ENGINEERING
TOMORROW

Danfoss

Operating Guide

VACON® NXP IP00 Drive Modules

Contents

1 Introduction

1.1 Purpose of this Operating Guide

This operating guide provides information for safe installation and commissioning of the AC drive. It is intended for use by qualified personnel.

Read and follow the instructions to use the drive safely and professionally.

Pay particular attention to the safety instructions and general warnings. Always keep this operating guide with the drive.

1.2 Additional Resources

Other resources are available to understand advanced AC drive functions and programming.

- Extra information on installation of the drive is available in manuals VACON®NXS/NXP Wall-mounted and Standalone Operating Guide, VACON®NXI Inverters Operating Guide, and VACON®NXC Enclosed Drives Operating Guide.

- The VACON®NX application manuals provide greater detail on working with parameters and show many application examples.

- The VACON®NX I/O Boards User Manual gives more information on the I/O boards and their installation.

- Instructions for operation with option boards and other optional equipment.

Supplementary publications and manuals are available from Danfoss. See www.danfoss.com for listings.

> NOTE! Download the English and French product manuals with applicable safety, warning and caution information from https://www.danfoss.com/en/service-and-support/.

> REMARQUE Vous pouvez télécharger les versions anglaise et française des manuels produit contenant l'ensemble des informations de sécurité, avertissements et mises en garde applicables sur le site https://www.danfoss.com/en/service-and-support/.

1.3 Disposal

Do not dispose of equipment containing electrical components together with domestic waste. Collect it separately in accordance with local and currently valid legislation.

1.4 Manual Version

This manual is regularly reviewed and updated. All suggestions for improvement are welcome.

The original language of this manual is English.

Table 1: Manual Version

Edition	Remarks
DPD00888B	New structure throughout the manual.

1.5 Type Approvals and Certifications

The following list is a selection of possible type approvals and certifications for Danfoss drives:

Table 2: Type Approvals and Certifications

CE	ErP READY	♻	DNV·GL
c(UL)us	EAC	Ⓥ 089	OSHPD
BUREAU VERITAS	LR		RINA 1861
ClassNK		♿	Ⓒ
ABS			

N O T I C E

The specific approvals and certification for the drive are on the nameplate of the drive. For more information, contact the local Danfoss office or partner.

2 Safety

2.1 Safety Symbols

The following symbols are used in this guide:

<table>
<tr><td>⚠ D A N G E R ⚠</td></tr>
<tr><td>Indicates a hazardous situation which, if not avoided, will result in death or serious injury.</td></tr>
</table>

<table>
<tr><td>⚠ W A R N I N G ⚠</td></tr>
<tr><td>Indicates a hazardous situation which, if not avoided, could result in death or serious injury.</td></tr>
</table>

<table>
<tr><td>⚠ C A U T I O N ⚠</td></tr>
<tr><td>Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.</td></tr>
</table>

<table>
<tr><td>N O T I C E</td></tr>
<tr><td>Indicates information considered important, but not hazard-related (for example, messages relating to property damage).</td></tr>
</table>

2.2 Danger and Warnings

<table>
<tr><td colspan="1">⚠ D A N G E R ⚠</td></tr>
<tr><td>

SHOCK HAZARD FROM POWER UNIT COMPONENTS

The power unit components are live when the drive is connected to mains. A contact with this voltage can lead to death or serious injury.

- Do not touch the components of the power unit when the drive is connected to mains. Before connecting the drive to mains, make sure that the covers of the drive are closed.
</td></tr>
</table>

<table>
<tr><td>⚠ D A N G E R ⚠</td></tr>
<tr><td>

SHOCK HAZARD FROM TERMINALS

The motor terminals U, V, W, the brake resistor terminals, or the DC terminals are live when the drive is connected to mains, also when the motor does not operate. A contact with this voltage can lead to death or serious injury.

- Do not touch the motor terminals U, V, W, the brake resistor terminals, or the DC terminals when the drive is connected to mains. Before connecting the drive to mains, make sure that the covers of the drive are closed.
</td></tr>
</table>

<table>
<tr><td>⚠ D A N G E R ⚠</td></tr>
<tr><td>

SHOCK HAZARD FROM DC LINK OR EXTERNAL SOURCE

The terminal connections and the components of the drive can be live 5 minutes after the drive is disconnected from the mains and the motor has stopped. Also the load side of the drive can generate voltage. A contact with this voltage can lead to death or serious injury.

- Before doing electrical work on the drive:
  Disconnect the drive from the mains and make sure that the motor has stopped.
  Lock out and tag out the power source to the drive.
  Make sure that no external source generates unintended voltage during work.
  Wait 5 minutes before opening the cabinet door or the cover of the AC drive.
  Use a measuring device to make sure that there is no voltage.
</td></tr>
</table>

⚠ W A R N I N G ⚠

SHOCK HAZARD FROM CONTROL TERMINALS

The control terminals can have a dangerous voltage also when the drive is disconnected from mains. A contact with this voltage can lead to injury.

- Make sure that there is no voltage in the control terminals before touching the control terminals.

⚠ W A R N I N G ⚠

ACCIDENTAL MOTOR START

When there is a power-up, a power break, or a fault reset, the motor starts immediately if the start signal is active, unless the pulse control for Start/Stop logic is selected. If the parameters, the applications or the software change, the I/O functions (including the start inputs) can change. If you activate the auto reset function, the motor starts automatically after an automatic fault reset. See the Application Guide. Failure to ensure that the motor, system, and any attached equipment are ready for start can result in personal injury or equipment damage.

- Disconnect the motor from the drive if an accidental start can be dangerous. Make sure that the equipment is safe to operate under any condition.

⚠ W A R N I N G ⚠

LEAKAGE CURRENT HAZARD

Leakage currents exceed 3.5 mA. Failure to ground the drive properly can result in death or serious injury.

- Ensure the correct grounding of the equipment by a certified electrical installer.

⚠ W A R N I N G ⚠

SHOCK HAZARD FROM PE CONDUCTOR

The drive can cause a DC current in the PE conductor. Failure to use a residual current-operated protective (RCD) device Type B or a residual current-operated monitoring (RCM) device can lead to the RCD not providing the intended protection and therefore can result in death or serious injury.

- Use a type B RCD or RCM device on the mains side of the drive.

2.3 Cautions and Notices

⚠ C A U T I O N ⚠

DAMAGE TO THE AC DRIVE FROM INCORRECT MEASUREMENTS

Doing measurements on the AC drive when it is connected to mains can damage the drive.

- Do not do measurements when the AC drive is connected to mains.

⚠ C A U T I O N ⚠

DAMAGE TO THE AC DRIVE FROM INCORRECT SPARE PARTS

Using spare parts that are not from the manufacturer can damage the drive.

- Do not use spare parts that are not from the manufacturer.

⚠ C A U T I O N ⚠

DAMAGE TO THE AC DRIVE FROM INSUFFICIENT GROUNDING

Not using a grounding conductor can damage the drive.

- Make sure that the AC drive is always grounded with a grounding conductor that is connected to the grounding terminal that is identified with the PE symbol.

⚠ C A U T I O N ⚠

CUT HAZARD FROM SHARP EDGES

There can be sharp edges in the AC drive that can cause cuts.

- Wear protective gloves when mounting, cabling, or doing maintenance operations.

⚠ C A U T I O N ⚠

BURN HAZARD FROM HOT SURFACES

Touching surfaces, which are marked with the 'hot surface' sticker, can result in injury.

- Do not touch surfaces which are marked with the 'hot surface' sticker.

N O T I C E

DAMAGE TO THE AC DRIVE FROM STATIC VOLTAGE

Some of the electronic components inside the AC drive are sensitive to ESD. Static voltage can damage the components.

- Remember to use ESD protection always when working with electronic components of the AC drive. Do not touch the components on the circuit boards without proper ESD protection.

N O T I C E

DAMAGE TO THE AC DRIVE FROM MOVEMENT

Movement after installation can damage the drive.

- Do not move the AC drive during operation. Use a fixed installation to prevent damage to the drive.

N O T I C E

DAMAGE TO THE AC DRIVE FROM INCORRECT EMC LEVEL

The EMC level requirements for the AC drive depend on the installation environment. An incorrect EMC level can damage the drive.

- Before connecting the AC drive to the mains, make sure that the EMC level of the AC drive is correct for the mains.

N O T I C E

RADIO INTERFERENCE

In a residential environment, this product can cause radio interference.

- Take supplementary mitigation measures.

N O T I C E

MAINS DISCONNECTION DEVICE

If the AC drive is used as a part of a machine, the machine manufacturer must supply a mains disconnection device (refer to EN 60204-1).

N O T I C E

MALFUNCTION OF FAULT CURRENT PROTECTIVE SWITCHES

Because there are high capacitive currents in the AC drive, it is possible that the fault current protective switches do not operate correctly.

N O T I C E
VOLTAGE WITHSTAND TESTS
Doing voltage withstand tests can damage the drive.
–   Do not do voltage withstand tests on the AC drive. The manufacturer has already done the tests.

3 Product Overview

3.1 Intended Use

The VACON®NXP IP00 Drive Modules are intended for installation in a cabinet, switchgear, or any other enclosure.

The drive 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 AC drive, the motor, and equipment driven by the motor.

- System and motor status surveillance.

The drive can also be used for motor overload protection.

VACON®NXP IP00 Drive Modules are available as both 6-pulse (standard) and 12-pulse (optional) supply versions. VACON®NXP IP00 Drive Modules have a different number of units depending on the enclosure size:

- FR8, FR9, FR10, and FR11: 1 power unit

- FR12: 2 power units

- FR13 and FR14:

  - 2–4 non-regenerative front-end (NFE) units

  - 1 (FR13) or 2 (FR14) inverter units

AC chokes mounted in parallel are also included in the delivery of FR10–FR14. FR8 and FR9 have internal AC chokes.

VACON®NXP AC Drive can be used as programmable logic controller (PLC) in many applications due to extensive I/O and fieldbus options and easy programmability. Custom application development can be done with VACON®Programming tool and standard PLC programming languages defined in the IEC 61131/3.

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

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

N O T I C E
In a residential environment, this product can cause radio interference, in which case supplementary mitigation measures can be required.

Foreseeable misuse
Do not use the drive in applications which are non-compliant with specified operating conditions and environments. Ensure compliance with the conditions specified in 12.10 VACON® NXP IP00 Drive Modules Technical Data.

3.2 Package Label

The package label gives detailed information about the delivery.
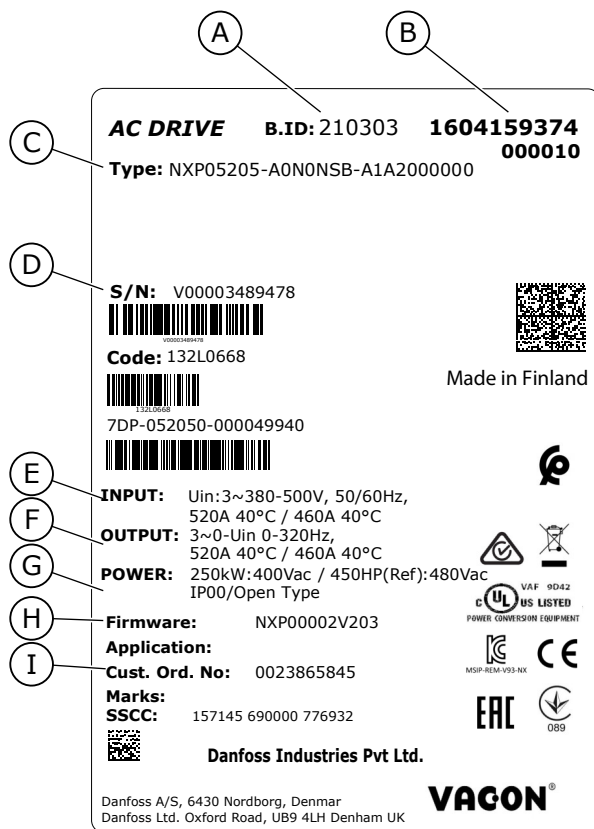
Illustration 1: Package Label of VACON℠ NXP IP00 Drive Module

A	The batch ID	F	The nominal output current
B	The order number of VACON℠	G	The protection rating
C	The type code	H	The firmware code
D	The serial number	I	The order number of the customer
E	The mains voltage		

3.3 Description of the Type Code

The type code of VACON℠ is made of standard codes and optional codes. Each part of the type code agrees to the data in the order.

Example

The code can have this format, for example:

• NXP03855-A0N0SSG-A1A20000E3

Table 3: Description of the Type Code

Code	Description
NXP	The product range: • NXP = VACON℠ NXP Air-cooled AC Drive
0385	The drive rating in amperes. For example, 0385 = 385 A

Code	Description
5	The mains voltage: • 5 = 380–500 V • 6 = 525–690 V
A	The control panel: • A = Standard (text display) • B = No local control panel • F = Dummy keypad • G = Graphical display
0	The protection rating: • 0 = IP00 (drive module only)
N	The EMC emission level: • N = No EMC emission protection. Requires cabinet assembly to comply with level L • T = Complies with the standard IEC/EN 61800-3 + A1 when used in IT networks (C4).
0	The brake chopper: • 0 = No brake chopper • 1 = Internal brake chopper

SSG	The hardware changes:
	• The supply, the first letter (**X**xx):
	  - S = Standard 6-pulse with chokes
	  - B = 6-pulse with choke and DC connection
	  - N = 6-pulse, no chokes for spare units
	  - T = 12-pulse
	  - U = 12-pulse, no chokes for spare units
	  - H = 6-pulse, no AC chokes, and with DC connection for spare units
	• The mounting, the second letter: (x**X**x):
	  - S = Air-cooled drive
	  - O = DC fan external supply
	• The boards, the third letter (xx**X**):
	  - F = Direct connection/non varnished
	  - G = Direct connection/varnished
	  - A = Fiber,integrated control
	  - B = Fiber,integrated control, Varnished
	  - N = IP54 control unit for standard/fiber connection
	  - O = IP54 control unit for varnished/fiber connection
	  - X = IP00 for cabinet use, standard PCB
	  - Y = IP00 for cabinet use, standard PCB, varnished

A1A20000E3	The option boards. 2 characters for each slot. 00 = the slot is not used

Code	Description
	The option board abbreviations: • A = Basic I/O board • B = Expander I/O board • C = Special board • D = Fieldbus board • E = Fieldbus board For example, E3 = PROFIBUS DP
+DNOT	The optional codes. See full list of option codes in the VACON℀ NXP Selection Guide.

3.4 Enclosure Sizes

Example

The codes for nominal current and nominal mains voltage are part of the type code (see 3.3 Description of the Type Code) on the package label (see 3.2 Package Label). Use these values to find out the enclosure size of the AC drive from the table.

In the example "NXP**03855**-A0N0SSG-A1A20000E3", the code for nominal current is 0385 and the code for nominal mains voltage is 5.

Table 4: Enclosure Sizes

Nominal mains voltage	Nominal current	Enclosure size
5 (380–500 V)	0140	FR8
	0168	
	0205	
	0261	FR9
	0300	
	0385	FR10
	0460	
	0520	
	0590	FR11
	0650	
	0730	
	0820	FR12
	0920	
	1030	
	1150	FR13
	1300	
	1450	
	1770	FR14
	2150	

Nominal mains voltage	Nominal current	Enclosure size
6 (500–690 V)	0125	FR8
	0144	
	0170	
	0208	
	0125	FR9
	0144	
	0170	
	0208	
	0261	FR10
	0325	
	0385	
	0416	
	0460	FR11
	0502	
	0590	
	0650	FR12
	0750	
	0820	
	0920	FR13
	1030	
	1180	
	1500	FR14
	1900	
	2250	

3.5 Available EMC Classes

The product standard (EMC immunity requirements) IEC/EN 61800-3 + A1 has 5 categories. The VACON® AC drives are divided into 5 EMC classes that have equivalents in the standard. All VACON® NX AC drives comply with the standard IEC/EN 61800-3 + A1.

The type code tells which category requirement the AC drive complies with (see 3.3 Description of the Type Code).

The category changes when these properties in the AC drive change:

• Level of electromagnetic disturbances

• Requirements of a power system network

• Installation environment (see the standard IEC/EN 61800-3 + A1)

Table 5: Available EMC Classes

EMC class in IEC/EN 61800-3 + A1	VACON® equivalent EMC class	Description	Available for
C4	T	These AC drives comply with the standard IEC/EN 61800-3 + A1 if they are used in IT systems. In IT systems, the networks are isolated from ground, or connected to ground through high impedance to decrease the leakage current. **N O T I C E** If the AC drives are used with other supplies, they do not comply with the EMC requirements.	All products
No EMC emission protection	N	The AC drives of this category do not give EMC emission protection. These drives are installed in enclosures. **N O T I C E** An external EMC filter is usually necessary to comply with the EMC emission requirements. **N O T I C E** **RADIO INTERFERENCE** In a residential environment, this product can cause radio interference. – Take supplementary mitigation measures.	IP00

3.6 Control Panel

3.6.1 Keypad

The VACON® keypad has 9 buttons with which to control the AC drive (and motor), set parameters, and monitor values.
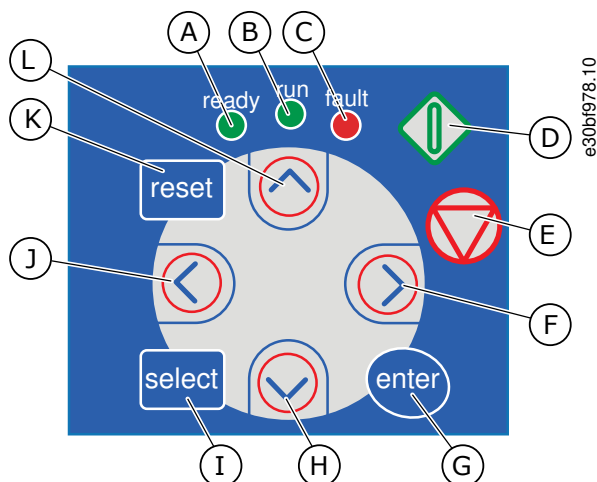
Illustration 2: Keypad Buttons for VACON® NXP

A	The [ready] LED is on when the AC power is connected to the drive and no faults are active. At the same time, the drive status indication shows *READY*.	G	The [enter] button. Use it to accept a selection, reset the fault history (push for 2–3 s).
B	The [run] LED is on when the drive operates. The LED blinks when the Stop button is pushed and the drive ramps down.	H	The Browser button Down. Use it to scroll the main menu and the pages of different submenus and to decrease a value.
C	The [fault] LED blinks when the AC drive is stopped because of dangerous conditions (Fault Trip). See 8.5.1 Finding the Active Faults Menu.	I	The [select] button. Use it to move between 2 last displays, for example, to see how new value changes some other value.
D	The Start button. When the keypad is the active control mode, this button starts the motor. See 8.4.3 Changing the Control Mode.	J	The Menu button Left. Use it to move back in the menu, move the cursor left (in the Parameter menu).
E	The Stop button. The button stops the motor (unless the stop is disabled by the parameter R3.4/R3.6). See 8.4.2 Keypad Control Parameters M3.	K	The [reset] button. Use it to reset a fault.
F	The Menu button Right. Use it to move forward in the menu, move the cursor right (in the parameter menu) and to go to the edit mode.	L	The Browser button Up. Use it to scroll the main menu and the pages of different submenus and to increase a value.

3.6.2 Display

The following figure describes the sections of the display.
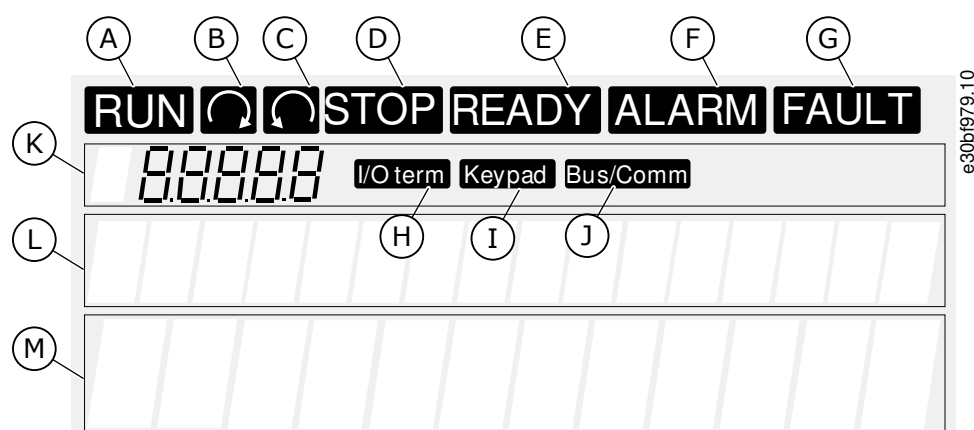
Illustration 3: Display Indications

A	The motor is in RUN state. The indication starts to blink when a stop command is given and blinks while the speed continues to decrease.	H	The I/O terminals is the active control mode.
B	The motor rotation direction is forward.	I	The control panel is the active control mode.
C	The motor rotation direction is reverse.	J	The fieldbus is the active control mode.
D	The drive does not operate.	K	The location indication. The line shows the symbol and number of the menu, parameter, and so on. For example, *M2* = Menu 2 (Parameters) or *P2.1.3* = Acceleration time.
E	The AC power is on.		
F	An alarm is given.	L	The description line. The line shows the description of the menu, value, or fault.
G	A fault is given and the AC drive is stopped.	M	The value line. The line shows the numerical and text values of references, parameters, and so on. It also shows the number of submenus that are available in each menu.

The drive status indicators (A–G) give information about the status of the motor and the AC drive.

The control mode indications (H, I, J) show the selection of the control mode. The control mode tells from where the START/STOP commands are given and reference values are changed. To make this selection, go to the Keypad control menu (M3) (see 8.4.3 Changing the Control Mode).

The three text lines (K, L, M) give information about the current location in the menu structure and the operation of the drive.

3.6.3 Basic Menu Structure

The data of the AC drive is in menus and submenus. The figure shows the basic menu structure of the AC drive.

This menu structure is only an example and the contents and items can vary depending on the application in use.

Main menu	Submenus		Main menu	Submenus
M1 Monitor	V1.1 Output frequency		M4 Active faults	
	V1.2 Frequency ref.			
	V1.3 Motor speed		M5 Fault history	
	V1.4 Motor current			
	V1.5 Motor torque		M6 System menu	S6.1 Language selection
	V1.6 Motor power			S6.2 Application selection
	V1.7 Motor voltage			S6.3 Copy parameters
	V1.8 DC-link voltage			S6.4 Compare param.
	V1.9 Unit temperature			S6.5 Security
	V1.10 Motor temp.			S6.6 Keypad settings
	V1.11 Analogue Input 1			S6.7 Hardware settings
	V1.12 Analogue Input 2			S6.8 System information
	V1.13 Current input			S6.9 Power monitor
	V1.14 DIN1, DIN2, DIN3			S6.11 Power multi-monitor
	V1.15 DIN4, DIN5, DIN6			
	V1.16 Analogue output		M7 Expander boards	
	V1.17 Multimonit. items			
M2 Parameters	See Application Manual			
M3 Keypad control	P3.1 Control place			
	R3.2 Keypad reference			
	P3.3 Direction (on keypad)			
	P3.4 Stop button			

e30bf981.10

Illustration 4: Basic Menu Structure of the AC Drive

4 Receiving the Delivery

4.1 Checking the Delivery, FR8–FR12

Before a VACON℠ AC drive is sent to the customer, the manufacturer makes many tests on the drive.

Procedure

1. After removing the packaging, examine the drive for transport damage.

   > If the drive was damaged during the shipping, speak to the cargo insurance company or the carrier.

2. To make sure that the delivery is correct, compare the order data to the data on the package label, see 3.2 Package Label.

   > If the delivery does not agree with the order, contact the vendor immediately.

3. To make sure that the contents of the delivery is correct and complete, compare the type code of the product to the type code, see 3.3 Description of the Type Code.

   Check that the delivery contains all ordered items.

   Standard delivery:

   - Power unit(s) with one integrated control unit. The power unit in FR12 with the integrated control unit is referred to as Power unit 1 the other one as Power unit 2 later in this manual.

   - AC choke(s), check the amount in tables in 12.5 AC Chokes. FR8 and FR9 have internal AC chokes.

   - FR12 units only: optical cable set for internal control connections between control unit and power units

   Delivered on request:

   - Door installation kit NXDRA02B for installing the control panel on the enclosure door.

   - Control unit with fixing plate. See also 5.5.1.3 Mounting the Control Unit, FR8–FR12.

   - Cable set, including seven optical cables and a 24 V connecting cable, readily connected to the power unit and the control unit. Standard length: 2.3 m (4.265 ft).

4. Attach the Product Modified Label. See 4.6 Using the Product Modified Label.

4.2 Checking the Delivery, FR13–FR14

Before a VACON℠ AC drive is sent to the customer, the manufacturer makes many tests on the drive.

Procedure

1. After removing the packaging, examine the drive for transport damage.

   > If the drive was damaged during the shipping, speak to the cargo insurance company or the carrier.

2. To make sure that the delivery is correct, compare the order data to the data on the package label, see 3.2 Package Label.

   > If the delivery does not agree with the order, contact the vendor immediately.

3. To make sure that the contents of the delivery is correct and complete, compare the type code of the product to the type code, see 3.3 Description of the Type Code.

   Check that the delivery contains all ordered items.

   Standard delivery (check the exact number of components in 12.5 AC Chokes):

   - 1or 2 NXI inverter units

   - 2–4 NXN non-generative front-end (NFE) units with 2 or 3 units mounted in brackets

   - Control unit with fixing plate. See also 5.5.2.3 Mounting the Control Unit, FR13–FR14.

   - AC choke per each NFE unit

   - FR14 only: dU/dt filter (optional; 1 per inverter unit)

   - Cable set for NFEs and inverter units

   - Optical cable set for internal control connections between control unit and power units

   Delivered on request:

- Door installation kit NXDRA02B for installing the control panel on the enclosure door.

- Cable set, including seven optical cables and a 24 V connecting cable, readily connected to the power unit and the control unit. Standard length: 2.3 m (4.265 ft).

4. Attach the Product Modified Label. See 4.6 Using the Product Modified Label.

4.3 Storing the Product

If the product has to be stored before installing it, follow these instructions.

Procedure

1. If the AC drive must be stored before using it, make sure that the ambient conditions agree to the following:

   - Storage temperature: -40…+70 ° C (-40...+158 ° F)

   - Relative humidity: 0–95%, no condensation

   - The environment must be free from dust. If there is dust in the air, the AC drive must be well protected to make sure that no dust gets into the AC drive.

2. If the AC drive must be kept in storage for a long time, connect the power to the AC drive each year. Keep the power on for a minimum of 2 hours.

3. If the storage time is more than 12 months, charge the electrolytic DC capacitors with caution. To reform the capacitors, obey the instructions in 10.2 Reforming the Capacitors.

   We do not recommend a long storage time.

4.4 Lifting the Units

The units are delivered either in a plywood case. To lift the unit out of the case, use lifting equipment capable of handling the weight of the units.

Find the lifting holes on the top of the unit.

Check the weights of the modules in 12.1 Weights of the Units.

Procedure

1. Place the lifting hooks symmetrically in at least 2 holes. The maximum allowed lifting angle is 45 °.
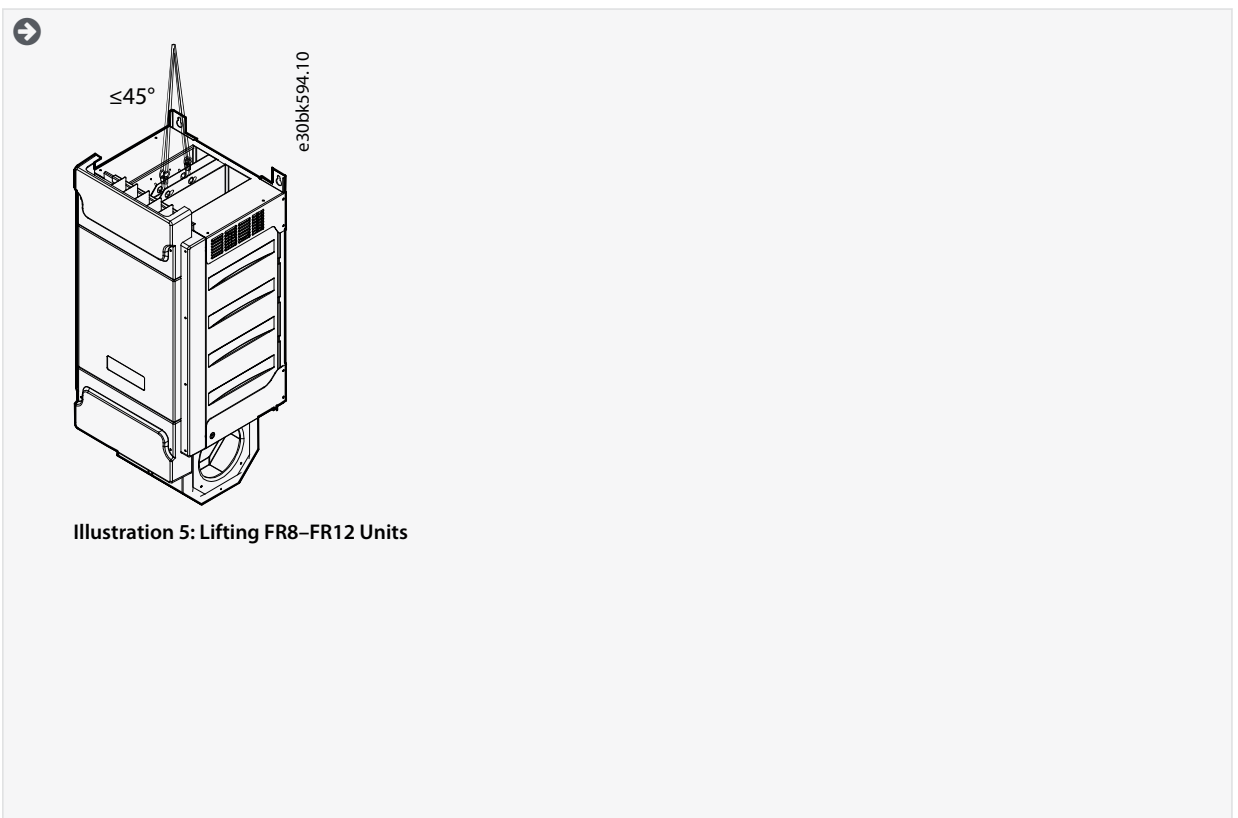
Illustration 5: Lifting FR8–FR12 Units

Illustration 6: Lifting NXN/NXI Units
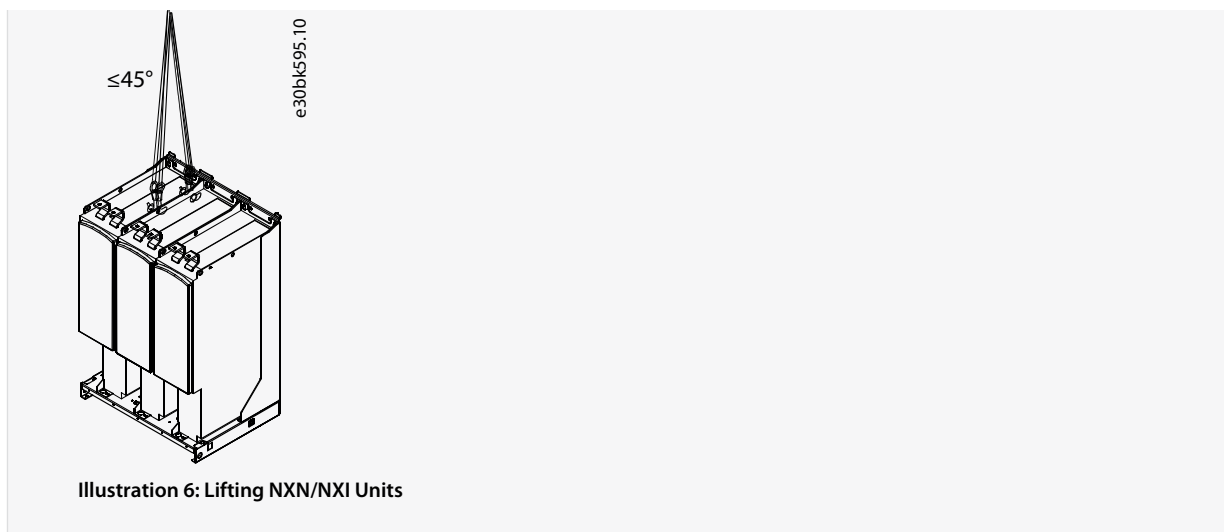
2. Move the unit to the place needed.

