



## Magnetic Bearing & Motor Control Unit

# MMC15 / IMC15

BG10837-xxN



# Operating Instructions

Translation of the original operating instructions  
BG13961-01NA V1.00  
© 2023





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

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

**Name:** Stefan Geser  
**Funktion:** Project Manager

**Brand:** MECOS  
**Item No.:** BG10837-xxN  
**Equipment Type:** Magnetic Bearing and Motor Controller  
**Type:** MMC15 resp. IMC15

The CE mark was first applied in 2004.

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 61800-5-1:2007 UL 61800-5-1:2012 Ed.1	Standard For Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements - Electrical, Thermal And Energy
EN 61000-6-2: 2005 /AC:2005	Electromagnetic compatibility (EMC) – Part 6-2: Generic standards - Immunity for industrial environments
EN 61000-6-4: 2007 /A1: 2011	Electromagnetic compatibility (EMC) – Part 6-4: Generic standards - Emission standard for industrial environments

This product may be used exclusively in a switch cabinet or a similar appliance. 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, December 5, 2023

  
Nicolas Krauer  
Head of Engineering

  
Christopher Bowles  
COO MECOS AG

---

## Table of contents

---

<b>1.</b>	<b>General information</b>	<b>6</b>
1.1	Device description	6
1.1.1	EC Directives	6
1.2	Information on the operating instructions	7
1.2.1	Location and reading obligation	7
1.3	Property rights	7
1.4	Manufacturer, service address	7
1.5	Access aids and conventions	8
1.5.1	Safety instructions	8
1.5.2	Pictograms	8
<b>2.</b>	<b>Safety</b>	<b>9</b>
2.1	Safety concept	9
2.1.1	Intended use	9
2.1.2	Safety instructions for transport	10
2.1.3	Safety instructions for installation and operation	10
2.1.4	Safety instructions for repairs/servicing/maintenance	11
2.1.5	Residual dangers	11
2.1.6	Safety instructions for the operator	11
2.2	Electricity	11
2.3	Immediate measures in the event of accidents involving electrical current	12
2.4	Fighting electrical fire	12
2.5	Noise	12
2.6	Safety equipment	12
2.7	UL markings	13
2.7.1	Short-circuit protection for branch circuits	13
2.7.2	Overload, overcurrent and overspeed protection	13
2.8	Safety instructions on the device	13
2.9	Operating modes	13
<b>3.</b>	<b>Technical data</b>	<b>14</b>
3.1	Ambient conditions	14
3.2	General data	14
3.3	Drive	14
3.4	Power amplifier of magnetic bearing	15
3.5	Controller and position sensors	15
3.6	Communication interfaces	15
3.6.1	Control panel	15
3.6.2	Digital I/O	15
<b>4.</b>	<b>Transport</b>	<b>17</b>
<b>5.</b>	<b>Assembly and installation</b>	<b>17</b>
5.1	Assembly view	17
5.2	Ventilation	18
5.3	EMC regulations	18
5.4	Protective earth connection (housing)	19
5.5	Electrical connections	20
5.5.1	X1 TSA/SMX6B/CAN - Sensors with sensor amplifier box	21
5.5.2	X2 Dig I/O - Digital interface	21
5.5.3	X3 Bearings - Magnetic bearings	22

5.5.4	X4 Sensors - Sensors without sensor amplifier box	23
5.5.5	PE   U   V   W - Motor	24
5.5.6	PTC motor	24
5.5.7	L1   L2   L3   PE - Mains	25
5.6	Further information	25
<b>6.</b>	<b>Operation</b>	<b>26</b>
6.1	Operation via the operating console	26
6.2	Navigation with the keypad	27
6.3	Menu structure	28
6.4	The fault and warning monitor	29
6.4.1	General information	29
6.4.2	Operation	30
6.5	The fault memory	31
6.5.1	General information	31
6.5.2	Operation	32
6.6	Updating the firmware	33
6.6.1	General information	33
6.6.2	Flash card and handling	33
6.6.3	Complete update	34
6.6.4	Ini file Update	35
6.6.5	Display update	36
6.7	Further operating instructions	36
<b>7.</b>	<b>Malfunctions</b>	<b>37</b>
<b>8.</b>	<b>Cleaning and maintenance</b>	<b>37</b>
<b>9.</b>	<b>Disposal and recycling</b>	<b>37</b>
<b>10.</b>	<b>Warranty</b>	<b>38</b>
<b>11.</b>	<b>Accessories</b>	<b>38</b>
11.1	Sensor amplifier box SMX6B	38
11.2	TOOLBOX for MECOS magnetic bearing systems	39
<b>12.</b>	<b>Related documents</b>	<b>39</b>
<b>13.</b>	<b>Glossary</b>	<b>41</b>
<b>14.</b>	<b>Notes</b>	<b>42</b>

---

## 1. General information

---

### 1.1 Device description

The MMC15 (Magnetic Bearing and Motor Control Unit, 15 kW) or IMC15 (Integrated Magnetic Bearing and Motor Controller, 15 kW) contains both an electronic unit (MLE) for controlling 5-axis Active Magnetic Bearings (AMB) and a drive (FU) for synchronous machines with outputs of up to 15 kilowatts.

The magnetic bearing electronics are the tried-and-tested MECOS design, which supports cable lengths of over 23 metres. In this case, a sensor amplifier of type SMX6B (Sensor Matching BoX, 6 channels) must be used on the machine side. The drive is designed as a voltage source inverter with IGBT output stage and output filter (sine filter), whose vector control guarantees very good dynamic properties. The sine filter and braking resistor are housed in the MMC15 housing and do not require any additional installation.

Both the drive and the magnetic bearing are supplied with energy from the same intermediate voltage circuit and controlled by the same processor. This makes it possible to access all the system functions via a single interface and, in the event of a fault, to safely shut down the system by feeding back the energy stored in the rotor.

A display with keypad, a CAN bus and a configurable digital interface (digital I/O) are available as interfaces. The display is limited to the most important functions relevant to the end customer and operator, while the entire system can be configured and monitored as required via the CAN interface and corresponding software. The digital I/O interface is designed for connection to a PLC and offers 10 digital inputs or outputs as well as an electrically isolated 24 V supply.

The technical data of the MMC15 is described in chapter 3.

A glossary explaining the most common abbreviations can be found at the end of these operating instructions.

#### 1.1.1 EC Directives

An inverter & magnetic bearing electronics is a component that is intended for installation in stationary electrical systems or machines. Commissioning (i.e. commencement of intended operation) is only permitted if the EMC Directive is complied with.

For compliant operation of the EMC Directive, only use a mains filter specified by MECOS AG, see chapter 5.3.



The EMC regulations for the installation are listed in chapter 5.3.

## 1.2 Information on the operating instructions

These operating instructions are an essential aid for the successful and safe use of the MMC15. They contain important information on how to operate the electronics safely, properly and economically. Observing them helps to **avoid dangers**, minimise repair costs and downtimes and increase the reliability and service life of the electronics.

### 1.2.1 Location and reading obligation

Keep the current version of the operating instructions in the immediate vicinity of the control unit to ensure constant access. This applies for the entire service life of the MMC15.

The **operator** of the electronics must ensure that all persons working with it are familiar with and comply with the contents of the operating instructions.

Carry out the work according to 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. You should therefore adhere to the following rules:

- Reproductions of any kind and for any application, even in extracts, may only be made with the consent of MECOS AG.
- Prevent third parties from accessing the operating instructions. This also applies to extracts and reproductions of any kind.
- Inform MECOS AG if you transfer the electronics 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 non-compliance.

## 1.4 Manufacturer, service address

Manufacturer: MECOS AG  
Hardstrasse 319  
8005 Zurich  
Switzerland

Phone: +41 52 355 52 11  
Website: [www.mecos.com](http://www.mecos.com)

Service: MECOS AG  
[aftersales@mecos.com](mailto: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 (based on EN 82079-1).

### 1.5.1 Safety instructions

The signal words are assigned to different hazard levels in accordance with EN 82079 and ANSI Z535:



#### **DANGER!**

The signal word DANGER! indicates an immediate hazard with a high risk that will result in death or serious 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 possible 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 risk.



#### **CAUTION!**

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

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



#### **NOTICE!**

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

### 1.5.2 Pictograms

The following pictograms are used to emphasise information and facts:



Useful tip or fact.



Important technical information or reference to further technical information.



## 2. Safety

This chapter is aimed at all users of the inverter & magnetic bearing electronics. It contains information on the safety concept and provides the minimum requirements for the safe use of the electronics.



Information on the connections can be found in chapter 5.4 and 5.5.

