
AMB Control cabinet

MBX22

BG20015-xxN / BG20017-xxN / BG20019-xxN



Operating instructions



Manufacturer: MECOS AG
Address: Hardstrasse 319, 8005 Zurich, Switzerland

Name of the person who is authorized to compile the technical documentation:

Name: Julian Risi
Funktion: Project Manager

Brand: MECOS
Item No.: BG20015-xxN, BG20017-xxN, BG20019-xxN
Equipment Type: AMB Control cabinet
Type: MBX22

The CE mark was first applied in 2014.

Herewith we declare, that the above-mentioned equipment is compliant with all relevant requirements of the following EU Directives:

- Low voltage directive 2014/35/EU
- EMC directive 2014/30/EU
- RoHS directive 2011/65/EU

Furthermore, we declare that the following standards (or parts or clauses thereof) have been applied:

EN 60204-1:2018	Safety of machinery – Electrical equipment of machines – Part 1: General requirements
EN 61000-6-2:2015	Electromagnetic compatibility (EMC) – Part 6: Generic standards – Section 2: Immunity for industrial environments
EN 61000-6-4:2007/A1: 2011	Electromagnetic compatibility (EMC) – Part 6: Generic standards – Section 4: Emission standard for industrial environments


The safety objectives of the Low Voltage Directive 2014/35/EU have been fulfilled according to the Machinery Directive 2006/42/EC Annex I, No. 1.5.1.

Operating this product is not allowed as long as the necessary protective measures for the entire system cannot be guaranteed and as long as the whole system is not in conformity with the provisions of the Low Voltage Directive.

The relevant technical documentation in accordance with the above mentioned EU Directives has been compiled. In response to a justified request, the documentation can be transmitted in digital format to the responsible market surveillance authorities of the Member States.

This declaration relates exclusively to the product in the condition in which it was placed on the market, components added and/or operations carried out subsequently by the final user are explicitly excluded. The declaration will become invalid, if the product is modified without the consent of MECOS AG.

Zurich, March 7, 2024


Nicolas Krauer
Head of Engineering


Christopher Bowles
COO MECOS AG

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1. General information

1.1 Device description

The AMB control cabinet MBX22 is a system that can store rotor systems in five to nine axes without contact. The main components are the magnetic bearing controller, rectifier and five to nine amplifiers.

The power amplifiers have a wide range and so position deviations of the levitated rotor can be corrected quickly. Controlling takes place through a multiple processor system, which simultaneously performs various control and monitoring functions. The real-time measurement of the rotor position allows various rotor dynamic effects to be influenced actively, for example, the unbalance can be actively compensated using the control.

Basic operation is carried out via the digital I/O interface of the magnetic bearing controller. This can be used to carry out elementary functions such as lifting and lowering the rotor. For more advanced operation, e.g. reading out errors, the optional field bus interface or the toolbox mentioned below can be used.

The integrated Ethernet interface allows communication with a PC. With the optionally available MATLAB® Toolbox for MECOS magnetic bearing systems (MecosTools), a large number of system parameters can be changed. In addition, real-time measurements of all processor variables of the magnetic bearing system can be carried out.

The AMB control cabinet MBX22 contains its own UPS. In the event of a mains power interruption, the rotor can continue to be stored without contact until the rotor comes to a standstill.

To communicate with external control and monitoring systems of any kind, the AMB control cabinet MBX22 provides a configurable interface consisting of potential-free digital I/O channels.

The technical specifications of the AMB control cabinet MBX22 are given in section 4.

A glossary explaining the most common abbreviations is given at the end of these operating instructions.

1.1.1 EC Directives

The AMB control cabinet MBX22 is a component intended for installation in stationary electrical systems or machines. Commissioning (i.e. the start of intended operation) is only permitted if the EMC directive is complied with.

1.2 Information on the operating instructions

This operating manual is an essential aid for the successful and safe use of the AMB control cabinet. It contains important information on how to operate the control cabinet safely, properly and economically. Following these instructions helps **avoid dangers**, reduce repair costs and downtimes and increase the reliability and service life of the control cabinet.

1.2.1 Storage location and obligation to read

Keep the latest version of the operating instructions in the immediate vicinity of the AMB control cabinet so that access is guaranteed at all times. This should be done for the entire service life of the AMB control cabinet.

The **operator** of the AMB control cabinet must ensure that anyone who works with it knows and complies with the contents of the operating instructions.

Carry out the work in accordance with the revision notice if you receive a revision of the operating instructions from MECOS AG.

1.3 Property rights

MECOS AG reserves all property rights to these operating instructions. Therefore, please adhere to the following rules:

- Make copies of any kind and for any application, even in part, only with the consent of MECOS AG.
- Prevent third parties from accessing the operating instructions. This also applies to excerpts and reproductions of any kind.
- Inform MECOS AG if you hand over the AMB control cabinet to another owner and pass the operating instructions on to the new owner.

MECOS AG reserves the right to take legal action in the event of infringement.

1.4 Manufacturer, Service address

Manufacturer: MECOS AG
Hardstrasse 319
8005 Zurich
Switzerland

Phone: +41 52 355 52 11

Internet: www.mecos.com

Service: MECOS AG
aftersales@mecos.com

1.5 Access aids and conventions

A distinction is made between safety instructions and pictograms for the structural elements appearing in the operating instructions (orientation to EN 82079-1).

1.5.1 Safety instructions

The signal words are assigned to different danger levels according to EN 82079 and ANSI Z535:



DANGER!

The signal word DANGER! indicates an immediate hazard with high risk, which will result in death or serious physical injury if you do not avoid the situation.

DANGER! is used to draw attention to an immediate hazard.



WARNING!

The signal word WARNING! indicates a potential hazard with medium risk, which will result in death or serious injury if you do not avoid the situation.

WARNING! is used to draw attention to a danger.



CAUTION!

The signal word CAUTION! indicates a low-risk hazard that could result in minor or moderate bodily injury if you do not avoid the situation.

CAUTION! is used to draw attention to a hazard or unsafe procedure.



NOTICE!

The signal word NOTICE! indicates a dangerous situation that can lead to property damage if you do not avoid the situation.

1.5.2 Pictograms

The following pictograms are used to highlight information and facts:



Useful tip or fact.



Important technical information or reference to further technical information.

2. Safety

This chapter is intended for all users of the AMB control cabinet. It contains information on the safety concept and provides the minimum requirements for the safe use of the AMB control cabinet.



For information on the connections, see sections 6.3 and 6.4 for more information.

2.1 Safety concept

In principle, the AMB control cabinet has been developed and manufactured according to the state of the art and the recognised safety rules. Nevertheless, hazards to persons or damage to the control cabinet and other property can occur during use if:

- the specifications for personal authorisation are not observed (see section 2.1.3)
- the control cabinet is not operated as intended (see section 2.1.1)
- the control cabinet is transported, installed or maintained improperly (see sections 5, 6 and 10)

2.1.1 Intended use

The AMB control cabinet is used exclusively to control active magnetic bearing systems from MECOS AG. It may only be used in the commercial sector. The written approval of MECOS AG is required for other purposes or areas of application.

The following operational functionalities exist:

- Five, seven and nine axis active magnetic bearing of a rotor system
- Lifting and lowering the magnetic bearing rotor (switching the magnetic bearings on or off) via the control panel, by an external signal or via the optional fieldbus interface
- Communication with an external control via a configurable interface
- Carrying out measurements using the MATLAB® Toolbox for MECOS magnetic bearing systems (optional)
- Modification of control and other system parameters using the MATLAB® toolbox for MECOS magnetic bearing systems (optional)

The information in section 4 «Technical specifications» must be observed and complied with.

The intended use of the AMB control cabinet also includes compliance with the precautionary measures prescribed in these operating instructions as well as the operating and maintenance regulations.

This device is intended for use in clean and dry environments in accordance with pollution degree II and overvoltage category III (see section 4.2).

Any other use or use that goes beyond this is considered improper. The user/operator of the AMB control cabinet shall be solely liable for any resulting damage. This also applies to unauthorised modifications to the AMB control cabinet.

2.1.2 Safety instructions for transport

The AMB control cabinet must be packed and transported by qualified personnel. Particular attention must be paid to the weight and the resulting dangers.



WARNING!

The AMB control cabinet has a total weight which, together with the packaging, exceeds 1100 kg. A corresponding health hazard results due to failure of the transport equipment or improper handling. The national and local regulations for handling heavy loads must be observed. Only suitable and tested lifting gear and slings are to be used.



NOTICE!

Detailed information on transport is given in section 5.

2.1.3 Safety instructions during operation

The responsibilities for the different activities within the operation must be clearly defined by the operator and the personnel thus assigned must comply with these specifications.

The AMB control cabinet may only be used in a technically perfect condition and in accordance with its intended use, in a safety-conscious and hazard-conscious manner and in compliance with these operating instructions. In particular, faults that could impair safety must be rectified immediately.

Work on the electrical system (wiring to the control cabinet) may only be carried out by qualified electricians. The international, national and local regulations in this context must be followed.



WARNING!

The AMB control cabinet is operated with a dangerous voltage. Do not open any device inside or plug or unplug any cables during operation. There is a danger of fatal electric shock and accidental ejection of the machine's rotor.

2.1.4 Safety instructions for repairs/maintenance/servicing

Repairs to the AMB control cabinet shall be carried out exclusively by MECOS. The devices installed on and in the control cabinet must not be opened.

Prescribed intervals or intervals specified in the operating instructions for regular maintenance work and recurring tests/inspections must be followed.

The operating personnel must be informed about the execution of this work before it begins, and the maintenance area must be secured over a wide area if necessary.

Basically, the following points must be followed before any maintenance work:

1. Shut down the machine and wait until the speed reaches 0 Hz.
2. Switch off the main switch at the AMB control cabinet and secure it against being switched on again.
3. Wait until the built-in UPS is switched off (duration approx. 3 minutes).
4. For a complete shutdown, the external supply line must be disconnected
5. If necessary, allow the AMB control cabinet to cool down sufficiently.
6. Attach a warning sign to the AMB control cabinet



WARNING!

The AMB control cabinet is operated with a dangerous voltage and has components for storing electrical energy. Do not open any device inside and do not connect or disconnect any cables during operation. There is a danger of fatal electric shock and unintentional ejection of the machine's rotor, which may result in injury to persons and property damage.



WARNING!

The AMB control cabinet has a built-in uninterruptible power supply system with batteries (UPS). In the event of a fault or an external battery disconnect, the UPS can continue to supply the machine with power despite the main path being switched off. There is a danger of electric shock.

The UPS must be switched off completely according to section 2.1.4.