The power unit can temporarily rest on the cooling fan assembly.

N O T I C E

RISK OF DAMAGE TO THE FANS

Shocks or nonvertical forces can damage the fans.

- Avoid abruptly placing the power unit on the cooling fan assembly during the lifting of the unit.

3. After lifting the unit, check for signs of damage on the unit.

4. Recycle the packaging material according to local regulations.

4.5 Lifting the AC Chokes

The units are delivered either in a plywood case. To lift the units out of the case, use lifting equipment capable of handling the weight of the units.

Find the eyebolts on the top of the unit.

Check the weights in 12.2 Weights of the AC Chokes.

Procedure

1. Place the lifting hooks on the eyebolts.
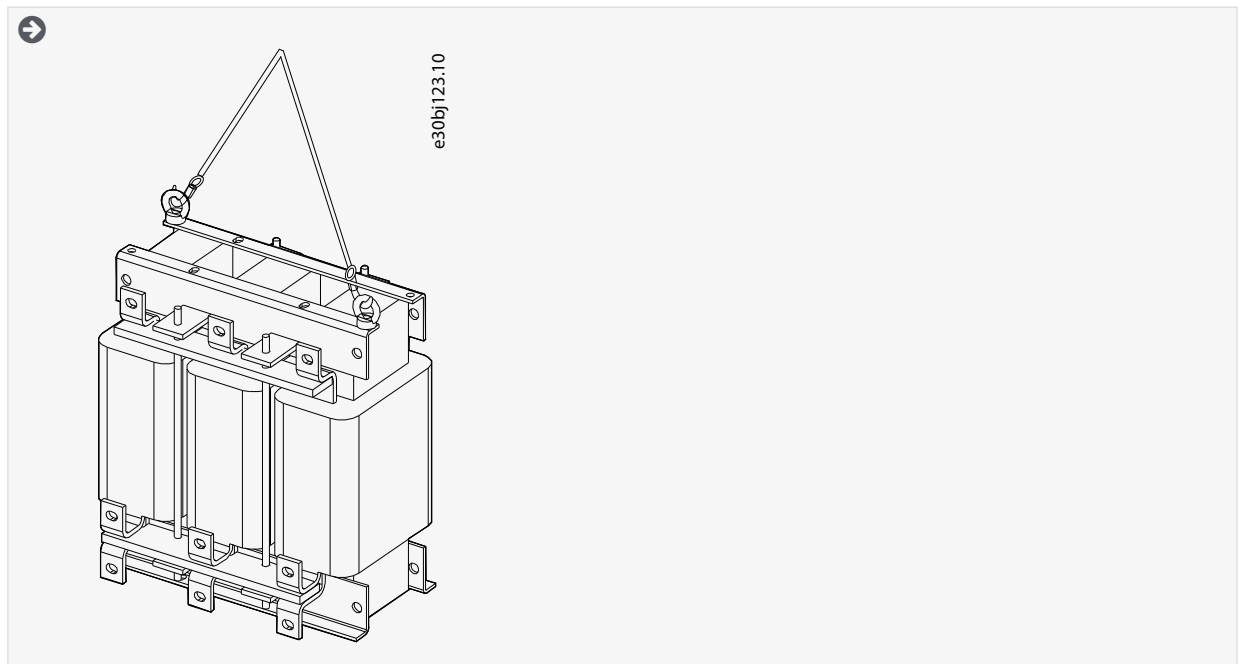
2. Move the unit to the place needed.
3. After lifting the unit, check for signs of damage on the unit.
4. Recycle the packaging material according to local regulations.

4.6 Using the Product Modified Label

In the accessories bag, there is also a "product modified" label. The function of the label is to tell the service personnel about the changes that are made in the AC drive.

Procedure

1. Attach the label on the side of the AC drive, in a place where it is easy to find.
2. If changes are made to the AC drive, write the change and date on the label.

5 Mounting the Unit

5.1 Environmental Requirements

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

Ensure that the space where the AC drive is installed, and the AC drive itself, is clean and free from particles, dust, or humidity that could harm the AC drive when it is powered on. For detailed ambient conditions specifications, see 12.10 VACON® NXP IP00 Drive Modules Technical Data.

Vibration and shock

The AC drive complies with requirements for units mounted on the walls and floors of production premises, and in panels bolted to walls or floors.

AC drive is suitable for marine installations.

Installation requirements:

- Make sure that there is sufficiently free space around the AC drive for cooling, see 5.2 Cooling Requirements.

- Some free space is also necessary for maintenance.

- Make sure that the mounting surface is sufficiently flat.

5.2 Cooling Requirements

The AC drive produces heat in operation. The fan moves air and decreases the temperature of the drive. Make sure that there is sufficiently free space around the drive.

Make sure that the temperature of the cooling air does not go above the maximum ambient operating temperature or below the minimum ambient operating temperature.

N O T I C E
Repeated overheating will shorten the lifetime of the converter.
– It is of utmost importance for the operation and lifetime of the frequency converter that the enclosure is well ventilated to keep the temperature below the maximum operating temperature.
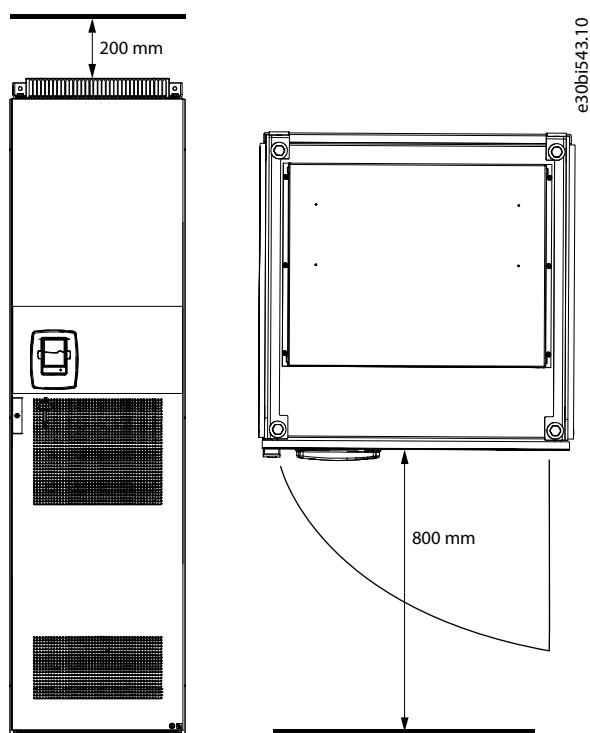
Illustration 7: Minimum Clearances around the AC Drive

Table 6: Required Cooling Air of VACON⁄ᴱ NXP IP00 Drive Modules

Drive type	The quantity of cooling air [m³/h]	The quantity of cooling air [CFM]
0140 5–0205 5	650	383
0261–0300 5 0125–0208 6	1000	589
0385–0520 5 0261–0416 6	2000	900
0590–0730 5 0460–0590 6	3000	1765
0820–1030 5 0650–0820 6	4000	2354
1150 5 0920–1180 6	5000	2943
1300–1450 5 (6-p)	6000	3531
1300–1450 6 (12-p)	7000	4120
1500 6 (6-p)	9000	5297
1770–2150 5 1900–2250 6	10000	5886

For more information on the power losses in all operating conditions, see http://ecosmart.danfoss.com/.

5.2.1 Ventilation of the Cabinet

The enclosure door must be provided with air gaps for air intake. To achieve sufficient cooling inside the cabinet, the dimensions for the total area of free openings for incoming air given in Table 7 must be followed. For instance, there could be two shielded gaps as presented in Illustration 8 (recommendation). This layout ensures a sufficient airflow to the unit fans and cooling of the additional components.

Air outlet gaps must be on top of the cabinet. The minimum effective air outlet area per AC drive frame is given in Table 7. The cooling arrangements inside the cabinet must be such that they prevent hot output air from mixing with the incoming fresh air (see 5.2.2 Steering the Internal Airflow).

The ventilation gaps must fulfill the requirements set by the selected protection rating. The examples in this manual apply to protection class IP21.

During operation, air is sucked in and circulated by a fan blower at the bottom of the power unit. If the power unit is placed in the upper part of the cabinet, the fan blower is in the mid of the cabinet, at the height of the upper ventilation grid.

Table 7: Ventilation Requirements (Ventilation Gap Dimensions)

Ventilation gap	Cabinet size: 600 mm (23.6 in)	Cabinet size: 800 mm (31.5 in)
1	510*255 mm (20.08*10.04 in)	765*255 mm (30.12*10.04 in)
2	7 dm² (0.75 ft²)	10.5 dm² (1.13 ft²)
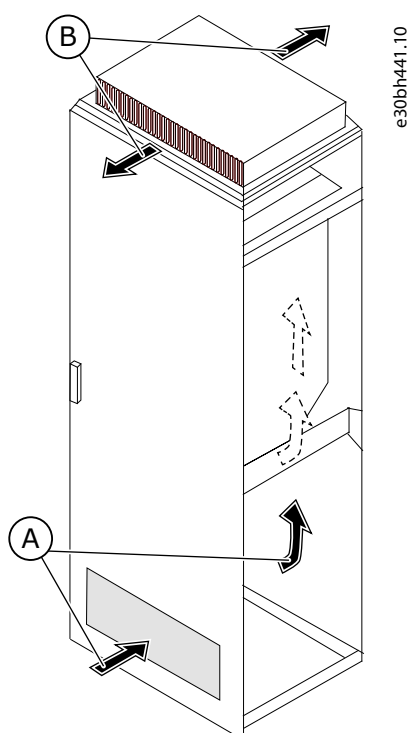
Illustration 8: Ventilation Arrangements on the Cabinet (Examples)

A	Cool air going in
B	Hot air coming out

5.2.2 Steering the Internal Airflow

Cooling air must be sucked in through the ventilation gaps on the door and blown out at the top of the enclosure. To steer the hot air from the power unit to the outlet at the top of the enclosure and prevent it from circulating back to the fan blower, use either of the following arrangements:

A: Install a closed air duct from the power unit to the outlet on top of the enclosure (1 in Illustration 9).

B: Install shields in the gaps between the power unit and the cabinet walls (2 in Illustration 9). Place the shields above the air outlet gaps at the sides of the unit.

In enclosure size FR12, close the opposing gaps in the upper part of the cabinets with a sheet metal plate to ensure proper cooling.
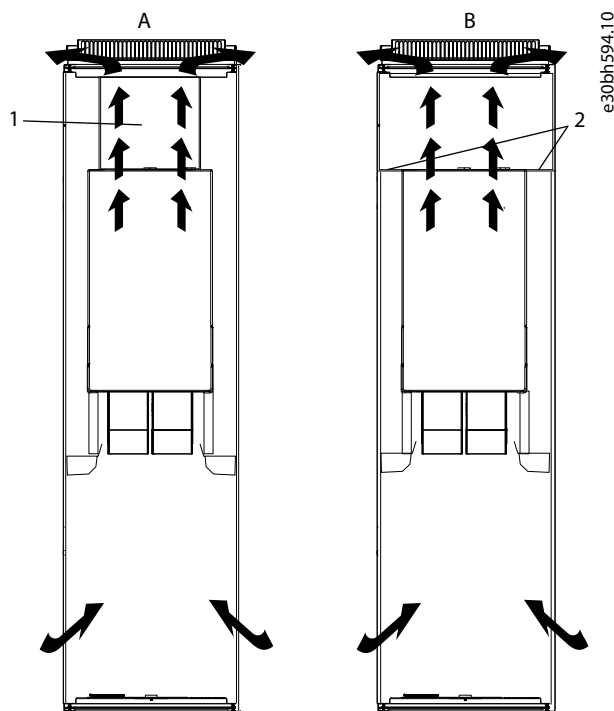
Illustration 9: Arrangements for Steering Internal Airflow

A	Arrangement with air duct	1	Air duct
B	Arrangement with air barriers	2	Shields

To allow free air circulation, the touch cover at the bottom of the cabinet must be of type meshed sheet metal screen. Also, the busbar touch protection cover and the upper support for the AC choke must be equipped with holes. See Illustration 9.

If a flat roof is used, mount a V-shaped air guide on the underside of the roof to direct the airflow horizontally. See Illustration 10.
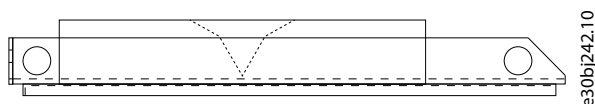
Illustration 10: Roof Structure (Side View)

5.2.3 Heat Dissipation

The efficiency of the AC drive is a function of switching frequency, operating frequency, and load (see VACON NXC Enclosed Drive Operating Guide). Based on this information, heat dissipation can be calculated at a certain operating point. For most cases the following general formula based on AC drive load can be used to estimate the heat dissipation of the power unit:

$$P_{\text{loss}}[\text{kW}] = [\text{kW}] * 0.025$$

The following table shows the heat dissipation from the AC choke.

Table 8: Heat Dissipation from the AC Choke

AC choke	Heat dissipation
CHK0261	460 W
CHK0400	570 W
CHK0520	810 W
CHK0650	890 W

5.2.4 Temperatures Measured during Test Run

The following table shows the temperatures measured during a test run of a 520 A/400 V unit with nominal load at 50 Hz frequency. The test unit was installed in a Rittal TS8 enclosure following the guidelines described in this manual.

Table 9: Temperatures Measured during an Accepted Test Run

Measurement	Temperature in °C (in °F)	Note
Ambient air	30 (86)	Outside enclosure
Fan intake air	36 (97)	-
Unit input terminal	59 (138)	L2-phase
Output terminal	65 (149)	V-phase
AC choke	92 (198)	L2 winding surface

5.3 Cabinet Requirements for FR8–FR12

VACON® NXP IP00 power units of enclosures FR8–FR12 can be installed in cabinets. The cabinets have to meet the following requirements.

The AC drives can be installed in any enclosure that fulfills these requirements. In the illustrations in this manual, Rittal TS8 is used as an example enclosure.

Table 10: Cabinet Requirements for FR8–FR12

Requirement	FR8	FR9	FR10	FR11	FR12
Minimum width:	400 mm (15.75 in)	600 mm (23.62 in)	600 mm (23.62 in)	800 mm (31.50 in)	1200 mm (47.24 in)
Minimum depth:	600 mm (23.62 in)[1]				
Minimum height:	1800 mm (70.87 in) if the AC choke is installed beneath the power unit, otherwise minimum 1500 mm (59.06 in)				
Mechanical requirements: Total weight of equipment the cabinet must be able to support (if the power unit and the AC choke are installed in the same cabinet).	58.0 kg (128 lb)	146 kg (322 lb)	275 kg (606.3 lb)	350 kg (771.6 lb)	550 kg (1212.5 lb)
Protection rating:	This manual applies to IP21.				
Construction:	According to EN60439-1				
Ventilation openings:	See 5.2.1 Ventilation of the Cabinet.				

[1] Minimum 490 mm (19.29 in) if the control unit is installed in another position than at the front of the power unit

5.4 Cabinet Requirements for FR13–FR14

The power section of enclosures FR13 and FR14 includes 2–4 non-generative front-end (NFE) units, AC chokes, inverter units, and dU/dt-filters (required for FR14). Several cabinets are, therefore, needed. Here are some example installations and their cabinet requirements.

The AC drives can be installed in any enclosure that fulfills these requirements. In the illustrations in this manual, Rittal TS8 is used as an example enclosure.

Example 1
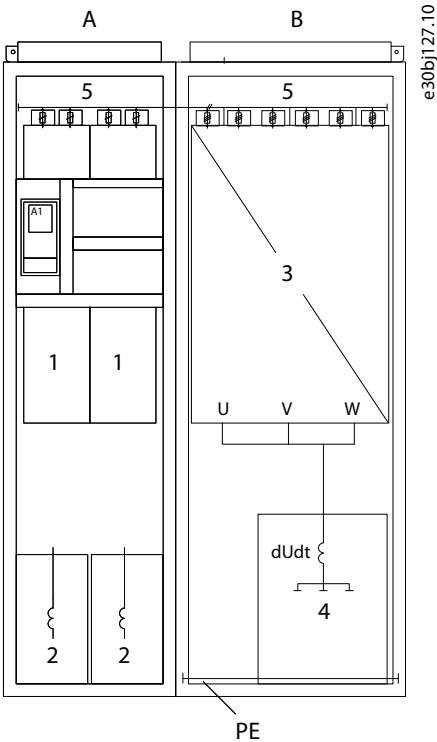
Illustration 11: Example Installation 1

1	NFE units	4	dU/dt filter
2	AC chokes	5	DC busbars
3	FI13 (inverter unit)		

Table 11: Cabinet Data for Installation Example 1

This installation applies to drive types:	NXP1150 5 NXP0920 6 NXP1030 6 NXP1180 6
Minimum required cabinet width:	600 mm (Cabinet A) + 800 mm (Cabinet B) (23.62 in (Cabinet A) + 31.50 in (Cabinet B))
Minimum required cabinet height:	2200 mm (86.61 in)
Required weight carrying capacity:	NXP1150 5: 480 kg (1058.2 lb) (Cab. A); 540 kg (1190.5 lb) (Cab. B) NXP0920 6: 450 kg (992.1 lb) (Cab. A); 540 kg (1190.5 lb) (Cab. B) NXP1030 6: 450 kg (992.1 lb) (Cab. A); 540 kg (1190.5 lb) (Cab. B) NXP1180 6: 480 kg (1058.2 lb) (Cab. A); 540 kg (1190.5 lb) (Cab. B)
Protection rating:	This manual applies to IP21.
Construction:	According to EN60439-1
Ventilation openings:	See 5.2.1 Ventilation of the Cabinet.

Example 2

Illustration 12: Example Installation 2

1	NFE units		4	dU/dt filter
2	AC chokes		5	DC busbars
3	FI13 (inverter unit)			

Table 12: Cabinet Data for Installation Example 2

This installation applies to drive types:	NXP1300 5 (6-pulse) NXP1450 5 (6-pulse)
Minimum required cabinet width:	800 mm (Cab. A) + 800 mm (Cab. B) (31.50 in (Cab. A) + 31.50 in (Cab. B)
Minimum required cabinet height:	2200 mm (86.61 in)
Required weight carrying capacity:	635 kg (1399.9 lb) (Cab. A); 590 kg (1300.7 lb) (Cab. B)
Protection rating:	This manual applies to IP21.
Construction:	According to EN60439-1
Ventilation openings:	See 5.2.1 Ventilation of the Cabinet.

Example 3
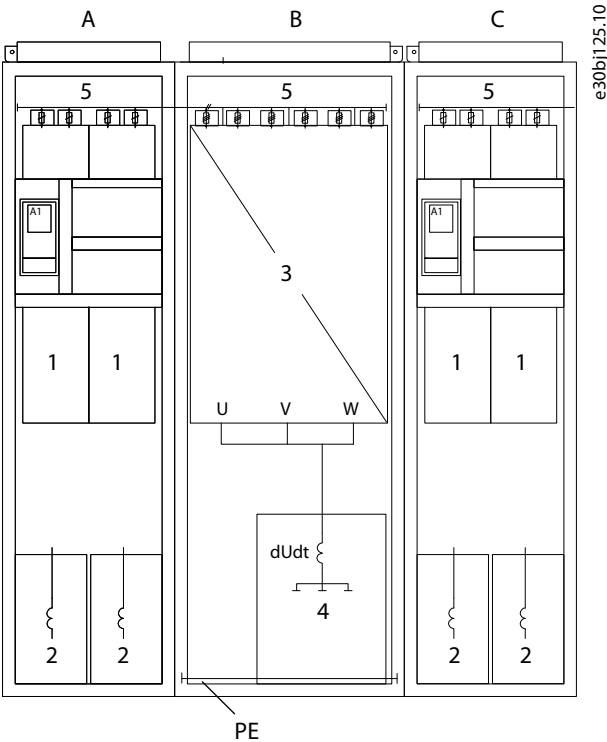
Illustration 13: Example Installation 3

1	NFE units	4	dU/dt filter
2	AC chokes	5	DC busbars
3	FI13 (inverter unit)		

Table 13: Cabinet Data for Installation Example 3

This installation applies to drive types:	NXP1300 5 (12-pulse) NXP1450 5 (12-pulse)
Minimum required cabinet width:	600 mm (Cab. A) + 800 mm (Cab. B) + 600 mm (Cab. C) (23.62 in (Cab. A) + 31.50 in (Cab. B) + 23.62 in (Cab. C))
Minimum required cabinet height:	2200 mm (86.61 in)
Required weight carrying capacity:	450 kg (992.08 lb) (Cab. A and C); 540 kg (1190.5 lb) (Cab. B)
Protection rating:	This manual applies to IP21.
Construction:	According to EN60439-1
Ventilation openings:	See 5.2.1 Ventilation of the Cabinet.

Example 4
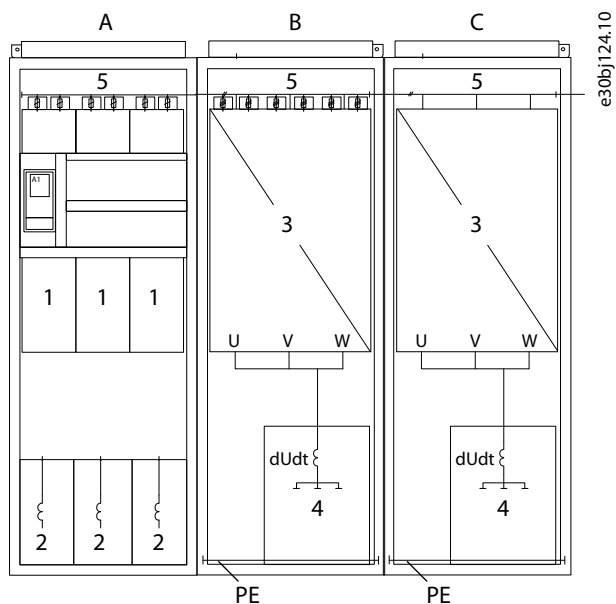
Illustration 14: Example Installation 4

1	NFE units	4	dU/dt filter
2	AC chokes	5	DC busbars
3	FI13 (inverter unit)		

Table 14: Cabinet Data for Installation Example 4

This installation applies to drive type:	NXP1500 6 (6-pulse)
Minimum required cabinet width:	800 mm (Cab. A) + 800 mm (Cab. B) + 800 mm (Cab. C) (31.50 in (Cab. A) + 31.50 in (Cab. B) + 31.50 in (Cab. C))
Minimum required cabinet height:	2200 mm (86.61 in)
Required weight carrying capacity:	635 kg (1399.9 lb) (Cab. A); 540 kg (1190.5 lb) (Cab. B); 540 kg (1190.5 lb) (Cab. C)
Protection rating:	This manual applies to IP21.
Construction:	According to EN60439-1
Ventilation openings:	See 5.2.1 Ventilation of the Cabinet.

Example 5
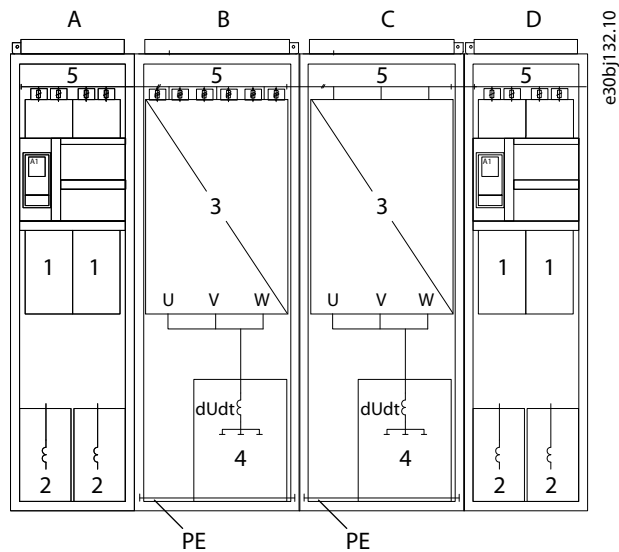
Illustration 15: Example Installation 5

1	NFE units	4	dU/dt filter
2	AC chokes	5	DC busbars
3	FI13 (inverter unit)		

Table 15: Cabinet Data for Installation Example 4

This installation applies to drive types:	NXP1770 5 NXP2150 5 NXP1500 6 (12-pulse) NXP1900 6 NXP2250 6
Minimum required cabinet width:	600 mm (Cab. A and D) + 800 mm (Cab. B and C) (23.62 in (Cab. A and D) + 31.50 in (Cab. B and C))
Minimum required cabinet height:	2200 mm (86.61 in)
Required weight carrying capacity:	NXP1500 6 (12-pulse): 450 kg (992.1 lb) (Cab. A and D); 540 kg (1190.5 lb) (Cab. B and C) NXP1770 5: 450 kg (992.1 lb) (Cab. A and D); 540 kg (1190.5 lb) (Cab. B and C) NXP1900 6: 450 kg (992.1 lb) (Cab. A and D); 540 kg (1190.5 lb) (Cab. B and C) NXP2150 5: 480 kg (1058.2 lb) (Cab. A and D); 540 kg (1190.5 lb) (Cab. B and C) NXP2250 6: 480 kg (1058.2 lb) (Cab. A and D); 540 kg (1190.5 lb) (Cab. B and C)
Protection rating:	This manual applies to IP21.
Construction:	According to EN60439-1
Ventilation openings:	See 5.2.1 Ventilation of the Cabinet.

5.5 Installation Sequence

5.5.1 Installation Sequence for FR8–FR12

Use these instructions to install the VACON® NXP IP00 Drive Modules.

Check the following:

- Environmental requirements, see 5.1 Environmental Requirements
- Cooling requirements, see 5.2 Cooling Requirements
- Cabinet requirements, see 5.3 Cabinet Requirements for FR8–FR12
- The dimensions of the AC drive, see 12.3.3 List of Dimension Information

Procedure

1. FR10–FR12: Install the AC choke, see 5.5.1.1 Mounting the AC Choke, FR10–FR12.
2. Install the power unit, see 5.5.1.2 Mounting the Power Unit, FR8–FR12.
3. If the drive was ordered with the control unit separated from the power unit, install the control unit, see 5.5.1.3 Mounting the Control Unit, FR8–FR12.

   The VACON® NXP FR10–FR12 drive can be delivered with the control unit either integrally mounted on the power unit or separated from the power unit and fixed to the mounting box. The mounting box can be installed to a sidewall or the frame of the enclosure.

4. Make sure that there is sufficiently free space around the AC drive for cooling, see 5.2 Cooling Requirements. Some free space is also necessary for maintenance.
5. Continue to the grounding and cabling, see 6.7 Installing the Cables.

5.5.1.1 Mounting the AC Choke, FR10–FR12

This topic gives instructions on how and where to mount the AC choke in the cabinet for VACON® NXP IP00 Drive Modules, FR10–FR12.

NOTE! VACON® NXP IP00 Drive Modules, FR8 and FR9 does not have the external AC choke.

Procedure

1. Mount the AC choke in the bottom part of the cabinet close to the rear wall.

   In case a fuse switch is later installed, mount the AC choke somewhat to the left.

2. Fasten the AC choke on an assembly plate or using mounting rails.
3. If the cabinet is transported in horizontal position, install an upper support plate above the AC choke, and equip the support plate with air circulation holes.
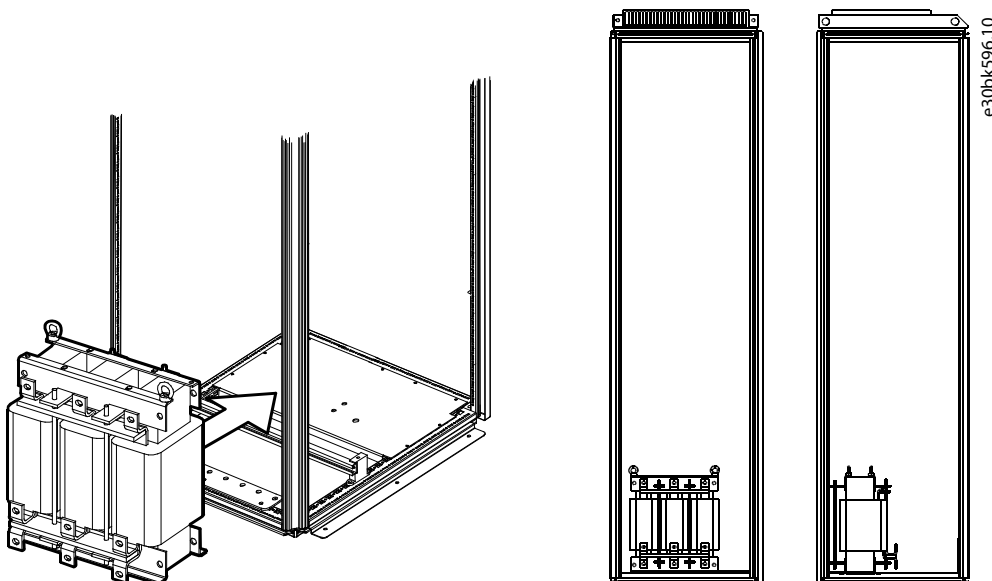
Illustration 16: Mounting AC Choke

5.5.1.2 Mounting the Power Unit, FR8–FR12

This topic gives instructions on how to mount the power unit in the cabinet for VACON® NXP IP00, FR8–FR12.

To make replacement of spare parts and other service work easier, we recommend mounting the power unit on rails. See all installation measurements for mounting rails in 12.3.1 Mounting Dimensions, FR8–FR12. See also dimensional drawings in 12.3.3 List of Dimension Information.

NOTE! If the power unit is installed before the AC choke, the center of gravity is high at this stage. Support the enclosure thoroughly during the assembly.

Procedure

1. Fasten the mounting rails to the sides of the cabinet. Leave a space between the unit and the walls on both sides for the internal cooling air circulation.

2. To allow mounting the power unit to the rear wall of the cabinet, install two fixing bars on the rear wall of the cabinet at appropriate levels.

3. If the space around the power unit is narrow, lead the internal power cables along the wall and fasten them in brackets before mounting the power unit. See 6.7 Installing the Cables.