### 2.1 Safety concept

The electronics have been developed and manufactured in accordance with the state of the art and recognised safety regulations. Nevertheless, danger to persons or damage to the electronics and other property may occur during use if:

- the specifications for personal authorisation are not observed (see chapter 2.1.3)
- the electronics are not operated as intended (see chapter 2.1.1)
- the electronics are transported, installed or maintained improperly (see chapter 2.1.2, 2.1.4, 8)

#### 2.1.1 Intended use

The inverter & magnetic bearing electronics are used exclusively to control active magnetic bearing systems with a motor that have been approved by MECOS AG and for which the MMC15 is set. When installed in machines, the MMC15 must not be commissioned (start of intended operation) until it has been established that the machine complies with the provisions of EU Directive 98/37/EC (Machinery Directive). EN60204 must be observed. The electronics may only be used in commercial applications. Written authorisation from MECOS AG is required for other purposes or areas of application.

The following operating options are available:

- Control of a synchronous motor excited by a permanent magnet
- Five-axis active magnetic bearing of a rotor system
- Lifting and lowering the magnetically levitated rotor (switching the magnetic bearings on and off) via the control panel or via an external signal
- Switching between several predefined controller parameter sets (only with corresponding implementation of the parameter sets)
- Communication with an external control system 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 chapter 3 «Technical data» must be observed and complied with.

The MMC15 was designed as an «open type device» and must always be operated in a machine or system. An installation situation, in which the device is openly accessible, is not permitted.

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

This device is intended for use in clean and dry environments in accordance with UL 61800-5-1, pollution degree 2 and overvoltage category III (see chapter 3.2).

Any other use or use beyond this is considered improper use. The user/operator of the electronics is solely liable for any resulting damage. This also applies to unauthorised modifications to the electronics.

### 2.1.2 Safety instructions for transport

The electronics must be packed and transported by qualified specialist personnel. Particular attention must be paid to the weight and the resulting dangers.



#### **CAUTION!**

The total weight of the electronics together with the packaging exceeds 11 kg. Failure of the transport equipment or improper handling poses a corresponding health hazard. 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 can be found in chapter 4.

### 2.1.3 Safety instructions for installation and operation

The responsibilities for the various activities involved in installation and operation must be clearly defined by the operator, and the personnel deployed must comply with these requirements.

The electronics may only be used when in perfect technical condition and in accordance with its intended use, in a safety-conscious and danger-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 of the cabinet, electronics, magnetic bearing components and motor) may only be carried out by qualified electricians. The relevant international, national and local regulations must be observed.



#### **WARNING!**

The electronics do not have a built-in main switch. The supply must therefore be switched on or off with an external switch. To comply with functional safety in accordance with EN 61800-5-2, an upstream emergency shutdown must be provided in compliance with the standard.



#### **WARNING!**

The electronics are operated with a dangerous voltage and have components for storing electrical energy. The appliance must not be opened and no cables may be connected or disconnected. There is a risk of fatal electric shock and unintentional ejection of the machine's rotor.

#### 2.1.4 Safety instructions for repairs/servicing/maintenance

Repairs to the electronics are carried out exclusively by MECOS. The device must not be opened.



#### **WARNING!**

The electronics are operated with a dangerous voltage and have components for storing electrical energy. The appliance must not be opened and no cables may be connected or disconnected. There is a risk of fatal electric shock and unintentional ejection of the machine's rotor, which can lead to personal injury and damage to property.

#### 2.1.5 Residual dangers

Even if all safety regulations are observed, certain residual dangers remain when handling electronics.

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

#### 2.1.6 Safety instructions for the operator

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

The operator must also observe and implement the accident prevention and 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 electronics are operated with a voltage of up to 460 V<sub>AC</sub>, which is classified as 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!

Proper earthing of the electrical system of the control unit and the associated magnetically levitated machine must be ensured by a protective conductor system.



#### **WARNING!**

The electronics are operated with a dangerous voltage and have components for storing electrical energy. Unauthorised opening of the device and improper tampering can lead to personal injury and damage to property. The device must not be opened.



#### **WARNING!**

The electronics are supplied externally. Even after the power supply is switched off, these cables are still energised and there is a danger of electric shock.

## 2.3 Immediate measures in the event of accidents involving electrical current

Basic procedure in the event of an electrical accident:

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

In principle, any person who has come into contact with electric current should be taken to a doctor for a check-up.

The life of an injured person often depends on first aid being administered as quickly as possible at the scene of the accident.

## 2.4 Fighting electrical fire

Basic procedure in the event of an electrical fire:

1. Switch off affected circuits in consultation with the operator
2. Support for the fire brigade by qualified electricians
3. Extinguish fire
4. Ventilate the fire room and persons, who have come into contact with decomposition products, must receive immediate specialised medical care

## 2.5 Noise

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

Fan sound power level: max. 41.5 dB(A)

## 2.6 Safety equipment

The electronics do not have a built-in main switch. The AC supply must therefore be switched on or off using an external switch. The control panel (see chapter 6.1) can be used to check whether the electronics are switched on and therefore energised.



### **WARNING!**

The electronics are supplied externally. Even after the power supply has been switched off, these cables may still be live and there is a danger of electric shock.

## 2.7 UL markings

### 2.7.1 Short-circuit protection for branch circuits

The device is intended for use in supply networks that can deliver a maximum current carrying capacity of 30 kA<sub>RMS</sub> at 480 V and is protected by a motor circuit breaker not smaller than 35 kA<sub>RMS</sub> at 480 V.

### 2.7.2 Overload, overcurrent and overspeed protection

The motor must have integrated PTC overtemperature protection in accordance with DIN VDE V 0898-1-401. The PTC must be connected to terminal J2.

Maximum motor power: 29.5 A<sub>RMS</sub> AC, 15 kW.

## 2.8 Safety instructions on the device

The safety instructions on the electronics have the following meaning:

**!! WARNUNG !!    !! WARNING !!    !! AVERTISSEMENT !!**

Gefährliche Restspannungen können an berührbaren Teilen im Inneren des IMC15 Gerätes auftreten. Entladezeit vor dem Öffnen des Gerätes: 5 Min.

Dangerous residual voltages may appear on internal live parts of the IMC15 device. Discharge time before opening cover: 5 min.

Des tensions résiduelles dangereuses peuvent apparaître sur des composants non isolés à l'intérieur de l'appareil IMC15. Il est impératif de respecter un temps de décharge de 5 minutes avant d'ouvrir le boîtier.

Figure 1: Warning label on capacitor discharge time

After de-energising, wait for 5 minutes until the DC link voltage has reduced to a safe voltage, as this is capacitively supported.

## 2.9 Operating modes

The electronics are designed for continuous operation.

### 3. Technical data

#### 3.1 Ambient conditions

Operating temperature	0 ... +55 °C
Storage temperature	-10 ... +60 °C
Maximum installation height	2000 m above sea level
Relative humidity	< 85 % without condensation

#### 3.2 General data

Dimensions (L x W x H)	409 mm x 222 mm x 229 mm
Degree of protection	IP20
Weight	11 kg
Supply voltages	3 x 400 ... 460 V <sub>AC</sub> ±10 % / 50 ... 60 Hz
Overvoltage category of connection	III
Degree of pollution	2
Electrical safety	According to the Declaration of Conformity
UL CCN / File Number	NMTR / 3058899
Power consumption	16 kVA
Protection	32 A, see also note in chapter 5.5.7
Cooling	2 axial fans

#### 3.3 Drive

Model	MDRA15B
DC link capacity	42 µF
Amplifier type of input	Uncontrolled three-phase bridge (B6U)
Maximum power output	15'000 W
Output frequency	0 ... 900 Hz (1100 Hz at 14 kW)
PWM switching frequency	21.7 kHz
Input filter	External, see chapter 5.3
Output filter	Integrated sine filter
Short circuit/earth fault	monitored
Operating modes	2-quadrant operation (acceleration, braking, field weakening in one direction of rotation)
Braking power	600 W
Motor temperature protection	PTC in triplet design according to DIN VDE V 0898-1-401 <sup>1</sup>

<sup>1</sup> Temperature sensor on the winding heads of the machine's stator. Evaluation by MMC15: Short-circuit detection in the self-test ( $R_{PTC} < 80 \Omega$  corresponds to fault condition), interruption and overtemperature detection during operation ( $R_{PTC} > 700 \Omega$  corresponds to fault condition).