2.1.5 Residual dangers

Even if all safety regulations are followed, certain residual dangers remain when handling the AMB control cabinet.

All persons working on and with the AMB control cabinet must be aware of these dangers and follow the safety instructions in the operating instructions or on the AMB control cabinet.

2.1.6 Safety instructions for the operator

The operator must organise the responsibilities of the personnel in accordance with the specifications of these operating instructions. The different requirements within the life cycle phases (transport, installation, commissioning, operation, troubleshooting, maintenance) must be taken into account and appropriately qualified persons must be assigned.

The operator must also follow and implement the accident prevention and occupational health and safety regulations applicable at the place of use of the machine.



NOTICE!

Installation, operation and maintenance must be carried out by qualified personnel.

2.2 Electricity

The AMB control cabinet is operated with a voltage of 400 V_{AC}, which must be classified as more dangerous. The corresponding precautionary measures for handling electricity must be observed.

Work on the electrical equipment may only be carried out by qualified electricians in accordance with the electrotechnical regulations.

In the event of faults and before working on the electrical system, it must be switched off and secured in accordance with the following safety rules:

1. Disconnect.
2. Secure against being switched on again.
3. Check that no voltage is present.
4. Ground and short circuit.
5. Cover or block adjacent parts that are live.

If work on live components is necessary (only in exceptional situations!), an additional person must be called in to operate the main switch in an emergency. Only use voltage-insulated tools.

Only original fuses with prescribed current ratings may be used. Never repair or bridge defective fuses.

During and after work, always keep the control cabinet locked as soon as it is left unattended.

Changes to the programme of the control unit may impair safe operation. Changes to the programme require the approval of the manufacturer alone.

When carrying out repairs, ensure that design features are not changed in a way that reduces safety (e.g. creepage distances and clearances).

The proper earthing of the electrical system of the AMB control cabinet and the associated magnetic-bearing machine must be ensured with a protective conductor system.



WARNING!

The AMB control cabinet is operated with a dangerous voltage and has devices that contain components for storing electrical energy. Unauthorised opening of these devices, as well as improper tampering, can lead to injury to persons and property damage. These devices must not be opened.



WARNING!

The AMB control cabinet has a built-in uninterruptible power supply system with batteries (UPS). In the event of a fault or an external battery disconnect, the UPS can continue to supply the machine with power despite the main path being switched off. There is a danger of electric shock.

The UPS must be switched off completely according to section 2.1.4.

2.3 Emergency measures in the event of accidents with electric current

Basic procedure in the event of an electrical accident:

1. Disconnect the circuit.
2. Assess the severity of the accident.
3. Call the ambulance/emergency medical service.
4. If unconscious, place the person in the recovery position.
5. In case of muscle cramp and heart palpitations, place the affected person in a supine position.
6. In case of unconsciousness and respiratory arrest, start resuscitation.

In principle, any person who has had contact with electric current should be taken for a medical check-up.

Often, the life of an injured person depends on first aid being administered as quickly as possible, right at the scene of the accident.

2.4 Fire fighting in case of electrical fire

Basic procedure in the event of an electrical fire:

1. Disconnect affected circuits in consultation with the operator.
2. Support to the fire brigade by electrical specialists.
3. Extinguish fire.
4. Ventilate the fire area and people who have come into contact with decomposition products must be given specialist medical attention immediately.

2.5 Noise

The airborne noise emissions of the AMB control cabinet are caused exclusively by the built-in fans and depend on the location of the installation. Local regulations must be followed.

Fan sound power level: max. 75 dB(A)

2.6 Safety devices

2.6.1 Blow Down Signal

To disconnect the power outputs from the voltage, the AMB control cabinet has an input that disconnects the connection between the UPS and the DC link, short-circuits the DC link and discharges it via earthing with a delay. The control and sensors remain active. For connection via terminals, see section 6.4.



NOTICE!

Actuation of the signal will in any case cause the rotor to be ejected into the machine's touch down bearings.



WARNING!

The AMB control cabinet has a built-in uninterruptible power supply system with batteries (UPS). In the event of a fault or an external battery disconnect, the UPS can continue to supply the machine with power despite the main path being switched off. There is a danger of electric shock.

The UPS must be switched off completely according to section 2.1.4.

2.6.2 Mains disconnection device



The main switch on the front side of the control cabinet is used to disconnect from the mains. After the main switch is switched off it can be secured against accidental switch-on using a padlock (also see section 2.1.4).

Figure 1: Main switch Control cabinet door



WARNING!

The AMB control cabinet is operated with a dangerous voltage and has devices that contain components for storing electrical energy. Unauthorised opening of these devices, as well as improper tampering, can lead to injury to persons and property damage. These devices must not be opened.



WARNING!

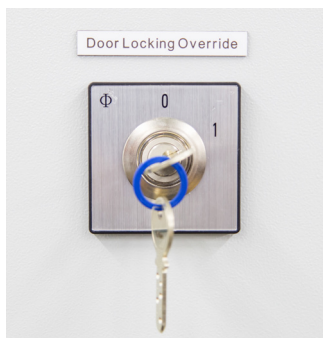
The AMB control cabinet has a built-in uninterruptible power supply system with batteries (UPS). In the event of a fault or an external battery disconnecter, the UPS can continue to supply the machine with power despite the main path being switched off. There is a danger of electric shock. The UPS must be switched off completely according to section 2.1.4.

2.6.3 Safety device



The control cabinet has an electromechanical door lock. This prevents the door of the control cabinet from being opened while the mains is switched on. Electrically, the door openers are fitted before the UPS, i.e. switching off the UPS is not sufficient to release the door locking.

Figure 2: Electromechanical door lock



For maintenance and repair work, there is a key switch on the front side of the control cabinet to release the door lock.

Figure 3: Key switch for releasing the door lock



WARNING!

The AMB control cabinet is operated with a dangerous voltage. Do not open any device or plug or unplug any cables during operation. There is a danger of fatal electric shock and accidental ejection of the machine's rotor.

2.7 Safety instructions on the device

The safety instructions on the AMB control cabinet have the following meaning:



Attention! Voltage also present when main switch is turned off

Warning that dangerous voltage may still be present internally through the UPS and through the external supply line even when the main switch is switched off.

Figure 4: Warning sign External voltage



Caution: Dangerous electrical voltage

Warning of dangerous electrical voltage inside the control cabinet.

Figure 5: Warning sign for electrical voltage

2.8 Operating modes

The AMB control cabinet is basically designed for continuous operation.

The following operating modes can be set for various types of work on the AMB control cabinet, whereby the information on the permissible operating modes in the respective sections must be noted:

Remote

The control system has basically been developed for automatic operation and thus for integration into a higher-level system control. The complete control is implemented here exclusively via the interfaces provided for this purpose. After switching on, the AMB control cabinet is in automatic mode.

Local

For commissioning or test operation, the AMB control cabinet can be switched to «local». In this operating mode, control is implemented via the display and/or via a connected external PC with the corresponding MecosTools.

Main switch OFF

The entire control system can be switched off by pressing the main switch on the AMB control cabinet. A stop signal is applied to the digital outputs (e.g. to switch off an external variable frequency drive). As soon as the speed reaches zero, the rotor is lowered and the UPS is switched off.



WARNING!

The AMB control cabinet is operated with a dangerous voltage. Do not open any device or plug or unplug any cables during operation. There is a danger of fatal electric shock and accidental ejection of the machine's rotor.

3. Control cabinet configurations

The AMB control cabinet MBX22 is available in different variants. The project-specific configuration of the AMB control cabinet is shown in the diagram (see section 14 [4]) belonging to the project.

3.1 Exterior view of the AMB control cabinet

Externally, the AMB control cabinet has the following accessible elements in the standard configuration:



Figure 6: Exterior view of the AMB control cabinet MBX22 in standard configuration

Item	Term	Description
1	Key switch electromechanical door lock	Serves to override the electromechanical door lock (see section 2.6.3).
2	Main switch	Main switch of the control cabinet (see section 2.6.2).
3	IPC	Industrial PC with touch screen as operating console, for displaying the most important system information and for extended data recording (see section 4.5.1 and 4.6).
4	Junction box for the IX32-Box plus service and USB interface	Behind this cover there are connections for: <ul style="list-style-type: none"> • Optional: IX32 measuring box for analogue measurement of magnetic bearing-specific signals (see section 4.4.6). Instruction by MECOS personnel necessary. • Service interface for maintenance and service (see section 4.4.4) • Optional: USB interface for data backup via IPC

3.2 Interior view of AMB control cabinet

In the standard configuration, the AMB control cabinet consists of the following assemblies and components:

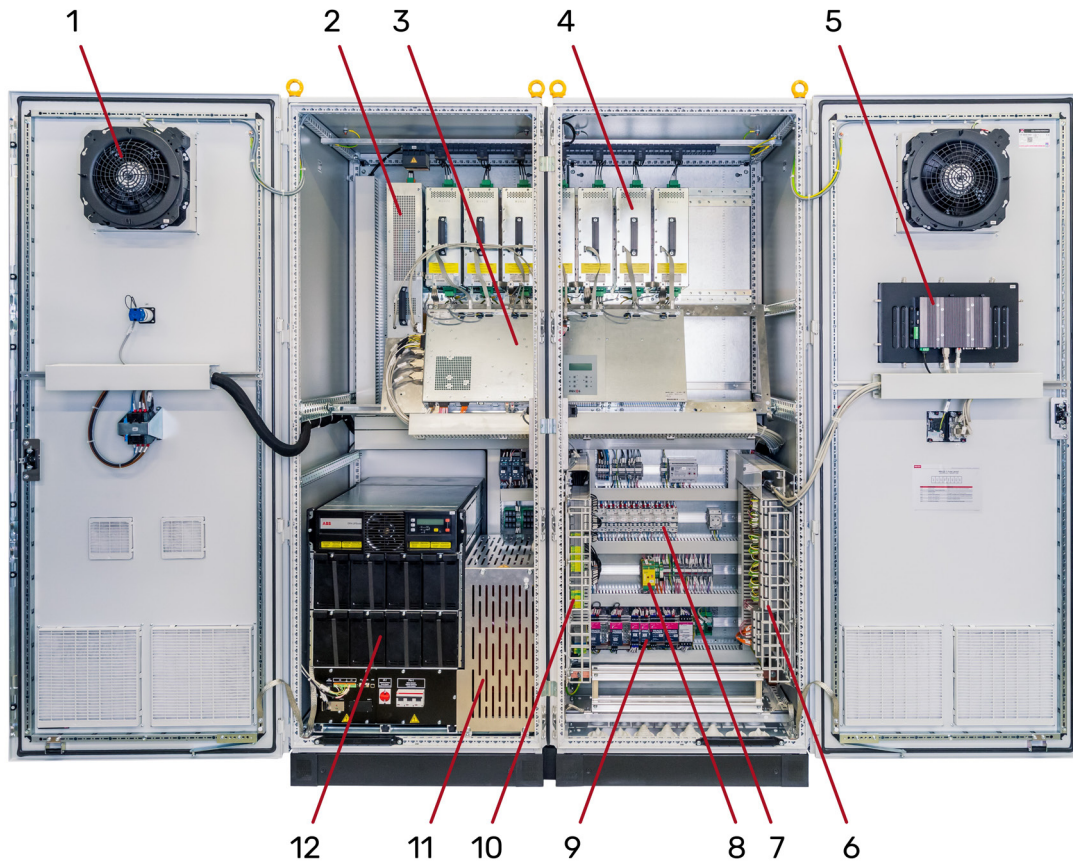


Figure 7: AMB control cabinet MBX22 open (example picture shows a 7-axis version of the magnetic bearing control)

