



Operating Instructions

VLT® DriveMotor FCP 106/FCM 106





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EU DECLARATION OF CONFORMITY
Danfoss Drives A/S

declares under our sole responsibility that the products **VLT® DriveMotor series**
FCP106/FCM106

Typecodes:

FCM106XYYYT4*****XYYY*****
FCP106XYYYT4*****

X: N or H

YYY: K55, K75, 1K1, 1K5, 2K2, 3K0, 3K7, 4K0, 5K5, 7K5

* may be any number or letter indicating drive options which do not impact this DoC.

Covered by this declaration is in conformity with the following directive(s), standard(s) or other normative document(s), provided that the product is used in accordance with our instructions.

Low Voltage Directive 2014/35/EU

EN61800-5-1:2007

Adjustable speed electrical power drive systems – Part 5-1: Safety requirements – Electrical, thermal and energy.

EMC Directive 2014/30/EU

EN61800-3:2005 + A1:2012

Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods.

EN61000-3-2:2014

Electromagnetic compatibility (EMC). Part 3-2: Limits. Limits for harmonic current emissions (equipment input current ≤ 16 A per phase

EN61000-6-1:2007

Electromagnetic compatibility (EMC). Generic standards. Immunity for residential, commercial and light-industrial environments

EN61000-6-2:2005

Electromagnetic compatibility (EMC). Generic standards. Immunity for industrial environments

Date:	Issued by Signature Name: Leo Birkkjær Lauritsen Title: Head of P400 Group	Date:	Approved by Signature Name: Michael Termansen Title: Vice President, Design Center DK and DE
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Danfoss only vouches for the correctness of the English version of this declaration. In the event of the declaration being translated into any other language, the translator concerned shall be liable for the correctness of the translation.

EN61000-6-4:2007+A1:2011

Electromagnetic compatibility (EMC). Generic standards. Emission standard for industrial environments

RoHS Directive 2011/65/EU

EN50581: 2012

Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances.

The meaning of the 39 characters (FCM106) and 25 characters (FCP106) in the type code string can be found in appendix 00729776.

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1 Introduction

1.1 Purpose of the Manual

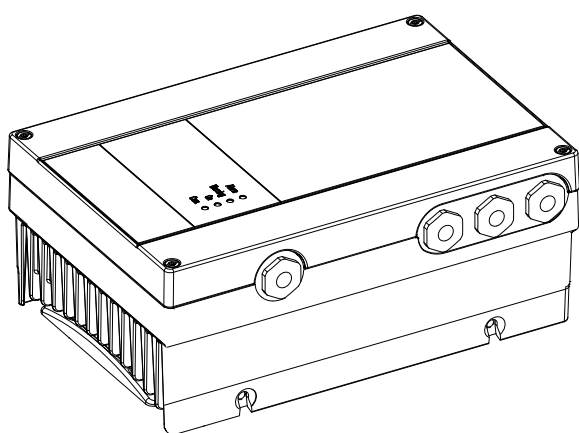
This manual provides information required to install and commission the frequency converter.

VLT® DriveMotor FCP 106

The delivery comprises the frequency converter only. A wall mount adapter plate, or motor adapter plate and power crimp terminals are also required for installation. Order the wall mount kit or adapter plate and power crimp terminals separately.

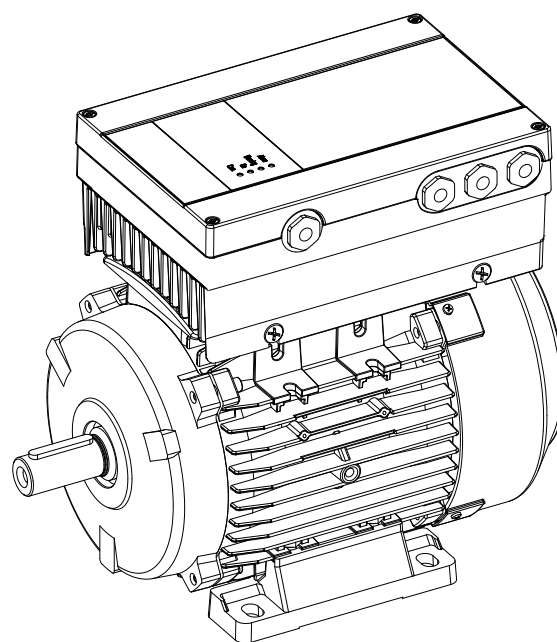
VLT® DriveMotor FCM 106

The frequency converter is mounted onto the motor at delivery. The combined FCP 106 and motor is known as the VLT® DriveMotor FCM 106.



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Illustration 1.1 FCP 106



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Illustration 1.2 FCM 106

1.2 Additional Resources

Available literature:

- *VLT® DriveMotor FCP 106/FCM 106 Operating Instructions*, for information required to install and commission the frequency converter.
- *VLT® DriveMotor FCP 106/FCM 106 Design Guide* provides information required for integration of the frequency converter into a diversity of applications.
- *VLT® DriveMotor FCP 106/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* and *VLT® DriveMotor FCP 106/FCM 106 BACnet Operating Instructions* for information required for controlling, monitoring, and programming of the frequency converter.
- The *VLT® PROFIBUS DP MCA 101 Installation Guide* provides information about installing the PROFIBUS and troubleshooting.
- The *VLT® PROFIBUS DP MCA 101 Programming Guide* provides information about configuring the system, controlling the frequency converter, accessing the frequency converter, programming, and troubleshooting. It also contains some typical application examples.
- *VLT® Motion Control 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 vlt-drives.danfoss.com/Support/Service/.

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.
 - Equipment driven by the motor.
- System and motor status surveillance.

The frequency converter can also be used for motor overload protection. The frequency converter is allowed for use in residential, industrial, and commercial environments in accordance with local laws and standards.

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

When using a motor with thermal protection, the frequency converter is allowed for use in residential, industrial, and commercial environments in accordance with local laws and standards.

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

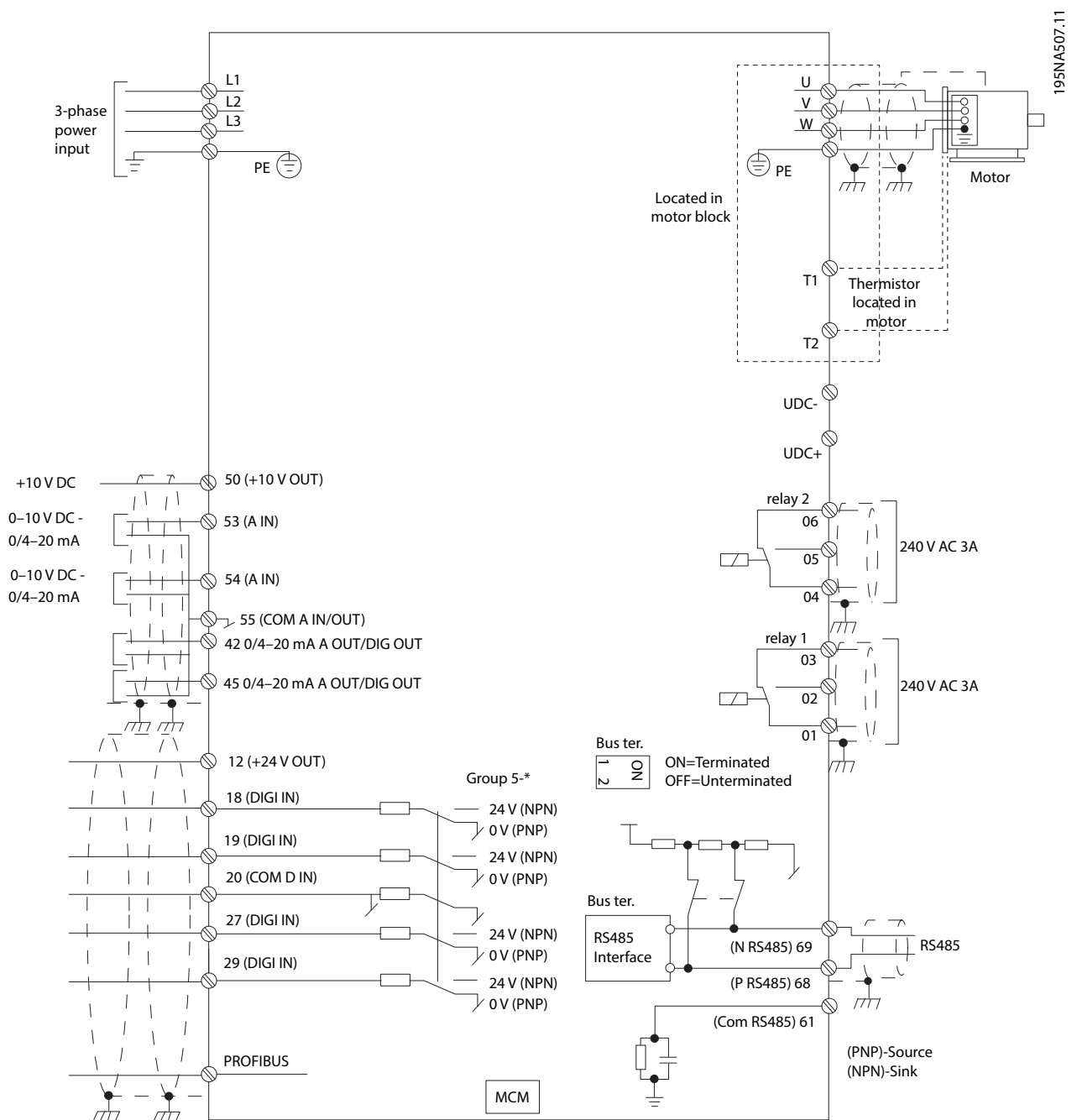






Illustration 1.3 Electrical Overview

1.4 Approvals

Certification		FCP 106	FCM 106
EC Declaration of Conformity		✓	✓
UL listed		-	✓
UL recognized		✓	-
C-tick		✓	✓

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

- Low Voltage Directive 2006/95/EC, based on EN 61800-5-1 (2007).
- EMC Directive 2004/108/EC, based on EN 61800-3 (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 recognized

More 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 UL 508C thermal memory retention requirements. For more information, refer to the section *Motor Thermal Protection* in the product-specific *design guide*.

1.5 Disposal Instruction

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

The following symbols are used in this manual:

⚠ WARNING

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

⚠ CAUTION

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

NOTICE

Indicates important information, including situations that can 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 are allowed to install and operate this equipment.

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

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, DC supply, or load sharing, the motor can start at any time. Unintended start during programming, service, or repair work can result in death, serious injury, or property damage. The motor can start with an external switch, a fieldbus command, an input reference signal from the LCP or LOP, via remote operation using a software tool, or after a cleared fault condition.

To prevent unintended motor start:

- Disconnect the frequency converter from mains.
- Press [Off/Reset] on the LCP before programming parameters.
- Ensure that the frequency converter, motor, and any driven equipment are fully wired and assembled when the frequency converter is connected to AC mains, DC supply, or load sharing.

⚠ WARNING

DISCHARGE TIME

The frequency converter contains DC-link capacitors, which can remain charged even when the frequency converter is not powered. High voltage can be present even when the warning LED indicator lights are off. Failure to wait the specified time after power has been removed before performing service or repair work can result in death or serious injury.

- Stop the motor.
- Disconnect AC mains and remote DC-link power supplies, including battery back-ups, UPS, and DC-link connections to other frequency converters.
- Disconnect or lock PM motor.
- Wait for the capacitors to discharge fully. The minimum duration of waiting time is specified in *Table 2.1*.
- Before performing any service or repair work, use an appropriate voltage measuring device to make sure that the capacitors are fully discharged.

Voltage [V]	Power range ¹⁾ [kW (hp)]	Minimum waiting time (minutes)
3x400	0.55–7.5 (0.75–10)	4

Table 2.1 Discharge Time

1) Power ratings relate to normal overload (NO).

⚠ 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.

⚠ WARNING

EQUIPMENT HAZARD

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

- Ensure that 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 guide.

⚠ WARNING

UNINTENDED MOTOR ROTATION WINDMILLING

Unintended rotation of permanent magnet motors creates voltage and can charge the unit, resulting in death, serious injury, or 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 (PE) 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. The DC component 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/IEC 61800-5-1 (Power Drive System Product Standard) requires special care because the leakage current exceeds 3.5 mA. See EN 60364-5-54 section 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 that the ground wire has a cross-section of at least 10 mm² (7 AWG).
 - Ensure that 2 separate ground wires are used, both complying with the dimensioning rules.

NOTICE

HIGH ALTITUDES

For installation at altitudes above 2000 m (6562 ft), contact Danfoss regarding PELV.

⚠ WARNING

DC CURRENT RISK

This product can cause a DC current in the protective conductor. Failure to follow the precautions can lead to personal injury or property damage.

Take the following precautions:

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

⚠ 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 according to 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 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 high-strand wire to reduce electrical noise.
- Follow the motor manufacturer's 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 that gaskets, sealants, and guards are correctly fitted.
- Ensure correct belt tension.

3.1.1 Items Supplied, FCP 106

Check that all items are included:

- 1 FCP 106 frequency converter.
- 1 accessory bag.
- 1 VLT® Memory Module MCM 101.
- Operating instructions.

3.1.2 Further Items Required, FCP 106

- 1 adapter plate (wall mount 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 pieces for motor terminals, U, V, and W.
 - 2 pieces for thermistor (optional).
 - 1 piece for grounding terminal.
- 2 guiding pins (optional).

3.1.3 Items Supplied, FCM 106

Check that all items are included:

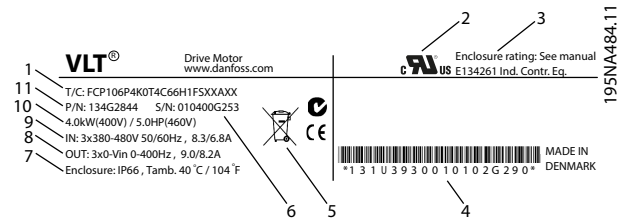
- 1 FCM 106 frequency converter with motor.
- 1 accessory bag.
- Operating Instructions.

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.

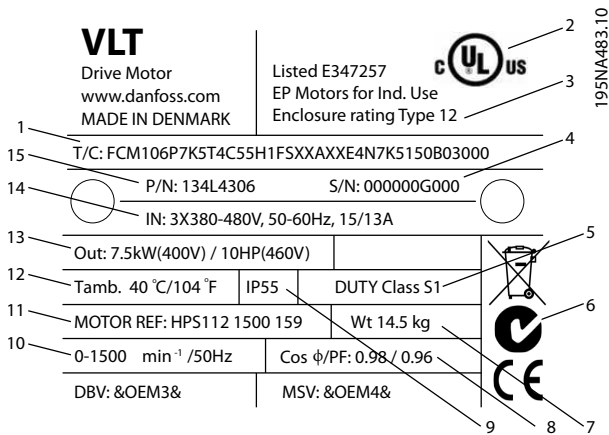
3.1.5 Nameplates



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, maximum ambient temperature without derating
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 without derating
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

LOSS OF WARRANTY

Do not remove the nameplate from the frequency converter.

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.

Only qualified personnel must undertake handling and lifting of the unit. 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 the 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 the 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 the 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 several mounting alternatives.

FCM 106

The frequency converter is mounted onto the motor at 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*.

Go directly to *chapter 3.3.4 Mount the DriveMotor*.

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 the frequency converter to the 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, see *chapter 4.7.1 Connecting to Mains*.

3.3.2 Prepare Gasket

Preparation of a gasket applies only when mounting an 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, or 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 and ensure metallic contact between the motor adapter plate and motor.
- Use a UL recognised 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.

3

For adapter plate with no pre-drilled holes, refer to *Illustration 3.3*.

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.

