

Astraada One Compact Slim



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Notes about this handbook

This equipment handbook contains information which is specific to the product and valid at the time of printing.

This equipment handbook is only complete in conjunction with the product-related hardware and software manuals required for the specific application.

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Astraada One Compact Slim is certified to DIN EN ISO 9001:2015.

Revision log

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1.0	18/06/2020	Formatting revised in the document
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1.5	14.11.2023	Adaption Cyber security
1.6	24.04.2024	Supplement connector X10 for characteristics S01 and S02

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1. General information

This user handbook is intended for use by qualified personnel and contains information on the assembly, installation, start-up and maintenance of the device.

1.1. Notes about this handbook

This user handbook is a component of the product and applies to the following devices:

- Astraada One Compact Slim


It contains information on the following topics:

- Areas of application
- Safety
- Mechanical design
- Electrical design
- Connections
- Start-up
- Servicing and maintenance
- Decommissioning
- Disposal

- ▶ Keep this user handbook available alongside the product at all times.

1.2. Symbols and visual depictions

The following symbols and visual depictions are used in this user handbook:

Symbol	Meaning
→ ...	List entry
▶ ...	Individual instruction or list of instructions which can be carried out in any order.
1. ...	List of instructions which must be carried out in the order given.
2. ...	
	Additional product information

Structure of the warnings:

WARNING

Optional:	Type and source of the danger
More symbols	Brief description and consequences Preventive measures

1.3. Hazard categories and indications

The following indications are used for warning messages that must be observed to ensure your personal safety and avoid any damage to property.

The indications have the following meanings:

DANGER

Serious injury or death

Failure to observe the safety measures will result in death or serious injury.
Take preventive measures.

WARNING

Possible serious injury or death

Failure to observe the safety measures may result in death or serious injury.
Take preventive measures.

CAUTION

Possible minor injuries

Failure to observe the safety measures may result in minor injuries.
Take preventive measures.

NOTICE

Possible damage to property

Failure to observe the safety measures may result in damage to property.
Take preventive measures.

1.4. Qualified personnel

The installation, start-up and maintenance of the machine must be carried out by qualified personnel. For the purposes of this documentation and the safety instructions contained therein, “qualified personnel” means trained staff with the authorisation to assemble, install, start up, earth and identify devices, systems and electrical circuits in accordance with the standards set in safety engineering and who are familiar with safety concepts in automation engineering.

1.5. Duty of care

1.5.1. General

The user or processor (OEM) must ensure the following:

- The device must only be used for its intended purpose.
- The device must only be used in a perfect, fully functional condition.
- The user handbook must always be kept legible and fully available.
- Only sufficiently qualified and authorised personnel carry out assembly, installation, start-up and maintenance of the device.
- This authorised personnel must receive regular training in all relevant questions of occupational health and safety and environmental protection and must be familiar with the contents of this user handbook, particularly the sections containing safety instructions.
- Any markings or identification labels and safety and warning signs on the device must not be removed and must be kept legible at all times.
- The national and international regulations regarding the operation of machinery and installations where the device is being used must be observed.
- The user must always be kept abreast of any current relevant information regarding the device and its use or operation.
- The user is responsible for coordinating the use of the safety-related control components with the responsible authority and for adhering to its specifications.

1.6. Intended use

The devices are components of the CANtrol modular automation system based on CAN bus for industrial control applications in the medium to high performance range. It extends the communication options with EtherCAT, Profinet or Modbus for example.

The automation system is designed for use in overvoltage category I (IEC 364-4-443) for the control and regulation of machinery and industrial processes in low-voltage installations in accordance with the following basic conditions:

- Maximum rated supply voltage of 1,000 V AC (50/60 Hz) or 1,500 V DC
- For use in an environment with max. category 2 level of pollution (EN 60950)
- For use in a maximum altitude of 2,000 m a.s.l.
- For indoor use in areas not exposed to direct UV radiation
- Max. ambient temperature inside and outside the control cabinet according to the technical specifications (see “Information and options”).
- Not for use in residential areas (270011500 only)



The Astraada One Compact Slim is not designed for use in residential areas and is unable to guarantee adequate protection of radio reception in such environments.

Correct and safe operation of the automation system requires qualified project planning, proper transport, storage, installation and use as well as careful maintenance.

The automation system may only be used within the scope of the information and applications specified in this documentation and associated user handbooks.

The automation system must only be used as follows:

- ▶ As intended
- ▶ In technically perfect condition
- ▶ Without unauthorised modifications
- ▶ By qualified users only

- ▶ Observe the rules of the employers' liability insurance association, the German Technical Inspection Association (TÜV), the Association of German Electrical Engineers (VDE) or relevant national regulations.

The device is intended for installation in a suitable installation cut-out in industrial machines and systems in indoor areas.

- ▶ During installation, make sure that the existing seal profiles are undamaged.
- ▶ For operation, refer to the applicable ambient conditions (see “Information and options”).

1.7. Transport and storage

The device is susceptible to impacts, heavy vibrations, moisture and extreme temperatures.

Transport and storage

- ▶ Protect the device from heavy mechanical stresses during transport.
- ▶ Always transport the device in its original packaging.
- ▶ For storage, refer to the applicable ambient conditions.
- ▶ Protect the device from condensation and moisture.

Operation

- ▶ If the device has been stored or transported in cold weather or under conditions of large fluctuations in temperature, do not start to operate it until it has acclimatised to room temperature for the place in which it is used.
- ▶ Wait at least 12 hours after it has reached room temperature before operating the device.

Devices with (rechargeable) batteries

Lithium metal batteries are a hazardous material. According to the manufacturers, they fall under UN 3091 (contained in the device).

Special provision 188 of the ADR can be applied for transport.

1.8. Unpacking

Upon receipt of the device, make sure that it is undamaged and complete.

- ▶ Check the packaging for external damage.
- ▶ If the packaging is seriously damaged or if damage to the contents is evident: do not proceed further with opening the packaging; instead immediately inform the transport company and your supplier.
- ▶ Remove the packaging and keep it safe for subsequent transport.
- ▶ Check the contents for evidence of damage in transport.
- ▶ Check the contents for completeness against the order documentation and keep all delivery documentation for future reference. The delivery documentation contains important information about the device and is part of the product.
- ▶ If you notice any damage in transport or the contents do not match the order: inform the suppliers immediately.

2. Safety

2.1. Safety-related systems

The use of PLC controls in safety-related systems requires specific measures. If a PLC controller is to be used in a safety-related system, the user must be given comprehensive advice by the PLC manufacturer in addition to any available standards or guidelines regarding safety installations.

- ▶ Before starting work on the devices, switch off all power supplies, including those of connected peripherals.
- ▶ Keep all ventilation openings unobstructed.

The failure of certain components in an electronic control system may result in uncontrolled and/or unpredictable operational behaviour.

- ▶ All types of failure must be considered at the system level and the associated preventative measures identified.
- ▶ If necessary, request information from your automation system provider.

2.2. Safety instructions

CAUTION

Possible minor injuries and/or burning of the surface of the skin

Non-compliance with the safety features may result in minor injuries / burning of the surface of the skin

The device may be operated only when it is in good working order. Exposed sharp edges or broken glass pose an injury risk.

- ▶ If you discover damage to the front glass of the device, do not continue to operate the device. Immediately disconnect it from the power supply.

The device may heat up during operation, especially in hot environments, because of the passive cooling mechanism of the electronics inside. The surface temperature may be high enough to cause burning if there is prolonged contact with the human skin.

- ▶ If possible, avoid touching the rear panel of the device during operation.
 - ▶ If you plan to work on e.g. the installation or cabling of the device, first shut it down by disconnecting the power supply and let it cool down for a while.
 - ▶ It is recommended to wear personal protective equipment, e.g. protective gloves when handling the warmed up device.
-

Working on the device

Do not start work on the device until all necessary safety precautions have been taken. Take precautions to avoid unforeseeable functional events and movements of the system.

- ▶ Bring the system into a safe state.
- ▶ Switch the system and the device off.
- ▶ Secure the system against being switched on again.
- ▶ Disconnect the device from the system.

Do not open the device housing.

- ▶ If it is necessary to work on internal parts of the device, contact the manufacturer.

2.3. Cybersecurity

- ▶ Never place the control unit on the Internet without additional protection mechanisms, this product is not designed for this purpose
- ▶ Change the default passwords specified on delivery
- ▶ Always use an upstream external firewall to prevent access from the outside to the inside.
- ▶ Use the security mechanisms of VPN server portals (e.g. IXON) to which the controller can actively connect via VPN or comparable mechanisms
- ▶ Always use https instead of http
- ▶ Deactivate unnecessary services such as (FTP/SSH/Webserver)

3. Product description

This handbook describes Astraada One Compact Slim series products.

The Astraada One Compact Slim is a control module without a display for the control and regulation of machinery and industrial processes in low-voltage installations in real time.

The development environment CODESYS 3.5 (IEC 61131-3) from 3S-Smart Software Solutions is used for programming.

Astraada One Compact Slim controllers can be connected via various interfaces and also have their own digital and analogue inputs and outputs.

The connections are located on the front of the device. Devices from this series are intended for installation on a mounting rail in the control cabinet. All the connections are of the plug-in type.

3.1. Overview of Astraada One Compact Slim



The Compact Slim is installed on a mounting rail.

