MAKING MODERN LIVING POSSIBLE

Operating Instructions
VLT® DriveMotor FCP 106 and FCM 106

www.danfoss.com/drives

THE REAL DRIVE

⚠WARNING

RISK OF DEATH OR SERIOUS INJURY

According to UL 508C, the VLT® DriveMotor FCP 106 and VLT® DriveMotor FCM 106 do not support the use of *delta grounded grid*.

Using the VLT® DriveMotor FCP 106 or VLT® DriveMotor FCM 106 on a delta grounded grid may cause death or serious injury.

To avoid the risk:

- **Do *not* install VLT® DriveMotor FCP 106 and VLT® DriveMotor FCM 106 on a delta grounded grid.**

Contents

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1 Introduction

1.1 Purpose of the Manual

This manual provides information required to install and commission the frequency converter.

VLT® DriveMotor FCP 106
The delivery comprises frequency converter only. A wall adapter plate or motor adapter plate is also required for installation. Order the adapter plate separately.

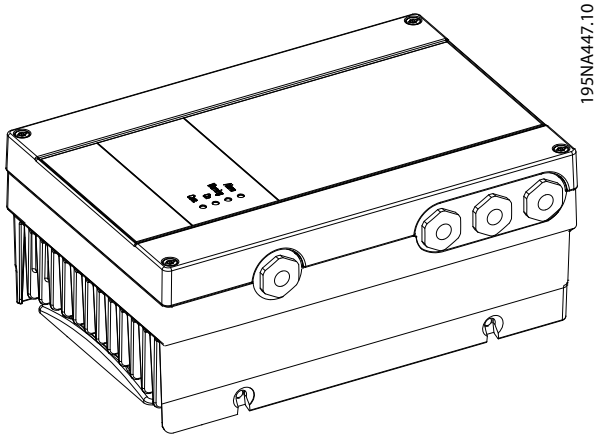

Illustration 1.1 FCP 106

VLT® DriveMotor FCM 106
The frequency converter is mounted onto the motor upon delivery. The combined FCM 106 and motor from Danfoss is known as the DriveMotor.

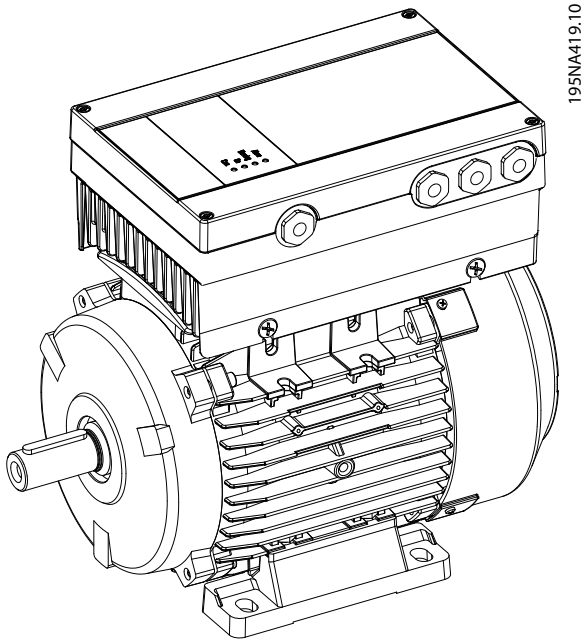

Illustration 1.2 FCM 106

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1.2 Additional Resources

Literature available:

- *VLT® DriveMotor FCP 106 and FCM 106 Operating Instructions,* for information required to install and commission the frequency converter.
- *VLT® DriveMotor FCP 106 and FCM 106 Design Guide,*provides information required for integration of the frequency converter into a diversity of applications.
- *VLT® DriveMotor FCP 106 and FCM 106 Programming Guide*, for how to program the unit, including complete parameter descriptions.
- *VLT® LCP Instruction*, for operation of the local control panel (LCP).
- *VLT® LOP Instruction*, for operation of the local operation pad (LOP).
- *Modbus RTU Operating Instructions*, *Operating Instructions VLT® DriveMotor FCP 106 and FCM 106 BACnet,* and
  Operating Instructions VLT® DriveMotor FCP 106 and FCM 106 Metasys, for information required for controlling, monitoring, and programming the frequency converter.
- *PC-based Configuration Tool MCT 10,* enables configuration of the frequency converter from a Windows™ based PC environment.
- *Danfoss VLT® Energy Box* software, for energy calculation in HVAC applications.

Technical literature and approvals are available online at *www.danfoss.com/BusinessAreas/DrivesSolutions/Documentations/Technical+Documentation.*

Danfoss VLT® Energy Box software is available at *www.danfoss.com/BusinessAreas/DrivesSolutions*, PC software download area.

1.3 Product Overview

1.3.1 Intended Use

The frequency converter is an electronic motor controller intended for

- regulation of motor speed in response to system feedback or to remote commands from external controllers. A power drive system consists of the frequency converter, the motor, and equipment driven by the motor.
- system and motor status surveillance.

The frequency converter can also be used for motor protection.

Depending on configuration, the frequency converter can be used in standalone applications or form part of a larger appliance or installation.

The frequency converter is allowed for use in residential, industrial, and commercial environments in accordance with local laws and standards.

NOTICE

In a residential environment, this product can cause radio interference, in which case supplementary mitigation measures can be required.

Foreseeable Misuse
Do not use the frequency converter in applications which are non-compliant with specified operating conditions and environments. Ensure compliance with the conditions specified in *chapter 7 Specifications*.

1.3.2 Electrical Overview

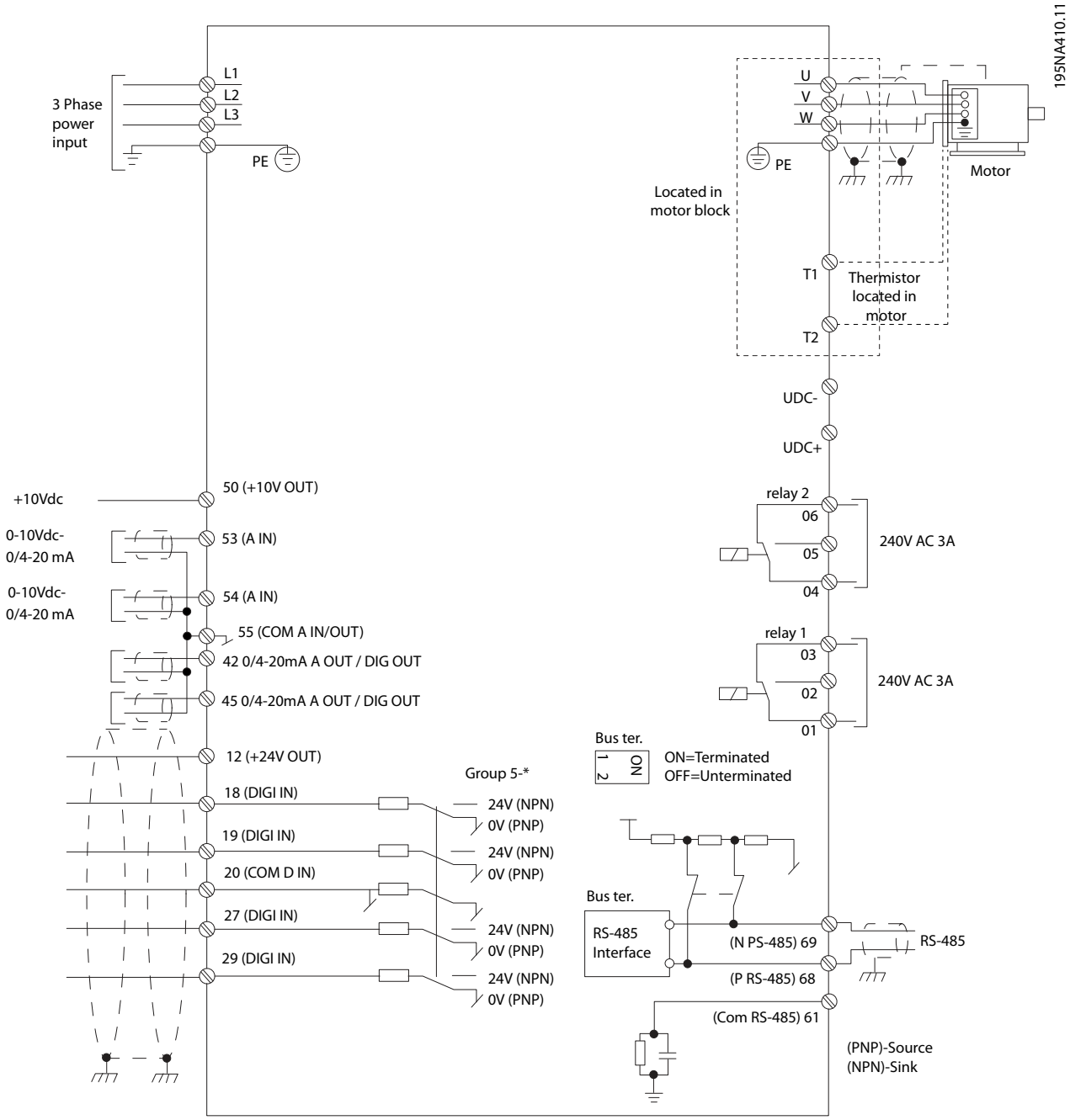

Illustration 1.3 Electrical Overview

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1.4 Approvals

NOTICE

In a domestic environment, this product may cause radio interference, in which case supplementary mitigation measures may be required.

Certification		FCP 106	FCM 106
EC Declaration of Conformity		✓	✓
UL Listed		-	✓
UL Recognised		✓	-
C-tick		✓	✓

Table 1.1 Approvals

The EC declaration of conformity is based on the following directives:

- Low Voltage Directive 2006/95/EC, based on EN61800-5-1 (2007)
- EMC Directive 2004/108/EC based on EN61800-3 (2004)

UL Listed
Product evaluation is complete and the product can be installed in a system. The system must also be UL listed by the appropriate party.

UL Recognised
Additional evaluation is required before the combined frequency converter and motor can be operated. The system in which the product is installed must also be UL listed by the appropriate party.

The frequency converter complies with UL508C thermal memory retention requirements. For more information, refer to the section *Motor Thermal Protection* in the *Design Guide*.

1.5 Disposal Instruction

Equipment containing electrical components must not be disposed of together with domestic waste.
It must be separately collected with electrical and electronic waste according to local and currently valid legislation.

2 Safety

The following symbols are used in this document:

⚠WARNING

Indicates a potentially hazardous situation which could result in death or serious injury.

⚠CAUTION

Indicates a potentially hazardous situation which could result in minor or moderate injury. It may also be used to alert against unsafe practices.

NOTICE

Indicates important information, including situations that may result in damage to equipment or property.

2.1 Qualified Personnel

Correct and reliable transport, storage, installation, operation and maintenance are required for the trouble-free and safe operation of the frequency converter. Only qualified personnel is allowed to install or operate this equipment.

Qualified personnel is defined as trained staff, who are authorised to install, commission, and maintain equipment, systems and circuits in accordance with pertinent laws and regulations. Additionally, the personnel must be familiar with the instructions and safety measures described in this document.

2.2 Safety Precautions

⚠WARNING

HIGH VOLTAGE

Frequency converters contain high voltage when connected to AC mains input power. Failure to perform installation, start up, and maintenance by qualified personnel could result in death or serious injury.

- **Only qualified personnel are permitted to perform installation, start up, and maintenance.**

⚠WARNING

UNINTENDED START

When the frequency converter is connected to AC mains, the motor may start at any time, causing risk of death, serious injury, equipment, or property damage. The motor can start by means of an external switch, a serial bus command, an input reference signal from the LCP or LOP, or after a cleared fault condition.

1. **Disconnect the frequency converter from mains whenever personal safety considerations make it necessary to avoid unintended motor start.**
2. **Press [Off/Reset] on the LCP, before programming parameters.**
3. **The frequency converter, motor, and any driven equipment must be in operational readiness when the frequency converter is connected to AC mains.**

⚠WARNING

DISCHARGE TIME

The frequency converter contains DC-link capacitors, which can remain charged even when the frequency converter is not powered. Failure to wait the specified time after power has been removed before performing service or repair work, could result in death or serious injury.

1. **Stop motor.**
2. **Disconnect AC mains, permanent magnet type motors, and remote DC-link power supplies, including battery back-ups, UPS, and DC-link connections to other frequency converters.**
3. **Wait for the capacitors to discharge fully, before performing any service or repair work. The duration of waiting time is specified in *Table 2.1*.**

Voltage [V]	Power Range[1)] [kW]	Minimum waiting time (min)
3x400	0.55–7.5	4
High voltage can be present even when the warning LED indicator lights are off.		

Table 2.1 Discharge Time

1) Power ratings relate to NO, see chapter 7.2 Electrical Data.

2

⚠WARNING

EQUIPMENT HAZARD

Contact with rotating shafts and electrical equipment can result in death or serious injury.

- **Ensure only trained and qualified personnel perform installation, start up, and maintenance.**
- **Ensure that electrical work conforms to national and local electrical codes.**
- **Follow the procedures in this manual.**

⚠CAUTION

WINDMILLING

Unintended rotation of permanent magnet motors causes risk of personal injury and equipment damage.

- **Ensure that permanent magnet motors are blocked to prevent unintended rotation.**

⚠WARNING

LEAKAGE CURRENT HAZARD

Follow national and local codes regarding protective earthing of equipment with a leakage current exceeding 3.5 mA. Frequency converter technology implies high frequency switching at high power. This switching generates a leakage current in the ground connection. A fault current in the frequency converter at the output power terminals can contain a DC component which can charge the filter capacitors and cause a transient ground current. The ground leakage current depends on various system configurations including RFI filtering, screened motor cables, and frequency converter power. EN/IEC61800-5-1 (Power Drive System Product Standard) requires special care because the leakage current exceeds 3.5 mA. See EN60364-5-54 paragraph 543.7 for further information.

- **Ensure correct grounding of the equipment by a certified electrical installer.**
- **Grounding must be reinforced in one of the following ways:**
  - **Ensure ground wire with cross-section of at least 10 mm^2, or**
  - **Ensure 2 separate ground wires, both complying with the dimensioning rules.**

NOTICE

HIGH ALTITUDES

For installation at altitudes above 2000 m, contact Danfoss regarding PELV.

⚠WARNING

DC CURRENT RISK

This product can cause a DC current in the protective conductor. Take the following precautions:

- **Where a residual current device (RCD) is used for extra protection, use only an RCD of Type B (time delayed) on the supply side of this product.**
- **Protective earthing of the frequency converter and the use of RCDs must always follow national and local regulations.**

Failure to follow the precautions can lead to personal injury or property damage.

⚠WARNING

GROUNDING HAZARD

For operator safety, it is important to ground the frequency converter properly in accordance with national and local electrical codes, as well as the instructions in this manual. Ground currents are higher than 3.5 mA. Failure to ground the frequency converter properly could result in death or serious injury.
It is the responsibility of the user or certified electrical installer, to ensure correct grounding of the equipment in accordance with national and local electrical codes and standards.

- **Follow all local and national electrical codes to ground electrical equipment properly.**
- **Establish proper protective grounding for equipment with current higher than 3.5 mA.**
- **A dedicated ground wire is required for input power, motor power, and control wiring.**
- **Use the clamps provided with on the equipment for proper ground connections.**
- **Do not ground one frequency converter to another in a "daisy chain" fashion.**
- **Keep the ground wire connections as short as possible.**
- **Use of high-strand wire to reduce electrical noise is recommended.**
- **Follow motor manufacturer wiring requirements.**

3 Mechanical Installation

3.1 Unpacking

NOTICE

INSTALLATION - EQUIPMENT DAMAGE RISK
Incorrect installation can result in equipment damage.