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

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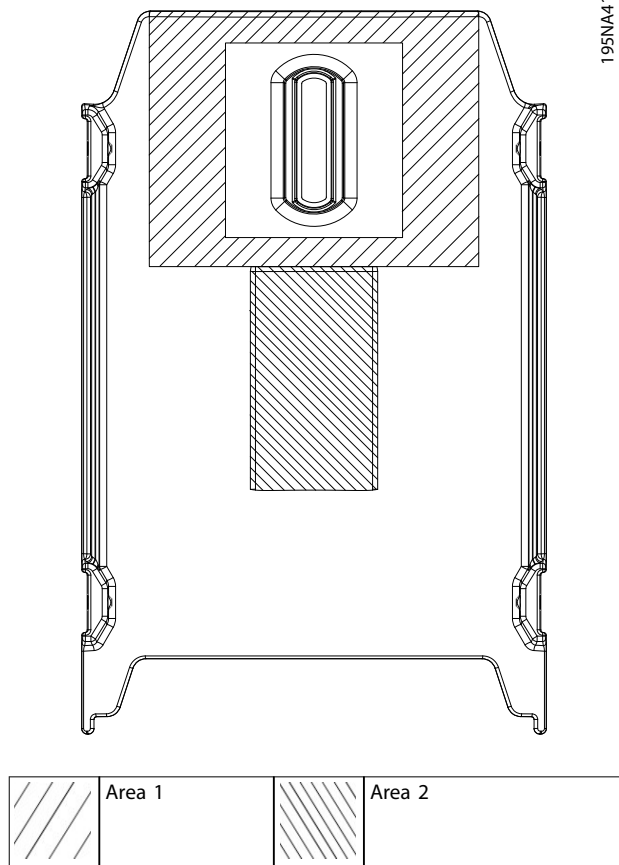
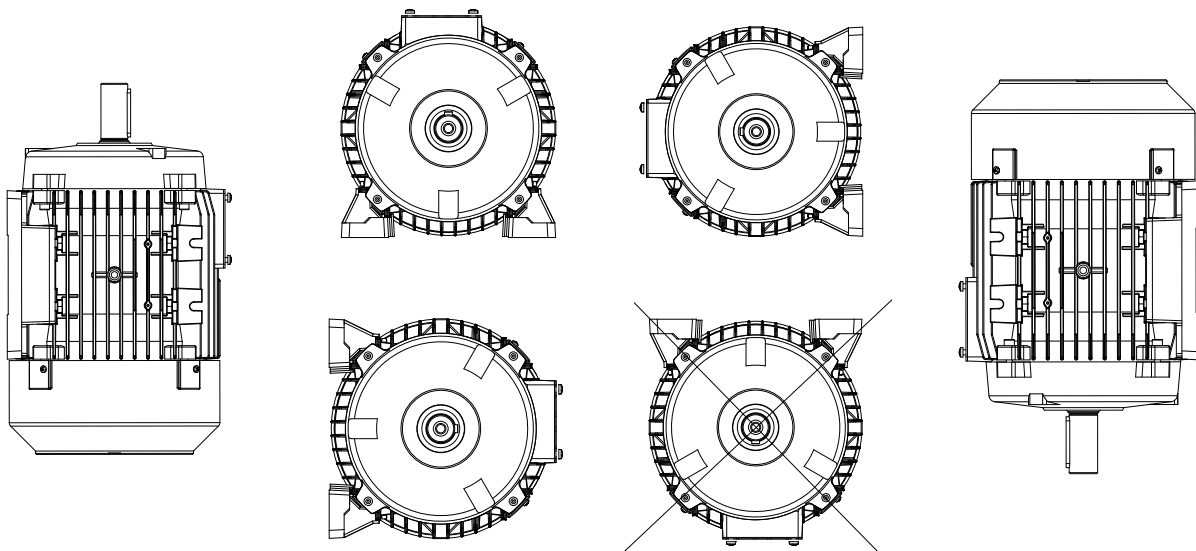


Illustration 3.3 Adapter Plate, Guide for Drilling Holes

3.3.4 Mount the DriveMotor



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3

Illustration 3.4 Installation Orientation, IP54/UL Type 3R

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 1 DriveMotor are mounted close by, 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 on the frequency converter, as this foil 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 damage results in an increase in bearing noise and a significant reduction in bearing life.

3.3.5 Shaft Alignment

When the application requires direct coupling, the shafts must be correctly aligned in all 3 planes. Incorrect alignment can be a major source of noise, vibration, and reduced bearing life.

Make allowance for shaft end float 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 according to *Table 3.1* and *Table 3.2*, when the following conditions are fulfilled:

- Temperature of 80 °C (176 °F).
- Radial forces in load point corresponding to half-shaft extension do not exceed the values specified in *Table 3.1* and *Table 3.2*.

3

IE2 50 Hz 3-phase motors		Permissible radial forces		Permissible axial forces (IMB3)		Permissible axial forces (IMV1)		Permissible axial forces (IMV1)	
				Both directions		Force upwards		Force downwards	
		Motor size	Number of poles	20000 h F rad [N]	40000 h F rad [N]	20000 h F ax [N]	40000 h F ax [N]	20000 h F ax [N]	40000 h F ax [N]
71	2	460	370	230	175	260	205	210	170
	4	580	465	330	250	350	275	300	240
80	2	590	475	320	255	340	280	290	220
	4	830	665	440	350	470	380	410	310
90	2	670	535	340	260	380	315	310	235
	4	940	750	480	365	470	385	440	330
100	2	920	735	480	360	540	460	430	325
	4	1290	1030	680	530	740	620	620	465
112	2	930	745	480	380	560	475	400	300
	4	1300	1040	680	540	750	630	600	450
132 S	2	1350	1080	800	625	1000	845	610	460
	4	1900	1520	1130	880	1320	1095	930	700
132 M	2	1400	1120	780	610	990	835	580	435
	4	1970	1575	1090	850	1300	1080	890	670
160 M	2	1550	1240	840	685	1180	975	500	395
	4	2170	1735	1180	950	1520	1245	830	640
160 L	2	1580	1265	820	675	1180	980	460	365
	4	2220	1775	1150	925	1510	1245	790	610

Table 3.1 Permissible Forces, IE2 50 Hz 3-phase Motors

Permissible radial forces: Load point corresponding to half-shaft extension, 0 axial force assumed.

Permissible axial forces: 0 radial force assumed.

Permissible loads of simultaneous radial and axial forces can be supplied on request.

HPS motors		Permissible radial forces		Permissible axial forces (IMB3)		Permissible axial forces (IMV1)		Permissible axial forces (IMV1)	
				Both directions		Force upwards		Force downwards	
		20000 h	40000 h	20000 h	40000 h	20000 h	40000 h	20000 h	40000 h
Motor size	Speed [RPM]	F rad [N]	F rad [N]	F ax [N]	F ax [N]	F ax [N]	F ax [N]	F ax [N]	F ax [N]
71	1500	580	465	330	250	350	275	300	240
	1800	520	420	295	225	315	250	270	215
	3000	460	370	230	175	260	205	210	170
	3600	415	335	205	155	235	185	190	150
90	1500	940	750	480	365	470	385	440	330
	1800	845	675	430	330	420	345	395	300
	3000	670	535	340	260	380	315	310	235
	3600	600	480	305	235	340	285	280	210
112	1500	1300	1040	680	540	750	630	600	450
	1800	1170	935	610	485	675	565	540	405
	3000	930	745	480	380	560	475	400	300
	3600	835	670	430	340	505	430	360	270
132 M	1500	–	–	–	–	–	–	–	–
	1800	1710	1370	1015	790	1190	985	835	630
	3000	1350	1080	800	625	1000	845	610	460
	3600	1215	970	720	565	900	760	550	415
132 XL	1500	1970	1575	1090	850	1300	1080	890	670
	1800	–	–	–	–	–	–	–	–
	3000	1400	1120	780	610	990	835	580	435
	3600	1260	1010	700	550	890	750	520	390
132 XXL	1500	1970	1575	1090	850	1300	1080	890	670
	1800	1770	1415	980	765	1170	970	800	600
	3000	1400	1120	780	610	990	835	580	435
	3600	1260	1010	700	550	890	750	520	390

Table 3.2 Permissible Forces, HPS Motors

Permissible radial forces: Load point corresponding to half-shaft extension, 0 axial force assumed.

Permissible axial forces: 0 radial force assumed.

Permissible loads of simultaneous radial and axial forces can be supplied on request.

Motor type	Motor frame size	Lubrication type	Temperature range
Asynchronous	80–180	Lithium basis	-40 to +140 °C (-40 to +280 °F)
PM	71–160		

Table 3.3 Lubrication

Motor 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	–	–	6205 2ZC3	6303 2ZC3
80	1500/3000	6204 2ZC3	6204 2ZC3	–	–
90	1500/3000	6205 2ZC3	6205 2ZC3	6206 2ZC3	6205 2ZC3
100	1500/3000	6206 2ZC3	6206 2ZC3	–	–
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	1)	1)	–	–
180	1500/3000	1)	1)	–	–

Table 3.4 Standard Bearing References and Oil Seals for Motors

1) Data available at 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 means that the RCD may not provide the intended protection.

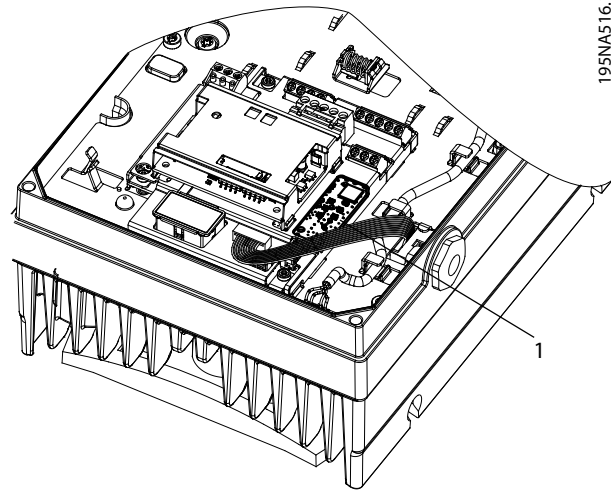
- When a residual current-operated protective device (RCD) is used for protection against electrical shock, only an RCD of Type B is permitted on the supply side.

CAUTION

EQUIPMENT HAZARD

The PCB area is sensitive to electrostatic discharge. Touching the PCB area can cause equipment damage.

- Do not touch the PCB area.



195NA516.10

1	PCB area
---	----------

Illustration 4.1 Avoid Touching the PCB Area

Overcurrent protection

- Extra 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 overcurrent protection. If not factory-supplied, the installer must provide fuses. See maximum fuse ratings in *Table 7.15*, *Table 7.16*, and *Table 7.17*.

Wire type and ratings

NOTICE

Insulation requirements, MH1

For control card and relay card wires, the minimum required insulation is 300 V and 75 °C (167 °F).

- All wiring must comply with local and national regulations regarding cross-section and ambient temperature requirements.
- Power connection wire recommendation: Minimum 75 °C (167 °F) rated copper wire.

See *chapter 7 Specifications* and *chapter 7.6 Cable Specifications* for recommended wire sizes and types.

4.2 IT Mains

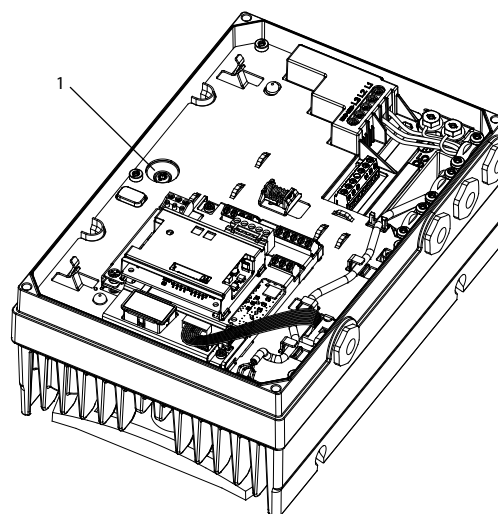
CAUTION**IT MAINS**

Installation on isolated mains source, that is, IT mains.
Maximum 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 4.7*.
- Disable the RFI filter by removing the RFI switch/screw. For location, see *Illustration 4.2*.

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



195NA403.11

4

1	RFI switch/screw
---	------------------

Illustration 4.2 Location of RFI Switch/Screw

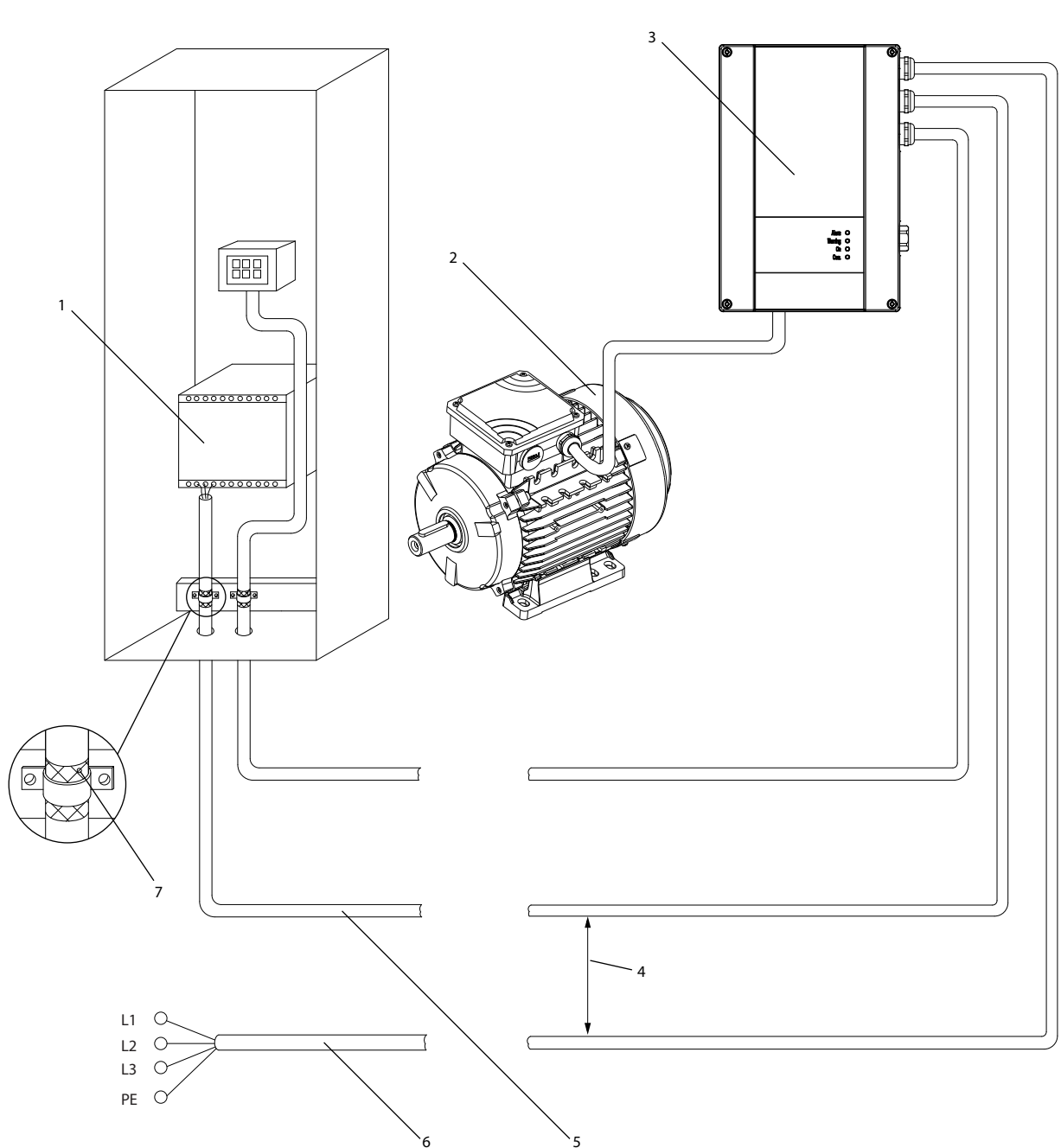
CAUTION

To reinsert, use an M3.5x20 screw only.

