ACOPOS

User's Manual

Version: **2.01 (November 2014)**
Model no.: **MAACP2-ENG**

Chapter 1: General information

Chapter 2: Technical data

Chapter 3: Installation

Chapter 4: Dimensioning

Chapter 5: Wiring

Chapter 6: Safety technology

Chapter 7: Standards and certifications

Appendix A: Accessories included in delivery

Chapter 1 • General information

1 Manual history

Information:

B&R keeps the printed version of user's manuals as current as possible.
From a safety standpoint, however, the current version from the B&R website must be used (www.br-automation.com) .

Version	Date	Comment
2.01	11/5/2014	Changes / New features • Adjusted images for translation. • Updated accessories for 8AC114.60-2. • Technical data chapter: - Corrected technical data for connectors. - Added battery module. • Dimensioning chapter: - Revised "Dimensioning the power mains and fuse" section. - Added section "Motor cables - Not for use in cable drag chains" to "Motor connection". • Updated appendix "Accessories included in delivery".
2.00	12/12/2012	Changes / New features • Plug-in module 8AC126.60-1 added: - Order data - Technical data - Pinout • 0.75 mm² motor cables added: - Order data - Technical data • Dimensioning chapter: - Using a mains choke added - Dimensioning cooling systems updated
1.43	26-Mar-11	Changes / New features • Safety notices: New section "Specifications for functional safety" added • Safety technology: Safety functions/parameters modified, proof test interval changed to 20 years
1.42	31-Jul-10	Changes / New features • Technical data / 8Vxxxx: Heat dissipation values modified • Wiring / AC121: Input/Output circuit diagram added. • Plug-in module 8AC125.60-1 added: - Technical data - Wiring • Indicators: LED status adjusted to firmware > V2.130 • Technical data / 8AC122.60-3: ParIDs for setting the gear ratio added to footnote
1.41	31-Oct-08	Start of revision history publication

Table 1: Manual history

2 ACOPOS

2.1 High-performance servo drive design

The ACOPOS servo drive family is an important component of the complete automation solutions provided by B&R. Industry-specific functions and intuitive tools form the basis for short development times.

An important criteria for the performance of an automation solution is fast and precise reactions to events handled the application or to immediate changes in the production process. Because of this, ACOPOS servo drives work with very short sampling times and communication cycles of 400 μs, which only amount to 50 μs in the control loop.

2.2 More room for innovation

The successful application of ACOPOS servo drives in the following fields demonstrates the impressive innovative power of their pioneering design: performance and function coupled with ease of use.

- Packaging industry
- Handling technology
- Plastics processing
- Paper and printing
- Textile industry
- Wood industry
- Metalworking industry
- Semiconductor industry

2.3 Maximum safety

The ACOPOS servo family was thoroughly tested during the development phase. Under difficult conditions, such as heavy vibrations or increased temperatures, the devices were subject to loads that greatly exceed the values that occur in normal everyday operation.

Figure 1: EMC testing of ACOPOS servo drives - maximum security for the user

EMC was given special attention to facilitate use in a harsh industrial environments. Field tests have been carried out under difficult conditions in addition to the tests defined in the standard. The results confirm the excellent values measured by the testing laboratory and during operation. The necessary filters, which meet CE guidelines, are also integrated in the device. Using computer-aided models, the thermal behavior of the entire system is pre-calculated based on measured currents and temperatures. This results in maximum performance by taking advantage of the system's full capabilities. ACOPOS servo drives use the information on the motor's embedded parameter chip, which contains all relevant mechanical and electronic data. The work-intensive and error-prone task of manually setting parameters is no longer necessary and start-up times are substantially reduced. During service, relevant data can be requested and the cause of any problems that may exist can be determined.

The ACOPOS servo family is also available with partially-coated circuit boards. These versions are – with identical specifications – more robust in regard to environmental influences such as dust, aggressive vapors or moisture.

2.4 Modular and precise with communication options

The I/O channels needed to operate a servo axis are part of the standard equipment for ACOPOS servo drives. The user is provided two trigger inputs for tasks requiring precise measurements or registration mark control.

Figure 2: Plug-in modules allow optimized, application-specific configuration of ACOPOS servo drives

Further configuration of the ACOPOS servo drive to meet the respective application-specific demands takes place using plug-in modules. Plug-in modules are available to establish network connections with other drives, controllers and visualization devices as well as for the connection of encoders, sensors and actuators. Additionally, CPU modules for controller and drive integration are also available for drive-based automation.

2.5 Configuring instead of programming

ACOPOS servo drives can be configured for demanding positioning tasks such as electronic gears or cam profiles. Based on long-term cooperation with customers from all over the world, B&R shares its know-how in the form of compact function blocks for many applications. Industry-specific functionality can be quickly and easily implemented in an application program.

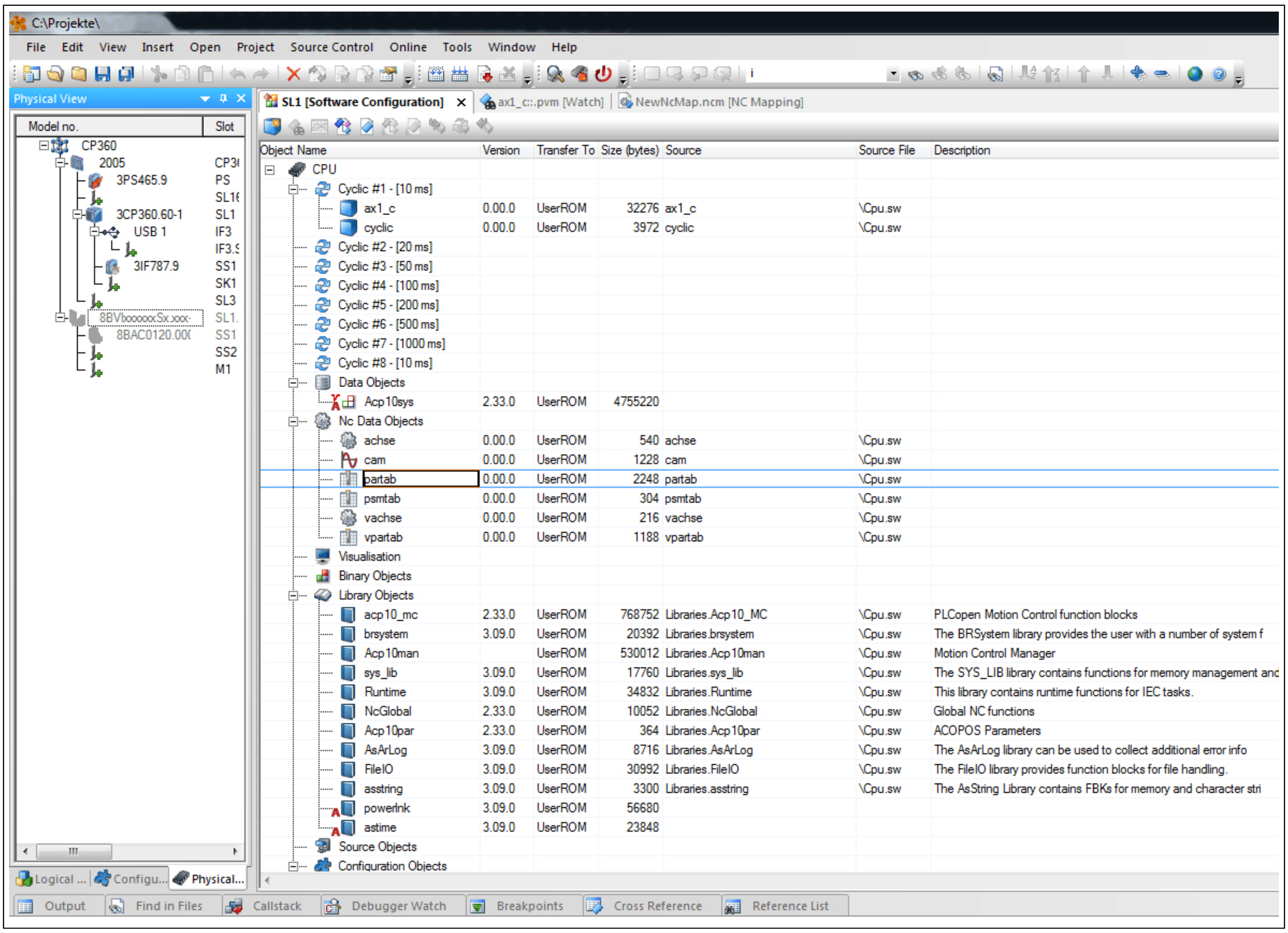


Figure 3: Configuring ACOPOS servo drives using B&R Automation Studio guarantees fast and easy implementation of application requirements

2.6 PLCopen motion control function blocks

Motion control is one of the central topics in automation technology. This is due in part to the fact that this area bears a relatively high share of the costs of an entire automation solution. As a result, the potential for savings are high as well.

PLCopen motion control function blocks comply with the IEC 61131-3 standard and support users in this endeavor by offering vendor-independence and reducing overall development times. They provide additional support in that they can be used with a wide variety of programming languages, including Ladder Diagram (LD), Structured Text (ST) and the high-level language C.

The range of functions offered by these blocks are grouped according to single and multi-axis movements. In addition to conventional relative and absolute movements, the first of these two groups also includes the possibility of overlapping movements. With multi-axis movements, functions such as gears, cam profile functions, up/down synchronization and differential gears (changing the phase angle) are also supported.

2.7 Higher productivity with Smart Process Technology

Smart Process Technology meets customer needs for cost-effective solutions and high production speeds. This freely configurable technology library is uniformly integrated into existing motion control products.

The use of indirect process parameters makes it possible to eliminate sensors, which are often not fast enough to keep up with high production speeds. Synchronous processing and short response times make it possible to achieve excellent productivity and precision. In addition, powerful and intelligent decentralized units allow seamless quality control. In the field, this significantly reduces cycle times while improving component quality.

As a result, the demands placed on advanced motion control components – high product quality, machine productivity, short maintenance and down times and, increasingly important, seamless quality control during production – are met completely.

2.8 ACOPOS – Perfect for CNC applications as well

The integrated Soft CNC system from B&R combines all of the software components necessary for machine automation on a 64-bit processing platform and provides more than enough computing power to handle complex processing machines. Its integrated system architecture, used together with ACOPOS servo drives, opens up many opportunities with regard to response speed, data throughput and precision, all while providing a way to reduce overall costs.

- Uniformly integrated ACOPOS servo drive technology
- Powerful, with fast response times
- Ultimate freedom for automation concepts with unlimited PLC and CNC system flexibility
- 8 independent CNC channels
- Up to a total of 100 axes for positioning, CNC and electronic gears
- Customized graphical interface
- Nearly unlimited system memory for programs, diagnostics and process data
- Internet or intranet connection for inspections or remote maintenance

Leading manufacturers of water jet, laser and flame cutting machines are already utilizing these technological advantages.

2.9 Quick and easy commissioning

All B&R products are programmed in the same way using the Windows-based tool B&R Automation Studio. This software allows complex drive solutions to be created after just a short orientation period. Hardware components and program sections can be added and configured in dialog boxes, considerably reducing project development time.

Axis movements can be checked without programming using the NC Test feature. All types of motions, ranging from point-to-point movements to gear functions, can be carried out interactively. The response of an axis can even be monitored while the system is online. In addition, Trace functionality records relevant drive data for clear evaluation at any time.

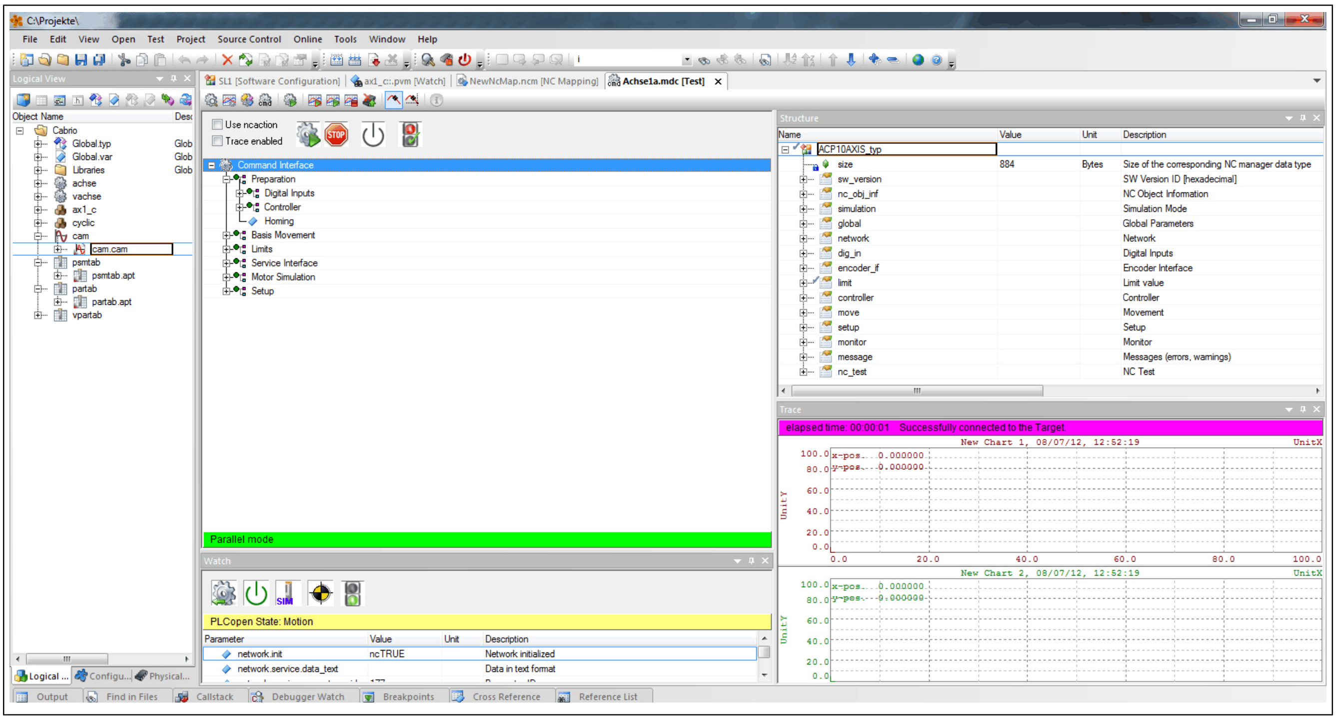


Figure 4: Optimal control of the movement using NC Test and Trace functionality

2.10 Tools for straightforward and efficient diagnostics

Drives are monitored in real time using an oscilloscope function, with a wide variety of trigger options able to generate informative data for analyzing movements during operation. A graphic display allows the user to make fine adjustments and optimize movements in the microsecond range. The integration of powerful tools such as the cam editor reduces programming for complex coupled movements to simple drag-and-drop procedures. The results and effects on speed, acceleration and jolt can be immediately analyzed in graphic form.

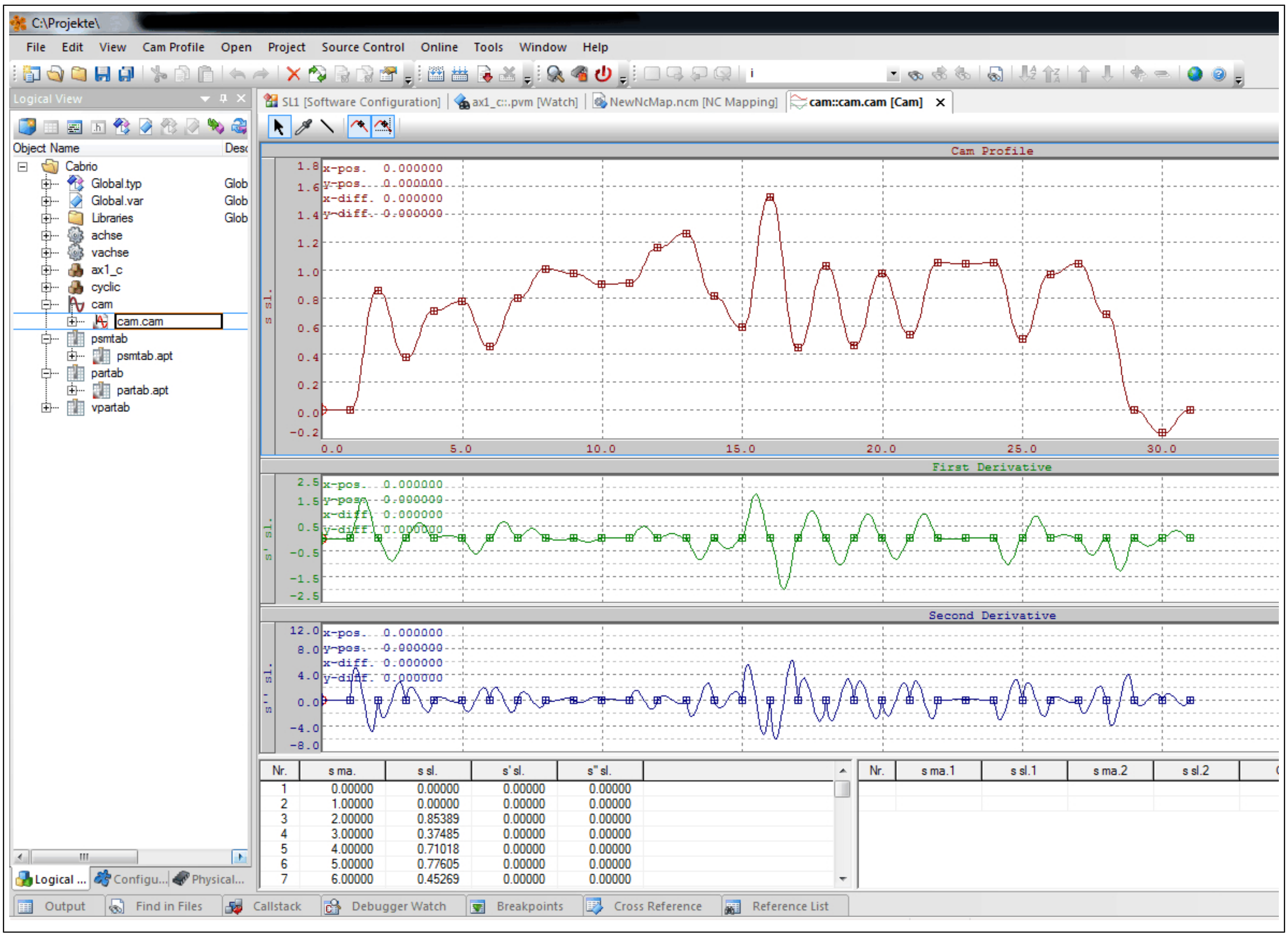


Figure 5: Cam editor - for creating movement profiles simply and precisely

3 ACOPOS configurations

ACOPOS servo drives include several technology-specific functions with performance, flexibility and capability in the field which has been remarkably proven in countless applications. The ACOPOS functions listed below are basic functions that the user can switch between as needed within 400 µs. In addition, manipulations such as changes in product length, registration mark control, overlying torque control, brief process adaptations and quality checks can be carried out at any time.

- Point-to-point movements
- Electronic gears
- Electronic differential gears
- Cutting units
- Electronic cam profiles
- Flying saws
- Line shafts
- CNC

ACOPOS servo drives can be used in various configurations depending on the network type and the requirements of the application. The functions listed above are available to the user in each of the topology examples shown.

Response speeds are not influenced by the network and control system being used if technology functions are processed directly on the ACOPOS servo drive. Additional sensors and actuators must be integrated in the control system for more complex processes. In these cases, the level of performance depends mostly on the type of network and control system being used.

The topology examples shown on the following pages provide an overview of the bandwidths that are possible with B&R automation components.

3.1 ACOPOS in a POWERLINK network

High-performance machine architectures require flexible networks and fieldbuses. With POWERLINK, a network is available to the user that fully meets the high demands of dynamic motion systems. POWERLINK adapts to the requirements of the machine and the system. The rigid coupling of many axes with controllers, industrial PCs, I/O systems and operator panels allows machines and systems to be created with the highest level of precision. Compatibility to standard Ethernet also reduces the number of networks and fieldbuses on the machine level.

Successful areas of use for these topologies:

- Packaging industry
- Handling technology
- Plastics processing
- Paper and printing
- Textile industry
- Wood industry
- Metalworking industry
- Semiconductor industry

3.1.1 Recommended topology for POWERLINK networks

In the POWERLINK network (seen from the manager), the tree structure should always come first followed by the line structure. Otherwise, the line structure delay affects the entire tree beneath it.

Information:

It should be noted that the longest path is allowed a maximum of 10 hubs by the manager.

Information:

Communication to all POWERLINK stations connected to the POWERLINK network in a line-formed network via the mini-hub of this ACOPOS servo drive is interrupted during the network initialization (startup) of an ACOPOS servo drive.

3.1.2 Further literature

Unless otherwise stated, the recommendations in the following documents apply:

- "Industrial Ethernet Planning and Installation Guide",
  Draft 2.0, IAONA (www.iaona-eu.com)
- "Guide to Understanding and Obtaining High Quality Generic Cabling",
  3P Third Party Testing (www.3ptest.dk)

3.2 Compact, modular motion control applications

All ACOPOS servo drives serve as a mini-hub for cabling and allow line-formed routing of the POWERLINK network. This considerably reduces the cabling expenditure (without reducing functionality).

- Modular machine architectures with up to 100 m between individual axes
- Minimal wiring required due to line structure (no ring)
- No additional infrastructure components needed
- Synchronization from the PLC program to the drive control loop

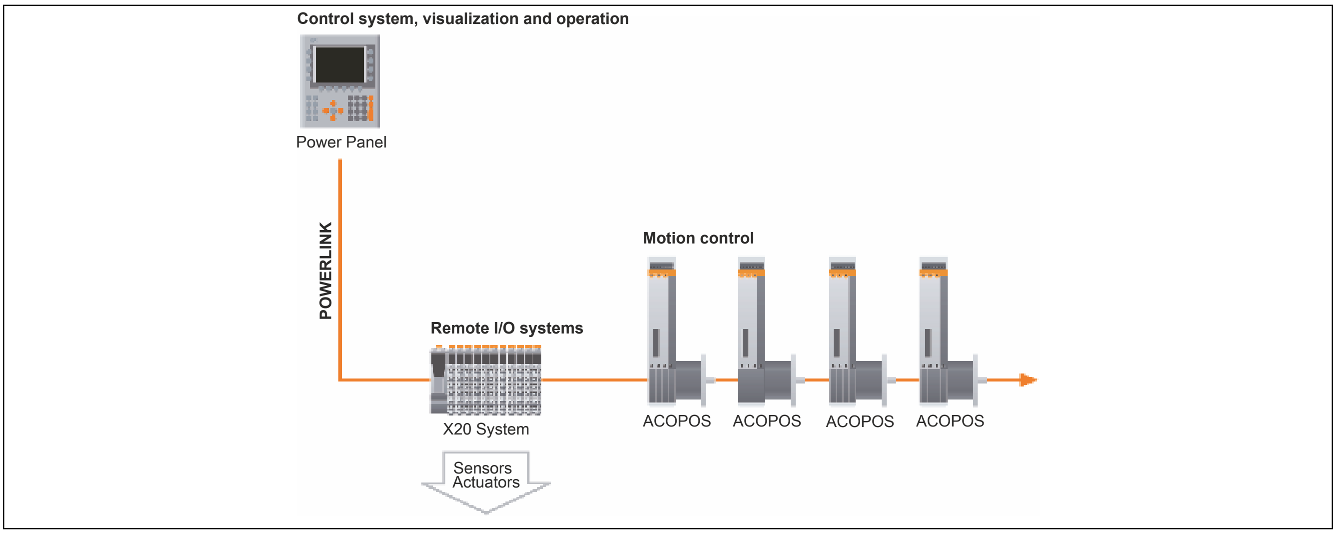


Figure 6: Compact, modular motion control applications

3.3 Extensive, modular motion control applications with up to 253 axes

ACOPOS servo drives are connected to the POWERLINK network in star topologies using hubs and line topologies.

- Modular machine architectures with up to 100 m between individual axes
- Optimized wiring using a mixed star/line structure
- Nodes with fast and slow sampling rates operable within a single network, eliminating the need to divide the network into fast and slow segments
- Synchronization from the PLC program to the drive control loop

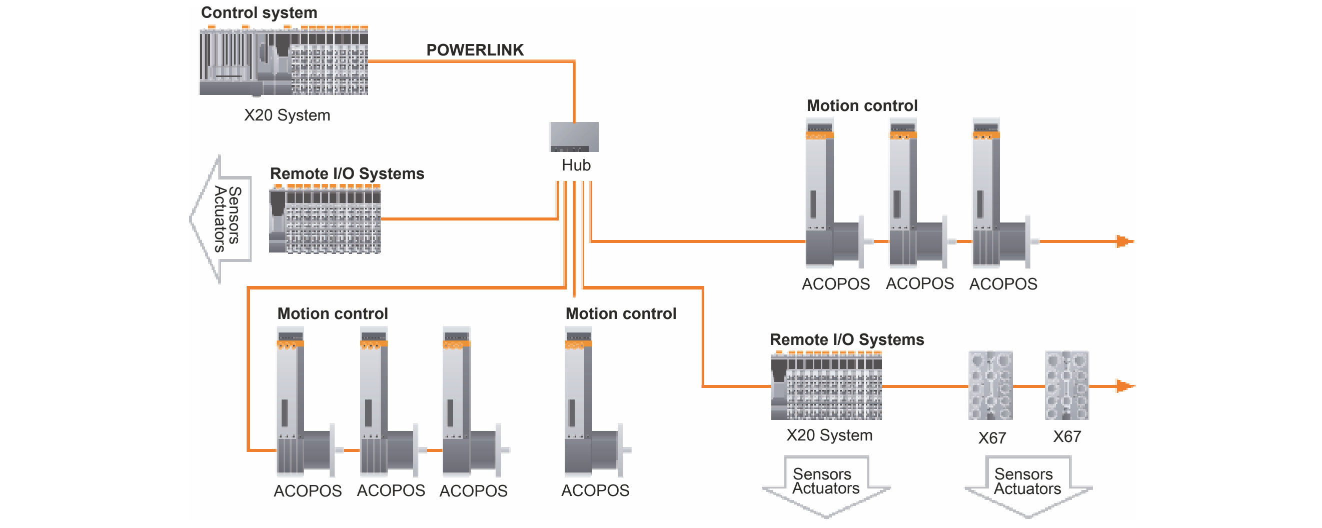


Figure 7: Extensive, modular motion control applications with up to 253 axes

3.4 ACOPOS in a CAN bus network

The dynamic requirements for small and mid-sized machines with several axes can be handled efficiently using a CAN bus.
The CAN bus is a cost-effective fieldbus for networking ACOPOS servo drives with controllers, industrial PCs, I/O systems and operator panels.

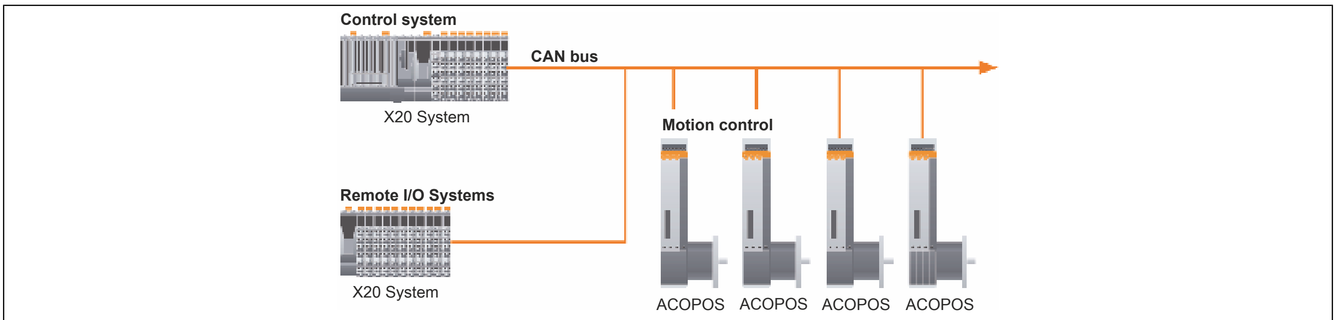


Figure 8: ACOPOS in a CAN bus network

3.5 Drive-based control

The controller is located centrally on an ACOPOS servo drive. The drives are networked and synchronized with each other via the CAN bus. As a result, electronic gear and cam profile applications as well as CNC applications are possible in addition to simple point-to-point movements. Powerful operation and visualization is managed by the controller in the ACOPOS servo drive. I/O signals are connected in the control cabinet or directly in the machine room. By eliminating the need for an external controller, even very limited space can be used optimally.

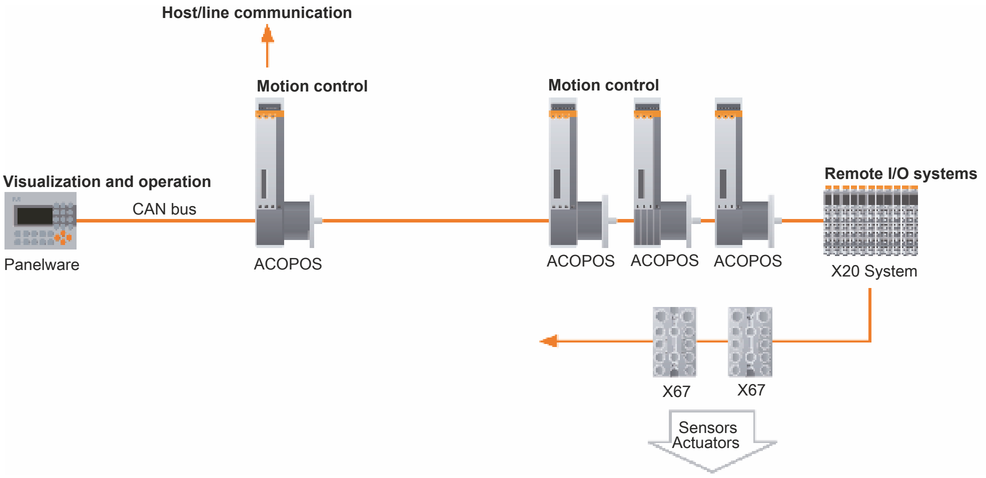


Figure 9: Drive-based automation with ACOPOS

4 Safety guidelines

4.1 Organization of safety notices

Safety notices in this manual are organized as follows:

Safety notice	Description
Danger!	Disregarding these safety guidelines and notices can be life-threatening.
Warning!	Disregarding these safety guidelines and notices can result in severe injury or substantial damage to equipment.
Caution!	Disregarding these safety guidelines and notices can result in injury or damage to equipment.
Information:	This information is important for preventing errors.

Table 2: Description of the safety notices used in this documentation

4.2 General information

B&R servo drives and servo motors have been designed, developed and manufactured for conventional use in industrial environments. They were not designed, developed and manufactured for any use involving serious risks or hazards that could lead to death, injury, serious physical damage or loss of any kind without the implementation of exceptionally stringent safety precautions. In particular, such risks and hazards include the use of these devices to monitor nuclear reactions in nuclear power plants, their use in flight control or flight safety systems as well as in the control of mass transportation systems, medical life support systems or weapons systems.

Servo drives, inverter modules and frequency inverters from B&R are not dual-use goods in accordance with Regulation (EG) No. 428/2009 | 3A225.

Danger!

Drive systems and motors can have exposed parts that carry voltage (e.g. terminals) as well as hot surfaces. Additional hazards include moving machine parts. Improperly removing required covers, inappropriate use of the devices or their improper installation or operation can result in severe personal injury or damage to property.

All tasks such as the transport, installation, commissioning and servicing of devices are only permitted to be carried out by qualified personnel. Qualified personnel are those familiar with the transport, mounting, installation, commissioning and operation of devices who also have the appropriate qualifications (e.g. IEC 60364). National accident prevention regulations must be observed.

The safety notices, connection descriptions (type plate and documentation) and limit values listed in the technical data are to be read carefully before installation and commissioning and must be observed.

Danger!

The improper handling of servo drives and servo motors can cause severe personal injury or damage to property!

4.3 Intended use

Servo drives are components designed to be installed in electrical systems or machines. They are not permitted to be used unless the machine meets directive 2006/42/EC (machine directive) as well as directive 2004/108/EC (EMC directive).

Servo drives are only permitted to be operated directly on grounded, three-phase industrial mains (TN, TT power mains). When used in residential areas, shops or small businesses, additional measures must be implemented by the user.

Danger!

Servo drives are not permitted to be operated directly on IT and TN-S mains with a grounded phase conductor and protective ground conductor!

Technical data as well as connection and environmental specifications can be found on the type plate and in this user's manual. These specifications regarding connection and environmental conditions must be observed!

Danger!

Electronic devices are never completely failsafe. If the servo drive fails, the user is responsible for ensuring that the connected motor is brought to a secure state.

4.4 Protection against electrostatic discharge

Electrical components that can be damaged by electrostatic discharge (ESD) must be handled accordingly.

4.4.1 Packaging

Electrical components with a housing do not require any special ESD packaging, but they must still be handled properly (see section 4.4.2 "Guidelines for proper ESD handling" on page 24).

Electrical components without a housing are protected by ESD protective packaging.

4.4.2 Guidelines for proper ESD handling

Electrical components with a housing

- Do not touch the connector contacts on connected cables.
- Do not touch the contact tips on circuit boards.

Electrical components without a housing

The following applies in addition to the points listed under "Electrical components with a housing":

- Any persons handling electrical components or devices with installed electrical components must be grounded.
- Components may only be touched on their narrow sides or front plate.
- Components should always be stored in a suitable medium (ESD packaging, conductive foam, etc.).
  Metallic surfaces are not suitable storage surfaces!
- Components should not be subjected to electrostatic discharge (e.g. through the use of charged plastics).
- Ensure a minimum distance of 10 cm from monitors and TV sets.
- Measurement devices and equipment must be grounded.
- Measurement probes on potential-free measurement devices must be discharged on sufficiently grounded surfaces before taking measurements.

Individual components

- ESD protective measures for individual components are thoroughly integrated at B&R (conductive floors, footwear, arm bands, etc.).
- These increased ESD protective measures for individual components are not necessary for customers handling B&R products.

4.5 Transport and storage

During transport and storage, devices must be protected against undue stress (mechanical loads, temperature, humidity, aggressive atmospheres, etc.).

Servo drives contain components sensitive to electrostatic charges that can be damaged by inappropriate handling. It is therefore necessary to provide the required protective measures against electrostatic discharge when installing or removing these servo drives.

4.6 Installation

Installation must be performed according to this documentation using suitable equipment and tools.

Devices may only be installed by qualified personnel without voltage applied. Before installation, voltage to the control cabinet must be switched off and prevented from being switched on again.

General safety guidelines and national accident prevention regulations (e.g. VBG 4) for working with high voltage systems must be observed.

Electrical installation must be carried out according to applicable guidelines (e.g. line cross sections, fuses, protective ground connections, see also see "Dimensioning" on page 215).

4.7 Operation

4.7.1 Protection against touching electrical parts

> **Danger!**
>
> **To operate servo drives, it is necessary for certain parts to carry dangerous voltages over 42 VDC. Touching one of these parts can result in a life-threatening electric shock. This could lead to death, severe injury or damage to equipment.**

Before turning on a servo drive, it is important to ensure that the housing is properly connected to ground (PE rail). The ground connection must be established even when testing the drive or operating it for a short time!

Before turning the device on, all parts that carry voltage must be securely covered. During operation, all covers and control cabinet doors must remain closed.

> **Danger!**
>
> **If an application uses the safety functions integrated in the drive system, then the safety functions must be fully validated before being turned on for the first time. This could lead to death, severe injury or damage to equipment.**

Control and power connections can still carry voltage even if the motor is not turning. Touching these connections when the device is switched on is prohibited.Before performing any work on servo drives, they must first be disconnected from the power mains and prevented from being switched on again.

> **Danger!**
>
> **After switching off the servo drive, wait until the DC bus discharge time of at least five minutes has passed. The voltage currently on the DC bus must be measured between -DC1 and +DC1 with a suitable measuring device before beginning work. This voltage must be less than 42 VDC to rule out danger. An unlit Run LED does not indicate that voltage is not present on the device!**

Servo drives are labeled with the following warning:

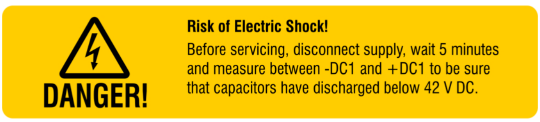


Figure 10: Warning on the servo drive

The connections for servo drive signal voltages ranging from 5 to 30 V are safely isolated circuits. The signal voltage connections and interfaces are therefore only permitted to be connected to devices or electrical components that have sufficient isolation in accordance with IEC 60364-4-41 or EN 61800-5-1 and that correspond to SELV / PELV or a class DVC A safety extra low voltage in accordance with EN 61800-5-1.

Never remove the electrical connections from the servo drive with voltage applied. In some cases, electric arcs may occur that can cause personal injury and/or damage to contacts.

4.7.2 Protection against hazardous movements

Danger!

Improper control of motors can result in unintended hazardous movements! Such incorrect behavior can have various causes:

- **Incorrect installation or a mistake when handling components**
- **Improper or incomplete wiring**
- **Defective devices (servo drive, motor, position encoder, cables, brake)**
- **Incorrect control (e.g. caused by software error)**

Some of the errors listed above can be detected and prevented by the servo drive's internal monitoring. Nevertheless, it is still possible for the motor shaft to move any time the device is switched on! For this reason, higher-level safety precautions need to be put in place to ensure that personnel and machines are protected.

The moving parts on machines must be shielded in such a way as to prevent unintentional access by personnel. This type of protection can be achieved by using stable mechanical protective equipment such as protective covers, protective fences, protective gates or light barriers.

Removing, bypassing or circumventing these safety measures and entering the area where movement takes place is prohibited.

A sufficient number of emergency stop switches must be installed in direct proximity to the machine and be easily accessible at all times. This emergency stop equipment must be checked before the machine is commissioned.

On free running motors, the shaft key (if present) must be removed or measures taken to prevent its ejection.

The holding brake built into motors cannot prevent hoisting equipment from dropping hanging loads.

4.7.3 Protection against burns

The surfaces of servo drives and servo motors can reach very high temperatures during operation.

Servo drives are therefore labeled with the following warning:

Figure 11: Warning on the servo drive

4.8 Specifications for functional safety

Specifications for functional safety are listed in the section "Safety technology".

Specifications are calculated based on a proof test interval of up to 20 years. Since a proof test cannot be carried out for B&R drive systems, the proof test interval is the same as the system's mission time.

In accordance with the EN ISO 13849, EN 62061 and IEC 61508 standards, the safety functions described in the "Safety technology" section cannot be used beyond the specified mission time.

Danger!

The user must ensure that all B&R drive systems that fulfill a safety function are replaced by new B&R drive systems or removed from operation before their mission time expires.

4.9 Environmentally friendly disposal

All B&R drive systems and servo motors are designed to inflict as little harm as possible on the environment.

4.9.1 Separation of materials

It is necessary to separate different materials so the device can undergo an environmentally friendly recycling process.

Component	Disposal
Drive systems, servo motors, cables	Electronic recycling
Cardboard box / paper packaging	Paper/cardboard recycling

Table 3: Environmentally friendly separation of materials

Disposal must comply with applicable legal regulations.

Chapter 2 • Technical data

1 Module overview

ACOPOS 1010, 1016

Product ID	Short description	on page
8V1010.00-2	ACOPOS servo drive, 3x 400-480 V, 1.0 A, 0.45 kW, line filter, braking resistor and electronic secure restart inhibit integrated	35
8V1010.001-2	ACOPOS servo drive, 3x 400-480 V, 1.0 A, 0.45 kW, coated, line filter, integrated braking resistor and electronic secure restart inhibit	35
8V1010.50-2	ACOPOS servo drive, 3x 110-230 V / 1x 110-230 V, 2.0 A, 0.45 kW, line filter, braking resistor and electronic secure restart inhibit integrated	39
8V1010.501-2	ACOPOS servo drive, 3x 110-230 V / 1x 110-230 V, 2.3 A, 0.45 kW, coated, line filter, integrated braking resistor and electronic secure restart inhibit	39
8V1016.00-2	ACOPOS servo drive, 3x 400-480 V, 1.6 A, 0.7 kW, line filter, braking resistor and electronic secure restart inhibit integrated	43
8V1016.001-2	ACOPOS servo drive, 3x 400-480 V, 1.6 A, 0.7 kW, coated, line filter, integrated braking resistor and electronic secure restart inhibit	43
8V1016.50-2	ACOPOS servo drive, 3x 110-230 V / 1x 110-230 V, 3.6 A, 0.7 kW, line filter, integrated braking resistor and electronic secure restart inhibit	47
8V1016.501-2	ACOPOS servo drive, 3x 110-230 V / 1x 110-230 V, 3.6 A, 0.7 kW, coated, line filter, integrated braking resistor and electronic secure restart inhibit	47

ACOPOS 1022, 1045, 1090

Product ID	Short description	on page
8V1022.00-2	ACOPOS servo drive, 3x 400-480 V, 2.2 A, 1 kW, line filter, integrated braking resistor and electronic secure restart inhibit	58
8V1022.001-2	ACOPOS servo drive, 3x 400-480 V, 2.2 A, 1 kW, coated, line filter, integrated braking resistor and electronic secure restart inhibit	58
8V1045.00-2	ACOPOS servo drive, 3x 400-480 V, 4.4 A, 2 kW, line filter, braking resistor and electronic secure restart inhibit integrated	62
8V1045.001-2	ACOPOS servo drive, 3x 400-480 V, 4.4 A, 2 kW, coated, line filter, integrated braking resistor and electronic secure restart inhibit	62
8V1090.00-2	ACOPOS servo drive, 3x 400-480 V, 8.8 A, 4 kW, line filter, integrated braking resistor and electronic secure restart inhibit	66
8V1090.001-2	ACOPOS servo drive, 3x 400-480 V, 8.8 A, 4 kW, coated, line filter, integrated braking resistor and electronic secure restart inhibit	66

ACOPOS 1180, 1320

Product ID	Short description	on page
8V1180.00-2	ACOPOS servo drive, 3x 400-480 V, 19 A, 9 kW, line filter, braking resistor, DC bus power supply and electronic secure restart inhibit integrated	76
8V1180.001-2	ACOPOS servo drive, 3x 400-480 V, 19 A, 9 kW, coated, line filter, integrated braking resistor, DC bus power supply and electronic secure restart inhibit	76
8V1320.00-2	ACOPOS servo drive, 3x 400-480 V, 34 A, 16 kW, line filter, braking resistor, DC bus power supply and electronic secure restart inhibit integrated	80
8V1320.001-2	ACOPOS servo drive, 3x 400-480 V, 34 A, 16 kW, coated, line filter, integrated braking resistor, DC bus power supply and electronic secure restart inhibit	80

ACOPOS 1640, 128M

Product ID	Short description	on page
8V128M.00-2	ACOPOS servo drive, 3x 400-480 V, 128 A, 64 kW, line filter, integrated braking resistor, DC bus power supply and electronic secure restart inhibit	95
8V128M.001-2	ACOPOS servo drive, 3x 400-480 V, 128 A, 64 kW, coated, line filter, integrated braking resistor, DC bus power supply and electronic secure restart inhibit	95
8V1640.00-2	ACOPOS servo drive, 3x 400-480 V, 64 A, 32 kW, line filter, integrated braking resistor, DC bus power supply and electronic secure restart inhibit	91
8V1640.001-2	ACOPOS servo drive, 3x 400-480 V, 64 A, 32 kW, coated, line filter, integrated braking resistor, DC bus power supply and electronic secure restart inhibit	91

ACOPOS plug-in modules

Product ID	Short description	on page
8AC110.60-3	ACOPOS plug-in module, CAN interface	107
8AC114.60-2	ACOPOS plug-in module, POWERLINK V2 interface	109
8AC120.60-1	ACOPOS plug-in module, EnDat encoder and sine incremental encoder interface	112
8AC121.60-1	ACOPOS plug-in module, HIPERFACE interface	116
8AC122.60-3	ACOPOS plug-in module, resolver interface 10 kHz	120
8AC122.60-4	ACOPOS plug-in module, resolver interface 10 kHz, no open line detection	122
8AC123.60-1	ACOPOS plug-in module, incremental encoder and SSI absolute encoder interface	125
8AC125.60-1	ACOPOS plug-in module, BiSS encoder interface 5 V	129
8AC125.60-2	ACOPOS plug-in module, BiSS encoder interface 5V, baud rate 6.25 Mbit/s	131
8AC125.61-2	ACOPOS plug-in module, BiSS encoder interface 12V, baud rate 6.25 Mbit/s	134
8AC126.60-1	ACOPOS plug-in module, EnDat 2.2 encoder interface	137
8AC130.60-1	ACOPOS plug-in module, 8 digital I/O configurable in pairs as 24 V input or as output 400/100 mA, 2 digital outputs 2 A, order TB712 terminal block separately.	140
8AC131.60-1	ACOPOS plug-in module, 2 analog inputs ±10 V, 2 digital I/O points which can be configured as a 24 V input or 45 mA output, order TB712 terminal block separately.	144
8AC140.60-3	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 1 CAN interface, 1 Ethernet interface 100 Base-T, 1 PROFIBUS DP slave interface, 1 RS232 interface, 3 digital I/O can be configured as 24 VDC input or 500 mA output, 1 analog input ±10 V, order program memory and 0TB708 terminal block separately.	148
8AC140.61-3	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 1 CAN interface, 1 Ethernet interface 100 Base-T, 1 PROFIBUS DP slave interface, 1 RS232 interface, 3 digital I/O can be configured as 24 VDC input or 500 mA output, 1 analog input ±10 V, order program memory and 0TB708 terminal block separately.	149
8AC141.60-2	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 16 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 2 CAN interfaces, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 1 X2X Link Master interface, 3 digital I/O can be configured as 24 VDC input or output 500 mA, 1 analog input ±10 V, order program memory and 0TB704 and 0TB708 terminal blocks separately	160
8AC141.61-3	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 2 CAN interfaces, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 1 X2X Link Master interface, 3 digital I/O can be configured as 24 VDC input or output 500 mA, 1 analog input ±10 V, order program memory and 0TB704 and 0TB708 terminal blocks separately	160

Battery module

Product ID	Short description	on page
8AXB000.0000-00	8AC126.60-1 accessory set for encoder buffering consisting of: Battery module with 3.6 V lithium battery	171

8B0W external braking resistors

Product ID	Short description	on page
8B0W0045H000.000-1	ACOPOSmulti braking resistor, 450 W, 50 R, IP20, terminals	173
8B0W0045H000.001-1	ACOPOSmulti braking resistor, 450 W, 50 R, IP65, terminals	173
8B0W0079H000.000-1	ACOPOSmulti braking resistor, 790 W, 33 R, IP20, terminals	173
8B0W0079H000.001-1	ACOPOSmulti braking resistor, 790 W, 33 R, IP65, terminals	173

2 ACOPOS servo drives

Controlling your power transmission system with B&R ACOPOS servo drives allows you to fully use the advantages of an optimized system architecture. Applications that require additional positioning tasks such as torque limitation or torque control can be created quickly and elegantly. The flexible system concept for B&R servo drives is made possible by coordinated hardware and software components. You can select the optimal system configuration for your application and increase your competitiveness.

- Perfect integration in all B&R product families
- Object-oriented axis programming minimizes development time and increases reusability
- Integrated technology functions for industry-specific tasks
- Operation of synchronous and induction motors possible
- Current controller scan time up to 50 µs
- Reduced commissioning and service times using "embedded motor parameter chip"
- CAN bus and POWERLINK network connection
- Input voltage range from 400 - 480 VAC (±10%) for many areas of use
- Connection possibilities for all standard encoder systems
- Up to two free slots for optional technology modules
- Electronic secure restart inhibit integrated
- Optionally available as version with partially-coated circuit boards – more robust with regard to environmental influences

2.1 Overview

The ACOPOS servo drive series covers a current range from 1.0 - 128 A and a power range from 0.5 - 64 kW with 11 devices in 4 groups. The devices in a group are designed using the same basic concept. They offer connection possibilities for all standard encoder systems and modular fieldbus interfaces.

Group	8V1010.xxx-2 8V1010.5xx-2 8V1016.xxx-2 8V1016.5xx-2	8V1022.0xx-2 8V1045.0xx-2 8V1090.0xx-2	8V1180.0xx-2 8V1320.0xx-2	8V1640.0xx-2 8V128M.0xx-2
Power connections	Plug connection	Plug connection	Plug connection	Fixed
Integrated line filter	Yes	Yes	Yes	Yes
Power failure monitoring	Yes	Yes	Yes	Yes
DC bus connection	Yes	Yes	Yes	Yes
24 VDC supply	External 1)	External 1)	External or internal via DC bus	External or internal via DC bus
24 VDC output	No	No	24 V / 0.5 A	24 V / 0.5 A
Integrated brake chopper	Yes	Yes	Yes	Yes
Internal braking resistor	Yes	Yes	Yes	Yes 2)
Connection of external braking resistor possible	No	No	Yes	Yes
Monitored output for motor holding brake	Yes	Yes	Yes	Yes
Monitored input for motor temperature sensor	Yes	Yes	Yes	Yes
Max. number of plug-in modules	3	4	4	4

Table 4: Overview of the ACOPOS servo drive series

1) An external DC bus power supply can be used.
2) The braking resistors integrated in 1640 and 128M ACOPOS servo drives are dimensioned so that it is possible to brake to a complete stop (in a typical drive situation).

ACOPOS servo drives are suitable for both synchronous and induction servo motors and have built-in line filters to meet the limit values for CISPR11, Group 2, Class A.

Warning!

ACOPOS drive systems are suitable for power mains that can provide a maximum short circuit current (SCCR) of 65 kA at a maximum of 482 V and that are protected with class J fuses.

2.1.1 24 VDC supply during power failures

In order to be able to provide the stop function for Category 1 in accordance with IEC 60204-1 during a power failure, the 24 VDC supply voltage for the servo drives as well as encoders, sensors and the safety circuit must remain active during the entire stopping procedure.

ACOPOS servo drives recognize a power failure and can immediately initiate active braking of the motor. The brake energy generated when braking is returned to the DC bus, and the DC bus power supply can use it to create the 24 VDC supply voltage.

Danger!

In some applications, the DC bus is not ready for operation or there is not enough brake energy provided to guarantee that the 24 VDC supply voltage remains active until the system is stopped.

Internal DC bus power supplies are not ready for operation during the ACOPOS servo drive switch-on interval; external DC bus power supplies are not ready for operation while booting.

An external DC bus power supply must be used for ACOPOS servo drives 8V1010 to 8V1090. A DC bus power supply is integrated in ACOPOS servo drives 8V1180 to 8V128M.

ACOPOS servo drives with an integrated DC bus power supply provide the 24 VDC supply for the servo drive and also a 24 VDC output to supply encoders, sensors and the safety circuit. In many cases, it is not necessary to use an uninterruptible power supply (UPS) which is otherwise needed.

2.2 Status indicators

ACOPOS servo drives are equipped with three LEDs for direct diagnostics:

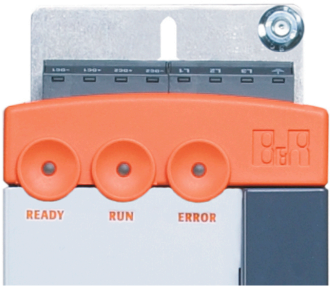


Figure 12: ACOPOS servo drives - Status indicators

Labeling	Color	Function	Description	
READY	Green	Ready	Green (lit)	The module is operational and the power stage can be enabled (operating system present and booted, no permanent or temporary errors).
			Green (blinking) [1]	The module is not ready for operation. Examples: • No signal on one or both enable inputs • DC bus voltage outside the tolerance range • Overtemperature on the motor (temperature sensor) • Motor feedback not connected or defective • Motor temperature sensor not connected or defective • Overtemperature on the module (IGBT junction, heat sink, etc.) • Disturbance on network
RUN	Orange	Run	Orange (lit)	The module's power stage is enabled.
ERROR	Red	Error	Red (lit) [1]	There is a permanent error on the module. Examples: • Permanent overcurrent • Invalid data in EPROM

Table 5: LED status - ACOPOS servo drives

1) Firmware V2.130 and higher

If no LEDs are lit, the ACOPOS servo drive is not being supplied with 24 VDC.

Danger!

After switching off the device, wait until the DC bus discharge time of at least five minutes has passed. The voltage currently on the DC bus must be measured with a suitable measuring device before beginning work. This voltage must be less than 42 VDC to rule out danger. An unlit Run LED does not indicate that voltage is not present on the device!

2.2.1 LED status

The following timing is used for the indication diagrams:

Block size: 125 ms
Repeats after: 3000 ms

Status changes when booting the operating system loader

Status	LED	Display
1. Boot procedure for base hardware active	Green	
	Orange	
	Red	
2. Configuration of network plug-in module active	Green	
	Orange	
	Red	
3. Waiting for network telegram	Green	
	Orange	
	Red	
4. Network communication active	Green	
	Orange	
	Red	

Table 6: Status changes when booting the operating system loader

Error status with reference to the CAN plug-in module AC110

Status	LED	Display
Invalid hardware ID 1)	Green	
	Orange	
	Red	
Boot error on CAN basic hardware	Green	
	Orange	
	Red	
Bus Off	Green	
	Orange	
	Red	
CAN station number is 0	Green	
	Orange	
	Red	

Table 7: Error status with reference to the CAN plug-in module AC110

1) Possible errors:
- ACOPOS servo drive defect
- Plug-in module defect
- Plug-in module not inserted correctly in the slot

Error status with reference to the POWERLINK V2 plug-in module AC114

Status	LED	Display
Invalid hardware ID 1)	Green	
	Orange	
	Red	
Boot error on POWERLINK basic hardware	Green	
	Orange	
	Red	
Error when booting the AC114-ARM	Green	
	Orange	
	Red	
POWERLINK station number is 0	Green	
	Orange	
	Red	

Table 8: Error status with reference to the POWERLINK V2 plug-in module AC114

1) Possible errors:
- ACOPOS servo drive defect (plug-in module not recognized)
- Plug-in module defect
- Plug-in module not inserted correctly in the slot
- Plug-in module functioning but not automatically recognized by the ACOPOS servo drive (old bootstrap loader)

2.3 ACOPOS 1010, 1016

2.3.1 ACOPOS 8V1010.0xx-2

2.3.1.1 Order data

Model number	Short description	Figure
	Servo drives	
8V1010.00-2	ACOPOS servo drive, 3x 400-480 V, 1.0 A, 0.45 kW, line filter, braking resistor and electronic secure restart inhibit integrated	
8V1010.001-2	ACOPOS servo drive, 3x 400-480 V, 1.0 A, 0.45 kW, coated, line filter, integrated braking resistor and electronic secure restart inhibit	
	Optional accessories	
	Plug-in modules	
8AC110.60-2	ACOPOS plug-in module, CAN interface	
8AC110.60-3	ACOPOS plug-in module, CAN interface	
8AC114.60-2	ACOPOS plug-in module, POWERLINK V2 interface	
8AC120.60-1	ACOPOS plug-in module, EnDat encoder and sine incremental encoder interface	
8AC121.60-1	ACOPOS plug-in module, HIPERFACE interface	
8AC122.60-3	ACOPOS plug-in module, resolver interface 10 kHz	
8AC122.60-4	ACOPOS resolver interface 10 kHz, no open line detection	
8AC123.60-1	ACOPOS plug-in module, incremental encoder and SSI absolute encoder interface	
8AC125.60-1	ACOPOS plug-in module, BiSS encoder interface 5 V	
8AC125.60-2	ACOPOS plug-in module, BiSS encoder interface 5V, baud rate 6.25 Mbit/s	
8AC125.61-2	ACOPOS plug-in module, BiSS encoder interface 12V, baud rate 6.25 Mbit/s	
8AC126.60-1	ACOPOS plug-in module, EnDat 2.2 encoder interface	
8AC130.60-1	ACOPOS plug-in module, 8 digital I/O configurable in pairs as 24 V input or as output 400/100 mA, 2 digital outputs 2 A, order TB712 terminal block separately.	
8AC131.60-1	ACOPOS plug-in module, 2 analog inputs ±10 V, 2 digital I/O points which can be configured as a 24 V input or 45 mA output, order TB712 terminal block separately.	
8AC132.60-1	ACOPOS plug-in module, 2 analog inputs ±10 V	
8AC140.60-3	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 1 CAN interface, 1 Ethernet interface 100 Base-T, 1 PROFIBUS DP slave interface, 1 RS232 interface, 3 digital I/O can be configured as 24 VDC input or 500 mA output, 1 analog input ±10 V, order program memory and 0TB708 terminal block separately.	
8AC140.61-3	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 1 CAN interface, 1 Ethernet interface 100 Base-T, 1 PROFIBUS DP slave interface, 1 RS232 interface, 3 digital I/O can be configured as 24 VDC input or 500 mA output, 1 analog input ±10 V, order program memory and 0TB708 terminal block separately.	
8AC141.60-2	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 16 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 2 CAN interfaces, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 1 X2X Link Master interface, 3 digital I/O can be configured as 24 VDC input or output 500 mA, 1 analog input ±10 V, order program memory and 0TB704 and 0TB708 terminal blocks separately	
8AC141.61-3	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 2 CAN interfaces, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 1 X2X Link Master interface, 3 digital I/O can be configured as 24 VDC input or output 500 mA, 1 analog input ±10 V, order program memory and 0TB704 and 0TB708 terminal blocks separately	
	Shielding component sets	
8X0040.00-1	ACOPOS shielding components set for 8V1010.xxx-x and 8V1016.xxx-x	
	Terminal sets	
8X0001.00-1	ACOPOS accessories, plug set for 8V1010.00 and 8V1090.00 (3 phase)	

Table 9: 8V1010.00-2, 8V1010.001-2 - Order data

2.3.1.2 Technical data

Product ID	8V1010.00-2	8V1010.001-2
General information		
Note	-	Variant with partially coated circuit boards
B&R ID code	0x18D6	0xA6D4
Slots for plug-in modules	3	
Certification CE cULus KC FSC	 Yes Yes Yes Yes	
Power mains connection		
Permissible power mains forms	TT, TN [1]	TT, TN [2]
Mains input voltage	3x 400 VAC to 480 VAC ±10%	
Frequency	50 / 60 Hz ±4%	
Installed load	Max. 1.35 kVA	
Starting current	2 A (at 400 VAC)	
Switch-on interval	>10 s	
Integrated line filter in accordance with EN 61800-3, Category C3 [3]	Yes	
Power loss at max. device power without braking resistor	80 W	
DC bus connection		
DC bus capacitance	165 µF	
24 VDC supply		
Input voltage [4]	24 VDC +25% / -20%	
Input capacitance	5600 µF	
Power consumption [5]	Max. 1.47 A + current for motor holding brake	
Motor connection		
Quantity	1	
Continuous current [6]	1 A_{eff}	
Reduction of continuous current depending on the ambient temperature Mains input voltage: 400 VAC Switching frequency 5 kHz Switching frequency 10 kHz Switching frequency 20 kHz Mains input voltage: 480 VAC Switching frequency 5 kHz Switching frequency 10 kHz Switching frequency 20 kHz	 No reduction No reduction [7] No reduction No reduction No reduction [7] 0.13 A_{eff} per °C (starting at 45°C)	
Reduction of continuous current depending on the installation elevation Starting at 500 m above sea level	 0.1 A_{eff} per 1000 m	
Peak current	2.8 A_{eff}	
Nominal switching frequency	10 kHz	
Possible switching frequencies	5 / 10 / 20 kHz	
Electrical stress of the connected motor in accordance with IEC TS 60034-25 [8]	Limit value curve A	
Max. motor line length	15 m	
Protective measures Overload protection Short circuit and ground fault protection	 Yes Yes	
Max. output frequency	600 Hz [9]	600 Hz [10]
Motor holding brake connection		
Response threshold for open line monitoring	Approx. 245 mA	
Max. output current	1.3 A	
Max. number of switching cycles	Unlimited since done electronically	Unlimited since handled electronically
Braking resistors		
Peak power output	2 kW	
Continuous power	130 W	
Limit switch and reference inputs		
Quantity	3	
Wiring	Sink	
Electrical isolation Input - ACOPOS Input - Input	 Yes No	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Switching threshold Low High	 <5 V >15 V	
Input current at nominal voltage	Approx. 4 mA	

Table 10: 8V1010.00-2, 8V1010.001-2 - Technical data

Product ID	8V1010.00-2	8V1010.001-2
Switching delay	Max. 2.0 ms	
Modulation compared to ground potential	Max. ±38 V	
Enable inputs		
Quantity	1	
Wiring	Sink	
Electrical isolation Input - ACOPOS	 Yes	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Input current at nominal voltage	Approx. 30 mA	
Switching threshold Low High	 <5 V >15 V	
Switching delay Enable 0 -> 1, ready for PWM Enable 1 -> 0, PWM off	 Max. 100 µs Max. 2.0 ms	
Modulation compared to ground potential	Max. ±38 V	
OSSD signal connections [11]	Not permitted	
Trigger inputs		
Quantity	2	
Wiring	Sink	
Electrical isolation Input - ACOPOS Input - Input	 Yes No	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Switching threshold Low High	 <5 V >15 V	
Input current at nominal voltage	Approx. 10 mA	
Switching delay Positive edge Negative edge	 52 µs ±0.5 µs (digitally filtered) 53 µs ±0.5 µs (digitally filtered)	
Modulation compared to ground potential	Max. ±38 V	
Electrical characteristics		
Discharge capacitance	550 nF	
Operating conditions		
Permitted mounting orientations Hanging vertically Lying horizontally Standing horizontally	 Yes Yes No	
Installation at elevations above sea level Nominal Maximum [12]	 0 to 500 m 2000 m	
Degree of pollution in accordance with EN 60664-1	2 (non-conductive pollution)	
Overvoltage category in accordance with IEC 60364-4-443:1999	II	
EN 60529 protection	IP20	
Environmental conditions		
Temperature Operation Nominal Maximum [13] Storage Transport	 5 to 40°C 55°C -25 to 55°C -25 to 70°C	
Relative humidity Operation Storage Transport	 5 to 85% 5 to 95% Max. 95% at 40°C	
Mechanical characteristics		
Dimensions Width Height Depth	 58.5 mm 257 mm 220 mm	
Weight	2.5 kg	

Table 10: 8V1010.00-2, 8V1010.001-2 - Technical data

1) In the USA, the terms "Delta / Wye with Grounded Wye neutral" are common for TT and TN power mains.
2) In the USA, TT and TN power mains are commonly referred to as "Delta/Wye with grounded Wye neutral".
3) Limit values from EN 61800-3 C3 (second environment).
4) When using motor holding brakes, the valid input voltage range is reduced. The input voltage range should be selected so that the proper supply voltage for the motor holding brake can be maintained.
5) The current requirements depend on the configuration of the ACOPOS servo drive.

6) Valid in the following conditions: Mains input voltage 400 VAC, nominal switching frequency, 40°C ambient temperature, installation altitudes <500 m above sea level.
7) Value for the nominal switching frequency.
8) If necessary, the stress of the motor isolation system be reduced by an additional externally-wired dU/dt choke. For example, the RWK 305 three-phase dU/dt choke from Schaffner (www.schaffner.com) can be used. IMPORTANT: Even when using a dU/dt choke, it is necessary to ensure that an EMC-compatible, low inductance shield connection is used!
9) The module's electrical output frequency (SCTRL_SPEED_ACT * MOTOR_POLEPAIRS) is monitored to protect against dual-use in accordance with EC 428/2009 | 3A225. If the electrical output frequency of the module exceeds the limit value of 600 Hz uninterrupted for more than 0.5 s, then the current motion is aborted and error 6060 is output (Power element: Limit speed exceeded).
10) The module's electrical output frequency (SCTRL_SPEED_ACT * MOTOR_POLEPAIRS) is monitored to protect against dual use in accordance with EC 428/2009 | 3A225. If the electrical output frequency of the module exceeds the limit value of 600 Hz uninterrupted for more than 0.5 s, then the current movement is aborted and error 6060 is output (power unit: limit speed exceeded).
11) OSSD (Open Signal Switching Device) signals are used to monitor signal lines for short circuits and cross faults.
12) Continuous operation of ACOPOS servo drives at altitudes ranging from 500 m to 2000 m above sea level is possible (taking the continuous current reductions listed into consideration). Requirements that go above and beyond this need to be arranged with B&R.
13) Continuous operation of ACOPOS servo drives at ambient temperatures ranging from 40°C to max. 55°C is possible (taking the specified continuous current reductions into consideration), but this will result in a shorter service life.

2.3.2 ACOPOS 8V1010.5xx-2

2.3.2.1 Order data

Model number	Short description	Figure
	Servo drives	
8V1010.50-2	ACOPOS servo drive, 3x 110-230 V / 1x 110-230 V, 2.0 A, 0.45 kW, line filter, braking resistor and electronic secure restart inhibit integrated	
8V1010.501-2	ACOPOS servo drive, 3x 110-230 V / 1x 110-230 V, 2.3 A, 0.45 kW, coated, line filter, integrated braking resistor and electronic secure restart inhibit	
	Optional accessories	
	Plug-in modules	
8AC110.60-2	ACOPOS plug-in module, CAN interface	
8AC110.60-3	ACOPOS plug-in module, CAN interface	
8AC114.60-2	ACOPOS plug-in module, POWERLINK V2 interface	
8AC120.60-1	ACOPOS plug-in module, EnDat encoder and sine incremental encoder interface	
8AC121.60-1	ACOPOS plug-in module, HIPERFACE interface	
8AC122.60-3	ACOPOS plug-in module, resolver interface 10 kHz	
8AC122.60-4	ACOPOS resolver interface 10 kHz, no open line detection	
8AC123.60-1	ACOPOS plug-in module, incremental encoder and SSI absolute encoder interface	
8AC125.60-1	ACOPOS plug-in module, BiSS encoder interface 5 V	
8AC125.60-2	ACOPOS plug-in module, BiSS encoder interface 5V, baud rate 6.25 Mbit/s	
8AC125.61-2	ACOPOS plug-in module, BiSS encoder interface 12V, baud rate 6.25 Mbit/s	
8AC126.60-1	ACOPOS plug-in module, EnDat 2.2 encoder interface	
8AC130.60-1	ACOPOS plug-in module, 8 digital I/O configurable in pairs as 24 V input or as output 400/100 mA, 2 digital outputs 2 A, order TB712 terminal block separately.	
8AC131.60-1	ACOPOS plug-in module, 2 analog inputs ±10 V, 2 digital I/O points which can be configured as a 24 V input or 45 mA output, order TB712 terminal block separately.	
8AC132.60-1	ACOPOS plug-in module, 2 analog inputs ±10 V	
8AC140.60-3	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 1 CAN interface, 1 Ethernet interface 100 Base-T, 1 PROFIBUS DP slave interface, 1 RS232 interface, 3 digital I/O can be configured as 24 VDC input or 500 mA output, 1 analog input ±10 V, order program memory and 0TB708 terminal block separately.	
8AC140.61-3	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 1 CAN interface, 1 Ethernet interface 100 Base-T, 1 PROFIBUS DP slave interface, 1 RS232 interface, 3 digital I/O can be configured as 24 VDC input or 500 mA output, 1 analog input ±10 V, order program memory and 0TB708 terminal block separately.	
8AC141.60-2	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 16 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 2 CAN interfaces, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 1 X2X Link Master interface, 3 digital I/O can be configured as 24 VDC input or output 500 mA, 1 analog input ±10 V, order program memory and 0TB704 and 0TB708 terminal blocks separately	
8AC141.61-3	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 2 CAN interfaces, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 1 X2X Link Master interface, 3 digital I/O can be configured as 24 VDC input or output 500 mA, 1 analog input ±10 V, order program memory and 0TB704 and 0TB708 terminal blocks separately	
	Shielding component sets	
8X0040.00-1	ACOPOS shielding components set for 8V1010.xxx-x and 8V1016.xxx-x	
	Terminal sets	
8X0006.00-1	ACOPOS accessories, plug set for 8V1010.50 and 8V1016.50 (1 phase)	

Table 11: 8V1010.50-2, 8V1010.501-2 - Order data

2.3.2.2 Technical data

Product ID	8V1010.50-2	8V1010.501-2
General information		
Note	-	Variant with partially coated circuit boards
B&R ID code	0x18D4	0xA6D5
Slots for plug-in modules	3	
Certification		
CE	Yes	
cULus	Yes	
KC	Yes	
FSC	Yes	
Power mains connection		
Permissible power mains forms	TT, TN [1)]	TT, TN [2)]
Mains input voltage	3x 110 VAC to 230 VAC ±10% or 1x 110 VAC to 230 VAC ±10%	
Frequency	50 / 60 Hz ±4%	
Installed load	Max. 1.35 kVA	
Starting current	5 A (at 230 VAC)	
Switch-on interval	>10 s	
Integrated line filter in accordance with EN 61800-3, Category C3 [3)]	Yes	
Power loss at max. device power without braking resistor	80 W	
DC bus connection		
DC bus capacitance	2040 µF	
24 VDC supply		
Input voltage [4)]	24 VDC +25% / -20%	
Input capacitance	5600 µF	
Power consumption [5)]	Max. 1.47 A + current for motor holding brake	
Motor connection		
Quantity	1	
Continuous current [6)]	2.3 A_{eff}	
Reduction of continuous current depending on the ambient temperature		
Mains input voltage: 110 VAC		
Switching frequency 5 kHz	No reduction	
Switching frequency 10 kHz	No reduction	No reduction [7)]
Switching frequency 20 kHz	No reduction	
Mains input voltage: 230 VAC		
Switching frequency 5 kHz	No reduction	
Switching frequency 10 kHz	No reduction	No reduction [7)]
Switching frequency 20 kHz	No reduction	
Reduction of continuous current depending on the installation elevation		
Starting at 500 m above sea level	0.23 A_{eff} per 1000 m	
Peak current	7.8 A_{eff}	
Nominal switching frequency	10 kHz	
Possible switching frequencies	5 / 10 / 20 kHz	
Electrical stress of the connected motor in accordance with IEC TS 60034-25 [8)]	Limit value curve A	
Max. motor line length	15 m	
Protective measures		
Overload protection	Yes	
Short circuit and ground fault protection	Yes	
Max. output frequency	600 Hz [9)]	600 Hz [10)]
Motor holding brake connection		
Response threshold for open line monitoring	Approx. 245 mA	
Max. output current	1.3 A	
Max. number of switching cycles	Unlimited since done electronically	Unlimited since handled electronically
Braking resistors		
Peak power output	1.9 kW	
Continuous power	130 W	
Limit switch and reference inputs		
Quantity	3	
Wiring	Sink	
Electrical isolation		
Input - ACOPOS	Yes	
Input - Input	No	
Input voltage		
Nominal	24 VDC	
Maximum	30 VDC	
Switching threshold		
Low	<5 V	
High	>15 V	
Input current at nominal voltage	Approx. 4 mA	

Table 12: 8V1010.50-2, 8V1010.501-2 - Technical data

Product ID	8V1010.50-2	8V1010.501-2
Switching delay	Max. 2.0 ms	
Modulation compared to ground potential	Max. ±38 V	
Enable inputs		
Quantity	1	
Wiring	Sink	
Electrical isolation Input - ACOPOS	 Yes	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Input current at nominal voltage	Approx. 30 mA	
Switching threshold Low High	 <5 V >15 V	
Switching delay Enable 0 -> 1, ready for PWM Enable 1 -> 0, PWM off	 Max. 100 µs Max. 2.0 ms	
Modulation compared to ground potential	Max. ±38 V	
OSSD signal connections [11]	Not permitted	
Trigger inputs		
Quantity	2	
Wiring	Sink	
Electrical isolation Input - ACOPOS Input - Input	 Yes No	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Switching threshold Low High	 <5 V >15 V	
Input current at nominal voltage	Approx. 10 mA	
Switching delay Positive edge Negative edge	 52 µs ±0.5 µs (digitally filtered) 53 µs ±0.5 µs (digitally filtered)	
Modulation compared to ground potential	Max. ±38 V	
Electrical characteristics		
Discharge capacitance	330 nF	
Operating conditions		
Permitted mounting orientations Hanging vertically Lying horizontally Standing horizontally	 Yes Yes No	
Installation at elevations above sea level Nominal Maximum [12]	 0 to 500 m 2000 m	
Degree of pollution in accordance with EN 60664-1	2 (non-conductive pollution)	
Overvoltage category in accordance with IEC 60364-4-443:1999	II	
EN 60529 protection	IP20	
Environmental conditions		
Temperature Operation Nominal Maximum [13] Storage Transport	 5 to 40°C 55°C -25 to 55°C -25 to 70°C	
Relative humidity Operation Storage Transport	 5 to 85% 5 to 95% Max. 95% at 40°C	
Mechanical characteristics		
Dimensions Width Height Depth	 58.5 mm 257 mm 220 mm	
Weight	2.5 kg	

Table 12: 8V1010.50-2, 8V1010.501-2 - Technical data

1) In the USA, the terms "Delta / Wye with Grounded Wye neutral" are common for TT and TN power mains.
2) In the USA, TT and TN power mains are commonly referred to as "Delta/Wye with grounded Wye neutral".
3) Limit values from EN 61800-3 C3 (second environment).
4) When using motor holding brakes, the valid input voltage range is reduced. The input voltage range should be selected so that the proper supply voltage for the motor holding brake can be maintained.
5) The current requirements depend on the configuration of the ACOPOS servo drive.

6) Valid in the following conditions: Mains input voltage 230 VAC, nominal switching frequency, 40 °C ambient temperature, installation altitudes <500 m above sea level.
7) Value for the nominal switching frequency.
8) If necessary, the stress of the motor isolation system be reduced by an additional externally-wired dU/dt choke. For example, the RWK 305 three-phase dU/dt choke from Schaffner (www.schaffner.com) can be used. IMPORTANT: Even when using a dU/dt choke, it is necessary to ensure that an EMC-compatible, low inductance shield connection is used!
9) The module's electrical output frequency (SCTRL_SPEED_ACT * MOTOR_POLEPAIRS) is monitored to protect against dual-use in accordance with EC 428/2009 | 3A225. If the electrical output frequency of the module exceeds the limit value of 600 Hz uninterrupted for more than 0.5 s, then the current motion is aborted and error 6060 is output (Power element: Limit speed exceeded).
10) The module's electrical output frequency (SCTRL_SPEED_ACT * MOTOR_POLEPAIRS) is monitored to protect against dual use in accordance with EC 428/2009 | 3A225. If the electrical output frequency of the module exceeds the limit value of 600 Hz uninterrupted for more than 0.5 s, then the current movement is aborted and error 6060 is output (power unit: limit speed exceeded).
11) OSSD (Open Signal Switching Device) signals are used to monitor signal lines for short circuits and cross faults.
12) Continuous operation of ACOPOS servo drives at altitudes ranging from 500 m to 2000 m above sea level is possible (taking the continuous current reductions listed into consideration). Requirements that go above and beyond this need to be arranged with B&R.
13) Continuous operation of ACOPOS servo drives at ambient temperatures ranging from 40°C to max. 55°C is possible (taking the specified continuous current reductions into consideration), but this will result in a shorter service life.

2.3.3 ACOPOS 8V1016.0xx-2

2.3.3.1 Order data

Model number	Short description	Figure
	Servo drives	
8V1016.00-2	ACOPOS servo drive, 3x 400-480 V, 1.6 A, 0.7 kW, line filter, braking resistor and electronic secure restart inhibit integrated	
8V1016.001-2	ACOPOS servo drive, 3x 400-480 V, 1.6 A, 0.7 kW, coated, line filter, integrated braking resistor and electronic secure restart inhibit	
	Optional accessories	
	Plug-in modules	
8AC110.60-2	ACOPOS plug-in module, CAN interface	
8AC110.60-3	ACOPOS plug-in module, CAN interface	
8AC114.60-2	ACOPOS plug-in module, POWERLINK V2 interface	
8AC120.60-1	ACOPOS plug-in module, EnDat encoder and sine incremental encoder interface	
8AC121.60-1	ACOPOS plug-in module, HIPERFACE interface	
8AC122.60-3	ACOPOS plug-in module, resolver interface 10 kHz	
8AC122.60-4	ACOPOS resolver interface 10 kHz, no open line detection	
8AC123.60-1	ACOPOS plug-in module, incremental encoder and SSI absolute encoder interface	
8AC125.60-1	ACOPOS plug-in module, BiSS encoder interface 5 V	
8AC125.60-2	ACOPOS plug-in module, BiSS encoder interface 5V, baud rate 6.25 Mbit/s	
8AC125.61-2	ACOPOS plug-in module, BiSS encoder interface 12V, baud rate 6.25 Mbit/s	
8AC126.60-1	ACOPOS plug-in module, EnDat 2.2 encoder interface	
8AC130.60-1	ACOPOS plug-in module, 8 digital I/O configurable in pairs as 24 V input or as output 400/100 mA, 2 digital outputs 2 A, order TB712 terminal block separately.	
8AC131.60-1	ACOPOS plug-in module, 2 analog inputs ±10 V, 2 digital I/O points which can be configured as a 24 V input or 45 mA output, order TB712 terminal block separately.	
8AC132.60-1	ACOPOS plug-in module, 2 analog inputs ±10 V	
8AC140.60-3	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 1 CAN interface, 1 Ethernet interface 100 Base-T, 1 PROFIBUS DP slave interface, 1 RS232 interface, 3 digital I/O can be configured as 24 VDC input or 500 mA output, 1 analog input ±10 V, order program memory and 0TB708 terminal block separately.	
8AC140.61-3	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 1 CAN interface, 1 Ethernet interface 100 Base-T, 1 PROFIBUS DP slave interface, 1 RS232 interface, 3 digital I/O can be configured as 24 VDC input or 500 mA output, 1 analog input ±10 V, order program memory and 0TB708 terminal block separately.	
8AC141.60-2	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 16 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 2 CAN interfaces, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 1 X2X Link Master interface, 3 digital I/O can be configured as 24 VDC input or output 500 mA, 1 analog input ±10 V, order program memory and 0TB704 and 0TB708 terminal blocks separately	
8AC141.61-3	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 2 CAN interfaces, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 1 X2X Link Master interface, 3 digital I/O can be configured as 24 VDC input or output 500 mA, 1 analog input ±10 V, order program memory and 0TB704 and 0TB708 terminal blocks separately	
	Shielding component sets	
8X0040.00-1	ACOPOS shielding components set for 8V1010.xxx-x and 8V1016.xxx-x	
	Terminal sets	
8X0001.00-1	ACOPOS accessories, plug set for 8V1010.00 and 8V1090.00 (3 phase)	

Table 13: 8V1016.00-2, 8V1016.001-2 - Order data

2.3.3.2 Technical data

Product ID	8V1016.00-2	8V1016.001-2
General information		
Note	-	Variant with partially coated circuit boards
B&R ID code	0x18D5	0xA6D6
Slots for plug-in modules	3	
Certification CE cULus KC FSC	 Yes Yes Yes Yes	
Power mains connection		
Permissible power mains forms	TT, TN [1]	TT, TN [2]
Mains input voltage	3x 400 VAC to 480 VAC ±10%	
Frequency	50 / 60 Hz ±4%	
Installed load	Max. 2.1 kVA	
Starting current	2 A (at 400 VAC)	
Switch-on interval	>10 s	
Integrated line filter in accordance with EN 61800-3, Category C3 [3]	Yes	
Power loss at max. device power without braking resistor	110 W	
DC bus connection		
DC bus capacitance	165 µF	
24 VDC supply		
Input voltage [4]	24 VDC +25% / -20%	
Input capacitance	5600 µF	
Power consumption [5]	Max. 1.47 A + current for motor holding brake	
Motor connection		
Quantity	1	
Continuous current [6]	1.6 A_{eff}	
Reduction of continuous current depending on the ambient temperature Mains input voltage: 400 VAC Switching frequency 5 kHz Switching frequency 10 kHz Switching frequency 20 kHz Mains input voltage: 480 VAC Switching frequency 5 kHz Switching frequency 10 kHz Switching frequency 20 kHz	 No reduction No reduction [7] No reduction No reduction No reduction [7] 0.13 A_{eff} per °C (starting at 40°C)	
Reduction of continuous current depending on the installation elevation Starting at 500 m above sea level	 0.16 A_{eff} per 1000 m	
Peak current	5 A_{eff}	
Nominal switching frequency	10 kHz	
Possible switching frequencies	5 / 10 / 20 kHz	
Electrical stress of the connected motor in accordance with IEC TS 60034-25 [8]	Limit value curve A	
Max. motor line length	15 m	
Protective measures Overload protection Short circuit and ground fault protection	 Yes Yes	
Max. output frequency	600 Hz [9]	600 Hz [10]
Motor holding brake connection		
Response threshold for open line monitoring	Approx. 245 mA	
Max. output current	1.3 A	
Max. number of switching cycles	Unlimited since done electronically	Unlimited since handled electronically
Braking resistors		
Peak power output	2 kW	
Continuous power	130 W	
Limit switch and reference inputs		
Quantity	3	
Wiring	Sink	
Electrical isolation Input - ACOPOS Input - Input	 Yes No	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Switching threshold Low High	 <5 V >15 V	
Input current at nominal voltage	Approx. 4 mA	

Table 14: 8V1016.00-2, 8V1016.001-2 - Technical data

Product ID	8V1016.00-2	8V1016.001-2
Switching delay	Max. 2.0 ms	
Modulation compared to ground potential	Max. ±38 V	
Enable inputs		
Quantity	1	
Wiring	Sink	
Electrical isolation		
Input - ACOPOS	Yes	
Input voltage		
Nominal	24 VDC	
Maximum	30 VDC	
Input current at nominal voltage	Approx. 30 mA	
Switching threshold		
Low	<5 V	
High	>15 V	
Switching delay		
Enable 0 -> 1, ready for PWM	Max. 100 µs	
Enable 1 -> 0, PWM off	Max. 2.0 ms	
Modulation compared to ground potential	Max. ±38 V	
OSSD signal connections [11]	Not permitted	
Trigger inputs		
Quantity	2	
Wiring	Sink	
Electrical isolation		
Input - ACOPOS	Yes	
Input - Input	No	
Input voltage		
Nominal	24 VDC	
Maximum	30 VDC	
Switching threshold		
Low	<5 V	
High	>15 V	
Input current at nominal voltage	Approx. 10 mA	
Switching delay		
Positive edge	52 µs ±0.5 µs (digitally filtered)	
Negative edge	53 µs ±0.5 µs (digitally filtered)	
Modulation compared to ground potential	Max. ±38 V	
Electrical characteristics		
Discharge capacitance	550 nF	
Operating conditions		
Permitted mounting orientations		
Hanging vertically	Yes	
Lying horizontally	Yes	
Standing horizontally	No	
Installation at elevations above sea level		
Nominal	0 to 500 m	
Maximum [12]	2000 m	
Degree of pollution in accordance with EN 60664-1	2 (non-conductive pollution)	
Overvoltage category in accordance with IEC 60364-4-443:1999	II	
EN 60529 protection	IP20	
Environmental conditions		
Temperature		
Operation		
Nominal	5 to 40°C	
Maximum [13]	55°C	
Storage	-25 to 55°C	
Transport	-25 to 70°C	
Relative humidity		
Operation	5 to 85%	
Storage	5 to 95%	
Transport	Max. 95% at 40°C	
Mechanical characteristics		
Dimensions		
Width	58.5 mm	
Height	257 mm	
Depth	220 mm	
Weight	2.5 kg	

Table 14: 8V1016.00-2, 8V1016.001-2 - Technical data

1) In the USA, the terms "Delta / Wye with Grounded Wye neutral" are common for TT and TN power mains.
2) In the USA, TT and TN power mains are commonly referred to as "Delta/Wye with grounded Wye neutral".
3) Limit values from EN 61800-3 C3 (second environment).
4) When using motor holding brakes, the valid input voltage range is reduced. The input voltage range should be selected so that the proper supply voltage for the motor holding brake can be maintained.
5) The current requirements depend on the configuration of the ACOPOS servo drive.

6) Valid in the following conditions: Mains input voltage 400 VAC, nominal switching frequency, 40°C ambient temperature, installation altitudes <500 m above sea level.
7) Value for the nominal switching frequency.
8) If necessary, the stress of the motor isolation system be reduced by an additional externally-wired dU/dt choke. For example, the RWK 305 three-phase dU/dt choke from Schaffner (www.schaffner.com) can be used. IMPORTANT: Even when using a dU/dt choke, it is necessary to ensure that an EMC-compatible, low inductance shield connection is used!
9) The module's electrical output frequency (SCTRL_SPEED_ACT * MOTOR_POLEPAIRS) is monitored to protect against dual-use in accordance with EC 428/2009 | 3A225. If the electrical output frequency of the module exceeds the limit value of 600 Hz uninterrupted for more than 0.5 s, then the current motion is aborted and error 6060 is output (Power element: Limit speed exceeded).
10) The module's electrical output frequency (SCTRL_SPEED_ACT * MOTOR_POLEPAIRS) is monitored to protect against dual use in accordance with EC 428/2009 | 3A225. If the electrical output frequency of the module exceeds the limit value of 600 Hz uninterrupted for more than 0.5 s, then the current movement is aborted and error 6060 is output (power unit: limit speed exceeded).
11) OSSD (Open Signal Switching Device) signals are used to monitor signal lines for short circuits and cross faults.
12) Continuous operation of ACOPOS servo drives at altitudes ranging from 500 m to 2000 m above sea level is possible (taking the continuous current reductions listed into consideration). Requirements that go above and beyond this need to be arranged with B&R.
13) Continuous operation of ACOPOS servo drives at ambient temperatures ranging from 40°C to max. 55°C is possible (taking the specified continuous current reductions into consideration), but this will result in a shorter service life.

2.3.4 ACOPOS 8V1016.5xx-2

2.3.4.1 Order data

Model number	Short description	Figure
	Servo drives	
8V1016.50-2	ACOPOS servo drive, 3x 110-230 V / 1x 110-230 V, 3.6 A, 0.7 kW, line filter, integrated braking resistor and electronic secure restart inhibit	
8V1016.501-2	ACOPOS servo drive, 3x 110-230 V / 1x 110-230 V, 3.6 A, 0.7 kW, coated, line filter, integrated braking resistor and electronic secure restart inhibit	
	Optional accessories	
	Plug-in modules	
8AC110.60-2	ACOPOS plug-in module, CAN interface	
8AC110.60-3	ACOPOS plug-in module, CAN interface	
8AC114.60-2	ACOPOS plug-in module, POWERLINK V2 interface	
8AC120.60-1	ACOPOS plug-in module, EnDat encoder and sine incremental encoder interface	
8AC121.60-1	ACOPOS plug-in module, HIPERFACE interface	
8AC122.60-3	ACOPOS plug-in module, resolver interface 10 kHz	
8AC122.60-4	ACOPOS resolver interface 10 kHz, no open line detection	
8AC123.60-1	ACOPOS plug-in module, incremental encoder and SSI absolute encoder interface	
8AC125.60-1	ACOPOS plug-in module, BiSS encoder interface 5 V	
8AC125.60-2	ACOPOS plug-in module, BiSS encoder interface 5V, baud rate 6.25 Mbit/s	
8AC125.61-2	ACOPOS plug-in module, BiSS encoder interface 12V, baud rate 6.25 Mbit/s	
8AC126.60-1	ACOPOS plug-in module, EnDat 2.2 encoder interface	
8AC130.60-1	ACOPOS plug-in module, 8 digital I/O configurable in pairs as 24 V input or as output 400/100 mA, 2 digital outputs 2 A, order TB712 terminal block separately.	
8AC131.60-1	ACOPOS plug-in module, 2 analog inputs ±10 V, 2 digital I/O points which can be configured as a 24 V input or 45 mA output, order TB712 terminal block separately.	
8AC132.60-1	ACOPOS plug-in module, 2 analog inputs ±10 V	
8AC140.60-3	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 1 CAN interface, 1 Ethernet interface 100 Base-T, 1 PROFIBUS DP slave interface, 1 RS232 interface, 3 digital I/O can be configured as 24 VDC input or 500 mA output, 1 analog input ±10 V, order program memory and 0TB708 terminal block separately.	
8AC140.61-3	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 1 CAN interface, 1 Ethernet interface 100 Base-T, 1 PROFIBUS DP slave interface, 1 RS232 interface, 3 digital I/O can be configured as 24 VDC input or 500 mA output, 1 analog input ±10 V, order program memory and 0TB708 terminal block separately.	
8AC141.60-2	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 16 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 2 CAN interfaces, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 1 X2X Link Master interface, 3 digital I/O can be configured as 24 VDC input or output 500 mA, 1 analog input ±10 V, order program memory and 0TB704 and 0TB708 terminal blocks separately	
8AC141.61-3	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 2 CAN interfaces, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 1 X2X Link Master interface, 3 digital I/O can be configured as 24 VDC input or output 500 mA, 1 analog input ±10 V, order program memory and 0TB704 and 0TB708 terminal blocks separately	
	Shielding component sets	
8X0040.00-1	ACOPOS shielding components set for 8V1010.xxx-x and 8V1016.xxx-x	
	Terminal sets	
8X0006.00-1	ACOPOS accessories, plug set for 8V1010.50 and 8V1016.50 (1 phase)	

Table 15: 8V1016.50-2, 8V1016.501-2 - Order data

2.3.4.2 Technical data

Product ID	8V1016.50-2	8V1016.501-2
General information		
Note	-	Variant with partially coated circuit boards
B&R ID code	0x18D7	0xA6D7
Slots for plug-in modules	3	
Certification		
CE	Yes	
cULus	Yes	
KC	Yes	
FSC	Yes	
Power mains connection		
Permissible power mains forms	TT, TN [1]	
Mains input voltage	3x 110 VAC to 230 VAC ±10% or 1x 110 VAC to 230 VAC ±10%	
Frequency	50 / 60 Hz ±4%	
Installed load	Max. 2.1 kVA	
Starting current	5 A (at 230 VAC)	
Switch-on interval	>10 s	
Integrated line filter in accordance with EN 61800-3, Category C3 [2]	Yes	
Power loss at max. device power without braking resistor	110 W	
DC bus connection		
DC bus capacitance	2040 µF	
24 VDC supply		
Input voltage [3]	24 VDC +25% / -20%	
Input capacitance	5600 µF	
Power consumption [4]	Max. 1.47 A + current for motor holding brake	
Motor connection		
Quantity	1	
Continuous current [5]	3.6 A_{eff}	
Reduction of continuous current depending on the ambient temperature		
Mains input voltage: 110 VAC		
Switching frequency 5 kHz	No reduction	
Switching frequency 10 kHz	No reduction [6]	
Switching frequency 20 kHz	No reduction	
Mains input voltage: 230 VAC		
Switching frequency 5 kHz	No reduction	
Switching frequency 10 kHz	No reduction [6]	
Switching frequency 20 kHz	No reduction	
Reduction of continuous current depending on the installation elevation		
Starting at 500 m above sea level	0.36 A_{eff} per 1000 m	
Peak current	12 A_{eff}	
Nominal switching frequency	10 kHz	
Possible switching frequencies	5 / 10 / 20 kHz	
Electrical stress of the connected motor in accordance with IEC TS 60034-25 [7]	Limit value curve A	
Max. motor line length	15 m	
Protective measures		
Overload protection	Yes	
Short circuit and ground fault protection	Yes	
Max. output frequency	600 Hz [8]	
Motor holding brake connection		
Response threshold for open line monitoring	Approx. 245 mA	
Max. output current	1.3 A	
Max. number of switching cycles	Unlimited since handled electronically	
Braking resistors		
Peak power output	1.9 kW	
Continuous power	130 W	
Limit switch and reference inputs		
Quantity	3	
Wiring	Sink	
Electrical isolation		
Input - ACOPOS	Yes	
Input - Input	No	
Input voltage		
Nominal	24 VDC	
Maximum	30 VDC	
Switching threshold		
Low	<5 V	
High	>15 V	
Input current at nominal voltage	Approx. 4 mA	

Table 16: 8V1016.50-2, 8V1016.501-2 - Technical data

Product ID	8V1016.50-2	8V1016.501-2
Switching delay	Max. 2.0 ms	
Modulation compared to ground potential	Max. ±38 V	
Enable inputs		
Quantity	1	
Wiring	Sink	
Electrical isolation Input - ACOPOS	 Yes	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Input current at nominal voltage	Approx. 30 mA	
Switching threshold Low High	 <5 V >15 V	
Switching delay Enable 0 -> 1, ready for PWM Enable 1 -> 0, PWM off	 Max. 100 µs Max. 2.0 ms	
Modulation compared to ground potential	Max. ±38 V	
OSSD signal connections 9)	Not permitted	
Trigger inputs		
Quantity	2	
Wiring	Sink	
Electrical isolation Input - ACOPOS Input - Input	 Yes No	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Switching threshold Low High	 <5 V >15 V	
Input current at nominal voltage	Approx. 10 mA	
Switching delay Positive edge Negative edge	 52 µs ±0.5 µs (digitally filtered) 53 µs ±0.5 µs (digitally filtered)	
Modulation compared to ground potential	Max. ±38 V	
Operating conditions		
Permitted mounting orientations Hanging vertically Lying horizontally Standing horizontally	 Yes Yes No	
Installation at elevations above sea level Nominal Maximum 10)	 0 to 500 m 2000 m	
Degree of pollution in accordance with EN 60664-1	2 (non-conductive pollution)	
Overvoltage category in accordance with IEC 60364-4-443:1999	II	
EN 60529 protection	IP20	
Environmental conditions		
Temperature Operation Nominal Maximum 11) Storage Transport	 5 to 40°C 55°C -25 to 55°C -25 to 70°C	
Relative humidity Operation Storage Transport	 5 to 85% 5 to 95% Max. 95% at 40°C	
Mechanical characteristics		
Dimensions Width Height Depth	 58.5 mm 257 mm 220 mm	
Weight	2.5 kg	

Table 16: 8V1016.50-2, 8V1016.501-2 - Technical data

1) In the USA, TT and TN power mains are commonly referred to as "Delta/Wye with grounded Wye neutral".
2) Limit values from EN 61800-3 C3 (second environment).
3) The permissible input voltage range is reduced when using motor holding brakes. The input voltage range should be selected so that the proper supply voltage for the motor holding brake can be maintained.
4) The current requirements depend on the configuration of the ACOPOS servo drive.
5) Valid in the following conditions: 230 VAC mains input voltage, nominal switching frequency, 40°C ambient temperature, installation altitude <500 m above sea level.
6) Value for the nominal switching frequency.