- **Before installation check for fan cover damage, shaft damage, foot or mounting damage, and loose fasteners.**
- **Check nameplate details.**
- **Ensure level mounting surface, balanced mounting. Avoid misalignment.**
- **Ensure gaskets, sealants, and guards are correctly fitted.**
- **Ensure correct belt tension.**

3.1.1 Items Supplied, FCP 106

Check all items are present:

- 1 FCP 106 frequency converter
- 1 accessory bag
- Operating Instructions

3.1.2 Additional Items Required, FCP 106

- 1 adapter plate (wall adapter plate or motor adapter plate)
- 1 gasket, used between motor adapter plate and frequency converter
- 1 motor connector
- 4 screws for fastening frequency converter to adapter plate
- 4 screws for fastening motor adapter plate to motor
- Crimp terminals:

  AMP standard power timer contacts female, see *chapter 4.6.1 Connect FCP 106 to Motor* for ordering numbers

  - 3 pcs for motor terminals, UVW
  - 2 pcs for thermistor (optional)
- 2 guiding pins (optional)

3.1.3 Items Supplied, FCM 106

Check all items are present:

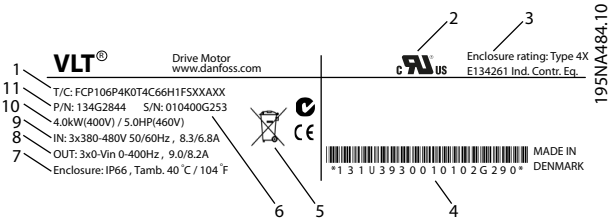
- 1 FCM 106 frequency converter with motor
- 1 accessory bag
- Operating Instructions

3.1.4 Identification of Unit

Items supplied may vary according to product configuration.

- Make sure the items supplied and the information on the nameplate correspond to the order confirmation.
- Check the packaging and the frequency converter visually for damage caused by inappropriate handling during shipment. File any claim for damage with the carrier. Retain damaged parts for clarification.

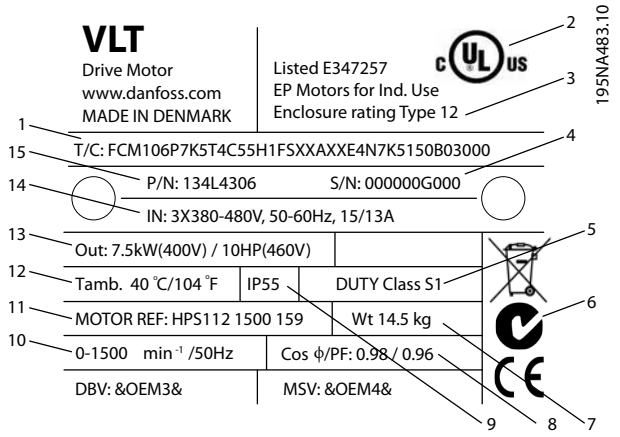
3.1.5 Nameplates



1	Type code
2	Certifications
3	Enclosure rating
4	Bar code for manufacturer use
5	Certifications
6	Serial number[1)]
7	Enclosure type and IP rating, max. ambient temperature
8	Output voltage, frequency, and current (at low/high voltages)
9	Input voltage, frequency, and current (at low/high voltages)
10	Power rating
11	Ordering number

Illustration 3.1 FCP 106 Nameplate (Example)

1): Example of format: Serial number 'xxxxx253' indicates manufacture in week 25, year 2013



1	Type code
2	Certifications
3	Enclosure rating
4	Serial number[1)]
5	Motor duty class
6	Certifications
7	Weight
8	Motor power factor
9	Enclosure rating - Ingress protection (IP) class
10	Frequency range
11	Motor reference
12	Maximum ambient temperature
13	Power rating
14	Input voltage, current, and frequency (at low/high voltages)
15	Ordering number

Illustration 3.2 FCM 106 Nameplate (Example)

1): Example of format: Serial number 'xxxxx253' indicates manufacture in week 25, year 2013

NOTICE

Do not remove the nameplate from the frequency converter (loss of warranty).

3.1.6 Lifting

NOTICE

LIFTING - EQUIPMENT DAMAGE RISK
Incorrect lifting can result in equipment damage.

- **Use both lifting lugs when provided.**
- **For vertical lift, prevent uncontrolled rotation.**
- **For lift machine, do not lift other equipment with motor lifting points only.**

Handling and lifting of the unit must only be undertaken by qualified personnel. Ensure

- availability of full product documentation, together with tools and equipment necessary for safe working practice.
- cranes, jacks, slings, and lifting beams are rated to bear the weight of equipment to be lifted. For weight of unit, see *chapter 7.1.4 Weight*.
- when using an eyebolt, that the shoulder of the eyebolt is tightened firmly against the face of the stator frame, before lifting.

Eyebolts or lifting trunnions supplied with the unit are rated to bear the weight of the unit only, not the additional weight of ancillary equipment attached.

3.1.7 Storage

Ensure that requirements for storage are fulfilled. Refer to *chapter 7.5 Ambient Conditions* for further details.

3.2 Installation Environment

NOTICE

In environments with airborne liquids, particles, or corrosive gases, ensure that the IP/Type rating of the equipment matches the installation environment. Failure to meet requirements for ambient conditions can reduce lifetime of the frequency converter. Ensure that requirements for air humidity, temperature and altitude are met.

Vibration and Shock
The frequency converter complies with requirements for units mounted on the walls and floors of production premises, as well as in panels bolted to walls or floors.

For detailed ambient conditions specifications, refer to *chapter 7.5 Ambient Conditions*.

3.3 Mounting

3.3.1 Introduction

There are different mounting alternatives.

FCM 106
The frequency converter is mounted onto the motor upon delivery. The combined unit is known as the DriveMotor. Installation procedure:

1. Mount the DriveMotor, see *chapter 3.3.4 Mount the DriveMotor*.
2. Perform the electrical installation, starting with *chapter 4.7.1 Connecting to Mains*.

FCP 106
Mount the frequency converter onto the adapter plate, which is

- fastened to a flat surface beside the motor, or
- mounted directly onto the motor. When assembled, the combined frequency converter and motor is known as the DriveMotor.

Installation procedure:

1. Prepare the gasket and adapter plate, see *chapter 3.3.2 Prepare Gasket* and *chapter 3.3.3 Prepare Adapter Plate*.
2. Connect frequency converter to motor. See *chapter 4.6.1 Connect FCP 106 to Motor*. The combined unit is then known as the DriveMotor.
3. Mount the DriveMotor, see *chapter 3.3.4 Mount the DriveMotor*.
4. Perform the remaining electrical installation, from the section *chapter 4.7.1 Connecting to Mains*.

3.3.2 Prepare Gasket

Preparation of a gasket applies only when mounting FCP 106 onto a motor.

Mounting of FCP 106 onto a motor requires fitting a customised gasket. The gasket fits between the motor adapter plate and the motor.

No gasket is supplied with the FCP 106. Therefore, before installation, design and test a gasket to fulfil the ingress protection requirement (for example IP55, IP54, Type 3R).

Requirements for gasket:

- Maintain the ground connection between frequency converter and motor. The frequency converter is grounded to the motor adapter plate. Use a wire connection between motor and frequency converter, or ensure metallic contact between the motor adapter plate and motor.
- Use a UL approved material for the gasket, when UL listing or recognition is required for the assembled product.

3.3.3 Prepare Adapter Plate

The adapter plate is available with or without pre-drilled holes.

- For adapter plate with pre-drilled holes, no extra holes are required. Pre-drilled holes are specific for FCM 106 motors only
- For adapter plate with no pre-drilled holes, refer to *Illustration 3.3*.

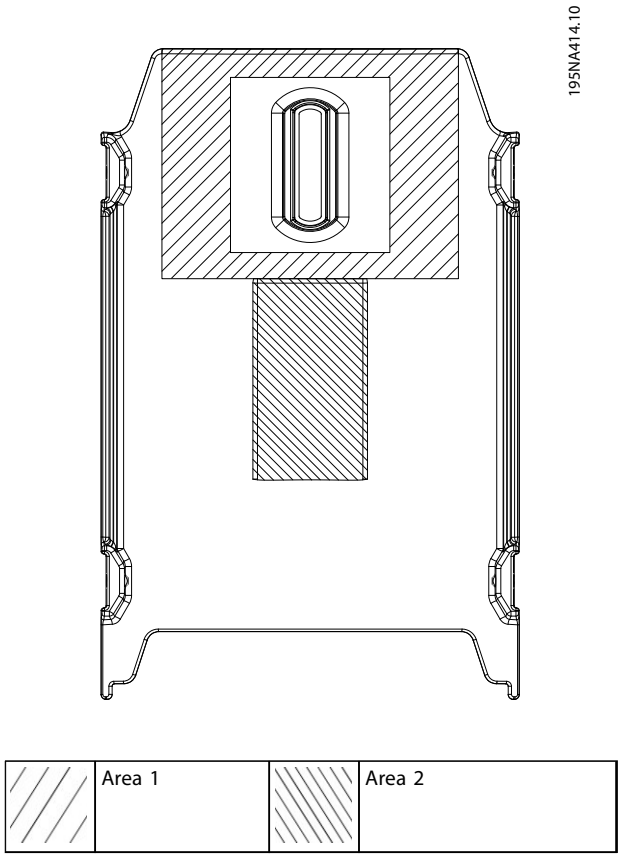


Illustration 3.3 Adapter Plate, Guide for Drilling Holes

When the adapter plate has no holes, drill them as follows:

- 4 holes within area 1, for fastening adapter plate to motor (required).
- 1 hole within area 2, for a lifting lug (optional).
- Make allowance for countersunk screws.

3

3.3.4 Mount the DriveMotor

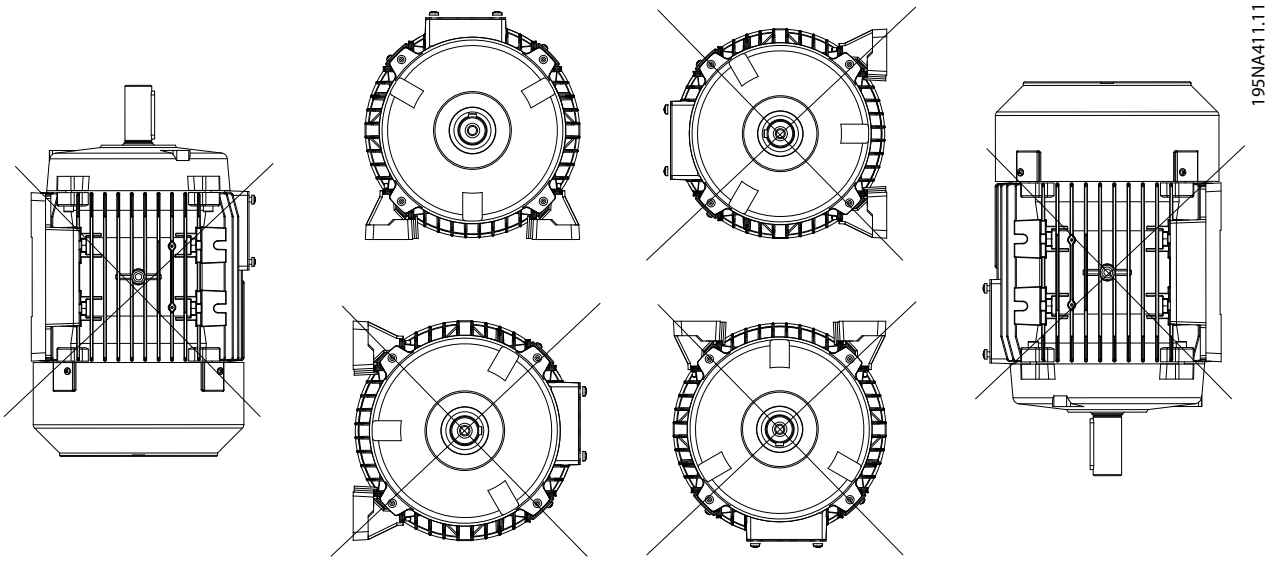


Illustration 3.4 Installation Orientation

Mount the DriveMotor with adequate access for routine maintenance. Observe the recommended clearances, see *chapter 7 Specifications*. A minimum of 0.75 m clearance around the motor is recommended, both for working access and adequate airflow at the motor fan inlet. See also *chapter 7.1 Clearances, Dimensions and Weights*. Where more than one DriveMotor is mounted in close proximity, ensure that there is no recirculation of exhausted warm air. Foundations must be solid, rigid and level.

NOTICE

Electrical installation
Do not remove the top foil inside the inverter part, as this is a part of the protective arrangements.

Fitting pinions, pulleys and couplings.
Drill pinions, pulleys and couplings to standard limits and fit on the shaft with a screwing motion. Ensure correct guarding of all moving parts.

NOTICE

Tapping of fittings onto the motor shaft, with a hammer or mallet, causes bearing damage. This results in an increase in bearing noise and a significant reduction in bearing life.

3.3.5 Shaft Alignment

When the application calls for direct coupling, the shafts must be correctly aligned in all three planes. Bad alignment can be a major source of noise, vibration, and reduced bearing lifetime.

Make allowance for shaft endfloat and thermal expansion in both axial and vertical planes. Flexible drive couplings are preferred.

3.3.6 Bearing Life and Lubrication

The life expectancy of the ball bearings is standard, when the following conditions are fulfilled:

- temperature of 80 °C
- radial forces in load point corresponding to half shaft extension do not exceed the values specified by motor manufacturer

Motor type	Frame size	Lubrication type	Temperature range
Asynchronous	80-180	Lithium basis	-40 to 140°C
PM	71-160		

Table 3.1 Lubrication

Frame size	Speed [RPM]	Bearing type, asynchronous motors		Bearing type, PM motors	
		Drive end	Non-drive end	Drive end	Non-drive end
71	1500/3000	N.A.	N.A.	6203 2ZC3	6203 2ZC3
80	1500/3000	6204 2ZC3	6204 2ZC3	N.A.	N.A.
90	1500/3000	6205 2ZC3	6205 2ZC3	6206 2ZC3	6205 2ZC3
100	1500/3000	6206 2ZC3	6206 2ZC3	N.A.	N.A.
112	1500/3000	6306 2ZC3	6306 2ZC3	6208 2ZC3	6306 2ZC3
132	1500/3000	6208 2ZC3	6208 2ZC3	6309 2ZC3	6208 2ZC3
160	1500/3000	*a)*	*a)*	N.A.	N.A.
180	1500/3000	*a)*	*a)*	N.A.	N.A.

Table 3.2 Standard Bearing References and Oil Seals for Motors

a) Data available upon future release.

4 Electrical Installation

4.1 Safety Instructions

See *chapter 2 Safety* for general safety instructions.

4

⚠WARNING

INDUCED VOLTAGE

Induced voltage from output motor cables that run together can charge equipment capacitors even with the equipment turned off and locked out. Failure to run output motor cables separately or use screened cables could result in death or serious injury.

- **run output motor cables separately, or**
- **use screened cables**

⚠CAUTION

SHOCK HAZARD

The frequency converter can cause a DC current in the PE conductor. Failure to follow the recommendation below means the RCD may not provide the intended protection.