4

4.3 EMC-compliant Installation

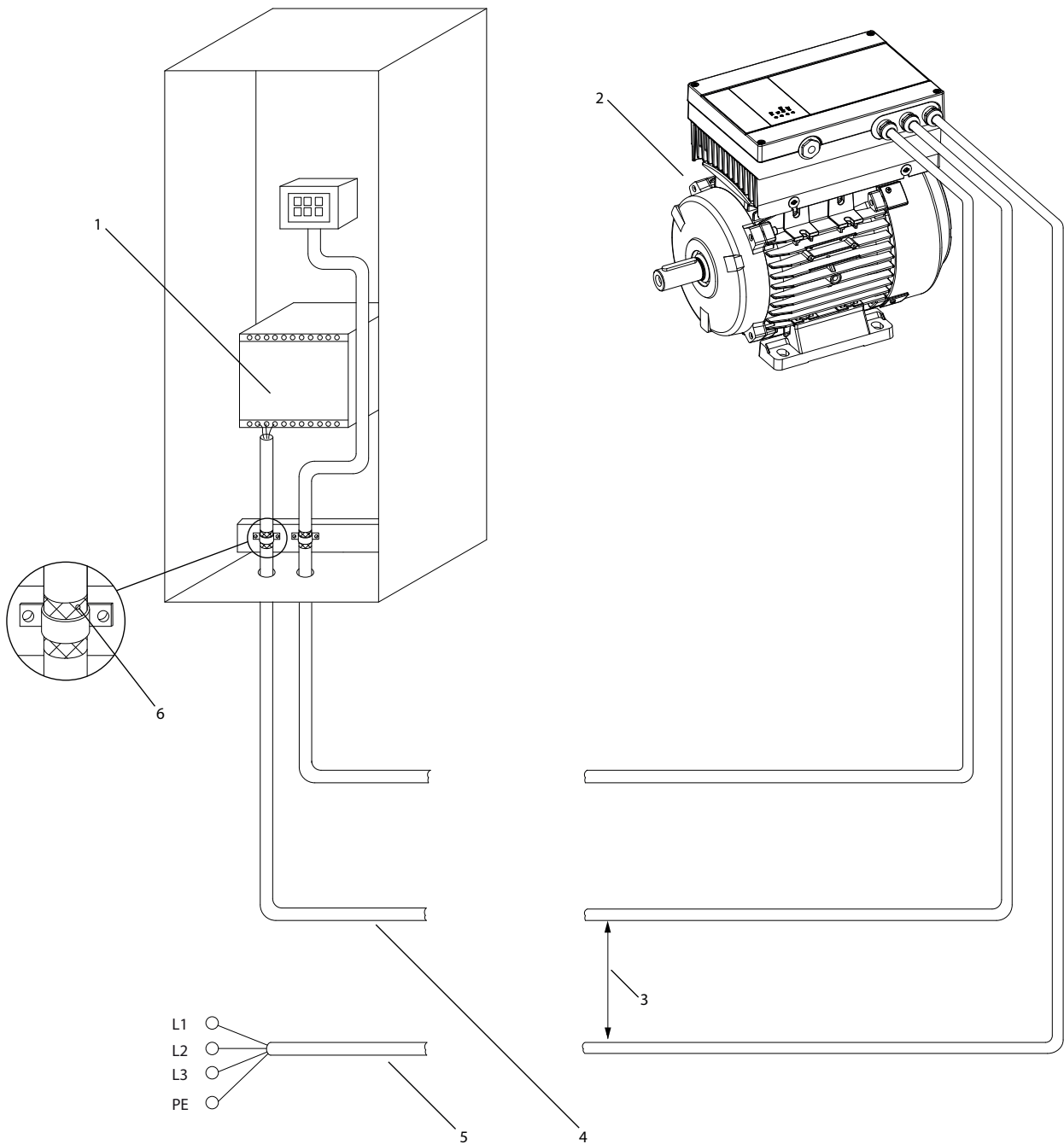
4.3.1 EMC-compliant Electrical Installation



195NA420.10

1	PLC	5	Control cables
2	Motor	6	Mains, 3-phase, and reinforced PE
3	Frequency converter	7	Cable insulation (stripped)
4	Minimum 200 mm (7.87 in) clearance between control cable, mains cable, and mains motor cable.		

Illustration 4.3 EMC-compliant Electrical Installation, FCP 106



1	PLC	4	Control cables
2	DriveMotor	5	Mains, 3-phase, and reinforced PE
3	Minimum 200 mm (7.87 in) clearance between control cable and mains cable.	6	Cable insulation (stripped)

Illustration 4.4 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 ground at both ends.
- Avoid installation with twisted screen ends (pigtailed), since this type of installation ruins the screen effect at high frequencies. Use the cable clamps provided instead.
- Ensure the same potential between frequency converter and ground potential of the 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 are required (75 °C (167 °F) (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 protective bonding:

- Ensure metal contact between the frequency converter and the motor, see *Illustration 4.5*.
- 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

Screws extending too far into the enclosure or too far above the adapter plate pose a risk of damage to motor or frequency converter.

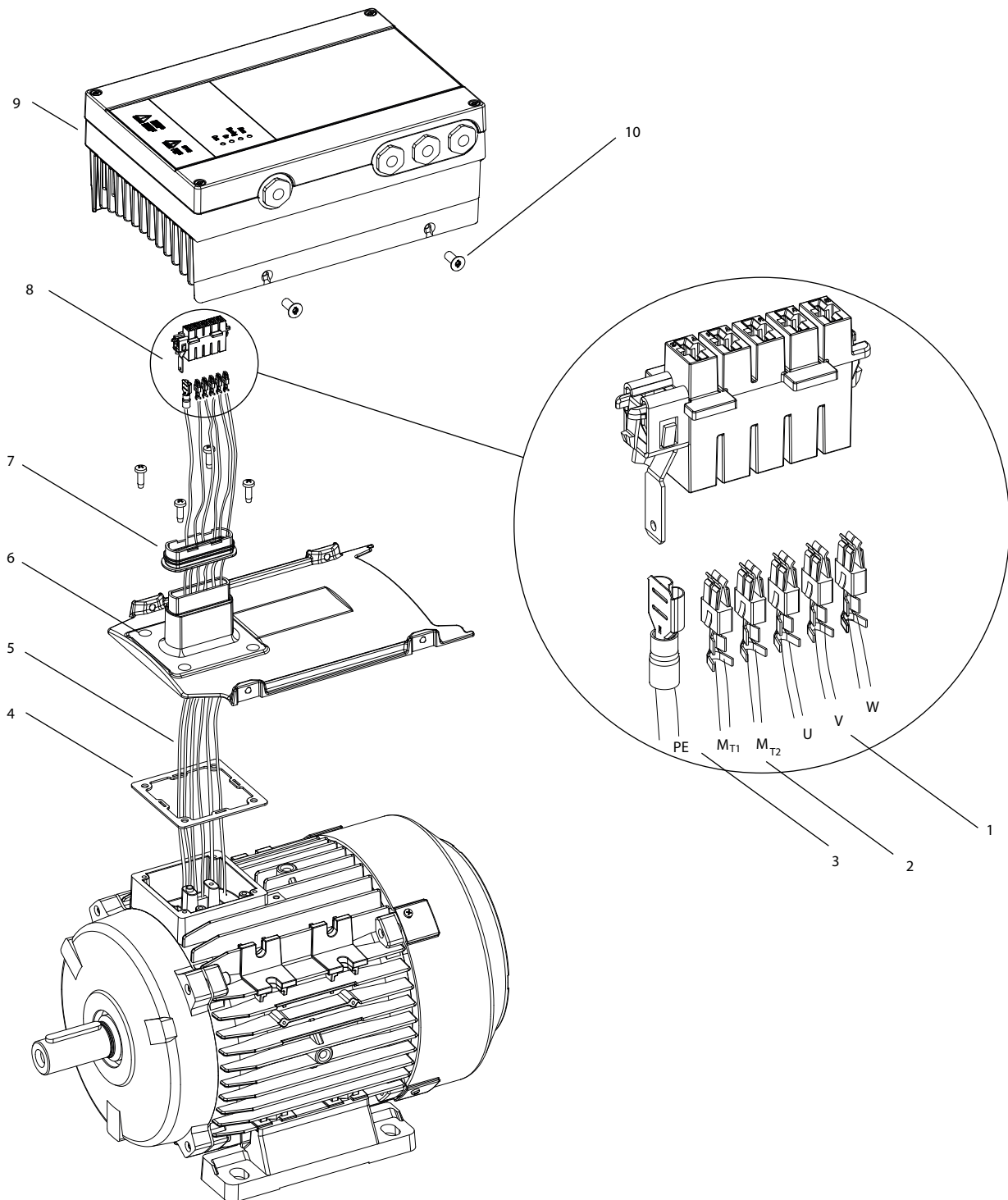
To connect the FCP 106 to the motor, follow the installation steps shown in *Table 4.1* and *Illustration 4.5*.

Step	Description
1	Mount motor phases and thermistor wires in crimp terminals. Crimp ordering numbers (AMP standard power timer contacts) ¹⁾ : <ul style="list-style-type: none"> • 134B0495 (0.2–0.5 mm²) [AWG 24–20]. • 134B0496 (0.5–1 mm²) [AWG 20–17]. • 134B0497 (1–2.5 mm²) [AWG 17–13.5]. • 134B0498 (2.5–4 mm²) [AWG 13–11]. • 134B0499 (4–6 mm²) [AWG 12–10].
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 <i>chapter 3.3.2 Prepare Gasket</i> .
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. <ul style="list-style-type: none"> • Insert guide pins into 2 of the screw holes, before lowering the adapter plate into position. Remove the guide pins when mounting screws. • Ensure that 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. <ul style="list-style-type: none"> • 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. <p>NOTICE The thermistor is not galvanically isolated. Interchanging the thermistor wires with the motor wires may permanently damage the frequency converter.</p>
8	Click motor connector into the neck of the adapter plate.
9	Position the 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 4.5*

1) Contacts from other manufacturers, and contacts made with equal or better electrical conductivity and plating, are also suitable if they fulfil the mechanical and electrical requirements.

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



1	U, V, W (motor phases)	6	Adapter plate
2	MT1, MT2 (motor thermistor wires)	7	Motor connector gasket
3	PE	8	Motor connector
4	Gasket between motor and motor bracket	9	Frequency converter
5	Motor cables	10	Fastening screw

Illustration 4.5 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 *chapter 4.6.1 Connect FCP 106 to Motor*.

Set *parameter 1-90 Motor Thermal Protection* according to guidelines in *chapter 5.4.5 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

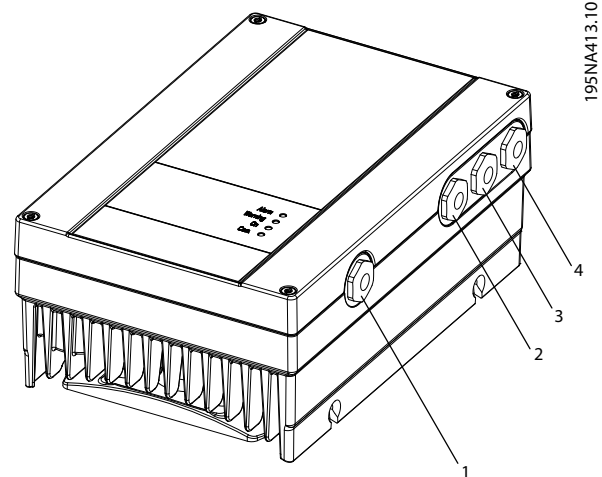
The frequency converter is designed to operate all standard 3-phased asynchronous motors and PM motors. For maximum cross-section on wires, see *chapter 7.2.1 Mains Supply 3x380–480 V AC Normal and High Overload*.

FCP 106 wall mount

- To comply with EMC emissions requirements:
 - Use screened motor cable, maximum length 0.5 m (1.64 ft).
 - Connect this cable to the metal housing of both the frequency converter and the motor.
- See also *chapter 4.3 EMC-compliant Installation*.

Procedure for connection of mains power

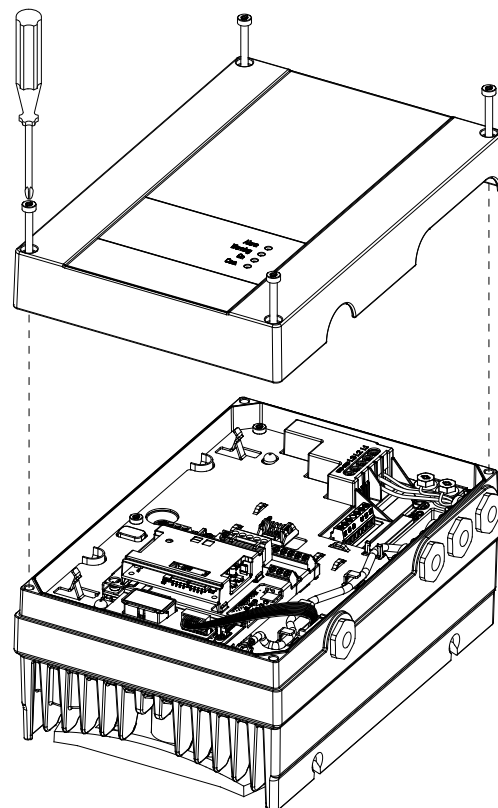
1. Observe safety precautions, see *chapter 2.2 Safety Precautions*.
2. Loosen front cover screws.
3. Remove the front cover, see *Illustration 4.7*.
4. Mount cable glands fulfilling the requirements for the needed enclosure integrity.
5. Connect the ground wires to the ground terminals via the cable glands, see *Illustration 4.8*.
6. Connect the mains cable to terminals L1, L2, and L3, and tighten the screws. See *Illustration 4.8*.
7. Reassemble cover and tighten screws.
8. For tightening torques, see *chapter 7.8 Connection Tightening Torques*.



195NA413.10

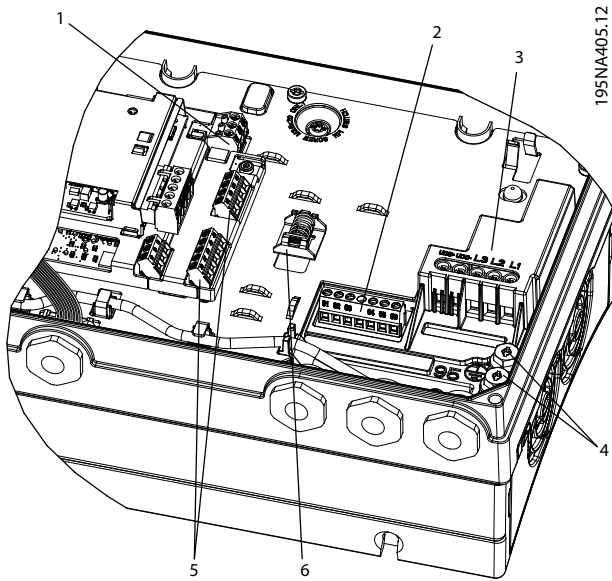
1	LCP extension cable entry
2, 3	Entries for other cables: Control, RS485, and relay cables
4	Mains cable entry

Illustration 4.6 Location of Cable Entries, MH1–MH3



195NA408.11

Illustration 4.7 Remove Front Cover



195NA405.12

1	Control terminals
2	Relays
3	Mains (L3, L2, L1)
4	PE
5	RS485
6	Spring clamp for PROFIBUS cable

Illustration 4.8 Cabling, MH1-MH3

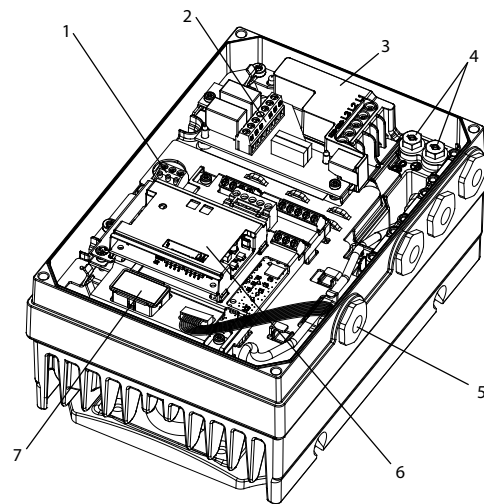
4.8 Control Wiring

4.8.1 Control Terminals and Relays 2

Procedure:

1. Connect the terminal and cables at the locations shown in *Illustration 4.9* and *Illustration 4.10*.
2. For more terminal details, refer to *chapter 4.8.2 Control Terminals and Relays 3*.
3. Mount the front cover and tighten the screws.
4. The frequency converter is now ready. For start-up, go to *chapter 5.1.2 Start-up*.

