metronix
servo drives

Mounting Instructions

smartServo BL 4000-D
smartServo BL 4000-M

Important!
Read thoroughly before use!
Retain for future reference!

Original Mounting Instructions

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Table of Contents

1 About this Mounting Instructions

The purpose of these Mounting Instructions is to ensure the safe installation and proper wiring of the servo drives of the smartServo BL 4000-D or BL 4000-M series. The safe use of the servo drive and of the Metronix ServoCommander® parameterisation program is described in the Product manual smartServo BL 4000-D and BL 4000-M.

The safety instructions and warnings in this Mounting Instructions must always be followed.

1.1 Explanations and notation

1.1.1 Structure of the warning notes

Warning notes have the following structure:

- Signal word
- Type of hazard
- Measures to prevent the hazard

› Signal words

⚠ DANGER

Indicates an imminent hazard.
If the situation is not avoided, extremely serious and possibly fatal injuries will result.

⚠ WARNING

Indicates a potentially hazardous situation.
If the situation is not avoided, extremely serious and possibly fatal injuries may result.

⚠ CAUTION

Indicates a potentially hazardous situation.
If the situation is not avoided, slight or minor injuries may result.

NOTICE

Warns against damage to property.

› Warning signs as per ISO 7010

Warning sign	Explanation
	Warning against fatal electric voltage.
	Warning against hot surfaces.

1.1.2 Structure of notes

The notes in this Mounting Instructions have the following structure:

- Signal word "NOTE"
- Introductory phrase
- Explanations and special tips

1.2 Additional documents

Further information can be found in the following manuals:

- Product manual smartServo BL 4000-D and BL 4000-M: Describes the safe installation and proper wiring of the servocontrollers smartServo BL 4000-D or BL 4000-M, as well as safe working with the servocontroller and the parameterisation program Metronix ServoCommander® .
- EtherCAT and CANopen manual BL 4000: This manual describes the commissioning procedure for the servo drives ARS 2000 FS or BL 4000 with a CANopen or EtherCAT control system.
- PROFIBUS/PROFINET manual ARS 2000 FS / smartServo BL 4000: This manual describes the commissioning procedure for the servo drives ARS 2000 FS or BL 4000 with a PROFINET control system.

You can find all of these documents on our homepage for download. Certificates and declarations of conformity for the products described in this manual can also be found at our homepage: https://www.metronix.de

1.3 Order numbers

Order number	Description
9200-4840-2000	BL 4840-M
9200-4840-3000	BL 4840-D
9200-4840-2015	BL 4840-M CAN
9200-4840-3015	BL 4840-D CAN

Order number	Description
9200-4104-2000	BL 4104-M
9200-4104-3000	BL 4104-D
9200-4104-2015	BL 4104-M CAN
9200-4104-3015	BL 4104-D CAN

1.4 Applicable standards

Standard	Description
EN 13849-1:2015	Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design
EN 50581	Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances
EN 60204-1	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN 61800-3	Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods
EN 61800-5-1	Adjustable speed electrical power drive systems - Part 5-1: Safety requirements - Electrical, thermal and energy
EN 61800-5-2	Adjustable speed electrical power drive systems - Part 5-2: Safety requirements - Functional
EN 62061	Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems
EN ISO 12100	Safety of machinery - General principles for design - Risk assessment and risk reduction
IEC 61508 Teil 1-7	Functional safety of electrical/electronic/programmable electronic safety-related systems
IEC 82079-1	Preparation of instructions for use - Structuring, content and presentation - Part 1: General principles and detailed requirements
UL 61800-5-1	Standard for Adjustable Speed Electrical Power Drive Systems - Part 5-1: Safety Requirements - Electrical, Thermal and Energy
CSA C22.2 No. 274	Adjustable speed drives

2 For your own safety

Servo drives of the BL 4000-M / BL 4000-D series can only be used safely, if you read and comply with this document.

2.1 General information

The servo drive has a safe design. However, certain hazards exist in the context of certain activities. These hazards can be avoided by following the correct procedures. The correct procedures for avoiding these hazards are described in this document.

In addition to the instructions described in this document, there may be additional health and safety instructions as well as general safety instructions that you must comply with. Keep informed about all of these aspects.

Professional project planning is a prerequisite for the correct and trouble-free operation of the servo drive.

The following requirements must be fulfilled to ensure the trouble-free and safe operation of the servo drive.

- Proper and correct transport
- Proper storage
- Proper installation
- Proper project planning taking in consideration all of the potential risks, necessary protective and emergency measures and the installation
- Careful operation and proper maintenance.

Only trained and qualified personnel in accordance with section 2.3 *Target group* on page 10 are authorised to work with or on the electrical systems.

The following instructions must be read and understood prior to the initial operation of the system in order to prevent injuries and/or damage to property. The following safety instructions must be complied with at all times:

- Do not attempt to install or start the servo drive without having read all of the safety instructions in this document concerning the electrical drives and controllers. These safety instructions and all other user notes must be read prior to performing any work with the servo drive.
- If the servo drive is sold, rented out or otherwise distributed to third parties, these safety instructions must be included.
- The user must not open the servo drive for safety and warranty reasons.

2.2 Intended use

The electronic drive control unit (servo drive) is intended for operation in combination with electric motors in an industrial environment. The handling of the servo drive requires qualified personnel that have been trained in terms of general and, in particular, electrical safety. The intended use also includes compliance with the information and instructions in this manual.

Any use going beyond or deviating from the intended use will be considered as misuse.

⚠WARNING Hazards caused by misuse

Misuse of the servo drive will lead to dangerous situations.

- Use the servo drive only under the specified ambient condition.
- Do not use the servo drive outdoors or in explosive atmospheres.
- Use suitable and qualified specialist personnel for any type of work on the servo drive.
- Always comply with the voltage ranges that are specified in section 6 *Technical data* on page 63.
- Follow all of the instructions in this manual concerning the safe use of the servo drive.

2.3 Target group

Over its entire service life, work on the servo drive, with the exception of its operation, may only be performed by specialist personnel and/or instructed persons who have been trained for the required tasks. The servo drive is to be operated by the user.

› Trained and qualified personnel

Qualified personnel in the sense of this document are persons who are sufficiently familiar with the project, set-up, installation, commissioning and operation of the servo drive as well as with all of the warnings and precautions and who are sufficiently qualified in their field of expertise:

- They have been trained, instructed and authorised to perform the switching and earthing (grounding) of the devices/systems in line with the applicable safety standards and to label them accordingly as per the job requirements.
- The service and maintenance personnel have undergone special training in the context of ESD protection measures.
- They have been trained and instructed in line with the applicable safety standards in terms of the maintenance and use of adequate safety equipment.
- They have completed first aid training.

2.4 General safety instructions

DANGER **Danger to life due to electric shock!**

Non-compliance with the safety instructions will lead to a potentially fatal electric shock. The general set-up and safety rules and regulations concerning the work on power installations (e.g. DIN, VDE, EN, IEC or any other national or international rules and regulations) must be complied with.

- Safety-critical applications of the servo drive are not allowed unless specifically approved by the manufacturer.
- For information about the EMC-compliant installation, see section 5.1 *Notes concerning the safe and EMC-compliant installation* on page 26. The manufacturer of the machine or system is responsible for ensuring compliance with the limits that are specified by the applicable national rules and regulations.
- The ambient conditions that are specified in the product manual must be strictly observed.
- The technical data as well as the connection and installation conditions of the servo drive are stated in this document and must be complied with at all times.
- Refer to *General technical data* on page *63* for the protection rating and pollution degree of the servo drive. Ensure that the environment corresponds to this protection rating and pollution degree rating.
- Use only original accessories and original spare parts that have been approved by the manufacturer.
- The servo drives must be connected to the mains power supply in accordance with the country-specific regulations (EN standards, VDE rules) so that they can be disconnected from the mains power supply by way of suitable disconnectors (e.g. main switches, contactors, circuit breakers).
- Use gold contacts or contacts with a high contact pressure for switching the control contacts.
- Preventive interference suppression measures should be taken for the switchgear. This can be done, for example, by connecting RC circuits or diodes to the contactors and relays.

2.5 Personal protective equipment

Always use personal protective equipment during the transport, installation, start-up, cleaning, maintenance and removal of the servo drive, for example:

- **Protective gloves**
  To prevent superficial hand injuries.
- **ESD safety shoes**
  To prevent foot injuries caused by falling parts.
  To prevent electrostatic charging.
- **Protective work clothes**
  To prevent superficial injuries and soiling.
- **Protective goggles**
  To prevent eye injuries caused by dust or shards/splinters.
- **Light respiratory protection**
  To prevent the inhalation of harmful substances.

2.6 Safety notes for installation and maintenance

⚠ DANGER ⚠ **Dangerous electrical voltage!**

Prior to performing any maintenance tasks, you need to ensure that the power supply and the external power supply of the servo drive have been disconnected and secured against reconnection and that the DC bus has discharged.

During operation and also for a very long time after the servo drive has been switched off, the corresponding connections and an external braking resistor carry dangerous DC bus voltages. Contact with these voltages may result in serious or even fatal injuries.

Make sure that the DC bus has discharged by measuring at the DC bus terminals ZK+ and ZK- or wait for the maximum discharge time. This is for the BL 4100-M / BL 4100-D **30 minutes**. For the BL 4800-M / BL 4800-D no waiting time is required. In the event of a device defect, connections other than those specified here may also carry a life-threatening voltage. Under these circumstances, the discharge time must be waited for in any case.

⚠ WARNING ⚠ **Risk of burns due to hot surfaces**

The servo drive and, in particular, the (external or internal) braking resistor may become hot during operation. Always wait a sufficient amount of time prior to touching these parts.

Always use suitable personal protective equipment to avoid severe burns.

⚠ CAUTION **Risk of injury for unqualified personnel!**

Only personnel who are trained and qualified for working on or with electrical devices are authorised to install, maintain and repair the servo drive.

› To prevent accidents, injuries and damage to property:

Perform a risk assessment and follow all of the statutory and local safety instructions and accident prevention regulations when installing or maintaining the system.

Ensure that the AC or DC power supplies are switched off and locked prior to performing any work in the area of the machine. The deactivation of the output stages or servo drive enable signals is not a suitable means of locking. In the case of a malfunction, the drive may accidentally be put into action. This does not apply to drives with the special "Safe Torque Off" feature in accordance with EN 61800-5-2.

Electronic devices are never completely fail-safe. It is the user's responsibility to ensure that the system is brought to a safe state if the electrical device fails.

Disconnect the electric equipment from the power supply via the main switch and secure it against reconnection. Wait until the DC bus has discharged in the following cases:

- maintenance and repairs
- cleaning
- long downtimes

The standard motor holding brake that is included in the scope of supply or any other external motor holding brake that is actuated by the servo drive is not suitable for the protection of the operators if used alone!

Be particularly careful during the installation process. During the installation and also later on during the operation of the drive, ensure that no drilling chips, metal dust or installation parts (screws, nuts, cable sections) can fall into the servo drive.

Use suitable personal protective equipment during the installation.

Vertical axes must be additionally secured against falling down or lowering after the motor has been switched off, for example by way of the following:

• mechanical locking of the vertical axis,

• external braking, catching or clamping devices, or

• sufficient weight counterbalance of the axis.

Perform the start-up process with idling motors. This is to avoid mechanical damage, e.g. due to an incorrect direction of rotation.

2.7 Protection against contact with electrical parts

⚠ DANGER ⚠ Dangerous electrical voltage!

In certain device constellations, the rapid discharge of the DC bus voltage of the servo drive may be rendered ineffective. In these cases, the servo drives may still carry dangerous voltage levels for a very long time after they have been switched off (residual capacitor charge).

Make sure that the DC bus has discharged by measuring at the DC bus terminals ZK+ and ZK- or wait for the maximum discharge time. This is for the BL 4100-M / BL 4100-D **30 minutes**. For the BL 4800-M / BL 4800-D no waiting time is required. In the event of a device defect, connections other than those specified here may also carry a life-threatening voltage. Under these circumstances, the discharge time must be waited for in any case.

› To prevent accidents, injuries and damage to property:

Follow the national accident prevention regulations (for Germany, this is DGUV regulation 3 (formerly BGV A3)).

Do not touch the electrical connections of the components when they are switched on.

Prior to accessing electrical parts carrying voltages above 50 V, disconnect the device from the mains power supply or voltage source. Secure it against reconnection.

Install the respective covers and guards against accidental contact prior to switching the device/system on. Rack-mounted devices must be protected against accidental contact by way of an enclosure, e.g. a switch cabinet.

Prior to start-up and even for brief measurements or tests, connect the protective earth conductor (ground conductor) of all of the electrical devices in accordance with the circuit diagram (see section 5 *Electrical installation* on page 26) in a fixed manner (hardwiring) to the supply network or to the earthing system on site.

Comply with the minimum copper cross-section for the protective earth conductor (ground conductor) over its entire length (see EN 61800-5-1). Otherwise, the housing may carry high voltages which can cause electric shock.

With mains-powered servo drives (BL 4100-M / BL 4100-D), the leakage current is greater than 3.5 mA due to the integrated mains filters. Therefore, two separate protective earth connection points must be hard-wired for these units.

The magnitude of the DC bus voltage must be taken into consideration during the installation process in order to ensure proper insulation and protection. Ensure proper earthing (grounding), conductor rating and protection against short circuits.

2.8 Protection against electric shock by way of protective extra-low voltage (PELV)

⚠ DANGER ⚠ Dangerous electrical voltage!

There is a risk of high electrical voltage due to incorrect electrical connections.

Always follow the safety instructions stated hereinbelow.

All of the connections and terminals with voltages up to 50 V of the servo drive have protective extra-low voltage. They are protected against contact in accordance with IEC 61800-5-1 and EN 61800-5-1.

Only devices, electrical components and wires or cables with protective extra-low voltage (PELV) may be connected to connectors and terminals with voltages from 0 to 50 V.

When connecting voltages and circuits, ensure that they are securely isolated from any dangerous voltages. This isolation can be realised by way of isolation transformers, safe optocouplers or battery operation without mains power.

2.9 Protection against dangerous movements

⚠ WARNING Risk of injury due to dangerous movements

Always follow the safety instructions stated hereinbelow.

Dangerous movements can be caused by the faulty actuation of the connected motors. Causes may be as follows:

- improper or faulty wiring or cabling
- errors during the operation of the components
- errors of the sensors and transducers
- defective or non-EMC-compliant components
- software errors in the superordinate control system.

These errors can occur directly after the activation of the device or after some time during the operation.

The monitoring systems in the drive components exclude any malfunction in the connected drives to the greatest possible extent. However, in view of the protection of the operators, particularly in terms of the risk of injuries and damage to property, relying solely on this measure is not recommended. Until the built-in monitoring systems become effective, faulty drive movements should always be anticipated. The extent of these faulty drive movements depends on the type of control and on the operating state.

For the reasons mentioned above, protection must be ensured by monitoring or by superordinate measures. This must be implemented by the system manufacturer based on the specific system situation and on a hazard and fault analysis. This also includes the safety rules and regulations that apply to the system. Random movements of the machine or other malfunctions may be caused by deactivating, bypassing or failing to activate the safety devices.

2.10 Protection against contact with hot parts

⚠WARNING **Risk of burns due to hot surfaces**

The servo drive and, in particular, the (external or internal) braking resistor may become hot during operation. Always wait a sufficient amount of time prior to touching these parts. Always use suitable personal protective equipment to avoid severe burns.

2.11 Protection during the handling and installation of the devices

⚠CAUTION **Risk of injury caused by crushing, shearing, cutting or impacts**

Improper handling and installation of certain parts will cause injuries.
Always follow the safety instructions stated hereinbelow.

- When installing the servo drive, ensure that it can be installed, operated and removed without any danger.
- Appropriate installation clearances must also be defined.
- Comply with the intended use of the servo drive.
- When transporting the servo drive, pay particular attention to the edges and corners of housings and other components. Use suitable personal protective equipment.
- If you install the components of the system on a wall or on the floor, dust may be created by drilling. Use suitable personal protective equipment.
- Use only suitable installation and transport equipment.
- Prevent trapping and crushing by suitable protective measures.
- Use only suitable tools. If specified, use special tools.
- Use lifting equipment and tools in a proper manner.
- Do not step under suspended loads.
- Liquid spills on the floor must be removed immediately.

3 Product description

The servo drives of the smartServo BL 4000-M / BL 4000-D series are smart AC servo drives for controlling three-phase synchronous motors, torque motors and linear motors. The servo drives can be used in a universal manner, since they can be combined with a wide range of encoder systems and motors. Due to their extensive parameterisation options, they can be adapted to a variety of different applications. The decentralised servo drives of the BL 4000-M / BL 4000-D device family are available in 4 different variants: BL 4000-M are designed for mounting on the motor, BL 4000-D for decentralised mounting near the motor outside a control cabinet. For both device families, devices with 230 V power supply as well as with 48 V power supply are available. Depending on the fieldbus variant, the connection to a superordinate control system can be realised via the integrated CANopen or EtherCAT/PROFINET interface.

Parameter sets that have been created for the ARS 2000 FS series can be used for the BL 4000-C, BL 4000-M / BL 4000-D series and vice versa.

3.1 Type designation

Type key using the example of a BL 4840-D.

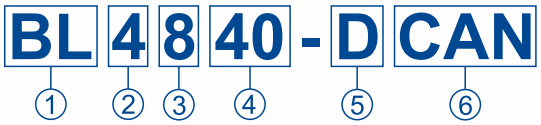

Figure 1: Nomenclature

Pos.	Description
1	Type designation: Basic Line
2	4th servo drive product family
3	Mains power connection: 1 = single-phase / 3 = three-phase
4	Nominal current in [A_{eff}]
5	Cabinet (control cabinet device) Decentral (separate from the motor) Mounted (mounted on the motor)
6	Fieldbus variant CAN = CANopen / not stated = PROFINET / EtherCAT

Based on this, the following type designations are used:

Designation	Description
BL 4000-D	Any decentralised (separate from the motor) device, regardless if with 48 V or 230 V supply
BL 4000-M	Any device mounted on the motor, regardless if with 48 V or 230 V supply
BL 4100-D	Any decentralised device (separate from the motor) with 230 V supply
BL 4800-D	Any decentralised device (separate from the motor) with 48 V supply
BL 4100-M	Any motor-mounted device supplied with 230 V
BL 4800-M	Any motor-mounted device supplied with 48 V

Designation	Description
BL 4840-D	A servo drive supplied with 48 V DC, separated from the motor, with 40 A_{eff} rated current
BL 4104-M	A motor-mounted servo drive supplied with 230 V and 4 A_{eff} rated current

All listed examples can also be marked with the addition CAN. In this case, the information refers to the units with the CANopen fieldbus variant.