### 3.4 Power amplifier of magnetic bearing

Model	MACY210
DC link voltage	100 V <sub>DC</sub>
DC link capacity	1200 µF
Amplifier type	10 channel PWM amplifier
Maximum power output (dynamic)	10 x 150 VA
Number of magnetic bearing axes	5 (4 radial, 1 axial)
Output current	2 A per channel
Continuous	3 A
Peak value	
PWM switching frequency	39 kHz

### 3.5 Controller and position sensors

Model	MACY210
Processor	TMS320LF2407A PGEA
Sensor Measuring principle	Eddy current
Sensor resolution	depending on the sensor used
Number of sensor inputs	6 (4 radial, 1 axial, 1 pulse)

### 3.6 Communication interfaces

#### 3.6.1 Control panel

Model	MACY210
Function	Interface for operation, diagnostics and status information
Display	<ul style="list-style-type: none"> <li>• Display with 4 x 20 characters and backlight</li> <li>• 3 LED displays</li> </ul>
Control elements	6 function keys
Languages	English

#### 3.6.2 Digital I/O

Digital inputs											
Quantity	5										
Electrical description (see Figure 2)	Inputs isolated by optocouplers										
Maximum input voltage	30 V <sub>DC</sub>										
Logic level of input voltage HIGH	> 15 V <sub>DC</sub>										
Maximum input current at 24 V	50 mA										
Description:	<table border="0"> <tr> <td>«Reset_Fault»</td> <td>Reset fault</td> </tr> <tr> <td>«Drive_Start»</td> <td>Start drive</td> </tr> <tr> <td>«Inifile 1/2»</td> <td>Select ini file</td> </tr> <tr> <td>«Inifile 3/4»</td> <td>Select ini file</td> </tr> <tr> <td>«Sleep_Mode»</td> <td>Sleep mode</td> </tr> </table>	«Reset_Fault»	Reset fault	«Drive_Start»	Start drive	«Inifile 1/2»	Select ini file	«Inifile 3/4»	Select ini file	«Sleep_Mode»	Sleep mode
«Reset_Fault»	Reset fault										
«Drive_Start»	Start drive										
«Inifile 1/2»	Select ini file										
«Inifile 3/4»	Select ini file										
«Sleep_Mode»	Sleep mode										

Digital outputs		
Quantity	5	
Electrical description (see Figure 3)	Outputs isolated by optocouplers	
Maximum output voltage OFF	80 V <sub>DC</sub>	
Maximum output current ON	50 mA	
Description:	«NOM_SPEED»	Nominal speed reached
	«NO_DRIVE_FLT»	No drive fault
	«NO_BEARING_FLT»	No magnetic bearing fault
	«NO_Warning»	No fault
	DigIO_3	<i>Not used, can also be used as input</i>



## NOTICE!

The digital outputs are not short-circuit-proof!

### Schematic extract of the digital I/O

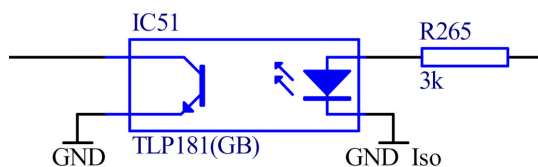


Figure 2: Digital input

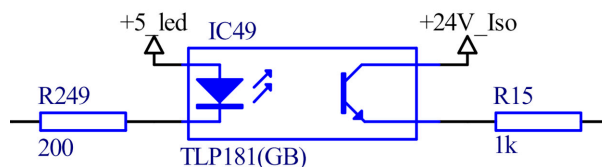


Figure 3: Digital output



Additional information for the I/O interface is provided in chapter 5.5.2.



## 4. Transport

For longer journeys and especially for outdoor transport, the original packaging of the electronics must be used as impact and moisture protection. It is therefore essential to keep the original packaging.

No special packaging precautions need to be taken for transport within a building. However, care must be taken to ensure that the electronics are not exposed to any shocks or loads.

## 5. Assembly and installation



### WARNING!

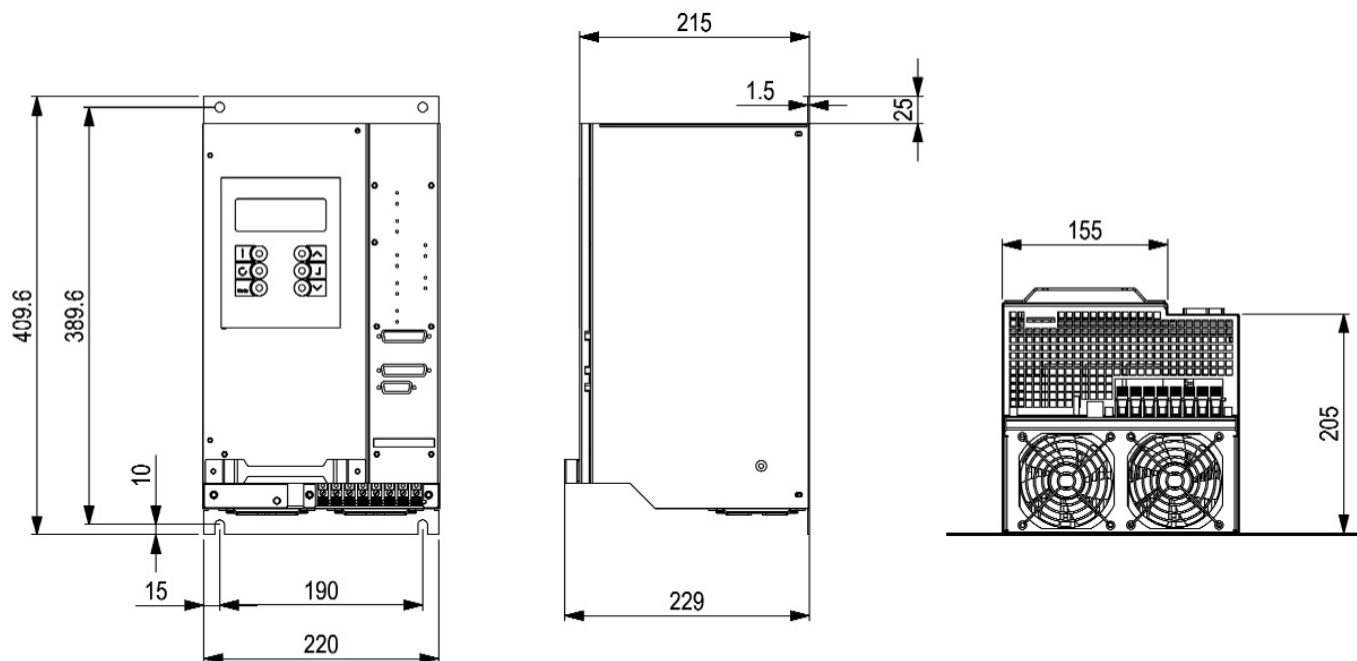
When unpacking, the electronics must be checked for transport damage. Visibly damaged devices must never be connected to the mains supply. Any transport damage must be reported to the manufacturer immediately. The original packaging must be retained.



### DANGER!

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

### 5.1 Assembly view



The electronics must be installed in a switch cabinet. Installation takes place in a vertical position (see Figure 4). Use the four fixing points provided for this purpose on the rear panel of the device. Appropriate M8 screws must be used for assembly.

Horizontal hole spacing: 190 mm, vertical hole spacing: 389.6 mm



## WARNING!

The mounting plate must be earthed.



## NOTICE!

The distances for cooling the electronics must be observed (see chapter 5.2). If the specified minimum distances are not guaranteed, the reduced air circulation can lead to overheating of the electronics, which can cause the control unit to switch off prematurely.

## 5.2 Ventilation

The ventilation of the switch cabinet must fulfil the requirements specified in chapter 3. Ensure that the air flow generated by the built-in fans is not blocked. For the supply air and exhaust air, the space above and below the enclosure must remain free up to a minimum distance of 150 mm. The minimum distance for the other sides is 20 mm in each case according to the following drawing:

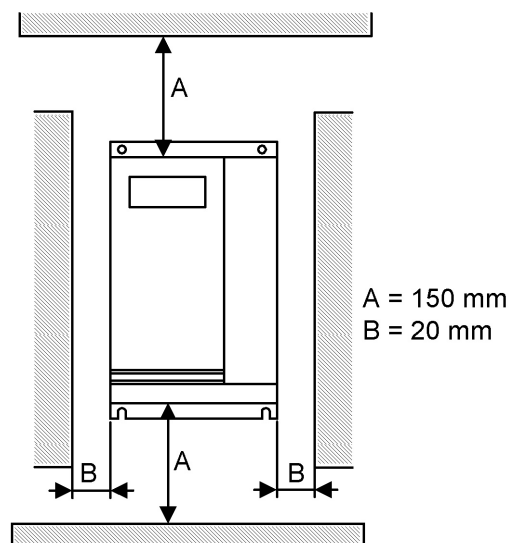


Figure 5 : Minimum distances in the switch cabinet

## 5.3 EMC regulations

For compliant operation with AC in accordance with the EMC Directive, a suitable 3-phase mains filter must be connected upstream. Only use a mains filter specified by MECOS AG!