7) If necessary, the stress of the motor isolation system be reduced by an additional externally-wired dU/dt choke. For example, the RWK 305 three-phase dU/dt choke from Schaffner (www.schaffner.com) can be used. IMPORTANT: Even when using a dU/dt choke, it is necessary to ensure that an EMC-compatible, low inductance shield connection is used!

8) The module's electrical output frequency (SCTRL_SPEED_ACT * MOTOR_POLEPAIRS) is monitored to protect against dual use in accordance with EC 428/2009 | 3A225. If the electrical output frequency of the module exceeds the limit value of 600 Hz uninterrupted for more than 0.5 s, then the current movement is aborted and error 6060 is output (power unit: limit speed exceeded).

9) OSSD (open signal switching device) signals are used to monitor signal lines for short circuits and cross faults.

10) Continuous operation of ACOPOS servo drives at altitudes ranging from 500 m to 2000 m above sea level is possible (taking the specified continuous current reductions into consideration). Requirements that go above and beyond this need to be arranged with B&R.

11) Continuous operation of ACOPOS servo drives at ambient temperatures ranging from 40°C to max. 55°C is possible (taking the specified continuous current reductions into consideration), but this will result in a shorter service life.

2.3.5 Wiring

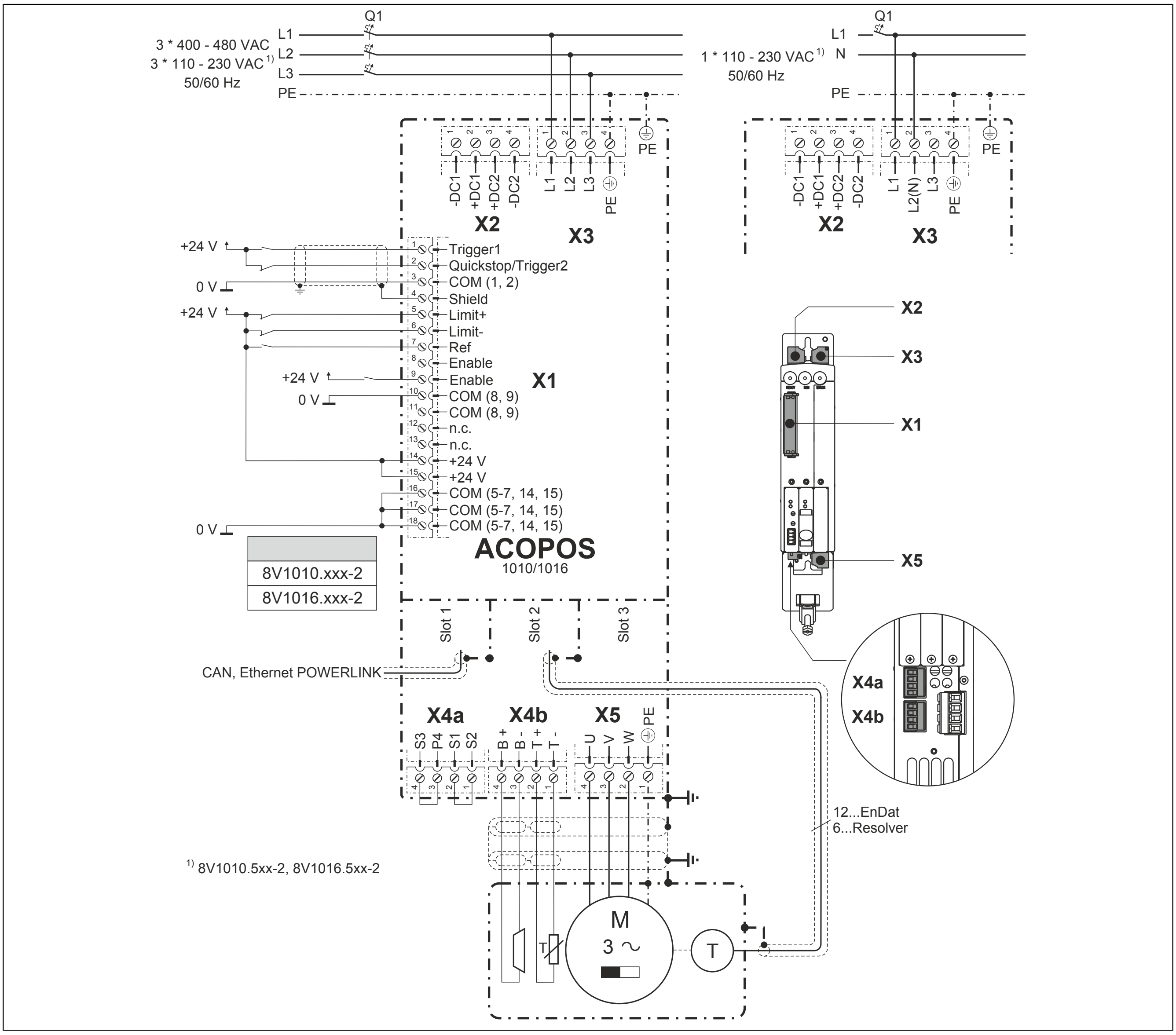


Figure 13: ACOPOS 1010, 1016 - Pinout overview

2.3.5.1 X1 - Pinout

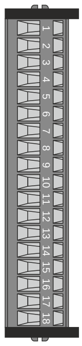
X1	Pin	Name	Function
	1	Trigger1	Trigger 1
	2	Quickstop/Trigger2	Quickstop/Trigger2
	3	COM (1, 2)	Trigger 1, Quickstop/Trigger 2 0 V
	4	Shield	Shield
	5	Limit+	Positive HW limit
	6	Limit-	Negative HW limit
	7	Ref	Reference switch
	8	Enable [1)]	Enable
	9	Enable [1)]	Enable
	10	COM (8, 9)	Enable 0 V
	11	COM (8, 9)	Enable 0 V
	12	---	---
	13	---	---
	14	+24 V	+24 V supply
	15	+24 V	+24 V supply
	16	COM (5-7, 14, 15)	0 V supply
	17	COM (5-7, 14, 15)	0 V supply
	18	COM (5-7, 14, 15)	0 V supply
	The following connections are linked with each other internally in the device: • Pin 8 --> Pin 9 (Enable) • Pin 10 --> Pin 11 (Enable 0 V) • Pin 14 --> Pin 15 (Supply +24 V) • Pin 16 --> Pin 17 --> Pin 18 (Supply 0 V) Terminal cross sections see "Overview of clampable cross sections" on page 255		

Table 17: X1 - Pinout

1) The wiring is not permitted to exceed a total length of 30 m.

2.3.5.2 X2 - Pinout

2.3.5.2.1 8V1010.0xx-2, 8V1016.0xx-2

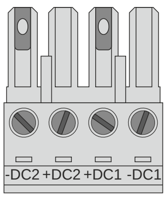
X2	Pin	Name	Function
	1	-DC1	U DC bus -
	2	+DC1	U DC bus +
	3	+DC2	U DC bus +
	4	-DC2	U DC bus -
	Terminal cross sections see "Overview of clampable cross sections" on page 255		

Table 18: X2 - Pinout

2.3.5.2.2 8V1010.5xx-2, 8V1016.5xx-2

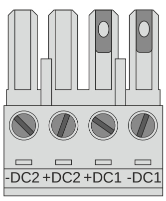
X2	Pin	Name	Function
	1	-DC1	U DC bus -
	2	+DC1	U DC bus +
	3	+DC2	U DC bus +
	4	-DC2	U DC bus -
	Terminal cross sections see "Overview of clampable cross sections" on page 255		

Table 19: X2 - Pinout

Warning!

Only DC bus circuits of ACOPOS servo drives with the same supply voltage range are permitted to be connected in a group.

See "Supply voltage range for ACOPOS servo drives" on page 216.

Therefore, the DC bus circuits of ACOPOS servo drives 8Vxxxx.5xx-2 and 8Vxxxx.0xx-2 are not allowed to be linked! For this reason, the X2 plugs for ACOPOS servo drives 8Vxxxx.5xx-2 and 8Vxxxx.0xx-2 are keyed differently.

All ACOPOS servo drives 8Vxxxx.5xx-2 with a single-phase supply that should have their DC buses connected together must be connected to the same phase! If this is not done, the DC bus voltage increases to a level that is not permitted, causing the devices to be destroyed!

2.3.5.3 X3 - Pinout

Danger!

Servo drives are not permitted to be operated directly on IT and TN-S mains with a grounded phase conductor and protective ground conductor!

2.3.5.3.1 8V1010.0xx-2, 8V1016.0xx-2

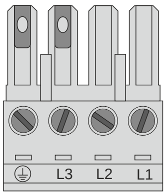
X3	Pin	Name	Function
	1	L1	Power mains connection L1
	2	L2	Power mains connection L2
	3	L3	Power mains connection L3
	4	PE	Protective ground conductor
	Terminal cross sections see "Overview of clampable cross sections" on page 255		

Table 20: X3 - Pinout

2.3.5.3.2 8V1010.5xx-2, 8V1016.5xx-2

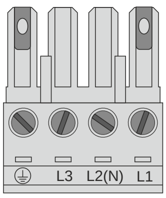
X3	Pin	Name	Function
	1	L1	Power mains connection L1
	2	L2(N)	Power mains connection N
	3	L3	---
	4	PE	Protective ground conductor
	Terminal cross sections see "Overview of clampable cross sections" on page 255		

Table 21: X3 - Pinout

2.3.5.4 X4a, X4b - Pinout

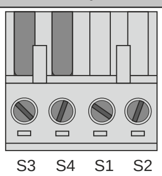
X4a	Pin	Name	Function
	1	S2 [1)]	Activation, supply for the external holding brake (+)
	2	S1 [1)]	Activation for the external holding brake (+)
	3	P4	Activation, supply for the external holding brake (-)
	4	S3	Activation for the external holding brake (-)
	Terminal cross sections see "Overview of clampable cross sections" on page 255		

Table 22: X4a - Pinout

1) If the holding brake is connected via an additional external relay contact (ground-in e.g. via the connections S1/S2) instead of via the internal transistor, then the internal quenching circuit has no effect! In this case, the customer must make sure that neither the relay contact nor the braking coil are damaged when switching off the brake. This can be done by interconnecting the coil or - better still - interconnecting the contact with a quenching circuit.

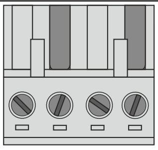
<table>
<tr><th>X4b</th><th>Pin</th><th>Name</th><th>Function</th></tr>
<tr><td rowspan="5">
</td><td>1</td><td>T-</td><td>Temperature sensor -</td></tr>
<tr><td>2</td><td>T+</td><td>Temperature sensor +</td></tr>
<tr><td>3</td><td>B- [1)]</td><td>Brake -</td></tr>
<tr><td>4</td><td>B+ [1)]</td><td>Brake +</td></tr>
<tr><td colspan="3">Terminal cross sections see "Overview of clampable cross sections" on page 255</td></tr>
</table>

Table 23: X4b - Pinout

1) If the holding brake is connected via an additional external relay contact (ground-in e.g. via the connections S1/S2) instead of via the internal transistor, then the internal quenching circuit has no effect! In this case, the customer must make sure that neither the relay contact nor the braking coil are damaged when switching off the brake. This can be done by interconnecting the coil or - better still - interconnecting the contact with a quenching circuit.

Danger!

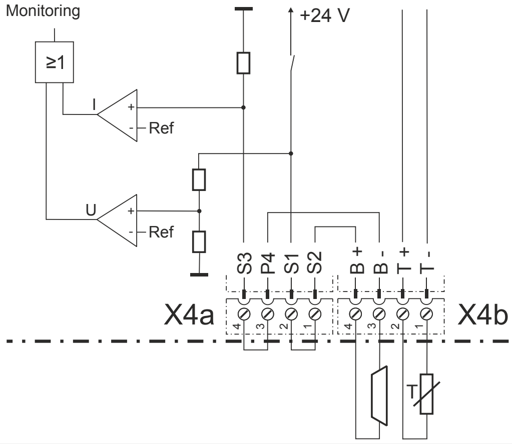
The connections for the motor temperature sensors and the motor holding brake are isolated circuits. Therefore, these connections are only allowed to be connected to devices or components with at least safe isolation in accordance with IEC 60364-4-41 or EN 61800-5-1.

Caution!

If B+ and B- are swapped when connecting the permanent magnet holding brakes, then the brakes cannot be opened! ACOPOS servo drives cannot determine if a holding brake is connected with reverse polarity!

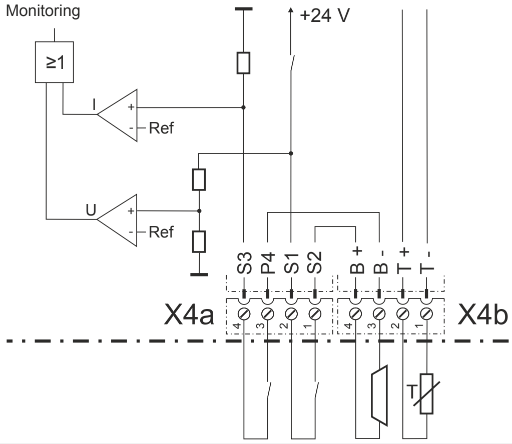
2.3.5.4.1 Wiring the connections for the motor holding brake

The supply, activation and monitoring of the output for the motor holding brake can take place via the X4a connector in three different ways:

<table>
<tr><th colspan="2">Figure</th><th>Description</th></tr>
<tr><td>1</td><td>
</td><td>

- **Supply:**
Internally by the ACOPOS servo drive
- **Activation:**
Internally by the ACOPOS servo drive
- **Monitoring:**
Internally by the ACOPOS servo drive

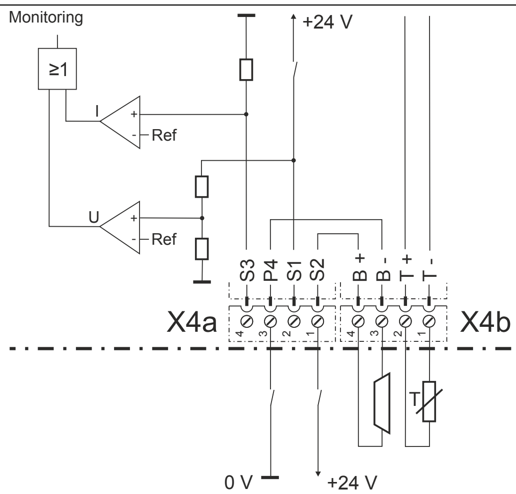
A jumper must be placed between S1 and S2 as well as S3 and S4 on the X4a connector. 1)

</td></tr>
<tr><td>2</td><td>
</td><td>

- **Supply:**
Internally by the ACOPOS servo drive
- **Activation:**
Internally by the ACOPOS servo drive and also possible externally using potential-free contacts 2)
- **Monitoring:**
Internally by the ACOPOS servo drive

Information:

The parameters for internal monitoring via the ACOPOS must be set according to the requirements of the application. 3)

</td></tr>
<tr><td>3</td><td>
</td><td>

- **Supply:**
External
- **Activation:**
External
- **Monitoring:**
External

Information:

ACOPOS internal monitoring cannot be used here; therefore, it must be disabled using software. 4)

</td></tr>
</table>

Table 24: Activation for the external holding brake

1) Both jumpers are already on the X4a connector delivered with the ACOPOS servo drives.
2) External potential-free contacts can be connected between S1 and S2 as well as between S3 and S4. This makes it possible to activate the holding brake using an external safety circuit independent of the control integrated in the ACOPOS servo drive.
3) The parameters are set using ParID 90 (1 ... internal monitoring active; 5 ... internal monitoring not active).
4) Deactivation takes place using ParID 90 (5 ... internal monitoring not active).

2.3.5.5 X5 - Pinout

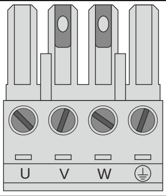
X5	Pin	Name	Function
	1	PE	Protective ground conductor
	2	W	Motor connection W
	3	V	Motor connection V
	4	U	Motor connection U
	Terminal cross sections see "Overview of clampable cross sections" on page 255		

Table 25: X5 - Pinout

2.3.5.6 Additional protective ground connection (PE)

The protective ground conductor is connected to the M5 threaded bolt provided using a cable lug.

For information concerning dimensioning, see "Protective ground connection (PE)" on page 216.

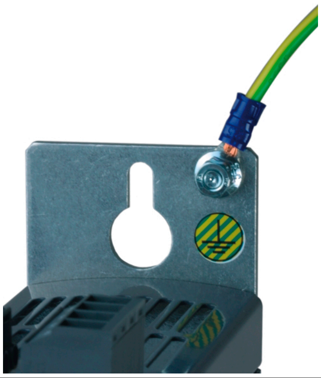
Figure	Pin	Name	Function
	---	PE	Protective ground conductor
Terminal cross sections	**[mm²]**		**AWG**
Cable lug for M5 threaded bolt	0.25 - 16		23 - 5

Table 26: Protective ground connection (PE) - ACOPOS

Danger!

Before turning on the servo drive, make sure that the housing is properly connected to ground (PE rail). The ground connection must be established even when testing the drive or operating it for a short time!

2.3.5.7 Input/output circuit diagram

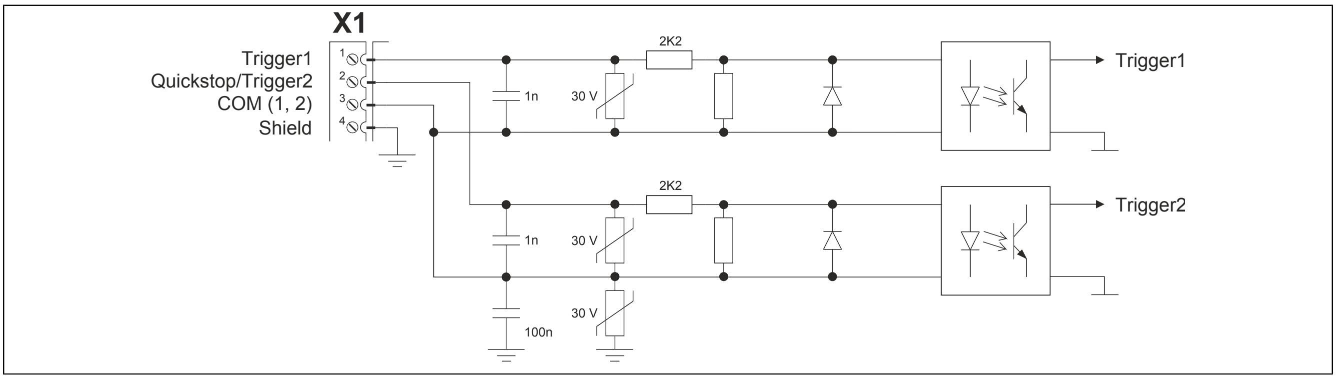


Figure 14: Trigger

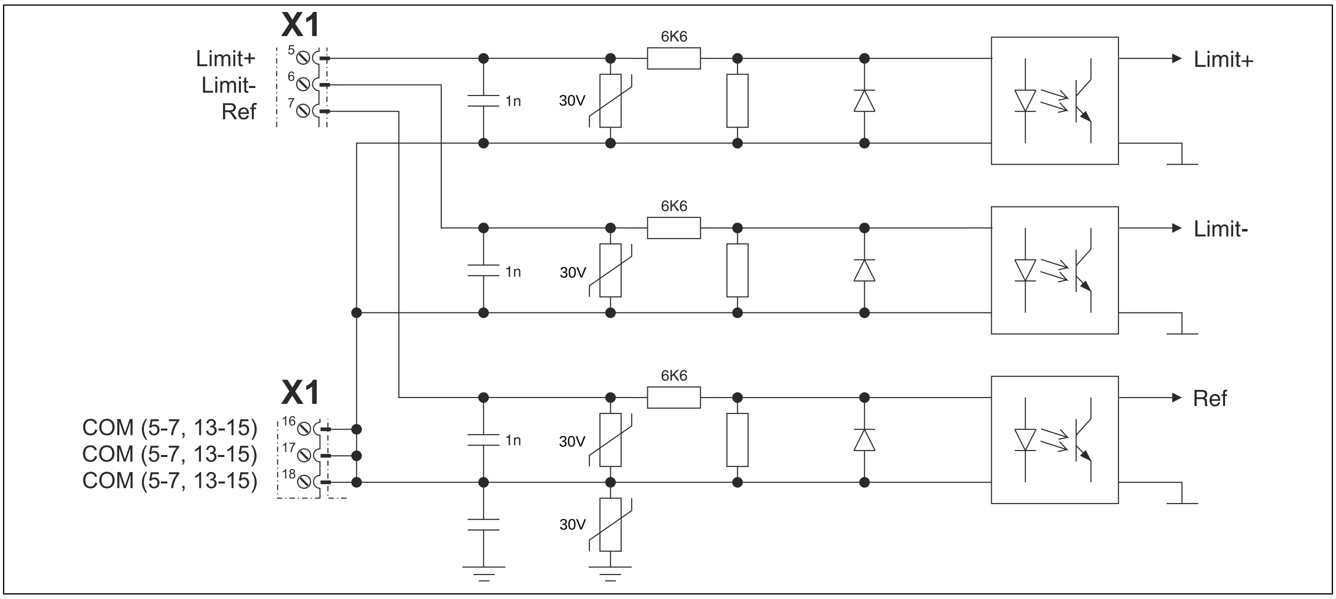


Figure 15: Limit

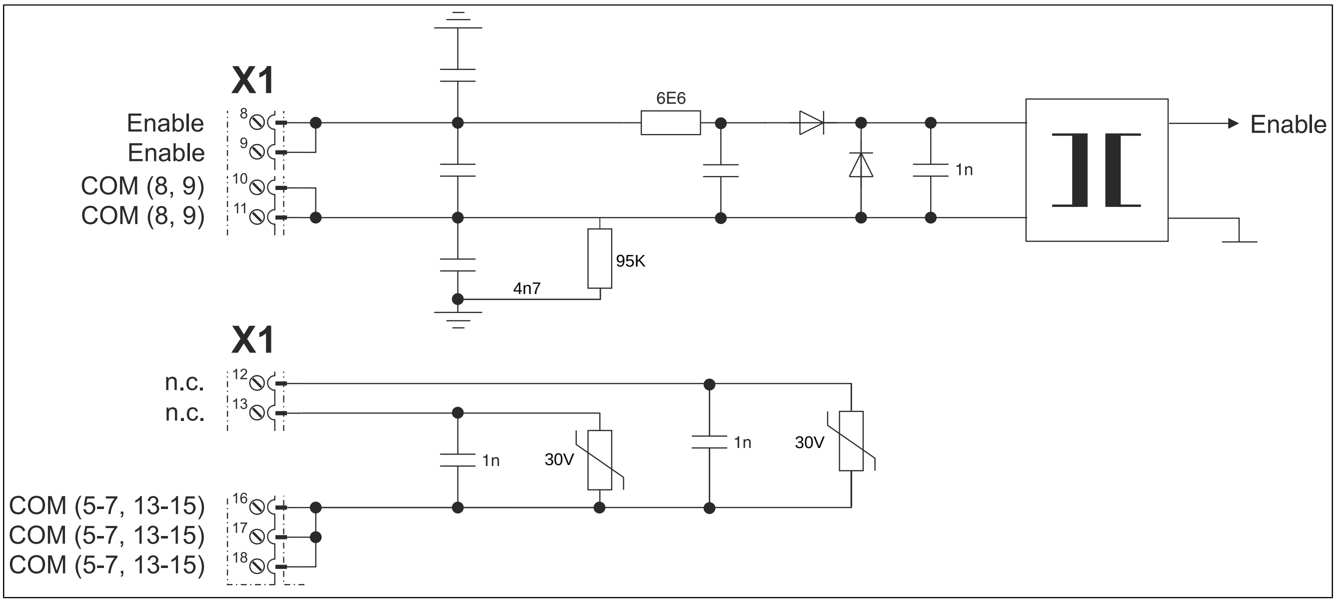


Figure 16: Enable

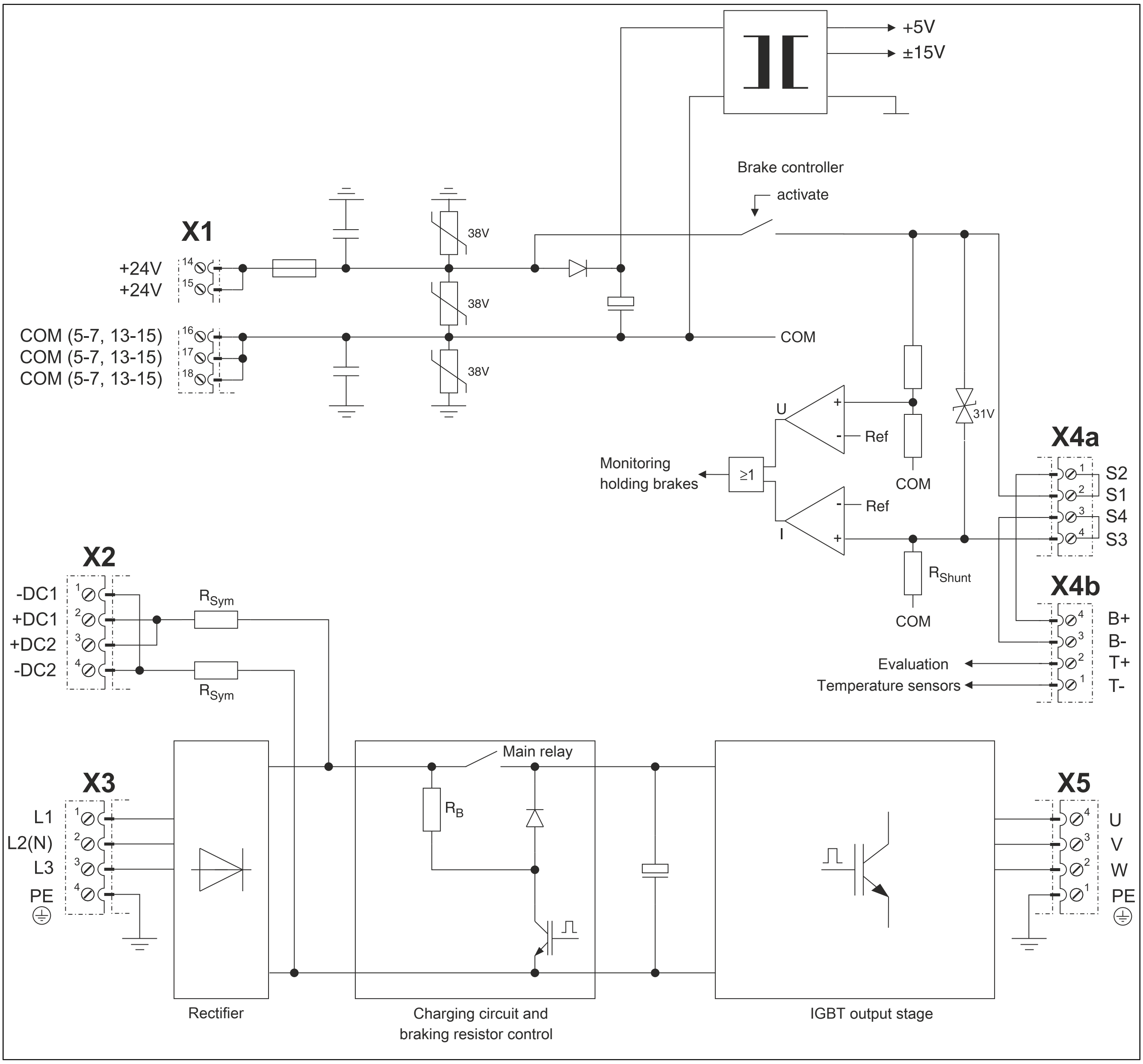


Figure 17: Input/output circuit diagram - ACOPOS 1010, 1016

2.4 ACOPOS 1022, 1045, 1090

2.4.1 ACOPOS 1022

2.4.1.1 Order data

Model number	Short description	Figure
	Servo drives	
8V1022.00-2	ACOPOS servo drive, 3x 400-480 V, 2.2 A, 1 kW, line filter, integrated braking resistor and electronic secure restart inhibit	
8V1022.001-2	ACOPOS servo drive, 3x 400-480 V, 2.2 A, 1 kW, coated, line filter, integrated braking resistor and electronic secure restart inhibit	
	Optional accessories	
	Plug-in modules	
8AC110.60-2	ACOPOS plug-in module, CAN interface	
8AC110.60-3	ACOPOS plug-in module, CAN interface	
8AC114.60-2	ACOPOS plug-in module, POWERLINK V2 interface	
8AC120.60-1	ACOPOS plug-in module, EnDat encoder and sine incremental encoder interface	
8AC121.60-1	ACOPOS plug-in module, HIPERFACE interface	
8AC122.60-3	ACOPOS plug-in module, resolver interface 10 kHz	
8AC122.60-4	ACOPOS resolver interface 10 kHz, no open line detection	
8AC123.60-1	ACOPOS plug-in module, incremental encoder and SSI absolute encoder interface	
8AC125.60-1	ACOPOS plug-in module, BiSS encoder interface 5 V	
8AC125.60-2	ACOPOS plug-in module, BiSS encoder interface 5V, baud rate 6.25 Mbit/s	
8AC125.61-2	ACOPOS plug-in module, BiSS encoder interface 12V, baud rate 6.25 Mbit/s	
8AC126.60-1	ACOPOS plug-in module, EnDat 2.2 encoder interface	
8AC130.60-1	ACOPOS plug-in module, 8 digital I/O configurable in pairs as 24 V input or as output 400/100 mA, 2 digital outputs 2 A, order TB712 terminal block separately.	
8AC131.60-1	ACOPOS plug-in module, 2 analog inputs ±10 V, 2 digital I/O points which can be configured as a 24 V input or 45 mA output, order TB712 terminal block separately.	
8AC132.60-1	ACOPOS plug-in module, 2 analog inputs ±10 V	
8AC140.60-3	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 1 CAN interface, 1 Ethernet interface 100 Base-T, 1 PROFIBUS DP slave interface, 1 RS232 interface, 3 digital I/O can be configured as 24 VDC input or 500 mA output, 1 analog input ±10 V, order program memory and 0TB708 terminal block separately.	
8AC140.61-3	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 1 CAN interface, 1 Ethernet interface 100 Base-T, 1 PROFIBUS DP slave interface, 1 RS232 interface, 3 digital I/O can be configured as 24 VDC input or 500 mA output, 1 analog input ±10 V, order program memory and 0TB708 terminal block separately.	
8AC141.60-2	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 16 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 2 CAN interfaces, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 1 X2X Link Master interface, 3 digital I/O can be configured as 24 VDC input or output 500 mA, 1 analog input ±10 V, order program memory and 0TB704 and 0TB708 terminal blocks separately	
8AC141.61-3	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 2 CAN interfaces, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 1 X2X Link Master interface, 3 digital I/O can be configured as 24 VDC input or output 500 mA, 1 analog input ±10 V, order program memory and 0TB704 and 0TB708 terminal blocks separately	
	Shielding component sets	
8X0010.00-1	ACOPOS shielding components set for 8V1022.xxx-x up to 8V1090.xxx-x	
	Terminal sets	
8X0001.00-1	ACOPOS accessories, plug set for 8V1010.00 and 8V1090.00 (3 phase)	

Table 27: 8V1022.00-2, 8V1022.001-2 - Order data

2.4.1.2 Technical data

Product ID	8V1022.00-2	8V1022.001-2
General information		
Note	-	Variant with partially coated circuit boards
B&R ID code	0x1284	0xA099
Slots for plug-in modules	4	
Certification CE cULus KC FSC	 Yes Yes Yes Yes	
Power mains connection		
Permissible power mains forms	TT, TN 1)	
Mains input voltage	3x 400 VAC to 480 VAC ±10%	
Frequency	50 / 60 Hz ±4%	
Installed load	Max. 3 kVA	
Starting current at 400 VAC	4 A	
Switch-on interval	>10 s	
Integrated line filter in accordance with EN 61800-3, Category C3 2)	Yes	
Power loss at max. device power without braking resistor	Approx. 120 W	
DC bus connection		
DC bus capacitance	235 µF	
24 VDC supply		
Input voltage 3)	24 VDC ±25%	
Input capacitance	8200 µF	
Power consumption 4)	Max. 2.5 A + current for motor holding brake	
Motor connection		
Quantity	1	
Continuous current 5)	2.2 A_{eff}	
Reduction of continuous current depending on the ambient temperature Mains input voltage: 400 VAC Switching frequency 5 kHz Switching frequency 10 kHz Switching frequency 20 kHz Mains input voltage: 480 VAC Switching frequency 5 kHz Switching frequency 10 kHz Switching frequency 20 kHz	 No reduction No reduction No reduction 6) No reduction No reduction 0.13 A_{eff} per °C (starting at 51°C) 6)	
Reduction of continuous current depending on the installation elevation Starting at 500 m above sea level	 0.22 A_{eff} per 1000 m	
Peak current	14 A_{eff}	
Nominal switching frequency	20 kHz	
Possible switching frequencies	5 / 10 / 20 kHz	
Electrical stress of the connected motor in accordance with IEC TS 60034-25 7)	Limit value curve A	
Max. motor line length	25 m	
Protective measures Overload protection Short circuit and ground fault protection	 Yes Yes	
Max. output frequency	600 Hz 8)	
Motor holding brake connection		
Response threshold for open line monitoring	Approx. 385 mA	
Max. output current	1 A	
Max. number of switching cycles	Unlimited since handled electronically	
Braking resistors		
Peak power output	3.5 kW	
Continuous power	130 W	
Limit switch and reference inputs		
Quantity	3	
Wiring	Sink	
Electrical isolation Input - ACOPOS Input - Input	 Yes No	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Switching threshold Low High	 <5 V >15 V	
Input current at nominal voltage	Approx. 4 mA	

Table 28: 8V1022.00-2, 8V1022.001-2 - Technical data

Product ID	8V1022.00-2	8V1022.001-2
Switching delay	Max. 2.0 ms	
Modulation compared to ground potential	Max. ±38 V	
Enable inputs		
Quantity	1	
Wiring	Sink	
Electrical isolation Input - ACOPOS	 Yes	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Input current at nominal voltage	Approx. 30 mA	
Switching threshold Low High	 <5 V >15 V	
Switching delay Enable 0 -> 1, ready for PWM Enable 1 -> 0, PWM off	 Max. 100 µs Max. 2.0 ms	
Modulation compared to ground potential	Max. ±38 V	
OSSD signal connections [9)]	Not permitted	
Trigger inputs		
Quantity	2	
Wiring	Sink	
Electrical isolation Input - ACOPOS Input - Input	 Yes No	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Switching threshold Low High	 <5 V >15 V	
Input current at nominal voltage	Approx. 10 mA	
Switching delay Positive edge Negative edge	 52 µs ±0.5 µs (digitally filtered) 53 µs ±0.5 µs (digitally filtered)	
Modulation compared to ground potential	Max. ±38 V	
Electrical characteristics		
Discharge capacitance	660 nF	
Operating conditions		
Permitted mounting orientations Hanging vertically Lying horizontally Standing horizontally	 Yes Yes No	
Installation at elevations above sea level Nominal Maximum [10)]	 0 to 500 m 2000 m	
Degree of pollution in accordance with EN 60664-1	2 (non-conductive pollution)	
Overvoltage category in accordance with IEC 60364-4-443:1999	II	
EN 60529 protection	IP20	
Environmental conditions		
Temperature Operation Nominal Maximum [11)] Storage Transport	 5 to 40°C 55°C -25 to 55°C -25 to 70°C	
Relative humidity Operation Storage Transport	 5 to 85% 5 to 95% Max. 95% at 40°C	
Mechanical characteristics		
Dimensions Width Height Depth	 70.5 mm 375 mm 235.5 mm	
Weight	4.0 kg	

Table 28: 8V1022.00-2, 8V1022.001-2 - Technical data

1) In the USA, TT and TN power mains are commonly referred to as "Delta/Wye with grounded Wye neutral".
2) Limit values from EN 61800-3 C3 (second environment).
3) The permissible input voltage range is reduced when using motor holding brakes. The input voltage range should be selected so that the proper supply voltage for the motor holding brake can be maintained.
4) The current requirements depend on the configuration of the ACOPOS servo drive.
5) Valid in the following conditions: 400 VAC mains input voltage, nominal switching frequency, 40°C ambient temperature, installation altitude <500 m above sea level.

6) Value for the nominal switching frequency.
7) If necessary, the stress of the motor isolation system be reduced by an additional externally-wired dU/dt choke. For example, the RWK 305 three-phase dU/dt choke from Schaffner (www.schaffner.com) can be used. IMPORTANT: Even when using a dU/dt choke, it is necessary to ensure that an EMC-compatible, low inductance shield connection is used!
8) The module's electrical output frequency (SCTRL_SPEED_ACT * MOTOR_POLEPAIRS) is monitored to protect against dual use in accordance with EC 428/2009 | 3A225. If the electrical output frequency of the module exceeds the limit value of 600 Hz uninterrupted for more than 0.5 s, then the current movement is aborted and error 6060 is output (power unit: limit speed exceeded).
9) OSSD (open signal switching device) signals are used to monitor signal lines for short circuits and cross faults.
10) Continuous operation of ACOPOS servo drives at altitudes ranging from 500 m to 2000 m above sea level is possible (taking the specified continuous current reductions into consideration). Requirements that go above and beyond this need to be arranged with B&R.
11) Continuous operation of ACOPOS servo drives at ambient temperatures ranging from 40°C to max. 55°C is possible (taking the specified continuous current reductions into consideration), but this will result in a shorter service life.

2.4.2 ACOPOS 1045

2.4.2.1 Order data

Model number	Short description	Figure
	Servo drives	
8V1045.00-2	ACOPOS servo drive, 3x 400-480 V, 4.4 A, 2 kW, line filter, braking resistor and electronic secure restart inhibit integrated	
8V1045.001-2	ACOPOS servo drive, 3x 400-480 V, 4.4 A, 2 kW, coated, line filter, integrated braking resistor and electronic secure restart inhibit	
	Optional accessories	
	Plug-in modules	
8AC110.60-2	ACOPOS plug-in module, CAN interface	
8AC110.60-3	ACOPOS plug-in module, CAN interface	
8AC114.60-2	ACOPOS plug-in module, POWERLINK V2 interface	
8AC120.60-1	ACOPOS plug-in module, EnDat encoder and sine incremental encoder interface	
8AC121.60-1	ACOPOS plug-in module, HIPERFACE interface	
8AC122.60-3	ACOPOS plug-in module, resolver interface 10 kHz	
8AC122.60-4	ACOPOS resolver interface 10 kHz, no open line detection	
8AC123.60-1	ACOPOS plug-in module, incremental encoder and SSI absolute encoder interface	
8AC125.60-1	ACOPOS plug-in module, BiSS encoder interface 5 V	
8AC125.60-2	ACOPOS plug-in module, BiSS encoder interface 5V, baud rate 6.25 Mbit/s	
8AC125.61-2	ACOPOS plug-in module, BiSS encoder interface 12V, baud rate 6.25 Mbit/s	
8AC126.60-1	ACOPOS plug-in module, EnDat 2.2 encoder interface	
8AC130.60-1	ACOPOS plug-in module, 8 digital I/O configurable in pairs as 24 V input or as output 400/100 mA, 2 digital outputs 2 A, order TB712 terminal block separately.	
8AC131.60-1	ACOPOS plug-in module, 2 analog inputs ±10 V, 2 digital I/O points which can be configured as a 24 V input or 45 mA output, order TB712 terminal block separately.	
8AC132.60-1	ACOPOS plug-in module, 2 analog inputs ±10 V	
8AC140.60-3	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 1 CAN interface, 1 Ethernet interface 100 Base-T, 1 PROFIBUS DP slave interface, 1 RS232 interface, 3 digital I/O can be configured as 24 VDC input or 500 mA output, 1 analog input ±10 V, order program memory and 0TB708 terminal block separately.	
8AC140.61-3	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 1 CAN interface, 1 Ethernet interface 100 Base-T, 1 PROFIBUS DP slave interface, 1 RS232 interface, 3 digital I/O can be configured as 24 VDC input or 500 mA output, 1 analog input ±10 V, order program memory and 0TB708 terminal block separately.	
8AC141.60-2	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 16 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 2 CAN interfaces, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 1 X2X Link Master interface, 3 digital I/O can be configured as 24 VDC input or output 500 mA, 1 analog input ±10 V, order program memory and 0TB704 and 0TB708 terminal blocks separately	
8AC141.61-3	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 2 CAN interfaces, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 1 X2X Link Master interface, 3 digital I/O can be configured as 24 VDC input or output 500 mA, 1 analog input ±10 V, order program memory and 0TB704 and 0TB708 terminal blocks separately	
	Shielding component sets	
8X0010.00-1	ACOPOS shielding components set for 8V1022.xxx-x up to 8V1090.xxx-x	
	Terminal sets	
8X0001.00-1	ACOPOS accessories, plug set for 8V1010.00 and 8V1090.00 (3 phase)	

Table 29: 8V1045.00-2, 8V1045.001-2 - Order data

2.4.2.2 Technical data

Product ID	8V1045.00-2	8V1045.001-2
General information		
Note	-	Variant with partially coated circuit boards
B&R ID code	0x12C7	0xA09A
Slots for plug-in modules	4	
Certification CE cULus KC FSC	 Yes Yes Yes Yes	
Power mains connection		
Permissible power mains forms	TT, TN 1)	TT, TN 2)
Mains input voltage	3x 400 VAC to 480 VAC ±10%	
Frequency	50 / 60 Hz ±4%	
Installed load	Max. 5 kVA	
Starting current at 400 VAC	7 A	
Switch-on interval	>10 s	
Integrated line filter in accordance with EN 61800-3, Category C3 3)	Yes	
Power loss at max. device power without braking resistor	Approx. 180 W	
DC bus connection		
DC bus capacitance	235 µF	
24 VDC supply		
Input voltage 4)	24 VDC ±25%	
Input capacitance	8200 µF	
Power consumption 5)	Max. 2.5 A + current for motor holding brake	
Motor connection		
Quantity	1	
Continuous current 6)	4.4 A_{eff}	4.4 A_{eff}
Reduction of continuous current depending on the ambient temperature Mains input voltage: 400 VAC Switching frequency 5 kHz Switching frequency 10 kHz Switching frequency 20 kHz Mains input voltage: 480 VAC Switching frequency 5 kHz Switching frequency 10 kHz Switching frequency 20 kHz	 No reduction No reduction 0.13 A_{eff} per °C (starting at 45°C) 7) No reduction No reduction 0.13 A_{eff} per °C (starting at 35°C) 7)	
Reduction of continuous current depending on the installation elevation Starting at 500 m above sea level	 0.44 A_{eff} per 1000 m	
Peak current	24 A_{eff}	24 A_{eff}
Nominal switching frequency	20 kHz	
Possible switching frequencies	5 / 10 / 20 kHz	
Electrical stress of the connected motor in accordance with IEC TS 60034-25 8)	Limit value curve A	
Max. motor line length	25 m	
Protective measures Overload protection Short circuit and ground fault protection	 Yes Yes	
Max. output frequency	600 Hz 9)	600 Hz 10)
Motor holding brake connection		
Response threshold for open line monitoring	Approx. 385 mA	
Max. output current	1 A	
Max. number of switching cycles	Unlimited since done electronically	Unlimited since handled electronically
Braking resistors		
Peak power output	7 kW	
Continuous power	200 W	
Limit switch and reference inputs		
Quantity	3	
Wiring	Sink	
Electrical isolation Input - ACOPOS Input - Input	 Yes No	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Switching threshold Low High	 <5 V >15 V	
Input current at nominal voltage	Approx. 4 mA	

Table 30: 8V1045.00-2, 8V1045.001-2 - Technical data

Product ID	8V1045.00-2	8V1045.001-2
Switching delay	Max. 2.0 ms	
Modulation compared to ground potential	Max. ±38 V	
Enable inputs		
Quantity	1	
Wiring	Sink	
Electrical isolation Input - ACOPOS	 Yes	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Input current at nominal voltage	Approx. 30 mA	
Switching threshold Low High	 <5 V >15 V	
Switching delay Enable 0 -> 1, ready for PWM Enable 1 -> 0, PWM off	 Max. 100 µs Max. 2.0 ms	
Modulation compared to ground potential	Max. ±38 V	
OSSD signal connections [11]	Not permitted	
Trigger inputs		
Quantity	2	
Wiring	Sink	
Electrical isolation Input - ACOPOS Input - Input	 Yes No	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Switching threshold Low High	 <5 V >15 V	
Input current at nominal voltage	Approx. 10 mA	
Switching delay Positive edge Negative edge	 52 µs ±0.5 µs (digitally filtered) 53 µs ±0.5 µs (digitally filtered)	
Modulation compared to ground potential	Max. ±38 V	
Electrical characteristics		
Discharge capacitance	660 nF	
Operating conditions		
Permitted mounting orientations Hanging vertically Lying horizontally Standing horizontally	 Yes Yes No	
Installation at elevations above sea level Nominal Maximum [12]	 0 to 500 m 2000 m	
Degree of pollution in accordance with EN 60664-1	2 (non-conductive pollution)	
Overvoltage category in accordance with IEC 60364-4-443:1999	II	
EN 60529 protection	IP20	
Environmental conditions		
Temperature Operation Nominal Maximum [13] Storage Transport	 5 to 40°C 55°C -25 to 55°C -25 to 70°C	
Relative humidity Operation Storage Transport	 5 to 85% 5 to 95% Max. 95% at 40°C	
Mechanical characteristics		
Dimensions Width Height Depth	 70.5 mm 375 mm 235.5 mm	
Weight	4.1 kg	

Table 30: 8V1045.00-2, 8V1045.001-2 - Technical data

1) In the USA, the terms "Delta / Wye with Grounded Wye neutral" are common for TT and TN power mains.
2) In the USA, TT and TN power mains are commonly referred to as "Delta/Wye with grounded Wye neutral".
3) Limit values from EN 61800-3 C3 (second environment).
4) When using motor holding brakes, the valid input voltage range is reduced. The input voltage range should be selected so that the proper supply voltage for the motor holding brake can be maintained.
5) The current requirements depend on the configuration of the ACOPOS servo drive.

6) Valid in the following conditions: Mains input voltage 400 VAC, nominal switching frequency, 40 °C ambient temperature, installation altitudes <500 m above sea level.
7) Value for the nominal switching frequency.
8) If necessary, the stress of the motor isolation system be reduced by an additional externally-wired dU/dt choke. For example, the RWK 305 three-phase dU/dt choke from Schaffner (www.schaffner.com) can be used. IMPORTANT: Even when using a dU/dt choke, it is necessary to ensure that an EMC-compatible, low inductance shield connection is used!
9) The module's electrical output frequency (SCTRL_SPEED_ACT * MOTOR_POLEPAIRS) is monitored to protect against dual-use in accordance with EC 428/2009 | 3A225. If the electrical output frequency of the module exceeds the limit value of 600 Hz uninterrupted for more than 0.5 s, then the current motion is aborted and error 6060 is output (Power element: Limit speed exceeded).
10) The module's electrical output frequency (SCTRL_SPEED_ACT * MOTOR_POLEPAIRS) is monitored to protect against dual use in accordance with EC 428/2009 | 3A225. If the electrical output frequency of the module exceeds the limit value of 600 Hz uninterrupted for more than 0.5 s, then the current movement is aborted and error 6060 is output (power unit: limit speed exceeded).
11) OSSD (Open Signal Switching Device) signals are used to monitor signal lines for short circuits and cross faults.
12) Continuous operation of ACOPOS servo drives at altitudes ranging from 500 m to 2000 m above sea level is possible (taking the continuous current reductions listed into consideration). Requirements that go above and beyond this need to be arranged with B&R.
13) Continuous operation of ACOPOS servo drives at ambient temperatures ranging from 40 °C to max. 55 °C is possible (taking the continuous current reductions listed into consideration), but results in a shorter lifespan.

2.4.3 ACOPOS 1090

2.4.3.1 Order data

Model number	Short description	Figure
	Servo drives	
8V1090.00-2	ACOPOS servo drive, 3x 400-480 V, 8.8 A, 4 kW, line filter, integrated braking resistor and electronic secure restart inhibit	
8V1090.001-2	ACOPOS servo drive, 3x 400-480 V, 8.8 A, 4 kW, coated, line filter, integrated braking resistor and electronic secure restart inhibit	
	Optional accessories	
	Plug-in modules	
8AC110.60-2	ACOPOS plug-in module, CAN interface	
8AC110.60-3	ACOPOS plug-in module, CAN interface	
8AC114.60-2	ACOPOS plug-in module, POWERLINK V2 interface	
8AC120.60-1	ACOPOS plug-in module, EnDat encoder and sine incremental encoder interface	
8AC121.60-1	ACOPOS plug-in module, HIPERFACE interface	
8AC122.60-3	ACOPOS plug-in module, resolver interface 10 kHz	
8AC122.60-4	ACOPOS resolver interface 10 kHz, no open line detection	
8AC123.60-1	ACOPOS plug-in module, incremental encoder and SSI absolute encoder interface	
8AC125.60-1	ACOPOS plug-in module, BiSS encoder interface 5 V	
8AC125.60-2	ACOPOS plug-in module, BiSS encoder interface 5V, baud rate 6.25 Mbit/s	
8AC125.61-2	ACOPOS plug-in module, BiSS encoder interface 12V, baud rate 6.25 Mbit/s	
8AC126.60-1	ACOPOS plug-in module, EnDat 2.2 encoder interface	
8AC130.60-1	ACOPOS plug-in module, 8 digital I/O configurable in pairs as 24 V input or as output 400/100 mA, 2 digital outputs 2 A, order TB712 terminal block separately.	
8AC131.60-1	ACOPOS plug-in module, 2 analog inputs ±10 V, 2 digital I/O points which can be configured as a 24 V input or 45 mA output, order TB712 terminal block separately.	
8AC132.60-1	ACOPOS plug-in module, 2 analog inputs ±10 V	
8AC140.60-3	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 1 CAN interface, 1 Ethernet interface 100 Base-T, 1 PROFIBUS DP slave interface, 1 RS232 interface, 3 digital I/O can be configured as 24 VDC input or 500 mA output, 1 analog input ±10 V, order program memory and 0TB708 terminal block separately.	
8AC140.61-3	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 1 CAN interface, 1 Ethernet interface 100 Base-T, 1 PROFIBUS DP slave interface, 1 RS232 interface, 3 digital I/O can be configured as 24 VDC input or 500 mA output, 1 analog input ±10 V, order program memory and 0TB708 terminal block separately.	
8AC141.60-2	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 16 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 2 CAN interfaces, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 1 X2X Link Master interface, 3 digital I/O can be configured as 24 VDC input or output 500 mA, 1 analog input ±10 V, order program memory and 0TB704 and 0TB708 terminal blocks separately	
8AC141.61-3	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 2 CAN interfaces, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 1 X2X Link Master interface, 3 digital I/O can be configured as 24 VDC input or output 500 mA, 1 analog input ±10 V, order program memory and 0TB704 and 0TB708 terminal blocks separately	
	Shielding component sets	
8X0010.00-1	ACOPOS shielding components set for 8V1022.xxx-x up to 8V1090.xxx-x	
	Terminal sets	
8X0001.00-1	ACOPOS accessories, plug set for 8V1010.00 and 8V1090.00 (3 phase)	

Table 31: 8V1090.00-2, 8V1090.001-2 - Order data

2.4.3.2 Technical data

Product ID	8V1090.00-2	8V1090.001-2
General information		
Note	-	Variant with partially coated circuit boards
B&R ID code	0x12C8	0xA09B
Slots for plug-in modules	4	
Certification CE cULus KC FSC	 Yes Yes Yes Yes	
Power mains connection		
Permissible power mains forms	TT, TN [1]	
Mains input voltage	3x 400 VAC to 480 VAC ±10%	
Frequency	50 / 60 Hz ±4%	
Installed load	Max. 10 kVA	
Starting current at 400 VAC	7 A	
Switch-on interval	>10 s	
Integrated line filter in accordance with EN 61800-3, Category C3 [2]	Yes	
Power loss at max. device power without braking resistor	Approx. 200 W	
DC bus connection		
DC bus capacitance	470 µF	
24 VDC supply		
Input voltage [3]	24 VDC ±25%	
Input capacitance	8200 µF	
Power consumption [4]	Max. 2.5 A + current for motor holding brake	
Motor connection		
Quantity	1	
Continuous current [5]	8.8 A_{eff}	
Reduction of continuous current depending on the ambient temperature Mains input voltage: 400 VAC Switching frequency 5 kHz Switching frequency 10 kHz Switching frequency 20 kHz Mains input voltage: 480 VAC Switching frequency 5 kHz Switching frequency 10 kHz Switching frequency 20 kHz	 No reduction 0.18 A_{eff} per °C (starting at 54°C) [6] 0.18 A_{eff} per °C (starting at 30°C) No reduction 0.18 A_{eff} per °C (starting at 48°C) [6] 0.18 A_{eff} per °C (starting at 18°C)	
Reduction of continuous current depending on the installation elevation Starting at 500 m above sea level	 0.88 A_{eff} per 1000 m	
Peak current	24 A_{eff}	
Nominal switching frequency	10 kHz	
Possible switching frequencies	5 / 10 / 20 kHz	
Electrical stress of the connected motor in accordance with IEC TS 60034-25 [7]	Limit value curve A	
Max. motor line length	25 m	
Protective measures Overload protection Short circuit and ground fault protection	 Yes Yes	
Max. output frequency	600 Hz [8]	600 Hz [9]
Motor holding brake connection		
Response threshold for open line monitoring	Approx. 385 mA	
Max. output current	1 A	
Max. number of switching cycles	Unlimited since handled electronically	
Braking resistors		
Peak power output	7 kW	
Continuous power	200 W	
Limit switch and reference inputs		
Quantity	3	
Wiring	Sink	
Electrical isolation Input - ACOPOS Input - Input	 Yes No	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Switching threshold Low High	 <5 V >15 V	 <5 V >15 V
Input current at nominal voltage	Approx. 4 mA	

Table 32: 8V1090.00-2, 8V1090.001-2 - Technical data

Product ID	8V1090.00-2	8V1090.001-2
Switching delay	Max. 2.0 ms	
Modulation compared to ground potential	Max. ±38 V	
Enable inputs		
Quantity	1	
Wiring	Sink	
Electrical isolation Input - ACOPOS	 Yes	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Input current at nominal voltage	Approx. 30 mA	
Switching threshold Low High	 <5 V >15 V	 <5 V >15 V
Switching delay Enable 0 -> 1, ready for PWM Enable 1 -> 0, PWM off	 Max. 100 µs Max. 2.0 ms	
Modulation compared to ground potential	Max. ±38 V	
OSSD signal connections [10]	Not permitted	
Trigger inputs		
Quantity	2	
Wiring	Sink	
Electrical isolation Input - ACOPOS Input - Input	 Yes No	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Switching threshold Low High	 <5 V >15 V	 <5 V >15 V
Input current at nominal voltage	Approx. 10 mA	
Switching delay Positive edge Negative edge	 52 µs ±0.5 µs (digitally filtered) 53 µs ±0.5 µs (digitally filtered)	
Modulation compared to ground potential	Max. ±38 V	
Electrical characteristics		
Discharge capacitance	660 nF	
Operating conditions		
Permitted mounting orientations Hanging vertically Lying horizontally Standing horizontally	 Yes Yes No	
Installation at elevations above sea level Nominal Maximum [11]	 0 to 500 m 2000 m	
Degree of pollution in accordance with EN 60664-1	2 (non-conductive pollution)	
Overvoltage category in accordance with IEC 60364-4-443:1999	II	
EN 60529 protection	IP20	
Environmental conditions		
Temperature Operation Nominal Maximum [12] Storage Transport	 5 to 40°C 55°C -25 to 55°C -25 to 70°C	
Relative humidity Operation Storage Transport	 5 to 85% 5 to 95% Max. 95% at 40°C	
Mechanical characteristics		
Dimensions Width Height Depth	 70.5 mm 375 mm 235.5 mm	
Weight	4.4 kg	

Table 32: 8V1090.00-2, 8V1090.001-2 - Technical data

1) In the USA, TT and TN power mains are commonly referred to as "Delta/Wye with grounded Wye neutral".
2) Limit values from EN 61800-3 C3 (second environment).
3) The permissible input voltage range is reduced when using motor holding brakes. The input voltage range should be selected so that the proper supply voltage for the motor holding brake can be maintained.
4) The current requirements depend on the configuration of the ACOPOS servo drive.
5) Valid in the following conditions: 400 VAC mains input voltage, nominal switching frequency, 40°C ambient temperature, installation altitude <500 m above sea level.

6) Value for the nominal switching frequency.
7) If necessary, the stress of the motor isolation system be reduced by an additional externally-wired dU/dt choke. For example, the RWK 305 three-phase dU/dt choke from Schaffner (www.schaffner.com) can be used. IMPORTANT: Even when using a dU/dt choke, it is necessary to ensure that an EMC-compatible, low inductance shield connection is used!
8) The module's electrical output frequency (SCTRL_SPEED_ACT * MOTOR_POLEPAIRS) is monitored to protect against dual use in accordance with EC 428/2009 | 3A225. If the electrical output frequency of the module exceeds the limit value of 600 Hz uninterrupted for more than 0.5 s, then the current movement is aborted and error 6060 is output (Power element: Limit speed exceeded).
9) The module's electrical output frequency (SCTRL_SPEED_ACT * MOTOR_POLEPAIRS) is monitored to protect against dual use in accordance with EC 428/2009 | 3A225. If the electrical output frequency of the module exceeds the limit value of 600 Hz uninterrupted for more than 0.5 s, then the current movement is aborted and error 6060 is output (power unit: limit speed exceeded).
10) OSSD (open signal switching device) signals are used to monitor signal lines for short circuits and cross faults.
11) Continuous operation of ACOPOS servo drives at altitudes ranging from 500 m to 2000 m above sea level is possible (taking the specified continuous current reductions into consideration). Requirements that go above and beyond this need to be arranged with B&R.
12) Continuous operation of ACOPOS servo drives at ambient temperatures ranging from 40°C to max. 55°C is possible (taking the specified continuous current reductions into consideration), but this will result in a shorter service life.

2.4.4 Wiring

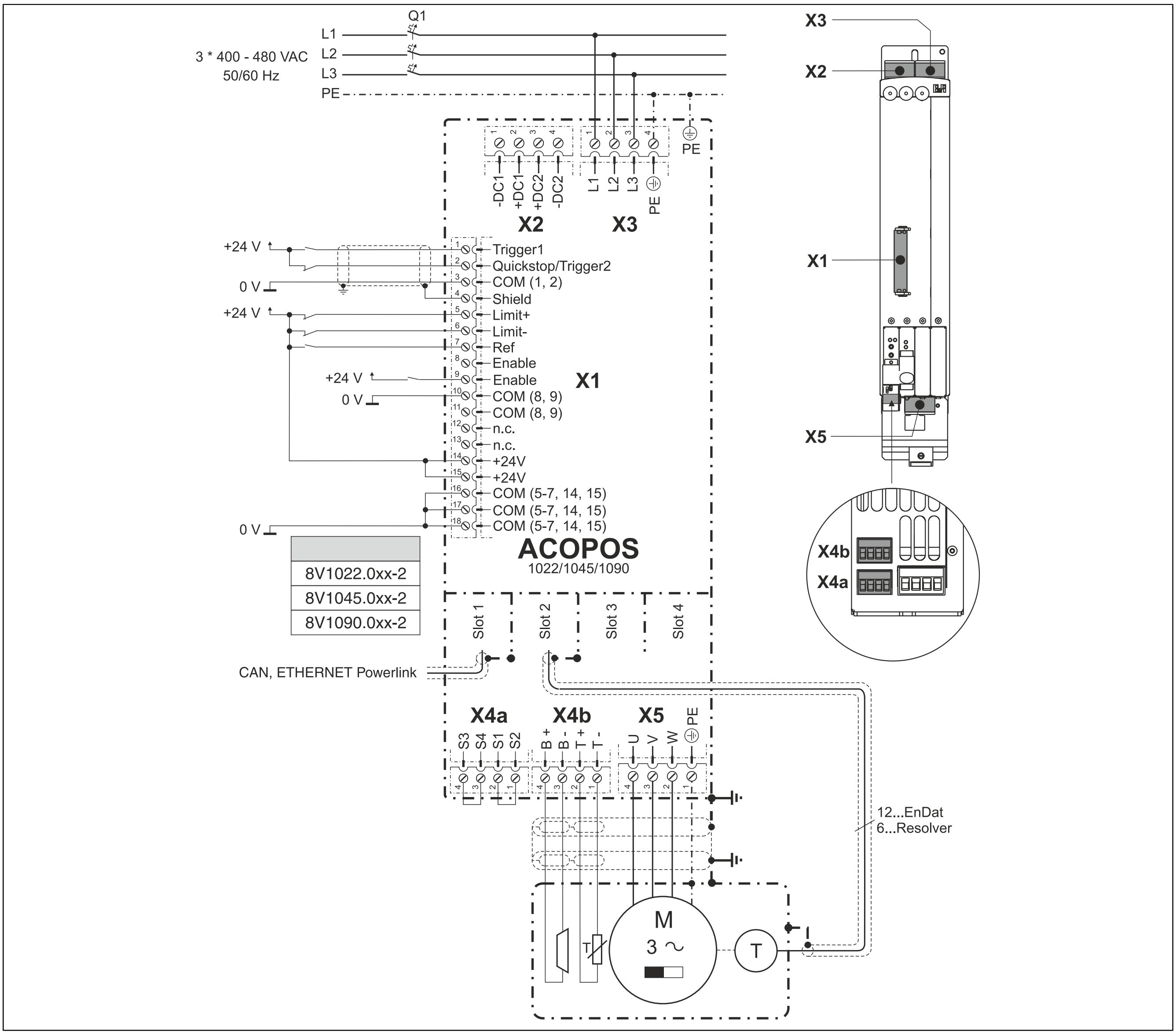


Figure 18: ACOPOS 1022, 1045, 1090 - Pinout overview

2.4.4.1 X1 - Pinout

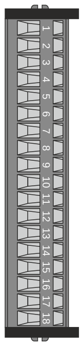
X1	Pin	Name	Function
	1	Trigger1	Trigger 1
	2	Quickstop/Trigger2	Quickstop/Trigger2
	3	COM (1, 2)	Trigger 1, Quickstop/Trigger 2 0 V
	4	Shield	Shield
	5	Limit+	Positive HW limit
	6	Limit-	Negative HW limit
	7	Ref	Reference switch
	8	Enable [1]	Enable
	9	Enable [1]	Enable
	10	COM (8, 9)	Enable 0 V
	11	COM (8, 9)	Enable 0 V
	12	---	---
	13	---	---
	14	+24 V	+24 V supply
	15	+24 V	+24 V supply
	16	COM (5-7, 14, 15)	0 V supply
	17	COM (5-7, 14, 15)	0 V supply
	18	COM (5-7, 14, 15)	0 V supply
	The following connections are linked with each other internally in the device: • Pin 8 --> Pin 9 (Enable) • Pin 10 --> Pin 11 (Enable 0 V) • Pin 14 --> Pin 15 (Supply +24 V) • Pin 16 --> Pin 17 --> Pin 18 (Supply 0 V) Terminal cross sections see "Overview of clampable cross sections" on page 255		

Table 33: X1 - Pinout

1) The wiring is not permitted to exceed a total length of 30 m.

2.4.4.2 X2 - Pinout

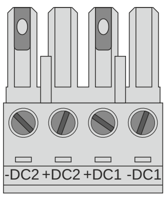
X2	Pin	Name	Function
	1	-DC1	U DC bus -
	2	+DC1	U DC bus +
	3	+DC2	U DC bus +
	4	-DC2	U DC bus -
	Terminal cross sections see "Overview of clampable cross sections" on page 255		

Table 34: X2 - Pinout

2.4.4.3 X3 - Pinout

Danger!

Servo drives are not permitted to be operated directly on IT and TN-S mains with a grounded phase conductor and protective ground conductor!

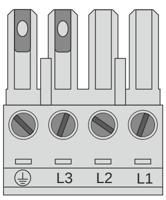
X3	Pin	Name	Function
	1	L1	Power mains connection L1
	2	L2	Power mains connection L2
	3	L3	Power mains connection L3
	4	PE	Protective ground conductor
	Terminal cross sections see "Overview of clampable cross sections" on page 255		

Table 35: X3 - Pinout

2.4.4.4 X4a, X4b - Pinout

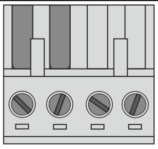
X4a	Pin	Name	Function
	1	S2 1)	Activation, supply for the external holding brake (+)
	2	S1 1)	Activation for the external holding brake (+)
	3	P4	Activation, supply for the external holding brake (-)
	4	S3	Activation for the external holding brake (-)
	Terminal cross sections see "Overview of clampable cross sections" on page 255		

Table 36: X4a - Pinout

1) If the holding brake is connected via an additional external relay contact (ground-in e.g. via the connections S1/S2) instead of via the internal transistor, then the internal quenching circuit has no effect! In this case, the customer must make sure that neither the relay contact nor the braking coil are damaged when switching off the brake. This can be done by interconnecting the coil or - better still - interconnecting the contact with a quenching circuit.

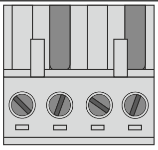
X4b	Pin	Name	Function
	1	T-	Temperature sensor -
	2	T+	Temperature sensor +
	3	B- 1)	Brake -
	4	B+ 1)	Brake +
	Terminal cross sections see "Overview of clampable cross sections" on page 255		

Table 37: X4b - Pinout

1) If the holding brake is connected via an additional external relay contact (ground-in e.g. via the connections S1/S2) instead of via the internal transistor, then the internal quenching circuit has no effect! In this case, the customer must make sure that neither the relay contact nor the braking coil are damaged when switching off the brake. This can be done by interconnecting the coil or - better still - interconnecting the contact with a quenching circuit.

Danger!

The connections for the motor temperature sensors and the motor holding brake are isolated circuits. Therefore, these connections are only allowed to be connected to devices or components with at least safe isolation in accordance with IEC 60364-4-41 or EN 61800-5-1.

Caution!

If B+ and B- are swapped when connecting the permanent magnet holding brakes, then the brakes cannot be opened! ACOPOS servo drives cannot determine if a holding brake is connected with reverse polarity!

2.4.4.4.1 Wiring the connections for the motor holding brake

The supply, activation and monitoring of the output for the motor holding brake can take place via the X4a connector in three different ways:

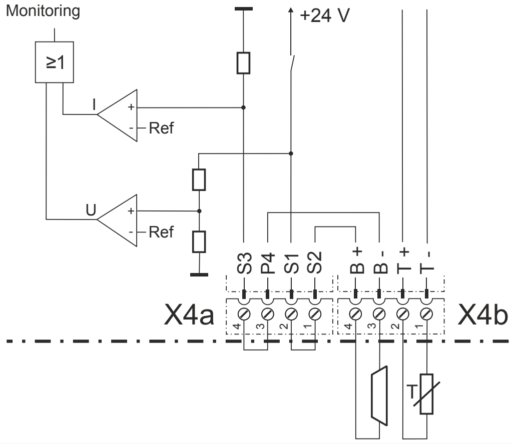
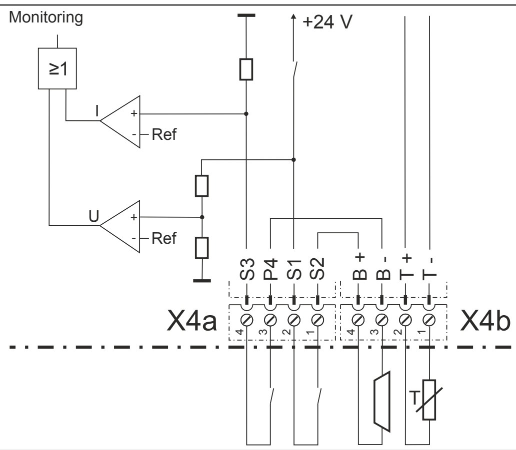
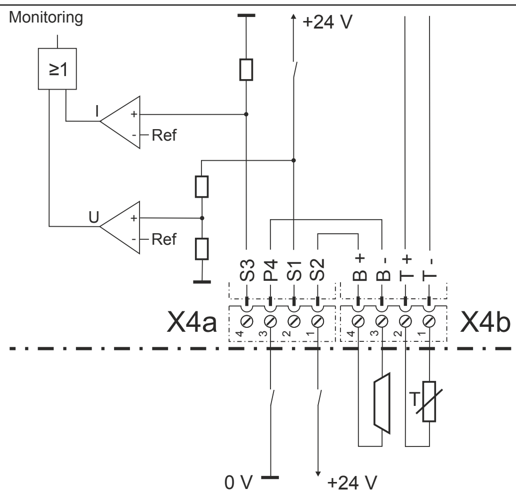
Figure		Description
1		• **Supply:** Internally by the ACOPOS servo drive • **Activation:** Internally by the ACOPOS servo drive • **Monitoring:** Internally by the ACOPOS servo drive A jumper must be placed between S1 and S2 as well as S3 and S4 on the X4a connector. 1)
2		• **Supply:** Internally by the ACOPOS servo drive • **Activation:** Internally by the ACOPOS servo drive and also possible externally using potential-free contacts 2) • **Monitoring:** Internally by the ACOPOS servo drive **Information:** **The parameters for internal monitoring via the ACOPOS must be set according to the requirements of the application. 3)**
3		• **Supply:** External • **Activation:** External • **Monitoring:** External **Information:** **ACOPOS internal monitoring cannot be used here; therefore, it must be disabled using software. 4)**

Table 38: Activation for the external holding brake

1) Both jumpers are already on the X4a connector delivered with the ACOPOS servo drives.
2) External potential-free contacts can be connected between S1 and S2 as well as between S3 and S4. This makes it possible to activate the holding brake using an external safety circuit independent of the control integrated in the ACOPOS servo drive.
3) The parameters are set using ParID 90 (1 ... internal monitoring active; 5 ... internal monitoring not active).
4) Deactivation takes place using ParID 90 (5 ... internal monitoring not active).

2.4.4.5 X5 - Pinout

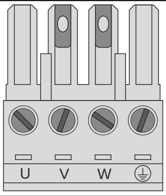
X5	Pin	Name	Function
	1	PE	Protective ground conductor
	2	W	Motor connection W
	3	V	Motor connection V
	4	U	Motor connection U
	Terminal cross sections see "Overview of clampable cross sections" on page 255		

Table 39: X5 - Pinout

2.4.4.6 Additional protective ground connection (PE)

The protective ground conductor is connected to the M5 threaded bolt provided using a cable lug.

For information concerning dimensioning, see "Protective ground connection (PE)" on page 216.

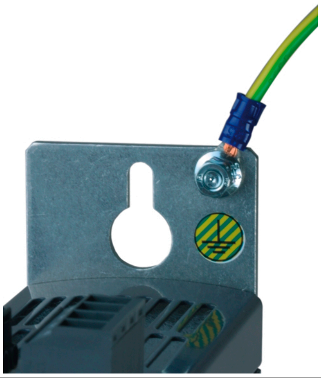
Figure	Pin	Name	Function
	---	PE	Protective ground conductor
Terminal cross sections	**[mm²]**		**AWG**
Cable lug for M5 threaded bolt	0.25 - 16		23 - 5

Table 40: Protective ground connection (PE) - ACOPOS

Danger!

Before turning on the servo drive, make sure that the housing is properly connected to ground (PE rail). The ground connection must be established even when testing the drive or operating it for a short time!

2.4.4.7 Input/Output circuit diagram

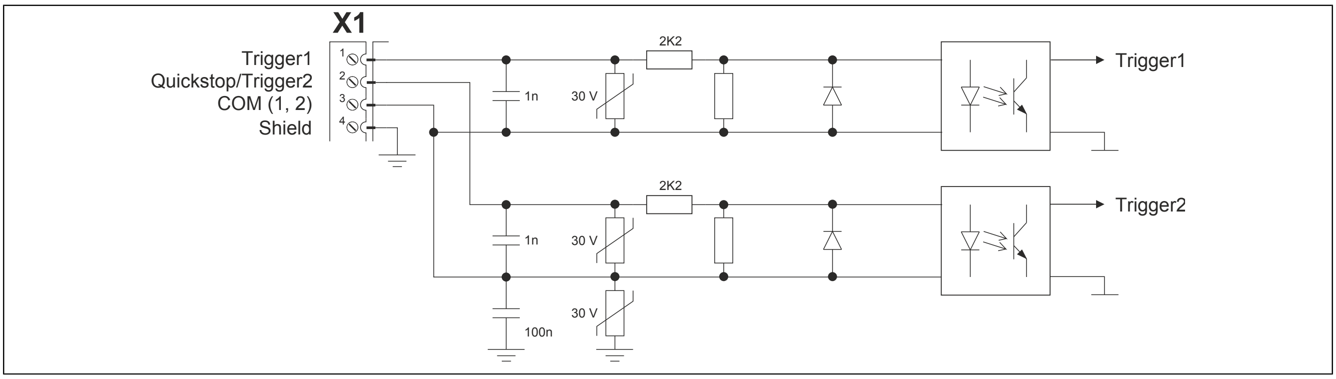


Figure 19: Trigger

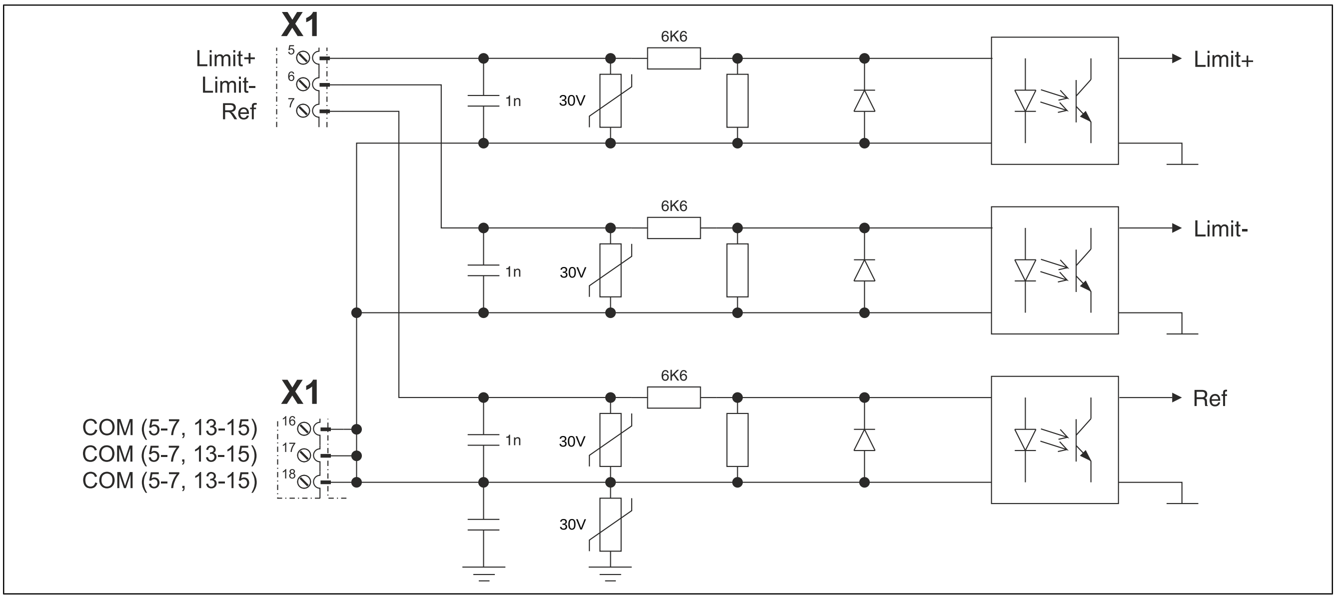


Figure 20: Limit

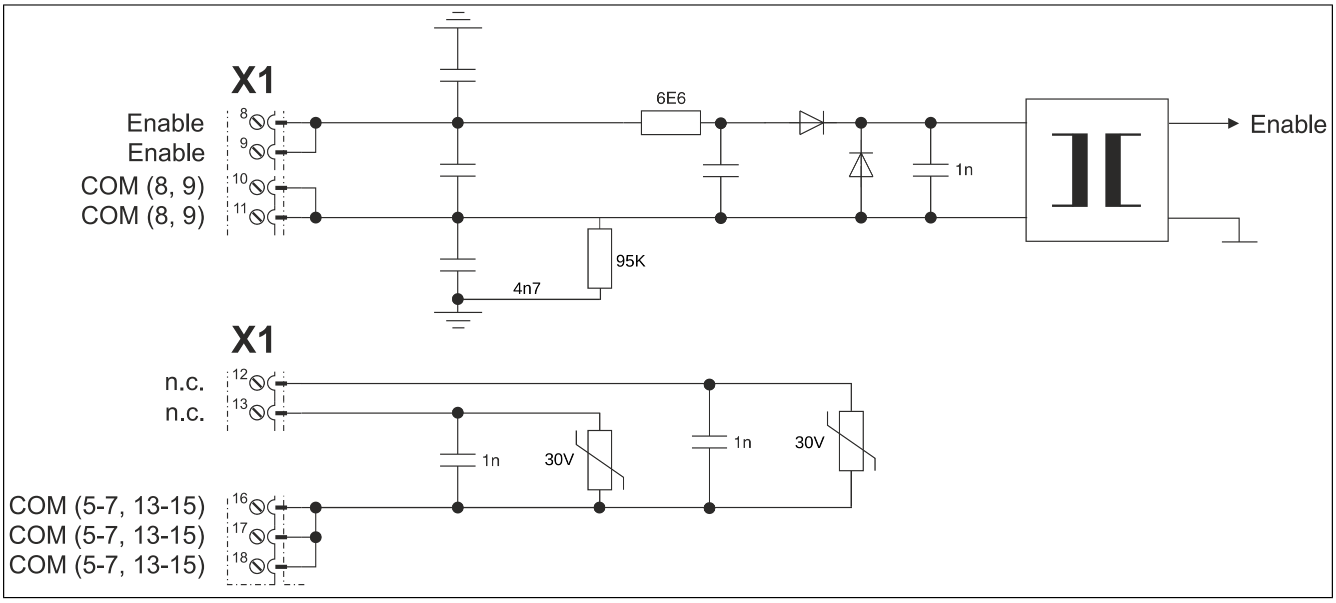


Figure 21: Enable

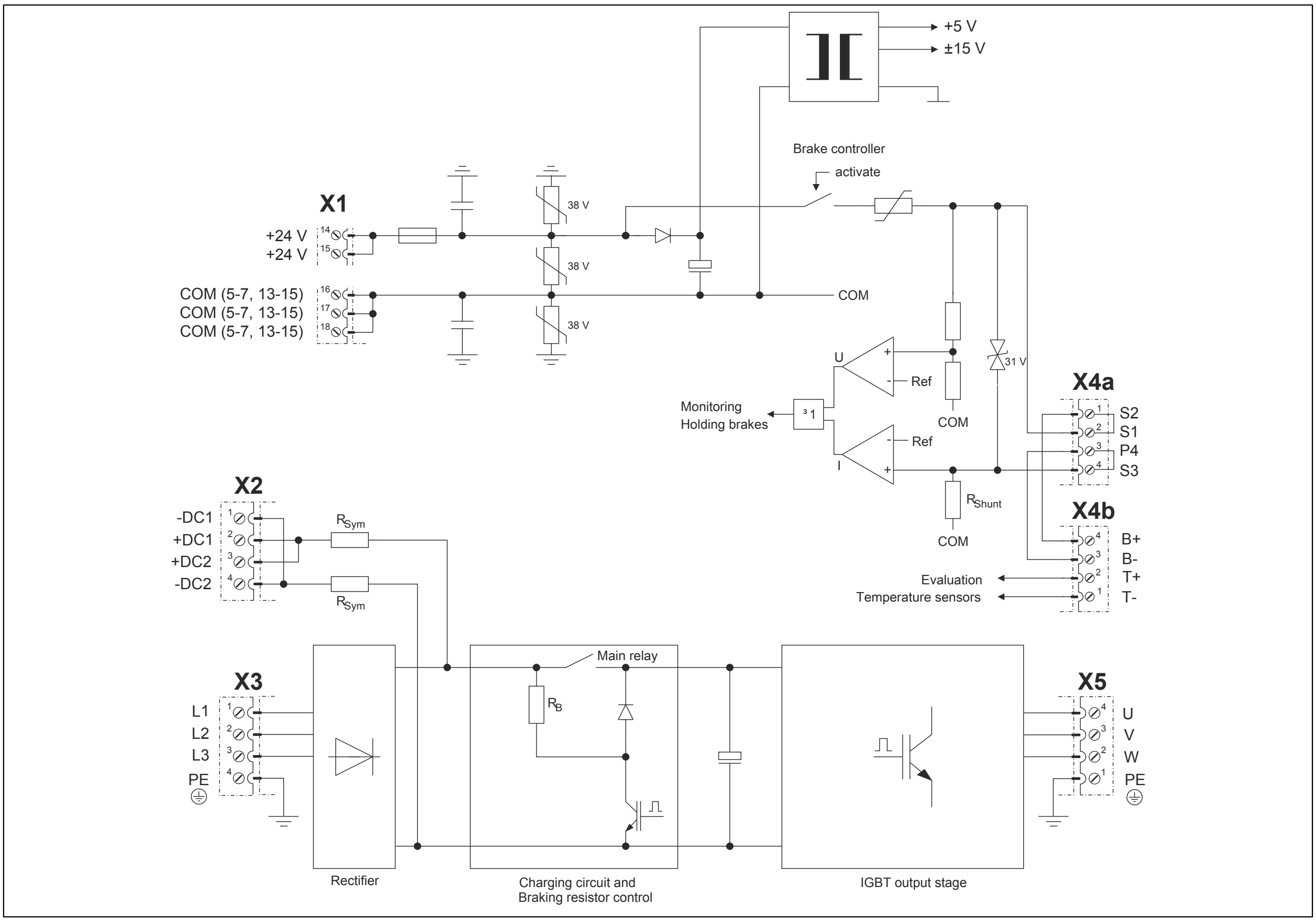


Figure 22: ACOPOS 1022, 1045, 1090 - Input/Output circuit diagram

2.5 ACOPOS 1180, 1320

2.5.1 ACOPOS 1180

2.5.1.1 Order data

Model number	Short description	Figure
	Servo drives	
8V1180.00-2	ACOPOS servo drive, 3x 400-480 V, 19 A, 9 kW, line filter, braking resistor, DC bus power supply and electronic secure restart inhibit integrated	
8V1180.001-2	ACOPOS servo drive, 3x 400-480 V, 19 A, 9 kW, coated, line filter, integrated braking resistor, DC bus power supply and electronic secure restart inhibit	
	Optional accessories	
	Braking resistors	
8B0W0045H000.000-1	ACOPOSmulti braking resistor, 450 W, 50 R, IP20, terminals	
8B0W0045H000.001-1	ACOPOSmulti braking resistor, 450 W, 50 R, IP65, terminals	
8B0W0079H000.000-1	ACOPOSmulti braking resistor, 790 W, 33 R, IP20, terminals	
8B0W0079H000.001-1	ACOPOSmulti braking resistor, 790 W, 33 R, IP65, terminals	
	Plug-in modules	
8AC110.60-2	ACOPOS plug-in module, CAN interface	
8AC110.60-3	ACOPOS plug-in module, CAN interface	
8AC114.60-2	ACOPOS plug-in module, POWERLINK V2 interface	
8AC120.60-1	ACOPOS plug-in module, EnDat encoder and sine incremental encoder interface	
8AC121.60-1	ACOPOS plug-in module, HIPERFACE interface	
8AC122.60-3	ACOPOS plug-in module, resolver interface 10 kHz	
8AC122.60-4	ACOPOS resolver interface 10 kHz, no open line detection	
8AC123.60-1	ACOPOS plug-in module, incremental encoder and SSI absolute encoder interface	
8AC125.60-1	ACOPOS plug-in module, BiSS encoder interface 5 V	
8AC125.60-2	ACOPOS plug-in module, BiSS encoder interface 5V, baud rate 6.25 Mbit/s	
8AC125.61-2	ACOPOS plug-in module, BiSS encoder interface 12V, baud rate 6.25 Mbit/s	
8AC126.60-1	ACOPOS plug-in module, EnDat 2.2 encoder interface	
8AC130.60-1	ACOPOS plug-in module, 8 digital I/O configurable in pairs as 24 V input or as output 400/100 mA, 2 digital outputs 2 A, order TB712 terminal block separately.	
8AC131.60-1	ACOPOS plug-in module, 2 analog inputs ±10 V, 2 digital I/O points which can be configured as a 24 V input or 45 mA output, order TB712 terminal block separately.	
8AC132.60-1	ACOPOS plug-in module, 2 analog inputs ±10 V	
8AC140.60-3	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 1 CAN interface, 1 Ethernet interface 100 Base-T, 1 PROFIBUS DP slave interface, 1 RS232 interface, 3 digital I/O can be configured as 24 VDC input or 500 mA output, 1 analog input ±10 V, order program memory and 0TB708 terminal block separately.	
8AC140.61-3	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 1 CAN interface, 1 Ethernet interface 100 Base-T, 1 PROFIBUS DP slave interface, 1 RS232 interface, 3 digital I/O can be configured as 24 VDC input or 500 mA output, 1 analog input ±10 V, order program memory and 0TB708 terminal block separately.	
8AC141.60-2	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 16 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 2 CAN interfaces, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 1 X2X Link Master interface, 3 digital I/O can be configured as 24 VDC input or output 500 mA, 1 analog input ±10 V, order program memory and 0TB704 and 0TB708 terminal blocks separately	
8AC141.61-3	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 2 CAN interfaces, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 1 X2X Link Master interface, 3 digital I/O can be configured as 24 VDC input or output 500 mA, 1 analog input ±10 V, order program memory and 0TB704 and 0TB708 terminal blocks separately	
	Shielding component sets	
8X0020.00-1	ACOPOS shielding components set for 8V1180.xxx-x and 8V1320.xxx-x	
	Terminal sets	
8X0002.00-1	ACOPOS accessories, plug set for 8V1180.00 and 8V1320.00 (3 phase)	

Table 41: 8V1180.00-2, 8V1180.001-2 - Order data

2.5.1.2 Technical data

Product ID	8V1180.00-2	8V1180.001-2
General information		
Note	-	Variant with partially coated circuit boards
B&R ID code	0x1282	0xA000
Slots for plug-in modules	4	
Certification		
CE	Yes	
cULus	Yes	
KC	Yes	
FSC	Yes	
Power mains connection		
Permissible power mains forms	TT, TN [1)]	TT, TN [2)]
Mains input voltage	3x 400 VAC to 480 VAC ±10%	
Frequency	50 / 60 Hz ±4%	
Installed load	Max. 17 kVA	
Starting current at 400 VAC	13 A	
Switch-on interval	>10 s	
Integrated line filter in accordance with EN 61800-3, Category C3 [3)]	Yes	
Power loss at max. device power without braking resistor	Approx. 500 W	
DC bus connection		
DC bus capacitance	940 µF	
24 VDC supply		
Input voltage	24 VDC +25% / -20%	
Input capacitance	40,000 µF	
Current requirements at 24 VDC [4)]		
Mains input voltage applied	- [5)]	- [6)]
Mains input voltage not applied	Max. 2.8 A + current for the motor holding brake + current on the 24 VDC output	
DC bus power supply		
Switch-on voltage	455 VDC	
24 VDC output		
Output voltage		
Mains input voltage applied	22 to 24 VDC	
Mains input voltage not applied	16.7 to 30 VDC [7)]	16.7 to 30 VDC [8)]
Output current	Max. 0.5 A	
Motor connection		
Quantity	1	
Continuous current [9)]	19 A_{eff}	19 A_{eff}
Reduction of continuous current depending on the ambient temperature		
Mains input voltage: 400 VAC		
Switching frequency 5 kHz	No reduction	
Switching frequency 10 kHz	No reduction [10)]	
Switching frequency 20 kHz	No reduction	
Mains input voltage: 480 VAC		
Switching frequency 5 kHz	No reduction	
Switching frequency 10 kHz	No reduction [10)]	
Switching frequency 20 kHz	No reduction	
Reduction of continuous current depending on the installation elevation		
Starting at 500 m above sea level	1.9 A_{eff} per 1000 m	
Peak current	50 A_{eff}	50 A_{eff}
Nominal switching frequency	10 kHz	
Possible switching frequencies	5 / 10 / 20 kHz	
Electrical stress of the connected motor in accordance with IEC TS 60034-25 [11)]	Limit value curve A	
Max. motor line length	25 m	
Protective measures		
Overload protection	Yes	
Short circuit and ground fault protection	Yes	
Max. output frequency	600 Hz [12)]	600 Hz [13)]
Motor holding brake connection		
Response threshold for open line monitoring	Approx. 250 mA	
Max. output current	1.5 A	
Max. number of switching cycles	Unlimited since done electronically	Unlimited since handled electronically
Braking resistors		
Peak power int. / ext.	14 / 40 kW	
Continuous power int. / ext.	0.4 / 8 kW [14)]	0.4 / 8 kW [15)]
Minimum braking resistance (ext.)	15 Ω	
Rated current of the built-in fuse	12 A (fast-acting)	
Limit switch and reference inputs		
Quantity	3	

Table 42: 8V1180.00-2, 8V1180.001-2 - Technical data

Product ID	8V1180.00-2	8V1180.001-2
Wiring	Sink	
Electrical isolation Input - ACOPOS Input - Input	 Yes No	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Switching threshold Low High	 <5 V >15 V	
Input current at nominal voltage	Approx. 4 mA	
Switching delay	Max. 2.0 ms	
Modulation compared to ground potential	Max. ±38 V	
Enable inputs		
Quantity	1	
Wiring	Sink	
Electrical isolation Input - ACOPOS	 Yes	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Input current at nominal voltage	Approx. 30 mA	
Switching threshold Low High	 <5 V >15 V	
Switching delay Enable 0 -> 1, ready for PWM Enable 1 -> 0, PWM off	 Max. 100 μs Max. 2.0 ms	
Modulation compared to ground potential	Max. ±38 V	
OSSD signal connections [16]	Not permitted	
Trigger inputs		
Quantity	2	
Wiring	Sink	
Electrical isolation Input - ACOPOS Input - Input	 Yes No	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Switching threshold Low High	 <5 V >15 V	
Input current at nominal voltage	Approx. 10 mA	
Switching delay Positive edge Negative edge	 52 μs ±0.5 μs (digitally filtered) 53 μs ±0.5 μs (digitally filtered)	
Modulation compared to ground potential	Max. ±38 V	
Electrical characteristics		
Discharge capacitance	3.1 μF	
Operating conditions		
Permitted mounting orientations Hanging vertically Lying horizontally Standing horizontally	 Yes Yes No	
Installation at elevations above sea level Nominal Maximum [17]	 0 to 500 m 2000 m	
Degree of pollution in accordance with EN 60664-1	2 (non-conductive pollution)	
Overvoltage category in accordance with IEC 60364-4-443:1999	II	
EN 60529 protection	IP20	
Environmental conditions		
Temperature Operation Nominal Maximum [18] Storage Transport	 5 to 40°C 55°C -25 to 55°C -25 to 70°C	
Relative humidity Operation Storage Transport	 5 to 85% 5 to 95% Max. 95% at 40°C	

Table 42: 8V1180.00-2, 8V1180.001-2 - Technical data

Product ID	8V1180.00-2	8V1180.001-2
Mechanical characteristics		
Dimensions		
Width	200 mm	
Height	375 mm	
Depth	234 mm	
Weight	10.1 kg	

Table 42: 8V1180.00-2, 8V1180.001-2 - Technical data

1) In the USA, the terms "Delta / Wye with Grounded Wye neutral" are common for TT and TN power mains.
2) In the USA, TT and TN power mains are commonly referred to as "Delta/Wye with grounded Wye neutral".
3) Limit values from EN 61800-3 C3 (second environment).
4) The current requirements depend on the configuration of the ACOPOS servo drive.
5) If the mains input voltage (3x 400 VAC to 480 VAC ±10%) is applied, the 24 VDC supply voltage for the ACOPOS servo drive is created by the internal DC bus power supply, which reduces the 24 VDC current requirements (I_{24VDC}) to 0.
6) If the mains input voltage (3x 400 VAC to 480 VAC ±10%) is applied, then the 24 VDC supply voltage for the ACOPOS servo drive is generated by the internal DC bus power supply, reducing the 24 VDC current consumption ($I_{24\ VDC}$) to 0.
7) If the mains input voltage (3x 400 VAC to 480 VAC ±10%) is not applied, the voltage is created at the 24 VDC output from the ACOPOS servo drive's 24 VDC supply voltage; in this case it is between the maximum allowable and the minimum allowable (reduced by max. 2.5 V) 24 VDC supply voltage of the ACOPOS servo drive.
8) If the mains input voltage (3x 400 VAC to 480 VAC ±10%) is not applied, the voltage is generated at the 24 VDC output from the ACOPOS servo drive's 24 VDC supply voltage; in this case, it is between the maximum permissible and minimum permissible (reduced by max. 2.5 V) 24 VDC supply voltage of the ACOPOS servo drive.
9) Valid in the following conditions: Mains input voltage 400 VAC, nominal switching frequency, 40 °C ambient temperature, installation altitudes <500 m above sea level.
10) Value for the nominal switching frequency.
11) If necessary, the stress of the motor isolation system be reduced by an additional externally-wired dU/dt choke. For example, the RWK 305 three-phase dU/dt choke from Schaffner (www.schaffner.com) can be used. IMPORTANT: Even when using a dU/dt choke, it is necessary to ensure that an EMC-compatible, low inductance shield connection is used!
12) The module's electrical output frequency (SCTRL_SPEED_ACT * MOTOR_POLEPAIRS) is monitored to protect against dual-use in accordance with EC 428/2009 | 3A225. If the electrical output frequency of the module exceeds the limit value of 600 Hz uninterrupted for more than 0.5 s, then the current motion is aborted and error 6060 is output (Power element: Limit speed exceeded).
13) The module's electrical output frequency (SCTRL_SPEED_ACT * MOTOR_POLEPAIRS) is monitored to protect against dual use in accordance with EC 428/2009 | 3A225. If the electrical output frequency of the module exceeds the limit value of 600 Hz uninterrupted for more than 0.5 s, then the current movement is aborted and error 6060 is output (power unit: limit speed exceeded).
14) Continuous power refers to the maximum braking power the ACOPOS servo driver can yield continuously. Depending on the application, the actual continuous power provided by the external braking resistor is limited by the rated current of fuse I_B (integrated in the ACOPOS servo drive), and the value of the external braking resistance R_{BR}.
15) Continuous power refers to the maximum braking power the ACOPOS servo drive can exchange continuously. Depending on the application, the actual continuous power provided by the external braking resistor is limited by the rated current of fuse I_B (integrated in the ACOPOS servo drive), and the value of the external braking resistance R_{BR}.
16) OSSD (Open Signal Switching Device) signals are used to monitor signal lines for short circuits and cross faults.
17) Continuous operation of ACOPOS servo drives at altitudes ranging from 500 m to 2000 m above sea level is possible (taking the continuous current reductions listed into consideration). Requirements that go above and beyond this need to be arranged with B&R.
18) Continuous operation of ACOPOS servo drives at ambient temperatures ranging from 40 °C to max. 55 °C is possible (taking the continuous current reductions listed into consideration), but results in a shorter lifespan.

