
Variable frequency drive

MC53 / MC53A

BG13720-03N / BG14048-00N



Operating instructions

Translation of the original operating instructions
BG13921-03NA V1.00
© 2023

Table of contents

1.	General	6
1.1	Device description	6
1.1.1	EC Directives	6
1.2	Information on the operating instructions	7
1.2.1	Storage location and obligation to read	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
2.	Safety	9
2.1	Safety concept	9
2.1.1	Intended use	9
2.1.2	Safety instructions for transport	10
2.1.3	Safety instructions during operation	10
2.1.4	Safety instructions for repairs/maintenance/servicing	11
2.1.5	Residual risks	11
2.1.6	Safety instructions for the operator	11
2.2	Electricity	12
2.3	Emergency measures in the event of accidents with electric current	13
2.4	Fire fighting in case of electrical fire	13
2.5	Noise	13
2.6	Safety devices	13
2.7	Safety instructions on the device	14
2.8	Operating modes	14
3.	Device configurations	14
3.1	Optional extension interfaces	14
4.	Technical data	15
4.1	Environmental conditions	15
4.2	General information	15
4.3	Water cooling	15
4.4	Controller board	15
4.5	Power amplifier	16
4.6	Communication interfaces	16
4.6.1	Control panel	16
4.6.2	PC communication	16
4.6.3	Digital I/O	16
4.6.4	Relay output	17
4.7	Temperature input	18
4.8	DC link	18
4.9	Extension module	18
4.9.1	Expansion card IBE723 (EtherCAT)	18
5.	Transport	19
6.	Assembly and installation	19
6.1	Installation view	20
6.2	Ventilation	21
6.3	Cooling water connection	21

6.4	EMC regulations	22
6.5	Protective earth connection (housing)	22
6.6	Electrical connections	23
6.6.1	X1 - CAN	24
6.6.2	X2 - MECOS Service	24
6.6.3	X3 - DIG. I/O & 24 V Ext.	24
6.6.4	X4 - Motor PTC	25
6.6.5	X5 - Mains	25
6.6.6	X6 - Motor	26
6.6.7	X7 - DC link	27
6.6.8	X10 / X11 - EtherCAT (optional)	27
6.6.9	X20 (optional)	27
6.7	Further notes	28
7.	Operation	28
7.1	General information	28
7.1.1	Status displays	28
7.2	Boot button	28
7.3	Operation via the digital I/O interface	28
7.4	Operation via the PC interface (optional)	29
7.5	Parameterisation of the communication interfaces	29
7.5.1	Configuration Digital I/O	29
7.5.2	Monitoring parameters	29
7.5.3	Fieldbus variables	29
7.6	Further operating instructions	29
8.	Disruptions	30
9.	Cleaning and maintenance	30
10.	Disposal and recycling	31
11.	Warranty	31
12.	Accessories	32
12.1	TOOLBOX for MECOS variable frequency drives	32
13.	Related documents	32
14.	Glossary	33
15.	Notes	34

1. General

1.1 Device description

The MC53/MC53A variable frequency drive is a device for operating synchronous machines with outputs of up to 53 kVA. It contains an actively controlled voltage link inverter with a multilevel IGBT output stage. The input filter and the output filter (sinusoidal filter) are located in the housing of the MC53/MC53A and do not require any additional installation.

An external speed sensor is not required for the control.

The vector control guarantees very good dynamic properties. The control is model-based, so that any changes can be implemented easily.

In the event of a fault, the system can be shut down safely using the energy stored in the rotor. However, it is not possible to feed the power back into the grid.

A touch display, a fieldbus interface, a CAN interface 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 system can be configured and monitored via the fieldbus interface and corresponding software. The digital I/O interface is designed with a view to connection to a PLC and offers 6 digital inputs, 2 digital outputs, a relay output and an electrically isolated 24 V supply.

The integrated USB interface allows communication with a PC. With the optionally available TOOLBOX for MECOS variable frequency drive inverter (MecosTools), a large number of system parameters can be changed. In addition, real-time measurements of process variables can be carried out.

The technical specifications of the variable frequency drive MC53/MC53A are described in chapter 4.

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

1.1.1 EC Directives

A variable frequency drive 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.

Proof of compliance with the protection objectives required by the EMC Directive must be provided by the installer/operator of a machine and/or system.



The EMC regulations for installation are listed in chapter 6.4.

1.2 Information on the operating instructions

These operating instructions are an essential aid for the successful and safe use of the MC53/MC53A variable frequency drive. It contains important information on how to operate the electronics safely, properly and economically. Following these instructions helps **avoid dangers**, reduce repair costs and downtimes, and increase the reliability and service life of the electronics.

1.2.1 Storage location and obligation to read

Store the latest version of the operating instructions in the immediate vicinity of the variable frequency drive so that access is guaranteed at all times. This applies for the entire service life of the variable frequency drive.

The **operator** of the variable frequency drive must ensure that all persons who work with it know and comply 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 parts, 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 transfer the variable frequency drive 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 possible hazard with medium risk, which will result in death or serious bodily 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 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 variable frequency drive. It contains information on the safety concept and provides the minimum requirements for the safe use of the magnetic bearing electronics.