4. Fasten the power unit to the rear wall of the enclosure using the fixing holes in the frame.

5. Install a PE busbar, for instance, at the bottom front of the enclosure.

    The PE busbar must be connected to external ground at the installation site according to local regulations.
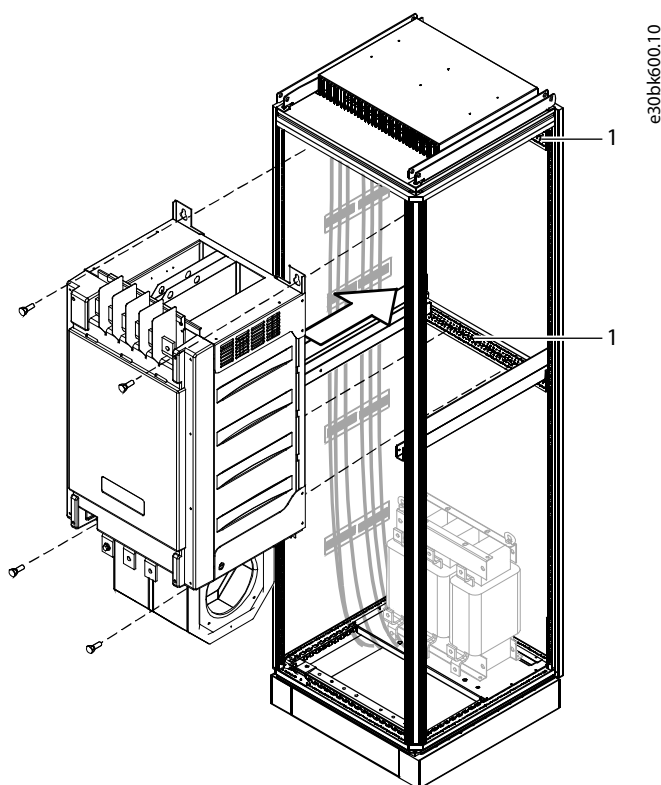
Illustration 17: Mounting the Power Unit, FR8-FR12

1	Fixing bars

5.5.1.3 Mounting the Control Unit, FR8–FR12

The VACON® NXP FR8–FR12 drive can be delivered with the control unit either integrally mounted on the power unit or separated from the power unit and fixed to the mounting box. The mounting box can be installed to a sidewall or the frame of the enclosure. If the drive was ordered with the control unit separated from the power unit, use these instructions to mount the control unit in the cabinet.

NOTE! If needed, connect the 24 V connecting cable and the fiber optic cables to the power unit before mounting the control unit. See 7.4 Fiber Cable Connections.

For further installation of other devices (breakers, fuses, EMC grounding), it is recommended that an installation plate be mounted in front of the AC choke, leaving the bottom part open for air circulation.

Procedure

1. Fasten the mounting box with the control unit to a sidewall or to the frame of the enclosure.

   > The standard length of the connecting cable and the fiber optic cables is 2.3 m, so the control unit must be placed within this distance from the power unit. Pay attention to the minimum bending radius of the fibre optic cables 7.4 Fiber Cable Connections.

2. To ensure a proper grounding of the control unit assembly, we recommend that an extra grounding cable is drawn from the mounting box and connected to the cabinet frame. Use a braided copper cable designed for high frequency signals.

In Illustration 18, the control unit is mounted on a hinged assembly box (not included in standard delivery) in front of the power unit, FR8–FR12.
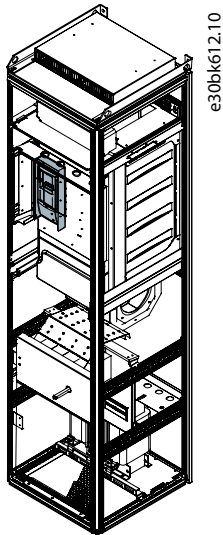
Illustration 18: Mounted Control Unit, FR8–FR12

5.5.2 Installation Sequence for FR13–FR14

Use these instructions to install the VACON℗NXP IP00 Drive Modules.

Check the following:

- Environmental requirements, see 5.1 Environmental Requirements

- Cooling requirements, see 5.2 Cooling Requirements

- Cabinet requirements, see 5.4 Cabinet Requirements for FR13–FR14

- The dimensions of the AC drive, see 12.3.3 List of Dimension Information

Procedure

1. Install the AC chokes, see 5.5.2.1 Mounting the AC Chokes, FR13–FR14.
2. Install the power unit, see 5.5.2.2 Mounting the Power Unit, FR13–FR14.
3. If the drive was ordered with the control unit separated from the power unit, install the control unit, see 5.5.2.3 Mounting the Control Unit, FR13–FR14.

   > The VACON℗NXP FR10–FR12 drive can be delivered with the control unit either integrally mounted on the power unit or separated from the power unit and fixed to the mounting box. The mounting box can be installed to a sidewall or the frame of the enclosure.

4. Make sure that there is sufficiently free space around the AC drive for cooling, see 5.2 Cooling Requirements. Some free space is also necessary for maintenance.
5. Continue to the grounding and cabling, see 6.7 Installing the Cables.

5.5.2.1 Mounting the AC Chokes, FR13–FR14

This topic gives instructions on how and where to mount the AC choke in the cabinet for VACON® NXP IP00 Drive Module, FR13–FR14.

Check the needed amount and type of chokes in 12.5 AC Chokes and 5.4 Cabinet Requirements for FR13–FR14.

Procedure

1. Mount the AC chokes in the bottom part of the cabinet.
2. Fasten the AC chokes on an assembly plate or using mounting rails.
3. If the cabinet is transported in horizontal position, install an upper support plate above the AC chokes, and equip the support plate with air circulation holes. See Illustration 9.
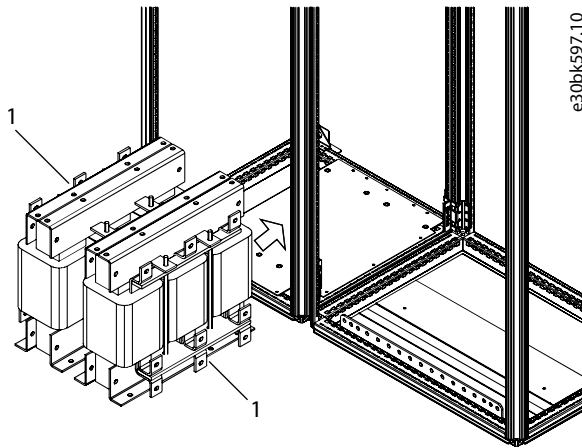
Illustration 19: Mounting 2 AC Chokes

1	Terminals pointing outwards
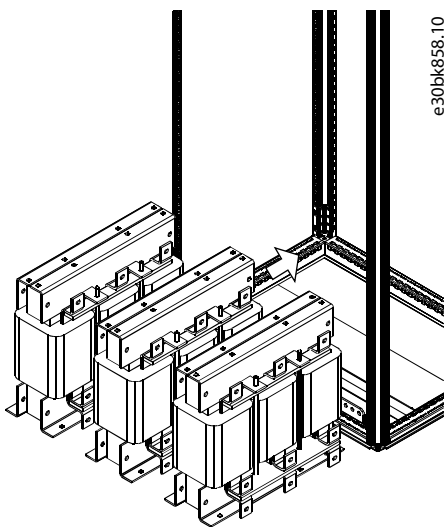
Illustration 20: Mounting 3 AC chokes

5.5.2.2 Mounting the Power Unit, FR13–FR14

This topic gives instructions on how to mount the power unit in the cabinet for VACON® NXP IP00 Drive Module, FR13–FR14.

To make replacement of spare parts and other service work easier, we recommend mounting the power unit on rails. See all installation measurements for mounting rails in 12.3.2 Mounting Dimensions, FR13–FR14. See also dimensional drawings in 12.3.3 List of Dimension Information.

NOTE! If the power unit is installed before the AC chokes, the center of gravity is high at this stage. Support the enclosure thoroughly during the assembly.

Procedure

1. Fasten the mounting rails to the sides of the cabinet.
2. To allow mounting the power unit to the rear wall of the cabinet, install a fixing bar on the rear wall of the cabinet at appropriate level.
3. Mount two unit supports on the sides. The units are intended to rest on these supports.
4. Fasten the power unit to the rear wall of the enclosure using the fixing holes in the frame.

5. Install a PE busbar, for instance, at the bottom front of the enclosure.

> The PE busbar must be connected to external ground at the installation site according to local regulations.
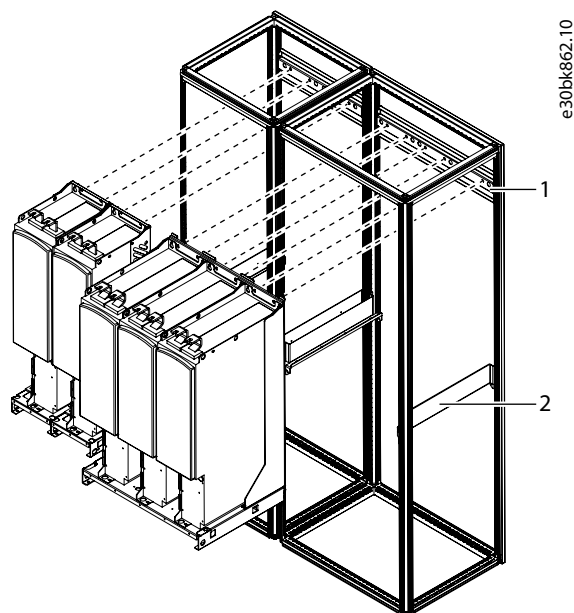
Illustration 21: Mounting the Power Unit, FR13–FR14

1	Fixing bars
2	Module supports

5.5.2.3 Mounting the Control Unit, FR13–FR14

The control unit for VACON℠ NX FR13–FR14 is always delivered separately. Use these instructions to mounting the control unit. For dimensions of the control unit, see 12.3.6 Dimensions for Control Unit.

NOTE! If needed, connect the 24 V connecting cable and the fibre optic cables to the power unit before mounting the control unit. See 7.4 Fiber Cable Connections.

Procedure

1. Fasten the mounting box with the control unit to a sidewall or to the frame of the enclosure.

> The standard length of the connecting cable and the fiber optic cables is 2.3 m, so the control unit must be placed within this distance from the power unit. Pay attention to the minimum bending radius of the fiberd optic cables 7.4 Fiber Cable Connections.

2. To ensure a proper grounding of the control unit assembly, we recommend that an extra grounding cable is drawn from the mounting box and connected to the cabinet frame. Use a braided copper cable designed for high frequency signals.

In Illustration 22, the control unit mounted on a hinged assembly box (not included in standard delivery) on the cabinet frame, FR13–FR14
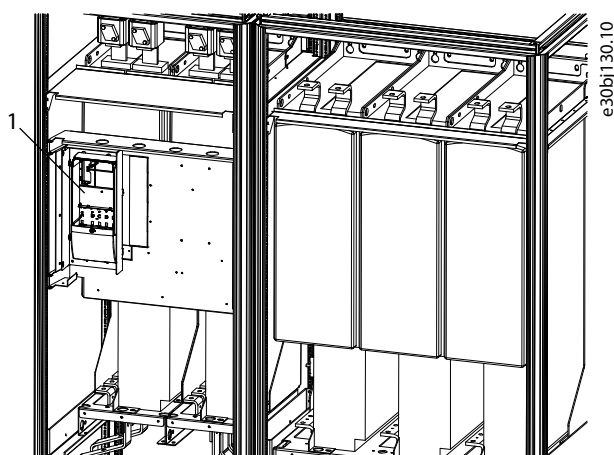
Illustration 22: Mounted Control Unit, FR13–FR14

1	Control unit

6 Electrical Installation

6.1 Cable Connections

The mains cables are connected to terminals L1, L2, and L3 (12-pulse units 1L1, 1L2, 1L3, 2L1, 2L2, 2L3). The motor cables are connected to terminals U, V, and W.
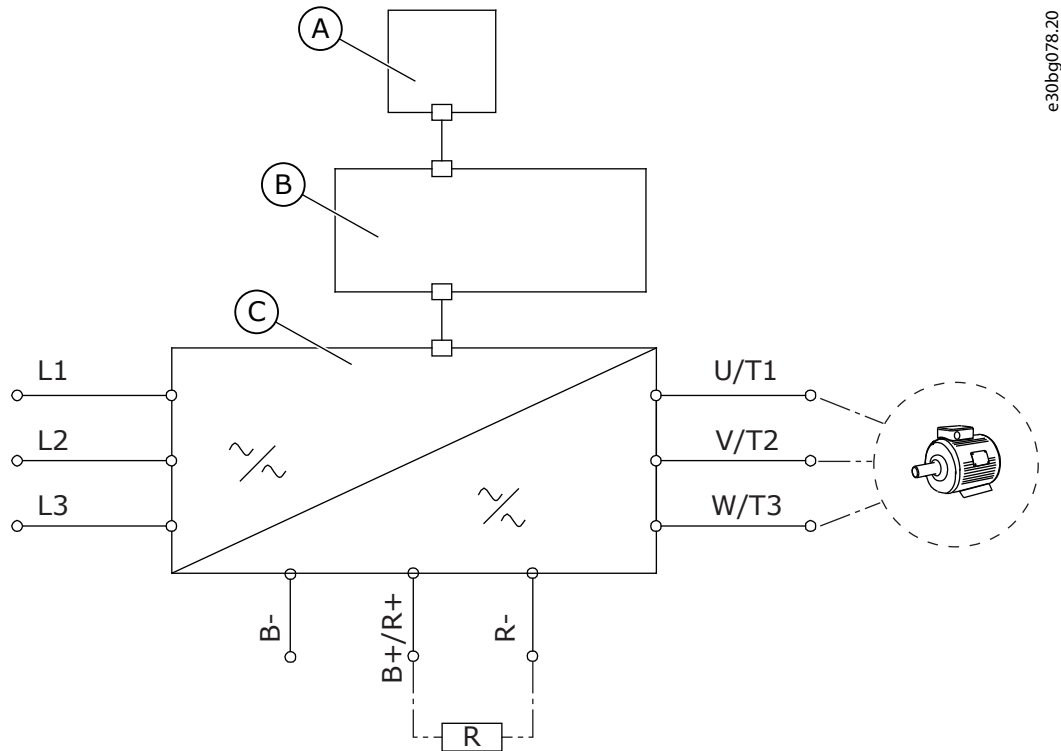
Illustration 23: Principal Connection Diagram

A	The control panel	C	The power unit
B	The control unit		

For EMC-compliant installation, see 6.2 EMC-compliant Installation.

6.1.1 General Cable Requirements

Use cables with a minimum heat resistance of +70 °C (158 °F). In the selection of the cables and the fuses, refer to the nominal output current of the drive. Find the nominal output current on the nameplate.

We recommend selecting the cables and the fuses to agree with the output current because the input current of the AC drive is almost the same as the output current.

In AC drives consisting of double input sections, an even number of input cables is required. In AC drives consisting of double power units an even number of motor cables is needed. See 12.4 Cable and Fuse Sizes for list of cabling recommendations.

> ⚠ **C A U T I O N** ⚠
>
> **RISK OF DAMAGE TO DRIVE DUE TO UNEQUAL LOAD**
>
> In case the cabling between the units is not symmetrical, unequal load might occur and reduce loadability or even damage the AC drive.
>
> - In 12-pulse drives with double inputs or outputs it is very important that the same cable dimensions, type and routing is used for all cables.

NOTE! If a safe switch between the AC drive and the motor is used, make sure that it is switched on before setting the AC drive in run state.

For information on how to make the cable installation to comply with the UL standards, see 6.1.2 UL Standards on Cabling.

If the motor temperature protection of the drive (see VACON® All in One Application Guide) is used as an overload protection, select the cable to agree with the protection. If 3 or more cables are used in parallel for larger AC drives, use a separate overload protection for each cable.

6.1.2 UL Standards on Cabling

To comply with the UL (Underwriters Laboratories) regulations, use a UL-approved copper wire with a minimum heat resistance of 60 °C or 75 °C (140 °F or 167 °F).

The cable must be suitable for use on a circuit that gives a maximum of 100 000 rms symmetrical amperes, and a maximum of 600 V. Use Class 1 wire only.

For the tightening torques of the terminals, see 12.8 Tightening Torques of the Terminals.

6.1.3 Cable Selection and Dimensioning

Find the typical sizes and types of cables used with the AC drive in the tables in 12.4 Cable and Fuse Sizes. In the selection of cables, refer to local regulations, cable installation conditions, and cable specification.

The dimensions of the cables must comply with the requirements of the standard IEC60364-5-52.

- The maximum ambient temperature is +30 °C.

- The maximum temperature of the cable surface is +70 °C.

- Use only motor cables with a concentric copper shield.

- The maximum number of parallel cables is 9.

When using parallel cables, make sure to obey the requirements of the cable cross-sections.

For important information on the requirements of the grounding conductor, see 6.3 Grounding.

For the correction factors for each temperature, see the standard IEC60364-5-52.

6.1.4 Fuse Selection

We recommend the fuse type aR (UL recognized, IEC 60269-4). To make a selection of the fuse voltage rating, refer to the mains. Refer also to local regulations, cable installation conditions, and cable specification. Do not use larger fuses than what is recommended.

External fuses in the input line are required for overload and short-circuit protection of the drive.

Find the recommended fuses in tables in 12.4 Cable and Fuse Sizes.

6.1.5 Principle of the Power Unit Topology

The principles for mains and motor connections of the basic 6-pulse drive in enclosure sizes FR10 to FR14 show in Illustration 24.

Some units built in enclosure size FR11 have double input devices and require an even number of supply cables but an uneven number of motor cables can be used.

Units built in enclosure size FR12 consist of two power units and require an even number of supply and motor cables. See Illustration 24 and the tables in 12.4 Cable and Fuse Sizes.

The 12-pulse drives always have a double set of inputs. The motor connection is size dependent as described in Illustration 24.

In all VACON® NXP IP00 Drive Module FR14 sizes, dU/dt filters are integrated by default.
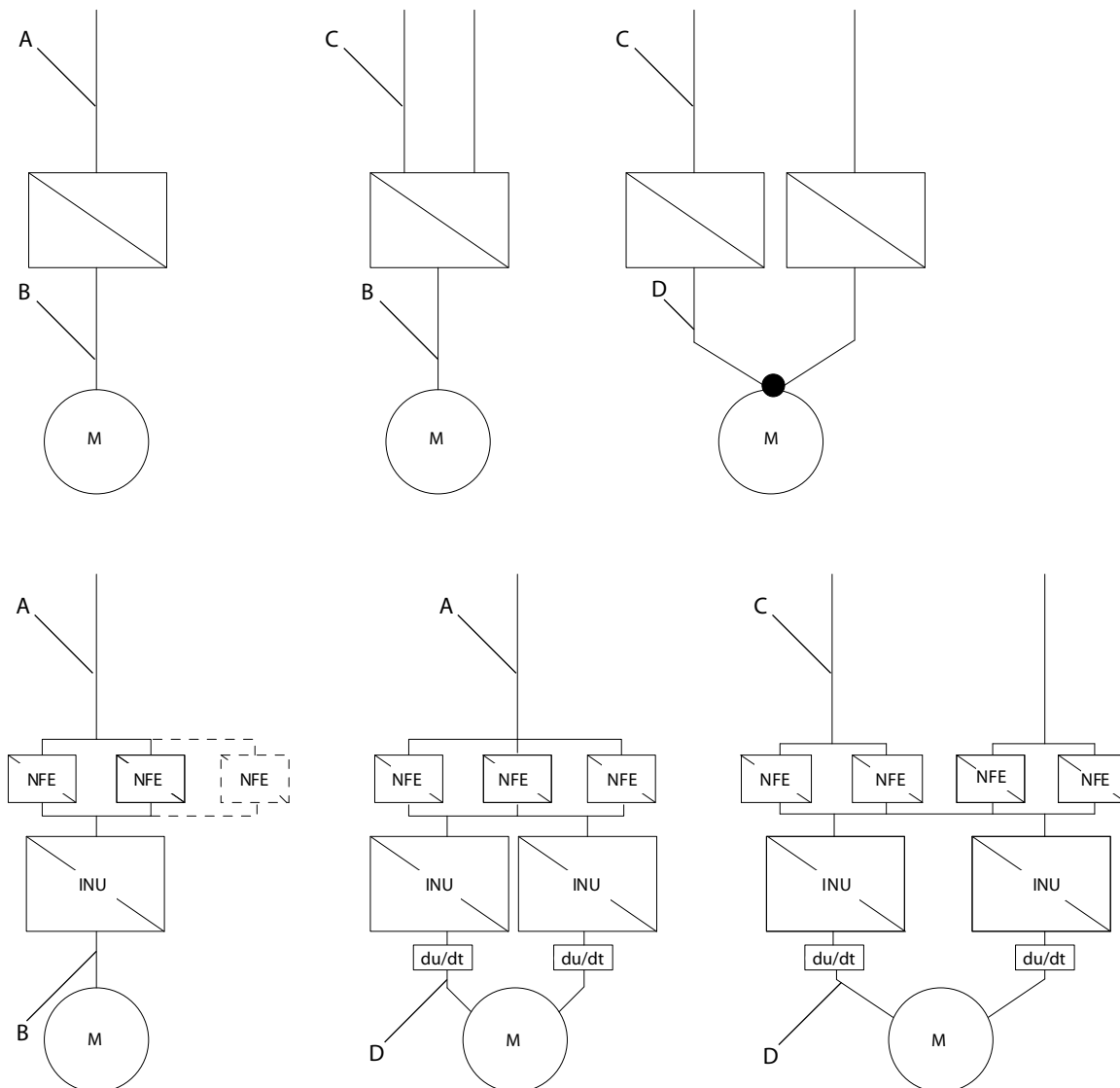
| A | Single input | C | Double input |
| B | Single output | D | Double output |

Illustration 24: Topology of Mechanical Sizes FR9–FR14, 6/12-pulse Supply

NOTE! Minimum cable length for double output without dU/dt filter is 5 meters (16.4 ft).

In FR13 units NXP1300 and NXP 1450 there are 3 NFE units.

NOTE! Minimum cable length for matched power units without dU/dt filter is 5 meters (16.4 ft). For unmatched power units, a min of 40 m (131.2 ft) of cable length is required from each power unit if dU/dt or sine filters are not used.

NOTE! Some options affect the wiring direction and principle for power cables; always check delivery specific documentation for exact information.

6.1.6 DC Supply and Brake Resistor Cables

VACON® 6- and 12-pulse AC drives have terminals for the DC supply and an optional external brake resistor. These terminals are identified with B–, B+/R+, and R–. The DC bus connection is made to terminals B– and B+ and the brake resistor connection to R+ and R–. The AC drive terminals can also optionally be wired to customer terminals in the cabinet. For additional information on integrated brake chopper and resistor values, see the VACON® NXS/NXP Wall-mounted and Standalone Operating Guide.

<div style="text-align: center;">⚠️ **C A U T I O N** ⚠️</div>

RISK OF DAMAGE TO THE DRIVE

Connecting the brake resistor between the terminals B- and B+ damages the drive.

- Connect the brake resistor to the brake resistor terminals R- and R+.

6.2 EMC-compliant Installation

For cable selections in different EMC levels, see Table 16.

The output cables to the motor must be 360º EMC grounded. The EMC grounding clamps can, for instance, be installed on the mounting plate in front of the AC choke. The EMC grounding clamps must be suited to the output cable diameter to give a 360º contact with the cables.

Table 16: Recommendations for Cables

Cable type	Category C3[1]	Category C4[2]
Motor cable	A symmetrical power cable with a compact low-impedance shield. A cable for the specified mains voltage. We recommend DRAKA NK CABLES - MCCMK or similar.	• A symmetrical power cable with a compact low-impedance shield OR (recommended) with a concentric protection wire. • A cable for the specified mains voltage. • We recommend DRAKA NK CABLES - MCMK or similar.
Mains cable	A power cable for a fixed installation. A cable for the specified mains voltage. A shielded cable is not necessary. We recommend DRAKA NK CABLES - MCMK or similar.	
Control cable	A shielded cable with a compact low-impedance shield, for example, DRAKA NK CABLES - JAMAK, SAB/ÖZCuY-O, or similar.	

[1] EN61800-3, 2nd environment

[2] For IT networks

For the definitions of EMC protection levels, see IEC/EN 61800-3 + A1.

In all the enclosure sizes, to comply with the EMC standards, use the default values of the switching frequencies.

When using a safety switch, make sure that the EMC protection continues from the start of the cables until their ends.

The drive must obey the standard IEC 61000-3-12. To obey it, the short circuit power S_{SC} must be a minimum of 120 R_{SCE} at the interface point between mains and the public mains. Make sure to connect the drive and the motor to mains with a short circuit power S_{SC} that is a minimum of 120 R_{SCE}. If necessary, contact the mains operator.

6.3 Grounding

Ground the AC drive in accordance with applicable standards and directives.

<div style="text-align: center;">⚠️ **C A U T I O N** ⚠️</div>

DAMAGE TO THE AC DRIVE FROM INSUFFICIENT GROUNDING

Not using a grounding conductor can damage the drive.

- Make sure that the AC drive is always grounded with a grounding conductor that is connected to the grounding terminal that is identified with the PE symbol.

> ⚠ **W A R N I N G** ⚠
>
> **LEAKAGE CURRENT HAZARD**
>
> Leakage currents exceed 3.5 mA. Failure to ground the drive properly can result in death or serious injury.
>
> – Ensure the correct grounding of the equipment by a certified electrical installer.

The standard EN 61800-5-1 tells that 1 or more of these conditions for the protective circuit must be true.

The connection must be fixed.

- The protective earthing conductor must have a cross-sectional area of minimum 10 mm^2 Cu or 16 mm^2 Al. OR

- There must be an automatic disconnection of the mains, if the protective earthing conductor breaks. OR

- There must be a terminal for a second protective earthing conductor in the same cross-sectional area as the first protective earthing conductor.

Cross-sectional area of the phase conductors (S) [mm^2]	The minimum cross-sectional area of the protective earthing conductor in question [mm^2]
S ≤ 16	S
16 < S ≤ 35	16
35 < S	S/2

The values of the table are valid only if the protective earthing conductor is made of the same metal as the phase conductors. If this is not so, the cross-sectional area of the protective earthing conductor must be determined in a manner that produces a conductance equivalent to that which results from the application of this table.

The cross-sectional area of each protective earthing conductor that is not a part of the mains cable or the cable enclosure, must be a minimum of:

- 2.5 mm^2 if there is mechanical protection, and

- 4 mm^2 if there is not mechanical protection. With cord-connected equipment, make sure that the protective earthing conductor in the cord is the last conductor to be interrupted, if the strain-relief mechanism breaks.

Obey the local regulations on the minimum size of the protective earthing conductor.

> **N O T I C E**
>
> **MALFUNCTION OF FAULT CURRENT PROTECTIVE SWITCHES**
>
> Because there are high capacitive currents in the AC drive, it is possible that the fault current protective switches do not operate correctly.

> **N O T I C E**
>
> **VOLTAGE WITHSTAND TESTS**
>
> Doing voltage withstand tests can damage the drive.
>
> – Do not do voltage withstand tests on the AC drive. The manufacturer has already done the tests.

> ⚠ **W A R N I N G** ⚠
>
> **SHOCK HAZARD FROM PE CONDUCTOR**
>
> The drive can cause a DC current in the PE conductor. Failure to use a residual current-operated protective (RCD) device Type B or a residual current-operated monitoring (RCM) device can lead to the RCD not providing the intended protection and therefore can result in death or serious injury.
>
> – Use a type B RCD or RCM device on the mains side of the drive.

6.4 AC Choke Connections

The AC input choke carries out several functions in the VACON®NX 6- and 12-pulse AC drive. The AC choke is needed as an essential component for motor control. It protects the input and DC-link components against abrupt changes of current and voltage as well as to function as a protection against harmonics.

The VACON®NXP (6- and 12-pulse) AC drive is equipped with one or more AC chokes. The AC chokes have two inductance levels to optimize the functionality at different supply voltages. In the installation phase, the wiring of the AC chokes must be checked and changed if needed (not for FR8 and FR9).

The input is always connected to terminal #1 (see Illustration 25). Do not change the connection. The output of the AC choke must be connected to terminal #2 or #3 (see Illustration 25) as listed in Table 17. The terminals are marked with inductance values and applicable voltage.

In units FR10 to FR12, the connection is changed by moving the cable to the appropriate terminals. In FR13/14, the bridges of the busbar connection must be moved according to the settings shown in Table 17.

N O T I C E

RISK OF DAMAGE DUE TO INCONSISTENT AC CHOKE INSTALLATION

In units with two or more parallel AC chokes (some FR11 and all FR12 and FR13), all AC chokes have to be wired in the same way. If AC chokes are wired differently, the AC drive can be damaged.

- Always wire all AC chokes in the same way.
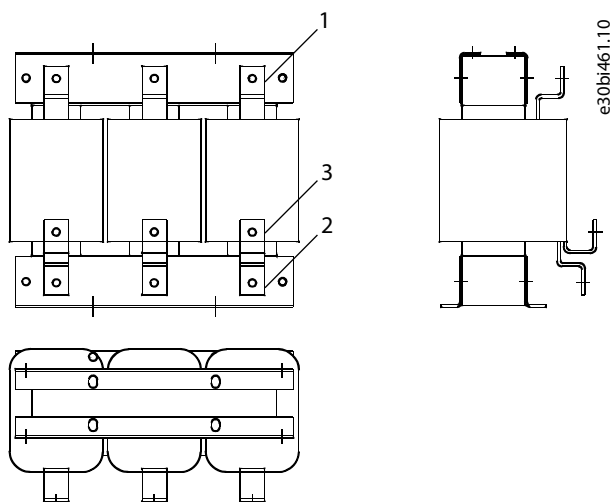
1	Terminal #1	3	Terminal #3
2	Terminal #2		

Illustration 25: AC Chokes

Table 17: AC Drive Terminals for AC Choke Connection

Supply voltage	AC drive connection (terminals)
400–480 V AC/50–60 Hz (500 V unit)	2
500 V AC/50 Hz (500 V unit)	3
575–690 V AC/50–60 Hz (690 V unit)	3

6.5 Common-mode Chokes on Motor Cables

The delivery consists of fixed sets of ferrite rings (Common-mode Choke option). When common-mode chokes are used to attenuate the risk of bearing damage, always use 2 common-mode chokes per motor cable.

Route only the motor phase conductors through the common-mode chokes. Do not route the PE/ground wire through the common-mode chokes. Leave the shield under and outside the common-mode chokes. Mount the PE/ground wire or pigtail on the ground busbar.

If there are parallel motor cables, reserve an equal amount of common-mode chokes for each cable. Route all the phase conductors of one cable through one common-mode choke.

NOTE! The common-mode chokes are only extra protection. The basic protection against bearing currents is an insulated bearing.

NOTE! When there are 2 or more motor cables, use the +OCH option. The +OCH option is easier to install and has enhanced common-mode inductance.
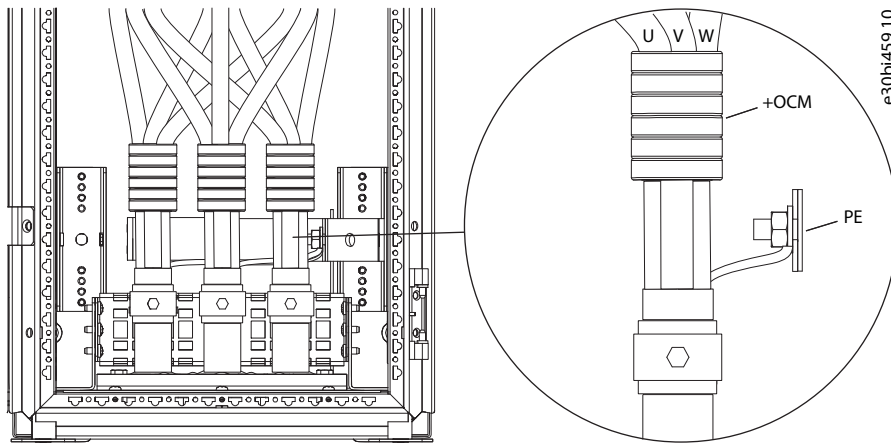
Illustration 26: Installation of Common-mode Chokes on Motor Cables

6.6 Fuse Installation

The delivery of VACON Æ NXP IP00 Drive Module contains no internal fuses. To protect the device and allow the installation of a main switch in the enclosure, we recommend that a fuse switch is installed. Use Bussmann aR type fuses according to 12.4 Cable and Fuse Sizes, and install them in the same enclosure as the AC drive, or in another enclosure in the immediate vicinity.

To ensure reliable function of the fuse, pay attention to a proper installation and a good contact between the fuse and the connecting cables/busbars or the fuse holder. Furthermore, the generated heat is better removed through a well-made connection. Follow, therefore, the given tightening torques given in Table 18. We recommend a fuse connection made with busbars.