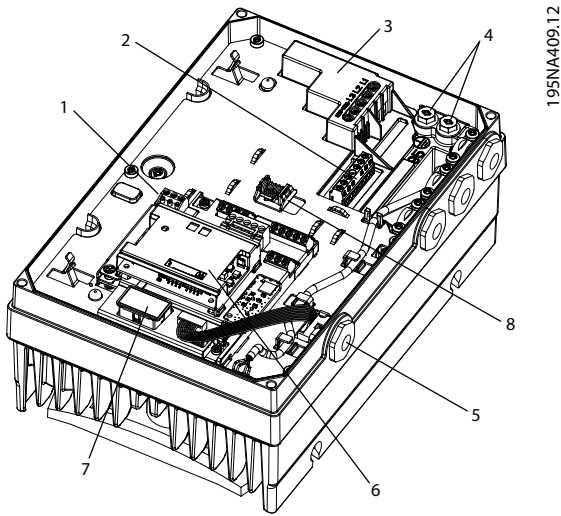
4.8.2 Control Terminals and Relays 3



195NA458.12

1	Control terminals
2	Relay terminals
3	UDC+, UDC-, Line (L3, L2, L1)
4	PE
5	LCP connector
6	VLT® PROFIBUS DP MCA 101
7	VLT® Memory Module MCM 101

Illustration 4.9 Location of Terminals and Relays, MH1



1	Control terminals
2	Relay terminals
3	UDC+, UDC-, Line (L3, L2, L1)
4	PE
5	LCP connector
6	VLT® PROFIBUS DP MCA 101
7	VLT® Memory Module MCM 101
8	Spring clamp for PROFIBUS cable

Illustration 4.10 Location of Terminals and Relays, MH2-MH3

Control terminals

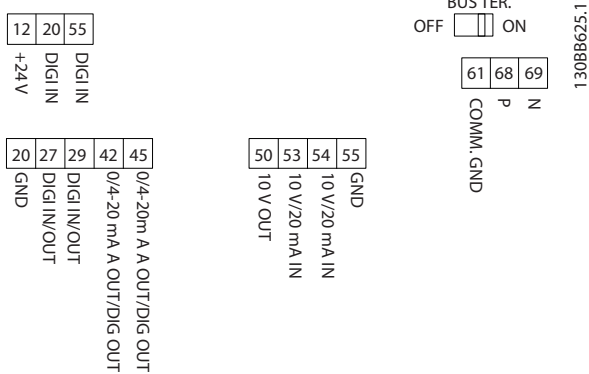


Illustration 4.11 Control Terminals

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/output	*PNP/NPN	Coast inverse
29	Digital input/output/pulse 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	10 bit	*0–20 mA/4–20 mA/DO	Analog
45	10 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 4.2 Control Terminal Functions

* Indicates default setting.

NOTICE

PNP/NPN is common for terminals 18, 19, 27, and 29.

4.8.3 Load Sharing

Load sharing is not allowed.

4.8.4 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 decreases life, and may permanently damage the frequency converter.

4.9 Installation Checklist

Before completing installation of the unit, inspect the entire installation as detailed in *Table 4.3*. Check and mark the items when completed.

Inspect for	Description	<input type="checkbox"/>
Auxiliary equipment	<ul style="list-style-type: none"> Look for auxiliary equipment, switches, disconnects, or input fuses/circuit breakers, residing 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 the function and installation of any sensors used for feedback to the frequency converter. Remove any power factor correction caps on the motor. Adjust any power factor correction caps on the mains side and ensure that they are dampened. 	<input type="checkbox"/>
Cable routing	<ul style="list-style-type: none"> Ensure that the motor wiring and control wiring are separated, screened, or in 3 separate metallic conduits for high frequency interference isolation. 	<input type="checkbox"/>
Control wiring	<ul style="list-style-type: none"> Check for broken or damaged wires and loose connections. Check that the control wiring is isolated from power and motor wiring for noise immunity. Check the voltage source of the signals, if necessary. <p>The use of screened cable or twisted pair is recommended. Ensure that the screen is terminated correctly.</p>	<input type="checkbox"/>
Cooling clearance	<ul style="list-style-type: none"> Ensure that the top and bottom clearance is adequate to ensure proper air flow for cooling, see <i>chapter 7.1 Clearances, Dimensions and Weights</i>. 	<input type="checkbox"/>
Ambient conditions	<ul style="list-style-type: none"> Check that requirements for ambient conditions are met. 	<input type="checkbox"/>
Fusing and circuit breakers	<ul style="list-style-type: none"> 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. 	<input type="checkbox"/>
Grounding	<ul style="list-style-type: none"> Check for sufficient ground connections and ensure that those connections are tight and free of oxidation. Grounding to conduit, or mounting the back panel to a metal surface, is not a suitable grounding. 	<input type="checkbox"/>
Input and output power wiring	<ul style="list-style-type: none"> Check for loose connections. Check that the motor and mains cables are in separate conduit or separated screened cables. 	<input type="checkbox"/>
Panel interior	<ul style="list-style-type: none"> 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. 	<input type="checkbox"/>
Switches	<ul style="list-style-type: none"> Ensure that all switch and disconnect settings are in the proper positions. 	<input type="checkbox"/>
Vibration	<ul style="list-style-type: none"> Check that the unit is mounted solidly, or that shock mounts are used, as necessary. Check for an unusual amount of vibration. 	<input type="checkbox"/>

Table 4.3 Installation Check List

CAUTION

POTENTIAL HAZARD IN THE EVENT OF INTERNAL FAILURE

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

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

4.9.1 Recommendations for UL-listed PRGY Systems

⚠ WARNING

FIRE HAZARD

For VLT® DriveMotor FCM 106 with either asynchronous or permanent magnet motors listed under UL PRGY systems, conduct a locked rotor temperature test and a running overload test to avoid motor overtemperature. The need for conducting the tests is determined by the end product standard where the VLT® DriveMotor FCM 106 is used. Failure to complete/pass the locked rotor temperature test and the running overload test could prevent the frequency converter from functioning.

- Check and set the following parameters before test:
 - *Parameter 1-90 Motor Thermal Protection.*
 - *Parameter 4-18 Current Limit.*
 - *Parameter 14-20 Reset Mode.*
 - *Parameter 14-21 Automatic Restart Time.*
 - *Parameter 14-90 Fault Level.*
 - *Parameter 30-22 Locked Rotor Detection.*
- Do not exceed the temperature limits stated in the motor data provided by the motor manufacturer.

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 *parameter 0-01 Language*.

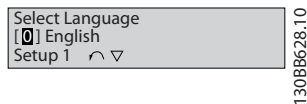


Illustration 5.1 Select Language

5.2 Local Control Panel Operation

NOTICE

The frequency converter can also be programmed from a PC via the RS485 COM port by installing the MCT 10 Set-up Software.

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).

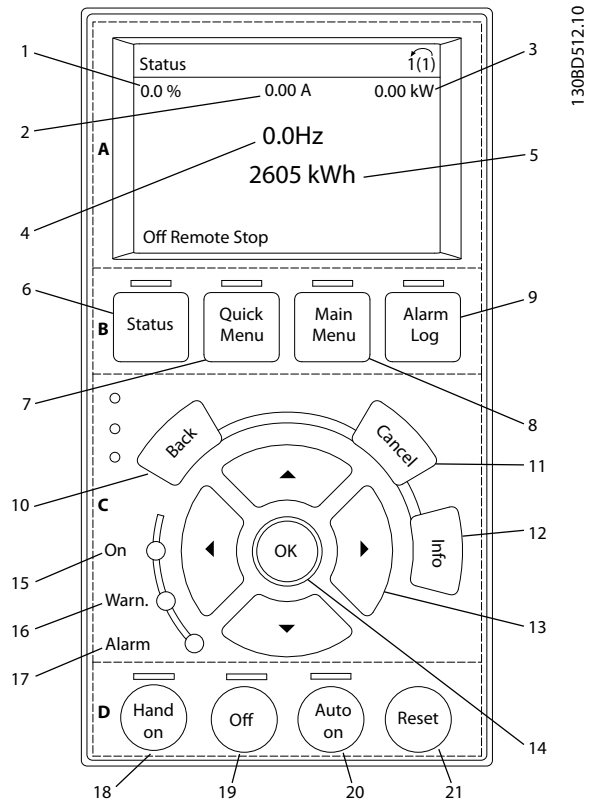


Illustration 5.2 Local Control Panel (LCP)

A. Display area

The display area is activated when the frequency converter receives power from mains voltage, a DC bus terminal, or a 24 V DC external supply.

The information shown on the LCP can be customized for user application. Select options in the Quick Menu Q3-13 *Display settings*.

Call-out	Display	Parameter number	Default setting
1	1.1	0-20	Reference %
2	1.2	0-21	Motor current
3	1.3	0-22	Power [kW]
4	2	0-23	Frequency
5	3	0-24	kWh counter

Table 5.1 Legend to Illustration 5.2

B. Display menu key

Menu keys are used for menu access for parameter set-up, toggling through status display modes during normal operation, and viewing fault log data.

Callout	Key	Function
6	Status	Shows operational information.
7	Quick Menu	Allows access to programming parameters for initial set-up instructions and many detailed application instructions.
8	Main Menu	Allows access to all programming parameters.
9	Alarm Log	Shows a list of current warnings, the last 10 alarms, and the maintenance log.

Table 5.2 Legend to Illustration 5.2

C. Navigation keys and indicator lights (LEDs)

Navigation keys are used for programming functions and moving the display cursor. The navigation keys also provide speed control in local operation. There are also 3 frequency converter status indicator lights in this area.

Callout	Key	Function
10	Back	Reverts to the previous step or list in the menu structure.
11	Cancel	Cancels the last change or command as long as the display mode has not changed.
12	Info	Press for a definition of the function shown.
13	Navigation keys	Press to move between items in the menu.
14	OK	Press to access parameter groups or to enable a selection.

Table 5.3 Legend to Illustration 5.2

Call-out	Indicator	Light	Function
15	ON	Green	The ON light activates when the frequency converter receives power from mains voltage, a DC bus terminal, or a 24 V external supply.
16	WARN	Yellow	When warning conditions are met, the yellow WARN light turns on, and text appears in the display area identifying the problem.
17	ALARM	Red	A fault condition causes the red alarm light to flash, and an alarm text is shown.

Table 5.4 Legend to Illustration 5.2

D. Operation keys and indicator lights (LEDs)

Operation keys are at the bottom of the LCP.

Callout	Key	Function
18	Hand On	Starts the frequency converter in local control. <ul style="list-style-type: none"> An external stop signal by control input or serial communication overrides the local hand on.
19	Off	Stops the motor but does not remove power to the frequency converter.
20	Auto On	Puts the system in remote operational mode. <ul style="list-style-type: none"> Responds to an external start command by control terminals or serial communication.
21	Reset	Resets the frequency converter manually after a fault has been cleared.

Table 5.5 Legend to Illustration 5.2

NOTICE

To adjust the display contrast, press [Status] and [▲]/[▼].

5.2.1 Connect LCP Cable

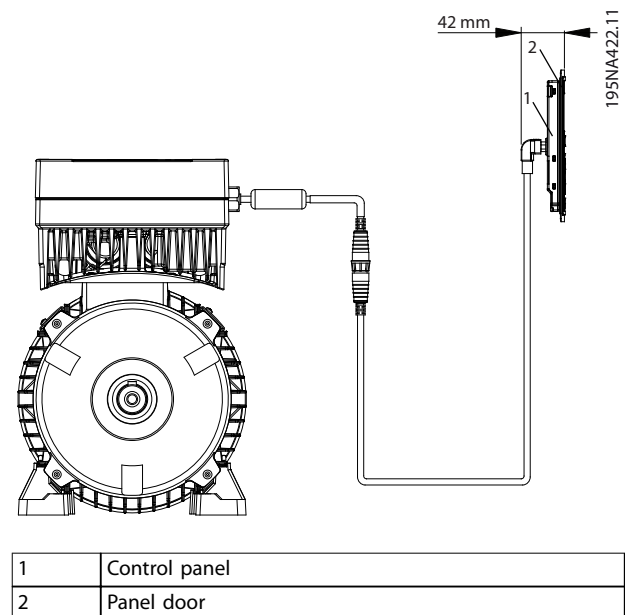


Illustration 5.3 LCP Remote Mounting

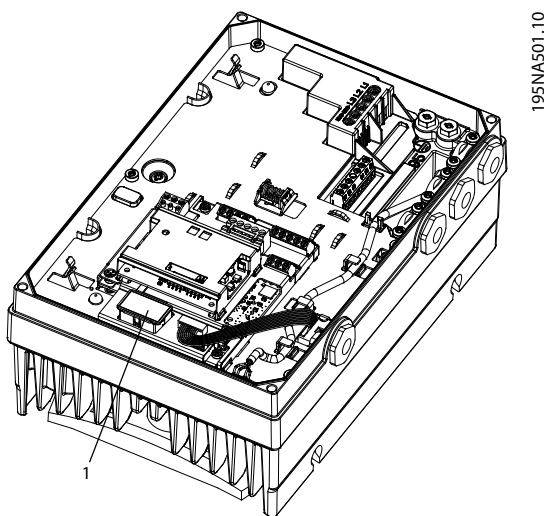
To view or change the frequency converter settings, attach the LCP using the LCP cable. See Illustration 5.3. After use, remove the LCP cable from the frequency converter to maintain the ingress protection class of the enclosure.

5.3 Memory Module MCM 101

The VLT® Memory Module MCM 101 is a small memory plug containing data such as:

- Firmware.
- SIVP file.
- Pump table.
- Motor database.
- Parameter lists.

The frequency converter comes with the module installed from the factory.



1	VLT® Memory Module MCM 101
---	----------------------------

Illustration 5.4 Location of Memory Module

If the memory module becomes defect, it does not prevent the frequency converter from working. The warning LED on the lid flashes, and a warning shows in the LCP (if installed).

Warning 206, Memory module indicates that either a frequency converter runs without a memory module, or that the memory module is defect. To see the exact reason for the warning, refer to *parameter 18-51 Memory Module Warning Reason*.

A new memory module can be ordered as a spare part. Ordering number: 134B0791.

5.3.1 Configuring with the VLT® Memory Module MCM 101

When replacing or adding a frequency converter to a system, it is easy to transfer existing data to the new frequency converter. However, the frequency converters must be of the same power size and with compatible hardware.

WARNING

DISCONNECT POWER BEFORE SERVICING!

Before performing repair work, disconnect the frequency converter from AC mains. After mains has been disconnected, wait 4 minutes for the capacitors to discharge. Failure to follow these steps can result in death or serious injury.

1. Remove the lid from a frequency converter containing a memory module.
2. Unplug the memory module.
3. Place and tighten the lid.
4. Remove the lid from the new frequency converter.
5. Insert the memory module in the new/other frequency converter and leave it in.
6. Place and tighten the lid on the new frequency converter.
7. Power up the frequency converter.