For information on the connections, see chapter 6.3, 6.5 and 6.6.

2.1 Safety concept

In principle, the variable frequency drive has been developed and manufactured according to the state of the art and the recognised safety rules. Nevertheless, danger to persons or damage to the electronics and other property may occur during use if:

- the specifications for personnel 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, 6)

2.1.1 Intended use

The variable frequency drive is used exclusively to control synchronous machines that have been approved by MECOS AG and for which the MC53/MC53A is configured. 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 operating options exist:

- Operation of a synchronous machine
- Starting and stopping the drive by an external signal or via the optional fieldbus interface.
- Switching between several pre-set controller parameter sets (only with corresponding implementation of the parameter sets).
- Communication with an external control via a configurable interface
- Carrying out measurements using the TOOLBOX for MECOS variable frequency drives (optional)
- Modification of control and other system parameters using the TOOLBOX for MECOS variable frequency drives (optional)

The information in chapter 4 «Technical data» must be observed and complied with.

Intended use of the variable frequency drive also includes compliance with the precautionary measures prescribed in this manual as well as the operating and maintenance regulations.

This device is intended for use in clean and dry environments in accordance with pollution degree 2 and overvoltage category III (see chapter 4.2).

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

2.1.2 Safety instructions for transport

The variable frequency drive must be packed and transported by qualified personnel. Particular attention must be paid to the weight and the resulting dangers.



WARNING!

The variable frequency drive has a total weight which, together with the packaging, exceeds 25 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 followed. Only suitable and tested lifting gear and slings are to be used.



NOTICE!

Detailed information on transport is given in chapter 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 variable frequency drive may only be used in a technically perfect condition as well as 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 of the cabinet and variable frequency drive) may only be carried out by qualified electricians. The international, national and local regulations in this context must be followed.



WARNING!

The variable frequency drive does not have a built-in main switch. The supply must therefore be switched on or off with an external switch. For compliance with functional safety according to EN 61800-5-2, an upstream emergency stop must be provided in compliance with the standard.



WARNING!

The variable frequency drive is operated with a dangerous voltage. Do not open the unit or connect or disconnect any cables during operation. There is a risk of fatal electric shock.

2.1.4 Safety instructions for repairs/maintenance/servicing

Repairs to the variable frequency drive are carried out exclusively by MECOS. The device 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. Ensure that the external supply line is voltage-free and check this.
3. For a complete shutdown, the external supply line must be disconnected.
4. Attach a warning sign that the control unit must remain voltage-free.
5. Wait 10 minutes so that the capacitively supported DC link voltage has reduced to a harmless voltage and the electronics have had time to cool down sufficiently.



WARNING!

The variable frequency drive is operated with a dangerous voltage. During operation, the unit must not be opened and cables must not be connected or disconnected. There is a risk of fatal electric shock.



WARNING!

The variable frequency drive has components for storing electrical energy. Therefore, a residual voltage is present for a certain time even after switching off or disconnecting the supply voltage. Assembly and disassembly may only be carried out by trained personnel.

2.1.5 Residual risks

Even if all safety regulations are followed, certain residual dangers remain when handling the variable frequency drive.

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

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 variable frequency drive is operated with a voltage of up to 480 V_{AC} which can be classified as dangerous. The corresponding precautionary measures for handling electricity must be followed.

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. Determine the absence of voltage.
4. Earth and short-circuit.
5. Cover or cordon off adjacent live parts.

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).

Proper earthing of the electrical system of the variable frequency drive and the associated synchronous machine must be ensured by a protective conductor system.



WARNING!

The variable frequency drive is operated with dangerous voltage and has components for storing electrical energy. Unauthorised opening of the device, as well as improper tampering, can lead to injury to persons and damage to property. The device must not be opened.



WARNING!

The variable frequency drive has components for storing electrical energy. Therefore, a residual voltage is present for a certain time even after switching off or disconnecting the supply voltage. Assembly and disassembly may only be carried out by trained personnel.

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 variable frequency drive 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. 63 dB(A)

2.6 Safety devices

The variable frequency drive does not have a built-in main switch. The supply must therefore be switched on or off with an external switch. Via the LED displays (see chapter 7.1.1) it can be checked whether the electronics are switched on and therefore live.



WARNING!

The variable frequency drive has components for storing electrical energy. Therefore, a residual voltage is present for a certain time even after switching off or disconnecting the supply voltage. Assembly and disassembly may only be carried out by trained personnel.

2.7 Safety instructions on the device

The safety notice on the variable frequency drive has the following meaning:



Figure 1: Warning label Capacitor discharge time

After powering off, wait 10 minutes for the DC link voltage to reduce to a non-hazardous voltage, as this is capacitively supported.

2.8 Operating modes

The MC53/MC53A variable frequency drive is basically designed for continuous operation.

3. Device configurations

The MC53/MC53A variable frequency drive is available in various hardware configurations. The project-specific configuration of the variable frequency drive is given in the documentation belonging to the project (see in chapter 13).

There can be several device variants with the same hardware configuration, but they differ in the project-specific parameterisation of the software. The relevant parameterisation in the software for the customer is given in the corresponding reports (see chapter 13).

