Servo Controller
SE-Power FS

- **Mounting Instructions**

Complementary document to the Operating Instruction

afag

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List of figures:

List of tables:

This manual is a complementary document to the operating instructions and applies to:

Type	Order No.
Servo Controller SE-Power FS STO 1kVA	50036337
Servo Controller SE-Power FS STO 3kVA	50162993
Servo Controller SE-Power FS STO 6kVA	50183996

Version of this documentation: SE-Power FS-Mounting Instructions-vers. 4.4 en.01.06.2022

Assembly and initial start-up may be carried out by qualified personnel only and according to these operating instructions.

Caution!

As this manual is a complementary document to the operating instructions it alone is not sufficient to carry out installation and commissioning of the device.

Please pay attention to the notes in:

1.1 Documentation

1 General

1.1 Documentation

For the Servo Controllers of the SE-Power series are considerably documentations available.

There are main documents and complementary documents.

The documents contain safety instructions that must be followed.

Main document:

present	documentation / description
☐	▪ **SE-Power FS Operating manual** Description of the technical data and the functions of the device as well as notes on the plug assignment, installation and operation of the SE-Power FS servo controller series. It is meant for persons who want to get familiar with the SE-Power FS servo controller

Caution!

The operating manual is the main document and must be read by all means before installation and start-up of all devices of the SE-Power FS series.

Complementary documents to the operating manual:

present	documentation / description
☒	▪ **SE-Power FS mounting instructions** This manual is included during delivery of the SE-Power FS devices and provides an extract from the manual represents the installation instructions contained therein make sure that they can easily operate the servo drive.
☐	▪ **SE-Power FS STO-manual** Description of the technical data and the device functionality, installation, and operation of the safety module STO.
☐	▪ **SE-Power FS MOV-manual** Description of the technical data and the device functionality, installation, and operation of the safety module MOV.
☐	▪ **SE-Power Software-manual** Description of the software SE-Commander with the individual functions.
☐	▪ **SE-Power CANopen-manual** Description of the implemented CANopen protocol according to CiA DSP402 and DS301.

☐	▪ **SE-Power FS PROFIBUS/PROFINET-manual** Description of the implemented PROFIBUS-DP and PROFINET protocols, the technical data and the device functionality, installation, and operation of the fieldbus-modules „SE-Power Profibus Interface“ and „SE-Power Profinet Interface“.
☐	▪ **SE-Power EtherCAT-manual** Description of the fieldbus control by using the CoE (CANopen over EtherCAT) protocol, the technical data and the device functionality, installation, and operation of the fieldbus-module „SE-Power EtherCAT Interface“.
☐	▪ **SE-Power FS programming example Siemens S7 V5.5** Description of the configuration and program from the programming example for Siemens S7 V5.5.
☐	▪ **SE-Power FS programming example Siemens S7 TIA V12** Description of the configuration and program from the programming example for Siemens S7 TIA V12.
☐	▪ **SE-Power FS Programming example Profinet Siemens S7 TIA V13/V14** Description of the configuration and program to the programming example for Profinet for Siemens S7 TIA V13.1 and V14.0.

These documents are available for download on our homepage:

www.afag.com

2 Safety notes for electrical drives and controllers

2.1 Used symbols

Information

Important information and notes.

Caution!

No observance may result in severe property damages.

DANGER!

No observance may result in property damages and in personal injuries.

Caution! Life-threatening voltages.
The safety instruction contains a pointer to the occurrence of a possibly life-threatening voltage.

2.2 General Notes

In the case of damage resulting from non-compliance of the safety notes in this manual Afag will assume any liability.

Prior to the initial use you must read the chapters *2 Safety notes for electrical drives and* controller and *6.3 EMC compliant cabling*

If the documentation in the language at hand is not understood accurately, please contact and inform your supplier.

Sound and safe operation of the servo positioning controller requires proper and professional transportation, storage, mechanical installation, and project planning – with a consideration of the risks as well as the protective and emergency measures – plus the proper and professional electrical installation, operation, and maintenance of the devices:

TRAINED AND QUALIFIED PERSONNEL

in the sense of this product manual or the safety notes on the product itself are persons who are sufficiently familiar with the project, the setup, assembly, commissioning and operation of the product as well as all warnings and precautions as per the instructions in this manual and who are sufficiently qualified in their field of expertise:

- Education and instruction concerning the standards and accident prevention regulations for the application, or authorisation to switch devices/systems on and off and to ground them as per the standards of safety engineering and to efficiently label them as per the job demands.
- Education and instruction as per the standards of safety engineering regarding the maintenance and use of adequate safety equipment.
- First aid training.

The following notes must be read prior to the initial operation of the system to prevent personal injuries and/or property damages:

These safety notes must be complied with at all times.

Do not try to install or commission the servo positioning controller before carefully reading all safety notes for electrical drives and controllers contained in this document. These safety instructions and all other user notes must be read prior to any work with the servo positioning controller.

In case you do not have any user notes for the servo positioning controller, please contact your sales representative. Immediately demand these documents to be sent to the person responsible for the safe operation of the servo positioning controller.

If you sell, rent and/or otherwise make this device available to others, these safety notes must also be included.

The user must not open the servo drive controller for safety and warranty reasons.

Professional control process design is a prerequisite for sound functioning of the servo positioning controller!

DANGER!

Inappropriate handling of the servo drive controller and non-compliance of the warnings as well as inappropriate intervention in the safety features may result in property damage, personal injuries, electric shock or in extreme cases even death.

2.3 Danger resulting from misuse

DANGER!

High electrical voltages and high load currents!

Danger to life or serious personal injury from electrical shock!

DANGER!

High electrical voltage caused by wrong connections!

Danger to life or serious personal injury from electrical shock!

DANGER!

Surfaces of device housing may be hot!

Risk of injury! Risk of burning!

DANGER!

Dangerous movements!

Danger to life, serious personal injury or property damage due to unintentional movements of the motors!

2.4 Safety notes

2.4.1 General safety notes

The servo drive controller corresponds to IP20 class of protection as well as pollution level 1. Make sure that the environment corresponds to this class of protection and pollution level.

Only use replacements parts and accessories approved by the manufacturer.

The devices must be connected to the mains supply as per EN regulations, so that they can be cut off the mains supply by means of corresponding separation devices (e.g. main switch, contactor, power switch).

The servo drive controller may be protected using an AC/DC sensitive 300mA fault current protection switch (RCD = Residual Current protective Device).

Gold contacts or contacts with a high contact pressure should be used to switch the control contacts.

Preventive interference rejection measures should be taken for control panels, such as connecting contactors and relays using RC elements or diodes.

The safety rules and regulations of the country in which the device will be operated must be complied with.

The environment conditions defined in the product documentation must be kept. Safety-critical applications are not allowed, unless specifically approved by the manufacturer.

For notes on installation corresponding to EMC, please refer to chapter *6.3 EMC compliant cabling*. The compliance with the limits required by national regulations is the responsibility of the manufacturer of the machine or system.

The technical data and the connection and installation conditions for the servo drive controller are to be found in this product manual and must be met.

DANGER!

The general setup and safety regulations for work on power installations (e.g. DIN, VDE, EN, IEC or other national and international regulations) must be complied with.

Non-compliance may result in death, personal injury or serious property damages.

Without any claims to completeness, the following specifications shall apply:

VDE 0100	Regulations for the installation of high voltage (up to 1000V) devices
EN 1037	Safety of machinery - Prevention of unexpected start-up
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 ISO 12100	Safety of machinery - General principles for design - Risk assessment and risk reduction
DIN EN ISO 13849-1	Safety of machinery - Safety-related parts of control systems Part 1: General principles for design
EN ISO 13849-2	Safety of machinery - Safety-related parts of control systems Part 2: Validation

More standards to be respected by the user:

EN 574	Safety of machinery - Two-hand control devices
EN 1088	Safety of machinery - Interlocking devices associated with guards
EN 1037	Safety of machinery - Prevention of unexpected start-up
EN ISO 13850	Safety of machinery - Emergency stop

2.4.2 Safety notes for assembly and maintenance

The appropriate DIN, VDE, EN and IEC regulations as well as all national and local safety regulations and rules for the prevention of accidents apply for the assembly and maintenance of the system. The plant engineer or the operator is responsible for compliance with these regulations:

The servo positioning controller must only be operated, maintained and/or repaired by personnel trained and qualified for working on or with electrical devices.

Prevention of accidents, injuries and/or damages:

Additionally secure vertical axes against falling down or lowering after the motor has been switched off, for example by means of:

- Mechanical locking of the vertical axle,
- External braking, catching or clamping devices or
- Sufficient balancing of the axle.

The motor holding brake supplied by default or an external motor holding brake driven by the drive controller alone is not suitable for personal protection!

Keep the electrical equipment voltage-free using the main switch and protect it from being switched on again until the DC bus circuit is discharged, in the case of:

- Maintenance and repair work
- Cleaning
- long machine shutdowns

Prior to carrying out maintenance work make sure that the power supply has been turned off, locked and the DC bus circuit is discharged.

The external or internal brake resistor carries dangerous DC bus voltages during operation of the servo positioning controller and up to 5 minutes thereafter. Contact may result in death or serious personal injury. Wait for this time prior to performing any work on the affected connections. Measure the voltages for your own protection. Contact with these high DC bus circuit voltages may result in death or serious personal injury.

Be careful during the assembly. During the assembly and also later during operation of the drive, make sure to prevent drill chips, metal dust or assembly parts (screws, nuts, cable sections) from falling into the device.

Also make sure that the external power supply of the controller (24 V) is switched off.

The DC bus circuit or the mains supply must always be switched off prior to switching off the 24 V controller supply.

Carry out work in the machine area only, if AC and/or DC supplies are switched off. Switched off output stages or controller enabling's are no 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 Stop" feature in accordance with EN 954-1 CAT 3 or with the "Safe Torque Off" feature in accordance with EN 61800-5-2. This feature can be achieved with the SE-Power FS by integrating the module SE-Power FS Safety Module STO for example.

Initial operation must be carried out with idle motors, to prevent mechanical damages for example due to the wrong direction of rotation.

Electronic devices are never fail-safe. It is the user's responsibility, in the case an electrical device fails, to make sure the system is transferred into a secure state.

The servo positioning controller and in particular the brake resistor, externally or internally, can assume high temperatures, which may cause serious burns.

2.4.3 Protection against contact with electrical parts

This section only concerns devices and drive components carrying voltages exceeding 50 V. Contact with parts carrying voltages of more than 50 V can be dangerous for people and may cause electrical shock. During operation of electrical devices some parts of these devices will inevitably carry dangerous voltages.

DANGER!

High electrical voltage!

Danger to life, danger due to electrical shock or serious personal injury!

The appropriate DIN, VDE, EN and IEC regulations as well as all national and local safety regulations and rules for the prevention of accidents apply for the assembly and maintenance of the system. The plant engineer or the operator is responsible for compliance with these regulations:

Before switching on the device, install the appropriate covers and protections against accidental contact. Rack-mounted devices must be protected against accidental contact by means of housing, for example a switch cabinet. The national regulations for safety/accident prevention must be complied with!

Always connect the ground conductor of the electrical equipment and devices securely to the mains supply. Due to the integrated line filter the leakage current exceeds 3.5 mA!

Comply with the minimum copper cross-section for the ground conductor over its entire length (see for example EN 60800-5-1).

Prior to the initial operation, even for short measuring or testing purposes, always connect the ground conductor of all electrical devices as per the terminal diagram or connect it to the ground wire. Otherwise the housing may carry high voltages which can cause electrical shock.