3.2 Device view BL 4000-M

› Front view

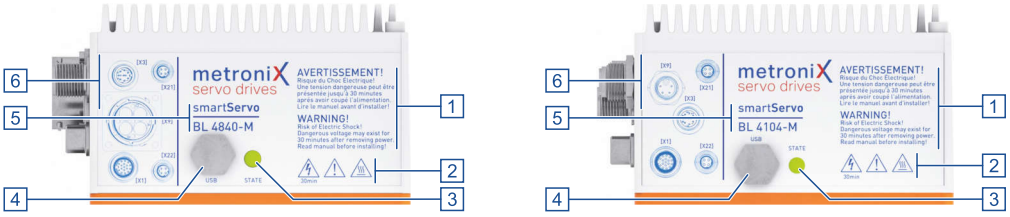

Figure 2: Front view of a BL 4800-M (left) and BL 4100-M (right)

1	Warnings	4	[X19] USB interface with cover cap
2	Safety Symbols as per ISO 7000	5	Product name
3	Status indicator LED (READY, ERROR, ENABLE, BLUETOOTH)	6	Connector descriptions

› View on connector side

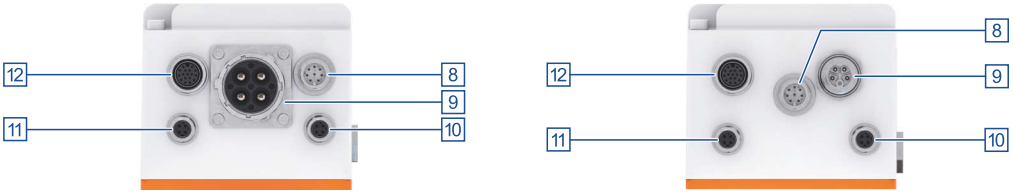

Figure 3: View on connector side of aBL 4800-M (left) and a BL 4100-M (right)

8	[X3] 24 V supply and STO	11	[X22] Real-time Ethernet interface
9	[X9] Power supply	12	[X1] I/O communication
10	[X21] Real-time Ethernet interface		

3.3 Device view BL 4000-D

› Front view

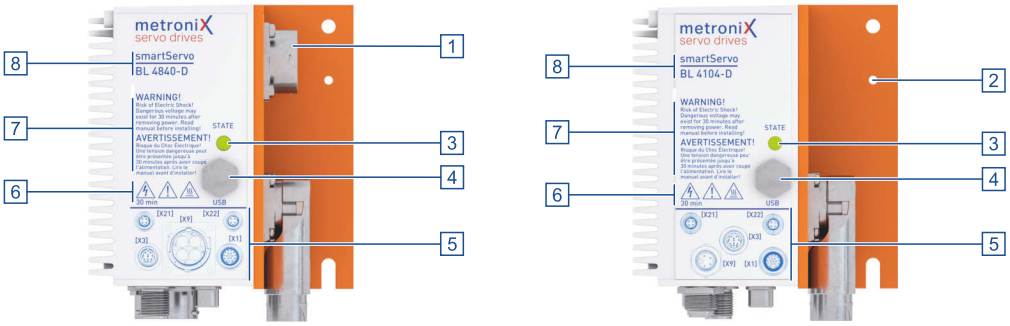

Figure 4: Front view of a BL 4800-D (left) and BL 4100-D (right)

1	[X6A] Motor connection	5	Connector descriptions
2	Earthing screw	6	Safety Symbols as per ISO 7000
3	Status indicator LED (READY, ERROR, ENABLE, BLUETOOTH)	7	Warnings
4	[X19] USB interface with cover cap	8	Product name

› Bottom view

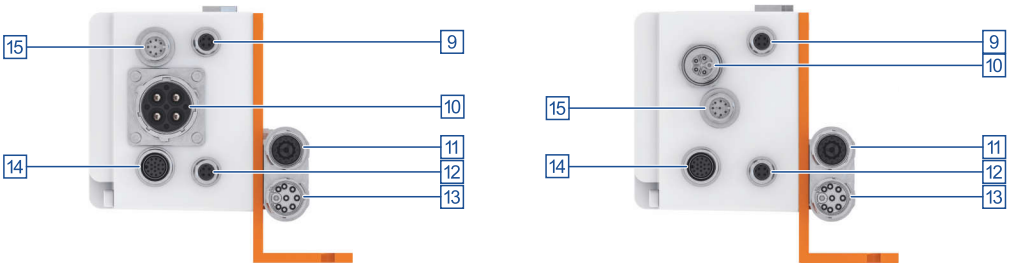

Figure 5: Bottom view of a BL 4800-D (left) and BL 4100-D (right)

9	[X21] Real-time Ethernet interface	13	[X6] Motor connection
10	[X9] Power supply	14	[X1] I/O communication
11	[X2] Resolver/Multi-encoder	15	[X3] 24 V supply and STO
12	[X22] Real-time Ethernet interface		

› Side view

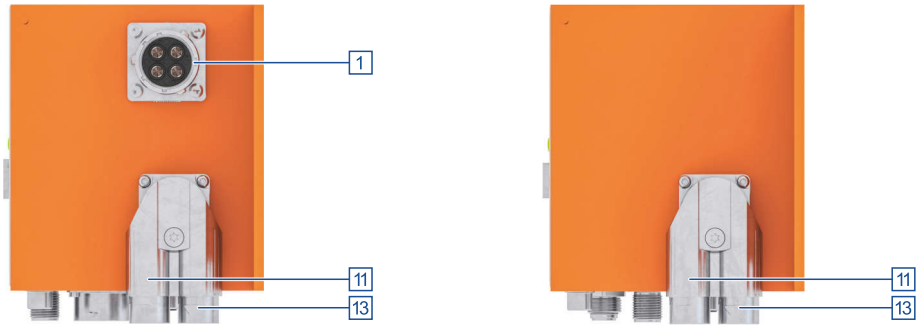

Figure 6: Side view of a BL 4800-D (left) and BL 4100-D (right)

1	[X6A] BL 4800-D: Motor connection	13	[X6] BL 4100-D: Motor connection
11	[X2] Resolver/Multi-encoder		

3.4 Features

All of the servo drives of this series have the following features:

› Integrated fieldbus interfaces

- Fieldbus variant CAN: CANopen interface
- Fieldbus variant EtherCAT/PROFINET:
  - EtherCAT interface (CoE)
  - PROFINET interface (Metronix standard telegrams, based on PROFIdrive)

› Integrated universal shaft encoder evaluation for the following encoder types:

- Resolvers
- Analogue and digital incremental encoders with and without commutation signals
- High-resolution Stegmann incremental encoders with HIPERFACE®
- High-resolution Sick incremental encoders with HIPERFACE DSL® (single-cable variant)
- High-resolution Heidenhain incremental encoders with EnDat 2.2 (ENDAT22)
- Master frequency input/output and pulse direction interface

› Suitable motors

- Permanent-magnet synchronous machines with sinusoidal EMF
- Torque motors
- Linear motors
  - Air-core and iron-core linear motors with a low motor inductance (0,1 … 4 mH)
  - Automatic determination of the motor parameters

› User-friendly parameterisation with the Metronix ServoCommander® software

- Adjustment of all of the parameters via a PC and online representation of operating parameters and diagnostic messages
- User-guided initial start-up, loading and saving of parameter sets as well as offline parameterisation are possible
- Oscilloscope function for optimising the drive and for analysing the PLC I/O coupling
- Supported languages: German, English
- Automatic motor identification and procedures for the automatic determination of the commutation position in the case of encoders without a commutation track
- Automatic adjustment of the control circuits for current, speed and position control

Integrated functional safety

- "Safe Torque Off (STO)" safety function integrated in the device
- SS1 functionality possible

Homing and positioning

- Integrated positioning control with a wide range of functions as per "CAN in Automation (CiA) DSP402" plus numerous additional application-specific functions.
- Jerk-free or time-optimal positioning, relative or absolute with regard to a reference point. Point-to-point positioning with and without smooth position transitions.
- High-speed sample inputs for triggering the storage of position marks
- Numerous homing methods
- Rotor and position triggers

Brake control and automatic brake

- Direct control of a motor holding brake with high current without using an external relay
- Adjustable brake delay times
- "Automatic brake" for deactivating the power section during longer breaks to save energy

Electrical characteristics BL 4100-M / BL 4100-D

- Wide-range supply input (AC)
- "Soft switch-on" features for the soft precharging and quick charging of the DC bus
- DC bus coupling between devices with the same mains power supply for buffering the brake energy
- Improved monitoring and analysis of the mains power supply by a direct measurement of the mains voltage

Electrical characteristics BL 4800-M / BL 4800-D

- Wide-range supply input (DC)
- Due to the robust design, no DC link precharging is required when connecting the battery
- DC bus coupling between devices with the same mains power supply for buffering the brake energy

› Applications

- Speed- and angle-synchronous operation with an electronic gear unit via the incremental encoder input or fieldbus. Extensive modes of operation for synchronisation, e.g. "flying saw"
- Jog mode, teach-in mode, motion programs, torque-limited set control and much more

› Special control features

- High control quality due to high-quality sensors, far superior to conventional market standards, and above-average processor resources
- Short cycle times, bandwidth in the current control circuit approx. 2 kHz (with t_i= 32 µs), in the speed control circuit approx. 500 Hz (with t_n= 64 µs)
- Parameterisable band-stop filters for suppressing the natural frequency of the controlled system
- Load torque compensation for vertical axes
- Synchronisable internal clock system for the synchronisation with external clock sources for CANopen and EtherCAT fieldbus systems by way of an internal PLL

› Certification and qualification

- Integration of numerous filters (e.g. filters for the 24 V supply, the inputs and outputs, etc.) within the device, so that only with the BL 4100-M / BL 4100-D an external mains filter has to be used to comply with the current CE and EN standards
- Enclosed on all sides, EMC-optimised housing for mounting on or near the motor
- Protection class IP54, depending on the mounting and the sealing up to IP67 can be achieved
- UL Recognized

4 Mounting

› Mounting BL 4000-D

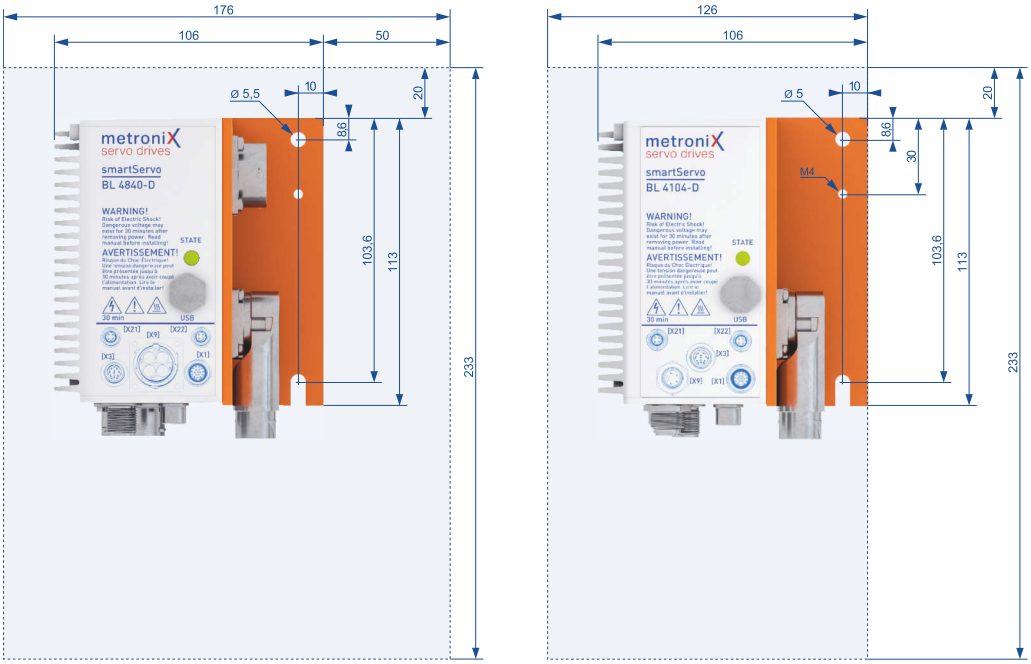

Figure 7: Dimensions and installation clearance for BL 4800-D (left) and BL 4100-D (right)

The following requirements must be fulfilled for the installation of the servo drive:

- Follow the general set-up and safety rules and regulations concerning the installation.
- Follow the safety instructions in section 2.6 *Safety notes for installation and maintenance* on page 12.
- Use only suitable tools. If specified, use special tools.
- Always use suitable personal protective equipment, see section 2.5 *Personal protective equipment* on page 12 section 2.5 *Personal protective equipment* on page 12.
- The servo drives of device family BL 4000-D are intended for decentralised mounting near the motor outside a control cabinet.
- Preferred installation position: Vertical with the circular connectors [X1], [X3], etc. facing downwards. Generally, other mounting positions are also possible.
- The servo drives of device family BL 4000-D have mounting holes at the top and bottom of the mounting bracket. The servo drive is fastened with these holes using two M5 screws. Recommended tightening torque for an M5 screw of property class 5.6: 2.8 Nm.
- Excessive heating may cause premature ageing and/or damage to the device. For sufficient heat dissipation, the minimum distances from other components shown in the illustration above must therefore be observed. If these distances cannot be complied with in special installation situations, please contact the Technical Support.

- As the Intercontec connector [X6]/[X2] can be turned, the motor/encoder cable can also be connected from the front or from above.

› Mounting BL 4000-M

Servo drives of device family BL 4000-M are usually already mounted on the motor and do not have to be mounted separately. However, when mounting the motor/servo drive combination, always observe the following requirements and notes:

- Follow the general set-up and safety rules and regulations concerning the installation.
- Follow the safety instructions in section 2.6 *Safety notes for installation and maintenance* on page 12.
- Use only suitable tools. If specified, use special tools.
- Always use suitable personal protective equipment, see section 2.5 *Personal protective equipment* on page 12 section 2.5 *Personal protective equipment* on page 12.
- The motor/servo drive combination can be mounted in any position. However, it must be ensured that the heat loss can be properly dissipated. Excessive heating can lead to premature ageing and/or damage to the device. Please contact the Technical Support if you have any questions about the installation situation.

5 Electrical installation

This chapter provides all of the relevant information for the electrical installation of a servo drive of the BL 4000-M / BL 4000-D series with an integrated "Safe Torque Off (STO)" safety function.

5.1 Notes concerning the safe and EMC-compliant installation

5.1.1 Explanations and terminology

Electromagnetic compatibility (EMC) or electromagnetic interference (EMI) includes the following requirements:

- Sufficient **immunity** of an electrical installation or an electrical device against external electrical, magnetic or electromagnetic interferences via cables or the environment.
- Sufficiently small **unwanted emission** of electrical, magnetic or electromagnetic interference from an electrical installation or an electrical device to other devices in the vicinity via cables or the environment.

5.1.2 General information about electromagnetic compatibility

The interference emission and interference immunity of a servo drive always depend on the overall drive concept consisting of the following components:

- Power supply
- Servo drive
- Motor
- Electromechanical system
- Configuration and type of wiring
- Superordinate control system

In order to increase interference immunity and to decrease interference emissions, the servo drive has numerous integrated filters so that BL 4800-M / BL 4800-D servo drives can be operated in most applications completely without additional shielding and filtering devices, and with BL 4100-M / BL 4100-D servo drives only an external mains filter needs to be used.

5.1.3 BL 4100-M / BL 4100-D: Proper wiring

The following must be observed for servo drives of type BL 4100-M / BL 4100-D to ensure a safe and EMC-compliant design of the drive system:

DANGER ⚠ **Dangerous electrical voltage!**

For safety reasons, all of the PE earth (ground) conductors must be connected prior to the initial operation of the system. The shields must be connected on both sides.

The EN 61800-5-1 regulations concerning protective earthing (grounding) must be complied with during the installation.

Motor and servo drive must be screwed firmly and with good conductivity to the machine or the control cabinet, which in turn must be well earthed. Moving system parts on which motors or servo controllers are installed must also be earthed with low impedance (e.g. by using copper tape).

- In order to keep the leakage currents and losses in the motor connecting cable as small as possible, the servo drive should be located as close to the motor as possible.
- The motor cable and angle encoder cable must be shielded.
- Connect the shield of the motor cable to the back panel of the control cabinet by way of suitable shield terminals. The unshielded cable end should not be longer than 80 mm.
- The mains-end PE connector must be connected to the PE connection point of the supply connector [X9].
- The earthing (grounding) screw of the mounting plate must also be connected to the mains-side PE connector via a separate earth lead:
  BL 4100-D: See section 3.3 *Device view BL 4000-D* on page 19.
- The cross-section of each earth lead must not be smaller than the cross-section of the supply leads (L/N or L1-L3).
- The inner PE conductor of the motor cable must be connected to the PE connection point of the motor connector [X6].
- The signal lines must be as far away from the power cables as possible. They should not be laid in parallel. If intersections cannot be avoided, they should be installed at right angles if possible.
- Unshielded signal and control lines should not be used. If their use is inevitable, they should at least be twisted.
- All connectors must be correctly locked or screwed with the tightening torque specified by the manufacturer. For circular connectors we recommend the use of suitable special tools (e.g. TSD 02 SAC/TSD 04 SAC with matching plug attachments).

In general, the following applies:

- Connect the inner shields to the associated pins of the connectors.
- Connect the overall shield on the motor side to the connector or motor housing over a large contact area.

5.1.4 ESD protection

NOTICE **Damage to property due to ESD (electrostatic discharge)**

At unassigned plug connectors, damage can occur to the device or to other system parts as a result of ESD (electrostatic discharge). To prevent this type of damage, comply with the following:

- Ensure proper earthing of all of the system components and wire the servo drive completely prior to switching on the voltage supply.
- The person commissioning the system as well as the service and maintenance personnel must have undergone ESD training and wear corresponding footwear.
- When handling the system, e.g. the USB connector, it is useful to touch the control cabinet housing (should be at PE potential) with your hand prior to touching one of the connectors of the servo drive.

5.2 Additional requirements for the UL approval

› Mains power supply protection

Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the Manufacturer Instructions, National Electrical Code and any additional local codes.

- BL 4000-M / BL 4000-D:
  For Use On A Circuit Capable Of Delivering Not More Than 5000rms Symmetrical Amperes, 240V maximum and When Protected by Circuit Breaker S201UP K16 manufactured by ABB, rated 277V/16A.
- BL 4800-M / BL 4800-D:
  For use in Protective Class III circuits in which dc supply source meets following criteria:
  - DC source shall provide galvanic separation from mains voltage
  - DC source voltage shall not exceed 48Vdc and be capable of delivering not more than 1000Adc of prospective current and
  - When products are protected by fuses or circuit breakers:
    Fuse: BF1 142.5631.5702, Littelfuse
    Circuit breaker: Listed S201UDC K20, ABB

› Wiring requirements and environmental conditions

- For use in Pollution Degree 2 Environment only.
- BL 4000-M: Suitability of the controller when installed onto other motor series [than those tested] shall be determined in end-use by subjecting the combination to temperature rise test.

› Motor overload protection

For effective motor protection, the motor parameters and the I²t-Integral must be parameterised appropriately (see section *Configuration of the motor data* in the Product manual smartServo BL 4000-D and BL 4000-M).

5.3 Connector BL 4100-M / BL 4100-D: Power supply [X9]

Servo drives of the BL 4100-M / BL 4100-D series must be connected to the power supply in accordance with the following illustration:

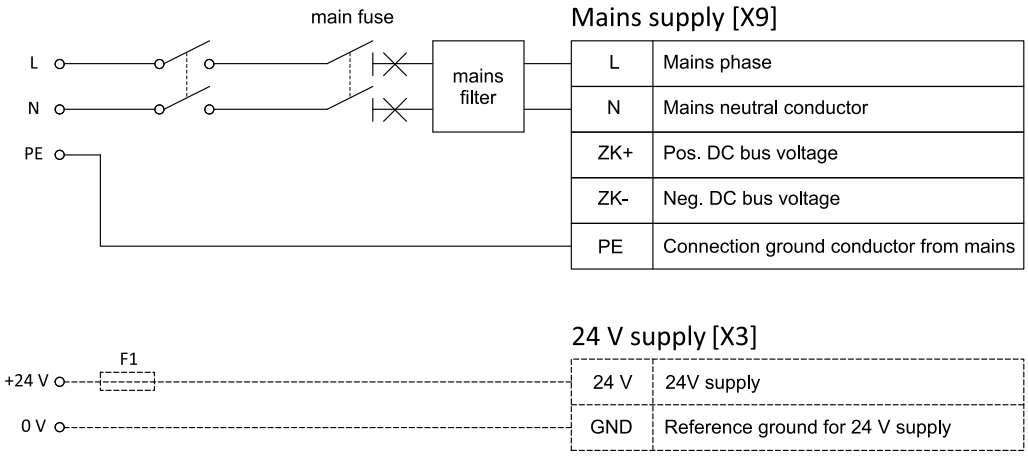

Figure 8: Connecting a BL 4100-M / BL 4100-D to the supply voltage

NOTICE **Risk of damage to the servo drive**

The servo drive will be damaged in the following cases:

- reverse connection of the 24 V operating voltage connections,
- excessive operating voltage, or
- accidental interchanging of the operating voltage and motor connectors.