3.1 Optional extension interfaces

Up to 5 different extension modules can be operated in parallel with the MC53/MC53A. Various industrial buses and a wide range of measured variables are supported. The microbus standard serves as the standard.



Further information is available on request. Details are also available on the MIKROE website (www.mikroe.com).

4. Technical data

4.1 Environmental conditions

Operating temperature	0 ... +55 °C
Storage temperature	-20 ... +55 °C
Maximum installation height	2000 m above sea level
Relative humidity	< 85 % without condensation

4.2 General information

Dimensions (L x W x H)	516 mm x 330 mm x 260 mm
Degree of protection	IP20
Weight	31 kg
Supply voltages	400 ... 480 V _{AC} ±10 % / 50 ... 60 Hz
Overvoltage category Connection	III
Pollution degree	2
Electrical safety	According to the declaration of conformity
Functional safety	Must be ensured by external measures
UL CCN / File Number	Prepared for certification
Power consumption (depending on machine, cable length and parameterisation)	Typically 58 kW
Maximum current consumption	100 A _{eff}
Maximum output frequency	2200 Hz
Cooling	Water cooling and 2 PWM-controlled axial fans

4.3 Water cooling

Flow temperature water	10 ... 35 °C
Minimum flow	4 l/min
Maximum flow overpressure	8 bar

4.4 Controller board

Model	FDC723
Processor	ARM STM32

4.5 Power amplifier

Model	MDRA53
DC link voltage	$\pm 400 V_{DC}$
DC link capacity	2520 μF
Amplifier type Input	Vienna Rectifier
Amplifier type Output	Multilevel module
Maximum power output	53,000 VA
PWM switching frequency	40 kHz
Input filter	Integrated sinusoidal filter
Output filter	Integrated sinusoidal filter

4.6 Communication interfaces

4.6.1 Control panel

Model	NX3224x028
Function	Interface for diagnostic and status communication
Display	TFT colour display with 320 x 240 pixels and backlight
Operating elements	Touchscreen
Languages	English

4.6.2 PC communication

Interface type	USB C
Log	Proprietary MECOS log
Identifier	5-digit serial number

With the help of the TOOLBOX for MECOS variable frequency drives (optional), complete access to the processor of the controller board is possible. See chapter 12.1.



The serial number for Ethernet communication can be seen on the type plate. In addition, the serial number can be read on the display.

4.6.3 Digital I/O

Digital inputs	
Number	6
Electrical description (see Figure 2)	Isolated inputs with common GND
Maximum input voltage	30 V_{DC}
Logic level input voltage HIGH/LOW	$> 18 V_{DC} / < 8 V_{DC}$
Maximum input current at 24 V	5 mA

Description: The function of the inputs can be parameterised, see chapter 7.5

Digital outputs	
Number	2
Electrical description (see Figure 3)	Isolated outputs with common GND
Maximum output voltage	24 V _{DC}
Maximum output current	50 mA
Description: The function of the outputs can be parameterised, see chapter 7.5	
Schematic excerpt of the digital I/O	