Suitable mains filters:

Manufacturer	Type designation
Schaffner EMV	FN3258-30-33
Schaffner EMV	FN3258-30-47
FUSS	3F460-030.270

The MMC15 complies with the Low Voltage Directive and, if installed correctly, also with the EMC Directive. The device has been approved in an accredited test laboratory and is not bindingly transferable to the installed state in any system or machine. Details can be found in the Declaration of Conformity on page 3.

To comply with the EMC Directive, the following instructions must be observed:

1. Ensure good contact between the device and the mounting plate, use toothed lock washers
2. Connect the shield connection of the motor cable to the mounting plate as close as possible to the device
3. Use shielded motor cable over the entire length
4. Ensure load-side earth connection
5. Use the mains filter as described above
6. Low-resistance connection to the neutral point of the system
7. Shield control cables, connect shield with low resistance to housing or mounting plate
8. Use strain relief as a shield connection

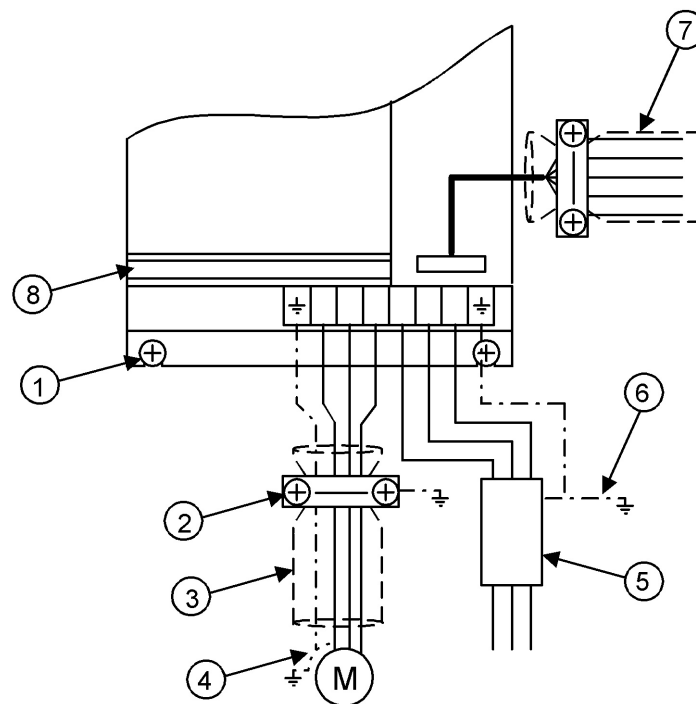


Figure 6: Explanations of EMC measures

In addition, the mounting plate must be earthed for the discharge of high-frequency interference signals and a low-impedance connection of the mounting plate to the neutral point must be ensured.

Furthermore, no choke may be used to adjust the input voltage or smooth the mains current.

## 5.4 Protective earth connection (housing)

For a secure protective earth connection of the MMC15 housing, a PE terminal is provided for the mains connection (see chapter 5.5.7). The cable cross-section of the PE connection must be the same size or larger than the cross-section of the supply cable between the power supply and the MMC15. It is generally recommended to use a cable with a cross-section of at least 2.5 mm<sup>2</sup>.

Connection data:	Connection type of the terminal	Slotted screw
	Cable cross-section of connection	
	rigid	0.5 ... 16 mm <sup>2</sup>
	flexible (with or without ferrule)	0.5 ... 10 mm <sup>2</sup>
	AWG	20 ... 6
Stripping of connection	12 mm	
Tightening torque	1.2 ... 1.5 Nm	



## DANGER!

Danger of electric shock due to missing or improper protective earth connection. Without a protective earth connection, personal injury can occur in the event of a fault due to dangerous voltages on the housing. A controlled, proper and secure protective earth connection of the electronics is therefore essential for safe operation. When connecting, make sure that the earth connection is firmly screwed in.

## 5.5 Electrical connections

The electrical connections are made according to a separate connection diagram. As this is application-specific, it must be ensured that the correct document is used.

To operate the magnetic bearings, the bearing and sensor system must be connected, with 2 options available for the sensor system:

1. Cable length of 0 to 23 m without sensor amplifier
2. Cable length of 2 to 31 m with sensor amplifier box SMX6B, this is connected on the machine side

The following connections are located on the front and underside of the electronics:



Figure 7: Front view of inverter & magnetic bearing electronics MMC15

Pos	Designation	Description
1	X3	Magnetic bearing connection, see chapter 5.5.3
2	X1	Sensor connection for cables > 23 m plus CAN bus, see chapter 5.5.1
3	X4	Sensor connection for cables < 23 m, see chapter 5.5.4
4	X2	Digital I/O connection, see chapter 5.5.2
5	L1, L2, L3, PE	Mains connection, see chapter 5.5.7
6	PE, U, V, W	Motor connection, see chapter 5.5.5
7	Earth rail	Connection of cable shields and strain relief
8	PTC	Motor temperature sensor connection, see chapter 5.5.6



### DANGER!

The electronics may only be switched on when all connections have been made correctly. The mains connection of the device 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 electronics (see chapter 3.2).



### NOTICE!

Improper connection can damage the electronics.

#### 5.5.1 X1 TSA/SMX6B/CAN - Sensors with sensor amplifier box

If the sensor signals are routed via a sensor amplifier box, this connection must be used for this purpose. X1 is a D-Sub connector with mixed polarity.

Connector control unit: D-Sub connector 20+1 pin socket

Connector cable: D-Sub connector 20+1 pin male



### NOTICE!

Ensure a good connection of the shielding and a good hold on the anchor channel.



When connecting, ensure that the plug is secured against loosening using the integrated screws.

#### 5.5.2 X2 Dig I/O - Digital interface

The digital inputs and outputs as well as an isolated power supply are routed via the 12-pin connector X2. Its counterpart is equipped with screw terminals.

Connector control unit: Phoenix Contact | MCV 1.5/12-GF-3.81 P26 THR (1707735)

Connector cable: Phoenix Contact | MC 1.5/12-STF-3.81 BD:1-12 (1711792)

Pin no.	Designation	Description															
1	+24V_Iso	Output: +24V of the isolated power supply															
2	GND_Iso	Output: GND of the isolated power supply															
3	NOM_SPEED	Output: nominal speed reached															
4	NO_DRIVE_FLT	Output: no drive fault															
5	NO_BEARING_FLT	Output: no magnetic bearing fault															
6	Reset_Fault	Input: reset fault															
7	Drive_Start	Input: start drive															
8	Inifile_1/2	Input: ini file selection (see pin 10 for explanation)															
9	NO_Warning	Output: no fault															
10	Inifile_3/4	Input: ini file selection <table border="1" style="margin-left: 20px; border-collapse: collapse;"> <thead> <tr> <th></th> <th><u>X2:8</u></th> <th><u>X2:10</u></th> </tr> </thead> <tbody> <tr> <td>• ini file 1 (LSM4000, 900 Hz):</td> <td>open</td> <td>open</td> </tr> <tr> <td>• ini file 2 (LSM3000, 900 Hz):</td> <td>+24V</td> <td>open</td> </tr> <tr> <td>• ini file 3 (LSM4000, 1100 Hz):</td> <td>open</td> <td>+24V</td> </tr> <tr> <td>• ini file 4 (LSM3000, 760 Hz):</td> <td>+24V</td> <td>+24V</td> </tr> </tbody> </table>		<u>X2:8</u>	<u>X2:10</u>	• ini file 1 (LSM4000, 900 Hz):	open	open	• ini file 2 (LSM3000, 900 Hz):	+24V	open	• ini file 3 (LSM4000, 1100 Hz):	open	+24V	• ini file 4 (LSM3000, 760 Hz):	+24V	+24V
	<u>X2:8</u>	<u>X2:10</u>															
• ini file 1 (LSM4000, 900 Hz):	open	open															
• ini file 2 (LSM3000, 900 Hz):	+24V	open															
• ini file 3 (LSM4000, 1100 Hz):	open	+24V															
• ini file 4 (LSM3000, 760 Hz):	+24V	+24V															
11	Sleep_Mode	Input: Sleep mode															
12	DigIO_3	Not used, can be used as input or output															



When connecting, ensure that the plug is secured against loosening using the integrated screw connection.



## NOTICE!

Maximum voltage and current values of the digital I/O must be observed, otherwise the hardware may be damaged (see chapter 3.6.2).

### 5.5.3 X3 Bearings - Magnetic bearings

The magnetic bearings are connected to X3.