2.5.2 ACOPOS 1320

2.5.2.1 Order data

Model number	Short description	Figure
	Servo drives	
8V1320.00-2	ACOPOS servo drive, 3x 400-480 V, 34 A, 16 kW, line filter, braking resistor, DC bus power supply and electronic secure restart inhibit integrated	
8V1320.001-2	ACOPOS servo drive, 3x 400-480 V, 34 A, 16 kW, coated, line filter, integrated braking resistor, DC bus power supply and electronic secure restart inhibit	
	Optional accessories	
	Braking resistors	
8B0W0045H000.000-1	ACOPOSmulti braking resistor, 450 W, 50 R, IP20, terminals	
8B0W0045H000.001-1	ACOPOSmulti braking resistor, 450 W, 50 R, IP65, terminals	
8B0W0079H000.000-1	ACOPOSmulti braking resistor, 790 W, 33 R, IP20, terminals	
8B0W0079H000.001-1	ACOPOSmulti braking resistor, 790 W, 33 R, IP65, terminals	
	Plug-in modules	
8AC110.60-2	ACOPOS plug-in module, CAN interface	
8AC110.60-3	ACOPOS plug-in module, CAN interface	
8AC114.60-2	ACOPOS plug-in module, POWERLINK V2 interface	
8AC120.60-1	ACOPOS plug-in module, EnDat encoder and sine incremental encoder interface	
8AC121.60-1	ACOPOS plug-in module, HIPERFACE interface	
8AC122.60-3	ACOPOS plug-in module, resolver interface 10 kHz	
8AC122.60-4	ACOPOS resolver interface 10 kHz, no open line detection	
8AC123.60-1	ACOPOS plug-in module, incremental encoder and SSI absolute encoder interface	
8AC125.60-1	ACOPOS plug-in module, BiSS encoder interface 5 V	
8AC125.60-2	ACOPOS plug-in module, BiSS encoder interface 5V, baud rate 6.25 Mbit/s	
8AC125.61-2	ACOPOS plug-in module, BiSS encoder interface 12V, baud rate 6.25 Mbit/s	
8AC126.60-1	ACOPOS plug-in module, EnDat 2.2 encoder interface	
8AC130.60-1	ACOPOS plug-in module, 8 digital I/O configurable in pairs as 24 V input or as output 400/100 mA, 2 digital outputs 2 A, order TB712 terminal block separately.	
8AC131.60-1	ACOPOS plug-in module, 2 analog inputs ±10 V, 2 digital I/O points which can be configured as a 24 V input or 45 mA output, order TB712 terminal block separately.	
8AC132.60-1	ACOPOS plug-in module, 2 analog inputs ±10 V	
8AC140.60-3	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 1 CAN interface, 1 Ethernet interface 100 Base-T, 1 PROFIBUS DP slave interface, 1 RS232 interface, 3 digital I/O can be configured as 24 VDC input or 500 mA output, 1 analog input ±10 V, order program memory and 0TB708 terminal block separately.	
8AC140.61-3	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 1 CAN interface, 1 Ethernet interface 100 Base-T, 1 PROFIBUS DP slave interface, 1 RS232 interface, 3 digital I/O can be configured as 24 VDC input or 500 mA output, 1 analog input ±10 V, order program memory and 0TB708 terminal block separately.	
8AC141.60-2	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 16 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 2 CAN interfaces, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 1 X2X Link Master interface, 3 digital I/O can be configured as 24 VDC input or output 500 mA, 1 analog input ±10 V, order program memory and 0TB704 and 0TB708 terminal blocks separately	
8AC141.61-3	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 2 CAN interfaces, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 1 X2X Link Master interface, 3 digital I/O can be configured as 24 VDC input or output 500 mA, 1 analog input ±10 V, order program memory and 0TB704 and 0TB708 terminal blocks separately	
	Shielding component sets	
8X0020.00-1	ACOPOS shielding components set for 8V1180.xxx-x and 8V1320.xxx-x	
	Terminal sets	
8X0002.00-1	ACOPOS accessories, plug set for 8V1180.00 and 8V1320.00 (3 phase)	

Table 43: 8V1320.00-2, 8V1320.001-2 - Order data

2.5.2.2 Technical data

Product ID	8V1320.00-2	8V1320.001-2
General information		
Note	-	Variant with partially coated circuit boards
B&R ID code	0x1283	0xA001
Slots for plug-in modules	4	
Certification		
CE	Yes	
cULus	Yes	
KC	Yes	
FSC	Yes	
Power mains connection		
Permissible power mains forms	TT, TN [1]	TT, TN [2]
Mains input voltage	3x 400 VAC to 480 VAC ±10%	
Frequency	50 / 60 Hz ±4%	
Installed load	Max. 30 kVA	
Starting current at 400 VAC	13 A	
Switch-on interval	>10 s	
Integrated line filter in accordance with EN 61800-3, Category C3 [3]	Yes	
Power loss at max. device power without braking resistor	Approx. 800 W	
DC bus connection		
DC bus capacitance	1645 µF	
24 VDC supply		
Input voltage	24 VDC +25% / -20%	
Input capacitance	40,000 µF	
Current requirements at 24 VDC [4]		
Mains input voltage applied	- [5]	- [6]
Mains input voltage not applied	Max. 2.8 A + current for the motor holding brake + current on the 24 VDC output	
DC bus power supply		
Switch-on voltage	455 VDC	
24 VDC output		
Output voltage		
Mains input voltage applied	22 to 24 VDC	
Mains input voltage not applied	16.7 to 30 VDC [7]	16.7 to 30 VDC [8]
Output current	Max. 0.5 A	
Motor connection		
Quantity	1	
Continuous current [9]	34 A_{eff}	
Reduction of continuous current depending on the ambient temperature		
Mains input voltage: 400 VAC		
Switching frequency 5 kHz	No reduction	
Switching frequency 10 kHz	No reduction [10]	
Switching frequency 20 kHz	0.61 A_{eff} per °C (starting at 40°C)	
Mains input voltage: 480 VAC		
Switching frequency 5 kHz	No reduction	
Switching frequency 10 kHz	No reduction [10]	
Switching frequency 20 kHz	0.61 A_{eff} per °C (starting at 25°C)	
Reduction of continuous current depending on the installation elevation		
Starting at 500 m above sea level	3.4 A_{eff} per 1000 m	
Peak current	80 A_{eff}	
Nominal switching frequency	10 kHz	
Possible switching frequencies	5 / 10 / 20 kHz	
Electrical stress of the connected motor in accordance with IEC TS 60034-25 [11]	Limit value curve A	
Max. motor line length	25 m	
Protective measures		
Overload protection	Yes	
Short circuit and ground fault protection	Yes	
Max. output frequency	600 Hz [12]	600 Hz [13]
Motor holding brake connection		
Response threshold for open line monitoring	Approx. 250 mA	
Max. output current	1.5 A	
Max. number of switching cycles	Unlimited since done electronically	Unlimited since handled electronically
Braking resistors		
Peak power int. / ext.	14 / 40 kW	
Continuous power int. / ext.	0.4 / 8 kW [14]	0.4 / 8 kW [15]
Minimum braking resistance (ext.)	15 Ω	
Rated current of the built-in fuse	12 A (fast-acting)	
Limit switch and reference inputs		
Quantity	3	

Table 44: 8V1320.00-2, 8V1320.001-2 - Technical data

Product ID	8V1320.00-2	8V1320.001-2
Wiring	Sink	
Electrical isolation Input - ACOPOS Input - Input	 Yes No	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Switching threshold Low High	 <5 V >15 V	
Input current at nominal voltage	Approx. 4 mA	
Switching delay	Max. 2.0 ms	
Modulation compared to ground potential	Max. ±38 V	
Enable inputs		
Quantity	1	
Wiring	Sink	
Electrical isolation Input - ACOPOS	 Yes	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Input current at nominal voltage	Approx. 30 mA	
Switching threshold Low High	 <5 V >15 V	
Switching delay Enable 0 -> 1, ready for PWM Enable 1 -> 0, PWM off	 Max. 100 µs Max. 2.0 ms	
Modulation compared to ground potential	Max. ±38 V	
OSSD signal connections [16]	Not permitted	
Trigger inputs		
Quantity	2	
Wiring	Sink	
Electrical isolation Input - ACOPOS Input - Input	 Yes No	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Switching threshold Low High	 <5 V >15 V	
Input current at nominal voltage	Approx. 10 mA	
Switching delay Positive edge Negative edge	 52 µs ±0.5 µs (digitally filtered) 53 µs ±0.5 µs (digitally filtered)	
Modulation compared to ground potential	Max. ±38 V	
Electrical characteristics		
Discharge capacitance	3.1 µF	
Operating conditions		
Permitted mounting orientations Hanging vertically Lying horizontally Standing horizontally	 Yes Yes No	
Installation at elevations above sea level Nominal Maximum [17]	 0 to 500 m 2000 m	
Degree of pollution in accordance with EN 60664-1	2 (non-conductive pollution)	
Overvoltage category in accordance with IEC 60364-4-443:1999	II	
EN 60529 protection	IP20	
Environmental conditions		
Temperature Operation Nominal Maximum [18] Storage Transport	 5 to 40°C 55°C -25 to 55°C -25 to 70°C	
Relative humidity Operation Storage Transport	 5 to 85% 5 to 95% Max. 95% at 40°C	

Table 44: 8V1320.00-2, 8V1320.001-2 - Technical data

Product ID	8V1320.00-2	8V1320.001-2
Mechanical characteristics		
Dimensions		
Width	200 mm	
Height	375 mm	
Depth	234 mm	
Weight	10.6 kg	

Table 44: 8V1320.00-2, 8V1320.001-2 - Technical data

1) In the USA, the terms "Delta / Wye with Grounded Wye neutral" are common for TT and TN power mains.
2) In the USA, TT and TN power mains are commonly referred to as "Delta/Wye with grounded Wye neutral".
3) Limit values from EN 61800-3 C3 (second environment).
4) The current requirements depend on the configuration of the ACOPOS servo drive.
5) If the mains input voltage (3x 400 VAC to 480 VAC ±10%) is applied, the 24 VDC supply voltage for the ACOPOS servo drive is created by the internal DC bus power supply, which reduces the 24 VDC current requirements (I_{24VDC}) to 0.
6) If the mains input voltage (3x 400 VAC to 480 VAC ±10%) is applied, then the 24 VDC supply voltage for the ACOPOS servo drive is generated by the internal DC bus power supply, reducing the 24 VDC current consumption ($I_{24\ VDC}$) to 0.
7) If the mains input voltage (3x 400 VAC to 480 VAC ±10%) is not applied, the voltage is created at the 24 VDC output from the ACOPOS servo drive's 24 VDC supply voltage; in this case it is between the maximum allowable and the minimum allowable (reduced by max. 2.5 V) 24 VDC supply voltage of the ACOPOS servo drive.
8) If the mains input voltage (3x 400 VAC to 480 VAC ±10%) is not applied, the voltage is generated at the 24 VDC output from the ACOPOS servo drive's 24 VDC supply voltage; in this case, it is between the maximum permissible and minimum permissible (reduced by max. 2.5 V) 24 VDC supply voltage of the ACOPOS servo drive.
9) Valid in the following conditions: Mains input voltage 400 VAC, nominal switching frequency, 40 °C ambient temperature, installation altitudes <500 m above sea level.
10) Value for the nominal switching frequency.
11) If necessary, the stress of the motor isolation system be reduced by an additional externally-wired dU/dt choke. For example, the RWK 305 three-phase dU/dt choke from Schaffner (www.schaffner.com) can be used. IMPORTANT: Even when using a dU/dt choke, it is necessary to ensure that an EMC-compatible, low inductance shield connection is used!
12) The module's electrical output frequency (SCTRL_SPEED_ACT * MOTOR_POLEPAIRS) is monitored to protect against dual-use in accordance with EC 428/2009 | 3A225. If the electrical output frequency of the module exceeds the limit value of 600 Hz uninterrupted for more than 0.5 s, then the current motion is aborted and error 6060 is output (Power element: Limit speed exceeded).
13) The module's electrical output frequency (SCTRL_SPEED_ACT * MOTOR_POLEPAIRS) is monitored to protect against dual use in accordance with EC 428/2009 | 3A225. If the electrical output frequency of the module exceeds the limit value of 600 Hz uninterrupted for more than 0.5 s, then the current movement is aborted and error 6060 is output (power unit: limit speed exceeded).
14) Continuous power refers to the maximum braking power the ACOPOS servo driver can yield continuously. Depending on the application, the actual continuous power provided by the external braking resistor is limited by the rated current of fuse I_B (integrated in the ACOPOS servo drive), and the value of the external braking resistance R_{BR}.
15) Continuous power refers to the maximum braking power the ACOPOS servo drive can exchange continuously. Depending on the application, the actual continuous power provided by the external braking resistor is limited by the rated current of fuse I_B (integrated in the ACOPOS servo drive), and the value of the external braking resistance R_{BR}.
16) OSSD (Open Signal Switching Device) signals are used to monitor signal lines for short circuits and cross faults.
17) Continuous operation of ACOPOS servo drives at altitudes ranging from 500 m to 2000 m above sea level is possible (taking the continuous current reductions listed into consideration). Requirements that go above and beyond this need to be arranged with B&R.
18) Continuous operation of ACOPOS servo drives at ambient temperatures ranging from 40 °C to max. 55 °C is possible (taking the continuous current reductions listed into consideration), but results in a shorter lifespan.

2.5.3 Wiring

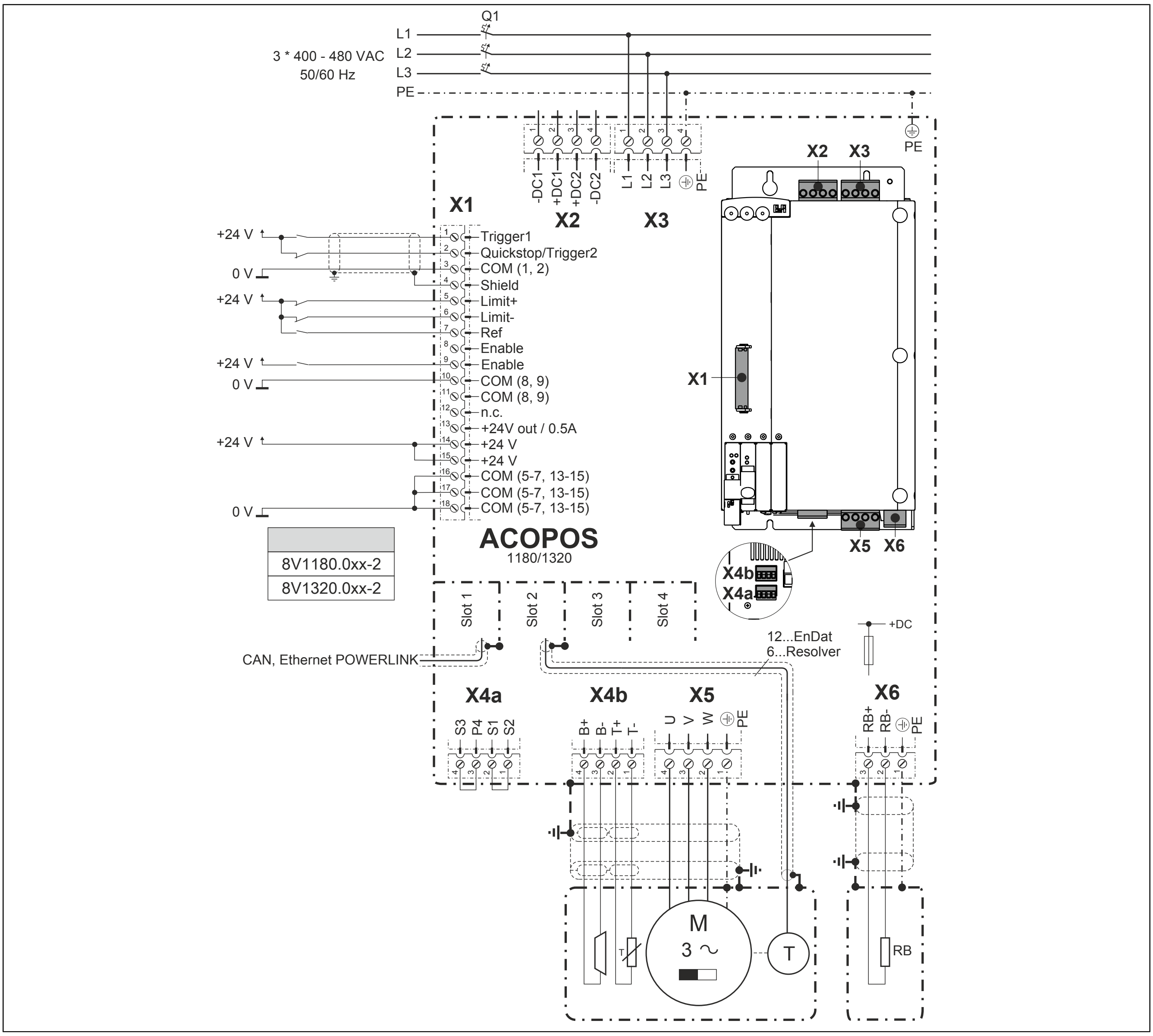


Figure 23: ACOPOS 1180, 1320 - Pinout overview

2.5.3.1 X1 - Pinout

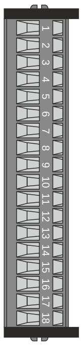
<table>
<tr><th>X1</th><th>Pin</th><th>Name</th><th>Function</th></tr>
<tr><td rowspan="19"></td><td>1</td><td>Trigger1</td><td>Trigger 1</td></tr>
<tr><td>2</td><td>Quickstop/Trigger2</td><td>Quickstop/Trigger2</td></tr>
<tr><td>3</td><td>COM (1, 2)</td><td>Trigger 1, Quickstop/Trigger 2 0 V</td></tr>
<tr><td>4</td><td>Shield</td><td>Shield</td></tr>
<tr><td>5</td><td>Limit+</td><td>Positive HW limit</td></tr>
<tr><td>6</td><td>Limit-</td><td>Negative HW limit</td></tr>
<tr><td>7</td><td>Ref</td><td>Reference switch</td></tr>
<tr><td>8</td><td>Enable [1)]</td><td>Enable</td></tr>
<tr><td>9</td><td>Enable [1)]</td><td>Enable</td></tr>
<tr><td>10</td><td>COM (8, 9)</td><td>Enable 0 V</td></tr>
<tr><td>11</td><td>COM (8, 9)</td><td>Enable 0 V</td></tr>
<tr><td>12</td><td>---</td><td>---</td></tr>
<tr><td>13</td><td>+24V out / 0.5A</td><td>+24 V output / 0.5 A</td></tr>
<tr><td>14</td><td>+24 V</td><td>+24 V supply</td></tr>
<tr><td>15</td><td>+24 V</td><td>+24 V supply</td></tr>
<tr><td>16</td><td>COM (5-7, 13-15)</td><td>0 V supply</td></tr>
<tr><td>17</td><td>COM (5-7, 13-15)</td><td>0 V supply</td></tr>
<tr><td>18</td><td>COM (5-7, 13-15)</td><td>0 V supply</td></tr>
<tr><td colspan="3">The following connections are linked with each other internally in the device:
• Pin 8 --> Pin 9 (Enable)
• Pin 10 --> Pin 11 (Enable 0 V)
• Pin 14 --> Pin 15 (Supply +24 V)
• Pin 16 --> Pin 17 --> Pin 18 (Supply 0 V)
Terminal cross sections see "Overview of clampable cross sections" on page 255</td></tr>
</table>

Table 45: X1 - Pinout

1) The wiring is not permitted to exceed a total length of 30 m.

2.5.3.2 X2 - Pinout

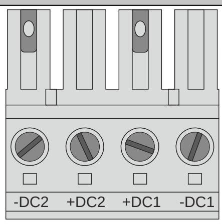
<table>
<tr><th>X2</th><th>Pin</th><th>Name</th><th>Function</th></tr>
<tr><td rowspan="5"></td><td>1</td><td>-DC1</td><td>U DC bus -</td></tr>
<tr><td>2</td><td>+DC1</td><td>U DC bus +</td></tr>
<tr><td>3</td><td>+DC2</td><td>U DC bus +</td></tr>
<tr><td>4</td><td>-DC2</td><td>U DC bus -</td></tr>
<tr><td colspan="3">Terminal cross sections see "Overview of clampable cross sections" on page 255</td></tr>
</table>

Table 46: X2 - Pinout

2.5.3.3 X3 - Pinout

Danger!

Servo drives are not permitted to be operated directly on IT and TN-S mains with a grounded phase conductor and protective ground conductor!

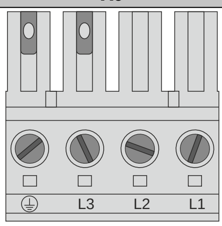
<table>
<tr><th>X3</th><th>Pin</th><th>Name</th><th>Function</th></tr>
<tr><td rowspan="5"></td><td>1</td><td>L1</td><td>Power mains connection L1</td></tr>
<tr><td>2</td><td>L2</td><td>Power mains connection L2</td></tr>
<tr><td>3</td><td>L3</td><td>Power mains connection L3</td></tr>
<tr><td>4</td><td>PE</td><td>Protective ground conductor</td></tr>
<tr><td colspan="3">Terminal cross sections see "Overview of clampable cross sections" on page 255</td></tr>
</table>

Table 47: X3 - Pinout

2.5.3.4 X4a, X4b - Pinout

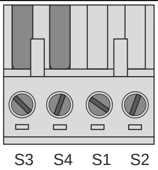
X4a	Pin	Name	Function
	1	S2 1)	Activation, supply for the external holding brake (+)
	2	S1 1)	Activation for the external holding brake (+)
	3	P4	Activation, supply for the external holding brake (-)
	4	S3	Activation for the external holding brake (-)
	Terminal cross sections see "Overview of clampable cross sections" on page 255		

Table 48: X4a - Pinout

1) If the holding brake is connected via an additional external relay contact (ground-in e.g. via the connections S1/S2) instead of via the internal transistor, then the internal quenching circuit has no effect! In this case, the customer must make sure that neither the relay contact nor the braking coil are damaged when switching off the brake. This can be done by interconnecting the coil or - better still - interconnecting the contact with a quenching circuit.

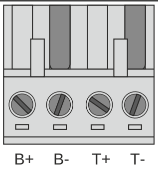
X4b	Pin	Name	Function
	1	T-	Temperature sensor -
	2	T+	Temperature sensor +
	3	B- 1)	Brake -
	4	B+ 1)	Brake +
	Terminal cross sections see "Overview of clampable cross sections" on page 255		

Table 49: X4b - Pinout

1) If the holding brake is connected via an additional external relay contact (ground-in e.g. via the connections S1/S2) instead of via the internal transistor, then the internal quenching circuit has no effect! In this case, the customer must make sure that neither the relay contact nor the braking coil are damaged when switching off the brake. This can be done by interconnecting the coil or - better still - interconnecting the contact with a quenching circuit.

Danger!

The connections for the motor temperature sensors and the motor holding brake are isolated circuits. Therefore, these connections are only allowed to be connected to devices or components with at least safe isolation in accordance with IEC 60364-4-41 or EN 61800-5-1.

Caution!

If B+ and B- are swapped when connecting the permanent magnet holding brakes, then the brakes cannot be opened! ACOPOS servo drives cannot determine if a holding brake is connected with reverse polarity!

2.5.3.4.1 Wiring the connections for the motor holding brake

The supply, activation and monitoring of the output for the motor holding brake can take place via the X4a connector in three different ways:

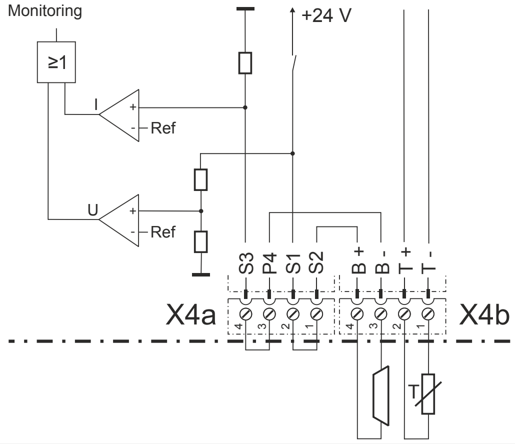
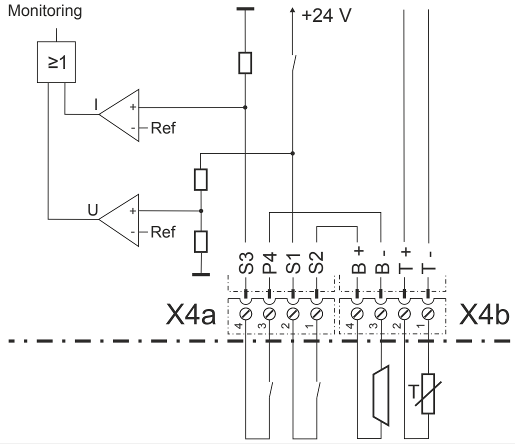
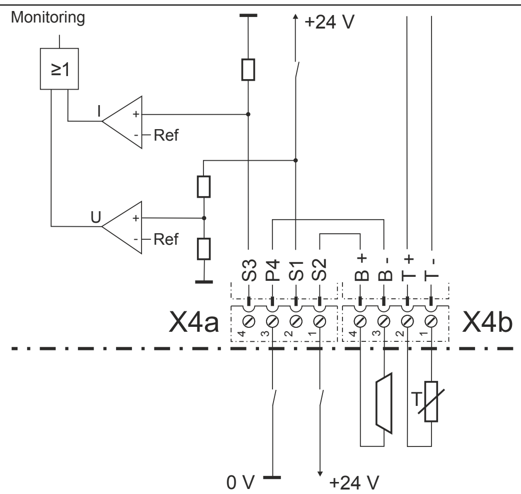
Figure		Description
1		• **Supply:** Internally by the ACOPOS servo drive • **Activation:** Internally by the ACOPOS servo drive • **Monitoring:** Internally by the ACOPOS servo drive A jumper must be placed between S1 and S2 as well as S3 and S4 on the X4a connector. [1]
2		• **Supply:** Internally by the ACOPOS servo drive • **Activation:** Internally by the ACOPOS servo drive and also possible externally using potential-free contacts [2] • **Monitoring:** Internally by the ACOPOS servo drive **Information:** **The parameters for internal monitoring via the ACOPOS must be set according to the requirements of the application.** [3]
3		• **Supply:** External • **Activation:** External • **Monitoring:** External **Information:** **ACOPOS internal monitoring cannot be used here; therefore, it must be disabled using software.** [4]

Table 50: Activation for the external holding brake

1) Both jumpers are already on the X4a connector delivered with the ACOPOS servo drives.
2) External potential-free contacts can be connected between S1 and S2 as well as between S3 and S4. This makes it possible to activate the holding brake using an external safety circuit independent of the control integrated in the ACOPOS servo drive.
3) The parameters are set using ParID 90 (1 ... internal monitoring active; 5 ... internal monitoring not active).
4) Deactivation takes place using ParID 90 (5 ... internal monitoring not active).

2.5.3.5 X5 - Pinout

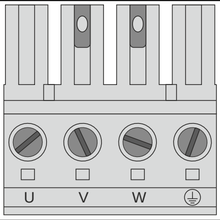
X5	Pin	Name	Function
	1	PE	Protective ground conductor
	2	W	Motor connection W
	3	V	Motor connection V
	4	U	Motor connection U
	Terminal cross sections see "Overview of clampable cross sections" on page 255		

Table 51: X5 - Pinout

2.5.3.6 X6 - Pinout

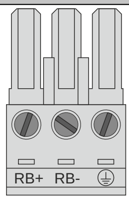
X6	Pin	Name	Function
	1	PE	Protective ground conductor
	2	RB-	Braking resistor -
	3	RB+	Braking resistor +
	Terminal cross sections see "Overview of clampable cross sections" on page 255		

Table 52: X6 - Pinout

2.5.3.7 Additional protective ground connection (PE)

The protective ground conductor is connected to the M5 threaded bolt provided using a cable lug.

For information concerning dimensioning, see "Protective ground connection (PE)" on page 216.

Figure	Pin	Name	Function
	---	PE	Protective ground conductor
Terminal cross sections	**[mm²]**		**AWG**
Cable lug for M5 threaded bolt	0.25 - 16		23 - 5

Table 53: Protective ground connection (PE) - ACOPOS

Danger!

Before turning on the servo drive, make sure that the housing is properly connected to ground (PE rail). The ground connection must be established even when testing the drive or operating it for a short time!

2.5.3.8 Input/output circuit diagram

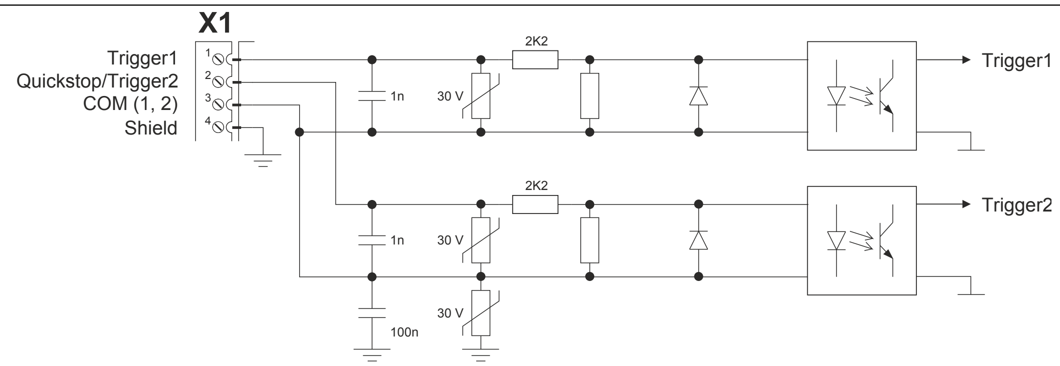


Figure 24: Trigger

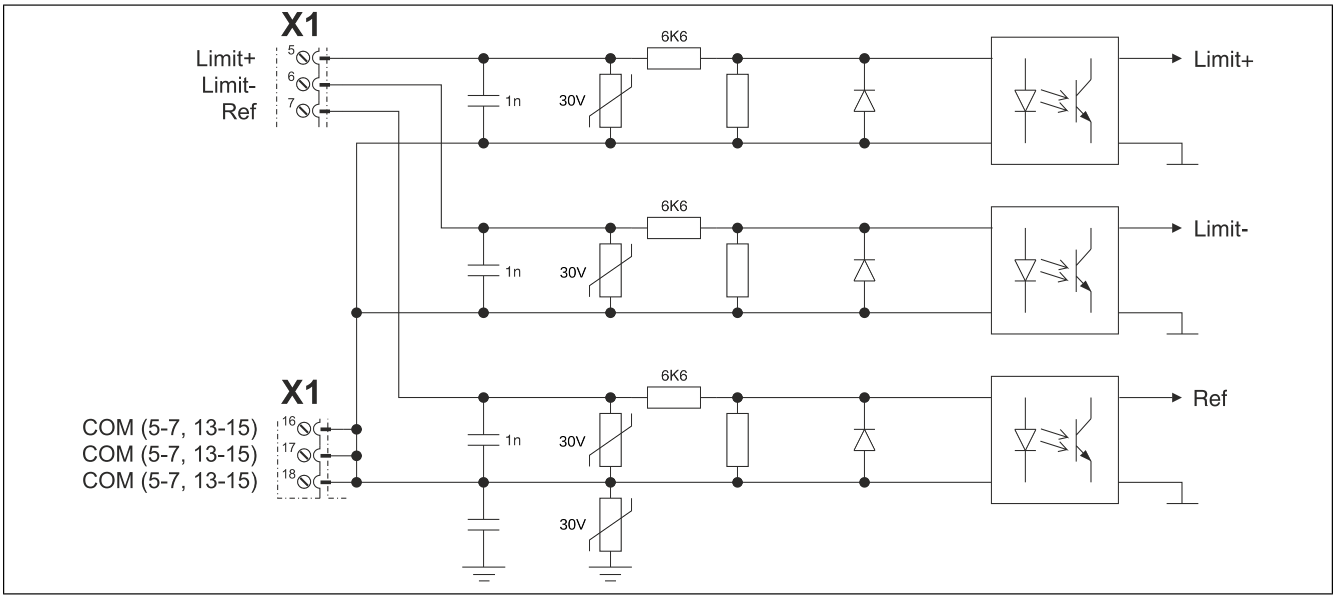


Figure 25: Limit

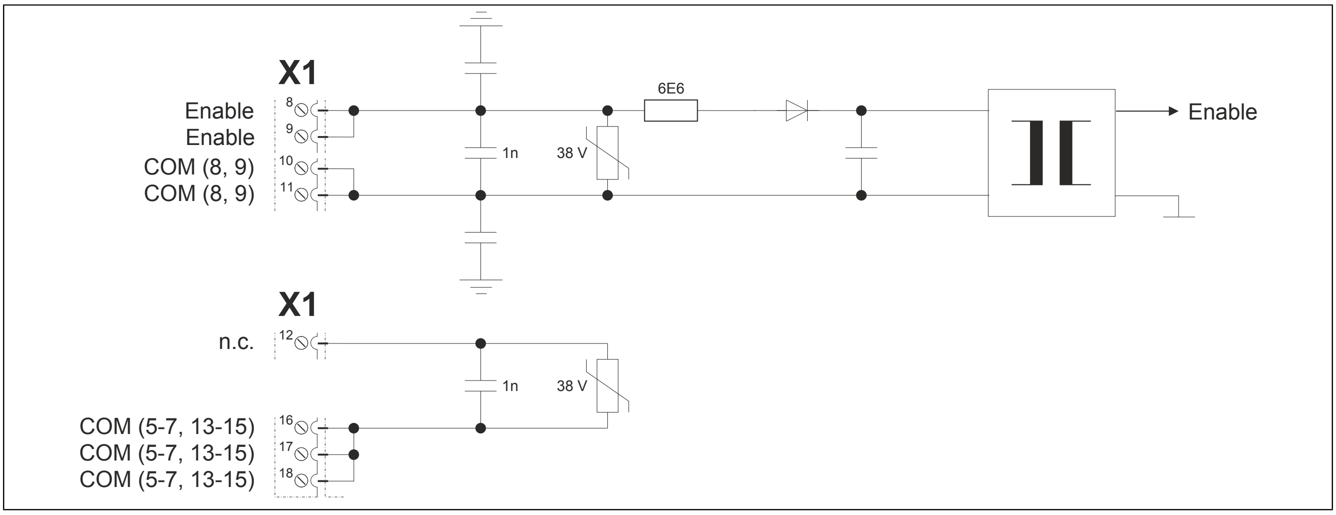


Figure 26: Enable

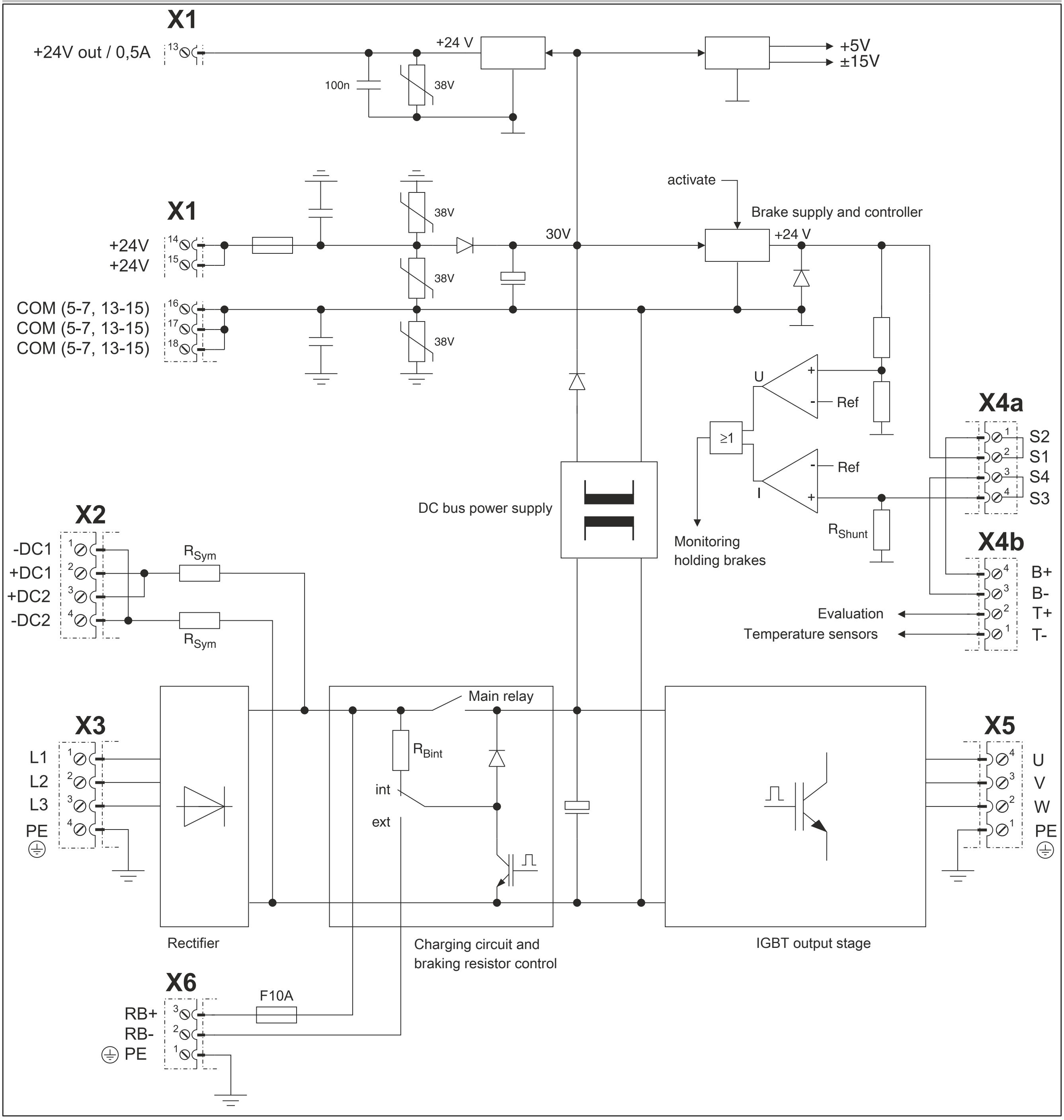


Figure 27: Input/output circuit diagram - ACOPOS 1180, 1320

2.6 ACOPOS 1640, 128M

2.6.1 ACOPOS 1640

2.6.1.1 Order data

Model number	Short description	Figure
	Servo drives	
8V1640.00-2	ACOPOS servo drive, 3x 400-480 V, 64 A, 32 kW, line filter, integrated braking resistor, DC bus power supply and electronic secure restart inhibit	
8V1640.001-2	ACOPOS servo drive, 3x 400-480 V, 64 A, 32 kW, coated, line filter, integrated braking resistor, DC bus power supply and electronic secure restart inhibit	
	Optional accessories	
	Braking resistors	
8B0W0045H000.000-1	ACOPOSmulti braking resistor, 450 W, 50 R, IP20, terminals	
8B0W0045H000.001-1	ACOPOSmulti braking resistor, 450 W, 50 R, IP65, terminals	
8B0W0079H000.000-1	ACOPOSmulti braking resistor, 790 W, 33 R, IP20, terminals	
8B0W0079H000.001-1	ACOPOSmulti braking resistor, 790 W, 33 R, IP65, terminals	
	Plug-in modules	
8AC110.60-2	ACOPOS plug-in module, CAN interface	
8AC110.60-3	ACOPOS plug-in module, CAN interface	
8AC114.60-2	ACOPOS plug-in module, POWERLINK V2 interface	
8AC120.60-1	ACOPOS plug-in module, EnDat encoder and sine incremental encoder interface	
8AC121.60-1	ACOPOS plug-in module, HIPERFACE interface	
8AC122.60-3	ACOPOS plug-in module, resolver interface 10 kHz	
8AC122.60-4	ACOPOS resolver interface 10 kHz, no open line detection	
8AC123.60-1	ACOPOS plug-in module, incremental encoder and SSI absolute encoder interface	
8AC125.60-1	ACOPOS plug-in module, BiSS encoder interface 5 V	
8AC125.60-2	ACOPOS plug-in module, BiSS encoder interface 5V, baud rate 6.25 Mbit/s	
8AC125.61-2	ACOPOS plug-in module, BiSS encoder interface 12V, baud rate 6.25 Mbit/s	
8AC126.60-1	ACOPOS plug-in module, EnDat 2.2 encoder interface	
8AC130.60-1	ACOPOS plug-in module, 8 digital I/O configurable in pairs as 24 V input or as output 400/100 mA, 2 digital outputs 2 A, order TB712 terminal block separately.	
8AC131.60-1	ACOPOS plug-in module, 2 analog inputs ±10 V, 2 digital I/O points which can be configured as a 24 V input or 45 mA output, order TB712 terminal block separately.	
8AC132.60-1	ACOPOS plug-in module, 2 analog inputs ±10 V	
8AC140.60-3	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 1 CAN interface, 1 Ethernet interface 100 Base-T, 1 PROFIBUS DP slave interface, 1 RS232 interface, 3 digital I/O can be configured as 24 VDC input or 500 mA output, 1 analog input ±10 V, order program memory and 0TB708 terminal block separately.	
8AC140.61-3	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 1 CAN interface, 1 Ethernet interface 100 Base-T, 1 PROFIBUS DP slave interface, 1 RS232 interface, 3 digital I/O can be configured as 24 VDC input or 500 mA output, 1 analog input ±10 V, order program memory and 0TB708 terminal block separately.	
8AC141.60-2	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 16 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 2 CAN interfaces, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 1 X2X Link Master interface, 3 digital I/O can be configured as 24 VDC input or output 500 mA, 1 analog input ±10 V, order program memory and 0TB704 and 0TB708 terminal blocks separately	
8AC141.61-3	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 2 CAN interfaces, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 1 X2X Link Master interface, 3 digital I/O can be configured as 24 VDC input or output 500 mA, 1 analog input ±10 V, order program memory and 0TB704 and 0TB708 terminal blocks separately	
	Shielding component sets	
8X0030.00-1	ACOPOS shielding components set for 8V1640.xxx-x and 8V128M.xxx-x	
	Terminal sets	
8X0005.00-1	ACOPOS accessories, plug set for 8V1640.00 and 8V128M.00 (3 phase)	

Table 54: 8V1640.00-2, 8V1640.001-2 - Order data

2.6.1.2 Technical data

Product ID	8V1640.00-2	8V1640.001-2
General information		
Note	-	Variant with partially coated circuit boards
B&R ID code	0x12C9	0xA09C
Slots for plug-in modules	4	
Certification CE cULus KC FSC	 Yes Yes Yes Yes	
Power mains connection		
Permissible power mains forms	TT, TN [1]	
Mains input voltage	3x 400 VAC to 480 VAC ±10%	
Frequency	50 / 60 Hz ±4%	
Installed load	Max. 54 kVA	
Starting current at 400 VAC	26 A	
Switch-on interval	>10 s	
Integrated line filter in accordance with EN 61800-3, Category C3 [2]	Yes	
Power loss at max. device power without braking resistor	Approx. 1600 W	
DC bus connection		
DC bus capacitance	3300 µF	
24 VDC supply		
Input voltage	24 VDC +25% / -20%	
Input capacitance	32,800 µF	
Current requirements at 24 VDC [3] Mains input voltage applied Mains input voltage not applied	 - [4] Max. 4.6 A + 1.4 * (current for the motor holding brake + current on the 24 VDC output)	
DC bus power supply Switch-on voltage	 455 VDC	
24 VDC output		
Output voltage Mains input voltage applied Mains input voltage not applied	 22 to 24 VDC 16.7 to 30 VDC [5]	
Output current	Max. 0.5 A	
Motor connection		
Quantity	1	
Continuous current [6]	64 A_{eff}	
Reduction of continuous current depending on the ambient temperature Mains input voltage: 400 VAC Switching frequency 5 kHz Switching frequency 10 kHz Switching frequency 20 kHz Mains input voltage: 480 VAC Switching frequency 5 kHz Switching frequency 10 kHz Switching frequency 20 kHz	 No reduction No reduction [7] 0.96 A_{eff} per °C (starting at 25°C) No reduction 0.96 A_{eff} per °C (starting at 50°C) [7] 0.96 A_{eff} per °C (starting at 10°C)	
Reduction of continuous current depending on the installation elevation Starting at 500 m above sea level	 6.4 A_{eff} per 1000 m	
Peak current	200 A_{eff}	
Nominal switching frequency	10 kHz	
Possible switching frequencies	5 / 10 / 20 kHz	
Electrical stress of the connected motor in accordance with IEC TS 60034-25 [8]	Limit value curve A	
Max. motor line length	25 m	
Protective measures Overload protection Short circuit and ground fault protection	 Yes Yes	
Max. output frequency	600 Hz [9]	
Motor holding brake connection		
Response threshold for open line monitoring	Approx. 210 mA	
Max. output current	3 A	
Max. number of switching cycles	Approx. 80,000	
Braking resistors		
Peak power int. / ext.	7 / 250 kW	
Continuous power int. / ext.	0.2 / 24 kW [10]	
Minimum braking resistance (ext.)	2.5 Ω	
Rated current of the built-in fuse	30 A (fast-acting)	
Limit switch and reference inputs		
Quantity	3	

Table 55: 8V1640.00-2, 8V1640.001-2 - Technical data

Product ID	8V1640.00-2	8V1640.001-2
Wiring	Sink	
Electrical isolation Input - ACOPOS Input - Input	 Yes No	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Switching threshold Low High	 <5 V >15 V	
Input current at nominal voltage	Approx. 4 mA	
Switching delay	Max. 2.0 ms	
Modulation compared to ground potential	Max. ±38 V	
Enable inputs		
Quantity	1	
Wiring	Sink	
Electrical isolation Input - ACOPOS	 Yes	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Input current at nominal voltage	Approx. 30 mA	
Switching threshold Low High	 <5 V >15 V	
Switching delay Enable 0 -> 1, ready for PWM Enable 1 -> 0, PWM off	 Max. 100 µs Max. 2.0 ms	
Modulation compared to ground potential	Max. ±38 V	
OSSD signal connections [11)]	Not permitted	
Trigger inputs		
Quantity	2	
Wiring	Sink	
Electrical isolation Input - ACOPOS Input - Input	 Yes No	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Switching threshold Low High	 <5 V >15 V	
Input current at nominal voltage	Approx. 10 mA	
Switching delay Positive edge Negative edge	 52 µs ±0.5 µs (digitally filtered) 53 µs ±0.5 µs (digitally filtered)	
Modulation compared to ground potential	Max. ±38 V	
Electrical characteristics		
Discharge capacitance	5.4 µF	
Operating conditions		
Permitted mounting orientations Hanging vertically Lying horizontally Standing horizontally	 Yes Yes No	
Installation at elevations above sea level Nominal Maximum [12)]	 0 to 500 m 2000 m	
Degree of pollution in accordance with EN 60664-1	2 (non-conductive pollution)	
Overvoltage category in accordance with IEC 60364-4-443:1999	II	
EN 60529 protection	IP20	
Environmental conditions		
Temperature Operation Nominal Maximum [13)] Storage Transport	 5 to 40°C 55°C -25 to 55°C -25 to 70°C	
Relative humidity Operation Storage Transport	 5 to 85% 5 to 95% Max. 95% at 40°C	

Table 55: 8V1640.00-2, 8V1640.001-2 - Technical data

Product ID	8V1640.00-2	8V1640.001-2
Mechanical characteristics		
Dimensions		
Width	276 mm	
Height	460 mm	
Depth	295 mm	
Weight	24.1 kg	

Table 55: 8V1640.00-2, 8V1640.001-2 - Technical data

1) In the USA, TT and TN power mains are commonly referred to as "Delta/Wye with grounded Wye neutral".
2) Limit values from EN 61800-3 C3 (second environment).
3) The current requirements depend on the configuration of the ACOPOS servo drive.
4) If the mains input voltage (3x 400 VAC to 480 VAC ±10%) is applied, then the 24 VDC supply voltage for the ACOPOS servo drive is generated by the internal DC bus power supply, reducing the 24 VDC current consumption ($I_{24\ VDC}$) to 0.
5) If the mains input voltage (3x 400 VAC to 480 VAC ±10%) is not applied, the voltage is generated at the 24 VDC output from the ACOPOS servo drive's 24 VDC supply voltage; in this case, it is between the maximum permissible and minimum permissible (reduced by max. 2.5 V) 24 VDC supply voltage of the ACOPOS servo drive.
6) Valid in the following conditions: 400 VAC mains input voltage, nominal switching frequency, 40°C ambient temperature, installation altitude <500 m above sea level.
7) Value for the nominal switching frequency.
8) If necessary, the stress of the motor isolation system be reduced by an additional externally-wired dU/dt choke. For example, the RWK 305 three-phase dU/dt choke from Schaffner (www.schaffner.com) can be used. IMPORTANT: Even when using a dU/dt choke, it is necessary to ensure that an EMC-compatible, low inductance shield connection is used!
9) The module's electrical output frequency (SCTRL_SPEED_ACT * MOTOR_POLEPAIRS) is monitored to protect against dual use in accordance with EC 428/2009 | 3A225. If the electrical output frequency of the module exceeds the limit value of 600 Hz uninterrupted for more than 0.5 s, then the current movement is aborted and error 6060 is output (power unit: limit speed exceeded).
10) Continuous power refers to the maximum braking power the ACOPOS servo drive can exchange continuously. Depending on the application, the actual continuous power provided by the external braking resistor is limited by the rated current of fuse I_B (integrated in the ACOPOS servo drive), and the value of the external braking resistance R_{BR}.
11) OSSD (open signal switching device) signals are used to monitor signal lines for short circuits and cross faults.
12) Continuous operation of ACOPOS servo drives at altitudes ranging from 500 m to 2000 m above sea level is possible (taking the specified continuous current reductions into consideration). Requirements that go above and beyond this need to be arranged with B&R.
13) Continuous operation of ACOPOS servo drives at ambient temperatures ranging from 40°C to max. 55°C is possible (taking the specified continuous current reductions into consideration), but this will result in a shorter service life.

2.6.2 ACOPOS 128M

2.6.2.1 Order data

Model number	Short description	Figure
	Servo drives	
8V128M.00-2	ACOPOS servo drive, 3x 400-480 V, 128 A, 64 kW, line filter, integrated braking resistor, DC bus power supply and electronic secure restart inhibit	
8V128M.001-2	ACOPOS servo drive, 3x 400-480 V, 128 A, 64 kW, coated, line filter, integrated braking resistor, DC bus power supply and electronic secure restart inhibit	
	Optional accessories	
	Braking resistors	
8B0W0045H000.000-1	ACOPOSmulti braking resistor, 450 W, 50 R, IP20, terminals	
8B0W0045H000.001-1	ACOPOSmulti braking resistor, 450 W, 50 R, IP65, terminals	
8B0W0079H000.000-1	ACOPOSmulti braking resistor, 790 W, 33 R, IP20, terminals	
8B0W0079H000.001-1	ACOPOSmulti braking resistor, 790 W, 33 R, IP65, terminals	
	Plug-in modules	
8AC110.60-2	ACOPOS plug-in module, CAN interface	
8AC110.60-3	ACOPOS plug-in module, CAN interface	
8AC114.60-2	ACOPOS plug-in module, POWERLINK V2 interface	
8AC120.60-1	ACOPOS plug-in module, EnDat encoder and sine incremental encoder interface	
8AC121.60-1	ACOPOS plug-in module, HIPERFACE interface	
8AC122.60-3	ACOPOS plug-in module, resolver interface 10 kHz	
8AC122.60-4	ACOPOS resolver interface 10 kHz, no open line detection	
8AC123.60-1	ACOPOS plug-in module, incremental encoder and SSI absolute encoder interface	
8AC125.60-1	ACOPOS plug-in module, BiSS encoder interface 5 V	
8AC125.60-2	ACOPOS plug-in module, BiSS encoder interface 5V, baud rate 6.25 Mbit/s	
8AC125.61-2	ACOPOS plug-in module, BiSS encoder interface 12V, baud rate 6.25 Mbit/s	
8AC126.60-1	ACOPOS plug-in module, EnDat 2.2 encoder interface	
8AC130.60-1	ACOPOS plug-in module, 8 digital I/O configurable in pairs as 24 V input or as output 400/100 mA, 2 digital outputs 2 A, order TB712 terminal block separately.	
8AC131.60-1	ACOPOS plug-in module, 2 analog inputs ±10 V, 2 digital I/O points which can be configured as a 24 V input or 45 mA output, order TB712 terminal block separately.	
8AC132.60-1	ACOPOS plug-in module, 2 analog inputs ±10 V	
8AC140.60-3	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 1 CAN interface, 1 Ethernet interface 100 Base-T, 1 PROFIBUS DP slave interface, 1 RS232 interface, 3 digital I/O can be configured as 24 VDC input or 500 mA output, 1 analog input ±10 V, order program memory and 0TB708 terminal block separately.	
8AC140.61-3	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 1 CAN interface, 1 Ethernet interface 100 Base-T, 1 PROFIBUS DP slave interface, 1 RS232 interface, 3 digital I/O can be configured as 24 VDC input or 500 mA output, 1 analog input ±10 V, order program memory and 0TB708 terminal block separately.	
8AC141.60-2	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 16 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 2 CAN interfaces, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 1 X2X Link Master interface, 3 digital I/O can be configured as 24 VDC input or output 500 mA, 1 analog input ±10 V, order program memory and 0TB704 and 0TB708 terminal blocks separately	
8AC141.61-3	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 2 CAN interfaces, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 1 X2X Link Master interface, 3 digital I/O can be configured as 24 VDC input or output 500 mA, 1 analog input ±10 V, order program memory and 0TB704 and 0TB708 terminal blocks separately	
	Shielding component sets	
8X0030.00-1	ACOPOS shielding components set for 8V1640.xxx-x and 8V128M.xxx-x	
	Terminal sets	
8X0005.00-1	ACOPOS accessories, plug set for 8V1640.00 and 8V128M.00 (3 phase)	

Table 56: 8V128M.00-2, 8V128M.001-2 - Order data

2.6.2.2 Technical data

Product ID	8V128M.00-2	8V128M.001-2
General information		
Note	-	Variant with partially coated circuit boards
B&R ID code	0x12F3	0xA09D
Slots for plug-in modules	4	
Certification		
CE	Yes	
cULus	Yes	
KC	Yes	
FSC	Yes	
Power mains connection		
Permissible power mains forms	TT, TN [1)]	
Mains input voltage	3x 400 VAC to 480 VAC ±10%	
Frequency	50 / 60 Hz ±4%	
Installed load	Max. 98 kVA	
Starting current at 400 VAC	26 A	
Switch-on interval	>10 s	
Integrated line filter in accordance with EN 61800-3, Category C3 [2)]	Yes	
Power loss at max. device power without braking resistor	Approx. 3200 W	
DC bus connection		
DC bus capacitance	6600 µF	
24 VDC supply		
Input voltage	24 VDC +25% / -20%	
Input capacitance	32,800 µF	
Current requirements at 24 VDC [3)]		
Mains input voltage applied	- [4)]	
Mains input voltage not applied	Max. 5.7 A + 1.4 * (current for the motor holding brake + current on the 24 VDC output)	
DC bus power supply		
Switch-on voltage	455 VDC	
24 VDC output		
Output voltage		
Mains input voltage applied	22 to 24 VDC	
Mains input voltage not applied	16.7 to 30 VDC [5)]	
Output current	Max. 0.5 A	
Motor connection		
Quantity	1	
Continuous current [6)]	128 A_{eff}	
Reduction of continuous current depending on the ambient temperature		
Mains input voltage: 400 VAC		
Switching frequency 5 kHz	No reduction [7)]	
Switching frequency 10 kHz	1.65 A_{eff} per °C (starting at 52°C)	
Switching frequency 20 kHz	1.65 A_{eff} per °C (starting at 12°C)	
Mains input voltage: 480 VAC		
Switching frequency 5 kHz	No reduction [7)]	
Switching frequency 10 kHz	1.65 A_{eff} per °C (starting at 36°C)	
Switching frequency 20 kHz	1.65 A_{eff} per °C (starting at 10°C) [8)]	
Reduction of continuous current depending on the installation elevation		
Starting at 500 m above sea level	12.8 A_{eff} per 1000 m	
Peak current	300 A_{eff}	
Nominal switching frequency	5 kHz	
Possible switching frequencies	5 / 10 / 20 kHz	
Electrical stress of the connected motor in accordance with IEC TS 60034-25 [9)]	Limit value curve A	
Max. motor line length	25 m	
Protective measures		
Overload protection	Yes	
Short circuit and ground fault protection	Yes	
Max. output frequency	600 Hz [10)]	
Motor holding brake connection		
Response threshold for open line monitoring	Approx. 210 mA	
Max. output current	3 A	
Max. number of switching cycles	Approx. 80,000	
Braking resistors		
Peak power int. / ext.	8.5 / 250 kW	
Continuous power int. / ext.	0.24 / 24 kW [11)]	
Minimum braking resistance (ext.)	2.5 Ω	
Rated current of the built-in fuse	30 A (fast-acting)	
Limit switch and reference inputs		
Quantity	3	

Table 57: 8V128M.00-2, 8V128M.001-2 - Technical data

Product ID	8V128M.00-2	8V128M.001-2
Wiring	Sink	
Electrical isolation Input - ACOPOS Input - Input	 Yes No	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Switching threshold Low High	 <5 V >15 V	
Input current at nominal voltage	Approx. 4 mA	
Switching delay	Max. 2.0 ms	
Modulation compared to ground potential	Max. ±38 V	
Enable inputs		
Quantity	1	
Wiring	Sink	
Electrical isolation Input - ACOPOS	 Yes	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Input current at nominal voltage	Approx. 30 mA	
Switching threshold Low High	 <5 V >15 V	
Switching delay Enable 0 -> 1, ready for PWM Enable 1 -> 0, PWM off	 Max. 100 µs Max. 2.0 ms	
Modulation compared to ground potential	Max. ±38 V	
OSSD signal connections [12)]	Not permitted	
Trigger inputs		
Quantity	2	
Wiring	Sink	
Electrical isolation Input - ACOPOS Input - Input	 Yes No	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Switching threshold Low High	 <5 V >15 V	
Input current at nominal voltage	Approx. 10 mA	
Switching delay Positive edge Negative edge	 52 µs ±0.5 µs (digitally filtered) 53 µs ±0.5 µs (digitally filtered)	
Modulation compared to ground potential	Max. ±38 V	
Electrical characteristics		
Discharge capacitance	5.4 µF	
Operating conditions		
Permitted mounting orientations Hanging vertically Lying horizontally Standing horizontally	 Yes Yes No	
Installation at elevations above sea level Nominal Maximum [13)]	 0 to 500 m 2000 m	
Degree of pollution in accordance with EN 60664-1	2 (non-conductive pollution)	
Overvoltage category in accordance with IEC 60364-4-443:1999	II	
EN 60529 protection	IP20	
Environmental conditions		
Temperature Operation Nominal Maximum [14)] Storage Transport	 5 to 40°C 55°C -25 to 55°C -25 to 70°C	
Relative humidity Operation Storage Transport	 5 to 85% 5 to 95% Max. 95% at 40°C	

Table 57: 8V128M.00-2, 8V128M.001-2 - Technical data

Product ID	8V128M.00-2	8V128M.001-2
Mechanical characteristics		
Dimensions		
Width	402 mm	
Height	460 mm	
Depth	295 mm	
Weight	33.8 kg	

Table 57: 8V128M.00-2, 8V128M.001-2 - Technical data

1) In the USA, TT and TN power mains are commonly referred to as "Delta/Wye with grounded Wye neutral".
2) Limit values from EN 61800-3 C3 (second environment).
3) The current requirements depend on the configuration of the ACOPOS servo drive.
4) If the mains input voltage (3x 400 VAC to 480 VAC ±10%) is applied, then the 24 VDC supply voltage for the ACOPOS servo drive is generated by the internal DC bus power supply, reducing the 24 VDC current consumption ($I_{24\ VDC}$) to 0.
5) If the mains input voltage (3x 400 VAC to 480 VAC ±10%) is not applied, the voltage is generated at the 24 VDC output from the ACOPOS servo drive's 24 VDC supply voltage; in this case, it is between the maximum permissible and minimum permissible (reduced by max. 2.5 V) 24 VDC supply voltage of the ACOPOS servo drive.
6) Valid in the following conditions: 400 VAC mains input voltage, nominal switching frequency, 40°C ambient temperature, installation altitude <500 m above sea level.
7) Value for the nominal switching frequency.
8) For a mains input voltage of 480 VAC and a switching frequency of 20 kHz, a maximum continuous current of 95 A_{eff} is permitted. At ambient temperatures >10°C, a reduction of the continuous current of 1.65 A_{eff} per °C must be taken into consideration.
9) If necessary, the stress of the motor isolation system be reduced by an additional externally-wired dU/dt choke. For example, the RWK 305 three-phase dU/dt choke from Schaffner (www.schaffner.com) can be used. IMPORTANT: Even when using a dU/dt choke, it is necessary to ensure that an EMC-compatible, low inductance shield connection is used!
10) The module's electrical output frequency (SCTRL_SPEED_ACT * MOTOR_POLEPAIRS) is monitored to protect against dual use in accordance with EC 428/2009 | 3A225. If the electrical output frequency of the module exceeds the limit value of 600 Hz uninterrupted for more than 0.5 s, then the current movement is aborted and error 6060 is output (power unit: limit speed exceeded).
11) Continuous power refers to the maximum braking power the ACOPOS servo drive can exchange continuously. Depending on the application, the actual continuous power provided by the external braking resistor is limited by the rated current of fuse I_B (integrated in the ACOPOS servo drive), and the value of the external braking resistance R_{BR}.
12) OSSD (open signal switching device) signals are used to monitor signal lines for short circuits and cross faults.
13) Continuous operation of ACOPOS servo drives at altitudes ranging from 500 m to 2000 m above sea level is possible (taking the specified continuous current reductions into consideration). Requirements that go above and beyond this need to be arranged with B&R.
14) Continuous operation of ACOPOS servo drives at ambient temperatures ranging from 40°C to max. 55°C is possible (taking the specified continuous current reductions into consideration), but this will result in a shorter service life.

2.6.3 Wiring

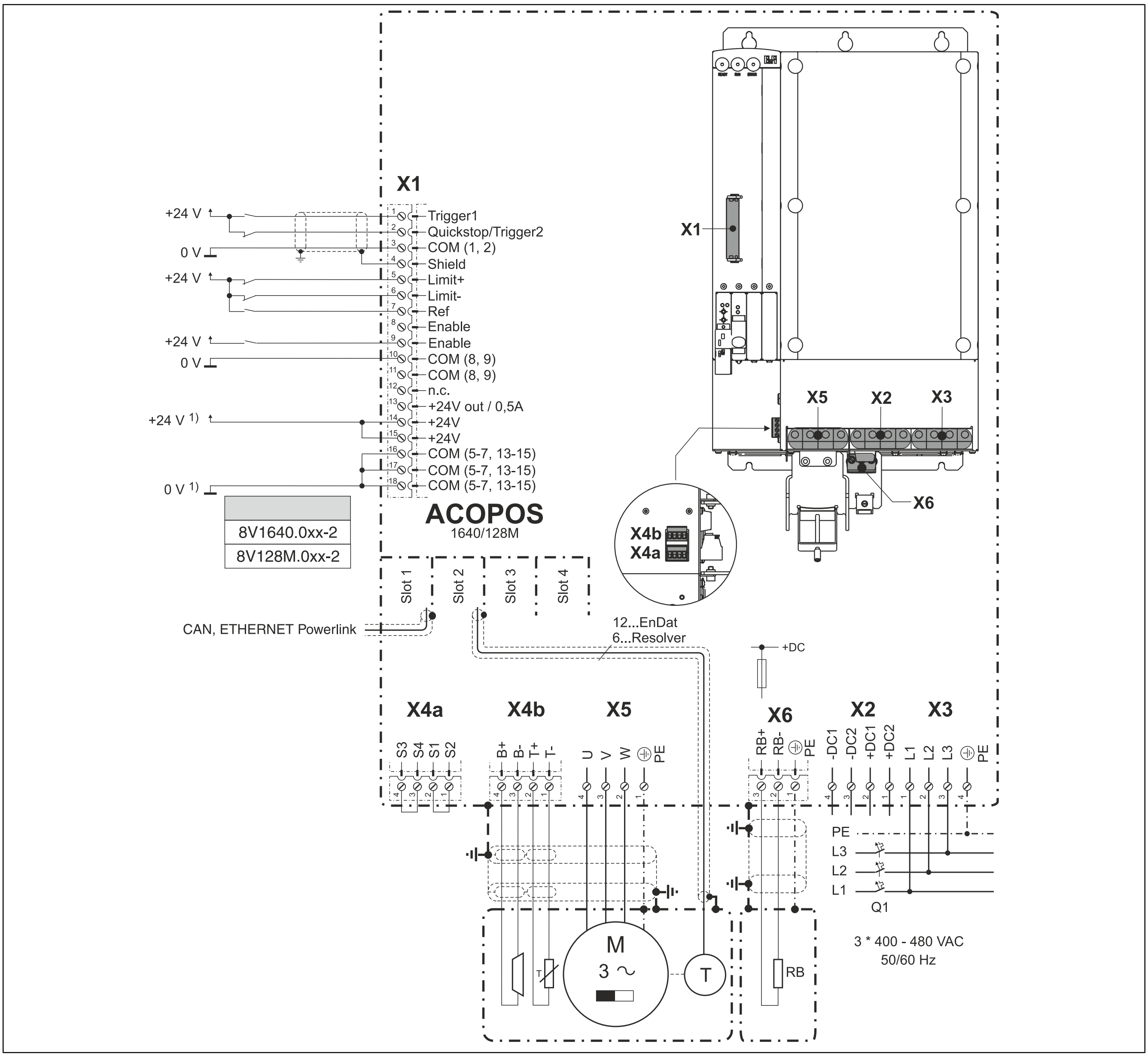


Figure 28: ACOPOS 1640, 128M - Pinout overview

1) When using an external 24 VDC supply for the ACOPOS 1640 and 128M servo drives, both +24 VDC connections (X1/14, X1/15) and at least two of the three COM connections (X1/16, X1/17, X1/18) always have to be wired so that the individual terminals are not overloaded.

2.6.3.1 X1 - Pinout

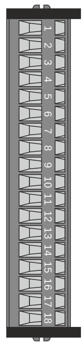
X1	Pin	Name	Function
	1	Trigger1	Trigger 1
	2	Quickstop/Trigger2	Quickstop/Trigger2
	3	COM (1, 2)	Trigger 1, Quickstop/Trigger 2 0 V
	4	Shield	Shield
	5	Limit+	Positive HW limit
	6	Limit-	Negative HW limit
	7	Ref	Reference switch
	8	Enable [1)]	Enable
	9	Enable [1)]	Enable
	10	COM (8, 9)	Enable 0 V
	11	COM (8, 9)	Enable 0 V
	12	---	---
	13	+24V out / 0.5A	+24 V output / 0.5 A
	14	+24 V	+24 V supply [2)]
	15	+24 V	+24 V supply [2)]
	16	COM (5-7, 13-15)	0 V supply [2)]
	17	COM (5-7, 13-15)	0 V supply [2)]
	18	COM (5-7, 13-15)	0 V supply [2)]
	The following connections are linked with each other internally in the device: • Pin 8 --> Pin 9 (Enable) • Pin 10 --> Pin 11 (Enable 0 V) • Pin 14 --> Pin 15 (Supply +24 V) • Pin 16 --> Pin 17 --> Pin 18 (Supply 0 V) Terminal cross sections see "Overview of clampable cross sections" on page 255		

Table 58: X1 - Pinout

1) The wiring is not permitted to exceed a total length of 30 m.
2) When using an external 24 VDC supply for the ACOPOS 1640 and 128M servo drives, both +24 VDC connections (X1/14, X1/15) and at least two of the three COM connections (X1/16, X1/17, X1/18) always have to be wired so that the individual terminals are not overloaded.

2.6.3.2 X2 connector - Pinout

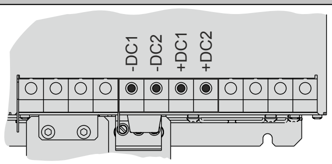
X2	Pin	Name	Function
	1	+DC2	U DC bus +
	2	+DC1	U DC bus +
	3	-DC2	U DC bus -
	4	-DC2	U DC bus -
	Terminal cross sections see "Overview of clampable cross sections" on page 255		

Table 59: X2 connector - Pinout

2.6.3.3 X3 connector - Pinout

Danger!

Servo drives are not permitted to be operated directly on IT and TN-S mains with a grounded phase conductor and protective ground conductor!

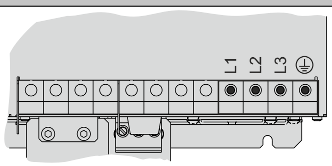
X3	Pin	Name	Function
	1	L1	Power mains connection L1
	2	L2	Power mains connection L2
	3	L3	Power mains connection L3
	4	⏚	Protective ground conductor
	Terminal cross sections see "Overview of clampable cross sections" on page 255		

Table 60: X3 connector - Pinout

2.6.3.4 X4a, X4b - Pinout

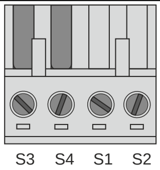
X4a	Pin	Name	Function
	1	S2 1)	Activation, supply for the external holding brake (+)
	2	S1 1)	Activation for the external holding brake (+)
	3	P4	Activation, supply for the external holding brake (-)
	4	S3	Activation for the external holding brake (-)
	Terminal cross sections see "Overview of clampable cross sections" on page 255		

Table 61: X4a - Pinout

1) If the holding brake is connected via an additional external relay contact (ground-in e.g. via the connections S1/S2) instead of via the internal transistor, then the internal quenching circuit has no effect! In this case, the customer must make sure that neither the relay contact nor the braking coil are damaged when switching off the brake. This can be done by interconnecting the coil or - better still - interconnecting the contact with a quenching circuit.

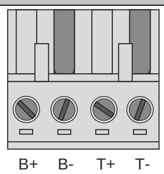
X4b	Pin	Name	Function
	1	T-	Temperature sensor -
	2	T+	Temperature sensor +
	3	B- 1)	Brake -
	4	B+ 1)	Brake +
	Terminal cross sections see "Overview of clampable cross sections" on page 255		

Table 62: X4b - Pinout

1) If the holding brake is connected via an additional external relay contact (ground-in e.g. via the connections S1/S2) instead of via the internal transistor, then the internal quenching circuit has no effect! In this case, the customer must make sure that neither the relay contact nor the braking coil are damaged when switching off the brake. This can be done by interconnecting the coil or - better still - interconnecting the contact with a quenching circuit.

Danger!

The connections for the motor temperature sensors and the motor holding brake are isolated circuits. Therefore, these connections are only allowed to be connected to devices or components with at least safe isolation in accordance with IEC 60364-4-41 or EN 61800-5-1.

Caution!

If B+ and B- are swapped when connecting the permanent magnet holding brakes, then the brakes cannot be opened! ACOPOS servo drives cannot determine if a holding brake is connected with reverse polarity!

2.6.3.4.1 Wiring the connections for the motor holding brake

The supply, activation and monitoring of the output for the motor holding brake can take place via the X4a connector in three different ways:

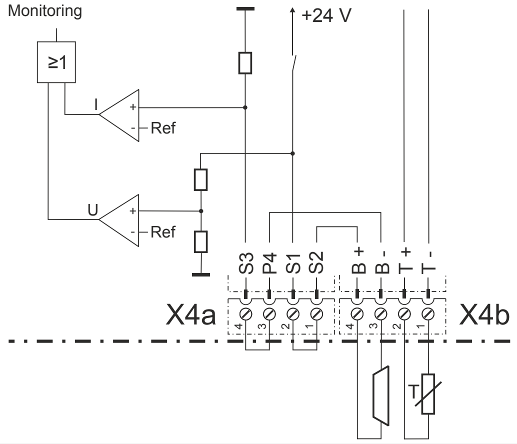
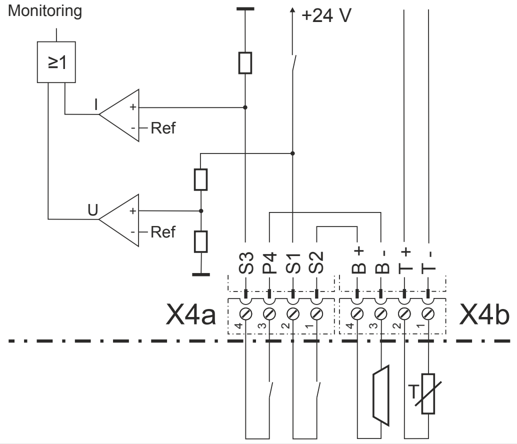
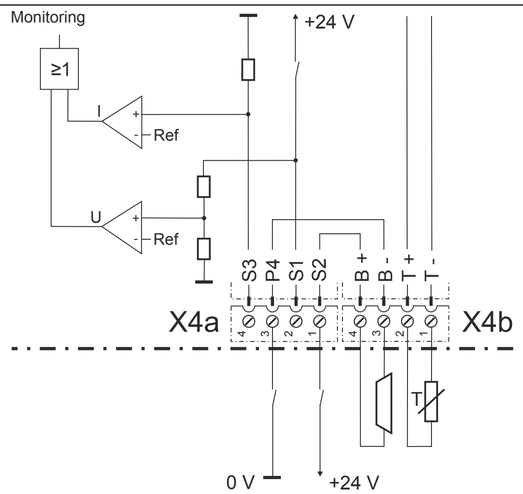
	Figure	Description
1		• **Supply:** Internally by the ACOPOS servo drive • **Activation:** Internally by the ACOPOS servo drive • **Monitoring:** Internally by the ACOPOS servo drive A jumper must be placed between S1 and S2 as well as S3 and S4 on the X4a connector. 1)
2		• **Supply:** Internally by the ACOPOS servo drive • **Activation:** Internally by the ACOPOS servo drive and also possible externally using potential-free contacts 2) • **Monitoring:** Internally by the ACOPOS servo drive **Information:** **The parameters for internal monitoring via the ACOPOS must be set according to the requirements of the application. 3)**
3		• **Supply:** External • **Activation:** External • **Monitoring:** External **Information:** **ACOPOS internal monitoring cannot be used here; therefore, it must be disabled using software. 4)**

Table 63: Activation for the external holding brake

1) Both jumpers are already on the X4a connector delivered with the ACOPOS servo drives.
2) External potential-free contacts can be connected between S1 and S2 as well as between S3 and S4. This makes it possible to activate the holding brake using an external safety circuit independent of the control integrated in the ACOPOS servo drive.
3) The parameters are set using ParID 90 (1 ... internal monitoring active; 5 ... internal monitoring not active).
4) Deactivation takes place using ParID 90 (5 ... internal monitoring not active).

2.6.3.5 X5 connector - Pinout

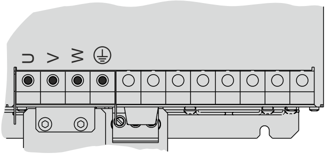
X5	Pin	Name	Function
	1	⏚	Protective ground conductor
	2	W	Motor connection W
	3	V	Motor connection V
	4	U	Motor connection U
	Terminal cross sections see "Overview of clampable cross sections" on page 255		

Table 64: X5 connector - Pinout

2.6.3.6 X6 connector - Pinout

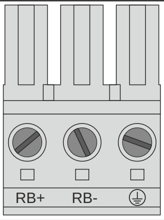
X6	Pin	Name	Function
	1	PE	Protective ground conductor
	2	RB-	Braking resistor -
	3	RB+	Braking resistor +
	Terminal cross sections see "Overview of clampable cross sections" on page 255		

Table 65: X6 connector - Pinout

2.6.3.7 Input/output circuit diagram

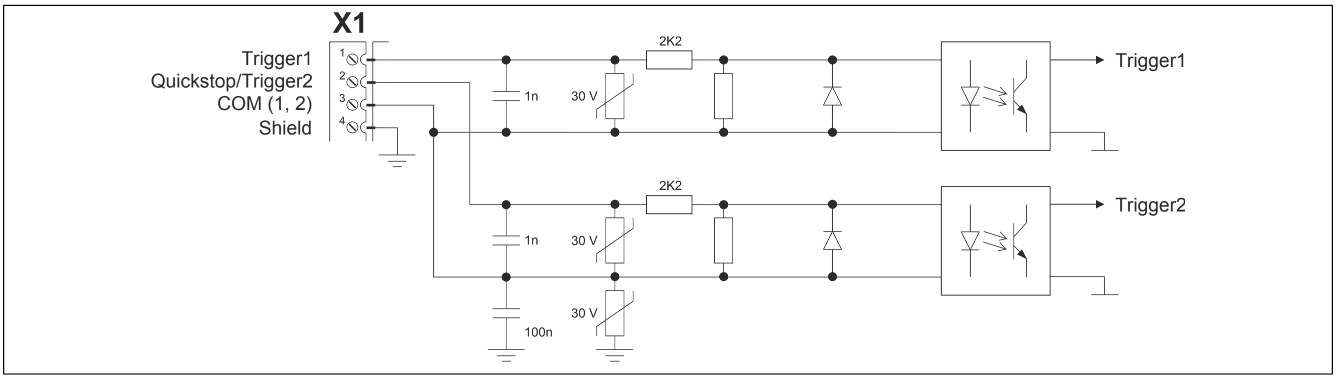


Figure 29: Trigger

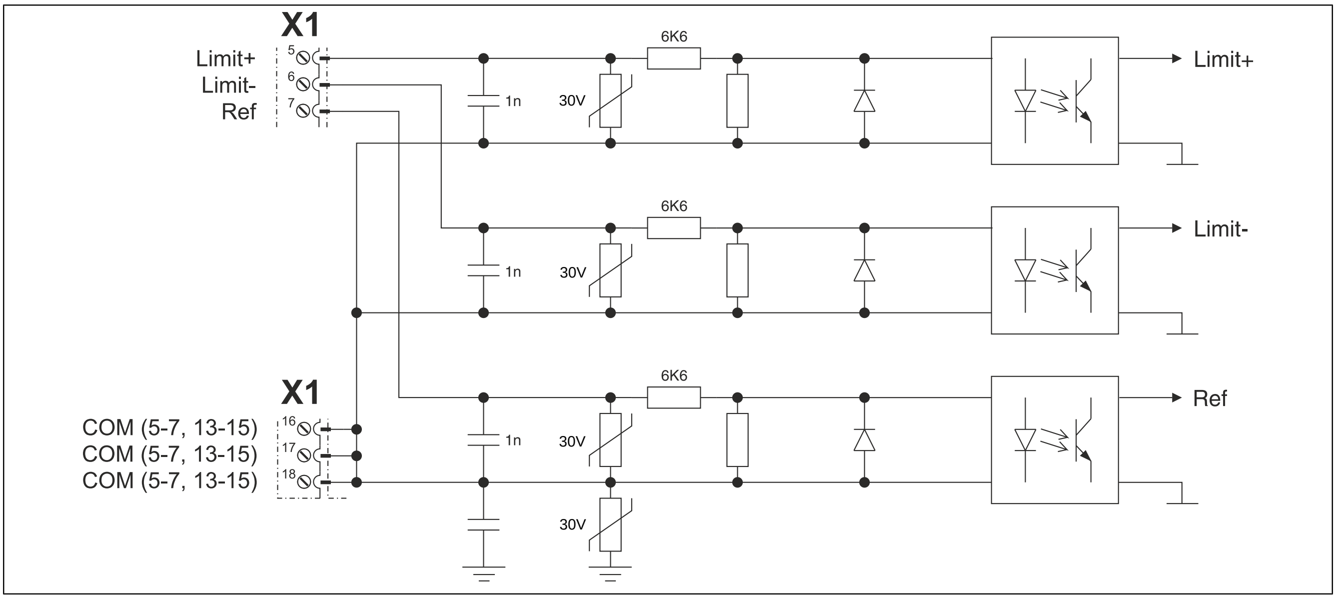


Figure 30: Limit

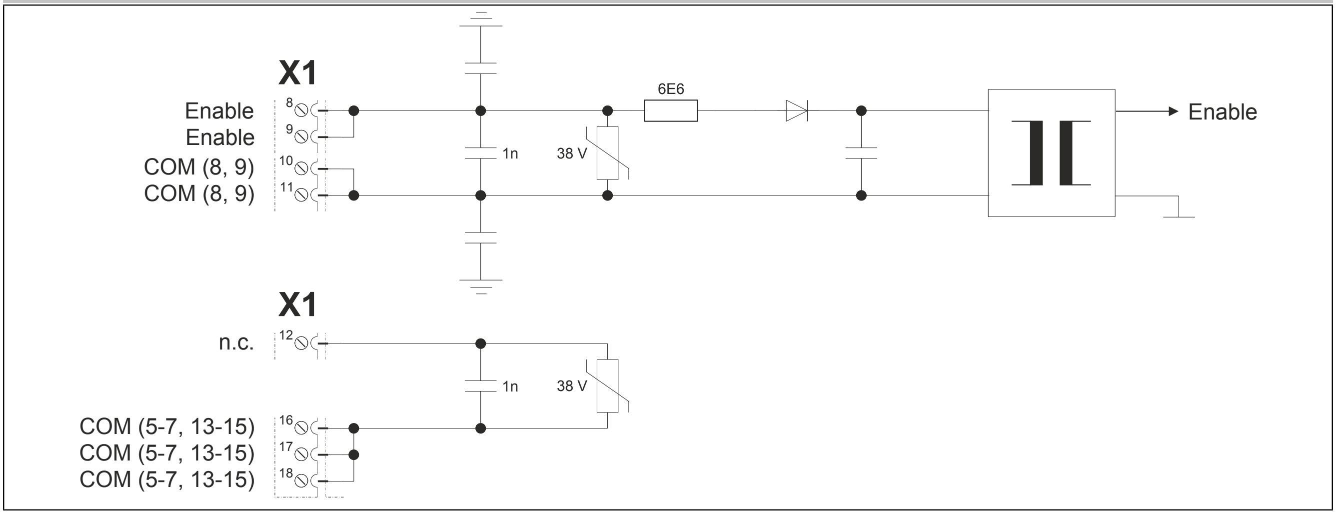


Figure 31: Enable

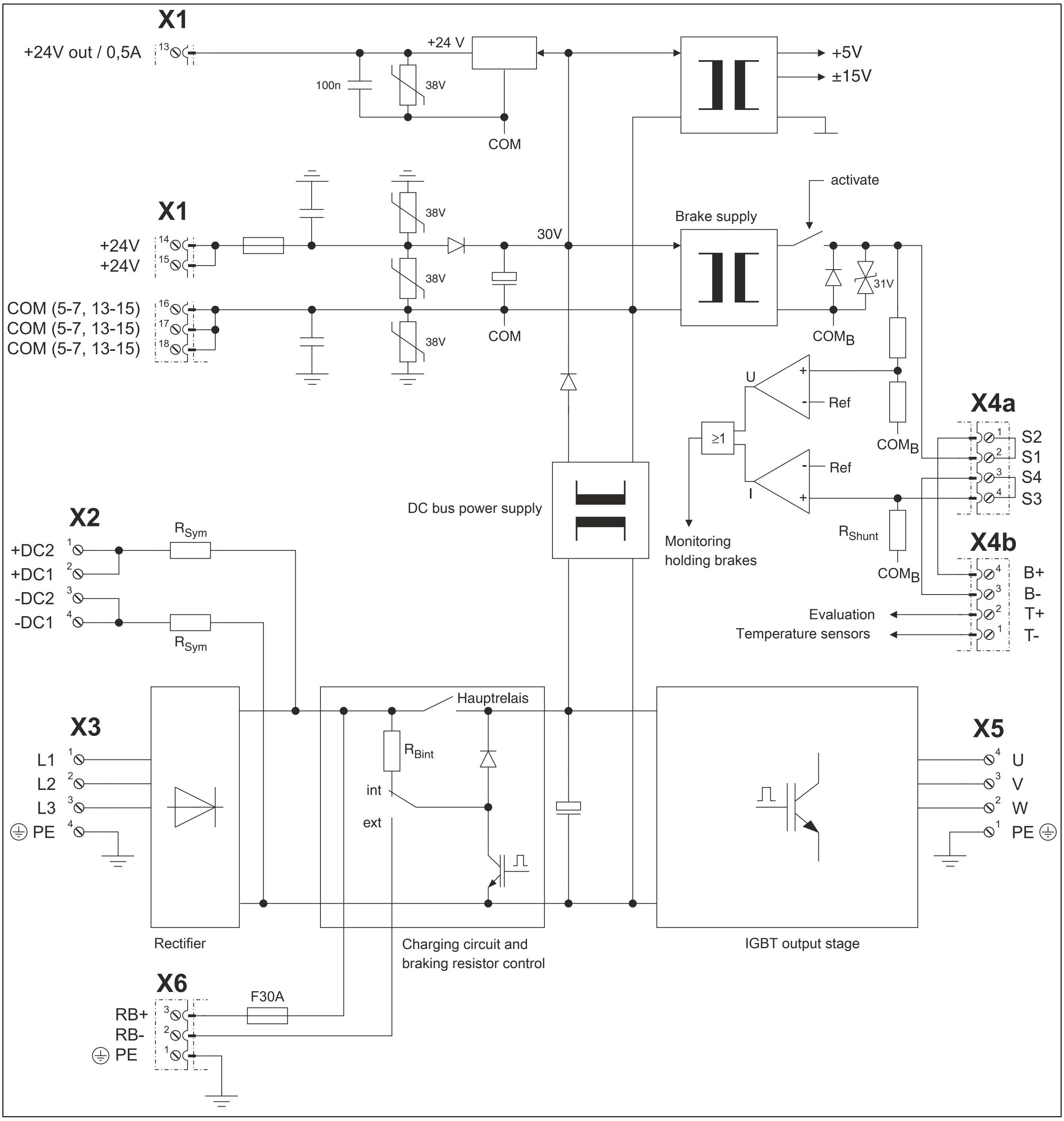


Figure 32: Input/output circuit diagram - ACOPOS 1640, 128M

3 ACOPOS plug-in modules

3.1 General information

ACOPOS drives are equipped with up to four plug-in module slots depending on the size.

	8V1010.0xx-2 8V1010.5xx-2 8V1016.0xx-2 8V1016.5xx-2	**8V1022.0xx-2 8V1045.0xx-2 8V1090.0xx-2**	**8V1180.0xx-2 8V1320.0xx-2**	**8V1640.0xx-2 8V128M.0xx-2**
Max. number of plug-in modules	3	4		

Table 66: The maximum number of plug-in modules depends on the size of the servo drive

You can select the plug-in modules required for your application and insert them into the ACOPOS servo drive.

All ACOPOS servo drives are equipped with three or four slots for plug-in modules depending on the size of the drive. Please note the following module arrangements:

Figure	Plug-in module	Operation possible in			
		Slot 1	Slot 2	Slot 3	Slot 4 [1]
	8AC110.60-3	Yes	No	No	No
	8AC114.60-2	Yes	No	No	No
	8AC120.60-1	No	Yes	Yes	Yes
	8AC121.60-1	No	Yes	Yes	Yes
	8AC122.60-3	No	Yes	Yes	Yes
	8AC122.60-4	No	Yes	Yes	Yes
	8AC123.60-1	No	Yes	Yes	Yes
	8AC125.60-1	No	Yes	Yes	Yes
	8AC125.60-2	No	Yes	Yes	Yes
	8AC125.61-2	No	Yes	Yes	Yes
	8AC126.60-1	No	Yes	Yes	Yes
	8AC130.60-1	No	No	Yes	Yes
	8AC131.60-1	No	Yes	Yes	Yes
	8AC140.60-3	Yes [2]		No	No
	8AC140.61-3	Yes [2]		No	No
	8AC141.60-2	Yes [2]		No	No
	8AC141.61-3	Yes [2]		No	No

Table 67: Slot overview for ACOPOS plug-in modules

1) Not available for ACOPOS servo drives 8V1010.xxx-2 and 8V1016.xxx-2.
2) This module uses two slots.

Caution!

For the installation and removal of plug-in modules, the specifications listed in section "Protection against electrostatic discharge" on page 24 must be followed!

3.2 AC110 - CAN module

3.2.1 General information

The AC110 plug-in module is equipped with a CAN interface. This fieldbus interface is used for communication and setting parameters on the ACOPOS servo drive for standard applications. The connections and software of the 8AC110.60-3 plug-in module are compatible with the 8AC110.60-2 plug-in module.

3.2.2 Order data

Model number	Short description	Figure
	Plug-in modules	
8AC110.60-3	ACOPOS plug-in module, CAN interface	
	Optional accessories	
	Infrastructure components	
0AC912.9	Bus adapter, CAN, 1 CAN interface	
0AC913.92	Bus adapter, CAN, 2 CAN interfaces, including 30 cm attachment cable (DSUB)	
7AC911.9	Bus connector, CAN	

Table 68: 8AC110.60-3 - Order data

3.2.3 Technical data

Product ID	8AC110.60-3
General information	
Module type	ACOPOS plug-in module
B&R ID code	0xE248
Slot	Slot 1
Power consumption	Max. 0.7 W
Certification	
CE	Yes
cULus	Yes
KC	Yes
Interfaces	
CAN	
Quantity	1
Module-side connection	9-pin male DSUB connector
Status indicators	RXD/TXD LEDs
Baud rate	500 kbit/s
Bus terminating resistor	Externally wired
Electrical isolation	Yes
Max. distance	60 m
Network-capable	Yes
Environmental conditions	
Temperature	
Operation	
Nominal	5 to 40°C
Maximum	55°C
Storage	-25 to 55°C
Transport	-25 to 70°C
Relative humidity	
Operation	5 to 85%
Storage	5 to 95%
Transport	Max. 95% at 40°C

Table 69: 8AC110.60-3 - Technical data

3.2.4 CAN node number settings

The CAN node number can be set using two HEX switches:

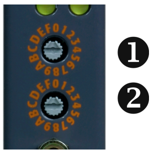
Figure	Rotary code switch	CAN node number
	❶	16s position (high)
	❷	1s position (low)
	The node number change takes effect the next time the ACOPOS servo drive is switched on. **Information:** **Changing the node number using software is not possible (Basis CAN ID can be changed).** **The ACOPOS Manager only supports node numbers 1 - 32.**	

Table 70: Setting the CAN node number

There must be a terminating resistor (120 Ω, 0.25 W) between CAN_H and CAN_L at the beginning and end of the CAN bus.

3.2.5 Status indicators

The status LEDs indicate if data is being received (RXD) or sent (TXD).

3.2.6 Firmware

The firmware is part of the operating system for the ACOPOS servo drives. Firmware is updated by updating the ACOPOS operating system.