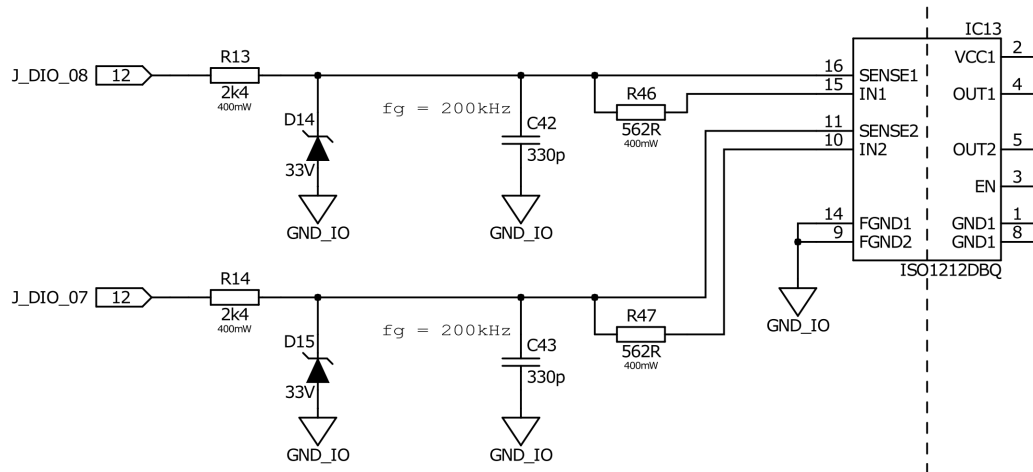


Figure 2: digital input

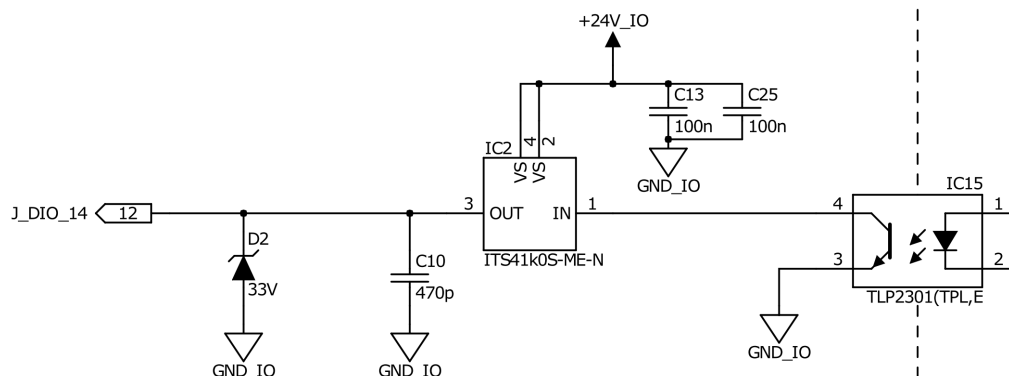


Figure 3: digital output



Additional information for the I/O interface is given in chapter 7.3.

4.6.4 Relay output

Number	1
Maximum switching current	1 A
Maximum voltage	30 V _{DC}

4.7 Temperature input

Number	1
Type	PT1000/PTC, 2-wire measurement
Maximum measuring current	5 mA

4.8 DC link

Maximum output voltage	800 V _{DC} not PE balanced
Maximum output current	2 A

4.9 Extension module

Extension interface	
Number	5
Description: The MC53/MC53A has five expansion slots. MECOS currently has the following expansion cards in its range. The expansion cards are intended for factory installation.	

4.9.1 Expansion card IBE723 (EtherCAT)

Interface type	EtherCAT
Number	1 In Port, 1 Out Port

5. Transport

For longer transports and especially for outdoor transports, the original packaging of the variable frequency drive must be used as impact and moisture protection. It is therefore essential to keep the original packaging.

For transport within a building, no special precautions need to be taken for packaging. However, care must be taken to ensure that the electronics are not subjected to any shocks or stresses.

6. Assembly and installation



WARNING!

When unpacking, the variable frequency drive 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. The original packaging must be kept.



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 chapter 2.

6.1 Installation view

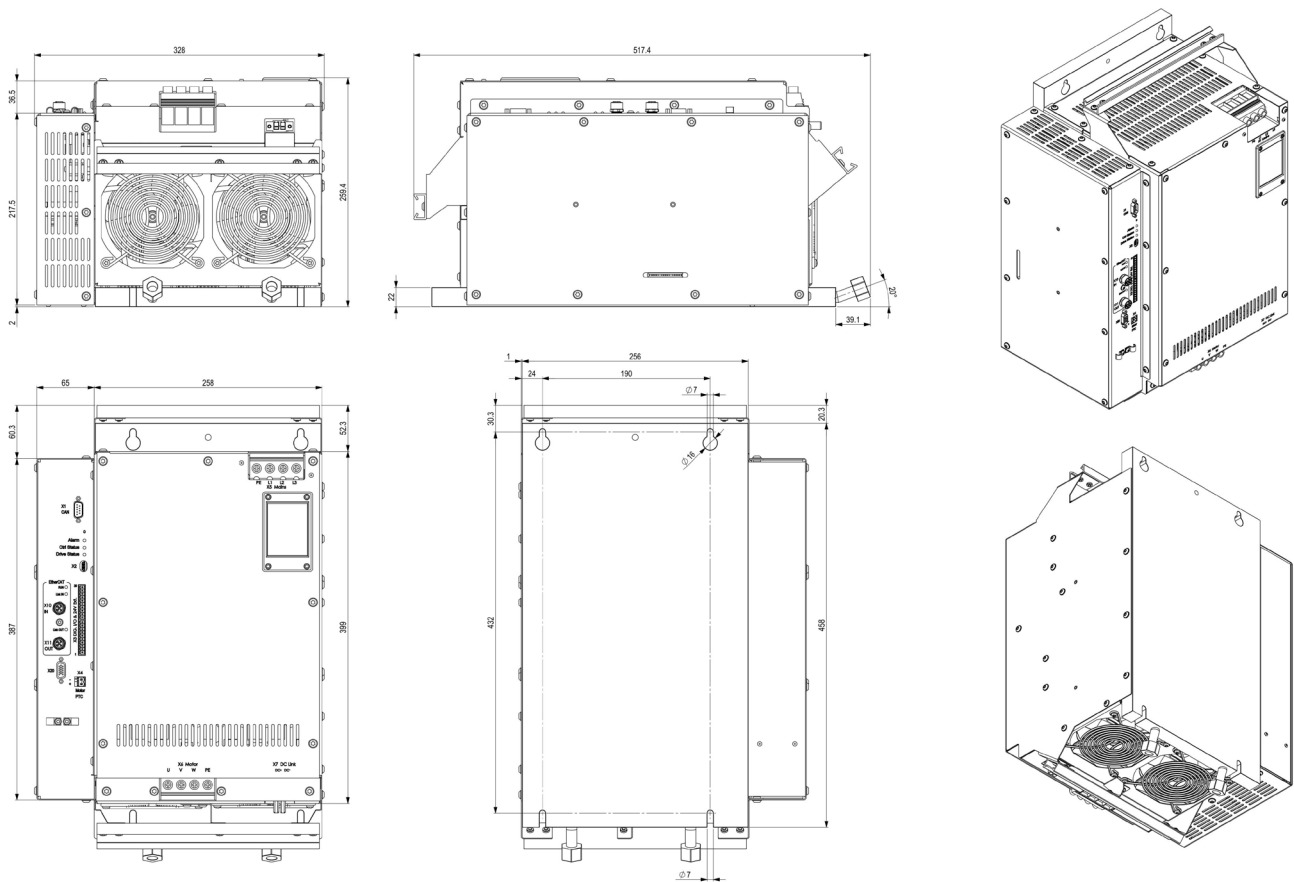


Figure 4: Installation view (dimensions in millimetres)