- **When a residual current-operated protective device (RCD) is used for protection against electrical shock, only an RCD of Type B is permitted on the supply side.**

Over-current Protection

- Additional protective equipment such as short-circuit protection or motor thermal protection between frequency converter and motor is required for applications with multiple motors.
- Input fusing is required to provide short-circuit and over-current protection. If not factory-supplied, fuses must be provided by the installer. See maximum fuse ratings in *Table 7.15*.

Wire Type and Ratings

- All wiring must comply with local and national regulations regarding cross-section and ambient temperature requirements.
- Power connection wire recommendation: minimum 75 °C rated copper wire.

See *chapter 7.10 Fuse and Circuit Breaker Specifications* and *chapter 7.6 Cable Specifications* for recommended wire sizes and types.

4.2 IT Mains

⚠CAUTION

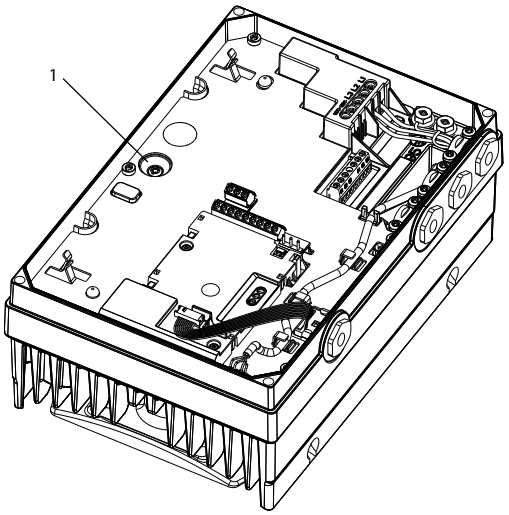
IT MAINS

Installation on isolated mains source, that is, IT mains. Max. supply voltage allowed when connected to mains: 440 V (3x380-480 V units).

For IT mains operation only,

- disconnect power and wait until discharged. See discharge time in *Table 2.1*.
- remove cover, see *Illustration 4.6*.
- disable the RFI filter by removing the RFI switch/ screw. For location, see *Illustration 4.1*.

In this mode, the internal RFI filter capacitors between housing and the mains RFI filter circuit are disabled, to reduce the ground capacity currents.



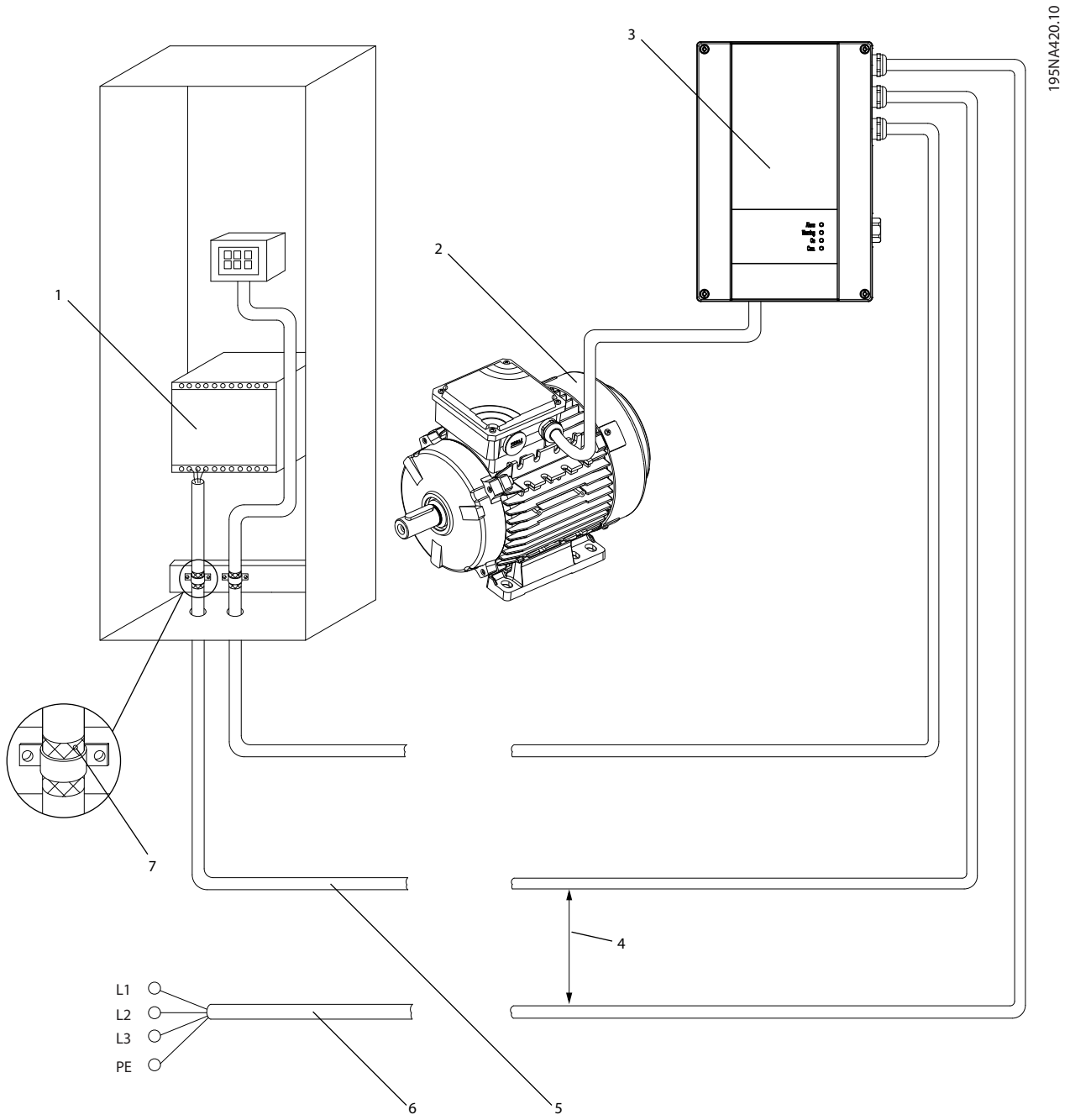
1	RFI switch/screw

Illustration 4.1 Location of RFI Switch/Screw

⚠CAUTION

To reinsert, use an M3x12 screw only.

4.3 EMC-Compliant Installation



1	PLC	5	Control cables
2	Motor	6	Mains, 3-phase, and reinforced PE
3	Frequency converter	7	Cable insulation (stripped)
4	Min. 200 mm clearance between control cable, mains cable, and mains motor cable.		

Illustration 4.2 EMC-compliant Electrical Installation, FCP 106

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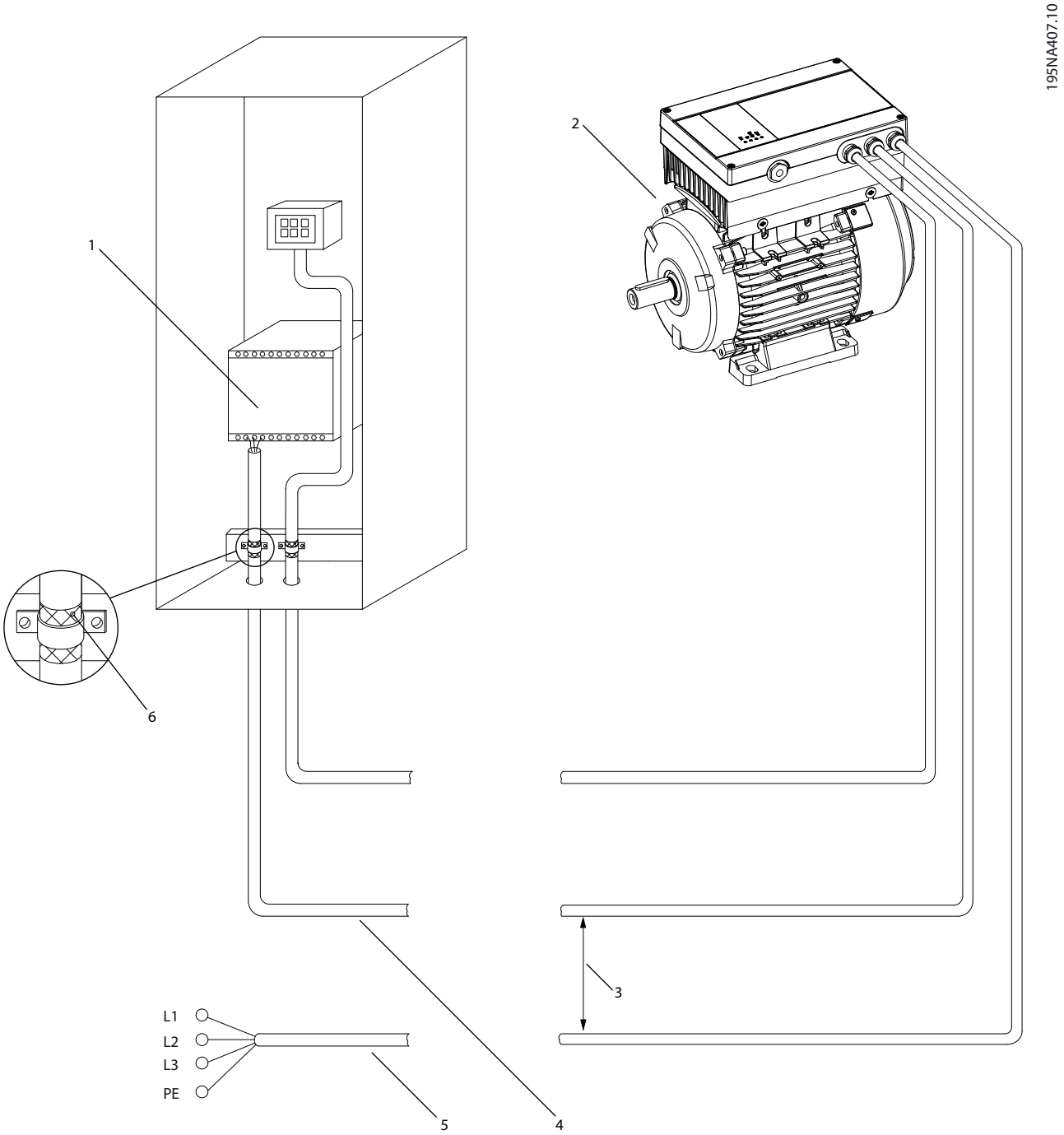


1	PLC	4	Control cables
2	DriveMotor	5	Mains, 3-phase, and reinforced PE
3	Min. 200 mm clearance between control cable, mains cable, and mains motor cable.	6	Cable insulation (stripped)

Illustration 4.3 EMC-compliant Electrical Installation, FCM 106

To ensure EMC-compliant electrical installation, observe these general points:

- Use only screened motor cables and screened control cables.
- Connect the screen to earth at both ends.
- Avoid installation with twisted screen ends (pigtails), since this ruins the screen effect at high frequencies. Use the cable clamps provided instead.
- Ensure the same potential between frequency converter and ground potential of PLC.
- Use star washers and galvanically conductive installation plates.

4.4 Cable Requirements

All cabling must comply with national and local regulations on cable cross-sections and ambient temperature. Copper or aluminium conductors required, (75 °C) recommended. For cable specifications refer to *chapter 7.6 Cable Specifications*.

4.5 Grounding

When connecting the FCP 106 to a third party motor, ensure the frequency converter is grounded at minimum 2 points:

- Ensure metal contact between adapter plate and motor.
- Mount an extra ground wire on the adapter plate.
- Mount an extra ground wire on the motor.

4.6 Motor Connection

4.6.1 Connect FCP 106 to Motor

NOTICE

To avoid damage to equipment, before mounting the FCP 106 on the motor,

- **observe cooling clearances specified in *Table 7.1*.**
- **observe screw clearances listed in *Table 7.2*.**

NOTICE

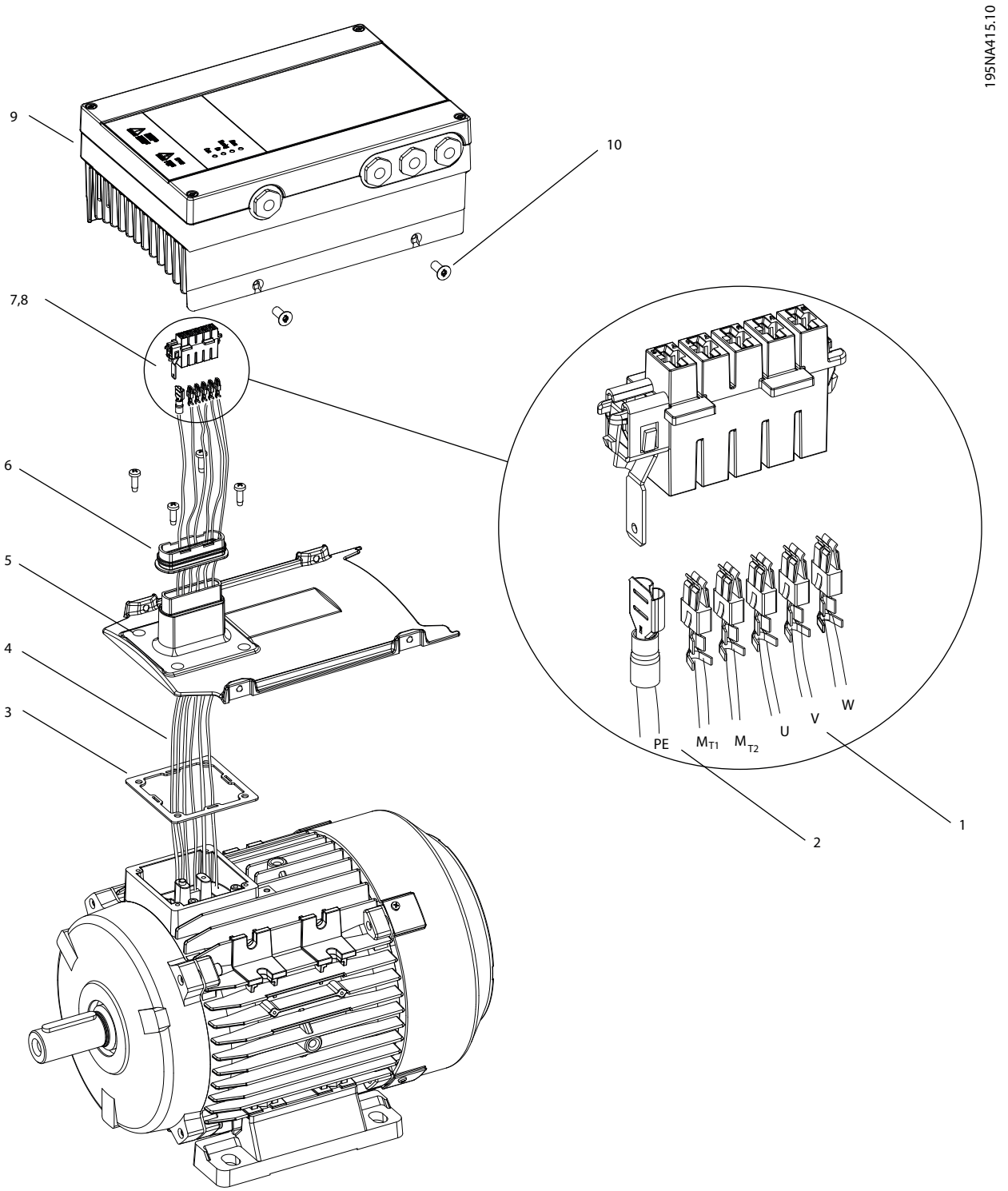
RISK OF DAMAGE
Risk of damage to motor or frequency converter exists if screws extend too far into the enclosure or too far above the adapter plate.

To connect the FCP 106 to the motor, follow the installation steps shown in *Table 4.1* and *Illustration 4.4*.