Item	Term	Description
1	Fan	The control cabinet is cooled by 2 built-in fans (4 fans are also available as an option). These fans have speed control with temperature sensor. If the fans fail, a message is sent to the control system via the controls. The air is drawn in via the lower intake openings equipped with filter mats. The fans mounted in the upper area blow the heated air out of the control cabinet through filter mats.
2	MUS20 DC link supply	Supplies the DC link with the necessary energy (see section 3.2.2).
3	MUC262 + MUCE262 Magnetic bearing controller	Controller module (MUC262) of the magnetic bearing controller plus 1 extension (MUCE262) for 7-axis systems, for 9-axis systems 2 extensions are necessary (see section 3.2.1).
4	MUA22 Output amplifier	Output amplifier for the individual actuators, depending on the number of axes 5, 7 or 9 (see section 3.2.3). The connection to the actuators is made via the control cabinet terminals (see section 6.4.5).
5	IPC	Industrial PC with touch screen as operating console and for extended data recording (see section 4.5.1 and 4.6).
6	Terminals Sensors and Dig I/O	Connection of sensors, temperature sensors, digital I/O and relays of magnetic bearing (see section 4.3). For details, see diagram of AMB control cabinet, section 14 [4].

Item	Term	Description
7	Circuit breaker	The various subsystems of the control cabinet are protected by circuit breakers. For details see the diagram for AMB control cabinet in section 14 [4].
8	Safety relay for blow down	Serves to disconnect the DC link and thus the power outputs (see section 2.6.1).
9	Auxiliary supply 24V / 12V	The magnetic bearing controller has a dual 24V supply and 12V supply (24V/20A and 12V/10A respectively). The power supply units are supported by the UPS.
10	Terminals Power to Magnetic bearing and Connection terminals of mains	Connecting actuators, magnetic bearings and mains connection of the control cabinet. For details see the diagram for AMB control cabinet in section 14 [4].
11	Mains transformer	Provides galvanic isolation between the mains and the DC link.
12	UPS	Supports the magnetic bearing system for a certain duration in the event of a power failure (see section 3.2.4).

3.2.1 Magnetic bearing controller MUC262

The MUC262 is the controller module for the AMB control cabinet MBX22. It controls, regulates and monitors all relevant process parameters of the magnetic bearing system.

The pin assignments are shown in the diagram of the AMB control cabinet in section 14 [4].

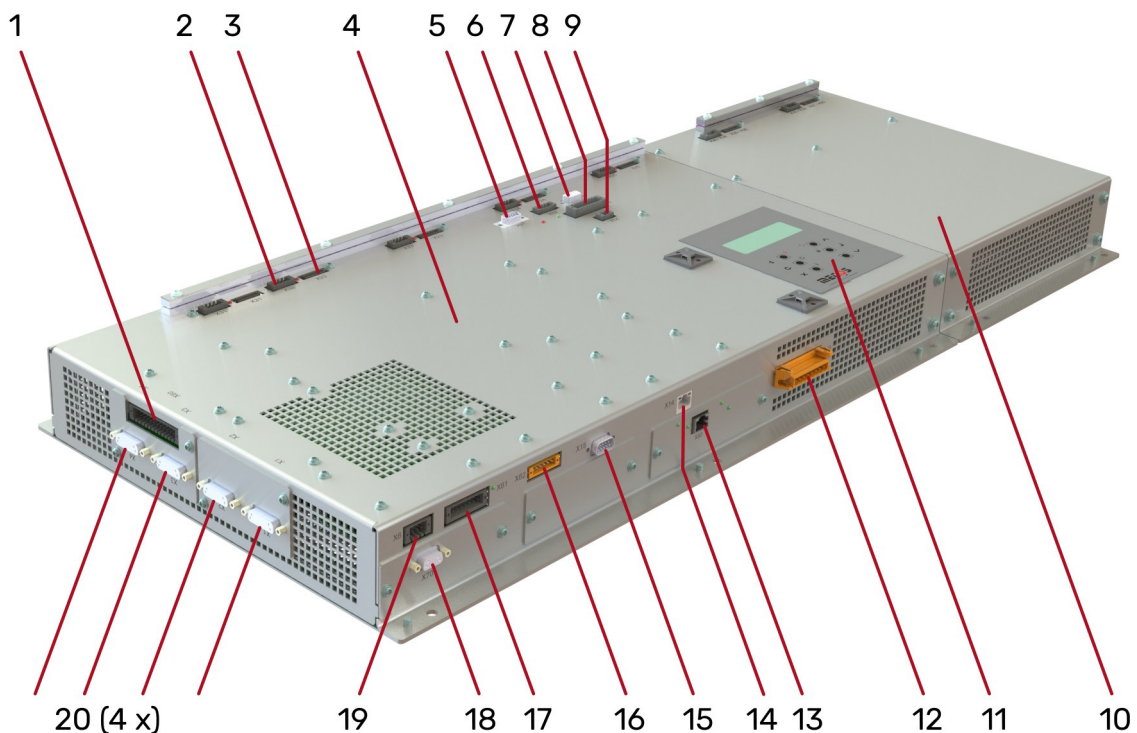


Figure 8: MUC262 and MUCE262 assemblies for a 7-axis system

Item	Term	Description
1	X60	Connection for reading in a maximum of 6 temperature sensors of the bearings.
2	X31 - 35 X36, 37 / X38, 39	1 fan connection per MUA22 (see section 3.2.3). A 7-axis system is shown, therefore 7 connections.
3	X21 - 25 X26, 27 / X28, 29	1 ribbon cable connection per MUA22 (see section 3.2.3) for the control signals. A 7-axis system is shown, therefore 7 connections.
4	MUC262	Control module of the AMB control cabinet
5	X51	RS232 interface
6	X52	Fan connection for the MUS20 (see section 3.2.2).
7	X53	Connection for the measuring signals of the MUS20 (see section 3.2.2).
8	X5	Connection for various digital inputs and outputs for controlling the AMB control cabinet.
9	X54	Connection for reading in the temperature of the transformer.
10	MUCE262	Extension of the controller module for 7-axis systems (1 unit) and 9-axis systems (2 units).
11	Control panel DP204	Internal operating console for commissioning and service work (see section 7.2).
12	X50	Connection of the auxiliary power supplies (12V, 24V) for the controller module.
13	X90	Optional: Connection of the fieldbus module.
14	X14	Service interface Ethernet MX25: Interface for maintenance and service via the MECOS proprietary MX25 protocol.
15	X15	CAN interface
16	X62	Connection of 2 relays.
17	X61	Connection for external digital I/O signals and 1 analogue output.
18	X70	Optional: Connection of IX32 measuring box (see section 4.4.6).
19	X6	Connection of the optional UPS with 3 digital status signals from the UPS and a digital control signal to switch off the UPS.
20	X1 - 4	Connection of the SID7A board for reading in the position sensors of the magnetic bearing.

3.2.2 Magnetic bearing supply MUS20

The MUS20 is a twelve-pulse rectifier and supplies the voltage for the DC link.

The pin assignments are shown in the diagram of the AMB control cabinet in section 14 [4].

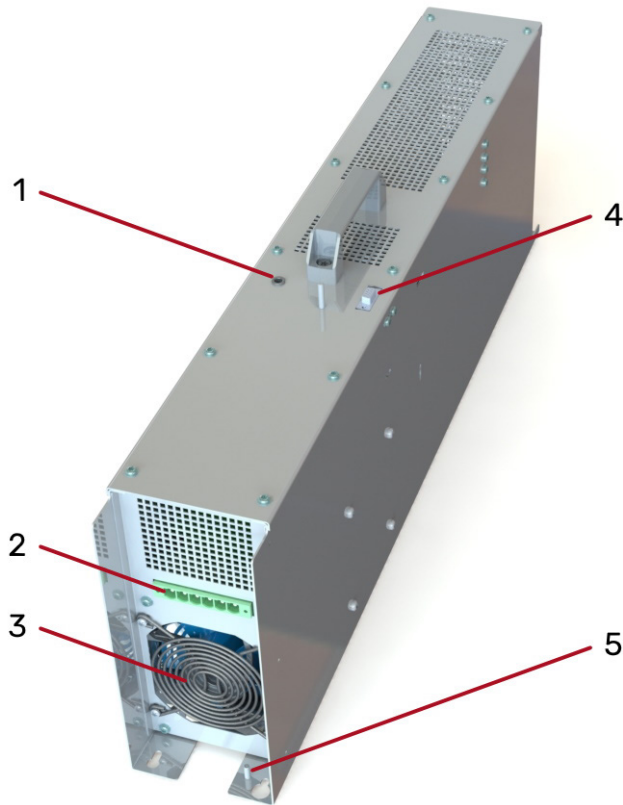


Figure 9: MUS20 assembly from front/bottom

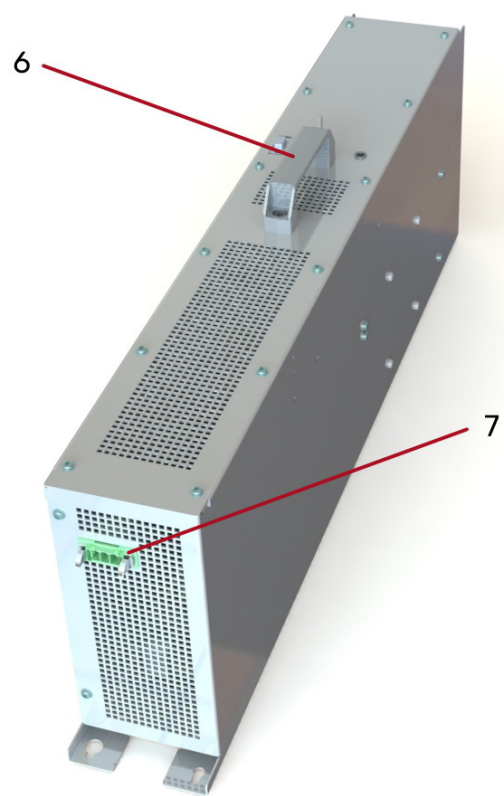


Figure 10: MUS20 assembly from front/top

Item	Term	Description
1	Fan connection	The fans are supplied with power and monitored via the cable that passes through this bushing.
2	Supply connection	Connection for 2 x 3 x 228 V from mains transformer. The max. input power is 20 kVA.
3	Fan	2 fans in series supply the internal heat sink with sufficient cooling air.
4	Control connection	Interface to transmit the analogue signals of this supply (current measurement of DC link and midpoint, voltage measurement of DC link, temperature monitoring of the rectifier) to the controller.
5	Earth conductor connection	M5 thread for connecting the earthing to the housing.
6	Handle	Handle for mounting and transporting the MUS20.
7	DC link connection	Connection for the DC link (DC+, DC- and midpoint).