The MC53/MC53A frequency inverter must be installed in a control cabinet. The installation is done in a vertical position (see Figure 4). To do this, use the four fastening points provided for this purpose on the rear wall of the device. Use the appropriate M6 screws for installation.

Hole spacing horizontal: 190 mm, hole spacing vertical: 432 mm

To ensure proper cooling of the MC53/MC53A, a minimum distance of 20 cm must be maintained for the air supply as well as the air exhaust (see Figure 5).



WARNING!

The mounting plate must be earthed.



NOTICE!

The distances for cooling the variable frequency drive must be followed (see chapter 6.2). If the specified minimum distances are not ensured, the reduced air circulation may cause the variable frequency drive to overheat, which will lead to an untimely shutdown of the control system.

6.2 Ventilation

The ventilation of the control cabinet must comply with the conditions specified in chapter 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 above and below the housing must remain free at least to the distance of 20 cm. The minimum distance for the other sides is 4 cm each according to the following drawing:

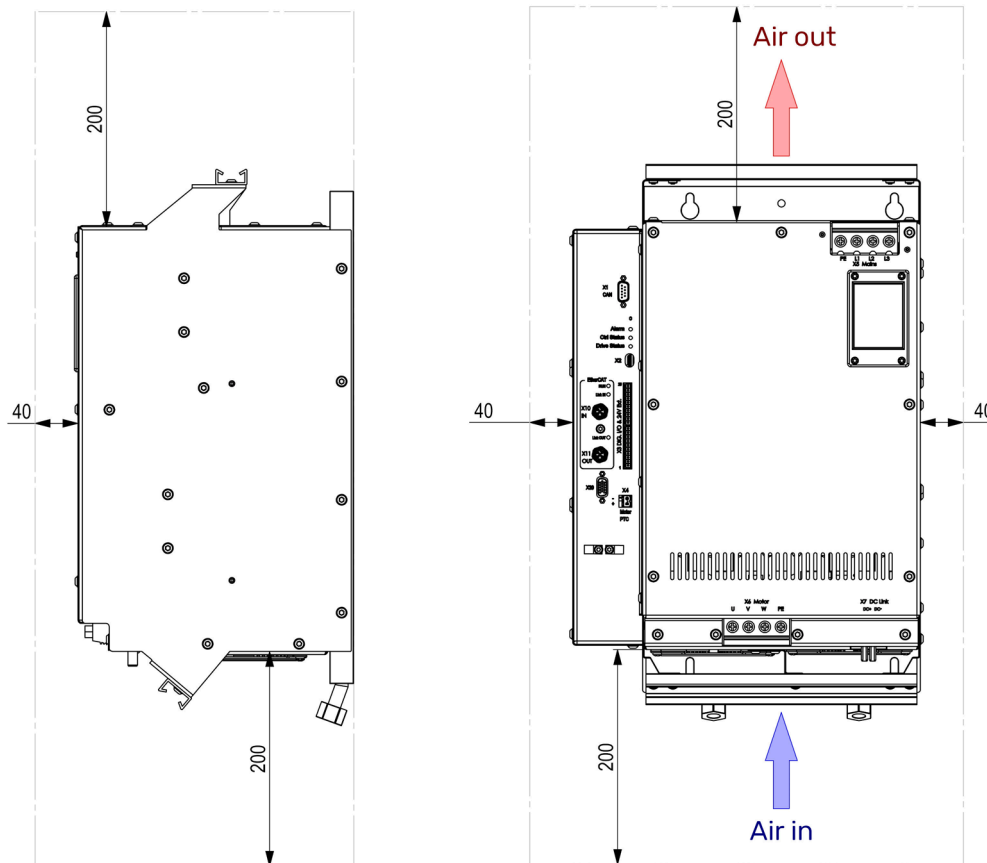


Figure 5 Minimum distances in the control cabinet and airflow direction (dimensions in millimetres)

6.3 Cooling water connection

Inlet and outlet can be freely selected on the variable frequency drive.

Connection type: 3/8" female thread

All further information on the cooling water system is given in chapter 4.3 «Water cooling».



NOTICE!

Water cooling is mandatory for safe operation of the variable frequency drive. In addition, the water supply line and the connections must be checked for leaks before switching on the mains voltage.

6.4 EMC regulations

A variable frequency drive 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.

Proof of compliance with the protection objectives required by the EMC Directive must be provided by the installer/operator of a machine and/or system. For specific questions on compliant operation in accordance with the EMC directive Directive IEC61800-3, please contact MECOS AG.