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

Prior to accessing electrical parts carrying voltages exceeding 50 Volts, disconnect the device from the mains or power supply. Protect it from being switched on again.

For the installation the amount of DC bus voltage must be considered, particularly regarding insulation and protective measures. Ensure proper grounding, wire dimensioning and corresponding short-circuit protection.

The device comprises a rapid discharge circuit for the DC bus as per EN 60204-1. In certain device constellations, however, mostly in the case of parallel connection of several servo positioning controllers in the DC bus or in the case of an unconnected brake resistor, this rapid discharge may be rendered ineffective. The servo positioning controllers can carry voltage until up to 5 minutes after being switched off (residual capacitor charge).

2.4.4 Protection against electrical shock by means of protective extra-low voltage (PELV)

All connections and terminals with voltages between 5 and 50 Volts at the servo positioning controller are protective extra-low voltage, which are designed safe from contact in correspondence with the following standards:

International: IEC 60364-4-41

European countries within the EU: EN 61800-5-1

DANGER!

High electrical voltages due to wrong connections!

Danger to life, risk of injury due to electrical shock!

Only devices and electrical components and wires with a protective extra low voltage (PELV) may be connected to connectors and terminals with voltages between 0 to 50 Volts.

Only connect voltages and circuits with protection against dangerous voltages. Such protection may be achieved by means of isolation transformers, safe optocouplers or battery operation.

2.4.5 Protection against dangerous movements

Dangerous movements can be caused by faulty control of connected motors, for different reasons:

- Improper or faulty wiring or cabling
- Error in handling of components
- Error in sensor or transducer
- Defective or non-EMC-compliant components
- Error in software in super ordinated control system

These errors can occur directly after switching on the device or after an indeterminate time of operation.

The monitors in the drive components for the most part rule out malfunctions in the connected drives. In view of personal protection, particularly the danger of personal injury and/or property damage, this may not be relied on exclusively. Until the built-in monitors come into effect, faulty drive movements must be taken into account; their magnitude depends on the type of control and on the operating state.

DANGER!

Dangerous movements!

Danger to life, risk of injury, serious personal injuries or property damage!

For the reasons mentioned above, personal protection must be ensured by means of monitoring or super ordinated measures on the device. These are installed in accordance with the specific data of the system and a danger and error analysis by the manufacturer. The safety regulations applying to the system are also taken into consideration. Random movements or other malfunctions may be caused by switching the safety installations off, by bypassing them or by not activating them.

2.4.6 Protection against contact with hot parts

DANGER!

Housing surfaces may be hot!

Risk of injury! Risk of burning!

Do not touch housing surfaces in the vicinity of heat sources! Danger of burning!

Before accessing devices let them cool down for 10 minutes after switching them off.

Touching hot parts of the equipment such as the housing, which contain heat sinks and resistors, may cause burns!

2.4.7 Protection during handling and assembly

Handling and assembly of certain parts and components in an unsuitable manner may under adverse conditions cause injuries.

DANGER!

Risk of injury due to improper handling!

Personal injury due to pinching, shearing, cutting, crushing!

The following general safety notes apply:

Comply with the general setup and safety regulations on handling and assembly.

Use suitable assembly and transportation devices.

Prevent incarcerations and contusions by means of suitable protective measures.

Use suitable tools only. If specified, use special tools.

Use lifting devices and tools appropriately.

If necessary, use suitable protective equipment (for example goggles, protective footwear, protective gloves).

Do not stand underneath hanging loads.

Remove leaking liquids on the floor immediately to prevent slipping.

3 Technical data

Table 1: Technical data: Ambient conditions and qualification

Range	Values	
Admissible temperature ranges	Storage temperature:	-25°C to +70°C
	Operating temperature:	0°C to +40°C +40°C to +50°C at reduced power 2,5% /K
Admissible installation height	Up to 1000 m above msl, 1000 to 2000 m above msl at reduced power according to EN 61800-5-1	
Humidity	Relative humidity up to 90 %, not bedewing	
Protection class	IP20	
Pollution degree	1	
CE conformity Low-voltage directive: EMC regulation: Current harmonics:	 EN 60 800 – 5 - 1 EN 61 800 - 3 EN 61 000 - 3 – 2	
Further certifications	UL certified	

Table 2: Technical data: Dimensions and weight

Type	SE-Power FS 1kVA	SE-Power FS 3kVA	SE-Power FS 6kVA
Dimensions including the mounting plate (H*W*D)	261mm*54,5mm*205mm	334,5mm*69mm*245,5mm	
Dimensions (H*W*D)	200mm*54mm*200mm	250mm*69mm*240mm	
Weight	approx. 2,1kg	approx. 3,7kg	

Table 3: Technical data: Cable specifications

Range	SE-Power FS 1kVA	SE-Power FS 3kVA	SE-Power FS 6kVA
Maximum motor cable length for interference emission as per EN 61800-3			
Category C2 Switch cabinet assembly (see chapter *6.3 EMC compliant cabling*)	l ≤ 25m	l ≤ 50m	
Category C3 (industrial area)	l ≤ 25m	l ≤ 50m	
Cable capacity of a phase against shield or between two lines	C‘ ≤ 200pF/m		

Table 4: Technical data: Motor temperature monitoring

Motor temperature monitoring	Values		
Digital Sensor	Normally closed contact:	R_{cold} < 500 Ω	R_{hot} > 100 kΩ
Analogue Sensor	Silicon temperature sensor, for example KTY81, 82 or similar. R_{25} ≈ 2000 Ω R_{100} ≈ 3400 Ω		

3.1 Operating and display elements

On the front, the servo positioning controller SE-Power FS has tree LED‘s and a seven-segment display to indicate the operating status.

Table 5: Display elements and RESET button

Element	Function
Seven-segment display	Display of operating mode and a coded error number in the case of a malfunction
LED1 (two-colour LED, green/red)	Operational state respectively fault
LED2 (green)	Controller enable
LED3 (yellow)	Status display CAN bus
RESET-Button	Hardware reset for processor

3.2 Supply [X9]

Table 6: Technical data: Performance data [X9]

Type	SE-Power FS 1kVA	SE-Power FS 3kVA	SE-Power FS 6kVA
Supply voltage (ZME, RME)	1 x 48 VAC [± 10%]	-	
Supply voltage (RE)	1 x 230 VAC [± 10%]	-	
Supply voltage (LME, PME, PME-c, PEZ, PDZ, OZ, LE, SA)	1 x 230 VAC [± 10%]	3 x 400 VAC [± 10%] 50…60Hz	
Alternative DC supply (ZME, RME)	48 ... 70 VDC	-	
Alternative DC supply (RE)	320 VDC	-	
Alternative DC supply (LME, PME, PME-c, PEZ, PDZ, OZ, LE, SA)	320 ... 380 VDC	560V DC	
In continuous operation maximum of mains current	4.7 A_{eff}	5 A_{eff}	9 A_{eff}
24V supply	24 VDC [± 20%] (0,65 A) *)	24 VDC [± 20%] (1 A) *)	

*) plus current consumption of a possibly connected holding brake and I/O’s

3.3 Motor connection [X6]

Table 7: Technical data: Motor connection data [X6]

Type	SE-Power FS 1kVA	SE-Power FS 3kVA	SE-Power FS 6kVA
Specifications for operation with:	1x 230 VAC [± 10%], 50 Hz	3x 400 VAC [± 10%], 50 Hz	
Output power	1,0 kVA	3,0 kVA	6,0 kVA
Max. output power for 5 s	2,0 kVA	3,0 kVA	12,0 kVA
Output current	5 A_{eff}	5 A_{eff}	10 A_{eff}
Max. output current for 5 s	10 A_{eff}	10 A_{eff} (15 A_{eff} for 2 s)	20 A_{eff}
Max. output current for 0.5s	20 A_{eff}	20 A_{eff}	40 A_{eff}
Current derating from	12 kHz	12,5 kHz	5 kHz
Max. clock frequency	Ca. 20 kHz	4 … 16 kHz	

3.4 I/O interface [X1]

Table 8: Technical Data: digital inputs and outputs [X1]

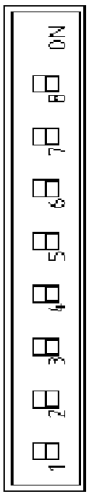
Digital inputs / outputs	Values	
Signal level	24V (8V...30V) active high, conform with EN 1131-2	
Logical inputs general DIN0 DIN1 DIN2 DIN3	Bit 0 \ Bit 1, \ Target selection for positioning Bit 2, / 16 targets selectable from target table Bit 3 /	
DIN4	Control input stage enable at High	
DIN5	Controller enable at high signal, ack. error with falling edge	
DIN6	End switch input 0	If hardware limit switches are required, a parameter file must be requested in accordance with specification Afag.
DIN7	End switch input 1	
DIN8	Homing switch	
DIN9	Control signal Start positioning	
DIN AIN1	Start homing	
DIN AIN2	Set-up mode (low active)	0V ➔ slow 24V ➔ normal operation
Logic outputs general	Galvanically separated, 24V (8V...30V) active high	
DOUT0	Servo controller operational	24 V, max. 100 mA
DOUT1	Homing position valid	24 V, max. 100 mA
DOUT2	In position	24 V, max. 100 mA
DOUT3	Remaining distance	24 V, max. 100 mA
DOUT4 [X6]	Holding brake	24 V, max. 1 A

4 Functional safety technology

Table 9: Overview safety activation module for the SE-Power FS

Type	Description
FSM 2.0 – STO	Safety module with function STO and DIP switches.
FSM 2.0 – MOV	Safety module with extended safety functions (in preparation)

Table 10: Fieldbus specific assignment of the r DIP switches

DIP switch		Functionality of the DIP switch (fieldbus specific with technology module)		
		CAN (in the basic unit)	PROFIBUS	EtherCAT
	8	Communication: 1: On 0: Off	Communication: 1: On 0: Off	No function
	7	Baud rate: 11: 1 MBaud 10: 500 kBaud 01: 250 KBaud 00: 125 kBaud	Slave address respectively address offset: 0 .. 127 Valid range: 3 .. 125	No function
	6			
	5	Node number respectively address offset: 1 ... 31		
	4			
	3			
	2			
	1			

4.1 Function and application

The safety module SE-Power FS SafetyModule STO has the following features:

- Reaching of the function „Safe Torque Off“ (STO),
- Floating feedback contact for the operational status,
- Designed as a pluggable module from the outside, thereby refitting is possible,
- Only suitable for servo positioning controller SE-Power FS product family.

With a suitable external safety switching device and appropriate circuit of the basic unit SE-Power FS, the function "Safe Standstill" (SS1) can be realized.

DANGER!

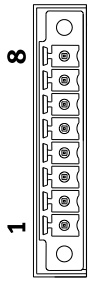
- The STO function is, for drives on a permanent moment acts (eg suspended loads), as the sole safety function, not sufficient.
- The bridging of safety devices is not permitted.
- Repairs are not permitted on the module!!

DANGER!

The STO function must be validated after installation and after changes in the installation.

This validation must be documented by the commissioner.