Flush End Fuses
For all kinds of flush end fuses the fuse manufacturer recommends (screw in) studs according to DIN 913. The studs must be tightened carefully applying a torque of 5–8 Nm. Usually, the tightening torque for the nuts relates to the dimension of the threaded hole in the fuse contact. The recommended tightening torques for the fuses are given in Table 18.

Table 18: Tightening Torques for Flush End Fuses

Size/Type	Threaded hole [mm]	Tightening torque [Nm]
2B	M10	40
3B–3G	M12	50
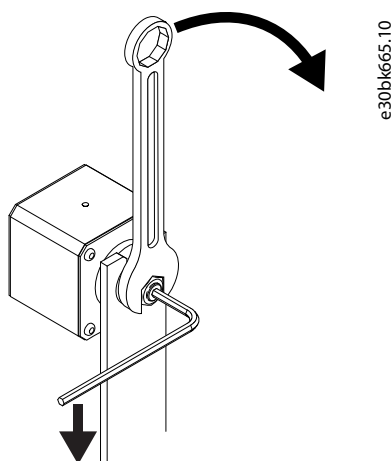
Illustration 27: Installing Flush End Fuse

1	Establish balance

Fuses with Contact Knives

We recommend two types of fuses with contact knives: fuses with slotted knives according to DIN 43653 and fuses with solid knives according to DIN 43620. The former are mounted direct on busbars or in special fuse holders and the latter in spring-loaded fuse bases.

Use the biggest possible bolts/studs, nuts, and washers (recommended) to tighten the DIN 43653 fuses to a torque of 50 Nm.

Tighten the DIN 43653 fuses in accordance with the specification provided with the base.

6.7 Installing the Cables

Use these instructions to find the installation instructions of the correct enclosure size.

Procedure

1. Check the requirements related to lengths, distances, and positioning of the cables according to instructions in 6.7.1 Additional Instructions for Cable Installation.
2. Follow the installation instructions of the correct enclosure size. To check the enclosure size of the AC drive, see 3.4 Enclosure Sizes.

   - 6.7.2 Installing the Cables, FR8
   - 6.7.3 Installing the Cables, FR9
   - 6.7.4 Installing the Cables, FR10/FR12
   - 6.7.5 Installing the Cables, FR11
   - 6.7.6 Installing the Cables, FR13/FR14

6.7.1 Additional Instructions for Cable Installation

- Before starting, make sure that none of the components of the AC drive is live. Read carefully the warnings in Safety section.
- Make sure the connection of the AC choke and the optional 230 V auxiliary voltage transformer are suitable for the supply voltage in use (see 6.4 AC Choke Connections).
- Make sure that the motor cables are sufficiently far from other cables.
- The motor cables must go across other cables at an angle of 90°.
- If it is possible, do not put the motor cables in long parallel lines with other cables.
- If the motor cables are in parallel with other cables, obey the minimum distances (see Table 19).
- The distances are also valid between the motor cables and the signal cables of other systems.
- The maximum length of the motor cables is 300 m. If output dU/dt filters (+ODU option) are used, see the limitations for cable lengths in Table 20.
- If the cable insulation checks are necessary, see 9.3 Measuring the Cable and Motor Insulation.

Table 19: Minimum Distances between Cables

The distance between cables [m]	The length of the shielded cable [m]	The distance between cables [ft]	The length of the shielded cable [ft]
0.3	≤ 50	1.0	≤ 164
1.0	≤ 300	3.3	≤ 984

Table 20: Maximum Cable Lengths with dU/dt Filter

Maximum cable length with dU/dt filter	Switching frequency
100 m (328 ft) at 500 V level	3.6 kHz
150 m (492 ft) at 690 V level [1]	1.5 kHz

[1] For longer cable lenghts, contact Danfoss.

6.7.2 Installing the Cables, FR8

Follow these instructions to install the cables.

For information on how to comply with the UL regulations in cable installations, see 6.1.2 UL Standards on Cabling.

Make sure that the delivery contains all necessary components.

Mount the units according to instructions in section Mounting the unit.

Procedure

1. Strip the motor and mains cables. See 12.6 Cable Stripping Lengths.
2. Open the front cover.
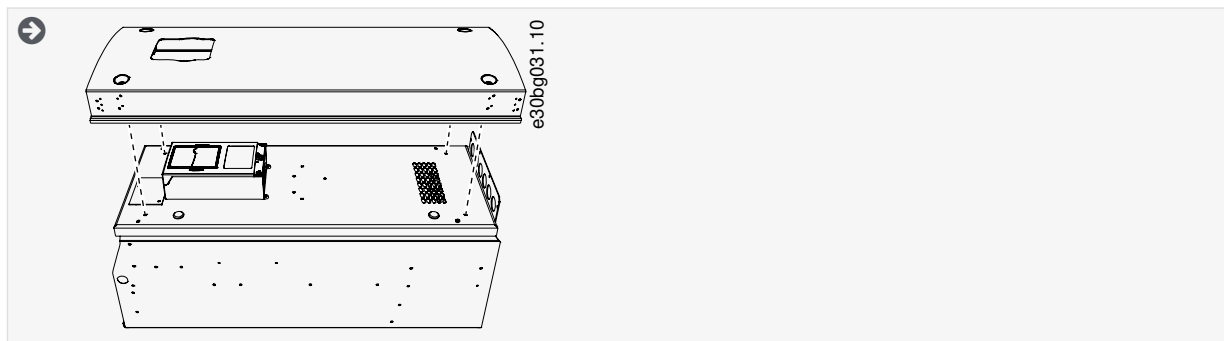
3.   Open the power unit cover.
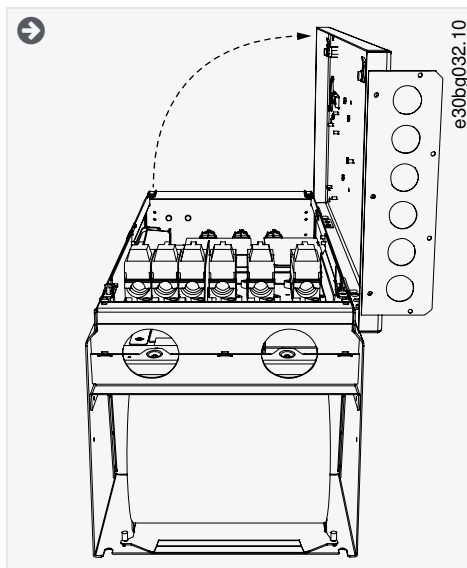
4.   Pull the cable through the bottom plate of the cabinet and fix the PE conductor to the PE busbar of the cabinet.
5.   Route the motor phase conductors through common mode chokes. See 6.5 Common-mode Chokes on Motor Cables.
6.   To make a 360° connection with the grounding clamp for cable shield, expose the shield of motor cables.
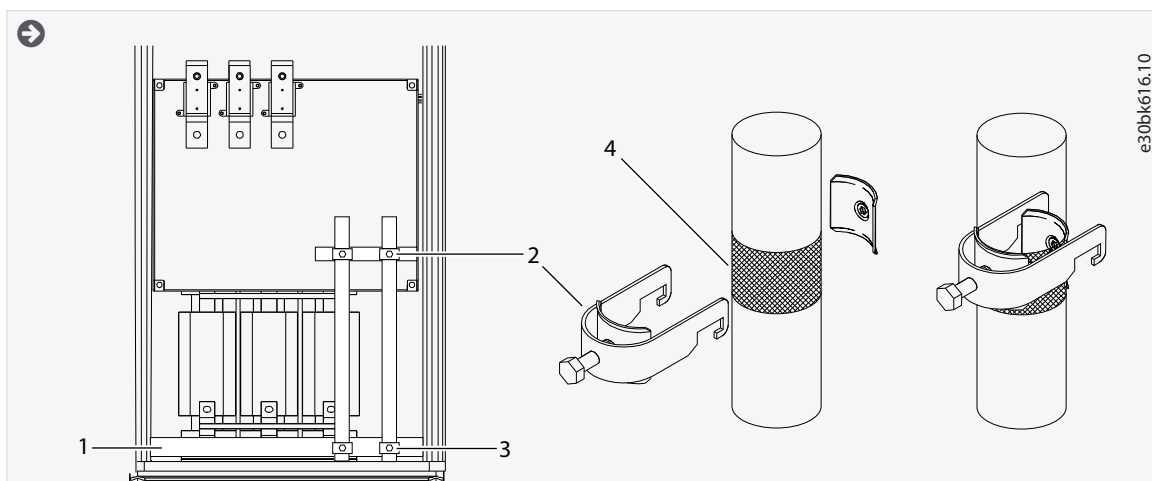
Illustration 28: Installing EMC Grounding

1	PE busbar	3	Cable clamp
2	Grounding clamp	4	Exposed cable

7.   Connect the cables. See the correct tightening torques in 12.8 Tightening Torques of the Terminals.
   - **a.**   Connect 3 power cables to the input terminals of the power unit. It is recommended to use cables designed for 90 °C (194 °F). Connect the L1 cable to the L1 input terminal of the power unit, the L2 cable to the L2 terminal, and the L3 cable to the L3 terminal.
   - **b.**   Connect 3 motor cables to the output terminals U, V, and W of the power unit.
   - **c.**   Connect the control cables. See 7 Control Unit for more information on control cables.

     Make sure that the control cable wires do not come in contact with the electronic components of the unit or control components inside the cabinet.

   - **d.**   Attach the grounding conductor of each cable to the PE busbar.

A	Mains terminals	C	Grounding terminal
B	Motor terminals		

8. Connect a grounding cable from the grounding connector at the lower right hand side of the power unit frame to the PE busbar of the enclosure. Use a copper grounding cable with a cross-sectional area of at least 2*35 mm^2 per power unit, which obeys the local regulations for grounding cables.

9. If an external brake resistor (option) is used, connect its cable to the appropriate terminal (R+/R–). Also make sure that the AC drive is equipped with a brake chopper (indicated in the type code of the AC drive).
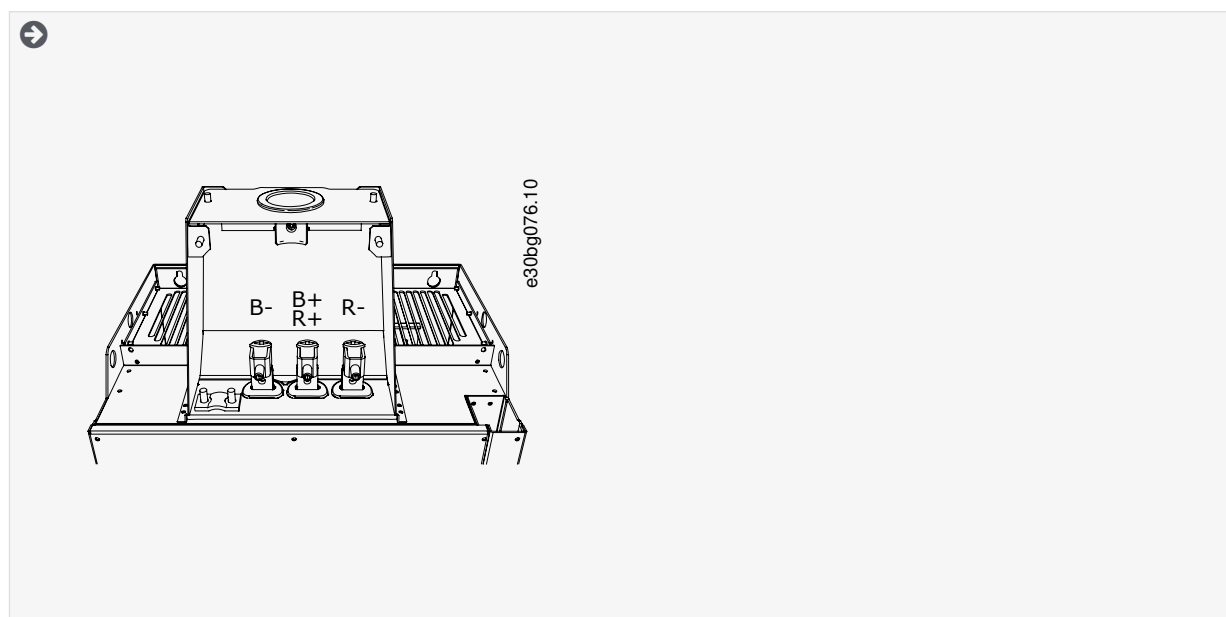
6.7.3 Installing the Cables, FR9

Follow these instructions to install the cables.

For information on how to comply with the UL regulations in cable installations, see 6.1.2 UL Standards on Cabling.

Make sure that the delivery contains all necessary components.

Mount the units according to instructions in section Mounting the unit.

Procedure

1. Strip the motor and mains cables. See 12.6 Cable Stripping Lengths.
2. Remove the cable cover.
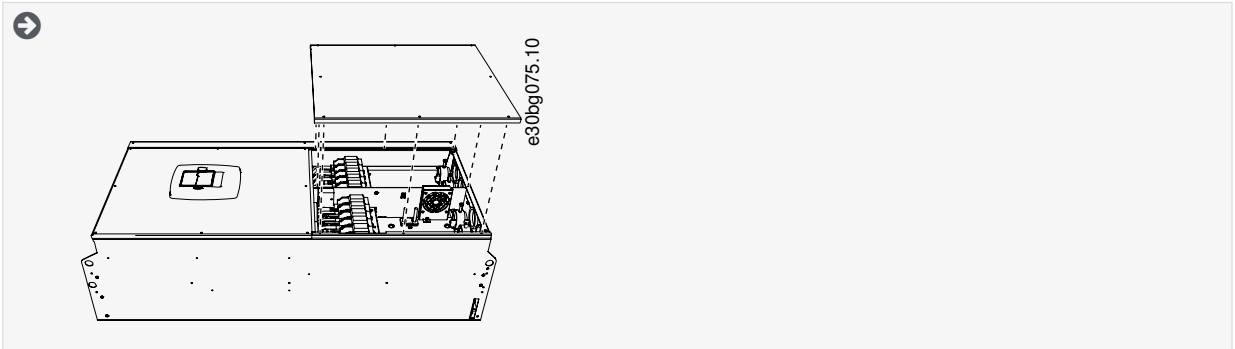
3. Pull the cable through the bottom plate of the cabinet and fix the PE conductor to the PE busbar of the cabinet.
4. Route the motor phase conductors through common mode chokes. See 6.5 Common-mode Chokes on Motor Cables.
5. To make a 360° connection with the grounding clamp for cable shield, expose the shield of motor cables.
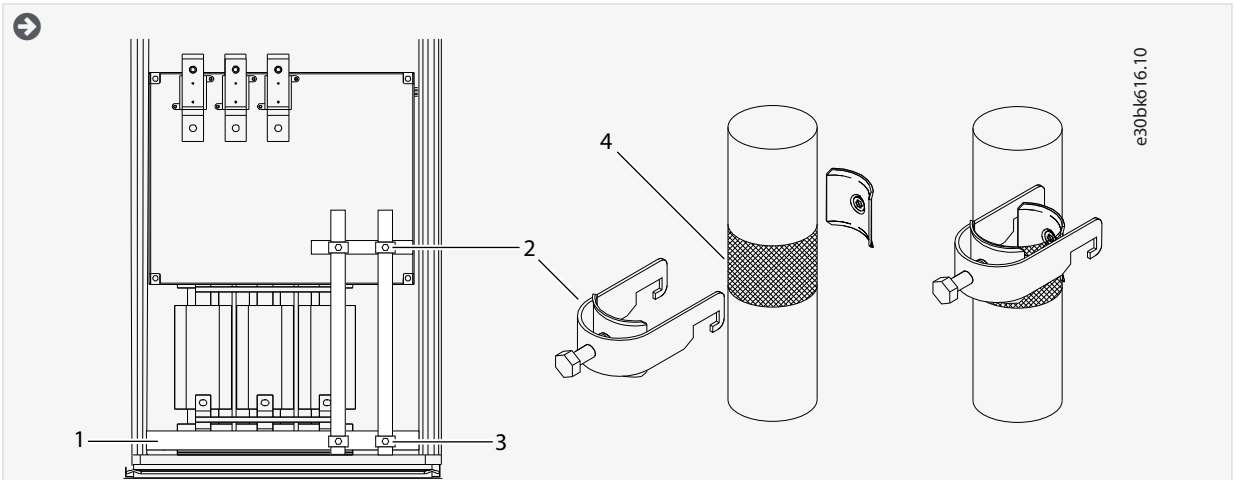
Illustration 29: Installing EMC Grounding

1	PE busbar	3	Cable clamp
2	Grounding clamp	4	Exposed cable

6. Connect the cables. See the correct tightening torques in 12.8 Tightening Torques of the Terminals.
    - **a.** Connect 3 power cables to the input terminals of the power unit. It is recommended to use cables designed for 90 °C (194 °F). Connect the L1 cable to the L1 input terminal of the power unit, the L2 cable to the L2 terminal, and the L3 cable to the L3 terminal.
    - **b.** Connect 3 motor cables to the output terminals U, V, and W of the power unit.
    - **c.** Connect the control cables. See 7 Control Unit for more information on control cables.

      > Make sure that the control cable wires do not come in contact with the electronic components of the unit or control components inside the cabinet.

    -

    d.   Attach the grounding conductor of each cable to the PE busbar.

FR9

A	Mains terminals	C	Grounding terminals
B	Motor terminals		

7. Connect a grounding cable from the grounding connector at the lower right hand side of the power unit frame to the PE busbar of the enclosure. Use a copper grounding cable with a cross-sectional area of at least 2*35 mm^2 per power unit, which obeys the local regulations for grounding cables.

8. If an external brake resistor (option) is used, connect its cable to the appropriate terminal (R+/R–). Also make sure that the AC drive is equipped with a brake chopper (indicated in the type code of the AC drive).
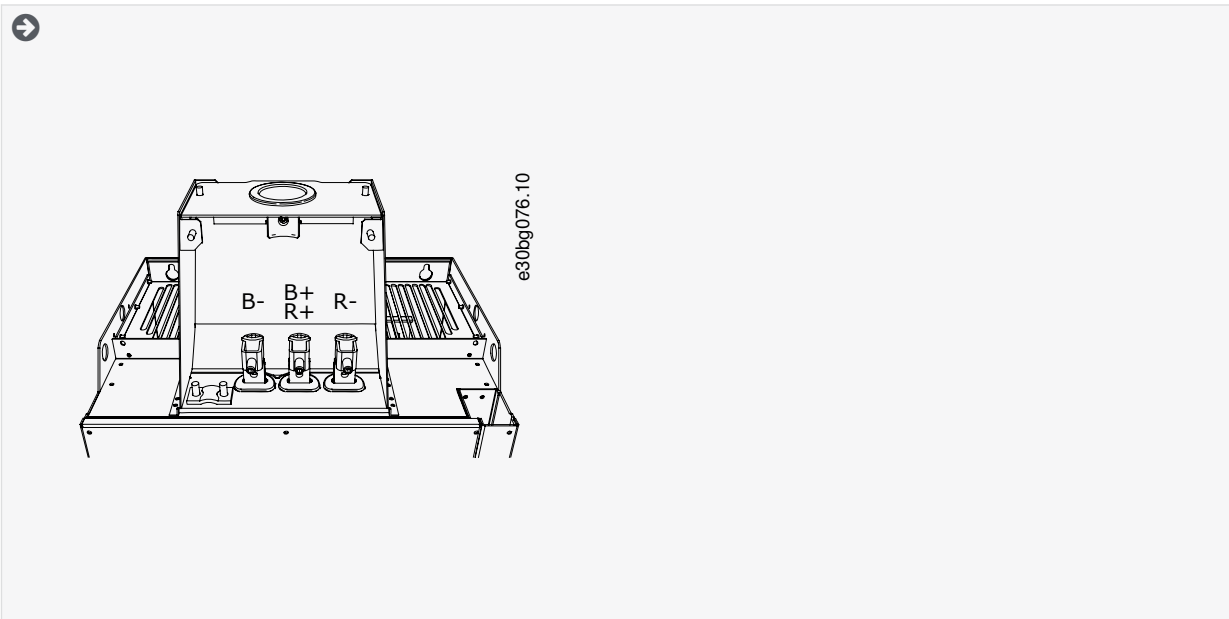
6.7.4 Installing the Cables, FR10/FR12

Follow these instructions to install the cables.

For information on how to comply with the UL regulations in cable installations, see 6.1.2 UL Standards on Cabling.

Make sure that the delivery contains all necessary components.

Mount the units according to instructions in section Mounting the unit.

Procedure

1. Strip the motor and mains cables. See 12.6 Cable Stripping Lengths.
2. Remove the protection grids for the input terminals and the protection covers on the unit(s).
3. Pull the cable through the bottom plate of the cabinet and fix the PE conductor to the PE busbar of the cabinet.
4. Route the motor phase conductors through common mode chokes. See 6.5 Common-mode Chokes on Motor Cables.
5. To make a 360° connection with the grounding clamp for cable shield, expose the shield of motor cables.

Illustration 30: Installing EMC Grounding

1	PE busbar	3	Cable clamp
2	Grounding clamp	4	Exposed cable

6. Connect the cables. See the correct tightening torques in 12.8 Tightening Torques of the Terminals.
    - **a.** Connect 3 power cables to the output terminals of the AC choke and the input terminals of the power unit. It is recommended to use cables designed for 90 °C (194 °F). Connect the L1 cable from the L1 terminal of the AC choke to the L1 input terminal of the power unit, the L2 cable to the L2 terminal, and the L3 cable to the L3 terminal.

    The AC choke has two sets of output terminals designed for different voltages/frequencies. Use the upper set for 500 V/50 Hz, 525 V/50 Hz, 600 V/60 Hz, and 690 V/50 Hz and the lower set for 400 V/50 Hz and 480 V/60 Hz.

Illustration 31: Connecting the power cables between the AC choke and the power unit

1	Upper set of terminals
2	Lower set of terminals

- **b.** Connect 3 motor cables to the output terminals U,V, and W of the power unit.

Illustration 32: Location of motor terminals, FR10/FR12

- **c.** Connect the control cables. See 7 Control Unit for more information on control cables.
- **d.** Attach the grounding conductor of each cable to the PE busbar.

7. Install input terminals on the installation plate and connect them to the input terminals (the uppermost terminals) of the AC choke using busbars or flexible busbars according to <u>12.4.2 Busbar and Terminal Dimensions for 380–500 V AC</u> and <u>12.4.6 Busbar and Terminal Dimensions for 525–690 V AC</u>. Also see <u>6.4 AC Choke Connections</u>.

Illustration 33: Power Input Terminals and Busbars to AC Choke

1	Input terminals	3	AC choke input terminals
2	Installation plate		

8. Connect a grounding cable from the grounding connector at the lower right hand side of the power unit frame to the PE busbar of the enclosure. Use a copper grounding cable with a cross-sectional area of at least 2*35 mm^2 per power unit, which obeys the local regulations for grounding cables.

Illustration 34: Grounding the power unit, FR10/FR12

1	PE busbar
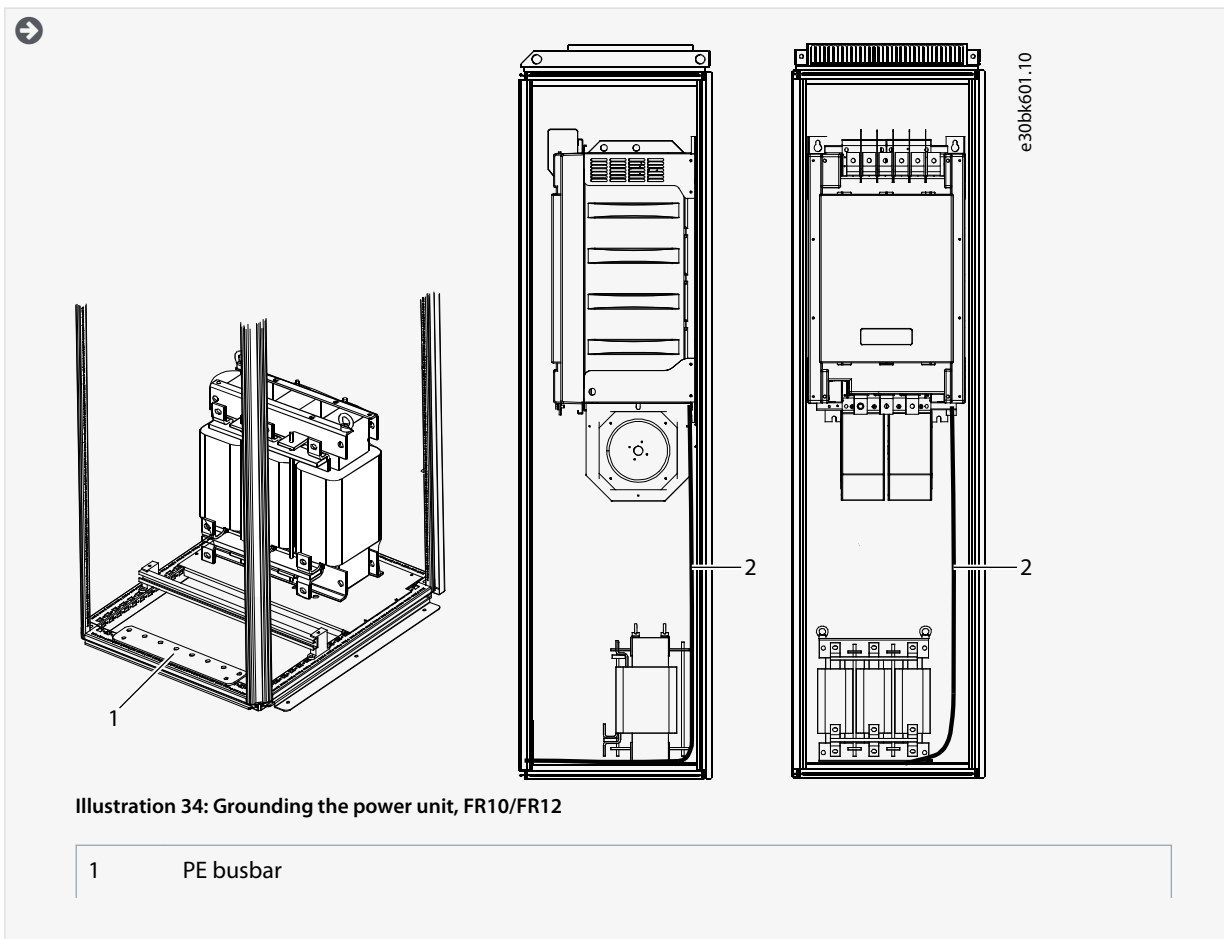
2	Grounding cable

9. If an external brake resistor (option) is used, connect its cable to the appropriate terminal (R+/R–). Also make sure that the AC drive is equipped with a brake chopper (indicated in the type code of the AC drive).

Illustration 35: Location of brake/DC terminals, FR10/FR12
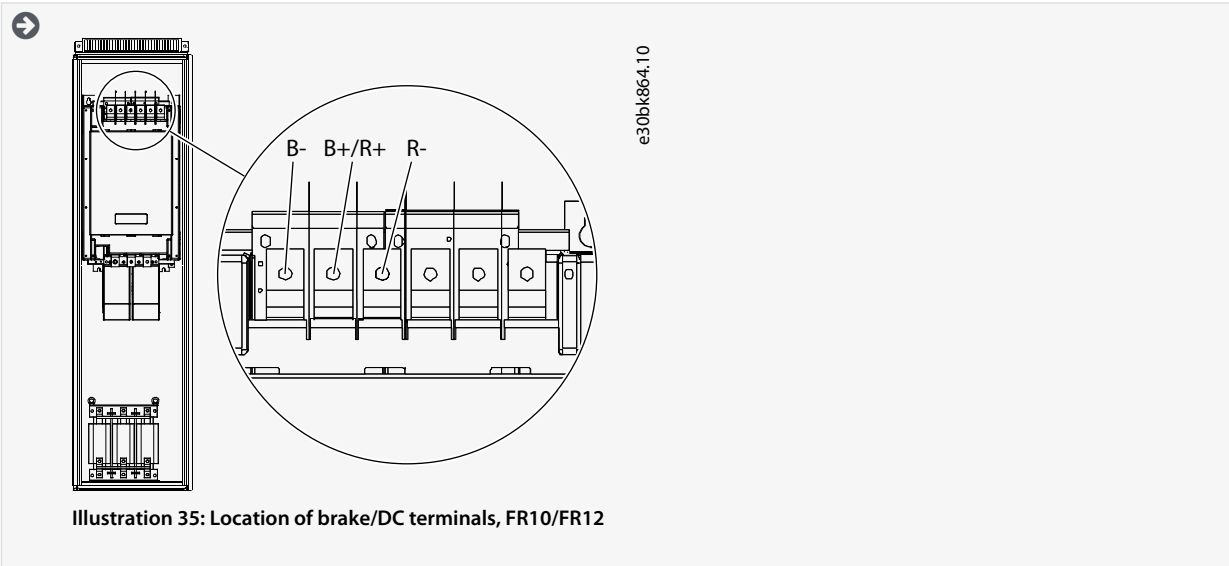
6.7.5 Installing the Cables, FR11

Follow these instructions to install the cables.

For information on how to comply with the UL regulations in cable installations, see 6.1.2 UL Standards on Cabling.

Make sure that the delivery contains all necessary components.

Mount the units according to instructions in section Mounting the unit.

Procedure

1. Strip the motor and mains cables. See 12.6 Cable Stripping Lengths.
2. Remove the protection grids for the input terminals and the protection covers on the unit(s).
3. Pull the cable through the bottom plate of the cabinet and fix the PE conductor to the PE busbar of the cabinet.
4. Route the motor phase conductors through common mode chokes. See 6.5 Common-mode Chokes on Motor Cables.
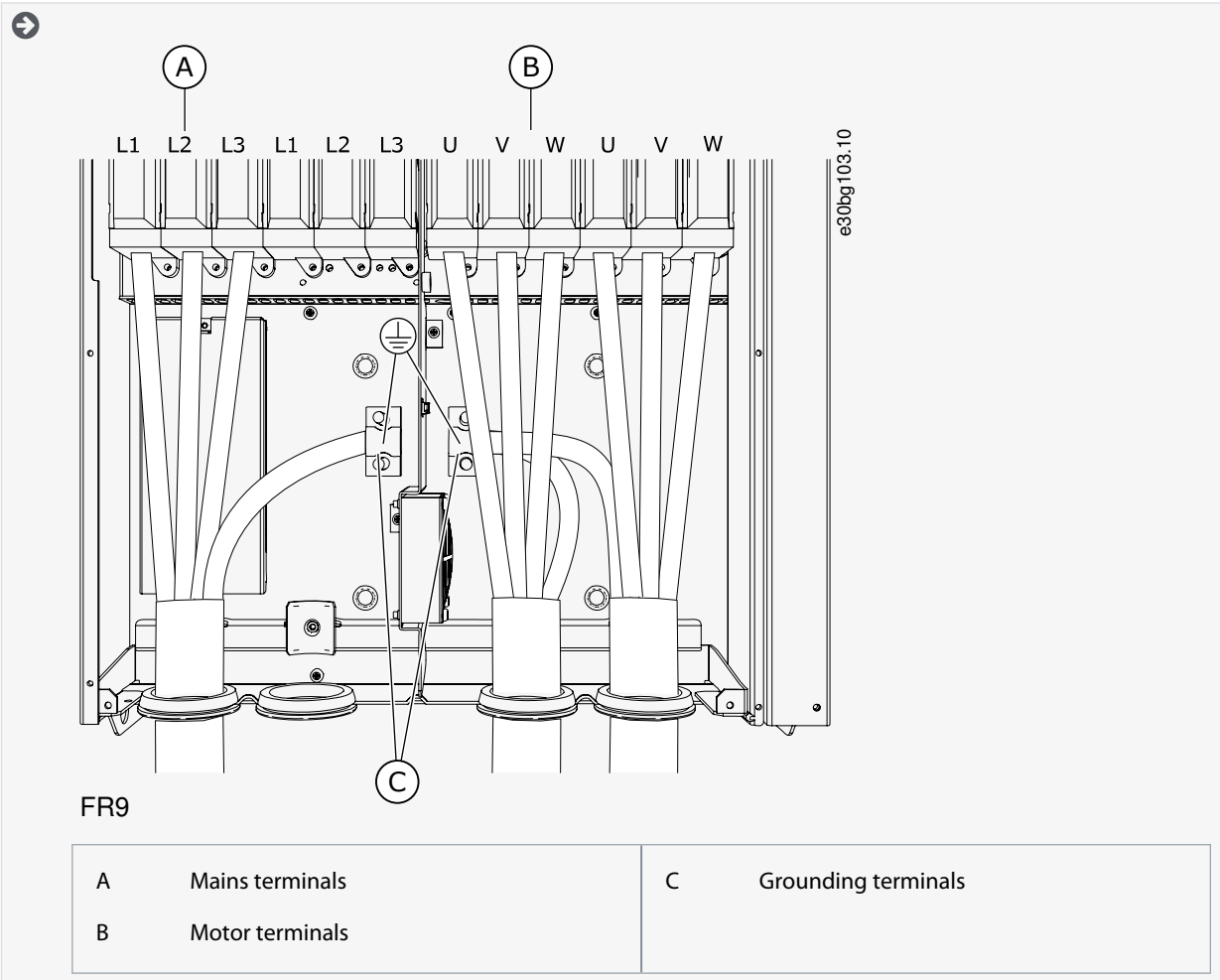5. To make a 360° connection with the grounding clamp for cable shield, expose the shield of motor cables.