A 24 V supply and a single-phase mains power supply are required to operate a BL 4100-M / BL 4100-D. Mains voltage is supplied via [X9], whereas the 24 V supply is provided via [X3] (See section 5.5 *Connector : 24 V supply and STO [X3]* on page 35).

A single-phase automatic circuit breaker and a mains filter must be installed in the mains power supply line (see *Cable type and configuration [X9]* on page 31). In addition, you can protect the servo drive with an AC/DC-sensitive residual-current device (RCD) with 300 mA minimum.

Direct DC coupling of the DC buses of several devices with equal DC bus voltage is possible by way of the terminals ZK+ and ZK- (see section *DC bus coupling* in the product manual BL 4000-M / BL 4000-D).

The servo drive has an internal brake chopper and an internal braking resistor. For greater braking power, an external braking module or capacitor storage can be connected in parallel to the DC link. In such cases, please contact the Technical Support.

The servo drive must be connected to earth (ground) with its PE connector (Be sure to see section 5.1.3 *BL 4100-M / BL 4100-D: Proper wiring* on page 27) .

First, wire the servo drive completely. Then, switch on the 24 V supply and the mains power supply.

› Configuration on the device [X9]

Phoenix Contact SACC-CI-M12MSK-4PE-L180 THR T (M12, 5-pin K-coded)

› Mating connector [X9]

3m Power cable, schielded: SAC-5P- 3,0-PUR/M12FSK PE SH - 1414789
Single plug: SACC-M12FSK-4PECT-CL SH

INFORMATION **Self-assembly connectors**

The connectors for self-assembly have a larger outer radius than pre-assembled connectors. For space reasons, a self-assembly connector can therefore only be used for [X9] or [X3]. The other plug must be pre-assembled.

› Pin assignment [X9]

Figure 9: Connector "Power supply [X9]", pin side view

Pin	Name	Specification
1	L	Phase conductor/mains phase
2	N	Neutral conductor
3	ZK+	Pos. DC bus voltage
4	ZK-	Neg. DC bus voltage
PE	PE	Connection of the protective earth (ground) conductor of the mains power supply

› Cable type and configuration [X9]

We recommend using the pre-assembled cables from Phoenix Contact listed above. If other cables are used, the minimum cross-sections listed in the following table must be observed in any case. The power supply cable must be shielded up to the mains filter. A single-phase circuit breaker with the listed characteristics ("Circuit breaker") must be used in the mains supply line.

Specification (L, N, PE)	Circuit Breaker
5 x 1,0 mm², shielded (AWG 18)	K 16

DANGER ⚠ **Dangerous electrical voltage!**

When using pre-assembled cables, always connect all available wires. For example, life-threatening DC link voltage is present on the wires at connection 3/4.

› Mains filter

To comply with the EMC standard, an external mains filter is required between the circuit breaker and the controller:

Mains filter Würth 810912010 or comparable.

In larger systems with many controllers of the same family, the use of a suitable common mains filter may make more sense. In this case, contact the technical support.

5.4 Connector BL 4800-M / BL 4800-D: Power supply [X9]

Servo drives of the BL 4800-M / BL 4800-D series must be connected to the power supply in accordance with the following illustration:

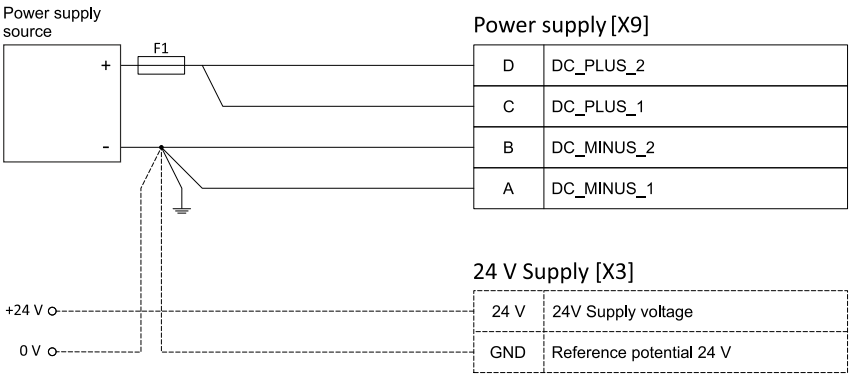

Figure 10: Connecting a BL 4800-M / BL 4800-D to the supply voltage

NOTICE Risk of damage to the servo drive

The servo drive will be damaged in the following cases:

- reverse connection of the 24 V operating voltage connections,
- excessive operating voltage, or
- accidental interchanging of the operating voltage and motor connectors.

NOTICE Risk of destruction due to a connection with reverse polarity

If the polarity of the 24 V supply at [X3] is reversed, the servo drive and the PC will be destroyed. It is essential that you follow the correct connection instructions.

A 24 V supply and a 48 V power supply are required to operate a BL 4800-M / BL 4800-D. The 48 V is supplied via [X9], whereas the 24 V supply is provided via [X3]. (See section 5.5 *Connector : 24 V supply and STO [X3]* on page 35). A melting fuse or an automatic circuit breaker must be used in the 48 V power supply (see *Cable type and configuration [X9]* on page 34). The GND potentials of the 24 V and the 48 V supply must be connected to each other at a common point to reduce potential shifts. This common point must be earthed.

It is possible to couple the DC links of several devices of the BL 4800-M / BL 4800-D device family by connecting them to a common voltage source. Even in this case, all GND lines should be connected at a common point.

NOTICE BL 4800-M / BL 4800-D: Danger of destroying the power supply unit

During braking, a high voltage can be present at [X9], which can destroy the power supply unit. To prevent this, the switch-off threshold in case of overvoltage must be suitably parameterised (see section *Power supply via main power unit* in the Product manual smartServo BL 4000-D and BL 4000-M).

First, wire the servo drive completely. Then, switch on the 24 V supply and the mains power supply.

› Configuration on the device [X9]

Amphenol RT00164PNH03
Inserts: male, SC000518S

› Mating connector [X9]

Amphenol RT06164SNH Gasket
Amphenol RT0L-16CG-S1 Backshell straight
Amphenol RT0B-16CG-S1 Backshell angled
Inserts: female, SC000519S

› Pin assignment [X9]

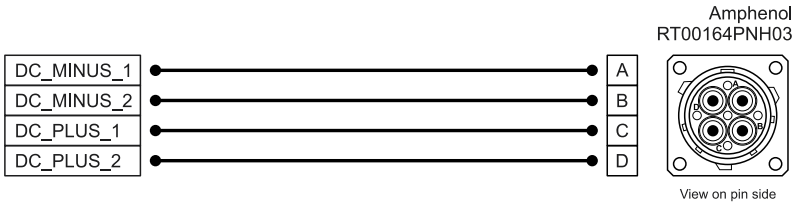

Figure 11: Connector "Power supply [X9]", pin side view

Pin	Name	Specification
A	DC_MINUS_1	Reference potential 48 V power supply
B	DC_MINUS_2	Reference potential 48 V power supply
C	DC_PLUS_1	48 V power supply
D	DC_PLUS_2	48 V power supply

› Cable type and configuration [X9]

The cable names that are stated refer to cables made by Letronic and Kaltenbach. They have proved to be reliable and are successfully used in many applications. However, it is also possible to use comparable cables from other manufacturers. A melting fuse or an automatic circuit breaker must be used in the supply line to protect the cable and the device.

For fixed installation: ÖLFLEX SERVO 719 CY 4G4
For flexible use: ÖLFLEX SERVO FD 796CP 4G4
Single stranded wires:
Letronic UL 3289 4 mm^2 rt. 56x0,30 or
Kaltenbach RADOX® – Stranded wire UL 3289/CSA CL 1503 AWG8

Specification	Fuse/Circuit breaker
4 x 4,0 mm²	Littelfuse BF1 142.5631.5402 or similar or Circuit breaker 20A, K-Type, 60 VDC, SCCR 14kA

5.5 Connector : 24 V supply and STO [X3]

NOTICE Risk of damage to the servo drive

The servo drive will be damaged in the following cases:

- reverse connection of the 24 V operating voltage connections,
- excessive operating voltage, or
- accidental interchanging of the operating voltage and motor connectors.

NOTICE Risk of destruction due to a connection with reverse polarity

If the polarity of the 24 V supply at [X3] is reversed, the servo drive and the PC will be destroyed. It is essential that you follow the correct connection instructions.

DANGER ⚠ Dangerous electrical voltage!

Use only PELV circuits for the STO wiring and the 24V supply!

Make sure that no jumpers or the like can be inserted parallel to the safety wiring. For example, use the maximum wire cross-section of 1.5 mm² or suitable wire end sleeves with insulating collars for the connection to the associated connector.

› Configuration on the device [X3]

Phoenix Contact SACC-CIP-M12MS-8P SMD SH T - 1411959 (M12, 8-pin, A-coded)

› Mating connector

Phoenix Contact:

1,5 m Cable (PVC): SAC-8P- 1,5-PUR/M12FS SH - 1522862
2,0 m Cable (PUR): SAC-8P- 2,0-542/ FS SH SCO BK - 1406083
Single plug: SACC-FS-8QO-0,5 SH SCO - 1414611

INFORMATION Self-assembly connectors

The connectors for self-assembly have a larger outer radius than pre-assembled connectors. For space reasons, a self-assembly connector can therefore only be used for [X9] or [X3]. The other plug must be pre-assembled.

› Pin assignment [X3]

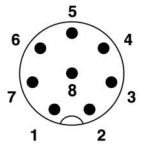

Figure 12: Connector 24 V supply and STO [X3], view on pin side

Pin	Name	Specification
1	STOA	Control input A for the STO function
2	GNDA	Reference potential for STOA
3	STOB	Control input B for the STO function
4	GNDB	Reference potential for STOB
5	DIN6	Digital input 6 (limit switch 0)
6	DIN7	Digital input 7 (limit switch 1)
7	24 V	24 V supply
8	GND	Reference potential for 24 V supply

For wiring the 24 V supply, be sure to also observe the instructions in section 5.3 *Connector BL 4100-M / BL 4100-D: Power supply [X9]* on page 30 or in section 5.4 *Connector BL 4800-M / BL 4800-D: Power supply [X9]* on page 33.

To ensure the STO ("Safe Torque Off") function, the control inputs STOA and STOB must be connected in a dual-channel manner with parallel wiring. See section *Safe torque off (STO)* in the Product manual smartServo BL 4000-D and BL 4000-M. This type of connection can be part of an emergency stop circuit or safety door setup, for example.

› Cable type and configuration [X3]

Characteristic	Value
Max. cable length, unshielded	30 m
Max. cable length, shielded	> 30 m
Cable cross-section (flexible conductors, wire end sleeve with insulating collar), one conductor	0.25 mm²… 0.5 mm²

› Minimum wiring for commissioning [X3]

⚠ DANGER Danger to life due to bypassed safety functions

Safety functions must never be bypassed.

For the commissioning of the system without any safety systems, STOA and STOB can be connected to the 24 V supply and GNDA and GNDB can be connected to GND in a fixed manner.

Perform the minimum wiring of the inputs STOA/STOB and GNDA/GNDB for the commissioning process in such a way that it must be removed when the final safety wiring is performed.

5.6 Connector BL 4100-M: motor [X6], [X6B]

On BL 4100-M type devices, the motor is connected via a PCB connector ([X6], see the following figure, label A), before the servo drive is mounted on the motor. The motor is connected to the terminals U,V,W. A possibly existing motor holding brake can be connected via a PCB terminal with push-in technology [X6B] (Label B). An analogue motor temperature sensor is connected via the encoder interface at [X2] (Label C). This is described in section 5.11 *Connector BL 4000-M: resolvers and encoder [X2]* on page 53.

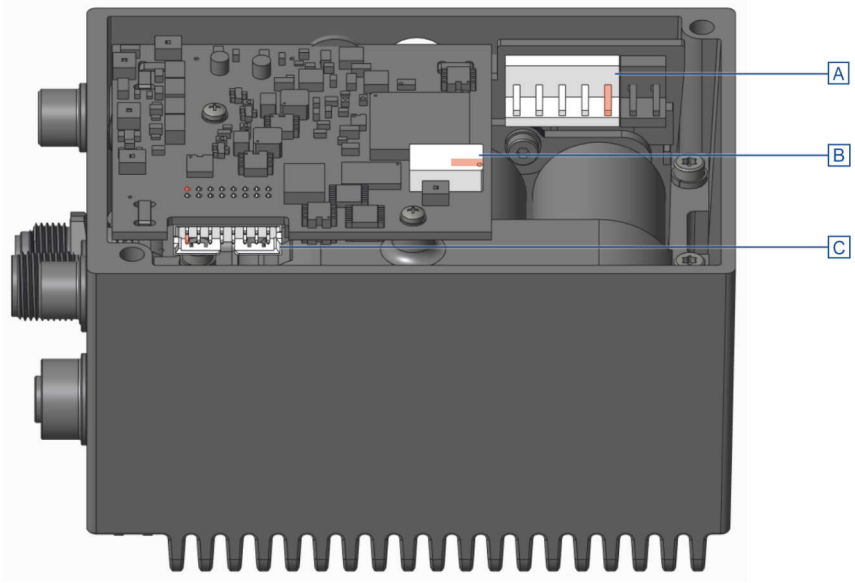

Figure 13: Connector arrangement: motor [X6], holding brake [X6B] and angle encoder [X2]

› Configuration on the device [X6], [X6B]

X6: B5P-VH-B LF (Manufacturer: JST)
X6B: Push-in PCB terminal 2060-452/998-404 (Manufacturer: Wago)

› Mating connector [X6]

X6: VHR-5N with 4 Contacts SVH-41T-P1.1 (Manufacturer: JST)

› Pin assignment

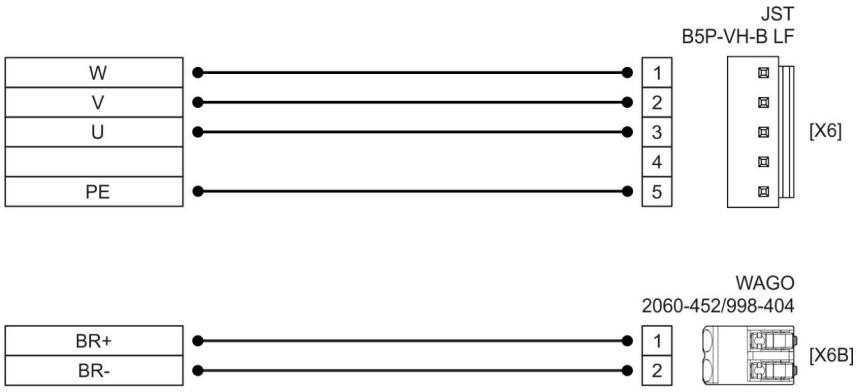

Figure 14: Pin assignment: motor connector (motor with hoding brake) [X6], [X6B]“

Pin X6	Name	Specification
1	W	Motor phase W
2	V	Motor phase V
3	U	Motor phase U
4		
5	PE	Protective earth conductor of the motor

Pin X6B	Name	Specification
1	BR+	Holding brake +
2	BR-	Holding brake -

⚠WARNING Risk of injury

The brake output of the servo drive (BR+, BR-) must not be used as the sole stop element in safety-oriented applications.

› Cable type and configuration [X6]

The cable names that are stated refer to cables made by Lapp and Helukabel. However, it is also possible to use comparable cables from other manufacturers, for example Lütze.

U,V,W and PE: LAPP KABEL MULTI-STANDARD SC 1 (UL), 0,75 mm², 300V, 105 °C
BR+, BR-: HELUTHERM 145 (UL), AWG 24, 0,2 mm², 300V, 120 °C,

INFORMATION Comply with the required minimum cross-section

Always observe the minimum cross-sections for the lines U, V, W and PE.

› Connection notes [X6]

Assemble the connector [X6] according to the manufacturer's specifications. To maintain the necessary safety distance, pin 4 must not be equipped with a crimp contact.

An existing holding brake in the motor is connected to the terminals BR+ and BR- of [X6B]. The cables must be fitted with suitable wire ferrules on the plug side.

When connecting the holding brake, be sure to observe the maximum output current provided by the servo drive.

5.7 Connector BL 4100-D: motor [X6]

On BL 4100-D type devices, the motor is connected via a Intercontec connector. The motor is connected to the terminals U,V,W. An analogue motor temperature sensor can be connected to the terminals MT+ and MT- if it is routed together with the motor phases in one cable. Alternatively, it can be connected via the encoder cable to [X2] (section 5.10 *Connector BL 4000-D: resolvers and encoder [X2]* on page 48). A holding brake of the motor can be connected to terminals BR+ and BR-. If a motor with a HIPERFACE DSL® encoder is used, this encoder is also connected via [X6].

› Configuration on the device [X6]

Intercontec 615/915 ytec Double-Receptacles angled rotatable
EEDA107NN00000002000 with Inserts 60.251.11 and 60.252.11

› Mating connector [X6]

Intercontec 615/915 ytec Double-Receptacles angled rotatable
ESTA201MR01320500000 with Inserts 61.231.11 and 61.232.11

› Pin assignment: motor with a motor temperature sensor

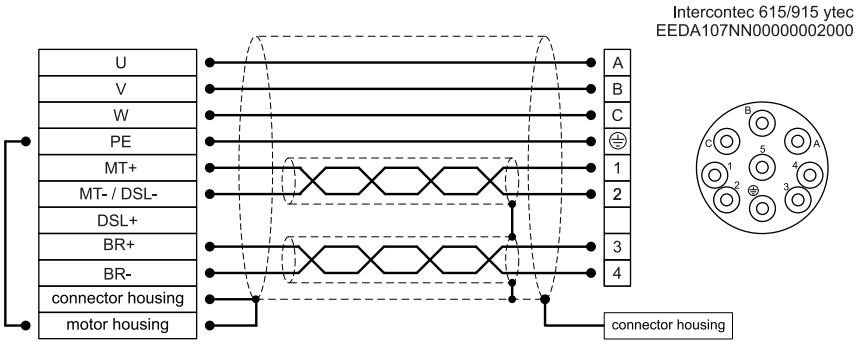

Figure 15: Pin assignment „motor with a motor temperature sensor [X6]“

Pin	Name	Specification
A	U	Motor phase U
B	V	Motor phase V
C	W	Motor phase W
PE	PE	Protective earth conductor of the motor
1	MT+	Motor temperature sensor +
2	MT-/ DSL-	Motor temperature sensor -
3	BR+	Holding brake +
4	BR-	Holding brake -
5	DSL+	

› Pin assignment: motor connector (HIPERFACE DSL®)

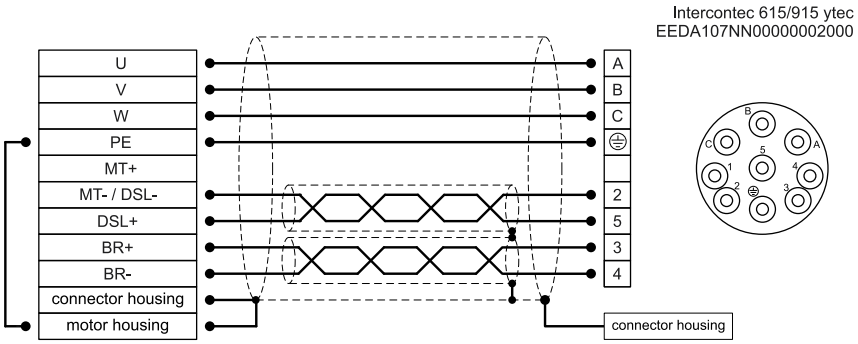

Figure 16: Pin assignment: „motor connector (HIPERFACE DSL®) [X6]“

Pin	Name	Specification
A	U	Motor phase U
B	V	Motor phase V
C	W	Motor phase W
PE	PE	Protective earth conductor of the motor
1	MT+	
2	MT-/ DSL-	HIPERFACE DSL -
3	BR+	Holding brake +
4	BR-	Holding brake -
5	DSL+	HIPERFACE DSL +

› Cable type and configuration [X6]

The cable names that are stated refer to cables made by Lapp. However, it is also possible to use comparable cables from other manufacturers, for example Lütze or Helukabel.

