: 1 kV Communication lines: - Line to ground: 1 kV
Influence of radiated disturbances IEC 61000-4-3, criterion A	Test field strength: 10 V/m
Influence of line-conducted interferences IEC 61000-4-6, criterion A	Test voltage: 10 V
Power frequency magnetic fields IEC 61000-4-8, criterion A	30 A/m 50 Hz 30 A/m 60 Hz

4.5 Mechanical data

Parameter	Value
Mounting	Horizontal/Vertical
Wiring method	Spring/screw terminals
Degree of protection	PLC system: IP 20 • With all modules or option boards plugged in. • With all terminals plugged in. • With all covers closed.
Housing	Classification V-2 according to UL 94
Vibration resistance (sinusoidal) acc. to IEC 60068-2-6	All three axes 2 Hz ... 8.4 Hz, 3.5 mm peak, 8.4 Hz ... 150 Hz, 1 g
Shock test acc. to IEC 60068-2-27	All three axes 15 g, 11 ms, half-sinusoidal
Mounting of the modules:	

Parameter	Value
Mounting Rail Top Hat according to IEC 60715	35 mm, depth 7.5 mm or 15 mm
Mounting with screws	M4
Fastening torque	1.2 Nm

4.6 Approvals and certifications

The PLC Automation catalog contains an [overview of the available approvals and certifications](#).

5 System data AC500-XC

5.1 Environmental conditions

Table 3: Process and supply voltages

Parameter	Value
24 V DC	
Voltage	24 V (-15 %, +20 %)
Protection against reverse polarity	Yes
100 V AC...240 V AC wide-range supply	
Voltage	100 V ... 240 V (-15 %, +10 %)
Frequency	50/60 Hz (-6 %, +4 %)
Allowed interruptions of power supply, according to EN 61131-2	
DC supply	Interruption < 10 ms, time between 2 interruptions > 1 s, PS2
AC supply	Interruption < 0.5 periods, time between 2 interruptions > 1 s



NOTICE!

Risk of damaging the PLC due to improper voltage levels!

- Never exceed the maximum tolerance values for process and supply voltages.
- Never fall below the minimum tolerance values for process and supply voltages. Observe the **system data** [Chapter 4 “System data AC500” on page 5](#) and the **technical data** of the module used.



NOTICE!

Improper voltage level or frequency range which cause damage of AC inputs:

- AC voltage above 264 V.
- Frequency below 47 Hz or above 62.4 Hz.



NOTICE!

Improper connection leads cause overtemperature on terminals.

PLC modules may be destroyed by using wrong cable type, wire size and cable temperature classification.

Parameter		Value
Temperature		
	Operating	-40 °C ... +70 °C -40 °C ... 0 °C: Due to the LCD technology, the display might respond very slowly. -40 °C ... +40 °C: Vertical mounting of modules possible, output load limited to 50 % per group +60 °C ... +70 °C with the following deratings: • System is limited to maximum 2 communication modules per terminal base. • Digital inputs: maximum number of simultaneously switched on input channels limited to 75 % per group (e.g. 8 channels => 6 channels). • Digital outputs: output current maximum value (all channels together) limited to 75 % per group (e.g. 8 A => 6 A). • Analog outputs only if configured as voltage output: maximum total output current per group is limited to 75 % (e.g. 40 mA => 30 mA). • Analog outputs only if configured as current output: maximum number of simultaneously used output channels limited to 75 % per group (e.g. 4 channels => 3 channels).
	Storage / Transport	-40 °C ... +85 °C
Humidity		Operating / Storage: 100 % r. H. with condensation
Air pressure		Operating: -1000 m 5000 m (1080 hPa ... 620 hPa) > 2000 m (< 795 hPa): • Maximum operating temperature must be reduced by 10 K for each 1000 m exceeding 2000 m. • I/O module relay contacts must be operated with 24 V nominal only.
Immunity to corrosive gases		Yes, according to: ISA S71.04.1985 Harsh group A, G3/GX IEC60068-2-60 Method 4 with the following concentrations: • H2S 100 ± 10ppb • NO2 1250 ± 20ppb • CL2 100 ± 10ppb • SO2 300 ± 20ppb
Immunity to salt mist		Yes, horizontal mounting only, according to IEC 60068-2-52 severity level: 1

**NOTICE!****Risk of corrosion!**

Unused connectors and slots may corrode if XC devices are used in salt-mist environments.

Protect unused connectors and slots with TA535 protective caps for XC devices.