Step	Description
1	Mount motor phases and thermistor wires in crimp terminals. Note: Crimp order numbers from manufacturer TE (AMP standard power timer contacts): • 927827 (0.5-1mm^2) [AWG 20-17] • 927833 (1.5-2.5mm^2) [AWG 15.5-13.5] • 927824 (2.5-4mm^2) [AWG 13-11]
2	Mount PE clamp to motor connector and connect crimp PE terminal to wire.
3	Mount the gasket between the motor and adapter plate. See *chapter 3.3.2 Prepare Gasket*
4	Pull motor phases and thermistor wires through the neck of the adapter plate.
5	Mount the adapter plate onto the motor using 4 screws. • Insert guide pins into 2 of the screw holes, before lowering the adapter plate into position. Remove the guide pins when mounting screws. • Ensure metallic contact is established between the adapter plate and the motor, via the screws.
6	Mount motor connector gaskets onto the neck of the adapter plate.
7	Click the terminals into the motor connector. • Mount the 3 motor phases. • Mount the 2 thermistor wires. • Mount PE connector • For correct installation refer to terminal numbers printed on the motor connector. ***NOTICE*** **The thermistor is not galvanically isolated. Interchanging the thermistor wires with the motor wires may permanently damage the frequency converter.**
8	Click motor connector into the neck of the adapter plate.
9	Position FCP 106 on adapter plate.
10	Fasten the FCP 106 to adapter plate using 4 screws.

Table 4.1 Installation steps as shown in *Illustration 4.4*

The FCP 106 is now mounted onto the motor. The combined unit is known as the DriveMotor.



M_{T1}, M_{T2}	Motor thermistor wires
U, V, W	Motor phases

Illustration 4.4 Connecting FCP 106 to Motor

4.6.2 Thermistor Input from Motor

Connect the motor thermistor to the terminals located in the motor connector, as shown in section *chapter 4.6.1 Connect FCP 106 to Motor*.

Set *1-90 Motor Thermal Protection* according to guidelines in *chapter 5.3.5 Thermistor Set-up*. For more detailed information refer to the *VLT® DriveMotor FCP 106 and FCM 106 Programming Guide*.

NOTICE

The thermistor is not galvanically isolated. Interchanging the thermistor wires with the motor wires may permanently damage the frequency converter.

4.7 AC Mains Connection

4.7.1 Connecting to Mains

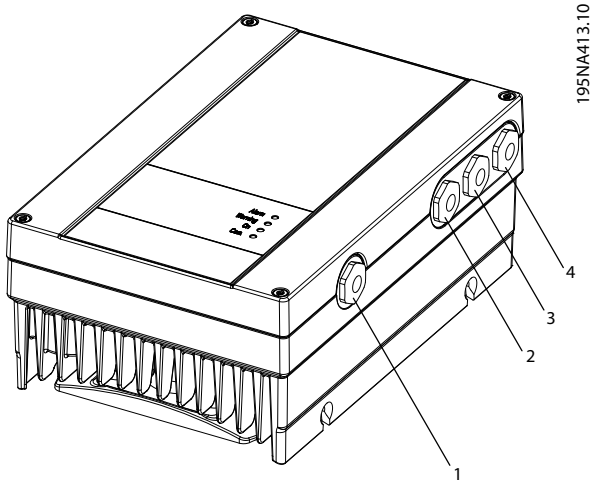
The frequency converter is designed to operate all standard 3-phased asynchronous motors and PM motors. For maximum cross section on wires, see *chapter 7.2.1 Mains Supply 3x380-480 V AC Normal and High Overload*.

For wall mount of FCP 106

- To comply with EMC emissions requirements,
  - use screened motor cable, maximum length 0.5 m.
  - connect this cable to both the decoupling plate and the metal housing of the motor.
- See also *chapter 4.3 EMC-Compliant Installation*.

Procedure for connection of mains power

1. Observe safety precautions, see *chapter 2.2 Safety Precautions*.
2. Loosen front cover screws.
3. Remove the front cover, see *Illustration 4.6*.
4. Mount cable glands.
5. Connect the earth wires to the earth terminals via the cable glands, see *Illustration 4.7*.
6. Connect the mains cable to terminals L1, L2, and L3, and tighten screws. See *Illustration 4.7*.
7. Reassemble cover and tighten screws.
8. For tightening torques, see *chapter 7.8 Connection Tightening Torques*.



1	LCP extension cable entry
2, 3	Entries for other cables: control, RS-485, and relay cables
4	Mains cable entry

Illustration 4.5 Location of Cable Entries, MH1-MH3

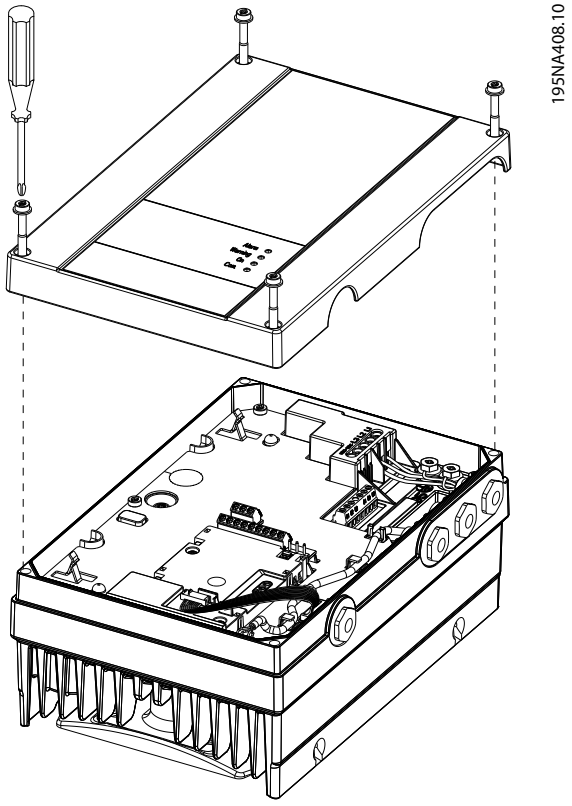
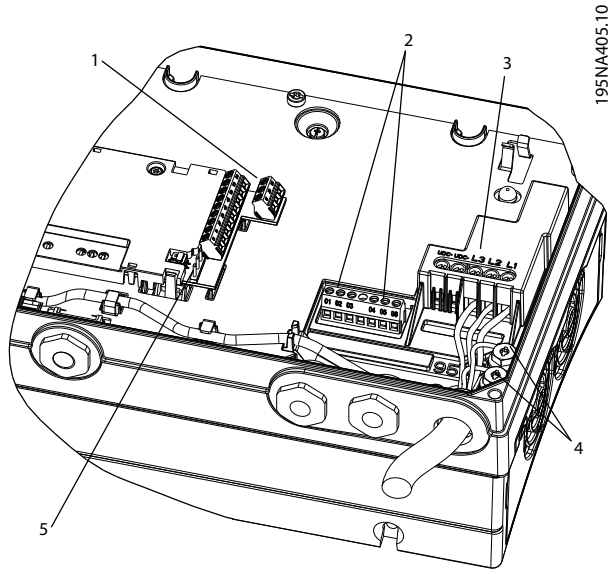


Illustration 4.6 Remove Front Cover



1	Control terminals
2	Relays
3	Line (L3, L2, L1)
4	PE
5	RS-485

Illustration 4.7 Cabling, MH1-MH3

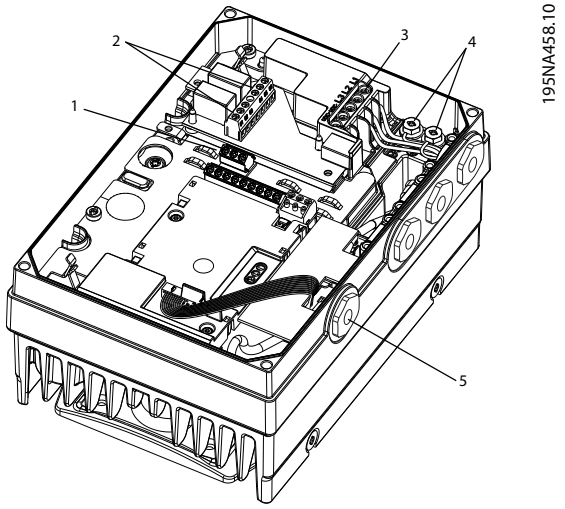


Illustration 4.8 Location of Terminals and Relays, MH1

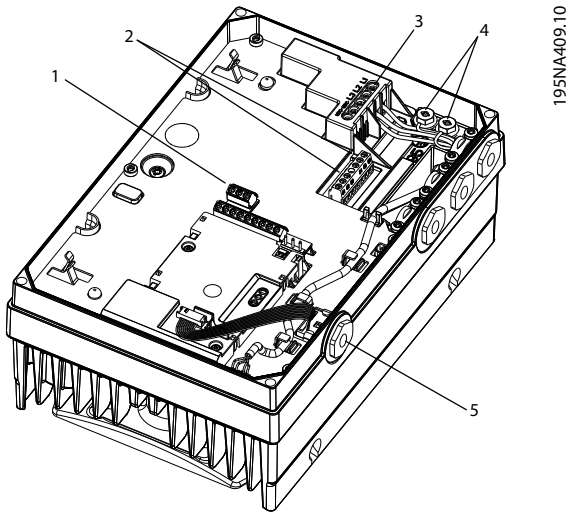


Illustration 4.9 Location of Terminals and Relays, MH2-MH3

4.8 Control Wiring

4.8.1 Control Terminals

Procedure:

1. Connect the terminal and cables at the locations shown in *Illustration 4.8* and *Illustration 4.9*.
2. For additional terminal details, refer to the following sections.
3. Mount the front cover and tighten the screws.
4. The frequency converter is now ready. For start-up, go to section *chapter 5.1.2 Start-up*

1	Control terminals
2	Relays
3	UDC+, UDC-, Line (L3, L2, L1)
4	PE
5	LCP connector

Table 4.2 Legend to *Illustration 4.9*, *Illustration 4.8*

Control terminals

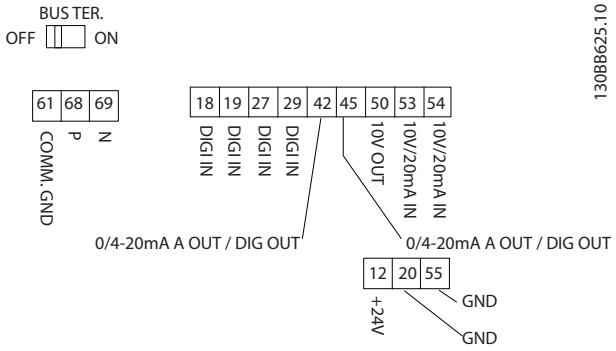


Illustration 4.10 Control Terminals

Terminal number	Function	Configuration	Factory setting
12	+24 V output		
18	Digital input	*PNP/NPN	Start
19	Digital input	*PNP/NPN	No operation
20	Com		
27	Digital input	*PNP/NPN	Coast inverse
29	Digital input	*PNP/NPN	Jog
50	+10 V output		
53	Analog input	*0-10 V/0-20 mA/ 4-20 mA	Ref1
54	Analog input	*0-10 V/0-20 mA/ 4-20 mA	Ref2
55	Com		
42	12 bit	*0-20 mA/4-20 mA/DO	Analog
45	12 bit	*0-20 mA/4-20 mA/DO	Analog
1, 2, 3	Relay 1	1,2 NO 1,3 NC	[9] Alarm
4, 5, 6	Relay 2	4,5 NO 4,6 NC	[5] Drive running

Table 4.3 Control Terminal Functions

** indicates default setting*

Note: PNP/NPN is common for terminals 18, 19 and 27

4.8.2 Load Sharing

Load sharing is not permissible.

4.8.3 Brake

The frequency converter has no internal brake. An external brake can be connected between the UDC+ and UDC- terminals. Limit the voltage between these terminals to maximum 768 V.

NOTICE

Increasing voltage beyond the limit will decrease lifetime, and may permanently damage the frequency converter.

4

4.9 Installation Checklist

Before completing installation of the unit, inspect the entire installation as detailed in *Table 4.4*. Check and mark the items when completed.

Inspect for	Description	☑
Auxiliary equipment	• Look for auxiliary equipment, switches, disconnects, or input fuses/circuit breakers that may reside on the input power side of the frequency converter or output side to the motor. Ensure that they are ready for full-speed operation • Check function and installation of any sensors used for feedback to the frequency converter • Remove any power factor correction caps on motor(s) • Adjust any power factor correction caps on the mains side and ensure that they are dampened	
Cable routing	• Ensure that motor wiring and control wiring are separated or screened or in 3 separate metallic conduits for high-frequency interference isolation	
Control wiring	• Check for broken or damaged wires and loose connections • Check that control wiring is isolated from power and motor wiring for noise immunity • Check the voltage source of the signals, if necessary • The use of screened cable or twisted pair is recommended. Ensure that the shield is terminated correctly	
Cooling clearance	• Measure that top and bottom clearance is adequate to ensure proper air flow for cooling, see *chapter 7.1 Clearances, Dimensions and Weights*	
Ambient conditions	• Check that requirements for ambient conditions are met	
Fusing and circuit breakers	• Check for proper fusing or circuit breakers • Check that all fuses are inserted firmly and are in operational condition and that all circuit breakers are in the open position	
Grounding	• Check for sufficient ground connections that are tight and free of oxidation • Grounding to conduit, or mounting the back panel to a metal surface, is not a suitable grounding	
Input and output power wiring	• Check for loose connections • Check that motor and mains are in separate conduit or separated screened cables	
Panel interior	• Inspect that the unit interior is free of dirt, metal chips, moisture, and corrosion • Check that the unit is mounted on an unpainted, metal surface	
Switches	• Ensure that all switch and disconnect settings are in the proper positions	
Vibration	• Check that the unit is mounted solidly, or that shock mounts are used, as necessary • Check for an unusual amount of vibration	

Table 4.4 Installation Check List

⚠CAUTION

POTENTIAL HAZARD IN THE EVENT OF INTERNAL FAILURE

Risk of personal injury when the frequency converter is not properly closed.

- **Before applying power, ensure all safety covers are in place and securely fastened.**

5 Commissioning

5.1 Applying Power

5.1.1 Turn on Mains Power

Turn on mains power to power up the frequency converter.

5.1.2 Start-up

Start the frequency converter.
At the first power-up with LCP connected, select the preferred language. Once selected, this screen does not appear again in the following power-ups. To change language at a later stage, go to *0-01 Language*.

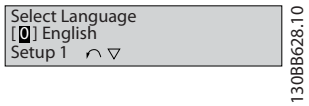


Illustration 5.1 Select Language

5.2 Local Control Panel Operation

5.2.1 Programming with the Local Control Panel (LCP)

NOTICE

The frequency converter can also be programmed from a PC via RS-485 COM port by installing the MCT 10 Set-up Software. Order this software using code number 130B1000, or download from the Danfoss web site: *www.danfoss.com/BusinessAreas/DrivesSolutions/software-download*

The LCP is divided into 4 functional sections.