Connector control unit: D-Sub connector 25-pin socket

Connector cable: D-Sub connector 25-pin male

Pin no.	Designation	Description
1	out0+	Channel IXPA HI
2	out0-	Channel IXNA HI
3	out1+	Channel IYPA HI
4	out1-	Channel IYNA HI
5	out2+	Channel IXPB HI
6	out2-	Channel IXNB HI
7	out3+	Channel IYPB HI
8	out3-	Channel IYNB HI
9	out4+	Channel IZP HI
10	out4-	Channel IZN HI
11	lph1	Motor current phase U
12	U_HV	Not used

Pin no.	Designation	Description
13	GND	Signal earth
14	out_S	Channel IXPA LO / Star point
15	out_S	Channel IXNA LO / Star point
16	out_S	Channel IYPA LO / Star point
17	out_S	Channel IYNA LO / Star point
18	out_S	Channel IXPB LO / Star point
19	out_S	Channel IXNB LO / Star point
20	out_S	Channel IYPB LO / Star point
21	out_S	Channel IYNB LO / Star point
22	out_S	Channel IZP LO / Star point
23	out_S	Channel IZN LO / Star point
24	lph2	Motor current phase V
25	Pulse	Pulse signal output



## NOTICE!

Ensure a good connection of the shielding and a good hold on the anchor channel.



When connecting, ensure that the plug is secured against loosening using the integrated screws.

### 5.5.4 X4 Sensors - Sensors without sensor amplifier box

The sensors are connected to X4, provided the sensor cable is not longer than 23 metres.

Connector control unit: D-Sub connector 15-pin socket

Connector cable: D-Sub connector 15-pin male

Pin no.	Designation	Description
1	IN_CABLE	Resistor to read in the cable length
2	IN0+	Channel SXPA
3	IN1+	Channel SYPA
4	IN2+	Channel SXPB
5	IN3+	Channel SYPB
6	IN4+	Channel SZ
7	IN5+	Channel Pulse P
8	SGND	Signal earth
9	SGND	Signal earth
10	IN0-	Channel SXNA
11	IN1-	SYNA channel
12	IN2-	Channel SXNB
13	IN3-	Channel SYN B
14	IN4-	Channel SZD
15	IN5-	Channel Pulse N


**NOTICE!**

Ensure a good connection of the shielding and a good hold on the anchor channel.



When connecting, ensure that the plug is secured against loosening using the integrated screws.

**5.5.5 PE | U | V | W - Motor**

The motor is connected to these terminals. The sequence of phases specified by the manufacturer must be observed to ensure the correct direction of rotation of the motor.

Pin no.	Designation	Description
PE	PE	Protective earth motor
U	U	Motor phase U
V	V	Motor phase V
W	W	Motor phase W

Connection data:	Connection type of the terminal	Slotted screw
	Cable cross-section of connection rigid flexible (with or without ferrule) AWG	0.5 ... 16 mm <sup>2</sup> 0.5 ... 10 mm <sup>2</sup> 20 ... 6
	Stripping of connection	12 mm
	Tightening torque	1.2 ... 1.5 Nm


**NOTICE!**

A tight connection of the cable shielding to the mounting plate as close as possible to the device must be ensured.

The device was developed for permanent magnet synchronous motors and must be reset for each motor type. Operation of any machine without the consent of MECOS AG is prohibited.

**5.5.6 PTC motor**

There is a 2-pin spring-loaded terminal to the left of the motor terminals. This is intended for connecting a PTC to monitor the temperature of the motor. The specifications of the PTC and the limit values can be found in the technical data of the drive in chapter 3.3.

Connection data:	Connection type of the terminal	Push-in spring connection
	Cable cross-section of connection rigid flexible (with or without ferrule) AWG	0.5 ... 2.5 mm <sup>2</sup> 0.25 ... 2.5 mm <sup>2</sup> 24 ... 12
	Stripping of connection	10 mm



## 5.5.7 L1 | L2 | L3 | PE - Mains

The mains is connected to these terminals. The phase sequence can be freely selected, but the conventions of the respective switch cabinet must be observed.

Pin no.	Designation	Description
L1	L1	Mains phase L1
L2	L2	Mains phase L2
L3	L3	Mains phase L3
PE	PE	Protective earth

Connection data:	Connection type of the terminal	Slotted screw
	Cable cross-section of connection	
	rigid	0.5 ... 16 mm <sup>2</sup>
	flexible (with or without ferrule)	0.5 ... 10 mm <sup>2</sup>
	AWG	20 ... 6
	Stripping of connection	12 mm
	Tightening torque	1.2 ... 1.5 Nm



### NOTICE!

The following points must be observed when connecting the mains:

- Only use the mains filter specified by MECOS AG, see chapter 5.3.
- No choke may be used to adjust the input voltage or smooth the mains current.
- When installing the device, ensure that it is adequately fused (see chapter 2.7.1). Only motor protection switches that conform to UL 61800-5-1 and are approved for use as «self-protected combination motor controller».
- The electronics do not have a built-in main switch. The power supply must therefore be switched on or off using an external switch.

## 5.6 Further information

- Never exceed the specified maximum ambient temperature (see chapter 3.1)
- Avoid any contact with the electronic components
- The electronics must not be operated in an explosive atmosphere

## 6. Operation

### 6.1 Operation via the operating console

The menu navigation on the display is available only in English.

The control panel consists of a display with four lines of 20 characters and backlighting, three command buttons with LED display (left) and three buttons for menu control (right).

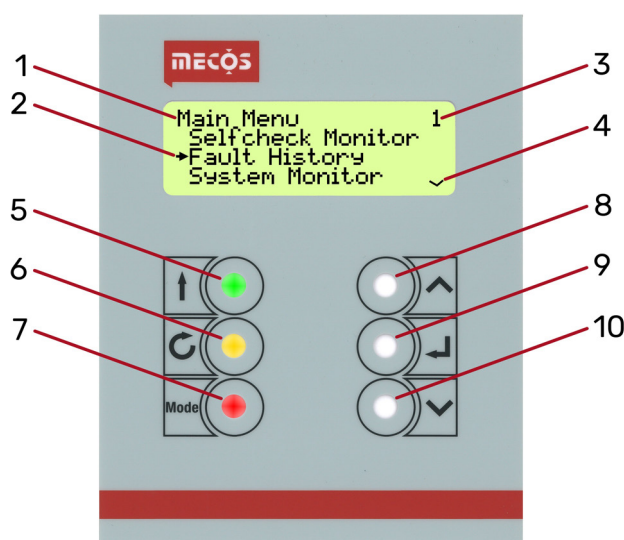
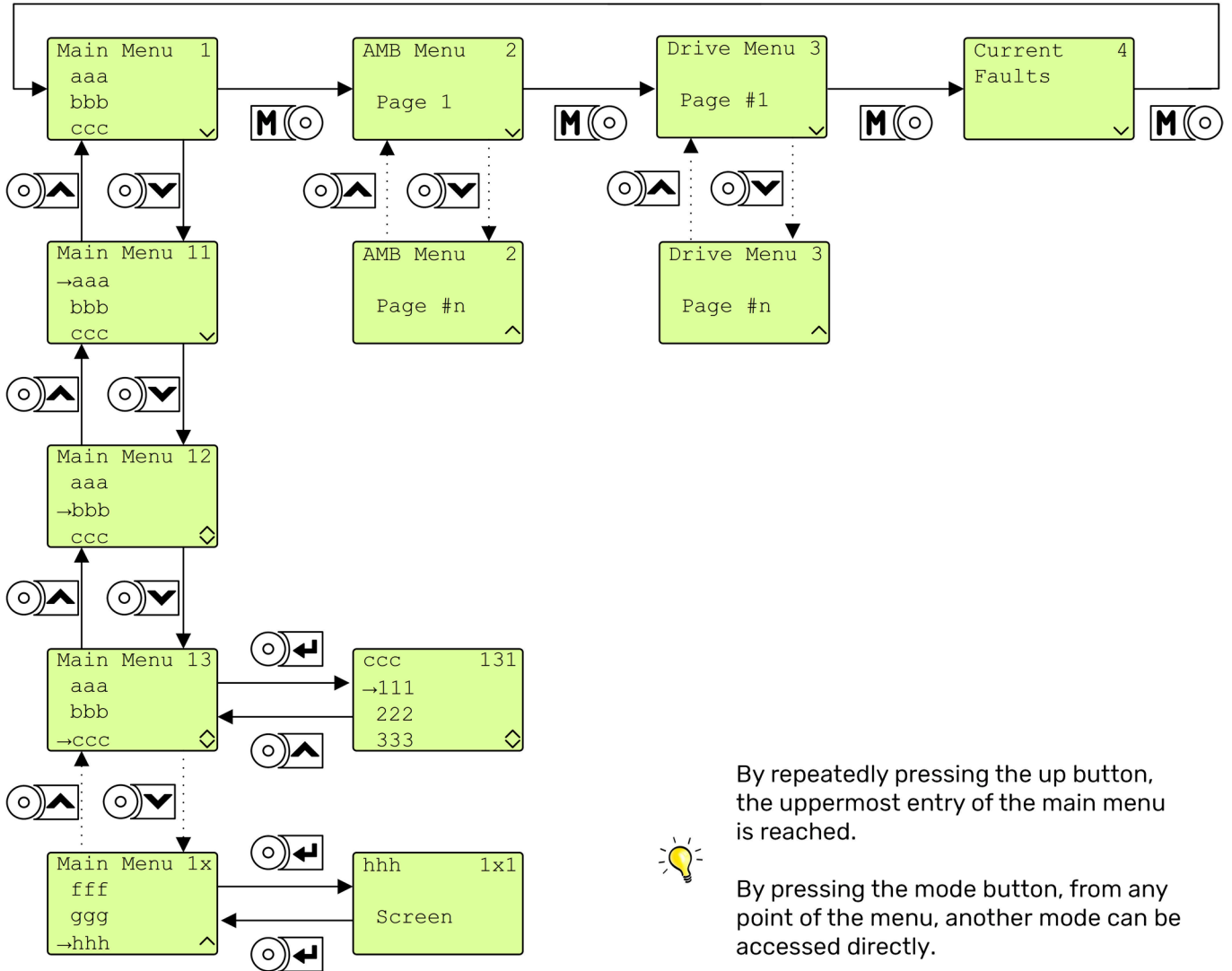