Illustration 36: Installing EMC Grounding

| 1	PE busbar	3	Cable clamp
2	Grounding clamp	4	Exposed cable

6. Connect the cables. See the correct tightening torques in 12.8 Tightening Torques of the Terminals.

- **a.** Connect 3 power cables to the output terminals of the AC choke and the input terminals of the power unit. It is recommended to use cables designed for 90 °C (194 °F). Connect the L1 cable from the L1 terminal of the AC choke to the L1 input terminal of the power unit, the L2 cable to the L2 terminal, and the L3 cable to the L3 terminal.

> The AC choke has two sets of output terminals designed for different voltages/frequencies. Use the upper set for 500 V/50 Hz, 525 V/50 Hz, 600 V/60 Hz, and 690 V/50 Hz and the lower set for 400 V/50 Hz and 480 V/60 Hz.

Illustration 37: Connecting the power cables between the AC choke and the power unit, FR11

1	Upper set of terminals
2	Lower set of terminals

- **b.** Connect 3 motor cables to the output terminals U, V, and W of the power unit.
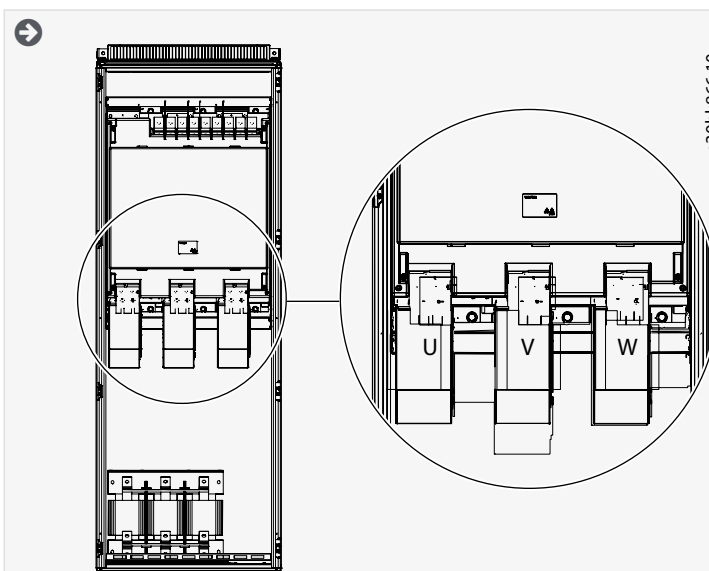
Illustration 38: Location of motor terminals, FR11

- **c.** Connect the control cables. For more information on control cables , see 7 Control Unit.
- **d.** Attach the grounding conductor of each cable to the PE busbar.

7. Install input terminals on the installation plate and connect them to the input terminals (the uppermost terminals) of the AC choke using busbars or flexible busbars according to 12.4.2 Busbar and Terminal Dimensions for 380–500 V AC and

Illustration 39: Power Input Terminals and Busbars to AC Choke

1	Input terminals	3	AC choke input terminals
2	Installation plate		

8. Connect a grounding cable from the grounding connector at the lower right hand side of the power unit frame to the PE busbar of the enclosure. Use a copper grounding cable with a cross-sectional area of at least 2*35 mm^2 per power unit, which obeys the local regulations for grounding cables.

Illustration 40: Grounding the power unit, FR11

1	Grounding cable	3	Grounding terminal
2	PE busbar		

9. If an external brake resistor (option) is used, connect its cable to the appropriate terminal (R+/R–). Also make sure that the AC drive is equipped with a brake chopper (indicated in the type code of the AC drive).

Illustration 41: Location of brake/DC terminals, FR11

6.7.6 Installing the Cables, FR13/FR14
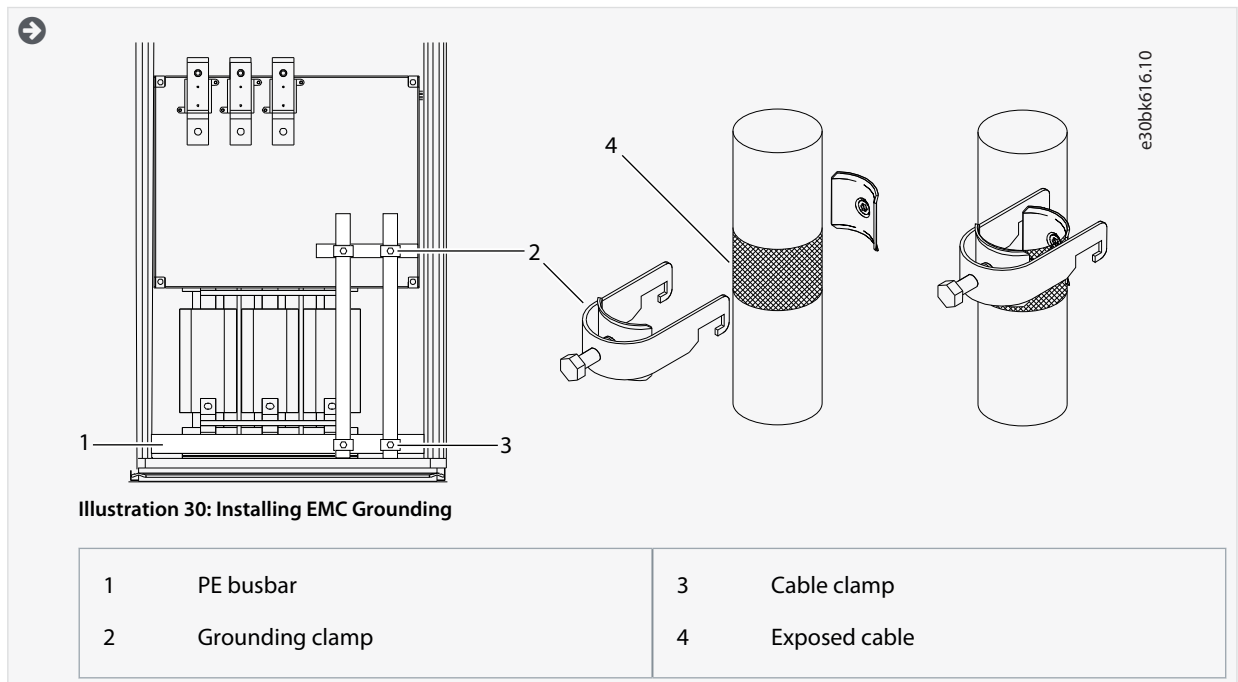
To install the cables, follow these instructions.

For information on how to comply with the UL regulations in cable installations, see 6.1.2 UL Standards on Cabling.

Make sure that the delivery contains all necessary components.

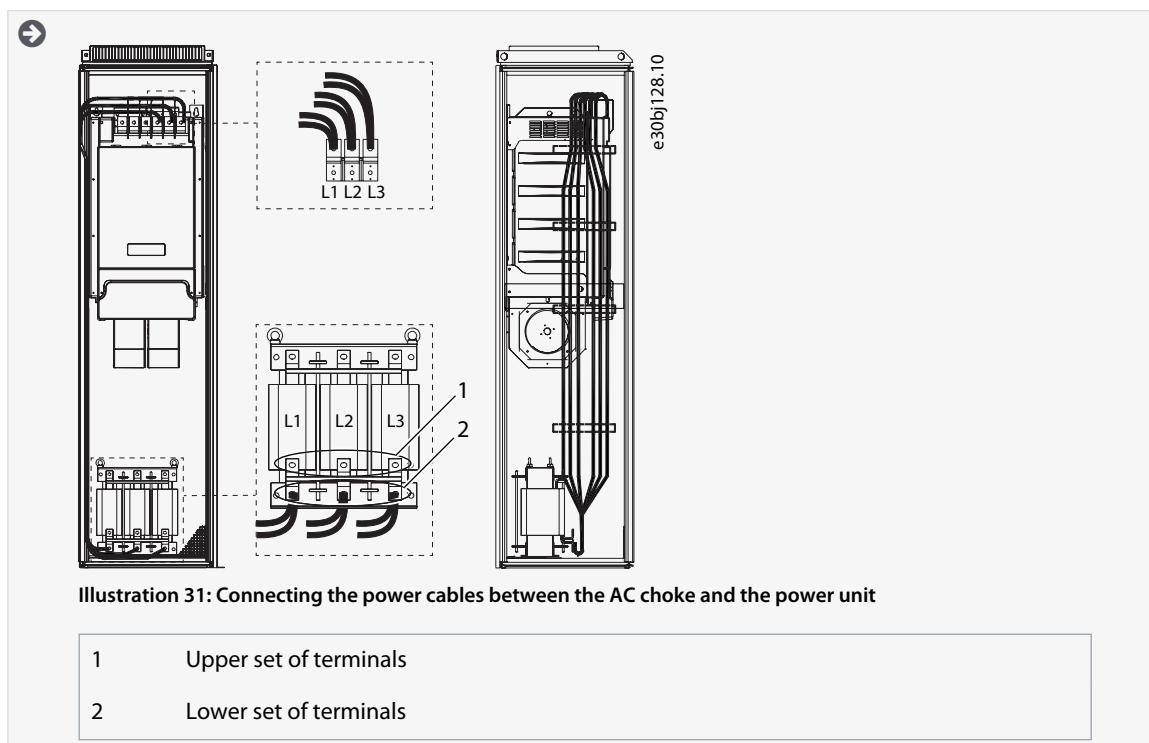Mount the units according to instructions in section Mounting the unit.

Procedure

1. Strip the motor and mains cables. See 12.6 Cable Stripping Lengths.
2. Remove the protection grids for the input terminals and the protection covers on the unit(s).
3. Pull the cable through the base plate and fix the PE conductor to the PE busbar of the cabinet.
4. Route the motor phase conductors through common-mode chokes. See 6.5 Common-mode Chokes on Motor Cables.
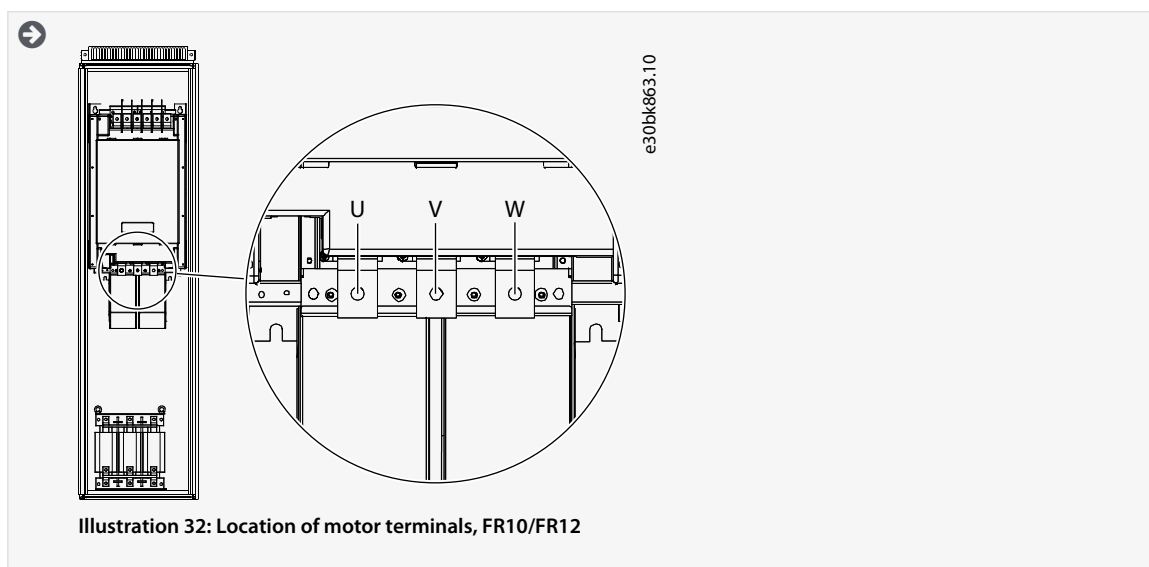5. To make a 360° connection with the grounding clamp for cable shield, expose the shield of motor cables.

Illustration 42: Installing EMC Grounding
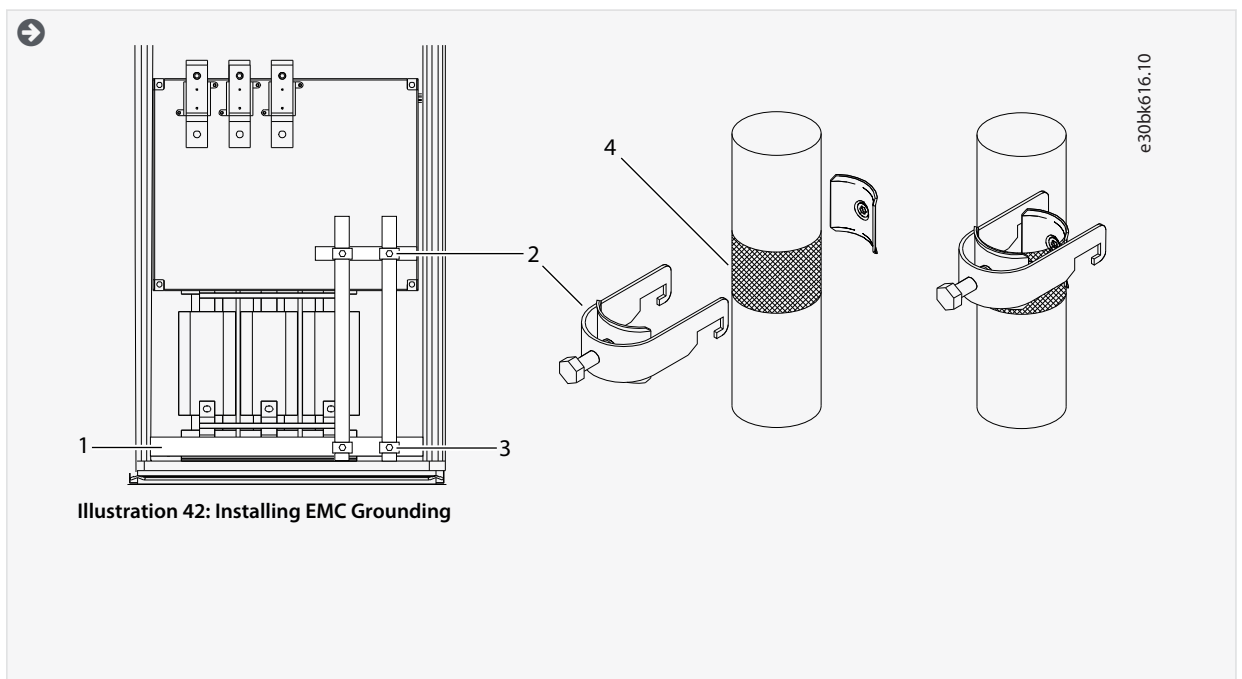
1	PE busbar	3	Cable clamp
2	Grounding clamp	4	Exposed cable

6. Connect the cables. See the correct tightening torques in 12.8 Tightening Torques of the Terminals.

   - **a.** Connect the electrical power connections between the NFE units and the inverter unit using busbars. For the internal connections from the AC choke to the NFE unit, also copper cable can be used. See the figures for the correct placement of the busbars/cables and 12.4.1 Internal Cable Sizes for 380–500 V AC and 12.4.5 Internal Cable Sizes for 525–690 V AC for the recommended sizes.

   > Busbar alignment must be vertical to allow the maximum flow of cooling air.

1	Fuses (not included in delivery)
2	Busbars

   - **b.** Connect 3 input power cabled to the input terminals L1,L2, and L3 of the NFE units.

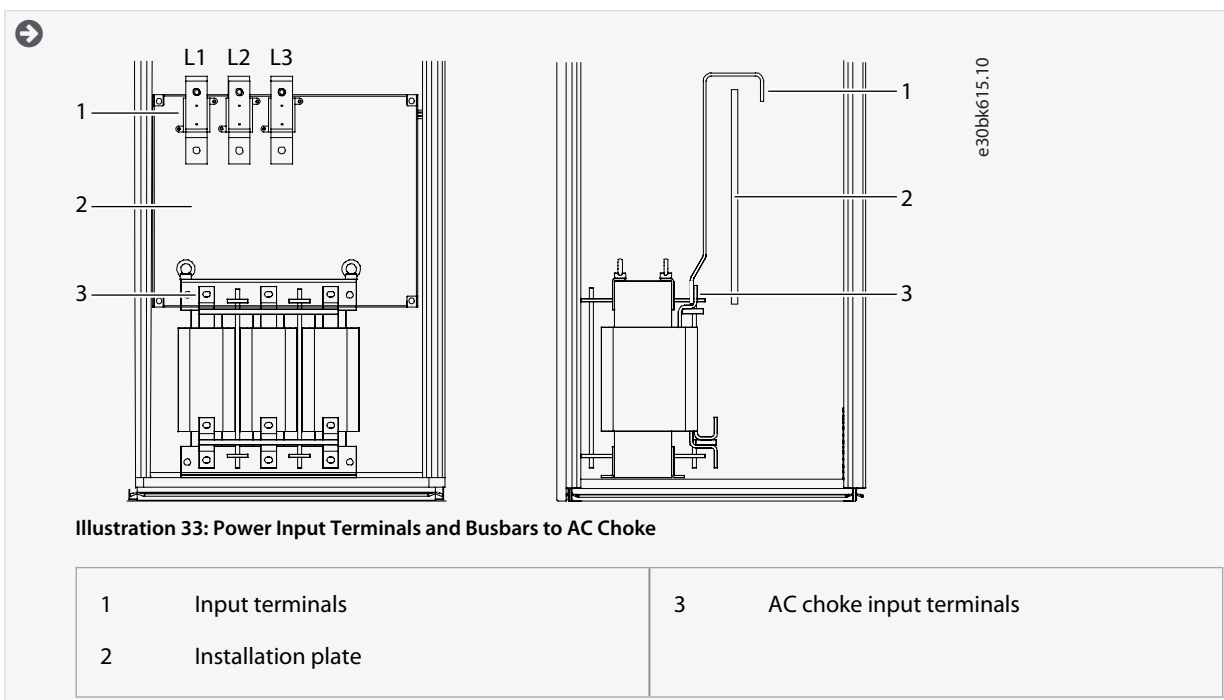   **Illustration 43: Location of NFE input terminals and FR13 output terminals**
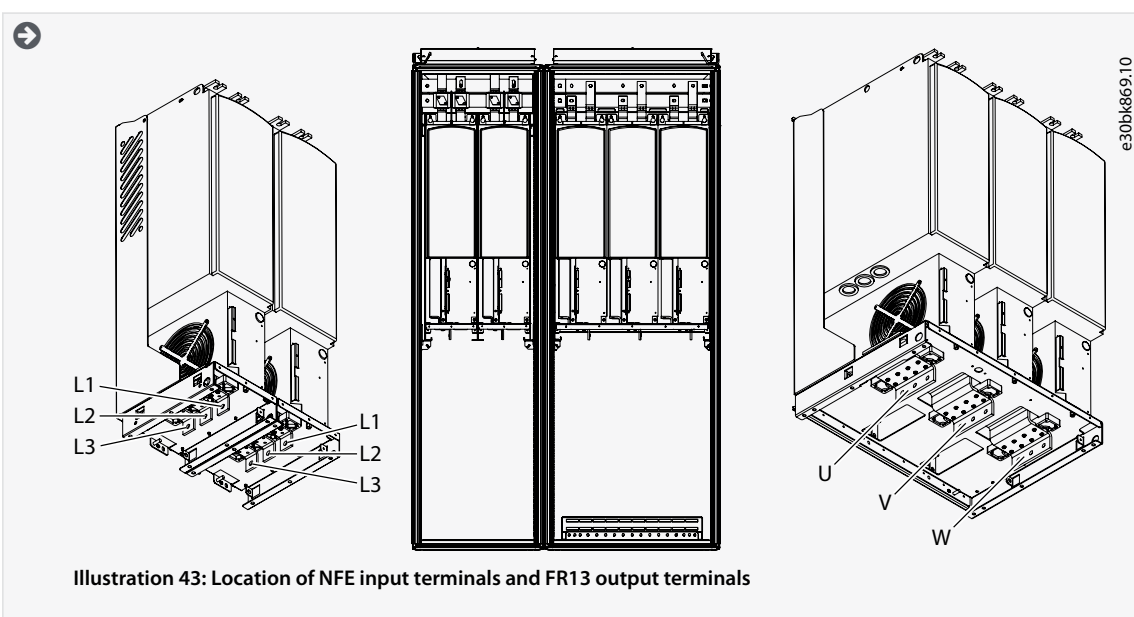
   - **c.** Connect 3 motor cables to the output terminals U, V, and W of the power unit.
   - **d.** Connect the control cables.For more information on control cables, see 7 Control Unit.
   - **e.** Attach the grounding conductor of each cable to the PE busbar.

7. To link the NFE units and the inverter units together,

   -

a. Remove the terminal compartment cover.
- b. Direct the sleeving through the rubber grommet.
- c. Insert the connectors into appropriate terminals.
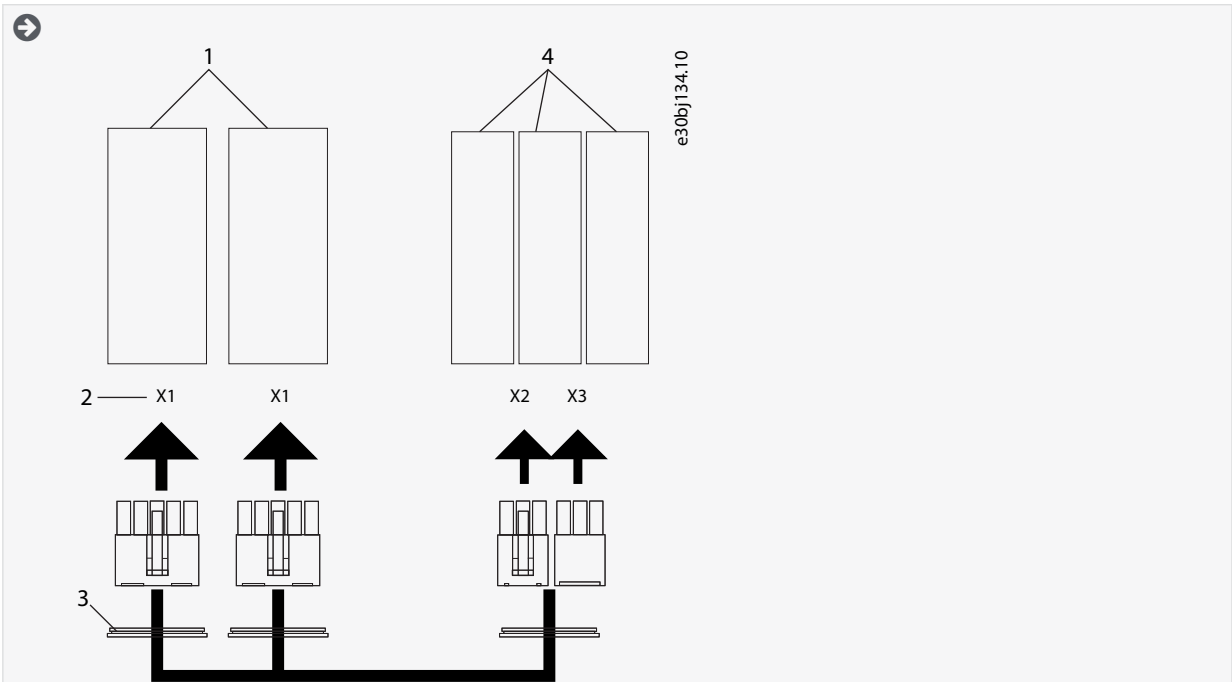
Illustration 44: FR13 with 2 NFE units

1	NFE unit	3	Rubber grommet
2	Terminal on the unit	4	Inverter unit
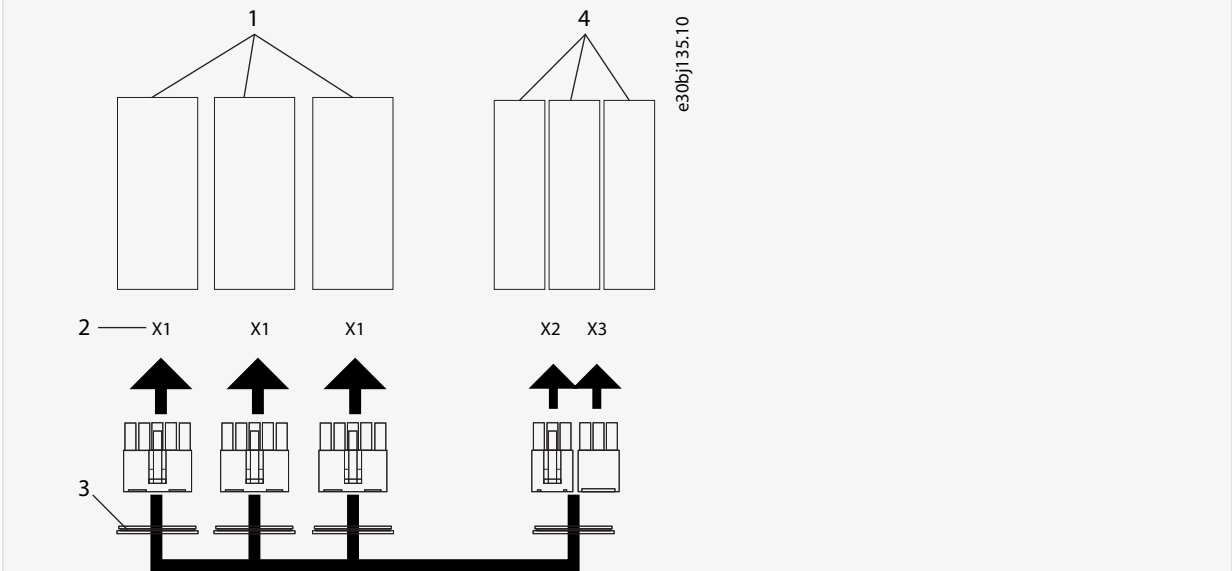
Illustration 45: FR13 with 3 NFE units

1	NFE unit	3	Rubber grommet
2	Terminal on the unit	4	Inverter unit
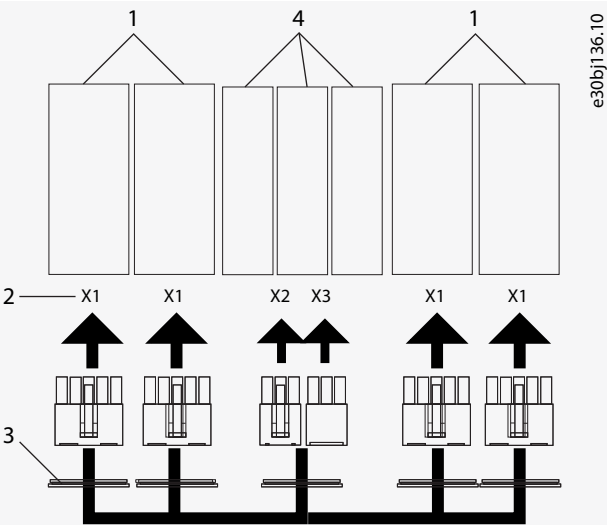
Illustration 46: FR13 with 4 NFE units

1	NFE unit	3	Rubber grommet
2	Terminal on the unit	4	Inverter unit
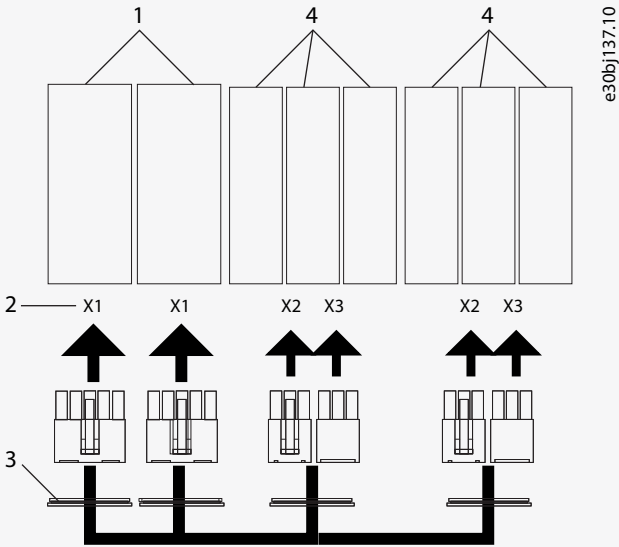
Illustration 47: FR14 with 2 NFE units

1	NFE unit	3	Rubber grommet
2	Terminal on the unit	4	Inverter unit

Illustration 48: FR14 with 4 NFE units

1	NFE unit	3	Rubber grommet
2	Terminal on the unit	4	Inverter unit
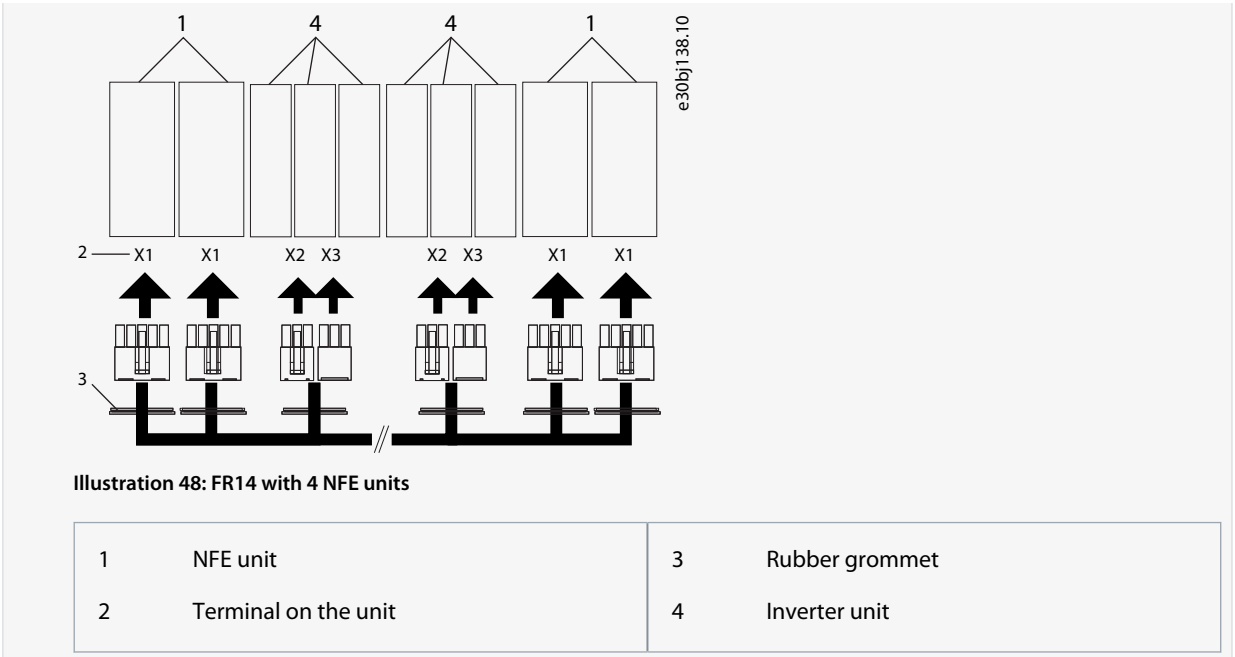
8. Route the incoming busbars to the AC chokes in the cabinet. See 12.4.2 Busbar and Terminal Dimensions for 380–500 V AC and 12.4.6 Busbar and Terminal Dimensions for 525–690 V AC for the dimensions for the used busbars. Install a busbar on each pole of the AC choke. See 6.4 AC Choke Connections for information about AC choke connections.