3.2.7 Wiring

3.2.7.1 Pinout

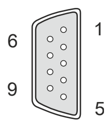
Figure	X11	Pin	Name	Function
		1	---	---
		2	CAN_L	CAN low
		3	COM (2, 7))	0 V CAN card
		4	---	---
		5	---	---
		6	---	---
		7	CAN_H	CAN high
		8	---	---
		9	---	---

Table 71: AC110 CAN interface - Pinout

3.2.7.2 Input/Output circuit diagram

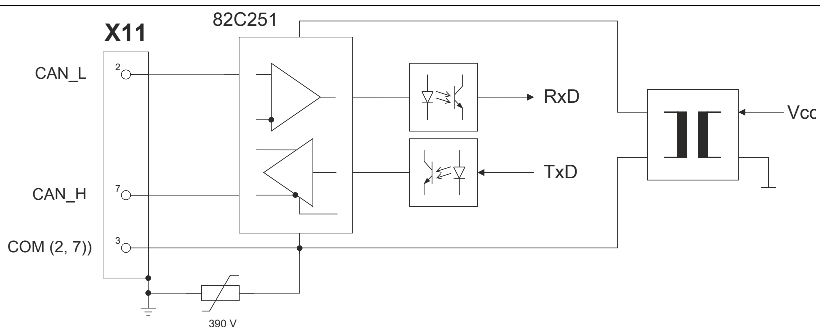


Figure 33: AC110 - Input/Output circuit diagram

3.3 AC114 - POWERLINK V2 module

3.3.1 General information

The AC114 plug-in module is equipped with a POWERLINK interface. This fieldbus interface is used for communication and setting parameters on the ACOPOS servo drive for complex and time critical applications.

The plug-in module is a 2x hub. This makes it easy to establish a device-to-device connection (line topology).

3.3.2 Order data

Model number	Short description	Figure
	Plug-in modules	
8AC114.60-2	ACOPOS plug-in module, POWERLINK V2 interface	
	Optional accessories	
	POWERLINK cables	
X20CA0E61.00020	POWERLINK connection cable, RJ45 to RJ45, 0.2 m	
X20CA0E61.00050	POWERLINK connection cable, RJ45 to RJ45, 0.5 m	
X20CA0E61.00100	POWERLINK connection cable, RJ45 to RJ45, 1 m	
X20CA0E61.00200	POWERLINK connection cable, RJ45 to RJ45, 2 m	
X20CA0E61.00500	POWERLINK connection cable, RJ45 to RJ45, 5 m	
X20CA0E61.01000	POWERLINK connection cable, RJ45 to RJ45, 10 m	

Table 72: 8AC114.60-2 - Order data

3.3.3 Technical data

Product ID	8AC114.60-2
General information	
Module type	ACOPOS plug-in module
B&R ID code	0xA5C1
Slot	Slot 1
Power consumption	Max. 3 W
Certification	
CE	Yes
cULus	Yes
KC	Yes
Interfaces	
POWERLINK	
Quantity	1
Module-side connection	2x RJ45 port
Status indicators	Status LED + 2x Link LED
Transfer rate	100 Mbit/s
Hub, 2x	Yes
Possible station operating modes	Synchronous to POWERLINK cycle
Electrical isolation	Yes
Cabling topology	Star or tree with level 2 hubs
Maximum number of hub levels	10
Cable length	Max. 100 m between two stations (segment length) [1)]
Network-capable	Yes
Watchdog functionality	
Hardware	Yes (via ACOPOS servo drive)
Software	Yes (via ACOPOS servo drive)
Environmental conditions	
Temperature	
Operation	
Nominal	5 to 40°C
Maximum	55°C
Storage	-25 to 55°C
Transport	-25 to 70°C
Relative humidity	
Operation	5 to 85%
Storage	5 to 95%
Transport	Max. 95% at 40°C

Table 73: 8AC114.60-2 - Technical data

1) With 10 ACOPOS servo drives and a cycle time of 400 µs, the maximum total cable length becomes 200 m.

3.3.4 Setting the POWERLINK node number

The POWERLINK node number can be set using two HEX switches:

Image	Code switch	POWERLINK node number
	❶	16s position (high)
	❷	1s position (low)
	A changed POWERLINK node number will take effect the next time the ACOPOS servo drive is switched on. **Information:** **In principle, node numbers between $01 and $FD are permitted. However, node numbers between $F0 and $FD are intended for future system expansions. To ensure compatibility, these node numbers should be avoided.** **Node numbers $00, $FE and $FF are reserved and may therefore not be set.**	

Table 74: Setting the POWERLINK node number

3.3.5 Status indicators

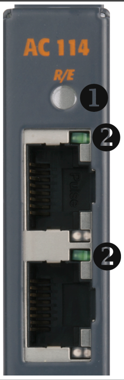
Figure	LED	Labeling	Color	Function	Description
	❶	R/E	Green/Red	Ready/Error	See "POWERLINK - LED status indicators" on page 110
	❷	RX	Green	Link / data activity	

Table 75: AC114 - Status LEDs

Labeling	Color	Function	Description	
R/E	Green/Red	Ready/Error	LED not lit	The module is not receiving power or initialization of the network interface has failed.
			Red (lit)	The POWERLINK station number of the module is 0.
			Red/green, blinking	The client is in an error state (drops out of cyclic operation).
			Green (blinking) (single)	The client detects a valid POWERLINK frame on the network.
			Green (blinking) (2x)	Cyclic operation on the network is taking place, but the client itself is not yet a participant.
			Green (blinking) (3x)	Cyclic operation of the client is in preparation.
			Green (lit)	The client is participating in cyclic operation.
			Green (flickering)	The client is not participating in cyclic operation and also does not detect any other stations on the network participating in cyclic operation.
RX	Green	Link / data activity	Green (not lit)	Hardware not connected
			Green (lit)	Hardware connected
			Green (flickering)	Activity on port

Table 76: POWERLINK - LED status indicators

3.3.6 Firmware

The firmware is part of the operating system for the ACOPOS servo drives. Firmware is updated by updating the ACOPOS operating system.

3.3.7 Wiring

3.3.7.1 Pinout

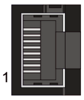
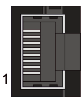
Figure	IF2	Pin	Name	Function
	 1	1	RXD	Receive signal
		2	RXD\	Receive signal inverted
		3	TXD	Transmit signal
		4	Shield	Shield
		5	Shield	Shield
		6	TXD\	Transmit signal inverted
		7	Shield	Shield
		8	Shield	Shield
	IF1	**Pin**	**Name**	**Function**
	 1	1	RXD	Receive signal
		2	RXD\	Receive signal inverted
		3	TXD	Transmit signal
		4	Shield	Shield
		5	Shield	Shield
		6	TXD\	Transmit signal inverted
		7	Shield	Shield
		8	Shield	Shield

Table 77: AC114 POWERLINK V2 interface - Pinout

Information:

In general, crossover Ethernet cables must be used for POWERLINK connections!

Cables should be plugged in and unplugged carefully. Otherwise, the shield connection could break between the RJ45 connector and the cable shield which could then cause connection disturbances!

3.3.7.2 Input/output diagram

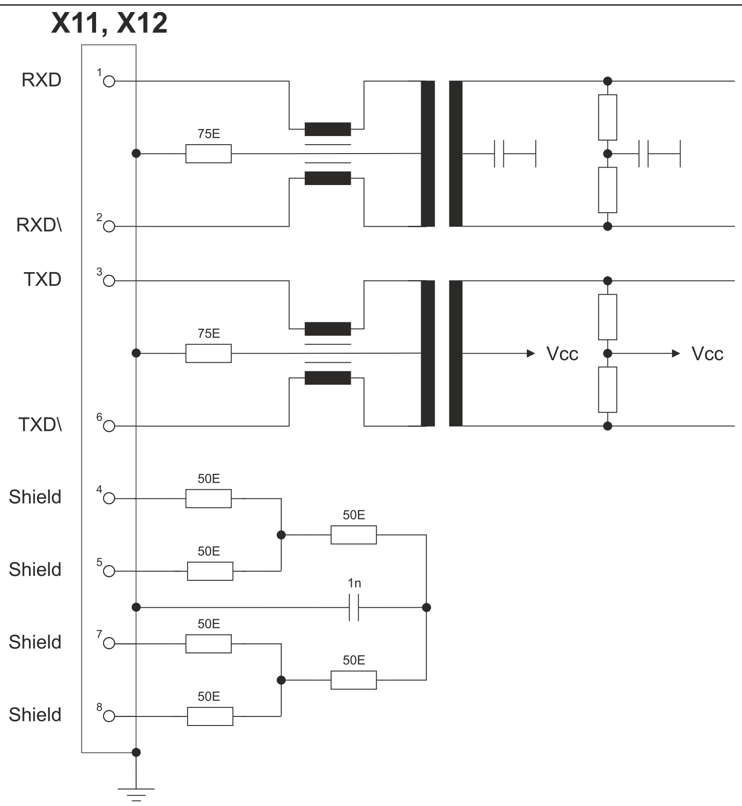


Figure 34: AC114 - Input/Output circuit diagram

3.4 AC120 - EnDat 2.1 encoder module

3.4.1 General information

The AC120 plug-in module has an EnDat 2.1 encoder interface but can also be used to evaluate simple incremental encoders with a sinusoidal output signal. [1)]

This module can be used to evaluate encoders installed in B&R servo motors as well as encoders for external axes (encoders that scan any machine movement). The input signals are monitored. This makes it possible to detect open or shorted lines as well as encoder supply failures.

During startup, the plug-in module is automatically identified, configured and its parameters set by the ACOPOS servo drive operating system.

EnDat 2.1 encoder:

EnDat 2.1 is a standard developed by Johannes Heidenhain GmbH (www.heidenhain.de) that incorporates the advantages of absolute and incremental position measurement and also offers a read/write parameter memory in the encoder. With absolute position measurement (the absolute position is sampled serially), a homing procedure for referencing is usually not required. Where necessary, a multi-turn encoder (4096 revolutions) should be installed. To reduce costs, a single-turn encoder and a reference switch can also be used. In this case, a homing procedure must be carried out.

The incremental process allows the short delay times necessary for position measurement on drives with exceptional dynamic properties. With the sinusoidal incremental signal and the fine resolution in the EnDat module, a very high positioning resolution is achieved in spite of the moderate signal frequencies used.

The parameter memory in the EnDat encoder is used by B&R to store motor data (among other things). In this way, the ACOPOS drive system is always automatically provided the correct motor parameters and limit values. This is referred to as the "embedded parameter chip".

Incremental encoder with sine formed output signal:

When using the AC120 plug-in module to evaluate simple incremental encoders with an sinusoidal output signal, only the incremental transfer channel is used. The "embedded parameter chip" it not available in this case because this encoder does not have parameter memory. The absolute position is also not available immediately after switching the device on. In this situation, a homing procedure normally has to be carried out. The module is equipped with a reference pulse input for this purpose.

3.4.2 Order data

Model number	Short description	Figure
	Plug-in modules	
8AC120.60-1	ACOPOS plug-in module, EnDat encoder and sine incremental encoder interface	
	Optional accessories	
	EnDat cables	
8CE005.12-1	EnDat 2.1 cable, length 5 m, 10x 0.14 mm² + 2x 0.5 mm², Intercontec 17-pin female EnDat connector, 15-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	
8CE007.12-1	EnDat 2.1 cable, length 7 m, 10x 0.14 mm² + 2x 0.5 mm², Intercontec 17-pin female EnDat connector, 15-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	
8CE010.12-1	EnDat 2.1 cable, length 10 m, 10x 0.14 mm² + 2x 0.5 mm², Intercontec 17-pin female EnDat connector, 15-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	
8CE015.12-1	EnDat 2.1 cable, length 15 m, 10x 0.14 mm² + 2x 0.5 mm², Intercontec 17-pin female EnDat connector, 15-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	
8CE020.12-1	EnDat 2.1 cable, length 20 m, 10x 0.14 mm² + 2x 0.5 mm², Intercontec 17-pin female EnDat connector, 15-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	
8CE025.12-1	EnDat 2.1 cable, length 25 m, 10x 0.14 mm² + 2x 0.5 mm², Intercontec 17-pin female EnDat connector, 15-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	

Table 78: 8AC120.60-1 - Order data

[1)] Starting with revision F0.

3.4.3 Technical data

Product ID	**8AC120.60-1**
General information	
Module type	ACOPOS plug-in module
B&R ID code	0x0FCC
Slot 1)	Slots 2, 3 and 4
Power consumption	
Depends on the encoder connected	Yes
E0 ... EnDat single-turn, 512 lines	Max. 2.3 W
E1 ... EnDat multi-turn, 512 lines	Max. 3.1 W
E2 ... EnDat single-turn, 32 lines (inductive)	Max. 3.1 W
E3 ... EnDat multi-turn, 32 lines (inductive)	Max. 3.1 W
E4 ... EnDat single-turn, 512 lines	Max. 2.4 W
E5 ... EnDat multi-turn, 512 lines	Max. 2.7 W
E8 ... EnDat single-turn, 16 lines (inductive)	Max. 29 W
E9 ... EnDat multi-turn, 16 lines (inductive)	Max. 31 W
EA ... EnDat single-turn, 32 lines (inductive)	Max. 27 W
EB ... EnDat multi-turn, 32 lines (inductive)	Max. 30 W
Certification	
CE	Yes
cULus	Yes
KC	Yes
Encoder inputs	
Quantity	1
Module-side connection	15-pin female DSUB connector
Status indicators	UP/DN LEDs
Electrical isolation	
Encoder - ACOPOS	No
Encoder monitoring	Yes
Max. encoder cable length	50 m 2)
Encoder supply	
Output voltage	Typ. 5 V
Load capability	250 mA 3)
Sense lines	2, compensation of max. 2x 0.7 V
Sine/Cosine inputs	
Signal transmission	Differential signals, symmetric
Signal frequency (-3 dB)	DC up to 300 kHz
Signal frequency (-5 dB)	DC up to 400 kHz
Differential voltage	0.5 to 1.25 V_{ss}
Common-mode voltage	Max. ±7 V
Terminating resistor	120 Ω
Resolution 4)	16384 * number of encoder lines
Precision 5)	-
Reference input	
Signal transmission	Differential signal, symmetric
Differential voltage for low	≤-0.2 V
Differential voltage for high	≥+0.2 V
Common-mode voltage	Max. ±7 V
Terminating resistor	120 Ω
Serial interface	
Signal transmission	Synchronous
Protocol	RS485
Baud rate	625 kbaud
Environmental conditions	
Temperature	
Operation	
Nominal	5 to 40°C
Maximum	55°C
Storage	-25 to 55°C
Transport	-25 to 70°C
Relative humidity	
Operation	5 to 85%
Storage	5 to 95%
Transport	Max. 95% at 40°C

Table 79: 8AC120.60-1 - Technical data

1) The AC120 is a single encoder module. It is also possible to insert multiple encoder modules. In this case, the encoder module in the slot with the lowest number is automatically used for motor feedback.
2) Requirements: The encoder is cabled using a shielded cable that has a wire cross section of at least 0.14 mm² for all signal lines and a wire cross section of at least 0.5 mm² for all encoder supply lines. The sense lines must be used.
3) This value only applies to the encoder. The actual load capacity of the encoder supply is approx. 300 mA. The difference of approx. 50 mA covers the consumption of the terminating resistors, which are always present. For longer encoder cables, it is important to note that the maximum voltage drop permitted on the supply wires (there and back) is 1.45 V. This can reduce the permissible load current.
4) Only a part of the resolution of the connected encoder can be used in practice. The usable resolution can be further reduced by signal interference from the connected encoder.
5) In practice, the precision is limited by the encoder.

3.4.4 Status indicators

The UP/DN LEDs are lit depending on the rotational direction and the speed of the connected encoder.

UP LED ... Lit when the encoder position changes in the positive direction.
DN LED ... Lit when the encoder position changes in the negative direction.

The faster the encoder position changes, the brighter the respective LED is lit.

3.4.5 Firmware

The firmware is part of the operating system for the ACOPOS servo drives. Firmware is updated by updating the ACOPOS operating system.

3.4.6 Wiring

3.4.6.1 Pinout

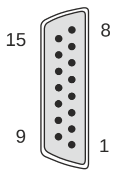
Figure	X11	Pin	Name	Function	
				EnDat mode	Incremental mode
		1	A	Channel A	
		2	COM (1, 3 - 9, 11, 13 - 15)	Encoder supply 0 V	
		3	B	Channel B	
		4	+5V out / 0.25A	Encoder supply +5 V	
		5	D	Data input	---
		6	---	---	
		7	R\	---	Reference pulse inverted
		8	T	Clock output	---
		9	A\	Channel A inverted	
		10	Sense COM	Sense input 0 V	
		11	B\	Channel B inverted	
		12	Sense +5V	Sense input +5 V	
		12	D\	Data inverted	---
		14	R	---	Reference pulse
		15	T\	Clock output inverted	---

Table 80: AC120 EnDat encoder interface - Pinout

Danger!

The connections for the encoders are isolated circuits. These connections are therefore only permitted to be connected to devices or components that have sufficient isolation in accordance with IEC 60364-4-41 or EN 61800-5-1.

3.4.6.2 Input/Output circuit diagram

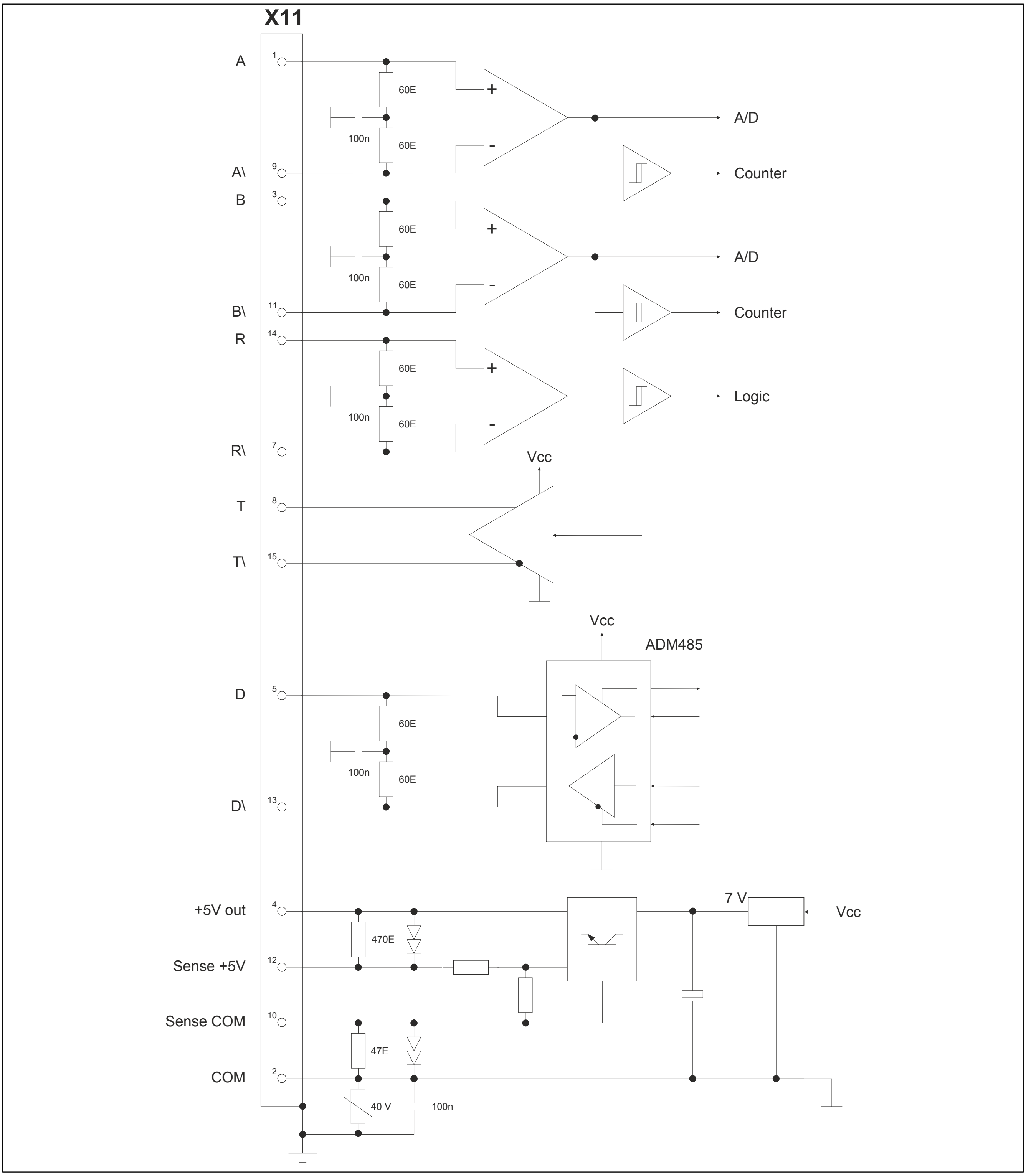


Figure 35: AC120 - Input/Output circuit diagram

3.5 AC121 - HIPERFACE encoder module

3.5.1 General information

The AC121 plug-in module is equipped with a HIPERFACE encoder interface.

This module can be used to evaluate encoders installed in motors from other manufacturers as well as encoders for external axes (encoders that scan any machine movement). The input signals are monitored. This makes it possible to detect open or shorted lines as well as encoder supply failures.

During startup, the plug-in module is automatically identified, configured and its parameters set by the ACOPOS servo drive operating system.

HIPERFACE

HIPERFACE is a standard developed by Max Stegmann GmbH (www.stegmann.de), which like EnDat incorporates the advantages of absolute and incremental position measurement while also offering a read/write parameter memory in the encoder. With absolute position measurement (the absolute position is sampled serially), a homing procedure for referencing is usually not required. Where necessary, a multi-turn encoder (4096 revolutions) should be installed. To reduce costs, a single-turn encoder and a reference switch can also be used. In this case, a homing procedure must be carried out.
The incremental process allows the short deceleration periods necessary for position measurement when using drives with highly dynamic characteristics. The sinusoidal incremental signal and extremely high resolution in the HIPERFACE module also make it possible to achieve a very high degree of positioning precision despite the moderate signal frequencies used.
The parameter memory in the HIPERFACE encoder is available starting with firmware version V1.221.

3.5.2 Order data

Model number	Short description	Figure
	Plug-in modules	
8AC121.60-1	ACOPOS plug-in module, HIPERFACE interface	

Table 81: 8AC121.60-1 - Order data

3.5.3 Technical data

Product ID	8AC121.60-1
General information	
Module type	ACOPOS plug-in module
B&R ID code	0x1558
Slot [1)]	Slots 2, 3 and 4
Power consumption	
With encoder power consumption of 0 mA	0.35 W
With encoder power consumption of 100 mA	1.4 W
With encoder power consumption of 170 mA	2.1 W
Certification	
CE	Yes
cULus	Yes
KC	Yes
Encoder inputs	
Quantity	1
Module-side connection	15-pin female DSUB connector, 2 pins closed
Status indicators	UP/DN LEDs
Electrical isolation	
Encoder - ACOPOS	No

Table 82: 8AC121.60-1 - Technical data

Product ID	8AC121.60-1
Encoder monitoring	Yes
Max. encoder cable length	50 m 2)
Encoder supply Output voltage Load capability Sense lines	 8 to 9 V 170 mA - 3)
Sine/Cosine inputs Signal transmission Signal frequency Differential voltage Common-mode voltage Terminating resistor Resolution 4) Precision 5)	 Differential signal, asymmetric DC up to 200 kHz 0.5 to 1.25 V_{ss} Max. ±7 V 120 Ω 16384 * number of encoder lines -
Serial interface Signal transmission Protocol Baud rate	 Asynchronous RS485 9600 baud
Environmental conditions	
Temperature Operation Nominal Maximum Storage Transport	 5 to 40°C 55°C -25 to 55°C -25 to 70°C
Relative humidity Operation Storage Transport	 5 to 85% 5 to 95% Max. 95% at 40°C

Table 82: 8AC121.60-1 - Technical data

1) The AC121 is a single encoder module. It is also possible to insert multiple encoder modules. In this case, the module in the slot with the lowest number is automatically used for motor feedback.
2) Requirements: The encoder is cabled using a shielded cable that has a wire cross section of at least 0.14 mm² for all signal lines and a wire cross section of at least 0.5 mm² for all encoder supply lines. The sense lines must be used.
3) No sense lines are present since the supply voltage for the HIPERFACE encoder is permitted to be between 7 and 12 V.
4) Noise on the encoder signal reduces the resolution that can be used by approx. 5 bits (factor of 32).
5) In practice, the precision is limited by the encoder.

3.5.4 Status indicators

The UP/DN LEDs are lit depending on the rotational direction and the speed of the connected encoder.

UP LED ... Lit when the encoder position changes in the positive direction.
DN LED ... Lit when the encoder position changes in the negative direction.

The faster the encoder position changes, the brighter the respective LED is lit.

3.5.5 Firmware

The firmware is part of the operating system for the ACOPOS servo drives. Firmware is updated by updating the ACOPOS operating system.

3.5.6 Wiring

3.5.6.1 Pinout

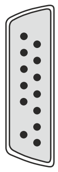
Figure	X11	Pin	Name	Function
		1	SIN	Channel SIN
		2	COM (1, 3 - 5, 9, 11, 13)	Encoder supply 0 V
		3	COS	Channel COS
		4	+8V out / 0.15A	Encoder supply +8 V
		5	D	Data
		6	---	---
		7	---	---
		8	---	--- [1)]
		9	REF SIN	Reference for SIN
		10	---	--- [1)]
		11	REF COS	Reference for COS
		12	---	---
		13	D\	Data inverted
		14	---	---
		15	---	---

Table 83: AC121 HIPERFACE encoder interface - Pinout

1) Pins 8 and 10 are closed with plastic plugs. This prevents the accidental connection of a B&R EnDat cable.

Danger!

The connections for the encoders are isolated circuits. These connections are therefore only permitted to be connected to devices or components that have sufficient isolation in accordance with IEC 60364-4-41 or EN 61800-5-1.

3.5.6.2 Input/Output circuit diagram

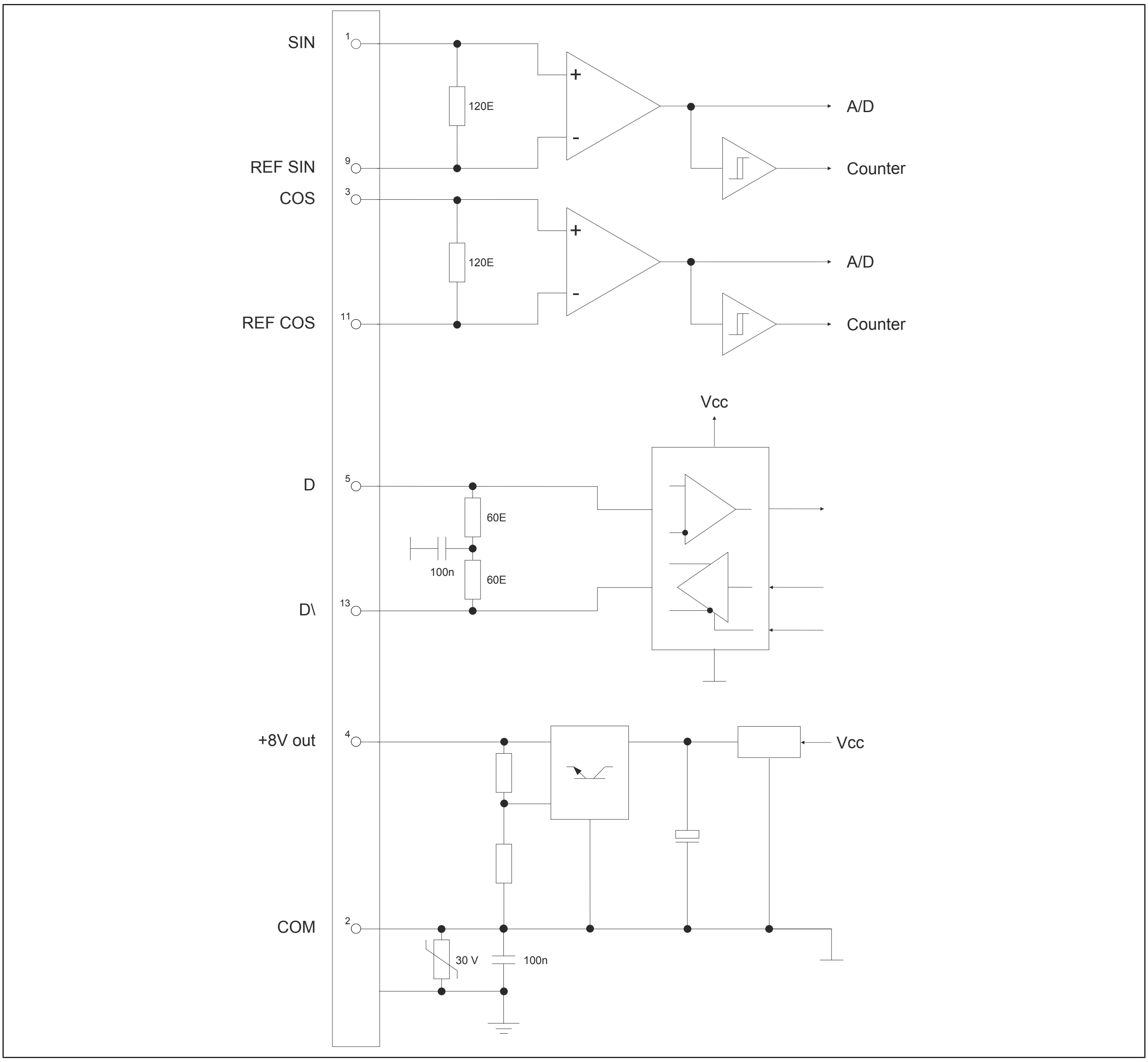


Figure 36: AC121 - Input/Output circuit diagram

3.6 AC122 - Resolver module

3.6.1 8AC122.60-3

3.6.1.1 General information

The AC122 plug-in module is equipped with a resolver interface.

This plug-in module handles the output from resolvers which are built into B&R servo motors or used as an encoder for external axes. This resolver delivers the absolute position over one revolution. Normally, the movement path is longer than one revolution. In this case, a reference switch must be used and a homing procedure carried out.

The encoder input signals are monitored. This makes it possible to detect open or shorted lines as well as encoder supply (reference signal) failures.

During startup, the plug-in module is automatically identified by the ACOPOS operating system. Making automatic adjustments to the motor (motor parameters, limit values, encoder resolution, etc.) is not possible because the resolver does not have parameter memory like the EnDat encoder.

If the precision, resolution, bandwidth or ease of setting parameters is not sufficient with the resolver, the EnDat system should be used (see "AC120 - EnDat 2.1 encoder module " on page 112).

3.6.1.2 Order data

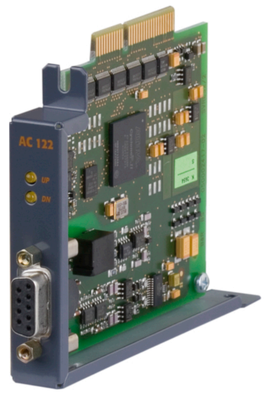
Model number	Short description	Figure
	Plug-in modules	
8AC122.60-3	ACOPOS plug-in module, resolver interface 10 kHz	
	Optional accessories	
	Resolver cables	
8CR005.12-1	Resolver cable, length 5 m, 3x 2x AWG 24 (19x 0.127), Intercontec 12-pin female resolver connector, 9-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	
8CR007.12-1	Resolver cable, length 7 m, 3x 2x AWG 24 (19x 0.127), Intercontec 12-pin female resolver connector, 9-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	
8CR010.12-1	Resolver cable, length 10 m, 3x 2x AWG 24 (19x 0.127), Intercontec 12-pin female resolver connector, 9-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	
8CR015.12-1	Resolver cable, length 15 m, 3x 2x AWG 24 (19x 0.127), Intercontec 12-pin female resolver connector, 9-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	
8CR020.12-1	Resolver cable, length 20 m, 3x 2x AWG 24 (19x 0.127), Intercontec 12-pin female resolver connector, 9-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	
8CR025.12-1	Resolver cable, length 25 m, 3x 2x AWG 24 (19x 0.127), Intercontec 12-pin female resolver connector, 9-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	

Table 84: 8AC122.60-3 - Order data

3.6.1.3 Technical data

Product ID	**8AC122.60-3**
General information	
Module type	ACOPOS plug-in module
B&R ID code	0xA48B
Slot [1]	Slots 2, 3 and 4
Power consumption	Max. 2.5 W
Max. cable length	100 m
Certification	
CE	Yes
cULus	Yes
KC	Yes
Resolver inputs	
Reference output	
Output current	Max. 50 mA_{eff}
Differential voltage	Typ. 3.4 V_{eff}
Frequency	10 kHz
Signal transmission	Differential signals
Angular position resolution	14 bits/rev [2]
Module-side connection	9-pin female DSUB connector
Status indicators	UP/DN LEDs
Bandwidth	2.5 kHz
Encoder monitoring	Yes
Precision	±8 angular minutes
Electrical isolation	
Resolver - ACOPOS	No
Resolver	
Input frequency	10 kHz
Input voltage	3 to 7 V_{rms}
Number of pins	2-pin
Type	BRX [3]
Max. phase shift	±45°
Max. elec. angular error	±10 angular minutes
Nominal conversion ratio [4]	0.5 ±10%
Sine/Cosine inputs	
Input impedance at 10 kHz (per pin)	10.4 kΩ - j 11.1 kΩ
Signal transmission	Differential signals
Encoder-ACOPOS electrical isolation	No, common-mode voltage on the sine-cosine inputs max ± 20 V
Environmental conditions	
Temperature	
Operation	
Nominal	5 to 40°C
Maximum	55°C
Storage	-25 to 55°C
Transport	-25 to 70°C
Relative humidity	
Operation	5 to 85%
Storage	5 to 95%
Transport	Max. 95% at 40°C

Table 85: 8AC122.60-3 - Technical data

1) The AC122 is a single encoder module. It is also possible to insert multiple encoder modules. In this case, the encoder module in the slot with the lowest number is automatically used for motor feedback.
2) A resolution of 12 bits/rev is configured by default, but it can be changed to 14 bits/rev.
3) BRX resolvers are fed with a sine signal (reference signal) from the module and provide two sine signals with a 90° phase shift as a result. The amplitude of these signals changes with the angular position of the resolver. Unlike BRX resolvers, BRT resolvers can be fed with two sine signals which are offset by 90°. A single sine signal with constant amplitude is returned. The phase position of this signal changes with the angular position of the resolver. An evaluation of BRT resolvers with the 8AC122.60-3 is fundamentally possible starting with firmware V2.040; however, resolution and accuracy are limited by the inverse operation of the resolver. Additionally, the nominal conversion ratio deviates from the default value of 0.5 and must be configured accordingly.
4) Starting with firmware V2.040, the nominal gear ratio can be configured in the range 0.3 ... 0.5 (default value).
Starting with firmware V2.230, the nominal gear ratio can be configured in the range 0.2 ... 0.5 (default value).

3.6.2 8AC122.60-4

3.6.2.1 General information

This resolver plug-in module 8AC122.60-4 has a resolver interface for evaluating BRX resolvers.

The plug-in module handles the output from resolvers which are built into B&R servo motors or used as an encoder for external axes. Resolvers with one pole pair deliver the absolute position over one revolution. If the movement path is longer than one revolution and an absolute position determination is required, then a reference switch must be used and a homing procedure carried out.

The encoder input signals are not monitored. Open or shorted lines as well as encoder supply (reference signal) failures therefore cannot be recognized. [2]

During startup, the plug-in module is automatically identified by the ACOPOS operating system. Making automatic adjustments to the motor (motor parameters, limit values, encoder resolution, etc.) is not possible because resolvers, as opposed to EnDat encoders, don't contain a parameter memory.

If the precision, resolution, bandwidth or ease of setting parameters is not sufficient with the resolver, the EnDat system should be used (see "AC120 EnDat encoder interface").

Information:

The plug-in module 8AC122.60-4 is the compatible replacement for the plug-in module 8AC122.60-1. [3]

3.6.2.2 Order data

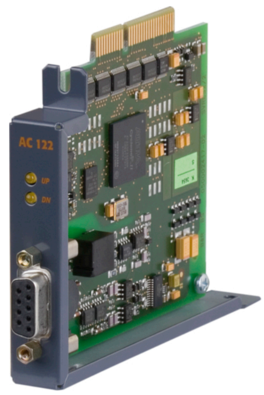
Model number	Short description	Figure
	Plug-in modules	
8AC122.60-4	ACOPOS plug-in module, resolver interface 10 kHz, no open line detection	
	Optional accessories	
	Resolver cables	
8CR005.12-1	Resolver cable, length 5 m, 3x 2x AWG 24 (19x 0.127), Intercontec 12-pin female resolver connector, 9-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	
8CR007.12-1	Resolver cable, length 7 m, 3x 2x AWG 24 (19x 0.127), Intercontec 12-pin female resolver connector, 9-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	
8CR010.12-1	Resolver cable, length 10 m, 3x 2x AWG 24 (19x 0.127), Intercontec 12-pin female resolver connector, 9-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	
8CR015.12-1	Resolver cable, length 15 m, 3x 2x AWG 24 (19x 0.127), Intercontec 12-pin female resolver connector, 9-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	
8CR020.12-1	Resolver cable, length 20 m, 3x 2x AWG 24 (19x 0.127), Intercontec 12-pin female resolver connector, 9-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	
8CR025.12-1	Resolver cable, length 25 m, 3x 2x AWG 24 (19x 0.127), Intercontec 12-pin female resolver connector, 9-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	

Table 86: 8AC122.60-4 - Order data

[2] If monitoring the encoder input signals is required, then the ACOPOS plug-in module 8AC122.60-3 can be inserted.
[3] In Automation Studio, the plug-in module upgrade 8AC122.60-1 should be used for the plug-in module 8AC122.60-4.

3.6.2.3 Technical data

Product ID	8AC122.60-4
General information	
Module type	ACOPOS plug-in module
B&R ID code	0xE10E
Slot [1)]	Slots 2, 3 and 4
Power consumption	Max. 2.5 W
Max. cable length	100 m
Certification cULus	 Yes
Resolver inputs	
Reference output Output current Differential voltage Frequency Signal transmission	 Max. 50 mA_{eff} Typ. 3.4 V_{eff} 10 kHz Differential signals
Angular position resolution	14 bits/rev [2)]
Module-side connection	9-pin female DSUB connector
Status indicators	UP/DN LEDs
Bandwidth	2.5 kHz
Encoder monitoring	Yes
Precision	±8 angular minutes [3)]
Electrical isolation Resolver - ACOPOS	 No
Resolver Input frequency Input voltage Type Max. phase shift Nominal conversion ratio [6)]	 10 kHz 3 to 7 V_{rms} BRX [4)] ±45° [5)] 0.5 ±10%
Sine/Cosine inputs Input impedance at 10 kHz (per pin) Signal transmission Encoder-ACOPOS electrical isolation	 10.4 kΩ - j 11.1 kΩ Differential signals No, common-mode voltage on the sine-cosine inputs max ± 20 V
Environmental conditions	
Temperature Operation Nominal Maximum Storage Transport	 5 to 40°C 55°C -25 to 55°C -25 to 70°C
Relative humidity Operation Storage Transport	 5 to 85% 5 to 95% Max. 95% at 40°C

Table 87: 8AC122.60-4 - Technical data

1) The AC122 is a single encoder module. It is also possible to insert multiple encoder modules. In this case, the encoder module in the slot with the lowest number is automatically used for motor feedback.
2) A resolution of 12 bits/rev is configured by default, but it can be changed to 14 bits/rev.
3) Accuracy of the evaluation electronics. The max. electrical angular error of the resolver being used must also be taken into consideration.
4) BRX resolvers are fed with a sine signal (reference signal) from the module and provide two sine signals with a 90° phase shift as a result. The amplitude of these signals changes with the angular position of the resolver. Unlike BRX resolvers, BRT resolvers can be fed with two sine signals which are offset by 90°. A single sine signal with constant amplitude is returned. The phase position of this signal changes with the angular position of the resolver. An evaluation of BRT resolvers with the 8AC122.60-4 is fundamentally possible starting with firmware V2.040; however, resolution and accuracy are limited by the inverse operation of the resolver. Additionally, the nominal conversion ratio deviates from the default value of 0.5 and must be configured accordingly.
5) Phase shift between the reference signal and the output signals.
6) Starting with firmware V2.040, the nominal gear ratio can be configured in the range 0.3 ... 0.5 (default value).
Starting with firmware V2.230, the nominal gear ratio can be configured in the range 0.2 ... 0.5 (default value).

3.6.3 Status indicators

The UP/DN LEDs are lit depending on the rotational direction and the speed of the connected encoder.

UP LED ... Lit when the encoder position changes in the positive direction.
DN LED ... Lit when the encoder position changes in the negative direction.

The faster the encoder position changes, the brighter the respective LED is lit.

3.6.4 Wiring

3.6.4.1 Pinout

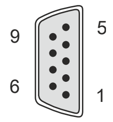
Figure	X11	Pin	Name	Function	Typical wire colors for the resolver
		1	---	---	---
		2	---	---	---
		3	S4	Sine input +	Blue
		4	S1	Cosine input -	Red
		5	R2	Reference output +	black/white (or yellow/white)
		6	---	---	---
		7	S2	Sine input -	Yellow
		8	S3	Cosine input +	Black
		9	R1	Reference output -	red/white

Table 88: AC122 resolver interface - Pinout

Danger!

The connections for the encoders are isolated circuits. These connections are therefore only permitted to be connected to devices or components that have sufficient isolation in accordance with IEC 60364-4-41 or EN 61800-5-1.

3.6.4.2 Input/Output circuit diagram

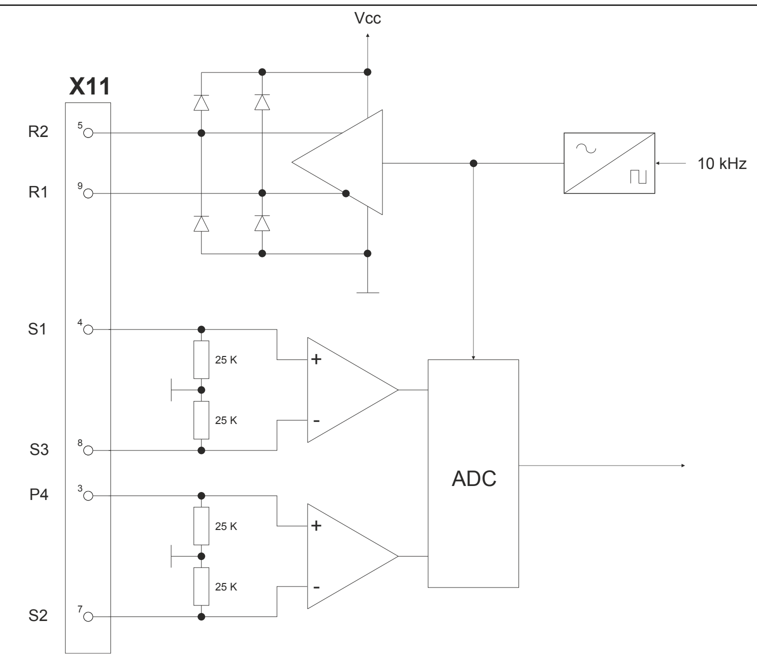


Figure 37: AC122 - Input/Output circuit diagram

3.7 AC123 - Incremental encoder and SSI absolute encoder module

3.7.1 General information

The ACOPOS plug-in module AC123 is used to connect standard industrial incremental or absolute encoders with a synchronous serial interface (SSI) to ACOPOS servo drives. For example, this allows electronic gears to be configured which read master movements using external encoders. If the encoder resolution is high enough, motor feedback for induction motors is also possible.

With incremental encoders, the maximum counter frequency is 800kHz. Single and multi-turn encoders with a maximum of 31 bits at 200 kbaud can be read as SSI absolute encoders.

The position is determined cyclically (initiated by the module) and is exactly synchronized with the ACOPOS controller clock. The input signals are monitored for both encoder types. This makes it possible to detect open or shorted lines as well as encoder supply failures.

With incremental encoders the counter frequency and distance between edges is also monitored. With absolute encoders, the parity bit is evaluated and a plausibility check carried out.

3.7.2 Order data

Model number	Short description	Figure
	Plug-in modules	
8AC123.60-1	ACOPOS plug-in module, incremental encoder and SSI absolute encoder interface	

Table 89: 8AC123.60-1 - Order data

3.7.3 Technical data

Product ID	8AC123.60-1
General information	
Module type	ACOPOS plug-in module
B&R ID code	0x1067
Slot [1]	Slots 2, 3 and 4
Power consumption	Max. 7.5 W Depends on the current consumption of the connected encoder [2]
Certification CE cULus KC	 Yes Yes Yes
Encoder inputs	
Quantity	1
Signal transmission	Differential signal transfer
Module-side connection	15-pin female DSUB connector
Status indicators	UP/DN LEDs
Electrical isolation Encoder - ACOPOS	 Yes
Encoder monitoring	Yes
Max. encoder cable length [3]	50 m
Encoder supply	
Short circuit protection, overload protection	Yes
Supply voltages	Internal, either 5 V or 15 V
Load capability 5 VDC 15 V	 350 mA 350 mA
Sense lines For 5 V For 15 V	 Yes, 2, compensation of max. 2 V No

Table 90: 8AC123.60-1 - Technical data

Product ID	8AC123.60-1
Incremental encoder	
Counter size	32-bit
Input frequency	Max. 200 kHz
Evaluation	4x
Signal form	Square wave pulse
Counter frequency	Max. 800 kHz
Reference frequency	Max. 200 kHz
Distance between edges	Min. 0.6 µs
Inputs	A, A\, B, B\, R, R\
Differential voltage inputs A, B, R Minimum Maximum	 2.5 V 6 V
SSI absolute encoder	
Keying	Gray, binary
Baud rate	200 kbit/s
Word size	Max. 31-bit
Differential voltage clock output - 120 Ω Minimum Maximum	 2.5 V 5 V
Differential voltage data input Minimum Maximum	 2.5 V 6 V
Environmental conditions	
Temperature Operation Nominal Maximum Storage Transport	 5 to 40°C 55°C -25 to 55°C -25 to 70°C
Relative humidity Operation Storage Transport	 5 to 85% 5 to 95% Max. 95% at 40°C

Table 90: 8AC123.60-1 - Technical data

1) The AC123 is a single encoder module. It is also possible to insert multiple encoder modules. In this case, the encoder module in the slot with the lowest number is automatically used for motor feedback.
2) The power consumption of the plug-in module can be approximated using the following formula:
P_{Module} [W] = $P_{Encoder}$ [W] . k + 0.6 W
The power consumed by the encoder $P_{Encoder}$ is calculated from the selected encoder supply voltage (5 V / 15 V) and the current required:
$P_{Encoder}$ [W] = $U_{Encoder}$ [V] . $I_{Encoder}$ [A]
The following values must be used for k:
k = 1.2 (for 15 V encoder supply)
k = 1.75 (for 5 V encoder supply)
3) The maximum cable length requires at least one 4x 2x 0.14 mm² + 2x 0.5 mm² cable. The sense lines must be used.

3.7.4 Status indicators

The UP/DN LEDs are lit depending on the rotational direction and the speed of the connected encoder.

UP LED ... Lit when the encoder position changes in the positive direction.
DN LED ... Lit when the encoder position changes in the negative direction.

The faster the encoder position changes, the brighter the respective LED is lit.

3.7.5 Firmware

The firmware is part of the operating system for the ACOPOS servo drives. Firmware is updated by updating the ACOPOS operating system.

3.7.6 Wiring

3.7.6.1 Pinout

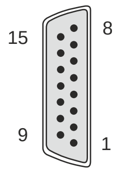
Figure	X11	Pin	Name	Function	
				Incremental mode	SSI mode
		1	A	Channel A	---
		2	A\	Channel A inverted	---
		3	B	Channel B	---
		4	B\	Channel B inverted	---
		5	RD	Reference pulse	Data input
		6	RD\	Reference pulse inverted	Data input inverted
		7	T	---	Clock output
		8	T\	---	Clock output inverted
		9	+5V out / 0.35A	Encoder supply +5 V	
		10	Sense +5V	Sense +5V	
		11	Sense COM	Sense 0V	
		12	COM (7 - 9, 13)	Encoder supply 0 V	
		13	+15V out / 0.35A	Encoder supply +15 V	
		14	A1	Activate encoder supply [1)]	
		15	A2	Activate encoder supply [1)]	

Table 91: AC123 incremental encoder and SSI absolute encoder interface - Pinout

1) To activate the encoder supply, pins 14 and 15 must be connected in the encoder cable connector.
Caution: To read from SSI encoders, the encoder supply also has to be activated if the encoder is supplied externally!

Danger!

The connections for the encoders are isolated circuits. These connections are therefore only permitted to be connected to devices or components that have sufficient isolation in accordance with IEC 60364-4-41 or EN 61800-5-1.

3.7.6.2 Input/Output circuit diagram

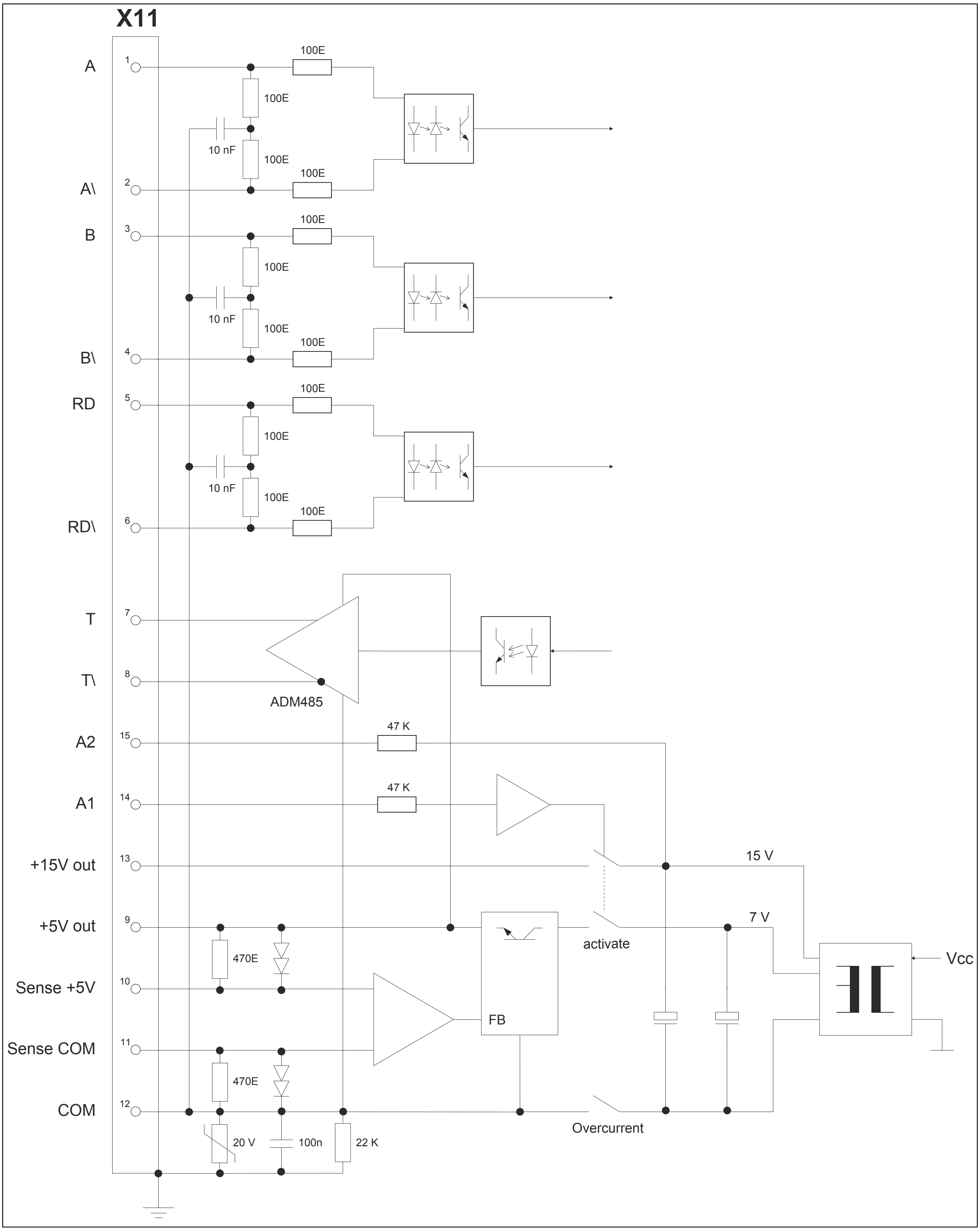


Figure 38: AC123 - Input/Output circuit diagram

3.8 AC125 - BiSS encoder module

3.8.1 8AC125.60-1

3.8.1.1 General information

The AC125 plug-in module has a BiSS encoder interface (MODE C) with a baud rate of 1.25 Mbit/s. BiSS encoders with a supply voltage of 5 V can be connected.

This plug-in module can be used to evaluate encoders installed in B&R servo motors as well as encoders for external axes (encoders that scan any machine movement). The input signals are monitored. This makes it possible to detect open or shorted lines as well as encoder supply failures.

3.8.1.2 Order data

Model number	Short description	Figure
	Plug-in modules	
8AC125.60-1	ACOPOS plug-in module, BiSS encoder interface 5 V	

Table 92: 8AC125.60-1 - Order data

3.8.1.3 Technical data

Product ID	8AC125.60-1
General information	
Module type	ACOPOS plug-in module
B&R ID code	0xACF3
Slot [1]	Slots 2, 3 and 4
Power consumption	Max. 4.5 W
Certification	
CE	Yes
cULus	Yes
KC	Yes
Encoder inputs [2]	
Quantity	1
Type	BiSS
Module-side connection	15-pin female DSUB connector
Status indicators	UP/DN LEDs
Electrical isolation	
Encoder - ACOPOS	No
Encoder monitoring	Yes
Max. encoder cable length	50 m [3]
Encoder supply	
Output voltage	Typ. 5 V
Load capability	250 mA [4]
Sense lines	No
Reference input	
Signal transmission	Differential signal, symmetric
Differential voltage for low	≤-0.2 V
Differential voltage for high	≥+0.2 V
Common-mode voltage	Max. ±7 V
Terminating resistor	120 Ω
Serial interface	
Signal transmission	Synchronous
Protocol	RS485
Baud rate	1250 kbaud

Table 93: 8AC125.60-1 - Technical data

Product ID	8AC125.60-1
Environmental conditions	
Temperature	
Operation	
Nominal	5 to 40°C
Maximum	55°C
Storage	-25 to 55°C
Transport	-25 to 70°C
Relative humidity	
Operation	5 to 85%
Storage	5 to 95%
Transport	Max. 95% at 40°C

Table 93: 8AC125.60-1 - Technical data

1) The AC125 is a single encoder module. It is also possible to insert multiple encoder modules. In this case, the encoder module in the slot with the lowest number is automatically used for motor feedback.
2) The BiSS encoder must be wired using a cable with a shield.
3) Requirements: The encoder is cabled using a shielded cable that has a wire cross section of at least 0.14 mm² for all signal lines and a wire cross section of at least 0.5 mm² for all encoder supply lines.
4) This value only applies to the encoder. The actual load capacity of the encoder supply is approx. 300 mA. The difference of approx. 50 mA covers the consumption of the terminating resistors, which are always present. For longer encoder cables, it is important to note that the maximum voltage drop permitted on the supply wires (there and back) is 1.45 V. This can reduce the permissible load current.

3.8.1.4 Wiring

3.8.1.4.1 Pinout

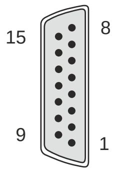
Figure	X11	Pin	Name	Function
		1	A	Channel A
		2	COM (1, 3 - 9, 11, 13 - 15)	Encoder supply 0 V
		3	B	Channel B
		4	+5V out / 0.25A	Encoder supply +5 V
		5	D	Data input
		6	---	---
		7	R\	Reference pulse inverted
		8	T	Clock output
		9	A\	Channel A inverted
		10	---	---
		11	B\	Channel B inverted
		12	---	---
		13	D\	Data inverted
		14	R	Reference pulse
		15	T\	Clock output inverted

Table 94: AC125 BiSS encoder interface - Pinout

Danger!

The connections for the encoders are isolated circuits. These connections are therefore only permitted to be connected to devices or components that have sufficient isolation in accordance with IEC 60364-4-41 or EN 61800-5-1.

3.8.2 8AC125.60-2

3.8.2.1 General information

The AC125 plug-in module has a BiSS encoder interface (MODE C) with a baud rate of 6.25 Mbit/s. BiSS encoders with a supply voltage of 5 V can be connected.

This plug-in module can be used to evaluate encoders installed in B&R servo motors as well as encoders for external axes (encoders that scan any machine movement). The input signals are monitored. This makes it possible to detect open or shorted lines as well as encoder supply failures.

3.8.2.2 Order data

Model number	Short description	Figure
	Plug-in modules	
8AC125.60-2	ACOPOS plug-in module, BiSS encoder interface 5V, baud rate 6.25 Mbit/s	

Table 95: 8AC125.60-2 - Order data

3.8.2.3 Technical data

Product ID	8AC125.60-2
General information	
Module type	ACOPOS plug-in module
B&R ID code	0xBD5A
Slot [1)]	Slots 2, 3 and 4
Max. power consumption	2.2 W
Certification	
CE	Yes
cULus	Yes
Encoder connection [2)]	
Module-side connection	9-pin female DSUB connector
Status indicators	UP/DN LEDs
Electrical isolation	
Encoder - ACOPOS	No
Encoder monitoring	Yes
Max. encoder cable length	100 m Depends on the cross section of the encoder's supply wires [3)]
Encoder supply	
Output voltage	5 V ... 5.25 V
Load capability	350 mA
Protective measures	
Overload protection	Yes
Short circuit protection	Yes
Synchronous serial interface	
Signal transmission	RS485
Baud rate	6.25 Mbit/s
Environmental conditions	
Temperature	
Operation	
Nominal	5 to 40°C
Maximum	55°C
Storage	-25 to 55°C
Transport	-25 to 70°C

Table 96: 8AC125.60-2 - Technical data

Product ID	8AC125.60-2
Relative humidity	
Operation	5 to 85%
Storage	5 to 95%
Transport	Max. 95% at 40°C

Table 96: 8AC125.60-2 - Technical data

1) The AC126 is an encoder module. Several encoder modules can also be inserted. In this case, the encoder module in the slot with the lowest number is automatically used for motor feedback.
2) B&R 8BCF EnDat 2.2 cables must be used when cabling the module.
3) The maximum encoder cable length I_{max} can be calculated as follows (the maximum permissible encoder cable length of 100 m must not be exceeded):

$I_{max} = 0.5 * (5.0 - U_{Gmin}) * A / [(I_G + 0.03) * \rho]$

U_{Gmin} ... Minimum permissible supply voltage of the encoder
I_G ... Max. current consumption of the encoder [A]
A ... Cross section of the supply wire [mm²]
ρ ... Specific resistance [Ωmm²/m] (e.g. for copper: ρ = 0.0178)

3.8.2.4 Wiring

3.8.2.4.1 Pinout

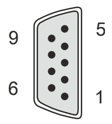
Figure	X11	Pin	Name	Function
		1	U+	Encoder supply +5 V
		2	---	---
		3	---	---
		4	D	Data input / output
		5	T	Clock output
		6	COM (1)	0 V encoder supply
		7	---	---
		8	D\	Data input / output inverted
		9	T\	Clock output inverted

Table 97: BiSS encoder interface 8AC125.60-2 - Pinout

Danger!

The connections for the encoders are isolated circuits. These connections are therefore only permitted to be connected to devices or components that have sufficient isolation in accordance with IEC 60364-4-41 or EN 61800-5-1.

3.8.2.4.2 Input/Output circuit diagram

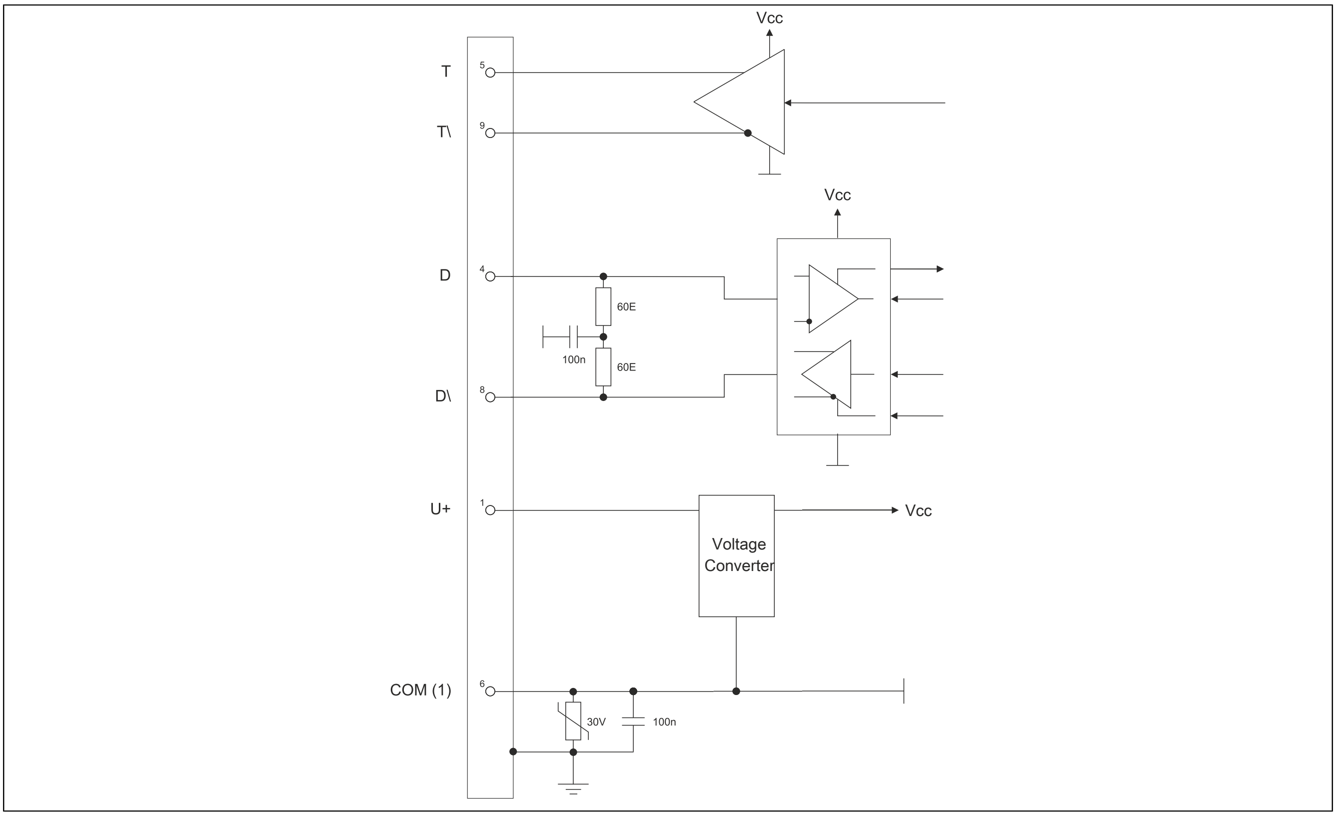


Figure 39: BISS encoder interface 8AC125.60-2 Input/Output circuit diagram

3.8.3 8AC125.61-2

3.8.3.1 General information

The AC125 plug-in module can be used in an ACOPOS slot. The module has a BISS encoder interface (MODE C) with a baudrate of 6.25 MBit/s. BiSS encoders with a supply voltage of 12 V can be connected.

This module can be used to evaluate encoders which are built into B&R servo motors and also encoders for external axes (encoders that evaluate any machine movement). The input signals are monitored. In this way, broken connections, shorted lines and encoder supply failure can be recognized.

3.8.3.2 Order data

Model number	Short description	Figure
	Plug-in modules	
8AC125.61-2	ACOPOS plug-in module, BiSS encoder interface 12V, baud rate 6.25 Mbit/s	

Table 98: 8AC125.61-2 - Order data

3.8.3.3 Technische Daten

Product ID	8AC125.61-2
General information	
Module type	ACOPOS plug-in module
B&R ID code	0xBD5A
Slot [1]	Slots 2, 3 and 4
Max. power consumption	5.8 W
Certification	
CE	Yes
cULus	Yes
Encoder connection [2]	
Module-side connection	9-pin female DSUB connector
Status indicators	UP/DN LEDs
Electrical isolation	
Encoder - ACOPOS	No
Encoder monitoring	Yes
Max. encoder cable length	100 m Depending on the cross section of the supply wires on the encoder cable [3]
Encoder supply	
Output voltage	Typ. 12 V
Load capability	350 mA
Protective measures	
Overload protection	Yes
Short circuit protection	Yes
Synchronous serial interface	
Signal transmission	RS485
Baud rate	6.25 Mbit/s
Environmental conditions	
Temperature	
Operation	
Nominal	5 to 40°C
Maximum	55°C
Storage	-25 to 55°C
Transport	-25 to 70°C

Table 99: 8AC125.61-2 - Technical data

Product ID	8AC125.61-2
Relative humidity	
Operation	5 to 85%
Storage	5 to 95%
Transport	Max. 95% at 40°C

Table 99: 8AC125.61-2 - Technical data

1) The AC126 is an encoder module. Several encoder modules can also be inserted. In this case, the encoder module in the slot with the lowest number is automatically used for motor feedback.
2) B&R 8BCF EnDat 2.2 cables must be used when cabling the module.
3) The maximum encoder cable length l_{max} can be calculated as follows (the maximum permissible encoder cable length of 100 m must not be exceeded):

l_{max} = 2.5 * A / [(I_G + 0.03) * ρ]

I_G ... Max. current consumption of the encoder [A]
A ... Cross section of the supply wire [mm²]
ρ ... Specific resistance [Ωmm²/m] (e.g. for copper: ρ = 0.0178)

3.8.3.4 Wiring

3.8.3.4.1 Pinout

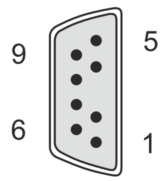
Figure	X11	Pin	Name	Function
		1	U+	Encoder supply +12 V
		2	---	---
		3	---	Coding
		4	D	Data input/output
		5	T	Clock output
		6	COM (1)	Encoder supply 0 V
		7	---	---
		8	D\	Data input/output inverted
		9	T\	Clock output inverted

Table 100: 8AC125.61-2 BiSS encoder interface - Pinout

Danger!

The connections for the encoders are isolated circuits. These connections are therefore only permitted to be connected to devices or components that have sufficient isolation in accordance with IEC 60364-4-41 or EN 61800-5-1.

3.8.3.4.2 Input/output circuit diagram

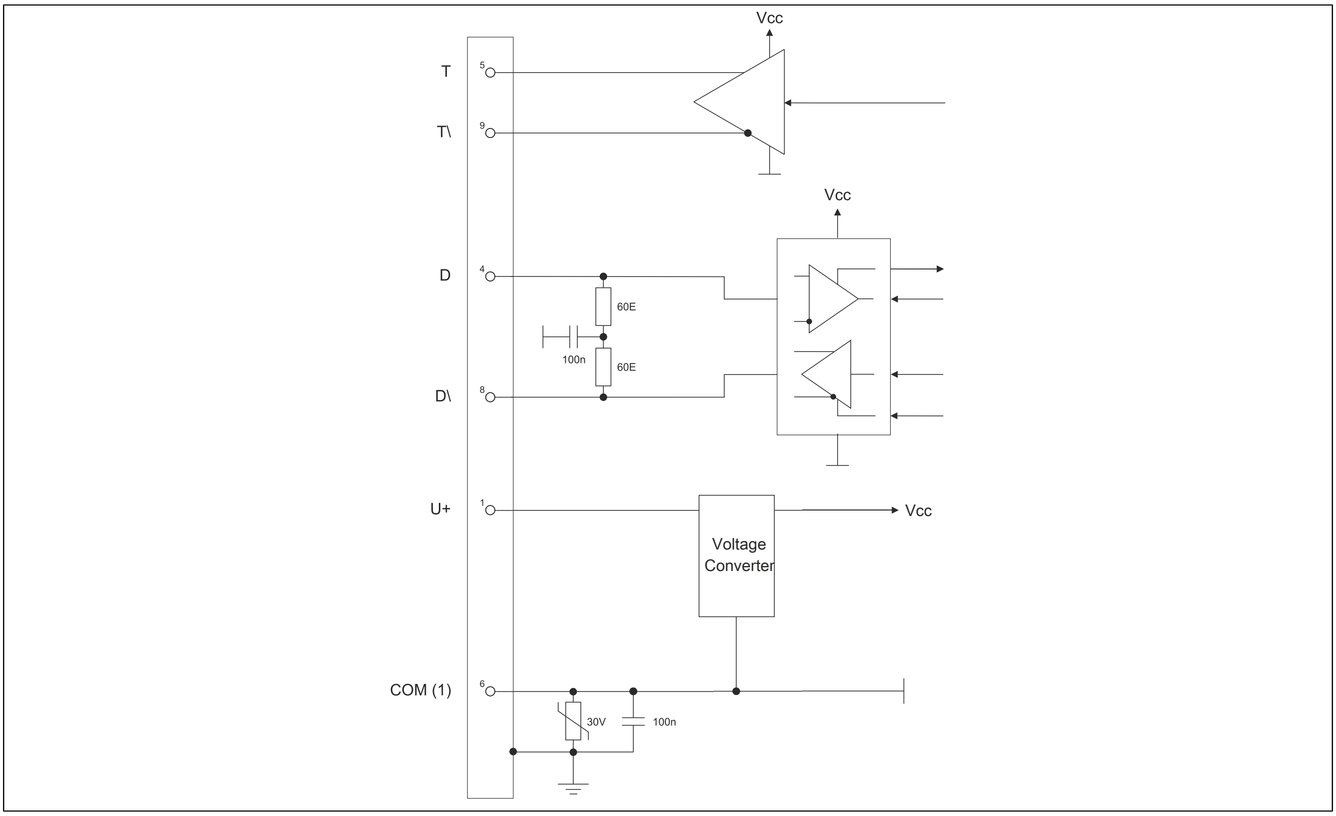


Figure 40: BISS encoder interface 8AC125.61-2 Input/Output circuit diagram

3.8.4 Status indicators

The UP/DN LEDs are lit depending on the rotational direction and the speed of the connected encoder.

UP LED ... Lit when the encoder position changes in the positive direction.
DN LED ... Lit when the encoder position changes in the negative direction.

The faster the encoder position changes, the brighter the respective LED is lit.

3.8.5 Firmware

The firmware is part of the operating system for the ACOPOS servo drives. Firmware is updated by updating the ACOPOS operating system.

3.9 AC126 - EnDat 2.2 module

3.9.1 General information

The AC126 plug-in module is equipped with an EnDat 2.2 encoder interface. This module can be used to evaluate encoders installed in B&R servo motor motors as well as encoders for external axes (encoders that sample any machine movement). The input signals are monitored. This makes it possible to detect open or shorted lines as well as encoder supply failures.

During startup, the plug-in module is automatically identified, configured and its parameters set by the ACOPOS servo drive operating system.

EnDat 2.2 encoder

EnDat 2.2 is a standard developed by Johannes Heidenhain GmbH (www.heidenhain.de) and is used in applications that demand high resolution and precision. Position data is transferred digitally via the serial port. With no analog signals, the number of cable conductors is reduced. EnDat 2.2 encoders also provide internal read/write parameter memory.

With absolute position measurement (the absolute position is sampled serially), a homing procedure for referencing is usually not required. Where necessary, a multi-turn encoder (4096 revolutions) should be installed. To save costs, a single-turn encoder and a reference switch can also be used. In this case, a homing procedure must be carried out.

The parameter memory in the encoder is used by B&R to store motor data (among other things). In this way, the ACOPOS drive system is always automatically provided the correct motor parameters and limit values. This parameter memory is referred to as the "embedded parameter chip".

EnDat 2.2 encoders with battery-backed multi-turn function:

When equipped with the optional 8AXB000.0000-0 battery module, the module also supports encoders with battery-backed multi-turn functionality. These are gearless multi-turn encoders that would lose position data in the event of a power failure. The battery voltage is automatically monitored by the encoder itself.

3.9.2 Order data

Model number	Short description	Figure
	Plug-in modules	
8AC126.60-1	ACOPOS plug-in module, EnDat 2.2 encoder interface	
	Required accessories	
	EnDat 2.2 cables	
8BCF0005.1221B-0	EnDat 2.2 cable, length 5 m, 1x 4x 0.14 mm² + 4x 0.34 mm², female 12-pin SpringTec connector, male 9-pin DSUB connector, can be used in cable drag chains, UL/CSA listed	
8BCF0007.1221B-0	EnDat 2.2 cable, length 7 m, 1x 4x 0.14 mm² + 4x 0.34 mm², female 12-pin SpringTec connector, male 9-pin DSUB connector, can be used in cable drag chains, UL/CSA listed	
8BCF0010.1221B-0	EnDat 2.2 cable, length 10 m, 1x 4x 0.14 mm² + 4x 0.34 mm², female 12-pin SpringTec connector, male 9-pin DSUB connector, can be used in cable drag chains, UL/CSA listed	
8BCF0015.1221B-0	EnDat 2.2 cable, length 15 m, 1x 4x 0.14 mm² + 4x 0.34 mm², female 12-pin SpringTec connector, male 9-pin DSUB connector, can be used in cable drag chains, UL/CSA listed	
8BCF0020.1221B-0	EnDat 2.2 cable, length 20 m, 1x 4x 0.14 mm² + 4x 0.34 mm², female 12-pin SpringTec connector, male 9-pin DSUB connector, can be used in cable drag chains, UL/CSA listed	
8BCF0025.1221B-0	EnDat 2.2 cable, length 25 m, 1x 4x 0.14 mm² + 4x 0.34 mm², female 12-pin SpringTec connector, male 9-pin DSUB connector, can be used in cable drag chains, UL/CSA listed	
	Optional accessories	
	Battery Modules	
8AXB000.0000-00	8AC126.60-1 accessory set for encoder buffering consisting of: Battery module with 3.6 V lithium battery	

Table 101: 8AC126.60-1 - Order data

3.9.3 Technical data

Product ID	8AC126.60-1
General information	
Module type	ACOPOS plug-in module
B&R ID code	0xBD5A
Slot [1)]	Slots 2, 3 and 4
Max. power consumption	4.4 W
Certification CE cULus KC	 Yes Yes Yes
Encoder connection [2)]	
Module-side connection	9-pin female DSUB connector
Status indicators	UP/DN LEDs, BAT LED
Electrical isolation Encoder - ACOPOS	 No
Encoder monitoring	Yes
Max. encoder cable length	100 m Depends on the cross section of the encoder's supply wires [3)]
Encoder supply	
Output voltage	Typ. 12 V
Load capability	300 mA [4)]
Protective measures Overload protection Short circuit protection	 Yes Yes
Synchronous serial interface	
Signal transmission	RS485
Baud rate	6.25 Mbit/s
Environmental conditions	
Temperature Operation Nominal Maximum Storage Transport	 5 to 40°C 55°C -25 to 55°C -25 to 70°C
Relative humidity Operation Storage Transport	 5 to 85% 5 to 95% Max. 95% at 40°C

Table 102: 8AC126.60-1 - Technical data

1) The AC126 is a single encoder module. It is also possible to insert multiple encoder modules. In this case, the encoder module in the slot with the lowest number is automatically used for motor feedback.
2) Only 8BCF EnDat 2.2 cables from B&R may be used to connect the module.
3) The maximum encoder cable length l_{max} can be calculated as follows (the maximum permissible encoder cable length of 100 m must not be exceeded):

$l_{max} = 2.5 * A / [(I_G + 0.03) * \rho]$

I_G ... Max. current consumption of the encoder [A]
A ... Cross section of the supply wire [mm²]
ρ ... Specific resistance [Ωmm²/m] (e.g. for copper: ρ = 0.0178)
4) An additional reserve exists for terminating resistors.

3.9.4 Status indicators

UP/DN LEDs

The UP/DN LEDs are lit depending on the rotational direction and the speed of the connected encoder.

UP LED ... Lit when the encoder position changes in the positive direction.
DN LED ... Lit when the encoder position changes in the negative direction.

The faster the encoder position changes, the brighter the respective LED is lit.

BAT LED

The BAT LED is used to monitor the backup battery on the optional battery module 8AXB000.0000-00.

Color	Description	
Green/Red	Green (lit)	Backup pattery voltage OK
	Red (lit)	Backup battery voltage too low or line break
	LED not lit	No encoder with battery-backed multi-turn functionality connected to module

Table 103: BAT Status LED - AC126

3.9.5 Firmware

The firmware is part of the operating system for the ACOPOS servo drives. Firmware is updated by updating the ACOPOS operating system.

3.9.6 Wiring

3.9.6.1 Pinout

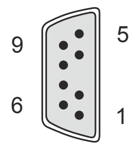
Figure	X11	Pin	Name	Function
		1	U+	+12 V encoder supply
		2	VBATT	Battery output 3.6 V
		3	---	Keying
		4	D	Data input / output
		5	T	Clock output
		6	COM (1)	Encoder supply 0 V
		7	COM (2)	Battery output 0 V
		8	D\	Data input / output inverted
		9	T\	Clock output inverted

Table 104: AC126 EnDat 2.2 interface - Pinout

Danger!

The connections for the encoders are isolated circuits. These connections are therefore only permitted to be connected to devices or components that have sufficient isolation in accordance with IEC 60364-4-41 or EN 61800-5-1.

Information:

If an encoder with battery-backed multi-turn functionality is to be connected, pins 2 and 7 must be wired to the encoder and a 8AXB000.0000-00 battery module must be used.

Information:

Only 8BCF EnDat 2.2 cables from B&R may be used to connect the module.

3.10 AC130 - Digital mixed module

3.10.1 General information

The AC130 plug-in module makes a maximum of 8 digital inputs or 10 digital outputs available.

I/O points can be configured in pairs as inputs or outputs. The first three inputs have incremental encoder functionality (A, B, R).

The inputs are divided into 4 standard (max. 10 kHz) and 4 high speed (max. 100 kHz) inputs.

The outputs include 4 high speed (push-pull) outputs with a maximum current of 100 mA, 4 standard (high-side) outputs with a maximum current of 400 mA and 2 low speed (high-side) outputs with a maximum current of 2 A. All outputs can be read.

3.10.2 Order data

Model number	Short description	Figure
	Plug-in modules	
8AC130.60-1	ACOPOS plug-in module, 8 digital I/O configurable in pairs as 24 V input or as output 400/100 mA, 2 digital outputs 2 A, order TB712 terminal block separately.	
	Required accessories	
	Terminal blocks	
7TB712:90-02	2003 B&R terminal block, 12 pin 20 pieces, screw clamp	
7TB712:91-02	2003 B&R terminal block, 12 pin 20 pieces, cage clamp	
7TB712.9	Accessory terminal block, 12-pin, screw clamp 1.5 mm²	
7TB712.91	Accessory terminal block, 12-pin, cage clamp 1.5 mm²	

Table 105: 8AC130.60-1 - Order data

3.10.3 Technical data

Product ID	8AC130.60-1
General information	
Module type	ACOPOS plug-in module
B&R ID code	0x1068
Slot [1]	Slots 3 and 4
Power consumption	Max. 0.8 W
Certification CE cULus KC	 Yes Yes Yes
Inputs/Outputs	
Module-side connection	12-pin connector
Status indicators	Status LED (24 V)
Configuration of digital inputs/outputs	Configured in pairs as input or output
Incremental encoder	
Counter size	16-bit
Input frequency	Max. 62.5 kHz
Evaluation	4x
Signal form	Square wave pulse
Encoder monitoring	No
Counter frequency	Max. 250 kHz
Reference frequency	Max. 62.5 kHz
Distance between edges	Min. 2.5 µs
Inputs Input 1 Input 2 Input 3	 Channel A Channel B Reference pulse R
Power supply	
Voltage monitoring (24 V - LED)	Yes, supply voltage >18 V
Reverse polarity protection	Yes
Power supply Minimum Nominal Maximum	 18 VDC 24 VDC 30 VDC

Table 106: 8AC130.60-1 - Technical data

Product ID	8AC130.60-1
Digital inputs 2)	
Quantity	Max. 8
Wiring	Sink
Switching threshold Low High	 <5 V >15 V
Input voltage Nominal Maximum	 24 VDC 30 VDC
Input current at nominal voltage Channel 1-4 Channel 5-8	 Approx. 10 mA Approx. 5.5 mA
Electrical isolation Channel - ACOPOS Channel - Channel	 Yes No
Switching delay Channel 1-4 Channel 5-8	 Max. 5 µs Max. 35 µs
Event counter	
Signal form	Square wave pulse
Input frequency	Max. 100 kHz
Counter size	16-bit
Inputs Input 1 Input 2	 Counter 1 Counter 2
Digital outputs	
Quantity	Max. 10
Readable outputs	Yes
Continuous current Outputs 1 - 4 Outputs 5 - 8 Outputs 9 - 10	 Max. 100 mA Max. 400 mA Max. 2 A
Short circuit current at 24 V (until cutoff) Outputs 1 - 4 Outputs 5 - 8 Outputs 9 - 10	 Approx. 1 A Approx. 1.2 A Approx. 24 A
Electrical isolation Output - ACOPOS Output - Output	 Yes No
Switching frequency (resistive load) Outputs 1 - 2 Outputs 3 - 4 Outputs 5 - 8 Outputs 9 - 10	 Max. 10 kHz 3) Max. 10 kHz 3) Max. 5 kHz Max. 100 Hz
Switching voltage Minimum Nominal Maximum	 18 VDC 24 VDC 30 VDC
Switching delay 0 -> 1 and 1 -> 0 Outputs 1 - 4 Outputs 5 - 8 Outputs 9 - 10	 Max. 5 µs Max. 50 µs Max. 500 µs
Protection Short circuit protection Overload protection	 Yes Yes
Type Outputs 1 - 4 Outputs 5 - 10	 Transistor outputs push-pull High-side transistor outputs
Environmental conditions	
Temperature Operation Nominal Maximum Storage Transport	 5 to 40°C 55°C -25 to 55°C -25 to 70°C
Relative humidity Operation Storage Transport	 5 to 85% 5 to 95% Max. 95% at 40°C

Table 106: 8AC130.60-1 - Technical data

1) The AC130 can also be used as an encoder module. Several encoder modules can also be inserted. In this case, the encoder module in the slot with the lowest number is automatically used for motor feedback.
2) Shielded cables must be used for inputs 1 - 4.
3) Encoder emulation mode: Max. 65 kHz.

3.10.4 Status indicators

Labeling	Color	Function	Description	
24 V	Green	Status	LED not lit	Supply voltage on pin 11 and pin 12 of the module accounts for less than 18 VDC
			LED is lit	Supply voltage on pin 11 and pin 12 of the module accounts for more than 18 VDC
			LED is blinking [1)]	Module error: • ACOPOS network error • Overvoltage on digital O 9 and/or digital O 10 • One or more I/O drives are defective • Incremental encoder emulation mode: Frequency too high

Table 107: LED status 8AC130

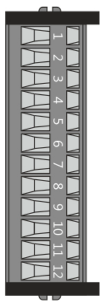
1) The LED blinks if supply voltage on pin 11 and pin 12 of the module accounts for more than 18 VDC.

3.10.5 Firmware

The firmware is part of the operating system for the ACOPOS servo drives. Firmware is updated by updating the ACOPOS operating system.

3.10.6 Wiring

3.10.6.1 Pinout

Figure	X11	Pin	Name	Function
		1	Digital I/O 1	Digital input/output 1
		2	Digital I/O 2	Digital input/output 2
		3	Digital I/O 3	Digital input/output 3
		4	Digital I/O 4	Digital input/output 4
		5	Digital I/O 5	Digital input/output 5
		6	Digital I/O 6	Digital input/output 6
		7	Digital I/O 7	Digital input/output 7
		8	Digital I/O 8	Digital input/output 8
		9	Digital O 9	Digital output 9
		10	Digital O 10	Digital output 10
		11	+24 V	+24 V supply
		12	COM (1 - 11)	0 V supply

Terminal cross sections	[mm²]	[AWG]
Solid core / multiple-conductor lines	0.5 - 1.5	20 - 14
Flexible, multiple wire line Without wire end sleeves With wire end sleeves	 0.5 - 1.5 0.5 - 1.5	 20 - 14 20 - 14
Approbation Data (UL/C-UL-US- and CSA) UL/C-UL-US CSA	 --- ---	 26 - 14 26 - 14
Tightening torque for the terminal screws [Nm]	0.2 ... 0.25	

Table 108: AC130 digital mixed module - Pinout

Danger!

The digital inputs are isolated circuits. Therefore, these connections are only allowed to be connected to devices or components with at least safe isolation in accordance with IEC 60364-4-41 or EN 61800-5-1.

3.10.6.2 Input/Output circuit diagram

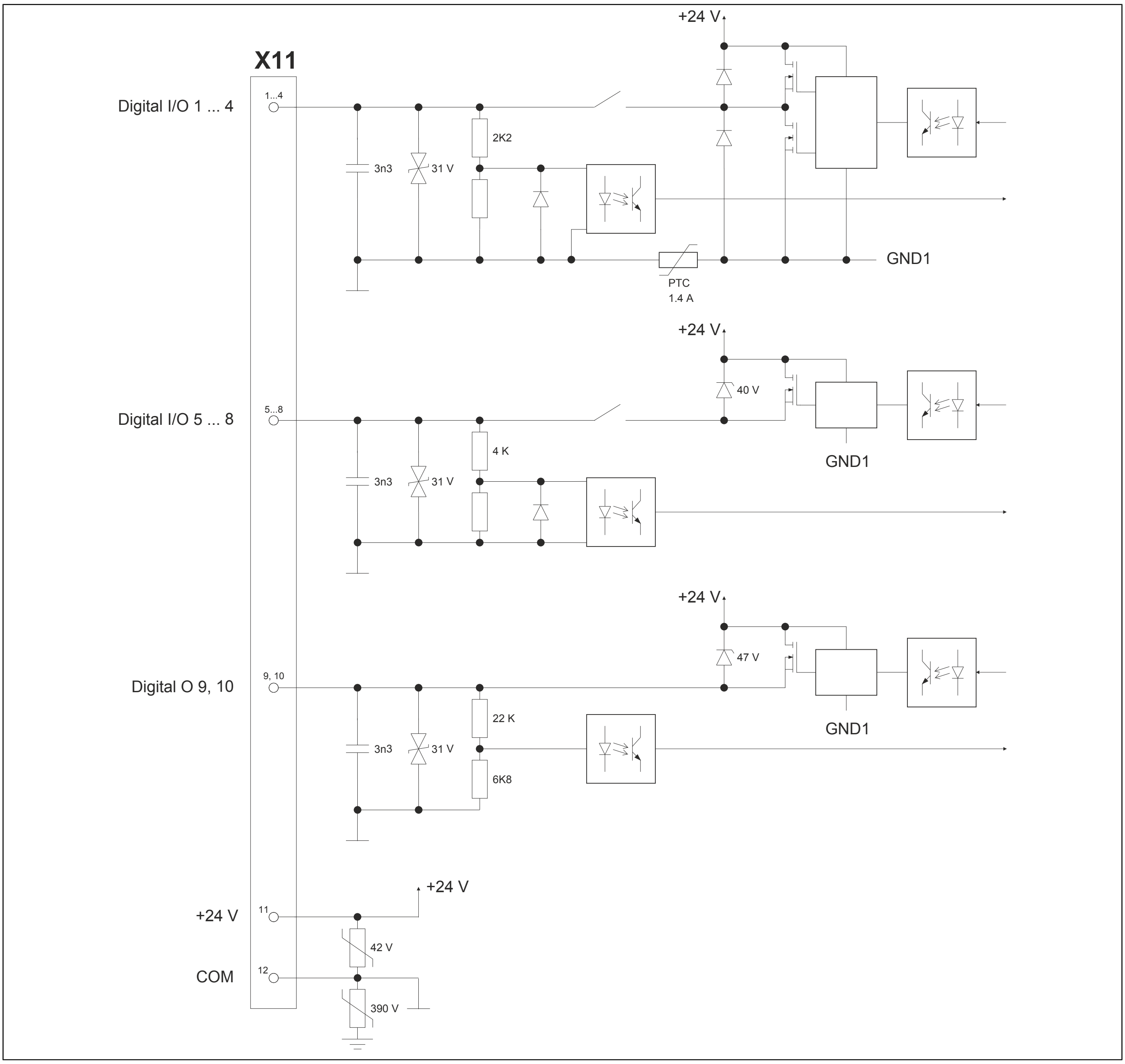


Figure 41: AC130 - Input/Output circuit diagram

3.11 AC131 - Mixed module

3.11.1 General information

The AC131 plug-in module provides a maximum of 2 analog inputs (±10 V differential inputs or single-ended inputs) and 2 digital inputs or digital outputs.

The analog inputs have a resolution of 12 bits and are scanned synchronously using the 50 µs clock for the ACOPOS servo drive. The analog inputs have a 10 kHz analog input filter (3rd order low pass).

The digital inputs and outputs can be configured individually as input or output. The digital inputs are equipped with a counter function. The digital outputs (push-pull) can be read.

3.11.2 Order data

Model number	Short description	Figure
	Plug-in modules	
8AC131.60-1	ACOPOS plug-in module, 2 analog inputs ±10 V, 2 digital I/O points which can be configured as a 24 V input or 45 mA output, order TB712 terminal block separately.	
	Required accessories	
	Terminal blocks	
7TB712:90-02	2003 B&R terminal block, 12 pin 20 pieces, screw clamp	
7TB712:91-02	2003 B&R terminal block, 12 pin 20 pieces, cage clamp	
7TB712.9	Accessory terminal block, 12-pin, screw clamp 1.5 mm²	
7TB712.91	Accessory terminal block, 12-pin, cage clamp 1.5 mm²	

Table 109: 8AC131.60-1 - Order data

3.11.3 Technical data

Product ID	8AC131.60-1
General information	
Module type	ACOPOS plug-in module
B&R ID code	0x11E9
Slot	Slots 2, 3 and 4
Power consumption	Max. 1 W
Certification	
CE	Yes
cULus	Yes
KC	Yes
Inputs/Outputs	
Module-side connection	12-pin connector
Status indicators	24 V LED
Configuration of digital inputs/outputs	Individually configurable as digital inputs or outputs
Power supply	
Voltage monitoring (24 V - LED)	Yes, supply voltage >18 V
Reverse polarity protection	Yes
Power supply	
Minimum	18 VDC
Nominal	24 VDC
Maximum	30 VDC
Digital inputs	
Quantity	Max. 2
Modulation compared to ground potential	Max. ±50 V
Wiring	Sink
Input current at nominal voltage	Approx. 8 mA
Switching threshold	
Low	<5 V
High	>15 V
Input voltage	
Nominal	24 VDC
Maximum	30 VDC
Electrical isolation	
Channel - ACOPOS	Yes
Channel - Channel	No

Table 110: 8AC131.60-1 - Technical data

Product ID	8AC131.60-1
Switching delay Counters Digital input	 Max. 5 µs Max. 55 µs (digitally filtered)
Event counter	
Signal form	Square wave pulse
Input frequency	Max. 100 kHz
Counter size	16-bit
Inputs Input 1 Input 2	 Counter 1 Counter 2
Analog inputs	
Quantity	2
Digital converter resolution	12-bit
Conversion time	<50 µs
Output format	INT16 $8000 - $7FF0 LSB = $0010 = 4.883 mV
Design	Differential input or single ended input
Electrical isolation Input - ACOPOS Input - Input	 Yes No
Input signal Nominal Maximum	 -10 to +10 V -15 to +15 V
Operating modes	Cyclic measurement synchronous to 50 µs ACOPOS clock
Conversion procedure	Successive approximation
Input filter	Analog 3rd order low pass / cut-off frequency: 10 kHz
Gain drift	Max. ±0.006% / °C 1)
Offset drift	Max. ±0.0005% / °C 1)
Common-mode rejection DC 50 Hz	 Min. -73 dB Min. -73 dB
Crosstalk between analog inputs	Min. -90 dB at 1kHz
Non-linearity	±1 LSB
Differential input impedance	>10 MΩ
Modulation compared to ground potential	Max. ±50 V
Modulation between analog input channels	Max. ±5 V
Basic accuracy at 25°C	±0.05% 1)
Environmental conditions	
Temperature Operation Nominal Maximum Storage Transport	 5 to 40°C 55°C -25 to 55°C -25 to 70°C
Relative humidity Operation Storage Transport	 5 to 85% 5 to 95% Max. 95% at 40°C

Table 110: 8AC131.60-1 - Technical data

1) Based on the measurement range end value.

3.11.4 Status indicators

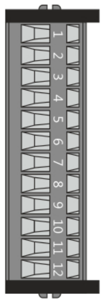
The 24V LED is lit as soon as the supply voltage for the plug-in module goes above 18 VDC.

3.11.5 Firmware

The firmware is part of the operating system for the ACOPOS servo drives. Firmware is updated by updating the ACOPOS operating system.