Figure 8: Operating console with display

Pos	Designation	Description
1	Menu title	Title of the displayed menu
2	Navigation sign	Selecting a menu and navigating through the menus
3	Menu number	Number of the displayed menu page and the displayed menu item
4	Navigation aid	Indicates whether further menu items or menu pages can be displayed using the Up and/or Down button
5	«Lift» button LED green	Lifting and lowering the rotor Dark: Rotor lowered Flashing: Rotor is being lifted Illuminated: Rotor is levitating
6	«Drive» button LED yellow	Button is inactive Dark: Drive off Flashing: Drive brakes Illuminated: Drive is running
7	«Mode» button LED red	Selecting the modes Dark: No warning or fault Flashing: Warning Illuminated: Fault
8	«Up» button	Menu control, arrow function up
9	«Enter» button	Menu control, input function
10	«Down» button	Menu control, arrow function down

## 6.2 Navigation with the keypad

The entire navigation is based on pages that are summarised in 4 modes to form a menu structure. Navigation is as follows:



## 6.3 Menu structure

The illustration below provides an overview of the menus that can be called up via the display of the MMC15. The 4 modes «Main Menu», «AMB», «Drive» and «Current Faults» can be selected using the «Mode button». The contents of the individual modes are described in the following sections.

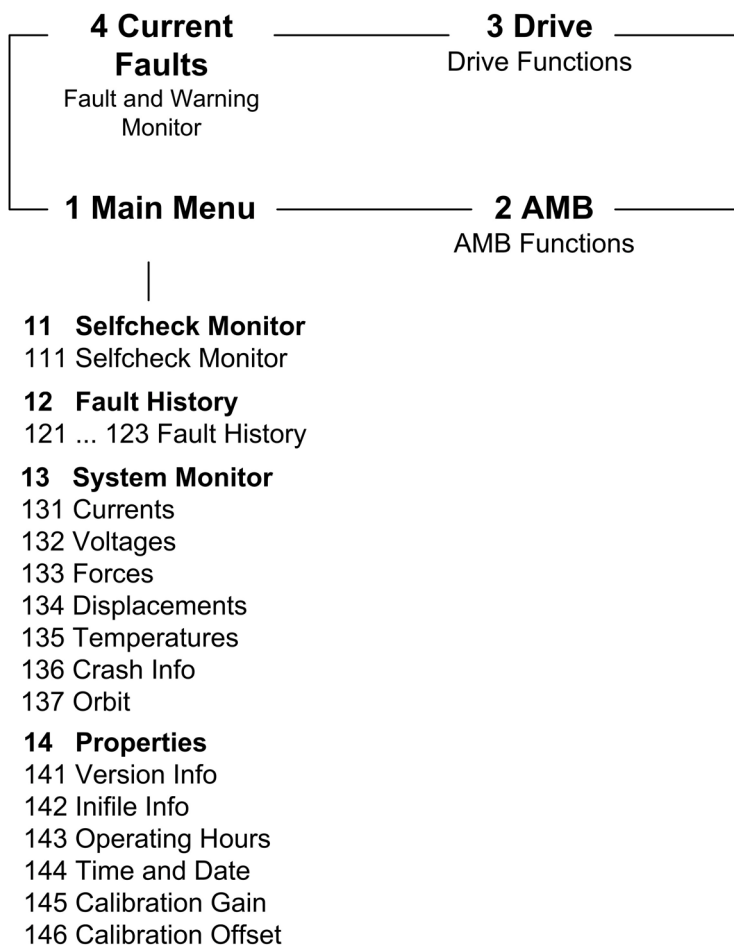


Figure 9: Menu items in the main menu

### Mode 1: Main Menu

All functions accessible via the display and keypad are summarised in the main menu.

### Mode 2: AMB (magnetic bearing functions)

Important magnetic bearing values are displayed in this mode.

### Mode 3: Drive (drive functions)

Mode for displaying the speed and the relevant inverter currents.

### Mode 4: Current Faults (fault and warning monitor)

The fault and warning monitor can be used to call up and reset the current messages from the device's internal monitoring system. Monitoring is activated automatically when the device is started up and writes all faults that have occurred in the fault memory. The following chapter 6.4 describes the fault and warning monitor in detail.

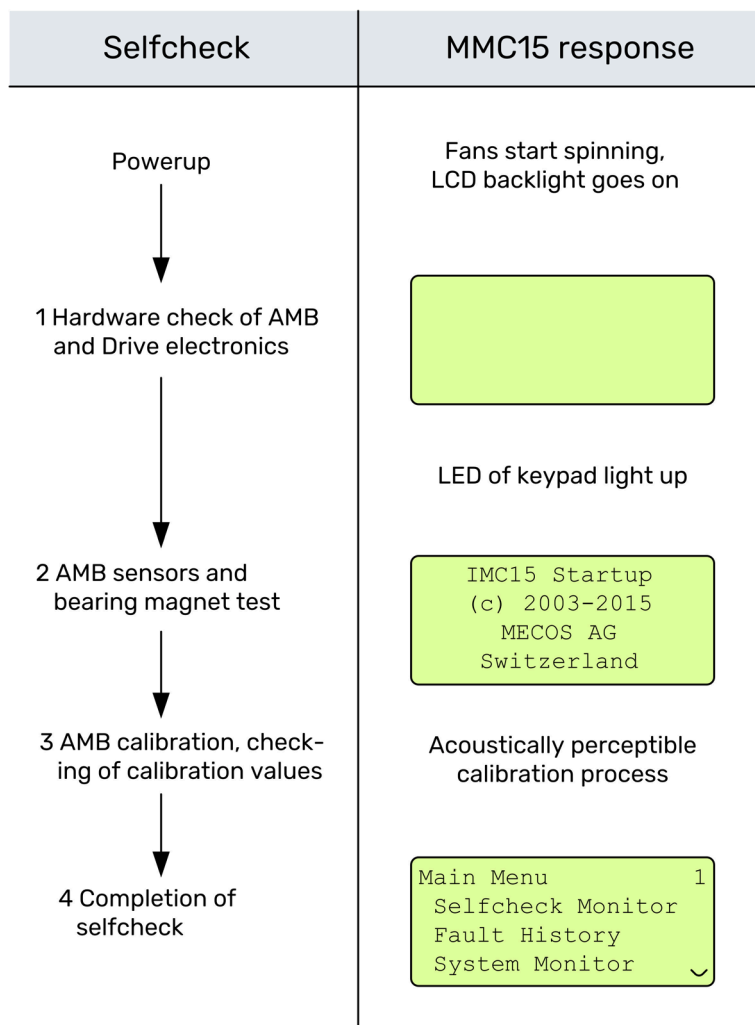
## 6.4 The fault and warning monitor

### 6.4.1 General information

Once the operating voltage is applied, the MMC15 monitors itself automatically. A distinction is made between 2 phases.

#### Phase 1: Self-test during start-up

During start-up, the firmware is booted and the device is subjected to a series of self-tests.



Once the self-tests have been successfully completed, page 1 (Main Menu) is shown on the display, the rotor is lifted and the green LED lights up. If one or more of these tests are not successful, page 1 is also shown on the display, the rotor remains lowered and the red LED lights up. The device is locked with the fault message «Perm» (Permission: fault in the magnetic bearing) or «DrivePerm» (Drive Permission: fault in the drive). The cause of the blocking (i.e. the registered self-test faults) can be called up using the self-test monitor. If the red LED flashes after starting up, there is a self-test warning or an operational warning. Like its counterpart, the operational warning, the self-test warning is informative in nature and does not result in any operational restrictions.