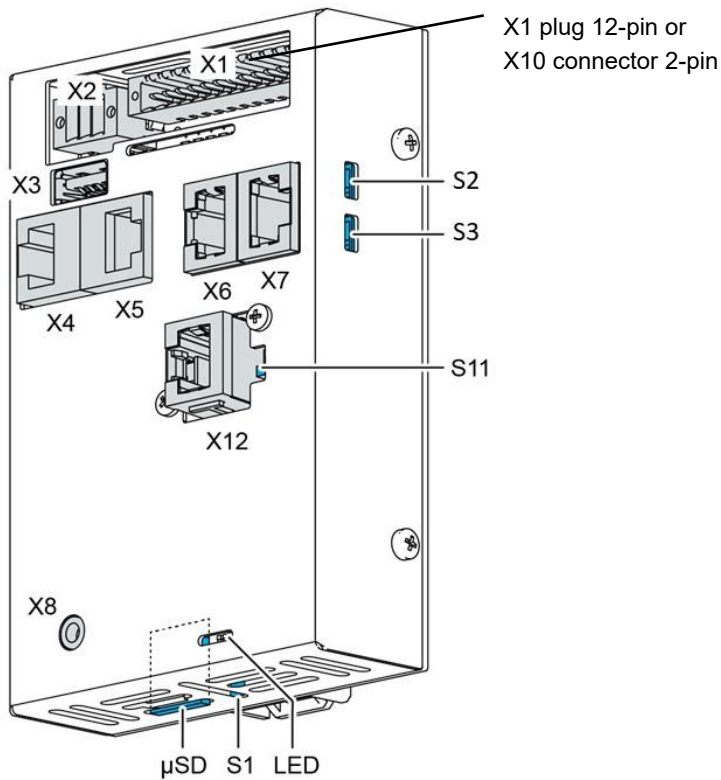


Fig. 1: Overview of Astraada One Compact Slim

No.	Designation	No.	Designation
X1	Power supply, digital inputs/outputs	X10	Power supply (S01 and S02 only)
X2	Analogue inputs	S12	CAN-Bus [CAN1] (S05 only)
X3	USB 2.0	S1	Function keys (Reset and Run/Stop)
X4	Ethernet [ETH0] ¹	S2	RS-485 terminating resistor (120 Ohm)
X5	EtherCAT [ETH1]	S3	RS-485 terminating resistor (120 Ohm)
X6	RS-232 [COM1] / RS-485 [COM2]	S11	CAN terminating resistor (120 Ohm)
X7	CAN-Bus [CAN0]	μSD	microSD card connection (optional)
X8	Debug interface	LED	LEDs: PWR, Run/Stop, Error

¹ Designations in []: CODESYS-designations of the connections

3.2. Scope of delivery and accessories

Scope of delivery

- Astraada One Compact Slim in the respective version
-

Accessories

The following accessories can be ordered directly or via the following options:

Astraada One Compact Slim plug kit:

Order option: – H001

Note: the appropriate plug kit for the respective device is supplied

Order number: S-02020105-0100

Plug kit comprising

- 12-pin plug-in connector for the digital inputs/outputs and power supply
Weidmüller BLZF 3.50/12/180
- 6-pin plug-in connector for the analogue inputs
Weidmüller B2CF 3.50/06/180

Extensions for tooling and debugging

- USB-to-Ethernet adapter order number: S-02040101-0000
- USB to WLAN adapter EasyConnect order number: S-02040102-0000

3.3. Product features

Assembly

The device is designed for installation in a control cabinet on a DIN mounting rail (35 mm) in pollution degree 2 industrial environments.

Processor

In its basic configuration, the device is equipped with an 800 MHz ARM® CPU with a Cortex™ A9 core. Customer-specific variants are available, which instead of a single core processor are equipped with a dual core or quad core processor.

Ethernet

The device has two 10/100 Mbit/s Ethernet interfaces.

The first Ethernet interface is used for standard Ethernet connections. The TCP/IP and UDP protocols permit flexible connections to visualisation software, upstream control units and to the IT infrastructure. The second Ethernet interface is used as an EtherCAT master interface.

Other protocols available for the Ethernet interfaces: PROFINET, BACnet and Modbus.

USB

The USB host interface allows a wide range of peripherals to be connected to the device. This allows a USB thumb drive to be used for updating the application or for downloading data directly.



USB thumb drives with FAT/FAT32 formatting are supported.

If you require support for other USB formats, please contact our Technical Support team.

CAN interfaces

Astraada One devices are available in versions with 1 or 2 standard CAN interface which can be used at a speed of up to 1 Mbit/s.

Serial interfaces

The device can have 2 serial interfaces (1x RS-485; 1x RS-232).

Onboard analogue inputs/outputs

The device incorporates digital inputs/outputs and analogue inputs.

Additional interfaces

There is also a debugging interface located on the device which is accessible via a 3.5-mm jack plug with a special cable (contact Customer Services if necessary).

Real-time clock

A software interface permits the current time and date to be set and read on a real-time clock with battery back-up.

microSD card

The standard commercial microSD card interface allows data to be written to or read from memory cards.

Summary of features(depends on variants)

- ARM® CPU with Cortex™-A9 single core (800 MHz; optional dual core or quad core)
- User program and data memory (RAM): 256 MB onboard
- User program memory (flash) 256 MB onboard
- 1 USB host interface (USB 2.0)
- Retain memory 100 kB
- 2 Ethernet 10/100 Base T interfaces (2nd interface: EtherCAT master interface)
- 1 or 2 CAN interfaces
- 2 serial interfaces (1x RS-232; 1x RS-485).
- 1 µSD card slot
- Onboard I/O (digital and analogue)
- Real-time clock

4. Assembly

The Astraada One Compact Slim is intended for installation on mounting rails according to DIN EN 60715:2001, 35 x 7.5 mm.

⚠ CAUTION

Danger of burns!

The surface of the device can get hot.

Ensure that there is sufficient convectional cooling.

There must be at least 50 mm clearance above and below the device.

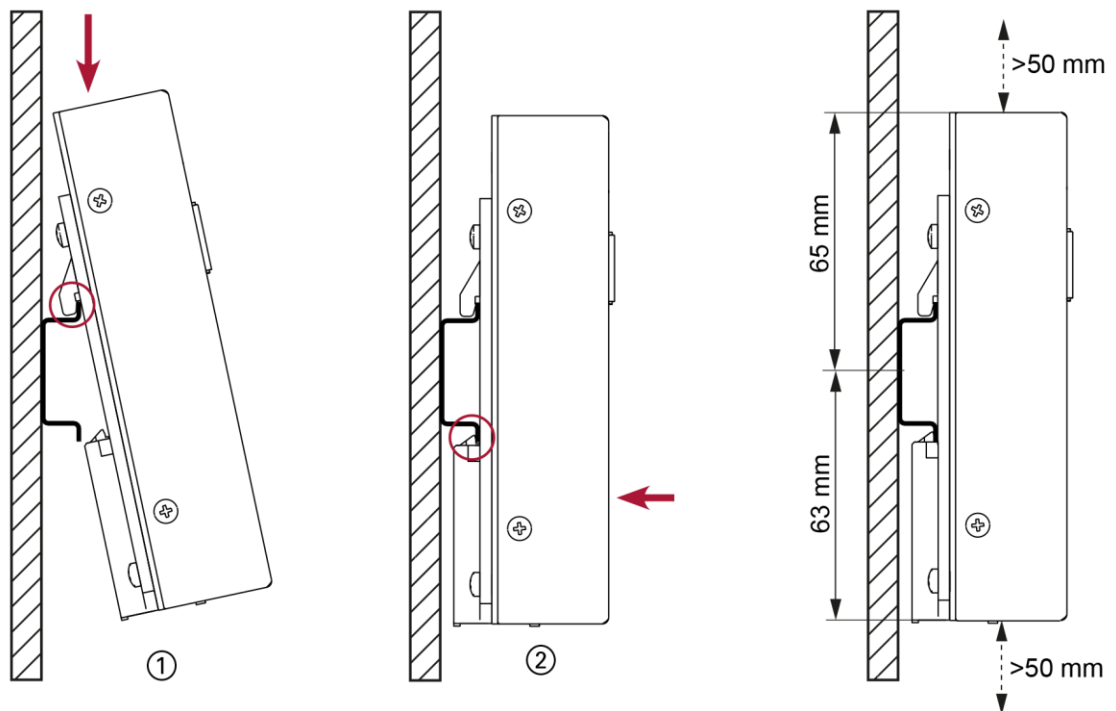


Fig. 2: Installing the device

Prerequisites:

Ensure that there is also a minimum of 10 mm free space to the next adjacent module.

- 1st Guide the device from the top towards the mounting rail as shown in the image so that the support is resting on the mounting rail.
- 2nd Push the device towards the mounting wall until the retaining spring snaps into place.

The device is clamped on the mounting rail.

5. Connection

WARNING

Uncontrolled and unpredictable operational behaviour!

The failure of certain components in electronic control systems may result in uncontrolled and unpredictable operational behaviour.

All types of failure and the associated fuse systems are to be taken into account at system level.

Follow the automation system manufacturer's instructions.

5.1. Power supply

The device is powered by an external 24 V DC power supply.

- ▶ Before plugging in the device, make sure that the external power supply meets the required specifications (type K to DIN EN 61131-2).

External power supply (24 V DC)

Supply voltage	+24 V DC SELV (-15% / +20%)
AC voltage component	Max. 5% The DC voltage level must not fall below 20.4 V.
Power consumption	Total max. 3 A at +24 V DC (0.3 A electronics; 2.7 A AIO)
Power buffering	10 ms

Internal power supply

A power supply for the system electronics for an input voltage of 24 V DC (-15% / +20%) is integrated into the device. The power supply unit has built-in reverse polarity protection and surge current protection (1.2 A).

Installation

- ▶ All connections and cables should be set up in a way that prevents interference and capacitive interference to the device.
- ▶ Make sure that the current and voltage resistance of the supply cables are sufficient.

5.1.1. Connecting the power supply

⚠ CAUTION

Live parts!

Before starting any work on the device, switch off all power supplies, including those of connected peripherals.

- ▶ Connect the power supply to plug X1 according to the following table.