3.2.3 Magnetic bearing amplifier MUA22

The MUA22 is a fan-cooled magnetic bearing amplifier with an output power of 22 kVA.

The pin assignments are shown in the diagram of the AMB control cabinet in section 14 [4].

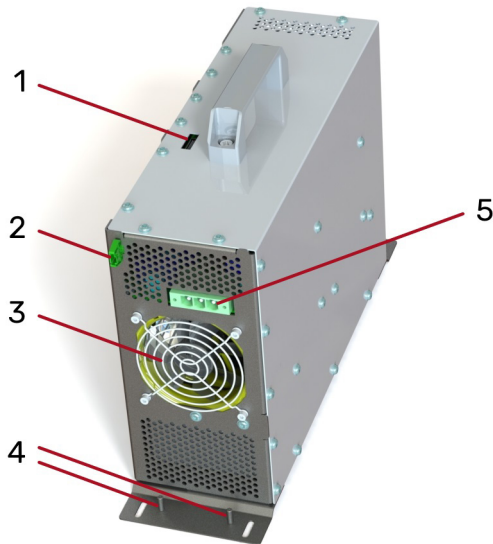


Figure 11: MUA22 assembly from front/bottom

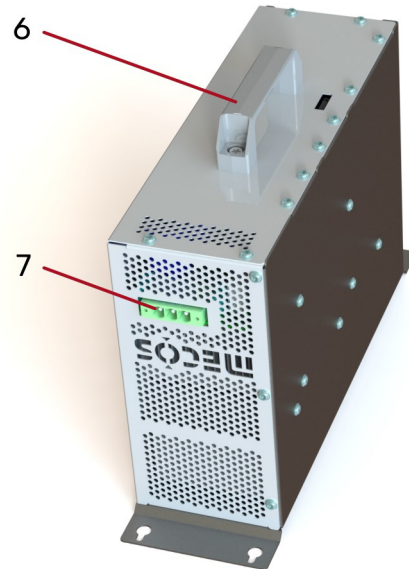


Figure 12: MUA22 assembly from front/top

Item	Term	Description
1	X3	Ribbon cable connection for the control signals from the MUC262 (see section 3.2.1).
2	X2	Fan connection for power supply and monitoring.
3	Fan	2 fans in series supply the internal heat sink with sufficient cooling air.
4	Earth conductor connection	Two M5 threads for connecting the earthing to the housing.
5	X4	3-phase output for connection of the magnetic bearing axis.
6	Handle	Handle for mounting and transporting the MUA22.
7	X1	Connection of DC link with 600 V _{DC} rated voltage with midpoint.

3.2.4 UPS

The UPS powers the AMB control cabinet in the event of a mains failure so that the machine can be shut down properly. Optionally, a UPS with dual input supply can also be installed.

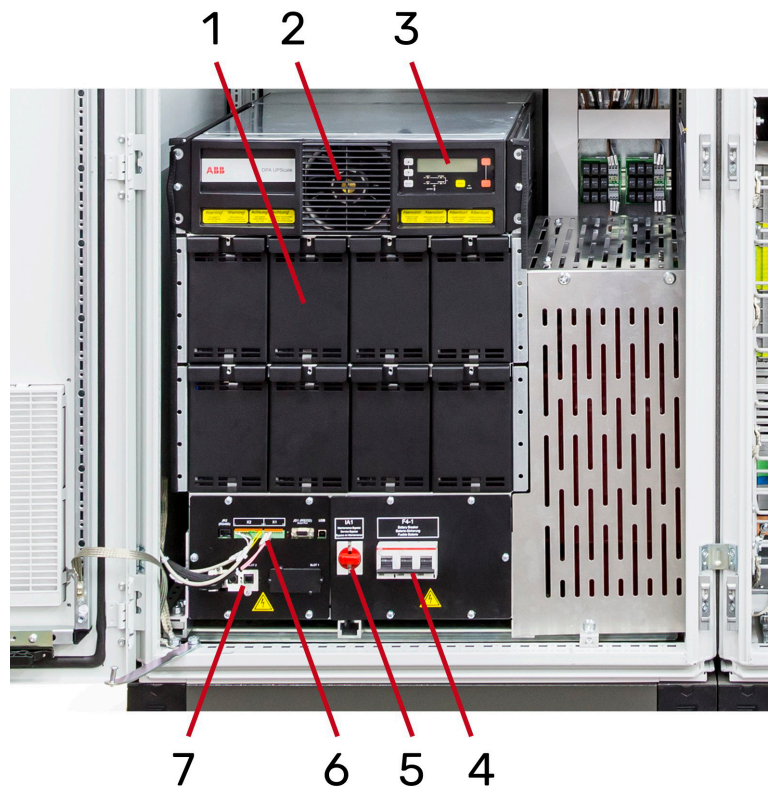


Figure 13: Standard UPS

Item	Term	Description
1	Battery compartments	80 block batteries 12 V / 7.2 Ah
2	Fan UPS	Cooling air fan of the UPS.
3	Control panel UPS	Operating interface of the UPS. ¹
4	Batteries fuse	These are the main fuses of the DC circuit. Remove them before changing the battery. ¹
5	Service switch bypass	This switch can be used to set the UPS to bypass mode. This mode is reserved for appropriately trained service personnel. ¹
6	Dig I/O Interface UPS	Digital I/O interface of the UPS (connection to MUC262). In addition to receiving status messages, the UPS can also be switched off via this interface (see AMB control cabinet diagram 14 [4] and footnote 1).
7	UPS Web Manager	Web server for UPS information (see manual for UPS Webmanager Section 14 [10]).

¹ See operating instructions for UPS Section 14 [9]

4. Technical specifications

4.1 Environmental conditions

General information	Indoor installation in non-explosive area
Operating temperature range	0 ... +30 °C Temporarily possible up to 40 °C, but reduces the life of the UPS batteries
Storage temperature range	0 ... +40 °C
Maximum installation height	2000 m above sea level, above that with power reduction
Relative humidity	< 95 %, non-condensing

4.2 Control cabinet

Dimensions (LxWxH)	1612 mm x 808 mm x 2108 mm (incl. 100 mm plinth)
Type - control cabinet	Rittal VX25
Colour	RAL 7035 (standard), other colours on request (option)
Degree of protection	IP54
Weight	5-axis system: 1035 kg 7-axis system: 1055 kg 9-axis system: 1080 kg
Cabinet doors	2 front doors with 180° hinges, locks and escape route safety device
Door locking system	Electrically controlled mechanical locking. Key switch on front door for manual unlocking
Air inlet and outlet	2 temperature-controlled fans in front doors
Cable entry	Bottom, right-hand side of cabinet Standard Rittal cable entry system
Wiring/cable ducts	Halogen-free Color coding and markings according to MECOS standard
Component labelling	PMMA signs
Total noise level	Max. 75 dBA when all fans (control cabinet cooling fan, amplifier fan, UPS fan) are running at full speed
Options	<ul style="list-style-type: none"> • Anti-condensation heating • 2 additional fans and air outlets incl. additional fan controller • Earthquake kit

4.3 Connection data

4.3.1 Mains connection - Control cabinet

General information	The mains power supply is fully protected by a UPS inside the cabinet, so that the rotor does not have to be lowered in the event of a power failure
Power supply	23 kW
Rated voltage	3 x 400 V _{AC} +6 %/-10 %
Power system	3P + N + PE
Rated frequency	50/60 Hz ±5 %
Overvoltage category - Connection	II
Electrical safety	IEC61010-1
Operating current	Typical continuous standby current ² (rotor levitated): 14 A Max current (5/7/9 axis system): 33.3 A
Backup fuse	40 A, type gR/gS
Main switch	With fuse 34 A (standard) or without fuse (option)
Connection	Spring-type terminals, max. 25 mm ²
UPS	Classification: VFI SS 111 according to EN 62040-3:2001 Battery type: VLRA, maintenance-free
Power supply - magnetic bearing electronics	Redundant dual feeds: <ul style="list-style-type: none"> • 24 V_{DC} for electronics and cooling fans • 12 V_{DC} for AMB controller
Options	<ul style="list-style-type: none"> • External battery disconnect switch for the internal UPS • External UPS instead of internal UPS • UPS with dual input supply

4.3.2 Power amplifier

Type Magnetic bearing	Unipolar
Rated power	22 kVA per channel
DC link voltage	±300 V _{DC}
Output voltage	-300 ... +300 V, filtered PWM signal
Output current	30 A duration, 33 A peak
PWM switching frequency	80 kHz
Cooling	2 redundant fans per channel, Cooling is monitored
Connection	Spring-type terminals, max. 16 mm ²

² Calculated typical values for a standard setup. Values depend on magnetic bearing losses, cable length, ambient temperature, controller settings and machine alignment.