Table 11: Pin assignment [X40]

Connector	Pin	Denomination	Values	Specification
	8	0V	0 V	Reference GND for Alternative supply voltage.
	7	24V	+24 V DC	Alternative supply voltage (24 V DC led out logic supply of the servo positioning).
	6	C2	–	Feedback contact for the "STO" to an external controller.
	5	C1		
	4	0V-B	0 V	Reference potential for STO-B.
	3	STO-B	0 V / 24 V	Control input B for the STO function.
	2	0V-A	0 V	Reference potential for STO-A.
	1	STO-A	0 V / 24 V	Control input A for the STO function

5 Mechanical installation

5.1 Important notes

- Only use the servo positioning controller SE-Power FS as a built-in device for switch cabinets
- Mounting position vertical with supply lines [X9] on top
- Mount to control cabinet plate using a fastening strap
- Installation spaces:
  Keep a minimum distance of 100 mm to other components each above and underneath the device to ensure sufficient venting.
  For optimal wiring of the motor or encoder cable at the bottom of the units SE-Power FS 3 kVA and 6 kVA an installation free space of 150mm is recommended!
- The servo positioning controller SE-Power FS may be installed adjacently in one switch cabinet without a gap, proper usage and installation on a heat-dissipating rear panel provided. Please note that excessive heat may cause premature aging and/or damaging of the device. In case the servo positioning controller SE-Power FS are subject to high thermal stress, for the SE-Power FS 1kVA a space of 59 mm and for the SE-Power FS 3kVA respectively 6kVA a space of 75 mm is recommended!

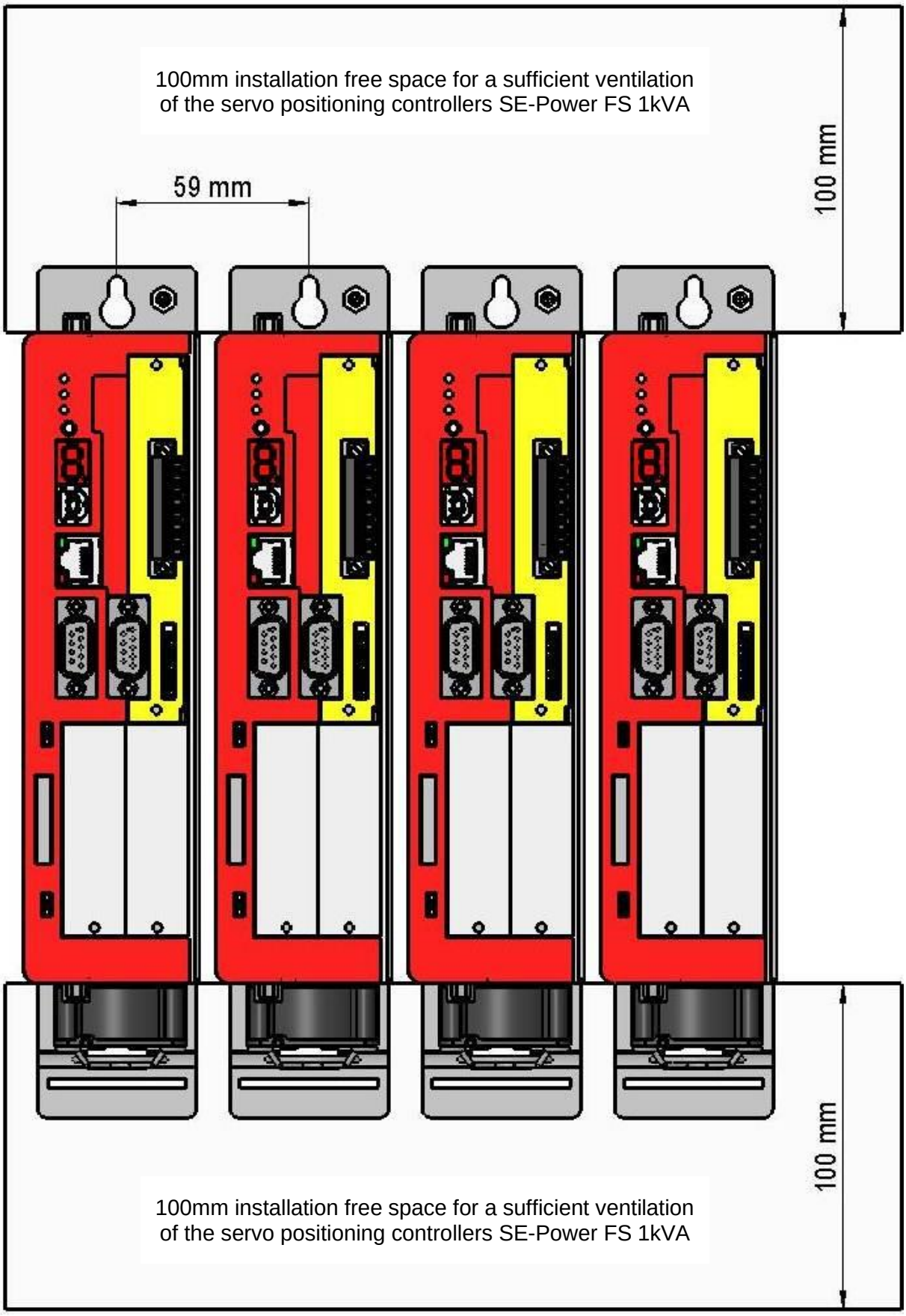


Figure 1: Servo positioning controller SE-Power FS 1kVA: Installation space

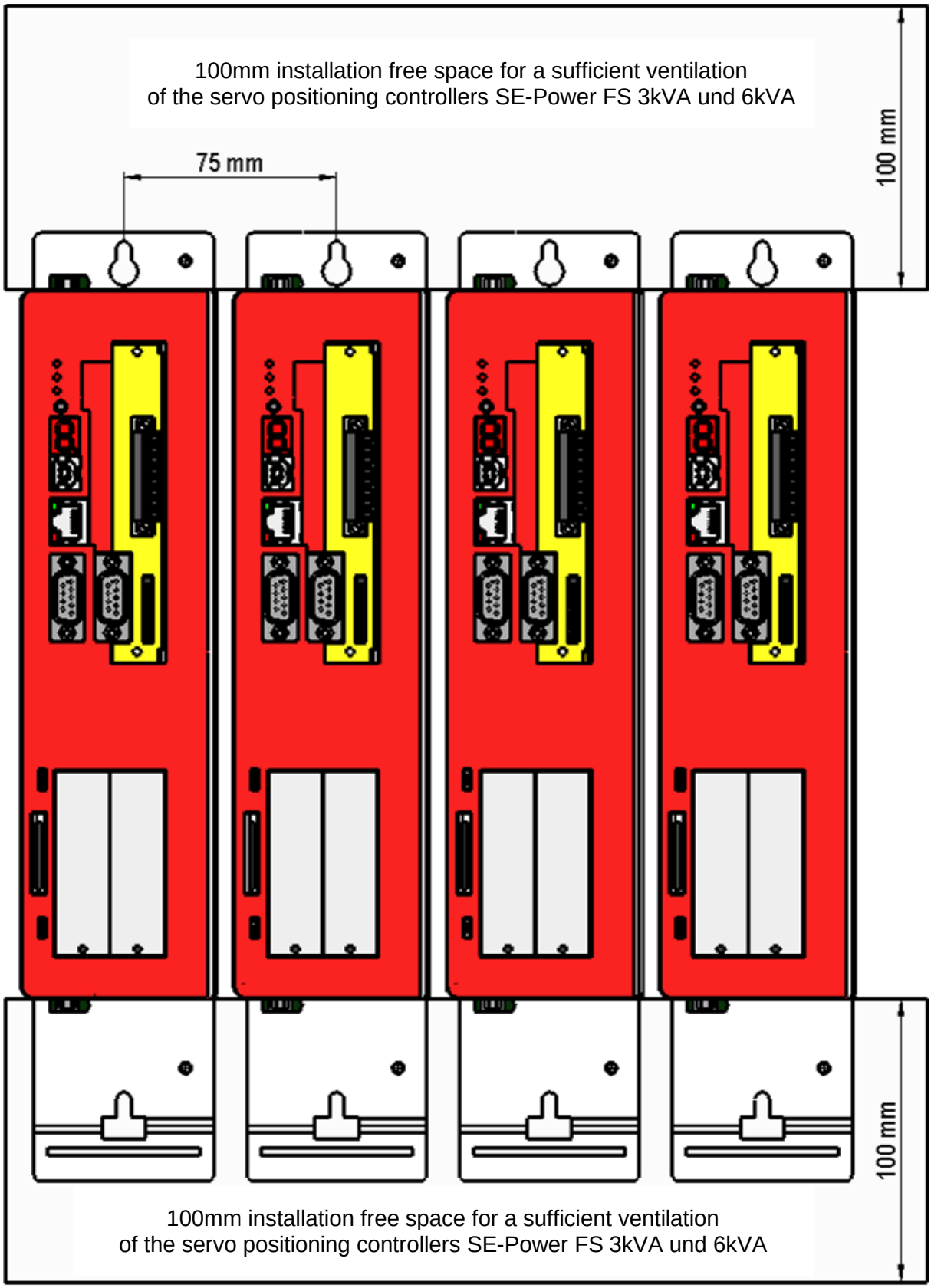


Figure 2: Servo positioning controller SE-Power FS 3kVA and 6kVA: Installation space