For fixed installation: LAPP KABEL ÖLFLEX SERVO 719 CY
For highly flexible use (drag chains): LAPP KABEL ÖLFLEX SERVO FD 796 CP

Device type	Cable type	Specification (U, V, W, PE)
BL 4104-D	4 G 1,0 + 2 x (2 x 0,75)	4 x 1,0 mm² (AWG 18)

INFORMATION **Comply with the required minimum cross-section**

Always observe the minimum cross-sections for the lines U, V, W and PE according to the above table. Comply also with the maximum permissible cable capacity as per section 6.5 *BL 4100-M / BL 4100-D: Motor connector [X6]* on page 72.

› Connection notes [X6]

Connect the inner and outer cable shield to the connector housing according to the connector manufacturer's specifications.

An existing holding brake in the motor is connected to the terminals BR+ and BR-. When connecting the holding brake, be sure to observe the maximum output current provided by the servo drive.

⚠ DANGER ⚠ Dangerous electrical voltage!

The signals for the temperature sensor "MT-" and "MT+" at the motor connector [X6] must be connected to protective extra-low voltage (PELV) on the motor side and they must be insulated against the motor phases.

⚠ WARNING Risk of injury

The brake output of the servo drive (BR+, BR-) must not be used as the sole stop element in safety-oriented applications.

NOTICE Risk of destruction due to the mix-up of connectors

The servo drive may be irreparably damaged if the connectors for the motor [X6] and supply [X9] are mixed up.

5.8 Connector BL 4800-M: motor [X6]

On BL 4800-M type devices, the motor is connected via threaded terminals on the power unit PCB ([X6], see the following Figure, Label C), before the servo drive is mounted on the motor. A possibly existing motor holding brake can be connected via a PCB terminal with push-in technology [X6B] (Label A). An analogue motor temperature sensor is connected via the encoder interface at [X2] (Label B). This is described in section 5.11 *Connector BL 4000-M: resolvers and encoder [X2]* on page 53.

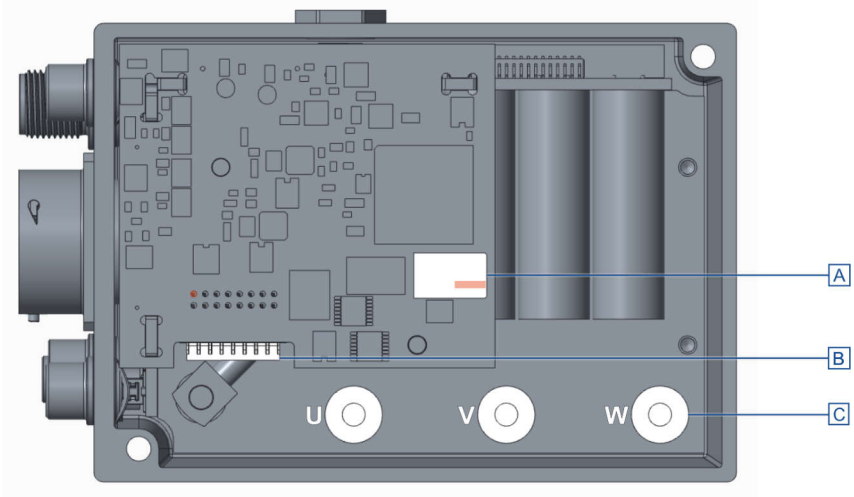

Figure 17: Threaded terminals motor [X6], holding brake plug [X6B] and angle encoder plug [X2]

› Configuration on the device [X6]

Threaded terminals M4

› Mating connector [X6]

Cable lug standard, e.g. Weitkowitz 13015, M4, 4mm²
Angled cable lug 90°, e.g. Weitkowitz 13115, M4, 4mm²
Screw hexagon socket
M4x10mm Tension washer (DIN 6796)

› Pin assignment: motor with holding brake

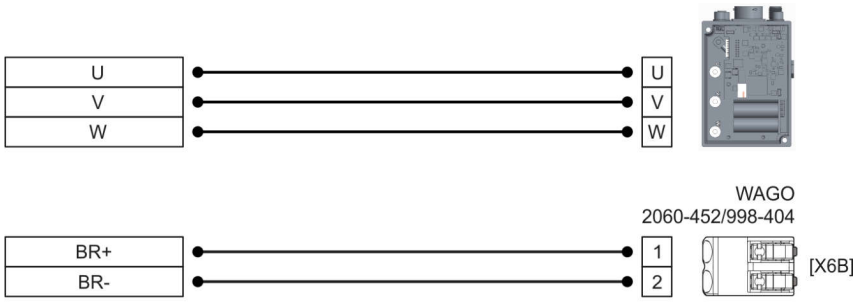

Figure 18: Pin assignment „motor with holding brake [X6], [X6B]“

Pin X6	Name	Specification
U	U	Motor phase U
V	V	Motor phase V
W	W	Motor phase W

Pin X6B	Name	Specification
1	BR+	Holding brake +
2	BR-	Holding brake -

⚠WARNING Risk of injury

The brake output of the servo drive (BR+, BR-) must not be used as the sole stop element in safety-oriented applications.

› Cable type and configuration [X6]

The cable names that are stated refer to cables made by Letronic and Helukabel. However, it is also possible to use comparable cables from other manufacturers, for example Lütze.

U,V,W und PE: Letronic UL 3289, 4 mm², 56 x 0,30 vz., 600V, 150°C
BR+, BR-: HELUTHERM 145 (UL), AWG 24, 0,2 mm², 300V, 120 °C

INFORMATION Comply with the required minimum cross-section

Always observe the minimum cross-sections for the lines U, V and W.

› Connection notes [X6]

Connect the motor phases U,V,W to the threaded terminals with standard or angled cable lugs. For optimum conductivity, the cable lug must rest directly on the screw terminal and be screwed tight with an M4x10 screw with a tightening torque of 2 Nm. A suitable clamping washer must be used to secure against vibration.

Since there is very little space available in the enclosure, it is essential to ensure

- that the cable lugs cannot touch the housing or the adjacent cable lug under any circumstances. In addition, the cable lug must be insulated with heat shrink tubing.
- that the specified bending radii of the cable used are observed.

5.9 Connector BL 4800-D: motor [X6], [X6A]

On BL 4800-D type devices, the motor is connected via an Amphenol connector [X6A]. The motor is connected to the terminals U,V,W. An analogue motor temperature sensor can be connected to the terminals MT+ and MT- if it is routed together with the motor phases in one cable. Alternatively, it can be connected via the encoder cable to [X2] (section 5.10 *Connector BL 4000-D: resolvers and encoder [X2]* on page 48). A holding brake of the motor can be connected to terminals BR+ and BR-. If a motor with a HIPERFACE DSL® encoder is used, this encoder is also connected via [X6].

› Configuration on the device [X6], [X6A]

X6: Intercontec 615/915 ytec Double-Receptacles angled rotatable EEDA107NN00000002000 with Inserts 60.252.11

X6A: Amphenol RT00164SNH03
X6A: Inserts: female, SC000519S

› Mating connector [X6], [X6A]

X6: Intercontec 615/915 ytec Stecker
ESTA201MR01320500000 with 4x Inserts 61.232.11

X6A: Amphenol RT06164PNH Gasket
X6A: Amphenol RT0L-16CG-S1 Backshell straight
X6A: Amphenol RT0B-16CG-S1 Backshell angled
X6A: Inserts: male, SC000518S

› Pin assignment: motor with a motor temperature sensor

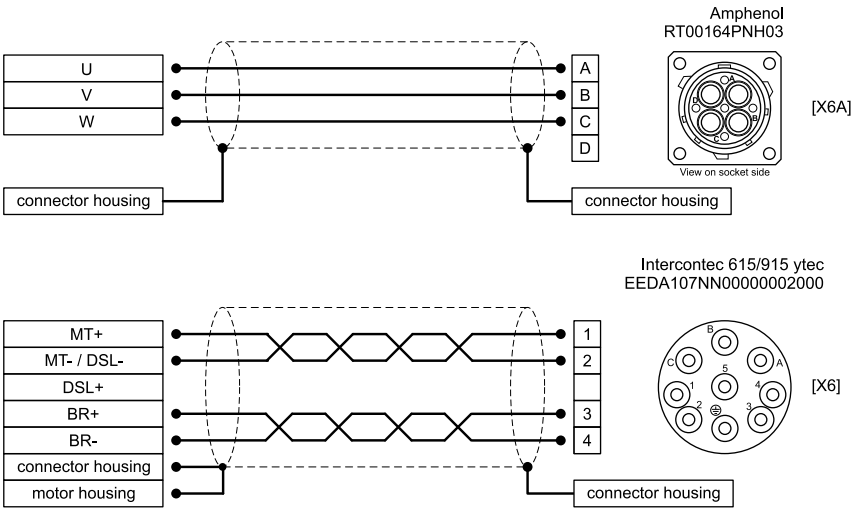

Figure 19: Pin assignment „motor with a motor temperature sensor [X6], [X6A]“

Pin X6A	Name	Specification
1	U	Motor phase U
2	V	Motor phase V
3	W	Motor phase W

Pin X6	Name	Specification
1	MT+	Motor temperature sensor +
2	MT-/ DSL-	Motor temperature sensor -
3	BR+	Holding brake +
4	BR-	Holding brake -
5	DSL+	

› Pin assignment: motor connector (HIPERFACE DSL®)

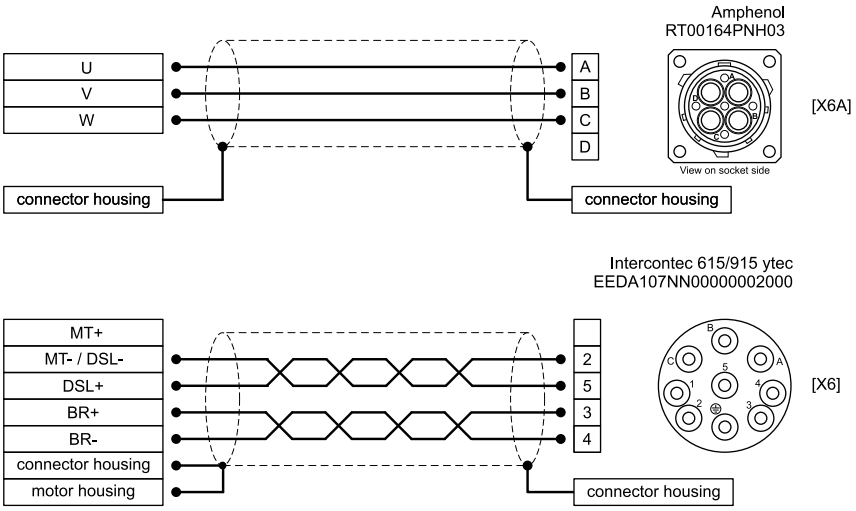

Figure 20: Pin assignment: „motor connector (HIPERFACE DSL®) [X6], [X6A]“

Pin X6A	Name	Specification
1	U	Motor phase U
2	V	Motor phase V
3	W	Motor phase W

Pin X6	Name	Specification
1	MT+	
2	MT-/ DSL-	HIPERFACE DSL -
3	BR+	Holding brake +
4	BR-	Holding brake -
5	DSL+	HIPERFACE DSL +

› Cable type and configuration [X6] und [X6A]

The cable names that are stated refer to cables made by Lapp. However, it is also possible to use comparable cables from other manufacturers, for example Lütze or Helukabel.

X6: LAPP UNITRONIC LiYCY (TP) 2x2x0,75
X6A: ÖLFLEX CLASSIC 135 CH 3G4

Connector	Cable type
X6	(2 x (2 x 0,75 mm²))
X6A	(3 x 4 mm²)

INFORMATION **Comply with the required minimum cross-section**

Always observe the minimum cross-sections for the lines U, V and W.

› Connection notes [X6]

Connect the outer cable shield to the connector housing according to the connector manufacturer's specifications.

An existing holding brake in the motor must be connected to the terminals BR+ and BR-. Please note the maximum output current that is provided by the servo drive.

⚠WARNING **Risk of injury**

The brake output of the servo drive (BR+, BR-) must not be used as the sole stop element in safety-oriented applications.

NOTICE **Risk of destruction due to the mix-up of connectors**

The servo drive may be irreparably damaged if the connectors for the motor [X6] and supply [X9] are mixed up.

5.10 Connector BL 4000-D: resolvers and encoder [X2]

Different types of encoders can be connected to the 15-pin Intercontec connector (see also section 6.7 *Resolver and encoder connector [X2]* on page 77):

- Resolvers
- Analogue Hall generators with tracks that are offset by 90° (sine/cosine)
- Analogue incremental encoders (1 V_{ss})
- Incremental encoders with a serial interface (RS485 level, e.g. EnDat, HIPERFACE®, BISS)
- Digital incremental encoders (RS422, HALL sensors)

It is also possible to evaluate an optional error signal (AS/NAS). With some incremental encoders, it is possible to detect and signal soiling or other faults/malfunctions of the measuring system via an output (AS or NAS). The error signal can be evaluated by digital as well as analogue incremental encoders. In the case of analogue incremental encoders, the evaluation is only possible if no commutation track (Z1) is parameterised and connected. The evaluation of the error signal can be inverted.

With all encoders except resolvers and analogue Hall encoders, the supply voltage of the angle encoder can be set. This must be set correctly before connecting the encoder.

NOTICE **Damage to property caused by an incorrect power supply**

If an incorrect power supply is used, the encoder may be destroyed. Ensure that the correct voltage is activated prior to connecting the encoder to [X2]. To do so, start the Metronix ServoCommander® parameterisation software and select the Parameters/Device parameters/Angle encoder settings.

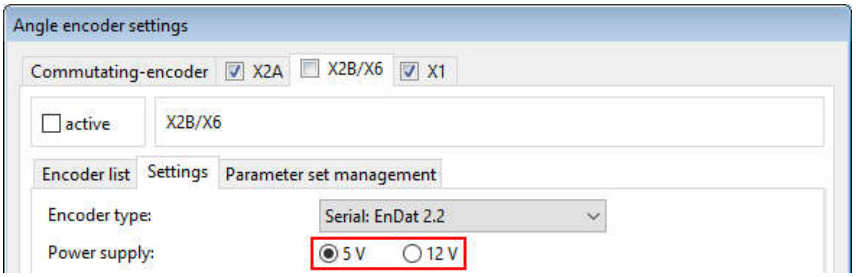

Figure 21: Angle encoder settings: Parameterisation of supply voltage

› Configuration on the device [X2]

Intercontec Double-Receptacles angled rotatable EEDA107NN00000002000,
15 pin female inserts

› Mating connector [X2]

ESTA204MR03330003000, 7x Pin 61.232.11, 1x Pin 61.231.11 (Contact A)

› Pin assignment: resolvers

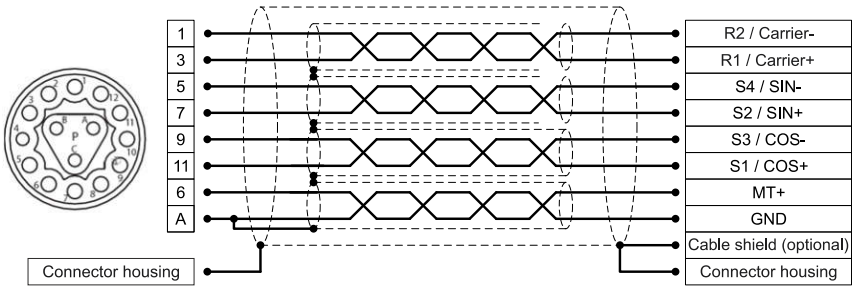

Figure 22: Pin assignment „resolvers [X2]“

Pin	Name	Specification
1	R2	Carrier signal for the resolver
3	R1	
5	S4/SIN-	SINE track signal, differential Analogue Hall sensor (SINE)
7	S2/SIN+	
9	S3/COS-	COSINE track signal, differential Analogue Hall sensor (COSINE)
11	S1/COS+	
6	MT+	Motor temperature sensor, normally closed contact, PTC, NTC, KTY
A	GND	Temperature sensor reference potential

› Pin assignment: analogue incremental encoders

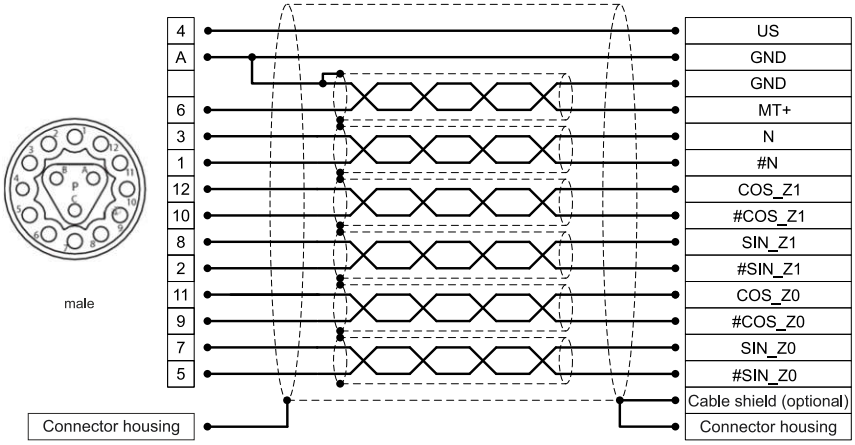

Figure 23: Pin assignment: „analogue incremental encoders [X2]“

Pin	Name	Specification
4	US	Operating voltage for incremental encoders
A	GND	Associated reference potential
6	MT+	Motor temperature sensor, normally closed contact, PTC, NTC, KTY
3	N	Index pulse track signal (differential) of the high-resolution incremental encoder
1	#N	
12	COS_Z1 / D+	COSINE commutation signal (differential) of the high-resolution incremental encoder
10	#COS_Z1 / D-	
8	SIN_Z1 / C+	SINE commutation signal (differential) of the high-resolution incremental encoder
2	#SIN_Z1 / C- / AS / NAS	
11	COS_Z0 / B+	COSINE track signal (differential) of the high-resolution incremental encoder
9	#COS_Z0 / B-	
7	SIN_Z0 / A+	SINE track signal (differential) of the high-resolution incremental encoder
5	#SIN_Z0 / A-	