Number of bearings	<u>5-axis system:</u> 1 thrust bearing (1 axis) 2 radial bearings (2 axes each) <u>7-axis system:</u> 1 thrust bearing (1 axis) 3 radial bearings (2 axes each) <u>9-axis system:</u> 1 thrust bearing (1 axis) 4 radial bearings (2 axes each)
--------------------	---

4.3.3 Position and pulse sensors

Type of Sensors	Inductive
Rated power Excitation	2 x 5 W @ 100 Ohm
Number of sensor channels Second axial sensor and second pulse sensor can be read in if required (number in brackets)	5-axis system: 5 (6) positions + 1 (2) pulse 7-axis system: 7 (8) positions + 1 (2) pulse 9-axis system: 9 (10) positions + 1 (2) pulse
Impedance matching	The sensor evaluation requires an impedance match of type SMX7. Two SMX7s are necessary for all configurations (5/7/9 axes) . ATEX certification magnetic bearing sensors: II 2G Ex db eb IIB T3 Gb IECEx certification magnetic bearing sensors: Ex db eb IIB T3 Gb IECEx Certificate No. : SEV 19.0015X, SEV 19.0017 ATEX certification SMX7: II 2G Ex eb mb IIC T4 Gb IECEx certification SMX7: Ex eb mb IIC T4 Gb IECEx Certificate No. : SEV 19.0016X
Connection	Spring-type terminals, max. 2.5 mm ²

4.3.4 Temperature sensors

Type of Sensors	PT100 (ATEX certification: II 2G Ex eb IIC) (IECEx certification: Ex ia IIC) (IECEx Certificate No. : IBE 11.0001U)
Operating current	1 mA
Number of sensor channels	6
Sensor system/connection	2- or 4-wire connection possible
Connection	Spring-type terminals, max. 2.5 mm ²

4.4 Communication interfaces

4.4.1 Digital I/O

Digital inputs	
Number	3
Insulation	Optocoupler, 250 V _{AC}
Description	Inputs with common GND are powered by 24 V inside the control cabinet. It must be switched in the higher-level control system with potential-free contacts.

Function	<ul style="list-style-type: none"> • Levitation on • Rotor Rotating • Pulse signal Time synchronisation
Connection	Spring-type terminals, max. 2.5 mm ²
Cable	max. 5 x 2 x 2.5 mm ² (incl. 2 x 2 x 2.5 mm ² reserve) with pair and collective screen
Digital outputs	
Number	5
Insulation	Relay, 2.5 kV
Description	1 NO (1 NC, not used) contact per relay, 1 COM connection
Function	<p><u>Terminal block 1:</u></p> <ul style="list-style-type: none"> • Rotor levitated • Ready to Rotate • Common alarm <p><u>Terminal block 2:</u></p> <ul style="list-style-type: none"> • Common shutdown • System Failure Watchdog
Connection	Spring-type terminals, max. 2.5 mm ²
Cable	<p><u>Terminal block 1:</u></p> <p>max. 5 x 2 x 2.5 mm² (incl. 2 x 2 x 2.5 mm² reserve) with pair and collective screen</p> <p><u>Terminal block 2:</u></p> <p>max. 4 x 2 x 2.5 mm² (incl. 2 x 2 x 2.5 mm² reserve) with pair and collective screen</p>



NOTICE!

The digital outputs are not short-circuit proof.

4.4.2 Extended input

Number	1
Description	Powered by 24 V inside the control cabinet. It must be switched in the higher-level control system with a potential-free contact.
Supply	Internal 24 V _{DC}
Function	«Compressor system de-energised» Input from higher-level safety control to switch off the DC link and magnetic bearing actuators when the compressor system is de-energised.
Connection	Spring-type terminals, max. 2.5 mm ²
Cable	max. 3 x 2 x 2.5 mm ² (incl. 2 x 2 x 2.5 mm ² reserve) with pair and collective screen

4.4.3 Analogue output

Number	1
Insulation	Digital isolator, 250 V _{AC}
Description	Isolated output: 4 ... 20 mA / 24 V _{DC} (Standard) or ±10 V / max. 30 mA (Option)
Accuracy	0.5% on the total range
Load	Maximum 500 Ohm
Function	Rotor speed for higher-level control system sequencer
Connection	Spring-type terminals, max. 2.5 mm ²
Cable	max. 2 x 2 x 2.5 mm ² (incl. 1 x 2 x 2.5 mm ² reserve) with pair and collective screen

4.4.4 Service Interface (PC communication)

Type interface	Ethernet (10/100/1000 Mbit/s)
Description	One (1) interface for maintenance and remote diagnosis as well as for configuration and external data processing
Protocol	Proprietary MECOS protocol via UDP
Identifier	5-digit serial number of the controller board

With the help of the MATLAB[®] toolbox for MECOS magnetic bearing systems (optional), complete access to the controller board's processor is possible. See section 13.2.



The serial number for the Ethernet communication is located below the type plate of the MUC262.

4.4.5 Fieldbus

Type of fieldbus	Modbus TCP or Profibus DPV1
Description	One (1) interface to connect the magnetic bearing system to the higher-level control system (output of operating parameters)
Modbus configuration (For details see section 14 [13])	Addressing according to MECOS standard
Configuration of Profibus (for details see section 14 [14])	Addressing according to MECOS standard <u>Cyclic data (152 bytes):</u> For dynamic signals, e.g. rotor unbalance, rotor position, bearing temperatures, system status, etc. <u>Acyclic data:</u> For quasi-static signals, e.g. signal ranges, alarm and trip values, etc.

4.4.6 BNC box IX32 (option)

Description	Analogue inputs and outputs for measuring purposes
Number of channels	1 pulse output, 8 analogue inputs, 32 analogue outputs
Connector plug	BNC
Electrical description	Factory setting via DIP switch: 0 ... 10 V / -10 ... +10 V / 0 ... 20 mA / 4 ... 20 mA Gain and offset parameterisable (parameter file)

4.5 IPC and network

4.5.1 IPC

Type	Cincoze CV-W115 Panel PC
Display and keyboard	15.6" TFT touch screen
Function	Advanced data recording and Data routing for remote access
Software	<ul style="list-style-type: none"> • Microsoft Windows 10® • MECOS SMServer and data logger

4.5.2 Network

Ethernet infrastructure	Internal Ethernet network with the following components: <ul style="list-style-type: none"> • 5 Port Gigabit Switch • IPC • MAN mGuard for remote access via VPN tunnel Internal and external connectivity
Connections	<u>Front doors:</u> <ul style="list-style-type: none"> • RJ45 Ethernet connection for maintenance purposes • USB-A port for alternative data transfer <u>Control cabinet internal:</u> <ul style="list-style-type: none"> • RJ45 Ethernet port for customer LAN or Internet connection (for remote access only)

4.6 Controller software

4.6.1 Trend data

Function	Recording trend data
Recording clock rate	1 Hz
Data storage	Industrial PC
Storage capacity	At least 1 year log data

4.6.2 Eventlogger

Function	Recording events. Events are changes in the state of the MBX22, e.g. the switching of the Dig I/O.
Recording clock rate	Event triggered
Data storage	Storage space for 150 events on the system controller. Event data is automatically exported to the industrial PC.

4.6.3 Fault History and Fault/Fast Log

Function	<ul style="list-style-type: none"> Recording system parameters in the event of a trip or alarm Recording the course of variables over time <p>The list of variables is parameterisable</p>
Clock rate / recording duration	<p>Ring buffer logger:</p> <ul style="list-style-type: none"> Fault Log: 50 Hz / ± 30 s, trigger adjustable Fast Log: 10 kHz / ± 100 ms and 1 kHz / ± 30 s <p>Ring buffer data is saved in the event of a fault</p>
Data storage	<ul style="list-style-type: none"> Fault Log: 150 events on the system controller Fast Log: 2 events on the system controller <p>Data and fault history are automatically exported to the industrial PC</p>

5. Transport

Have transport work carried out by qualified personnel only. Follow the safety instructions for transport in section 2.1.2 and the transport and storage conditions in section 14 [2].

6. Assembly and installation



WARNING!

When unpacking, the AMB control cabinet must be checked for transport damage. Visibly damaged units must never be connected to the mains. Any transport damage must be reported to the manufacturer immediately.



DANGER!

Assembly and installation may only be carried out by qualified personnel and with the main switch switched off and the mains supply line disconnected. Follow the safety instructions in section 2.

6.1 Set-up view

No additional clearance is required at the side or above the control cabinet, as the cooling air is supplied and discharged via the front doors (see section 6.2). The cable entry is in the right half of the control cabinet in the floor area, i.e. the cable feed is from below, also see section 14 [3].

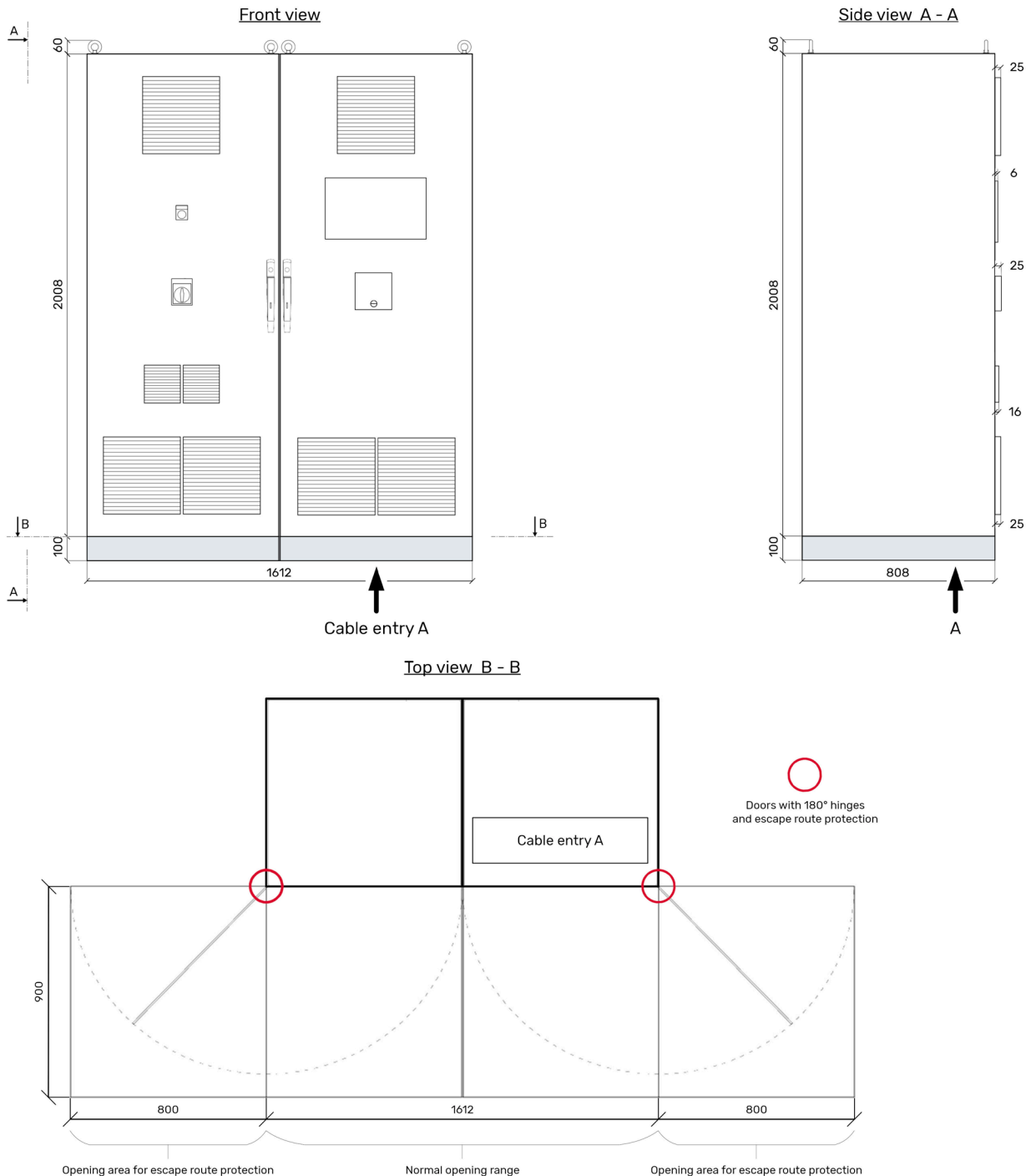


Figure 14: Control cabinet dimensions and position of cable entry (dimensions in mm)



WARNING!