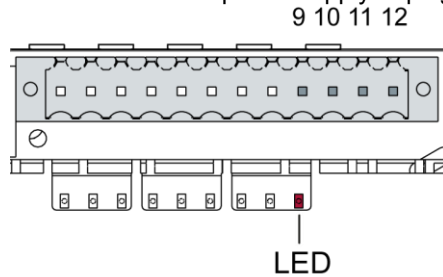


Fig. 3: Power supply to the Compact Slim plug X1 with power LED

Power supply plug X1

Pin	Des.	Assignment
1-8	I/O	Digital inputs and outputs (see "Digital inputs and outputs
9	L1+	Feed to digital output (max. 2 A) for I/O
10	L+ 24 V	Power supply 24 V DC (-15%/+20%) (PLC internal processing) max. 1.2 A
11	L+ 24 V	Power supply 24 V DC (-15%/+20%) (PLC internal processing) max. 1.2 A
12	GND	–

The following counterparts have been tested for the SL-SMT 3.5 plug-in connector (Weidmüller), and may be used with the device:

- BLZF 3.50/12/180

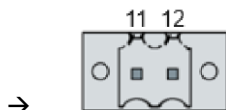


Fig. 4: Power supply to the Compact Slim plug X10 (S01 and S02 only)

Power supply plug X10 (S01 and S02 only)

Pin	Bez.	Belegung
11	L+ 24 V	Versorgung 24 V DC (-15 %/+20 %) max. 0.3 A
12	GND	–

5.2. Data connections

5.2.1. Block diagram

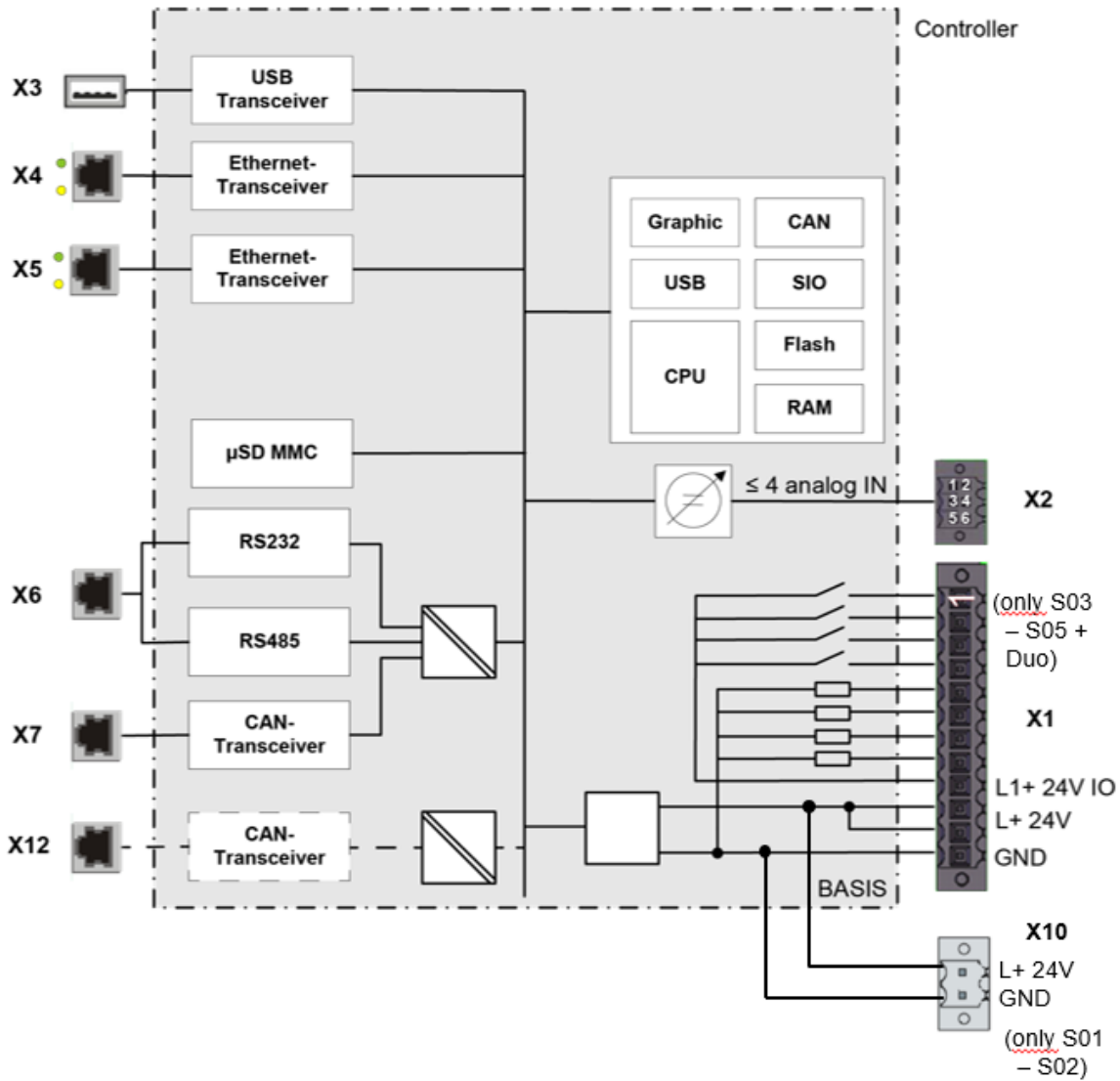


Fig. 5: Overview of Astraada One Compact Slim

CAN interface X12 only with Compact Slim **S05**

5.2.2. Digital inputs and outputs

The digital outputs are positive switching 24 V outputs with an output current of max. 500 mA. They have a common reference potential (GND) with the supply voltage.

NOTICE

Damage to the inputs or the device!

Voltages above ± 32 V can damage the inputs or the device.

Do not apply a voltage exceeding ± 32 V to the inputs.

The digital inputs are positive switching inputs, type 1 or 3 (IEC 61131-2) They are designed for nominal input voltages of 24 V. The input signals are transmitted internally on a cyclical basis for process data processing. An open input is interpreted as static 0 (LOW). The inputs also have a common reference potential (GND).

The following counterparts have been tested for the SL-SMT 3.5 plug-in connector (Weidmüller), and may be used with the device:

→ BLZF 3.50/12/180

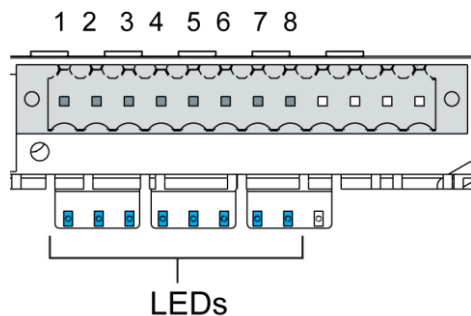


Fig. 6: Digital input and outputs, Compact Slim plug X1 with LEDs 1 to 8

Digital inputs and outputs, plug X1

Pin	Des.	Assignment
1	DI 1 / C1	digital input/counter input 1
2	DI 2 / C2	digital input/counter input 2
3	DI 3 / C3	digital input/counter input 3
4	DI 4 / C4	digital input/counter input 4
5	DO 1	digital output 1
6	DO 2	digital output 2
7	DO 3	digital output 3
8	DO 4	digital output 4
9-12	–	Power supply (see “Power supply”)

Data from the digital outputs		
Feature	Value	Description
Type of output	Semiconductor	Non-storing, current supplying (positive switching)
Protective circuit for inductive loads	41 V clamping voltage (typ.) compared to +24 V	Fast de-excitation (must be provided externally)
Status display	Yes	One orange LED per output Lights up at logical 1
Overload protection	Yes	In the case of thermal overload, auto-resetting
Short-circuit protection response threshold	Yes	Electronic current limitation: typ. 7 A The current is limited electronically. Activation of the short-circuit protection results in thermal overload and tripping of the thermal overload protection. Permissible limit values starting from cold state: max. 10,000 short circuits, total duration max. 500 hours.
Status in unsafe operating conditions	Logical 0	If the supply voltage is insufficient and the control system is started up or shut down, the outputs are set to logical 0.
Output delay "0" after "1"	typ. 1 ms	–
Output delay "1" after "0"	typ. 1 ms	–
Output capacitance	< 20 nF	–
Rated voltage	+24 V DC	–
Voltage drop (at rated current)	< 0.1 V	–
Rated current at "1" signal	0.5 A	–
Total current of all outputs	max. 2 A	–
Parallel switching of two outputs	max. 1 A	Maximum permissible value with a logical connection to increase power

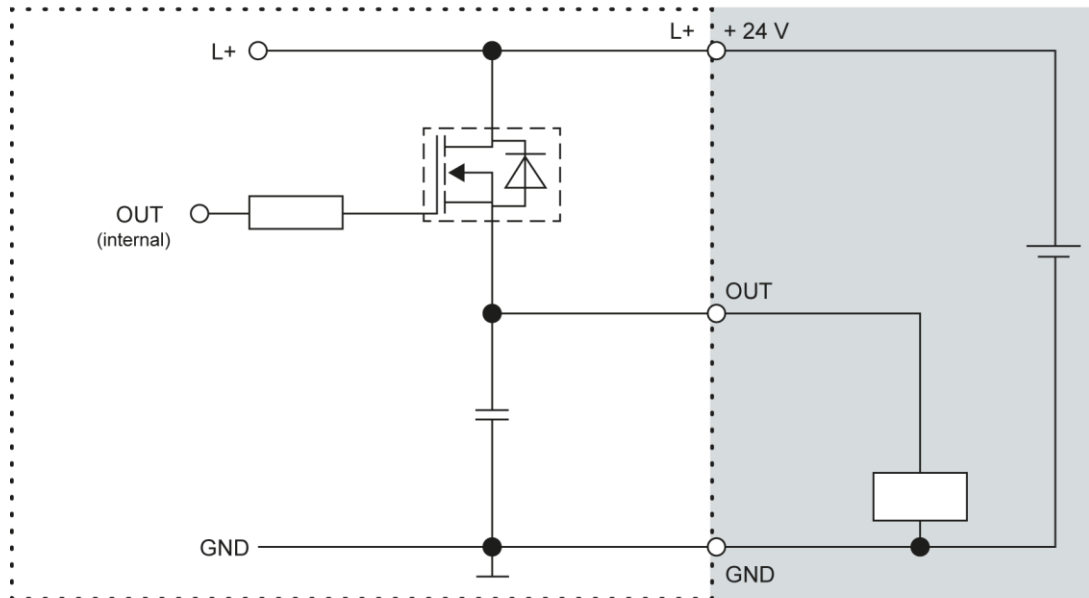


Fig. 7: Circuit diagram of the principles of positive switching, output

Data from the digital inputs		
Feature	Value	Description
Type of input	Type 1, 3	Acc. to IEC 61131-2 Current consuming (positive switching)
Cable length	max. 30 m	For unshielded connection cables Cables over 30 m in length must be shielded.
Cable cross-section in the control cabinet	0.14–1.5 mm ² (26-16 AWG)	Aim for plug connector limits to UL specifications.
Field wiring	comply with regulations and standards	Comply with all applicable local regulations and the requirements of DIN EN 61131-2.
Rated load voltage	24 V DC (SELV)	–
Delay time	1 ms	Applies to transitions from 0 to 1 and from 1 to 0
Signal evaluation	cyclical	Depends on the cycle time set in the programming system
Protection against reverse polarity	Yes	–
Potential isolation	No	–
Status display	Yes	One yellow LED per input Lights up at logical 1