5.2 View of the device

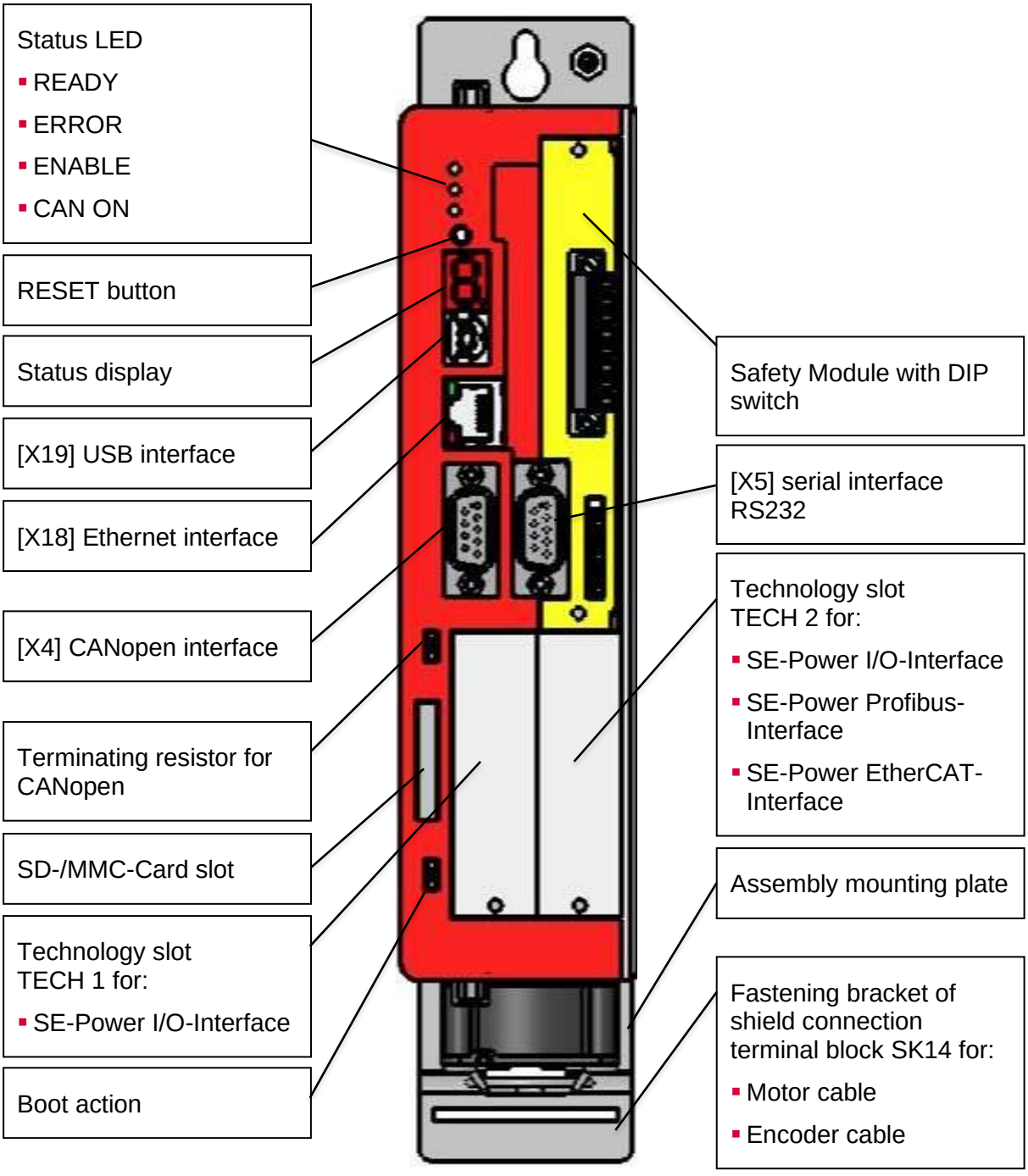


Figure 3: Servo positioning controller SE-Power FS 1kVA: Front view

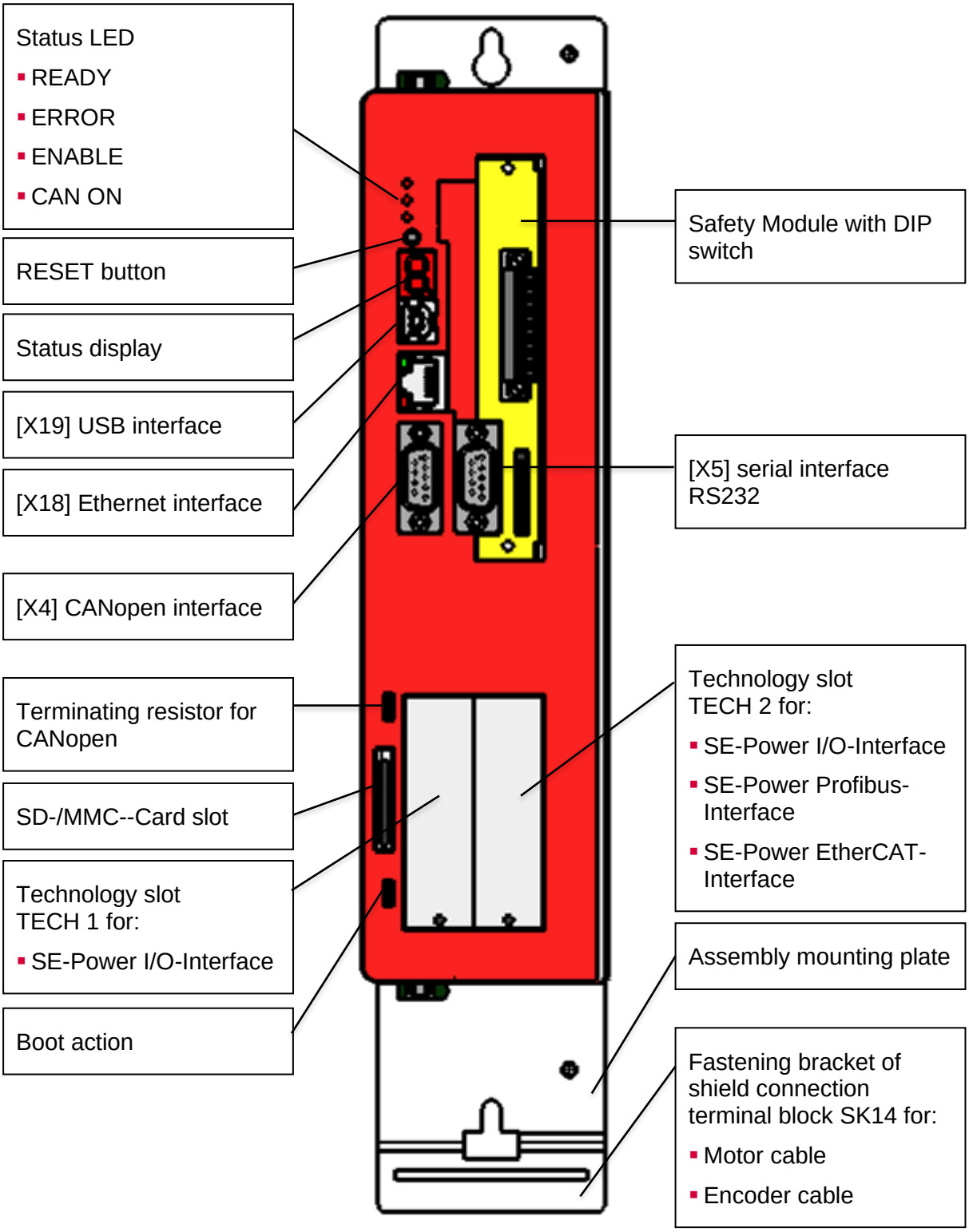


Figure 4: Servo positioning controller SE-Power FS 3kVA and 6kVA: Front view

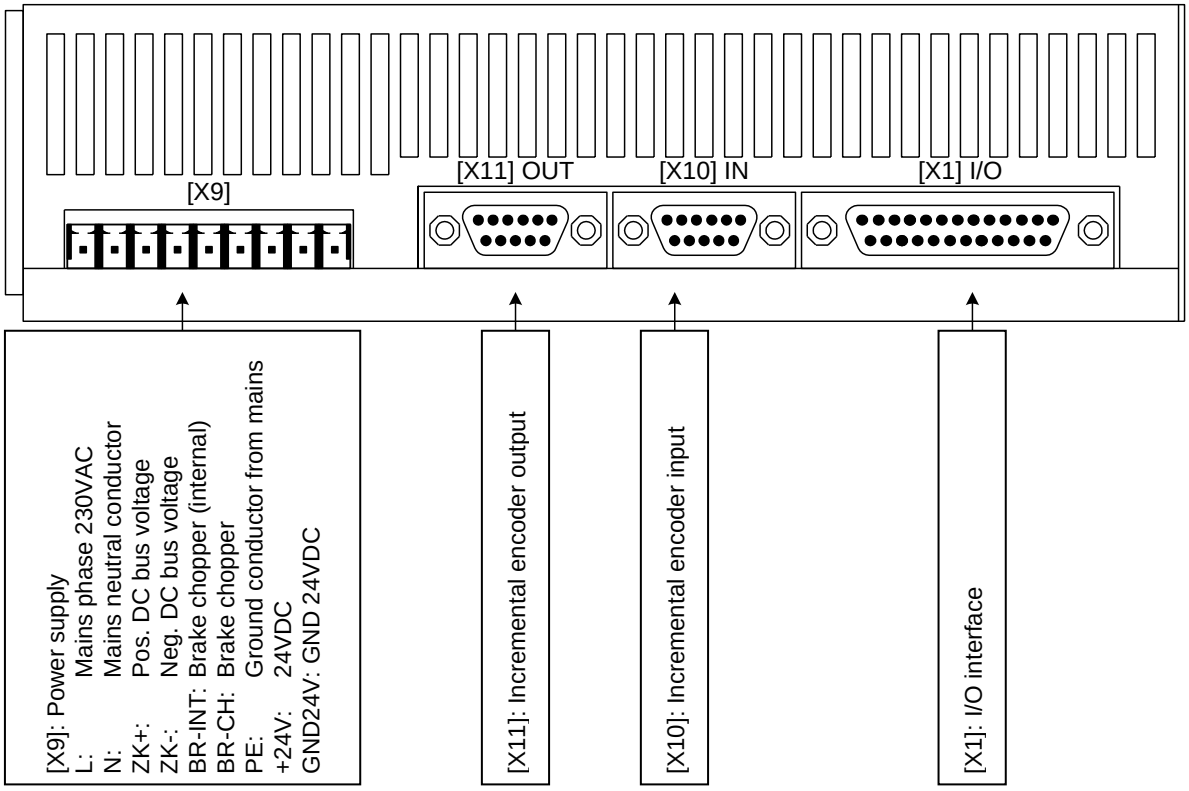


Figure 5: Servo positioning controller SE-Power FS 1kVA: Top view

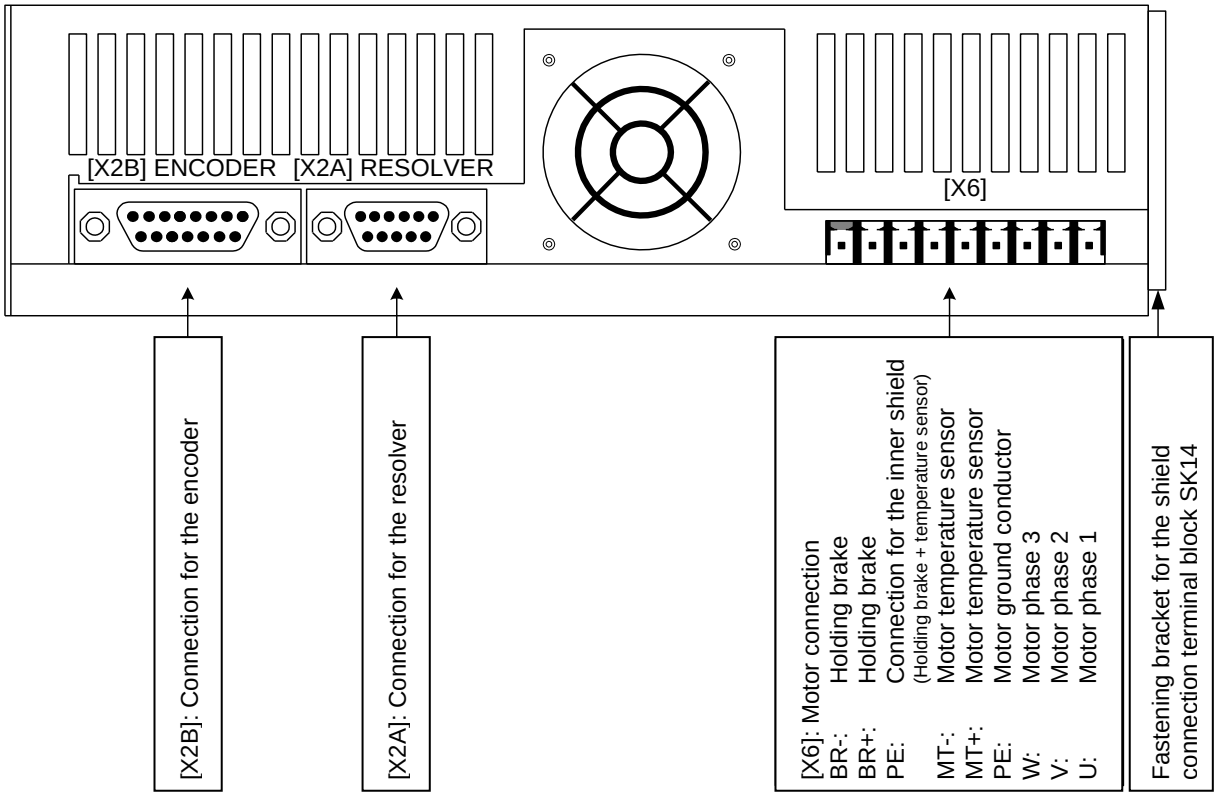


Figure 6: Servo positioning controller SE-Power FS 1kVA: Bottom view

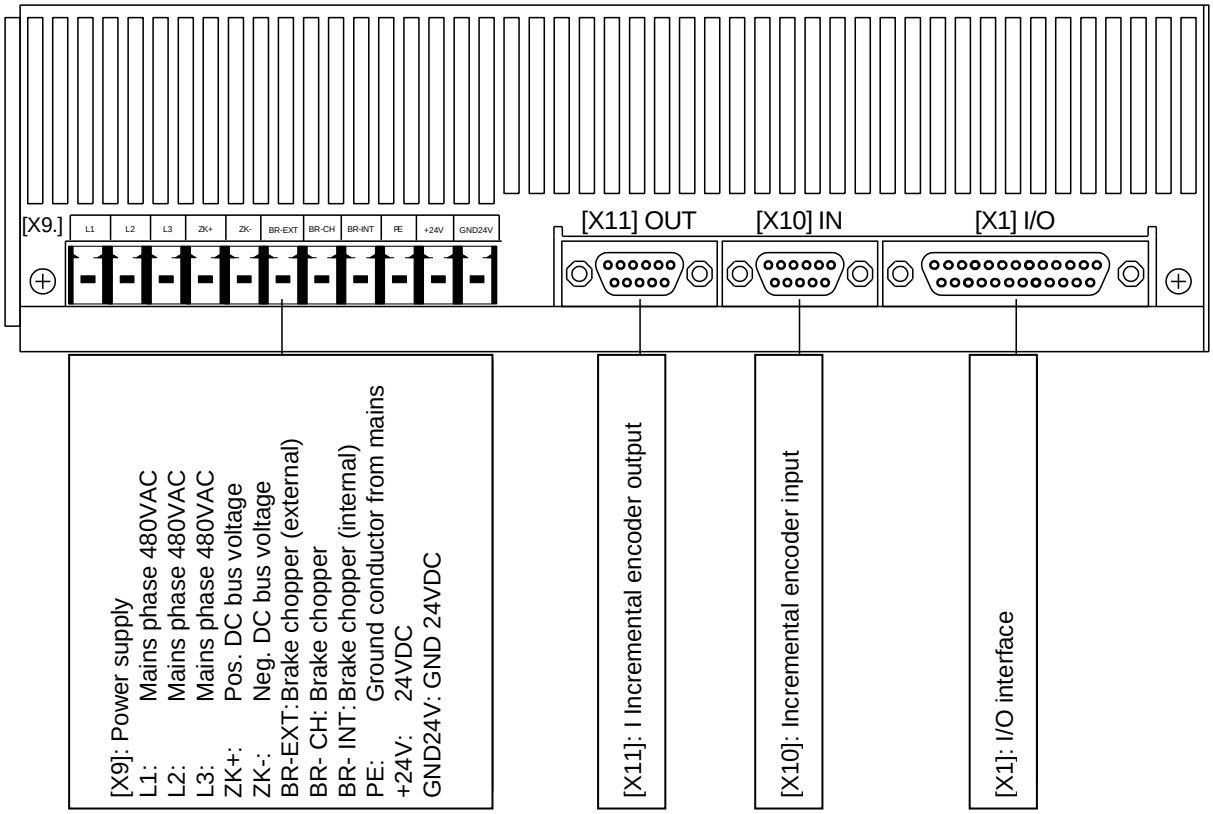


Figure 7: Servo positioning controller SE-Power FS 3kVA and 6kVA: Top view

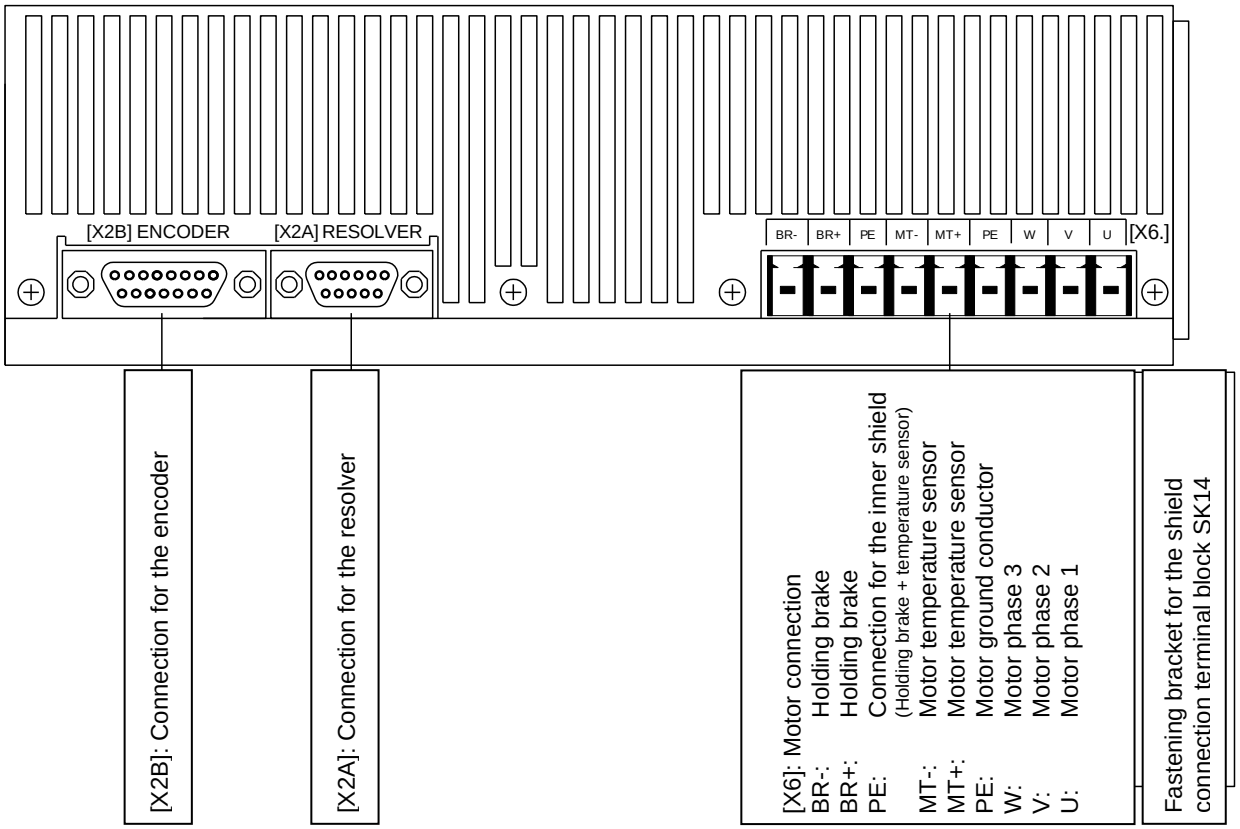


Figure 8: Servo positioning controller SE-Power FS 3kVA and 6kVA: Bottom view

5.3 Mounting