› Pin assignment: incremental encoder with a serial interface

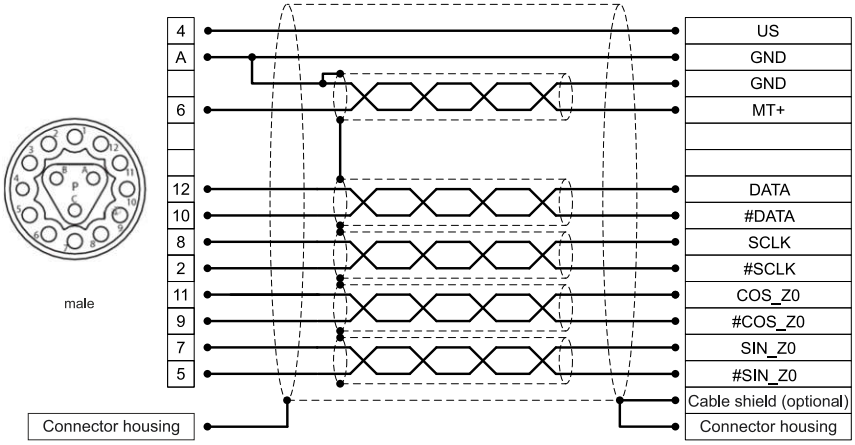

Figure 24: Pin assignment:„incremental encoder with a serial interface [X2]“

Pin	Name	Specification
4	US	Operating voltage
A	GND	Associated reference potential
6	MT+	Motor temperature sensor, normally closed contact, PTC, NTC, KTY
12	DATA / SL+	Bidirectional RS485 data line (differential) (EnDat/HIPERFACE®, BISS)
10	#DATA / SL-	
8	SCLK / MA+	Clock pulse output RS485 (differential) (EnDat, BiSS)
2	#SCLK / MA-	
11	COS_Z0 / B+	COSINE track signal (differential) of the high-resolution incremental encoder
9	#COS_Z0 / B-	
7	SIN_Z0 / A+	SINE track signal (differential) of the high-resolution incremental encoder
5	#SIN_Z0 / A-	

› Pin assignment: digital incremental encoder (RS422)

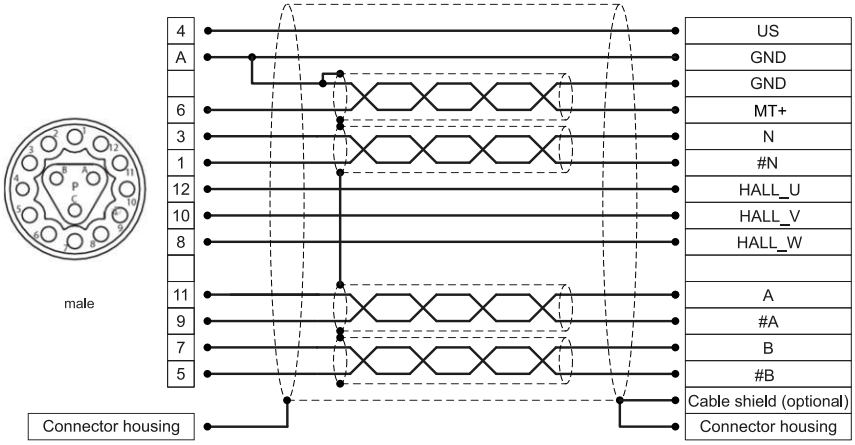

Figure 25: Pin assignment: „digital incremental encoder (RS422) [X2]“

Pin	Name	Specification
4	US	Operating voltage for incremental encoders
A	GND	Associated reference potential
6	MT+	Motor temperature sensor, normally closed contact, PTC, NTC, KTY
3	N / U_{a0}	Index pulse RS422 (differential) of the digital incremental encoder
1	#N / $\overline{U}_{a0}$	
12	HALL_U	Phase U of the Hall sensor for commutation
10	HALL_V	Phase V of the Hall sensor for commutation
8	HALL_W	Phase W of the Hall sensor for commutation
11	A / U_{a1}	A track signal RS422 (differential) of the digital incremental encoder
9	#A / $\overline{U}_{a1}$	
7	B / U_{a2}	B track signal RS422 (differential) of the digital incremental encoder
5	#B / $\overline{U}_{a2}$	

› Cable type and configuration [X2]

The cable names that are stated refer to cables made by Lapp. However, it is also possible to use comparable cables from other manufacturers, for example Lütze or Helukabel.

Resolvers / analogue Hall generators:
LAPP ÖLFLEX SERVO 728 CY; 3 x (2 x 0,14) + 2 x (0,5);
LAPP ÖLFLEX SERVO FD 798 CP; 3 x (2 x 0,14) + 2 x (0,5);
use 2 x (0,5) for the resolver carrier.

Other encoder types:

We recommend using the encoder connection cables that are approved by the respective manufacturer (Heidenhain, Sick-Stegmann, etc.) for their product. For the angle encoder supply US and GND we recommend a minimum cross-section of 0.25 mm².

5.11 Connector BL 4000-M: resolvers and encoder [X2]

On BL 4100-M type devices, the angle encoder is connected via a PCB connector [X2], see the following Figure (C), before the servo drive is mounted on the motor.

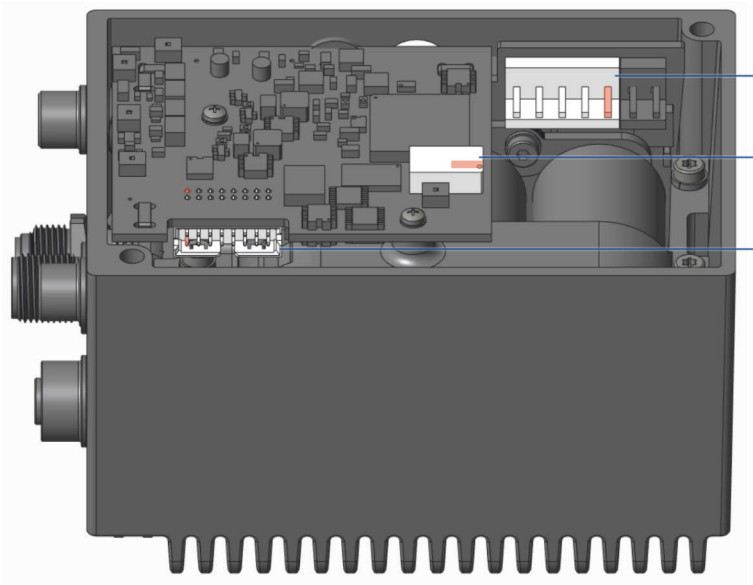

Figure 26: Connector arrangement: motor [X6], holding brake [X6B] and angle encoder [X2]

Different types of encoders can be connected to the Molex connector (see also section 6.7 *Resolver and encoder connector [X2]* on page 77):

- Resolvers
- Analogue Hall generators with tracks that are offset by 90° (sine/cosine)
- Analogue incremental encoders (1 V_{ss})
- Incremental encoders with a serial interface (RS485 level, e.g. EnDat, HIPERFACE®, BISS)
- Digital incremental encoders (RS422, HALL sensors)

It is also possible to evaluate an optional error signal (AS/NAS). With some incremental encoders, it is possible to detect and signal soiling or other faults/malfunctions of the measuring system via an output (AS or NAS). The error signal can be evaluated by digital as well as analogue incremental encoders. In the case of analogue incremental encoders, the evaluation is only possible if no commutation track (Z1) is parameterised and connected. The evaluation of the error signal can be inverted.

› Configuration on the device [X2]

Molex No. 0878331619

› Mating connector [X2]

Molex No. 51110-1651 with up to 16 contacts No. 50394-8051

With all encoders except resolvers and analogue Hall encoders, the supply voltage of the angle encoder can be set. This must be set correctly before connecting the encoder.

NOTICE **Damage to property caused by an incorrect power supply**

If an incorrect power supply is used, the encoder may be destroyed. Ensure that the correct voltage is activated prior to connecting the encoder to [X2]. To do so, start the Metronix ServoCommander® parameterisation software and select the Parameters/Device parameters/Angle encoder settings.

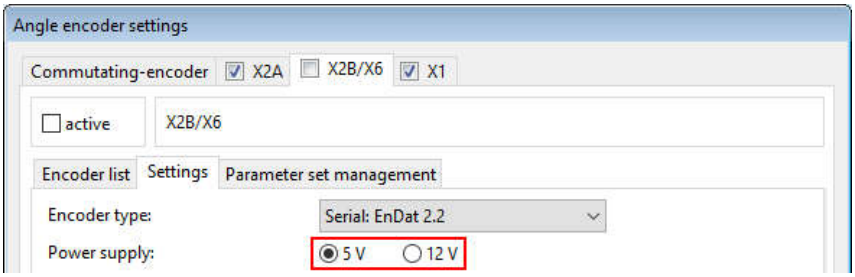

Figure 27: Angle encoder settings: Parameterisation of supply voltage

› Pin assignment: resolvers

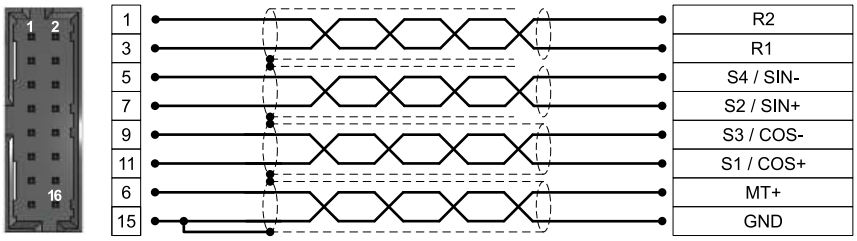

Figure 28: Pin assignment „resolvers [X2]“

Pin	Name	Specification
1	R2	Carrier signal for the resolver
3	R1	
5	S4/SIN-	SINE track signal, differential Analogue Hall sensor (SINE)
7	S2/SIN+	
9	S3/COS-	COSINE track signal, differential Analogue Hall sensor (COSINE)
11	S1/COS+	
6	MT+	Motor temperature sensor, normally closed contact, PTC, NTC, KTY
15	GND	Temperature sensor reference potential

› Pin assignment: analogue incremental encoders

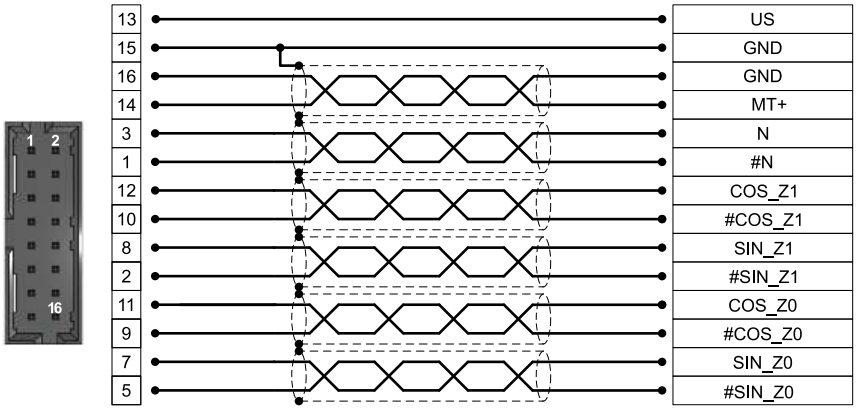

Figure 29: Pin assignment: „analogue incremental encoders [X2]“

Pin	Name	Specification
13	US	Operating voltage for incremental encoders
15	GND	Associated reference potential
14	MT+	Motor temperature sensor, normally closed contact, PTC, NTC, KTY
3	N	Index pulse track signal (differential) of the high-resolution incremental encoder
1	#N	
12	COS_Z1 / D+	COSINE commutation signal (differential) of the high-resolution incremental encoder
10	#COS_Z1 / D-	
8	SIN_Z1 / C+	SINE commutation signal (differential) of the high-resolution incremental encoder
2	#SIN_Z1 / C- / AS / NAS	
11	COS_Z0 / B+	COSINE track signal (differential) of the high-resolution incremental encoder
9	#COS_Z0 / B-	
7	SIN_Z0 / A+	SINE track signal (differential) of the high-resolution incremental encoder
5	#SIN_Z0 / A-	

› Pin assignment: incremental encoder with a serial interface

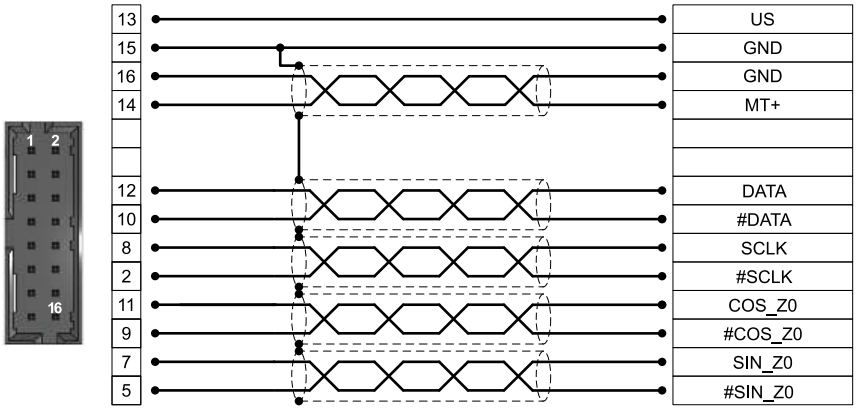

Figure 30: Pin assignment:„incremental encoder with a serial interface [X2]“

Pin	Name	Specification
13	US	Operating voltage
15	GND	Associated reference potential
14	MT+	Motor temperature sensor, normally closed contact, PTC, NTC, KTY
12	DATA / SL+	Bidirectional RS485 data line (differential) (EnDat/HIPERFACE®, BISS)
10	#DATA / SL-	
8	SCLK / MA+	Clock pulse output RS485 (differential) (EnDat, BiSS)
2	#SCLK / MA-	
11	COS_Z0 / B+	COSINE track signal (differential) of the high-resolution incremental encoder
9	#COS_Z0 / B-	
7	SIN_Z0 / A+	SINE track signal (differential) of the high-resolution incremental encoder
5	#SIN_Z0 / A-	

› Pin assignment: digital incremental encoder (RS422)

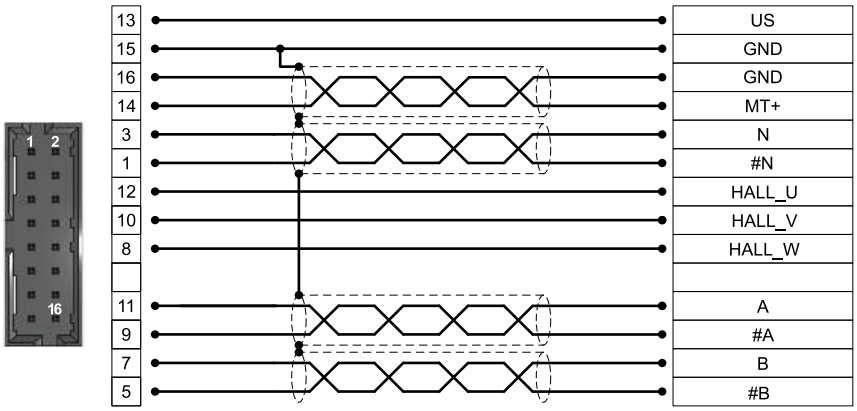

Figure 31: Pin assignment: „digital incremental encoder (RS422) [X2]“

Pin	Name	Specification
13	US	Operating voltage for incremental encoders
15	GND	Associated reference potential
14	MT+	Motor temperature sensor, normally closed contact, PTC, NTC, KTY
3	N / U_{a0}	Index pulse RS422 (differential) of the digital incremental encoder
1	#N / $\overline{U}_{a0}$	
12	HALL_U	Phase U of the Hall sensor for commutation
10	HALL_V	Phase V of the Hall sensor for commutation
8	HALL_W	Phase W of the Hall sensor for commutation
11	A / U_{a1}	A track signal RS422 (differential) of the digital incremental encoder
9	#A / $\overline{U}_{a1}$	
7	B / U_{a2}	B track signal RS422 (differential) of the digital incremental encoder
5	#B / $\overline{U}_{a2}$	

› Cable type and configuration [X2]

As only short cables are used for the motor installation variant, shielded and twisted cables can usually be omitted. However, the cables must not exceed a maximum length of 80 mm. For the encoder supply US and GND we recommend a minimum cross-section of 0.25 mm², for all other cables a cross-section of 0.14 mm².

5.12 Connector: USB [X19]

The BL 4000-M / BL 4000-D servo drive has a Type Mini-B USB connector.

The correct operation requires a short USB cable (< 3 m) and the correct installation and earthing of the servo drive. If excessive malfunctions/faults lead to communication problems (frozen communication), the USB connector can be briefly disconnected to restart the communication. In any case, we recommend using certified and double-shielded cables with shielded plugs of the following type :

Type AB type (USB 2.0 connecting cable, type A connector to type Mini-B connector) AWG24-2C

INFORMATION **Non-EMC-compliant wiring of the servo drive and motor**

In case of non-EMC-compliant wiring of the servo drive and motor, compensating electric current may flow via the connected computer and the USB interface. This may lead to communication problems. To avoid this, we recommend using an electrically isolated USB adapter "Delock USB Isolator" (type 62588 by Delock) or a comparable adapter.

INFORMATION **Use USB only during commissioning**

The USB interface should only be used during commissioning and not as a process interface in an application. In an industrial environment, the electrically much more robust Ethernet interface should be preferred instead.

› Configuration on the device [X19]

USB connector (female), type Mini-B

› Mating connector [X19]

USB connector (male), type Mini-B

› Pin assignment USB [X19]

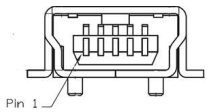

Figure 32: Pin assignment of the USB connector

Pin	Name	Specification
1		
2	D-	Data -
3	D+	Data +
4		
5	GND	GND

5.13 Connector: Fieldbus [X21], [X22]

The integration into a fieldbus network, is done via two M8 connectors according to IEC 61076-114 (4-pin, socket, D-coded). Depending on the existing fieldbus variant (see section 3.1 *Type designation* on page 17), the connector is either used for the connection of a real-time Ethernet fieldbus (EtherCAT/PROFINET) or a CAN fieldbus (CANopen). Both fieldbus variants must never be used simultaneously in the same network, as they are electrically incompatible! With fieldbus variant PROFINET/EtherCAT, the connection [X22] *RTE1* is also used for communication with the Metronix ServoCommander® as long as neither EtherCAT nor PROFINET are active. The CAN fieldbus variant does not have an Ethernet interface!

Details on the fieldbus connection can be found in the respective fieldbus manuals.

› Configuration on the device [X21], [X22]

Flush-type connector, Ethernet/PROFINET
Phoenix Contact, SACC-CIP-M8FSD-4P SMD SH R32 - 1068454

› Mating connector [X21], [X22]

Assembled network cable Phoenix Contact:

M8 plug to M8 plug: NBC-M8MSD/ 1,0-93C/M8MSD - 1423707
M8 plug to RJ45: NBC-M8MSD/ 1,0-93C/R4AC - 1423711
M8 plug to free cable end: NBC-M8MSD/ 1,0-93C - 1423703

› Pin assignment [X21], [X22]

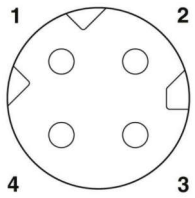

Figure 33: Pin assignment of the fieldbus connector

Pin assignment **EtherCAT/PROFINET**:

Pin	Name	Description	Colour
1	TD+	Transmission signal +	Yellow
2	RD+	Reception signal +	White
3	TD-	Transmission signal -	Orange
4	RD-	Reception signal -	Blue

Pin assignment **CANopen**:

Pin	Name	Description	Colour
1	CAN-H	Differential Signal High	Yellow
2	CAN-GND	Reference potential	Orange
3	CAN-L	Differential Signal Low	White
4	CAN-GND	Reference potential	Blue

› Cable type and configuration (CAN variant) [X21], [X22]

We recommend using the pre-assembled cables listed above or comparable products from other manufacturers.

For trouble-free operation of the CAN bus communication, the following instructions must be observed

- Ideally, the individual nodes of the networks are always connected in a linear manner so that the CAN cable is looped through from servo drive to servo drive.
- A terminating resistor of 120 Ω, 5%, must be present on both ends of the CAN bus cable
- We advise against the use of intermediate plugs for cabling the CAN bus. However, if this is necessary, use metal connector housings for connecting the cable shield.