The mounting plate must be earthed.

6.2 Ventilation

The ventilation of the control cabinet must comply with the conditions specified in section 4. Make sure that the air flow generated by the built-in fans is not blocked. For the supply air and the exhaust air, the space in front of the cabinet doors must remain free at least up to the distance of 90 cm.

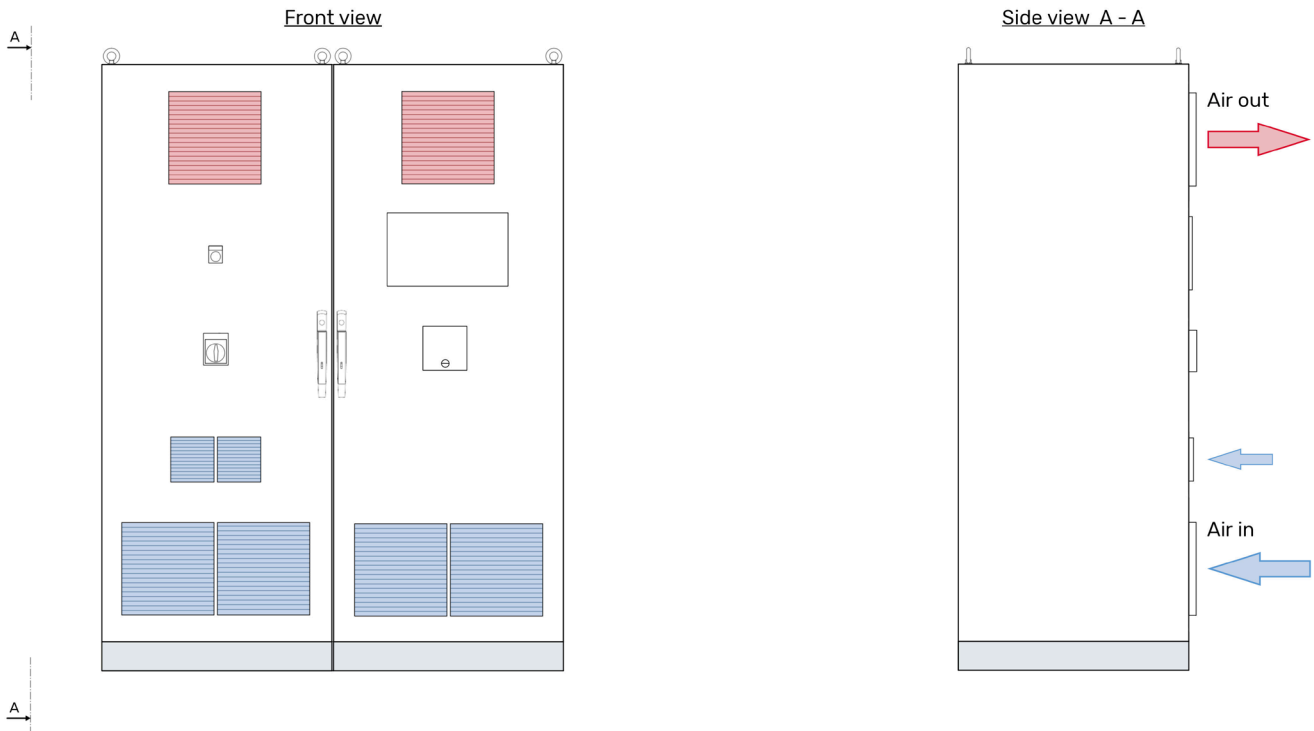


Figure 15: Ventilation of the control cabinet

6.3 Protective earth Connections

For a safe protective earth connection of the AMB control cabinet to the total earth potential, a 16 mm² conductor must be led from the building to the illustrated earth rail inside the AMB control cabinet. This connection must be executed by qualified personnel only. For details on cable entry into the control cabinet, refer to the document «Control cabinet Layout», see section 14 [3].



Figure 16: Earth rail in the AMB control cabinet



DANGER!

Danger of electric shock due to missing or improper earth connection. Without a protective earth connection, injury to persons can occur in the event of a fault due to dangerous voltages on the housing. A controlled, proper and safe earth connection of the AMB control cabinet is therefore mandatory for safe operation. When connecting, make sure that the earth connection is screwed tight and secured against loosening with ribbed washers.

6.4 Electrical connections

Open the AMB control cabinet and carry out the wiring of the control cabinet. For details on cable entry into the control cabinet, refer to the document «Control cabinet Layout», see section 14 [3].

The necessary wiring information is given in the diagram of the AMB control cabinet in section 14 [4].

Check the screw connections in the control cabinet. Loose connections must be tightened professionally. Any loose single wires may not protrude. The clearances and creepage distances provided by the terminals must be strictly observed. A wiring check must be carried out.



DANGER!

The AMB control cabinet must not be switched on until all connections have been made properly. The mains connection of all devices must be made last. When laying the connection cables, make sure that they are neither pinched nor routed over sharp corners and edges.



NOTICE!

Ensure that the local AC mains supply matches the input voltage range of the AMB control cabinet (see section 4.3.1).

6.4.1 Shield connections

It is particularly important that the individual shield connections are laid out correctly and cleanly. See the wiring instructions in section 14 [6].

6.4.2 Connection terminals Sensors and auxiliary terminals

5-axis system: A and B

7-axis system: A, B and C

9-axis system: A, B, C and D

For details see the diagram for AMB control cabinet in section 14 [4].

Connection: Spring-type terminals

Max. Cross section: 2.5 mm²



6.4.3 Connection terminals Temperature sensors Magnetic bearing

Connection for PT100 in 2- or 4-wire technology.
For details see the diagram for AMB control cabinet in section 14 [4].

Connection: Spring-type terminals
Max. Cross-section: 2.5 mm²

2-wire technology: Bridges between: RD + RD
WH + WH

Connection PT100: RD + WH

4-wire technology: Connection PT100: RD/RD
WH/WH



6.4.4 Connection terminals digital I/O and relay

For details see the diagram for AMB control cabinet in section 14 [4].

Connection: Spring-type terminals
Max. Cross section: 2.5 mm²



6.4.5 Terminals Power Magnetic bearing

5-axis system: A, B and Z

7-axis system: A, B, C and Z

9-axis system: A, B, C, D and Z

For details see the diagram for AMB control cabinet in section 14 [4].

Connection: Spring-type terminals
 Max. Cross section: 16 mm²



6.4.6 Connection terminals Mains connection

For details see the diagram for AMB control cabinet in section 14 [4].

Connection: Spring-type terminals
 Max. Cross section: 25 mm²



6.5 Further notes

- Never exceed the specified maximum ambient temperature (see section 4.1)
- Avoid any contact with the electronic components
- The AMB control cabinet must not be operated in explosive atmospheres

7. Operation

7.1 Panel IPC

On the panel IPC, which has a touch screen, certain measurement data of the individual axes can be read out, the system status can be queried, errors can be viewed and reset and the rotor can be lifted or lowered. By tapping on the individual areas, even more information can be displayed.

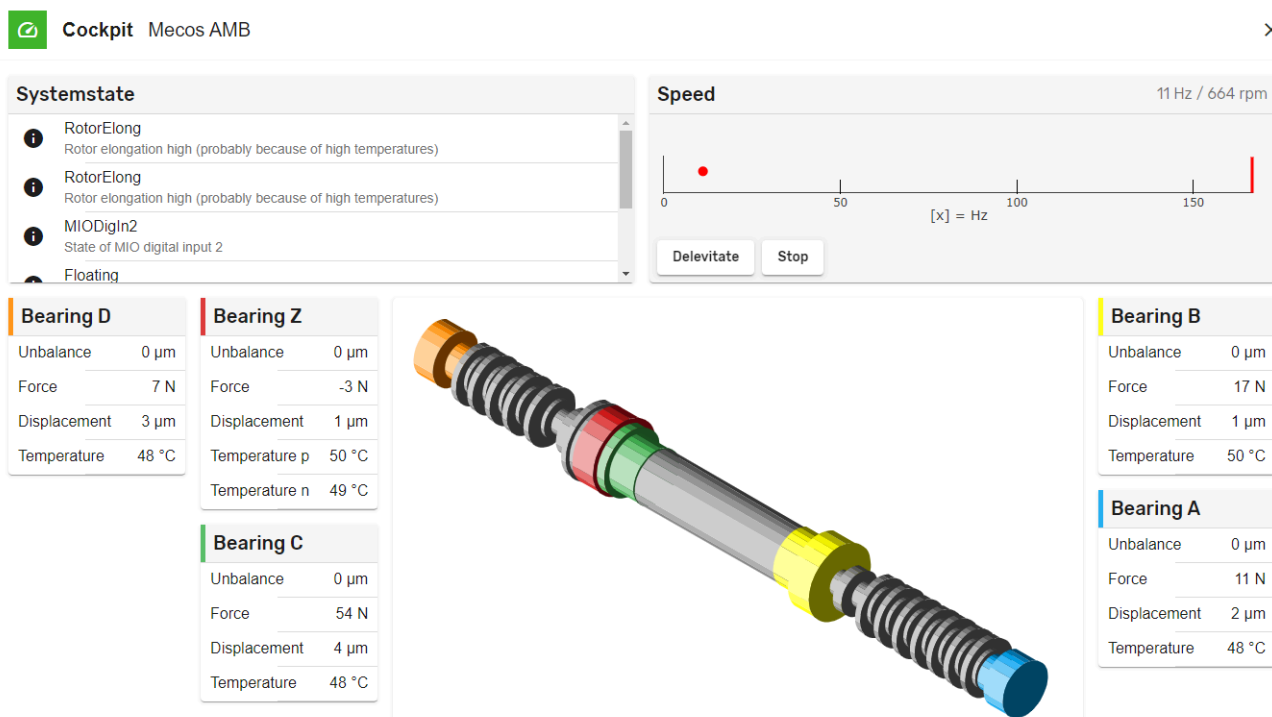


Figure 17: Panel IPC Cockpit (example image shows a 9-axis system)