NOTICE

The first power-up takes approximately 3 minutes. During this time, all data is transferred to the new frequency converter.

5.4 Basic Programming

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

At initial start-up, the frequency converter enters the start-up wizard for open-loop applications, see *chapter 5.4.1 Configuration for Open-loop Applications*. Once the start-up wizard has completed, the following extra set-up wizards and instructions are available:

- *Chapter 5.4.2 Set-up Wizard for Closed-loop Applications.*
- *Chapter 5.4.3 Quick Menu Motor Set-up.*
- *Chapter 5.4.5 Thermistor Set-up.*

For general instructions on how to change parameter settings, refer to *chapter 5.4.4 Changing Parameter Settings*.

5.4.1 Configuration for Open-loop Applications

This section 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 utilize a feedback signal from the process.

5

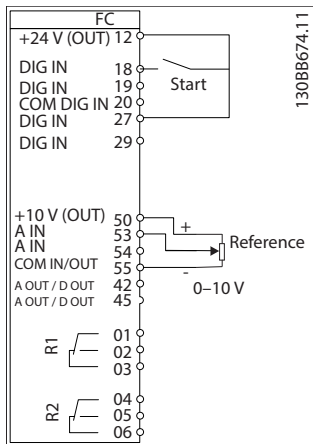


Illustration 5.5 Principle Wiring for Open-loop Applications

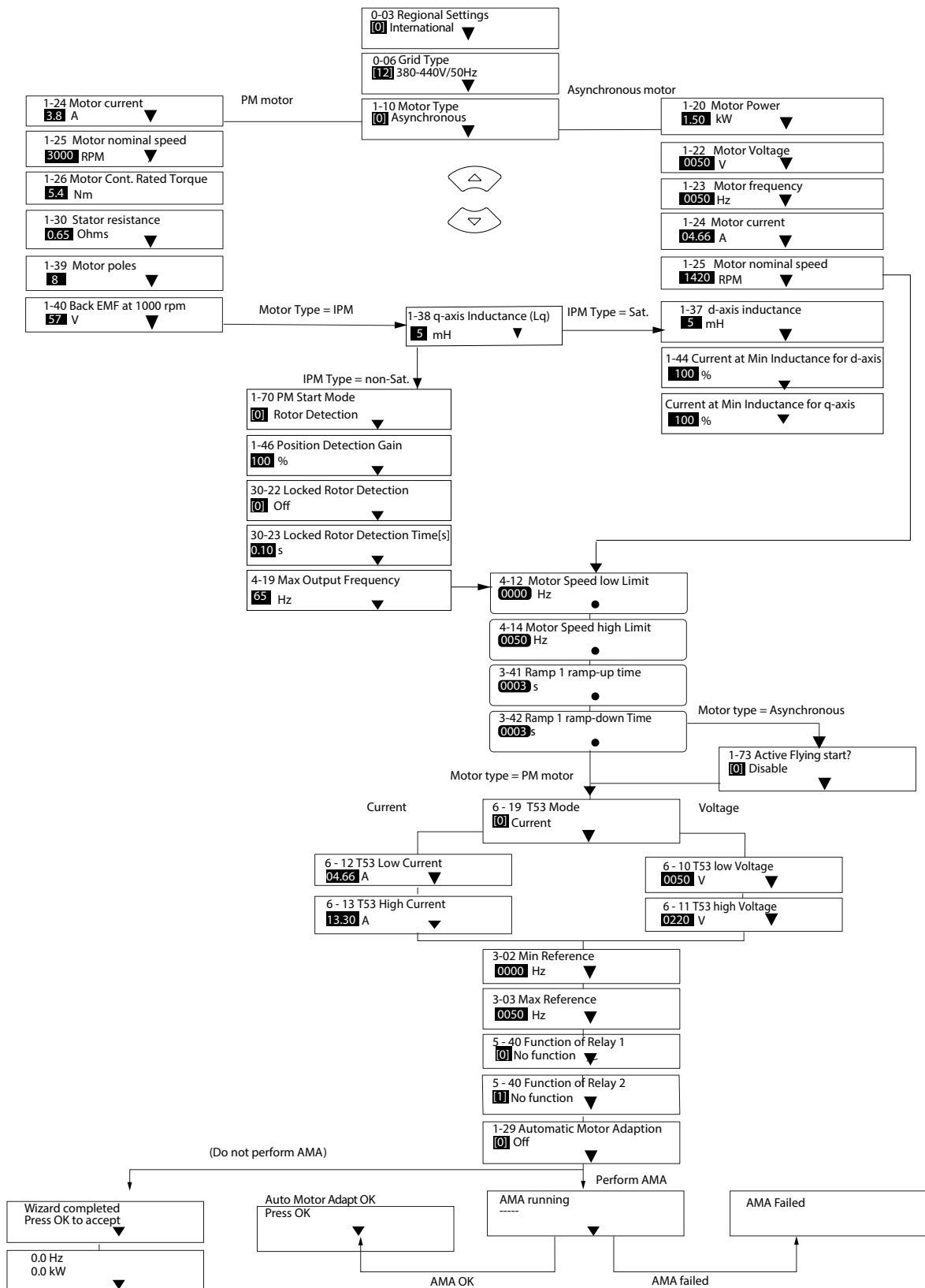
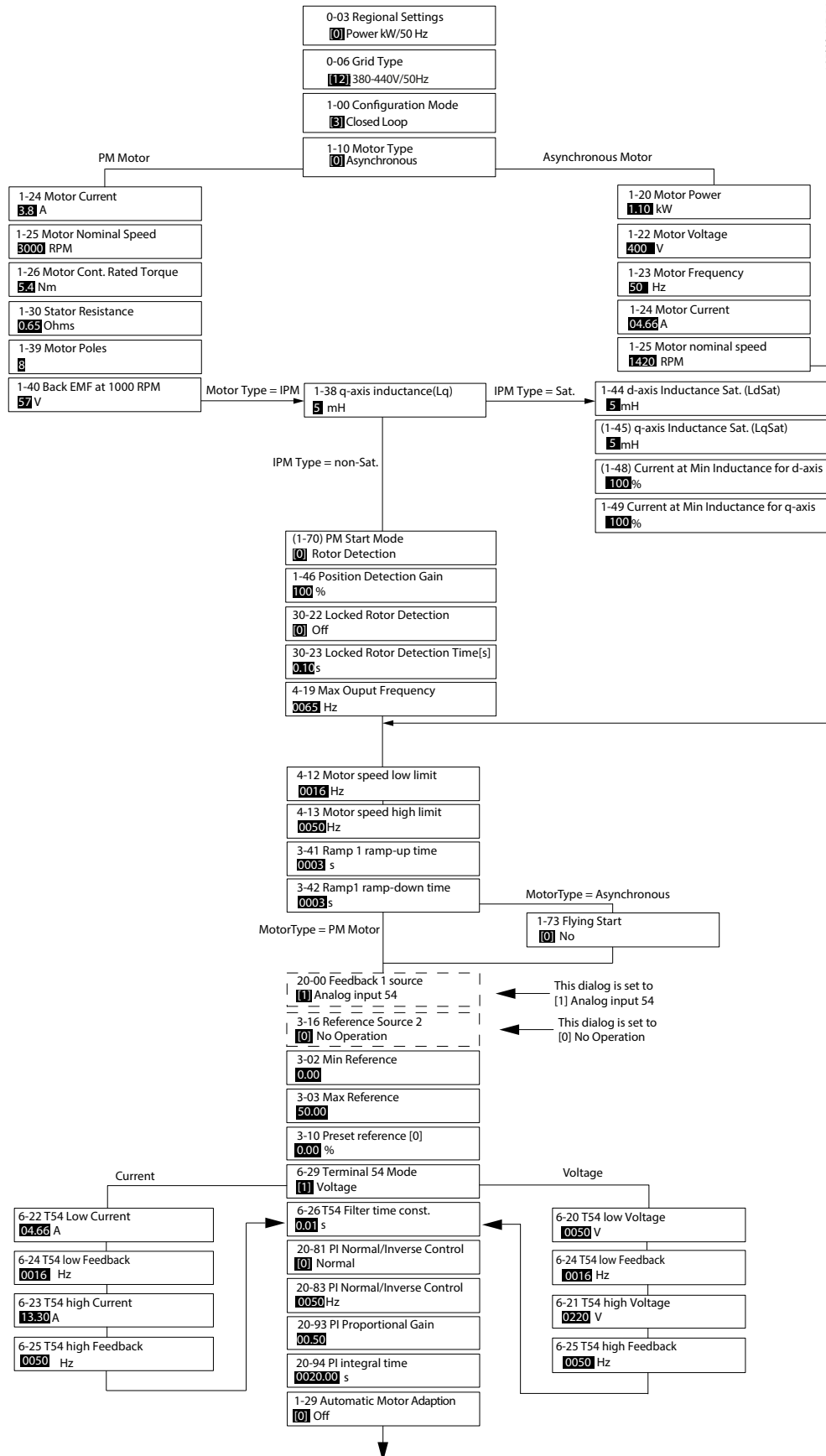


Illustration 5.6 Configuration for Open-loop Applications

5.4.2 Set-up Wizard for Closed-loop Applications

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Illustration 5.7 Closed-loop Set-up Wizard

5.4.3 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 *parameter 1-90 Motor Thermal Protection* to [4] ETR trip 1.

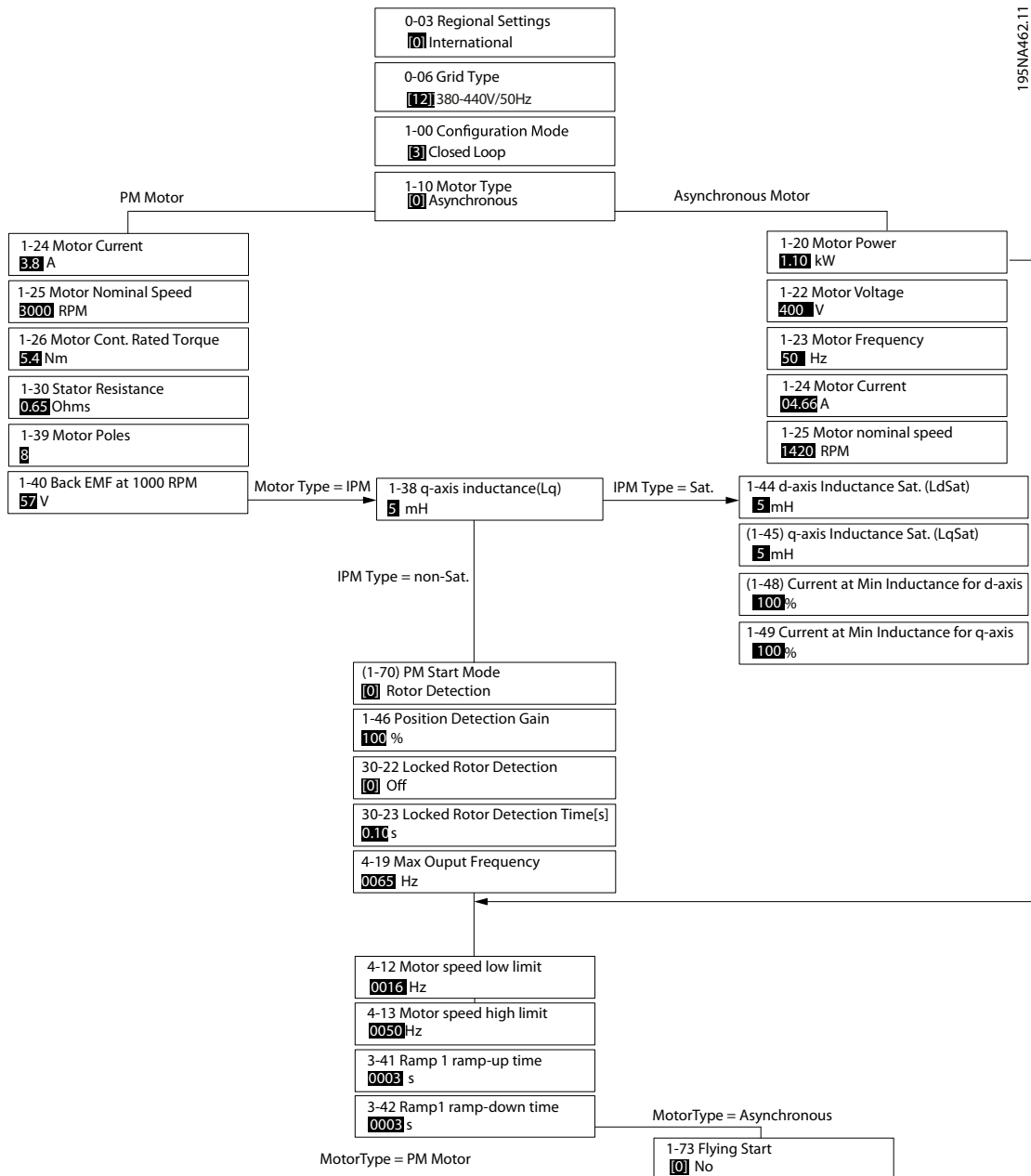


Illustration 5.8 Quick Menu Motor Set-up

5.4.4 Changing Parameter Settings

Quick access to change parameter settings:

1. To enter the *Quick Menu*, press [Menu] until the indicator in the display reaches *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. To select a parameter, press [OK].
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. To accept the change, press [OK].
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 reaches *Main Menu*.
2. Press [▲] [▼] to browse through the parameter groups.
3. To select a parameter group, press [OK].
4. Press [▲] [▼] to browse through the parameters in the specific group.
5. To select the parameter, press [OK].
6. Press [▲] [▼] to set/change the parameter value.

Changes made:

1. Press [Menu] until the indicator in the display reaches *Quick Menu*.
2. Press [▲] [▼] to browse through the quick menus.
3. To select *05 Changes Made*, press [OK].
 - *Changes Made* lists all parameters changed from default settings.
 - The list shows only parameters which have been changed in the current edit set-up.
 - Parameters which have been reset to default values are not listed.
 - The message *Empty* indicates that no parameters have been changed.

5.4.5 Thermistor Set-up

Set parameter 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, contact the local Danfoss supplier.

1. Read the safety warnings in *chapter 2 Safety*.
2. Disconnect the frequency converter from mains.

3. Disconnect the frequency converter from external DC supply, if present.
4. Disconnect the frequency converter from the 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 mount 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: <ul style="list-style-type: none"> • <i>Parameter 6-10 Terminal 53 Low Voltage.</i> • <i>Parameter 6-12 Terminal 53 Low Current.</i> • <i>Parameter 6-20 Terminal 54 Low Voltage.</i> • <i>Parameter 6-22 Terminal 54 Low Current.</i> See also parameter group 6-0* <i>Analog In/Out</i> .
3	No motor	X			A motor has not been connected to the frequency converter.
4	Mains ph. loss	X	X	X	Missing phase on supply side or excess voltage imbalance. Check supply voltage. See <i>parameter 14-12 Function at Mains Imbalance</i> .
7	DC over volt	X	X		DC-link voltage exceeds limit.
8	DC under volt	X	X		DC-link 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 <i>parameter 1-90 Motor Thermal Protection</i> .
11	Motor th over	X	X		Thermistor or thermistor connection is disconnected. See <i>parameter 1-90 Motor Thermal Protection</i> .
13	Over Current	X	X	X	Inverter peak current limit is exceeded.
14	Earth Fault	X	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* <i>Comm. and Options</i> .
24	Fan fault	X	X		External fans have failed either due to defect hardware, or due to missing fans.
25	Brake resistor short		X	X	Brake resistor short-circuited: The brake resistor is monitored during operation. If it short-circuits, the brake function is disconnected, and the warning appears. Turn off the frequency converter and replace the brake resistor.
27	Short circuited		X	X	Brake chopper fault: The brake transistor is short-circuited, or the brake function is disconnected. If short-circuited, substantial energy is dissipated in the brake resistor. Turn off the frequency converter as a fire precaution.
28	Brake check	X	X		Brake checked and failure detected.