Illustration 49: Cabling from AC choke to NFE

1	Cables or busbars to NFE	3	Upper set of terminals
2	Terminals for supply cables or busbars	4	Lower set of terminals
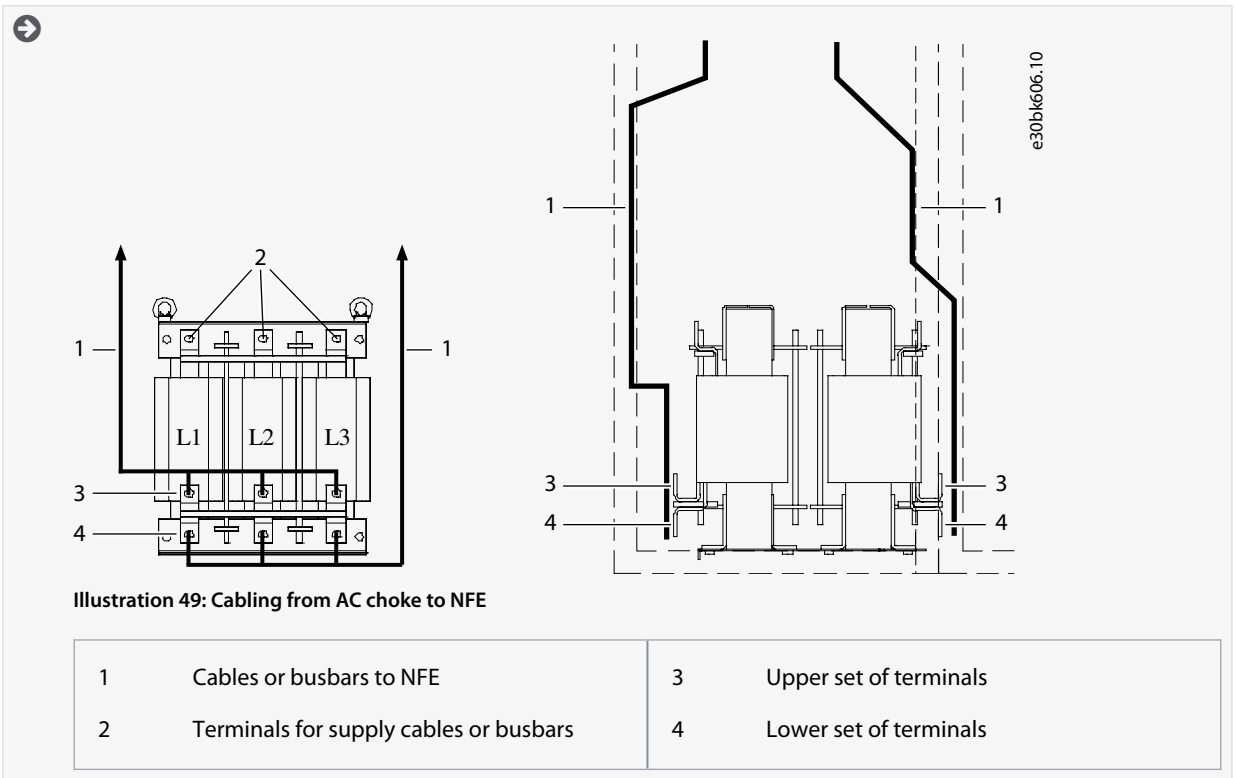
9. Route a grounding cable from the grounding connector of the NFE unit and the inverter unit through the cabinet wall to the PE busbar of the cabinet with the inverter unit. Use a copper grounding cable with a cross-sectional area of at least 2*35 mm^2 per power unit, which obeys the local regulations for grounding cables.
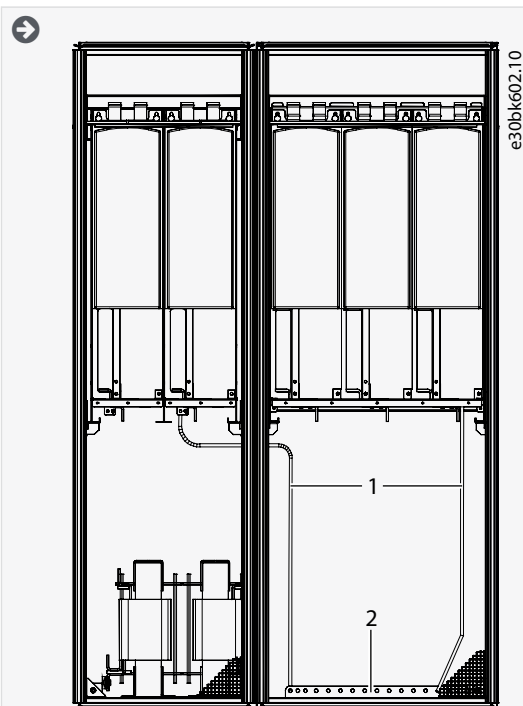
Illustration 50: Grounding the power unit, FR14

1	Grounding cable
2	PE busbar

7 Control Unit

7.1 Control Unit Components

The NXP control unit gives the flexibility to create advanced features with options and programmability. See selection guide and application manual for full list of features.

The control unit of the AC drive contains the control board and additional boards (see Illustration 51) connected to the 5 slot connectors (A to E) of the control board. The control board is connected to the power unit through a D-connector or fiber optic cables (FR9–FR14).

e30bh782.10
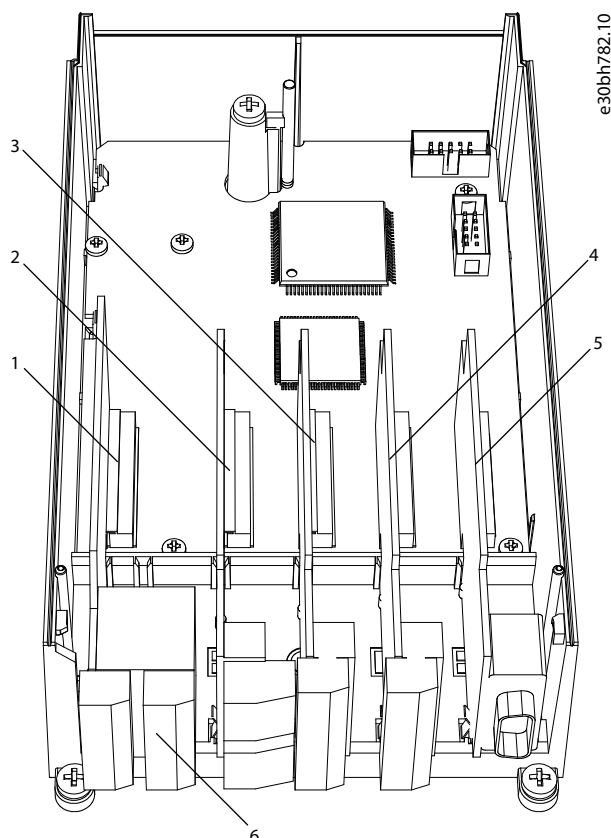
Illustration 51: Basic and Option Slots on the Control Board

1	Slot A; OPTA1	4	Slot D; option boards
2	Slot B; OPTA2	5	Slot E; option boards
3	Slot C; option boards	6	Control terminals

The control unit of the delivered AC drive contains the standard control interface. If the order included special options, the AC drive is delivered according to the order. The next pages contain information on the terminals and general wiring examples. The type code shows the I/O boards that are installed at the factory. For more information on the option boards, see VACON®NX I/O Boards User manual.

The OPTA1 basic board has 20 control terminals, and the relay board has 6 or 7. The standard connections of the control unit and the descriptions of signals are shown in 7.3.2 Control Terminals on OPTA1.

7.2 Control Voltage (+24 V/EXT +24 V)

It is possible to use the drive with an external power source with these properties: +24 V DC ±10%, minimum 1000 mA. Use it to externally power up the control board, and the basic and option boards. The analog outputs and inputs at OPTA1 do not work with only +24 V supplied to the control unit.

Connect the external power source to one of the 2 bidirectional terminals (#6 or #12), see the option board manual or VACON®NX I/O Boards User Manual. With this voltage, the control unit stays on and parameters can be set. The measurements of the main circuit (for example, the DC-link voltage, and the unit temperature) are not available when the drive is not connected to mains.

N O T I C E

If the AC drive is supplied with external 24 V DC power, use a diode in terminal #6 (or #12) to prevent the current to flow in opposite direction. Put a 1 A fuse in 24 V DC line for each AC drive. The maximum current consumption of each drive is 1 A from the external supply.
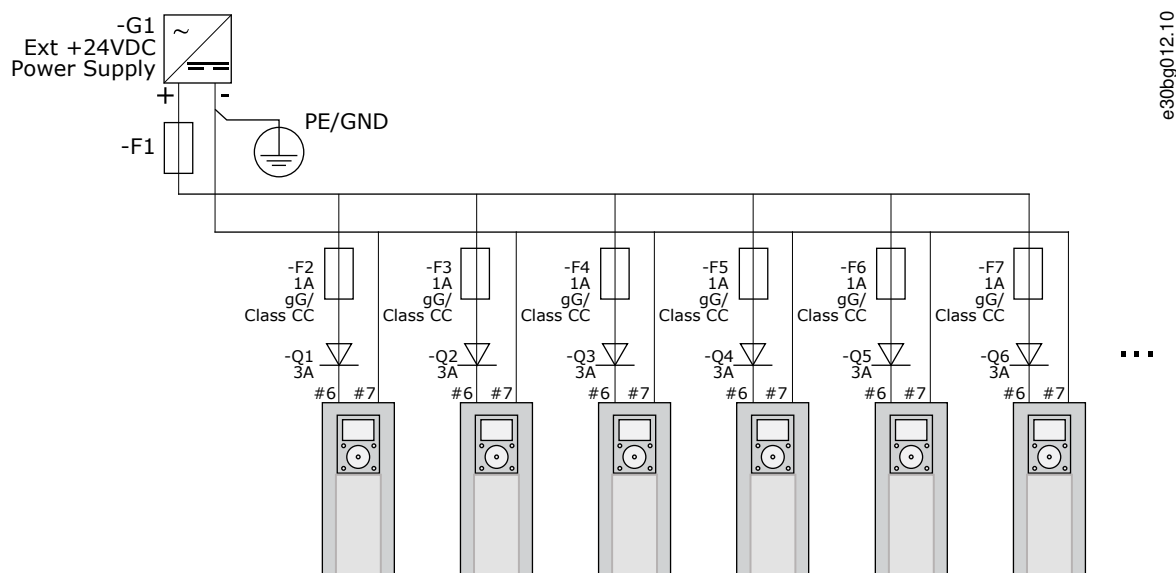
Illustration 52: Parallel Connection of 24 V Inputs with Many AC Drives

N O T I C E

The control unit I/O ground is not isolated from the chassis ground/protective earth. In the installation, consider the potential differences between the grounding points. We recommend using galvanic isolation in the I/O and 24 V circuitry.

7.3 Control Unit Cabling

7.3.1 Selection of the Control Cables

The control cables must be a minimum of 0.5 mm^2 (20 AWG) shielded multicore cables. See more on the cable types in Table 16. The terminal wires must be a maximum of 2.5 mm^2 (14 AWG) for the terminals of the relay board and 1.5 mm^2 (16 AWG) for other terminals.

NOTE! The drive option with the integrated control unit does not require connecting of cables by the customer except for frame FR12.

Table 21: Tightening Torques of the Control Cables

The terminal	The terminal screw	The tightening torque in Nm (in-lb)
Relay and thermistor terminals	M3	0.5 (4.5)
Other terminals	M2.6	0.2 (1.8)

7.3.2 Control Terminals on OPTA1

The figure shows the basic description of the terminals of the I/O board. For more information, see 7.3.2.2 Jumper Selections on the OPTA1 Basic Board. For more information on control terminals, see VACON®All in One Application manual.

Reference potentiometer, 1-10kΩ

e30bg013.10

Standard I/O board		
Terminal	**Signal**	**Description**
1	+10V_ref	Reference voltage	Maximum current 10 mA
2	AI1+	Analogue input, voltage or current	Selection V/mA with jumper block X1 (*) 0…+10 V (Ri = 200 kΩ) (-10V…+10V Joystick ctrl, sel. with jumper) 0-20 mA (Ri =250 Ω)
3	GND/AI1-	Analogue input common	Differential input if not connected to ground Allows ±20 V common mode voltage to GND
4	AI2+	Analogue input, voltage or current	Selection V/mA with jumper block X1 (*) 0…+10 V (Ri = 200 kΩ) (-10V…+10V Joystick ctrl, sel. with jumper) 0-20 mA (Ri =250 Ω)
5	GND/AI2-	Analogue input common	Differential input if not connected to ground Allows ±20 V common mode voltage to GND
6	+24V	24 V aux. voltage	±15%, max. 250 mA (all boards total) 150 mA (from single board) Can also be used as external power back-up for the control unit (and fieldbus)
7	GND	I/O ground	Ground for reference and controls
8	DIN1	Digital input 1	Ri = min. 5 kΩ 18-30 V = 1
9	DIN2	Digital input 2	
10	DIN3	Digital input 3	
11	CMA	Common A for DIN1—DIN3	Digital inputs can be disconnected from ground (*)
12	+24V	Control voltage output	Same as terminal #6
13	GND	I/O ground	Same as terminal #7
14	DIN4	Digital input 4	Ri = min. 5 kΩ 18-30 V = 1
15	DIN5	Digital input 5	
16	DIN6	Digital input 6	
17	CMB	Common B for DIN4-DIN6	Must be connected to GND or 24 V of I/O term. or to ext.24 V or GND Selection with jumper block X3 (*)
18	AO1+	Analogue signal (+output)	Output signal range: Current 0(4)-20 mA, RL max 500 Ω or Voltage 0-10 V, RL >1kΩ Selection with jumper block X6 (*)
19	AO1-	Analogue output common	
20	DO1	Open collector output	Maximum Uin = 48 VDC Maximum current = 50 mA

Illustration 53: Control Terminal Signals on OPTA1

*)	See figure in

Parameter references for I/O on control panel and NCDrive are: An.IN:A.1, An.IN:A.2, DigIN:A.1, DigIN:A.2, DigIN:A.3, DigIN:A.4, DigIN:A.5, DigIN:A.6, AnOUT:A.1 and DigOUT:A.1.

To use the control voltage output +24 V/EXT+24 V:

- Wire the +24 V control voltage to digital inputs through an external switch. OR
- Use the control voltage to power up external equipment, such as encoders and auxiliary relays.

The specified total load on all available +24 V/EXT+24 V output terminals must not exceed 250 mA.

The maximum load on the +24 V/EXT+24 V output per board is 150 mA. If there is a +24 V/EXT+24 V output on the board, it is locally short circuit protected. If one of the +24 V/ EXT+24 V outputs short circuits, the others remain powered because of the local protection.
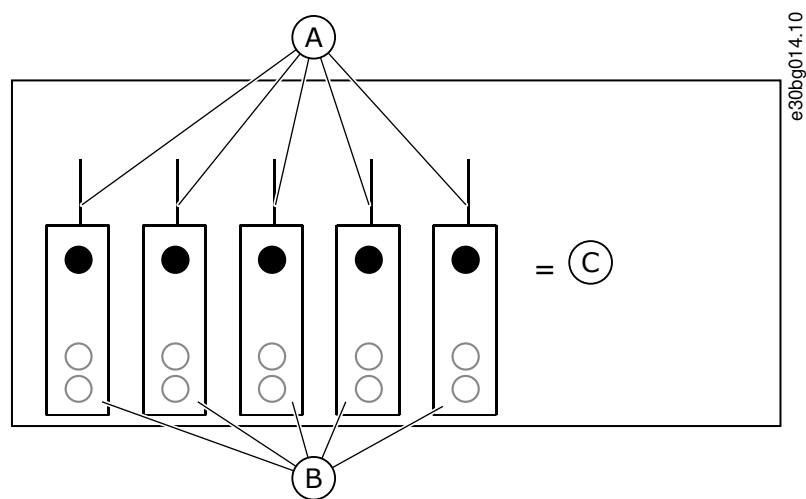
Illustration 54: Maximum Loads on +24 V/EXT+24 V Output

A	Maximum 150 mA	C	Maximum 250 mA
B	+24 V out		

7.3.2.1 Digital Input Signal Inversions

The active signal level is different when the common inputs CMA and CMB (terminals 11 and 17) are connected to +24 V or to ground (0 V).

The 24 V control voltage and the ground for the digital inputs and the common inputs (CMA, CMB) can be internal or external.
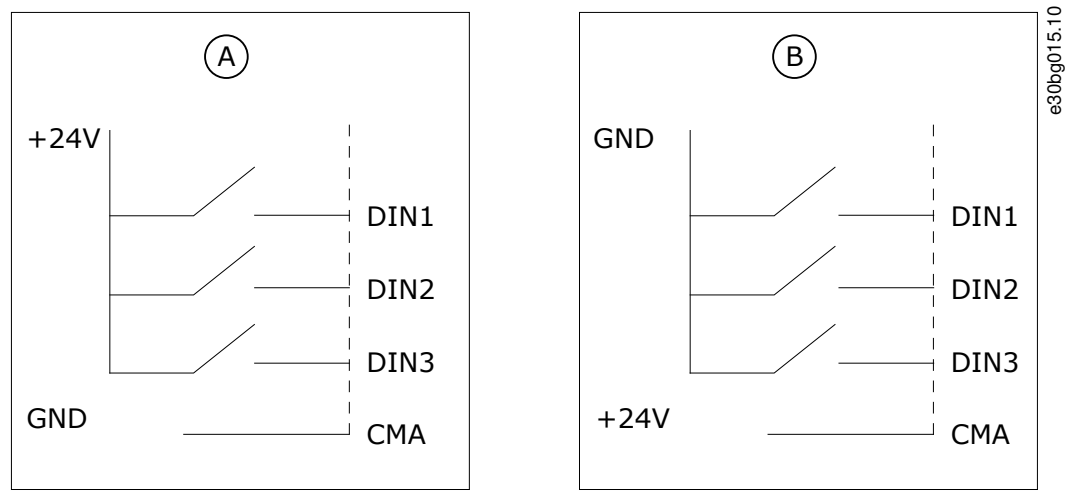
Illustration 55: Positive/Negative Logic

A	Positive logic (+24 V is the active signal) = the input is active when the switch is closed.
B	Negative logic (0 V is the active signal) = the input is active when the switch is closed. Set the jumper X3 to the position 'CMA/CMB isolated from ground'.

Related Links

- Jumper Selections on the OPTA1 Basic Board

7.3.2.2 Jumper Selections on the OPTA1 Basic Board

The functions of the AC drive can be changed to make them better agree with local requirements. To do it, change some positions for the jumpers on the OPTA1 board. The positions of the jumpers set the signal type of analog and digital inputs. Changing the AI/AO signal contents requires also a change in the related board parameter in menu M7.

On the A1 basic board, there are 4 jumper blocks: X1, X2, X3, and X6. Each jumper block contains 8 pins and 2 jumpers. See the possible jumper selections in .
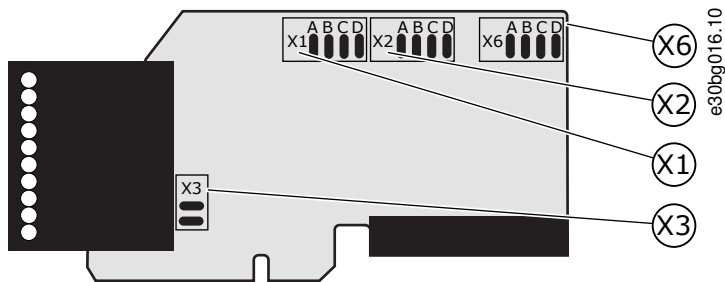
Illustration 56: Jumper Blocks on OPTA1

e30bg017.10

Jumper block X1:
AI1 mode
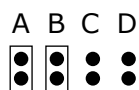
A B C D
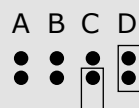
AI1 mode: 0…20mA; Current input

A B C D

AI1 mode: Voltage input; 0…10V

A B C D

AI1 mode: Voltage input; 0…10V
differential

A B C D
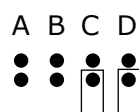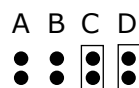
AI1 mode: Voltage input; -0…10V

Jumper block X2:
AI2 mode
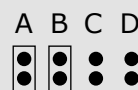
A B C D
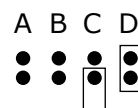
AI1 mode: 0…20mA; Current input

A B C D

AI2 mode:Voltage input; 0…10V

A B C D

AI2 mode: Voltage input; 0…10V
differential

A B C D
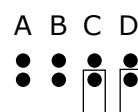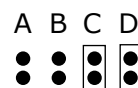
AI2 mode: Voltage input; -10…10V

Jumper block X6:
AO1 mode

A B C D
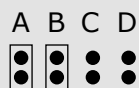
AO1 mode: 0….20mA; Current output

A B C D
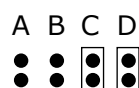
AO1 mode: Voltage output; 0…10V

Jumper block X3:
CMA and CMB grounding

CMB connected to GND
CMA connected to GND

CMB isolated from GND
CMA isolated from GND

CMB and CMA
internally connected together,
isolated from GND

= Factory default

Illustration 57: Jumper Selections for OPTA1

7.3.3 Control Terminals on OPTA2 and OPTA3

OPTA2			
21	RO1/1	Relay output 1 DigOUT:B.1 *)	Switching capacity • 24 VDC/8 A • 250 VAC/8 A • 125 VDC/0.4 A Minimum switching load • 5 V/10 mA
22	RO1/2		
23	RO1/3		
24	RO2/1	Relay output 2 DigOUT:B.2 *)	Switching capacity • 24 VDC/8 A • 250 VAC/8 A • 125 VDC/0.4 A Minimum switching load • 5 V/10 mA
25	RO2/2		
26	RO2/3		

OPTA3			
21	RO1/1	Relay output 1 DigOUT:B.1 *)	Switching capacity • 24 VDC/8 A • 250 VAC/8 A • 125 VDC/0.4 A Minimum switching load • 5 V/10 mA
22	RO1/2		
23	RO1/3		
25	RO2/1	Relay output 2 DigOUT:B.2 *)	Switching capacity • 24 VDC/8 A • 250 VAC/8 A • 125 VDC/0.4 A Minimum switching load • 5 V/10 mA
26	RO2/2		
28	TI1+	Thermistor input DigIN:B.1 *)	
29	TI1-		

Illustration 58: Control Terminal Signals on Relay Boards OPTA2 and OPTA3

*)	Parameter reference on control panel and NCDrive.
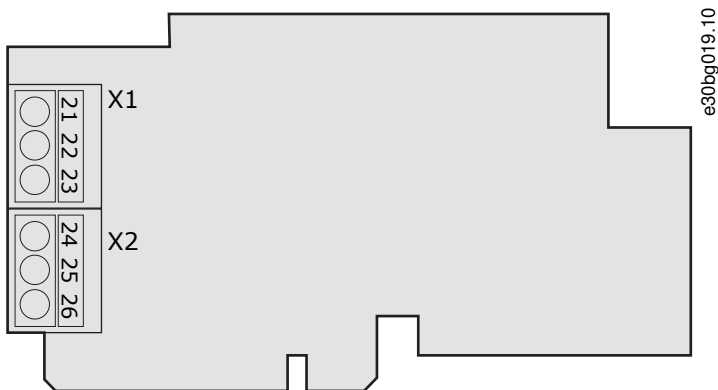
Illustration 59: OPTA2
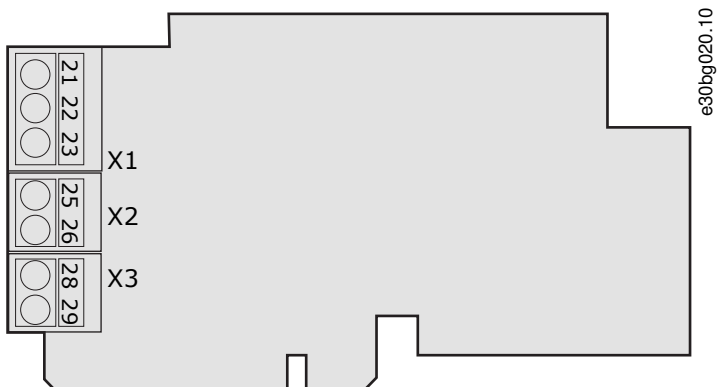
Illustration 60: OPTA3

7.4 Fiber Cable Connections

When optical cables are used to link the power unit and the control board, a special Optical Cable Adapter Board connected to the control board D-connector is used.

The control unit uses 24 V DC supplied from the ASIC board, which is on the left side of the power unit 1 in FR10–FR12, and in the inverter unit in FR13–FR14 (see Illustration 62).
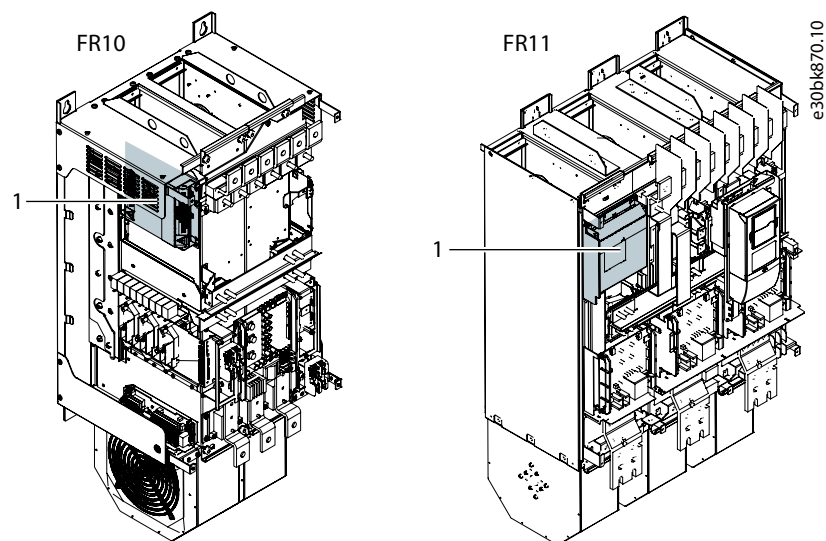
Illustration 61: Location of ASIC Board in FR10/FR11

1	ASIC board
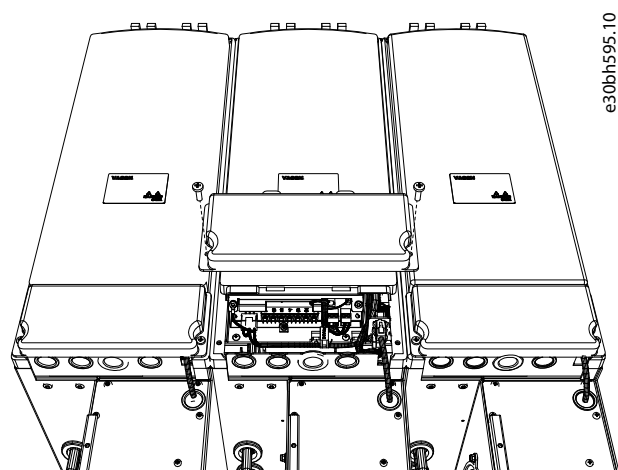
Illustration 62: Location of ASIC Board in FR13–FR14

Each fiber optic cable has a number 1–8 and 11–18 (1–7 for FR10–FR11 and FR13) marked on the cable shield at both cable ends. The list of the optic signals can be found in the following figures and table.
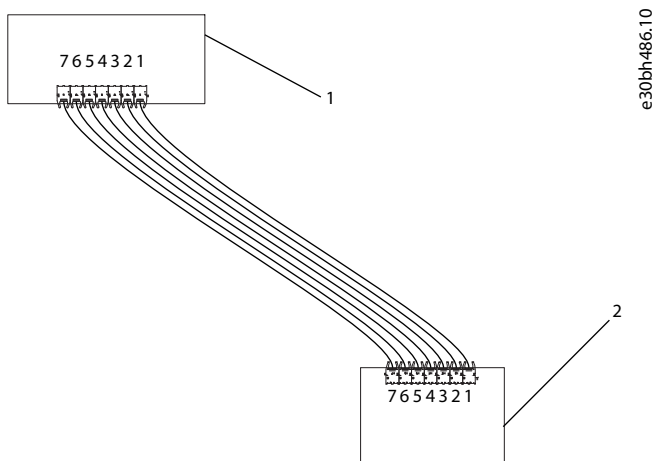
Illustration 63: Connections between the Optical Fiber Board and ASIC Board FR10–FR11, and FR13

1	Power unit (ASIC board)
2	Optical fiber board on control unit
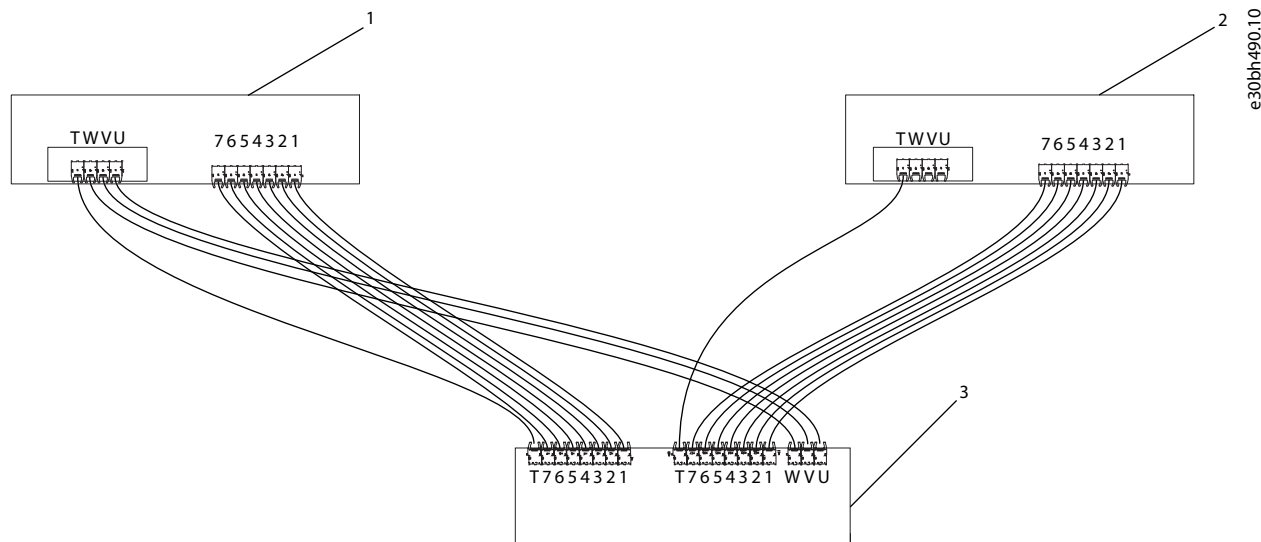
Illustration 64: Connections between the Star-coupler Board, ASIC Boards, and Feedback Boards, FR12 and FR14

1	Power unit 1 (ASIC board and Feedback board)	3	Star-coupler board on control unit
2	Power unit 2 (ASIC board and Feedback board)		

Table 22: Terminals on Optical Cable Adapter Board/Star-coupler Board, ASIC Boards, and Feedback Boards

Terminal	Description
ASIC board of Power unit 1/Power unit 2 (FR12 and FR14)	
1	Gate control enable
2	Phase U control
3	Phase V control
4	Phase W control

Terminal	Description
5	ADC synchronization
6	VaconBus data from control board to ASIC
7	VaconBus data from ASIC to control board
Feedback board (FR12 and FR14)	
T	Trip signal (Power unit 1/Power unit 2)
U	Feedback phase U (Power unit 1 only)
V	Feedback phase V (Power unit 1 only)
W	Feedback phase W (Power unit 1 only)
Optical fiber board/Star coupler board on control unit	
1	Gate control enable
2	Phase U control
3	Phase V control
4	Phase W control
5	ADC synchronization
6	VaconBus data from control board to ASIC
7	VaconBus data from ASIC to control board
T	Trip signal from power unit (FR12 and FR14)
U	Feedback phase U (FR12 and FR14)
V	Feedback phase V (FR12 and FR14)
W	Feedback phase W (FR12 and FR14)

7.4.1 Connecting the Optic Fiber Cables, FR10–FR12

In case the fiber cables are not connected, connect them from the optical fiber board (FR10–FR11) or star coupler board (FR12) to the power unit.