The servo positioning controller SE-Power FS has attachment lugs on the top and the bottom of the device. These lugs are used to mount the servo positioning controller vertically to a control cabinet plate. The lugs are part of the cooling body profile so that good heat transmission to the control cabinet plate must be ensured.

Recommended tightening torque for an M5 screw of property class 5.6: 2.8 Nm.

Please use M5 screws for the mounting of the servo positioning controllers SE-Power FS 1kVA.

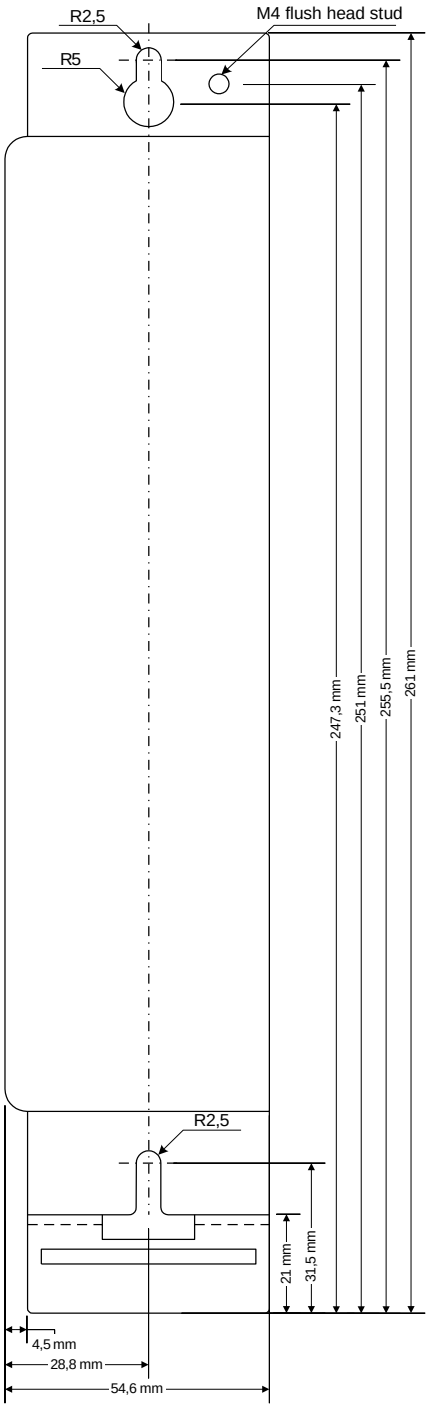


Figure 9: Servo positioning controller SE-Power FS 1kVA: Mounting plate

Please use M5 screws for the mounting of the servo positioning controllers SE-Power 3kVA and SE-Power 6kVA.

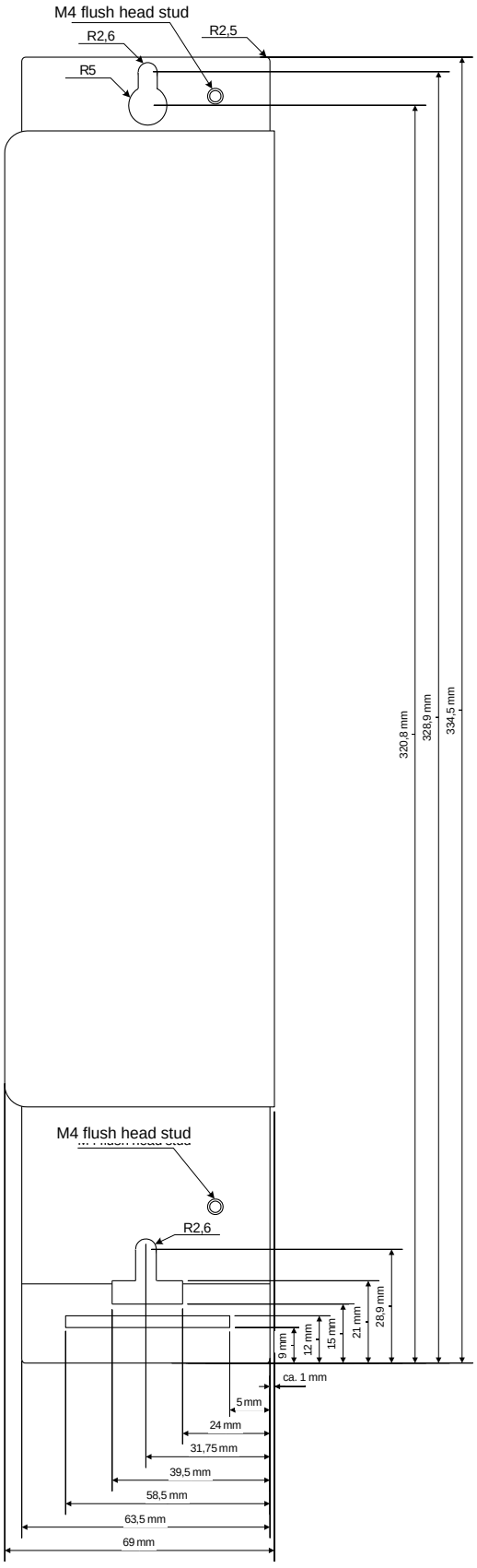


Figure 10: Servo positioning controller SE-Power FS 3kVA and 6kVA: Mounting plate