3.11.6 Wiring

3.11.6.1 Pinout

Figure	X11	Pin	Name	Function
		1	Analog I 1 +	Analog input 1 plus
		2	Analog I 1 -	Analog input 1 minus
		3	COM (1, 2, 5, 6)	0 V analog input
		4	Shield	Shield
		5	Analog I 2 +	Analog input 2 plus
		6	Analog I 2 -	Analog input 2 minus
		7	COM (1, 2, 5, 6)	0 V analog input
		8	Shield	Shield
		9	Digital I/O 1	Digital input/output 1
		10	Digital I/O 2	Digital input/output 2
		11	+24 V	+24 V supply
		12	COM (9 - 11)	0 V supply

Terminal cross sections	[mm²]	[AWG]
Solid core / multiple-conductor lines	0.5 - 1.5	20 - 14
Flexible, multiple wire line Without wire end sleeves With wire end sleeves	 0.5 - 1.5 0.5 - 1.5	 20 - 14 20 - 14
Approbation Data (UL/C-UL-US- and CSA) UL/C-UL-US CSA	 --- ---	 26 - 14 26 - 14
Tightening torque for the terminal screws [Nm]	0.2 ... 0.25	

Table 111: AC131 mixed module - Pinout

3.11.6.2 Input/Output circuit diagram

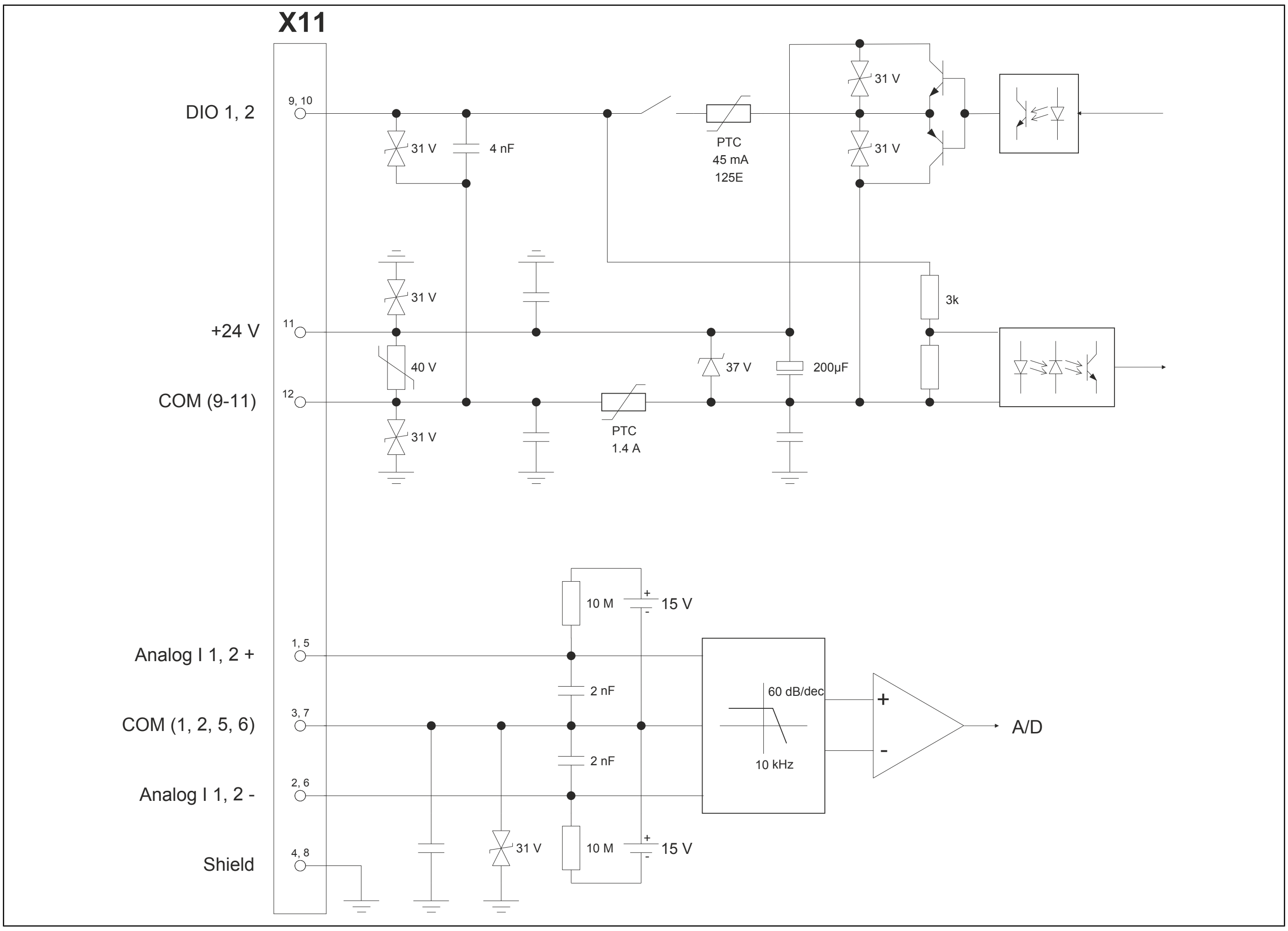


Figure 42: AC131 - Input/Output circuit diagram

3.12 AC140 - CPU module

3.12.1 General information

The AC140 plug-in module makes it possible to operate an ACOPOS servo drive without an external PLC and is also available with an integrated "Soft CNC" system (8AC140.61-3).

The module is equipped with up to four application interfaces:

- One RS232 interface (IF1) for programming and configuring using B&R Automation Studio™
- One CAN interface (IF2) for connecting to a CAN network
- one PROFIBUS DP slave interface (IF3) for connecting to a PROFIBUS network
- One Ethernet interface (IF6) for connecting to an Ethernet network (only 8AC140.61-3).

Communication in the ACOPOS network occurs as described in the section "Drive-based control" on page 22.

The ACOPOS servo drive in which the AC140 is plugged into is connected via emulation of an AC110 CAN interface plug-in module in slot 1. All other CAN stations are connected via the IF2 CAN interface.

This module offers interchangeable application memory in the form of a CompactFlash card as well as a separate backup battery for the module. [4)]

In addition, a maximum of three digital inputs / outputs are provided as well as one analog input (±10 V differential input).

The digital inputs and outputs can be configured individually as an input or output. Additional functions such as a counter function with direction switching (stepper motor) or period and gate measurement are integrated.
The inputs and outputs are scanned directly by the CPU module; the ACOPOS servo drive does not have direct access to these inputs and outputs.

The analog input has a resolution of 12 bits and an analog input filter with 10 kHz (3rd-order low pass).

The AC140 CPU module is run as a double-width plug-in module and occupies two slots.

3.12.2 Order data - 8AC140.60-3

Model number	Short description	Figure
	Plug-in modules	
8AC140.60-3	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 1 CAN interface, 1 Ethernet interface 100 Base-T, 1 PROFIBUS DP slave interface, 1 RS232 interface, 3 digital I/O can be configured as 24 VDC input or 500 mA output, 1 analog input ±10 V, order program memory and 0TB708 terminal block separately.	
	Required accessories	
	CompactFlash-cards	
0CFCRD.0128E.01	CompactFlash 128 MB WD extended temp.	
0CFCRD.0512E.01	CompactFlash 512 MB WD extended temp.	
5CFCRD.0064-03	CompactFlash 64 MB Western Digital (SLC)	
5CFCRD.0128-03	CompactFlash 128 MB Western Digital (SLC)	
5CFCRD.0256-03	CompactFlash 256 MB Western Digital (SLC)	
5CFCRD.0512-03	CompactFlash 512 MB Western Digital (SLC)	
5CFCRD.1024-03	CompactFlash 1 GB Western Digital (SLC)	
5CFCRD.2048-03	CompactFlash 2 GB Western Digital (SLC)	
5CFCRD.4096-03	CompactFlash 4 GB Western Digital (SLC)	
5CFCRD.8192-03	CompactFlash 8 GB Western Digital (SLC)	
	Terminal blocks	
0TB704.91	Accessory terminal block, 4-pin, cage clamps 2.5 mm²	
0TB708:91-02	Accessory terminal block, 8 pins, 20 pieces cage clamp 1,5 mm²	
0TB708.91	Accessory terminal block, 8-pin, cage clamp 1.5 mm²	
	Optional accessories	
	Batteries	
0AC201.91	Lithium batteries 4 pcs., 3 V / 950 mAh button cell We hereby state that the lithium cells contained in this shipment qualify as "partly regulated". Handle with care. If the package is damaged, inspect the cells, repack intact cells and protect the cells against short circuit. For emergency information, call RENATA SA at +41 61 319 28 27.	
	Cables	
0G0001.00-090	PC - PLC/PW cable, RS232, online cable	
	Infrastructure components	

Table 112: 8AC140.60-3 - Order data

4) Application memory must be ordered separately.

Model number	Short description	Figure
0AC912.9	Bus adapter, CAN, 1 CAN interface	
0AC913.92	Bus adapter, CAN, 2 CAN interfaces, including 30 cm attachment cable (DSUB)	
7AC911.9	Bus connector, CAN	

Table 112: 8AC140.60-3 - Order data

3.12.3 Order data - 8AC140.61-3

Model number	Short description	Figure
	Plug-in modules	
8AC140.61-3	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 1 CAN interface, 1 Ethernet interface 100 Base-T, 1 PROFIBUS DP slave interface, 1 RS232 interface, 3 digital I/O can be configured as 24 VDC input or 500 mA output, 1 analog input ±10 V, order program memory and 0TB708 terminal block separately.	
	Required accessories	
	CompactFlash-cards	
0CFCRD.0128E.01	CompactFlash 128 MB WD extended temp.	
0CFCRD.0512E.01	CompactFlash 512 MB WD extended temp.	
5CFCRD.0064-03	CompactFlash 64 MB Western Digital (SLC)	
5CFCRD.0128-03	CompactFlash 128 MB Western Digital (SLC)	
5CFCRD.0256-03	CompactFlash 256 MB Western Digital (SLC)	
5CFCRD.0512-03	CompactFlash 512 MB Western Digital (SLC)	
5CFCRD.1024-03	CompactFlash 1 GB Western Digital (SLC)	
5CFCRD.2048-03	CompactFlash 2 GB Western Digital (SLC)	
5CFCRD.4096-03	CompactFlash 4 GB Western Digital (SLC)	
5CFCRD.8192-03	CompactFlash 8 GB Western Digital (SLC)	
	Terminal blocks	
0TB704.9	Accessory terminal block, 4-pin, screw clamps 2.5 mm²	
0TB704.91	Accessory terminal block, 4-pin, cage clamps 2.5 mm²	
0TB708:91-02	Accessory terminal block, 8 pins, 20 pieces cage clamp 1,5 mm²	
0TB708.91	Accessory terminal block, 8-pin, cage clamp 1.5 mm²	
	Optional accessories	
	Batteries	
0AC201.91	Lithium batteries 4 pcs., 3 V / 950 mAh button cell We hereby state that the lithium cells contained in this shipment qualify as "partly regulated". Handle with care. If the package is damaged, inspect the cells, repack intact cells and protect the cells against short circuit. For emergency information, call RENATA SA at +41 61 319 28 27.	
	Cables	
0G0001.00-090	PC - PLC/PW cable, RS232, online cable	
	Infrastructure components	
0AC912.9	Bus adapter, CAN, 1 CAN interface	
0AC913.92	Bus adapter, CAN, 2 CAN interfaces, including 30 cm attachment cable (DSUB)	
0G1000.00-090	Bus connector, RS485, for PROFIBUS networks	
7AC911.9	Bus connector, CAN	

Table 113: 8AC140.61-3 - Order data

3.12.4 Technical data

Product ID	8AC140.60-3	8AC140.61-3
General information		
Module type	ACOPOS double-width plug-in module	
B&R ID code	0x26D9	0x2276
Slot [1]	Slots 1 + 2	
Power consumption	Max. 4.5 W	
ACOPOS capability	Yes	
Visual Components support	Yes	
Certification CE cULus KC	 Yes Yes -	 Yes
Controller		
Operating system	AC140 (version V2.67 and higher)	
DRAM	32 MB	
Processor clock	100 MHz	
SRAM	32 kB	
Inputs/Outputs		
Module-side connection	8-pin connector	
Configuration of digital inputs/outputs	Individually configurable as inputs or outputs	
Interfaces		
IF1 interface Type Design Status indicators Electrical isolation Max. baud rate Max. distance	 RS232 Male 9-pin DSUB connector X1 LED No 115.2 kbaud 15 m / 19200 Baud	
IF2 interface Type Design Status indicators Bus terminating resistor Electrical isolation Max. distance Network-capable Max. transfer rate Bus length ≤60 m Bus length ≤200 m Bus length ≤1000 m	 CAN bus Male 9-pin DSUB connector RX / TX LEDs Externally wired Yes 1000 m Yes 500 kbit/s 250 kbit/s 50 kbit/s	
IF3 interface Type Design Status indicators Bus terminating resistor Controller Electrical isolation RAM Max. distance Network-capable Transfer protocol Max. transfer rate Bus length ≤100 m Bus length ≤200 m Bus length ≤400 m Bus length ≤1000 m	 RS485 Female 9-pin DSUB connector PB LED External T-connector ASIC SPC3 Yes 1.5 kB 1000 m Yes PROFIBUS DP 12 Mbit/s 1.5 Mbit/s 500 kbit/s 187.5 kbit/s	
IF5 interface Type Design Status indicators Baud rate Electrical isolation Max. distance Network-capable	 Ethernet Male RJ45 connector ACT LED 10/100 Mbit/s Yes 100 m Yes	
Incremental encoder		
Counter size	16-bit	
Input frequency	Max. 20 kHz	
Evaluation	4x	
Signal form	Square wave pulse	
Encoder monitoring	No	
Counter frequency	Max. 80 kHz	
Reference frequency	Max. 20 kHz	
Distance between edges	Min. 5 µs	

Table 114: 8AC140.60-3, 8AC140.61-3 - Technical data

Product ID	8AC140.60-3	8AC140.61-3
Inputs Input 1 Input 2 Input 3	Channel A Channel B Reference pulse R	
Digital inputs [2]		
Quantity	Max. 3	
Modulation compared to ground potential	Max. ±30 V	
Wiring	Sink	
Input current at nominal voltage	Approx. 4.2 mA	
Input delay	<5 µs	
Switching threshold Low High	 <5 V >15 V	
Input voltage Nominal Maximum	 24 VDC 30 VDC	
Electrical isolation Channel - ACOPOS Channel - Channel	 Yes No	
Event counter		
Signal form	Square wave pulse	
Input frequency	Max. 100 kHz	
Pulse length	Min. 5 µs	
Counter size	32-bit	
Inputs Input 1	 Counter 1	
Gate measurement		
Signal form	Square wave pulse	
Counter frequency Internal External	 31.25 kHz or 4 MHz Max. 100 kHz	
Pulse length	Min. 5 µs	
Gate frequency	Max. 100 kHz	
Period measurement		
Signal form	Square wave pulse	
Input frequency	Max. 100 kHz	
Pulse length	Min. 5 µs	
Counter frequency Internal External	 31.25 kHz or 4 MHz Max. 100 kHz	
Analog inputs		
Digital converter resolution	12-bit	
Conversion time	<50 µs	
Output format	INT 16 $8001 - $7FFF LSB = $0010 = 4.88 mV	
Design	Differential input	
Electrical isolation Input - ACOPOS [3]	 No, max. modulation: ±13 V	
Input signal Nominal Maximum	 -10 to +10 V -13 to +13 V	
Operating modes	Cyclic measurement non-synchronous to 50 µs ACOPOS clock	
Conversion procedure	Successive approximation	
Input filter	Analog low pass 3rd-order Cut-off frequency: 10 kHz	
Common-mode rejection DC 50 Hz	 Min. 73 dB Min. 73 dB	
Non-linearity	±2 LSB	
Differential input impedance	20 MΩ	
Digital outputs		
Quantity	Max. 3	
Readable outputs	Yes	
Continuous short circuit current at 24 V	Typ. 4 A	
Continuous current	Max. 500 mA	
Switching frequency (resistive load)	Max. 100 Hz	
Switching delay	Max. 500 µs (typ. 250 µs)	
Type	High-side transistor outputs	
Electrical isolation Output - ACOPOS Output - Output	 Yes No	

Table 114: 8AC140.60-3, 8AC140.61-3 - Technical data

Product ID	8AC140.60-3	8AC140.61-3
Switching voltage		
Minimum	18 VDC	
Nominal	24 VDC	
Maximum	30 VDC	
Protection		
Short circuit protection	Yes	
Overload protection	Yes	
Environmental conditions		
Temperature		
Operation		
Nominal	5 to 40°C	
Maximum	55°C	
Storage	-25 to 55°C	
Transport	-25 to 70°C	
Relative humidity		
Operation	5 to 85%	
Storage	5 to 95%	
Transport	Max. 95% at 40°C	

Table 114: 8AC140.60-3, 8AC140.61-3 - Technical data

1) The AC140 is a double-width module that occupies slots 1 and 2.
2) Shielded cables must be used for inputs 1 - 3.
3) External electrical isolation of the connected sensors is recommended since the analog input is not electrically isolated.

3.12.5 Indicators

Image	LED	Product ID	Color	Description
	❶	Status (RUN)	Red Red with orange blinking Red/green blinking (1 Hz) Orange Green Green with orange blinking	ERROR/RESET Load/unload and start BOOT AR Startup of BOOT or CF - AR SERVICE/DIAG/BOOT mode RUN RUN - BATTERY LOW
	❷	RS232 (X1)	Orange blinking	Data transfer to application interface IF1 (RS232)
	❸	PROFIBUS (PB)	Orange	Data transfer on application interface IF3 (PROFIBUS)
	❹	Ethernet (ACT)	Orange Orange blinking	Ethernet LINK (IF6) Ethernet ACTIVE (IF6)
	❺	CAN (RX)	Orange	Receive data on application interface IF2 (CAN)
	❻	CAN (TX)	Orange	Send data to application interface IF2 (CAN)

Table 115: Indicators - 8AC140.60-3, 8AC140.61-3

3.12.6 Setting the CAN node number (IF2)

The CAN node number can be set using two HEX code switches:

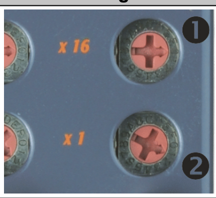
Image	Code switch	Description
	❶	CAN node number 16s position (high)
	❷	CAN node number 1s position (low)
	The settings $00, and $FF are reserved for special functions. **$00:** In this switch position, the operating system can be programmed via the online interface. User Flash is only deleted after the update begins. **$FF:** Diagnostics mode.	

Table 116: Setting the CAN node number

A changed CAN node number will take effect the next time the ACOPOS servo drive is switched on.

There must be a terminating resistor (120 Ω, 0.25 W) between CAN_H and CAN_L at the beginning and end of the CAN bus.

Information:

The CAN bus IF2 is always made up of at least two stations that are integrated in the AC140. These are the AC140 CPU and an AC110 emulation, which the ACOPOS uses for communication. Therefore, the AC140 CPU prevents a potential error in which no other stations are found on the CAN bus. This is why the AC140 CPU does not register a hardware error if there is no physical connection to external CAN devices.

3.12.7 Setting the PROFIBUS node number (IF3)

The PROFIBUS node number can be set using two HEX code switches:

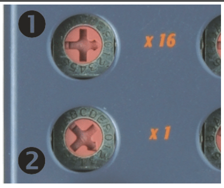
Image	Code switch	Description
	❶	PROFIBUS node number 16s position (high)
	❷	PROFIBUS node number 1s position (low)

Table 117: Setting the PROFIBUS node number

A changed PROFIBUS node number will take effect the next time the ACOPOS servo drive is switched on.

3.12.8 Setting the Ethernet network address (IF6)

The Ethernet network address can be set using software (B&R Automation Studio).

3.12.9 Reset button

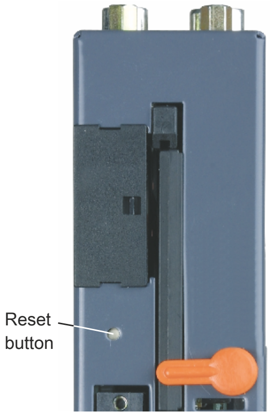
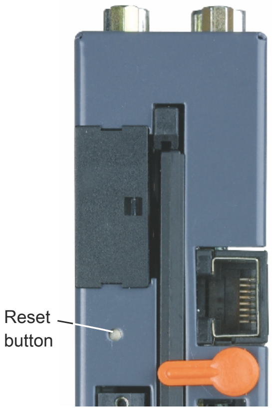
View (view from below)		Description
 8AC140.60-3	 8AC140.61-3	The reset button can be pressed with any small pointed object (e.g. paper clip). Pressing the reset button triggers a hardware reset, which means: • all application programs are stopped. • all outputs are set to zero. The AC140 then switches to SERVICE mode.

Table 118: Reset button

3.12.10 Slot for application memory (CompactFlash)

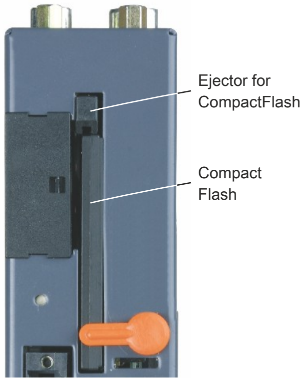
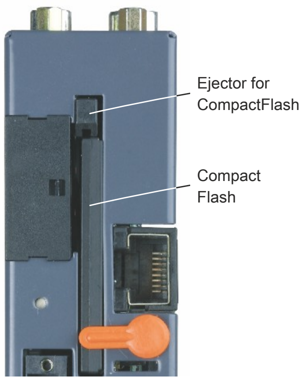
View (view from below)		Description
 8AC140.60-3	 8AC140.61-3	Program memory is required to operate the AC140. The application memory is CompactFlash. This is not included with the delivery of the AC140. CompactFlash must be ordered separately as an accessory! The CompactFlash memory card is used in the slot on the bottom of the AC140. Press the eject button to remove the card. The CompactFlash memory card can be secured with the safety clip.

Table 119: Application memory

3.12.11 Backup battery AC140

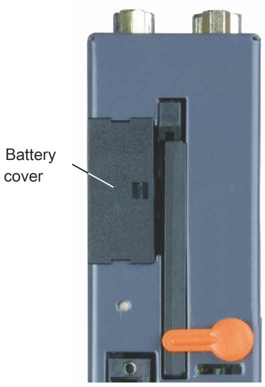
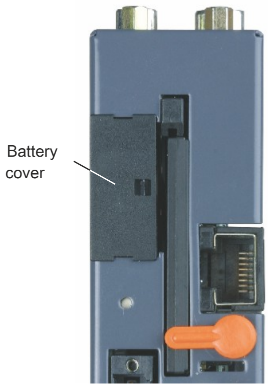
View (view from below)		Description	
 8AC140.60-3	 8AC140.61-3	The AC140 is equipped with a lithium battery. The lithium battery is placed in a separate compartment on the bottom of the module and protected by a cover.	
		Backup battery data	
		Lithium battery	3V / 950 mAh
		Model number	0AC201.91
		Short description	Lithium batteries, 4 pcs., 3 V / 950 mAh, button cell
		Storage temperature	-20 to +60°C
		Storage time	Max. 3 years at 30°C
		Relative humidity	0 to 95%, non-condensing

Table 120: Backup battery

Data / real-time buffering

The following areas are buffered:

- Remanent variables
- User RAM
- System RAM
- Real-time clock

Battery monitoring

The battery voltage is checked cyclically. The cyclic load test of the battery does not considerably shorten the battery life, instead it gives an early warning of weakened buffer capacity.

The status information "Battery OK" is available from the "BatteryInfo" system library function.

Battery change interval

Caution!

The battery should be changed every 4 years. The change intervals refer to the average service life and operating conditions and are recommended by B&R. It is not the maximum buffer duration.

Information:

Data stored in the AC140 RAM will be lost if the battery is changed with the PLC switched off! The battery can be changed with power applied, but this is not allowed in all countries!

Warning!

The battery must be replaced by a Type CR2477N Renata battery only. The use of another battery may present a risk of fire or explosion.

The battery may explode if handled improperly. Do not recharge, disassemble or dispose of in fire.

Procedure for changing the battery

1. Touch the mounting rail or ground connection (not the power supply!) in order to discharge any electrostatic charge from your body.
2. Remove the cover from the lithium battery holder using a screwdriver.

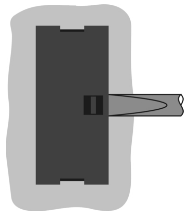


Figure 43: Remove the cover for the lithium battery

3. Remove the battery from the holder by pulling the removal strip (don't use uninsulated tools because of risk of short circuiting). The battery should not be held by its edges. Insulated tweezers may also be used for removing the battery.

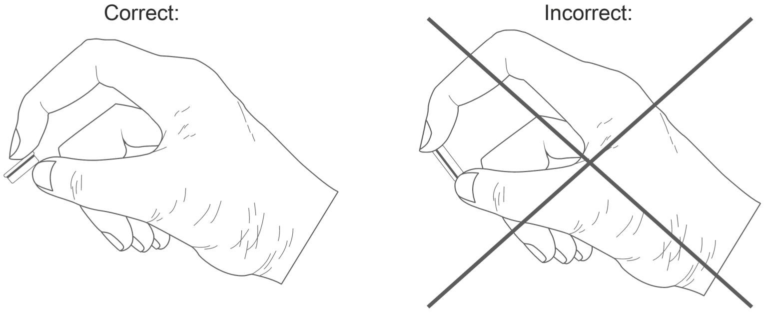


Figure 44: Hold the battery correctly

4. Insert the new battery with correct polarity. The removal strip should be pulled to the right of the battery holder and the "+" side of the battery should be facing left. In order to be able to remove the battery again in future, the removal strip **must be on the right side** of the battery.

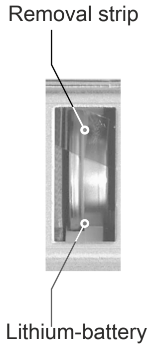


Figure 45: Removal strip should be pulled to the right

5. Now wrap the end of the removal strip over the top of the battery and insert it underneath the battery so that it does not protrude from the battery holder.
6. Replace cover. Insert the lower edge of the cover in the battery holder opening. Press the upper end of the cover home firmly.

Information:

Lithium batteries are considered hazardous waste. Used batteries should be disposed of appropriately.

3.12.12 Input/Output registers

Digital in r/- (16-bit):

Bit no.	Value	Description
0		Logical status of digital I/O 1
1		Logical status of digital I/O 2
2		Logical status of digital I/O 3
3 - 15		Reserved

Digital out r/w (16-bit):

All reserved bits must be written with 0.

Bit no.	Value	Description
0	0	Digital output 1 inactive
	1	Digital output 1 active
1	0	Digital output 2 inactive
	1	Digital output 2 active
2	0	Digital output 3 inactive
	1	Digital output 3 active
3 - 15		Reserved

Analog in (16-bit) r/-:

±10V (12 bit resolution)

Counter (32-bit) r/(w):

In addition to the typical counter modes, this counter has a "Stepper motor counter mode" (see Configuration register bits 4-6).

In stepper motor counter mode, the count direction is set using digital I/O 2 (0…increment, 1…decrement), and the counter clock is on digital I/O 1. Only one clock edge is used for counting (can be configured with bit 3 of the counter configuration register).

Counter configuration (16 bit) r/w:

All reserved bits must be written with 0.

Bit no.	Value	Description
0		Reserved
1	0	AB(R) counter mode: R input disabled
	1	AB(R) counter mode: R input enabled
2		Reserved
3	0	Measurement starts at increasing edge
	1	Measurement starts at falling edge
4 - 6	000	No counter operation
	001	AB(R) counter mode
	010	Event counter mode
	011	Period measurement mode
	100	stepper motor counter mode
	101	Gate measurement mode
	110	Not allowed
	111	Not allowed
7 - 8	00	Counter frequency 4MHz
	01	External counter frequency
	10	Counter frequency 31.25kHz
	11	Not allowed
9	0	Counter overflow recognition disabled / Reset counter overflow bit
	1	Overflow recognition of the continuous counter is enabled (value limited to $FFFF)
10 - 14		Reserved
15	0	Time / counter reset
	1	Time / counter enabled (ATTENTION: Only set bit after counter configuration is complete)

Status (16 Bit) r/- :

Bit no.	Value	Description
0 - 8		Reserved
9	0	Period or gate measurement within the counter range 0 - $FFFF (only valid if bit 9 is set in the counter configuration word)
	1	Counter overflow during period or gate measurement. Acknowledge by resetting bit 9 of the counter configuration word
10 - 14		Reserved
15	0	Output supply voltage monitoring 24 VDC - OK
	1	Output supply voltage monitoring 24 VDC error

3.12.13 Wiring

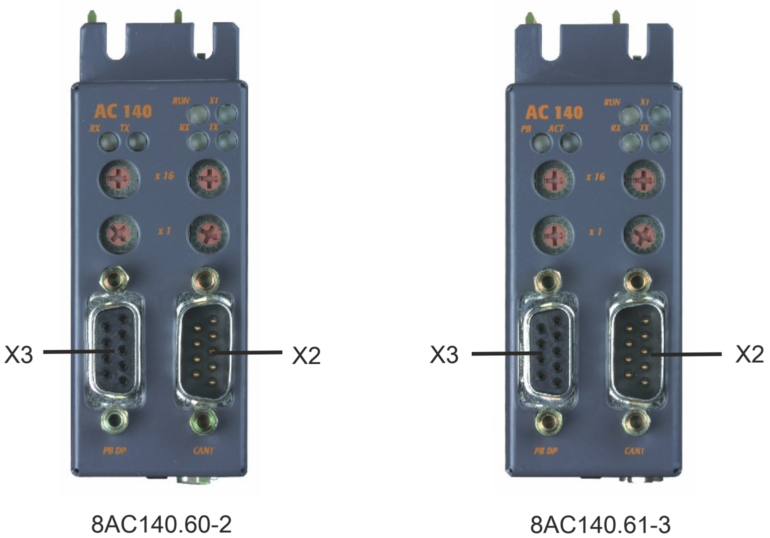


Figure 46: Overview of AC140 connections (view from front)

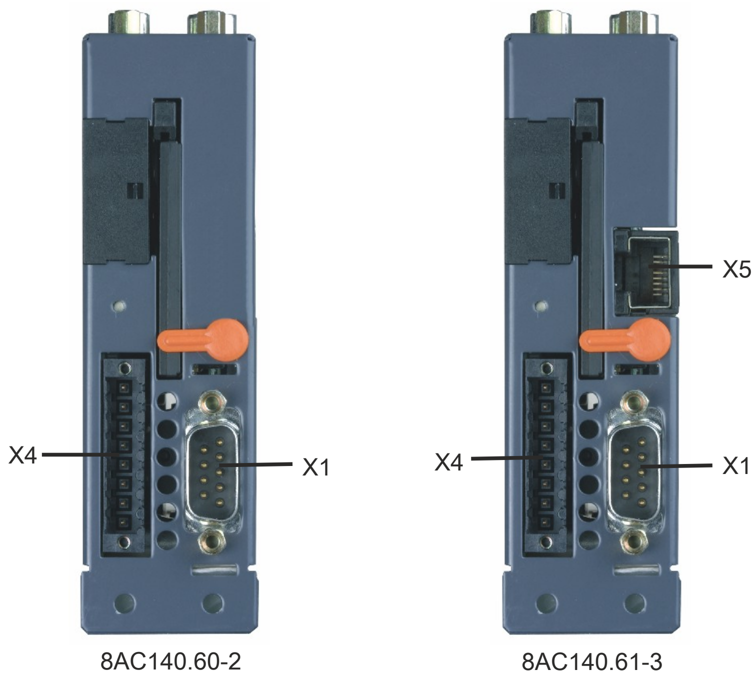


Figure 47: Overview of AC140 connections (view from below)

3.12.13.1 X1 - Pinout (application interface IF1 - RS232)

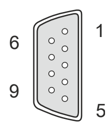
X1	Pin	Name	Function
	1	DCD	Data Carrier Detect
	2	RXD	Receive signal
	3	TXD	Transmit signal
	4	DTR	Data Terminal Ready
	5	GND	Ground
	6	DSR	Data Set Ready
	7	RTS	Request To Send
	8	CTS	Clear To Send
	9	RIN	Ring indicator

Table 121: X1 connector (RS232) - Pinout

3.12.13.2 X2 - Pinout (application interface IF2 - CAN)

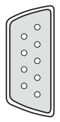
X2	Pin	Name	Function
	1	---	---
	2	CAN_L	CAN low
	3	CAN_GND	CAN 0 V
	4	---	---
	5	---	---
	6	---	---
	7	CAN_H	CAN high
	8	---	---
	9	---	---

Table 122: X2 connector (CAN) - Pinout

3.12.13.3 X3 - Pinout (application interface IF3 - PROFIBUS)

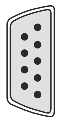
X3	Pin	Name	Function
	1	---	---
	2	---	---
	3	DATA	Data
	4	CNTRL	Transmit enable
	5	PROFIBUS_GND	PROFIBUS GND (electrically isolated)
	6	+5 V / 50 mA	+5 V supply / 50 mA (electrically isolated)
	7	---	---
	8	DATA\	Data\
	9	CNTRL\	Transmit enable\

Table 123: X3 connector (PROFIBUS) - Pinout

3.12.13.4 X4 connector (inputs/outputs) - Pinout

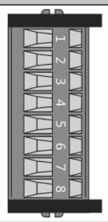
X4	Pin	Name	Function in incremental counter mode	Function in period/gate measurement mode	Function in stepper motor counter mode
	1	GND	GND		
	2	+24 VDC	Dig. supply I/O +24V [1]		
	3	Digital I/O 1	A	Counter input	
	4	Digital I/O 2	B	---	Counting direction
	5	Digital I/O 3	R	External clock	---
	6	Shield	Shield		
	7	Analog I +	Analog Input +		
	8	Analog I -	Analog Input -		

Table 124: X4 connector (inputs/outputs) - Pinout

1) The +24 V supply is only necessary for digital I/O 1 .. 3.

3.12.13.5 X5 - Pinout (application interface IF6 - Ethernet)

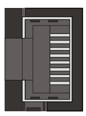
X5	Pin	Name	Function
	1	RXD	Receive signal
	2	RXD\	Receive signal inverted
	3	TXD	Transmit signal
	4	Termination	Termination
	5	Termination	Termination
	6	TXD\	Transmit signal inverted
	7	Termination	Termination
	8	Termination	Termination

Table 125: Pinout X5 (Ethernet)

3.13 AC141 - CPU module

3.13.1 General information

The AC141 plug-in module makes it possible to operate an ACOPOS servo drive without an external PLC and is also available with an integrated "Soft CNC" system (8AC141.61-3).

The module is equipped with five application interfaces:

- One RS232 interface (IF1) for programming and configuring using B&R Automation Studio™
- Two CAN interfaces (IF2, IF3) for connecting to CAN networks
- One X2X Link interface (IF4)
- One Ethernet interface (IF6) for connecting to an Ethernet network.

Communication in the ACOPOS network occurs as described in the section "Drive-based control" on page 22.

The ACOPOS servo drive in which the AC141 is plugged into is connected via emulation of an AC110 CAN interface plug-in module in slot 1. All other CAN stations are connected via the IF2 CAN interface.

This module offers interchangeable application memory in the form of a CompactFlash card as well as a separate backup battery for the module. [5)]

In addition, a maximum of three digital inputs / outputs are provided as well as one analog input (±10 V differential input).

The digital inputs and outputs can be configured individually as an input or output. Additional functions such as a counter function with direction switching (stepper motor) or period and gate measurement are integrated.
The inputs and outputs are scanned directly by the CPU module; the ACOPOS servo drive does not have direct access to these inputs and outputs.

The analog input has a resolution of 12 bits and an analog input filter with 10 kHz (3rd-order low pass).

The AC141 CPU module is run as a double-width plug-in module and occupies two slots.

3.13.2 Order data

Model number	Short description	Figure
	Plug-in modules	
8AC141.60-2	ACOPOS plug-in module, CPU, x86 100 MHz Intel compatible, 16 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 2 CAN interfaces, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 1 X2X Link Master interface, 3 digital I/O can be configured as 24 VDC input or output 500 mA, 1 analog input ±10 V, order program memory and 0TB704 and 0TB708 terminal blocks separately	
8AC141.61-3	ACOPOS plug-in module, CPU, ARNC0, x86 100 MHz Intel compatible, 32 MB DRAM, 32 kB SRAM, removable application memory: CompactFlash, 2 CAN interfaces, 1 Ethernet interface 100 Base-T, 1 RS232 interface, 1 X2X Link Master interface, 3 digital I/O can be configured as 24 VDC input or output 500 mA, 1 analog input ±10 V, order program memory and 0TB704 and 0TB708 terminal blocks separately	
	Required accessories	
	CompactFlash-cards	
0CFCRD.0128E.01	CompactFlash 128 MB WD extended temp.	
0CFCRD.0512E.01	CompactFlash 512 MB WD extended temp.	
5CFCRD.0064-03	CompactFlash 64 MB Western Digital (SLC)	
5CFCRD.0128-03	CompactFlash 128 MB Western Digital (SLC)	
5CFCRD.0256-03	CompactFlash 256 MB Western Digital (SLC)	
5CFCRD.0512-03	CompactFlash 512 MB Western Digital (SLC)	
5CFCRD.1024-03	CompactFlash 1 GB Western Digital (SLC)	
5CFCRD.2048-03	CompactFlash 2 GB Western Digital (SLC)	
5CFCRD.4096-03	CompactFlash 4 GB Western Digital (SLC)	
5CFCRD.8192-03	CompactFlash 8 GB Western Digital (SLC)	
	Terminal blocks	
0TB704.9	Accessory terminal block, 4-pin, screw clamps 2.5 mm²	
0TB704.91	Accessory terminal block, 4-pin, cage clamps 2.5 mm²	
0TB708.91	Accessory terminal block, 8-pin, cage clamp 1.5 mm²	
0TB708:91-02	Accessory terminal block, 8 pins, 20 pieces cage clamp 1,5 mm²	
	Optional accessories	
	Batteries	

Table 126: 8AC141.60-2, 8AC141.61-3 - Order data

5) Application memory must be ordered separately.

Model number	Short description	Figure
0AC201.91	Lithium batteries 4 pcs., 3 V / 950 mAh button cell We hereby state that the lithium cells contained in this shipment qualify as "partly regulated". Handle with care. If the package is damaged, inspect the cells, repack intact cells and protect the cells against short circuit. For emergency information, call RENATA SA at +41 61 319 28 27.	
	Cables	
0G0001.00-090	PC - PLC/PW cable, RS232, online cable	
	Infrastructure components	
0AC912.9	Bus adapter, CAN, 1 CAN interface	
0AC913.92	Bus adapter, CAN, 2 CAN interfaces, including 30 cm attachment cable (DSUB)	
7AC911.9	Bus connector, CAN	

Table 126: 8AC141.60-2, 8AC141.61-3 - Order data

3.13.3 Technical data

Product ID	8AC141.60-2	8AC141.61-3
General information		
Module type	ACOPOS double-width plug-in module	
B&R ID code	0x1DDA	0x2275
Slot [1)]	Slots 1 + 2	
Power consumption	Max. 4.5 W	
ACOPOS capability	Yes	
Visual Components support	Yes	
Certification		
CE	Yes	
cULus	Yes	
KC	Yes	
Controller		
Operating system	AC140 (version V2.80 and higher)	
DRAM	16 MB	32 MB
Processor clock	100 MHz	
SRAM	32 kB	
Inputs/Outputs		
Module-side connection	8-pin connector	
Configuration of digital inputs/outputs	Individually configurable as inputs or outputs	
Interfaces		
IF1 interface		
Type	RS232	
Design	Male 9-pin DSUB connector	
Status indicators	232 LED	
Electrical isolation	No	
Max. baud rate	115.2 kbaud	
Max. distance	15 m / 19200 Baud	
IF2 interface		
Type	CAN bus	
Design	Male 9-pin DSUB connector	
Status indicators	CAN1 LED	
Bus terminating resistor	Externally wired	
Electrical isolation	Yes	
Max. distance	1000 m	
Network-capable	Yes	
Max. transfer rate		
Bus length ≤60 m	500 kbit/s	
Bus length ≤200 m	250 kbit/s	
Bus length ≤1000 m	50 kbit/s	
IF3 interface		
Type	CAN bus	
Design	Male 9-pin DSUB connector	
Status indicators	CAN2 LED	
Bus terminating resistor	Externally wired	
Electrical isolation	Yes	
Max. distance	1000 m	
Network-capable	Yes	
Max. transfer rate		
Bus length ≤60 m	500 kbit/s	
Bus length ≤200 m	250 kbit/s	
Bus length ≤1000 m	50 kbit/s	

Table 127: 8AC141.60-2, 8AC141.61-3 - Technical data

Product ID	8AC141.60-2	8AC141.61-3
IF4 interface		
Type	X2X	
Design	4-pin connector	
Status indicators	X2X LED	
Electrical isolation	Yes	
Max. distance	100 m	
IF6 interface		
Type	Ethernet	
Design	Male RJ45 connector	
Status indicators	ACT LED	
Baud rate	10/100 Mbit/s	
Electrical isolation	Yes	
Max. distance	100 m	
Network-capable	Yes	
Incremental encoder		
Counter size	16-bit	
Input frequency	Max. 20 kHz	
Evaluation	4x	
Signal form	Square wave pulse	
Encoder monitoring	No	
Counter frequency	Max. 80 kHz	
Reference frequency	Max. 20 kHz	
Distance between edges	Min. 5 µs	
Inputs		
Input 1	Channel A	
Input 2	Channel B	
Input 3	Reference pulse R	
Digital inputs [2)]		
Quantity	Max. 3	
Modulation compared to ground potential	Max. ±30 V	
Wiring	Sink	
Input current at nominal voltage	Approx. 4.2 mA	
Input delay	<5 µs	
Switching threshold		
Low	<5 V	
High	>15 V	
Input voltage		
Nominal	24 VDC	
Maximum	30 VDC	
Electrical isolation		
Channel - ACOPOS	Yes	
Channel - Channel	No	
Event counter		
Signal form	Square wave pulse	
Input frequency	Max. 100 kHz	
Pulse length	Min. 5 µs	
Counter size	32-bit	
Inputs		
Input 1	Counter 1	
Input 2	Count direction (only in stepper motor mode)	
Gate measurement		
Signal form	Square wave pulse	
Counter frequency		
Internal	31.25 kHz or 4 MHz	
External	Max. 100 kHz	
Pulse length	Min. 5 µs	
Gate frequency	Max. 100 kHz	
Period measurement		
Signal form	Square wave pulse	
Input frequency	Max. 100 kHz	
Pulse length	Min. 5 µs	
Counter frequency		
Internal	31.25 kHz or 4 MHz	
External	Max. 100 kHz	
Analog inputs		
Digital converter resolution	12-bit	
Conversion time	<50 µs	
Output format	INT 16 $8001 - $7FFF LSB = $0010 = 4.88 mV	
Design	Differential input	
Electrical isolation		
Input - ACOPOS [3)]	No, max. modulation: ±13 V	

Table 127: 8AC141.60-2, 8AC141.61-3 - Technical data

Product ID	8AC141.60-2	8AC141.61-3
Input signal		
Nominal	-10 to +10 V	
Maximum	-13 to +13 V	
Operating modes	Cyclic measurement non-synchronous to 50 µs ACOPOS clock	
Conversion procedure	Successive approximation	
Input filter	Analog low pass 3rd-order Cut-off frequency: 10 kHz	
Common-mode rejection		
DC	Min. 73 dB	
50 Hz	Min. 73 dB	
Non-linearity	±2 LSB	
Differential input impedance	20 MΩ	
Digital outputs		
Quantity	Max. 3	
Readable outputs	Yes	
Continuous short circuit current at 24 V	Typ. 4 A	
Continuous current	Max. 500 mA	
Switching frequency (resistive load)	Max. 100 Hz	
Switching delay	Max. 500 µs (typ. 250 µs)	
Type	High-side transistor outputs	
Electrical isolation		
Output - ACOPOS	Yes	
Output - Output	No	
Switching voltage		
Minimum	18 VDC	
Nominal	24 VDC	
Maximum	30 VDC	
Protection		
Short circuit protection	Yes	
Overload protection	Yes	
Environmental conditions		
Temperature		
Operation		
Nominal	5 to 40°C	
Maximum	55°C	
Storage	-25 to 55°C	
Transport	-25 to 70°C	
Relative humidity		
Operation	5 to 85%	
Storage	5 to 95%	
Transport	Max. 95% at 40°C	

Table 127: 8AC141.60-2, 8AC141.61-3 - Technical data

1) The AC141 is a double-width module that occupies slots 1 and 2.
2) Shielded cables must be used for inputs 1 - 3.
3) External electrical isolation of the connected sensors is recommended since the analog input is not electrically isolated.

3.13.4 Indicators

Image	LED	Product ID	Color	Description
	❶	Status (RUN)	Red Red with orange blinking Red/green blinking (1 Hz) Orange Green Green with orange blinking	ERROR/RESET Load/unload and start BOOT AR Startup of BOOT or CF - AR SERVICE/DIAG/BOOT mode RUN RUN - BATTERY LOW
	❷	RS232 (232)	Orange blinking	Data transfer to application interface IF1 (RS232)
	❸	CAN2 (CAN2)	Orange	Data transfer on application interface IF3 (CAN2)
	❹	Ethernet (ACT)	Orange Orange blinking	Ethernet LINK (IF6) Ethernet ACTIVE (IF6)
	❺	CAN1 (CAN1)	Orange	Data transfer on application interface IF2 (CAN)
	❻	X2X (X2X)	Orange	Data transfer on application interface IF4 (X2X)

Table 128: AC141 indicators

3.13.5 Setting the CAN node number (IF2)

The CAN node number can be set using two HEX code switches:

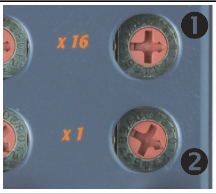
Image	Code switch	Description
	❶	CAN node number 16s position (high)
	❷	CAN node number 1s position (low)
	The settings $00, and $FF are reserved for special functions. **$00:** In this switch position, the operating system can be programmed via the online interface. User Flash is only deleted after the update begins. **$FF:** Diagnostics mode.	

Table 129: Setting the CAN node number

A changed CAN node number will take effect the next time the ACOPOS servo drive is switched on.

There must be a terminating resistor (120 Ω, 0.25 W) between CAN_H and CAN_L at the beginning and end of the CAN bus.

Information:

The CAN bus IF2 is always made up of at least two stations that are integrated in the AC141. These are the AC141 CPU and an AC110 emulation, which the ACOPOS servo drive uses for communication. Therefore, the AC141 CPU prevents a potential error in which no other stations are found on the CAN bus. This is why the AC141 CPU does not register a hardware error if there is no physical connection to external CAN devices.

3.13.6 Setting the CAN node number (IF3)

The CAN node number can be set using two HEX code switches:

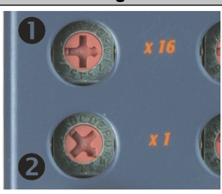
Image	Code switch	Description
	❶	CAN node number 16s position (high)
	❷	CAN node number 1s position (low)
	The settings $00, and $FF are reserved for special functions. **$00:** In this switch position, the operating system can be programmed via the online interface. User Flash is only deleted after the update begins. **$FF:** Diagnostics mode.	

Table 130: Setting the CAN node number (IF3)

A changed CAN node number will take effect the next time the ACOPOS servo drive is switched on.

There must be a terminating resistor (120 Ω, 0.25 W) between CAN_H and CAN_L at the beginning and end of the CAN bus.

3.13.7 Setting the Ethernet network address (IF6)

The Ethernet network address can be set using software (B&R Automation Studio).

3.13.8 Reset button

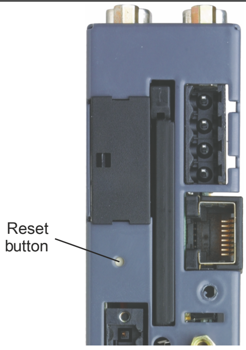
View (view from below)	Description
 View from below	The reset button can be pressed with any small pointed object (e.g. paper clip). Pressing the reset button triggers a hardware reset, which means: • All application programs are stopped. • All outputs are set to zero. The AC141 then switches to SERVICE mode.

Table 131: Reset button

3.13.9 Slot for application memory (CompactFlash)

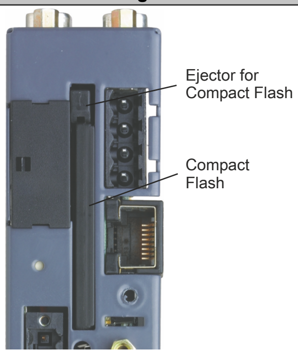
Figure	Description
 View from below	Program memory is required to operate the AC141. The application memory is CompactFlash. This is not included with the delivery of the AC141. CompactFlash must be ordered separately as an accessory! The CompactFlash memory card is used in the slot on the bottom of the AC141. Press the eject button to remove the card. The CompactFlash memory card can be secured with the safety clip.

Table 132: Application memory

3.13.10 Backup battery

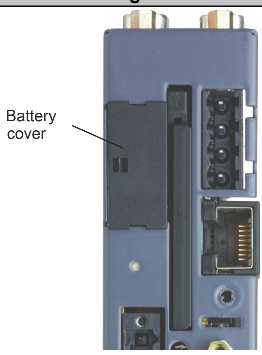
Image	Description	
 View from below	The AC141 is equipped with a lithium battery. The lithium battery is placed in a separate compartment on the bottom of the module and protected by a cover.	
	Backup battery data	
	Lithium battery	3V / 950 mAh
	Model number	0AC201.91
	Short description	Lithium batteries, 4 pcs., 3 V / 950 mAh, button cell
	Storage temperature	-20 to +60°C
	Storage time	Max. 3 years at 30°C
	Relative humidity	0 to 95%, non-condensing

Table 133: Backup battery

Data / real-time buffering

The following areas are buffered:

- Remanent variables
- User RAM
- System RAM
- Real-time clock

Battery monitoring

The battery voltage is checked cyclically. The cyclic load test of the battery does not considerably shorten the battery life, instead it gives an early warning of weakened buffer capacity.

The status information "Battery OK" is available from the "BatteryInfo" system library function.

Battery change interval

Caution!

The battery should be changed every 4 years. The change intervals refer to the average service life and operating conditions and are recommended by B&R. It is not the maximum buffer duration.

Information:

Data stored in the AC141 RAM will be lost if the battery is changed with the PLC switched off! The battery can be changed with power applied, but this is not allowed in all countries!

Warning!

The battery must be replaced by a Type CR2477N Renata battery only. The use of another battery may present a risk of fire or explosion.

The battery may explode if handled improperly. Do not recharge, disassemble or dispose of in fire.

Procedure for changing the battery

1. Touch the mounting rail or ground connection (not the power supply!) in order to discharge any electrostatic charge from your body.
2. Remove the cover from the lithium battery holder using a screwdriver.

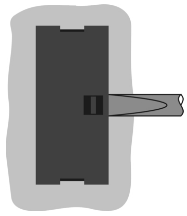


Figure 48: Remove the cover for the lithium battery

3. Remove the battery from the holder by pulling the removal strip (don't use uninsulated tools because of risk of short circuiting). The battery should not be held by its edges. Insulated tweezers may also be used for removing the battery.

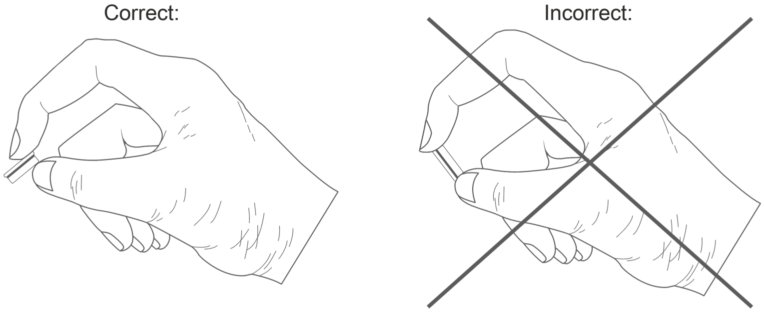


Figure 49: Hold the battery correctly

4. Insert the new battery with correct polarity. The removal strip should be pulled to the right of the battery holder and the "+" side of the battery should be facing left. In order to be able to remove the battery again in future, the removal strip **must be on the right side** of the battery.

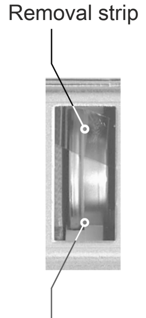


Figure 50: Removal strip should be pulled to the right

5. Now wrap the end of the removal strip over the top of the battery and insert it underneath the battery so that it does not protrude from the battery holder.
6. Replace cover. Insert the lower edge of the cover in the battery holder opening. Press the upper end of the cover home firmly.

Information:

Lithium batteries are considered hazardous waste. Used batteries should be disposed of appropriately.

3.13.11 Input/Output registers

Digital in r/- (16-bit):

Bit no.	Value	Description
0		Logical status of digital I/O 1
1		Logical status of digital I/O 2
2		Logical status of digital I/O 3
3 - 15		Reserved

Digital out r/w (16-bit):

All reserved bits must be written with 0.

Bit no.	Value	Description
0	0	Digital output 1 inactive
	1	Digital output 1 active
1	0	Digital output 2 inactive
	1	Digital output 2 active
2	0	Digital output 3 inactive
	1	Digital output 3 active
3 - 15		Reserved

Analog in (16-bit) r/-:

±10V (12 bit resolution)

Counter (32-bit) r/(w):

In addition to the typical counter modes, this counter has a "Stepper motor counter mode" (see Configuration register bits 4-6).

In stepper motor counter mode, the count direction is set using digital I/O 2 (0…increment, 1…decrement), and the counter clock is on digital I/O 1. Only one clock edge is used for counting (can be configured with bit 3 of the counter configuration register).

Counter configuration (16 bit) r/w:

All reserved bits must be written with 0.

Bit no.	Value	Description
0		Reserved
1	0	AB(R) counter mode: R input disabled
	1	AB(R) counter mode: R input enabled
2		Reserved
3	0	Measurement starts at increasing edge
	1	Measurement starts at falling edge
4 - 6	000	No counter operation
	001	AB(R) counter mode
	010	Event counter mode
	011	Period measurement mode
	100	stepper motor counter mode
	101	Gate measurement mode
	110	Not allowed
	111	Not allowed
7 - 8	00	Counter frequency 4MHz
	01	External counter frequency
	10	Counter frequency 31.25kHz
	11	Not allowed
9	0	Counter overflow recognition disabled / Reset counter overflow bit
	1	Overflow recognition of the continuous counter is enabled (value limited to $FFFF)
10 - 14		Reserved
15	0	Time / counter reset
	1	Time / counter enabled (ATTENTION: Only set bit after counter configuration is complete)

Status (16 Bit) r/- :

Bit no.	Value	Description
0 - 8		Reserved
9	0	Period or gate measurement within the counter range 0 - $FFFF (only valid if bit 9 is set in the counter configuration word)
	1	Counter overflow during period or gate measurement. Acknowledge by resetting bit 9 of the counter configuration word
10 - 14		Reserved
15	0	Output supply voltage monitoring 24 VDC - OK
	1	Output supply voltage monitoring 24 VDC error

3.13.12 Wiring

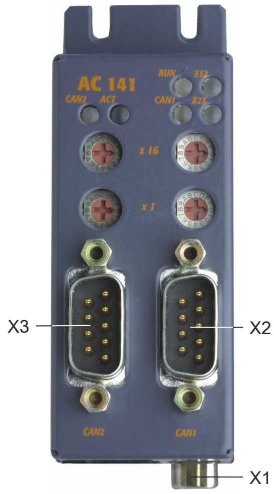


Figure 51: Overview of AC141 connections (view from front)

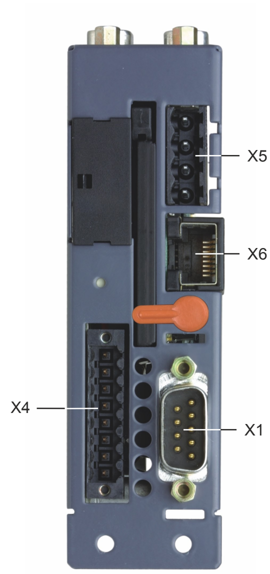


Figure 52: Overview of AC141 connections (view from below)

3.13.12.1 X1 - Pinout (application interface IF1 - RS232)

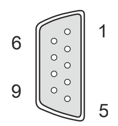
X1	Pin	Name	Function
 6 9 1 5	1	DCD	Data Carrier Detect
	2	RXD	Receive signal
	3	TXD	Transmit signal
	4	DTR	Data Terminal Ready
	5	GND	Ground
	6	DSR	Data Set Ready
	7	RTS	Request To Send
	8	CTS	Clear To Send
	9	RIN	Ring indicator

Table 134: X1 connector (RS232) - Pinout

3.13.12.2 X2 - Pinout (application interface IF2 - CAN1)

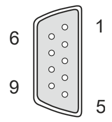
X2	Pin	Name	Function
	1	---	---
	2	CAN_L	CAN low
	3	CAN_GND	CAN 0 V
	4	---	---
	5	---	---
	6	---	---
	7	CAN_H	CAN high
	8	---	---
	9	---	---

Table 135: X2 connector (CAN1) - Pinout

3.13.12.3 X3 - Pinout (application interface IF3 - CAN2)

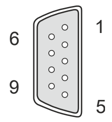
X3	Pin	Name	Function
	1	---	---
	2	CAN_L	CAN low
	3	CAN_GND	CAN 0 V
	4	---	---
	5	---	---
	6	---	---
	7	CAN_H	CAN high
	8	---	---
	9	---	---

Table 136: X3 connector (CAN2) - Pinout

3.13.12.4 X4 connector (inputs/outputs) - Pinout

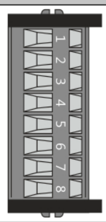
X4	Pin	Name	Function in incremental counter mode	Function in period/gate measurement mode	Function in stepper motor counter mode
	1	GND	GND		
	2	+24 VDC	Dig. supply I/O +24V [1]		
	3	Digital I/O 1	A	Counter input	
	4	Digital I/O 2	B	---	Counting direction
	5	Digital I/O 3	R	External clock	---
	6	Shield	Shield		
	7	Analog I +	Analog Input +		
	8	Analog I -	Analog Input -		

Table 137: X4 connector (inputs/outputs) - Pinout

1) The +24 V supply is only necessary for digital I/O 1 .. 3.

3.13.12.5 X5 - Pinout (application interface IF4 - X2X)

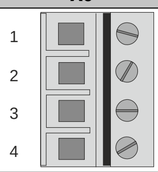
X5	Pin	Name	Function
	1	X2X	X2X data
	2	X2X⊥	X2X ground
	3	X2X\	X2X data inverted
	4	SHLD	Shield

Table 138: X5 connector (X2X) - Pinout

3.13.12.6 X6 - Pinout (application interface IF6 - Ethernet)

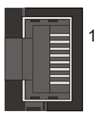
X6	Pin	Name	Function
	1	RXD	Receive signal
	2	RXD\	Receive signal inverted
	3	TXD	Transmit signal
	4	Termination	Termination
	5	Termination	Termination
	6	TXD\	Transmit signal inverted
	7	Termination	Termination
	8	Termination	Termination

Table 139: X6 connector (Ethernet) - Pinout

4 8AXB battery module

4.1 General information

The 8BAXB000.0000-00 battery module can be used in a 8AC126.60-1 plug-in module. It contains a 3.6 V lithium-thionyl chloride (Li/SOCl2) cell and serves as a backup battery for encoders with battery-backed multi-turn functionality. With these encoders, the multi-turn function is implemented using an electronic counter instead of a mechanical gearbox. The backup battery ensures that the encoder's absolute position data continues to be evaluated in the event of a power failure.

Information:

Lithium-thionyl chloride batteries have a high energy density and low self-discharge. Their cell voltage remains constant for a long time before dropping off rapidly towards the end of their capacity.

If the ACOPOS plug-in module 8AC126.60-1 reports an error, then the capacity of the battery module 8AXB000.0000-00 is only enough for a few more days. When in doubt, it is best to exchange the battery module 8AXB000.0000-00. This should be kept in mind if the machine is scheduled to be disconnected from the mains for several weeks.

4.2 Order data

Model number	Short description	Figure
	Battery Modules	
8AXB000.0000-00	8AC126.60-1 accessory set for encoder buffering consisting of: Battery module with 3.6 V lithium battery	

Table 140: 8AXB000.0000-00 - Order data

4.3 Technical data

Product ID	8AXB000.0000-00
General information	
Short description	8AC126.60-1 accessory set for encoder buffering consisting of: 1x Lithium battery 3.6 V, 1x battery holder
Certification	
CE	Yes
cULus	Yes
Mechanical characteristics	
Weight	11 g

Table 141: 8AXB000.0000-00 - Technical data

4.4 Changing/Inserting the battery module 8AXB000.0000-00

Caution!

The following conditions must be met for the position of the encoder position to be maintained when changing battery module 8AXB000.0000-00:

- **The 8AC126.60-1 plug-in module for which the 8AXB000.0000-00 battery module should be exchanged is installed in an ACOPOS servo drive.**
- **The battery backed encoder is connected to this 8AC126.60-1 plug-in module.**
- **The ACOPOS servo drive is supplied with 24 VDC (at least one of the three LEDs – RUN, READY or ERROR – on the ACOPOS servo drive is lit).**

Information:

The color of the BAT LED on the 8AC126.60-1 plug-in module changes to red and the plug-in module reports an error as soon as the 8AXB000.0000-00 battery module is removed. The encoder position is retained as long as the ACOPOS servo drive continues to be supplied with 24 VDC. The BAT LED remains red until a new 8AXB000.0000-00 battery module is inserted and the error is acknowledged. Then the BAT LED returns to green.

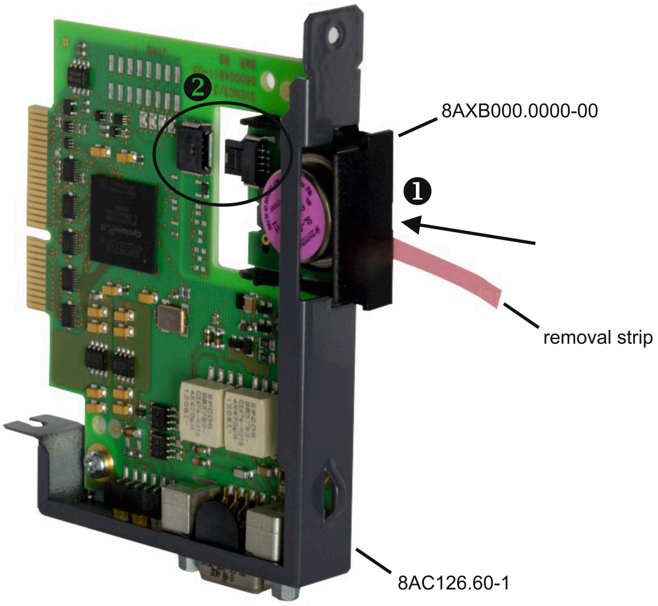


Figure 53: Changing/Inserting the battery module 8AXB000.0000-00

Procedure for changing/inserting

If there already is a 8AXB000.0000-00 battery module in the 8AC126.60-1 insert module:

1. Pull on the removal strip until the battery module is disconnected from the plug-in module.
2. Slide the battery module out of the plug-in module.
3. Insert a new battery module.

Insert a new 8AXB000.0000-00 battery module:

1. Carefully insert a new 8AXB000.0000-00 battery module into the opening of the 8AC126.60-1 ACOPOS plug-in module as shown. Ensure that the removal strip sticks out so that the battery can be removed later.
2. Push the battery module all the way into the opening so that the plug on the battery module connects to the socket on the plug-in module.

Caution!

The battery module 8AXB000.0000-00 should be replaced every 6 years. The replacement intervals recommended by B&R reflect the batteries' average service life and operating conditions. It does not represent the maximum buffer duration.

Warning!

The 8AXB000.0000-00 battery module must be replaced by another 8AXB000.0000-00 battery module. The battery module may explode if handled improperly. Do not recharge, disassemble or dispose of in fire.

Information:

The status of the battery is provided to the application software by a status bit. The application software must ensure an appropriate response to undervoltage. The drive is not stopped automatically.

5 8B0W external braking resistors

8B0W external braking resistors are used to dissipate braking energy on ACOPOS servo drives.

5.1 Order data

Model number	Short description	Figure
	Braking resistors	
8B0W0045H000.000-1	ACOPOSmulti braking resistor, 450 W, 50 R, IP20, terminals	
8B0W0045H000.001-1	ACOPOSmulti braking resistor, 450 W, 50 R, IP65, terminals	
8B0W0079H000.000-1	ACOPOSmulti braking resistor, 790 W, 33 R, IP20, terminals	
8B0W0079H000.001-1	ACOPOSmulti braking resistor, 790 W, 33 R, IP65, terminals	

Table 142: 8B0W0045H000.000-1, 8B0W0045H000.001-1, 8B0W0079H000.000-1, 8B0W0079H000.001-1 - Order data

5.2 Technical data

Product ID	8B0W0045H000.000-1	8B0W0045H000.001-1	8B0W0079H000.000-1	8B0W0079H000.001-1
General information				
RoHS-compliant	Yes			
Cooling and mounting method	Wall mounting			
Certification				
CE	Yes			
cULus	Yes			
KC	Yes			
Braking resistors				
Continuous power depending on the mounting orientation				
Standing horizontally	360 W		632 W	
Hanging vertically	450 W		790 W	
Reduction of continuous power depending on ambient temperature	7.5 W/K (from 40°C)		13.2 W/K (from 40°C)	
Ohmic resistance	50 Ω ±10%		33 Ω ±10%	
Max. operating voltage	850 VDC			
Isolation voltage type test	4000 VAC			
Intrinsically safe	Yes 1)			
Design				
RB1, RB2	Terminals with tension spring technology			
PE	M5 threaded bolt	M4 threaded bolt	M5 threaded bolt	M4 threaded bolt
Shield connection	Yes, on the terminal box via high-strength cable gland			
Terminal connection cross section				
Flexible and fine wire lines				
With wire end sleeves	1.5 to 10 mm²			
Approbation data				
UL/C-UL-US	24 to 6			
CSA	22 to 6			
Terminal cable outer-cross-section dimension of the connection cable	9 to 16.6 mm			
Temperature model data				
Thermal resistance between braking resistor and the environment	1.517 K/W		0.852 K/W	
Thermal capacity	30.88 Ws/K		40.68 Ws/K	
Max. permissible overtemperature	680°C		670°C	
Operating conditions				
Permitted mounting orientations				
Standing horizontally	Yes			
Hanging vertically				
Connection box, bottom	Yes			
Connection box, top	No			
EN 60529 protection				
Standing horizontally	IP20	IP65	IP20	IP65
Hanging vertically				
Connection box, bottom	IP21	-	IP21	-
Connection box, top	-			
Environmental conditions				
Temperature				
Operation	-40 to 90°C			
Relative humidity				
Operation	5 to 95%			

Table 143: 8B0W0045H000.000-1, 8B0W0045H000.001-1, 8B0W0079H000.000-1, 8B0W0079H000.001-1 - Technical data

Product ID	8B0W0045H000.000-1	8B0W0045H000.001-1	8B0W0079H000.000-1	8B0W0079H000.001-1
Mechanical characteristics				
Dimensions				
Width	124 mm			
Height	121 mm			
Depth	403 mm	332 mm	603 mm	532 mm
Weight	2.4 kg		3.9 kg	

Table 143: 8B0W0045H000.000-1, 8B0W0045H000.001-1, 8B0W0079H000.000-1, 8B0W0079H000.001-1 - Technical data

1) 8B0W external braking resistors can be considered intrinsically safe if they are connected to a 8B0P passive power supply module operated with a mains supply voltage of 3x 380 - 500 VAC. The maximum time until the 8B0W external braking resistors are destroyed is approximately 5.5 min in this case; a maximum surface temperature of approximately 480°C is achieved when this happens.
A lower mains supply voltage on the 8B0P passive power supply module allows a longer maximum time before the 8B0W external braking resistor is damaged, which also results in higher temperatures.

5.3 Wiring

5.3.1 8B0W braking resistors - Pinout

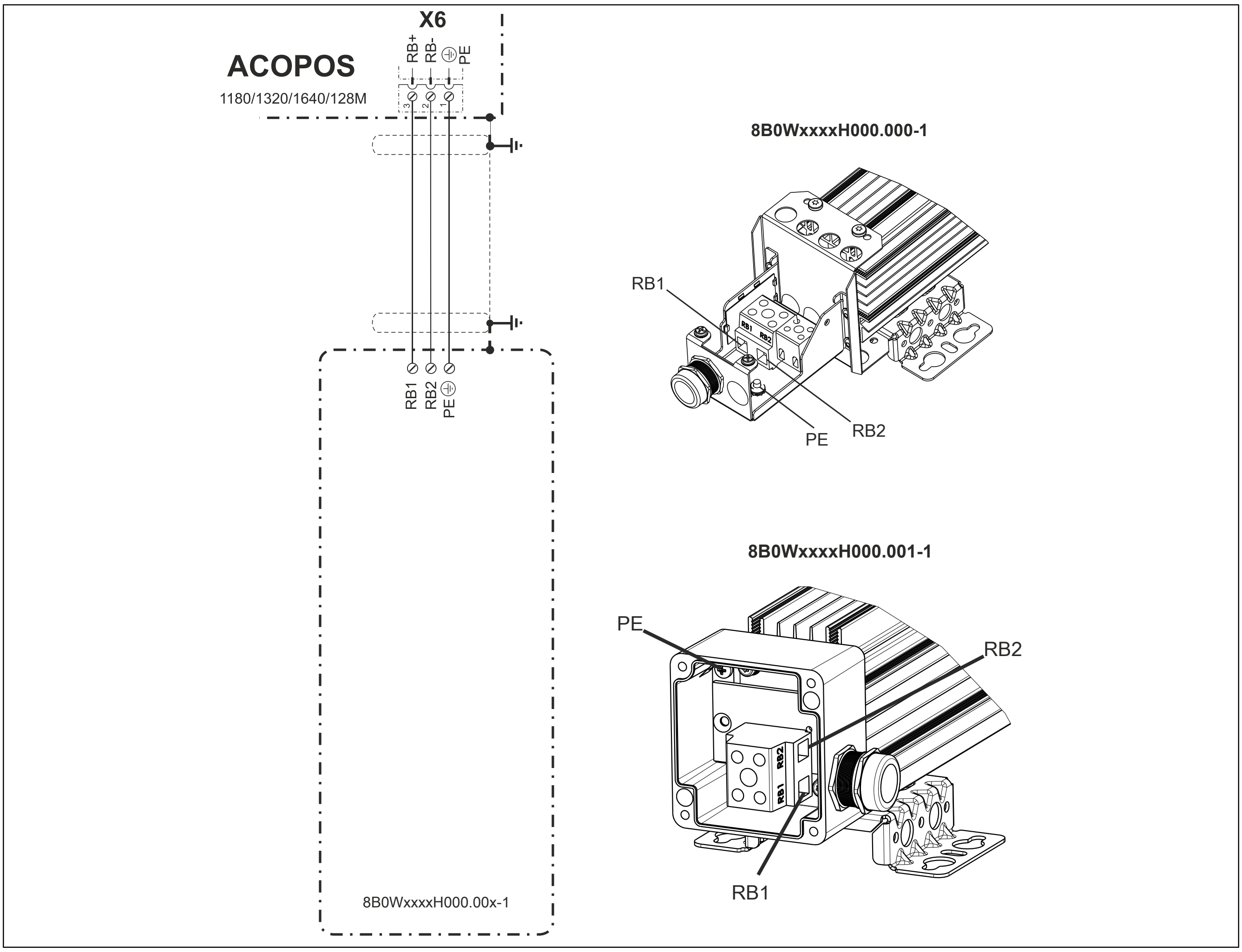


Figure 54: 8B0W - Pinout overview

Information:

8B0W external braking resistors must be wired using connection cables that are suited for maximum line temperatures >90°C.

Shielded cables must be used for wiring!

6 Cables

6.1 General information

B&R offers the cables for ACOPOS servo drives in six different lengths. All cables can be used for drag chain installations. [6)]

To prevent disturbances to encoder signals, the holding brake and temperature sensor wires are in the motor cable and not in the encoder cable.

6.1.1 Assembled cables

Using B&R cables guarantees that the EMC limits are not exceeded. The cables are assembled in the EU and are therefore subject to the strictest quality standards.

Information:

When using cables from other manufacturers, B&R cannot guarantee adherence to EMC limit values! The connectors on the cables as well as on the motors are part of a properly functioning EMC concept!

6.2 Motor cables

6.2.1 0.75 mm² motor cables

6.2.1.1 Order data

Model number	Short description	Figure
	0.75 mm² motor cables	
8CM005.12-0	Motor cable, length 5 m, 4x 0.75 mm² + 2x 2x 0.35 mm², 8-pin female Intercontec motor connector, can be used in drag chains, UL/CSA listed	
8CM007.12-0	Motor cable, length 7 m, 4x 0.75 mm² + 2x 2x 0.35 mm², 8-pin female Intercontec motor connector, can be used in drag chains, UL/CSA listed	
8CM010.12-0	Motor cable, length 10 m, 4x 0.75 mm² + 2x 2x 0.35 mm², 8-pin female Intercontec motor connector, can be used in drag chains, UL/CSA listed	
8CM015.12-0	Motor cable, length 15 m, 4x 0.75 mm² + 2x 2x 0.35 mm², 8-pin female Intercontec motor connector, can be used in drag chains, UL/CSA listed	
8CM020.12-0	Motor cable, length 20 m, 4x 0.75 mm² + 2x 2x 0.35 mm², 8-pin female Intercontec motor connector, can be used in drag chains, UL/CSA listed	
8CM025.12-0	Motor cable, length 25 m, 4x 0.75 mm² + 2x 2x 0.35 mm², 8-pin female Intercontec motor connector, can be used in drag chains, UL/CSA listed	

Table 144: 8CM005.12-0, 8CM007.12-0, 8CM010.12-0, 8CM015.12-0, 8CM020.12-0, 8CM025.12-0 - Order data

Information:

Other cable lengths and raw cables are available from B&R upon request.

6.2.1.2 Technical data

Product ID	8CM005.12-0	8CM007.12-0	8CM010.12-0	8CM015.12-0	8CM020.12-0	8CM025.12-0
General information						
Cable cross section	4x 0.75 mm² + 2x 2x 0.35 mm²					
Durability	Oil resistance according to VDE 0472 part 803 as well as standard hydraulic oil					
Listed	UL AWM Style 20234, 80°C, 1000 V, E63216 and CSA AWM I/II A/B, 90°C, 1000 V, FT2 LL46064					
Certification						
cULus	Yes					
Cable construction						
Power lines						
Quantity	4					
Wire insulation	Special thermoplastic material					
Wire colors	Black, brown, blue, yellow/green					
Design	Tinned copper litz wire					
Diameter	0.75 mm²					
Shield	No					
Stranding	No					

Table 145: 8CM005.12-0, 8CM007.12-0, 8CM010.12-0, 8CM015.12-0, 8CM020.12-0, 8CM025.12-0 - Technical data

6) Custom assembly of motor cables is available on request. For custom assembly of motor cables, the connector size must be matched to the motor used!

Product ID	8CM005.12-0	8CM007.12-0	8CM010.12-0	8CM015.12-0	8CM020.12-0	8CM025.12-0
Signal lines						
Quantity	4					
Wire insulation	Special thermoplastic material					
Wire colors	White, white/red, white/blue, white/green					
Design	Tinned copper litz wire					
Diameter	0.35 mm²					
Shield	Separate shielding for pairs, tinned copper mesh, optical coverage >85% and foil banding					
Stranding	White with white/red and white/blue with white/green					
Cable stranding	With filler elements and foil banding					
Complete shielding	Tinned copper mesh, optical coverage >85% and wrapped in isolating film					
Outer sheathing						
Material	PUR					
Color	Orange, similar to RAL 2003 flat					
Labeling	BERNECKER + RAINER 4x0,75+2x2x0,35 FLEX UL AWM STYLE 20234 80°C 1000 V E63216 CSA AWM I/II A/B 90°C 1000 V FT2 LL46064					
Connector						
Type	Motor plug, 8-pin, size 1, SpeedTec					
Connection cycles	>50					
Contacts	8 (4 power and 4 signal contacts)					
EN 60529 protection	IP67 when connected					
Electrical characteristics						
Test voltage						
Wire/Wire	3 kV					
Wire/Shield	3 kV					
Conductor resistance						
Power lines	≤0.15 Ω	≤0.20 Ω	≤0.29 Ω	≤0.44 Ω	≤0.58 Ω	≤0.73 Ω
Signal lines	≤0.28 Ω	≤0.39 Ω	≤0.55 Ω	≤0.83 Ω	≤1.1 Ω	≤1.38 Ω
Insulation resistance	>40 GΩ	>28.57 GΩ	>20 GΩ	>13.33 GΩ	>10 GΩ	>8 GΩ
Max. current load in accordance with IEC 60364-5-523 by installation type						
Wall mounting	13 A					
Installed in conduit or cable duct	11.5 A					
Installed in cable tray	13.5 A					
Environmental conditions						
Temperature						
Moving	-10 to 80°C					
Static	-40 to 90°C					
Mechanical characteristics						
Dimensions						
Length	5 m	7 m	10 m	15 m	20 m	25 m
Diameter	10.9 mm ±0.4 mm					
Flex radius						
Single bend	>34 mm					
Moving	≥85 mm					
Drag chain data						
Acceleration	<60 m/s²					
Flex cycles 1)	≥3,000,000					
Velocity	≤4 m/s					
Weight	0.98 kg	1.32 kg	1.82 kg	2.67 kg	3.52 kg	4.37 kg

Table 145: 8CM005.12-0, 8CM007.12-0, 8CM010.12-0, 8CM015.12-0, 8CM020.12-0, 8CM025.12-0 - Technical data

1) At an ambient temperature of 20°C and a flex radius of 125 mm.

6.2.2 1.5 mm² motor cables

6.2.2.1 Order data

Model number	Short description	Figure
	1.5 mm² motor cables	
8CM005.12-1	Motor cable, length 5 m, 4x 1.5 mm² + 2x 2x 0.75 mm², 8-pin female Intercontec motor connector, can be used in drag chains, UL/CSA listed	
8CM007.12-1	Motor cable, length 7 m, 4x 1.5 mm² + 2x 2x 0.75 mm², 8-pin female Intercontec motor connector, can be used in drag chains, UL/CSA listed	
8CM010.12-1	Motor cable, length 10 m, 4x 1.5 mm² + 2x 2x 0.75 mm², 8-pin female Intercontec motor connector, can be used in drag chains, UL/CSA listed	
8CM015.12-1	Motor cable, length 15 m, 4x 1.5 mm² + 2x 2x 0.75 mm², 8-pin female Intercontec motor connector, can be used in drag chains, UL/CSA listed	
8CM020.12-1	Motor cable, length 20 m, 4x 1.5 mm² + 2x 2x 0.75 mm², 8-pin female Intercontec motor connector, can be used in drag chains, UL/CSA listed	
8CM025.12-1	Motor cable, length 25 m, 4x 1.5 mm² + 2x 2x 0.75 mm², 8-pin female Intercontec motor connector, can be used in drag chains, UL/CSA listed	

Table 146: 8CM005.12-1, 8CM007.12-1, 8CM010.12-1, 8CM015.12-1, 8CM020.12-1, 8CM025.12-1 - Order data

Information:

Other cable lengths and raw cables are available from B&R upon request.

6.2.2.2 Technical data

Product ID	8CM005.12-1	8CM007.12-1	8CM010.12-1	8CM015.12-1	8CM020.12-1	8CM025.12-1
General information						
Cable cross section	4x 1.5 mm² + 2x 2x 0.75 mm²					
Durability	Oil resistance according to VDE 0472 part 803 as well as standard hydraulic oil					
Listed	UL AWM Style 20234, 80°C, 1000 V, E63216 and CSA AWM I/II A/B, 90°C, 1000 V, FT2 LL46064	UL AWM Style 20234, 80 °C, 1000 V, E63216 and CSA AWM I/II A/B, 90 °C, 1000 V, FT2 LL46064		UL AWM Style 20234, 80°C, 1000 V, E63216 and CSA AWM I/II A/B, 90°C, 1000 V, FT2 LL46064		
Certification						
cULus	Yes					
Cable construction						
Power lines						
Quantity	4					
Wire insulation	Special thermoplastic material					
Wire colors	Black, brown, blue, yellow/green					
Design	Tinned Cu wire			Tinned copper litz wire		
Diameter	1.5 mm²					
Shield	No					
Stranding	No					
Signal lines						
Quantity	4					
Wire insulation	Special thermoplastic material					
Wire colors	White, white/red, white/blue, white/green					
Design	Tinned Cu wire			Tinned copper litz wire		
Diameter	0.75 mm²					
Shield	Separate shielding for pairs, tinned Cu mesh, optical coverage >85% and foil banding		Separate shielding for pairs, tinned Cu mesh, optical coverage 85% and foil banding	Separate shielding for pairs, tinned copper mesh, optical coverage >85% and foil banding		
Stranding	White with white/red and white/blue with white/green					
Cable stranding	With filler elements and foil banding					
Complete shielding	Tinned Cu mesh, optical coverage >85% and wrapped in isolating film			Tinned copper mesh, optical coverage >85% and wrapped in isolating film		
Outer sheathing						
Material	PUR					
Color	Orange, similar to RAL 2003 flat					
Labeling	BERNECKER & RAINER 4x1.5+2x2x0.75 FLEX					
Connector						
Type	Intercontec 8-pin female motor connector					
Connection cycles	>50					

Table 147: 8CM005.12-1, 8CM007.12-1, 8CM010.12-1, 8CM015.12-1, 8CM020.12-1, 8CM025.12-1 - Technical data

Product ID	8CM005.12-1	8CM007.12-1	8CM010.12-1	8CM015.12-1	8CM020.12-1	8CM025.12-1
Contacts	8 (4 power and 4 signal contacts)					
EN 60529 protection	IP67 when connected					
Electrical characteristics						
Operating voltage	Max. 1000 V					
Test voltage						
Wire/Wire	1500 VAC					
Wire/Shield	1500 VAC					
Conductor resistance						
Power lines	≤0.07 Ω	≤0.1 Ω	≤0.14 Ω	≤0.21 Ω	≤0.28 Ω	≤0.35 Ω
Signal lines	≤0.09 Ω	≤0.13 Ω	≤0.19 Ω	≤0.29 Ω	≤0.38 Ω	≤0.48 Ω
Insulation resistance	>40 GΩ	>28.57 GΩ	>20 GΩ	>13.33 GΩ	>10 GΩ	>8 GΩ
Max. current load in accordance with IEC 60364-5-523 by installation type						
Wall mounting	20 A					
Installed in conduit or cable duct	17.8 A					
Installed in cable tray	20.9 A					
Environmental conditions						
Temperature						
Moving	-10 to 70°C					
Static	-20 to 90°C					
Mechanical characteristics						
Dimensions						
Length	5 m	7 m	10 m	15 m	20 m	25 m
Diameter	12.8 mm ± 0.4 mm			12.8 mm ±0.4 mm		
Flex radius						
Single bend	>40 mm					
Moving	≥99 mm					
Drag chain data						
Acceleration	<60 m/s²					
Flex cycles	≥3,000,000					
Velocity	≤4 m/s					
Weight	1.43 kg	2 kg	2.75 kg	3.98 kg	5.3 kg	6.6 kg

Table 147: 8CM005.12-1, 8CM007.12-1, 8CM010.12-1, 8CM015.12-1, 8CM020.12-1, 8CM025.12-1 - Technical data

6.2.3 4 mm² motor cables

6.2.3.1 Order data

Model number	Short description	Figure
	4 mm² motor cables	
8CM005.12-3	Motor cable, length 5 m, 4x 4 mm² + 2x 2x 1 mm², 8-pin female Intercontec motor connector, can be used in drag chains, UL/CSA listed	
8CM007.12-3	Motor cable, length 7 m, 4x 4 mm² + 2x 2x 1 mm², 8-pin female Intercontec motor connector, can be used in drag chains, UL/CSA listed	
8CM010.12-3	Motor cable, length 10 m, 4x 4 mm² + 2x 2x 1 mm², 8-pin female Intercontec motor connector, can be used in drag chains, UL/CSA listed	
8CM015.12-3	Motor cable, length 15 m, 4x 4 mm² + 2x 2x 1 mm², 8-pin female Intercontec motor connector, can be used in drag chains, UL/CSA listed	
8CM020.12-3	Motor cable, length 20 m, 4x 4 mm² + 2x 2x 1 mm², 8-pin female Intercontec motor connector, can be used in drag chains, UL/CSA listed	
8CM025.12-3	Motor cable, length 25 m, 4x 4 mm² + 2x 2x 1 mm², 8-pin female Intercontec motor connector, can be used in drag chains, UL/CSA listed	

Table 148: 8CM005.12-3, 8CM007.12-3, 8CM010.12-3, 8CM015.12-3, 8CM020.12-3, 8CM025.12-3 - Order data

Information:

Other cable lengths and raw cables are available from B&R upon request.

6.2.3.2 Technical data

Product ID	8CM005.12-3	8CM007.12-3	8CM010.12-3	8CM015.12-3	8CM020.12-3	8CM025.12-3
General information						
Cable cross section	4x 4 mm² + 2x 2x 1 mm²					
Durability	Oil resistance according to VDE 0472 part 803 as well as standard hydraulic oil					
Listed	UL AWM Style 20234, 80°C, 1000 V, E63216 and CSA AWM I/II A/B, 90°C, 1000 V, FT2 LL46064					
Certification						
cULus	Yes					
Cable construction						
Power lines						
Quantity	4					
Wire insulation	Special thermoplastic material					
Wire colors	Black, brown, blue, yellow/green					
Design	Tinned copper litz wire					
Diameter	4 mm²					
Shield	No					
Stranding	No					
Signal lines						
Quantity	4					
Wire insulation	Special thermoplastic material					
Wire colors	White, white/red, white/blue, white/green					
Design	Tinned copper litz wire					
Diameter	1 mm²					
Shield	Separate shielding for pairs, tinned copper mesh, optical coverage >85% and foil banding					
Stranding	White with white/red and white/blue with white/green					
Cable stranding	With filler elements and foil banding					
Complete shielding	Tinned copper mesh, optical coverage >85% and wrapped in isolating film					
Outer sheathing						
Material	PUR					
Color	Orange, similar to RAL 2003 flat					
Labeling	BERNECKER & RAINER 4x4.0+2x2x1.0 FLEX					
Connector						
Type	Intercontec 8-pin female motor connector					
Connection cycles	>50					
Contacts	8 (4 power and 4 signal contacts)					
EN 60529 protection	IP67 when connected					
Electrical characteristics						
Operating voltage	Max. 1000 V					
Test voltage						
Wire/Wire	1500 VAC					
Wire/Shield	1500 VAC					

Table 149: 8CM005.12-3, 8CM007.12-3, 8CM010.12-3, 8CM015.12-3, 8CM020.12-3, 8CM025.12-3 - Technical data

Product ID	8CM005.12-3	8CM007.12-3	8CM010.12-3	8CM015.12-3	8CM020.12-3	8CM025.12-3
Conductor resistance						
Power lines	≤0.03 Ω	≤0.04 Ω	≤0.05 Ω	≤0.08 Ω	≤0.1 Ω	≤0.13 Ω
Signal lines	≤0.09 Ω	≤0.13 Ω	≤0.19 Ω	≤0.28 Ω	≤0.38 Ω	≤0.48 Ω
Insulation resistance	>40 GΩ	>28.57 GΩ	>20 GΩ	>13.33 GΩ	>10 GΩ	>8 GΩ
Max. current load in accordance with IEC 60364-5-523 by installation type						
Wall mounting	36.4 A					
Installed in conduit or cable duct	31.9 A					
Installed in cable tray	38.2 A					
Environmental conditions						
Temperature						
Moving	-10 to 70°C					
Static	-20 to 90°C					
Mechanical characteristics						
Dimensions						
Length	5 m	7 m	10 m	15 m	20 m	25 m
Diameter	15.8 mm ±0.5 mm					
Flex radius						
Single bend	>50 mm					
Moving	≥122 mm					
Drag chain data						
Acceleration	<60 m/s²					
Flex cycles	≥3,000,000					
Velocity	≤4 m/s					
Weight	2.21 kg	3 kg	4.31 kg	6.6 kg	9 kg	11.1 kg

Table 149: 8CM005.12-3, 8CM007.12-3, 8CM010.12-3, 8CM015.12-3, 8CM020.12-3, 8CM025.12-3 - Technical data

6.2.4 10 mm² motor cables

6.2.4.1 Order data

Model number	Short description	Figure
	10 mm² motor cables	
8CM005.12-5	Motor cable, length 5 m, 4x 10 mm² + 2x 2x 1.5 mm², 8-pin female Intercontec motor connector, can be used in drag chains, UL/CSA listed	
8CM007.12-5	Motor cable, length 7 m, 4x 10 mm² + 2x 2x 1.5 mm², 8-pin female Intercontec motor connector, can be used in drag chains, UL/CSA listed	
8CM010.12-5	Motor cable, length 10 m, 4x 10 mm² + 2x 2x 1.5 mm², 8-pin female Intercontec motor connector, can be used in drag chains, UL/CSA listed	
8CM015.12-5	Motor cable, length 15 m, 4x 10 mm² + 2x 2x 1.5 mm², 8-pin female Intercontec motor connector, can be used in drag chains, UL/CSA listed	
8CM020.12-5	Motor cable, length 20 m, 4x 10 mm² + 2x 2x 1.5 mm², 8-pin female Intercontec motor connector, can be used in drag chains, UL/CSA listed	
8CM025.12-5	Motor cable, length 25 m, 4x 10 mm² + 2x 2x 1.5 mm², 8-pin female Intercontec motor connector, can be used in drag chains, UL/CSA listed	

Table 150: 8CM005.12-5, 8CM007.12-5, 8CM010.12-5, 8CM015.12-5, 8CM020.12-5, 8CM025.12-5 - Order data

Information:

Other cable lengths and raw cables are available from B&R upon request.

6.2.4.2 Technical data

Product ID	8CM005.12-5	8CM007.12-5	8CM010.12-5	8CM015.12-5	8CM020.12-5	8CM025.12-5
General information						
Cable cross section	4x 10 mm² + 2x 2x 1.5 mm²					
Durability	Oil resistance according to VDE 0472 part 803 as well as standard hydraulic oil					
Listed	UL AWM Style 20234, 80°C, 1000 V, E63216 and CSA AWM I/II A/B, 90°C, 1000 V, FT2 LL46064					
Certification						
cULus	Yes					
Cable construction						
Power lines						
Quantity	4					
Wire insulation	Special thermoplastic material					
Wire colors	Black, brown, blue, yellow/green					
Design	Tinned copper litz wire					
Diameter	10 mm²					
Shield	No					
Stranding	No					
Signal lines						
Quantity	4					
Wire insulation	Special thermoplastic material					
Wire colors	White, white/red, white/blue, white/green					
Design	Tinned copper litz wire					
Diameter	1.5 mm²					
Shield	Separate shielding for pairs, tinned copper mesh, optical coverage >85% and foil banding					
Stranding	White with white/red and white/blue with white/green					
Cable stranding	With filler elements and foil banding					
Complete shielding	Tinned copper mesh, optical coverage >85% and wrapped in isolating film					
Outer sheathing						
Material	PUR					
Color	Orange, similar to RAL 2003 flat					
Labeling	BERNECKER & RAINER 4x10,0+2x2x1.5 FLEX					
Connector						
Type	Intercontec 8-pin female motor connector					
Connection cycles	>50					
Contacts	8 (4 power and 4 signal contacts)					
EN 60529 protection	IP67 when connected					
Electrical characteristics						
Operating voltage	Max. 1000 V					
Test voltage						
Wire/Wire	1500 VAC					
Wire/Shield	1500 VAC					

Table 151: 8CM005.12-5, 8CM007.12-5, 8CM010.12-5, 8CM015.12-5, 8CM020.12-5, 8CM025.12-5 - Technical data

Product ID	8CM005.12-5	8CM007.12-5	8CM010.12-5	8CM015.12-5	8CM020.12-5	8CM025.12-5
Conductor resistance						
Power lines	≤0.01 Ω		≤0.02 Ω	≤0.03 Ω	≤0.04 Ω	≤0.05 Ω
Signal lines	≤0.07 Ω	≤0.1 Ω	≤0.14 Ω	≤0.21 Ω	≤0.28 Ω	≤0.35 Ω
Insulation resistance	>40 GΩ	>28.57 GΩ	>20 GΩ	>13.33 GΩ	>10 GΩ	>8 GΩ
Max. current load in accordance with IEC 60364-5-523 by installation type						
Wall mounting	64.6 A					
Installed in conduit or cable duct	54.6 A					
Installed in cable tray	68.3 A					
Environmental conditions						
Temperature						
Moving	-10 to 70°C					
Static	-20 to 90°C					
Mechanical characteristics						
Dimensions						
Length	5 m	7 m	10 m	15 m	20 m	25 m
Diameter	20.1 mm ±0.7 mm					
Flex radius						
Single bend	>62 mm					
Moving	≥156 mm					
Drag chain data						
Acceleration	<60 m/s²					
Flex cycles	≥3,000,000					
Velocity	≤4 m/s					
Weight	4.29 kg	6 kg	8.3 kg	12.2 kg	16 kg	19.9 kg

Table 151: 8CM005.12-5, 8CM007.12-5, 8CM010.12-5, 8CM015.12-5, 8CM020.12-5, 8CM025.12-5 - Technical data

6.2.5 35 mm² motor cables

6.2.5.1 Order data

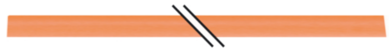
Model number	Short description	Figure
	35 mm² motor cables	
8CM005.12-8	Motor cable, length 5 m, 4x 35 mm² + 2x 2x 1.5 mm², not assembled, can be used in drag chains, UL/CSA listed	
8CM007.12-8	Motor cable, length 7 m, 4x 35 mm² + 2x 2x 1.5 mm², not assembled, can be used in drag chains, UL/CSA listed	
8CM010.12-8	Motor cable, length 10 m, 4x 35 mm² + 2x 2x 1.5 mm², not assembled, can be used in drag chains, UL/CSA listed	
8CM015.12-8	Motor cable, length 15 m, 4x 35 mm² + 2x 2x 1.5 mm², not assembled, can be used in drag chains, UL/CSA listed	
8CM020.12-8	Motor cable, length 20 m, 4x 35 mm² + 2x 2x 1.5 mm², not assembled, can be used in drag chains, UL/CSA listed	
8CM025.12-8	Motor cable, length 25 m, 4x 35 mm² + 2x 2x 1.5 mm², not assembled, can be used in drag chains, UL/CSA listed	

Table 152: 8CM005.12-8, 8CM007.12-8, 8CM010.12-8, 8CM015.12-8, 8CM020.12-8, 8CM025.12-8 - Order data

Information:

Other cable lengths and raw cables are available from B&R upon request.