In order to keep interferences as low as possible ensure that

- the motor cables are not installed parallel to signal lines
- the motor cables comply with the specification
- the motor cables are properly shielded and earthed (grounded)

5.14 Connector: I/O interface [X1]

The analogue input (AIN) and the analogue output (AOUT) are rated for voltages in the range ± 10 V. Both the analogue inputs and the analogue output must be connected to the controller via twisted and shielded cables.

If the control system has a single-ended output, the output is connected to AIN and the reference potential of the control system is connected to GND. Use a twisted pair of wires for AIN/GND.

If the controller has a differential output, the differential signals should - if possible - be led to the controller in a twisted pair of wires and the reference potential in another pair of wires. Directly in connector [X1], the negative differential signal is then connected to GND and the positive differential signal to AIN. This reduces potential shifts and equalising currents via [X1]. For the best possible interference suppression on the analogue signal lines, the wires of the analogue signals must also be shielded separately.

The connections related to 24 V can be unshielded. For long lines (l>2 m) to the controller, shielded lines should be used, with the shields connected to PE at both ends.

The servo drive provides a 5 V auxiliary voltage to supply external encoders connected to the master frequency input. The differential signals of the master frequency interface (A/#A and B/#B) should each be routed in a twisted pair of wires.

If a 24V auxiliary supply is needed, one of the digital outputs can be permanently configured to *On*. This can be used, for example, to supply an external switch or an operating unit.

The digital outputs are designed as so-called "high-side switches". This means that only the 24 V is switched through to the output in the active state. In the passive state, the output is high-impedance and the level is defined only by the flyback diode and a high-impedance internal resistor.

› Configuration on the device [X1]

M12 Flush-type connector Phoenix Contact, SACC-CI-M12FS-17P SMD T - 1411917

› Mating connector [X1]

Single connector:

Connector, Universal, 17-position, Plug straight M12 SPEEDCON, Coding: A, Piercecon® fast connection, knurl material: Zinc die-cast, nickel-plated, external cable diameter 5.4 mm ... 8.2 mm:
Phoenix Contact, SACC-MS-17PCON SCO - 1559602

Assembled cable:

Sensor/actuator cable, 17-position, PUR/PVC, black RAL 9005, shielded, Plug straight M12 SPEEDCON, coding: A, on free cable end, cable length: 1.5 m:
Phoenix Contact, SAC-17P-MS/ 1,5-35T SH SCO - 1430200

› Pin assignment [X1]

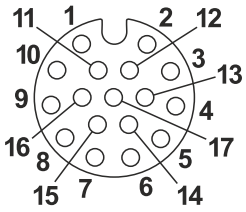

Figure 34: I/O interface [X1]

Pin	Name	Specification
1	DIN0	Digital input 0
2	DIN1	Digital input 1
3	DIN2	Digital input 2
4	DIN3	Digital input 3
5	DIN4	Digital input 4
6	DIN5	Digital input 5 (servo drive enable signal)
7	DIN8	Digital Input (flying saw, sampling)
8	DOUT0	Freely programmable digital output 0
9	DOUT1	Freely programmable digital output 1
10	AOUT	Analogue output
11	A / CLK	Incremental encoder signal A/stepper motor signal CLK
12	#A / CLK	Incremental encoder signal #A/stepper motor signal CLK
13	B / DIR	Incremental encoder signal B/stepper motor signal DIR
14	#B / DIR	Incremental encoder signal #B/stepper motor signal DIR
15	+5 V	Encoder supply (see pin 11 to 14)
16	AIN	Analogue input, input voltage 30 V max.
17	GND	Reference potential for Analogue input

› Cable type and configuration [X1]

The specified cable type refers to a ready-assembled cable from Phoenix Contact. It is possible to use comparable cables from other manufacturers.

Phoenix Contact, SAC-17P-MS/ 1,5-35T SH SCO - 1430200

6 Technical data

This chapter provides all of the relevant technical data of the BL 4000-M / BL 4000-D servo drives with an integrated "Safe Torque Off (STO)" safety function.

6.1 General technical data

› Qualification

Characteristic	Value
Low Voltage Directive	2014/30/EU by applying the harmonised standard EN 61800-5-1 See section 9.1 *CE conformity (EMC, RoHS, Low Voltage Directive)* on page 89
EMC	2014/35/EU by applying the harmonised standard EN 61800-3 See section 9.1 *CE conformity (EMC, RoHS, Low Voltage Directive)* on page 89 and section 5.1 *Notes concerning the safe and EMC-compliant installation* on page 26
Machinery Directive/ Functional Safety	2006/42/EC See section 9.2 *CE conformity (Machinery Directive)* on page 91
UL	Recognised according to UL 61800-5-1, C22.2 No. 274-13 See section 9.3 *cURus certification* on page 93 and section 5.2 *Additional requirements for the UL approval* on page 29

› Ambient conditions

Characteristic	Value
Storage temperature	-25°C to +70°C
Ambient temperature	0 °C to +30 °C (BL 4104-D : 0 °C to +40 °C) up to +50°C with a power reduction of 2.5%/K
Permissible installation altitude	Max. installation altitude 2,000 m above MSL; with a power reduction of 1% per 100 m as of 1,000 m above MSL
Atmospheric humidity	Relative humidity up to 90%, non-condensing
Type of enclosure	IP54, depending on mounting type up to IP67
Protection class	I
Pollution degree rating	2
Operational environment according to EN 61800-3	Without additional measures: First and second environment (C2/C3)

INFORMATION **Compliance with the pollution degree rating**

The integrated safety technology requires compliance with pollution degree rating 2 and thus a protected enclosure (IP54). This must always be ensured through appropriate measures.

⚠WARNING **Use in residential environment**

In a residential environment, servo drives of the BL 4000-M / BL 4000-D device family can cause high-frequency interference, which makes interference suppression measures necessary.

› Maximum housing temperature

Depending on the installation, the servo drive is additionally heated by the motor, for example. The following housing temperatures must not be exceeded under any circumstances:

Characteristic	BL 4840-M	BL 4840-D	BL 4104-M	BL 4104-D
Maximum housing temperature	82 °C	81 °C	85 °C	93 °C

› Dimensions and weight *)

Characteristic	BL 4000-M	BL 4000-D
Dimensions including the mounting plate (H*W*D)	125 mm*80 mm*65 mm	127 mm*106 mm*104 mm
Housing dimensions (H*W*D)	125 mm*80 mm*65 mm	125 mm*80 mm*65 mm
Weight	approx. 0.7 kg	approx. 1.0 kg

*) Device dimensions without the mating connector.

6.2 BL 4100-M / BL 4100-D: Power supply [X9]

› Power data

Characteristic	Value
Supply voltage	1 x 75...230 VAC [± 10 %], 50 ... 60 Hz
Supply network type	TN, TT
Maximum mains current in continuous operation (S1) *1)	6 A_{eff}
DC bus voltage	325 VDC (with U_{mains} = 230 VAC)

*1) with a supply voltage of 230 V and power factor 0.6

INFORMATION **Supply with low voltage**

If low-voltage operation is necessary, we recommend using a series transformer or isolating transformer for decreasing the voltage.

NOTICE **DC supply**

The BL 4100-M / BL 4100-D servo drives cannot be supplied with DC voltage via the DC link terminals nor via L1/N (DC supply).

› Internal braking resistor

Characteristic	Value
Braking resistor	47 Ω
Peak power	4 kW
Continuous power	13 W

6.3 BL 4800-M / BL 4800-D: Power supply [X9]

› Power data

Characteristic	Value
Supply voltage	24 ... 48 VDC [± 10 %]
Maximum mains current in continuous operation (S1)	40 A_{eff}
DC bus voltage	corresponds to the supply voltage

INFORMATION **Supplying with power supply unit**

The power supply unit used must

- be able to charge the capacitive load of the DC link capacitors with current limitation when switched on.
- be able to tolerate the high voltage at [X9] occurring during braking without raising an error.

Additional external buffer capacitors can be used to buffer the braking energy.

NOTICE **BL 4800-M / BL 4800-D: Danger of destroying the power supply unit**

During braking, a high voltage can be present at [X9], which can destroy the power supply unit. To prevent this, the switch-off threshold in case of overvoltage must be suitably parameterised (see section *Power supply via main power unit* in the Product manual smartServo BL 4000-D and BL 4000-M).

NOTICE **High charging current when battery is connected**

When connecting a battery, a high compensating current (>1000 A) flows until the internal capacitors of the servo drive are charged. We therefore recommend initially connecting the battery via a 1kΩ resistor for precharging.

› Internal braking resistor

Characteristic	Value
Braking resistor	3.9 Ω
Peak power	1.6 kW
Continuous power	5 W

6.4 24 V supply and STO [X3]

› 24 V supply

Characteristic	Value
24 V supply	24 VDC [± 20 %] (0.2 A) *1)

*1) plus the current consumption of the I/O's and a possibly existing holding brake.

› Characteristic values

Characteristic	Value
Safety level	Category 4 and performance level e or SIL3/SIL CL3.
PFH (probability of dangerous failure per hour)	3×10^{-11}
PFD (probability of dangerous failure on demand)	5×10^{-6}
DCavg (average diagnostic coverage)	High
MTTFd (mean time to dangerous failure)	Limited to 100 years (cat. 3) Limited to 2,500 years (cat. 4)

See also section 9.2 *CE conformity (Machinery Directive)* on page 91.

INFORMATION **Proof-testing of the STO function**

Comply with the following test intervals in order to reach the specified values:

- For SIL 2, PL d/category 3: 1x per year
- For SIL 3, PL e/category 3: every 3 months
- For SIL 3, PL e/category 4: daily

6.4.1 Electrical data of the STO function

› Control inputs STOA/STOB [X3]

Characteristic	Value
Nominal voltage	24 V (referred to GNDA/GNDB)
Voltage range	19.2 V… 28.8 V
Permissible ripple	2 % (referred to a nominal voltage of 24 V)
Nominal current	12 mA typ., 30 mA max.
Switch-on input voltage threshold	>= 16 V
Switch-off input voltage threshold	< 5 V

For the technical data of the digital inputs DIN6 and DIN7, see the section 6.10 *I/O Interface [X1]* on page 81.

› Response time until power output stage inactive and maximum OSSD test pulse duration

The typical response time and the maximum test pulse duration depend on the input voltage at STOA/STOB:

Characteristic	Value		
Input voltage (STOA/STOB)	19.2 V	24 V	28.8 V
Typical response time	2 ms	3 ms	4 ms
Max. test pulse duration (OSSD)	0.5 ms	1 ms	1.5 ms

The maximum response time $t_{STOAB/OFF}$ is described in section 6.4.2.1 *Time response of the STO activation during operation with a restart* on page 68.

6.4.2 Time response

INFORMATION **Equal inputs in terms of their functionality**

The inputs STOA and STOB are absolutely equal in terms of their functionality, which is why the switching sequence of STOA/STOB is interchangeable in all of the diagrams.

6.4.2.1 Time response of the STO activation during operation with a restart

The illustration shows the time response starting with the disconnection of the control voltage at STOA/B and the sequence that is necessary for restarting the device.

- The actuation of the holding brake is realised via the basic device and not in a safety-oriented manner.
- The illustration shows the coasting of the motor regardless of the activation/deactivation of the brake
- The setpoint will not be enabled until the holding brake delay T_F has elapsed.
- An error will be issued as the STO inputs are deactivated while the output stage is active. It is not included in the drawing.

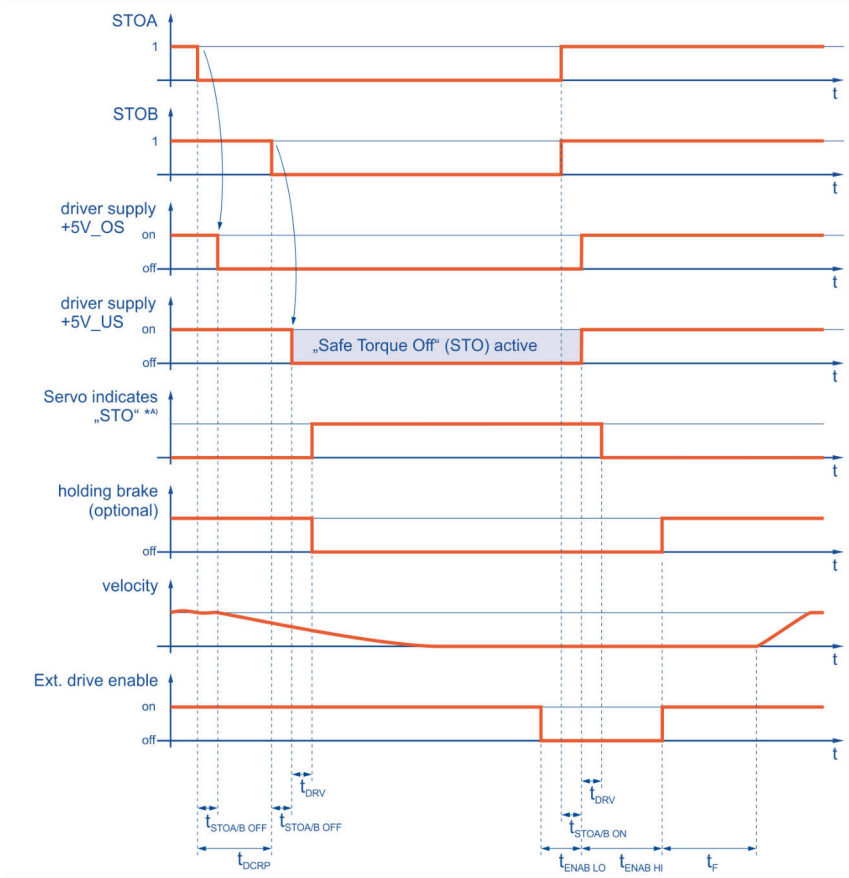

Figure 35: Time response of the activation of the STO safety function with a restart

*A) see section 0.1 *Operating mode and error indication* on page 1

Time	Description	Value
t_{DCRP}	Maximum permissible discrepancy time without the servo drive issuing an error	100 ms
$t_{STOA/B\ OFF}$	STOA/B – switching time from high to low (See also section *Response time until power output stage inactive and maximum OSSD test pulse duration* on page 68)	Maximum response time 5 ms
$t_{STOA/B\ ON}$	STOA/B switching time from low to high	0.6 ms typ., 1 ms max.
t_{DRV}	Delay of the internal sequence control of the servo drive	10 ms max.
$t_{ENAB\ LO}$	Time that the servo drive enable signal (DIN5 or bus enable signal) must be low before STOA/B will be activated	0
$t_{ENAB\ HI}$	Time that the servo drive enable signal (DIN5 or bus enable signal) must be low after STOA/B has been reactivated and the status of the STO circuit has changed	> 20 ms
t_F	Brake control and automatic brake	Parameterisable [1]

[1] see section *Brake control and automatic brake* in the Product manual smartServo BL 4000-D and BL 400

6.4.2.2 Time response of the SS1 activation during operation with a restart

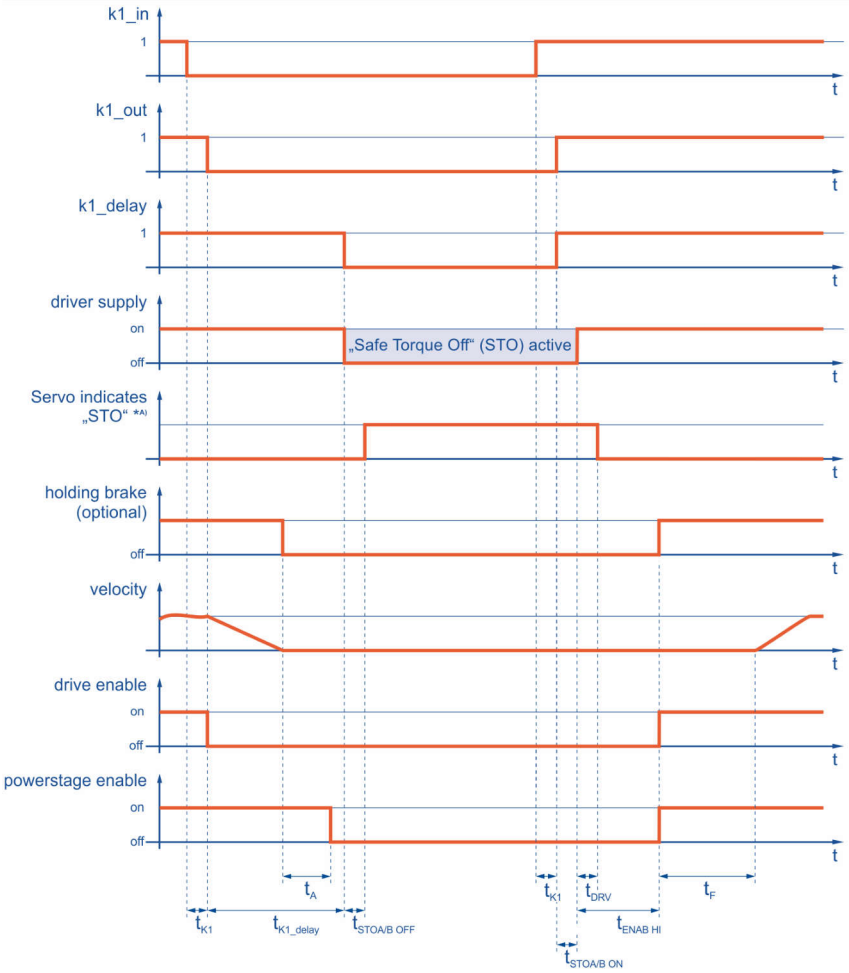

Figure 36: Time response during the activation of the SS1 safety function (external switching) with a restart

*A) see section 0.1 *Operating mode and error indication* on page 1

Time	Description	Value
t_{K1}	Delay between the switching of S1 and the closing of the undelayed contact K1	See the data sheet of the safety relay
t_{K1_delay}	Delay between S1 and the opening of the off-delayed contacts K1	Can be adjusted on the safety relay
$t_{STOA/B\ OFF}$	STOA/B – switching time from high to low See also section *Response time until power output stage inactive and maximum OSSD test pulse duration* on page 68	Maximum response time 5 ms
$t_{STOA/B\ ON}$	STOA/B – switching time from high to low	0.6 ms typ., 1 ms max.
t_{DRV}	Delay of the internal sequence control of the servo drive	10 ms max.
$t_{ENAB\ HI}$	Time that DIN5 must be low after STOA/B has been reactivated and the status of the STO circuit has changed	> 20 ms
t_A	Switch-off delay of the holding brake	Parameterisable [1]
t_F	Switch-on delay of the holding brake	Parameterisable [1]

[1] see section *Brake control and automatic brake* in the Product manual smartServo BL 4000-D and BL 400

6.5 BL 4100-M / BL 4100-D: Motor connector [X6]

› Performance data

Supply voltage 230 VAC [± 10 %], 50 Hz, f_{PWM} = 5 kHz, f_{el} > 2 Hz, $T_{Ambient}$= 30°C

Characteristic	BL 4104-D	BL 4104-M
Nominal output power	800 W	700 W
Maximum output power for 2 s	2400 W	2400 W
Nominal output current	4 A_{eff}	3 A_{eff}
Max. output current for 2 s	12 A_{eff}	12 A_{eff}
Power loss/efficiency*)	4 % / 96 %	

*) As a guide value for the cooling measures.

› Current derating

The BL 4100-M / BL 4100-D series servo drives have a current derating during nominal operation. The rated current and the duration of the maximum permissible peak current of the servo drive depend on several factors. These factors are:

- Output current level: The higher the output current is, the shorter the permissible time will be.
- Clock frequency of the power output stage: The higher the clock frequency is, the shorter the permissible time will be.