Alarm/ warning number	Fault text	Warning	Alarm	Trip lock	Cause of problem
30	U phase loss		X	X	Motor phase U is missing. Check the phase. See <i>parameter 4-58 Missing Motor Phase Function</i> .
31	V phase loss		X	X	Motor phase V is missing. Check the phase. See <i>parameter 4-58 Missing Motor Phase Function</i> .
32	W phase loss		X	X	Motor phase W is missing. Check the phase. See <i>parameter 4-58 Missing Motor Phase Function</i> .
34	Fieldbus fault	X			
35	Option fault		X		
36	Mains failure	X			
38	Internal fault		X	X	Contact the local Danfoss supplier.
40	Overload T27	X			
41	Overload T29	X			
44	Earth fault DESAT		X	X	
46	Gate drive voltage fault		X	X	
47	Control voltage fault	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 interrupted the AMA.
57	AMA time-out		X		Try to restart the AMA a number of times, until the AMA is complete. NOTICE Repeated runs can heat the motor to a level where the resistance R_s and R_r are increased. In most cases, however, this increased resistance is not critical.
58	AMA internal	X	X		Contact the local Danfoss supplier.
59	Current limit	X	X		The current is higher than the value in <i>parameter 4-18 Current Limit</i> .
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	Mech. brake low		X		The minimum required current for opening the mechanical brake has not been reached.
65	Ctr. card temp	X	X	X	
66	Heat sink temperature low	X			The heat sink temperature is measured as 0 °C. This result could indicate that the temperature sensor is defect. The defect causes the fan speed to increase to its maximum to cool down the power part or control card.
67	Option change		X		
69	Pwr. Card Temp	X	X	X	The temperature sensor on the power card is either too hot or too cold.

Alarm/ warning number	Fault text	Warning	Alarm	Trip lock	Cause of problem
70	Illegal FC config		X	X	Power size configuration fault on the power card.
80	Drive initialised		X		All parameter settings are initialised to default settings.
87	Auto DC Braking	X			The frequency converter is auto DC braking.
88	Option detection		X	X	
93	Dry pump	X	X		
94	End of curve	X	X		
95	Broken belt	X	X		Torque is below the torque level set for no load, indicating a broken belt. See parameter group 22-6* <i>Broken Belt Detection</i> .
99	Locked rotor		X		The frequency converter detected a locked rotor situation. See <i>parameter 30-22 Locked Rotor Protection</i> and <i>parameter 30-23 Locked Rotor Detection Time [s]</i> .
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			
200	Fire Mode	X			Fire mode has been activated.
202	Fire Mode Limits Exceeded	X			Fire mode has suppressed 1 or more warranty voiding alarms.
206	Memory module	X			
207	Memory module alarm		X	X	

Table 6.1 Warnings and Alarms

7 Specifications

7.1 Clearances, Dimensions and Weights

7.1.1 Clearances

To ensure sufficient air flow for the frequency converter, observe the minimum clearances listed in *Table 7.1*. 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 (hp)]	Clearance at ends [mm (in)]		
Enclosure size	Protection rating		Motor flange end	Cooling fan end	
	FCP 106	FCM 106			3x380–480 V
MH1	IP66/Type 4X ²⁾	IP55/Type 12	0.55–1.5 (0.75–2.0)	30 (1.2)	100 (4.0)
MH2	IP66/Type 4X ²⁾	IP55/Type 12	2.2–4.0 (3.0–5.0)	40 (1.6)	100 (4.0)
MH3	IP66/Type 4X ²⁾	IP55/Type 12	5.5–7.5 (7.5–10)	50 (2.0)	100 (4.0)

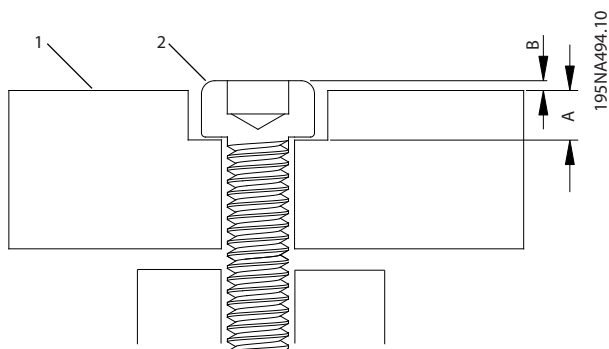
Table 7.1 Minimum Clearance for Cooling

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

2) The stated IP and Type rating only apply when the FCP 106 is mounted on a wall mount plate or a motor with the adapter plate. Ensure that the gasket between the adapter plate and the motor has a protection rating corresponding to the required rating for the combined motor and frequency converter. As standalone frequency converter, the enclosure rating is IP00 and Open type.

Enclosure size	Maximum depth of hole into adapter plate (A) [mm (in)]	Maximum height of screw above adapter plate (B) [mm (in)]
MH1	3 (0.12)	0.5 (0.02)
MH2	4 (0.16)	0.5 (0.02)
MH3	3.5 (0.14)	0.5 (0.02)

Table 7.2 Details for Motor Adapter Plate Screws



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

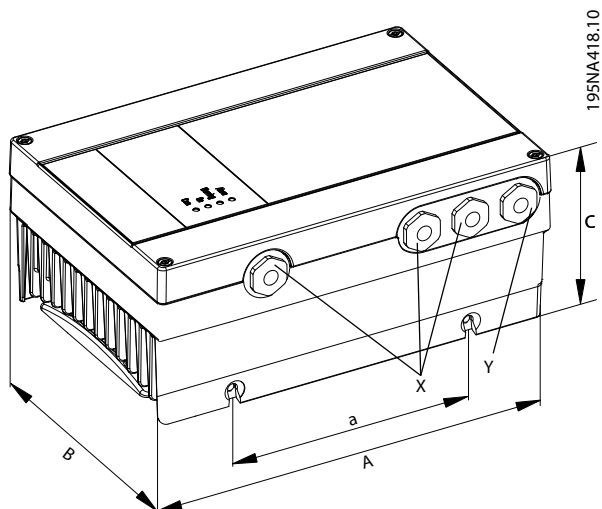


Illustration 7.2 FCP 106 Dimensions

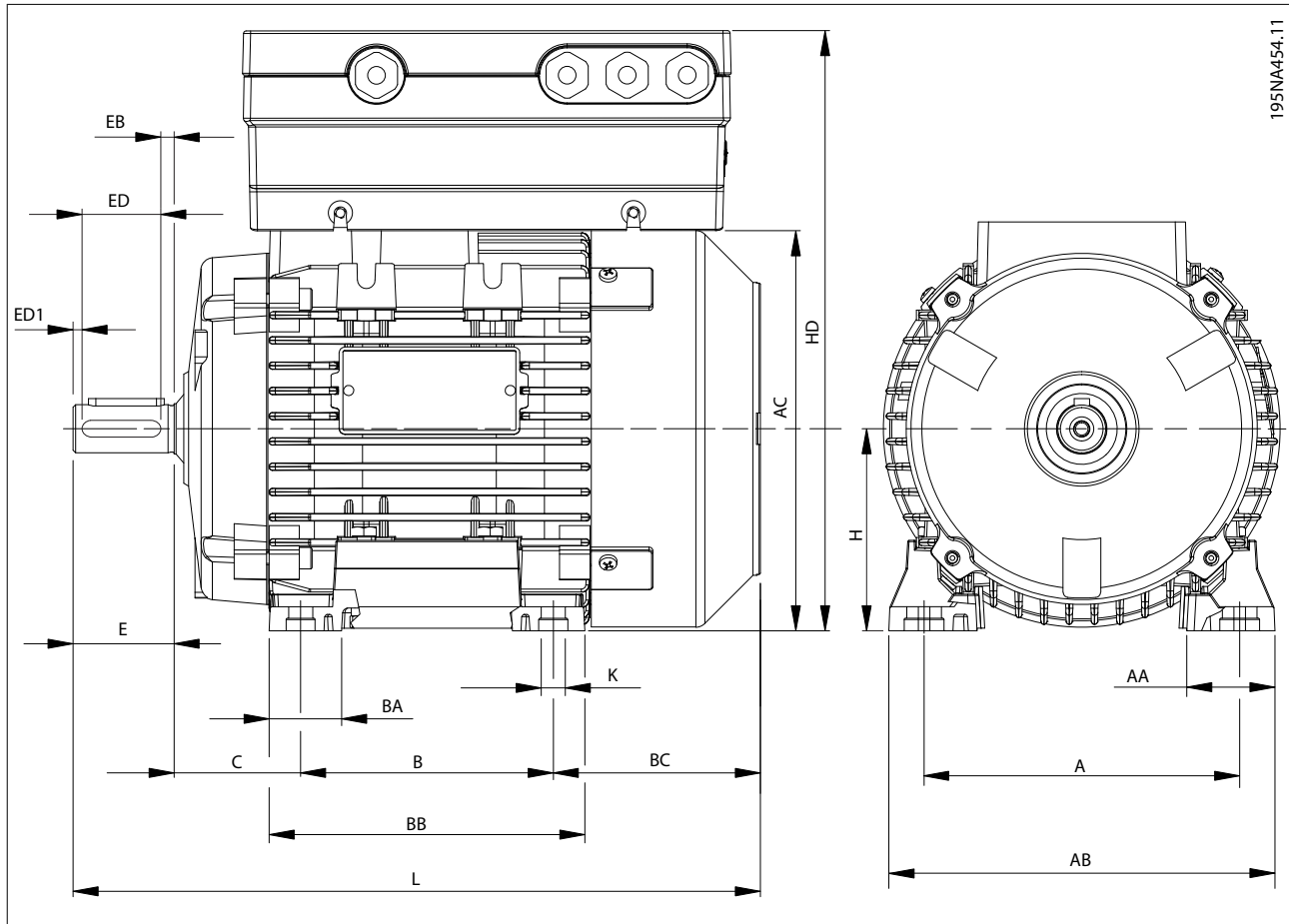
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Enclosure type	Power ¹⁾ [kW (hp)]	Length [mm (in)]		Width [mm (in)]	Height [mm (in)]		Cable gland diameter		Mounting hole
		A	a		Normal lid	High lid for VLT [®] PROFIBUS DP MCA 101 option	X	Y	
	3x380–480 V	A	a	B	C	C	X	Y	
MH1	0.55–1.5 (0.75–2.0)	231.4 (9.1)	130 (5.1)	162.1 (6.4)	106.8 (4.2)	121.4 (4.8)	M20	M20	M6
MH2	2.2–4.0 (3.0–5.0)	276.8 (10.9)	166 (6.5)	187.1 (7.4)	113.2 (4.5)	127.8 (5.0)	M20	M20	M6
MH3	5.5–7.5 (7.5–10)	321.7 (12.7)	211 (8.3)	221.1 (8.7)	123.4 (4.9)	138.1 (5.4)	M20	M25	M6

Table 7.3 FCP 106 Dimensions

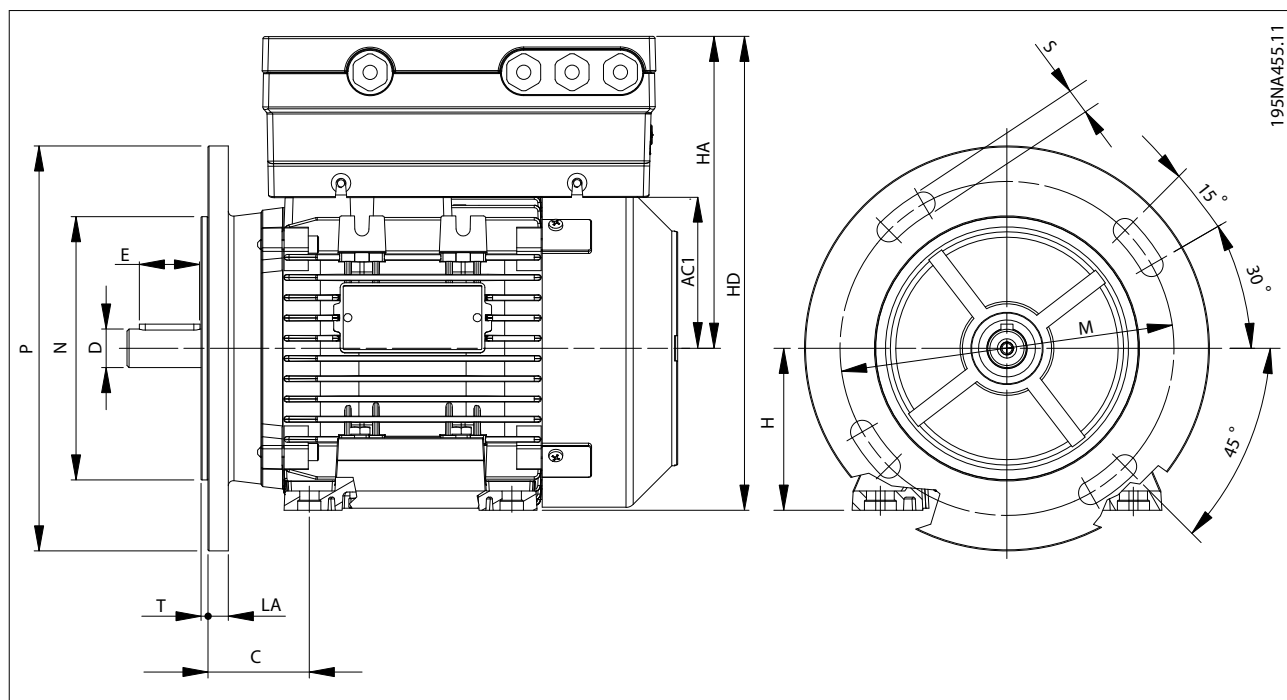
1) Power ratings relate to NO, see chapter 7.2 Electrical Data.