6.5 Protective earth connection (housing)

For a safe earth connection of the MC53/MC53A housing, an M8 threaded bolt with a length of 20 mm is provided on the housing. 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 MC53/MC53A.



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 protective earth connection of the variable frequency drive is therefore mandatory for safe operation. When connecting, make sure that the protective earth connection is screwed tight and secured against loosening with ribbed washers.

6.6 Electrical connections

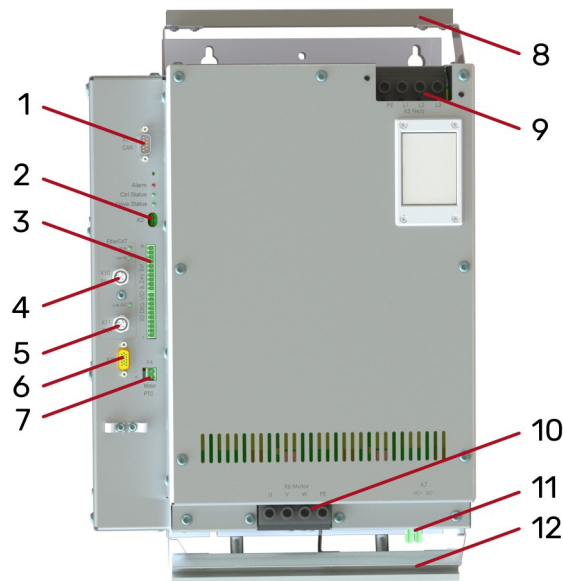


Figure 6: Front view - Variable frequency drive MC53/MC53A

Item	Designation	Description
1	X1	CAN connection, see chapter 6.6.1
2	X2	Service interface, see chapter 6.6.2
3	X3	Digital inputs and outputs plus external supply input, see chapter 6.6.3
4	X10	EtherCAT In Port, see chapter 6.6.8
5	X11	EtherCAT Out Port, see chapter 6.6.8
6	X20	Dummy plug, see chapter 6.6.9
7	X4	Motor temperature sensor connection, see chapter 6.6.4
8	Earth rail	Connection of cable shields and strain relief
9	X5	Mains connection, see chapter 6.6.5
10	X6	Motor connection, see chapter 6.6.6
11	X7	DC link output, see chapter 6.6.7
12	Earth rail	Connection of cable shields and strain relief



DANGER!

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



NOTICE!

Make sure that the local AC mains supply matches the input voltage range of the variable frequency drive (see chapter 4.2).



NOTICE!

Improper connection can damage the variable frequency drive.

6.6.1 X1 - CAN

CAN communication via a D-Sub connector. Intended for future extensions, currently MECOS does not offer compatible devices for this interface.

Control Connector: D-Sub connector 9 pin male
 Cable Connector: D-Sub connector 9 pin socket

Pin no.	Designation	Description
1	-	Not used
2	CAN_L	CAN Low
3	GND	GND
4	-	Not used
5	GND	GND
6	GND	GND
7	CAN_H	CAN High
8	-	Not used
9	+12V_CAN	12 V power supply for extension module (maximum current: 500 mA)



This interface is not a complete CAN-Open interface. Details can be requested from MECOS.



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

6.6.2 X2 - MECOS Service

The USB port X2 allows PC communication using a standard USB-C cable. With the help of the TOOLBOX for MECOS variable frequency drives (optional), complete access to the processor of the controller board is possible.

Control Connector: USB C socket
 Cable Connector: USB C Plug

6.6.3 X3 - DIG. I/O & 24 V Ext.

X3 are two 10-pin connectors for communication between the customer interface and the MC53/MC53A via digital inputs and outputs. 6 digital inputs (DIN0-5), 2 digital outputs (DOUT0-1) and a relay output are available for this purpose. In addition, the +24 V power supply for the Dig-I/Os can be tapped at connector pins 5 and 6. Furthermore, the controller board can be supplied with an isolated 24 V max. 4 A fused supply on connector pins 19 and 20.

Control Connector: 2 x Phoenix Contact | MC 1.5/10-G-3.81 (1803358)
 Cable Connector: 2 x Phoenix Contact | MC 1.5/10-ST-3.81 (1803659)

Pin no.	Designation	Description
1	-	Not used
2	-	Not used
3	-	Not used
4	-	Not used
5	+24V_IO	+24 V supply Digital IO (max. 100 mA including current at DOUT0 + 1)
6	GND_IO	GND Digital IO
7	DIN0	Digital input 0: ENPO
8	DIN1	Digital input 1: Start Drive
9	DIN2	Digital input 2: Reset Fault
10	DIN3	Digital input 3
11	DIN4	Digital input 4
12	DIN5	Digital input 5
13	GND_IO	GND Digital IO
14	DOUT0	Digital output 0: Ready
15	DOUT1	Digital output 1: No rotation
16	REL1_NO	Relay contact NO
17	REL1_COM	Relay contact COM
18	-	Not used
19	GND_EXT	GND of the external supply
20	+24V_EXT	+24 V supply input for feeding the controller board, fused with 1.6 A



NOTICE!

Maximum voltage and current values of the digital I/O must be observed, otherwise the hardware may be damaged (see chapter 4.6.3).