A. Alphanumeric display

B. Menu selection

C. Navigation keys and indicator lights (LEDs)

D. Operation keys and indicator lights (LEDs)

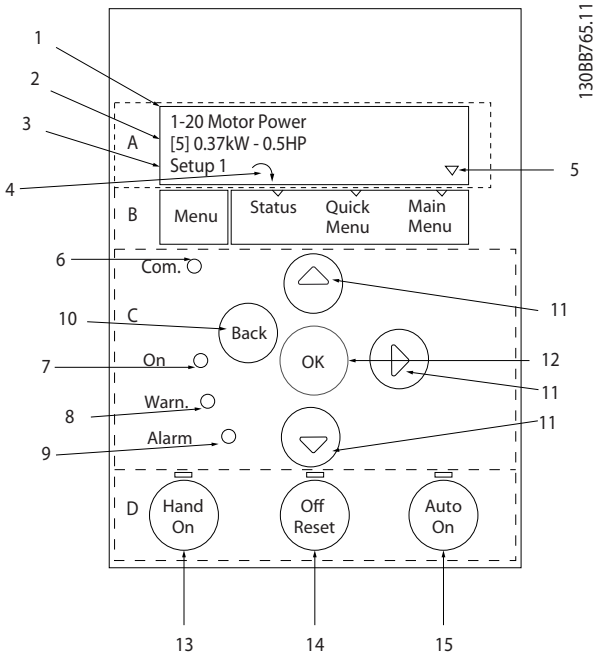


Illustration 5.2 Local Control Panel (LCP)

A. Alphanumeric display
The LCD-display is back-lit with 2 alphanumeric lines. All data is displayed on the LCP.

Information can be read from the display.

1	Parameter number and name.
2	Parameter value.
3	Set-up number shows the active set-up and the edit set-up. If the same set-up acts as both active and edit set-up, only that set-up number is shown (factory setting). When active and edit set-up differ, both numbers are shown in the display (Set-up 12). The number flashing, indicates the edit set-up.
4	Motor direction is shown to the bottom left of the display – indicated by a small arrow pointing either clockwise or counterclockwise.

B. Menu key
Use the [Menu] key to select between status, quick menu or main menu.

5	The triangle indicates if the LCP is in status, quick menu or main menu.

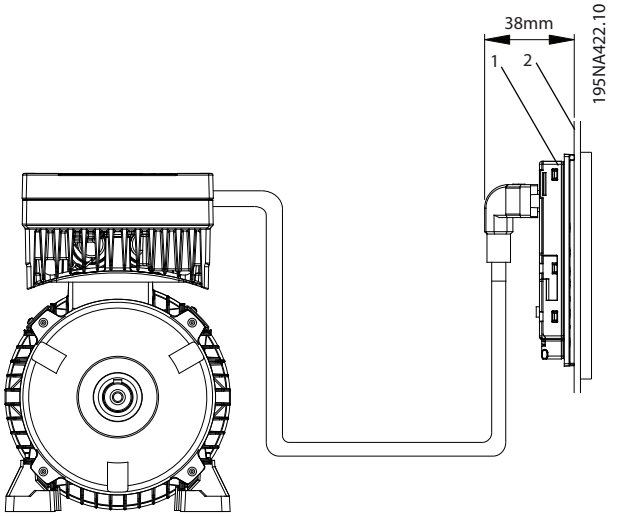
C. Navigation keys and indicator lights (LEDs)

6	Com LED: Flashes when bus communication is communicating.
7	Green LED/On: Control section is working.
8	Yellow LED/Warn.: Indicates a warning.
9	Flashing Red LED/Alarm: Indicates an alarm.
10	[Back]: For moving to the previous step or layer in the navigation structure
11	[▲] [▼] [►]: For maneuvering between parameter groups, parameters and within parameters. Can also be used for setting local reference.
12	[OK]: For selecting a parameter and for accepting changes to parameter settings

D. Operation keys and indicator lights (LEDs)

13	[Hand On]: Starts the motor and enables control of the frequency converter via the LCP. ***NOTICE*** **Terminal 27 Digital Input (*5-12 Terminal 27 Digital Input*) has coast inverse as default setting. This means that [Hand On] does not start the motor if there is no 24 V to terminal 27. Connect terminal 12 to terminal 27.**
14	[Off/Reset]: Stops the motor (Off). If in alarm mode the alarm is reset.
15	[Auto On]: Frequency converter is controlled either via control terminals or serial communication.

5.2.2 Connect LCP Cable



1	Control panel
2	Panel door

Illustration 5.3 LCP Remote Mounting

To view or change the frequency converter settings, attach the LCP using the LCP cable. See *Illustration 5.3*.

After use, remove the LCP cable from the frequency converter, to maintain the ingress protection class of the enclosure.

5.3 Basic Programming

This manual explains initial set-up only. For full parameter lists refer to the *VLT® DriveMotor FCP 106 and FCP 106 Programming Guide*.

Upon initial startup the frequency converter will enter the Start-up wizard for Open Loop Applications, see *chapter 5.3.1 Start-up Wizardfor Open Loop Applications*. Once the start-up wizard is complete, the following additional set-up wizards and instructions are available:

- *chapter 5.3.2 Set-up Wizard for Closed Loop Applications*
- *chapter 5.3.3 Quick Menu: Motor Set-up*
- *chapter 5.3.5 Thermistor Set-up*

For general instructions in changing parameter settings, refer to *chapter 5.3.4 Changing Parameter Settings*.

5.3.1 Start-up Wizardfor Open Loop Applications

The start-up wizard guides the installer through the set-up of the frequency converter in a clear and structured manner to set up an open loop application. An open loop application does not utilise a feedback signal from the process.

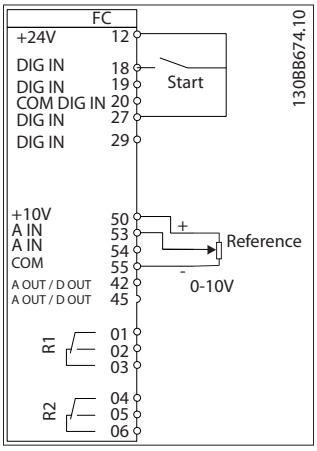


Illustration 5.4 Principle Wiring for Open Loop Start-up Wizard

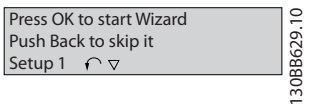


Illustration 5.5 Wizard Start View

The wizard start view appears after power up, and remains until a parameter setting is changed. Access to the wizard is always available later, via the quick menu. Press [OK] to start the wizard. Press [Back] to return to the status screen.

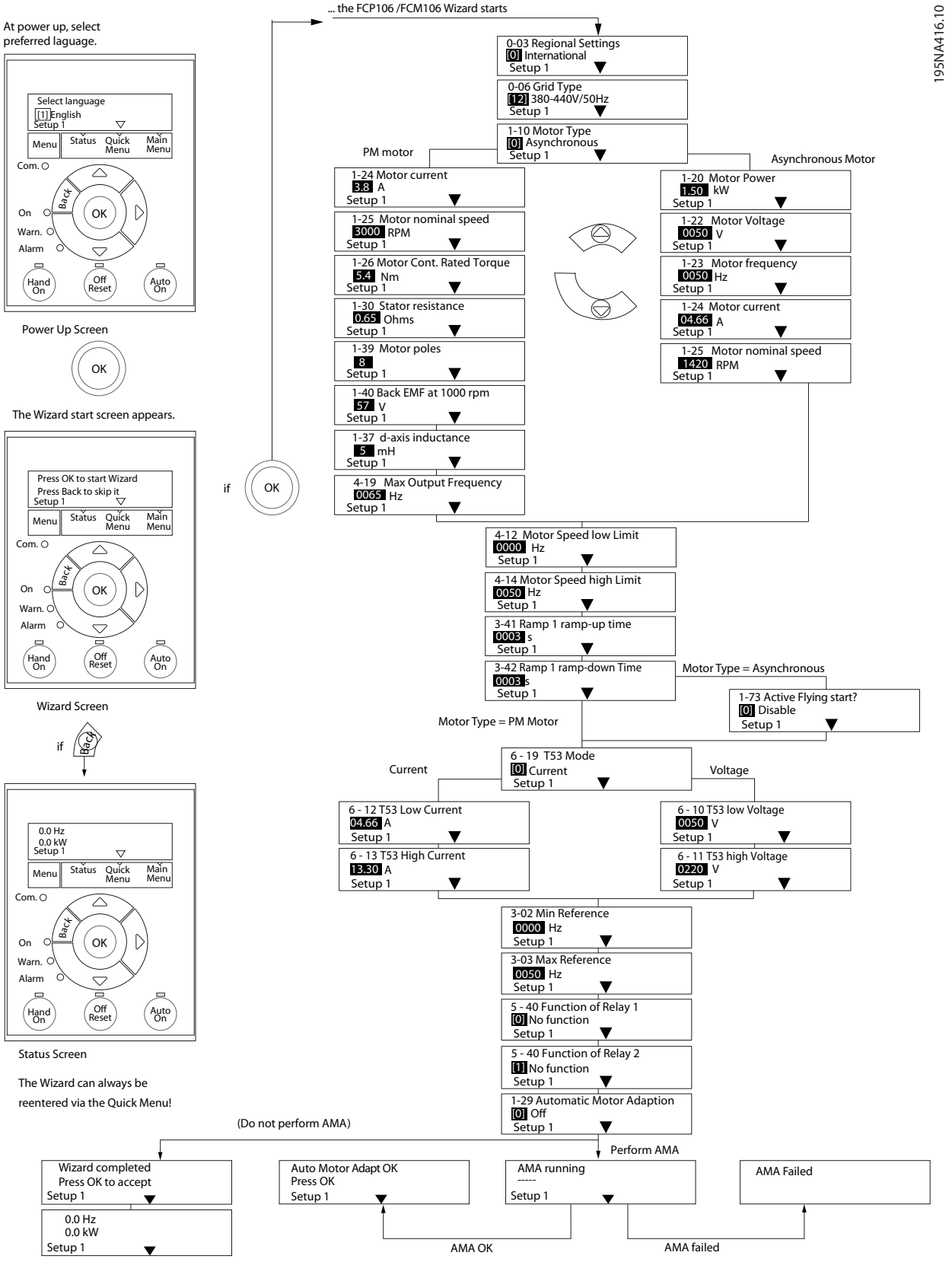


Illustration 5.6 Start-up Wizard for Open Loop Applications

5.3.2 Set-up Wizard for Closed Loop Applications

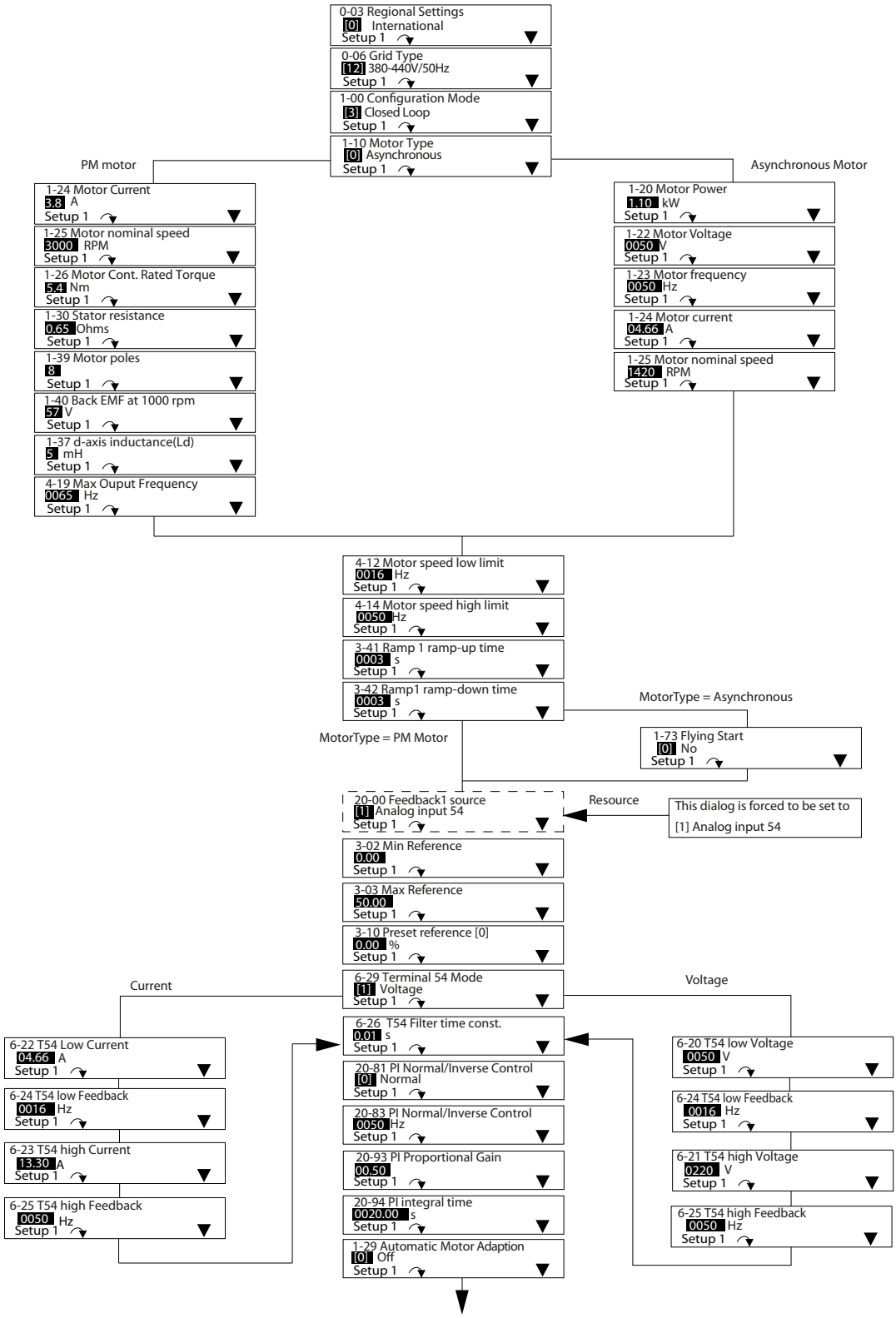


Illustration 5.7 Closed Loop Set-up Wizard

5.3.3 Quick Menu: Motor Set-up

The Quick Menu Motor Set-up guides the installer through setting of the required motor parameters.

NOTICE

MOTOR OVERLOAD PROTECTION

Thermal protection of the motor is recommended. Especially when running at low speed, the cooling from the integrated motor fan is often not sufficient.