**NOTICE!****Risk of malfunctions!**

Unused slots for communication modules are not protected against accidental physical contact.

- Unused slots for communication modules must be covered with dummy communication modules to achieve IP20 rating.
- I/O bus connectors must not be touched during operation.

5.2 Creepage distances and clearances

The creepage distances and clearances meet the requirements of the overvoltage category II, pollution degree 2.

5.3 Power supply units



AC500 and AC500-eCo PLC devices are Class II/Class III devices and do not require a Protective Earth (PE) connection.

For proper EMC performance, all metal parts, DIN rails, mounting screws, and cable shield connection terminals are connected to a common ground and provide Functional Earth (FE). This is typically connected to a common reference potential, such as equipotential bonding rails.

Signal Grounds (SGND or GND) are used for signal reference and must not be connected to cable shields, FE or other signals unless otherwise specified in the specific device description.

**Safety Extra Low Voltage (SELV) and Protective Extra Low Voltage (PELV)**

To ensure electrical safety of AC500/AC500-eCo extra low voltage circuits, 24 V DC supply, communication interfaces, I/O circuits, and all connected devices must be powered from sources meeting requirements of SELV, PELV, class 2, limited voltage or limited power according to applicable standards.

**WARNING!****Improper installation can lead to death by touching hazardous voltages!**

To avoid personal injury, safe separation, double or reinforced insulation and separation of the primary and secondary circuit must be observed and implemented during installation.

- Only use power converters for safety extra-low voltages (SELV) with safe galvanic separation of the primary and secondary circuit.
- Safe separation means that the primary circuit of mains transformers must be separated from the secondary circuit by double or reinforced insulation. The protective extra-low voltage (PELV) offers protection against electric shock.

5.4 Electromagnetic compatibility

Table 4: Electromagnetic compatibility

Parameter	Value
Device suitable only as <i>Control Equipment for Industrial Applications</i> , including marine applications. IEC 61131-2, zone B  Chapter 5.6 “Approvals and certifications” on page 13	
Radiated emission according to IEC 61000-6-4 CISPR11, class A	Yes
Conducted emission according to IEC 61000-6-4 CISPR11, class A	Yes
Electrostatic discharge (ESD) according to IEC 61000-4-2, criterion B	Air discharge: 8 kV Contact discharge: 6 kV
Fast transient interference voltages (burst) according to IEC 61000-4-4, criterion B	Power supply (DC): 4 kV Digital inputs/outputs (24 V DC): 2 kV Digital inputs/outputs (240 V AC): 4 kV Analog inputs/outputs: 2 kV Communication lines shielded: 2 kV
High energy transient interference voltages (surge) according to IEC 61000-4-5, criterion B	Power supply (DC): - Line to ground: 1 kV - Line to line: 0,5 kV Digital inputs/outputs/relay: (24 V DC): - Line to ground: 1 kV (AC): - Line to ground: 2 kV - Line to line: 1 kV Analog inputs/outputs: - Line to ground: 1 kV Communication lines: - Line to ground: 1 kV

Parameter	Value
Influence of radiated disturbances IEC 61000-4-3, criterion A	Test field strength: 10 V/m
Influence of line-conducted interferences IEC 61000-4-6, criterion A	Test voltage: 10 V
Power frequency magnetic fields IEC 61000-4-8, criterion A	30 A/m 50 Hz 30 A/m 60 Hz

5.5 Mechanical data

Parameter	Value
Mounting	Horizontal/vertical (no application in salt mist environment)
Wiring method	Spring terminals
Degree of protection	PLC system: IP 20 • With all modules or option boards plugged in. • With all terminals plugged in. • With all covers closed.
Housing	Classification V-2 according to UL 94
Vibration resistance (sinusoidal) acc. to IEC 60068-2-6	2 Hz ... 8.4 Hz, 3.5 mm peak, 8.4 Hz ... 500 Hz, 2 g
Vibration resistance (broadband random) acc. to IEC 60068-2-64	5 Hz ... 500 Hz, 1.9 g rms (operational) 5 Hz ... 500 Hz, 4 g rms (non operational)
Shock resistance	All three axes 15 g, 11 ms, half-sinusoidal
Mounting of the modules:	
Mounting Rail Top Hat according to IEC 60715	35 mm, depth 7.5 mm or 15 mm
Mounting with screws	M4
Fastening torque	1.2 Nm

5.6 Approvals and certifications

The PLC Automation catalog contains an [*overview of the available approvals and certifications*](#).