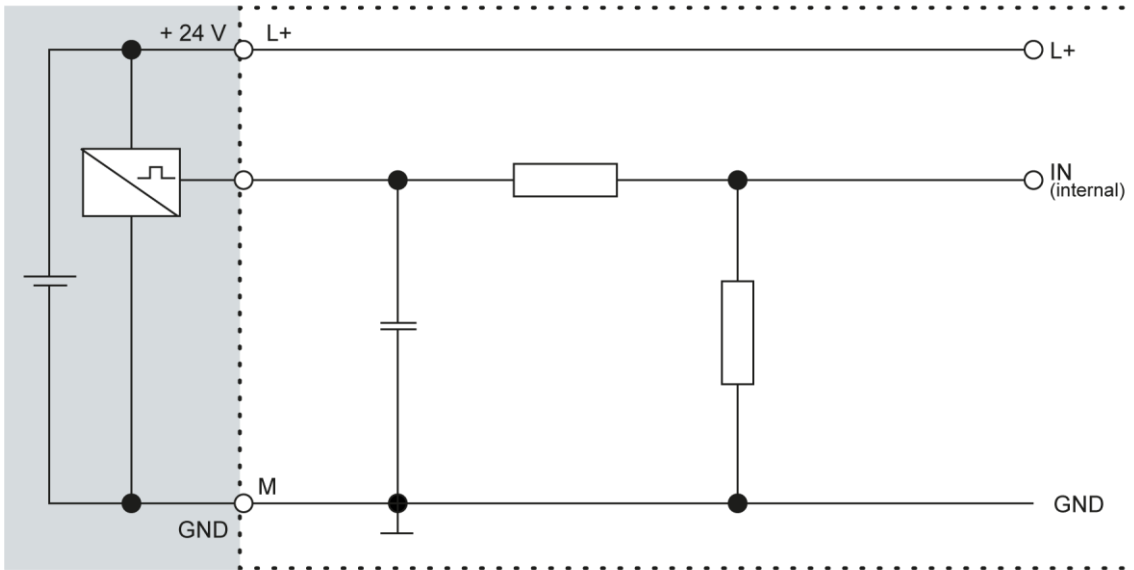


Fig. 8: Circuit diagram of the principles of positive switching, input

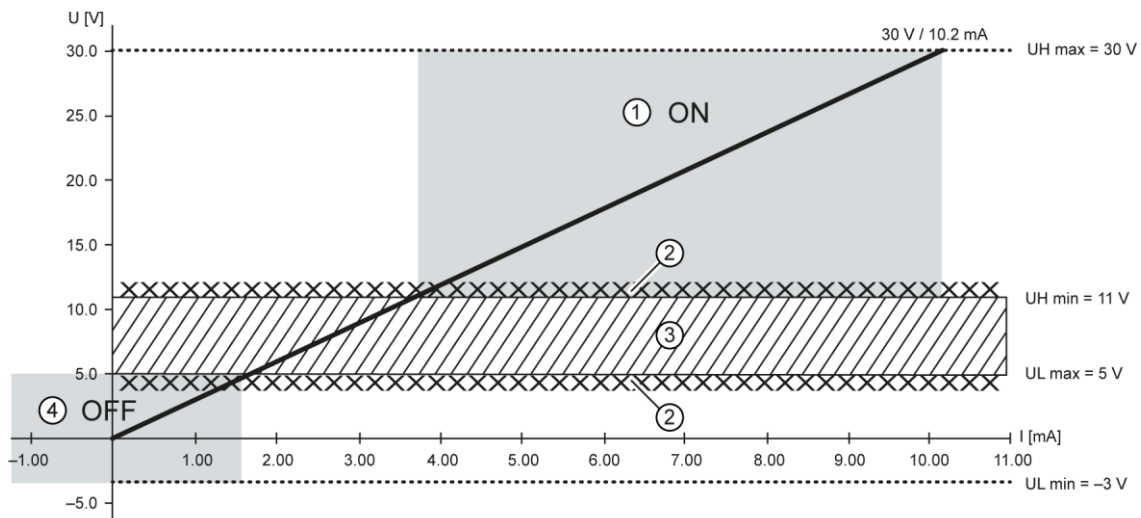


Fig. 9: Operating ranges of digital inputs (type 1/3)

No.	Designation	No.	Designation
1	"ON" range	3	Transition range
2	Signal-to-noise ratio < 1 V	4	"OFF" range

5.2.3. Counting inputs (C)

The 4 digital inputs can also be used as counter inputs (C1-C4). can be enabled by licensing (also possible later).

The counter inputs C1-C4 have a fast filter; the unipolar inputs I5-I16 have hysteresis. The counter inputs are connected to the signals of the other unipolar inputs. There is no changeover switching.

Available options for the counter inputs:

- Up/down counter
- Pulse/direction counter
- Quadrature decoder

One of the counter inputs may alternatively be used as a capture input. This configuration requires 3 inputs (partially as CNT input or CAPT input). The edges for up, down or pulse may be set to falling and/or rising edge.

Direction: High = up; low = down

Examples for counters: up/down; pulse/direction; encoder (A/B)

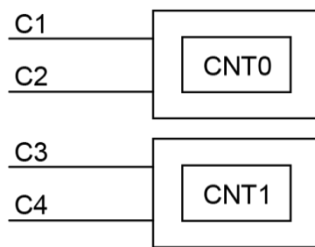


Fig. 10: Counter up/down or pulse/direction

Pin	Designation	Pin	Designation
C1	Up, pulse, A (CNT0)	C3	Up, pulse, A (CNT1)
C2	Down, direction, B (CNT0)	C4	Down, direction, B (CNT1)

Examples for counters: capture input or Z input

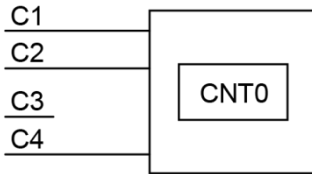


Fig. 11: Counter with capture input

Pin	Designation	Pin	Designation
C1	Up, A (CNT0)	C3	–
C2	Down, B (CNT0)	C4	Capture (rise), Z (CNT0)

Counter CNT1 is not available in this configuration.

Data from the counter inputs

Counter inputs		
Function	Value	Description
Number of counters	2	–
Signal voltage	(1): DC 15-28 V (0): DC -3-3 V	Pulse width at the valid level for at least 1 μ s
Max. frequency: signal counter	500 kHz 1 counts/s	For 100 kHz see specific installation information. At the maximum counter frequency, the signal transmitter must ensure an edge steepness of at least 20 V/ μ s.
Min. pulse width	1 μ s	Per level
Counter resolution	32 bit	–
Internal pull-up	3 k Ω	–

Installation information

- The counter inputs must be connected with shielded cables.
- Supply voltage (24 V DC; GND) and the signals of the transmitters must go through the same cable.
- The PLC and the transmitter must use the same power supply.

5.2.4. Ethernet

The onboard Ethernet adapter has one 10/100 Base-T interface with RJ-45 connection for networking. The Ethernet interface X4 can be used as a standard Ethernet interface.

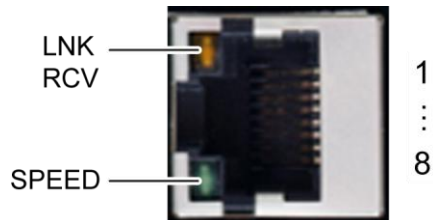


Fig. 12: Ethernet interface X4

Assignment of the Ethernet interface plug X4			
Pin	Assignment	Pin	Assignment
1	TX+	5	NC
2	TX-	6	RX-
3	RX+	7	NC
4	NC	8	NC

LEDs		
LED	Colour	Meaning according to IEEE 802.3 clause 25
LNK/RCV	Yellow	Link, Data Receive Flashing: connection active; data transfer in progress Off: no connection established
SPEED	Green	On = 100 Mbit/s Off = 10 Mbit/s

5.2.5. EtherCAT

The onboard Ethernet adapter has two RJ-45 10/100 Base-T connections for networking. The Ethernet interface X6 can be used as an EtherCAT master.