6.6.4 X4 - Motor PTC

X4 is the motor PTC input for a PT1000 or PTC temperature sensor.

Control Connector: Phoenix Contact | MSTB 2.5/ 2-G-5.08 (1759017)

Cable Connector: Phoenix Contact | MSTB 2,5/ 2-ST-5,08 (1757019)

Pin no.	Designation	Description
1	PTC+	Temperature sensor signal
2	0V_PTC	GND Temperature sensor

6.6.5 X5 - Mains

X5 is a 4-pole PCB terminal for connecting the power supply with a maximum cross-section of 50 mm² (Use Cu 75 °C wires). The pin assignment is printed on the front panel.

Pin no.	Designation	Description
1	L3	Mains connection L3
2	L2	Mains connection L2
3	L1	Mains connection L1
4	PE	Earth connection



The cable shield must be connected to the earth rail.

When connecting the mains, make sure that the terminal screws are tightened.



The tightening torque is 2.5 ... 4 Nm (22.1 ... 35.4 lbin).

The phase sequence can be freely selected for the mains connection. Conventions of the respective control cabinet must be observed.



WARNING!

The variable frequency drive does not have a built-in main switch. The supply must therefore be switched on or off with an external switch. For compliance with functional safety according to EN 61800-5-2, an upstream emergency stop must be provided in compliance with the standard.



WARNING!

The variable frequency drive has components for storing electrical energy. Therefore, a residual voltage is present for a certain time even after switching off or disconnecting the supply voltage. Assembly and disassembly may only be carried out by trained personnel.

6.6.6 X6 - Motor

X6 is a 4-pole PCB terminal for connecting the motor with a maximum cross-section of 50 mm² (Use Cu 75 °C wires). The pin assignment is printed on the front panel.

Pin no.	Designation	Description
1	U	Motor connection U
2	V	Motor connection V
3	W	Motor connection W
4	PE	Earth connection



The cable shield must be connected to the earth rail.

When connecting the motor, make sure that the terminal screws are tightened.



The tightening torque is 2.5 ... 4 Nm (22.1 ... 35.4 lbin).



WARNING!

The variable frequency drive has components for storing electrical energy. Therefore, a residual voltage is present for a certain time even after switching off or disconnecting the supply voltage. Assembly and disassembly may only be carried out by trained personnel.

6.6.7 X7 - DC link

X7 is a 2-pole connection for tapping the DC link. The pin assignment is printed on the front panel.

Control Connector: Phoenix Contact | IPC 5/ 2-GF-7.62 (1708491)

Cable Connector: Phoenix Contact | ISPC 5/ 2-STF-7.62 (1748972)

Pin no.	Designation	Description
1	DC+	Positive DC link output (max. 2 A)
2	DC-	Negative DC link output (max. 2 A)



When connecting, make sure that the plug is secured against loosening by means of the integrated flange fastening.



The tightening torque of the flange fastening is 0.3 ... 0.7 Nm (2.7 ... 6.2 lbin).



WARNING!

The variable frequency drive has components for storing electrical energy. Therefore, a residual voltage is present for a certain time even after switching off or disconnecting the supply voltage. Assembly and disassembly may only be carried out by trained personnel.

6.6.8 X10 / X11 - EtherCAT (optional)

X10 and X11 are optional EtherCAT connections with a corresponding communication interface. The corresponding parameter list for the interface is given in the corresponding variable list (see chapter13 [3]).

Control Connector: 2 x TE Connectivity | T4145535041-001

X10: IN Port

Pin no.	Designation	Description
1	Tx+	Transmit Data+
2	Rx+	Receive Data+
3	Tx-	Transmit Data-
4	Rx-	Receive Data-

X11: OUT Port

Pin no.	Designation	Description
1	Tx+	Transmit Data+
2	Rx+	Receive Data+
3	Tx-	Transmit Data-
4	Rx-	Receive Data-

6.6.9 X20 (optional)

X20 is a dummy connector as a support device for the pulse cable.

Control Connector: High Density D-Sub connector 15 pin socket

Cable Connector: High Density D-Sub Connector 15 pin

6.7 Further notes

- Never exceed the specified maximum ambient temperature (see chapter 4.1)
- Avoid any contact with the electronic parts
- The variable frequency drive must not be operated in explosive atmospheres

7. Operation

7.1 General information

Operation when the device is running takes place via the existing communication interfaces. For commissioning or test operation, complete access is guaranteed with the help of the TOOLBOX for MECOS variable frequency drives.

The MC53/MC53A also has a built-in display, which is mainly used as a display device.

7.1.1 Status displays

The MC53/MC53A has several status indicators, which are described in the table below.

Designation	Description	Colour
Alarm	On: An error has occurred Flashing: A warning is present	Red
Ctrl Status	Connection setup Service interface active (connection to client) Controller board is powered	Yellow Blue White
Drive status	The rotor turns	Green

7.2 Boot button

If the boot button (above the alarm display) is pressed and held during the boot process, the controller can be put into boot mode. After pressing the boot button, the drive cannot be activated (the MC53/MC53A is permanently in boot mode).



NOTICE!

The boot button may only be pressed in the event of a fault in the variable frequency drive by a MECOS service technician or by appropriately trained personnel.