⚠ **C A U T I O N** ⚠

DAMAGE TO THE COMPONENTS FROM INCORRECT CONNECTIONS

Connecting the cables incorrectly damages power electronic components.

- Be careful to connect the fiber optic cables according to instructions.

The maximum length of the optical cable is 8 m.

The minimum bending radius for optical cables is 50 mm.

Procedure

1. To access the ASIC board, remove the cable cover in front of the power unit.
2. Connect the supply cable to the X10 connector on the ASIC board and to the X2 connector on the rear side of the control unit. For FR12, connect only power unit 1. Power unit 2 is connected to ASIC load resistor.

   Terminals X2 and X3 can be in use simultaneously. However, if the +24 V supply from the control I/O terminals (for example, from board OPTA1) is used, this terminal must be protected with a diode.

3. Connect each cable to the connectors marked with the same number on the ASIC board and on the rear side of the control unit.

4. In FR12, connect the 4 fiber cables from the feedback boards to the star coupler board.

5. To prevent damages to the cables, attach the cable bundle at two or more points, at least once at each end.

6. Attach the cable cover on the power unit when the work is finished.
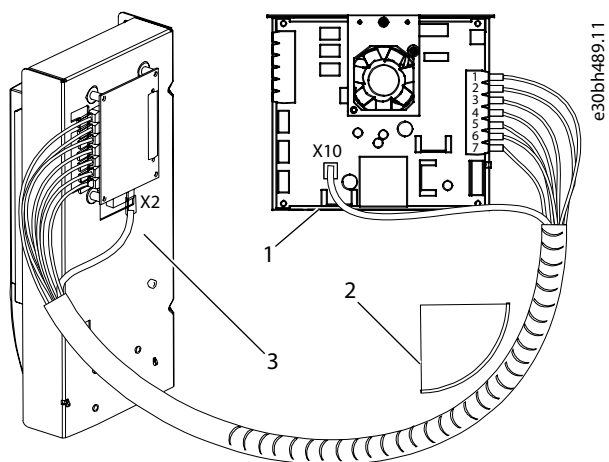
Illustration 65: Fiber Optic Cabling for FR10-FR11

1	Power module ASIC board	3	Optical fiber board
2	Minimum bending radius 50 mm		
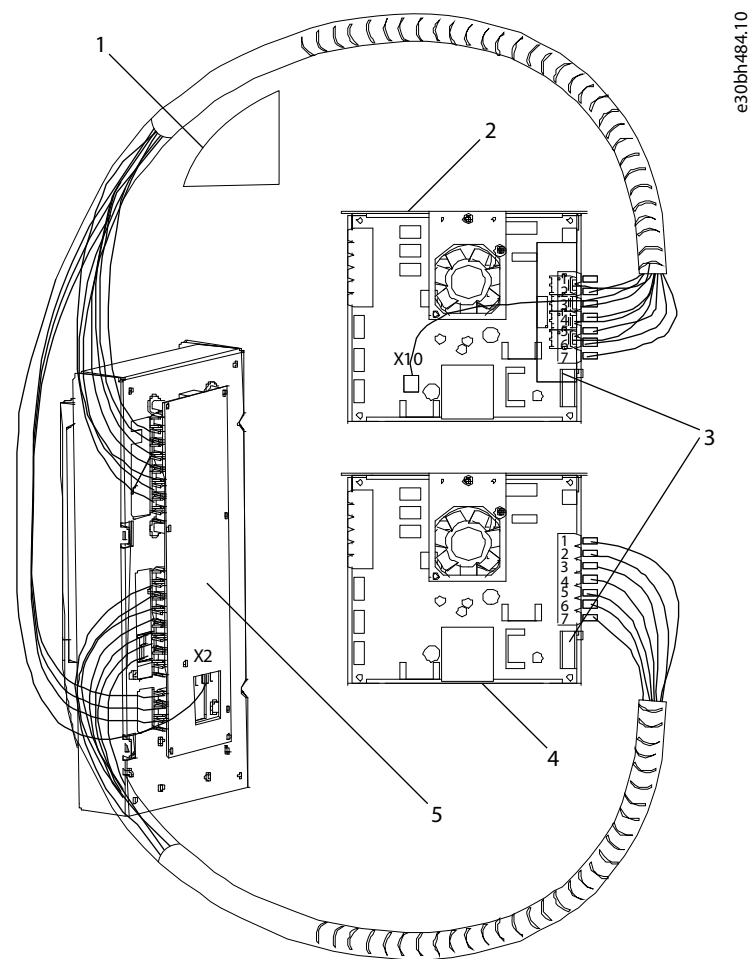
Illustration 66: Fiber Optic Cabling for FR12

1	Minimum bending radius 50 mm	4	Power module 2 ASIC board
2	Power module 1 ASIC board	5	Star-coupler board
3	Feedback board		

7.4.2 Connecting the Optic Fiber Cables, FR13–FR14

In case the fiber cables are not connected, connect them from the optical fiber board (FR13) or star coupler board (FR14) to the power module.

> ⚠ **C A U T I O N** ⚠
>
> **DAMAGE TO THE COMPONENTS FROM INCORRECT CONNECTIONS**
>
> Connecting the cables incorrectly damages power electronic components.
>
> – Be careful to connect the fiber optic cables according to instructions.

The maximum length of the optical cable is 8 m.

The minimum bending radius for optical cables is 50 mm.

⚠ **D A N G E R** ⚠
SHOCK HAZARD FROM FIBER CONNECTIONS The terminals for fiber connections are live when the drive is connected to mains, also when the motor does not operate. A contact with this voltage can lead to death or serious injury. –   Disconnect power and wait 5 minutes before touching the terminals.

Procedure

1. To access the board, remove the cover of the terminal compartment and the protective cover.
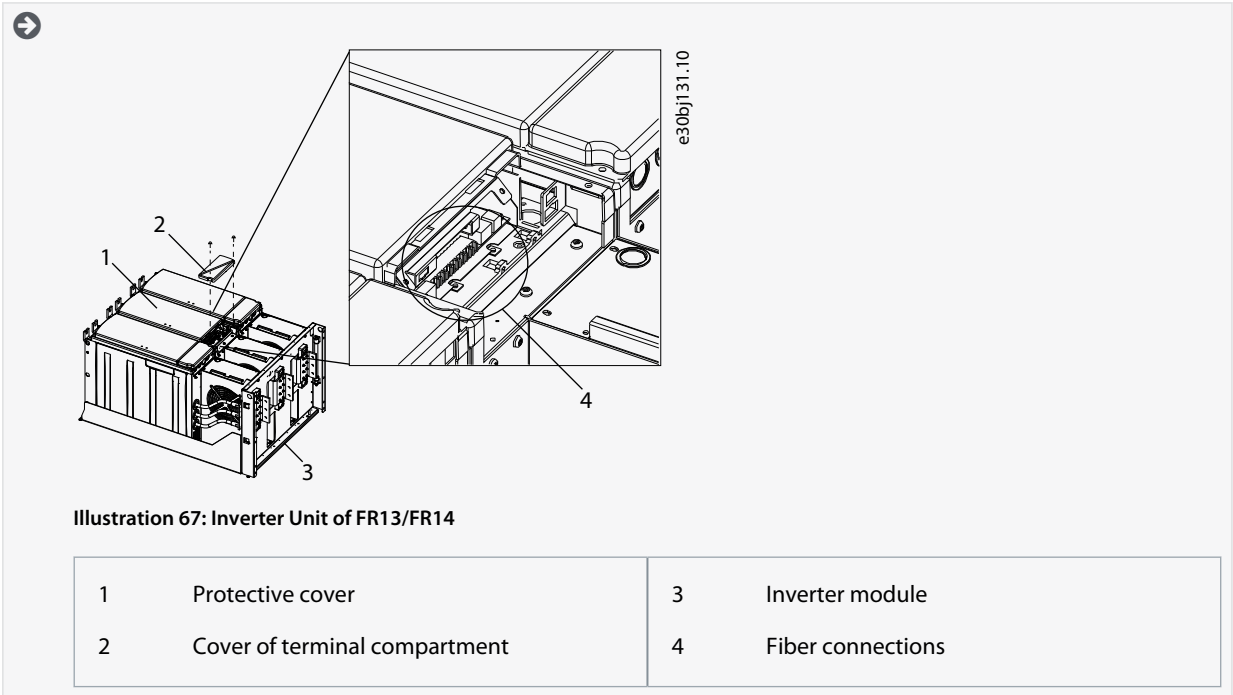
Illustration 67: Inverter Unit of FR13/FR14

1	Protective cover	3	Inverter module
2	Cover of terminal compartment	4	Fiber connections

2. Connect the supply cable to the X10 connector on the ASIC board and to the X2 connector on the rear side of the control unit. For FR14, connect only power unit 1. Power unit 2 is connected to ASIC load resistor.

    Terminals X2 and X3 can be in use simultaneously. However, if the +24 V supply from the control I/O terminals (for example, from board OPTA1) is used, this terminal must be protected with a diode.

3. Connect each cable to the connectors marked with the same number on the ASIC board and on the rear side of the control unit.

4. In FR14, connect the 4 fiber cables from the feedback boards to the star coupler board.

5. To prevent damages to the cables, attach the cable bundle at two or more points, at least once at each end.

6. Attach the cable cover on the power unit when the work is finished.
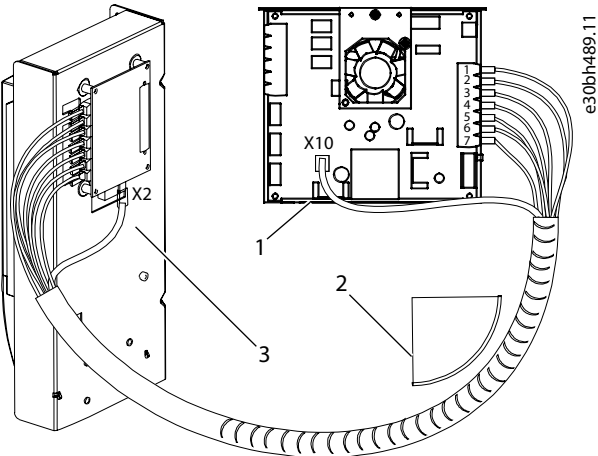
Illustration 68: Fiber Optic Cabling for FR13

1	Power module ASIC board	3	Optical fiber board
2	Minimum bending radius 50 mm		
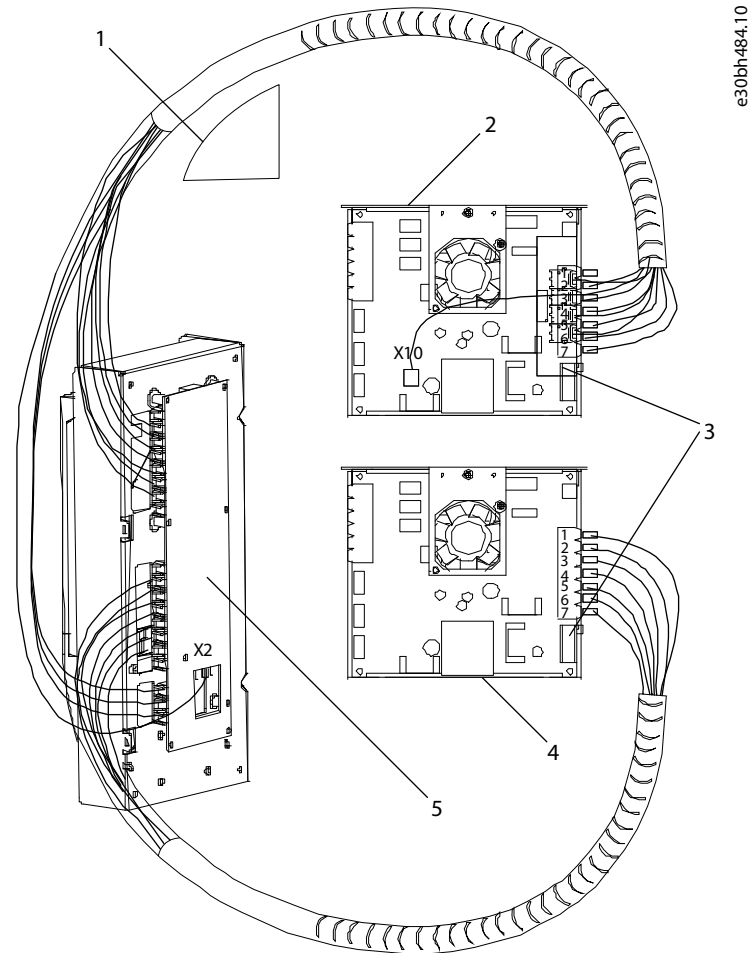
Illustration 69: Fiber Optic Cabling for FR14

1	Minimum bending radius 50 mm	4	Power module 2 ASIC board
2	Power module 1 ASIC board	5	Star-coupler board
3	Feedback board		

7.5 Installation of Option Boards

For information on how to install the option boards, see the option board manual or VACON®NX I/O Boards User Manual.

7.6 Galvanic Isolation Barriers

The control connections are isolated from mains. The GND terminals are permanently connected to I/O ground. See Illustration 70.

The digital inputs on the I/O board are galvanically isolated from the I/O ground (PELV). The relay outputs are also double-isolated from each other at 300 VAC (EN-50178).
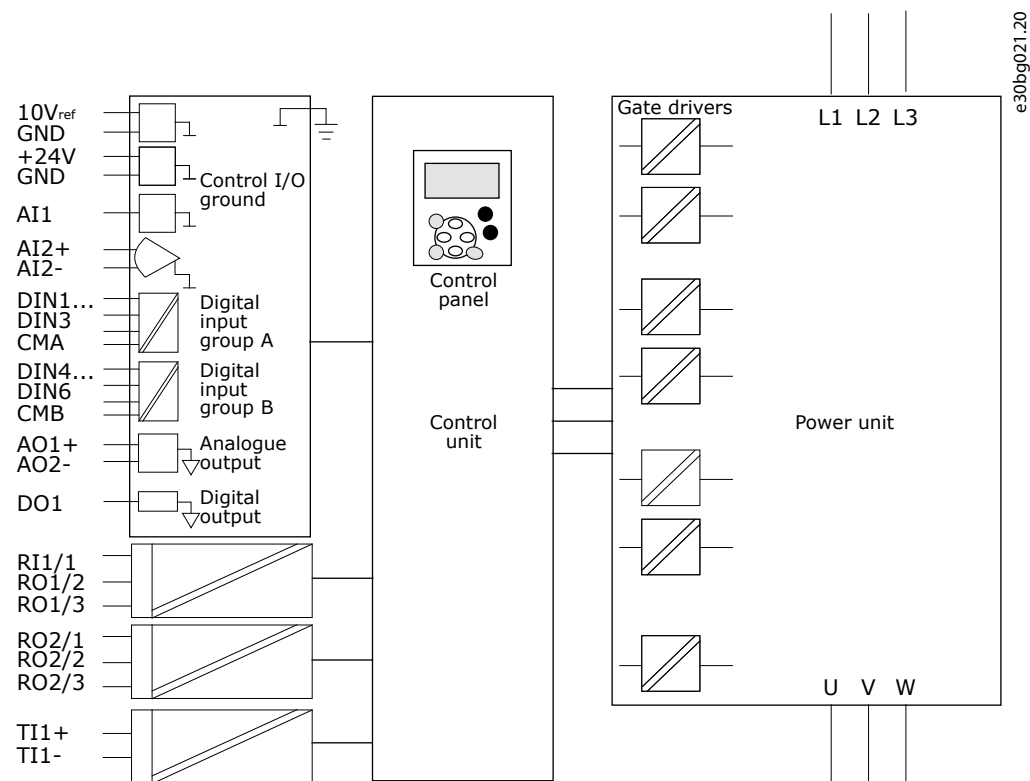
Illustration 70: Galvanic Isolation Barriers

8 Using the Control Panel

8.1 Navigating on the Control Panel

The data of the AC drive is in menus and submenus. Follow these instructions to navigate in the menu structure on the control panel.

Procedure

1. To move between the menus, use the Browser buttons Up and Down on the keypad.
2. To go into a group or an item, push the Menu button Right.

> To go back to the previous level, push the Menu button Left.

> ➔ The display shows the current location in the menu, for example *S6.3.2*. The display also shows the name of the group or item in the current location.
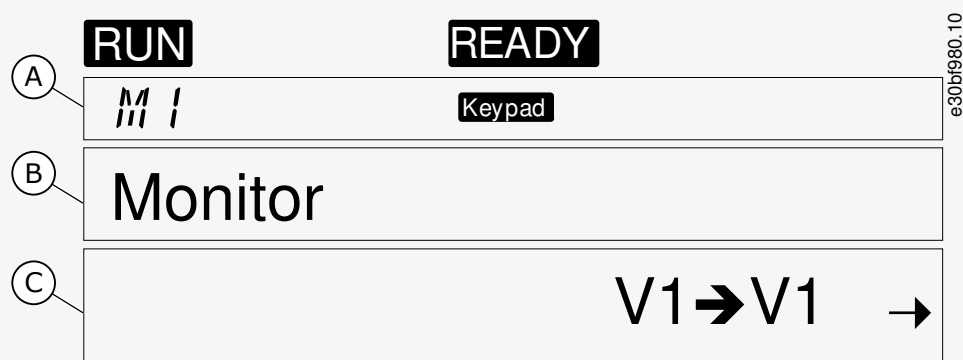
Illustration 71: Navigation Items on the Control Panel

A	The location on the menu	C	The number of items that are available or the item value.
B	The description (name of the page)		

8.2 Using the Monitoring Menu (M1)

Follow these instructions to monitor the actual values of the parameters and signals.

The values cannot be changed in the Monitoring menu. To change the values of parameters, see 8.3.2 Selecting Values or 8.3.3 Editing the Values Digit by Digit.

Procedure

1. To find the Monitoring menu, scroll down in the main menu until the location indication *M1* shows on the first line of the display.
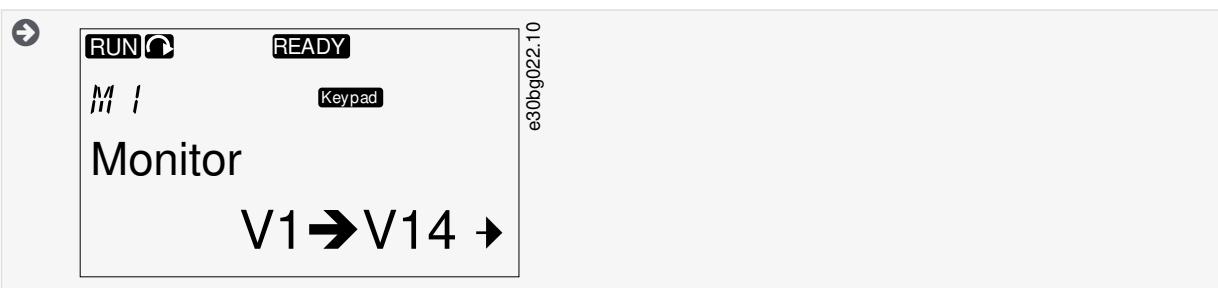
2. To go to the Monitoring menu from the main menu, push the Menu button Right.
3. To scroll through the menu, push the Browser buttons Up and Down.

8.2.1 Monitored Values

The monitored values have the indication V#.#. The values update each 0.3 s.

Index	Monitored value	Unit	ID	Description
V1.1	Output frequency	Hz	1	The output frequency to the motor
V1.2	Frequency reference	Hz	25	The frequency reference to motor control
V1.3	Motor speed	rpm	2	The actual speed of the motor in rpm
V1.4	Motor current	A	3	Measured motor current
V1.5	Motor torque	%	4	The calculated shaft torque
V1.6	Motor power	%	5	The calculated motor shaft power in percentage
V1.7	Motor voltage	V	6	The output voltage to the motor
V1.8	DC link voltage	V	7	The measured voltage in the DC-link of the drive
V1.9	Unit temperature	°C	8	The heat sink temperature in Celsius or Fahrenheit
V1.10	Motor temperature	%	9	The calculated motor temperature in percentage of the nominal temperature. See VACON® All in One Application Manual.
V1.11	Analog input 1	V/mA	13	AI1[1]
V1.12	Analog input 2	V/mA	14	AI2[1]
V1.13	DIN 1, 2, 3	−	15	Shows the status of the digital inputs 1–3
V1.14	DIN 4, 5, 6	−	16	Shows the status of the digital inputs 4–6
V1.15	DO1, RO1, RO2	−	17	Shows the status of the digital and relay outputs 1–3
V1.16	Analog I_{out}	mA	26	AO1
V1.17	Multimonitoring items	−	−	Shows 3 monitored values to select from. See 8.7.6.9 Enabling/Disabling the Change of Multimonitoring Items.

[1] If the AC drive only has +24 V supply (for control board power-up), this value is not reliable.

See VACON® All in One Application Manual for more monitored values.

8.3 Using the Parameter Menu (M2)

8.3.1 Finding the Parameter

Use these instructions to find the parameter to edit.

Procedure

1. To find the Parameter menu, scroll down in the main menu until the location indication *M2* shows on the first line of the display.
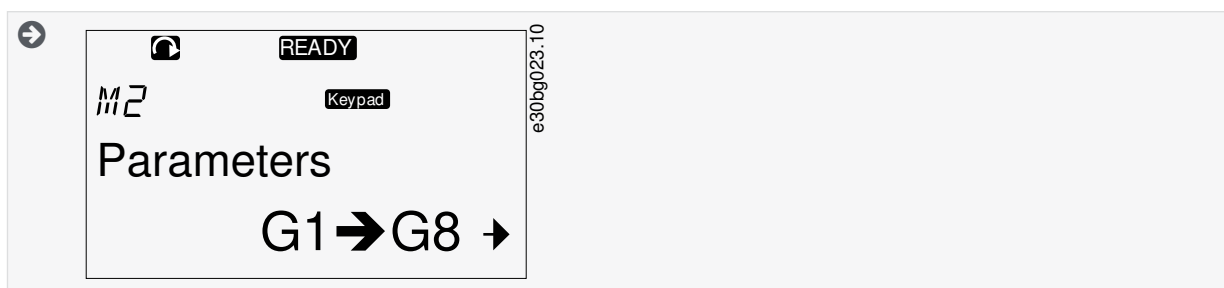
2. Push the Menu button Right to move into the Parameter Group Menu (G#).
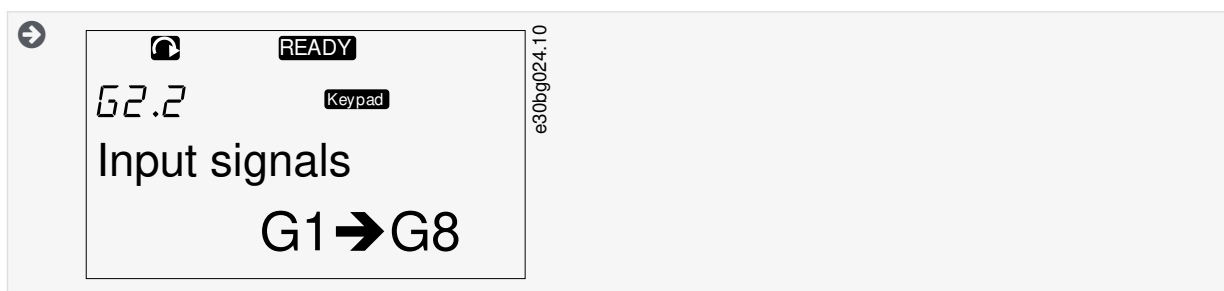
3. To find the parameter group, use the Browser buttons Up and Down.
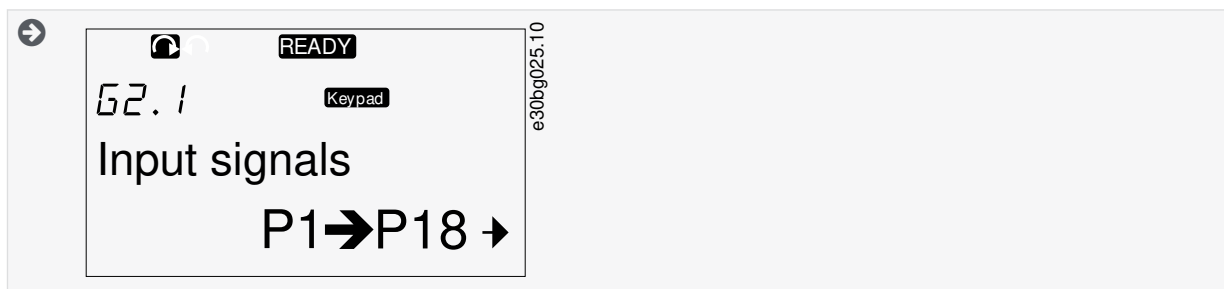
4. Use the Browser buttons Up and Down to find the parameter (P#) to edit. To move directly from the last parameter of a parameter group to the first parameter of that group, push the Browser button Up.
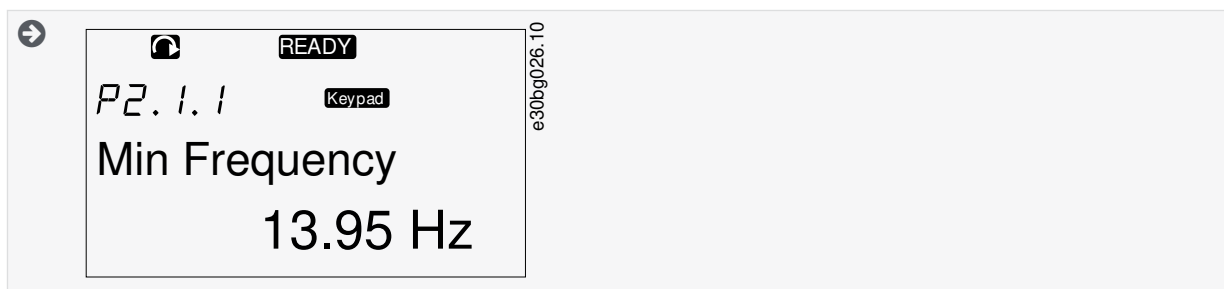
8.3.2 Selecting Values

Use these instructions to edit the text values on the control panel.

The basic application package "All in One+" includes 7 applications with different sets of parameters. For more information, see VACON™ All in One Application Manual.

When the drive is in RUN state, many parameters are locked, and cannot be edited. Only the text *Locked* shows on the display. Stop the AC drive to edit these parameters.

Procedure

1. Use the Browser buttons Up and Down to find the parameter (P#) to edit. To move directly from the last parameter of a parameter group to the first parameter of that group, push the Browser button Up.

2. To go to the Edit mode, push the Menu button Right. The parameter value starts to blink.

3. Set the new value with the Browser buttons Up and Down.

4. To accept the change, push the [enter] button or ignore the change with menu button Left.
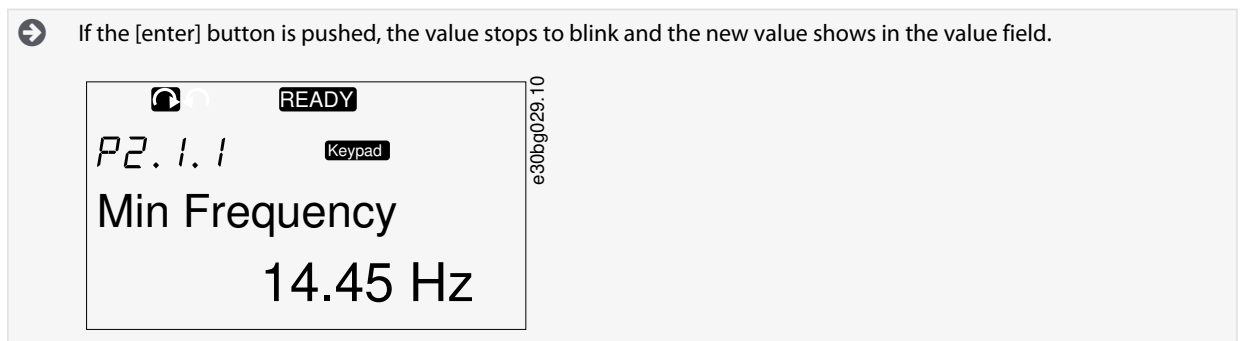
If the [enter] button is pushed, the value stops to blink and the new value shows in the value field.

5. For locking the parameter values, use the *Parameter Lock* function in menu *M6*, see 8.7.6.6 Locking a Parameter.

8.3.3 Editing the Values Digit by Digit

Use these instructions to edit the numerical values on the control panel.

The basic application package "All in One+" includes 7 applications with different sets of parameters. For more information, see VACON™ All in One Application Manual.

When the drive is in RUN state, many parameters are locked, and cannot be edited. Only the text *Locked* shows on the display. Stop the AC drive to edit these parameters.