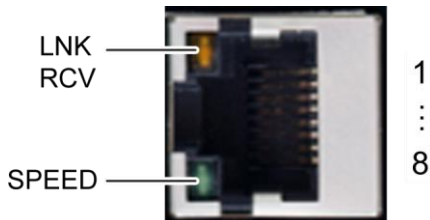


Fig. 13: EtherCAT interface X5

Assignment of the EtherCAT interface plug X5

Pin	Assignment	Pin	Assignment
1	TX+	5	NC
2	TX-	6	RX-
3	RX+	7	NC
4	NC	8	NC

LEDs

LED	Colour	Meaning according to IEEE 802.3 clause 25
LNK/RCV	Yellow	Link, Data Receive Flashing: connection active; data transfer in progress Off: no connection established
SPEED	Green	On = 100 Mbit/s Off = 10 Mbit/s

5.2.6. USB

Devices with a USB interface can be connected to the USB host port (Rev. 2.0). Suitable USB device classes are:

CODESYS user: USB thumb drive only

Linux level: USB thumb drive or mouse



B1
:
B4

Fig. 14: USB interface X3

Assignment of the USB interface plug X3			
Pin	Assignment	Pin	Assignment
B1	VCC	B3	D+
B2	D-	B4	GND

NOTICE

Damage to the USB thumb drive and malfunctions due to data loss!

Removing a USB thumb drive while it is still in use and data is being transferred can render the USB thumb drive unusable. Open files which cannot be accessed due to removal of the USB thumb drive can block the device.

Therefore ensure that all data operations are complete before removing the USB thumb drive.

NOTICE

Property damage and malfunctions due to data loss!

The USB interface is protected against overload (> 0.5 A). In the event of a short-circuit during operation, the controller can trigger a system reset.

This can result in considerable damage to property and damage to the USB device.

Before using a USB device, check its power consumption.

NOTICE

Failures and malfunctions when connected directly to signal ground!

Only use USB devices that do not have a direct connection between the signal ground and the housing.

USB thumb drives can be inserted and removed during operation. The inserted USB thumb drive is detected automatically and appears in the Linux directory/media/usbX. When the USB thumb drive is removed, the directory /media/usbX is again removed from the directory structure.

Either the first partition on the USB thumb drive, or, if the memory is not partitioned, the entire memory will be connected, i.e. the respective directory appears automatically.
 The X represents a number from 1 (first USB device) to 8 (last/max. USB device).



The mechanical design of the USB interface is designed to withstand 1,000 plugging and unplugging cycles.

5.2.7. Serial interfaces

The module has two serial communications interfaces (1x RS-232 and 1x RS-485), which are connected via the common RJ45 plug X6.

Maximum baud rate for both interfaces: 115 kBd

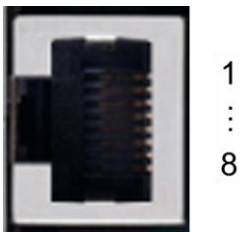


Fig. 15: RS-232/RS-485 interface X6

Assignment for RS-232/RS-485 interface plug X9			
Pin	Assignment/software interface	Pin	Assignment/software interface
1	RS-232 RX/COM 1	5	RS-485 Tx/Rx-/COM 2
2	RS-232 TX/COM 1	6	NC
3	NC	7	(reserved)
4	RS-485 Tx/Rx+ /COM 2	8	ISO GND

The RS-485 interface is “soft” terminated in the dialogue controller with 560 Ω.

If the interface is located at the start or end of the bus topology:

- ▶ Set switch S3 to ON in order to switch on the 120 Ω terminating resistor.

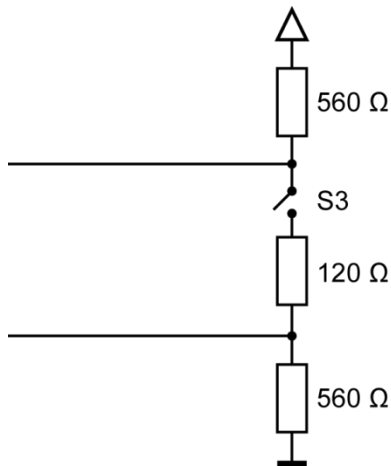


Fig. 16: RS-485 switchable terminating resistor



As far as possible, the assignment of the interfaces should be carried out in accordance with the specifications given in “MODBUS over Serial Line; Specification and Implementation Guide V1.02”.

Signal interference and terminating resistor

To minimise interference, the following instructions must be complied with.

Actively driven bus

- An appropriate protocol must be employed to ensure that at all times one of the bus participants is actively driving the bus.
- For a highly symmetrical signal-noise ratio, the bus must have defined statuses for logical “1” ($A-B < -0.2\text{ V}$) and logical “0” ($A-B > +0.2\text{ V}$).

Undriven bus

- The bus termination must be as asymmetrical as possible to ensure the greatest possible signal-noise ratio (to reduce the symmetrical signal-noise ratio).
- In order to achieve the necessary voltage difference between the signals, a suitable resistor network must be used as the line termination.
- The necessary size of the resistors is governed by the bus length and transmission rate (similarly to the line termination for Profibus, see DIN EN 61158-2).

Connections with GND

To minimise common-mode interference or malfunctions due to potential differences:

- ▶ Check the topology and line lengths to determine whether additional connections to GND are necessary.
- ▶ For electrically isolated interfaces with connections to the reference ground at one point: link to GND.
- ▶ Where necessary, provide an attenuated link to GND (e.g. via $200\ \Omega$) at multiple points.

5.2.8. CAN bus

Properties of the CAN interface	
Standard	ISO 11898
Maximum Baud rate	1 MBit/s
Lowest adjustable Baud rate	50 kBit/s
Contacts	Electrically isolated
Assignment	to CiA303

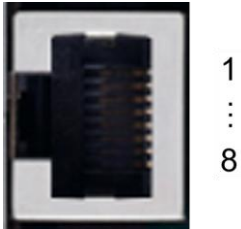


Fig. 17: CAN interface X7 (X12)

Assignment of the CAN interface plug X7 (X12)			
Pin	Assignment	Pin	Assignment
1	CAN_H	5	NC
2	CAN_L	6	NC
3	ISO GND	7	ISO GND
4	NC	8	NC

If the interface is located at the start or end of the CAN bus topology:

- ▶ Set switch S2 to ON in order to switch on the 120 Ω terminating resistor between CAN_L and CAN_H.

For Baud rates, settings and cable lengths, comply with the recommendations of CiA-303-1.

Example: at 1 Mbit, max. 25 m

5.2.9. Analogue inputs

Basic considerations for connecting analogue inputs

- An analogue input channel always consists of two connections: AI (U) or AI (U/T) and AGND.
- The AI (U/T) channels can measure either voltages (U) or evaluate PT100(0) sensors.
- The AI (U) channels can measure voltages or be used for compensation of the line resistances for PT100(0) measurements (3-wire measurement).
- The Earth/Ground/GND lead of a voltage sensor or temperature sensor connected to an analogue input may only be connected to AGND (not to GND or PE (equipotential)).
- Different AGNDs (e.g. on one terminal strip) may not be connected together.
- AGNDs may not be connected to the general GND of the control cabinet or to the “M” on the control cabinet (GND and AGND are already connected within the control cabinet via a special filter).
- AGNDs may not be connected directly to the PE conductor of the machine or system
- Long cables and wires with a small cross-section lead to voltage drops and deviations in PT100(0) measurements (due to resistivity). These unavoidable deviations must be taken into account when planning the wiring.
- To avoid interference, analogue I/O wires must be kept separate from digital signals and power cables.
- Screened cables are advisable for all analogue I/Os. The screen is connected to the sensor or encoder and in the control cabinet or near the controller.

The following counterparts have been tested for the S2C-SMT 3.5 plug-in connector (Weidmüller), and may be used with the device:

Weidmüller B2CF 3.50/06/180(F) SN BK

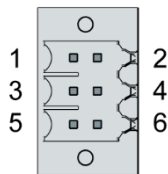


Fig. 18: Analogue inputs X2

Analogue inputs X2			
Pin	Assignment	Pin	Assignment
1	AI1 (U/T)	2	AI3 (U/T)
3	AGND	4	AGND
5	AI2 (U)	6	AI4 (U)

Data from analogue inputs

Data from analogue inputs		
Feature	Value	Description
Cable length	max. 30 m	Applies to unshielded connection cables. Cables over 30 m in length must be shielded.
Modulation method	Delta-sigma modulation	–
Shared points between the channels	AGND reference	–
Clamp arrangement	Shielding on common AGND pins	–
Sampling duration/rate for measuring values	1 ms	A reading is taken from each input channel every millisecond regardless of how many channels are actually in operation
Sampling rate AI-PT operating mode	250 ms	In AI-PT operating mode, calculations are carried out according to the millisecond sampling rate. A new value is available in the user program every 250 ms.

Digital filtering		
Possible filter settings	Time range for averaging	Time range for averaging AI-PT operating mode
0	1 ms	0.25 s
10	10 ms	2.5 s
100	100 ms	25 s
1,000	1,000 ms (1 s)	250 s

If filtering is active, an average is calculated for the set time range. However, a value is still issued during the sampling rate interval. For example, if the filter is set to 1,000, the average of the measurements for the last 1,000 ms / 1,000 measurements is issued each millisecond (or, in the case of AI-PT operating mode, every 250 ms, the average from the last 250 ms / 1,000 measurements).

The filtering can be activated and configured using CODESYS V3. The sampling rate is constant. It can only be filtered with a whole multiple of the sampling rate.

Operating modes for the analogue inputs

NOTICE

Damage to channel

High voltages can damage analogue channels, stopping them from working correctly.
Ensure the input voltage does not exceed ± 30 V.