6 Electrical installation

6.1 Connector configuration (SE-Power FS 1kVA)

The servo positioning controller SE-Power FS 1kVA is connected to the supply voltage, the motor, the optional external brake chopper and the holding brakes as shown in *Figure 11.*

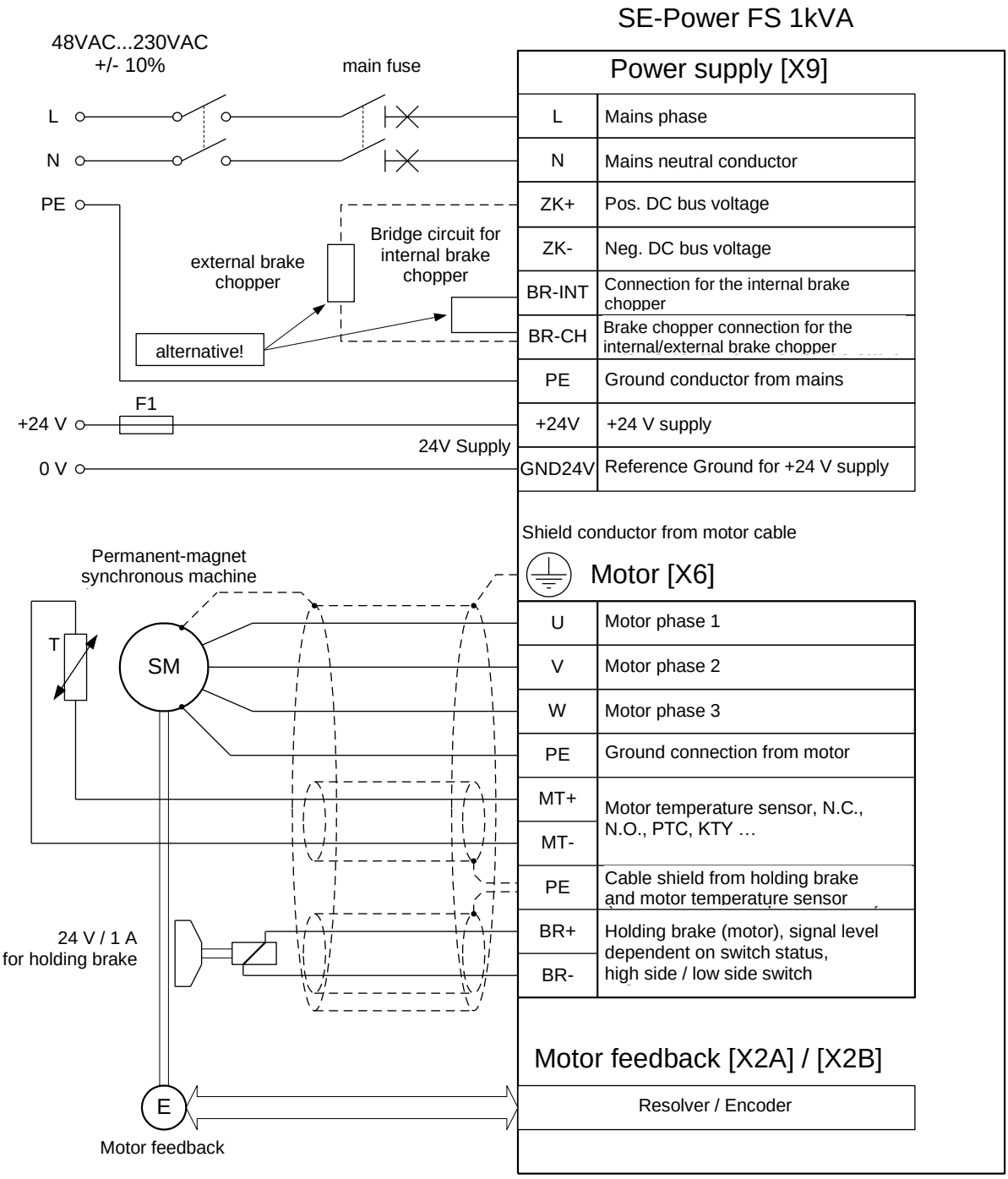


Figure 11: SE-Power FS 1kVA connection to the power supply and motor

6.2 Connector configuration (SE-Power FS 3kVA and 6kVA)

The servo positioning controllers SE-Power FS 3kVA and 6kVA are connected to the supply voltage, the motor, the optional external brake chopper and the holding brakes as shown in *Figure 12.*

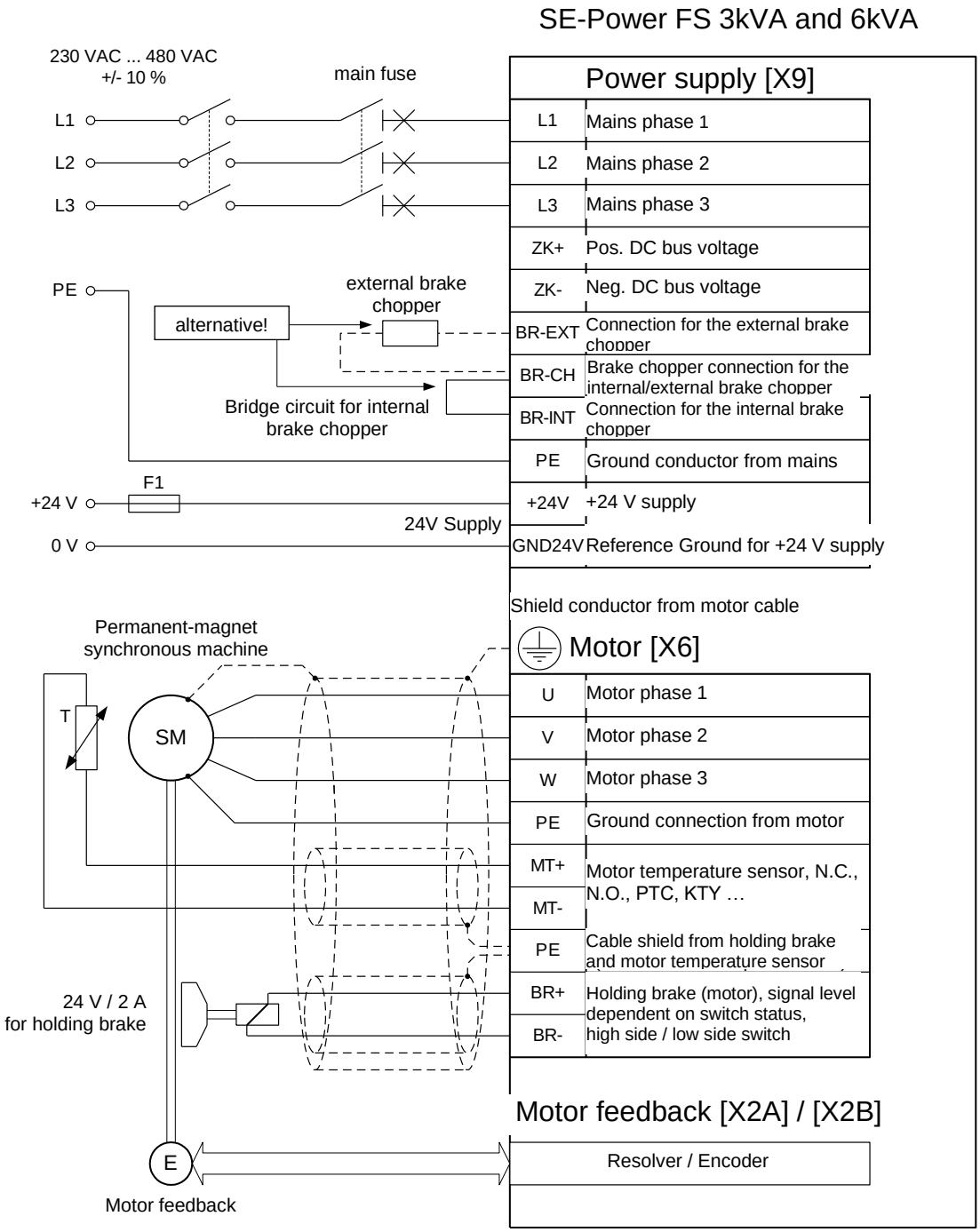


Figure 12: SE-Power FS 3kVA and 6kVA 1kVA connection to the power supply and motor

The operation of the servo positioning controller SE-Power FS requires a 24V voltage supply source for the electronics supply, which is connected to the terminals +24V and GND24V.

The connection to the supply for the power output stage at the SE-Power FS 1kVA is either made to terminals L1 and N for AC supply or to ZK+ and ZK- for DC supply.

The connection to the supply for the power output stage at the SE-Power FS 3kVA and 6kVA is either made to terminals L1, L2 und L3 for AC supply or to ZK+ and ZK- for DC supply.

The motor is connected to terminals U, V and W. The motor temperature switch (PTC or NC contact) is connected to terminals MT+ and MT–, if it is lead into one cable together with the motor phases. If an analogue temperature sensor is used in the motor (for example KTY81), the connection is realized via the encoder cable to [X2A] or [X2B].

The connection of the encoder via the D-Sub connector to [X2A] / [X2B] is roughly shown in *Figure 11* and *Figure 12*.

The servo positioning controller must be connected to ground with its PE connection.

The servo positioning controller must be completely wired first. Only then the operating voltages for the DC bus and the electronics may be switched on. In the case of inversed wiring of the operating voltage connections, excessive operating voltage or in the case of confusing the connections for operating voltage and motor the servo positioning controller will be damaged.

6.2.1 Connection: Power supply [X9]

The servo positioning controller SE-Power FS receives its 24 VDC power supply for the control electronics via connector [X9].

The mains voltage supply for the SE-Power FS 1kVA is single-phase and for the SE-Power FS 3kVA and 6kVA three-phase. As an alternative to AC feed or for the purpose of DC bus coupling a direct DC supply for the DC bus is possible.