- **Use PTC or Klixon, see *chapter 4.6.2 Thermistor Input from Motor*, or**
- **Enable motor thermal protection by setting *1-90 Motor Thermal Protection* to *[4] ETR trip 1*.**

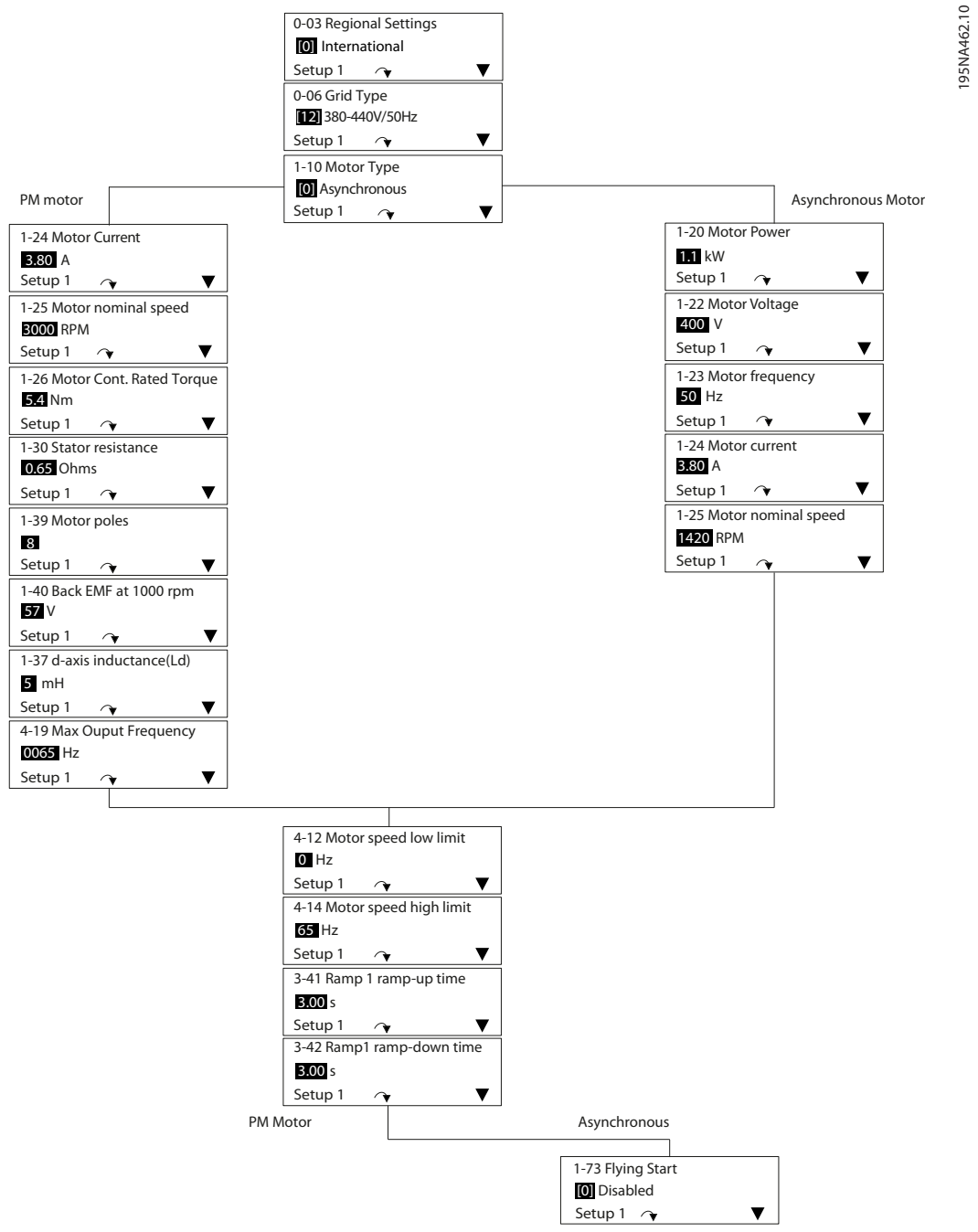


Illustration 5.8 Quick Menu Motor Set-up

5.3.4 Changing Parameter Settings

Quick access to change parameter settings

1. To enter the Quick Menu, press [Menu] until the indicator in the display is located at Quick Menu.
2. Press [▲] [▼] to select wizard, closed loop set-up, motor set-up, or changes made, then press [OK].
3. Press [▲] [▼] to browse through the parameters in the Quick Menu.
4. Press [OK] to select a parameter.
5. Press [▲] [▼] to change the value of a parameter setting.
6. Press [►] to shift digit when a decimal parameter is in the editing state.
7. Press [OK] to accept the change.
8. Press either [Back] twice to enter “Status”, or press [Menu] once to enter “Main Menu”.

The Main Menu accesses all parameters

1. Press [Menu] until the indicator in the display is located at “Main Menu”.
2. Press [▲] [▼] to browse through the parameter groups.
3. Press [OK] to select a parameter group.
4. Press [▲] [▼] to browse through the parameters in the specific group.
5. Press [OK] to select the parameter.
6. Press [▲] [▼] to set/change the parameter value.

Changes Made

1. Press [Menu] until the indicator in the display is located at “Quick Menus”.
2. Press [▲] [▼] to browse through the quick menus.
3. Press [OK] to select *05 Changes Made*.

- *Changes Made* lists all parameters changed from default settings
- The list shows only parameters which have been changed in the current edit-setup.
- Parameters which have been reset to default values are not listed.
- The message 'Empty' indicates that no parameters have been changed.

5.3.5 Thermistor Set-up

Set *1-90 Motor Thermal Protection* to *[1] Thermistor warning* or *[2] Thermistor trip*. For details refer to *VLT® DriveMotor FCP 106 and FCM 106 Programming Guide*.

6 Maintenance, Diagnostics and Troubleshooting

6.1 Maintenance

Under normal operating conditions and load profiles, the frequency converter is maintenance-free throughout its designed lifetime. To prevent breakdown, danger, and damage, examine the frequency converter at regular intervals depending on the operating conditions. Replace worn or damaged parts with original spare parts or standard parts. For service and support, refer to *www.danfoss.com/contact/sales_and_services/*.

6.1.1 Before Starting Repair Work

Before starting repair work:

1. Read the safety warnings in
2. Disconnect the frequency converter from mains.
3. Disconnect the frequency converter from external DC supply, if present.
4. Disconnect the frequency converter from motor as it can generate voltage when turned, for example by windmilling.
5. Wait for discharge of the DC link. For discharge time, see *Table 2.1*.
6. Remove the frequency converter from the motor adapter plate or wall mounting plate.

6.2 List of Warnings and Alarms

Alarm/ warning number	Fault text	Warning	Alarm	Trip lock	Cause of problem
2	Live zero error	X	X		Signal on terminal 53 or 54 is less than 50% of value set in 6-10 Terminal 53 Low Voltage, 6-12 Terminal 53 Low Current, 6-20 Terminal 54 Low Voltageor 6-22 Terminal 54 Low Current. See also parameter group *6–0* Analog In/Out*
4	Mains ph. loss	X	X	X	Missing phase on supply side or excess voltage imbalance. Check supply voltage. See *14-12 Function at Mains Imbalance*
7	DC over volt	X	X		Intermediate circuit voltage exceeds limit.
8	DC under volt	X	X		Intermediate circuit voltage is lower than “voltage warning low” limit.
9	Inverter overload	X	X		More than 100% load for too long.
10	Motor ETR over	X	X		Motor is overheated due to more than 100% load for too long. See *1-90 Motor Thermal Protection*.
11	Motor th over	X	X		Thermistor or thermistor connection is disconnected. See *1-90 Motor Thermal Protection*.
13	Over Current	X	X	X	Inverter peak current limit is exceeded.
14	Earth Fault		X	X	Discharge from output phases to ground.
16	Short Circuit		X	X	Short-circuit in motor or on motor terminals.
17	Control word timeout	X	X		No communication to frequency converter. See parameter group *8-0* Comm. and Options.*
25	Brake resistor short		X	X	
27	Short circuited		X	X	
28	Brake check	X	X		
30	U phase loss		X	X	Motor phase U is missing. Check the phase. See *4-58 Missing Motor Phase Function*.
31	V phase loss		X	X	Motor phase V is missing. Check the phase. See *4-58 Missing Motor Phase Function*.
32	W phase loss		X	X	Motor phase W is missing. Check the phase. See *4-58 Missing Motor Phase Function*.
38	Internal fault		X	X	Contact the local Danfoss supplier.

Alarm/ warning number	Fault text	Warning	Alarm	Trip lock	Cause of problem
40	Overload T27	X			The terminal 27 is overloaded or short circuited to earth.
41	Overload T29	X			The terminal 29 is overloaded or short circuited to earth.
44	Earth Fault DESAT		X	X	Discharge from output phases to ground, using the value of *15–31 Alarm Log Value* if possible.
46	Gate drive voltage fault		X	X	The supply on the power card is out of range. Contact the local Danfoss supplier.
47	24 V supply low	X	X	X	24 V DC is possibly overloaded.
51	AMA U_{nom} , I_{nom}		X		The setting of motor voltage, motor current, and motor power is presumably wrong. Check the settings.
52	AMA low I_{nom}		X		The motor current is too low. Check the settings.
53	AMA motor too big		X		The motor is too large to perform AMA.
54	AMA motor too small		X		The motor is too small to perform AMA.
55	AMA parameter out of range		X		The parameter values found from the motor are outside acceptable range
56	AMA interrupted by user		X		The user has interrrupted the AMA.
57	AMA time-out		X		Try to start the AMA again a number of times, until the AMA is complete. ***NOTICE*** **Repeated runs can heat the motor to a level where the resistance Rs and Rr are increased. In most cases, however, this is not critical**
58	AMA internal	X	X		Contact the local Danfoss supplier.
59	Current limit	X			The current is higher than the value in *4-18 Current Limit*
60	External Interlock		X		External interlock has been activated. To resume normal operation, apply 24 V DC to the terminal programmed for external interlock and reset the frequency converter. Reset via serial communication, digital I/O, or [Reset] on the LCP).
63	Mechanical brake low		X		The minimum required current for opening the mechanical brake has not been reached.
69	Pwr. Card Temp	X	X	X	The temperature sensor on the power card is either too hot or too cold.
80	Drive initialised		X		All parameter settings are initialised to default settings.
87	Auto DC Braking	X			The frequency converter is auto DC braking
95	Broken Belt	X	X		Torque is below the torque level set for no load, indicating a broken belt. See parameter group *22-6* Broken Belt Detection*.
99	Locked rotor		X		The drive detected a locked rotor situation. See *30-22 Locked Rotor Protection* and *30-23 Locked Rotor Detection Time [s]*.
101	Flow/pressure info missing		X		Flow/pressure information is missing
126	Motor Rotating		X		High back-emf voltage. Stop the rotor of the PM motor.
127	Back EMF too high	X			
201	Fire Mode	X			Fire mode has been activated
202	Fire Mode Limits Exceeded	X			Fire Mode has suppressed one or more warranty voiding alarms

Table 6.1 Warnings and Alarms

7 Specifications

7.1 Clearances, Dimensions and Weights

7.1.1 Clearances

Observe the minimum clearances listed in *Table 7.1* to ensure sufficient air flow for the frequency converter.
When air flow is obstructed close to the frequency converter, ensure adequate inlet of cool air and exhaust of hot air from the unit.

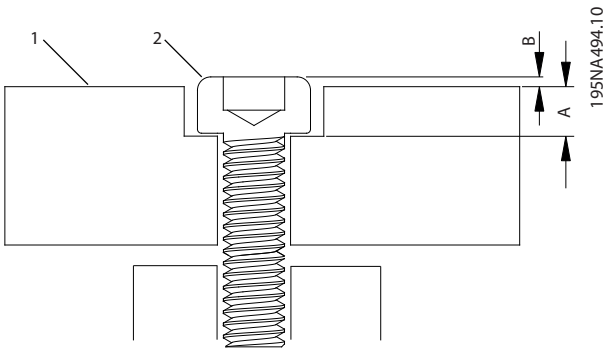
Enclosure		Power[1)] [kW]	Clearance at ends [mm]	
Enclosure type	IP class	3x380-480 V	Motor flange end	Cooling fan end
MH1	IP54/Type 3R	0.55-1.5	30	100
MH2	IP54/Type 3R	2.2-4.0	40	100
MH3	IP54/Type 3R	5.5-7.5	50	100

Table 7.1 Minimum Clearance for Cooling

1) Power ratings relate to NO, see chapter 7.2 Electrical Data.

Enclosure type	Maximum depth of hole into adapter plate (A) [mm]	Maximum height of screw above adapter plate (B) [mm]
MH1	3	0.5
MH2	4	0.5
MH3	3.5	0.5

Table 7.2 Information for Screws to Fasten Motor Adapter Plate



1	Adapter plate
2	Screw
A	Maximum depth of hole into adapter plate
B	Maximum height of screw above adapter plate

Illustration 7.1 Screws to Fasten Motor Adapter Plate

7.1.2 FCP 106 Dimensions

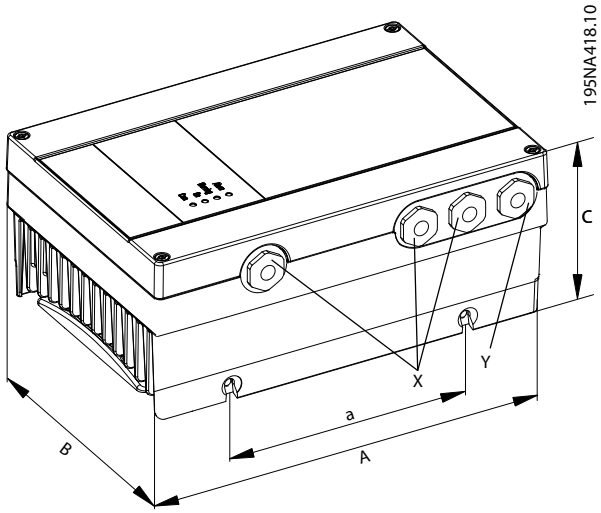


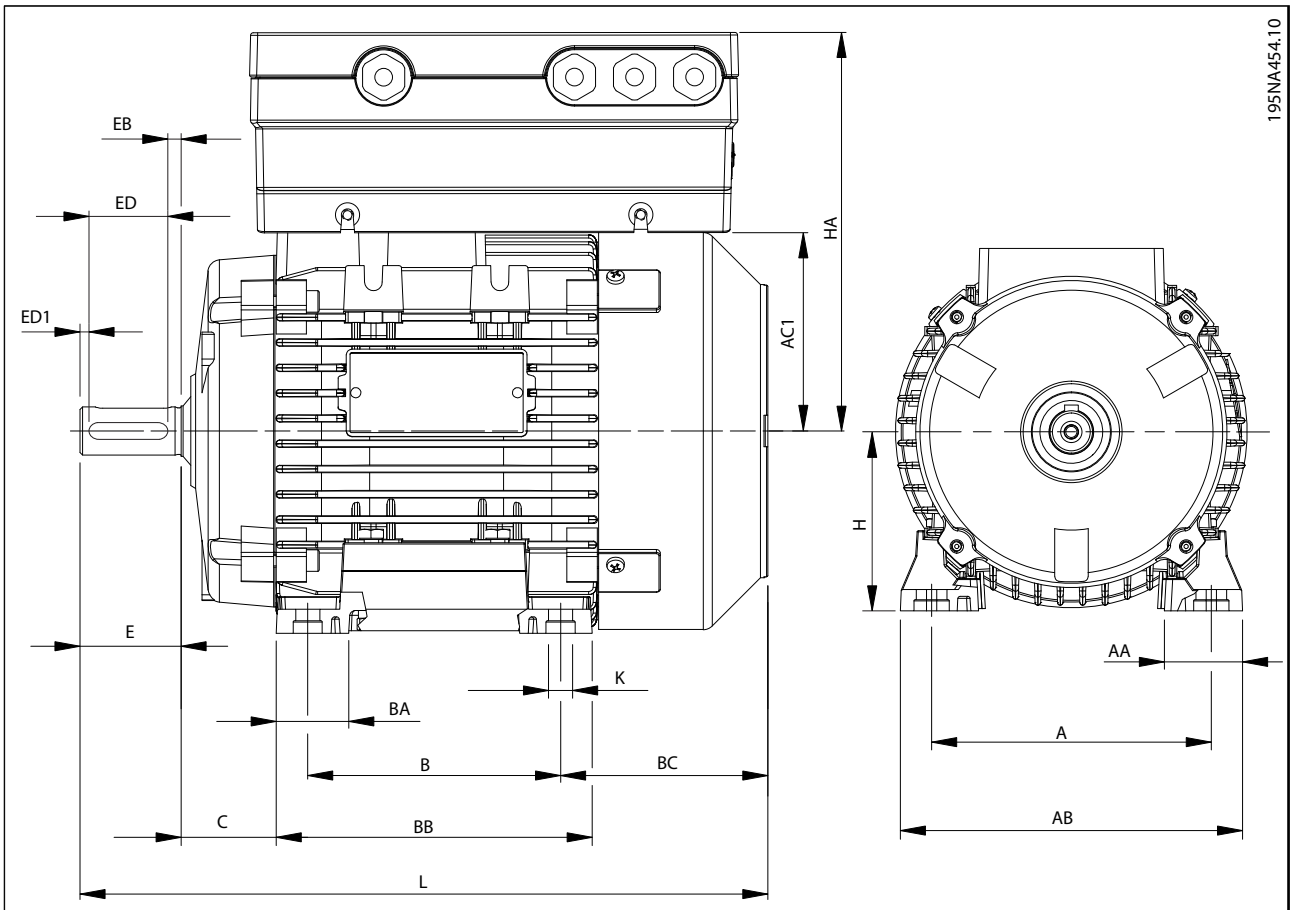
Illustration 7.2 FCP 106 Dimensions

Enclosure type	Power[1)] [kW]	Length [mm]		Width [mm]	Height [mm]	Cable gland diameter		Mounting hole
	3x380-480 V	A	a	B	C	X	Y	
MH1	0.55-1.5	231.4	130	162.1	106.8	M20	M20	M6
MH2	2.2-4.0	276.8	166	187.1	113.2	M20	M20	M6
MH3	5.5-7.5	321.7	211	221.1	123.4	M20	M25	M6