7.1.3 FCM 106 Dimensions



Motor frame size	71	80	90S	90L	100S	100L	112M	132S	132M
A [mm (in)]	112 (4.4)	125 (4.9)	140 (5.5)	140 (5.5)	160 (6.3)	160 (6.3)	190 (7.5)	216 (8.5)	216 (8.5)
B [mm (in)]	90 (3.5)	100 (4.0)	100 (4.0)	125 (4.9)	140 (5.5)	140 (5.5)	140 (5.5)	140 (5.5)	178 (7.0)
C [mm (in)]	45 (1.8)	50 (2.0)	56 (2.2)	56 (2.2)	63 (2.5)	63 (2.5)	70 (2.6)	89 (3.5)	89 (3.5)
H [mm (in)]	71 (2.8)	80 (3.1)	90 (3.5)	90 (3.5)	100 (4.0)	100 (4.0)	112 (4.4)	132 (5.2)	132 (5.2)
K [mm (in)]	8 (0.3)	10 (0.4)	10 (0.4)	10 (0.4)	11 (0.43)	11 (0.43)	12.5 (0.5)	12 (0.47)	12 (0.47)
AA [mm (in)]	31 (1.2)	34.5 (1.4)	37 (1.5)	37 (1.5)	44 (1.7)	44 (1.7)	48 (1.9)	59 (2.3)	59 (2.3)
AB [mm (in)]	135 (5.3)	153 (6.0)	170 (6.7)	170 (6.7)	192 (7.6)	192 (7.6)	220 (8.7)	256 (10.1)	256 (10.1)
BB [mm (in)]	108 (4.3)	125 (4.9)	150 (5.9)	150 (5.9)	166 (6.5)	166 (6.5)	176 (6.9)	180 (7.1)	218 (8.6)
BC [mm (in)]	83 (3.3)	89 (3.5)	116 (4.6)	91 (3.6)	110 (4.3)	144 (5.7)	126 (5.0)	134 (5.3)	136 (5.4)
L [mm (in)]	246 (9.7)	272 (10.7)	317 (12.5)	317 (12.5)	366 (14.4)	400 (15.7)	388 (15.3)	445 (17.5)	485 (19.1)
AC [mm (in)]	139 (5.5)	160 (6.3)	180 (7.1)	180 (7.1)	196 (7.7)	194 (7.6)	225 (8.9)	248 (9.8)	248 (9.8)
E [mm (in)]	30 (1.2)	40 (1.6)	50 (2.0)	50 (2.0)	60 (2.4)	60 (2.4)	60 (2.4)	80 (3.1)	80 (3.1)
ED [mm (in)]	20 (0.8)	30 (1.2)	30 (1.2)	40 (1.6)	40 (1.6)	50 (2.0)	50 (2.0)	70 (2.6)	70 (2.6)
EB [mm (in)]	4 (0.16)	4 (0.16)	4 (0.16)	4 (0.16)	4 (0.16)	4 (0.16)	4 (0.16)	4 (0.16)	4 (0.16)
HD [mm (in)] without VLT® PROFIBUS DP MCA 101									
MH1	247 (9.7)	267 (10.5)	286 (11.3)	286 (11.3)	–	–	–	–	–
MH2	248 (9.8)	268 (10.6)	287 (11.4)	287 (11.4)	304 (12)	304 (12)	332 (13.1)	–	–
MH3	–	–	299 (11.8)	299 (11.8)	316 (12.4)	316 (12.4)	344 (13.5)	379 (14.9)	379 (14.9)
HD [mm (in)] with VLT® PROFIBUS DP MCA 101									
MH1/	262 (10.3)	282 (11.1)	301 (11.9)	301 (11.9)	–	–	–	–	–
MH2	263 (10.4)	283 (11.1)	302 (11.9)	302 (11.9)	319 (12.6)	319 (12.6)	347 (13.7)	–	–
MH3	–	–	314 (12.4)	314 (12.4)	331 (13.0)	331 (13.0)	359 (14.1)	394 (15.5)	394 (15.5)

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

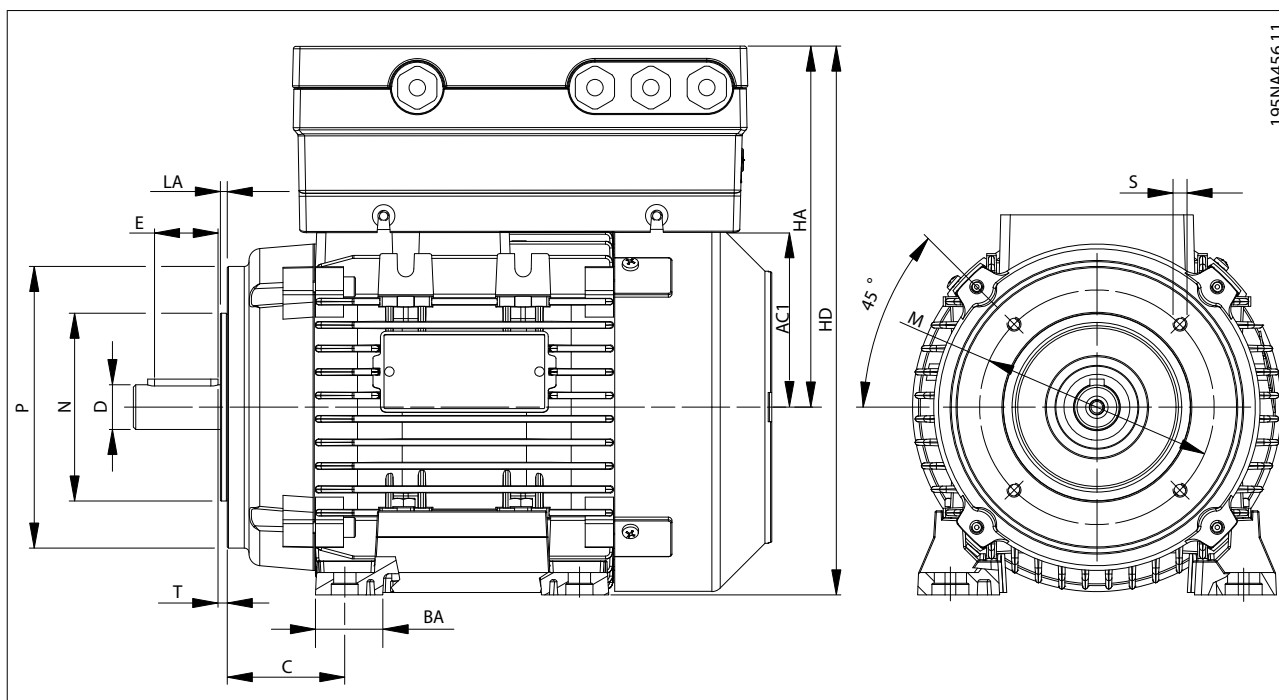


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Motor frame size	71	80	90S	90L	100L	112M	132S
M [mm (in)]	130 (5.1)	165 (6.5)	165 (6.5)	165 (6.5)	215 (8.5)	215 (8.5)	265 (10.4)
N [mm (in)]	110 (4.3)	130 (5.1)	130 (5.1)	130 (5.1)	180 (7.8)	180 (7.8)	230 (9.1)
P [mm (in)]	160 (6.3)	200 (7.9)	200 (7.9)	200 (7.9)	250 (9.8)	250 (9.8)	300 (11.8)
S [mm (in)]	M8	M10	M10	M10	M12	M12	M12
T [mm (in)]	3.5 (0.14)	3.5 (0.14)	3.5 (0.14)	3.5 (0.14)	4 (0.16)	4 (0.16)	4 (0.16)
LA [mm (in)]	10 (0.4)	10 (0.4)	12 (0.5)	12 (0.5)	14 (0.6)	14 (0.6)	14 (0.6)
HA [mm (in)]	HA = AC1 + height of the frequency converter. For frequency converter dimensions, see Table 7.3.						
HD [mm (in)] without VLT® PROFIBUS DP MCA 101							
MH1	247 (9.7)	267 (10.5)	286 (11.3)	286 (11.3)	–	–	–
MH2	248 (9.8)	268 (10.6)	287 (11.4)	287 (11.4)	304 (12)	332 (13.1)	–
MH3	–	–	299 (11.8)	299 (11.8)	316 (12.4)	244 (9.6)	379 (14.9)
HD [mm (in)] with VLT® PROFIBUS DP MCA 101							
MH1	262 (10.3)	282 (11.1)	301 (11.9)	301 (11.9)	–	–	–
MH2	263 (10.4)	283 (11.2)	302 (11.9)	302 (11.9)	319 (12.6)	347 (13.7)	–
MH3	–	–	314 (12.4)	314 (12.4)	331 (13.1)	359 (14.1)	394 (15.5)

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



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Small flange B14

Motor frame size	71	80	90S	100L	112M	132S
M [mm (in)]	85 (3.3)	100 (4.0)	115 (4.5)	130 (5.1)	130 (5.1)	165 (6.5)
N [mm (in)]	70 (2.8)	80 (3.1)	95 (3.7)	110 (4.3)	110 (4.3)	130 (5.1)
P [mm (in)]	105 (4.1)	120 (4.7)	140 (5.5)	160 (6.3)	160 (6.3)	200 (7.9)
S [mm (in)]	M6	M6	M8	M8	M8	M10
T [mm (in)]	2.5 (0.1)	3 (0.12)	3 (0.12)	3.5 (0.14)	3.5 (0.14)	3.5 (0.14)
LA [mm (in)]	11 (0.4)	9 (0.35)	9 (0.35)	10 (0.4)	10 (0.4)	30 (0.4)

Large flange B14

Motor frame size	71	80	90S	100L	112M	132S
M [mm (in)]	115 (4.5)	130 (5.1)	130 (5.1)	165 (6.5)	165 (6.5)	215 (8.5)
N [mm (in)]	95 (3.7)	110 (4.3)	110 (4.3)	130 (5.1)	130 (5.1)	180 (7.1)
P [mm (in)]	140 (5.5)	160 (6.3)	160 (6.3)	200 (7.9)	200 (7.9)	250 (9.8)
S [mm (in)]	M8	M8	M8	M10	M10	M12
T [mm (in)]	2.5 (0.1)	3.5 (0.14)	3.5 (0.14)	3.5 (0.14)	3.5 (0.14)	4 (0.16)
LA [mm (in)]	8 (0.31)	8.5 (0.33)	9 (0.35)	12 (0.5)	12 (0.5)	12 (0.5)

HA [mm (in)] HA = AC1 + height of the frequency converter.
For frequency converter dimensions, see Table 7.3.

HD [mm (in)] without VLT® PROFIBUS DP MCA 101

MH1	247 (9.7)	267 (10.5)	286 (11.3)	–	–	–
MH2	248 (9.8)	268 (10.6)	287 (11.4)	304 (12)	332 (13.1)	–
MH3	–	–	299 (11.8)	316 (12.4)	244 (9.6)	379 (14.9)

HD [mm (in)] with VLT® PROFIBUS DP MCA 101

MH1	262 (10.3)	282 (11.1)	301 (11.9)	–	–	–
MH2	263 (10.4)	283 (11.2)	302 (11.9)	319 (12.6)	347 (13.7)	–
MH3	–	–	314 (12.4)	331 (13)	359 (14.1)	394 (15.5)

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
D [mm (in)]	14 (0.6)	19 (0.7)	24 (1.0)	28 (1.1)	28 (1.1)	38 (1.5)
F [mm (in)]	5 (0.2)	6 (0.25)	8 (0.3)	8 (0.3)	8 (0.3)	10 (0.4)
G [mm (in)]	11 (0.4)	15.5 (0.6)	20 (0.8)	24 (1.0)	24 (1.0)	33 (1.3)
DH	M5	M6	M8	M10	M10	M12

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

7.1.4 Weight

To calculate the total weight of the unit, add:

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

Enclosure type	Weight		
	FCP 106 [kg (lb)]	Motor adapter plate [kg (lb)]	Combined FCP 106 and motor adapter plate [kg (lb)]
MH1	3.9 (8.6)	0.7 (1.5)	4.6 (10.1)
MH2	5.8 (12.8)	1.12 (2.5)	6.92 (15.3)
MH3	8.1 (17.9)	1.48 (3.3)	9.58 (21.2)

Table 7.8 Weight of FCP 106

Shaft power [kW (hp)]	PM motor				Asynchronous motor			
	1500 RPM		3000 RPM		1500 RPM		3000 RPM	
	Motor frame size	Weight [kg (lb)]	Motor frame size	Weight [kg (lb)]	Motor frame size	Weight [kg (lb)]	Motor frame size	Weight [kg (lb)]
0.55 (0.75)	71	4.8 (10.6)	-	-	-	-	-	-
0.75 (1.0)	71	5.4 (11.9)	71	4.8 (10.6)	80S	11 (24.3)	71	9.5 (20.9)
1.1 (1.5)	71	7.0 (15.4)	71	4.8 (10.6)	90S	16.4 (36.2)	80	11 (24.3)
1.5 (2.0)	71	10 (22)	71	6.0 (13.2)	90L	16.4 (36.2)	80	14 (30.9)
2.2 (3.0)	90	12 (26.5)	71	6.6 (14.6)	100L	22.4(49.4)	90L	16 (35.3)
3 (4.0)	90	14 (30.9)	90S	12 (26.5)	100L	26.5 (58.4)	100L	23 (50.7)
4 (5.0)	90	17 (37.5)	90S	14 (30.9)	112M	30.4 (67)	100L	28 (61.7)
5.5 (7.5)	112	30 (66)	90S	16 (35.3)	132S	55 (121.3)	112M	53 (116.8)
7.5 (10)	112	33 (72.8)	112M	26 (57.3)	132M	65 (143.3)	112M	53 (116.8)

Table 7.9 Approximate Weight of Motor

7.2 Electrical Data

7.2.1 Mains Supply 3x380–480 V AC Normal and High Overload

Enclosure	MH1							MH2						MH3
	PK55		PK75		P1K1		P1K5		P2K2		P3K0		P4K0	
Overload ¹⁾	NO	HO	NO	HO	NO	HO	NO	HO	NO	HO	NO	HO	NO	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	
Maximum cable cross-section in terminals ²⁾ (mains, motor) [mm ² /AWG]	4/12		4/12		4/12		4/12		4/12		4/12		4/12	
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
Maximum 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 (3x440–480 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
Maximum mains fuses	See chapter 7.10 Fuse and Circuit Breaker Specifications.													
Estimated power loss [W], best case/typical ³⁾	38		44		57		73		91		129		143	
Efficiency [%], best case/typical ⁴⁾⁵⁾	0.96		0.97		0.97		0.97		0.97		0.97		0.97	

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

3) Applies to dimensioning of frequency converter cooling. If the switching frequency is higher than the default setting, the power losses may increase. LCP and typical control card power consumptions are included. For power loss data according to EN 50-598-2, refer to www.danfoss.com/vltenergyefficiency.

4) Efficiency measured at nominal current. For energy efficiency class, see chapter 7.5 Ambient Conditions. For part load losses, see www.danfoss.com/vltenergyefficiency.

5) Measured using 4 m screened motor cables at rated load and rated frequency.

Enclosure	MH3		
	P5K5	P7K5	
Overload ¹⁾	NO	HO	NO
Typical shaft output [kW]	5.5		7.5
Typical shaft output [hp]	7.5		10
Maximum cable cross-section in terminals ²⁾ (mains, motor) [mm ² /AWG]	4/12		4/12
Output current			
40 °C ambient temperature			
Continuous (3x380–440 V) [A]	12		15.5
Intermittent (3x380–440 V) [A]	13.2	19.2	17.1
Continuous (3x440–480 V) [A]	11		14
Intermittent (3x440–480 V) [A]	12.1	13.2	15.4
Maximum 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 (3x440–480 V) [A]	10	15	14
Maximum mains fuses	See chapter 7.10 Fuse and Circuit Breaker Specifications.		
Estimated power loss [W], best case/typical ³⁾	143	236	
Efficiency [%], best case/typical ⁴⁾⁵⁾	0.97	0.97	

7

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 7.10 shows that a 1.5 kW motor for HO requires a P2K2 frequency converter.

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

3) Applies to dimensioning of frequency converter cooling. If the switching frequency is higher than the default setting, the power losses may increase. LCP and typical control card power consumptions are included. For power loss data according to EN 50-598-2, refer to www.danfoss.com/vtenergyefficiency.

4) Efficiency measured at nominal current. For energy efficiency class, see chapter 7.5 Ambient Conditions. For part load losses, see www.danfoss.com/vtenergyefficiency.

5) Measured using 4 m screened motor cables at rated load and rated frequency.

7.3 Mains Supply

Mains supply (L1, L2, L3)

Supply voltage	380–480 V ±10%
----------------	----------------

Mains voltage low/mains dropout:

- *During low mains voltage or a mains dropout, the frequency converter continues until the DC-link voltage drops below the minimum stop level. This level typically corresponds 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
------------------	----------

Maximum imbalance temporary between mains phases	3.0% of rated supply voltage
--------------------------------------------------	------------------------------

True power factor (λ)	≥0.9 nominal at rated load
---------------------------------	----------------------------

Displacement power factor (COS ϕ)	Near unity (>0.98)
-----------------------------------------	--------------------

Switching on the input supply L1, L2, L3 (power-ups)	Maximum 2 times/min.
------------------------------------------------------	----------------------

Environment according to EN 60664-1 and IEC 61800-5-1	Overvoltage category III/pollution degree 2
-------------------------------------------------------	---------------------------------------------

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

- 100000 RMS symmetrical Amperes, 480 V maximum, with fuses used as branch circuit protection.
- See *Table 7.15* and *Table 7.16* when using circuit breakers as branch circuit protection.