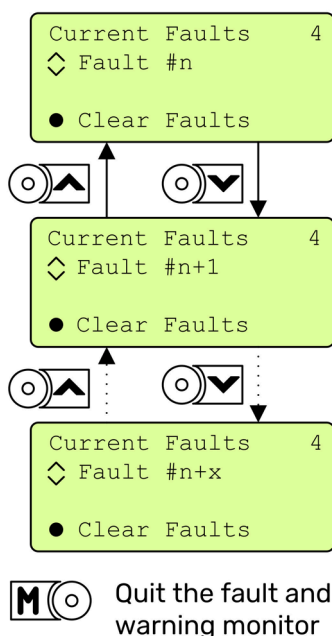
### Phase 2: Monitoring during operation

If the self-test has been successfully completed, monitoring of the operating variables is activated. If a limit is exceeded or not reached, the system reports a warning and/or an fault and switches off the drive in the event of a fault. The corresponding fault messages can be viewed using the fault and warning monitor. Self-test faults and warnings as well as operational faults and warnings are handled by the system in the same way. The difference is that faults and self-test faults must be reset, for example by a person or a PLC, and they are entered in the fault memory. Warnings and self-test warnings cannot be reset. Warnings are automatically deleted as soon as the cause disappears. Self-test warnings are present until the next self-test is carried out and are only deleted when the cause has disappeared at this point.

#### 6.4.2 Operation

The fault and warning monitor can be used to view and delete current operational faults and warnings.

##### View the current faults and warnings

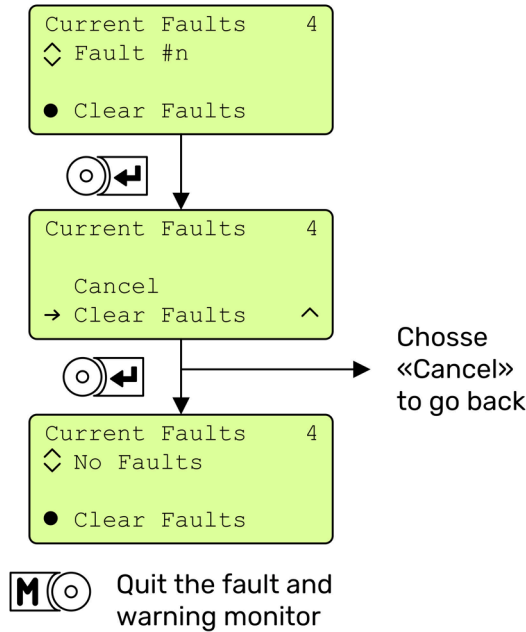


##### Explanation:



The self-test monitor in the main menu has the same operation as the fault and warning monitor and allows you to view the self-test warnings and self-test faults that have led to a «Perm» and/or a «DrivePerm» fault. However, self-test faults cannot be acknowledged directly. To do this, the cause of the fault must first be rectified and then the collective fault must be acknowledged in the fault monitor.

**Delete the current faults**



**6.5 The fault memory**

**6.5.1 General information**

All self-test and operational faults that have occurred are entered in the fault memory. The fault memory is organised as a list with 160 entries, which are overwritten cyclically. Access to the individual entries is sequential, with the last ("most recent") entry at the top. The fault causes (details) of the entries are displayed with the same messages as in the fault and warning monitor.

To simplify orientation when viewing the fault memory, each entry has a number that is supplemented by the date and time when the fault occurred. When viewing the fault causes (details) of an entry, the speed of the system when the fault occurred is also displayed.

If the fault memory is empty, the following default data set is displayed:

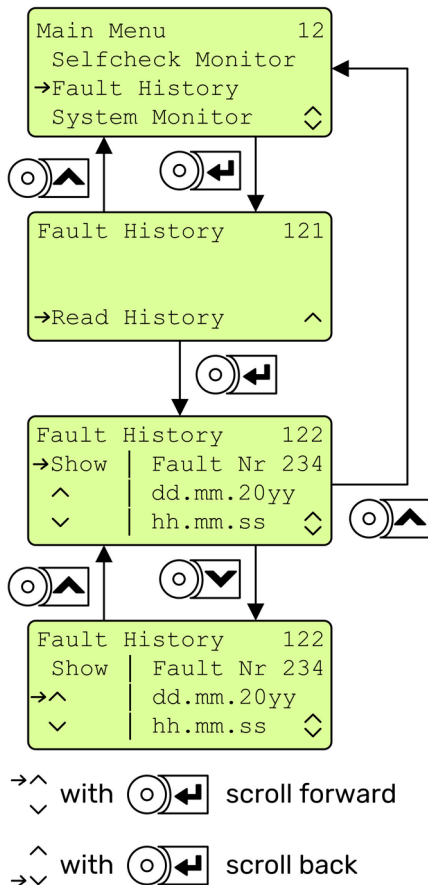
```

Fault History 122
→Show | Fault Nr -1
^      | XX.XX.20XX
v      | XX.XX.XX ◇
    
```

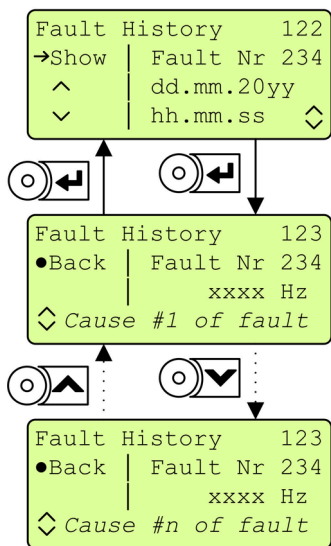
### 6.5.2 Operation

The fault memory can be accessed via the main menu. To access the fault memory, the data for the display must first be called up and made available (menu page 121). It is then possible to scroll through all fault causes (page 122) and, if required, view the fault causes (details) of each entry (page 123).

#### Calling up the fault memory, viewing the fault entries



#### Viewing the fault causes (details) of an entry





## 6.6 Updating the firmware

### 6.6.1 General information

To avoid having to send the MMC15 back to the manufacturer if the firmware is changed, it is possible to update the device using a portable storage medium.

The firmware on the MMC15 consists of three parts. The programme code, the ini files and the display file. As explained below, it is possible to update the complete firmware or, if required, only the ini files or the display.

### 6.6.2 Flash card and handling

The storage medium for the update is a flash card.

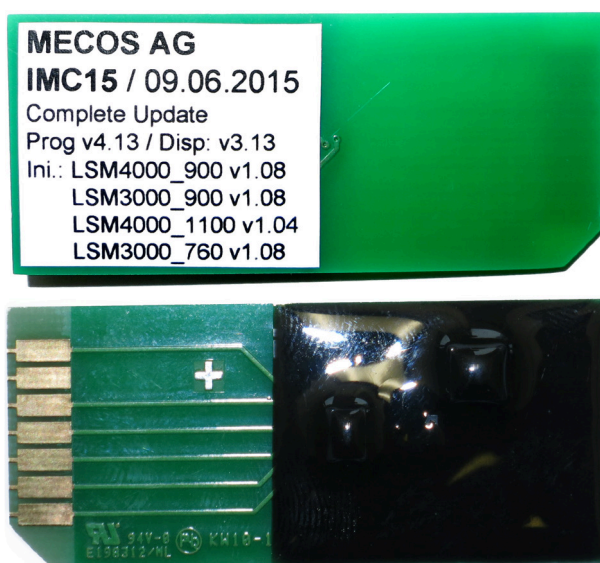


Figure 10: Flash card from the front and back (example)



### NOTICE!

The flash card contains electronic memory cells and is sensitive to electrostatic discharge (ESD). Avoid touching the contacts during handling.

The flash card is inserted into the slot at the bottom of the device. Ensure that it is carefully inserted with the text facing the user and the cut-off corner first.



Figure 11: Flash card inserted

Once the update has been completed (see the following chapter), the flash card must be removed and can be used to update any number of other devices.

Special attention should be paid to the following points:

- Firmware may only be installed by qualified personnel using flash cards that have been explicitly designed and provided by MECOS AG for the specified application.
- During the update process, the flash card must not be removed and/or the power supply disconnected under any circumstances. An incomplete update will always result in the device being returned.
- The card can only be used for the specified purpose. It is not possible to carry out a display and/or ini file update with a card for a complete update.

### 6.6.3 Complete update

A complete update is due if a new firmware (programme, ini files and possibly display) needs to be loaded onto the MMC15. The basic requirement for a complete update is the use of the latest flash card with a higher programme version number than is stored on the MMC15.