Operating mode: voltage input AI (U)		
Feature	Value	Description
Connections per input	–	AI (U/T) and AGND or AI (U) and AGND; connect shield to AGND.
Measuring range	-10 - +10 V	–
Input impedance in signal range	100 k Ω	between AI (U/T) and AGND or between AI (U) and AGND value applies when the channel is switched on or off
Max. errors at 25°C	$\pm 0.25\%$ (± 0.50 mV)	–
Temperature coefficient	± 40 ppm/K (± 0.4 mV/K)	–
Digital resolution	24 bit	–
Data format in application program	32 bit real	(floating-point number) in millivolts (mV)
Maximum permissible permanent overload	Max. ± 30 V compared to AGND	± 30 V = max. voltage on AI channel
Value of least significant bit	1.2 μ V	–
Output of digital value in case of overload	–	If a voltage of ± 10 V is applied to an AI (U), a plausible value is still given up to approx. ± 15 V. The specified accuracy is only valid for the range -10 to +10 V. When applying voltages above +15 V or below -15 V, a fault bit (FAULTN/FAULTP) is set in the process image which can be read by the user program.
Input type	–	Asymmetrical voltage metering (single-ended)
Reference potential	AGND	–

Operating mode: voltage input AI (U)

Feature	Value	Description
Dynamic properties		
Analogue filtering	Second-grade low-pass filter; cut-off frequency 650 Hz	–
Greatest temporary deviation during electrical error testing according to IEC 61131-2	1% of measuring range	–

Operating mode: temperature inputs AI-PT

Feature	Value	Description
Connections per input	–	Sensor connection between AI (U/T) and AGND (if applicable, an additional AI (U) channel is used for 3-wire measurement)
Possible sensors	PT100 and PT1000 acc. to EN 60751	Accuracy class AA, A, B and C platinum sensors may be used
Measuring range	-40 - +200°C	–
Measuring current (RMS)	0.3 mA	–
Conversion time	250 ms	–
Max. errors at 25°C	±2,100 ppm (±0.5°C)	–
Temperature coefficient	±50 ppm/K (±0.012°C/K)	–
Digital resolution	24 bit	–
Data format in application program	2 × 32 bit real	(floating-point number) in Ohms (Ω) and degrees Celsius (°C)
Linearisation	–	The value in degrees Celsius is calculated from the resistance value and linearised (6th degree polynomial)
Input type	–	2-wire measurement or 3-wire measurement
Reference potential	AGND	–
Dynamic properties		

Operating mode: temperature inputs AI-PT

Feature	Value	Description
Analogue filtering	Second-grade low-pass filter; cut-off frequency 650 Hz	–
Greatest temporary deviation during electrical error testing according to IEC 61131-2	1% of measuring range	–

Voltage input AI (U)

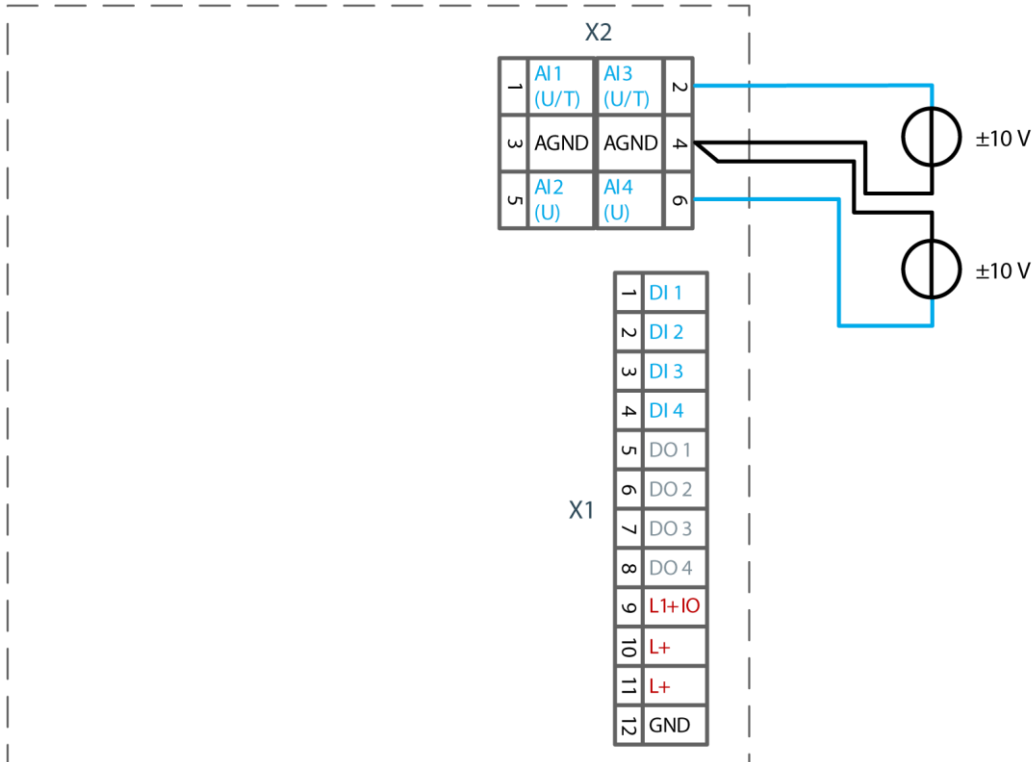


Fig. 19: Connection example: voltage input

- ▶ Only use the corresponding AGND for each voltage input.
- ▶ Do not connect AGNDs from different channels.
- ▶ AGNDs from different channels must always be connected separately to plug X1.
- ▶ Do not connect to the common GND. The required connections can already be found on the circuit board.
- ▶ Cables to the analogue sensors/encoders should be connected as directly as possible (avoid the use of terminals and terminal blocks).

Temperature measurement AI (T)

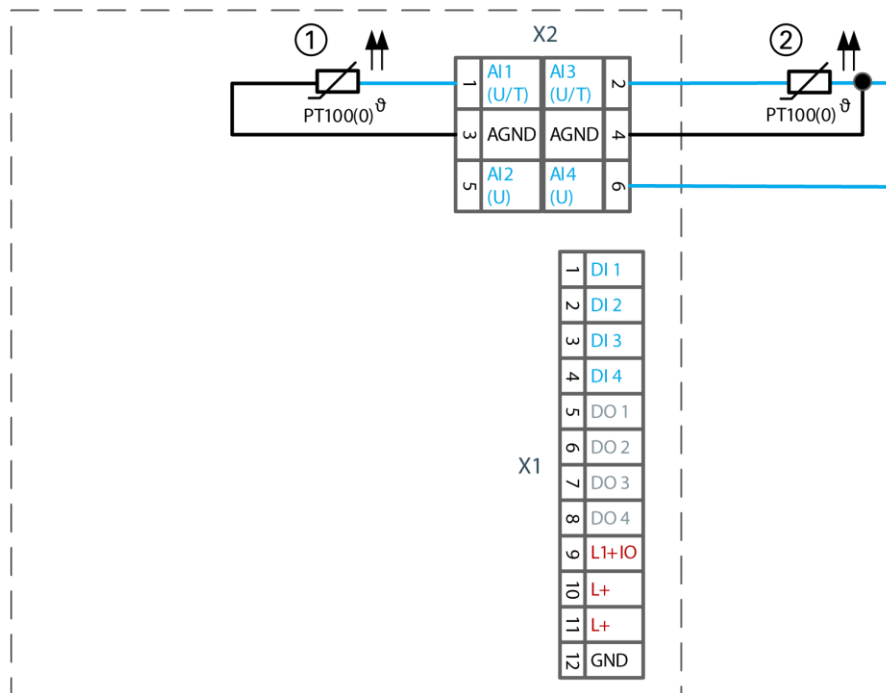


Fig. 20: Connection example: temperature measurement

No.	Description
1	PT 100 with 2-wire connection
2	PT 100 with 3-wire connection

- ▶ Only use the corresponding AGND for each input.
- ▶ Do not connect AGNDs from different channels.
- ▶ Do not connect to the common GND. The required connections can already be found on the circuit board.
- ▶ Cables to the PT100(0) sensors should be connected as directly as possible and without detours (avoid the use of terminals and terminal blocks).
- ▶ Only connect PT100(0) sensors to AI (U/T) channels.

2-wire measurement

Resistance can result in a measurement error, which in the case of long cables with a small cross-section can be up to 10°. If the temperature of the sensor is known, this deviation can be subtracted and compensated through the software (alternatively, use 3-wire measurement).

3-wire measurement

The nearest AI (U) connection is used to compensate the resistance in the cable. It can only be used directly in conjunction with the following AI (U/T) channel. Channels 1 and 2, and also channels 3 and 4 each form a pair for 3-wire measurement.

6. Operation

6.1. Switching on and off

NOTICE

Damage or malfunction!

Do not insert, connect, undo or touch any connections while the device is in operation.

Before starting any work on the device, switch off all power supplies, including those to any connected peripherals (externally powered encoders, programming devices etc.).

NOTICE

Damage to property!

Before connecting the power supply, ensure that all cabling and the polarity of all the connections are correct.

Switching on

The device does not have an on/off switch. The device starts automatically when the system is switched on or the power is connected.

Switching off

The device is switched off when the system is switched off or the power supply is disconnected.

6.2. Network start up

The device must be connected to the network with the correct settings before it can be used.

NOTICE

Damage to property!

Before connecting the power supply, ensure that all cabling and the polarity of all the connections are correct.

- 1st Supply power to the device (24 V).
- 2nd Connect the device to a programming computer using a network cable (X10) and network switch.
- 3rd Open a web browser on the programming computer.
- 4th Enter the IP address of the device into the web browser.
- 5th The login window is displayed.

User Login:

Name:

Password:

Fig. 21: Login window

- 6th Name: admin
The default password, which is printed on the device label, serves as the password.

NOTICE

Devices without a password on the device label

If your device does not have a password printed on the device label, the username and password are the same.

e.g. User: admin / Password: admin.

The web configuration page will be displayed.

Configuration

- [Network](#)
- [Real-Time-Clock](#)
- [Display](#)
- [FTP-Server](#)
- [Users](#)

System

- [Info](#)
- [Update](#)
- [Reboot](#)
- [Format Filesys](#)

PLC-Manager

- [Control](#)
- [Application Info](#)
- [Application Files](#)
- [Font Files](#)

Fig. 22: List of web interface settings

7th Click on the “Network” link.

The “Network Configuration” page will be displayed.