The current derating begins as of a PWM frequency of 10 kHz (f_{PWM}) and is linear between the reference values that are stated in the following table:

PWM frequency f_{PWM}*)	BL 4104-M / BL 4104-D	
	$I_{nominal}$	I_{max}
10 kHz	4 A	12 A
16 kHz	3 A	9 A

*) The PWM frequency is the reciprocal of half of the current controller cycle time t_i. The variable cycle times enable particularly high dynamics combined with reduced power data.

› Motor cable requirements

Characteristic	Value
Cable length	l ≤ 3 m See section 5.1 *Notes concerning the safe and EMC-compliant installation* on page 26
Cable capacity	C‘ ≤ 160 pF/m of one phase against shield or between two lines

› Motor temperature monitoring system

⚠ DANGER ⚠ Dangerous electrical voltage!

The signals for the temperature sensor "MT-" and "MT+" at the motor connector [X6] must be connected to protective extra-low voltage (PELV) on the motor side and they must be insulated against the motor phases.

NOTICE Electronic overload protection of the motor

The servo drive has an electronic cut-out for overload protection combined with thermal memory retention. For an effective protection, the nominal motor current, maximum motor current and overload time (I^2t time) must be parameterised as described in the product manual.

Characteristic	Value
Sensor type	Analogue
Sensor type	Silicon temperature sensor PTC/NTC, e.g. KTY84-130 or similar
Characteristic curve	Linear/non-linear, parameterisable (10 nodes)
Measuring range	from 300 Ω to 20 kΩ (+-10 %)
Output voltage	+ 3.3 V
Output current	1.7 mA max. (via 2 kΩ measuring resistor)
Internal resistance	approx. 2 kΩ

› Output for the holding brake in the motor

Characteristic	Value
Nominal voltage	24 V
Nominal current	700 mA (total of all digital outputs and of the holding brake: 900 mA max.)
Voltage drop referred to the 24 V input with a load current of 0.7 A	approx. 1.5 V
Overload protection	Yes, current limitation to 2 A max
Overvoltage protection	up to 60 V
Internal flyback diode	Yes

› HIPERFACE DSL® connector [X6]

Characteristic	Value
HPF_DSL-, HPF_DSL+	In accordance with the HIPERFACE DSL® specification RS485
Baud rate	9.37 MHz
Frame rate	12.1 to 27 µs
Supply voltage	10 V (250 mA)
Supported transfer modes	Transfer of short and long messages with storage of the set of parameters in the encoder
Characteristic impedance of the cable and line termination	110 Ω

6.6 BL 4800-M / BL 4800-D: Motor connector [X6]

› Performance data

With supply voltage 48 VDC [± 10 %], f_{PWM} = 5 kHz, f_{el} > 3 Hz, $T_{Ambient}$= 30°C

Characteristic	BL 4840-M	BL 4840-D
Nominal output power	1.0 kW	1.1 kW
Maximum output power for 2 s	3.6 kW	
Nominal output current	40 A_{eff}	42 A_{eff}
Max. output current for 2 s	120 A_{eff}	
Power loss/efficiency*)	3 % / 97 %	

*) As a guide value for the cooling measures.

› Current derating

The BL 4800-M / BL 4800-D series servo drives have a current derating during nominal operation. The rated current and the duration of the maximum permissible peak current of the servo drive depend on several factors. These factors are:

- Output current level: The higher the output current is, the shorter the permissible time will be.
- Clock frequency of the power output stage: The higher the clock frequency is, the shorter the permissible time will be.

The current derating begins as of a PWM frequency of 10 kHz (f_{PWM}) and is linear between the reference values that are stated in the following table:

PWM frequency f_{PWM}*)	BL 4840-M / BL 4840-D	
	$I_{nominal}$	I_{max}
10 kHz	40 A	120 A
16 kHz	30 A	90 A

*) The PWM frequency is the reciprocal of half of the current controller cycle time t_i. The variable cycle times enable particularly high dynamics combined with reduced power data.

› Motor cable requirements

Characteristic	Value
Cable length	l ≤ 3 m siehe section 5.1 *Notes concerning the safe and EMC-compliant installation* on page 26
Cable capacity	C‘ ≤ 160 pF/m of one phase against shield or between two lines

NOTICE **Electronic overload protection of the motor**

The servo drive has an electronic cut-out for overload protection combined with thermal memory retention. For an effective protection, the nominal motor current, maximum motor current and overload time (I^2t time) must be parameterised as described in the product manual.

Characteristic	Value
Sensor type	Analogue
Sensor type	Silicon temperature sensor PTC/NTC, e.g. KTY84-130 or similar
Characteristic curve	Linear/non-linear, parameterisable (10 nodes)
Measuring range	from 300 Ω to 20 kΩ (+-10 %)
Output voltage	+ 3.3 V
Output current	1.7 mA max. (via 2 kΩ measuring resistor)
Internal resistance	approx. 2 kΩ

› Output for the holding brake in the motor

Characteristic	Value
Nominal voltage	24 V
Nominal current	700 mA (total of all digital outputs and of the holding brake: max. 900 mA)
Voltage drop referred to the 24 V input with a load current of 2 A	approx. 0.5 V
Overload protection	Yes, current limitation to 2 A max.
Overvoltage protection	up to 60 V
Internal flyback diode	Yes

› HIPERFACE DSL® connector [X6]

Characteristic	Value
HPF_DSL-, HPF_DSL+	In accordance with the HIPERFACE DSL® specification RS485
Baud rate	9.37 MHz
Frame rate	12.1 to 27 µs
Supply voltage	10 V (250 mA)
Supported transfer modes	Transfer of short and long messages with storage of the set of parameters in the encoder
Characteristic impedance of the cable and line termination	110 Ω

6.7 Resolver and encoder connector [X2]

The correct parameterisation of the multi-encoder interface is described in section *„Encoder" tab* in the Product manual smartServo BL 4000-D and BL 4000-M.

INFORMATION **Possibly not all encoders of a manufacturer are supported**

It is possible that not all encoders of a manufacturer are fully supported. In individual cases it is therefore always recommended to test the encoder in advance in the intended application.

› Resolver

Characteristic	Value
Transformation ratio	1:2 to 1:4
Carrier frequency	5-10 kHz
Excitation voltage	5-6 V_{eff}, short-circuit-proof
Excitation impedance (at 10 kHz)	4 Ω
Stator impedance	> 30 Ω
Measuring range (for Hall sensors)	6 V_{ss}
Resolution	14 bits
Signal detection delay	< 200 µs
Speed resolution	approx. 5 rpm
Actual speed value filter	400 µs
Absolute angle detection accuracy	< 0.022°
Max. speed	16,000 rpm

› Power supply output

The power supply for the encoders can be changed.

NOTICE **Risk of destruction due to excessive voltage**

If the voltage is too high, the angle encoder may be destroyed. Ensure that you have selected the correct supply voltage prior to connecting the encoder to the [X2] connector.

Characteristic	Low voltage	High voltage
Output voltage	5.4 V	10.4 V
Output current	250 mA	200 mA
Short-circuit strength	Yes	Yes

› Digital incremental encoders

Digital incremental encoders with RS422-compatible A/B/N signals with a line count of up to 16,384 lines can be connected (e.g. ERN 420). In addition, Hall generator signals with a TTL level for determining the commutation position can also be connected.

Characteristic	Value
Parameterisable number of encoder lines	1 to 2^{18} lines/revolution
Track signals A, B (Z0 track)	In accordance with RS422 Input 0.4 V with a common-mode level of -0.3 to 5 V
Track signal N (index pulse)	In accordance with RS422 Input 0.4 V with a common-mode level of -0.3 to 5 V
Hall generator input	TTL level (<0.5 V = Low, > 2 V = Hi) 2 kΩ pull-up
Error input (AS/NAS)	TTL level (<0.5 V = Low, > 2 V = Hi) 2 kΩ pull-up
Track signal input impedance	Differential input ca. 400 Ω
Limit frequency	10 MHz

› Analogue incremental encoders with commutation signals

Analogue incremental encoders with RS422-compatible 1 V_{SS} signals (e.g. ERN 1387) can be connected.

Characteristic	Value
Parameterisable number of encoder lines	1 to 2^{18} lines/revolution
High position resolution of the AB track (Z0) and commutation track (Z1)	12 bits/period
Track signals A, B (Z0 track)	1.2 V_{SS} differential
Track signal N (index pulse) switching threshold	0.1 V_{SS} differential
Commutation track (Z1 track)	1.2 V_{SS} differential
Error input (AS/NAS)	TTL level (<0.5 V = Low, > 2 V = Hi) 2 kΩ pull-up
Z0 Track signal input impedance	Differential input 400 Ω
Z1 Track signal input impedance	Differential input 100 Ω
Z0 track limit frequency	f_{limit} > 300 kHz
Z1 track limit frequency	f_{limit} approx. 10 kHz (commutation track)

› HIPERFACE® encoders

Shaft encoders with HIPERFACE® made by Sick-Stegmann are supported in the single-turn and multi-turn variants. The following encoder models can be connected:

- Single-turn SinCos encoders: SCS 60/70, SKS 36, SRS 50/60/64, SEK 34/37/52
- Multi-turn SinCos encoders: SCM 60/70, SKM 36, SRM 50/60/64, SEL 34/37/52
- Single-turn SinCos encoders for hollow shaft drives: SCS-Kit 101, SHS 170, SCK 25/35/40/45/50/53
- Multi-turn SinCos encoders for hollow shaft drives: SCM-Kit 101, SCL 25/35/40/45/50/53

In addition, the following Sick-Stegmann encoder systems can be connected and evaluated:

- Absolute, non-contact length measuring systems L230 and TTK70 (HIPERFACE®)
- Digital incremental encoder CDD 50

Characteristic	Value
Parameterisable number of encoder lines	Depending on the encoder
Track signals A, B (Z0 track)	As per RS485 Input: 0.4 V, output: 0.8 V to 2 V
Hall generator input	TTL level (<0.5 V = Low, > 2 V = Hi) 2 kΩ pull-up
Error input (AS/NAS)	TTL level (<0.5 V = Low, > 2 V = Hi) 2 kΩ pull-up
Track signal input impedance	Differential input 120 Ω
Limit frequency	Up to 10 MHz, depending on the encoder system
Supported operating modes	Storage of the parameter set in the encoder in the case of Endat and HIPERFACE®

Angle encoders made by Sick with the HIPERFACE DSL® interface (e.g. EKM36) are also supported. They must be connected to X6 on the BL 4000-D. See section 6.6 *BL 4800-M / BL 4800-D: Motor connector [X6]* on page 75 or section 6.5 *BL 4100-M / BL 4100-D: Motor connector [X6]* on page 72.

› EnDat encoders

Incremental and absolute encoders by Heidenhain with the ordering code ENDAT22 can be evaluated. The following encoder models can be connected:

- Analogue incremental encoders: ROD 400, ERO 1200/1300/1400, ERN 100/400/1100/1300
- Single-turn encoders (ENDAT22): ROC 425, ECI 119/1118/1319, ECN 125/425/1023
- Multi-turn encoders (ENDAT22): ROQ 437/1035, EQI 1131/1331, EQN 437/1035/1135/1337
- Absolute length measuring systems (ENDAT22): LC 115/415
- Battery-buffered encoders (ENDAT22): EBI 135/1135/4010
- Angle encoder modules (ENDAT22): MRP 2010/5010/8010

› BiSS encoders®

Type C BiSS encoders are supported. The evaluation of the internal type plate, however, is not supported. The storage of data in the encoder is not possible.

Encoders made by Hengstler, Kübler and Balluff are supported.

6.8 USB [X19]

Communication interface	Value
Function	USB 2.0, USB-B, slave-client
Connector type	USB-B
Current consumption	None (self-powered)
Protocol	Manufacturer-specific (generic device)

6.9 Fieldbus [X21], [X22]

Depending on the fieldbus variant (see section 3.1 *Type designation* on page 17), the servo drives of the device family BL 4000-M / BL 4000-D support the following fieldbuses and application protocols:

Fieldbus	Profile	Fieldbus variant
CAN	CiA DS 402 CANopen V 2.0	CAN
PROFINET	Manufacturer-specific protocol (based on PROFIdrive V3.1)	PROFINET / EtherCAT
EtherCAT	CoE (Can over EtherCAT)	PROFINET / EtherCAT

The support of these fieldbus types is integrated in the servo drive. Additional modules are not required. The parameterisation is performed with the aid of the Metronix ServoCommander®. For further information about the fieldbus connection, see the fieldbus-specific product manuals (section 1.2 *Additional documents* on page 7).

Suitable GSDML (PROFINET) and XML (EtherCAT) files for the integration of the fieldbus slave into the environment of an external control system can be found at (https://www.metronix.de).

INFORMATION **Compatibility with servo drives of the ARS 2000 series**

The behaviour on the bus and the object directory is largely compatible with the behaviour of the ARS 2000 series. There are certain differences, e.g. in terms of the device IDs (CANopen product_code ID 1018_02).

6.10 I/O Interface [X1]

Servo drives of the BL 4000-M / BL 4000-D series have 2 digital outputs (DOUT), 9 digital inputs (DIN), 1 analogue input (AIN) and 1 analogue output (AOUT).

› Digital outputs

Characteristic	Value
Nominal voltage	24 V
Output current	Approx. 100 mA per output, but 900 mA max. in total, including the brake output

› Digital inputs

Characteristic	Value
Nominal voltage	24 V as per DIN EN 61131-2 (< 10 V low, >15..30 V high)
Current consumption	3.2 mA max.

The mode of operation of the digital inputs can be configured to a large extent. The default setting is stated in brackets.

Characteristic	Value	Filter time	Max. jitter
DIN0...DIN3	Freely configurable (position selector)	4 x t_x *)	1 x t_x
DIN4	Freely configurable (positioning start)	4 x t_x	1 x t_x, (15 ns for sampling)
DIN5	Controller enable signal	4 x t_x	1 x t_x
DIN6, DIN7	Limit switch 0, 1	4 x t_x	1 x t_x
DIN8	Freely configurable (sampling, flying saw)	4 x t_x	1 x t_x, (15 ns for sampling)

*) t_x corresponds to the configurable position controller cycle time

› Analogue input AIN

Characteristic	Value
Input range	± 10 V
Resolution	12 Bit
Filter time	configurable: 2 x t_i to 200 ms

*) t_i corresponds to the configurable current controller cycle time

› Analogue output AOUT

Characteristic	Value
Output voltage	± 10 V
Offset	± 0.4 V
Resolution	10 Bit
Filter time	1 x t_i+85 µs

*) t_i corresponds to the configurable current controller cycle time

› Master frequency input [X1]

This input cannot only be used for the connection of the master frequency output of another BL 4000-C , BL 4000-M / BL 4000-D. It can also be used for the connection of encoders as per the RS422 industry standard or of encoders with "single-ended" TTL output or "open-collector" outputs. If TTL encoders are used, it must be taken into consideration that the hysteresis is negligible. In addition, the requirements concerning the signal shield must be fulfilled.

As an alternative, the A and B track signals of the device are interpreted as pulse direction signals by the device so that the servo drive can also be controlled by stepper motor control boards.

Ensure the correct configuration of the interface. This is important since the master frequency input can also be used as the master frequency output.

Characteristic	Value
Parameterisable line count	1 to 2^{28} lines/revolution
Track signals A, B	As per the RS 422 specification
Maximum input frequency	10 MHz
Filtering	Quadruple oversampling
Supply output	5 V, 200 mA, short-circuit-proof – not overvoltage-proof

› Master frequency output [X1]

The connector [X1] also accommodates the master frequency output (encoder emulation). To use this function, [X1] must be configured as the master frequency output.

Characteristic	Value
Number of lines	Programmable 1 to 2^{16} lines/revolution
Track signals A, B	As per the RS422 specification
Limit frequency	f_{limit} > 10 MHz

The signals are generated based on the angle of rotation of the encoder with a freely programmable line count.

Please also note that the track signals will not be automatically output with a constant frequency. They may also be generated as so-called "pulse packets" depending on the covered rotational angle of the source. This means that the interface for any downstream circuits must be suitable for incremental encoders. As a result, the measurement of gate times or the analysis of the time between two lines for determining a speed value is possible only to a limited extent.

6.10.1 Time response of the digital inputs

The digital inputs are digitally filtered to improve the interference suppression.
The following illustration shows the filter time mechanism. In addition, the special reaction to the "Positioning start" function is also shown. Although the signal is evaluated during the position controller cycle t_x the start of a movement will be performed within the interpolation cycle time matrix t_p.

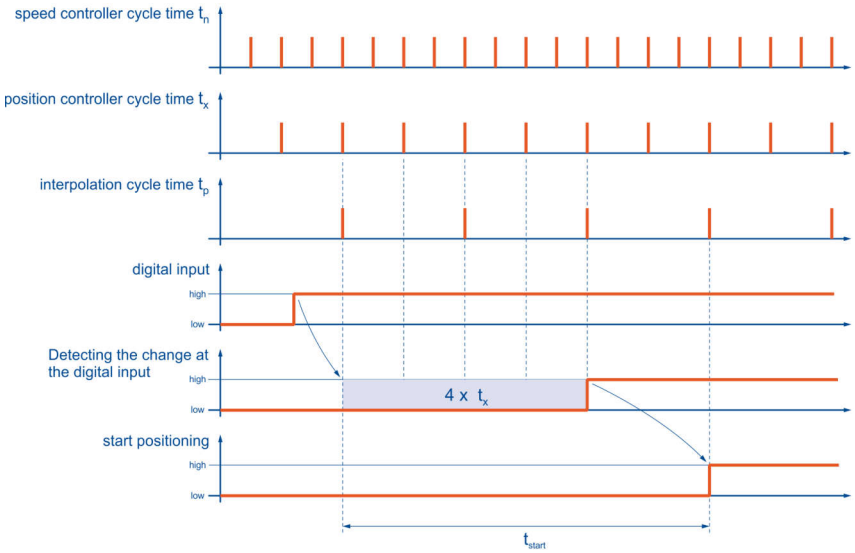

Figure 37: Filter time mechanism in the case of digital inputs

Parameter	Max.
Maximum delay until the start of a position set becomes active t_{start}	$5 \cdot t_x + t_p$
Current rise time (with current feedforward control)	$t_n + t_i + t_{pwm}$

t_i = Current controller cycle time (typically 50 µs)
t_x = position controller cycle time (typically 200 µs with a current controller cycle time t_i of 50 µs)
t_n = speed controller cycle time (typically 100 µs with a current controller cycle time t_i of 50 µs)
t_{pwm} = half the cycle time of the PWM (corresponds to t_i)

6.10.2 Time response of the digital outputs

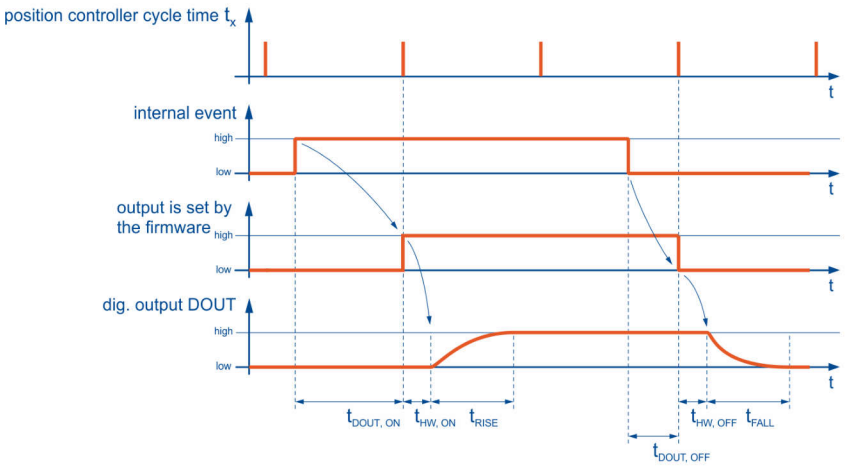

Figure 38: Filter time mechanism in the case of digital outputs

Parameter	Value
Delay caused by the firmware t_{DOUT_ON}/ t_{DOUT_OFF}	t_x
DOUT $t_{HW, ON}$	typically 100 µs
DOUT $t_{HW, OFF}$	typically 300 µs
t_{RISE}	typically 100 ms with 2 A and inductive load
t_{FALL}	typically 100 ms with 2 A and inductive load

t_x= position controller cycle time (typically 200 µs with a current controller cycle time t_i of 50 µs)