6.2.5.2 Technical data

Product ID	8CM005.12-8	8CM007.12-8	8CM010.12-8	8CM015.12-8	8CM020.12-8	8CM025.12-8
General information						
Cable cross section	4x 35 mm² + 2x 2x 1.5 mm²					
Durability	Oil resistance according to VDE 0472 part 803 as well as standard hydraulic oil					
Listed	UL AWM Style 20669, 90°C, 600 V, E63216 and CSA AWM I/II A/B, 90°C, 600 V, FT1 LL46064					
Certification						
CE	-				Yes	
cULus	Yes					
Cable construction						
Power lines						
Quantity	4					
Wire insulation	Special thermoplastic material					
Wire colors	Black, brown, blue, yellow/green					
Design	Tinned copper litz wire					
Diameter	35 mm²					
Shield	No					
Stranding	No					
Signal lines						
Quantity	4					
Wire insulation	Special thermoplastic material					
Wire colors	White, white/red, white/blue, white/green					
Design	Tinned copper litz wire					
Diameter	1.5 mm²					
Shield	Separate shielding for pairs, tinned copper mesh, optical coverage >85% and foil banding					
Stranding	White with white/red and white/blue with white/green					
Cable stranding	With filler elements and foil banding					
Complete shielding	Tinned copper mesh, optical coverage >85% and wrapped in isolating film					
Outer sheathing						
Material	PUR					
Color	Orange, similar to RAL 2003 flat					
Labeling	BERNECKER & RAINER 4x35.0+2x2x1.5 FLEX					
Electrical characteristics						
Operating voltage	Max. 600 V					
Test voltage						
Wire/Wire	1500 VAC					
Wire/Shield	1500 VAC					
Conductor resistance						
Power lines	≤0.003 Ω	≤0.004 Ω	≤0.006 Ω	≤0.009 Ω	≤0.01 Ω	
Signal lines	≤0.07 Ω	≤0.1 Ω	≤0.14 Ω	≤0.21 Ω	≤0.28 Ω	≤0.35 Ω
Insulation resistance	>40 GΩ	>28.57 GΩ	>20 GΩ	>13.33 GΩ	>10 GΩ	>8 GΩ
Max. current load in accordance with IEC 60364-5-523 by installation type						
Wall mounting	133.8 A					
Installed in conduit or cable duct	116.5 A					
Installed in cable tray	143.8 A					

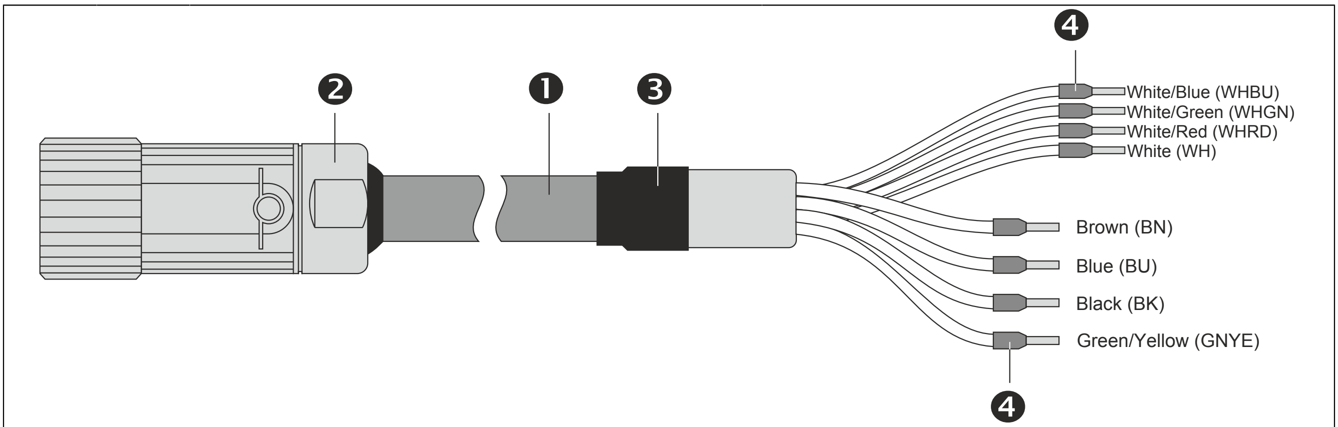
Table 153: 8CM005.12-8, 8CM007.12-8, 8CM010.12-8, 8CM015.12-8, 8CM020.12-8, 8CM025.12-8 - Technical data

Product ID	8CM005.12-8	8CM007.12-8	8CM010.12-8	8CM015.12-8	8CM020.12-8	8CM025.12-8
Environmental conditions						
Temperature						
Moving	-10 to 70°C					
Static	-20 to 90°C					
Mechanical characteristics						
Dimensions						
Length	5 m	7 m	10 m	15 m	20 m	25 m
Diameter	32.5 mm ±1 mm					
Flex radius						
Single bend	>101 mm					
Moving	≥252 mm					
Drag chain data						
Acceleration	<60 m/s²					
Flex cycles	≥3,000,000					
Velocity	≤4 m/s					
Weight	11 kg	15.4 kg	22 kg	33 kg	44 kg	55 kg

Table 153: 8CM005.12-8, 8CM007.12-8, 8CM010.12-8, 8CM015.12-8, 8CM020.12-8, 8CM025.12-8 - Technical data

6.2.6 Wiring

6.2.6.1 Motor cable construction



Pos.	Pieces	Name	Note
1	1	Motor lines	4x 0.75 mm² + 2x 2x 0.35 mm² 4x 1.5 mm² + 2x 2x 0.75 mm² 4x 4 mm² + 2x 2x 1 mm² 4x 10 mm² + 2x 2x 1.5 mm²
2	1	Male circular connector	BSTA 108 FR 19 58 0036 000 (for 8CMxxx.12-0, 8CMxxx.12-1) BSTA 108 FR 35 59 0036 000 (for 8CMxxx.12-3) CSTA 264 FR 48 25 0001 000 (for 8CMxxx.12-5)
3	1	Heat shrink tubing	
4	8	Wire end sleeves	

Table 154: Motor cable construction

6.2.6.2 Pinout

6.2.6.2.1 8CMxxx.12-0, 8CMxxx.12-1, 8CMxxx.12-3

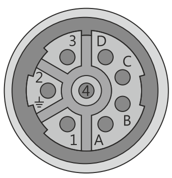
Male circular connector	Pin	Name	Function
	1	U	Motor connection U
	2	PE	Protective ground conductor
	3	W	Motor connection W
	4	V	Motor connection V
	A	T+	Temperature +
	B	T-	Temperature -
	C	B+	Brake +
	D	B-	Brake -

Table 155: Pinout - 8CMxxx.12-0, 8CMxxx.12-1, 8CMxxx.12-3 motor cables

6.2.6.2.2 8CMxxx.12-5

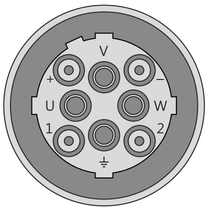
Circular connector	Pin	Name	Function
	U	U	Motor connection U
	V	V	Motor connection V
	W	W	Motor connection W
	⏚	PE	Protective ground conductor
	1	T+	Temperature +
	2	T-	Temperature -
	+	B+	Brake +
	-	B-	Brake -

Table 156: 8CMxxx.12-5 motor cables - Pinout

6.2.6.3 Cable diagram

6.2.6.3.1 8CMxxx.12-0

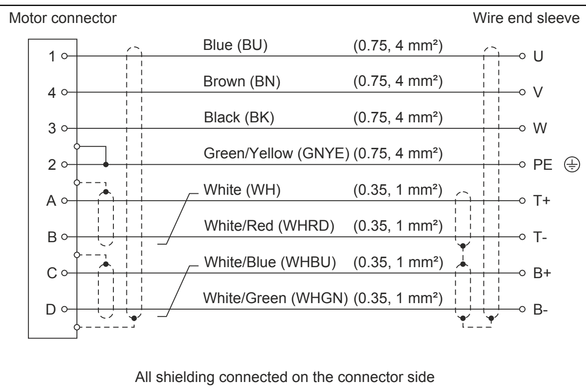


Figure 55: 8CMxxx.12-0 motor cables - Cable diagram

6.2.6.3.2 8CMxxx.12-1, 8CMxxx.12-3

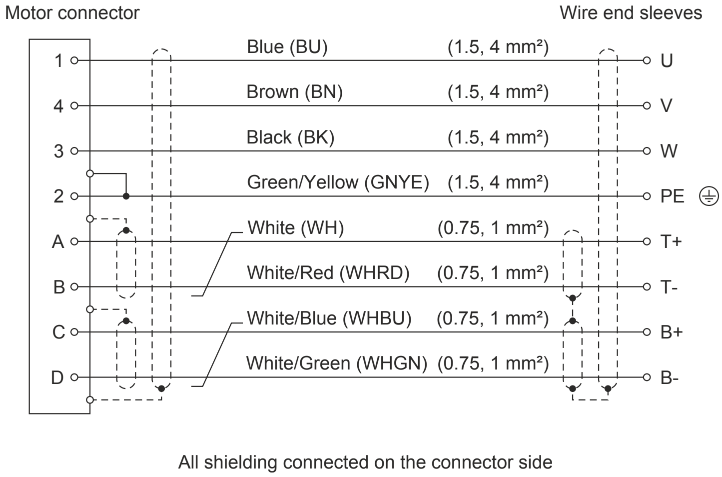


Figure 56: Cable diagram - 8CMxxx.12-1, 8CMxxx.12-3 motor cables

6.2.6.3.3 8CMxxx.12-5

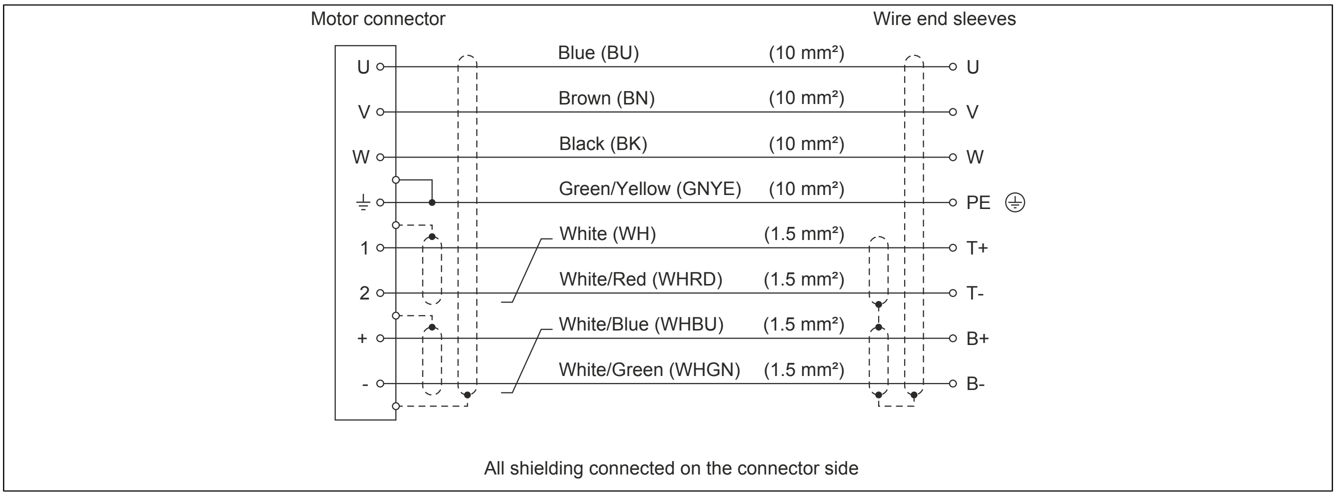


Figure 57: 8CMxxx.12-5 motor cables - Cable diagram

6.3 EnDat 2.1 cables

6.3.1 Order data

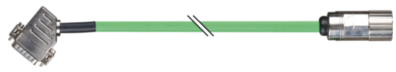
Model number	Short description	Figure
	EnDat cables	
8CE005.12-1	EnDat 2.1 cable, length 5 m, 10x 0.14 mm² + 2x 0.5 mm², Intercontec 17-pin female EnDat connector, 15-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	
8CE007.12-1	EnDat 2.1 cable, length 7 m, 10x 0.14 mm² + 2x 0.5 mm², Intercontec 17-pin female EnDat connector, 15-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	
8CE010.12-1	EnDat 2.1 cable, length 10 m, 10x 0.14 mm² + 2x 0.5 mm², Intercontec 17-pin female EnDat connector, 15-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	
8CE015.12-1	EnDat 2.1 cable, length 15 m, 10x 0.14 mm² + 2x 0.5 mm², Intercontec 17-pin female EnDat connector, 15-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	
8CE020.12-1	EnDat 2.1 cable, length 20 m, 10x 0.14 mm² + 2x 0.5 mm², Intercontec 17-pin female EnDat connector, 15-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	
8CE025.12-1	EnDat 2.1 cable, length 25 m, 10x 0.14 mm² + 2x 0.5 mm², Intercontec 17-pin female EnDat connector, 15-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	

Table 157: 8CE005.12-1, 8CE007.12-1, 8CE010.12-1, 8CE015.12-1, 8CE020.12-1, 8CE025.12-1 - Order data

Information:

Other cable lengths and raw cables are available from B&R upon request.

6.3.2 Technical data

Product ID	8CE005.12-1	8CE007.12-1	8CE010.12-1	8CE015.12-1	8CE020.12-1	8CE025.12-1
General information						
Cable cross section	10x 0.14 mm² + 2x 0.50 mm²					
Durability	Oil resistance according to VDE 0472 part 803 as well as standard hydraulic oil					
Listed	UL AWM Style 20963, 80°C, 30 V, E63216 and CSA AWM I/II A/B, 90°C, 30 V, FT1 LL46064					
Certification						
cULus	Yes					
Cable construction						
Supply lines						
Quantity	2					
Wire insulation	Special thermoplastic material					
Wire colors	White/green, white/red	White/Green, white/red	White/green, white/red	White/Green, white/red		
Design	Tinned Cu wire	Tinned copper litz wire	Tinned Cu wire	Tinned copper litz wire		
Diameter	0.5 mm²					
Shield	No					
Stranding	White/red with white/green and filler elements	White/Red with white/green and filler elements	White/red with white/green and filler elements	White/Red with white/green and filler elements		
Signal lines						
Quantity	10					
Wire insulation	Special thermoplastic material					
Wire colors	Blue, brown, yellow, gray, green, pink, red, black, violet, white					
Design	Tinned Cu wire	Tinned copper litz wire	Tinned Cu wire	Tinned copper litz wire		
Diameter	0.14 mm²					
Shield	No					
Stranding	Green with brown, gray with yellow, white with violet, black with red, pink with blue					
Cable stranding	With foil banding					
Complete shielding	Cu mesh, optical coverage >85% and wrapped in isolating film	Copper mesh, optical coverage >85% and wrapped in isolating film	Cu mesh, optical coverage >85% and wrapped in isolating film	Copper mesh, optical coverage >85% and wrapped in isolating film		
Outer sheathing						
Material	PUR					
Color	RAL 6018					
Labeling	BERNECKER & RAINER 10x0.14+2x0.50 FLEX					
Connector						
Type	Intercontec 17-pin female EnDat connector					
Connection cycles	>50					
Contacts	17					

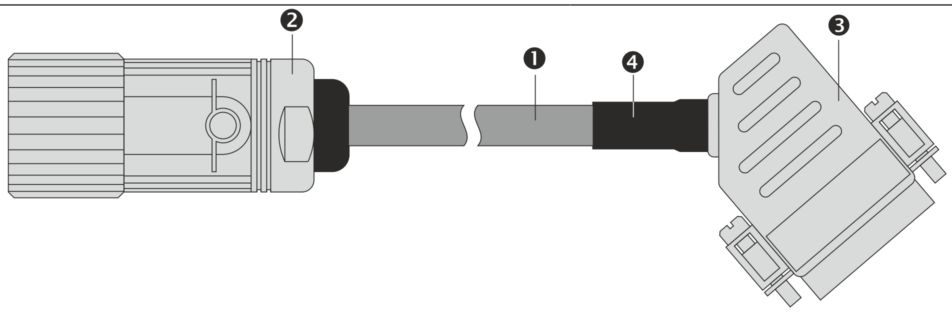
Table 158: 8CE005.12-1, 8CE007.12-1, 8CE010.12-1, 8CE015.12-1, 8CE020.12-1, 8CE025.12-1 - Technical data

Product ID	8CE005.12-1	8CE007.12-1	8CE010.12-1	8CE015.12-1	8CE020.12-1	8CE025.12-1
Additional connectors	15-pin male DSUB servo connector Connection cycles: >50 Contacts: 15 Protection in accordance with EN 60529: IP20 when connected					
EN 60529 protection	IP67 when connected					
Electrical characteristics						
Operating voltage	Max. 30 V					
Test voltage Wire/Wire Wire/Shield	 1.5 kV 0.8 kV					
Conductor resistance Supply lines Signal lines	 ≤0.2 Ω ≤0.7 Ω	 ≤0.28 Ω ≤0.98 Ω	 ≤0.4 Ω ≤1.4 Ω	 ≤0.6 Ω ≤2.1 Ω	 ≤0.8 Ω ≤2.8 Ω	 ≤1 Ω ≤3.5 Ω
Insulation resistance	>40 GΩ	>28.57 GΩ	>20 GΩ	>13.33 GΩ	>10 GΩ	>8 GΩ
Environmental conditions						
Temperature Moving Static	 -10 to 70°C -20 to 90°C					
Mechanical characteristics						
Dimensions Length Diameter	 5 m 7.3 mm ± 0.25 mm	 7 m 7.3 mm ±0.25 mm	 10 m 7.3 mm ± 0.25 mm	 15 m 7.3 mm ±0.25 mm	 20 m	 25 m
Flex radius Single bend Moving	 ≥24 mm ≥60 mm					
Drag chain data Acceleration Flex cycles Velocity	 <60 m/s² ≥3,000,000 ≤4 m/s					
Weight	0.51 kg	0.7 kg	0.95 kg	1.36 kg	1.77 kg	2.2 kg

Table 158: 8CE005.12-1, 8CE007.12-1, 8CE010.12-1, 8CE015.12-1, 8CE020.12-1, 8CE025.12-1 - Technical data

6.3.3 Wiring

6.3.3.1 construction



Pos.	Pieces	Name	Note
1	1	Encoder cable	10x 0.14 mm² + 2x 0.50 mm²
2	1	17-pin female circular connector	ASTA 035 FR 11 10 0035 000
3	1	DSUB housing 45°, metal plated, 15-pin male connector	
4	1	Heat shrink tubing	

Table 159: Construction - EnDat 2.1 cable

6.3.3.2 Pinout

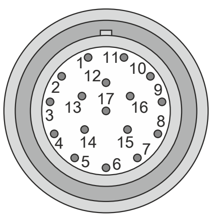
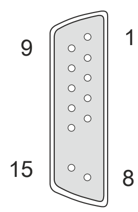
Circular connector	Pin	Name	Function	Pin	DSUB connector
	15	A	Channel A	1	
	10	COM (1, 3 - 9, 11, 13 - 15)	0 V encoder supply	2	
	12	B	Channel B	3	
	7	+5V out / 0.25A	+5 V encoder supply	4	
	14	B	Data input	5	
	8	T	Clock output	8	
	16	A\	Channel A inverted	9	
	4	Sense COM	Sense input 0 V	10	
	13	B\	Channel B inverted	11	
	1	Sense +5V	Sense input +5 V	12	
	17	D\	Data inverted	13	
	9	T\	Clock output inverted	15	

Table 160: EnDat 2.1 cables - Pinout

6.3.3.3 Cable schematic

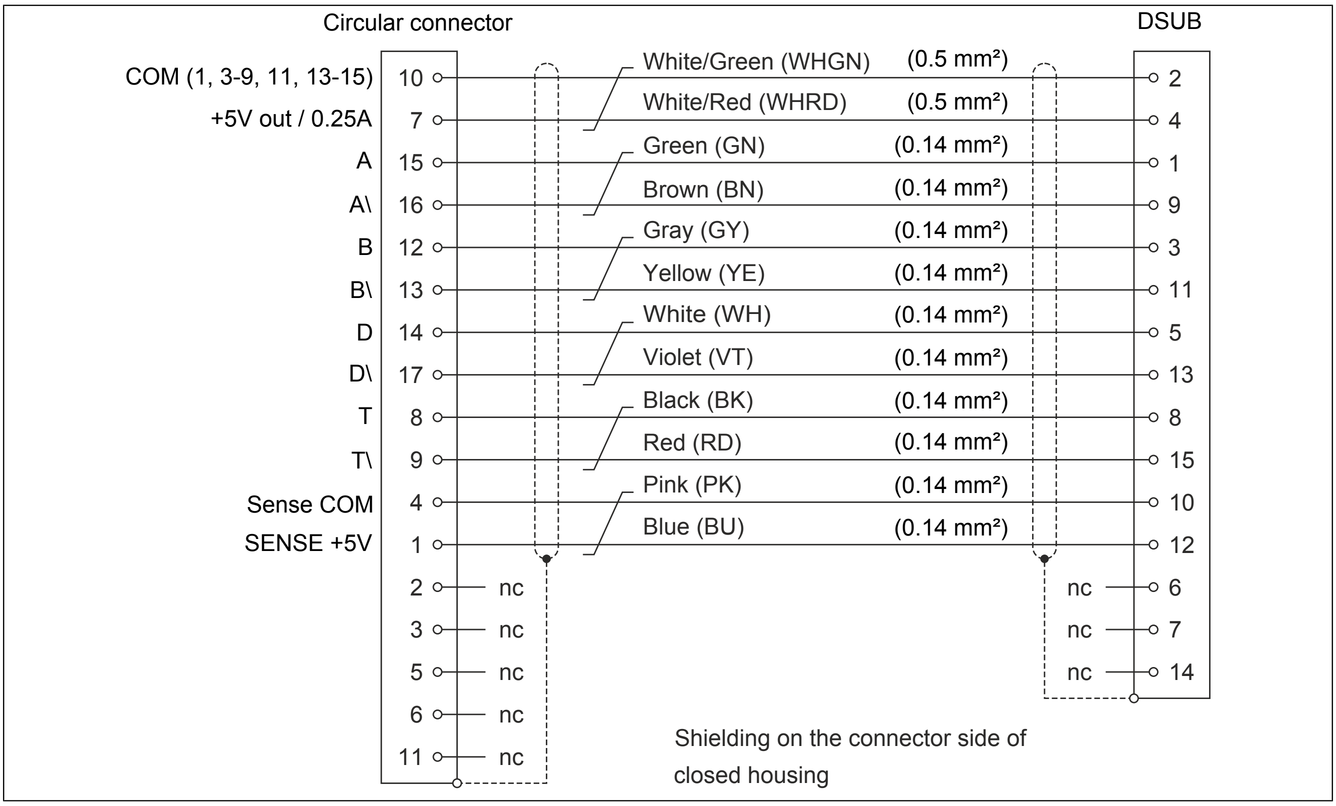


Figure 58: EnDat 2.1 cables - Cable diagram

6.4 Resolver cables

6.4.1 Order data

Model number	Short description	Figure
	Resolver cables	
8CR005.12-1	Resolver cable, length 5 m, 3x 2x AWG 24 (19x 0.127), Intercontec 12-pin female resolver connector, 9-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	
8CR007.12-1	Resolver cable, length 7 m, 3x 2x AWG 24 (19x 0.127), Intercontec 12-pin female resolver connector, 9-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	
8CR010.12-1	Resolver cable, length 10 m, 3x 2x AWG 24 (19x 0.127), Intercontec 12-pin female resolver connector, 9-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	
8CR015.12-1	Resolver cable, length 15 m, 3x 2x AWG 24 (19x 0.127), Intercontec 12-pin female resolver connector, 9-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	
8CR020.12-1	Resolver cable, length 20 m, 3x 2x AWG 24 (19x 0.127), Intercontec 12-pin female resolver connector, 9-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	
8CR025.12-1	Resolver cable, length 25 m, 3x 2x AWG 24 (19x 0.127), Intercontec 12-pin female resolver connector, 9-pin male DSUB servo connector, can be used in cable drag chains, UL/CSA listed	

Table 161: 8CR005.12-1, 8CR007.12-1, 8CR010.12-1, 8CR015.12-1, 8CR020.12-1, 8CR025.12-1 - Order data

Information:

Other cable lengths and raw cables are available from B&R upon request.

6.4.2 Technical data

Product ID	8CR005.12-1	8CR007.12-1	8CR010.12-1	8CR015.12-1	8CR020.12-1	8CR025.12-1
General information						
Cable cross section	3x 2x 24 19 AWG					
Durability	Oil resistance according to VDE 0472 part 803 as well as standard hydraulic oil					
Listed	UL AWM Style 20671, 90°C, 30 V, E63216 and CSA AWM, 90°C, 30 V, I/II A/B FT1 LL46064					
Certification						
cULus	Yes					
Cable construction						
Signal lines						
Quantity	6					
Wire insulation	Special thermoplastic material					
Wire colors	White, brown, green, yellow, gray, pink					
Design	Tinned Cu wire	Tinned copper litz wire				
Diameter	AWG 24 / AWG 19					
Shield	No					
Stranding	White with brown, green with yellow, gray with pink					
Cable stranding	The 3 pairs together covered by foil banding					
Complete shielding	Cu mesh, optical coverage ≥90% and wrapped in isolating film	Copper mesh, optical coverage ≥90% and wrapped in isolating film				
Outer sheathing						
Material	PUR					
Color	RAL 6018					
Labeling	BERNECKER & RAINER 3x2x24 AWG FLEX					
Connector						
Type	Intercontec 12-pin female resolver connector					
Connection cycles	>50					
Contacts	12					
Additional connectors	9-pin male DSUB servo connector Connection cycles: >50 Contacts: 9 Protection in accordance with EN 60529: IP20 when connected					
EN 60529 protection	IP67 when connected					
Electrical characteristics						
Operating voltage	Max. 30 V					
Test voltage						
Wire/Wire	1.5 kV					
Wire/Shield	0.8 kV					
Conductor resistance						
Signal lines	≤0.43 Ω	≤0.6 Ω	≤0.86 Ω	≤1.29 Ω	≤1.72 Ω	≤2.15 Ω
Insulation resistance	>40 GΩ	>28.57 GΩ	>20 GΩ	>13.33 GΩ	>10 GΩ	>8 GΩ

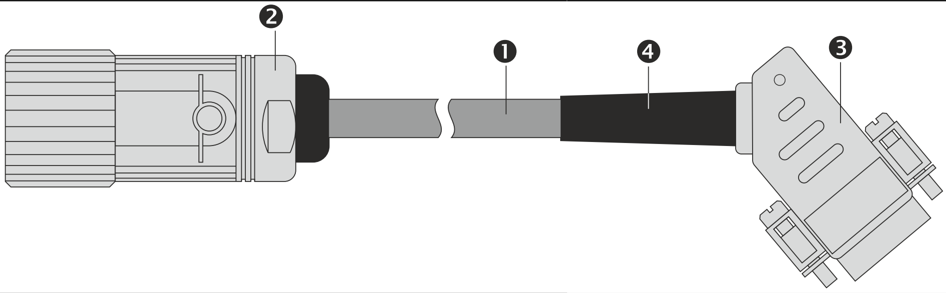
Table 162: 8CR005.12-1, 8CR007.12-1, 8CR010.12-1, 8CR015.12-1, 8CR020.12-1, 8CR025.12-1 - Technical data

Product ID	8CR005.12-1	8CR007.12-1	8CR010.12-1	8CR015.12-1	8CR020.12-1	8CR025.12-1
Environmental conditions						
Temperature Moving Static	-10 to 80°C -40 to 90°C					
Mechanical characteristics						
Dimensions						
Length	5 m	7 m	10 m	15 m	20 m	25 m
Diameter	6.5 mm ± 0.2 mm	6.5 mm ±0.2 mm				
Flex radius Single bend Moving	≥20 mm ≥50 mm					
Drag chain data Acceleration Flex cycles Velocity	<60 m/s² ≥3,000,000 ≤4 m/s					
Weight	0.4 kg	0.51 kg	0.75 kg	0.98 kg	1.26 kg	1.55 kg

Table 162: 8CR005.12-1, 8CR007.12-1, 8CR010.12-1, 8CR015.12-1, 8CR020.12-1, 8CR025.12-1 - Technical data

6.4.3 Wiring

6.4.3.1 Resolver cable construction



Pos.	Pieces	Name	Note
1	1	Encoder cable	3x 2x 24 AWG/19
2	1	12-pin female circular connector	ASTA 021 FR 11 10 0035 000
3	1	DSUB housing 45°, metal plated, 9-pin male connector	
4	1	Kink protection	

Table 163: Resolver cable construction

6.4.3.2 Pinout

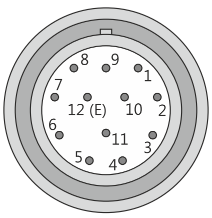
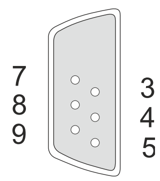
Circular connector	Pin	Name	Function	Pin	DSUB connector
	1	---			
	2	---			
	3	S4	Sine input +	3	
	4	S1	Cosine input -	4	
	5	R2	Reference output +	5	
	6	---			
	7	S2	Sine input -	7	
	8	S3	Cosine input +	8	
	9	R1	Reference output -	9	
	10	---			
	11	---			
	12	---			

Table 164: Resolver cables - Pinout

6.4.3.3 Cable diagram

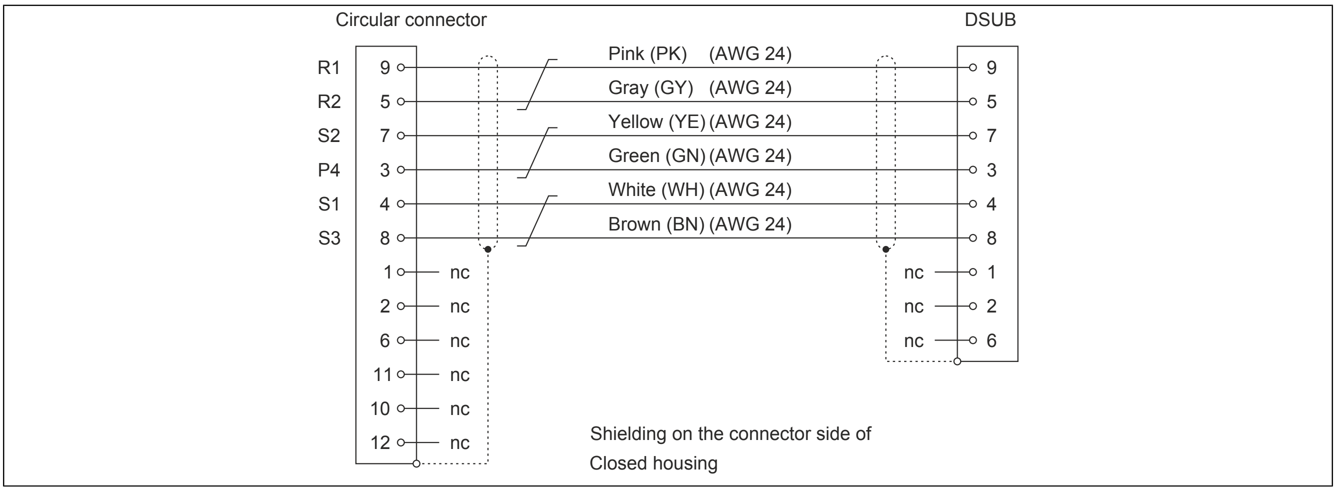


Figure 59: Cable diagram for resolver cables

7 Connectors

7.1 General information

B&R offers different motor/encoder connectors for B&R motors. All connectors have IP67 protection. The metallic housing provides a protective ground connection on the housing according to VDE 0627. All plastic used in the connector is UL94/V0 listed. High quality, gold-plated cage connector contacts guarantee a high level of contact stability even when reinserted many times.

Information:

Using B&R connectors guarantees that the EMC limits for the connection are not exceeded. Make sure that connectors are assembled correctly and include a proper shield connection.

7.2 Motor connectors

7.2.1 Order data

Model number	Short description	Figure
	Accessories	
8PM001.00-1	Intercontec 8-pin female motor connector, crimp range 4x 0.5-2.5 mm² + 4x 0.06-1.0 mm², for 9-14 mm cables, IP67, UL/CSA listed	
8PM002.00-1	Intercontec 8-pin female motor connector, crimp range 4x 2.5-4.0 mm² + 4x 0.06-1.0 mm², soldering range 4x 0.5-4.0 mm² + 4x 0.06-1.5 mm² for 14-17 mm cables, IP67, UL/CSA listed	
8PM003.00-1	Intercontec 8-pin female motor connector, crimp range 4x 1.5-10 mm² + 4x 0.5-2.5 mm², for 17-26 mm cables, IP67, UL/CSA listed	

Table 165: 8PM001.00-1, 8PM002.00-1, 8PM003.00-1 - Order data

7.2.2 Technical data

Product ID	8PM001.00-1	8PM002.00-1	8PM003.00-1
General information			
Insulator	PA 6.6 / PBT, UL94/V0 listed		
Contacts	8 (4 power and 4 signal contacts)		
Protective ground connection on housing	According to VDE 0627		
Certification			
UL/CSA	Yes		
Electrical characteristics			
Overvoltage category	3		
Power contacts			
Contact resistance	<3 mΩ		<1 mΩ
Nominal voltage	630 VAC / VDC		
Nominal current	30 A		75 A
Test voltage (L - L)	6000 V		
Signal contacts			
Contact resistance	<5 mΩ		<3 mΩ
Nominal voltage	250 VAC / VDC		630 VAC / VDC
Nominal current	10 A		30 A
Test voltage (L - L)	2500 V		4000 V
Operating conditions			
Degree of pollution in accordance with EN 60664-1	3		
EN 60529 protection	IP67 when connected		
Environmental conditions			
Temperature			
Operation	-20 to 130°C		
Altitude			
Operation	Up to 2000 m		
Mechanical characteristics			
Housing			
Material	Zinc die cast / brass, nickel plated		Magnesium die cast / aluminum, nickel plated
Crimp range	4x 0.5 - 2.5 mm² + 4x 0.06 - 1 mm²	4x 2.5 - 4 mm² + 4x 0.06 - 1 mm²	4x 1.5 - 10 mm² + 4x 0.5 - 2.5 mm²
Gasket	FPM / HNBR		
Connector size	Size 1		Size 1.5
Connection cycles	>50		

Table 166: 8PM001.00-1, 8PM002.00-1, 8PM003.00-1 - Technical data

Product ID	8PM001.00-1	8PM002.00-1	8PM003.00-1
Cable terminals	9.5 - 14.5 mm	14 to 17 mm	17 to 26 mm
Manufacturer information			
Manufacturer	INTERCONTEC (www.intercontec.biz)		
Manufacturer's product ID	BSTA 108 FR 19 58 0036 000	BSTA 108 FR 35 59 0036 000	CSTA 264 FR 48 25 0001 000

Table 166: 8PM001.00-1, 8PM002.00-1, 8PM003.00-1 - Technical data

7.3 Encoder connectors

7.3.1 EnDat connectors

7.3.1.1 Order data

Model number	Short description	Figure
	Accessories	
8PE001.00-1	Intercontec 17-pin female EnDat connector, crimp range 17x 0.06-1.0 mm², for 9-12 mm cables, IP67	

Table 167: 8PE001.00-1 - Order data

7.3.1.2 Technical data

Product ID	8PE001.00-1
General information	
Insulator	PA 6.6 / PBT, UL94/V0 listed
Contacts	17 signal contacts
Protective ground connection on housing	According to VDE 0627
Certification UL/CSA	 Yes
Electrical characteristics	
Overvoltage category	3
Signal contacts Contact resistance Nominal voltage Nominal current Test voltage (L - L)	 <5 mΩ 125 V 9 A 2500 V
Operating conditions	
Degree of pollution in accordance with EN 60664-1	3
EN 60529 protection	IP67 when connected
Environmental conditions	
Temperature Operation	 -20 to 130°C
Altitude Operation	 Up to 2000 m
Mechanical characteristics	
Housing Material	 Zinc die cast / brass, nickel plated
Crimp range	17x 0.06 - 1 mm²
Gasket	FPM / HNBR
Connector size	Size 1
Connection cycles	>50
Cable terminals	5.5 to 10.5 mm
Manufacturer information	
Manufacturer	INTERCONTEC (www.intercontec.biz)
Manufacturer's product ID	ASTA 035 FR 11 10 0035 000

Table 168: 8PE001.00-1 - Technical data

7.3.2 Resolver connectors

7.3.2.1 Order data

Model number	Short description	Figure
	Accessories	
8PR001.00-1	Intercontec 12-pin female resolver connector, crimp range 12x 0.06-1.0 mm², for 5.5-10.5 mm cables, IP67	

Table 169: 8PR001.00-1 - Order data

7.3.2.2 Technical data

Product ID	8PR001.00-1
General information	
Insulator	PA 6.6 / PBT, UL94/V0 listed
Contacts	12 signal contacts
Protective ground connection on housing	According to VDE 0627
Certification UL/CSA	 Yes
Electrical characteristics	
Overvoltage category	3
Signal contacts Contact resistance Nominal voltage Nominal current Test voltage (L - L)	 <5 mΩ 160 V 9 A 2500 V
Operating conditions	
Degree of pollution in accordance with EN 60664-1	3
EN 60529 protection	IP67 when connected
Environmental conditions	
Temperature Operation	 -20 to 130°C
Altitude Operation	 Up to 2000 m
Mechanical characteristics	
Housing Material	 Zinc die cast / brass, nickel plated
Crimp range	12x 0.06 - 1 mm²
Gasket	FPM / HNBR
Connector size	Size 1
Connection cycles	>50
Cable terminals	5.5 to 10.5 mm
Manufacturer information	
Manufacturer	INTERCONTEC (www.intercontec.biz)
Manufacturer's product ID	ASTA 021 FR 11 10 0035 000

Table 170: 8PR001.00-1 - Technical data

Chapter 3 • Installation

1 General

Installation must take place on a flat surface that is dimensioned correctly. The dimension diagram lists the number and type of mounting screws to be used.

The included eye bolt can be screwed into the top of the device in order to mount the ACOPOS 1640 and ACOPOS 128M:

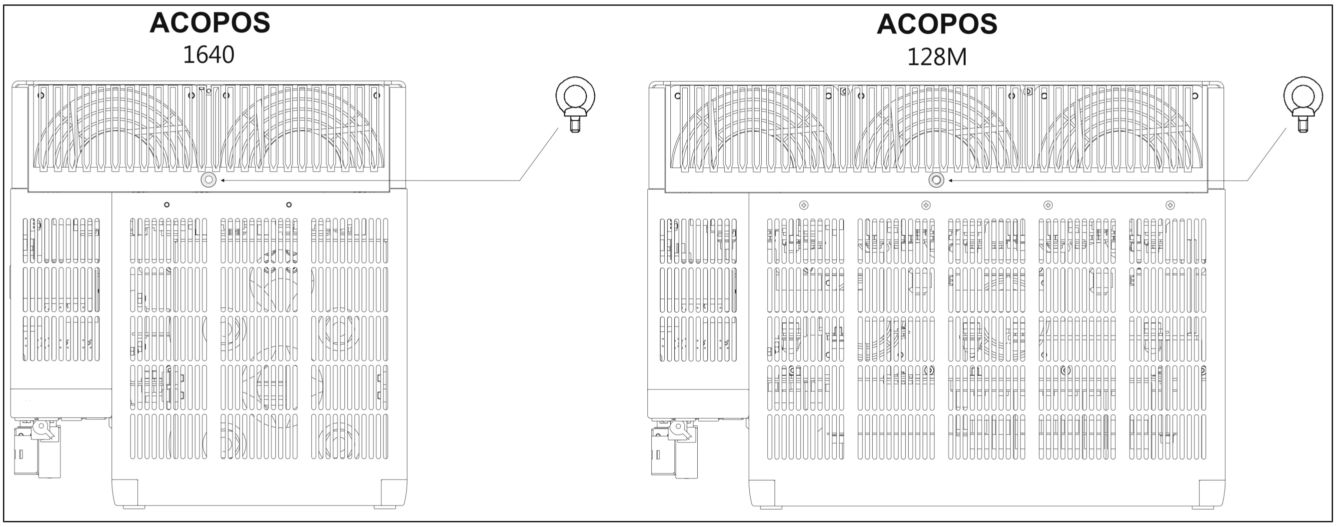


Figure 60: Attaching the eye bolt included in delivery to ACOPOS 1640, 128M drives

ACOPOS servo drives must be installed in control cabinets with at least IP54 protection. [7)]

ACOPOS servo drives can only be installed in environments that correspond to a pollution degree 2 (non-conductive pollution). When installing the device, the specifications listed in the technical data for maximum operating temperature and protection level must be met (see "Technical data" on page 29).

Sufficient space of at least 80 mm must be left above and below the ACOPOS servo drives in order to ensure proper air circulation. ACOPOS servo drives can be mounted directly next to each other; the required clearance between devices can be found in the respective dimension diagram.

Chapter 3
Installation

7) Except for 8B0WxxxxH000.001-1 braking resistors.

2 Dimension diagrams and installation dimensions

2.1 ACOPOS 1010, 1016

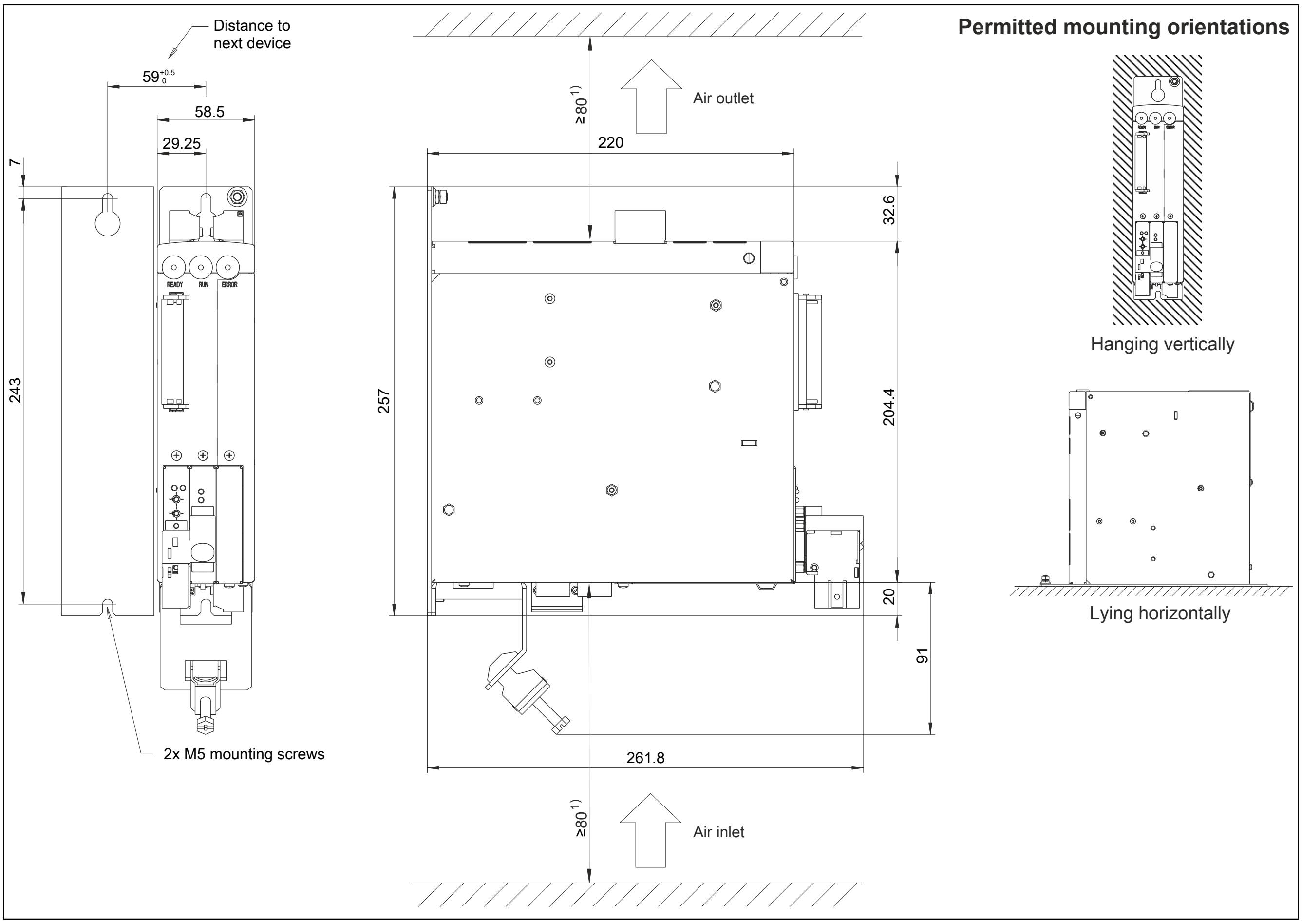


Figure 61: ACOPOS 1010, 1016 - Dimension diagram and installation dimensions

1) For proper air circulation, at least 80 mm clearance must be available above and below the ACOPOS servo drive. Approximately 100 mm clearance is required under the ACOPOS servo drive to prevent cabling problems.

2.2 ACOPOS 1022, 1045, 1090

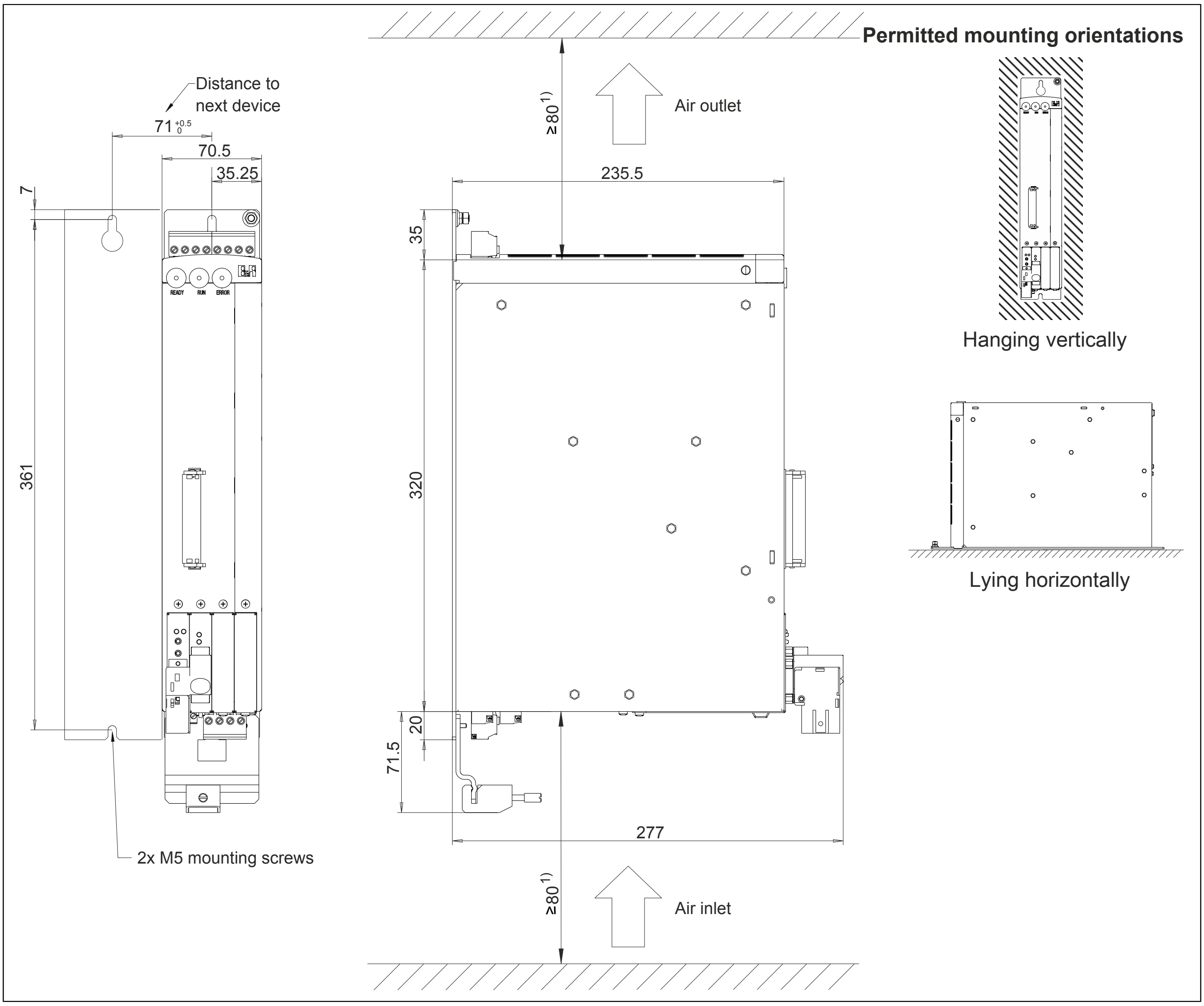


Figure 62: ACOPOS 1022, 1045, 1090 - Dimension diagram and installation dimensions

1) For proper air circulation, at least 80 mm clearance must be available above and below the ACOPOS servo drive.

2.3 ACOPOS 1180, 1320

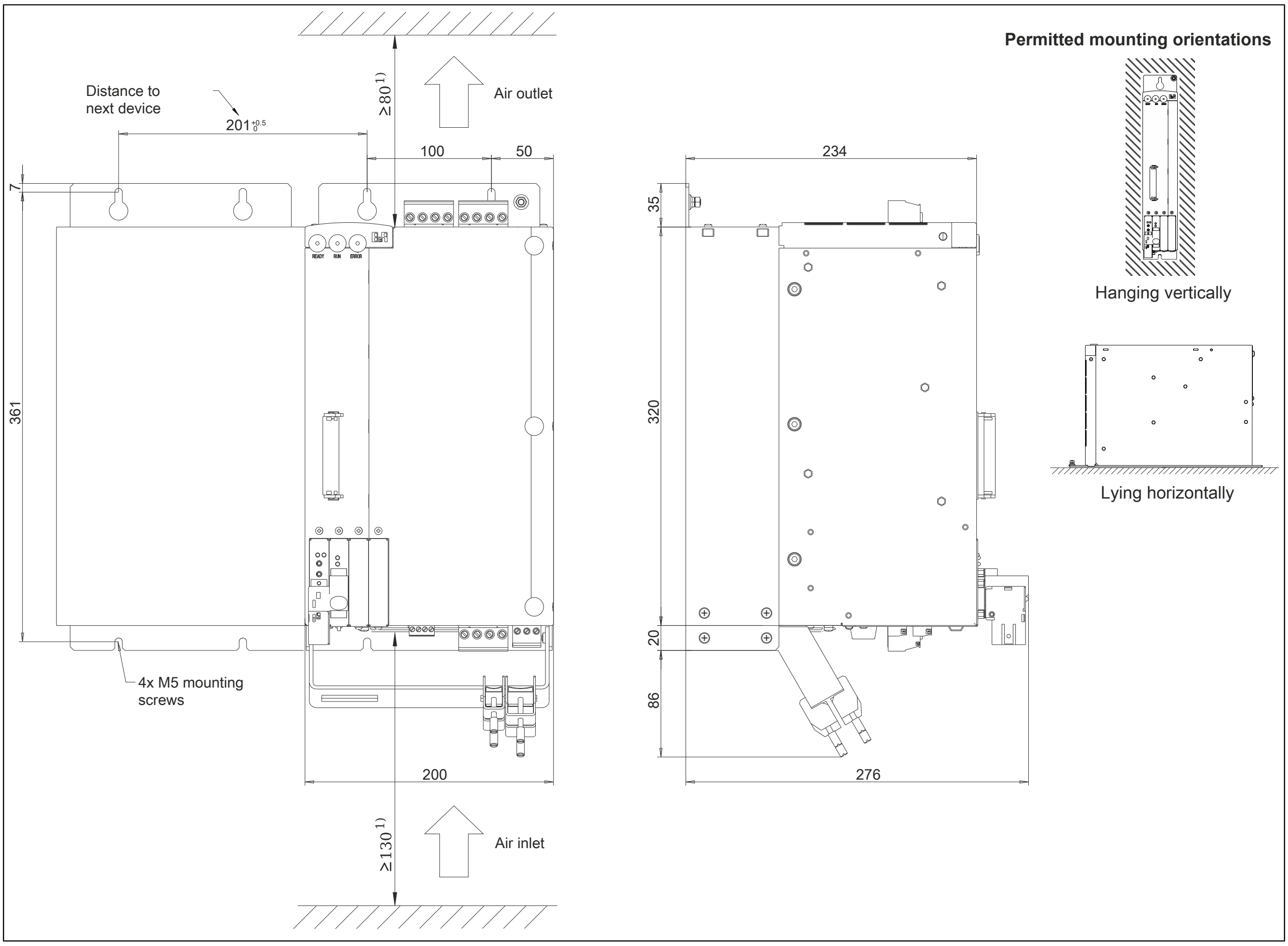


Figure 63: ACOPOS 1180, 1320 - Dimension diagram and installation dimensions

1) For proper air circulation, at least 80 mm clearance must be available above and below the ACOPOS servo drive. At least 130 mm free space is required under the ACOPOS servo drive to prevent cabling problems.

2.4 ACOPOS 1640

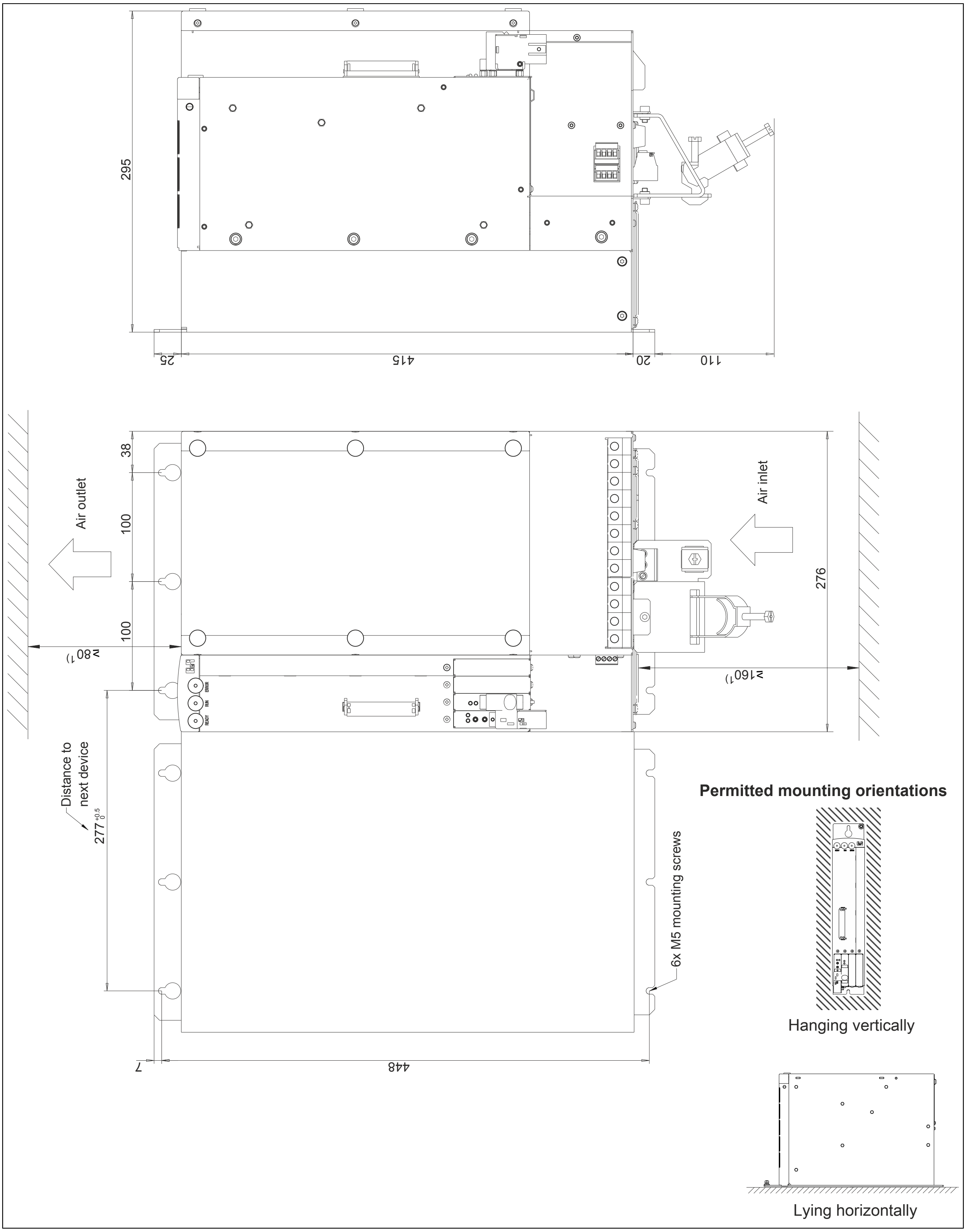


Figure 64: ACOPOS 1640 - Dimension diagram and installation dimensions

1) For proper air circulation, at least 80 mm clearance must be available above and below the ACOPOS servo drive. At least 160 mm free space is required under the ACOPOS servo drive to prevent cabling problems.

2.5 ACOPOS 128M

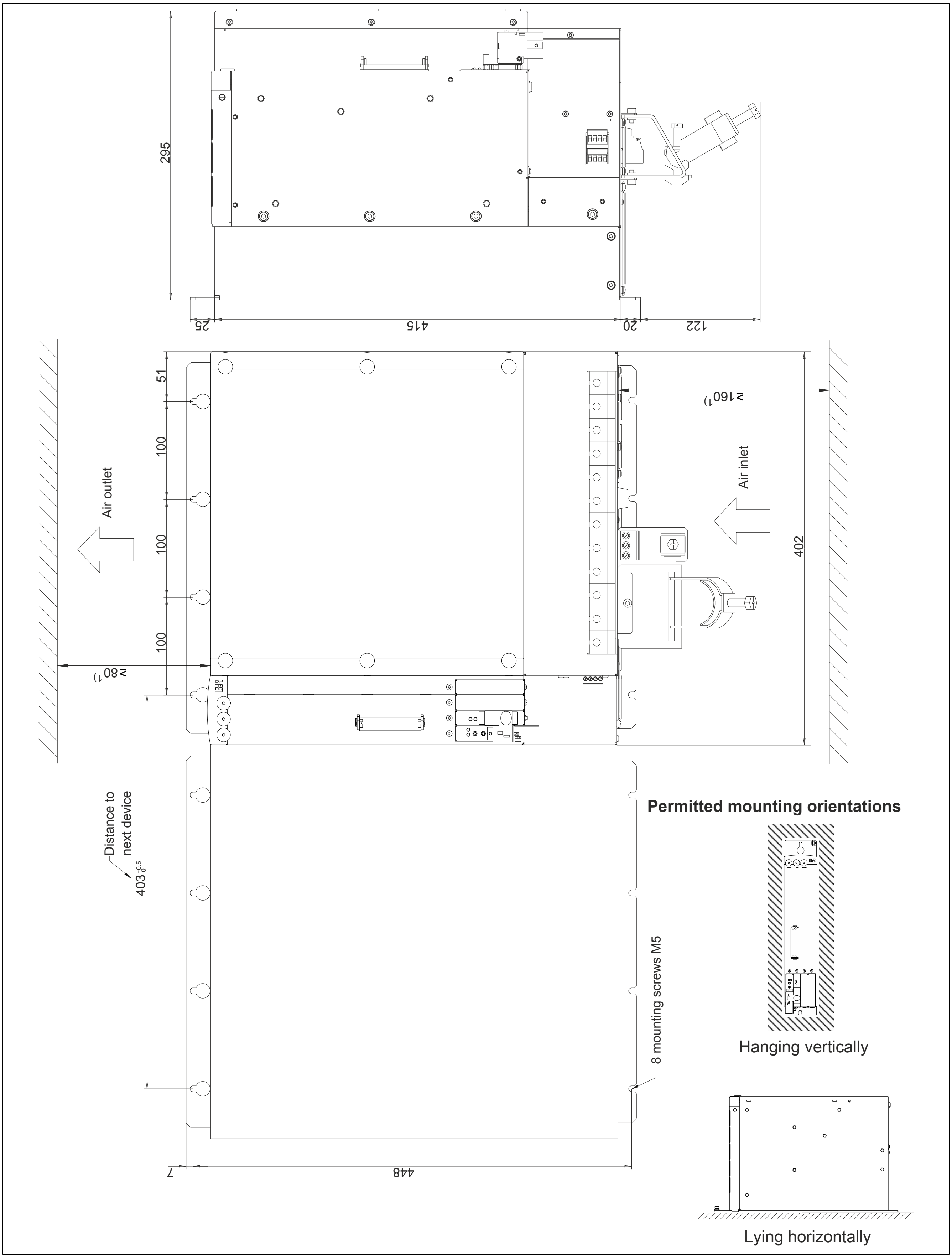


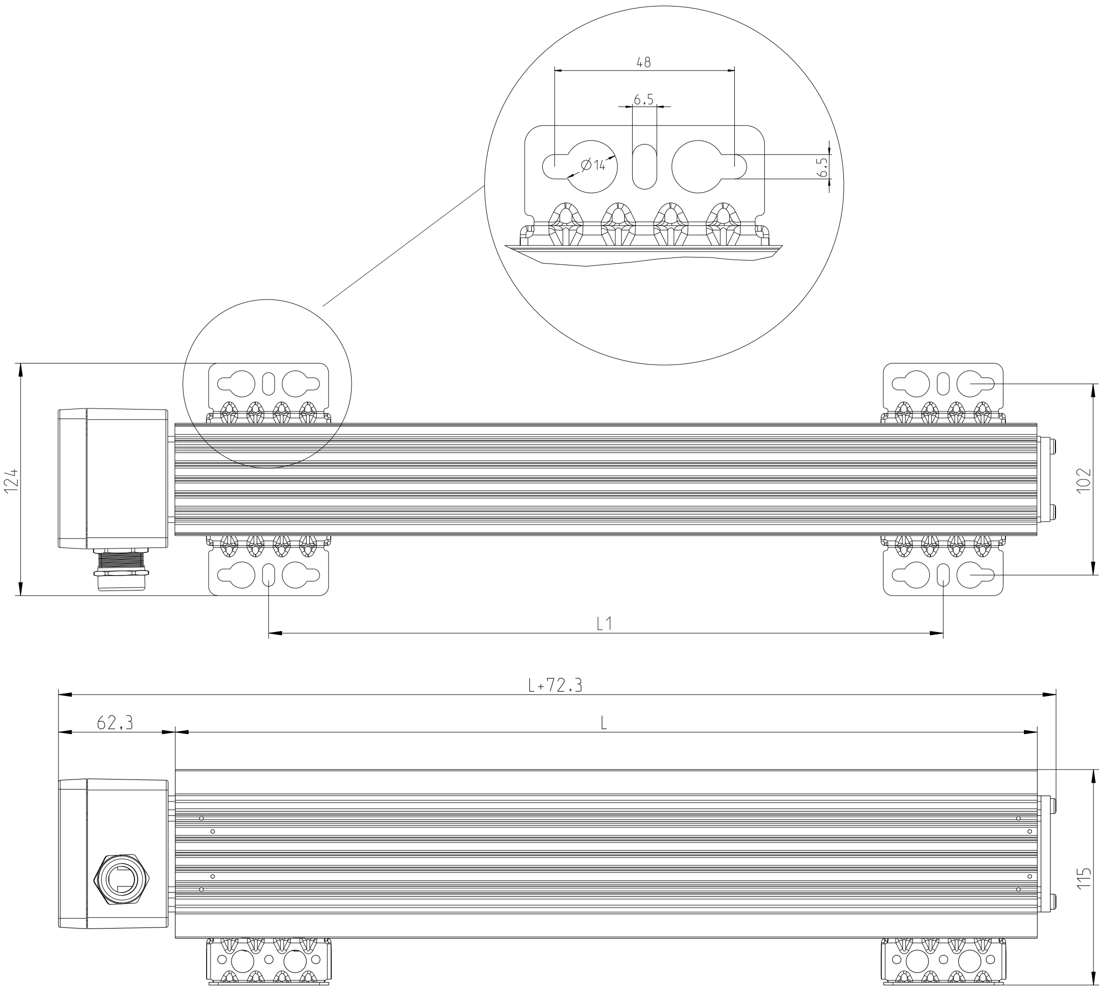
Figure 65: ACOPOS 128M - Dimension diagram and installation dimensions

1) For proper air circulation, at least 80 mm clearance must be available above and below the ACOPOS servo drive. Approximately 160 mm clearance is required under the ACOPOS servo drive to prevent cabling problems.

2.6 External braking resistors

2.6.1 8B0W0045H000.001-1, 8B0W0079H000.001-1

	8B0W0045H000.001-1	8B0W0079H000.001-1	8B0W0096H000.001-1
L	260±2 mm	460±2 mm	560±2 mm
L1	160±2 mm	360±2 mm	460±2 mm



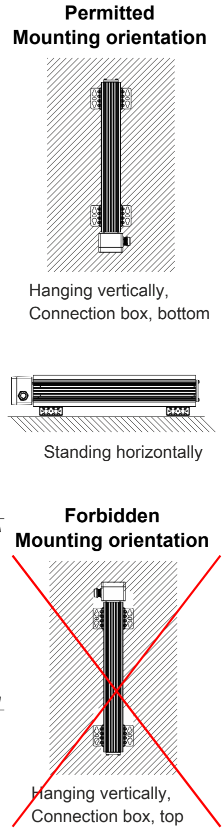


Figure 66: Dimension diagram for 8B0W0045H000.001-1, 8B0W0079H000.001-1

Warning!

8B0W external braking resistors can reach extremely high surface temperatures both during operation as well as after being switched off!

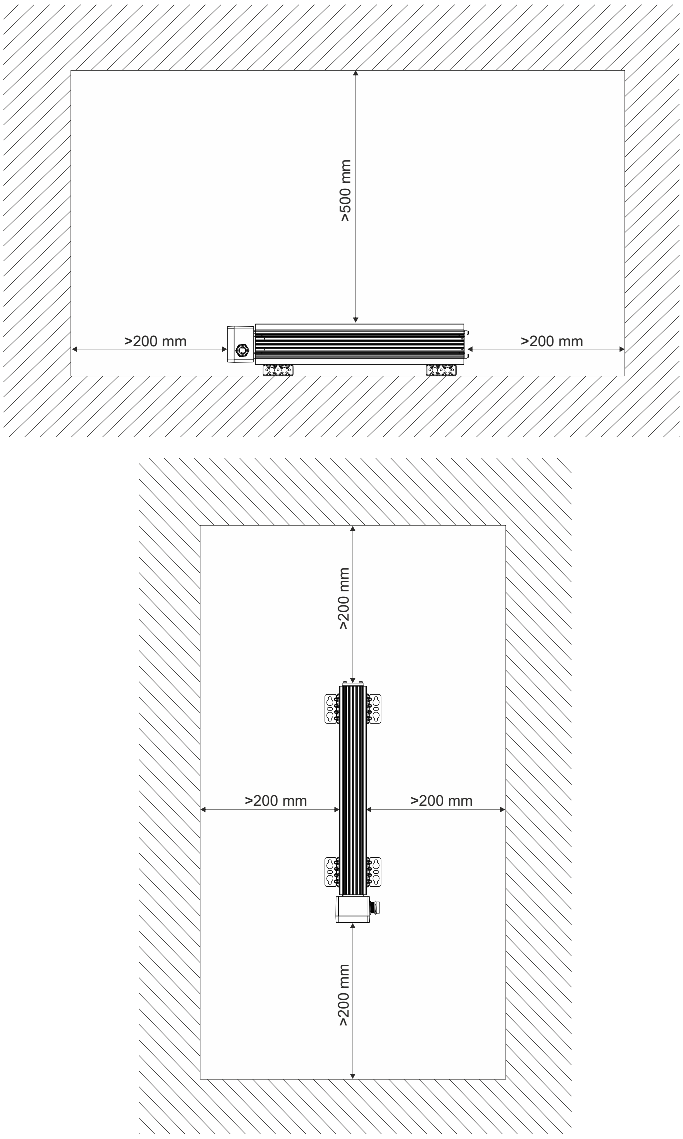


Figure 67: 8B0W external braking resistors - Installation dimensions

3 Installing and removing plug-in modules

3.1 General information

All ACOPOS servo drives are equipped with three or four slots for plug-in modules depending on the size of the drive. Certain module arrangements must be used (see "Slot overview for ACOPOS plug-in modules" on page 106).

Caution!

For the installation and removal of plug-in modules, the specifications listed in section "Protection against electrostatic discharge" on page 24 must be followed!

3.2 Installation

1. Disconnect the ACOPOS servo drive from the power mains and prevent reconnection.
2. Switch off the 24 VDC supply voltage.
3. Remove the screw from the bottom of the slot cover.
4. Loosen the screw on the front side.
5. Remove the slot cover.

Figure 68: Installing ACOPOS plug-in modules

6. Insert the plug-in module in available slot (see figure above).
7. Fasten the plug-in module with the two screws.
8. Switch on the 24 VDC supply voltage.
9. Connect the ACOPOS servo drive to the power mains.

3.3 Removal

1. Disconnect the ACOPOS servo drive from the power mains and prevent reconnection.
2. Switch off the 24 VDC supply voltage.
3. Remove the screw from bottom of plug-in module.
4. Loosen the screw on the front side of the plug-in module.
5. Remove the plug-in module.
6. Insert the slot cover in the open slot.
7. Fasten the slot cover with the two screws.
8. Switch on the 24 VDC supply voltage.
9. Connect the ACOPOS servo drive to the power mains.

Chapter 3
Installation

4 Installing devices from different ACOPOS series directly next to each other

When installing various ACOPOS series devices directly next to each other, we recommend aligning the vertical position so that the LED displays of the respective devices are lined up.

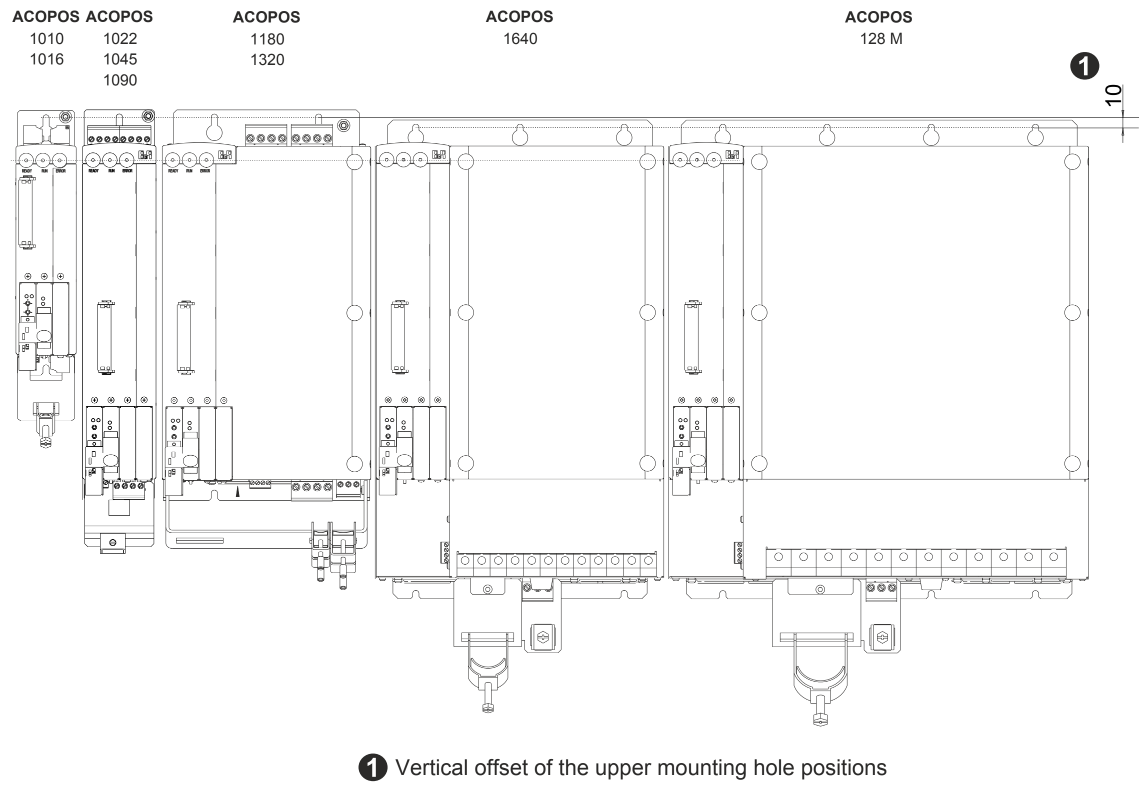


Figure 69: Installing various ACOPOS series devices directly next to each other

You can see from the image above that the vertical offset of the upper mounting holes is 10 mm. The distances for the lower mounting holes and the number and size of the screws required can be taken from the dimensional diagrams for the respective ACOPOS servo drives.

Overview of the vertical offsets:

<table>
<tr><th colspan="2" rowspan="2">Installed next to</th><th colspan="9">ACOPOS</th></tr>
<tr><th>1010</th><th>1016</th><th>1022</th><th>1045</th><th>1090</th><th>1180</th><th>1320</th><th>1640</th><th>128 M</th></tr>
<tr><td rowspan="9">ACOPOS</td><td>1010</td><td colspan="7" rowspan="7">No offset</td><td colspan="2" rowspan="7">10 mm</td></tr>
<tr><td>1016</td></tr>
<tr><td>1022</td></tr>
<tr><td>1045</td></tr>
<tr><td>1090</td></tr>
<tr><td>1180</td></tr>
<tr><td>1320</td></tr>
<tr><td>1640</td><td colspan="7" rowspan="2">10 mm</td><td colspan="2" rowspan="2">No offset</td></tr>
<tr><td>128 M</td></tr>
</table>

Table 171: Overview of the vertical offsets (ACOPOS - ACOPOS)

5 Using cooling systems in control cabinets

Cooling systems are generally used to maintain permissible ambient temperature levels of the ACOPOS servo drives in control cabinets.

For details about dimensioning cooling systems, see "Dimensioning cooling systems for cooling control cabinets" on page 241.

5.1 Natural convection

Warning!

Make sure that only well-sealed control cabinets are used. Otherwise, contaminated ambient air could permeate the control cabinet.

5.2 Using filter fans

Filter fans and outlet filters should be arranged on the control cabinet in such a way that the air is taken in from below and exits above.

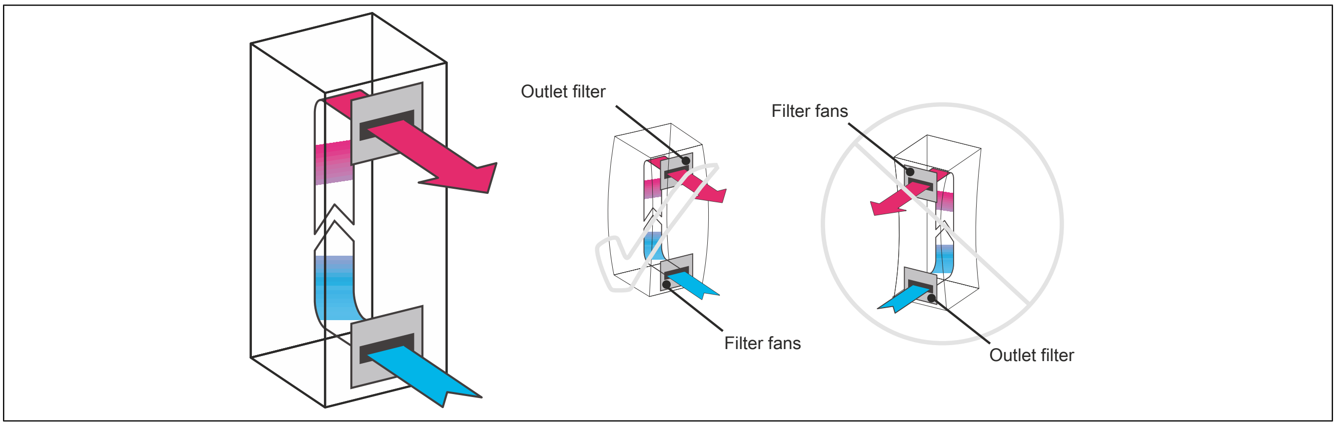


Figure 70: Function diagram of filter fans

Caution!

Dust can enter the control cabinet if it is not sealed properly when using a fan intake! This type of air flow should be avoided.

Warning!

Make sure that only well-sealed control cabinets are used. Otherwise, contaminated ambient air could permeate the control cabinet.

5.3 Using air/air heat exchangers

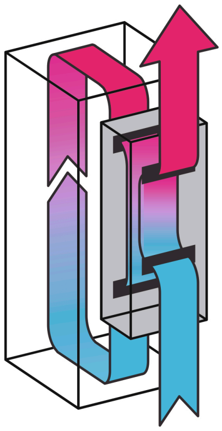


Figure 71: Function diagram of air/air heat exchangers

Caution!

An even circulation of air must be ensured in the control cabinet. Air intake openings and outlets for the inner circulation of the air/air heat exchanger must not be covered because this would prevent sufficient air circulation in the control cabinet.

It is recommended to allow for sufficient space (>200 mm) in front of the air intakes and outlets.

Caution!

If any modules or electronic components are used in the control cabinet that use their own fans, make sure that the direction of air flow does not go against the cooling system's flow of cool air. This could create air pockets that would prevent sufficient cooling in the control cabinet.

Warning!

Make sure that only well-sealed control cabinets are used. Otherwise, contaminated ambient air could permeate the control cabinet.

Installing air/air heat exchangers behind mounting plates should generally be avoided. If this is necessary, however, then corresponding air shields must be used. Air intake openings and outlets must also be added to the mounting plate.

5.4 Using air/water heat exchangers

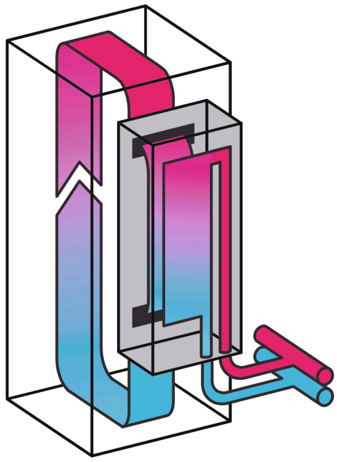


Figure 72: Function diagram of air/water heat exchangers

Caution!

An even circulation of air must be ensured in the control cabinet. Air intake openings and outlets for the inner circulation of the air/water heat exchanger must not be covered because this would prevent sufficient air circulation in the control cabinet.

It is recommended to allow for sufficient space (>200 mm) in front of the air intakes and outlets.

Caution!

If any modules or electronic components are used in the control cabinet that use their own fans, make sure that the direction of air flow does not go against the cooling system's flow of cool air. This could create air pockets that would prevent sufficient cooling in the control cabinet.

Warning!

Make sure that only well-sealed control cabinets are used. Otherwise, contaminated ambient air could permeate the control cabinet.

Installing air/water heat exchangers behind mounting plates should generally be avoided. If this is necessary, however, then corresponding air shields must be used. Air intake openings and outlets must also be added to the mounting plate.

5.5 Using cooling units

5.5.1 General information

Caution!

Incorrect installation of cooling units may cause condensation which can damage the ACOPOS servo drives installed there!

Condensation can enter the ACOPOS servo drives with the cooled air flow!

Warning!

Make sure that only well-sealed control cabinets are used. Otherwise, ambient air could penetrate and cause condensation.

During operation with the control cabinet doors open (e.g. service), the ACOPOS servo drives are not allowed to be cooler than the air in the control cabinet at any time after the doors are closed.

To keep the temperature of the ACOPOS servo drives and the control cabinet at the same level, the cooling unit must remain in operation even when the system is switched off.

Cooling units must be installed in a way that prevents condensation from dripping into the ACOPOS servo drives. This should be considered when selecting the control cabinet (special construction for use of cooling units on top of the control cabinet).

Also make sure that condensed water that forms in the cooling unit fan when it is switched off cannot sprinkle into the ACOPOS servo drives.

Make sure the temperature setting of the cooling unit is correct! Only set the control cabinet's internal temperature as low as is necessary.

Be sure to follow the installation guidelines for the cooling unit provided in its operating manual!

5.5.2 Placing a cooling unit on top of the control cabinet

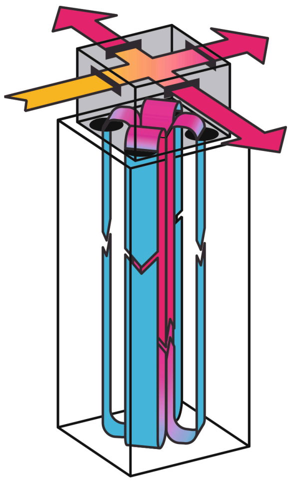


Figure 73: Placing a cooling unit on top of the control cabinet

Caution!

Targeted air flow must be ensured when arranging cooling units on the top of the control cabinet! The flow of cool air must be directed through air channel systems at the lowest possible point in the control cabinet (see image above).

Caution!

Make sure that the flow of cool air in the cooling system is not directed against the air flow from the fans in the ACOPOS servo drive. This could create air pockets that would prevent sufficient cooling of ACOPOS servo drives.

Condensation must be directed off the cooling unit according to manufacturer specifications so that it does not end up in the ACOPOS servo drives.

5.5.3 Placing a cooling unit on the front of the control cabinet

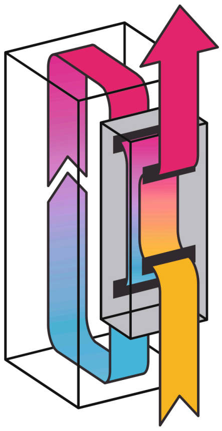


Figure 74: Placing a cooling unit on the front of the control cabinet

Caution!

The flow of cool air from the cooling unit must be directed through air channel systems at the lowest possible point in the control cabinet (see image above).

Caution!

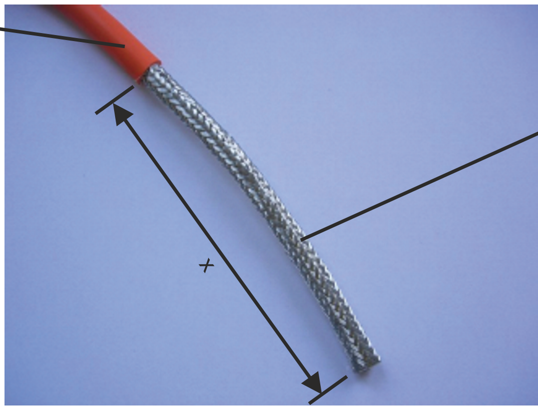
Make sure that the flow of cool air in the cooling system is not directed against the air flow from the fans in the ACOPOS servo drive. This could create air pockets that would prevent sufficient cooling of ACOPOS servo drives.

Condensation must be directed off the cooling unit according to manufacturer specifications so that it does not end up in the ACOPOS servo drives.

6 Motor cables

6.1 Assembly example (module-side) of a 1.5 mm² motor cable

1. Shorten the motor cable to the required length.
2. Strip the motor cable on the module end of the cable (make sure not to damage the entire shield mesh).



Motor cable	Length of stripped cable section x
1.5 mm²	75 mm
4 mm²	150 mm
10 mm²	180 mm

Figure 75: Stripped cable end

3. Pull the entire shield back over the cable sheath and cut off the stranding elements

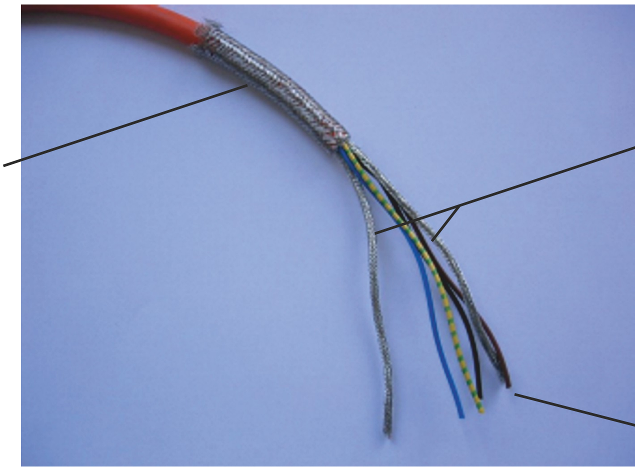


Figure 76: Cable end with shielding mesh pulled back

4. Pull the separately shielded signal lines (2x 2 lines) from the shielding mesh.

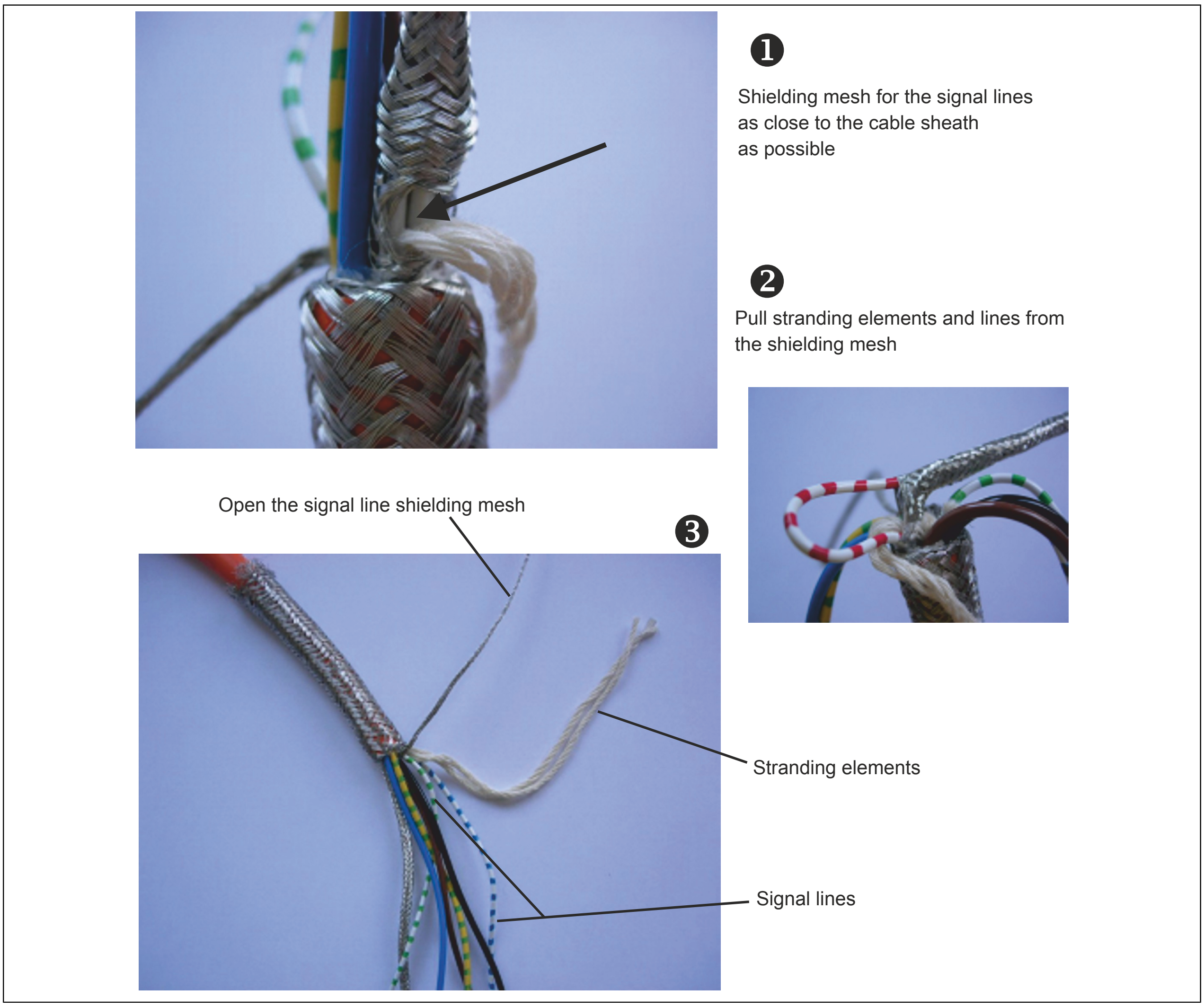


Figure 77: Pulling out the separately shielded signal lines

5. Cut the stranding elements of the separately shielded line.

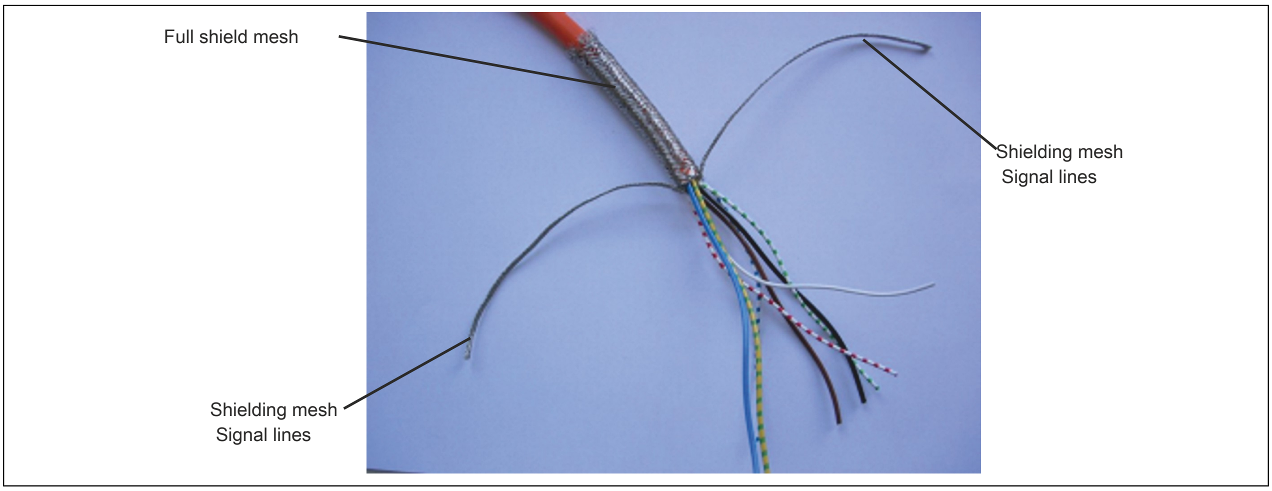


Figure 78: Cable end without stranding elements

6. Shorten the shielding mesh to a length of approximately 40 mm and pull the signal line's shielding mesh over the cable sheath.

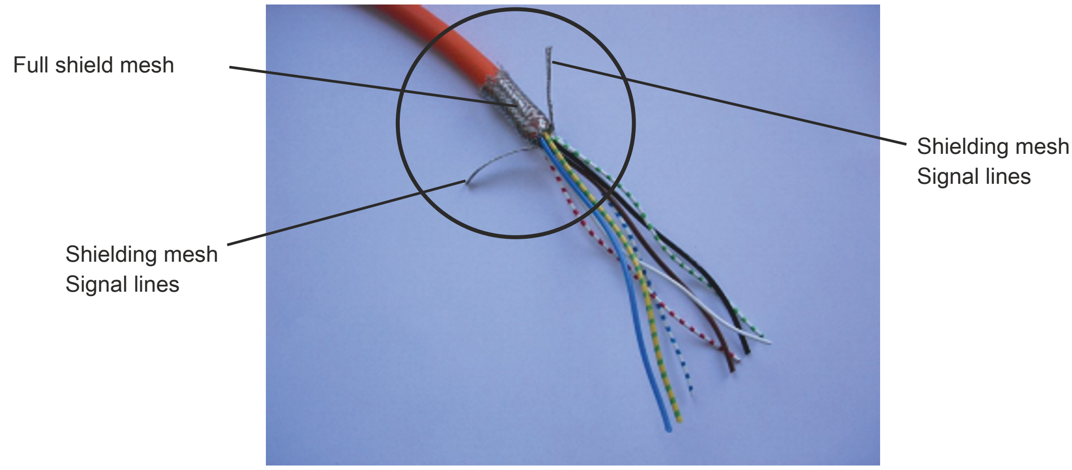


Figure 79: Cable ends with shortened shielding mesh

7. Attach all braided shields to the cable sheath using heat shrink tubing (approx. 20 mm long), leaving some of the braided shield free.