Network Configuration

COMMON

Hostname	<input type="text" value="BGH-IMX6"/>
Default Gateway	<input type="text" value="0.0.0.0"/>
DNS Server 1	<input type="text" value="0.0.0.0"/>
DNS Server 2	<input type="text" value="0.0.0.0"/>

ETH0

Mode:	<input type="text" value="static"/>
IPAdress	<input type="text" value="169.254.255.100"/>
NetMask	<input type="text" value="255.255.255.0"/>

ETH1

Mode:	<input type="text" value="ethernet"/>
-------	---------------------------------------

Fig. 23: “Network Configuration” page

8th Check the network settings and make any changes in the text boxes, if required.

CC-LITE configuration: ETH0 = X4, ETH1 = X3 (USB to Ethernet)

9th Save the settings by clicking on “Save”.

10th Additional settings can also be viewed and/or modified on the web configuration page (e.g. “System time”, display resolution, TargetVisu).

11th In order to accept all of the modified settings, reboot the device:

Briefly disconnect the device from the power supply.

– or –

Click on “Reboot” in the web interface and then confirm on the next page by clicking on “Reboot Module”.

The device is configured and ready for use.

6.3. Operation

6.3.1. Status indicators

The status indicator function is dependent on the software development environment used in conjunction with the device.

The operating status LEDs show the current status of the power supply, the module mode and any error messages.

The signals from the LEDs depend on the current operating status of the device:

CODESYS inactive: the firmware controls the LEDs.

CODESYS active: only the CODESYS runtime system (CODESYS Runtime) controls the LEDs.

Location of the operating status LEDs

The Run/Stop and Error LEDs display the system status.

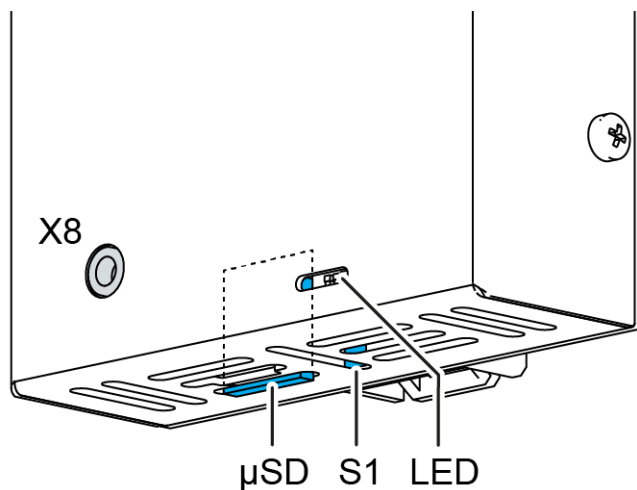


Fig. 24: Location of the operating status LEDs

LED	Meaning
1 PWR (green)	Shows that the power supply to the module electronics is correct.
2 Run/Stop (yellow/green/red)	Shows the system statuses.
3 Error (red)	Shows that the device has been stopped due to an error.

Meaning of the LED displays

System statuses are shown using flashing signals on the Run/Stop LED in yellow.

CODESYS operating statuses are shown via continuous illumination of the Run/Stop LED as either red or green.

While the Run/Stop light is flashing yellow: the device is in use and must not be switched off.

During the boot process, the device does not give any warnings via the LEDs.

6.3.2. Start/Stop

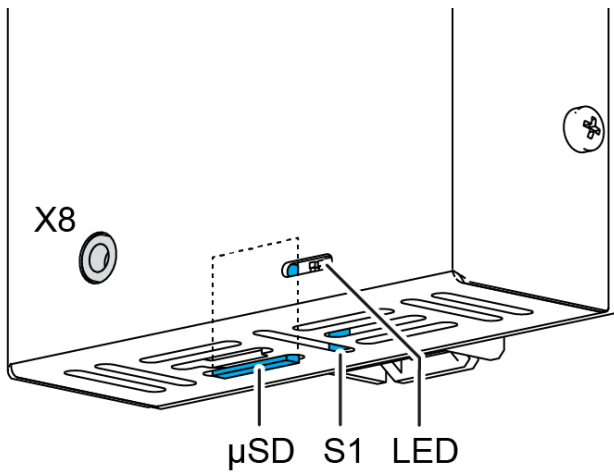


Fig. 25: Function key (S1)

Function key (S1)		
Operating status	Action	Command
Boot phase	Press.	Change to maintenance mode
CODESYS PLC/ CP1131-P	Press briefly.	Change between PLC run and stop mode
	Press and hold.	Stop PLC with reset of variables (cold reset)

6.3.3. Real time clock with battery back-up

Setting the date and time

The time can be set via the web configuration page or the CODESYS V3 library.

Changing the battery

The battery is not designed to be changed by the user; the manufacturer should be contacted in order to change the battery.



For batteries according to UN 3091-PI 970 Section II Button Cell, further information according to the manufacturer's PSDS/MSDS applies.

6.3.4. microSD card

WARNING

Serious injury as a result of uncontrolled and unpredictable operational behaviour!

Inserting or removing the microSD card can result in the device malfunctioning. The failure of electronic control systems may result in uncontrolled and unpredictable operational behaviour.

Insert or remove a microSD card only when the device is switched off.

NOTICE

Loss of data!

MicroSD cards do not have their own write protection system.

Ensure that no data is deleted or overwritten by accident.

Inserting a microSD card

1. Switch the device off.
- 2nd Insert the microSD card into the microSD card slot.
- 3rd Switch the device on again.

The microSD card is now ready for data transfer (read, write and copy).

Path: /media/sd



Max. possible storage capacity of a microSD card: 32 GB.

The operating life of the gold-plated contacts is up to 10,000 plugging and unplugging cycles.

The microSD card drive has a push-in/push-out insertion and ejection mechanism.

To avoid malfunction, the microSD card may not be removed by pulling.

6.4. Troubleshooting

6.4.1. No network connection

- ▶ Check the wiring/switch.
- ▶ Check whether an IP address has been assigned twice.
- ▶ Check the network settings on the PC: The subnet and subnet mask must match the settings in the controller.
- ▶ Check firewall/anti-virus programs on the PC.
- ▶ Check for an unknown IP address (see 6.4.3).

6.4.2. In error stop mode

- 1st Log into device on web browser
- 2nd Establish cause of fault (Diagnostics > PLC Log/System Log).
- 3rd Correct the cause of the fault.
- 4th Restart the device (press "Reset" on the device).

Device is ready for use.

6.4.3. Unknown IP address

If the IP address of the device is unknown, maintenance mode can be used to reconfigure it.

- 1st Reboot the device while pressing and holding S1 until the Run/Stop LED flashes every 2 seconds.

The device is now in maintenance mode and can be reached via the default IP address.

- 2nd Connect to the device using the default IP address:

IP address: 169.254.255.XX

Net mask: 255.255.255.0

XX corresponds to the last 2 digits of the device serial number. Exception: 00 becomes 100.

- 3rd Correct the network settings and make a note of them.
4. Restart the device.

Maintenance mode is turned off automatically.

The device is configured and ready for use.

7. Servicing / Maintenance

Repairs and corrective maintenance may only be carried out by the manufacturer or its authorised customer service centres.

7.1. Maintenance

WARNING

Uncontrolled and unpredictable operational behaviour!

Failures or malfunctions may result in uncontrolled and unpredictable operational behaviour.

Do not insert, connect, undo or touch any connections while the device is in operation.

Before starting any work on the device, switch off all power supplies, including those to any connected peripherals (externally powered encoders, programming devices etc.).

If the device is used correctly it should not require maintenance.

- ▶ Make sure all the ventilation openings are kept free of obstructions
- ▶ Do not open the device. If it is necessary to work in the device, contact the Service department.

8. Disassembly

CAUTION

Danger of burns!

The surface of the device can get hot.

If necessary, allow the device to cool down before disassembling it.

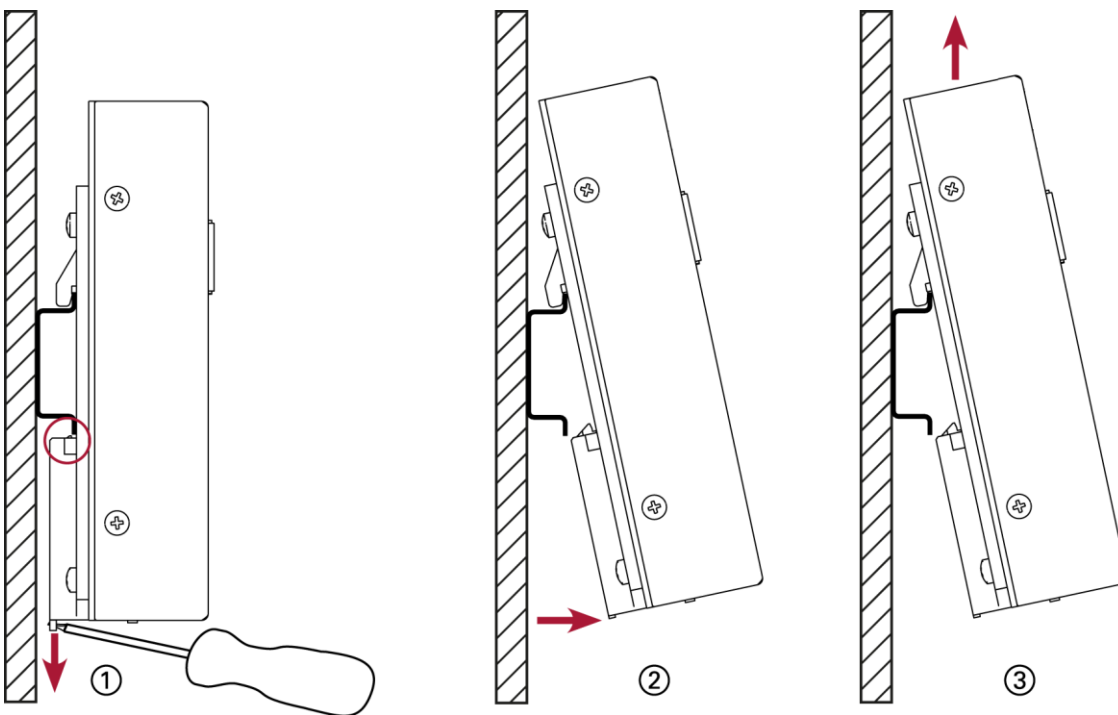


Fig. 26: Disassembling the device

- 1st Use a slotted screwdriver to pull the retaining spring all the way down and remove the unit from the mounting rail at the bottom.
- 2nd Pull the device at the bottom away from the mounting rail.
- 3rd Push the device upwards and remove from the mounting rail.