7.2 Internal control panel

7.2.1 Operating and display elements

The internal control panel has the following elements:

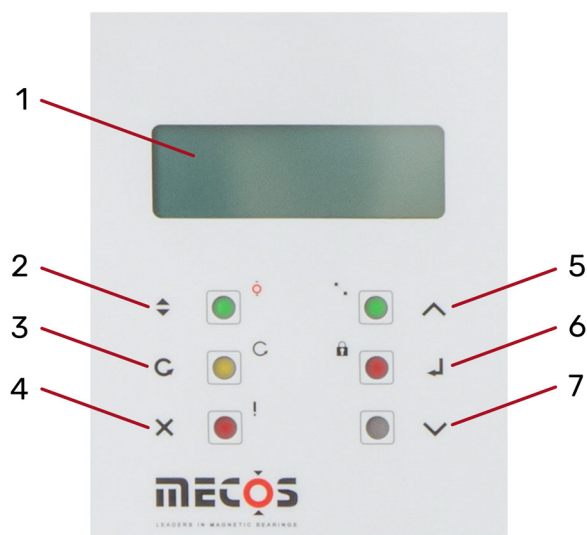


Figure 18: Internal control panel

Item	Term	Description
1	Display	Display with 4 x 20 characters and backlight
2	Lift LED green	Lifting/lowering the rotor (only possible in Local operating mode when the rotor is at standstill). Luminous: Rotor is hovering Flashing: Lifting/lowering, calibration Dark: Rotor is lowered
3	Ready to rotate LED yellow	Gives a corresponding signal to the higher-level control system, corresponds to a speed enable. Luminous: Magnetic bearing control recognises speed Flashing: Speed enable Magnetic bearing control removed, rotor still turning Dark: Magnetic bearing control does not detect speed
4	Cancel LED red	Cancelling the editing function Luminous: Trip Flashing: Alarm
5	Up LED green	Menu control, arrow function up Luminous: MX-25 connection to magnetic bearing control active Dark: No MX-25 connection active
6	Enter LED red	Menu control, input function Luminous: Remote operating mode, display locked Dark: Operating mode Local, display enabled
7	Down	Menu control, arrow function down

7.2.2 Initial commissioning

During the booting process, the message «MBX booting...» appears on the display and all keys light up. The following display then appears:

```
Speed:           0 rpm
                0.00 Hz
Thrust:         98.70 %
DSP OK                2
```

If the red LED of the Cancel key lights up instead, a malfunction has occurred. Explanations of the various fault messages are given in section 8.

7.2.3 Navigation through the software

The command structure of the operating software consists of a main menu in which the various sub-menus are selected with the Up or Down key. A selected menu item is activated with the Enter key. Within a menu and to display further information or values, scrolling is also done using Up/Down key.

To return to the higher-level menu, press the Up button.

7.2.4 Main menu of the display



Caution: The following menu descriptions correspond to a typical system and do not apply generally. Project-specific deviations are possible.

Menu no.	Display	Function
1	Fault Monitor	Error display and error reset
2	System State	Status display of the control signals
3	Settings	Setting the language and access level
4	AMB Monitor	Display of various measured values of the magnetic bearing
5	Cabinet Monitor	Display of various measured values of the magnetic bearing control system
6	Maintenance	Display of various settings, values and counters of the system
7	Help	Displaying the contact details of the manufacturer and service

In the main menu, the display shows a text analogous to the following example:

```
Main Menu           1
-> Fault Monitor
   System State
DSP OK                2
```

7.3 Operation via the service interface (option)

With the help of the MATLAB® toolbox for MECOS magnetic bearing systems (optional), complete access is possible via Ethernet. In addition to the control functions, the toolbox has a variety of different tools for parameterising and analysing the magnetic bearing system.

For measurements and analyses, a slimmed-down version of «MecosTools» is available as a so-called stand-alone application. This tool also runs without a MATLAB® licence and can be obtained from MECOS on request.



The functionality of the MATLAB® Toolbox is described in Section 13.2.

7.4 Parameterisation of the communication interfaces

The AMB control cabinet has a large number of parameters which are defined depending on the project. The parameters are set via the PC interface and can only be changed by the customer to a limited extent, as incorrect parameterisation can lead to damage or destruction of the system in addition to erroneous function. MECOS delivers the control system with the corresponding parameterisation - a subsequent change of the configuration is only possible and permitted in consultation with MECOS and with the involvement of a service technician or service personnel accredited by MECOS. In this document you will find the reference to the corresponding parameterisation reports in section 14 which are generated project-specifically.

7.5 Operation of UPS

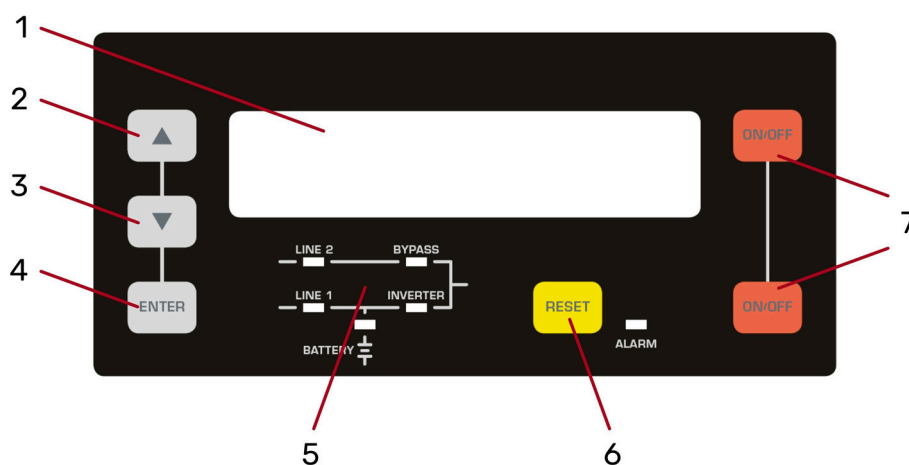


Figure 19: UPS control panel

Item	Term	Description
1	Display	UPS User Interface
2	Up	Menu navigation
3	Down	Menu navigation
4	Enter	Selection
5	LED displays	UPS status
6	Reset	Cancels the input, jumps back to the higher-level menu
7	Two-hand control	UPS On/Off



Also observe the information and notes in the operating instructions for the UPS Section 14 [9] and the manual for the UPS web manager Section 14 [10].

7.6 Further operating instructions



CAUTION!

Cables may not be plugged in or unplugged while the AMB control cabinet is switched on. The consequences could be, among others, an electric shock or the lowering of the rotor in the rotating state.



To prevent possible data loss, magnetic data carriers such as floppy disks, hard disks, etc. must not be stored in the immediate vicinity of the AMB control cabinet.



8. Disruptions

Personnel to be trained, instructed or undergoing general training may only work on the AMB control cabinet under the constant supervision of an experienced specialist.

If a malfunction occurs, this can have various causes. First of all, always try to find out whether the cause of the malfunction is the system itself or impermissible ambient conditions (see section 4.1).

In the AMB control cabinet MBX22, continuous monitoring of a variety of system states is carried out. Errors and warnings are always issued via digital I/O, the service interface X4 or the fieldbus interface. Details on these interfaces are given, if not described in this document, in the related document (see section 14).

If a connection via the service or fieldbus interface is not possible, the service department of MECOS AG (see section 1.4) must be notified.

The error response of the system depends on the parameterisation, also see section 14. The monitoring depends on the signal type (analogue or digital). In addition to the monitoring limit/level, a delay time can also be parameterised.



Please contact MECOS if errors occur repeatedly.

MECOS distinguishes between warning and error:

Term	Description
Warning (Warning)	Generates a warning message (alarm). A warning message is triggered when a warning limit value is exceeded and remains until the value falls below the warning limit value again and the minimum time for the warning has expired. An alarm usually leads to no reaction.
Error (Fault)	Generates an error message (Trip). An error message is triggered when a system-critical limit value is exceeded. An error usually leads to an error reaction and remains until it is reset by a clear command. An error can only be reset when the error is no longer present.

Both warning and error can be (dis)masked.

The following actions can be set:

Term	Description
noAction	No reaction
Stop	Switch off the drive (Emergency Stop)
Liftdown	Lower rotor (only possible at standstill or low speed)
Dropdown	Immediate ejection of the rotor under speed
ResetDisable	Blocks the reset of the error until the next restart
ResetNotRot	The error can only be reset at standstill
LevitatedOnly	Monitoring is only active when the rotor is hovering
History	Entry in the error memory in the SPI flash (fault history)
EventLog	Entry in the event logger in the SPI flash (Event Log)

These actions can only be programmed by MECOS staff with the associated tools. They cannot be adjusted during operation.

9. Cleaning and maintenance

The maintenance cycles indicated in the table refer to the elapsed operating hours. The operating hours counter can be displayed via the internal display (see section 7.2).

Maintenance work	Change interval	Reference
Changing the air filter	Depending on the degree of soiling, every year	Section 9.1
UPS battery change	About every 2 years	Section 9.2
Module change UPS	Every 5 years	Section 9.3

Since the life of the batteries is heavily dependent on temperature, it makes sense to check the batteries regularly, see section 14 [9].



DANGER!

Never bring the device into contact with water or other liquids. Never penetrate the device with any objects.



NOTICE!

Have maintenance work carried out only by qualified personnel. Also, follow the safety instructions in section 2. This work may only be carried out with the main switch and UPS switched off. The electrical safety regulations must be strictly observed.



NOTICE!

Improperly performed maintenance can lead to malfunctions and damage. In this regard, also observe the information and notes in the related documents, see section 14.



NOTICE!

For better control, we recommend keeping a maintenance log in which the completed maintenance work is recorded and signed off on accordingly. MECOS AG does not accept any warranty claims or liability for damage caused by inadequate maintenance.

9.1 Changing the air filter

It is recommended that the filter mats be replaced regularly, because depending on the environment they can become soiled through operation and thus lead to overheating in the control cabinet.

Pull the function logo in the louvred grille upwards a little with your finger to unlock it. The grille now flips up approx. 70° and enables easy filter mat replacement.

Place the filter mat as shown in Figure 21 into the filter housing and fold the louvred grille back onto the housing until it audibly clicks into place.