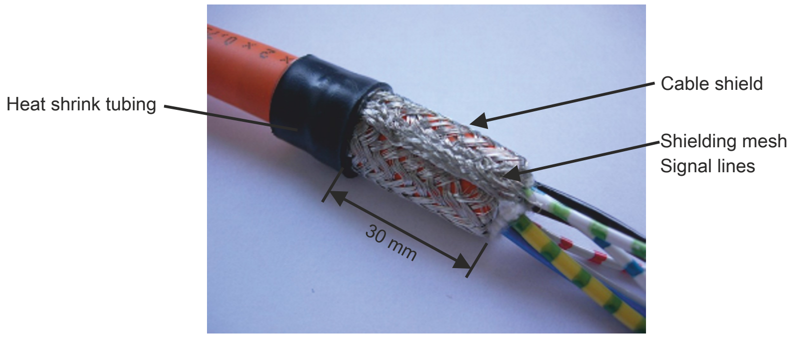
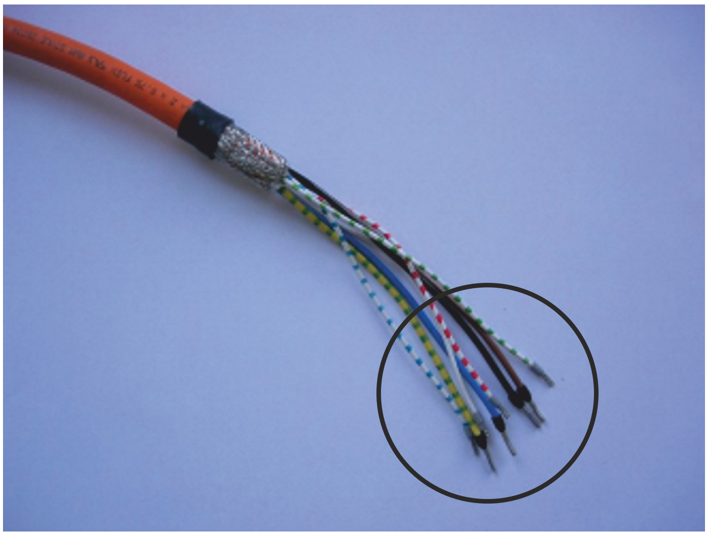


Figure 80: Attaching the shielding mesh

8. Strip the wire ends and attach wire end sleeves.



Motor cable	Stripped lengths	
	Power lines	Signal lines
1.5 mm²	10 mm	8 mm
4 mm²	12 mm	8 mm
10 mm²	18 mm	8 mm

Motor cable	Wire end sleeves	
	Power lines	Signal lines
1.5 mm²	1.5 mm²	0.75 mm²
4 mm²	4 mm²	1 mm²
10 mm²	10 mm²	1.5 mm²

Figure 81: Wire ends with wire end sleeves

Chapter 4 • Dimensioning

1 Power mains connection

1.1 General information

1.1.1 Mains configurations

The power mains connection is made using terminals X3 / L1, L2, L3 and PE. ACOPOS servo drives can be directly connected to TT and TN power mains (these are three-phase systems with grounded neutral).

When using ungrounded IT power mains (three-phase systems without grounded neutral or with an impedance grounded neutral) or TN-S power mains with grounded phase conductor and protective ground conductor, isolation transformers must be used. The secondary neutral must be grounded and connected to the ACOPOS protective ground conductor. In this way, it is possible to prevent overvoltages between external conductors and the ACOPOS housing. Three-phase isolation transformers with the corresponding input and output voltages and a vector group with secondary neutral can be used (e.g. 3x 400 V / 3x 400 V, Dyn5).

In the USA, TT and TN power mains are among the most common mains systems and are referred to as "Delta / Wye with grounded Wye neutral". IT power mains systems are also known as "systems with ungrounded secondary" and TN-S power mains with grounded phase conductor as "Delta / Delta with grounded leg".

Danger!

ACOPOS servo drives are only allowed to be operated directly on grounded, three-phase industrial mains (TN, TT power mains). When servo drives are used in residential areas, shops or small businesses, additional filtering measures must be implemented by the user.

Danger!

Servo drives are not permitted to be operated directly on IT and TN-S mains with a grounded phase conductor and protective ground conductor!

Warning!

ACOPOS drive systems are suitable for power mains that can provide a maximum short circuit current (SCCR) of 65 kA at a maximum of 482 V and that are protected with class J fuses.

Warning!

ACOPOS drive systems are equipped with integrated semiconductor short circuit protection. This semiconductor short circuit protection does not provide protection for branch circuits. Short circuit protection for branch circuits must be implemented in accordance with national directives or other local regulations.

Warning!

The fuse of a branch circuit being triggered can be a sign that a fault current has been interrupted. The current-bearing parts and other components of the module should be checked and replaced if they are damaged. If current-bearing parts of an overload relay have burned out due to a power overload, they must be replaced.

Warning!

The power mains short circuit capacity Sk must be 10 times greater than the continuous power of the selected servo drive.

1.1.2 Supply voltage range

The supply voltage range permitted for ACOPOS servo drives can be found in the following table:

	8V1010.5xx-2 8V1016.5xx-2	8V1010.0xx-2 8V1016.0xx-2	8V1022.0xx-2 8V1045.0xx-2 8V1090.0xx-2	8V1180.0xx-2 8V1320.0xx-2	8V1640.0xx-2 8V128M.0xx-2
Mains input voltage	3x 110 VAC to 230 VAC ±10% or 1x 110 VAC to 230 VAC ±10%	3x 400 VAC to 480 VAC ±10%			

Table 172: Supply voltage range for ACOPOS servo drives

Respective intermediate transformers must be used for other supply voltages. With grounded power mains, autotransformers can also be used to adjust the voltage. Neutral does not have to be connected for this type of transformer.

Warning!

The apparent power from the transformer (intermediate transformer, autotransformer) must be at least 25% of the continuous power from the ACOPOS drives being used. Otherwise, parasitic leakage inductances can cause excessive heating of the transformer. In extreme cases, this can cause critical damage to the transformer!

1.1.3 Protective ground connection (PE)

The following information concerning the protective ground connection corresponds to EN 61800-5-1, Item 4.2.5.4 "Connection elements for the protective ground conductor" and must be observed.

Wire cross section

The wire cross section of the protective ground wire is oriented to the outer wires and must be selected according to the following table:

Wire cross section for outer wire A [mm²]	Minimum wire cross section for protective ground connection A_{PE} [mm²] 1)
A ≤ 16	A
16 < A ≤ 35	16
35 < A	A = 2

Table 173: Selection of the protective ground wire cross section

1) Any protective ground conductor that is not part of a cable must have a minimum wire cross section of 4 mm².

Increased discharge current

ACOPOS servo drives are devices with increased discharge current (larger than 3.5 mA AC or 10 mA DC). Therefore, a fixed (immobile) protective ground connection is required on the servo drives.

The following conditions must be fulfilled depending on the ACOPOS device being used:

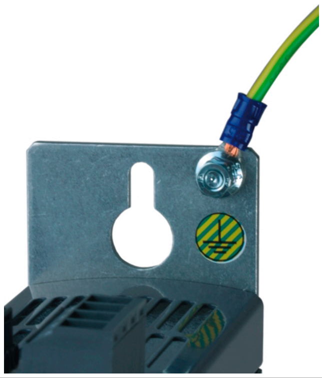
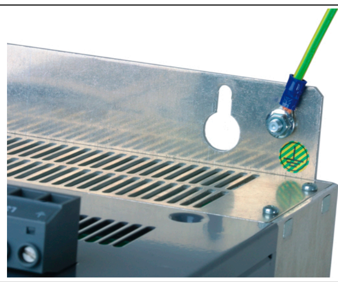
ACOPOS	Condition	Figure
1010 1016	In addition to the connection of the first protective ground conductor on terminal X3/PE, a second protective ground conductor with the same cross section must be connected on the designated terminal (M5 threaded bolt).	
1022 1045 1090	In addition to the connection of the first protective ground conductor on terminal X3/PE, a second protective ground conductor with the same cross section must be connected on the designated terminal (M5 threaded bolt).	
1180 1320	In addition to the connection of the first protective ground conductor on terminal X3/PE, a second protective ground conductor with the same cross section must be connected on the designated terminal (M5 threaded bolt).	
1640 128 M	The cross section of the protective ground conductor connected to terminal X3 / PE must be at least 10mm² Cu.	

Table 174: Protective ground conditions depending on the ACOPOS device

1.2 Dimensioning

In general, dimensioning the power mains, the overcurrent protection and (if necessary) the line contactors depends on the structure of the power mains connection.

ACOPOS servo drives can be connected individually (each drive has separate overcurrent protection and, if necessary, a separate line contactor) or together in groups.

1.2.1 Individual ACOPOS power mains connections

The structure of an individual power mains connection with line contactor and circuit breaker can be seen in the following diagram:

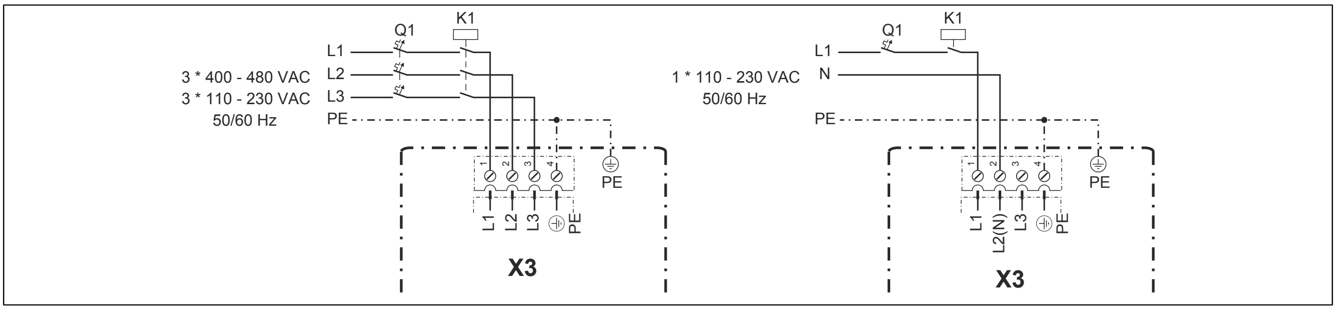


Figure 82: ACOPOS X3, individual power mains connection - Circuit diagram

Dimensioning the power mains and overcurrent protection

Information:

When choosing a suitable fuse, the user must also account for characteristics such as aging effects, temperature derating, overcurrent capacity and the definition of the rated current, which can vary by manufacturer and type. In addition, the fuse that is selected must also be able to handle application-specific characteristics (e.g. overcurrent that occurs in acceleration cycles).

The cross section of the power mains and the rated current for overcurrent protection I_B should be determined based on the average current load I_{Mains} to be expected.

The average current load I_{Mains} to be expected can be calculated as follows:

$$I_{mains}[A] = \frac{S[VA]}{\sqrt{3} . U_{mains}[V]}$$

The apparent power S can be estimated as follows: [8)]

$$S[VA] = M_{eff}[Nm] . k . \frac{2 . \pi . n_{avg}[min^{-1}]}{60}$$

8) If information concerning load torque, inertia and friction are available, the effective torque or the effective power is calculated according to the following formulas:

$$M_{eff}[Nm] = \sqrt{\frac{1}{T_{cycle}[s]} . \sum_{1} M_i[Nm]^2 . t_i[s]}$$

To calculate n_{avg}, information concerning the positioning cycle must be available.
n_{avg} can be calculated using the following formulas:

$$n_{avg}[min^{-1}] = \frac{1}{T_{cycle}[s]} . \sum_{i} n_i[min^{-1}] . t_i[s]$$

If the values n_{avg} become very low, this can cause imprecise results in some situations. In this case, you should contact B&R regarding the use of different calculation formulas or methods.

The following estimate is valid for linear motors: [9)]

$$S[VA] = F_{eff}[N].k.v_{avg}[m/s]$$

The constant k is dependent on the ACOPOS servo drives used and can be taken from the following table:

Name	ACOPOS								
	1010	1016	1022	1045	1090	1180	1320	1640	128 M
Constant k	3		2.8	2.4		2.1	1.9	1.7	1.5

Table 175: Constant k

The rated current of the fuse I_B is selected so that it's greater than/equal to the average current load I_{Mains} to be expected.

$I_B \geq I_{Mains}$

The cable cross section of the power mains input should be selected so that the permitted maximum current load of the cable cross section I_Z is greater than/equal to the selected rated current of the fuse I_B (see Table 176 "Maximum current load for PVC insulated three-phase cables or individual wires " on page 219).

$I_Z \geq I_B$

The following table shows the maximum current load of PVC insulated three-phase cables (or three current-carrying wires) in accordance with IEC 60204-1 at 40°C ambient temperature [10)] and 70°C maximum wire temperature (maximum current load for installation type F and cross sections greater than 35 mm²; IEC 60364-5-523 is used for installation types B1 and B2).

Wire cross section [mm²]	Maximum current load for the cable cross section I_Z / rated current for the overcurrent protection I_B [A] depending on the type of installation				
	Three individual wires in conduit or cable duct	Three-phase cable in conduit or cable duct	Three-phase cable on walls	Three-phase cable in a cable tray	Three individual wires in a cable tray
	B1	B2	C	E	E
1.5	13.5 / 13	12.2 / 10	15.2 / 13	16.1 / 16	---
2.5	18.3 / 16	16.5 / 16	21 / 20	22 / 20	---
4	25 / 25	23 / 20	28 / 25	30 / 25	---
6	32 / 32	29 / 25	36 / 32	37 / 32	---
10	44 / 32	40 / 32	50 / 50	52 / 50	---
16	60 / 50	53 / 50	66 / 63	70 / 63	---
25	77 / 63	67 / 63	84 / 80	88 / 80	96 / 80
35	97 / 80	83 / 80	104 / 100	114 / 100	119 / 100
50	117 / 100	103 / 100	123 / 100	123 / 100	145 / 125
70	149 / 125	130 / 125	155 / 125	155 / 125	188 / 160
95	180 / 160	156 / 125	192 / 160	192 / 160	230 / 200

Table 176: Maximum current load for PVC insulated three-phase cables or individual wires

When determining the cross section for the power mains, make sure that the cross section selected is within the range that can be used with the X3 power mains terminal (see "Overview of clampable cross sections" on page 255).

Overcurrent protection in the form of a circuit breaker or a fuse is required. Circuit breakers (time lag) with type C tripping characteristics (in accordance with IEC 60898) or fuses (time lag) with type gG tripping characteristics (in accordance with IEC 60269-1) must be used. [11)]

North America:

Only cables with copper wire can be used for cabling. These attachment cables must be able to withstand ambient temperatures up to 75°C.

9) If information concerning load torque, inertia and friction are available, the effective torque or the effective power is calculated according to the following formulas:

$$F_{eff}[N] = \sqrt{\frac{1}{T_{cycle}[s]} \cdot \sum_{1} F_i[N]^2 . t_i[s]}$$

To calculate v_{avg}, information concerning the positioning cycle must be available.
v_{avg} can be calculated using the following formulas:

$$v_{avg}[m/s] = \frac{1}{T_{cycle}[s]} \cdot \sum_{i} v_i[m/s] . t_i[s]$$

If the values v_{avg} become very low, this can cause imprecise results in some situations. In this case, you should contact B&R regarding the use of different calculation formulas or methods.

10) The maximum current load value in IEC 60204-1 is for an ambient temperature of 40°C. This reference temperature is 30°C in IEC 60364-5-523. The values in table "Maximum current load for PVC insulated three-phase cables or individual wires" from IEC 60364-5-523 are also converted for use at 40°C with the factor k_{Temp} =0.87 specified in the standard.
The specified maximum current load does not take a reduction factor for groups of cables and individual wires into consideration. If necessary, this must be taken from the corresponding standards and included in the calculation.

11) Circuit breakers are available on the market with rated currents from 6 A to 63 A. Outside of this range, fuses must be used.

Class J fuses according to UL Standard 248-8 can be used (for example fuses of type AJTxx from Ferraz Shawmut (www.ferrazshawmut.com) or type LPJ-xxSP from Bussmann (www.bussmann.com), where xx represents the nominal current of the respective fuse).

As an alternative, class CC fuses according to UL Standard 248-4 can be used (for example fuses of type LP-CC-xx from Bussmann (www.bussmann.com), where xx is the rated current of the respective fuse; fuses of type LP-CC-xx are available up to a nominal current of 30 A).

The fuse must have the following tripping characteristics:

Minimum tripping time [s]	Rated current for the fuse at an average expected current load of			
	12 ... 35 A	50 ... 80 A	100 ... 125 A	160 A
0.2	Approx. 5.1 * I_B	Approx. 4.5 * I_B	Approx. 3.6 * I_B	Approx. 4.0 * I_B
4	Approx. 3.7 * I_B	Approx. 3.3 * I_B	Approx. 2.8 * I_B	Approx. 3.2 * I_B
10	Approx. 2.9 * I_B	Approx. 2.5 * I_B	Approx. 2.0 * I_B	Approx. 2.3 * I_B
240	Approx. 1.7 * I_B	Approx. 1.7 * I_B	Approx. 1.6 * I_B	Approx. 1.8 * I_B

Table 177: Tripping characteristics of the fuse for the power mains connection

Dimensioning the line contactor

The rated current of the line contactor is oriented to the overcurrent protection for the power mains connection. The line contactor is set up so that nominal operating current specified by the manufacturer of the line contactor for category AC-1 in accordance with EN 60947-4-1 is approximately 1.3 times the rated current of the overcurrent protection.

Warning!

ACOPOS servo drive DC bus circuits that are connected separately to the power mains via line connectors must not be interconnected!

Connecting a line choke and a line contactor before each individual servo drive in a group is not permitted. If, in this case, the DC bus circuits of the individual servo drives are interconnected, the rectifiers in the servo drives can be overloaded and possibly destroyed.

1.2.2 Implementing ACOPOS power mains connections for drive groups

The structure of the power mains connection for a drive group with line contactor and circuit breaker can be seen in the following diagram:

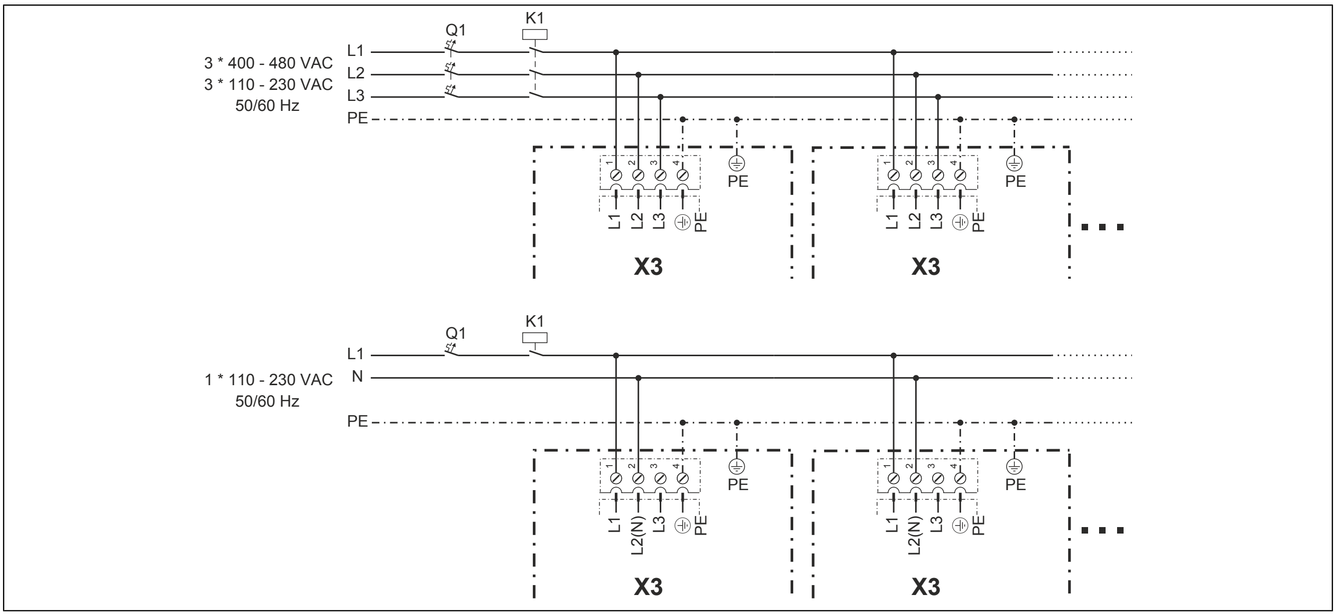


Figure 83: ACOPOS X3, power mains connection for a drive group - Circuit diagram

Using a mains choke

The optional use of a mains choke for drive groups can reduce the total harmonic distortion (THD) and the effective value for the mains current while increasing the total power factor (TPF). The nominal current for the line choke must be equal to the nominal current of the fuse that is protecting the drive group. In this way, the line choke is protected against overload by the fuse.

A line choke connection diagram is shown in the following image:

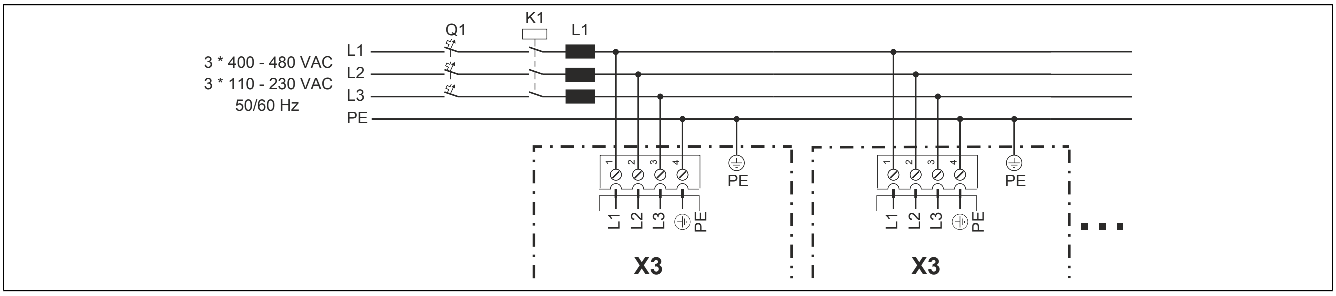


Figure 84: ACOPOS X3, power mains connection for a drive group with optional line choke - Circuit diagram

Warning!

For multi-axis configurations, only one line choke and one line contactor are permitted to be connected before the entire ACOPOS servo drive group (see "ACOPOS X3, power mains connection for a drive group with optional line choke - Circuit diagram" on page 221)!

Model number	Short description
8I0CT004.000-1	ACPi line choke 3-phase 4 A
8I0CT010.000-1	ACPi line choke 3-phase 10 A
8I0CT016.000-1	ACPi line choke 3-phase 16 A
8I0CT030.000-1	ACPi line choke 3-phase 30 A
8I0CT060.000-1	ACPi line choke 3-phase 60 A
8I0CT100.000-1	ACPi line choke 3-phase 100 A
8I0CT184.000-1	ACPi line choke 3-phase 184 A
8I0CT222.000-1	ACPi line choke 3-phase 222 A
8I0CT230.000-1	ACPi line choke 3-phase 230 A

Table 178: Model numbers for the line chokes available from B&R

Dimensioning the power mains and fuse

Information:

When choosing a suitable fuse, the user must also account for properties such as aging effects, temperature derating, overcurrent capacity and the definition of the rated current, which can vary by manufacturer and type. In addition, the fuse that is selected must also be able to handle application-specific characteristics (e.g. overcurrent that occurs in acceleration cycles).

The cross section of the distribution point and all power mains connections are chosen according to "Maximum current load for PVC insulated three-phase cables or individual wires " on page 219 so that the maximum current load for the cable cross section selected [12] is greater than or equal to the sum of the calculated mains current.

$$I_Z \geq \sum I_{mains}$$

The rated current of the overcurrent protection must be less than or equal to the maximum current load for the cable cross section selected (see Table 176 "Maximum current load for PVC insulated three-phase cables or individual wires " on page 219).

$$I_B \leq I_Z$$

Dimensioning the line contactor

The rated current of a common line contactor is oriented to the overcurrent protection for the power mains connection. The line contactor is set up so that nominal operating current specified by the manufacturer of the line contactor for category AC-1 is approximately 1.3 times the rated current of the overcurrent protection.

[12] When determining a common cross section for several drives (especially with different sized ACOPOS modules), make sure that the cross section selected is within the range that can be used with the power mains terminals (see "Overview of clampable cross sections" on page 255).

1.3 Fault current protection

Fault current protection (RCD - residual current-operated protective device) can be used with ACOPOS servo drives. The following points must be noted, however:

ACOPOS servo drives have a power rectifier. If a short circuit to the frame occurs, a flat DC fault current can be created which prevents an AC current or pulse current sensitive RCD (type A or AC) from being activated, therefore canceling the protective function for all connected devices.

Danger!

If used for protection during direct or indirect contact of the fault current protection (RCD), only a Type B RCD (AC-DC sensitive, in accordance with IEC 60755) can be used for the ACOPOS power mains connection. Otherwise, additional protective measures must be used, such as neutralization or isolation from the power mains using an isolation transformer.

1.3.1 Rated fault current

On ACOPOS servo drives, fault current protection with a rated fault current[13)] of ≥100 mA can be used. However, errors can occur:

- When connecting servo drives to the power mains (short-term single-phase or two-phase operation because of contact chatter on the line contactor).
- Because of high frequency discharge currents occurring during operation when using long motor cables.
- Because of an extreme unbalance factor for the three-phase system.

1.3.2 Estimating the discharge current

Depending on the connection of the ACOPOS servo drive, different discharge currents flow to ground on the protective ground conductor (PE):

Single-phase or two-phase operation (as intermediate state when switching on the line contactor):

$$I_A[A] = \frac{U_{mains}[V] . 2 . \pi . f_{mains}[Hz] . C_A[F]}{\sqrt{3}}$$

Single-phase operation with neutral line:

$$I_A[A] = \frac{U_{mains}[V] . 2 . \pi . f_{mains}[Hz] . C_A[F]}{2 . \sqrt{3}}$$

The discharge capacitance C_A of the various ACOPOS servo drives can be taken from the following table:

Name	ACOPOS								
	1010.0xx-2 1016.0xx-2	1010.5xx-2 1016.5xx-2	1022.0xx-2	1045.0xx-2	1090.0xx-2	1180.0xx-2	1320.0xx-2	1640.0xx-2	128M.0xx-2
Discharge capacitance C_A	550 nF	330 nF	660 nF			3.1 µF		5.4 µF	

Table 179: Discharge capacitance C_A

1.3.3 Manufacturer used

For example, the AC-DC sensitive, 4-pole fault current protective device F 804 from ABB (fault current: 300 mA; nominal current: 63 A) can be used. Using this fault current protective device, approximately 5 ACOPOS 1022 (or 1045, 1090) can be connected in parallel.

13) The rated fault current listed by the manufacturer are maximum values that will definitely trip the protective device. Normally, the protective device is tripped at approximately 60% of the rated fault current.

2 DC bus

2.1 General information

With ACOPOS servo drives, it is possible to connect several servo drives via the DC bus. This connection allows compensation of braking and drive energy of several axes or the distribution of braking energy to several braking resistors.

The connection is made using terminals X2 / +DC and -DC. The structure of the DC bus connections can be seen in the following diagram:

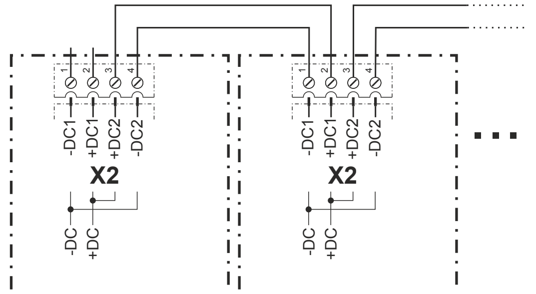


Figure 85: ACOPOS X2 DC bus connections - Circuit diagram

Caution!

To prevent excessively high discharge currents from flowing over the individual servo drives, make sure that smaller servo drives are not connected between two larger servo drives.

Warning!

For multi-axis configurations, only one line choke and one line contactor are permitted to be connected before the entire ACOPOS servo drive group (see "ACOPOS X3, power mains connection for a drive group with optional line choke - Circuit diagram" on page 221)!

Warning!

Only DC bus circuits of ACOPOS servo drives with the same supply voltage range are permitted to be connected in a group ("Supply voltage range for ACOPOS servo drives" on page 216).

Therefore, the DC bus circuits of ACOPOS servo drives 8Vxxxx.5xx-2 and 8Vxxxx.0xx-2 are not allowed to be linked! For this reason, the X2 plugs for ACOPOS servo drives 8Vxxxx.5xx-2 and 8Vxxxx.0xx-2 are keyed differently.

All ACOPOS servo drives 8Vxxxx.5xx-2 with a single-phase supply that should have their DC buses connected together must be connected to the same phase! If this is not done, the DC bus voltage increases to a level that is not permitted, causing the devices to be destroyed!

2.2 Wiring design

The DC bus connections on the ACOPOS servo drives do **not** have short circuit and ground fault protection and are not protected against reverse polarity. It is therefore very important that the DC bus connections be wired correctly.

Caution!

DC bus connections must be wired correctly (no short circuits, ground faults or reverse polarity).

A suitable measure to ensure that the wiring is secure against short circuits and ground faults[14)] is the use of appropriate electrical lines. Special rubber-insulated wires with increased resistance to heat (90°C) of types

- NSGAÖU
- NSGAFÖU
- NSGAFCMÖU

with a nominal voltage U_0/U of at least 1.7/3 kV are considered to be secure against short circuits and ground faults in switchgear and distribution systems up to 1000 V[15)] .

2.3 Equal distribution of the applied power via the power rectifiers

When creating a DC bus connection between several servo drives, it is possible that the parallel connection of the power rectifiers causes incorrect distribution of the applied power.

Warning!

Distribution of the supplied power that is not permitted can occur both during operation and when booting the ACOPOS servo drives!

To prevent this undesired effect, appropriately dimensioned balancing resistors are integrated in the ACOPOS servo drives.

The following rules must be observed so that the effect of these balancing resistors is not canceled out:

- The length of the DC bus wiring is not allowed to exceed a total length of 3 m and must be within a single control cabinet.
- Dimensioning the cross section of the ACOPOS servo drive power mains must be done according to section "Dimensioning the power mains and overcurrent protection" on page 218.
- The cross section of the DC bus wiring [16)] on the respective ACOPOS servo drives must be less than or equal to the cross section of the servo drive power mains.
- The selected cross section must be within the clampable cross section range for the DC bus connection terminal X2 (see "Overview of clampable cross sections" on page 255).
- For multi-axis configurations, only one line choke may be connected before the entire ACOPOS servo drive group.

Chapter 4
Dimensioning

14) Wiring design e.g. according to DIN VDE 0100, Part 200 "Electrical systems for buildings - terms", Item A.7.6.

15) See e.g. DIN VDE 0298, Part 3 "Use of cables and insulated wires for high-voltage systems", Item 9.2.8.

16) The cross section of the individual segments of the DC bus wiring must be dimensioned for the thermal equivalent effective value of the respective compensation current. If information concerning the compensation current flow is available, the thermal equivalent effective value for the compensation current can be calculated as follows:

$$I_q[A] = \sqrt{\frac{1}{T_{cycle}[s]} \cdot \sum_{1} I_i[A]^2 \cdot t_i[s]}$$

The cross section of the DC bus connection should then also be selected as described in "Overview of clampable cross sections" on page 255, so that the maximum current load of the cable cross section is greater than or equal to the thermal equivalent effective value of the compensation current ($I_Z \geq I_q$).

2.4 Equal distribution of the brake power on the braking resistors

The braking resistors integrated in ACOPOS servo drives as well as braking resistors that can be connected externally are controlled using a specially developed procedure. This guarantees that the brake power is optimally and equally distributed on the braking resistors when a DC bus connection is made between several units.

When using integrated braking resistors, additional configuration is not required.
When using external braking resistors, the corresponding parameters must be defined (see "Configuring brake resistor parameters" on page 238).

2.5 Connecting external DC bus power supplies

ACOPOS servo drives recognize a power failure and can immediately initiate active braking of the motor. The brake energy generated when braking is returned to the DC bus, and the DC bus power supply can use it to create the 24 VDC supply voltage. In this way, the ACOPOS servo drives as well as encoders, sensors and possible safety circuit can be supplied with 24 VDC while braking. [17]

An external DC bus power supply must be used for ACOPOS servo drives 8V1010 to 8V1090. A DC bus power supply is integrated in ACOPOS servo drives 8V1180 to 8V128M. [18]

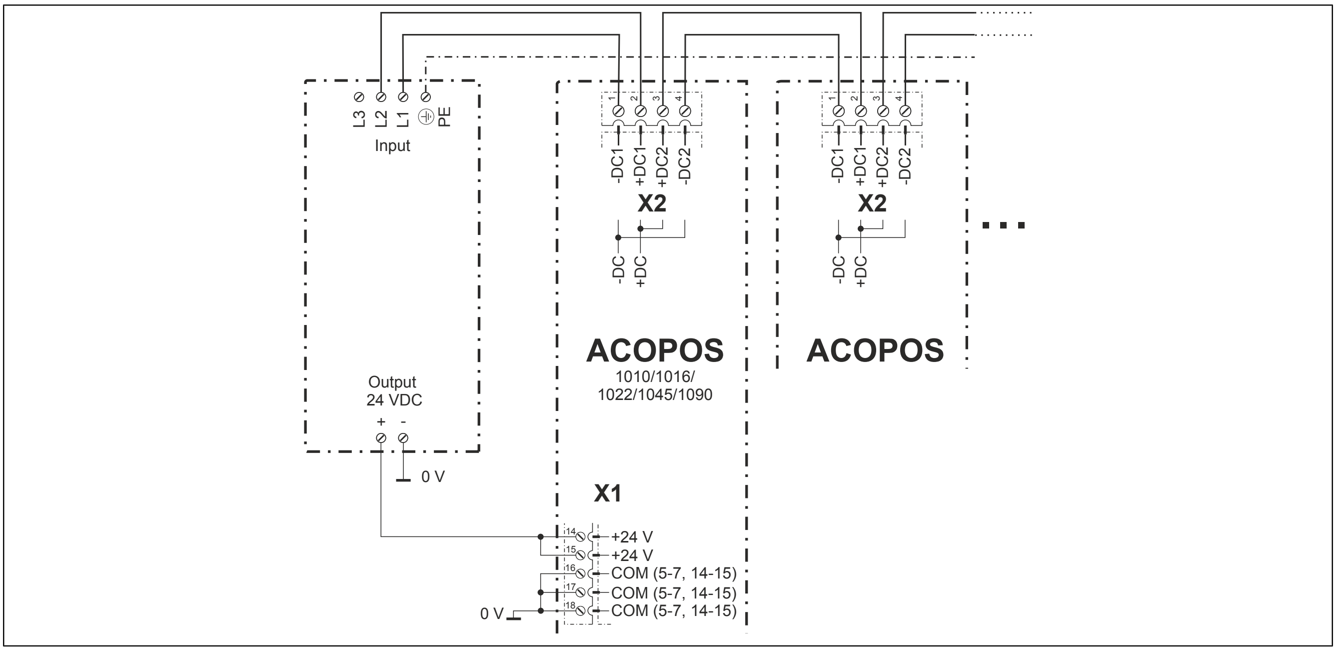


Figure 86: DC bus power supply for ACOPOS servo drives

17) IMPORTANT: In some applications, there is not enough brake energy provided to guarantee that the 24 VDC supply voltage remains active until the system is stopped.
18) The SL20.310 DC bus power supply from PULS can be used (www.pulspower.com).

3 Motor connection

On B&R motors, the power connections, the connections for the holding brake and the connections for the motor temperature sensor are all made using the same motor connector.
On the servo drive, the motor connection is made using terminals X5 / U, V, W and PE as well as terminals X4b / B+, B-, T+ and T-. This motor connection must be shielded appropriately (see "Electromagnetic compatibility of the installation " on page 249).

The design of the motor connection can be seen in the following diagram:

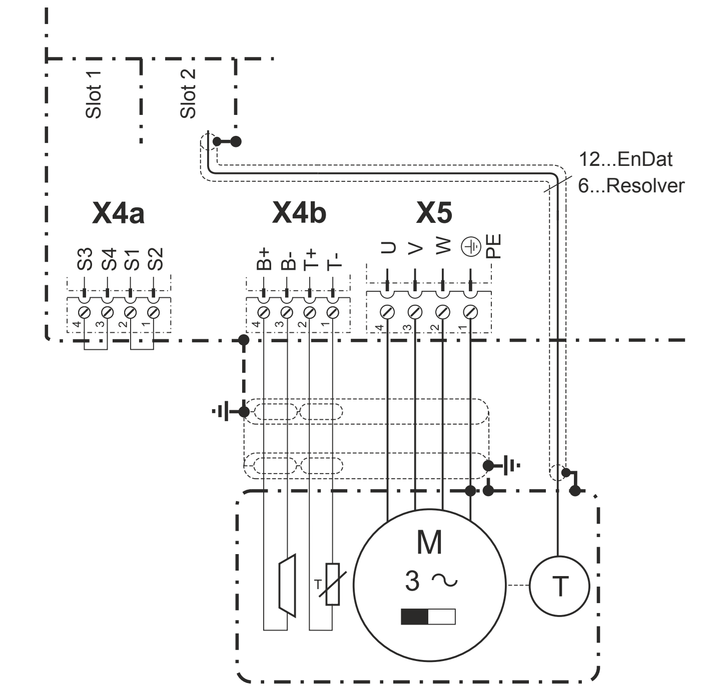


Figure 87: ACOPOS X4/X5 motor connections - Circuit diagram

The cross section of the motor cable must be dimensioned for the thermal equivalent effective value of the motor current. [19)]

The cross section of the motor cable is chosen for B&R motor cables according to the following table so that the maximum current load for the cable cross section selected is greater than or equal to the thermal equivalent effective value of the motor current:

$I_Z \geq I_q$

Motor cables - For use in cable drag chains

The following table shows the maximum current load for specially insulated three-phase cables in accordance with IEC 60364-5-523 at an ambient temperature of 40°C[20)] and 90°C maximum cable temperature.

Wire cross section [mm²]	Maximum current load on the wire I_Z [A] depending on type of installation		
	Three-phase cable in conduit or cable duct	Three-phase cable on walls	Three-phase cable in a cable tray
	B2	C	E
0.75	11.5	13	13.5
1.5	17.8	20	20.9
4	31.9 [1)]	36.4 [1)]	38.2 [1)]
10	54.6	64.6	68.3
35	116.5	133.8	143.8

Table 180: Maximum current load for specially insulated three-phase cables

1) The plug pins on assembled B&R 8BCMxxxx.1312A-0 motor cables can handle a max. load of 30 A.

19) If information concerning load torque, inertia and friction is available, the thermal equivalent effective value for the motor current of the motor used can be calculated as follows:

$$I_q[A] = \sqrt{\frac{1}{T_{cycle}[s]} \cdot \sum_1 I_i[A]^2 \cdot t_i[s]}$$

20) The maximum current load value in IEC 60364-5-523 is for an ambient temperature of 30°C. The values in table "Maximum current load for PVC insulated three-phase cables or individual wires" are converted for use at 40°C ambient temperature using the factor k_{Temp} = 0.91 given in the standard.
The specified maximum current load does not take a reduction factor for groups of cables and individual wires into consideration. If necessary, this must be taken from the corresponding standards and included in the calculation.

Motor cables - Not for use in cable drag chains

The following table shows the maximum current load for PVC-insulated three-phase cables in accordance with IEC 60364-5-523 at an ambient temperature of 40°C[21] and 70°C maximum cable temperature.

Wire cross section [mm²]	Maximum current load on the wire I_Z [A] depending on type of installation		
	Three-phase cable in conduit or cable duct	Three-phase cable on walls	Three-phase cable in a cable tray
	B2	C	E
0.75	8.5	9.8	10.4
1.5	13.1	15.2	16.1
4	23	28	30

Table 181: Maximum current load for PVC-insulated three-phase cables

When determining the cross section for the motor cable, make sure that the cross section selected is within the range that can be used with the X5 motor connection terminal (see section "Overview of clampable cross sections").

4 Braking resistors

4.1 General information

When braking servo motors, power is returned to the ACOPOS servo drive. This causes the capacitors in the DC bus to be charged to higher voltages. Starting with a DC bus voltage of approx. 800 V, the ACOPOS servo drive links the braking resistor to the DC bus using the brake chopper and converts the braking energy to heat.

For ACOPOS servo drives, braking resistors are integrated for this purpose or external braking resistors can be connected. The different features can be looked up in the following table:

Name	ACOPOS 1010	1016	1022	1045	1090	1180	1320	1640	128 M
Integrated brake chopper	Yes (all)								
Internal braking resistor	Yes (1010/1016)		Yes	Yes (1045/1090)		Yes (1180/1320)		Yes [3]	Yes [3]
Continuous power	130 W		130 W	200 W		400 W		200 W	240 W
Maximum power	2 kW [1] 1.9 kW [2]		3.5 kW	7 kW		14 kW		7 kW	8.5 kW
Connection of external braking resistor possible [4]	No [6] (1010–1090)					Yes (1180/1320)		Yes (1640/128 M)	
Continuous power (P_{BRmax})	---					--- [7]		--- [7]	
Maximum power (P_{BRmax})	---					40 kW		250 kW	
Minimum braking resistance ($R_{minServo}$)	---					15 Ω		2.5 Ω	
Rated current for the built-in fuse ($I_{BRServo}$) [5]	---					12 A (fast-acting)		30 A (fast-acting)	

Table 182: Braking resistors for ACOPOS servo drives

1) For 8V1010.0xx-2 and 8V1016.0xx-2.
2) For 8V1010.5xx-2 and 8V1016.5xx-2.
3) The braking resistor integrated in the ACOPOS servo drives 1640 and 128M is dimensioned so that it is possible to brake to a stop (in a typical drive situation).
4) The ACOPOS servo drives are designed so that either the integrated braking resistor **or** the external braking resistor can be activated. Braking with both braking resistors at the same time is not possible.
   Switching takes place using the software and is only possible during the ACOPOS servo drive initialization phase:

   ParID 398: Setting for an internal / external braking resistor

   0 ... Internal (default)
   1 ... External
5) The fuses used must be fast-acting fuses ∅10x38 mm for 600 VAC/VDC. For example, type KLKD0xx (xx is the rated current of the fuse in amperes e.g. KLKD030) from Littelfuse (www.littelfuse.com) can be used.
6) The braking resistors integrated in ACOPOS servo drives 1010, 1016, 1022, 1045 and 1090 are optimally dimensioned for the respective sizes.
7) Application-dependent (see "Overview of braking resistor data - 8B0W " on page 231).

21) The maximum current load value in IEC 60364-5-523 is for an ambient temperature of 30°C. The values in table "Maximum current load for PVC insulated three-phase cables or individual wires" are converted for use at 40°C ambient temperature using the factor k_{Temp} = 0.91 given in the standard.
The specified maximum current load does not take a reduction factor for groups of cables and individual wires into consideration. If necessary, this must be taken from the corresponding standards and included in the calculation.

4.2 External braking resistor connections

External braking resistors are connected using the X6 / RB+, RB- and PE terminals. The structure of the external braking resistor connection can be seen in the following diagram:

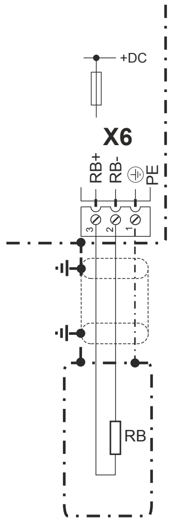


Figure 88: ACOPOS X6, external braking resistor on ACOPOS 1180/1320/1640/128M - Circuit diagram

When determining the cross section [22] for wiring the external braking resistor, make sure that the cross section selected is within the range that can be used with braking resistor connection terminal X6 (see "Overview of clampable cross sections" on page 255).

4.2.1 Fuse protection

To protect the external braking resistor connection, a fuse is built into the bottom of ACOPOS servo drives. [23]

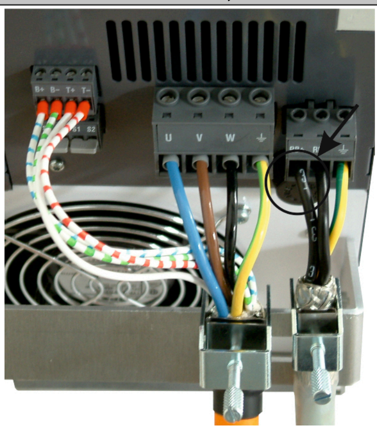
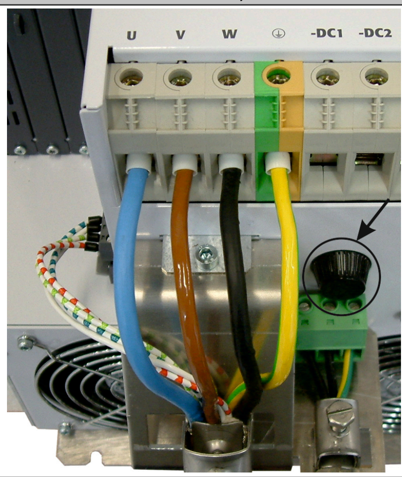
ACOPOS 1180, 1320	ACOPOS 1640, 128M
	

Table 183: The location where the fuse for the external braking resistor connection is installed

The relevant data for the fuses that are to be used can be found on the sticker close to the fuse holder.

22) The cross section of the braking resistor cable must be dimensioned for the thermal equivalent effective value of the respective brake current. If information concerning the the brake current flow is available, the thermal equivalent effective value for the brake current can be calculated as follows:

$$I_q[A]=\sqrt{\frac{1}{T_{cycle}[s]}\cdot\sum_1 I_i[A]^2\cdot t_i[s]}$$

The cross section of the braking resistor connection should then be selected as described in table "Maximum current load for PVC insulated three-phase cables or individual wires " on page 219, so that the maximum current load of the cable cross section is greater than or equal to the thermal equivalent effective value of the brake current ($I_Z \geq I_q$).

23) External braking resistors can only be connected to ACOPOS 8V1180.0xx-2, 8V1320.0xx-2, 8V1640.0xx-2 and 8V128M.0xx-2 devices. The fuses used must be fast-acting fuses ∅10x38 mm for 600 VAC/VDC. For example, type KLKD0xx (xx is the rated current of the fuse in amperes e.g. KLKD030) from Littelfuse (www.littelfuse.com) can be used.

4.3 Dimensioning the braking resistor

4.3.1 Basis of the calculation

An external braking resistor can be dimensioned based on a movement and load profile (for each axis in the corresponding application):

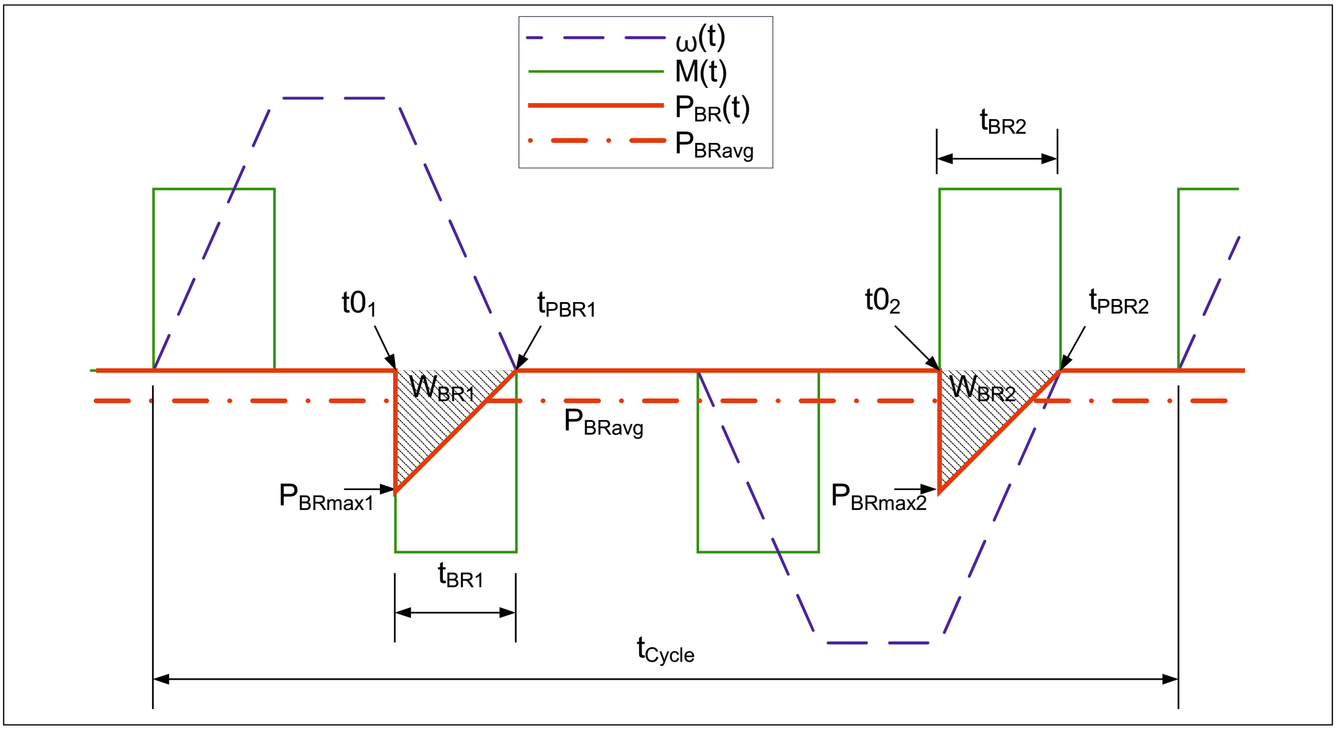


Figure 89: Movement and load profile for one axis in a sample application

$\omega(t)$	Angular velocity
$P_{BR}(t)$	Brake power
P_{BRavg}	Average brake power for one cycle
$M(t)$	Torque
t_{Cycle}	Cycle duration
$t0_1$	Start time for braking procedure 1
t_{PBR1}	End time for braking procedure 1
P_{BRmax1}	Maximum brake power in braking procedure 1
W_{BR1}	Brake power for braking procedure 1
t_{BR1}	Duration of braking procedure 1
$t0_2$	Start time for braking procedure 2
t_{PBR2}	End time for braking procedure 2
P_{BRmax2}	Maximum brake power in braking procedure 2
W_{BR2}	Brake power for braking procedure 2
t_{BR2}	Duration of braking procedure 2

Power calculation

$P(t) = M(t).\omega(t)$

All instances of P(t) <0 will be labeled as brake power ratings $P_{BR}(t)$.

Braking energy per braking procedure (responsible for heating up the braking resistor during a braking procedure)

$$W_{BR_i} = \int_{t0_i}^{tP_{BR_i}} P_{BR_i}(t)dt$$

$$P_{BR_i} < 0$$

Braking energy for one cycle (responsible for average heating of the braking resistor)

$$W_{BRges} = \sum_{N}^{i=1} W_{BR_i}$$

Maximum braking energy within one cycle (determinant variable for selecting the braking resistor value)

$$W_{BRges} = \sum_{N}^{i=1} W_{BR_i}$$

Average brake power for one cycle (determinant variable for the required continuous power of the braking resistor)

$$P_{BRavgAPPL} = \frac{W_{BRges}}{t_{Cycle}}$$

Total braking time within one cycle (determinant variable for determining the duty cycle ratio)

$$t = \sum_{0}^{t_{Cycle}} t_{BRi}$$

Determining braking resistor data

The following parameters must be determined for an external braking resistor according to the application:

- Resistor value (R_{BR})
- Nominal continuous power (P_{BRN})

Further parameters for external braking resistors can be taken from the manufacturer's data sheet:

- Thermal capacity (c_{th})
- Thermal resistance (R_{th})
- Maximum overtemperature on the external braking resistor (ΔT_{BRmax}) or absorbed heat up to ΔT_{BRmax} (Q_{BRmax}) [24)]

Data for B&R 8B0W braking resistors

Model number	Mounting orientation	R_{BR} [Ω]	T_{BRmax} [°C] 1)	R_{th} [K/W]	c_{th} [J/K]	Q_{BRmax} [J] 1) 2)	P_{BRN} [W] 1) 2)
8B0W0045H000.00x-1	Vertical	50	682	1.517	16.3	10465	450
	Horizontal	50	682	1.897	16.3	10465	360
8B0W0079H000.00x-1	Vertical	33	673	0.852	22.6	14306	790
	Horizontal	33	673	1.065	22.6	14306	632

Table 184: Overview of braking resistor data - 8B0W

1) T_{BRmax} can be reduced by application-related limitations (contact protection, warming of neighboring components, maximum warming of the control cabinet, installation position, etc.). In this case, the values for Q_{BRmax} and P_{BRN} will also change; these must be recalculated for the maximum value of T_{BRmax} permitted in the application!

2) Values for T_{amb} = 40°C.

24) Value for ambient temperature T_{amb} = 40°C.

Series and parallel connection of braking resistors

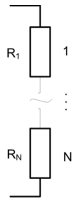
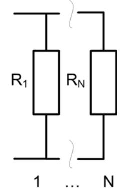
Parameter	Serial connection		Parallel connection	
Resistance value	$R_{ges} = \sum_{i=1}^{N} R_i$		$\frac{1}{R_{ges}} = \sum_{i=1}^{N} \frac{1}{R_i}$	
Thermal resistance	$\frac{1}{R_{thges}} = \sum_{i=1}^{N} \frac{1}{R_{th_i}}$		$\frac{1}{R_{thges}} = \sum_{i=1}^{N} \frac{1}{R_{th_i}}$	
Thermal capacity	$C_{th} = \sum_{i=1}^{N} C_{th_i}$		$C_{th} = \sum_{i=1}^{N} C_{th_i}$	
Max. permissible temperature	$T_{max} = T_{max}$		$T_{max} = T_{max}$	
Absorbed heat up to T_{max}	$Q_{maxges} = \sum_{i=1}^{N} Q_{max_i}$		$Q_{maxges} = \sum_{i=1}^{N} Q_{max_i}$	

Table 185: Series and parallel connection of braking resistors

Maximum heat that can be absorbed by the braking resistor:

$$Q_{BRmax} = (T_{BRmax} - T_{amb}).c_{th}$$

Maximum temperature in continuous operation:

$$\Delta T_{Lenght} = P_{avg}.R_{th}$$

Average overtemperature in continuous operation:

$$\Delta T_{BR} = \frac{W_{BRges}}{C_{th}}$$

Thermal time constant of the braking resistor:

$$\tau = R_{th}.c_{th}$$

4.3.2 Example

Scenario

An axis has the following movement and load profile:

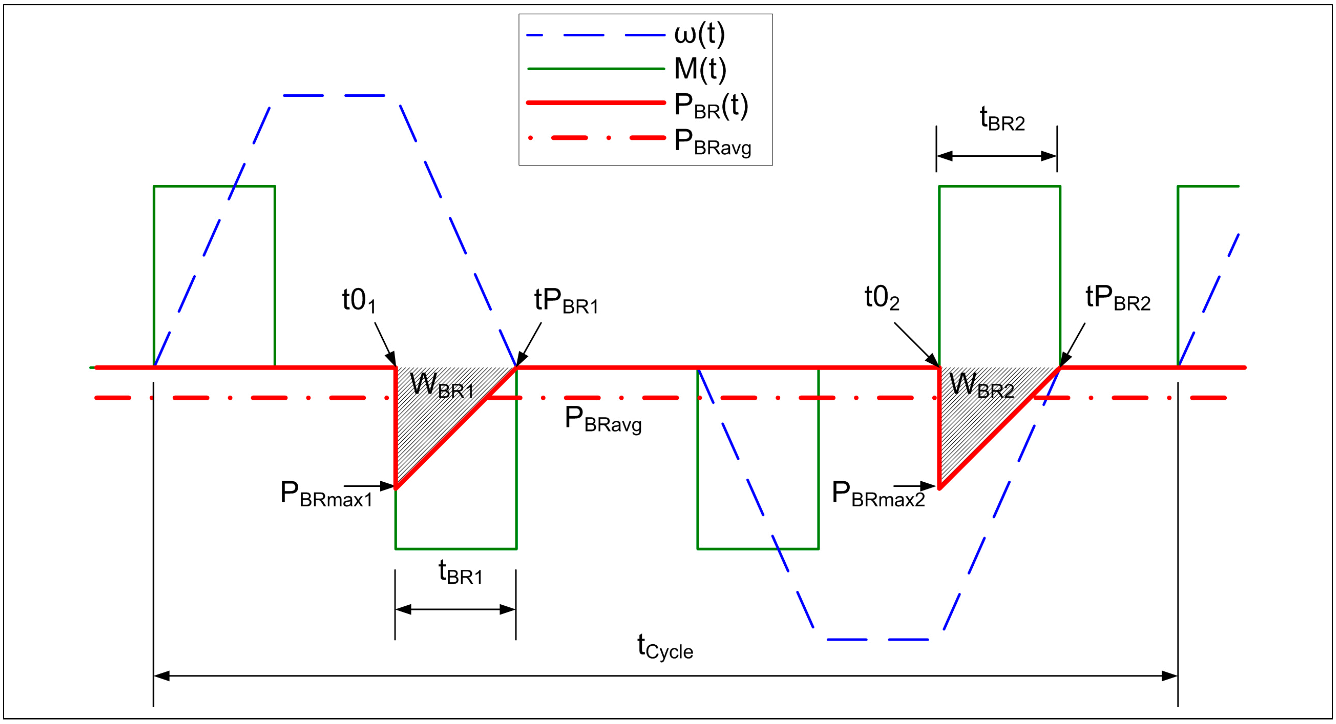


Figure 90: Movement and load profile of one axis example

Value

$P_{BRmax1} = P_{BRmax2} = 50$ kW
$t_{BR1} = t_{BR2} = 0.3$ s
$t_{Cycle} = 10$ s

- The ambient temperature is 40°C.
- There are no application-related limitations for the maximum surface temperature of the braking resistor.

Calculation

Step 1: Determine the maximum brake power within one cycle.

$P_{BRmaxAPPL} = P_{BRmax1} = P_{BRmax2} = 50kW$

Step 2: Determine the average brake power for one cycle.

$$W_{BRges} = \frac{P_{BRmax1} \cdot t_{BR1}}{2} + \frac{P_{BRmax2} \cdot t_{BR2}}{2} = \frac{50kW.0,3s}{2} + \frac{50kW.0,3s}{2} = 15kJ$$

$$P_{BRavgAPPL} = \frac{W_{BRges}}{t_{Cycle}} = \frac{15kJ}{10s} = 1,5kW$$

Step 3: Determine the right ACOPOS servo drive.

The following criteria must be met:

$P_{maxServo} \geq P_{BRmaxAPPL} \Rightarrow P_{maxServo} \geq 50kW$

$$I_{BRServo} \geq \frac{\sqrt{P_{BRavgAPPL} \cdot P_{BRavgAPPL}}}{U_{DC}} \Rightarrow I_{BRServo} \geq \frac{\sqrt{1500W.50000W}}{800V} \Rightarrow I_{BRServo} \geq 10,83A$$

The ACOPOS servo drive 8V1640.00-2 meets these criteria (see Table 182 "Braking resistors for ACOPOS servo drives" on page 228):

- $P_{maxServo} = 250$ kW ≥ 50 kW
- $I_{BRServo} = 30$ A ≥ 10.83 A

Can the selected ACOPOS servo drive conduct the peak power for the required braking duration for each individual braking procedure within the cycle?

This can be checked using the following diagrams:

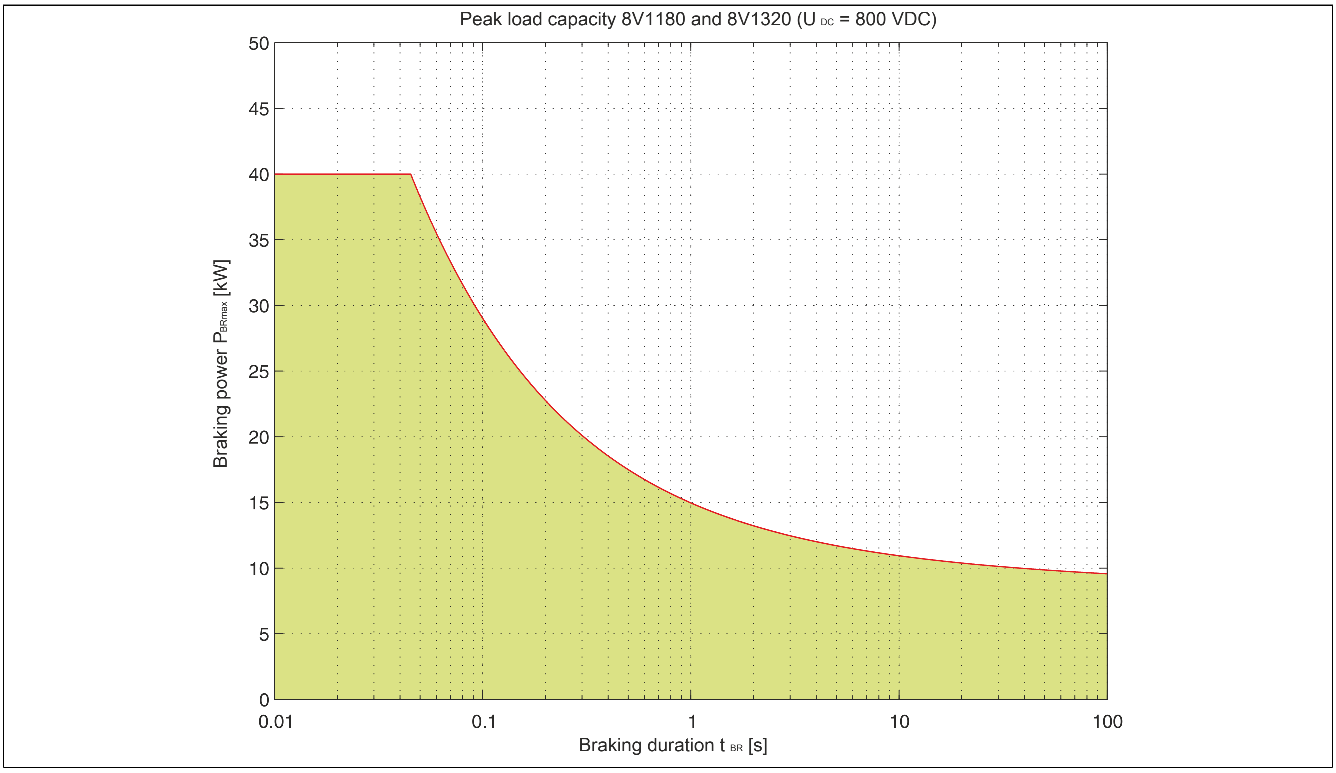


Figure 91: Peak load capacity - 8V1180 / 8V1320

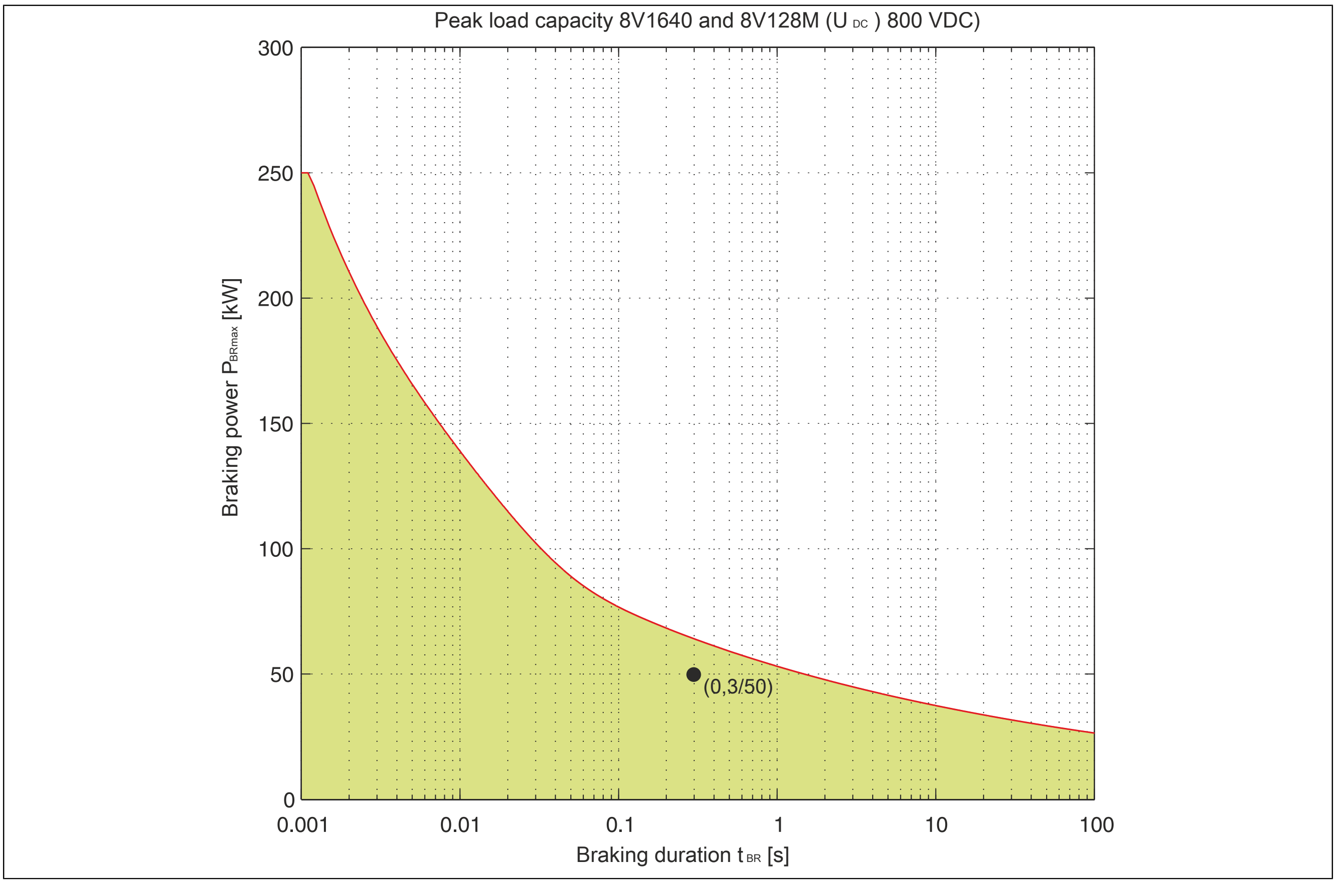


Figure 92: Peak load capacity - 8V1640 / 8V128M

The individual braking procedures within one cycle are entered in the diagram as points with the coordinates (t_{BR}/ P_{BRmax}) and must all be within the permissible range (marked green). If this is not the case, then a different ACOPOS servo drive must be selected!

Figure "Peak load capacity - 8V1640 / 8V128M" contains the individual braking procedures from the sample application (t_{BR} = 0.3 sec, P_{BRmax} = 50 kW). These are within the permissible range, which indicates that the selected ACOPOS servo drive is suitable for the peak power of each individual braking procedure in the application.

Step 4: Determine value of the required external braking resistor.

Maximum permissible braking resistor for the application:

$$R_{BRmaxAPPL} = \frac{U_{DCmax}{}^2}{P_{BRmaxAPPL}} = \frac{800V^2}{50000W} = 12{,}8\,\Omega$$

The value of the external braking resistor must meet the following criteria:

- $R_{BR} \geq R_{minServo} \Rightarrow R_{BR} \geq 2.5\ \Omega$
- $R_{BR} \geq \frac{P_{BRavgAPPL}}{I_{BRServo}{}^2} \Rightarrow R_{BR} \geq \frac{1500W}{30A^2} \Rightarrow R_{BR} \geq 1{,}67\,\Omega$
- $R_{BR} \leq R_{BRmaxAPPL} \Rightarrow R_{BR} \leq 12.8\ \Omega$

Therefore, a braking resistor or a combination of braking resistors must be selected with a resistance value between 2.5 Ω and 12.8 Ω.

Step 5: Select the external braking resistor.

Caution!

If the resistance falls below the minimum permitted value, then the brake chopper in the device could be destroyed!

Danger!

During braking, voltages up to 900 VDC can occur on the external braking resistor. The external braking resistor must be able to handle these voltages.

Information:

We recommend choosing braking resistor value so that its resistance value R_{BR} is as close as possible to the maximum value permissible for the application R_{BRmax}, in order to keep the current low through the fuse on the ACOPOS servo drive's braking resistor connection.

This can require a parallel or series connection of individual braking resistors.

Three braking resistors 8B0W0079H000.001-1 (R_{BR} = 33 Ω) will be connected in parallel to maintain a resistance value that is right for the application (for technical data, see see Table 184 "Overview of braking resistor data - 8B0W " on page 231):

- Resistance value:

$$\frac{1}{R_{BR}} = \sum_{i=1}^{N} \frac{1}{R_{BR_i}} \Rightarrow R_{BR} = 11\Omega\ \leq 12{,}8\,\Omega$$

- Thermal capacity:

$$c_{th} = \sum_{i=1}^{N} c_{th_i} \Rightarrow c_{th} = 77{,}8\frac{J}{K}$$

The continuous power P_{BRN} and the thermal resistance R_{th} of the selected combination of braking resistors depends on the mounting orientation:

- Horizontal mounting orientation:

$$\frac{1}{R_{th}} = \sum_{i=1}^{N} \frac{1}{R_{th_i}} \Rightarrow R_{th} = 0{,}355\,\Omega$$

$$P_{BRN} = \sum_{i=1}^{N} P_{BRN} \Rightarrow P_{BRN} = 1896W$$

- Vertical mounting orientation:

$$\frac{1}{R_{th}} = \sum_{i=1}^{N} \frac{1}{R_{th_i}} \Rightarrow R_{th} = 0{,}284\,\Omega$$

$$P_{BRN} = \sum_{i=1}^{N} P_{BRN} \Rightarrow P_{BRN} = 2370\text{W}$$

Information:

The nominal continuous power P_{BRN} of a braking resistor depends on the ambient temperature and the braking resistor's maximum permissible temperature.

The braking resistor's nominal power will be decreased if, for application reasons, the ambient temperature is increased and/or the braking resistor's maximum permissible temperature is limited (contact protection, warming of neighboring components, maximum warming of the control cabinet, installation position, etc.)!

Only for ACOPOS servo drives in the DC bus network!

The braking resistors integrated in ACOPOS servo drives as well as braking resistors that can be connected externally are controlled using a specially developed procedure. This guarantees that the brake power is optimally and equally distributed on the braking resistors when the DC bus connection of ACOPOS servo drives is made between several units.

The following condition must be met for the external braking resistor in order for this occur: $P_{BRN} \geq \frac{U_{DC}^2}{30.R_{BR}}$

- Horizontal mounting orientation:

  $P_{BRN} \geq \frac{U_{DC}^2}{30.R_{BR}} \Rightarrow 1896W \geq \frac{800\text{V}^2}{30.11\Omega} \Rightarrow 1896W \geq 1939\text{W}$

  --> Condition not met.

- Vertical mounting orientation:

  $P_{BRN} \geq \frac{U_{DC}^2}{30.R_{BR}} \Rightarrow 2370W \geq \frac{800\text{V}^2}{30.11\Omega} \Rightarrow 2370W \geq 1939\text{W}$

  --> Condition met.

Is the nominal continuous power P_{BRN} of the selected braking resistor combination sufficient for the application's average brake power $P_{BRavgAPPL}$?

The following condition must be met:

$P_{BRN} \geq P_{BRavgAPPL}$

This condition must be checked for all permissible mounting orientations:

- Horizontal mounting orientation:

  $P_{BRN} \geq P_{BRavgAPPL} \Rightarrow$ 1896W >1500W --> Nominal continuous power P_{BRN} is sufficient.
- Vertical mounting orientation:

  $P_{BRN} \geq P_{BRavgAPPL} \Rightarrow$ 2370W >1500W --> Nominal continuous power P_{BRN} is sufficient.

Can the selected braking resistor conduct the incidental braking energy without exceeding the maximum braking resistor temperature for the application?

The following condition must be met for this to happen:

$$P_{BRN} \geq \frac{W_{BR_i}}{t_i}.k$$

The peak load factor k for any braking resistor can be determined using the following diagram:

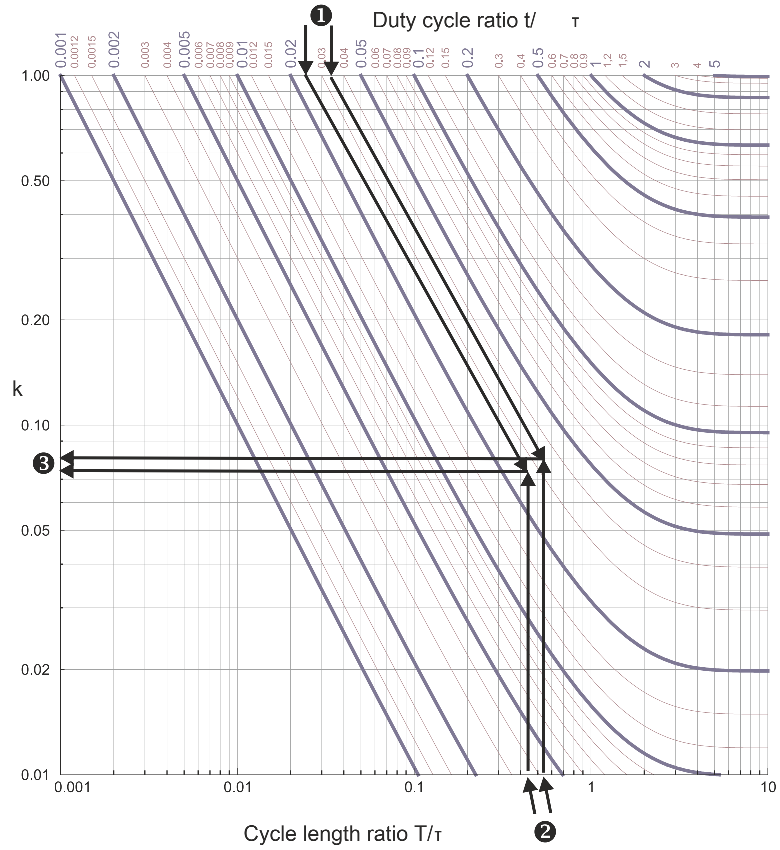


Figure 93: Determining the peak load factor k

k ... Peak load factor for the braking resistor
T ... Application cycle time (= t_{Cycle})
t ... Sum of all braking times (total braking time) within one cycle
τ ... Thermal time constant of the braking resistor (= R_{th} * c_{th})

1. Calculation of the duty cycle ratio
   - Horizontal mounting orientation:

     $$\frac{t}{\tau} = \frac{t_{BR1} + t_{BR2}}{R_{th} + c_{th}} = \frac{0{,}3 + 0{,}3}{0{,}355 . 67{,}8} = 0{,}025$$

   - Vertical mounting orientation:

     $$\frac{t}{\tau} = \frac{t_{BR1} + t_{BR2}}{R_{th} + c_{th}} = \frac{0{,}3 + 0{,}3}{0{,}284 . 67{,}8} = 0{,}031$$

2. Calculation of the cycle length ratio
   - Horizontal mounting orientation:

     $$\frac{T}{\tau} = \frac{t_{Cycle}}{R_{th} . c_{th}} = \frac{10}{0{,}355 . 67{,}8} = 0{,}415$$

   - Vertical mounting orientation:

     $$\frac{T}{\tau} = \frac{t_{Cycle}}{R_{th} . c_{th}} = \frac{10}{0{,}284 . 67{,}8} = 0{,}519$$

3. Reading the peak load factor k based on the values from 1 and 2 in figure "Calculation of the peak load factor k"
   - Horizontal installation: k = 0.075
   - Vertical installation: k = 0.08

This condition must be checked for all permissible mounting orientations:

- Horizontal mounting orientation:

  $$P_{BRN} \geq \frac{W_{BR_i}}{t_i}.k \Rightarrow 1896\text{W} \geq \frac{7500\text{J}}{0{,}3s}.0{,}075 \Rightarrow 1896\text{W} \geq 1875\text{W}$$

  --> The nominal power P_{BRN} of the braking resistor is barely sufficient for the application - No reserves! Horizontal mounting orientations are therefore not recommended!

- Vertical mounting orientation:

  $$P_{BRN} \geq \frac{W_{BR_i}}{t_i}.k \Rightarrow 2370\text{W} \geq \frac{7500\text{J}}{0{,}3s}.0{,}08 \Rightarrow 2370\text{W} \geq 2000\text{W}$$

  --> The nominal power P_{BRN} of the braking resistor is sufficient for the application.

Results

Three B&R braking resistors 8B0W0079H000.001-1 connected in parallel and installed vertically on an ACOPOS servo drive 8V1640.00-2 power supply module meet the requirements of the application.

4.4 Configuring brake resistor parameters

The braking resistors integrated in B&R drive systems or connected externally are controlled by a specially developed procedure. This guarantees that the brake power is optimally and equally distributed on the braking resistors when a DC bus connection is made between several units.

4.4.1 Using the integrated braking resistors

No settings or configuration is required by the user.

4.4.2 Using external braking resistors

When using external braking resistors, the following parameters must be set for the drive system using B&R Automation Studio:

ParID	Name	Formula symbols	Unit
10	Ohmic resistance	R_{BR}	[Ω]
11	Maximum overtemperature on the external braking resistor	ΔT_{BRmax}	[°C]
12	Thermal resistance between braking resistor and the environment	R_{th}	[K/W]
13	Heat capacitance of the filament	c_{th}	[Ws/°C]
398	Setting for an internal / external braking resistor 0 ... Internal (default) 1 ... External **Information:** **Switching is only possible during the ACOPOSservo drive initialization phase.**	---	---

Table 186: ParIDs for setting external braking resistor parameters

These parameters can normally be found on the data sheet from the respective manufacturer. [25)]

These parameters are based on the following thermal equivalent circuit diagram for the external braking resistor:

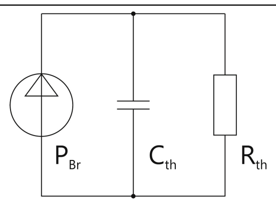


Figure 94: Thermal equivalent circuit diagram for the external braking resistor

If a value for the maximum overtemperature T_{BRmax} of the external braking resistor is not given, it can be determined using the following formula:

$$T_{BRmax} = P_{BRN}.R_{th}$$

25) An example of reliable braking resistors are Σ SIGMA type braking resistors (www.danotherm.com).

5 Configuring ACOPOS servo drives

The plug-in modules for ACOPOS servo drives allow each servo drive to be individually configured according to the requirements of the application. When putting together plug-in module combinations, the power consumption must be checked. This then results in the current requirements of the ACOPOS servo drive configuration.

5.1 Maximum power output for all slots on the ACOPOS servo drive

The maximum power output for all slots (P_{max}) depends on the size of the ACOPOS servo drive:

Name	ACOPOS								
	1010	1016	1022	1045	1090	1180	1320	1640	128 M
P_{max}	Max. 16 W		Max. 22 W						

Table 187: Maximum power output for all slots depending on the ACOPOS servo drive

The total power consumption for all plug-in modules must be less than or equal to the ACOPOS servo drive's maximum power output:

$$\sum P_{Modul}[W] \leq P_{max}[W]$$

The power consumption of the individual plug-in modules can be found in "Power consumption Pmodule of ACOPOS plug-in modules" or the technical data for the modules (see "Technical data" on page 29):

Plug-in module	Power consumption P_{module}
8AC110.60-3	Max. 0.7 W
8AC114.60-2	Max. 3 W
8AC120.60-1 E0 ... EnDat single-turn, 512 lines E1 ... EnDat multi-turn, 512 lines E2 ... EnDat single-turn, 32 lines (inductive) E3 ... EnDat multi-turn, 32 lines (inductive) E4 ... EnDat single-turn, 512 lines E5 ... EnDat multi-turn, 512 lines E8 ... EnDat single-turn, 16 lines (inductive) E9 ... EnDat multi-turn, 16 lines (inductive) EA ... EnDat single-turn, 32 lines (inductive) EB ... EnDat multi-turn, 32 lines (inductive)	Depends on the EnDat encoder connected Max. 23 W Max. 31 W Max. 31 W Max. 31 W Max. 24 W Max. 27 W Max. 29 W Max. 31 W Max. 27 W Max. 30 W
8AC121.60-1 With encoder current requirement of 0 mA With encoder current requirement of 100 mA With encoder current requirement of 170 mA	 0.35 W 1.4 W 2.1 W
8AC122.60-3	Max. 2.5 W
8AC122.60-4	Max. 25 W
8AC123.60-1	Max. 7.5 W Depends on the current requirements for the encoder connected [1]
8AC125.60-1	Max. 45 W
8AC125.60-2	22 W
8AC125.61-2	58 W
8AC126.60-1	Max. 44 W
8AC130.60-1	Max. 0.8 W
8AC131.60-1	Max. 1 W
8AC140.60-3, 8AC140.61-3	Max. 4.5 W
8AC141.60-2, 8AC141.61-3	Max. 4.5 W

Table 188: Power consumption P_{module} of ACOPOS plug-in modules

1) The power consumption of the plug-in module can be approximated using the following formula:
P_{Module} [W] = $P_{Encoder}$ [W] . k + 0.6 W
The power consumed by the encoder $P_{Encoder}$ is calculated from the selected encoder supply voltage (5 V / 15 V) and the current required:
$P_{Encoder}$ [W] = $U_{Encoder}$ [V] . $I_{Encoder}$ [A]
The following values must be used for k:
k = 1.2 (for 15 V encoder supply)
k = 1.75 (for 5 V encoder supply)

5.2 24 VDC current requirements for the ACOPOS servo drive

The 24 VDC current requirements (I_{24VDC}) must be regarded differently depending on the size of the ACOPOS servo drive.

- The following estimate can always be used for the ACOPOS 1010, 1016, 1022, 1045 and 1090:

  $$I_{24VDC}[A] = I_{24VDC_{max}}[A] - \frac{1,1}{24V.k}.(P_{max} - \sum P_{Modul}[W])$$

- This estimate can also be used for the ACOPOS 1180, 1320, 1640 and 128M as long as a mains input voltage is not applied. As soon as a mains input voltage is applied to these servo drives, the 24 VDC supply voltage is created via the integrated DC bus power supply; the 24 VDC current requirements (I_{24VDC}) is then reduced to 0.

The 24 VDC maximum current requirements for the ACOPOS servo drives can be found in "Maximum current requirements and constant k " or the technical data for the ACOPOSservo drives (see "Technical data").

Name	ACOPOS								
	1010	1016	1022	1045	1090	1180	1320	1640	128 M
$I_{24VDCmax}$	1.47 A		2.5 A			2.8 A		4.6 A	5.7 A
k	0.73		0.64			0.63		0.58	

Table 189: Maximum current requirements and constant k

The 24 VDC total current consumption for the ACOPOS servo drive is made up of the 24 VDC current requirements, the current on the 24 VDC output (only for ACOPOS 1180/1320/1640/128M) and the current for the motor holding brake (if used):

$$I_{24VDC_{total}} = I_{24VDC} + I_{24VDC_{out}} + I_{Br}$$

In this case, make sure that the 24 VDC total current consumption does not exceed the maximum current load for the connection terminals.

6 Dimensioning cooling systems for cooling control cabinets

6.1 General dimensioning criteria

- What are the environmental conditions where the control cabinet will be located (ambient temperature T_A, humidity, installation altitude above sea level)?
- How is the air circulation (intake and outlet) where the control cabinet will be located? Particularly small spaces can become significantly warmer due to the heat dissipation from a cooling device.
- Is the ambient air clean or contaminated with dust, oil, etc?
- Which type of control cabinet installation is intended according to DIN 57660, Part 500?
- Is the control cabinet open (allowing air flow) or closed (no air flow)? Control cabinets that are closed (no air flow) can only dissipate power loss via the control cabinet walls.
- What kind of material are the control cabinet walls made of (specification of the heat transfer coefficient k)?
- What is the control cabinet's minimum required level of protection in accordance with EN 60529?
- How high is the specified internal temperature T_{Iset} of the control cabinet? This value must be lower than the lowest permissible ambient temperature of all components used in the control cabinet.
- Is a coolant circulation available where the control cabinet is located?
- Is the maximum ambient temperature T_{Amax} lower than the desired internal temperature T_{Iset} of the control cabinet?

Chapter 4
Dimensioning

6.1.1 Basic selection of the cooling system

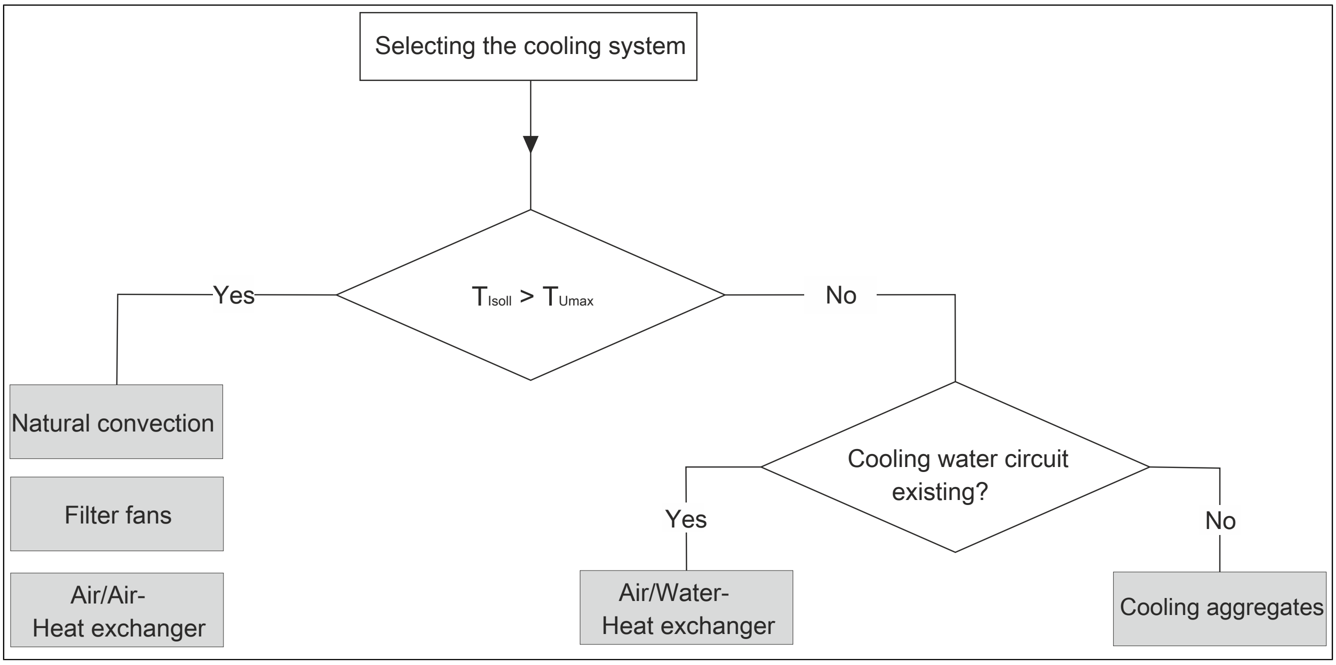


Figure 95: Basic selection of the cooling system

6.2 Natural convection

In this case, the power loss is emitted outwards through the control cabinet walls.

Information:

The ambient temperature T_A must be considerably lower than the internal temperature T_I of the control cabinet.

The heat capacity emitted from the control cabinet to the environment strongly depends on how the control cabinet is installed: A housing located in an open space can emit more heat to its environment than a housing that is mounted to a wall or built into a recess.

The calculation of the effective control cabinet surface A depending on the type of control cabinet installation is determined in DIN VDE 57 660 part 500 or IEC 890 (and VDE 0660 part 890):

Mounting arrangement in accordance with IEC 890		Formula for calculating A [m²] 1)
	Detached single cabinet, free-standing on all sides	A = 1.8 x H x (W + D) + 1.4 x W x D
	Single cabinet, against a wall	A = 1.4 x W x (H + D) + 1.8 x D x H
	First or last cabinet, detached on three sides	A = 1.4 x D x (H + W) + 1.8 x W x H
	First or last cabinet, against a wall	A = 1.4 x H x (W + D) + 1.4 x W x D
	Middle cabinet, detached on two sides	A = 1.8 x W x H + 1.4 x W x D + D x H
	Middle cabinet, against a wall	A = 1.4 x W x (H + D) + D x H
	Middle cabinet, against a wall, with covered roof	A = 1.4 x W x H + 0.7 x W x D + D x H

Table 190: Calculation of the effective control cabinet surface A (DIN VDE 57 660 part 500 or IEC 890)

1) W... Control cabinet width [m]; H ... Control cabinet height [m]; D ... Control cabinet depth [m].

6.2.1 Dimensioning

1. Determine the heat dissipation Q_v of all devices in the control cabinet.
2. Calculate the effective control cabinet surface area A.
3. Calculate the maximum control cabinet temperature T_{Imax}: [26)]

$$T_{Imax} = \frac{Q_V}{k.A} + T_U$$

The control cabinet's maximum internal temperature T_{Imax} must be lower than the maximum permissible ambient temperature of the components used inside the control cabinet.

6.2.2 Example

Two ACOPOS 8V1320.00-2 units and an ACOPOS 8V1640.00-2 are installed in a control cabinet. The heat dissipation from the braking resistors was determined over one machine cycle and is on average 800 W. The heat dissipation from all other active devices in the control cabinet is 500 W.

The steel control cabinet is 1 m wide, 2 m high, 0.5 m deep and is free-standing on all sides. The internal temperature of the control cabinet should not exceed 40°C. The ambient temperature is 30°C.

Now determine whether the heat dissipation occurring in the control cabinet can be diverted by its own natural convection.

1) Determine the heat dissipation of all devices in the control cabinet.

Components in the control cabinet	Quantity	Heat dissipation per component [W]	Total heat dissipation [W]
8V1320.00-2	2	800 1)	1600
8V1640.00-2	1	1600 1)	1600
Braking resistors	---	800 (average value over one machine cycle)	800
All other active devices	---	---	500
		Total:	**4500**

Table 191: Determining the heat dissipation of all devices in the control cabinet

1) The heat dissipation for ACOPOS servo drives is specified in the "Technical data" chapter. Maximum values are used in this example.

26) k ... Heat transfer coefficient [W/m²K]; for steel panel: k = 5.5
If the heat dissipation Q_V in the control cabinet is unknown, the actual power loss can be calculated by measuring T_A and T_I: $Q_V = A \cdot k \cdot (T_{Imax} - T_A)$

2) Calculate the effective control cabinet surface area.

A = 1.8 x H x (W + D) + 1.4 x W x D = 1.8 x 2 x (1+0.5) + 1.4 x 1 x 0.5 = 6.1 m²

3) Calculate the control cabinet inside temperature T_I.

$$T_I = \frac{Q_V}{k.A} + T_U = \frac{4500}{5{,}5.6{,}1} + 30 = 104°C$$

The control cabinet's calculated internal temperature considerably exceeds the desired internal temperature of 40°C. Therefore, the heat dissipation occurring inside the control cabinet cannot be diverted by its own natural convection. Another method must be used for cooling the control cabinet.

6.3 Filter fans

Filter fans are also a simple type of control cabinet cooling. The heat is dissipated by adding ambient air circulation and simultaneously allowing the heated air inside the control cabinet to be diverted.

> **Information:**
>
> **To use filter fans, the ambient temperature T_A must be considerably lower than the internal temperature T_I of the control cabinet.**

6.3.1 Dimensioning

1. Determine the heat dissipation Q_v of all devices in the control cabinet.
2. Determine the control cabinet's maximum internal temperature T_{Imax} at nominal load or identify it using the maximum ambient temperature of the components being used.
3. Specify the ambient temperature T_A of the control cabinet.
4. Specify the control cabinet's installation altitude h.
   Depending on the control cabinet's installation altitude, a compensation factor f might be required, which can be found in the following table:

Installation altitude h [m]	Compensation factor f [m³K/Wh]
0 ≤ h ≤ 100	3.1
100 < h ≤ 250	3.2
250 < h ≤ 500	3.3
500 < h ≤ 750	3.4
750 < h ≤ 1000	3.5

Table 192: Compensation factor f depending on the control cabinet's installation altitude

5. Calculate the air flow volume V:

$$V[m^3/h] = f.\frac{Q_V}{T_{Imax} - T_A}$$

The correct filter fan can now be selected based on the calculated air flow volume V.

> **Information:**
>
> **The required protection level of the control cabinet in accordance with EN 60529 must also be taken into consideration when selecting a filter fan.**

6.3.2 Example

Two ACOPOS 8V1320.00-2 units and an ACOPOS 8V1640.00-2 are installed in a control cabinet. The heat dissipation from the braking resistors was determined over one machine cycle and is on average 800 W. The heat dissipation from all other active devices in the control cabinet is 500 W.

The internal temperature of the control cabinet should not exceed 40°C. The ambient temperature is 30°C. The control cabinet should be installed at 800 m above sea level.

The right filter fan must be selected for this control cabinet.

1) Determine the heat dissipation of all devices in the control cabinet.

Components in the control cabinet	Quantity	Heat dissipation per component [W]	Total heat dissipation [W]
8V1320.00-2	2	800 [1)]	1600
8V1640.00-2	1	1600 [1)]	1600
Braking resistors	---	800 (average value over one machine cycle)	800
All other active devices	---	---	500
		Total:	**4500**

Table 193: Determining the heat dissipation of all devices in the control cabinet

1) The heat dissipation for ACOPOS servo drives is specified in the "Technical data" chapter. Maximum values are used in this example.

2) Determine the control cabinet's maximum internal temperature T_{Imax} at nominal load or identify it using the maximum ambient temperature of the components being used.

The internal temperature of the control cabinet should not exceed 40°C.

3) Specify the ambient temperature T_A of the control cabinet.

The ambient temperature is 30°C.

4) Specify the control cabinet's installation altitude h.

The compensation factor f can be taken from table "Compensation factor f depending on the control cabinet's installation altitude" and is equal to 3.5 m^3K/Wh.

5) Calculate the air flow volume V.