Table 7.3 FCP 106 Dimensions

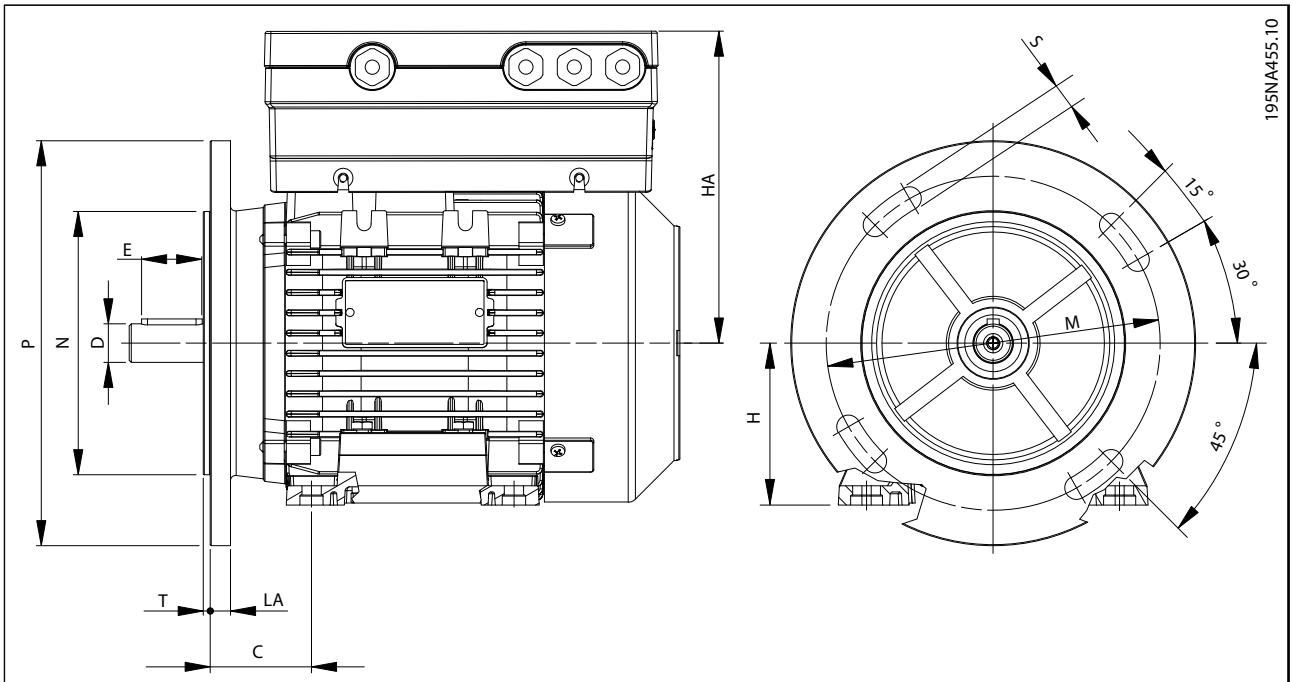
1) Power ratings relate to NO, see chapter 7.2 Electrical Data.

7.1.3 FCM 106 Dimensions



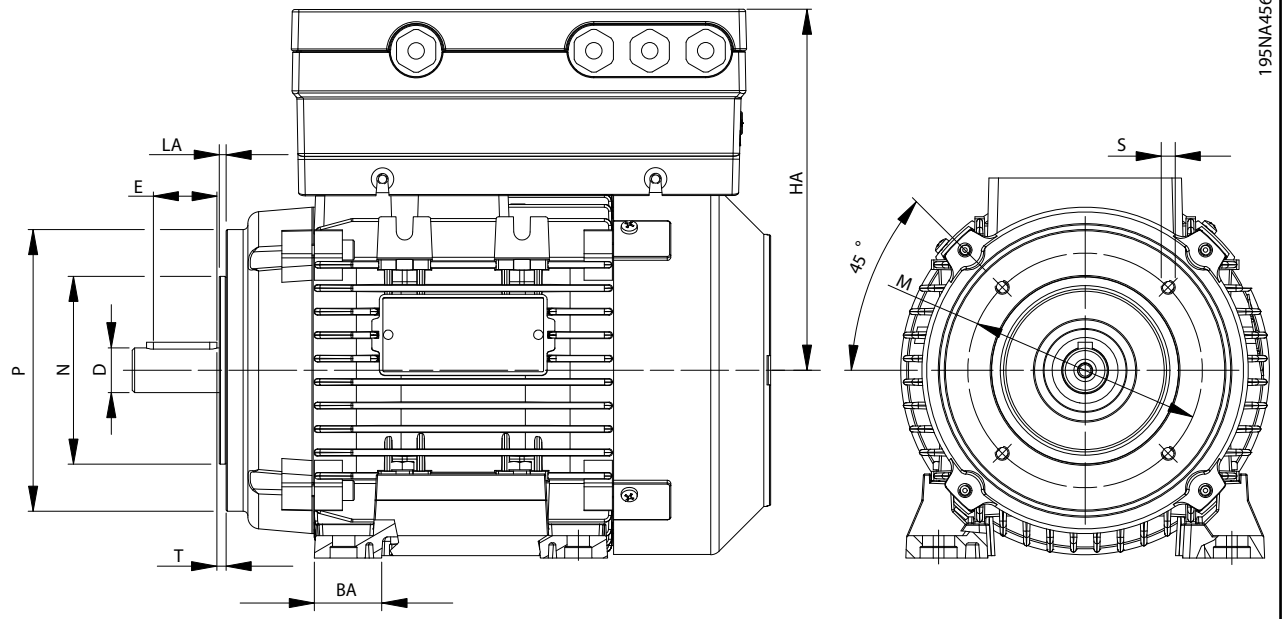
Motor frame size	71	80	90S	90L	100L	100L	112M	132S	132M	160M	160L	180M	180L
A [mm]	112	125	140	140	160	160	190	216	216	254	254	279	279
B [mm]	90	100	100	125	140	140	140	140	178	210	254	241	279
C [mm]	45	50	56	56	63	63	70	89	89	108	108	121	121
H [mm]	71	80	90	90	100	100	112	132	132	160	160	180	180
K [mm]	8	10	10	10	11	11	12.5	12	12	14	14	15	15
AA [mm]	31	34.5	37	37	44	44	48	59	59	76	76	75	75
AB [mm]	135	153	170	170	192	192	220	256	256	320	320	348	348
BB [mm]	108	125	150	150	166	166	176	180	218	270	310	310	348
BC [mm]	83	89	116	91	110	144	126	134	136	180	180	256	256
L [mm]	246	272	317	317	366	400	388	445	485	608	652	687	725
AC [mm]	139	160	180	180	196	194	225	248	248	317	317	360	360
E [mm]	30	40	50	50	60	60	60	80	80	110	110	110	110
ED [mm]	20	30	30	40	40	50	50	70	70	100	100	100	100
EB [mm]	4	4	4	4	4	4	4	4	4	4	4	5	5
FCL [mm]													
FCW [mm]													
HA [mm]	HA = H + (height of the frequency converter) For frequency converter dimensions, see *Table 7.3*.												

Table 7.4 FCM 106 Dimensions: Foot Mounting - B3 Asynchronous or PM Motor



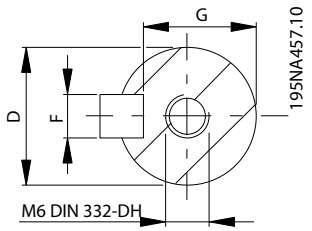
Motor frame size	71	80	90S	90L	100L	112M	132S	160M	180M
M [mm]	130	165	165	165	215	215	265	300	300
N [mm]	110	130	130	130	180	180	230	250	250
P [mm]	160	200	200	200	250	250	300	350	350
S [mm]	M8	M10	M10	M10	M12	M12	M12	M16	M16
T [mm]	3.5	3.5	3.5	3.5	4	4	4	5	5
LA [mm]	10	10	12	12	14	14	14	15	13
HA [mm]	HA = H + (height of the frequency converter) For frequency converter dimensions, see *Table 7.3*.								

Table 7.5 FCM 106 Dimensions: Flange Mounting - B5, B35 for Asynchronous or PM Motor



Small flange B14								
Motor frame size	**71**	**80**	**90S**	**100L**	**112M**	**132S**	**160M/L**	**180M**
M [mm]	85	100	115	130	130	165	215	-
N [mm]	70	80	95	110	110	130	180	-
P [mm]	105	120	140	160	160	200	250	-
S [mm]	M6	M6	M8	M8	M8	M10	M12	-
T [mm]	2.5	3	3	3.5	3.5	3.5	4	-
LA [MM]	11	9	9	10	10	30	12	-
Large flange B14								
Motor frame size	**71**	**80**	**90S**	**100L**	**112M**	**132S**	**160M/L**	**180M**
M [mm]	115	130	130	165	165	215	265	-
N [mm]	95	110	110	130	130	180	230	-
P [mm]	140	160	160	200	200	250	300	-
S [mm]	M8	M8	M8	M10	M10	M12	M16	-
T [mm]	2.5	3.5	3.5	3.5	3.5	4	5	-
LA [MM]	8	8.5	9	12	12	12	12	-
HA [mm]	HA = H + (height of the frequency converter) For frequency converter dimensions, see *Table 7.3*.							

Table 7.6 FCM 106 Dimensions: Face Mounting - B14, B34 for Asynchronous or PM motor



FCM 106 with Asynchronous or PM motor								
Motor frame size	**71**	**80**	**90S**	**100L**	**112M**	**132S**	**160M/L**	**180M**
D [mm]	14	19	24	28	28	38	42	48
F [mm]	5	6	8	8	8	10	12	14
G [mm]	11	15.5	20	24	24	33	37	42.5
DH	M5	M6	M8	M10	M10	M12	M16	M16

Table 7.7 FCM 106 Dimensions: Shaft Drive End - Asynchronous or PM Motor

7

7.1.4 Weight

To calculate the total weight of the unit, add

- weight of combined frequency converter and adapter plate, see *Table 7.8*, and
- weight of motor, see *Table 7.9*.

Enclosure type	Weight		
	FCP 106 [kg]	Motor adapter plate [kg]	Combined FCP 106 and motor adapter plate [kg]
MH1	3.9	0.42	4.3
MH2	5.8	0.54	6.3
MH3	8.1	0.78	8.9

Table 7.8 Weight of FCP 106

Shaft power [kW]	PM motor				Asynchronous motor			
	1500 rpm		3000 rpm		1500 rpm		3000 rpm	
	Frame size	Weight [kg]	Frame size	Weight [kg]	Frame size	Weight [kg]	Frame size	Weight [kg]
0.55	71	4.8	N.A.		N.A.		N.A.	
0.75	71	5.4	71	4.8	80S	11	71	9.5
1.1	71	7.0	71	4.8	90S	16.4	80	11
1.5	71	10	71	6.0	90L	16.4	80	14
2.2	90	12	71	6.6	100L	22.4	90L	16
3	90	14	90S	12	100L	26.5	100L	23
4	90	17	90S	14	112M	30.4	100L	28
5.5	112	30	90S	16	132S	55	112M	53
7.5	112	33	112M	26	132M	65	112M	53

Table 7.9 Approximate Weight of Motor

7.2 Electrical Data

Enclosure	MH1								MH2						MH3
	PK55		PK75		P1K1		P1K5		P2K2		P3K0		P4K0		P5K5
Overload[1]	NO	HO	NO	HO	NO	HO	NO	HO	NO	HO	NO	HO	NO	HO	HO
Typical shaft output [kW]	0.55		0.75		1.1		1.5		2.2		3.0		4.0		
Typical shaft output [hp]	0.75		1.0		1.5		2.0		3.0		4.0		5.0		
Max. cable cross-section in terminals[2] (mains, motor) [mm²/AWG]	4/10		4/10		4/10		4/10		4/10		4/10		4/10		
Output current															
40 °C ambient temperature															
Continuous (3x380-440 V) [A]	1.7		2.2		3.0		3.7		5.3		7.2		9.0		
Intermittent (3x380-440 V) [A]	1.9	2.7	2.4	3.5	3.3	4.8	4.1	5.9	5.8	8.5	7.9	11.5	9.9	14.4	
Continuous (3x440-480 V) [A]	1.6		2.1		2.8		3.4		4.8		6.3		8.2		
Intermittent (3x440-480 V) [A]	1.8	2.6	2.3	3.4	3.1	4.5	3.7	5.4	5.3	7.7	6.9	10.1	9.0	13.2	
Max. input current															
Continuous (3x380-440 V)[A]	1.3		2.1		2.4		3.5		4.7		6.3		8.3		
Intermittent (3x380-440 V) [A]	1.4	2.0	2.3	2.6	2.6	3.7	3.9	4.6	5.2	7.0	6.9	9.6	9.1	12.0	
Continuous (3x440-480 V) [A]	1.2		1.8		2.2		2.9		3.9		5.3		6.8		
Intermittent (3 x 440-480 V) [A]	1.3	1.9	2.0	2.5	2.4	3.5	3.2	4.2	4.3	6.3	5.8	8.4	7.5	11.0	
Max. mains fuses	See *chapter 7.10 Fuse and Circuit Breaker Specifications*														

Table 7.10 Mains Supply 3x380-480 V AC Normal and High Overload: MH1, MH2, and MH3 Enclosure

1) NO: Normal overload, 110% for 1 minute. HO: High overload, 160% for 1 minute

A frequency converter intended for HO requires a corresponding motor rating. For example, Table 7.10 shows that a 1.5 kW motor for HO requires a P2K2 frequency converter.

2) Max. cable cross-section is the largest cable cross-section that can be attached to the terminals. Always observe national and local regulations.