If the version numbers of the programme under «Version Info» match those on the card, the firmware will not be updated, i.e. neither the programme nor the ini files nor the display files will be updated.

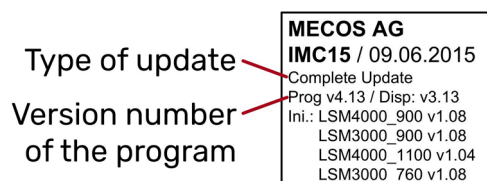
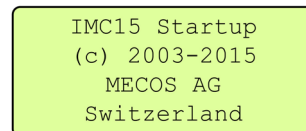


Figure 12: Labelling of the flash card (example)

Procedure for an update:

1. Compare the programme version on the flash card and on the MMC15.  
The version number on the flash card must be higher.
2. De-energise the device.
3. Insert card.
4. Switch on the device.
5. Wait until the startup screen appears on the display.  
The complete update can take up to one minute.
6. Unplug the card.
7. Use the display to check whether the update was successful.



**Explanation:**

As a rule, an update is an improvement of the currently delivered firmware version and therefore has a higher version number than the version stored on the device. However, it is also possible to install an old firmware version on the device using a flash card and the procedure described below. The prerequisite for an update or a backgrade is that the version number of the firmware on the flash card is different from the version number on the device.

**6.6.4 Ini file Update**

The ini file can be changed independently of the firmware if parameters of the system or operational monitoring need to be adjusted.



Ini files always match exactly one programme version. The MMC15 will not carry out an update with ini files that do not match the version stored on the device, but in this case it will not issue a failure message. It is therefore essential to make sure that the version number of the programme specified on the flash card is identical to that under «Version Info» before updating.

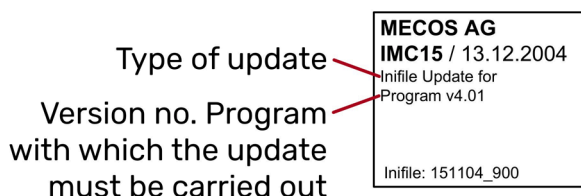
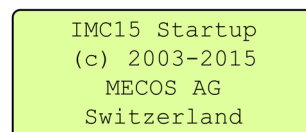


Figure 13: Labelling of the flash card (example)

Procedure for an ini file update:

1. Compare the programme version on the flash card and on the MMC15.  
Does it match?
2. De-energise the device.
3. Insert card.
4. Press and hold the Enter key.
5. Switch on the device.
6. Wait until the startup screen appears on the display.  
The ini file update usually takes a few seconds.
7. Release the Enter key.
8. Remove card.



### 6.6.5 Display update

A display update is required if the user guidance is customised via the display and keypad.



The procedure for the display update is identical to that for the ini file update. In the event that the display and ini file need to be updated, it is sufficient to carry out the process just once.

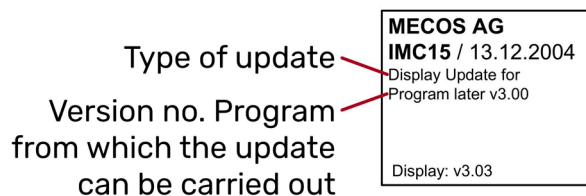
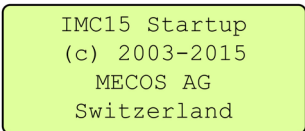


Figure 14: Labelling of the flash card (example)

Procedure for a display update:

1. Check display version.
2. De-energise the device.
3. Insert card.
4. Press and hold the Enter key.
5. Switch on the device.
6. Wait until the startup screen appears on the display.  
The display update takes up to 30 seconds.
7. Release the Enter key.
8. Remove card.
9. Use the display to check whether the update was successful.



### 6.7 Further operating instructions



#### CAUTION!

No cables may be plugged in or unplugged while the magnetic bearing electronics are switched on. This could result in an electric shock or lowering of the rotor while it is rotating.



To prevent possible data loss, magnetic data carriers such as hard discs etc. must not be stored in the immediate vicinity of the magnetic bearing electronics.

## 7. Malfunctions

Information on fault diagnosis and troubleshooting can be found in the enclosed document «Fault diagnosis and troubleshooting» (see chapter 12 [3]).

MECOS distinguishes between warnings and faults:

Designation	Description
Warning	Generates a warning message (alarm). A warning message is triggered when a warning limit value is exceeded and remains set 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 (error). An error message is triggered if a system-critical limit value is exceeded. An error usually leads to an error response and remains set until it is reset by a clear command. An error can only be reset when the error is no longer present.



Please contact MECOS if faults occur repeatedly.

## 8. Cleaning and maintenance

When used as intended (see chapter 2.1.1), the electronics are not subject to wear and are therefore maintenance-free.



### **DANGER!**

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

## 9. Disposal and recycling

If the electronics are decommissioned as old equipment, the **laws and regulations** applicable at that time for disposal must be complied with.

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

## 10. Warranty

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

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



### DANGER!

Unauthorised opening of the device and improper handling can lead to personal injury and damage to property. The device must not be opened.

Modifications to the device may result in undefined conditions that can lead to personal injury and damage to property.



### NOTICE!

No liability is accepted for damage caused by incorrect or improper operation, non-compliance with the information in these operating instructions, misuse or unauthorised modifications or the use of non-original spare parts. In such cases, all warranty claims are void.

## 11. Accessories

### 11.1 Sensor amplifier box SMX6B

The SMX6B sensor amplifier box is required for operation with sensor cables longer than 23 metres. If possible, the SMX6B box is screwed firmly to the housing of the magnetic bearing.

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

Designation	Item number	Description
Sensor amplifier box SMX6B	BG10633-02N	For variable sensor cable lengths from 2 ... 31 m



Figure 15: Sensor amplifier box SMX6B

## 11.2 TOOLBOX for MECOS magnetic bearing systems

The TOOLBOX for MECOS magnetic bearing systems (MecosTools) can be used to change a large number of system parameters and perform real-time measurements of all process 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®<sup>2</sup>. This allows the potential of MATLAB® to be used for modelling, controller synthesis, simulation, visualisation and scripting.



The TOOLBOX for MECOS magnetic bearing systems can only be used under Microsoft Windows®. Admin rights are required for installation.



### NOTICE!

Due to the various additional functions of MecosTools, it is generally 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.

## 12. Related documents

The following documents are not included in these operating instructions, but are nevertheless part of the device documentation. Some of these documents are created on a project-specific basis.

No.	Description	File name
[1]	Connection diagram ML system <sup>3</sup>	BGxxxxx-xxNx_SCH_ML-System_ {Project-specific}_Vxxx.pdf
[2]	Connection diagram ML system IMC15 LSM <sup>4</sup>	BG11006-00Nx_SCH_MMC15-ML-System_ LSM_Vxxx.pdf
[3]	Fault diagnosis and troubleshooting	BG13974-00Nx_BA-DIA-DE_MMC15_ Standard_Vxxx.pdf

x = number or letter

<sup>2</sup> MATLAB® is commercial software from MATHWORKS® Inc. for solving mathematical problems and visualising the results graphically. Link to the website: [www.mathworks.com](http://www.mathworks.com)

<sup>3</sup> Only supplied if it is not an «IMC15 LSM» system.

<sup>4</sup> As this is the predominant main application for these electronics, this diagram has been attached directly to these instructions, see following page.

*Connection diagram ML system IMC15 LSM*

*BG11006-00Nx\_SCH\_MMC15-ML-  
System\_LSM\_Vxxx.pdf*



### 13. Glossary

Term	Explanation
AMB	<b>Active Magnetic Bearings</b>
Digital I/O	Parallel customer interface on the electronics with potential-free digital inputs and outputs
Display file	File containing the description of the screens that define the user interface
Ini file	Application parameter set that defines the properties of the magnetic bearings, the drive and the operational monitoring systems
ML system	MECOS Designation for <b>MagnetLagerSystem</b> (Magnetic Bearing System) Used for magnetic bearing diagram and includes MBC, cable, machine incl. bearings and sensors and peripheral devices if necessary
MMC	<b>Magnetic bearing and Motor Control Unit</b>
PWM	<b>Pulse Width Modulation</b>
SMX	<b>Sensor Matching BoX</b> Additional device that amplifies the sensor signals on the machine side and thus enables longer sensor cables

---

**14. Notes**

---

A series of horizontal dotted lines for writing notes, spanning the width of the page.



---

MECOS AG  
Hardstrasse 319  
8005 Zurich  
Switzerland

Phone: +41 52 355 52 11  
[mecos@mecos.com](mailto:mecos@mecos.com)  
[www.mecos.com](http://www.mecos.com)

---

Subject to technical changes