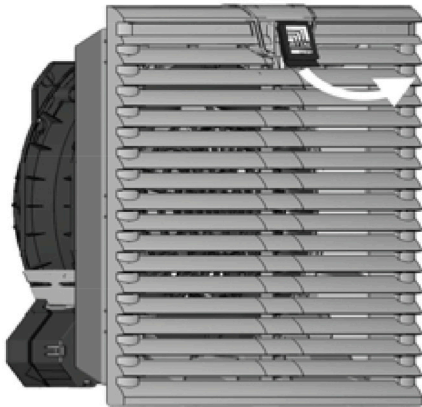


Figure 20: Unlocking the louvred grille

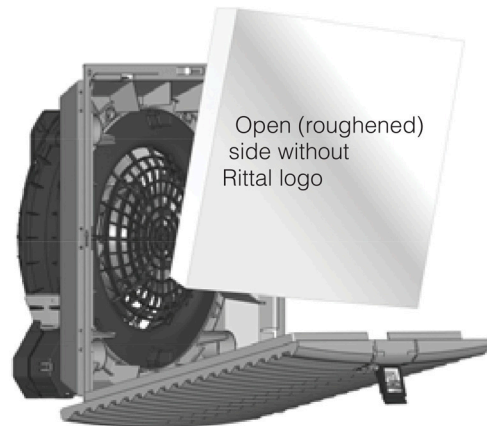


Figure 21: Installation of the filter mat



CAUTION!

Only change the filter mat when the fan wheel is stationary. Do not reach into the fan wheel.



NOTICE!

The compressed side of the filter mat faces the fan wheel.

9.2 UPS battery change

To ensure the correct functioning of the UPS, it is recommended to replace the batteries regularly. It is therefore recommended to change the UPS batteries as a precautionary maintenance measure after the mentioned operating time, see section 9.

1. Switching off the AMB control cabinet according to section 2.1.4.
2. Switch off the UPS, change the batteries according to the operating instructions of the UPS (see section 14 [9]).
3. Prepare UPS for restart according to the operating instructions of the UPS (see section 14 [9]).
4. Switch on the main switch. The system starts up automatically.

9.3 Module change UPS

To ensure correct functioning of the UPS, it is recommended to replace the UPS module regularly. It is therefore recommended to replace the UPS module as a precautionary maintenance measure after the mentioned operating time, see section 9.

1. Switching off the AMB control cabinet according to section 2.1.4.
2. Switch off the UPS, change the module in accordance with the operating instructions of the UPS (see section 14 [9]).
3. Prepare UPS for restart according to the operating instructions of the UPS (see section 14 [9]).
4. Switch on the main switch. The system starts up automatically.

10. Maintenance

Spare and wear parts are available from MECOS AG on request. In the enclosed spare parts list (see section 14 [5]) you will also find a list of all parts that can wear out or become defective during normal use.

The manufacturer recommends stocking spare and wear parts if necessary.



NOTICE!

MECOS AG only accepts liability and warranty claims within the scope of the service contract if only original parts are used.



NOTICE!

Defective components and spare parts may only be replaced by appropriately trained personnel.

11. Disposal and recycling

If the AMB control cabinet is decommissioned as an old system, the **laws and regulations** for disposal applicable at that time must be observed.

It makes sense to check which materials can be **recycled** and then to do so.

12. Warranty

Unless otherwise agreed, the General Terms and Conditions (GTC) of MECOS AG shall apply.

The entitlement to any warranty services expires with the unauthorised opening of the devices in the AMB control cabinet or the attempt to carry out repairs or modifications without consultation with written confirmation from MECOS AG.



DANGER!

Unauthorised opening of the devices in the AMB control cabinet, as well as improper tampering, can lead to injury to persons and property damage. The devices in the AMB control cabinet must not be opened.

After modifications to devices in the AMB control cabinet, undefined conditions can occur that lead to bodily injury and property damage.



NOTICE!

Liability is not accepted for damage caused by incorrect or improper operation, non-observance of the instructions in this operating manual, misuse or unauthorised modification, or by the use of spare parts other than the original ones. In such cases, all warranty claims shall become invalid.

13. Accessories

13.1 Passive sensor impedance matching SMX7

The SMX7 box is an impedance match for the sensor system, see section 14 [8]. This allows a cable length of up to 300 m when using cables that comply with the technical specification of the company MECOS.

The article is available from MECOS AG under the following item number:

Term	Item number	Description
Impedance matching box SMX7	BG11859-xxN	For cable lengths up to 300 m

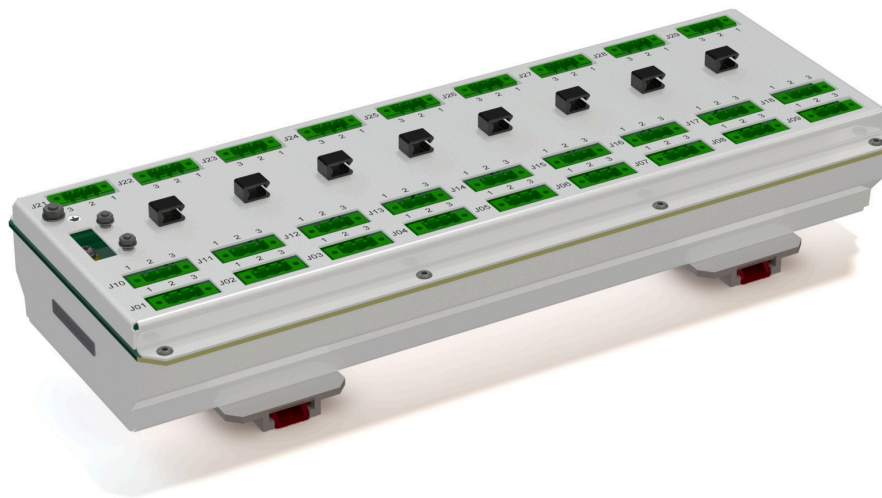


Figure 22: Impedance matching box SMX7 (example picture shows variant BG11859-04N)

13.2 Toolbox for MECOS magnetic bearing systems

The toolbox for MECOS magnetic bearing systems (MecosTools) can be used to change a wide range of system parameters and perform real-time measurements of all processor variables of the magnetic bearing system. It contains all functions for commissioning, validation and maintenance of the magnetic bearing system.

The MecosTools are integrated as a toolbox in the industrially recognised and widely used software MATLAB^{®3}. This allows the potential of MATLAB[®] to be used for modelling, controller synthesis, simulation, visualisation and scripting.

It is possible to create a customised AMB ServiceTool based on the Toolbox for MECOS magnetic bearing systems, which can also be used without MATLAB[®] installed.



The Toolbox for MECOS magnetic bearing systems or the MECOS AMB ServiceTool can only be used under Microsoft Windows[®]. Admin rights are required for installation.



NOTICE!

Due to the many additional functions of the MecosTools, it is basically possible to make changes to the controller parameter set that can lead to instability of the magnetic bearing. Under certain circumstances, this can lead to damage to the system.

3 MATLAB[®] is a commercial software of the company MATHWORKS[®] Inc. for solving mathematical problems and for the graphical representation of the results. Link to website: www.mathworks.com

13.3 Key set

Key set consisting of 2 double-bit keys and 2 keys for unlocking the electromechanical lock.

14. Related documents

The following table contains a list of the related documents. As these are created on a project-specific basis, they are not included in these operating instructions, but are nevertheless part of the device documentation.

No.	Description	MECOS Doc no.	MAN Doc no.	
[1]	Data sheet AMB control cabinet MBX22	BG13977-01N	10001628888 001	
[2]	Instructions for transport and storage	BG13978-01N	10001762983 002	
[3]	Control cabinet layout	BG13979-01N	10001611953 001	
[4]	Diagram of the AMB control cabinet	<i>Project-specific</i>	<i>Project-specific</i>	
[5]	Spare parts list MBX22	<i>Project-specific</i>	<i>Project-specific</i>	
[6]	Wiring instructions MBX22 system	-	10001816144 001	
[7]	Data sheet	Bearing cable: Sensor cable: PT100 cable:	- - -	10001629719 000 10001629719 001 10001629719 002
[8]	Operating Instructions for Impedance Matching Box SMX7 variant BG11859-03N SMX7 variant BG11859-04N	BG11876-01N BG13956-01N	10001854590 002 10003872652 001	
[9]	Operating Instructions for UPS «DPA Upscale™ RI»	BG13994-01N	10001907364 005	
[10]	User Manual for UPS Web Manager «CS141»	BG14041-01N	10003872654 001	
[11]	Data sheets and manuals for AMB control cabinet components: • Safety relay • Industrial Panel PC «CV-W115»	BG13981-01N BG13982-00N	10001907372 001 10003488556 000	
[12]	AMB Alarm and Trip List	<i>Project-specific</i>	<i>Project-specific</i>	
[13]	Modbus variable list	5 axes: 7 axes: 9 axes:	- - -	10003436753 001 10003436753 002 10003436753 003
[14]	Profibus variable list	5 axes: 7 axes: 9 axes:	- - -	10001587025 003 10001587025 004 10001587025 005

15. Glossary

Term	Explanation
AMB	Active Magnetic Bearings
Digital I/O	Parallel customer interface on AMB control cabinet with potential-free digital inputs and outputs
FDC	Fast Digital Controller Term for the MECOS controller board
MBX	Magnetic Bearing Control Cabinet Term for MECOS magnetic bearing electronics with power amplifier, power supply and controller in an AMB control cabinet.
AMB system	MECOS term for Active Magnetic Bearing System Used for magnetic bearing diagram and includes MBX, cables, machine incl. bearings and sensors and peripherals if applicable.
MUA	Magnetic Bearing Control Unit: Amplifier Term for the MECOS power unit (1 channel) ⁴
MUC	Magnetic Bearing Control Unit: Controller Term for the MECOS controller ⁴
MUCE	Magnetic Bearing Control Unit: Controller Extension There are extension modules for 7 and 9 axes for the MUC262 controller. This term applies to the individual extension. The entire assembly of MUC and MUCE does not have its own abbreviation.
MUS	Magnetic Bearing Control Unit: Power Supply Term for the MECOS supply ⁴
PWM	Pulse Width Modulation
RTC	Real Time Clock Battery-buffered clock in which the current time and date are stored
SMX	Sensor Matching BoX Auxiliary device which amplifies the sensor signals on the machine side and thus enables longer sensor cables
UPS	Uninterruptible Power Supply

⁴ For large systems, integration of the controller, power unit and power supply in one device does not make sense. For such systems, there are therefore separate device descriptions for controller, power unit and power supply

16. Notes

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MECOS AG
Hardstrasse 319
8005 Zurich
Switzerland

Tel.: +41 52 355 52 11
mecos@mecos.com
www.mecos.com

Subject to technical changes