Table 12: Pin assignment [X9] SE-Power FS 1kVA

Pin No.	Denomination	Value	Specification
1	L	48...230VAC ±10% 50...60Hz	Phase conductor
2	N		Neutral conductor
3	ZK+	< 440VDC	Pos. DC bus voltage
4	ZK-	GND_ZK	Neg. DC bus voltage
5	BR-INT	< 460VDC	Connection of internal brake chopper (bridge to BR-CH when using the internal chopper)
6	BR-CH	< 460VDC	Brake chopper connection for internal brake chopper against BR-INT or external brake chopper against ZK+
7	PE	PE	Connection ground conductor from mains
8	+24V	+24VDC ±20% / 0,65A *)	Supply for control module and holding brake
9	GND24V	GND24	Reference potential supply

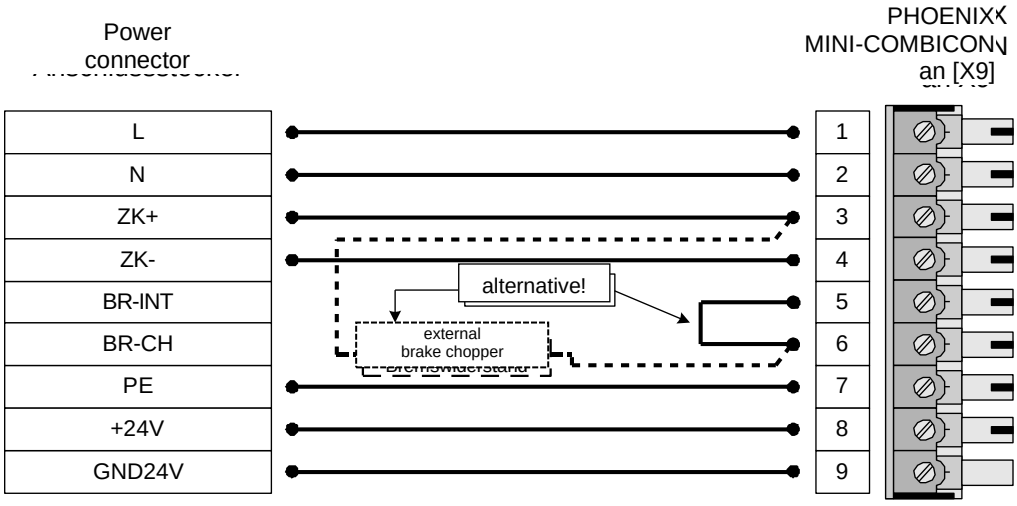


Figure 13: Supply [X9] SE-Power FS 1kVA

Table 13: Pin assignment [X9] SE-Power FS 3kVA und 6kVA

Pin No.	Denomination	Value	Specification
1	L1	230...480VAC ±10% 50...60Hz	Conductor phase 1
2	L2		Conductor phase 2
3	L3		Conductor phase 3
4	ZK+	< 700VDC	Pos. DC bus voltage
5	ZK-	GND_ZK	Neg. DC bus voltage
6	BR-EXT	< 800VDC	Connection of external brake chopper
7	BR-CH	< 800VDC	Brake chopper connection for internal brake chopper against BR-INT or external brake chopper against ZK+
8	BR-INT	< 800VDC	Connection of internal brake chopper (bridge to BR-CH when using the internal chopper)
9	PE	PE	Connection ground conductor from mains
10	+24V	+24VDC ±20% / 1,0A *)	Supply for control module and holding brake
11	GND24V	GND24	Reference potential supply

*) Plus current consumption of a possibly connected holding brake and I/O's

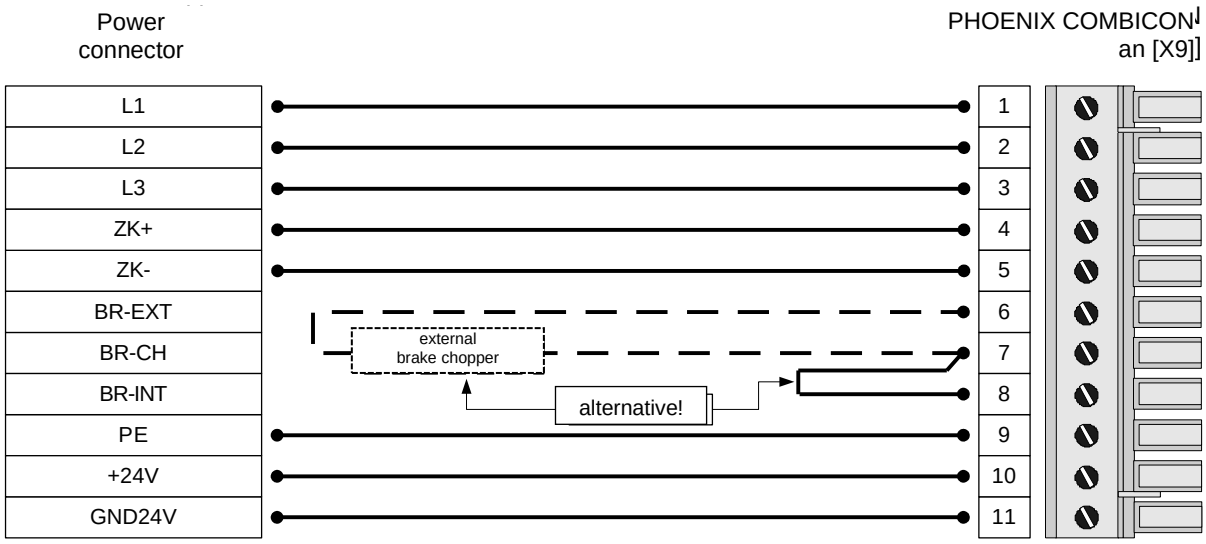


Figure 14: Supply [X9] SE-Power FS 3kVA and 6kVA

6.2.2 Connection: Motor [X6]

Table 14: Pin assignment [X6] SE-Power FS 1kVA

Pin No.	Denomination	Value	Specification
1	BR-	0V brake	Holding brake (motor), signal level dependent on switch status, high side / low side switch
2	BR+	24V brake	
3	PE	PE	Connection for inner shield (holding brake + temperature sensor)
4	MT-	GND	Motor temperature sensor, N.C. and N.O. contact, PTC, NTC
5	MT+	+5V / 5mA	
6	PE	PE	Motor ground conductor
7	W	0...270V_{eff} 0...5 A_{eff} 0...1000Hz	Connection of the three motor phases
8	V		
9	U		

Table 15: Pin assignment [X6] SE-Power FS 3kVA und 6kVA

Pin No.	Denomination	Value	Specification
1	BR-	0V brake	Holding brake (motor), signal level dependent on switch status, high side / low side switch
2	BR+	24V brake	
3	PE	PE	Connection for inner shield (holding brake + temperature sensor)
4	MT-	GND	Motor temperature sensor, N.C. and N.O. contact, PTC, NTC
5	MT+	+5V / 5mA	
6	PE	PE	Motor ground conductor
7	W	0...360V_{eff} 0...5 A_{eff} SE-Power FS 3kVA 0...10 A_{eff} SE-Power FS 6kVA 0...1000Hz	Connection of the three motor phases
8	V		
9	U		

The outer cable shield of the motor cable must also be placed flat on the mounting plate of the controller housing to shield terminal SK14.

6.2.3 Pin assignment [X1]

Table 16: Pin assignment: I/O communication [X1]

Pin No.		Denomination	Values	Specification
1		AGND	0V	Shield for analogue signals, AGND
	14	AGND	0V	Reference potential for analogue signals
2		AIN0	Uln = ±10V RI ≥20kΩ	Set point input 0, differential, max. 30 V input voltage
	15	#AIN0		
3		DIN AIN1	Start_Ref	Start reference run (homing)
	16	DIN AIN2	SET-UP-Mode	Set up mode
4		+VREF	+10V	Reference output for set point potentiometer
	17	AMON0	±10V	Analogue monitor output 0
5		AMON1	±10V	Analogue monitor output 1
	18	+24V	24V / 100mA	24 V supply out
6		GND24	ref. GND	Reference potential for digital I/O's
	19	DIN0	POS Bit0	Target selection positioning Bit0
7		DIN1	POS Bit1	Target selection positioning Bit1
	20	DIN2	POS Bit2	Target selection positioning Bit2
8		DIN3	POS Bit3	Target selection positioning Bit3
	21	DIN4	FG_E	Power stage enable
9		DIN5	FG_R	Input controller enable
	22	DIN6	END0	Input end switch 0 (locks n > 0)
10		DIN7	END1	Input end switch 1 (locks n < 0)
	23	DIN8	Ref	Homing switch
11		DIN9	START	Input for positioning start
	24	DOUT0 / BEREIT	24V / 100mA	Output operational
12		DOUT1	24V / 100mA	Homing position valid
	25	DOUT2	24V / 100mA	In position
13		DOUT3	24V / 100mA	Remaining distance

Note! The grey boxes are not required in the positioning mode.

6.2.4 Connection: RS232/COM [X5]

Table 17: Pin assignment RS232 interface [X5]

Pin No.		Denomination	Values	Specification
1		-	-	Not occupied
	6	-	-	Not occupied
2		RxD	10 V / R_I > 2kΩ	Receive line, RS232 specification
	7	-	-	Not occupied
3		TxD	10 V / R_A < 2kΩ	Transmitting line, RS232 specification
	8	-	-	Not occupied
4		-	-	Not occupied
	9	-	-	Not occupied
5		GND	0V	Interfaces GND, galvanically connected to GND DGND

6.2.5 Cable type and design [X5]

- Programming cable RS232 SE-Power, 3m (50038526)

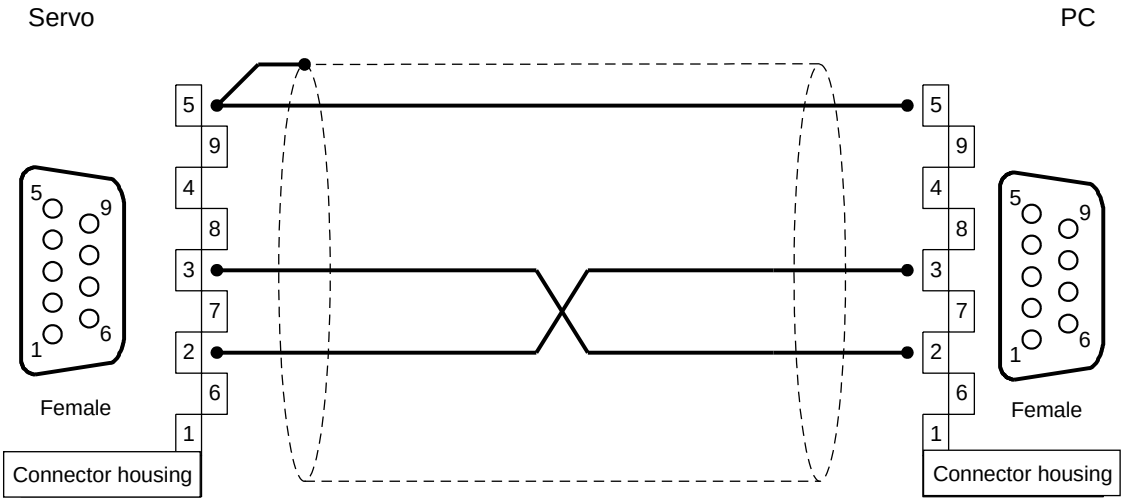


Figure 15: Pin assignment RS232-null modem cable [X5]

6.2.6 Connection: USB [X19]

Table 18: Pin assignment: USB interface [X19]

Pin No.	Denomination	Values	Specification
1	VCC		+ 5 VDC
2	D-		Data -
3	D+		Data +
4	GND		GND

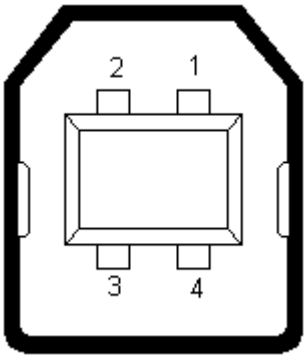


Figure 16: Pin assignment: USB interface [X19], front view

6.2.7 Cable type and design [X19]

- Programming cable USB SE-Power FS, 3m (50395197)

6.3 EMC compliant cabling

The following must be considered for an EMC-compliant setup of the drive system (see also *chapter 6 Electrical installation*):

- In order to keep the leakage currents and the losses in the motor connection cable as small as possible, the servo positioning controller should be located as close to the motor as possible.
- Motor cable and angle encoder cable must be shielded.
- The shield of the motor cable is connected to the housing of the servo positioning controller (shield connection terminal). The cable shield also has to be connected to the associated servo positioning controller so that the leakage currents can flow back into the controller causing the leakage.
- The mains-end PE connection is connected to the PE connection point of the supply connection [X9].
- The inner PE conductor of the motor cable is connected to the PE connection point of the motor connection [X6].
- The signal lines must be as far away from the power cables as possible. They should not be placed parallel. If intersections cannot be avoided, they should be perpendicular (that is at a 90° angle), if possible.
- Unshielded signal and control lines should not be used. If their use is inevitable they should at least be twisted.
- Even shielded cables will inevitably have short unshielded ends (unless shielded connector housings are used). In general, the following applies:
  - Connect the inner shields to the corresponding pins of the connectors; Maximum length 40 mm.
  - Length of the unshielded cores 35 mm maximum.
  - Connect the total shield on the controller side plane to the PE terminal; Maximum length 40 mm.
  - Connect the total shield on the motor side plane to the connector housing or motor housing; Maximum length 40 mm.