This results in an air flow volume of

$$V = f \cdot \frac{Q_V}{T_{Imax} - T_A} = 3{,}5 \cdot \frac{4500}{40 - 30} = 1575 m^3/h$$

The correct filter fan can now be selected based on the determined air flow volume.

6.4 Air/air heat exchangers

Air/Air heat exchangers dissipate the heat from the control cabinet using two hermetically isolated air currents in the opposing current principle. This prevents dust, oil and other (aggressive) materials in the ambient air from penetrating the control cabinet.

Information:

To use air/air heat exchangers, the ambient temperature T_A must be considerably lower than the internal temperature T_I of the control cabinet.

6.4.1 Dimensioning

1. Determine the heat dissipation Q_v of all devices in the control cabinet.
2. Determine the control cabinet's maximum internal temperature T_{Imax} at nominal load or identify it using the maximum ambient temperature of the components being used.
3. Specify the ambient temperature T_A of the control cabinet.
4. Calculate the effective control cabinet surface area A.
5. Calculate the specific heat capacity q_W: [27)]

$$q_w[\frac{W}{K}] = \frac{Q_V - (A.(T_{Imax} - T_A).k)}{T_{Imax} - T_A}$$

The right air/air heat exchanger can be selected based on the specific heat capacity q_W.

Information:

The required protection level of the control cabinet in accordance with EN 60529 must also be taken into consideration when selecting an air/air heat exchanger.

6.4.2 Example

Two ACOPOS 8V1320.00-2 units and an ACOPOS 8V1640.00-2 are installed in a control cabinet. The heat dissipation from the braking resistors was determined over one machine cycle and is on average 800 W. The heat dissipation from all other active devices in the control cabinet is 500 W.

The steel control cabinet is 1 m wide, 2 m high, 0.5 m deep and is free-standing on all sides. The internal temperature of the control cabinet should not exceed 40°C. The ambient temperature is 30°C.

The right air/air heat exchanger must be selected for this control cabinet.

1) Determine the heat dissipation of all devices in the control cabinet.

Components in the control cabinet	Quantity	Heat dissipation per component [W]	Total heat dissipation [W]
8V1320.00-2	2	800 [1)]	1600
8V1640.00-2	1	1600 [1)]	1600
Braking resistors	---	800 (average value over one machine cycle)	800
All other active devices	---	---	500
		Total:	**4500**

Table 194: Determining the heat dissipation of all devices in the control cabinet

1) The heat dissipation for ACOPOS servo drives is specified in the "Technical data" chapter. Maximum values are used in this example.

2) Determine the control cabinet's maximum internal temperature T_{Imax} at nominal load or identify it using the maximum ambient temperature of the components being used.

The internal temperature of the control cabinet should not exceed 40°C.

3) Specify the ambient temperature T_A of the control cabinet.

The ambient temperature is 30°C.

4) Calculate the effective control cabinet surface area.

A = 1.8 x H x (W + D) + 1.4 x W x D = 1.8 x 2 x (1 + 0.5) + 1.4 x 1 x 0.5 = 6.1 m²

27) k ... Heat transfer coefficient [W/m²K]; for steel panel: k = 5.5

5) Calculate the specific heat capacity.

The heat transfer coefficient k for steel panels is 5.5 W/m²K.

This results in a specific heat capacity q_W of

$$q_W = \frac{Q_v - (A.(T_{Imax} - T_A).k)}{T_{Imax} - T_A} = \frac{4500 - (6,1.(40 - 30).5,5)}{40 - 30} = 416,45 \frac{W}{K}$$

The right air/air heat exchanger can be selected based on the determined specific heat capacity q_W.

6.5 Air/water heat exchangers / Cooling units

Air/water heat exchangers and cooling units dissipate heat via a cooling circulation system. This prevents dust, oil and other (aggressive) materials in the ambient air from penetrating the control cabinet.

6.5.1 Dimensioning

1. Determine the heat dissipation Q_v of all devices in the control cabinet.
2. Determine the control cabinet's maximum internal temperature T_{Imax} at nominal load or identify it using the maximum ambient temperature of the components being used.
3. Specify the ambient temperature T_A of the control cabinet.
4. Calculate the effective control cabinet surface area A.
5. Calculate the required cooling capacity Q_E: [28]
   $Q_E[W] = Q_V - (A \cdot (T_{Imax} - T_A) \cdot k)$

The right air/water heat exchanger or cooling unit can now be selected based on the required cooling capacity Q_E.

Information:

The required protection level of the control cabinet in accordance with EN 60529 must also be taken into consideration when selecting an air/water heat exchanger or cooling unit.

6.5.2 Example

Scenario

Two ACOPOS 8V1320.00-2 units and an ACOPOS 8V1640.00-2 are installed in a control cabinet. The heat dissipation from the braking resistors was determined over one machine cycle and is on average 800 W. The heat dissipation from all other active devices in the control cabinet is 500 W.

The steel control cabinet is 1 m wide, 2 m high, 0.5 m deep and is free-standing on all sides. The internal temperature of the control cabinet should not exceed 40°C. The ambient temperature is 30°C.

The right air/water heat exchanger or cooling unit must be selected for this control cabinet.

1) Determine the heat dissipation of all devices in the control cabinet.

Components in the control cabinet	Quantity	Heat dissipation per component [W]	Total heat dissipation [W]
8V1320.00-2	2	800 [1]	1600
8V1640.00-2	1	1600 [1]	1600
Braking resistors	---	800 (average value over one machine cycle)	800
All other active devices	---	---	500
		Total:	**4500**

Table 195: Determining the heat dissipation of all devices in the control cabinet

1) The heat dissipation for ACOPOS servo drives is specified in the "Technical data" chapter. Maximum values are used in this example.

2) Determine the control cabinet's maximum internal temperature T_{Imax} at nominal load or identify it using the maximum ambient temperature of the components being used.

The internal temperature of the control cabinet should not exceed 40°C.

3) Specify the ambient temperature T_A of the control cabinet.

The ambient temperature is 30°C.

[28] k ... Heat transfer coefficient [W/m²K]; for steel panel: k = 5.5

4) Calculate the effective control cabinet surface area.

A = 1.8 x H x (W + D) + 1.4 x W x D = 1.8 x 2 x (1 + 0.5) + 1.4 x 1 x 0.5 = 6.1 m²

5) Calculate the required cooling capacity.

The heat transfer coefficient k for steel panels is 5.5 W/m²K.

This results in a required cooling capacity Q_E of

$$Q_E = Q_v - (A \cdot (T_{Imax} - T_A) \cdot k) = 4500 - (6,1 \cdot (40 - 30) \cdot 5,5) = 4164,5 W$$

The right air/water heat exchanger or cooling unit can now be selected based on the determined required cooling capacity Q_E.

7 Formula variables used

Character	Unit	Name
A	m²	Effective, power radiating control cabinet surface according to DIN 57660 section 500
C_A	F	Discharge capacitance
$C_{Br_{TH}}$	Ws/°C	Heat capacitance of the filament
c_{th}	Ws/°C	Thermal capacity
k	---	General constants
f_{Mains}	Hz	Mains frequency
I_{24VDC}	A	24 VDC current requirements
$I_{24VDC_{max}}$	A	24 VDC maximum current requirements
$I_{24VDC_{Total}}$	A	24 VDC total current consumption
$I_{24VDC_{out}}$	A	Current on 24 VDC output of the ACOPOS servo drive (max. 0.5 A)
I_A	A	Discharge current via protective ground conductor (PE)
I_B	A	Rated current for overcurrent protection
I_{Mains}	A	Mains current (phase current)
I_q	A	Thermal equivalent current effective value
I_Z	A	Maximum current load on a cable
k	W/m²K	Heat transfer coefficient (for steel: k = 5.5 W/m²K)
M	Nm	Torque (general)
M_{eff}	Nm	Effective load torque for one cycle
n	min^{-1}	Speed (general)
n_{avg}	min^{-1}	Average speed for one cycle
ω	rad/s	Angular velocity
P	W	Power or true power (general)
P_{Br}	W	Brake power
$P_{Br_{max}}$	W	Maximum brake power
$P_{Br_{avg}}$	W	Average brake power
P_{BRN}	W	Nominal continuous power
$P_{R_{B_{max}}}$	W	Maximum load on the external braking resistor
$P_{R_{B_N}}$	W	Nominal power of the external braking resistor
P_{max}	W	Maximum power output for all slots
P_{Module}	W	Power consumption of the ACOPOS plug-in modules
π	---	Pi (3.1415)
Q_E	W	Necessary cooling capacity
Q_v	W	Sum of the heat dissipation in the control cabinet
Q_S	W	Power that is radiated through the control cabinet surface (QS >0: radiation; QS <0: radiation into the control cabinet)
q_W	W/K	Specific heat output of a heat exchanger
V	m³/h	Air flow volume of a filter fan that is required in order to ensure that the maximum temperature difference between the intake and the exiting air is not exceeded
R_{Br}	Ω	Braking resistors
$R_{Br_{min}}$	Ω	Minimum braking resistance
$R_{Br_{Th}}$	°C/W	Thermal resistance between braking resistor and the environment
R_{th}	°C/W	Thermal resistance
S	VA	Apparent power
t	s	Time (general)
t_{Br}	s	Braking time
$T_{Br_{max}}$	°C	Maximum overtemperature of the resistor
T_{Imax}	°C	Maximum temperature permitted inside the control cabinet
T_A	°C	Ambient temperature of the control cabinet
T_{Cycle}	s	Cycle time
U_{DC}	V	DC bus voltage
U_{Mains}	V	Supply voltage (phase - phase)

Table 196: Formula variables used

Chapter 5 • Wiring

1 General information

1.1 Electromagnetic compatibility of the installation

1.1.1 General information

If the directives for elecromagnetic compatibility of the installation are followed, ACOPOS servo drives meet EMC directives 2004/108/CE and low-voltage directives 2006/95/CE. They also meet the requirements for harmonized EMC product standard IEC 61800-3:2004 for industrial areas (second environment).

Additional EMC measures must be implemented by the machine or system manufacturer in the event that the product standard for the machine includes lower limit values or the machine conforms to the basic standard IEC 61000-6-4. Additional EMC measures may also be needed for machines with a large number of ACOPOS servo drives. The installation of a central line filter is mostly sufficient in such cases. Proof of conformity to required limit values must be provided by the manufacturer or distributor of the machine or system in accordance with the guidelines for implementing the EMC directive.

Additional EMC measures are required when operating ACOPOS servo drives in a residential area or when connecting ACOPOS servo drives to a low voltage system that also supplies buildings in a residential area (first environment) without an intermediate transformer.

1.1.2 Installation guidelines

1. The control cabinet or system must be constructed properly.
2. To prevent the effects of disturbances, the following lines must be properly shielded:
    - Motor cables
    - Encoder cables
    - Control cables
    - Data cables
3. Inductive switching elements such as contactors or relays must be equipped with corresponding suppressor elements such as varistors, RC elements or damping diodes.
4. All electrical connections must be kept as short as possible.
5. Cable shields must always be attached to designated shield terminals and the plug housing. Twisting the shielding mesh or lengthening cable shields with a single line (pigtail) is not permitted!
6. Shielded cables with copper mesh or tinned copper must be used.
7. Unused cable conductors must be grounded on both sides whenever possible.

Information:

To satisfy UL/CSA requirements, components of B&R drive systems are only permitted to be wired with copper wires with a permitted wire temperature of at least 75°C.

The ground connections and shield connections must be made as illustrated in the following diagram:

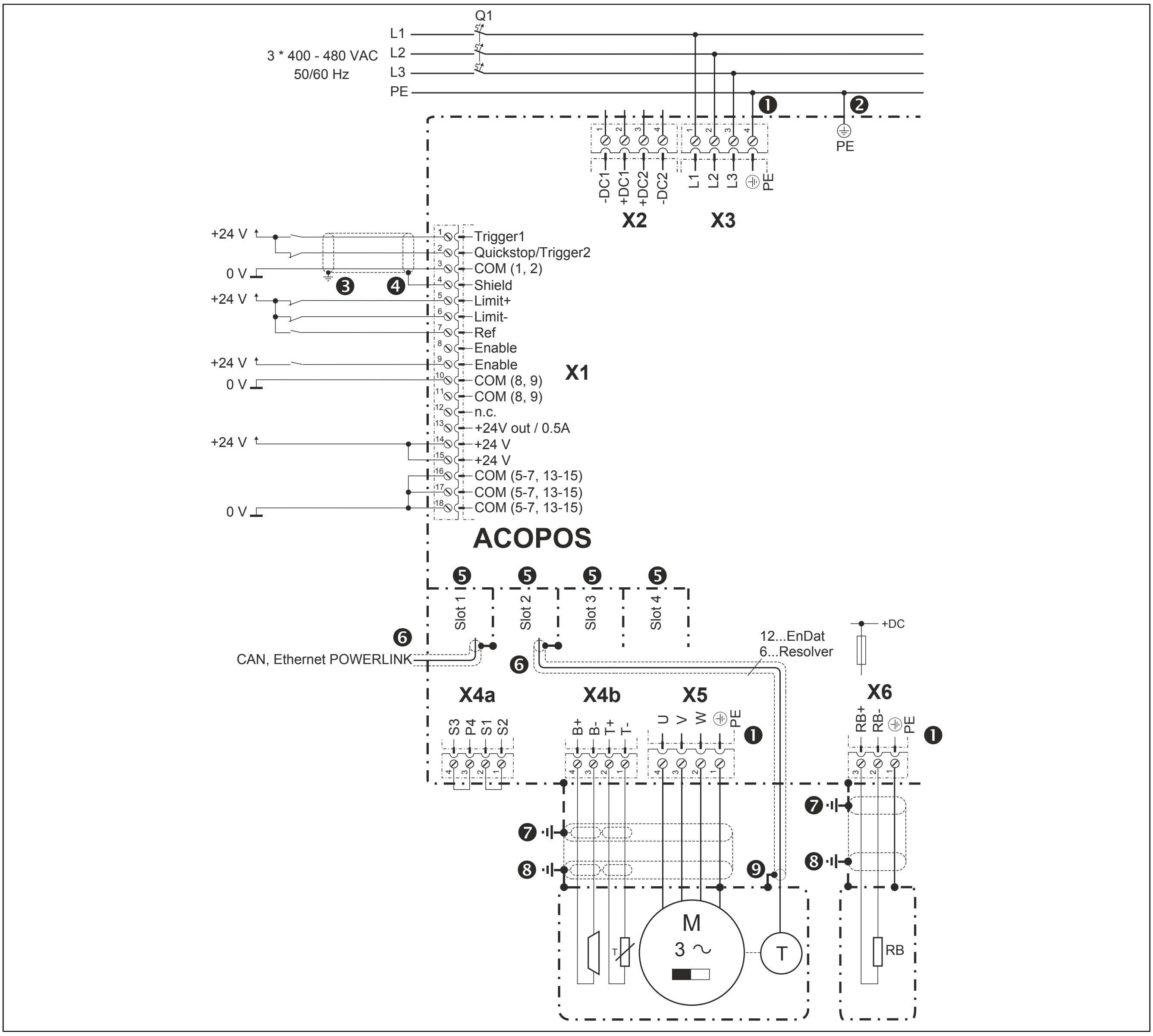


Figure 96: Connection diagram for ground and shield connections

1. The protective ground wires (PE) for the power mains, the motor lines and external braking resistor connection are internally connected to the housing of the ACOPOS servo drive.
2. The second protective ground wire connection is required because of the increased discharge current (3.5 mA) on ACOPOS servo drives 1022, 1045, 1090, 1180 and 1320. The same cross section as the power mains protective ground conductor must be used.
3. Both trigger inputs are only filtered internally with approx. 50 µs. Make sure the cable shield is grounded properly.
4. The cable shield must be attached to the shield connector.
5. On all plug-in modules, the two screws used to fasten the module must be tightened so that the mounting bracket is connected to ground.
6. Cable connection via DSUB plug:
   The cable shield must be sufficiently connected using the designated clamp in the metallic or metal-plated DSUB plug housing. The DSUB plug fastening screws must be tightened.

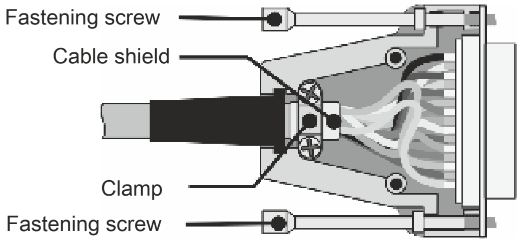


Figure 97: Cable shielding in DSUB housing

Cable connection via terminals:
The cable shield must be attached to the corresponding shield connection terminal.

Cable connection via RJ45 plug:
Grounding the cable shield as well provides an improvement in EMC properties. Grounding should take place on both sides, extensively and near to the connector.

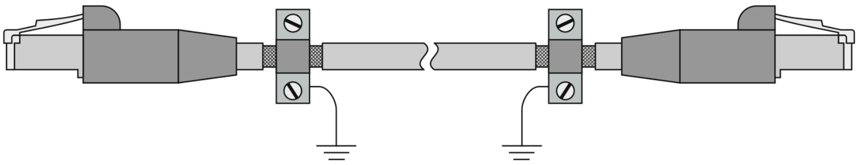


Figure 98: Grounding the POWERLINK cable shielding

Information:

When cabling POWERLINK networks with B&R POWERLINK cables, no additional grounding of the cable shield is required to ensure resistance to disturbances in accordance with EN 61800-3!

7. The cable shield for the motor line or the connection cable for the external braking resistor is connected with the housing of the ACOPOS servo drive via the grounding plate using the grounding clamp provided:

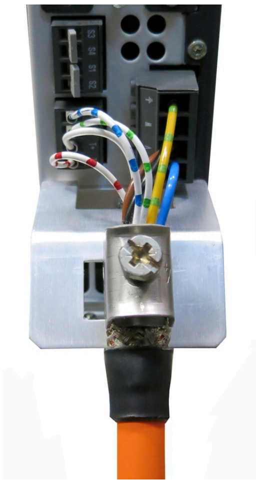
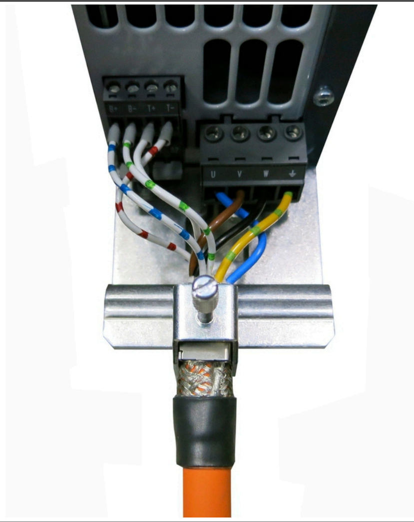
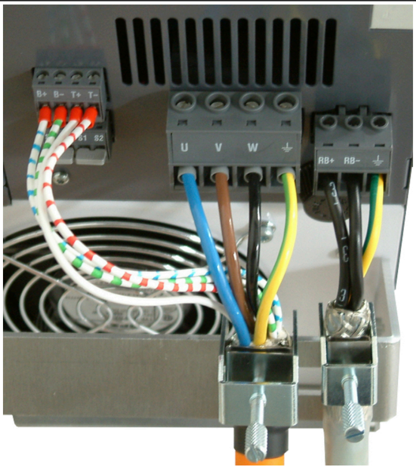
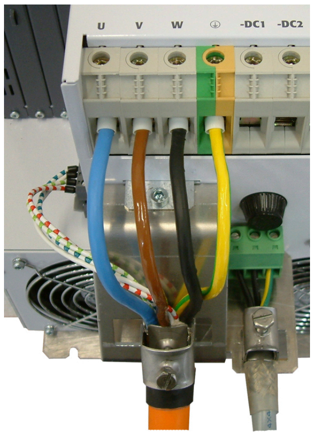
Shield connection for the motor cable using grounding clamps	
ACOPOS 1010, 1016	**ACOPOS 1022, 1045, 1090**
	
ACOPOS 1180, 1320	**ACOPOS 1640, 128M**
	

Table 197: Grounding of the motor cable on the ACOPOS servo drive

8. On the motor side, the cable shield of the motor line is connected to the motor housing via the motor connector and connected to ground via the machine. The cable shield on the connection cable for the external braking resistor must be connected with the housing of the braking resistor.
9. On the motor side, the encoder cable shield must be connected to the motor housing via the encoder connector and connected to ground via the machine.

   For external encoders, the cable shield of the encoder cable must be connected (on the encoder side) with the machine and therefore with ground via the encoder connector.

1.2 Insulation and high voltage testing

1.2.1 Insulation resistance testing in accordance with EN 60204

In accordance with EN 60204, the insulation resistance of electrical equipment is measured with 500 VDC between the main circuit conductors and the protective ground conductor system and is not permitted to be below a value of 1 MΩ. Testing individual sections of the system is permitted.

ACOPOS servo drive power mains connection (X3)

Insulation resistance testing can be carried out on the ACOPOS servo drive power mains connection (X3) as described above; however, values >1 MΩ are not expected because of the overvoltage protection circuit of the power mains.[29] The 50 kΩ minimum value required as specified in EN 60204, Section 18.3 is exceeded anyway.

ACOPOS servo drive motor connection (X5)

> **Warning!**
>
> **Insulation testing is not permitted to be carried out on the ACOPOS servo drive motor connection (X5) because that would destroy the ACOPOS servo drive!**
>
> **The motor cable must be removed from the ACOPOS servo drive motor connection (X5) before measuring the insulation resistance!**

B&R motors and B&R motor cables

In principle, an insulation resistance measurement can be carried out on B&R motor cables and B&R motors. However, the insulation resistance can be lower than 1 MΩ depending on the motor that is connected. The 50 kΩ minimum value required as specified in EN 60204, Section 18.3 is exceeded anyway.

> **Warning!**
>
> **Insulation testing is not permitted to be carried out on the ACOPOS servo drive motor connection (X5) because that would destroy the ACOPOS servo drive!**
>
> **The motor cable must be removed from the ACOPOS servo drive motor connection (X5) before measuring the insulation resistance!**

1.2.2 High voltage testing

In accordance with EN 60204, the electrical equipment must be able to withstand a test voltage connected between the conductors of all circuits and the protective ground conductor system for at least 1 s (exception: all circuits with a voltage < PELV voltage). The test voltage must be twice the rated voltage for the equipment and at least 1000 VAC (50/60 Hz). Components that cannot handle this test voltage must be disconnected before carrying out the high voltage test.

ACOPOS servo drive power mains connection (X3)

> **Warning!**
>
> **High voltage testing cannot be carried out on the ACOPOS servo drive power mains connection (X3) since arc flashes can occur that are caused by the internal wiring.**

ACOPOS servo drive motor connection (X5)

> **Warning!**
>
> **High voltage testing is not permitted to be carried out on the ACOPOS servo drive motor connection (X5) because it would destroy the ACOPOS servo drive!**

B&R motors and B&R motor cables

In principle, high voltage testing can be carried out on B&R motor cables and B&R motors. Depending on the size of the motor and length of the motor cable, increased measurement currents can occur because of capacitive coupling.

[29] Typical values are: 8V1010/1016: 880 kΩ; 8V1022/1045/1090: 820 kΩ; 8V1180/1320: 750 kΩ; 8V1640/128M: 820 kΩ.

Warning!

High voltage testing is not permitted to be carried out on the ACOPOS servo drive motor connection (X5) because it would destroy the ACOPOS servo drive!

The motor cable must be removed from the ACOPOS servo drive motor connection (X5) before the high voltage measurement!

1.3 Connecting cables to plug-in modules

Figure 99: Connecting cables to plug-in modules

Caution!

When installing plug-in module cables, the minimum permissible flex radius for the cables being used must be taken into consideration during cabling and also when cabling is finished! The minimum permissible flex radius can be found in the documentation for the respective cables.

Information:

B&R provides holes for fastening the cables with cable ties on the bottom of the plug-in modules (see image below). This type of fastening is only permitted if the minimum permissible flex radius values for the cables being used are adhered to!

Make sure that the ventilation slots on the bottom of the ACOPOS drive are not blocked.

1.4 Overview of clampable cross sections

Con-nection	Wire types Approbation data	8V1010.0xx-2 8V1010.5xx-2 8V1016.0xx-2 8V1016.5xx-2		8V1022.0xx-2 8V1045.0xx-2 8V1090.0xx-2 [1)		8V1180.0xx-2 8V1320.0xx-2 [2)		8V1640.0xx-2 [3)		8V128M.0xx-2 [4)	
		[mm²]	[AWG]	[mm²]	[AWG]	[mm²]	[AWG]	[mm²]	[AWG]	[mm²]	[AWG]
X1	Solid core / multiple-conductor lines	0.5 - 1.5	20 - 14	0.5 - 1.5	20 - 14	0.5 - 1.5	20 - 14	0.5 - 1.5	20 - 14	0.5 - 1.5	20 - 14
	Flexible and fine wire lines Without wire end sleeves With wire end sleeves	 0.5 - 1.5 0.5 - 1.5	 20 - 14 20 - 14	 0.5 - 1.5 0.5 - 1.5	 20 - 14 20 - 14	 0.5 - 1.5 0.5 - 1.5	 20 - 14 20 - 14	 0.5 - 1.5 0.5 - 1.5	 20 - 14 20 - 14	 0.5 - 1.5 0.5 - 1.5	 20 - 14 20 - 14
	Approbation data UL/C-UL-US CSA	 --- ---	 26 - 14 26 - 14	 --- ---	 26 - 14 26 - 14	 --- ---	 26 - 14 26 - 14	 --- ---	 26 - 14 26 - 14	 --- ---	 26 - 14 26 - 14
Tightening torque for the terminal screws [Nm]		0.2 ... 0.25		0.2 ... 0.25		0.2 ... 0.25		0.2 ... 0.25		0.2 ... 0.25	
X2 DC bus	Solid core / multiple-conductor lines	0.2 - 4	24 - 10	0.2 - 4	24 - 10	0.5 - 10	20 - 7	10 - 50	7 - 0	16 - 95	6 - 3/0
	Flexible and fine wire lines Without wire end sleeves With wire end sleeves	 0.2 - 4 0.25 - 4	 24 - 10 23 - 10	 0.2 - 4 0.25 - 4	 24 - 10 23 - 10	 0.5 - 6 0.5 - 6	 20 - 9 20 - 9	 10 - 35 10 - 35	 7 - 2 7 - 2	 10 - 70 10 - 70	 7 - 2/0 7 - 2/0
	Approbation data UL/C-UL-US CSA	 --- ---	 30 - 10 28 - 10	 --- ---	 30 - 10 28 - 10	 --- ---	 20 - 8 20 - 8	 --- ---	 10 - 2 12 - 2	 --- ---	 6 - 2/0 6 - 2/0
Tightening torque for the terminal screws [Nm]		0.5 ... 0.6		0.5 ... 0.6		1.2 ... 1.5		3 ... 4		6 ... 10	
X3 Mains	Solid core / multiple-conductor lines	0.2 - 4	24 - 10	0.2 - 4	24 - 10	0.5 - 10	20 - 7	10 - 50	7 - 0	16 - 95	6 - 3/0
	Flexible and fine wire lines Without wire end sleeves With wire end sleeves	 0.2 - 4 0.25 - 4	 24 - 10 23 - 10	 0.2 - 4 0.25 - 4	 24 - 10 23 - 10	 0.5 - 6 0.5 - 6	 20 - 9 20 - 9	 10 - 35 10 - 35	 7 - 2 7 - 2	 10 - 70 10 - 70	 7 - 2/0 7 - 2/0
	Approbation data UL/C-UL-US CSA	 --- ---	 30 - 10 28 - 10	 --- ---	 30 - 10 28 - 10	 --- ---	 20 - 8 20 - 8	 --- ---	 10 - 2 12 - 2	 --- ---	 6 - 2/0 6 - 2/0
Tightening torque for the terminal screws [Nm]		0.5 ... 0.6		0.5 ... 0.6		1.2 ... 1.5		3 ... 4		6 ... 10	
X4a, X4b Motor (holding brake, tem-perature sensor)	Solid core / multiple-conductor lines	0.2 - 2.5	24 - 12	0.2 - 2.5	24 - 12	0.2 - 2.5	24 - 12	0.2 - 2.5	24 - 12	0.2 - 2.5	24 - 12
	Flexible and fine wire lines Without wire end sleeves With wire end sleeves	 0.2 - 2.5 0.25 - 2.5	 24 - 12 23 - 12	 0.2 - 2.5 0.25 - 2.5	 24 - 12 23 - 12	 0.2 - 2.5 0.25 - 2.5	 24 - 12 23 - 12	 0.2 - 2.5 0.25 - 2.5	 24 - 12 23 - 12	 0.2 - 2.5 0.25 - 2.5	 24 - 12 23 - 12
	Approbation data UL/C-UL-US CSA	 --- ---	 30 - 12 28 - 12	 --- ---	 30 - 12 28 - 12	 --- ---	 30 - 12 28 - 12	 --- ---	 30 - 12 28 - 12	 --- ---	 30 - 12 28 - 12
Tightening torque for the terminal screws [Nm]		0.5 ... 0.6		0.5 ... 0.6		0.5 ... 0.6		0.5 ... 0.6		0.5 ... 0.6	
X5 Motor (power)	Solid core / multiple-conductor lines	0.2 - 4	24 - 10	0.2 - 4	24 - 10	0.5 - 10	20 - 7	10 - 50	7 - 0	16 - 95	6 - 3/0
	Flexible and fine wire lines Without wire end sleeves With wire end sleeves	 0.2 - 4 0.25 - 4	 24 - 10 23 - 10	 0.2 - 4 0.25 - 4	 24 - 10 23 - 10	 0.5 - 6 0.5 - 6	 20 - 9 20 - 9	 10 - 35 10 - 35	 7 - 2 7 - 2	 10 - 70 10 - 70	 7 - 2/0 7 - 2/0
	Approbation data UL/C-UL-US CSA	 --- ---	 30 - 10 28 - 10	 --- ---	 30 - 10 28 - 10	 --- ---	 20 - 8 20 - 8	 --- ---	 10 - 2 10 - 2	 --- ---	 6 - 2/0 6 - 2/0
Tightening torque for the terminal screws [Nm]		0.5 ... 0.6		0.5 ... 0.6		1.2 ... 1.5		3 ... 4		6 ... 10	
X6 External braking resistor	Solid core / multiple-conductor lines	---	---	---	---	0.2 - 4	24 - 10	0.5 - 10	20 - 7	0.5 - 10	20 - 7
	Flexible and fine wire lines Without wire end sleeves With wire end sleeves	 --- ---	 --- ---	 --- ---	 --- ---	 0.2 - 4 0.25 - 4	 24 - 10 23 - 10	 0.5 - 6 0.5 - 6	 20 - 9 20 - 9	 0.5 - 6 0.5 - 6	 20 - 9 20 - 9
	Approbation data UL/C-UL-US CSA	 --- ---	 --- ---	 --- ---	 --- ---	 --- ---	 30 - 10 28 - 10	 --- ---	 20 - 8 20 - 8	 --- ---	 20 - 8 20 - 8
Tightening torque for the terminal screws [Nm]		---		---		0.5 ... 0.6		1.2 ... 1.5		1.2 ... 1.5	

Table 198: Terminal cross sections for ACOPOS servo drives

1) Starting with revision I0.
2) Starting with revision F0.
3) Starting with revision K0.
4) Starting with revision C0.

Chapter 6 • Safety technology

1 Standard safety technology ("Wired safety technology")

Danger!

Especially in the area of safety technology, always consult the latest version of this user's manual on the B&R website (www.br-automation.com) for valid specifications. Specifications in this version of the user's manual are not necessarily current. Users should verify the correctness of specifications before implementing any safety functions.

1.1 General information

ACOPOS servo drives use integrated safe pulse disabling for secure shutdown and to prevent unwanted startup. This is designed to meet the following safety classifications depending on the external circuit: [30)]

Criteria	Safety characteristic
Maximum Safety Category in accordance with EN ISO 13849 and EN 954-1 [1)]	CAT 3
Maximum Performance Level in accordance with EN ISO 13849	PL d
Maximum Safety Integrity Level in accordance with IEC 62061	SIL 2
Maximum Safety Integrity Level in accordance with IEC 61508	SIL 2
PFH (probability of dangerous failure per hour)	$<4 * 10^{-9}$
PFD (probability of dangerous failure on demand)	$<4 * 10^{-4}$ with a proof test interval of 10 years $<7 * 10^{-5}$ with a proof test interval of 20 years
PTI (proof test interval) [2)]	Max. 20 years
DC (diagnostic coverage)	99%
MTTFd (mean time to dangerous failure)	>140 years

Table 199: Safety classifications, criteria and characteristics for safe pulse disabling

1) EN 954-1 is no longer valid and has been replaced by EN ISO 13849.
2) Corresponds to the mission time of the module

The following table provides an overview of the individual safety functions that can be implemented:

Label according to standard		Short description
EN 61800-5-2	**EN 60204-1**	
STO (Safe Torque Off)	Stop Category 0	Power supply cutoff
SS1 (Safe Stop 1)	Stop Category 1	Initiates active braking and activation of the STO function after a defined amount of time has passed
SS2 (Safe Stop 2)	Stop Category 2	Initiates active braking and activation of the SOS function after a defined amount of time has passed
SLS (Safely Limited Speed)	---	Protection against exceeding a defined speed limit
SOS (Safe Operating Stop)	---	Protection against impermissible position deviation

Table 200: Overview of safety functions according to standards

Safe pulse disabling interrupts the power supply to the motor by preventing the pulses to the IGBTs over one channel. In this way, a rotating field can no longer be created in synchronous and induction motors controlled by ACOPOS servo drives.

Integrated safe pulse disabling therefore meets the requirements for preventing unexpected startup in accordance with EN 1037 as well as the requirements concerning Category 0 and 1 stop functions in accordance with EN 60204-1. Both stop functions require the power supply to the machine drives to be switched off (immediately for Category 0 and after reaching standstill for Category 1). The requirements concerning the STO, SS1, SS2, SLS and SOS safety functions are also met in accordance with EN 61800-5-2.

The terminology of EN 61800-5-2 (STO, SS1, SS2, SLS, SOS) will be used in the following.

Danger!

If an application uses the safety functions integrated in the drive system, then the safety functions must be fully validated before being turned on for the first time. This could lead to death, severe injury or damage to equipment.

30) A detailed explanation of the standards and safety functions can be found in the section "Standards and Certifications".

1.2 Principle - Implementing the safety function

Safe pulse disabling is achieved by removing the IGBT driver supply from the ACOPOS servo drives. Terminals X1 / Enable and X1 / COM (8, 9) are used to supply an integrated DC-to-DC converter with 24 VDC. The converter creates the supply voltage for the IGBT driver from this voltage.

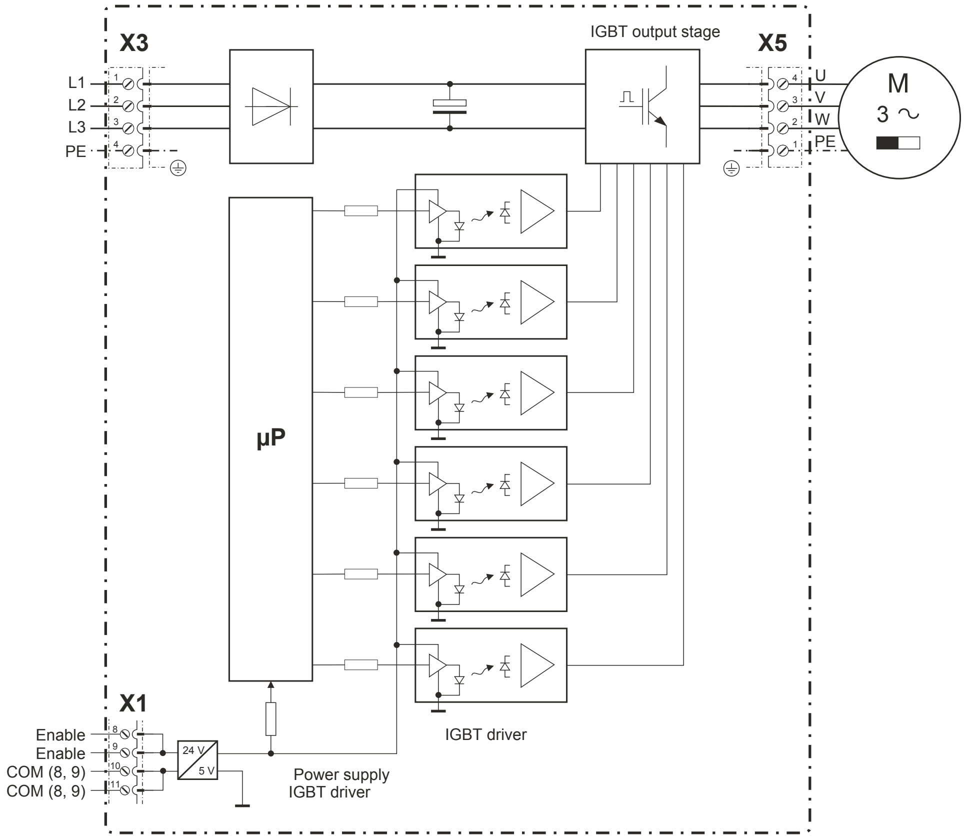


Figure 100: Block diagram of safe pulse disabling

If the 24 VDC voltage supply for the DC-to-DC converter is interrupted, the IGBT drivers are also no longer supplied. It is then no longer possible to transfer the modulation pattern needed to generate the rotating field on the IGBT output stage. This cuts off the supply of power to the motor.

1.2.1 Additional function

The availability of the DC-to-DC converter's output voltage is queries by the microprocessor. If voltage is not present on the output of the DC-to-DC converter, then the microprocessor suppresses generation of the modulation pattern.

Danger!

After activating safe pulse disabling using terminals X1 / Enable and X1/COM (8, 9), the motor is de-energized and therefore torque-free. If the motor was moving before activation of safe pulse disabling, it is only stopped by a safe operational brake (available under certain conditions) or from the friction of the entire system. The motor is therefore not able to hold hanging loads. Holding brakes must be used for this purpose.

For applications where this can be dangerous, the desired level of protection cannot be achieved.

Danger!

The switch-off time for the enable input must be taken into consideration since it has a substantial effect on the response time of the safety functions and therefore the remaining distances and times to be considered. In order to calculate the total safety response time, the user must validate the lag time throughout the entire system.

The switch-off times for the enable input can be found in the technical data for the respective ACOPOS servo drive.

Danger!

Activating safe pulse disabling via the terminals X1 / Enable1 and X1/COM (8, 9) is not sufficient for achieving a voltage-free drive and therefore does not provide sufficient protection against electrical shock!

Danger!

Depending on the application, it is possible for the drive to restart after safe pulse disabling is deactivated.

Danger!

The brake controller integrated in ACOPOS servo drives and the holding brake integrated in B&R standard motors fulfill the criteria up to Category B in accordance with EN ISO 13849-1.

Additional measures are necessary to achieve higher safety categories.

Danger!

The C standards applicable to applications must be adhered to!

Information:

Note that multiple errors in the IGBT bridge can cause a brief forward movement. The maximum turning angle of the motor shaft φ during this forward movement depends on the motor being used. For permanently excited synchronous motors, $\varphi = 360°/2p$ (for B&R standard motors, p=3 so the angle is 60°). For three-phase induction motors, there is a relatively small angle of rotation (between 5° and 15°).

This short forward movement can be ruled out as an error in accordance with EN ISO 13849-1, among other things due to the improbability that this would occur and due to general technical experience.

1.3 Enable input connected in accordance with Safety Category 3 / SIL 2 / PL d

Using the example of the STO safety function, different circuit variations for the enable input on the ACOPOS servo drives are given here with regard to the required Safety Category / SIL / PL.

Danger!

All errors (e.g. cross faults) that are not detected can lead to a loss of safety functionality.

Appropriate measures must be taken to ensure the exclusion of errors. For instance, errors caused by a short circuit between any two wires can be excluded in accordance with EN ISO 13849-2, Appendix D.5 if one of the following conditions is met:

- **The wires are permanently installed and protected against external damage (e.g. using a cable duct or armored conduit).**
- **The wires are installed in different sheathed cables or within an area for electrical equipment.**[31)]
- **The wires are each individually protected via a ground connection.**

For more error exclusions, see EN ISO 13849-2, Appendix D.5.

Danger!

To achieve Safety Category 3 / SIL 2 / PL d, it must be ensured that a single error does not lead to a loss of safety functionality.

1.3.1 STO, Category 3 / SIL 2 / PL d (Variant A)

The input X1 / Enable and X1 / COM (8, 9) of the ACOPOS servo drive are supplied via a safe digital output (Out1+, Out1-). If the safety function is requested, then the safe digital output separates input X1 / Enable and X1 / COM (8, 9).

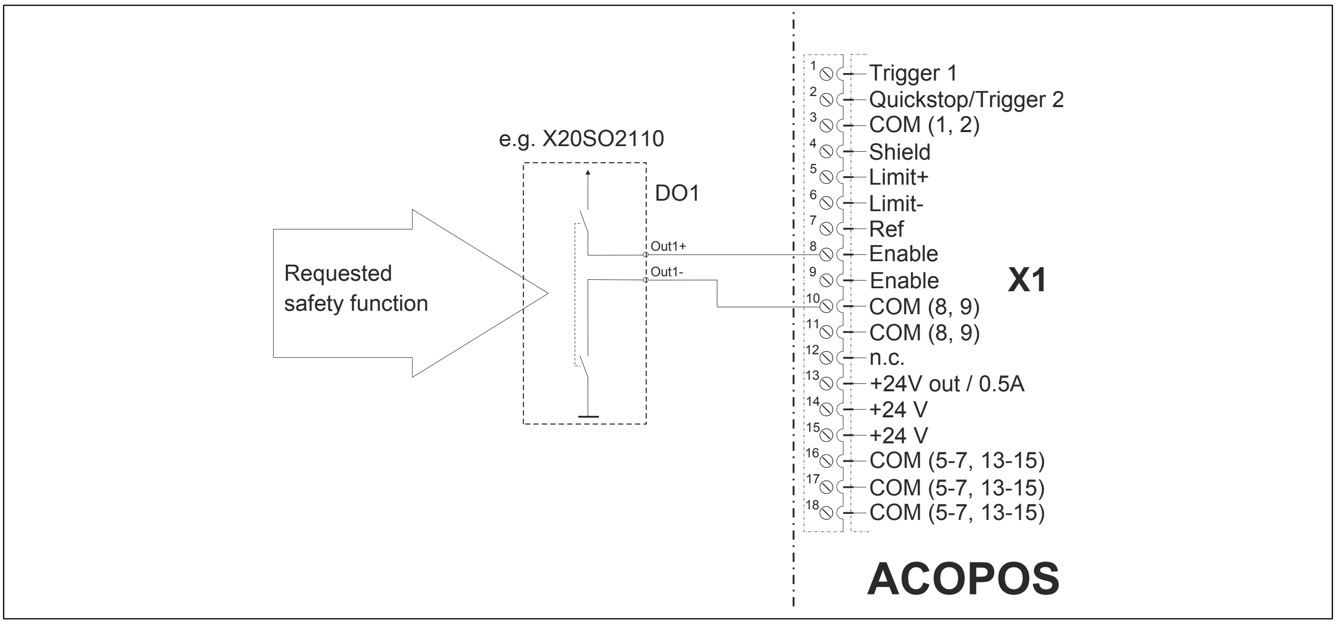


Figure 101: STO, Category 3 / SIL 2 / PL d (Variant A)

Danger!

At least one safe digital output module with Category 3 / SIL 2 / PL d must be used for the DO1 digital output shown.

The guidelines listed in the safe digital output module's user documentation must be observed!

Test signals on the safe digital output module must be turned off.

31) Prerequisite: Both the wires and the area for electrical equipment must meet the respective requirements (see IEC 60402-1).

1.3.2 STO, Category 3 / SIL 2 / PL d (Variant B)

When an E-stop button is pressed, the enable input on the ACOPOS servo drive is cut off from the +24 V supply by a switch, thereby cutting off the motor's power supply.

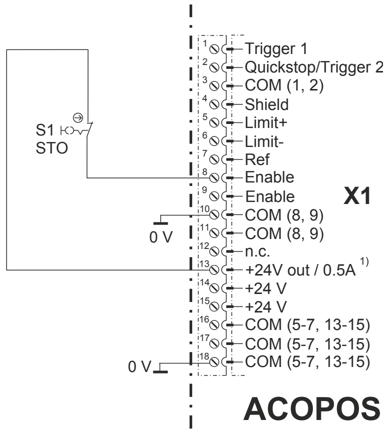


Figure 102: STO, Category 3 / SIL 2 / PL d (Variant B)

1) For servo drives which have no 24 VDC output (ACOPOS 1010/1016/1022/1045/1090), the control voltage must be provided externally.

Danger!

The S1 switch shown requires the use of a one-pin Category 3 / SIL 2 / PL d switching device with a positively-driven N.C. contact in accordance with EN 60947-5-1.

The guidelines in the switching device's user documentation must be observed!

1.4 Enable input circuits in accordance with Safety Category 3 / SIL 2 / PL d and functionality (STO, SS1, SS2, SLS, SOS)

The following image illustrates example wiring suggestions for the external wiring of the enable input on ACOPOS servo drives. They vary in their safety classification in accordance with EN 60204-1, ISO 13849 and EN 61800-5-2 as well as with regard to the safety function (STO, SS1, SS2, SLS, SOS).

1.4.1 STO, SLS, SOS - Safety Category 3 / SIL 2 / PL d

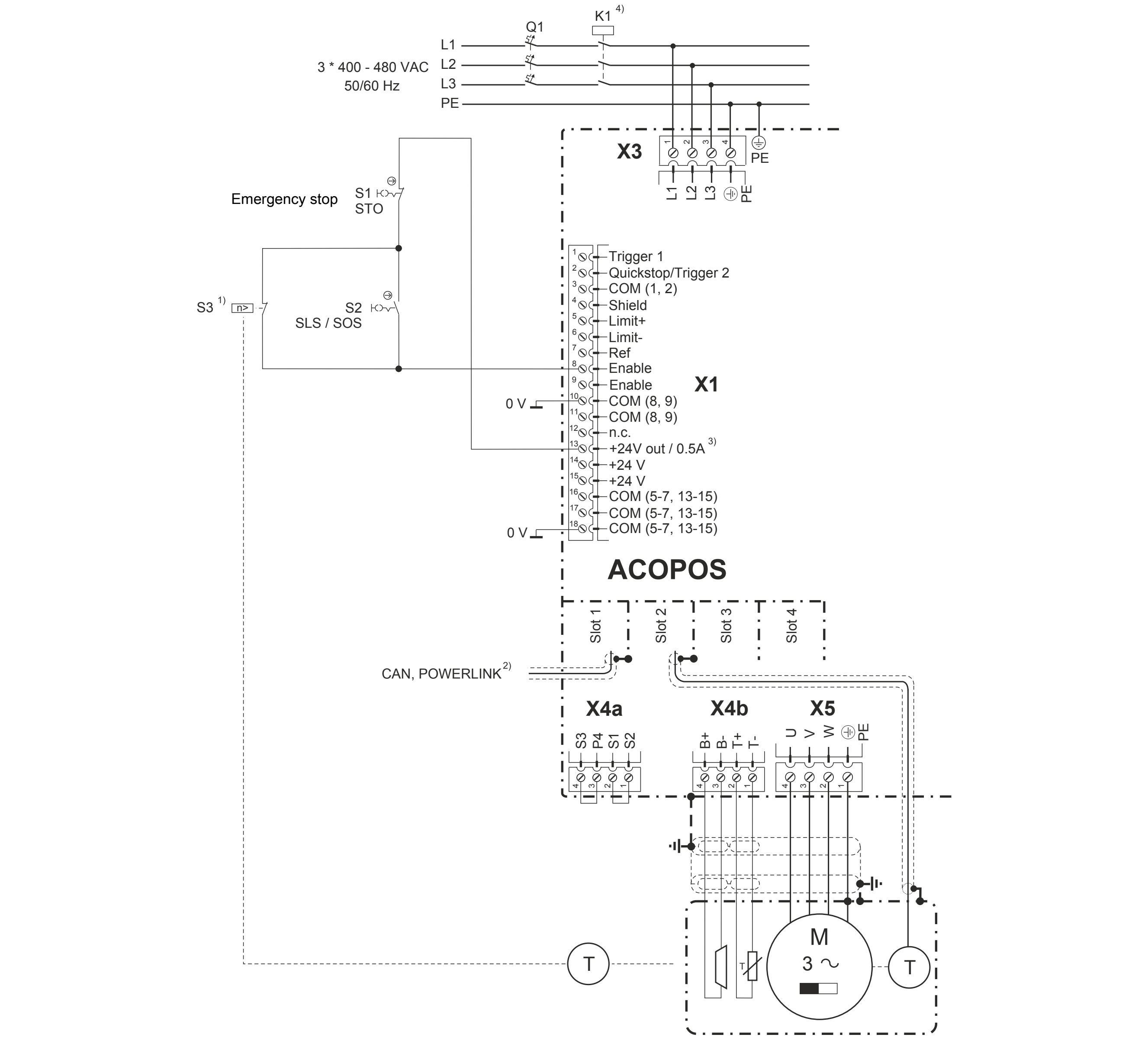


Figure 103: STO, SLS, SOS - Safety Category 3 / SIL 2 / PL d

1) S3 limit speed according to the application requirements.
S3 including the encoder is part of the safety function.
Implementation of S3 including the encoder must therefore meet Category 3 / SIL 2 / PL d.
2) The network connection is used for diagnostics and setting parameters.
3) For servo drives which have no 24 VDC output (ACOPOS 1010/1016/1022/1045/1090), the control voltage must be provided externally.
4) The K1 line contactor is not required for the safety function.

Danger!

The brake shown in this image as well as the brake control from the ACOPOS servo drive are not included in the safety function!

Description:

STO

When the S1 E-stop button is pressed, the enable input on the ACOPOS servo drive is de-energized. As a result, the supply of power to the motor is cut off.

This ensures that the supply of power to the motor is always cut off immediately.

Secure restart inhibit

Opening and locking the S1 E-stop switch prevents unexpected startup.

SLS

Opening the S2 switch activates the SLS safety function. The switching contact of the S3 overspeed monitor is opened if the monitor's configured speed limit is exceeded. This de-energizes the enable input of the ACOPOS servo drive. As a result, the supply of power to the motor is cut off.

This ensures that the supply of power to the motor is always cut off immediately when the speed limit set on the S3 overspeed monitor is exceeded.

SOS

Opening the S2 switch activates the SOS safety function. The switching contact of the overspeed monitor is opened when the S3 standstill monitor is activated. This de-energizes the enable input of the ACOPOS servo drive. As a result, the supply of power to the motor is cut off.

This ensures that the supply of power to the motor is always cut off immediately when the S3 standstill monitor is activated.

Information:

The SLS or SOS safety function can be implemented depending on the function of the S3 switching device (overspeed monitor or standstill monitor).

Danger!

The S1 and S2 switches shown require the use of one-pin Category 3 / SIL 2 / PL d switching devices with a positively-driven NC contact in accordance with EN 60947-5-1. A one-pin Category 3 / SIL 2 / PL d switching device must be used for the S3 switching device shown.

The guidelines in the switching device's user documentation must be observed!

1.4.2 SS1, SLS, SS2 - Safety Category 3 / SIL 2 / PL d (Variant A)

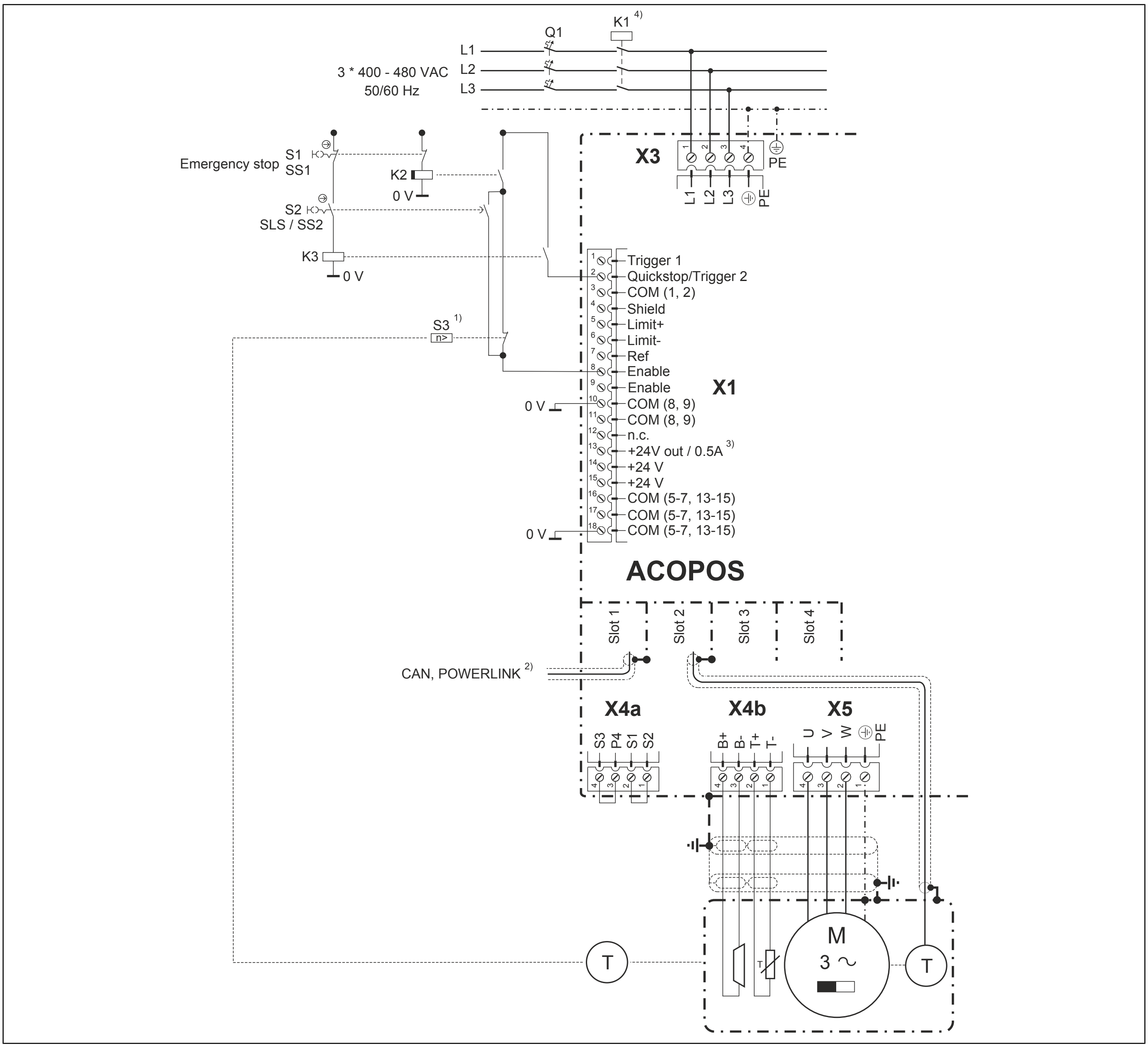


Figure 104: SS1, SLS, SS2 - Safety Category 3 / SIL 2 / PL d (Variant A)

1) S3 limit speed according to the application requirements. S3 including the encoder is part of the safety function. Implementation of S3 including the encoder must therefore meet Category 3 / SIL 2 / PL d.
2) The network connection is used for diagnostics and setting parameters.
3) For servo drives which have no 24 VDC output (ACOPOS 1010/1016/1022/1045/1090), the control voltage must be provided externally.
4) The K1 line contactor is not required for the safety function.

Danger!

The brake shown in this image as well as the brake control from the ACOPOS servo drive are not included in the safety function!

Information:

For this circuit, the input X1 / Quickstop / Trigger 2 of the ACOPOS servo drive must be configured as a quickstop for this connection.

Description:

SS1

Pressing the S1 E-stop button de-energizes the K3 relay. As a result, an active braking procedure is triggered via the X1 / Quickstop / Trigger2 input of the ACOPOS servo drive.

The K2 auxiliary drop-out delay relay is de-energized after a defined amount of time. This de-energizes the enable input of the ACOPOS servo drive. As a result, the supply of power to the motor is cut off.

This ensures that the supply of power to the motor is always cut off after a defined amount of time.

Secure restart inhibit

Opening and locking the S1 E-stop switch prevents unexpected startup.

SLS

When the S2 switch is opened, the SLS safety function is activated and triggers an active braking procedure via the X1 / Trigger1 input on the ACOPOS servo drive. After a defined amount of time, speed monitoring is activated on the S3 overspeed monitor. If the defined limit speed is exceeded, then the enable input of the ACOPOS servo drive is de-energized via the switching contact of the S3 overspeed monitor. As a result, the supply of power to the motor is cut off.

This ensures that the supply of power to the motor is always cut off immediately when the speed limit set on the S3 overspeed monitor is exceeded.

SS2

When the S2 switch is opened, the SS2 safety function is activated and triggers an active braking procedure via the X1 / Trigger1 input on the ACOPOS servo drive. After a defined amount of time, standstill monitoring is activated on the S3 standstill monitor. If the defined tolerance limit is exceeded (standstill monitor S3 is activated), then the enable input of the ACOPOS servo drive is cleared via the switching contact of the standstill monitor S3. As a result, the supply of power to the motor is cut off.

This ensures that the supply of power to the motor is always cut off immediately when the S3 standstill monitor is activated.

Information:

Either the SLS or the SS2 safety function can be implemented depending on the function of the S3 switching device (overspeed monitor or standstill monitor).

Danger!

The S1 and S2 switches shown require the use of one-pin Category 3 / SIL 2 / PL d switching devices with a positively-driven NC contact in accordance with EN 60947-5-1. A one-pin Category 3 / SIL 2 / PL d switching device must be used for the K2 relay shown as well as the S3 switching device.

The instructions in the switching device's user documentation must be observed!

1.4.3 SS1, SLS, SS2 - Safety Category 3 / SIL 2 / PL d (Variant B)

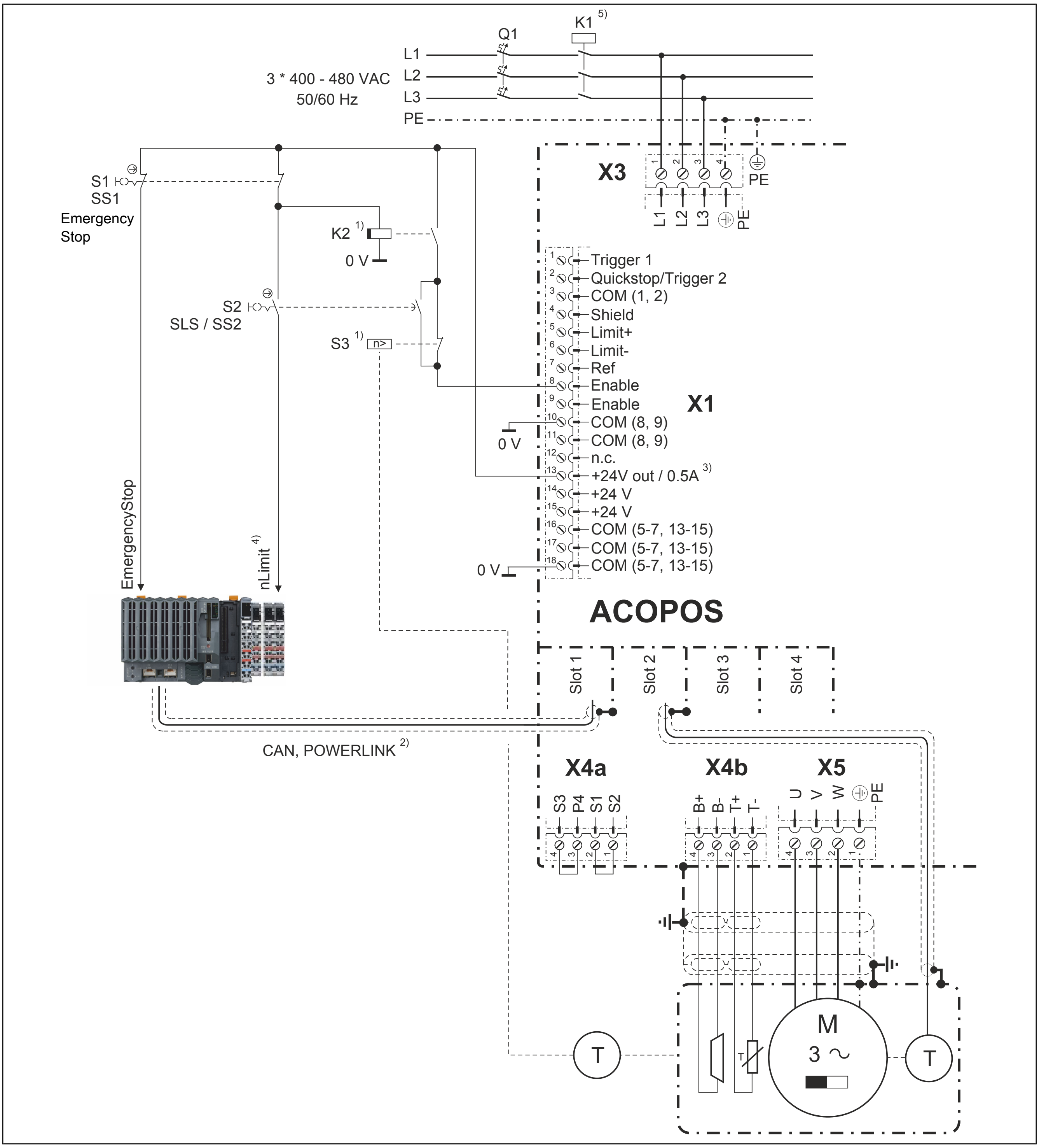


Figure 105: SS1, SLS, SS2 - Safety Category 3 / SIL 2 / PL d (Variant B)

1) K2 dropout delay and S3 limit speed according to the application requirements.
The K2 auxiliary drop-out delay relay and the S3 (including the encoder) are part of the safety function. The implementation of K2 and S3 including the encoder must therefore meet the requirements of Category 3 / SIL 2 / PL d.
2) The network connection is used to transfer the interruption command for active braking, diagnostics and setting parameters.
3) For servo drives which have no 24 VDC output (ACOPOS 1010/1016/1022/1045/1090), the control voltage must be provided externally.
4) Information about the status of the "EmergencyStop" digital input is also contained in the status of the "nLimit" digital input.
5) The K1 line contactor is not required for the safety function.

Danger!

The brake shown in this image as well as brake control from the ACOPOS servo drive are not included in the safety function!

Description:

SS1

Activating the S1 E-stop switch triggers an active braking procedure via the "EmergencyStop" digital input on the controller (see "Code example" on page 268).

The K2 auxiliary drop-out delay relay is de-energized after a defined amount of time. This de-energizes the enable input of the ACOPOS servo drive. As a result, the supply of power to the motor is cut off.

This ensures that the supply of power to the motor is always cut off after a defined amount of time.

Secure restart inhibit

Opening and locking the S1 E-stop switch prevents unexpected startup.

SLS

Opening the S2 switch activates the SLS safety function and triggers an active braking procedure via the "nLimit" digital input on the controller (see "Code example" on page 268). After a defined amount of time, speed monitoring is activated on the S3 overspeed monitor. If the defined limit speed is exceeded, then the enable input of the ACOPOS servo drive is de-energized via the switching contact of the S3 overspeed monitor. As a result, the supply of power to the motor is cut off.

This ensures that the supply of power to the motor is always cut off immediately when the speed limit set on the S3 overspeed monitor is exceeded.

SS2

Opening the S2 switch activates the SS2 safety function and triggers an active braking procedure via the "nLimit" digital input on the controller (see "Code example" on page 268). After a defined amount of time, standstill monitoring is activated on the S3 standstill monitor. If the defined tolerance limit is exceeded (standstill monitor S3 is activated), then the enable input of the ACOPOS servo drive is cleared via the switching contact of the standstill monitor S3. As a result, the supply of power to the motor is cut off.

This ensures that the supply of power to the motor is always cut off immediately when the S3 standstill monitor is activated.

Information:

Either the SLS or the SS2 safety function can be implemented depending on the function of the S3 switching device (overspeed monitor or standstill monitor).

Danger!

The S1 and S2 switches shown require the use of two or one-pin switching devices (Category 3 / SIL 2 / PL d) with a positively driven NC contact in accordance with EN 60947-5-1. A one-pin Category 3 / SIL 2 / PL d switching device must be used for the K2 relay shown as well as the S3 switching device.

The instructions in the switching device's user documentation must be observed!

Code example

Issuing the stop command (via CAN bus or POWERLINK):

```
if ( ! stop_active )
{
/* Movement stop not active: Test stop inputs */
  if ( EmergencyStop == ncLOW )
  {
  /* Activate movement stop with parameter set for "emergency stop" */
    stop_index = E_STOP_INDEX;
    step = MOV_STOP;
    stop_active = 1;
  }
  else
  {
  /* Activate movement stop with parameter set for "low speed" */
    stop_index = NLIMIT_INDEX;
    step = MOV_STOP;
    stop_active = 1;
  }
}
else
{
/* Movement stop was activated */
  if ( EmergencyStop == ncHIGH && nLimit == ncHIGH
       && step!= W_MOVE_STOP )
  {
  /* Movement stop completed */
    stop_active = 0;
  }
}

switch (step)
{
  ...
  case MOV_STOP:
  /* Call NC action for movement stop */
    p_ax_dat->move.stop.index.command = stop_index;

    action_status = ncaction(ax_obj,ncMOVE,ncSTOP);
    if ( action_status == ncOK )
    {
      step = W_MOVE_STOP;
    }
    break;

  case W_MOVE_STOP:
  /* Wait for movement stop procedure to complete */
    if ( p_ax_dat->move.mode == ncOFF )
    {
    /* Movement stop completed */
      step = <NEXT_STEP>
    }
    break;
  ...
}
```

Chapter 7 • Standards and certifications

1 Applicable European directives

- EMC directive 2004/108/EC
- Low-voltage directive 2006/95/EC
- Machinery directive 2006/42/EC[32)]

2 Applicable standards

Standard	Description
IEC/EN 61800-2	Adjustable speed electrical power drive systems • Part 2: General requirements; Rating specifications for low voltage adjustable frequency AC power drive systems
IEC/EN 61800-3	Adjustable speed electrical power drive systems • Part 3: EMC requirements including specific test methods
IEC 61800-5-1	Electrical drive systems with adjustable speed • Part 5-1: Safety requirements - Electrical, thermal and power requirements (IEC 61800-5-1:2003)
EN 61800-5-2	Adjustable speed electrical power drive systems • Part 5-2: Safety requirements - Functional requirements
IEC/EN 61131-2	Programmable logic controllers • Part 2: Equipment requirements and tests
EN 60204-1	Safety of machinery - Electrical equipment on machines • Part 1: General requirements
IEC 61508	Functional safety of electrical / electronic / programmable electronic safety-related systems
EN 50178-1	Electronic equipment for high voltage systems
EN 1037	Safety of machinery - Prevention of unexpected startup
EN ISO 13849-1	Safety of machinery - Safety-related parts of control systems • Part 1: General design principles
EN 62061	Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems
UL 508C	Power conversion equipment

Table 201: Applicable standards for ACOPOS servo drives

The limit values specified from section "Environmental limits" to section "Other environmental limit values in accordance with IEC 61800-2" are taken from the product standard EN 61800 (or IEC 61800) for servo drives in industrial environments (category C3[33)]). Stricter test procedures and limit values are used during the type tests for ACOPOS servo drives. Additional information is available from B&R.

[32)] This machinery directive only applies to logic units for safety functions that are initially being placed on the market by B&R for sale or use.
[33)] Limit values from CISPR11, Group 2, Class A (second environment)

3 Environmental limits

3.1 Mechanical conditions in accordance with IEC 61800-2

3.1.1 Operation

IEC 60721-3-3, class 3M1	
	EN 61800-2
Vibration during operation 2 ≤ f < 9 Hz 9 ≤ f < 200 Hz	 0.3 mm amplitude 1 m/s² acceleration

Table 202: Mechanical conditions during operation

3.1.2 Transport

IEC 60721-3-2, class 2M1	
	EN 61800-2
Vibration during transport 1) 2) 2 ≤ f < 9 Hz 9 ≤ f < 200 Hz 200 ≤ f < 500 Hz	 3.5 mm amplitude 10 m/s² acceleration 15 m/s² acceleration
Drop height in free fall 1) Weight <100 kg	 0.25 m

Table 203: Mechanical conditions during transport

1) Only valid for components in original packaging
2) The values in table "Mechanical conditions during operation " on page 270 apply to components that are not in their original packaging.

3.2 Climate conditions in accordance with IEC 61800-2

3.2.1 Operation

IEC 60721-3-3, class 3K3	
	EN 61800-2
Ambient temperature during operation	5 to 40°C
Relative humidity during operation	5 - 85%, non-condensing

Table 204: Climate conditions during operation

3.2.2 Storage

IEC 60721-3-1, class 1K4	
	EN 61800-2
Storage temperature	-25 to 55°C

Table 205: Climate conditions (temperature) during storage

IEC 60721-3-1, class 1K3	
	EN 61800-2
Relative humidity during storage	5 - 95%, non-condensing

Table 206: Climate conditions (humidity) during storage

3.2.3 Transport

IEC 60721-3-2, class 2K3	
	EN 61800-2
Transport temperature	-25 to 70°C
Relative humidity during transport	Max. 95% at 40°C

Table 207: Climate conditions during transport

4 Requirements for immunity to disturbances (EMC)

EN 61800-3 requirements apply.

4.1 Evaluation criteria (performance criteria)

Performance criteria (PC)	Description
A	The test object is not interfered with during testing.
B	The test object is only interfered with temporarily during testing.
C	The system does not reboot itself automatically (reset required).

Table 208: Evaluation criteria (performance criteria) for immunity to disturbances

4.2 Low-frequency disturbances in accordance with IEC 61800-3

The following limit values are applicable for industrial environments (category C3). [34)]

4.2.1 Power mains harmonics and commutation notches / voltage distortions

IEC 61000-2-4, class 3		
	EN 61800-3	Performance criteria
Harmonics	THD = 10%	A
Short harmonics (<15 s)	1.5x continuous level	B

Table 209: Limit values for power mains harmonics

IEC 60146-1-1, class 3		
	EN 61800-3	Performance criteria
Commutation notches	Depth = 40%, Total area = 250% x degree	A

Table 210: Limit values for commutation notches / voltage distortions

4.2.2 Voltage changes, fluctuations, dips and short-term interruptions

IEC 61000-2-4, class 3		
	EN 61800-3	Performance criteria
Voltage changes and fluctuations	±10%	A
Voltage changes and fluctuations (<1 min)	+10% to -15%	

Table 211: Limit values for voltage changes and fluctuations

IEC 61000-2-1		
	EN 61800-3	Performance criteria
Voltage dips and short-term interruptions	10% to 100%	C

Table 212: Limit values for voltage dips and short-term interruptions

4.2.3 Asymmetric voltages and frequency changes

IEC 61000-2-4, class 3		
	EN 61800-3	Performance criteria
Asymmetric voltages	3% negative component	A
Frequency change and change rate	±2%, 1%/s (±4 %, 2%/s if the power supply is isolated from general power mains)	

Table 213: Limit values for asymmetric voltages and frequency changes

[34)] Limit values from CISPR11, group 2, class A (second environment).

4.3 High-frequency disturbances in accordance with IEC 61800-3

These immunity tests are valid for industry (category C3). [35)]

4.3.1 Electrostatic discharge

Tests in accordance with IEC 61000-4-2		
	EN 61800-3	**Performance criteria**
Contact discharge to powder-coated and bare metal housing parts	6 kV	B
Discharge through the air to plastic housing parts	8 kV	

Table 214: Limits for electrical discharge

4.3.2 Electromagnetic fields

Tests in accordance with IEC 61000-4-3		
	EN 61800-3	**Performance criteria**
Housing, completely wired	80 MHz - 1 GHz, 10 V/m, 80% amplitude modulation 1 kHz	A

Table 215: Limits for electromagnetic fields

4.3.3 Burst

Tests in accordance with IEC 61000-4-4		
	EN 61800-3	**Performance criteria**
Power connection	2 kV, 1 min, direct coupling	B
Connections for measurement and control functions in the process environment	2 kV, 1 min	
Signal interfaces, other wires	1 kV, 1 min	

Table 216: Limits for burst

4.3.4 Surge

Tests in accordance with IEC 61000-4-5		
	EN 61800-3	**Performance criteria**
Power connection	1 kV (2 Ω) [1)], DM, symmetrical 2 kV (12 Ω) [1)], CM, unsymmetrical	B

Table 217: Limits for surge

1) The impedance from IEC 61000-4-5 has been added because it is not defined in IEC 61800-3.

4.3.5 High-frequency conducted disturbances

Tests in accordance with IEC 61000-4-6		
	EN 61800-3	**Performance criteria**
Power connection	0.15 - 80 MHz, 10 V, 80% amplitude modulation 1 kHz	A
Connections for measurement and control functions in the process environment		
Signal interfaces, other wires		

Table 218: Limits for conducted disturbances (radio frequency)

35) Limit values from CISPR11, group 2, class A (second environment).

5 Requirements for emissions (EMC)

5.1 High-frequency emissions in accordance with IEC 61800-3

These emission tests are valid for industry (category C3). [36)]

5.1.1 Disturbance voltages on the power connections

Tests in accordance with IEC 55011			
Continuous current on motor	**Frequency range [MHz]**	**Quasi-peak value**	**Average**
I ≤ 100 A	0.15 ≤ f < 0.5	100 dB (µV)	90 dB (µV)
	0.5 ≤ f < 5	86 dB (µV)	76 dB (µV)
	5 ≤ f < 30	90 dB (µV) Decreases with the logarithm of the frequency to 70	80 dB (µV) Decreases with the logarithm of the frequency to 60
100 A < I	0.15 ≤ f < 0.5	130 dB (µV)	120 dB (µV)
	0.5 ≤ f < 5	125 dB (µV)	115 dB (µV)
	5 ≤ f < 30	115 dB (µV)	105 dB (µV)

Table 219: Limits for disturbance voltages on the power connections

5.1.2 Electromagnetic emissions

Tests in accordance with IEC 55011	
Frequency range [MHz]	**Quasi-peak value**
30 ≤ f ≤ 230	40 dB (µV/m), measured at distance of 30 m [1)]
230 < f ≤ 1000	50 dB (µV/m), measured at distance of 30 m [1)]

Table 220: Limit values for electro-magnetic emissions

1) Limit values are increased by 10 dB (µV/m) when measured from a distance of 10 m.

6 Other environmental limit values in accordance with IEC 61800-2

	EN 61800-2
Degree of pollution in accordance with IEC 61800-2, 4.1.2.1.	2 (non-conductive pollution)
Overvoltage category in accordance with IEC 60364-4-443:1999	II
EN 60529 protection	IP20
Reduction of the continuous current at installation altitudes over 500 m above sea level	10 % per 1000 m
Maximum installation altitude	2,000 m [1)]

Table 221: Other environmental limit values

1) Requirements that go above and beyond this need to be arranged with B&R.

[36)] Limit values from CISPR11, group 2, class A (second environment).

7 International certifications

B&R products and services comply with applicable standards. This includes international standards from organizations such as ISO, IEC and CENELEC, as well as national standards from organizations such as UL, CSA, FCC, VDE, ÖVE, etc. We are committed to ensuring the reliability of our products in an industrial environment.

Certifications	
USA and Canada	All important B&R products are tested and listed by Underwriters Laboratories and checked quarterly by a UL inspector. This mark is valid for the USA and Canada and simplifies the certification of your machines and systems in these areas.
Europe	This mark certifies that all harmonized EN standards for the applicable directives have been met.
Russian Federation	GOST-R certification is available for the export of all ACOPOS servo drives to the Russian Federation.
Functional Safety Type Approved FS TÜVRheinland	All significant B&R servo drives have the FS - Functional Safety - mark from TÜV Rheinland.

Table 222: International certifications

8 Standards and definitions for safety technology

Stop functions in accordance with EN 60204-1:2006 (Electrical equipment for machines, Part 1: General requirements)

There are three categories of stop functions:

Category	Description
0	Stop by immediately switching off power to the machine drive elements (i.e. uncontrolled stop)
1	A controlled stop where power to the machine drive elements remains on until the stop procedure is completed. Power is only switched off after the stop is complete.
2	A controlled stop where power to the machine drive elements is not switched off

Table 223: Overview of stop function categories

The necessary stop functions must be determined based on a risk assessment of the machine. Stop functions in Category 0 and Category 1 must be able to function regardless of the operating mode. A Category 0 stop must have priority. Stop functions must have priority over assigned start functions. Resetting the stop function must never result in a dangerous state.

Emergency stops in accordance with EN 60204-1:2006 (Electrical equipment for machines, Part 1: General requirements)

The following requirements are valid for an emergency stop in addition to the requirements for stop functions:

- It must have priority over all other functions and operations in all operating modes.
- Power to machine drive elements that can cause a dangerous state must be switched off as quickly as possible without creating other dangers.
- Resetting is not permitted to cause a restart.

Emergency stops must be category 0 or category 1 stop functions. The stop function required must be determined based on a risk assessment for the machine.

For category 0 emergency stop functions, only hardwired electromechanical equipment can be used. In addition, this functionality is not permitted to depend on electronic switching logic (hardware or software) or the transfer of commands via a communication network or data connection. [37)]

When using a category 1 emergency stop function, it must be guaranteed that the power to the machine drive elements is completely switched off. These elements must be switched off using electromechanical equipment. [38)]

Performance Levels (PL) in accordance with EN ISO 13849-1 (Safety of machinery – Safety-related parts of control systems, Part 1: General design principles)

The safety-related parts of control systems must meet one or more of the requirements for five defined Performance Levels. These Performance Levels define the required behavior of safety-related controller parts with regard to their resistance to errors.

Performance Level (in accordance with EN ISO 13849-1)	Safety integrity level - SIL (in accordance with IEC 61508-2)	Brief description	System behavior
a	---	Safety-related components must be designed and built in such away that they can meet the expected operational requirements (no specific safety measures are implemented).	**Caution!** **An error can cause the loss of safety functionality.**
b	1	Safety-related components must be designed and built in such a way that only reliable components and safety principles are used (e.g. preventing short circuits by using sufficient distances, reducing the probability of errors by using oversized components, defining the failure route - failsafe principle, etc.).	**Caution!** **An error can cause the loss of safety functionality.**

Table 224: Overview of Performance Levels (PL)

Chapter 7
Standards and certifications

37) In accordance with the national foreword of the valid German-language version of IEC 60204-1:2006, electronic equipment – and especially emergency stop systems – may be used regardless of the stop category, if e.g. it provides the same safety using the standards EN ISO 13849-1:2008 and/or IEC 61508 as required by EN 60204-1.

38) In accordance with the national foreword of the valid German-language version of IEC 60204-1:2006, electronic equipment – and especially emergency stop systems – may be used regardless of the stop category, if e.g. it provides the same safety using the standards EN ISO 13849-1:2008 and/or IEC 61508 as required by EN 60204-1.

Performance Level (in accordance with EN ISO 13849-1)	Safety integrity level - SIL (in accordance with IEC 61508-2)	Brief description	System behavior
c	1	Safety-related parts must be designed and constructed in such a way that their safety functions are checked by the machine controls at suitable intervals. (For example, automatic or manual testing on start-up).	**Caution!** **An error between checks can cause the loss of safety functionality. The loss of safety functionality will be detected during the check.**
d	2	Safety-related components must be designed in such a way that individual errors do not cause the loss of safety functionality. Individual errors should – if possible – be detected the next time (or before) the safety function is required.	**Caution!** **Safety functionality remains active when an error occurs. Some but not all errors are detected. A buildup of undetected errors can cause safety functionality to fail.**
e	3	Safety-related components must be designed in such a way that individual errors do not cause the loss of safety functionality. Individual errors must be detected the next time (or before) the safety function is required. If this type of detection is not possible, a buildup of errors is not permitted to cause safety functionality to fail.	**Information:** **Safety functionality remains active when an error occurs. Errors are detected in time to prevent safety functionality from failing.**

Table 224: Overview of Performance Levels (PL)

A suitable Performance Level must be selected separately for each drive system (or for each axis) based on a risk assessment. This risk assessment is a part of the total risk assessment for the machine.

The following risk graph (in accordance with EN ISO 13849-1, Appendix A) provides a simplified procedure for risk assessment:

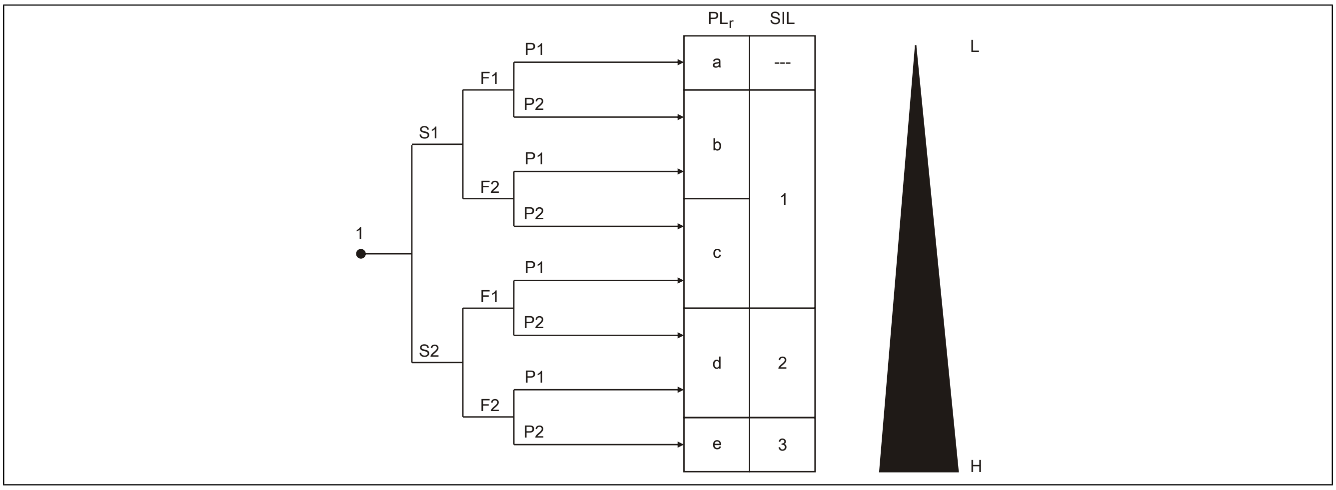


Figure 106: Risk diagram for determining the PL_r for each safety function in accordance with EN ISO 13849-1, Appendix A

Key

1	Starting point for assessing the impact on risk reduction
L	Low impact on risk reduction
H	High impact on risk reduction
PL_r	Required performance level
SIL	Safety Integrity Level in accordance with IEC 61508-2

Risk parameters

S	Severity of injury
S1	Slight (usually reversible) injury
S2	Serious (usually irreversible) injury or death
F	Frequency and/or duration of the exposure to the hazard
F1	Rare to often and/or short exposure to the hazard
F2	Frequent to continuous and/or long exposure
P	Possibility to circumvent the danger or limit the damage
P1	Possible under some conditions
P2	Nearly impossible

The Performance Level to be used is determined by starting at the specified starting point and taking the risk parameters S, F and P into consideration.

Restart inhibit in accordance with EN 1037/04.96 (Safety of machinery – Prevention of unexpected startup)

Keeping a machine in a state of rest when people are working in the danger zone is one of the most important requirements for safely operating machines.

Starting refers to the transition of a machine or its parts from a state of rest to a moving state. Any start is unexpected if it is caused by:

- A startup command sent because of a controller failure or because of external influences on the controller
- A startup command sent because of incorrect operation of a start element or another part of the machine
- Restoration of the power supply after an interruption
- External/Internal influences on parts of the machine

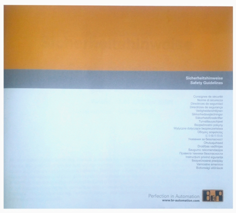
To prevent unexpected startup of machines or parts of machines, power should be removed and dissipated. If this is not practical (e.g. frequent brief interventions in danger zones), other measures must be taken:

- Measures to prevent random startup commands
- Measures to prevent random startup commands from causing unexpected startup
- Measures to automatically stop dangerous parts of the machine before a dangerous situation can be caused by unexpected startup

Appendix A • Accessories included in delivery

1 ACOPOS

1.1 8V1010.0xx-2/8V1016.0xx-2

<table>
<tr><th>Figure</th><th>Quan-
tity</th><th colspan="3">Name</th><th>Model number</th></tr>
<tr><td rowspan="8"></td><td rowspan="8">1</td><td colspan="3">Accessory set 8V1022/8V1045/8V1090 consisting of:</td><td rowspan="8">8X0001.00-1</td></tr>
<tr><td>Quan-
tity</td><td>Details</td><td>Model number</td></tr>
<tr><td>1</td><td>Screw clamp - 18 pin</td><td>7TB718.9</td></tr>
<tr><td>1</td><td>Screw clamp - 4 pin PC5, labeled 1010</td><td>8TB3104.203L-10</td></tr>
<tr><td>1</td><td>Screw clamp - 4 pin PC5, labeled 1100</td><td>8TB3104.202N-10</td></tr>
<tr><td>1</td><td>Screw clamp - 4 pin PC5, labeled 0110</td><td>8TB3104.204G-11</td></tr>
<tr><td>1</td><td>Screw clamp - 4 pin MSTB, labeled 1100</td><td>8TB2104.202N-00</td></tr>
<tr><td>1</td><td>Screw clamp - 4 pin MSTB, labeled 1010</td><td>8TB2104.203L-00</td></tr>
<tr><td rowspan="6"></td><td rowspan="6">1</td><td colspan="3">Accessory set for 8V1016/8V1010 consisting of:</td><td rowspan="6">8X0040.00-1</td></tr>
<tr><td>Quan-
tity</td><td>Details</td><td>Model number</td></tr>
<tr><td>1</td><td>Shield plate 1010/1016</td><td>-</td></tr>
<tr><td>1</td><td>Hammer foot bolt clamp B14ER</td><td>-</td></tr>
<tr><td>1</td><td>DIN7985 M3x5 Torx</td><td>-</td></tr>
<tr><td>2</td><td>M3 locknut</td><td>-</td></tr>
<tr><td></td><td>1</td><td colspan="3">Safety guidelines</td><td>MAACPSH-X</td></tr>
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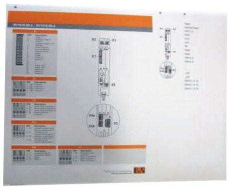
<tr><td></td><td>1</td><td colspan="3">Label sheet pinout ACOPOS 1010.00/1016.00</td><td>-</td></tr>
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1.2 8V1010.5xx-2/8V1016.5xx-2

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tity</th><th colspan="3">Name</th><th>Model number</th></tr>
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<tr><td>1</td><td>Screw clamp - 4 pin MSTB, labeled 1010</td><td>8TB2104.203L-00</td></tr>
<tr><td rowspan="6"></td><td rowspan="6">1</td><td colspan="3">Accessory set for 8V1016/8V1010 consisting of:</td><td rowspan="6">8X0040.00-1</td></tr>
<tr><td>Quan-
tity</td><td>Details</td><td>Model number</td></tr>
<tr><td>1</td><td>Shield plate 1010/1016</td><td>-</td></tr>
<tr><td>1</td><td>Hammer foot bolt clamp B14ER</td><td>-</td></tr>
<tr><td>1</td><td>DIN7985 M3x5 Torx</td><td>-</td></tr>
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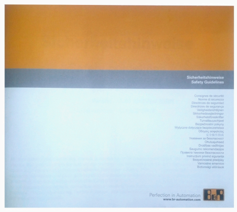
<tr><td></td><td>1</td><td colspan="3">Safety guidelines</td><td>MAACPSH-X</td></tr>
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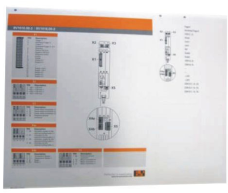
<tr><td></td><td>1</td><td colspan="3">Label sheet pinout ACOPOS 1010.50/1016.50</td><td>-</td></tr>
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1.3 8V1022.xxx-2/8V1045.xxx-2/8V1090.xxx-2

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<tr><td>1</td><td>Screw clamp - 4 pin MSTB, labeled 1010</td><td>8TB2104.203L-00</td></tr>
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<tr><td>Quantity</td><td>Details</td><td>Model number</td></tr>
<tr><td>1</td><td>Stress relief</td><td>-</td></tr>
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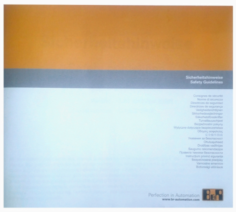
<tr><td></td><td>1</td><td colspan="3">Safety guidelines</td><td>MAACPSH-X</td></tr>
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1.4 8V1180.xxx-2/8V1320.xxx-2

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<tr><td>1</td><td>Screw clamp - 18 pin</td><td>7TB718.9</td></tr>
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<tr><td>1</td><td>Screw clamp - 4 pin 1r PC6 labeled 1100</td><td>8TB4104.202N-00</td></tr>
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<tr><th>Quantity</th><th>Details</th><th>Model number</th></tr>
<tr><td>1</td><td>Shielding bolt</td><td>-</td></tr>
<tr><td>2</td><td>Shield terminal SK14</td><td>-</td></tr>
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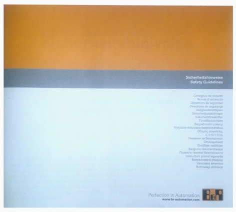
<tr><td></td><td>1</td><td>Safety guidelines</td><td>MAACPSH-X</td></tr>
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1.5 8V1640.xxx-2

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<tr><td>1</td><td>Screw clamp - 18 pin</td><td>7TB718.9</td></tr>
<tr><td>1</td><td>Screw clamp - 3 pin 1r PC6 labeled 000</td><td>8TB4103.202A-00</td></tr>
<tr><td>1</td><td>Screw clamp - 4 pin 1r MSTB labeled 1100</td><td>8TB2104.202N-00</td></tr>
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<tr><td></td><td>1</td><td>ACOPOS accessory set for shield contacting 8V1640 consisting of:
<table>
<tr><th>Quan-tity</th><th>Details</th><th>Model number</th></tr>
<tr><td>1</td><td>Shielding bolt</td><td>-</td></tr>
<tr><td>1</td><td>Hammer foot bolt clamp B18ER</td><td>-</td></tr>
<tr><td>1</td><td>Hammer foot bolt clamp B22ER</td><td>-</td></tr>
<tr><td>1</td><td>Hammer foot bolt clamp B34ER</td><td>-</td></tr>
<tr><td>3</td><td>Hexagonal socket head cap screw 8mm M5 DIN912 galv.</td><td>-</td></tr>
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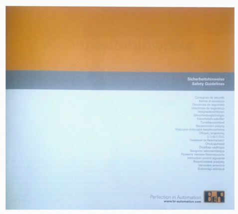
<tr><td></td><td>1</td><td>Safety guidelines</td><td>MAACPSH-X</td></tr>
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1.6 8V128M.xxx-2

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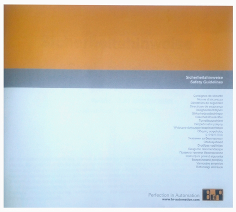
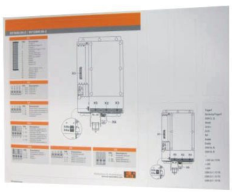
<tr><th>Figure</th><th>Quan-tity</th><th colspan="3">Name</th><th>Model number</th></tr>
<tr><td rowspan="6"></td><td rowspan="6">1</td><td colspan="3">ACOPOS accessory set for 8V1640 K0 consisting of:</td><td rowspan="6">8X0005.00-1</td></tr>
<tr><td>Quan-tity</td><td>Details</td><td>Model number</td></tr>
<tr><td>1</td><td>Screw clamp - 18 pin</td><td>7TB718.9</td></tr>
<tr><td>1</td><td>Screw clamp - 3 pin 1r PC6 labeled 000</td><td>8TB4103.202A-00</td></tr>
<tr><td>1</td><td>Screw clamp - 4 pin 1r MSTB labeled 1100</td><td>8TB2104.202N-00</td></tr>
<tr><td>1</td><td>Screw clamp - 4 pin 1r MSTB labeled 1010</td><td>8TB2104.203L-00</td></tr>
<tr><td rowspan="8"></td><td rowspan="8">1</td><td colspan="3">ACOPOS accessory set for shield contacting 8V128M consisting of:</td><td rowspan="8">8X0030.00-1</td></tr>
<tr><td>Quan-tity</td><td>Details</td><td>Model number</td></tr>
<tr><td>1</td><td>Shielding bolt</td><td>-</td></tr>
<tr><td>1</td><td>Hammer foot bolt clamp B18ER</td><td>-</td></tr>
<tr><td>1</td><td>Hammer foot bolt clamp B22ER</td><td>-</td></tr>
<tr><td>1</td><td>Hammer foot bolt clamp B34ER</td><td>-</td></tr>
<tr><td>1</td><td>Hammer foot bolt clamp B46ER</td><td>-</td></tr>
<tr><td>3</td><td>Hexagonal socket head cap screw 8mm M5 DIN912 galv.</td><td>-</td></tr>
<tr><td></td><td>1</td><td colspan="3">Safety guidelines</td><td>MAACPSH-X</td></tr>
<tr><td></td><td>1</td><td colspan="3">Label sheet ACOPOS stickers multilingual</td><td>-</td></tr>
<tr><td></td><td>1</td><td colspan="3">Label sheet pinout ACOPOS 8V1640/8V128M</td><td>-</td></tr>
</table>

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