7.4 Protection and Features

Protection and features

- Electronic motor thermal protection against overload.
- Temperature monitoring of the heat sink ensures that the frequency converter trips when the temperature reaches 90 °C (194 °F) ±5 °C (41 °F). An overload temperature cannot be reset until the temperature of the heat sink is below 70 °C (158 °F) ±5 °C (41 °F). However, these temperatures may vary for different power sizes, enclosures, and so on. The frequency converter autoderating function ensures that the heat sink temperature does not reach 90 °C (194 °F).
- The frequency converter motor terminals U, V, and W are protected against ground faults at power-up and start of the motor.
- 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 DC-link voltage ensures that the frequency converter trips when the DC-link voltage is too low or too high.
- The frequency converter is protected against ground faults on motor terminals U, V, and W.
- All control terminals and relay terminals 01–03/04–06 comply with PELV (protective extra low voltage). However, this compliance does not apply to grounded delta leg above 300 V.

7.5 Ambient Conditions

Environment

Enclosure protection rating	IP66/Type 4X ¹⁾
-----------------------------	----------------------------

Enclosure protection rating FCP 106 between lid and heat sink	IP66/Type 4X
---------------------------------------------------------------	--------------

Enclosure protection rating FCP 106 between heat sink and adapter plate	IP66/Type 4X
-------------------------------------------------------------------------	--------------

FCP 106 wall mount kit	IP66
------------------------	------

Stationary vibration IEC61800-5-1 Ed.2	Cl. 5.2.6.4
----------------------------------------	-------------

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 (104 °F) (24-hour average)
---------------------	----------------------------------

Minimum ambient temperature during full-scale operation	-10 °C (14 °F)
Minimum ambient temperature at reduced performance	-20 °C (-4 °F)
Maximum ambient temperature at reduced performance	50 °C (122 °F)
Temperature during storage	-25 to +65 °C (-13 to +149 °F)
Temperature during transport	-25 to +70 °C (-13 to +158 °F)
Maximum altitude above sea level without derating	1000 m (3280 ft)
Maximum altitude above sea level with derating	3000 m (9842 ft)
Safety standards	EN/IEC 60204-1, EN/IEC 61800-5-1, UL 508C
EMC standards, emission	EN 61000-3-2, EN 61000-3-12, EN 55011, EN 61000-6-4
EMC standards, immunity	EN 61800-3, EN 61000-6-1/2
Energy efficiency class, VLT® DriveMotor FCP 106 ²⁾	IE2
Energy efficiency class, VLT® DriveMotor FCM 106	IES

1) The stated IP and Type rating only apply when the FCP 106 is mounted on a wall mount plate or a motor with the adapter plate. Ensure that the gasket between the adapter plate and the motor has a protection rating corresponding to the required rating for the combined motor and frequency converter. As standalone frequency converter, the enclosure rating is IP00 and Open type.

2) Determined according to EN50598-2 at:

- Rated load.
- 90% rated frequency.
- Switching frequency factory setting.
- Switching pattern factory setting.

7.6 Cable Specifications

Cable lengths and cross-sections

Maximum motor cable length for wall mount kit, screened/armored	0.5 m (1.64 ft)
Maximum cross-section to motor, mains for MH1–MH3	4 mm ² /11 AWG
Maximum cross-section DC terminals on enclosure type MH1–MH3	4 mm ² /11 AWG
Maximum cross-section to control terminals, rigid wire	2.5 mm ² /13 AWG
Maximum cross-section to control terminals, flexible cable	2.5 mm ² /13 AWG
Minimum cross-section to control terminals	0.05 mm ² /30 AWG
Maximum cross-section to thermistor input (at motor connector)	4 mm ² /11 AWG

7.7 Control Input/Output and Control Data

Digital inputs

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	Approximately 4 kΩ
Digital input 29 as pulse input	Maximum frequency 32 kHz push-pull-driven & 5 kHz (O.C.)

Analog inputs

Number of analog inputs	2
Terminal number	53, 54
Terminal 53 mode	Parameter 6-19 Terminal 53 mode: 1=voltage, 0=current
Terminal 54 mode	Parameter 6-29 Terminal 54 mode: 1=voltage, 0=current
Voltage level	0–10 V
Input resistance, R _i	Approximately 10 kΩ

Maximum voltage	20 V
Current level	0/4 to 20 mA (scalable)
Input resistance, R_i	<500 Ω
Maximum current	29 mA

Analog output

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

1) Terminals 42 and 45 can also be programmed as digital outputs.

Digital output

Number of digital outputs	4
Terminals 27 and 29	
Terminal number	27, 29 ¹⁾
Voltage level at digital output	0–24 V
Maximum output current (sink and source)	40 mA
Terminals 42 and 45	
Terminal number	42, 45 ²⁾
Voltage level at digital output	17 V
Maximum output current at digital output	20 mA
Maximum load at digital output	1 k Ω

1) Terminals 27 and 29 can also be programmed as input.

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

The digital outputs are galvanically isolated from the supply voltage (PELV) and other high-voltage terminals.

Control card, RS485 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

Terminal number	12
Maximum load	80 mA

Relay output

Programmable relay output	2
Relay 01 and 02	01-03 (NC), 01-02 (NO), 04-06 (NC), 04-05 (NO)
Maximum terminal load (AC-1) ¹⁾ on 01-02/04-05 (NO) (Resistive load)	250 V AC, 3 A
Maximum terminal load (AC-15) ¹⁾ on 01-02/04-05 (NO) (Inductive load @ COS ϕ 0.4)	250 V AC, 0.2 A
Maximum terminal load (DC-1) ¹⁾ on 01-02/04-05 (NO) (Resistive load)	30 V DC, 2 A
Maximum terminal load (DC-13) ¹⁾ on 01-02/04-05 (NO) (Inductive load)	24 V DC, 0.1 A
Maximum terminal load (AC-1) ¹⁾ on 01-03/04-06 (NC) (Resistive load)	250 V AC, 3 A
Maximum terminal load (AC-15) ¹⁾ on 01-03/04-06 (NC) (Inductive load @ COS ϕ 0.4)	250 V AC, 0.2 A
	30 V DC, 2 A
Maximum terminal load (DC-1) ¹⁾ on 01-03/04-06 (NC) (Resistive load)	Minimum 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 sections 4 and 5.

Control card, 10 V DC output

Terminal number	50
Output voltage	10.5 V \pm 0.5 V
Maximum load	25 mA

7.8 Connection Tightening Torques

Location	Type	Torque [Nm (in-lb)]
Front cover screws	T20 or slot	3–3.5 (26.6–31)
Plastic cable blind plugs	24 mm or 28 mm socket	2.2 (19.5)
Control card	T10	1.3 (11.5)
Relay card	T10	1.3 (11.5)
Control plate	T20 or slot	1.5 (13.3)
Connection to adapter plate	T20 or slot	7.0 (62)

Table 7.12 Tightening Torques for Frequency Converter External Screws

Enclosure size	Power ¹⁾ [kW (hp)]	Torque [Nm (in-lb)]						
	3x380–480 V	Mains	Motor	DC connection	Control terminals	Ground	Relay	RFI switch
MH1	0.55–1.5 (0.75–2.0)	1.4 (12.4)	Crimp, no applied torque	1.4 (12.4)	0.5 (4.4)	3.0 (26.6)	0.5 (4.4)	0.9 (8.0)
MH2	2.2–4 (3.0–5.0)							
MH3	5.5–7.5 (7.5–10)							

Table 7.13 Tightening Torques for Frequency Converter Internal Screws

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

Enclosure size	Power ¹⁾ [kW (hp)]	Type						
	3x380–480 V	Mains	Motor	DC connection	Control terminals	Ground	Relay	RFI switch
MH1	0.55–1.5 (0.75–2.0)	Slot or Phillips	Crimp	Slot or Phillips	Slot or Phillips	T20, slot, or 10 mm socket	Slot	T20 or slot
MH2	2.2–4 (3.0–5.0)							
MH3	5.5–7.5 (7.5–10)							

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 ⁺), 0–400 Hz (u/f)
Output frequency, PM motor	0–390 Hz (VVC ⁺ PM)
Switching on output	Unlimited
Ramp times	0.05–3600 s

Thermistor input (at motor connector)

Input conditions	Fault: >2.9 k Ω , 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. Always carry out overcurrent protection according to local and national regulations. Design fuses for protection in a circuit capable of supplying a maximum of 100000 A_{rms} (symmetrical), 480 V maximum. See *Table 7.15* and *Table 7.16* for breaking capacity for Danfoss CTI25M circuit breaker at 480 V maximum.

UL/non-UL compliance

To ensure compliance with UL 508C or IEC 61800-5-1, use the circuit breakers or fuses listed in *Table 7.15*, *Table 7.16*, and *Table 7.17*.

NOTICE

EQUIPMENT DAMAGE

If there is a malfunction, failure to follow the protection recommendation can result in damage to the frequency converter.

Enclosure size	Power ¹⁾ [kW (hp)] 3x380–480 V	Circuit breaker			
		Recommended UL	Breaking capacity	Maximum UL	Breaking capacity
MH1	0.55 (0.75)	CTI25M - 47B3146	100000	CTI25M - 047B3149	50000
	0.75 (1.0)	CTI25M - 47B3147	100000	CTI25M - 047B3149	50000
	1.1 (1.5)	CTI25M - 47B3147	100000	CTI25M - 047B3150	6000
	1.5 (2.0)	CTI25M - 47B3148	100000	CTI25M - 047B3150	6000
MH2	2.2 (3.0)	CTI25M - 47B3149	50000	CTI25M - 047B3151	6000
	3.0 (4.0)	CTI25M - 47B3149	50000	CTI25M - 047B3151	6000
	4.0 (5.0)	CTI25M - 47B3150	6000	CTI25M - 047B3151	6000
MH3	5.5 (7.5)	CTI25M - 47B3150	6000	CTI25M - 047B3151	6000
	7.5 (10)	CTI25M - 47B3151	6000	CTI25M - 047B3151	6000

Table 7.15 Circuit Breakers, UL

Enclosure size	Power ¹⁾ [kW (hp)] 3x380–480 V	Circuit breaker			
		Recommended non-UL	Breaking capacity	Maximum non-UL	Breaking capacity
MH1	0.55 (0.75)	CTI25M - 47B3146	100000	CTI25M - 47B3149	100000
	0.75 (1.0)	CTI25M - 47B3147	100000	CTI25M - 47B3149	100000
	1.1 (1.5)	CTI25M - 47B3147	100000	CTI25M - 47B3150	50000
	1.5 (2.0)	CTI25M - 47B3148	100000	CTI25M - 47B3150	50000
MH2	2.2 (3.0)	CTI25M - 47B3149	100000	CTI25M - 047B3151	15000
	3.0 (4.0)	CTI25M - 47B3149	100000	CTI25M - 047B3151	15000
	4.0 (5.0)	CTI25M - 47B3150	50000	CTI25M - 047B3102 ¹⁾	15000
MH3	5.5 (7.5)	CTI25M - 47B3150	50000	CTI25M - 047B3102 ¹⁾	15000
	7.5 (10)	CTI25M - 47B3151	15000	CTI25M - 047B3102 ¹⁾	15000

Table 7.16 Circuit Breakers, Non-UL

1) Trip level maximum set to 32 A.

Enclosure size	Power ¹⁾ [kW] 3x380–480 V	Fuse							
		Recommended UL	Maximum UL					Recommend- ed non-UL	Maximum non-UL
			Type						
		RK5, RK1, J, T, CC	RK5	RK1	J	T	CC	gG	gG
MH1	0.55 (0.75)	6	6	6	6	6	6	10	10
	0.75 (1.0)	6	6	6	6	6	6	10	10
	1.1 (1.5)	6	10	10	10	10	10	10	10
	1.5 (2.0)	6	10	10	10	10	10	10	10
MH2	2.2 (3.0)	6	20	20	20	20	20	16	20
	3.0 (4.0)	15	25	25	25	25	25	16	25
	4.0 (5.0)	15	30	30	30	30	30	16	32
MH3	5.5 (7.5)	20	30	30	30	30	30	25	32
	7.5 (10)	25	30	30	30	30	30	25	32

Table 7.17 Fuses

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

8 Appendix

8.1 Abbreviations and Conventions

Degree of protection	The degree of protection is a standardised specification for electrical equipment that describes the protection against the ingress of foreign objects and water (for example: IP20).
Dix	DI1: Digital input 1. DI2: Digital input 2.
EMC	Electromagnetic compatibility.
Error	Discrepancy between a computed, observed, or measured value or condition, and the specified or theoretically correct value or condition.
Factory setting	Factory settings when the product is shipped.
Fault	An error can cause a fault state.
Fault reset	A function used to restore the frequency converter to an operational state after a detected error is cleared by removing the cause of the error. The error is then no longer active.
MM	Memory module.
MMP	Memory module programmer.
Parameter	Device data and values that can be read and set (to a certain extent).
PELV	Protective extra low voltage, low voltage with isolation. For more information, see IEC 60364-4-41 or IEC 60204-1.
PLC	Programmable logic controller.
RS485	Fieldbus interface as per EIA-422/485 bus description, which enables serial data transmission with multiple devices.
Warning	If the term is used outside the context of safety instructions, a warning alerts to a potential problem that a monitoring function detected. A warning is not an error and does not cause a transition of the operating state.

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.
- All dimensions are in mm (inch).

8.2 Parameter Menu Structure

0-0*	Operation / Display	3-15	Reference 1 Source	5-53	Term. 29 High Ref./Feedb. Value	8-40	Telegram Selection
0-0*	Basic Settings	3-16	Reference 2 Source	5-9*	Bus Controlled	8-42	PCD Write Configuration
0-01	Language	3-17	Reference 3 Source	5-90	Digital & Relay Bus Control	8-43	PCD Read Configuration
0-03	Regional Settings	3-4*	Ramp 1	6-5*	Analog In/Out	8-5*	Digital/Bus
0-04	Operating State at Power-up	3-41	Ramp 1 Ramp Up Time	6-0*	Analog I/O Mode	8-50	Coasting Select
0-06	GridType	3-42	Ramp 1 Ramp Down Time	6-00	Live Zero Timeout Time	8-51	Quick Stop Select
0-07	Auto DC Braking	3-5*	Ramp 2	6-01	Live Zero Timeout Function	8-52	DC Brake Select
0-10	Active Set-up	3-52	Ramp 2 Ramp Up Time	6-1*	Analog Input 53	8-53	Start Select
0-11	Programming Set-up	3-8*	Other Ramps	6-10	Terminal 53 Low Voltage	8-54	Reversing Select
0-12	Link Setups	3-80	Jog Ramp Time	6-11	Terminal 53 High Voltage	8-55	Set-up Select
0-2*	LCP Display	3-81	Quick Stop Ramp Time	6-13	Terminal 53 Low Current	8-56	Preset Reference Select
0-20	Display Line 1.1 Small	3-85	Check Valve Ramp Time	6-15	Terminal 53 High Current	8-57	Profdrive OFF2 Select
0-21	Display Line 1.2 Small	3-87	Check Valve Ramp End Speed [Hz]	6-14	Terminal 53 Low Ref./Feedb. Value	8-58	Profdrive OFF3 Select
0-22	Display Line 1.3 Small	4-*	Limits / Warnings	6-16	Terminal 53 Filter Time Constant	8-7*	BACnet
0-23	Display Line 2 Large	4-1*	Motor Limits	6-19	Terminal 53 mode	8-70	BACnet Device Instance
0-24	Display Line 3 Large	4-10	Motor Speed	6-2*	Analog Input 54	8-72	BACnet Max Masters
0-3*	LCP Custom Readout	4-12	Motor Speed Direction	6-20	Terminal 54 Low Voltage	8-73	MS/TP Max Info Frames
0-30	Custom Readout Unit	4-14	Motor Speed Low Limit [Hz]	6-21	Terminal 54 High Voltage	8-74	"I am" Service
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0-32	Custom Readout Max Value	4-19	Max Output Frequency	6-23	Terminal 54 High Current	8-79	Protocol Firmware version
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