9. Disposal

The device contains the following components which need to be disposed of separately:

- Metals
- Electronic components
- Battery

The respective national regulations for the disposal of electrical appliances in B2B business apply.

The following options are available for disposal of the device:

Disposal by the manufacturer

Unless otherwise agreed, the devices can be returned for disposal.

Disposal in accordance with regional regulations

- ▶ Dismantle the device and disassemble it completely into its component parts.
- ▶ Send the metal parts for metal recycling.
- ▶ Sort the electronic parts (circuit boards, drives, etc.).
- ▶ Dispose of electronic scrap in accordance with the national laws and regulations.
- ▶ Make sure that the battery is completely discharged.
- ▶ Dispose of batteries at a recognised collection point in accordance with national laws and regulations.

10. Information and options

Astraada One	Compact Slim S01 – S05
Order numbers	
Single Core	S-01020102-0100 (S01) S-01020102-0200 (S02) S-01020102-0300 (S03) S-01020102-0400 (S04) S-01020102-0500 (S05)
Dual Core	S-01020102-2400 (S04) S-01020102-2500 (S05)
CPU, user memory	
CPU	800 MHz ARM® CPU
Program memory (flash)	Single Core: 256 MB Dual Core: 256 MB
Program memory and data memory (RAM)	Single Core: 256 MB Dual Core: 512 MB
Retain memory	100 kB (FRAM)
Dimensions and weights	
Dimensions (WxHxD)	87 x 128 x 39 mm
Weight	approx. 550 g
Operating conditions	
Ambient temperature	If the installation are followed, this applies to the front and rear side of the device. Single Core: 0°C to 55°C Dual Core: 0°C to 50°C
Relative humidity	max. 85%, non-condensing
Transport and storage	
Ambient temperature	-20°C to +70°C
Relative humidity	max. 85%, non-condensing
Operation	
Assembly	on a mounting rail to DIN EN 60715:2001, 35 x 7.5 mm
Certification	to product standards DIN EN 61010-2-201, DIN EN 61131-2
Touch operation	CODESYS V3 (IEC 61131-3)

Astraada One	Compact Slim S01 – S05
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Shock resistance	
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Vibration	sinusoidal (EN 60068-2-6) test: Fc 10-150 Hz, 10 m/s ²
Shock	15 G (approx. 150 m/s ²), 11 ms duration, half-sine (EN 60068-2-27) Test: Ea

EMC, protection rating	
-------------------------------	--

Emission standard	EN 61131-2; EN 61000-6-3, residential areas
Resistance to interference	EN 61131-2; EN 61000-6-2, industrial areas
Protection class	III
Protection rating	IP20, front IP54

Power supply (24 V power supply unit)	
--	--

Supply voltage	+24 V DC (-15% / +20%) SELV max. AC voltage component 5%
Power consumption	typ. 0.3 A, max. 3 A at +24 V DC fused depending on the load on the I/O
Protection against reverse polarity	Yes
Bridging in case of power failure	10 ms at < 20.4 V DC

Ethernet interface	
---------------------------	--

No. / type of interface	1x 10/100 Base T
Connection system	RJ45
Protocols	Standard: TCP/IP, NTP, FTP Optional: Modbus, BACnet, Profinet, Ethernet/IP, SNMP, KNX, OPCuA, IoT

EtherCAT interfaces	
----------------------------	--

No. / type of interface	1x EtherCAT (EtherCAT master)
Connection system	RJ45

USB interface	
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No. / type of interface	1x host USB 2.0 / USB plug port A
No. plugging/unplugging cycles	max. 1,000

CAN bus interfaces	
---------------------------	--

Astraada One	Compact Slim S01 – S05
No. / type of interface	up to 2x CAN-Bus, depends on variant
Protocols	CAN-Bus and/or CANopen master
Serial interfaces	
No. / type of interface	1x RS-232; 1x RS-485, depends on variant
Protocols	Modbus RTU (Option)
Additional functions	
microSD card slot	1x microSD card
I/O	
Digital	4x, depends on variant
Digital OUT	4x (0.5 A) , depends on variant
Analogue IN	2x (-10 - +10 V, PT100/PT1000 with 2-wire) 2x (-10 - +10 V, or return for 3-wire) , depends on variant
Visualization	VNC, Optional: CODESYS-WebVisu
Battery	
Type	Panasonic VL2020 or similar
Operating life	10 years (depending on operating temperature)
Storage	1 year without voltage (any longer and RTC data can be lost)

10.1. Type plate

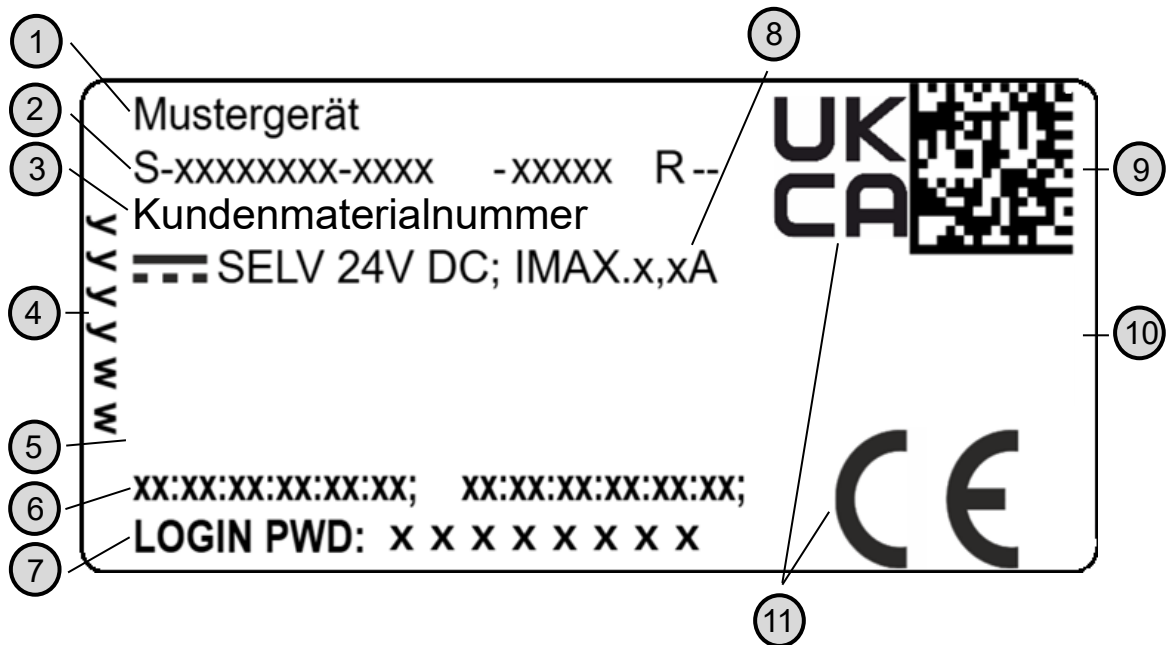


Fig. 27: Type plate

No.	Designation	No.	Designation
1	Product description	7	Default password
2	Order number / serial number / version identification	8	Supply voltage and maximum current
3	Customer material number	9	QR code (identification no.)
4	Production date (year/week)	10	Manufacturer's logo
5	Manufacturer (manufacturer's address)	11	Conformity marking
6	MAC addresses of the unit		

10.2. Device variants and identification

Designation	Order number	Features
Compact Slim S01	S-01020102-0100	1x Ethernet, 10/100 Base, 1x EtherCAT,
Compact Slim S02	S-01020102-0200	+ 1x CAN Bus, 1x RS232/485 Combi
Compact Slim S04	S-01020102-0400	+ 4 x AI, 4 x DI, 4 x DO
Compact Slim S05	S-01020102-0500	+ 2. CAN Bus,

10.3. Options and extensions

Options are ordered via the combination
"Order number option1 option2..."

e.g.: **S-01010104-0204 S001 S002 H001**

In addition to the order number, additional extensions in the form of hardware, software and customised options are indicated as follows:

Option code	Option type
S000-S999	Software options e.g. field buses
H000-H999	Hardware options e.g. plug kit, certifications
C000-C999	Customised options e.g. customised firmware, customised front membrane display

For more information about the options available for this device, please refer to our product catalogue or website.

The additional features included or installed in each device are listed on the options label. This label can be found on the device and/or on the packaging.



Fig. 28: Options label

Extensions for tooling and debugging

- USB-to-Ethernet adapter order number: S-02040101-0000
- USB to WLAN adapter EasyConnect order number: S-02040102-0000

11. Standards and certificates

11.1. Standards

Applicable directives

- EMC directive 2014/30/EU
- RoHS directive 2011/65/EU

Applicable standards

- Norm
 - EN 63000:2019-05
- SPS-Norm EN
 - EN 61131-2:2008-4
- Störaussendung
 - EN 61000-6-3:2012-11
 - Sicherheitsbestimmungen
 - DIN EN 61010-2-201

12. Appendix

12.1. Notes on copyright and the software licence

The device's firmware contains free software. Parts of this software are available under the following and other open source licences:

- GNU General Public License (GPL)
- GNU Lesser General Public License (LGPL)
- Mozilla Public License (MPL)
- FreeType License (FTL)

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