Enclosure	MH3		
	P5K5	P7K5	
Overload[1)]	NO	HO	NO
Typical shaft output [kW]	5.5		7.5
Typical shaft output [hp]	7.5		10
Max. cable cross-section in terminals[2] (mains, motor) [mm²/AWG]	4/10		4/10
Output current			
40 °C ambient temperature			
Continuous (3x380-440 V) [A]	12		15.5
Intermittent (3x380-440 V) [A]	13.2	14.4	17.1
Continuous (3x440-480 V) [A]	11		14
Intermittent (3x440-480 V) [A]	12.1	13.2	15.4
Max. input current			
Continuous (3x380-440 V)[A]	11		15
Intermittent (3x380-440 V) [A]	12	17	17
Continuous (3x440-480 V) [A]	9.4		13
Intermittent (3 x 440-480 V) [A]	10	15	14
Max. mains fuses	See *chapter 7.10 Fuse and Circuit Breaker Specifications*		

Table 7.11 Mains Supply 3x380-480 V AC Normal and High Overload: MH3 Enclosure

1) NO: Normal overload, 110% for 1 minute. HO: High overload, 160% for 1 minute

A frequency converter intended for HO requires a corresponding motor rating. For example, Table 7.11 shows that a 5.5 kW motor for HO requires a P7K5 frequency converter.

2) Max. cable cross-section is the largest cable cross-section that can be attached to the terminals. Always observe national and local regulations.

7.3 Mains Supply

Mains supply (L1, L2, L3)	
Supply voltage	380-480 V ±10%

Mains voltage low/mains drop-out:

- *During low mains voltage or a mains drop-out, the frequency converter continues until the intermediate circuit voltage drops below the minimum stop level, which corresponds typically to 15% below the lowest rated supply voltage of the frequency converter. Power-up and full torque cannot be expected at mains voltage lower than 10% below the lowest rated supply voltage of the frequency converter.*

Supply frequency	50/60 Hz
Max. imbalance temporary between mains phases	3.0% of rated supply voltage
True Power Factor (λ)	≥ 0.9 nominal at rated load
Displacement Power Factor (cosφ)	near unity (>0.98)
Switching on the input supply L1, L2, L3 (power-ups)	Max. 2 times/min.
Environment according to EN 60664-1	overvoltage category III/pollution degree 2

The unit is suitable for use on a circuit capable of delivering not more than

- 100,000 RMS symmetrical Amperes, 480 V maximum, with fuses used as branch circuit protection
- 10,000 RMS symmetrical Amperes, 480 V maximum, with circuit breakers used as branch circuit protection

7

7.4 Protection and Features

Protection and features

- Electronic thermal motor protection against overload.
- Temperature monitoring of the heat sink ensures that the frequency converter trips when the temperature reaches 90 °C ±5°C. An overload temperature cannot be reset until the temperature of the heatsink is below 70 °C ±5 °C (Guideline - these temperatures may vary for different power sizes, enclosures etc.). The frequency converter auto derating function ensures that the heatsink temperature does not reach 90 °C.
- The frequency converter is protected against short-circuits between motor terminals U, V, W.
- When a motor phase is missing, the frequency converter trips and issues an alarm.
- When a mains phase is missing, the frequency converter trips or issues a warning (depending on the load).
- Monitoring of the intermediate circuit voltage ensures that the frequency converter trips, when the intermediate circuit voltage is too low or too high.
- The frequency converter is protected against earth faults on motor terminals U, V, W.
- All control terminals and relay terminals 01-03/04-06 comply with PELV (Protective Extra Low Voltage). However this does not apply to grounded Delta leg above 400 V.

7.5 Ambient Conditions

Environment	
Enclosure	IP54/Type 3R
Stationary vibration (IEC 60721-3-3 Class 3M6)	2.0 g
Non-stationary vibration (IEC 60721-3-3 Class 3M6)	25.0 g
Relative humidity (IEC 60721-3-3; Class 3K4 (non-condensing))	5%-95% during operation
Aggressive environment (IEC 60721-3-3)	Class 3C3
Test method according to IEC 60068-2-43	H2S (10 days)
Ambient temperature	40 °C (24-hour average)
Minimum ambient temperature during full-scale operation	-10 °C
Minimum ambient temperature at reduced performance	-20 °C
Temperature during storage	-25 to +65 °C
Temperature during transport	-25 to +70 °C

Maximum altitude above sea level without derating	1000 m
Maximum altitude above sea level with derating	3000 m
Safety standards	EN/IEC 60204-1, EN/IEC 61800-5-1, UL 508C
EMC standards, Emission	EN61000-3-2, EN61000-3-12, EN55011, EN61000-6-4
EMC standards, Immunity	EN61800-3, EN61000-6-1/2

7.6 Cable Specifications

Cable lengths and cross sections	
Max. motor cable length, screened/armoured	0.5 m
Max. cross section to motor, mains for MH1-MH3	4 mm^2/10 AWG
Max. cross section DC terminals on enclosure type MH1-MH3	4 mm^2/10 AWG
Maximum cross section to control terminals, rigid wire	2.5 mm^2/14 AWG
Maximum cross section to control terminals, flexible cable	2.5 mm^2/14 AWG
Minimum cross section to control terminals	0.05 mm^2/30 AWG
Max. cross section to thermistor input (at motor connector)	4.0 mm^2

7

7.7 Control Input/Output and Control Data

Digital inputs[A)]	
Programmable digital inputs	4
Terminal number	18, 19, 27, 29
Logic	PNP or NPN
Voltage level	0-24 V DC
Voltage level, logic '0' PNP	<5 V DC
Voltage level, logic '1' PNP	>10 V DC
Voltage level, logic '0' NPN	>19 V DC
Voltage level, logic '1' NPN	<14 V DC
Maximum voltage on input	28 V DC
Input resistance, R_i	Approx. 4 kΩ
Digital input 29 as Pulse input	Max frequency 32 kHz Push-Pull-Driven & 5 kHz (O.C.)

Analog inputs[A)]	
Number of analog inputs	2
Terminal number	53, 54
Terminal 53 mode	Parameter 6-19: 1=voltage, 0=current
Terminal 54 mode	Parameter 6-29: 1=voltage, 0=current
Voltage level	0-10 V
Input resistance, R_i	approx. 10 kΩ
Max. voltage	20 V
Current level	0/4 to 20 mA (scalable)
Input resistance, R_i	<500 Ω
Max. current	29 mA

Analog output[A)]	
Number of programmable analog outputs	2
Terminal number	42, 45[1)]
Current range at analog output	0/4-20 mA
Max. load to common at analog output	500 Ω
Max. voltage at analog output	17 V
Accuracy on analog output	Max. error: 0.4% of full scale
Resolution on analog output	10 bit

[1)] Terminal 42 and 45 can also be programmed as digital outputs.

Digital output	
Number of digital outputs	2
Terminal number	42, 45[1)]
Voltage level at digital output	17 V
Max. output current at digital output	20 mA
Max. load at digital output	1 kΩ

1) Terminals 42 and 45 can also be programmed as analog output.

Control card, RS-485 serial communication	
Terminal number	68 (P, TX+, RX+), 69 (N, TX-, RX-)
Terminal number	61 Common for terminals 68 and 69

Control card, 24 V DC output[A)]	
Terminal number	12
Maximum load	80 mA

Relay output[A)]	
Programmable relay output	2
Relay 01 and 02	01-03 (NC), 01-02 (NO), 04-06 (NC), 04-05 (NO)
Max. terminal load (AC-1)[1)] on 01-02/04-05 (NO) (Resistive load)	250 V AC, 3 A
Max. terminal load (AC-15)[1)] on 01-02/04-05 (NO) (Inductive load @ cosφ 0.4)	250 V AC, 0.2 A
Max. terminal load (DC-1)[1)] on 01-02/04-05 (NO) (Resistive load)	30 V DC, 2 A
Max. terminal load (DC-13)[1)] on 01-02/04-05 (NO) (Inductive load)	24 V DC, 0.1 A
Max. terminal load (AC-1)[1)] on 01-03/04-06 (NC) (Resistive load)	250 V AC, 3 A
Max. terminal load (AC-15)[1)] on 01-03/04-06 (NC) (Inductive load @ cosφ 0.4)	250 V AC, 0.2 A
Max. terminal load (DC-1)[1)] on 01-03/04-06	30 V DC, 2 A
(NC) (Resistive load)	Min. terminal load on 01-03 (NC), 01-02 (NO) 24 V DC 10 mA, 24 V AC 20 mA
Environment according to EN 60664-1	Overvoltage category III/pollution degree 2

[1)] IEC 60947 parts 4 and 5.

Control card, 10 V DC output[A)]	
Terminal number	50
Output voltage	10.5 V ±0.5 V
Max. load	25 mA

[A)] All inputs, outputs, circuits, DC supplies and relay contacts are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

7

7.8 Connection Tightening Torques

Location	Type	Torque [Nm]
Front cover screws	T20 or slot	3-3.5
Plastic cable blind plugs	24 mm or 28 mm socket	2.2
Control card	T10	1.3
Relay card	T10	1.3
Control plate	T20 or slot	1.5
Connection to adapter plate	T20 or slot	7.0

Table 7.12 Tightening Torques for Frequency Converter External Screws

Enclosure type	Power[1) [kW]	Torque [Nm]						
	3x 380-480 V	Line	Motor	DC connection	Control terminals	Earth	Relay	RFI switch
MH1	0.55-1.5	1.4	crimp, no applied torque	1.4	0.5	3.0	0.5	0.9
MH2	2.2-4							
MH3	5.5-7.5							

Table 7.13 Tightening Torques for Frequency Converter Internal Screws

Enclosure type	Power[1) [kW]	Type						
	3x 380-480 V	Line	Motor	DC connection	Control terminals	Earth	Relay	RFI switch
MH1	0.55-1.5	slot or Phillips	crimp	slot or Phillips	slot or Phillips	T20, slot, or 10 mm socket	slot	T20 or slot
MH2	2.2-4							
MH3	5.5-7.5							

Table 7.14 Screw Types for Frequency Converter Internal Screws

1) Power ratings relate to NO, see chapter 7.2 Electrical Data.

7.9 FCM 106 Motor Specifications

Motor output (U, V, W)	
Output voltage	0-100% of supply voltage
Output frequency, asynchronous motor	0-200 Hz (VVC^{plus}), 0-400 Hz (u/f)
Output frequency, PM motor	0-390 Hz (VVC^{plus} PM)
Switching on output	Unlimited
Ramp times	0.05-3600 s

Thermistor input (at motor connector)	
Input conditions	Fault: >2.9 kΩ, no fault: <800 Ω

7.10 Fuse and Circuit Breaker Specifications

Overcurrent protection

Provide overload protection to avoid overheating of the cables in the installation. Overcurrent protection must always be carried out according to local and national regulations. Fuses must be designed for protection in a circuit capable of supplying a maximum of 100,000 A_{rms} (symmetrical), 480 V maximum. Circuit breakers must be designed for protection in a circuit capable of supplying a maximum of 10,000 A_{rms} (symmetrical), 480 V maximum; or the value rated on the individual circuit breaker.

UL/Non UL Compliance

Use the circuit breakers or fuses listed in *Table 7.15*, to ensure compliance with UL or IEC 61800-5-1.

Circuit breakers must be designed for protection in a circuit capable of supplying a maximum of 10,000 A_{rms} (symmetrical), 480 V maximum.

In the event of malfunction, failure to follow the protection recommendation can result in damage to the frequency converter.

Enclosure type	Power [1] [kW] 3x 380-480 V	Circuit Breaker				Fuse							
						Rec. UL	Maximum UL					Rec. non-UL	Max. non-UL
						Type							
		Rec. UL	Max. UL	Rec. non-UL	Max. non-UL	RK5, RK1, J, T, CC	RK5	RK1	J	T	CC	gG	gG
MH1	0.55	CTI25M - 047B3146	CTI25M - 047B3149	CTI25M - 047B3146	CTI25M - 047B3149	6	6	6	6	6	6	10	10
	0.75	CTI25M - 047B3147	CTI25M - 047B3149	CTI25M - 047B3147	CTI25M - 047B3149	6	6	6	6	6	6	10	10
	1.1	CTI25M - 047B3147	CTI25M - 047B3150	CTI25M - 047B3147	CTI25M - 047B3150	6	10	10	10	10	10	10	10
	1.5	CTI25M - 047B3148	CTI25M - 047B3150	CTI25M - 047B3148	CTI25M - 047B3150	6	10	10	10	10	10	10	10
MH2	2.2	CTI25M - 047B3149	CTI25M - 047B3152	CTI25M - 047B3149	CTI25M - 047B3152	6	20	20	20	20	20	16	20
	3.0	CTI25M - 047B3149	CTI25M - 047B3152	CTI25M - 047B3149	CTI25M - 047B3152	15	25	25	25	25	25	16	25
	4.0	CTI25M - 047B3150	CTI25M - 047B3102	CTI25M - 047B3150	CTI25M - 047B3102	15	30	30	30	30	30	16	32

Enclosure type	Power [1] [kW] 3x 380-480 V	Circuit Breaker				Fuse							
		Rec. UL	Max. UL	Rec. non-UL	Max. non-UL	Rec. UL	Maximum UL					Rec. non-UL	Max. non-UL
						Type							
						RK5, RK1, J, T, CC	RK5	RK1	J	T	CC	gG	gG
MH3	5.5	CTI25M - 047B3150	CTI25M - 047B3102	CTI25M - 047B3150	CTI25M - 047B3102	20	30	30	30	30	30	25	32
	7.5	CTI25M - 047B3151	CTI25M - 047B3102	CTI25M - 047B3151	CTI25M - 047B3102	25	30	30	30	30	30	25	32

Table 7.15 Fuses and Circuit Breakers

1) Power ratings relate to NO, see chapter 7.2 Electrical Data.

7

8 Appendix

8.1 Abbreviations and Conventions

AC	Alternating Current
AEO	Automatic Energy Optimization
AWG	American Wire Gauge
AMA	Automatic Motor Adaptation
°C	Degrees Celsius
DC	Direct Current
EMC	Electromagnetic Compatibility
ETR	Electronic Thermal Relay
$f_{M,N}$	Nominal Motor Frequency
FC	Frequency Converter
HO	High overload
IP	Ingress Protection
I_{LIM}	Current Limit
I_{INV}	Rated Inverter Output Current
$I_{M,N}$	Nominal Motor Current
$I_{VLT,MAX}$	The Maximum Output Current
$I_{VLT,N}$	The Rated Output Current Supplied by the Frequency Converter
LCP	Local Control Panel
N.A.	Not applicable
NO	Normal overload
$P_{M,N}$	Nominal Motor Power
PCB	Printed Circuit Board
PE	Protective earth
PELV	Protective Extra Low Voltage
Regen	Regenerative Terminals
RPM	Revolutions Per Minute
T_{LIM}	Torque Limit
$U_{M,N}$	Nominal Motor Voltage

Table 8.1 Abbreviations

Conventions

Numbered lists indicate procedures.

Bullet lists indicate other information and description of illustrations.

Italicised text indicates

- cross reference
- link
- footnote
- parameter name, parameter group name, parameter option

8.2 Parameter Menu Structure

- **0-** Operation / Display**
  - **0-0* Basic Settings**
    - 0-01 Language
    - 0-03 Regional Settings
    - 0-04 Operating State at Power-up
    - 0-06 GridType
    - 0-07 Auto DC Braking
  - **0-1* Set-up Operations**
    - 0-10 Active Set-up
    - 0-11 Programming Set-up
    - 0-12 Link Setups
  - **0-3* LCP Custom Readout**
    - 0-30 Custom Readout Unit
    - 0-31 Custom Readout Min Value
    - 0-32 Custom Readout Max Value
    - 0-37 Display Text 1
    - 0-38 Display Text 2
    - 0-39 Display Text 3
  - **0-4* LCP Keypad**
    - 0-40 [Hand on] Key on LCP
    - 0-42 [Auto on] Key on LCP
    - 0-44 [Off/Reset] Key on LCP
  - **0-5* Copy/Save**
    - 0-50 LCP Copy
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