7.3 Operation via the digital I/O interface

Communication between the variable frequency drive and the higher-level control takes place via the digital I/O interface and/or - if available - via the communication bus of the expansion card. The contact assignment of the interfaces is defined according to the parameter report Digital I/O Configuration (see chapter 13 [1]). The plug connectors are described in chapter 6.6.

7.4 Operation via the PC interface (optional)

With the help of the TOOLBOX for MECOS variable frequency drives (optional), complete access is possible via the USB interface. In addition to the control functions, the TOOLBOX has a variety of different tools for parameterising and analysing the variable frequency drive.



The functionality of the TOOLBOX is described in chapter 12.1.

7.5 Parameterisation of the communication interfaces

The MC53/MC53A has a large number of parameters which are defined depending on the project. The parameterisation is carried out via the PC interface (see chapter 7.4) 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 incorrect behaviour. MECOS delivers the control unit with the corresponding parameterisation. Subsequent modification 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 a reference to the corresponding parameterisation reports in chapter 13, which are generated project-specifically.

7.5.1 Configuration Digital I/O

This report (see chapter 13 [1]) contains the information for parameterising the digital inputs and outputs as well as the relay output.

7.5.2 Monitoring parameters

The report on monitoring (see chapter 13 [2]) contains all parameterisation information for the monitoring interface. In addition to the bit and error number for identification, there is also a description for each parameter, the indication of the lower and upper limits as well as the parameterised error response. The respective columns are labelled and provided with an explanation. Details on the error response are given in chapter 8.

7.5.3 Fieldbus variables

The report for fieldbus parameterisation (see chapter 13 [3]) contains all parameterisation information for the fieldbus interface (if available). The report provides the necessary address, type and access information, device and range information as well as a description of the variable for each available variable. The respective columns are labelled and provided with an explanation. Depending on the bus type, the columns may vary slightly.

7.6 Further operating instructions



CAUTION!

Do not plug in or unplug any cables while the MC53/MC53A variable frequency drive is switched on. The consequences could include electric shock.



To prevent possible data loss, magnetic data carriers such as hard disks etc. must not be stored in the immediate vicinity of the variable frequency drive.

8. Disruptions

Personnel to be trained, instructed or undergoing general training may only work on the variable frequency drive 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 chapter 4.1).

Continuous monitoring of a variety of system conditions is carried out in the MC53/MC53A variable frequency drive. Errors and warnings are always issued via the digital I/O, the service interface, the display or the optional fieldbus interface. Details on these interfaces are given, if not described in this document, in the associated document (see chapter 13).

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

The error response of the system depends on the parameterisation, also see chapter 7.5.2. The monitoring depends on the signal type (analogue or digital).

MECOS distinguishes between warning and fault:

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 response.
Fault	Generates an error message (Error). An error message is triggered when a system-critical limit value is exceeded. An error usually leads to an error response and remains 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 errors occur repeatedly.

9. Cleaning and maintenance

The variable frequency drive is not subject to wear when used as intended (see chapter 2.1.1) and is therefore maintenance-free.



DANGER!

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

10. Disposal and recycling

If the variable frequency drive 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.

11. 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 device or the attempt to carry out repairs or modifications without consultation with written confirmation from MECOS AG.



DANGER!

Unauthorised opening of the device, as well as improper tampering, can lead to injury to persons and damage to property. The device must not be opened.

After modifications to the device, unspecified conditions may occur, resulting in bodily injury and property damage.



NOTICE!

No liability is 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 become void.

12. Accessories

12.1 TOOLBOX for MECOS variable frequency drives

The TOOLBOX for MECOS variable frequency drives (MecosTools) can be used to change a wide range of system parameters and perform real-time measurements of all process variables. It contains all functions for commissioning, validation and maintenance of the variable frequency drive.

It is possible to create a customised ServiceTool based on the TOOLBOX for MECOS variable frequency drives.



The TOOLBOX for MECOS variable frequency drives or the MECOS ServiceTool can only be used with Microsoft Windows®. Admin rights are required for installation.



NOTICE!

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

13. Related documents

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

No.	Description	File name
[1]	Parameter Report Digital I/O Configuration	BGxxxxx-xxNx_RAP-DIO_ <i>Project name</i> _Vxx.pdf
[2]	Parameter report Monitoring parameters	BGxxxxx-xxNx_RAP-PAR_ <i>Project name</i> _Vxx.pdf
[3]	Parameter report fieldbus variables	BGxxxxx-xxNx_RAP-BUS_ <i>Project name</i> _Vxx.pdf

x = number or letter

14. Glossary

Term	Explanation
Digital I/O	Parallel customer interface with potential-free digital inputs and outputs
FDC	F ast D igital C ontroller Description for MECOS controller board
MC	M otor C ontrol Unit Motor control unit or variable frequency drive for a motor
MDRA	M otherboard with D Rive A C Description for MECOS amplifier board
PWM	P ulse W idth M odulation
RTC	R eal T ime C lock Battery-buffered clock in which the current time and date are stored.

15. Notes

A series of horizontal dotted lines for writing notes.

MECOS AG
Hardstrasse 319
8005 Zurich
Switzerland

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

Subject to technical changes