6.10.3 Time response during power ON

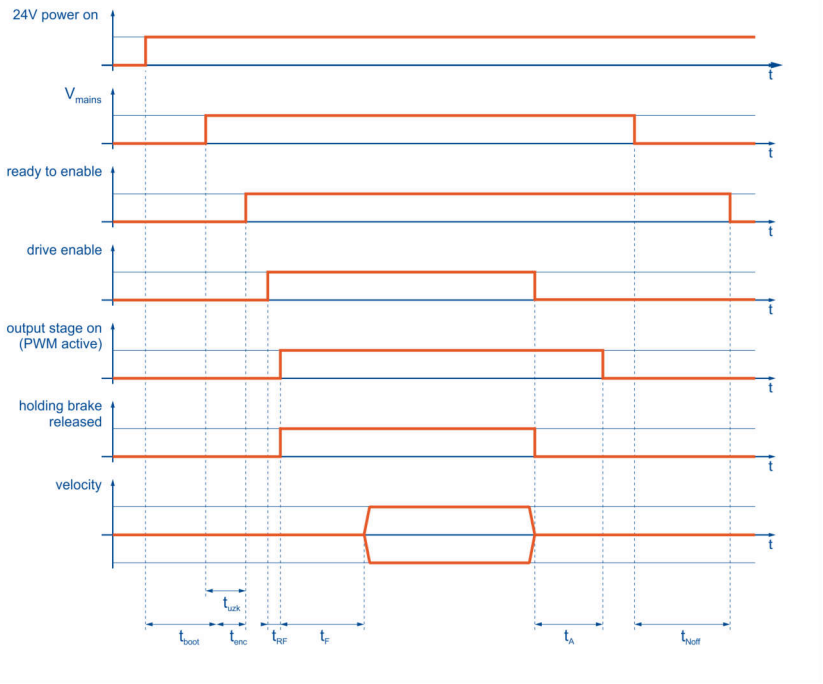

Figure 39: Time diagram of the servo drive

Parameter	Min.	Typ.	Max.
Start of the firmware after power ON t_{boot}			4 s
Encoder start time t_{enc}	0.7 s (resolver)		2 s (HIPERFACE DSL®)
DC bus charging time t_{UZK}		1 s	
Output stage active after servo drive enabling t_{RF}		6 ms	
Movement start delay t_F (parameterisable)	0		32 s
Stop delay t_A (parameterisable)	0		32 s
Detection of mains power OFF t_{Noff}		0.6 s	

7 Storage/transport

The following requirements must be fulfilled for the storage and transport of the servo drive:

› Storage

- Store the servo drive in line with the specified storage temperatures. Use only its original packaging.
- After approximately six months of storage, the oxide layer of the capacitors may become damaged. This is why the servo drive must be supplied with power for approximately 1 hour every six months (24 V and 230 V) in order to preserve the oxide layer.

› Transport

⚠ CAUTION Risk of injury due to improper transport

Follow these instructions to ensure the safe transport of the servo drive and to avoid injuries.

- Use only qualified personnel for the transport of the servo drive.
- Transport the servo drive only in its original packaging.
- Use only suitable transport equipment.
- Use suitable personal protective equipment.
- If you notice that the packaging is damaged, notify the carrier without delay. Then, inspect the servo drive for any signs of external or internal damage.

› Transport damage

⚠ DANGER ⚠ Dangerous electrical voltage!

Transport damage to the servo drive may compromise the insulation between the low-voltage part and the high-voltage part. This results in an extremely dangerous electrical voltage. Do not use the servo drive in this case. The servo drive needs to be checked by the sales partner or manufacturer.

In case of external damage (dents, deformed mounting flange, etc.) it must be presumed that some of the components have come loose and the breakdown strength concerning the high-voltage part may no longer be existent.

8 Maintenance, cleaning, repair and disposal

The following requirements must be fulfilled for the maintenance, cleaning, repair and disposal of the servo drive:

› Maintenance

Servo drives of the BL 4000-M / BL 4000-D device series are maintenance-free.

› Cleaning

NOTICE **Damage to the servo drive due to improper cleaning**

To remove surface soiling, e.g. residues of adhesive labels, the servo drive can be cleaned carefully on the outside with suitable tools. It must be absolutely ensured that liquids of any kind cannot penetrate the servo drive. Seals may be destroyed which, in turn, would to lead to short circuits.

Use the servo drive in a clean environment. Soiling due to dust, oil, oil vapour, grease, fibres or similar inside the device will compromise the insulation with regard to the high-voltage part. Stop using the device immediately if this is the case.

› Repair

Opening the device is not permissible and will render the warranty null and void. Only the manufacturer is authorised to perform repairs. Please contact your sales partner.

› Disposal, removal, decommissioning, replacement

⚠ DANGER ⚠ **Dangerous electrical voltage!**

Following the instructions stated hereinbelow to ensure the safe decommissioning of the servo drive.

- Switch the power supply completely off.
- Disconnect the mains power connectors.
- Lock the system so that it cannot be reactivated.
- Make sure that the DC bus has discharged by measuring at the DC bus terminals ZK+ and ZK- or wait for the maximum discharge time. This is for the BL 4100-M / BL 4100-D **30 minutes**. For the BL 4800-M / BL 4800-D no waiting time is required. In the event of a device defect, connections other than those specified here may also carry a life-threatening voltage. Under these circumstances, the discharge time must be waited for in any case.
- Contact a sales partner in terms of a return or replacement of the device.

9 Appendix

9.1 CE conformity (EMC, RoHS, Low Voltage Directive)

› BL 4100-M / BL 4100-D

CE

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06/2022

EU Konformitätserklärung | **EU Declaration of Conformity**

Metronix Meßgeräte und Elektronik GmbH, Kocherstrasse 3, 38120 Braunschweig GERMANY

erklärt hiermit in alleiniger Verantwortung, dass die Servoregler

hereby declares under sole responsibility that the Servo drives

smartServo BL 4104-D, smartServo BL 4104-D CAN
smartServo BL 4104-M, smartServo BL 4104-M CAN

konform sind mit den Vorschriften der folgenden Richtlinien und Normen:

comply with the following directives and standards:

Niederspannungsrichtlinie
2014/35/EU

Angewandte harmonisierte Normen:
EN 61800-5-1:2007 + A1: 2017

Low Voltage Directive
2014/35/EU

Applied harmonized standards:
EN 61800-5-1:2007 + A1:2017

EMV-Richtlinie
2014/30/EU

Angewandte harmonisierte Normen:
EN 61800-3:2004 + A1:2012
EN IEC 61800-3:2018

EMC Directive
2014/30/EU

Applied harmonized standards:
EN 61800-3:2004 + A1:2012
EN IEC 61800-3:2018

RoHS Richtlinie
2011/65/EU*

*inklusive aller aktuell gültigen Erweiterungen
Angewandte harmonisierte Normen:
EN IEC 63000:2018

RoHS Directive
2011/65/EU*

*including all currently valid amendments
Applied harmonized standards:
EN IEC 63000:2018

Weitere angewandte nicht harmonisierte Normen oder sonstige Spezifikationen:
Keine

More applied non-harmonized standards or specifications:
None

Besondere Bedingungen:

Die aufgeführten Geräte sind im Sinne der EMV-Richtlinie keine eigenständig betreibbaren Produkte. Die Einhaltung der Richtlinie setzt den korrekten Einbau der Produkte, die Beachtung der spezifischen Installationshinweise und der Produktdokumentation voraus. Dies wurde an bestimmten Anlagenkonfigurationen nachgewiesen.

Diese Erklärung bescheinigt die Übereinstimmung mit den genannten Richtlinien, beinhaltet jedoch keine Zusicherung von Eigenschaften.

Die Sicherheits- und Installationshinweise der Produktdokumentation sind zu beachten.

Specific Requirements:

According to the EMC Directive, the listed devices are not independently operable products. Compliance of the directive requires the correct installation of the product, the observance of the specific installation notes and product documentation. This was tested in specific system configurations.

This declaration certifies compliance with the stated Directive but implies no warranty of properties.

The safety and installation instructions of the product documentation are to be considered

Ort / Place: Braunschweig
Datum / Date: 3.3.2022

	Director Sales and Commercial	General Manager
Unterschrift / Signature:	i.V.	
	Olaf Donner	Walter Wehmeyer

FM 7.3.3-4 Vers. 2.1

› BL 4800-M / BL 4800-D

CE

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A company of Apex Tool Group, LLC.

05/2022

EU Konformitätserklärung | **EU Declaration of Conformity**

Metronix Meßgeräte und Elektronik GmbH, Kocherstrasse 3, 38120 Braunschweig GERMANY

erklärt hiermit in alleiniger Verantwortung, dass die Servoregler	hereby declares under sole responsibility that the Servo drives

smartServo BL 4840-D, smartServo BL 4840-D CAN
smartServo BL 4840-M, smartServo BL 4840-M CAN

konform sind mit den Vorschriften der folgenden Richtlinien und Normen:	comply with the following directives and standards:
EMV-Richtlinie 2014/30/EU	**EMC Directive** 2014/30/EU
Angewandte harmonisierte Normen: EN 61800-3:2004 + A1:2012 EN IEC 61800-3:2018	Applied harmonized standards: EN 61800-3:2004 + A1:2012 EN IEC 61800-3:2018
RoHS Richtlinie 2011/65/EU*	**RoHS Directive** 2011/65/EU*
*inklusive aller aktuell gültigen Erweiterungen	*including all currently valid amendments
Angewandte harmonisierte Normen: EN IEC 63000:2018	Applied harmonized standards: EN IEC 63000:2018
Weitere angewandte nicht harmonisierte Normen oder sonstige Spezifikationen: Keine	**More applied non-harmonized standards or specifications:** None
Besondere Bedingungen: Die aufgeführten Geräte sind im Sinne der EMV-Richtlinie keine eigenständig betreibbaren Produkte. Die Einhaltung der Richtlinie setzt den korrekten Einbau der Produkte, die Beachtung der spezifischen Installationshinweise und der Produktdokumentation voraus. Dies wurde an bestimmten Anlagenkonfigurationen nachgewiesen.	**Specific Requirements:** According to the EMC Directive, the listed devices are not independently operable products. Compliance of the directive requires the correct installation of the product, the observance of the specific installation notes and product documentation. This was tested in specific system configurations.
Diese Erklärung bescheinigt die Übereinstimmung mit den genannten Richtlinien, beinhaltet jedoch keine Zusicherung von Eigenschaften.	This declaration certifies compliance with the stated Directive but implies no warranty of properties.
Die Sicherheits- und Installationshinweise der Produktdokumentation sind zu beachten.	The safety and installation instructions of the product documentation are to be considered

Ort / Place: Braunschweig
Datum / Date: 3.3.2022

	Director Sales and Commercial	General Manager
Unterschrift / Signature:	i.V.	
	Olaf Donner	Walter Wehmeyer

FM 7.3.3-4 Vers. 2.1

9.2 CE conformity (Machinery Directive)

› BL 4000-M / BL 4000-D

CE

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A company of Apex Tool Group, LLC.

#4/2022

EG Konformitätserklärung	EC Declaration of Conformity
Metronix Meßgeräte und Elektronik GmbH, Kocherstrasse 3, 38120 Braunschweig GERMANY	
erklärt hiermit in alleiniger Verantwortung, dass das Sicherheitsmodul	hereby declares under sole responsibility that the safety module
Sicherheitsfunktion STO innerhalb der Servoregler **smartServo BL 4104-M** **smartServo BL 4840-M** **smartServo BL 4104-D** **smartServo BL 4840-D** **smartServo BL 4104-M CAN** **smartServo BL 4840-M CAN** **smartServo BL 4104-D CAN** **smartServo BL 4840-D CAN**	**Safety function STO** within the servo drives **smartServo BL 4104-M** **smartServo BL 4840-M** **smartServo BL 4104-D** **smartServo BL 4840-D** **smartServo BL 4104-M CAN** **smartServo BL 4840-M CAN** **smartServo BL 4104-D CAN** **smartServo BL 4840-D CAN**
konform ist mit den Vorschriften der folgenden Richtlinien und Normen:	complies with the following directives and standards:
Maschinenrichtlinie 2006/42/EG	**Machinery Directive** 2006/42/EC
Angewandte harmonisierte Normen:	Applied harmonized standards:
EN 61800-5-2:2017 max. SIL 3 (Sicherheitsfunktionen siehe Betriebsanleitung)	**EN 61800-5-2:2017** max. SIL 3 (safety functions see manual)
EN 62061:2005+AC:2010+A1:2013+A2:2015 max. SIL CL 3 (Sicherheitsfunktionen siehe Betriebsanleitung)	**EN 62061:2005+AC:2010+A1:2013+A2:2015** max. SIL CL 3 (safety functions see manual)
EN ISO 13849-1:2015 max. Kategorie 4 PL e (Sicherheitsfunktionen siehe Betriebsanleitung)	**EN ISO 13849-1:2015** max. Category 4 PL e (safety functions see manual)
IEC 61508 Teil 1-7:2010 max. SIL 3 (Sicherheitsfunktionen siehe Betriebsanleitung)	**IEC 61508 Parts 1-7:2010** max. SIL 3 (safety functions see manual)
Konformitätsbewertung Das bezeichnete Produkt verfügt über die integrierten Sicherheitsfunktionen STO. Es wird bestätigt, dass der Prüfgegenstand mit den Anforderungen nach Anhang I der Richtlinie 2006/42/EG über Maschinen übereinstimmt.	**Conformity Assessment** The designated product offers the integrated safety functions STO. It is confirmed, that the product under test complies with the requirements for machines defined in Annex I of the EC Directive 2006/42/EC.
Benannte Stelle TÜV Rheinland Industrie Service GmbH Certification Body for Machinery, NB 0035 Alboinstrasse 56 12103 Berlin / Germany	**notified body** TÜV Rheinland Industrie Service GmbH Certification Body for Machinery, NB 0035 Alboinstrasse 56 12103 Berlin / Germany
Zertifikat: 01/205/5701.00/19	Certificate: 01/205/5701.00/19
Gültigkeit 31.01.2024	Date of expiry 2024-01-31

FM 7.3.3-5 Vers. 2.0 (1/2)

CE

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#4/2022

Weitere angewandte nicht harmonisierte Normen oder sonstige Spezifikationen:	More applied non-harmonized standards or specifications:
keine	None
Besondere Bedingungen:	**Specific Requirements:**
Diese Erklärung bescheinigt die Übereinstimmung mit den genannten Richtlinien, beinhaltet jedoch keine Zusicherung von Eigenschaften.	This declaration certifies compliance with the stated Directive, but implies no warranty of properties.
Die Sicherheits- und Installationshinweise der Produktdokumentation sind zu beachten.	The safety and installation instructions of the product documentation are to be considered
Die Produkte sind bestimmt zum Einbau in Maschinen. Die Inbetriebnahme ist solange untersagt bis festgestellt wurde, dass die Maschine, in welche diese Produkte eingebaut werden sollen, den Bestimmungen der o.g. EG Richtlinie entsprechen.	These products are intended for installation in machines. Operation is prohibited until it has been determined that the machines in which these products are to be installed, conforms to the above mentioned EC Directive.

Ort / Place: Braunschweig

Datum / Date: 3.3.2022

	Director Sales and Commercial	General Manager
Unterschrift / Signature:		
	Olaf Donner	Walter Wehmeyer

9.3 cURus certification

› BL 4000-M / BL 4000-D

CERTIFICATE OF COMPLIANCE

Certificate Number	UL-US-2128204-0
Report Reference	E219816-20210527
Date	7-Jun-2021
Issued to:	Metronix Messgeraete und Elektronik GmbH Kocherstr. 3 Braunschweig Germany 38120
This is to certify that representative samples of	NMMS2 - Power Conversion Equipment - Component See Addendum Page for Product Designation(s).
	Have been investigated by UL in accordance with the component requirements in the Standard(s) indicated on this Certificate. UL Recognized components are incomplete in certain constructional features or restricted in performance capabilities and are intended for installation in complete equipment submitted for investigation to UL LLC.
Standard(s) for Safety:	UL 61800-5-1, 1st Ed., Issue Date: 2012-06-08, Revision Date: 2018-06-20
Additional Information:	See the UL Online Certifications Directory at https://iq.ulprospector.com for additional information

This *Certificate of Compliance* does not provide authorization to apply the UL Recognized Component Mark. Only the UL Follow-Up Services Procedure provides authorization to apply the UL Mark.

Only those products bearing the UL Recognized Component Mark should be considered as being UL Certified and covered under UL's Follow-Up Services.

Look for the UL Recognized Component Mark on the product.

Bruce Mahrenholz, Director North American Certification Program

UL LLC

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CERTIFICATE OF COMPLIANCE

Certificate Number	UL-US-2128204-0
Report Reference	E219816-20210527
Date	7-Jun-2021

This is to certify that representative samples of the product as specified on this certificate were tested according to the current UL requirements

Model	Category Description
smartServo, BL 4104-D	Power Conversion Equipment
smartServo, BL 4104-M	Power Conversion Equipment
smartServo, BL 4840-D	Power Conversion Equipment
smartServo, BL 4840-M	Power Conversion Equipment

Bruce Mahrenholz, Director North American Certification Program

UL LLC

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CERTIFICATE OF COMPLIANCE

Certificate Number	UL-CA-2123280-0
Report Reference	E219816-20210527
Date	7-Jun-2021
Issued to:	Metronix Messgeraete und Elektronik GmbH Kocherstr. 3 Braunschweig Germany 38120
This is to certify that representative samples of	NMMS8 - Power Conversion Equipment Certified for Canada - Component See Addendum Page for Product Designation(s).
	Have been investigated by UL in accordance with the component requirements in the Standard(s) indicated on this Certificate. UL Recognized components are incomplete in certain constructional features or restricted in performance capabilities and are intended for installation in complete equipment submitted for investigation to UL LLC.
Standard(s) for Safety:	CSA C22.2 NO. 274, 2nd Ed., Issue Date: 2017-04-01, Revision Date: 2017-04-01
Additional Information:	See the UL Online Certifications Directory at https://iq.ulprospector.com for additional information

This *Certificate of Compliance* does not provide authorization to apply the UL Recognized Component Mark. Only the UL Follow-Up Services Procedure provides authorization to apply the UL Mark.

Only those products bearing the UL Recognized Component Mark should be considered as being UL Certified and covered under UL's Follow-Up Services.

Look for the UL Recognized Component Mark on the product.

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CERTIFICATE OF COMPLIANCE

Certificate Number UL-CA-2123280-0
Report Reference E219816-20210527
Date 7-Jun-2021

This is to certify that representative samples of the product as specified on this certificate were tested according to the current UL requirements

Model	Category Description
smartServo, BL 4104-D	Power Conversion Equipment
smartServo, BL 4104-M	Power Conversion Equipment
smartServo, BL 4840-D	Power Conversion Equipment
smartServo, BL 4840-M	Power Conversion Equipment

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