DANGER!

For safety reasons, all PE ground conductors must be connected prior to initial operation.

The EN 61800-5-1 regulations for protective earthing must be complied with during installation!

6.4 ESD protection

Caution!

Unassigned D-Sub connectors may cause damage to the device or other parts of the systems due to ESD (electrostatic discharge).

To prevent such discharge, protective caps are available (for example Spoerle).

The servo positioning controller SE-Power FS has been designed to provide high interference immunity. For that reason, some individual functional blocks are electrically isolated. Inside the device the signals are transmitted via optocouplers.

The following isolated areas are distinguished:

- Power module with DC bus and mains input
- Control electronics with processing of analogue signals
- 24V supply and digital inputs and outputs

7 Initial operation

7.1 General notes on connection

Since the laying of the connection cables is very important in terms of EMC, make sure to comply with the previous chapter *6.3 EMC compliant cabling*!

DANGER!

Noncompliance with chapter *2 Safety notes for electrical drives and controller* may result in property damage, person injury, electric shock or in extreme cases in death.

All regulator parameters was saved on the corresponding Servo Controller by Afag, there's no further parameterization required.

If you have multiple controllers and axes in use, are they explicit identifiable by the labelling.

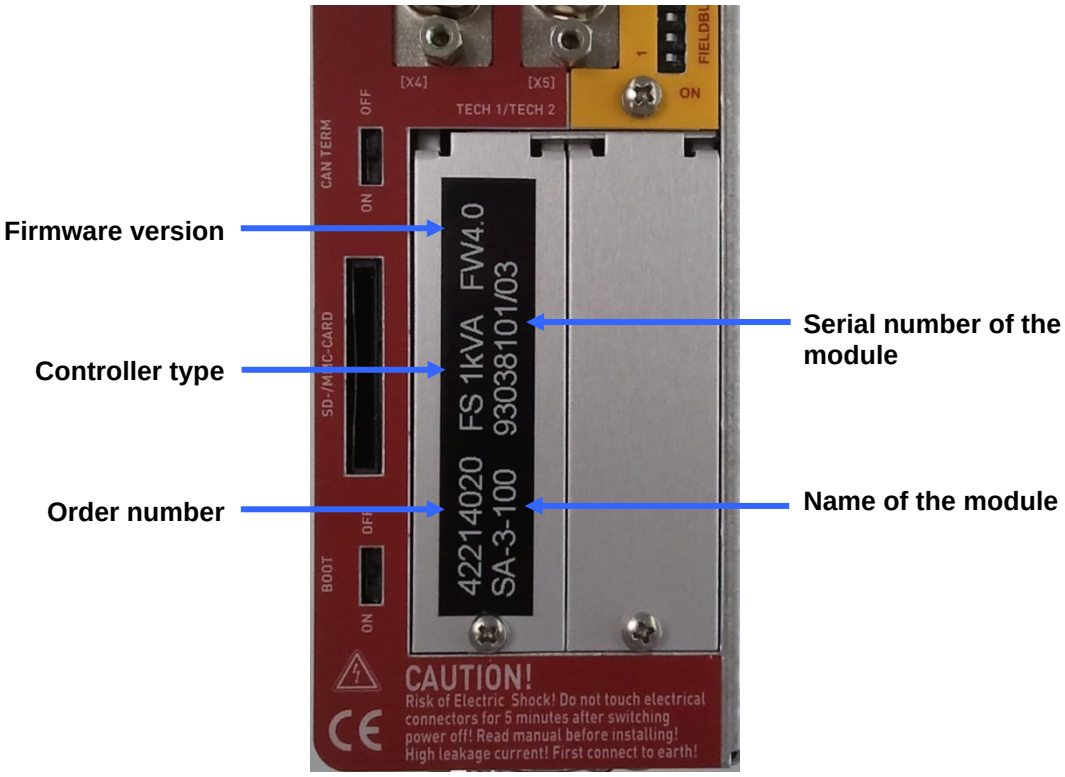


Figure 17: Servo positioning controller: Labelling Order

7.2 Connecting the motor

- Plug the connector of the motor cable into the corresponding socket of the motor and screw tight.
- Plug PHOENIX connector into socket **[X6]** of the device.
- Connect the PE line of the motor to the **PE** socket.
- Plug the connector of the encoder cable into the encoder output socket of the motor and screw tight.
- Plug the D-Sub connector into the socket **[X2A] Resolver** or **[X2B] Encoder** of the device and fasten the bolting screws.
- Connect the overall shield of the motor and encoder cable flat with the SK14 shield clamp
- Check all connections again.

7.3 Connecting the servo positioning controller to the power supply

- Make sure that the power supply has been switched off.
- Plug the PHOENIX connector into socket **[X9]** of the device.
- Connect the PE line of the mains to the **PE** socket.
- Connect the 24V connections to a suitable power supply unit.
- Make mains supply connections.
- Check all connections again.

7.4 Connecting the PC (USB Interface)

- Plug the connector A of the USB interface cable into the socket for the USB interface of the PC.
- Plug the connector B of the USB interface cable into the socket **[X19] USB** of the servo positioning controller SE-Power FS.
- Check all connections again.

7.5 Connecting the PC (RS232 Interface)

- Plug the D-Sub connector of the serial interface cable into the socket for the serial interface of the PC and fasten the bolting screws.
- Plug the D-Sub connector of the serial interface cable into the socket **[X5] RS232/COM** of the servo positioning controller and fasten the bolting screws.
- Check all connections again.

7.6 Checking operability

1. Make sure the controller enabling switch is turned off.
2. Switch on the power supply of all devices. The READY-LED on the front of the device should now be active.

If the READY-LED is not active, there is a malfunction. If the seven-segment display indicates a number sequence, it is displaying an error message. You have to take care of the corresponding problem. In this case please continue with *"Chapter 11.2.2 Error messages in the Operating Instructions"*. If the device displays nothing, follow these steps:

1. Switch off the power supply.
2. Wait 5 minutes, so the DC bus can discharge.
3. Check all connection cables.
4. Check the functionality of the 24 V power supply.
5. Switch the power supply back on.

7.7 Scaling check

- Proceed by hand a certain way with the axis and compare whether the travel coincides with the display in the SE-Commander (actual position).
- If the servo positioning controller is controlled by a fieldbus, please check the display of the actual position also there.

7.8 Switch on controller enable

Now the controller enable can be switched on and with this the motor is set under current. The ENABLE-LED on the front side of the devices should be green now.

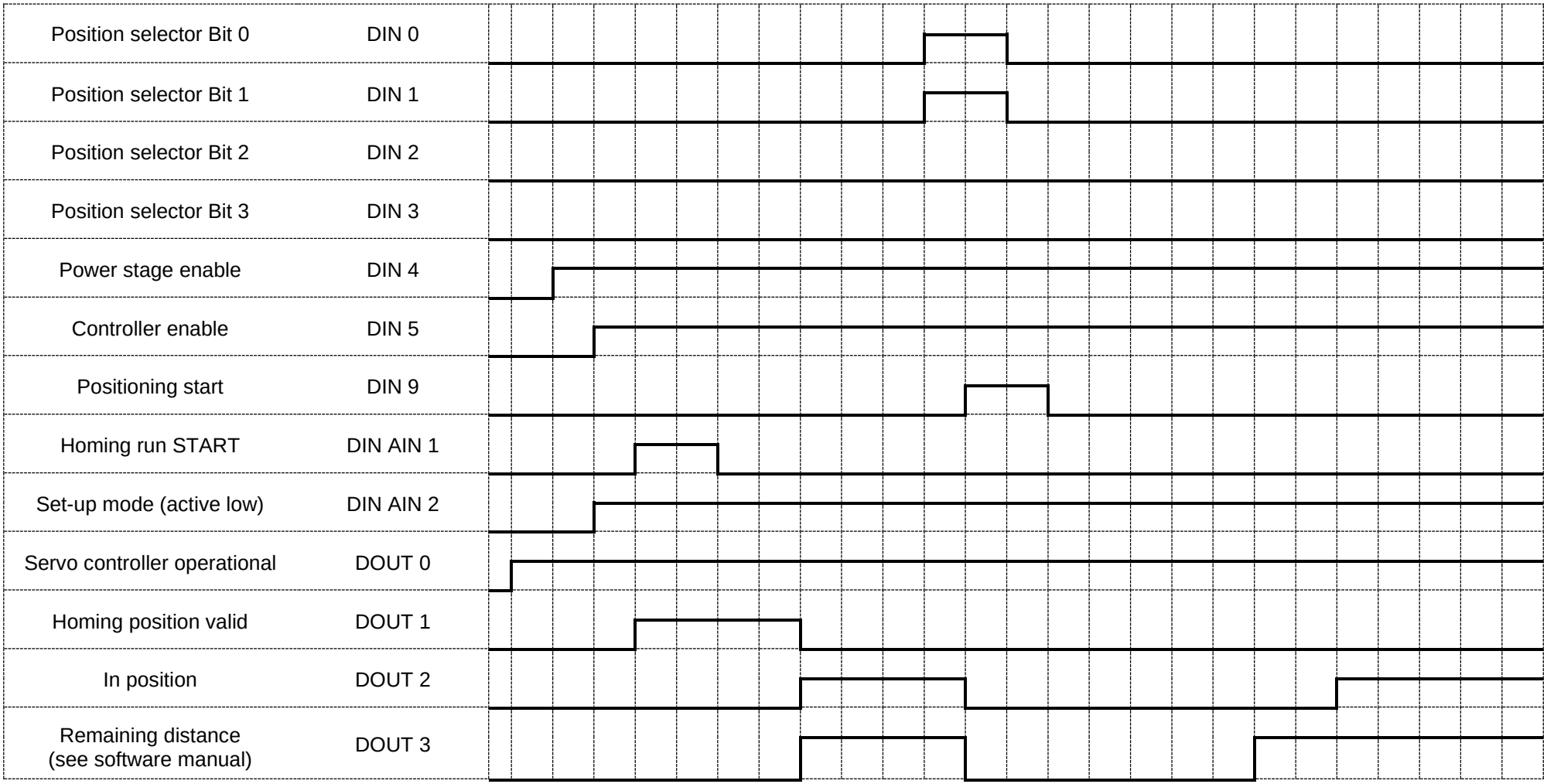
Note also the following table:

Table 19: Dependence power stage and controller enable

Power stage enable DIN4	Controller enable DIN5	Motor
0	0	Not active
0	1	Not active
1	0	Not active
1	1	Active, motor is controlled
1	1 ➔ 0	Controlled deceleration to stop, then motor rotate freely
1 ➔ 0	1	Motor is inactive immediately, drives on uncontrolled

8 Programming (over digital I/O's)

Example to drive to position 3



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