Procedure

1. Find the parameter with the Browser and Menu buttons.
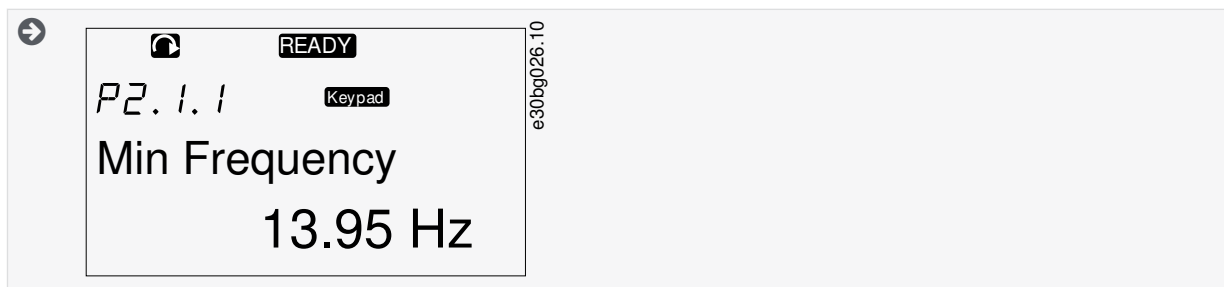
   ```
   ┌─────────────────────────────┐
   │  ⓒ              READY        │
   │  P2.1.1      Keypad          │
   │  Min Frequency               │
   │            13.95 Hz          │
   └─────────────────────────────┘
   ```
   e30bg026.10

2. To go to the Edit mode, push the Menu button Right. The parameter value starts to blink.

   ```
   ┌─────────────────────────────┐
   │  ⓒ              READY        │
   │  P2.1.1      Keypad          │
   │  Min Frequency               │
   │            13.95 Hz          │
   └─────────────────────────────┘
   ```
   e30bg028.10
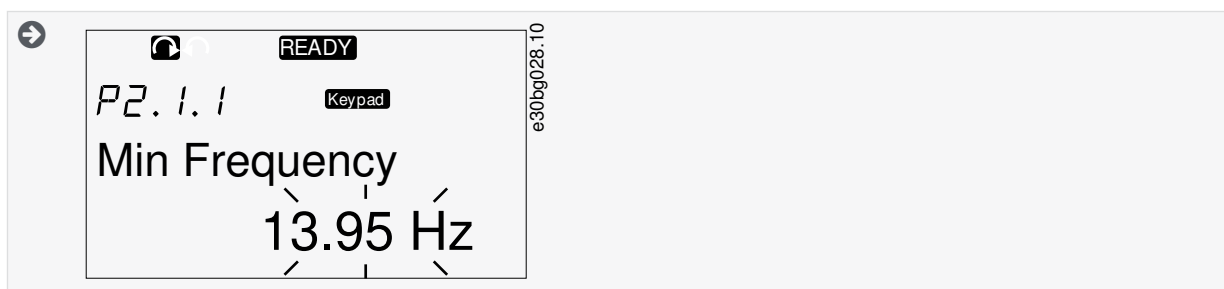
3. Push the Menu button Right. The value can now be edited digit by digit.

4. To accept the change, push the [enter] button.

   > To ignore the change, push Menu button Left many times, until the view goes back to the parameter list.

   → If the [enter] button is pushed, the value stops to blink and the new value shows in the value field.

   ```
   ┌─────────────────────────────┐
   │  ⓒ              READY        │
   │  P2.1.1      Keypad          │
   │  Min Frequency               │
   │            14.45 Hz          │
   └─────────────────────────────┘
   ```
   e30bg029.10
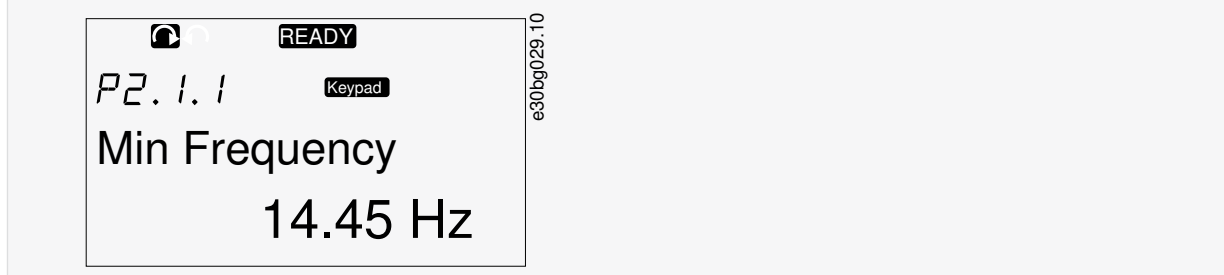
5. For locking the parameter values, use the *Parameter Lock* function in menu *M6*, see 8.7.6.6 Locking a Parameter.

8.4 Using the Keypad Control Menu

8.4.1 Finding the Keypad Control Menu

In the Keypad control menu, the following functions are available: selecting the control mode, editing the frequency reference, and changing the direction of the motor.

Procedure

1. To find the *Keypad control* menu, scroll down in the main menu until the location indication *M3* shows on the first line of the display.
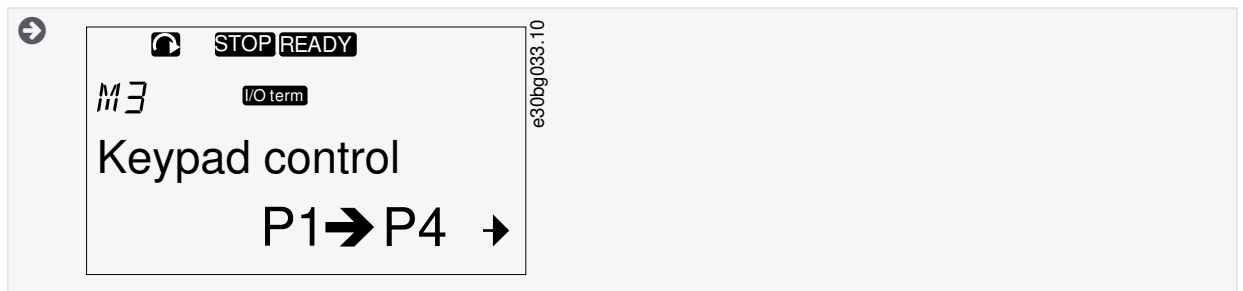
2. To go to the *Keypad control* menu from the main menu, push the Menu button Right.

8.4.2 Keypad Control Parameters M3

Index	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P3.1	Control place	1	3	–	1		125	The control mode 1 = I/0 terminal 2 = Keypad (control panel) 3 = Fieldbus
R3.2	Keypad reference	P2.1.1	P2.1.2	Hz	0.00		123	0 = Forward 1 = Reverse
P3.3	Direction (on keypad)	0	1	–	0		–	–
P3.4	Stop button	0	1	–	1		114	0 = Limited function of Stop button 1 = Stop button always enabled

8.4.3 Changing the Control Mode

3 control modes are available to control the AC drive. For each control place, a different symbol shows on the display:

The control mode	The symbol
I/O terminals	I/O term
Keypad (control panel)	Keypad
Fieldbus	Bus/Comm

Procedure

1. In the *Keypad control* menu (*M3*), find the control mode (*Control Place*) with Menu buttons Up and Down.


```
        STOP READY

P3.1     I/O term

Control Place

I/O Terminal
```

2. To go to the edit mode, push the Menu button Right.

   The parameter value starts to blink.
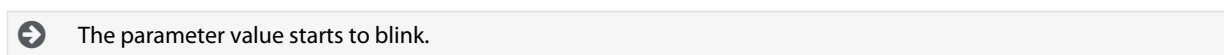
3. To scroll through the options, push the Browser buttons Up and Down.
4. To select the control mode, push the [enter] button.

8.4.4 Keypad Reference

The keypad reference submenu (*P3.2*) shows the frequency reference. In this submenu, also the frequency reference can be edited.

8.4.4.1 Editing the Frequency Reference

Use these instructions to change the frequency reference.

Procedure

1. In the *Keypad control* menu (*M3*), find the Keypad reference with Menu buttons Up and Down.
2. To go to the edit mode, push the Menu button Right. The frequency reference value starts to blink.
3. Set the new value with the Browser buttons.

   The value changes only on the control panel.
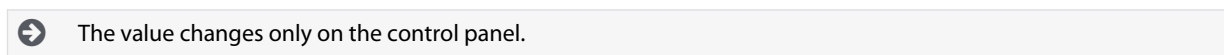
4. To make the motor speed to agree with the value on the control panel, select the keypad as the control mode, see 8.4.3 Changing the Control Mode.

8.4.5 Changing the Rotation Direction

The keypad direction submenu shows the rotation direction of the motor. In this submenu, also the rotation direction can be changed.

For more information on how to control the motor with the control panel, see 3.6.1 Keypad and 9.2 Commissioning the AC Drive.

Procedure

1. In the *Keypad control* menu (*M3*), find the Keypad direction with the Menu buttons Up and Down.
2. To go to the edit mode, push the Menu button Right.

3. Select the direction with Menu buttons Up and Down.

> ⊙ The rotation direction changes on the control panel.

4. To make the motor to agree with the set rotation direction, select the keypad as the control mode, see 8.4.3 Changing the Control Mode.

8.4.6 Disabling the Stop Motor Function

As a default, the motor stops when the Stop button is pushed no matter what is the control mode. Use these instructions to disable this function.

Procedure

1. In the *Keypad control* menu (*M3*), find the page 3.4. Stop button with the Browser buttons.
2. To go to the edit mode, push the Menu button Right.
3. To select Yes or No, use the Browser buttons.
4. Accept the selection with the [enter] button.

> ⊙ When the Stop motor function is not active, the Stop button stops the motor only when the keypad is the control mode.

8.4.7 Special Functions in Keypad Control Menu

8.4.7.1 Selecting the Keypad as the Control Mode

This is a special function only available in menu M3.

Make sure to be in the menu M3 and control mode is other than keypad.

Procedure

1. Do one of the following options:
   - Keep the Start button pushed down for 3 s when the motor is in RUN state.
   - Keep the Stop button pushed down for 3 s when the motor is stopped.

> In other menu than M3, when the keypad is not the active control mode and the start button is pushed, an error message *Keypad Control NOT ACTIVE* shows. In some applications this error message is not shown.

> ⊙ The keypad is selected as the control mode and the current frequency reference and direction is copied to the control panel.

8.4.7.2 Copying the Frequency Reference Set to the Control Panel

These are special functions only available in menu M3.

Use these instructions to copy the frequency reference set from I/O or fieldbus to control panel.

Make sure to be in menu M3 and that the control mode is other than keypad.

Procedure

1. Keep the [enter] button pushed down for 3 s.

> In other menu than M3, when the keypad is not the active control mode and the start button is pushed, an error message *Keypad Control NOT ACTIVE* shows.

8.5 Using the Active Faults Menu (M4)

8.5.1 Finding the Active Faults Menu

The Active faults menu shows a list of active faults. When there are no active faults, the menu is empty.

For more information on the fault types and how to reset faults, see 11.1 General Information on Fault Tracing and 11.2 Resetting a Fault. For the fault codes, possible causes and information on how to correct the fault, see the Faults and Alarms section.

Procedure

1. To find the *Active faults* menu, scroll down in the main menu until the location indication *M4* shows on the first line of the display.
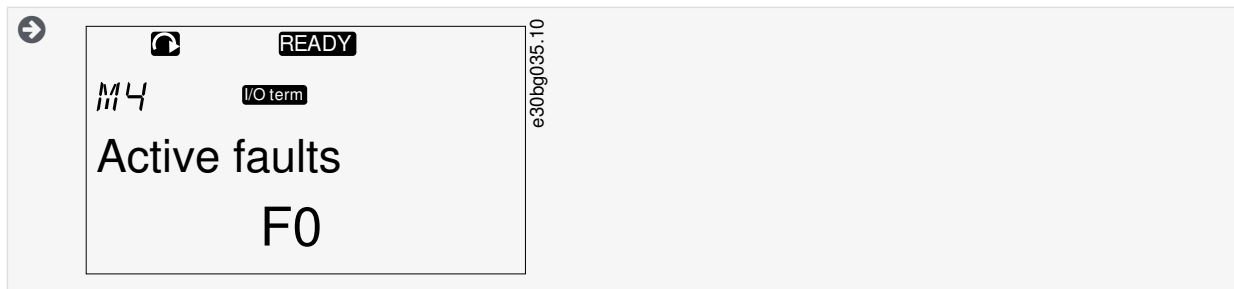
2. To go to the *Active faults* menu from the main menu, push the Menu button Right.

   Illustration 72: Fault Symbols

A	Fault symbol
B	Fault type symbol
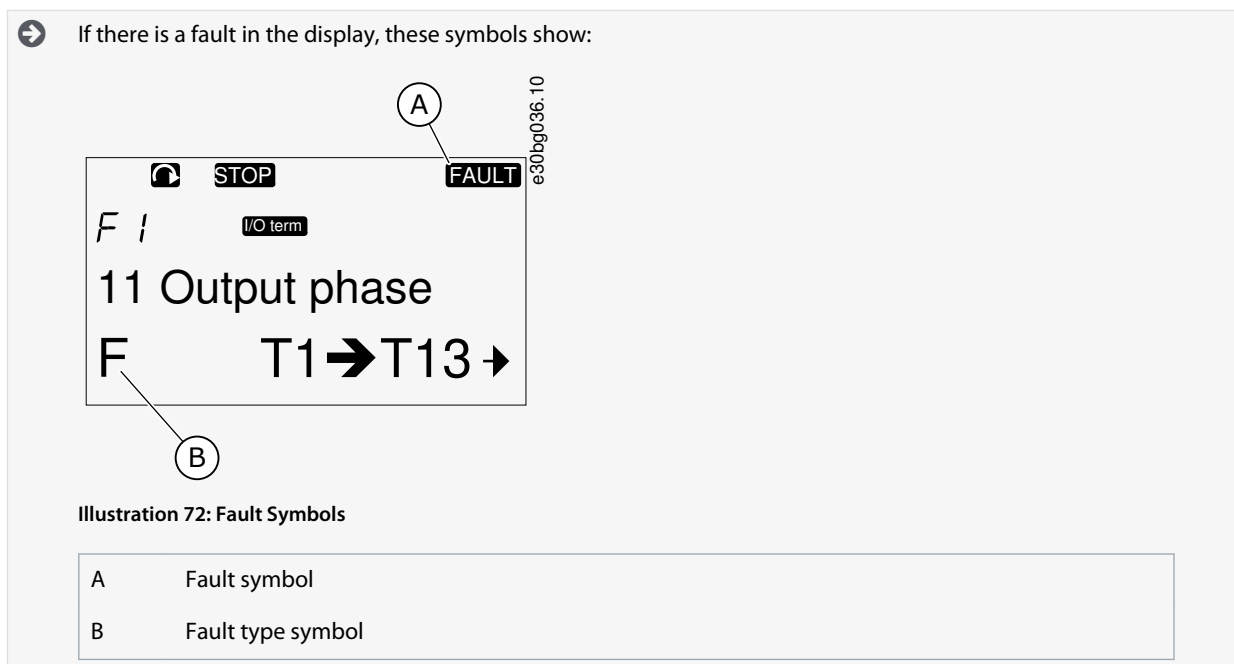
8.5.2 Examining the Fault Time Data Record

This menu shows some important data that was valid at the time of the fault. This helps to find the cause of the fault.

Procedure

1. Find the fault in *Active faults* menu or *Fault history* menu.
2. Push the Menu button Right.
3. Scroll the data *T.1-T.16* with the Browser buttons.

8.5.3 Fault Time Data Record

The fault time data record shows some important data that was valid at the time of the fault. This helps to find the cause of the fault.

If real time is set on the AC drive, the data items *T1* and *T2* show as in column Real Time Data Record.

In some special cases, some of the fields can show other data than described in the table. If the value of a field differs significantly from the expected value, this special usage can be the reason. Contact the nearest distributor to get help from the factory in understanding the data.

Code	Description	Value	Real Time Data Record
T.1	Counted operation days	d	yyyy-mm-dd
T.2	Counted operation hours	hh:mm:ss (d)	hh:mm:ss,sss
T.3	Output frequency	Hz (hh:mm:ss)	–
T.4	Motor current	A	–
T.5	Motor voltage	V	–
T.6	Motor power	%	–
T.7	Motor torque	%	–
T.8	DC voltage	V	–
T.9	Unit temperature	°C	–
T.10	Run status	–	–
T.11	Direction	–	–
T.12	Warnings	–	–
T.13	0-speed[1]	–	–
T.14	Subcode	–	–
T.15	Module	–	–
T.16	Submodule	–	–

¹ Tells if the drive was at zero speed (< 0.01 Hz) when the fault showed.

8.6 Using the Fault History Menu (M5)

8.6.1 Fault History Menu (M5)

There is a maximum number of 30 faults in the Fault history. The information on each fault shows in the Fault time data record, see 8.5.3 Fault Time Data Record.

The value line of the main page (H1->H#) shows the number of faults in the fault history. The location indication tells in which order the faults have shown. The newest fault has the indication *H5.1*, the second newest *H5.2*, and so on. If there are 30 faults in the history, the next fault that shows removes the oldest one (*H5.30*) from the history.

See the different fault codes in the Faults and Alarms section.

8.6.2 Resetting the Fault History

The Fault History shows 30 latest faults at a time. Use these instructions to reset the history.

Procedure

1. To find the *Fault history* menu, scroll down in the main menu until the location indication *M5* shows on the first line of the display.
2. To go to the *Fault history* menu from the main menu, push the Menu button Right.

3. In the *Fault history* menu, push the [enter] button for 3 s.

➡ The symbol H# changes to *0*.

8.7 Using the System Menu (M6)

8.7.1 Finding the System Menu

The System menu includes the general settings of the AC drive. These are, for example, application selection, parameter sets and information about the hardware and software. The number of submenus and subpages shows as the symbol S# (or P#) on the value line.

Procedure

1. To find the System menu, scroll down in the main menu until the location indication *M6* shows on the first line of the display.
2. To go to the System menu from the main menu, push the Menu button Right.

➡
```
        ☎              READY
   M6            I/O term

   System Menu
        S1➜S11 →
```
e30bg037.10
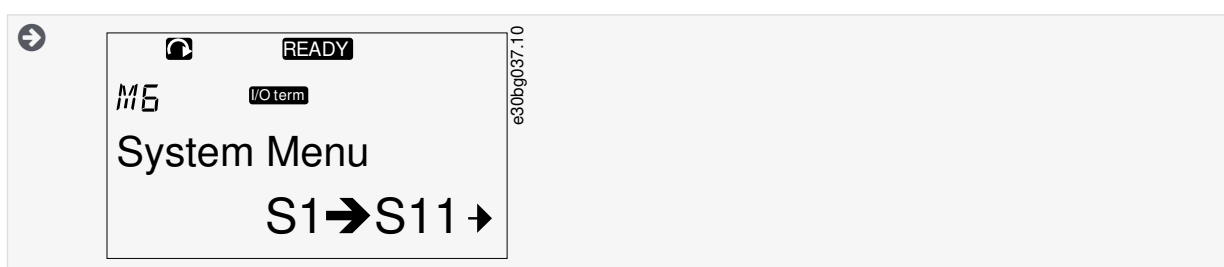
8.7.2 System Menu Functions

Table 23: System Menu Functions

Code	Function	Min	Max	Unit	Default	Cust	Description
S6.1	Language selection	–	–	–	English		The selection is different in all the language packages
S6.2	Application selection	–	–	–	Basic application		Basic application Standard application Local/Remote control appl. Multi-Step application PID Control application Multi-Purpose Control appl. Pump and Fan Control appl.
S6.3	Copy parameters	–	–	–	–		–
S6.3.1	Parameter sets	–	–	–	–		Store set 1 Load set 1 Store set 2 Load set 2 Load factory defaults
S6.3.2	Load up to keypad	–	–	–	–		All parameters
S6.3.3	Load down from keypad	–	–	–	–		All parameters All but motor parameters

Code	Function	Min	Max	Unit	Default	Cust	Description
							Application parameters
P6.3.4	Parameter back-up	–	–	–	Yes		Yes No
S6.4	Compare parameters	–	–	–	–		–
S6.4.1	Set1	–	–	–	Not used		–
S6.4.2	Set 2	–	–	–	Not used		–
S6.4.3	Factory settings	–	–	–	–		–
S6.4.4	Keypad set	–	–	–	–		–
S6.5	Security	–	–	–	–		–
S6.5.1	Password	–	–	–	Not used		0 = Not used
P6.5.2	Parameter lock	–	–	–	Change Ena-bled		Change Enabled Change Disabled
S6.5.3	Start-up wizard	–	–	–	–		No Yes
S6.5.4	Multimonitoring items	–	–	–	–		Change Enabled Change Disabled
S6.6	Keypad settings	–	–	–	–		–
P6.6.1	Default page	–	–	–	–		–
P6.6.2	Default page/ Operating menu	–	–	–	–		–
P6.6.3	Timeout time	0	65535	s	30		–
P6.6.4	Contrast	0	31	–	18		–
P6.6.5	Backlight time	Always	65535	min	10		–
S6.7	Hardware settings	–	–	–	–		–
P6.7.1	Internal brake resistor	–	–	–	Connected		Not connected Connected
P6.7.2	Fan control	–	–	–	Continuous		Continuous Temperature First start Calc temp
P6.7.3	HMI acknowledg. timeout	200	5000	ms	200		–

Code	Function	Min	Max	Unit	Default	Cust	Description
P6.7.4	HMI number of retries	1	10	–	5		–
P6.7.5	Sine filter	–	–	–	Connected		Not connected Connected
S6.8	System information	–	–	–	–		–
S6.8.1	Total counters	–	–	–	–		–
C6.8.1.1	MWh counter	–	–	kWh	–		–
C6.8.1.2	Power On day counter	–	–	–	–		–
C6.8.1.3	Power On hours counter	–	–	hh:mm: ss	–		–
S6.8.2	Trip counters	–	–	–	–		–
T6.8.2.1	MWh counter	–	–	kWh	–		–
T6.8.2.2	Clear MWh trip counter	–	–	–	–		–
T6.8.2.3	Operating days trip counter	–	–	–	–		–
T6.8.2.4	Operating hours trip counter	–	–	hh:mm: ss	–		–
T6.8.2.5	Clear operating time counter	–	–	–	–		–
S6.8.3	Software info	–	–	–	–		–
S6.8.3.1	Software package	–	–	–	–		–
S6.8.3.2	System software version	–	–	–	–		–
S6.8.3.4	System load	–	–	–	–		–
S6.8.4	Applications	–	–	–	–		–
S6.8.4.#	Name of application	–	–	–	–		–
D6.8.4.#. 1	Application ID	–	–	–	–		–
D6.8.4.#. 2	Applications: Version	–	–	–	–		–
D6.8.4.#. 3	Applications: Firmware inter-face	–	–	–	–		–
S6.8.5	Hardware	–	–	–	–		–
I6.8.5.1	Info: Power unit type code	–	–	–	–		–
I6.8.5.2	Info: Unit voltage	–	–	–	–		–

Code	Function	Min	Max	Unit	Default	Cust	Description
I6.8.5.3	Info: Brake chopper	–	–	–	–		–
I6.8.5.4	Info: Brake resistor	–	–	–	–		–
S6.8.6	Expander boards	–	–	–	–		–
S6.8.7	Debug menu	–	–	–	–		For Application programming only. Speak to the factory to get instructions.

8.7.3 Changing the Language

Use these instructions to change the language of the control panel. The possible languages are different in all language packages.

Procedure

1. In the *System* menu (*M6*), find the *Language* selection page (*S6.1*) with the Browser buttons.
2. To go to the edit mode, push the Menu button Right.

> ➡ The name of the language starts to blink.

3. To select the language for the control panel texts, use the Menu buttons Up and Down.
4. To accept the selection, push the [enter] button.

> ➡ The name of the languages stops to blink and all text information on the control panel shows in the selected language.

8.7.4 Changing the Application

The application can be changed in the *Application* selection page (*S6.2*). When the application is changed, all parameters are reset. For more information on the Application Package, see VACON®NX All in One Application Manual.

Procedure

1. In the *System* menu (*M6*), find the Application selection page (*S6.2*, *Application*) with the Browser buttons.
2. Push the Menu button Right.
3. To go to the edit mode, push the Menu button Right.

> ➡ The name of the application starts to blink.

4. Scroll through the applications with the Browser buttons and select a different application.
5. To accept the selection, push the [enter] button.

> ➡ The AC drive starts again and goes through the set-up.

6. When the display shows the question *Copy parameters?*, there are 2 options:

> This question shows only if the parameter *P6.3.4 Parameter back-up* is set to *Yes*.

   - To upload the parameters of the new application to the control panel, select *Yes* with the Browser buttons.
   - To keep the parameters of the application that was last used in the control panel, select *No* with the Browser buttons.

8.7.5 Copy Parameters (S6.3)

Use this function to copy parameters from one AC drive to a different AC drive or to save parameter sets in the internal memory of the AC drive.

Stop the AC drive before copying or downloading parameters.

8.7.5.1 Saving Parameter Sets (Parameter Sets S6.3.1)

Use this function to get the factory default values back or save 1–2 customized parameter sets. A parameter set includes all parameters of the application.

Procedure

1. In the Copy parameters (*S6.3*) subpage, find the *Parameter sets* (*S6.3.1*) with the Browser buttons.
2. Push the Menu button Right.
3. To go to the edit mode, push the Menu button Right.

   ➡   The text *LoadFactDef* starts to blink.

4. There are 5 options to select from. Select the function with the Browser buttons.

   - Select *LoadFactDef* to download again the factory default values.

   - Select *Store set 1* to save actual values of all parameters as set 1.

   - Select *Load set 1* to download the values in set 1 as the actual values.

   - Select *Store set 2* to save actual values of all parameters as set 2.

   - Select *Load set 2* to download the values in set 2 as the actual values.

5. To accept the selection, push the [enter] button.
6. Wait until *OK* shows on the display.

8.7.5.2 Uploading Parameters to Control Panel (Up To Keypad, S6.3.2)

Use this function to upload all parameter groups to the control panel when the AC drive is stopped.

Procedure

1. In the Copy parameters (*S6.3*) subpage, find the *Up to keypad* page (*S6.3.2*).
2. Push the Menu button Right.
3. To go to the edit mode, push the Menu button Right.

   ➡   *All param.* starts to blink.

4. To accept the selection, push the [enter] button.
5. Wait until *OK* shows on the display.

8.7.5.3 Downloading Parameters to Drive (Down From Keypad, S6.3.3)

Use this function to download 1 or all parameter groups from the control panel to an AC drive when the AC drive is stopped.

Procedure

1. In the Copy parameters (*S6.3*) subpage, find the *Down from keypad* page (*S6.3.3*).
2. Push the Menu button Right.
3. To go to the edit mode, push the Menu button Right.
4. Use the Browser buttons to select 1 of these 3 options:

   - All parameters (*All param.*)

   - All parameters but the motor nominal value parameters (*All. no motor*)

   - Application parameters

5. To accept the selection, push the [enter] button.
6. Wait until *OK* shows on the display.

8.7.5.4 Activating or Deactivating the Automatic Parameter Back-up (P6.3.4)

Use these instructions to activate or deactivate the parameter back-up.

When the application is changed, the parameters in the parameter settings on page S6.3.1 are deleted. To copy parameters from one application to a different application, first upload them to the control panel.

Procedure

1. In the Copy parameters (*S6.3*) subpage, find the Automatic parameter back-up page (*S6.3.4*).
2. To go to the edit mode, push the Menu button Right.
3. There are 2 options:
   - To activate the Automatic parameter back-up, select *Yes* with the Browser buttons.
   - To deactivate the Automatic parameter back-up, select *No* with the Browser buttons.

When the Automatic parameter back-up is active, the control panel makes a copy of the parameters of the application. Each time a parameter is changed, the keypad back-up is automatically updated.

8.7.5.5 Comparing the Parameters

Use the Parameter comparison submenu (*S6.4*, *Param.Comparison*) to compare the actual parameter values to the values of the customized parameter sets and those uploaded to the control panel. The actual values can be compared to Set 1, Set 2, Factory Settings, and Keypad Set.

Procedure

1. In the Copy parameters (*S6.3*) subpage, find the Comparing parameters submenu with the Browser buttons.
2. Push the Menu button Right.

   > The actual parameter values are first compared to those of the customized parameter Set 1. If no differences are found, *0* shows on the bottom line. If there are differences, the display shows the number of the differences (for example, *P1->P5* = 5 different values).

3. To compare the values to a different set, use the Browser buttons.
4. To go to the page with the parameter values, push the Menu button Right.

   > In the display that opens, check the values on different lines:
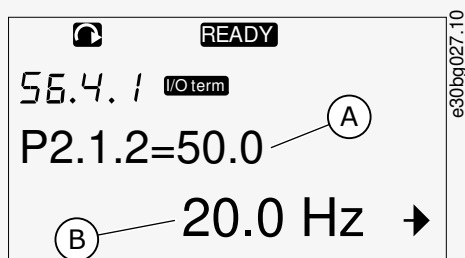
Illustration 73: Parameter Values in Parameter Comparison

A	Value of the selected set
B	Actual value

5. To go to the edit mode, push the Menu button Right.

   > The actual value starts to blink.

6. To change the actual value, use the Browser buttons, or change the value digit by digit with the Menu button Right.

8.7.6 Security

8.7.6.1 Finding the Security Menu

The Security menu is password protected. Use it to handle passwords, start-up wizards, and multimonitoring items, and to lock parameters.

Procedure

1. To find the *Security* submenu, scroll down in the *System* menu until the location indication *S6.5* shows on the first line of the display.
2. To go to the *Security* submenu from the *System* menu, push the Menu button Right.

8.7.6.2 Passwords

To prevent unauthorized changes in the application selection, use the Password function (*S6.5.1*). By default, the password is not active.

N O T I C E
Keep the password in a safe location!

8.7.6.3 Setting a Password

Set a password to protect the application selection menu.

N O T I C E
Keep the password in a safe location! The password cannot be changed if a valid password is not available.

Procedure

1. In *Security* submenu, push the Menu button Right.
2. To go to the edit mode, push the Menu button Right.

   ➡ The display shows *0* that blinks.

3. There are 2 options to set a password: with the Browser buttons or by digits. The password can be a number between 1 and 65535.

   - With the Browser buttons: Push the Browser buttons Up and Down to find a number.

   - By digits: Push the Menu button Right. A second *0* shows on the display.

      Push the Browser buttons to set digit on the right.

      Push the Menu button Left, and set the digit on the left.

      To add a third digit, push the Menu button Left. Set up to 5 digits with Menu and Browser buttons and set the digit for each one with the Browser buttons.

4. To accept the new password, push the [enter] button.

The password activates after the Timeout time (P6.6.3) (see 8.7.7.4 Setting the Timeout Time).

8.7.6.4 Entering a Password

In a password-protected submenu, the display shows *Password?* Use these instructions to enter the password.

Procedure

1. When the display shows *Password?*, give the password with the Browser buttons.

8.7.6.5 Deactivating the Password Function

Use these instructions to deactivate the password protection for application selection menu.

Procedure

1. Find the *Password* (*S6.5.1*) in the *Security* menu with the Browser buttons.
2. To go to the edit mode, push the Menu button Right.
3. Set value *0* for the password.

8.7.6.6 Locking a Parameter

Use the Parameter lock function to prevent changes to the parameters. If the parameter lock is active, the text *locked* shows on the display when trying to edit a parameter value.

N O T I C E
This function does not prevent unauthorized changes of parameter values.

Procedure

1. In the *Security* menu (*M6*), find the Parameter lock (*P6.5.2*) with the Browser buttons.
2. To go to the edit mode, push the Menu button Right.

3. To change the parameter lock status, use the Browser buttons.

4. To accept the change, push the [enter] button.

8.7.6.7 Start-up Wizard (P6.5.3)

The start-up wizard helps in the commissioning of the AC drive. By default, the start-up wizard is active.

In the start-up wizard, this information is set:

- the language

- the application

- the values for a set of parameters that are same to all applications

- the values for a set of application-specific parameters.

The table lists the functions of the keypad buttons in the start-up wizard.

Action	Button
Accepting a value	[enter] button
Scrolling for options	Browser buttons Up and Down
Changing a value	Browser buttons Up and Down

8.7.6.8 Activating/Deactivating the Start-up Wizard

Use these instructions to activate or deactivate the Start-up Wizard function.

Procedure

1. In the *System* menu (*M6*), find the page *P6.5.3*.

2. To go to the edit mode, push the Menu button Right.

3. Select the action:

   - To activate the start-up wizard, select *Yes* with the Browser buttons.

   - To deactivate the start-up wizard, select *No* with the Browser buttons.

4. To accept the selection, push the [enter] button.

8.7.6.9 Enabling/Disabling the Change of Multimonitoring Items

Use Multimonitoring to monitor up to 3 actual values at the same time (see 8.2 Using the Monitoring Menu (M1) and the chapter Monitored values in the Application Manual of your application).

Use these instructions to enable the change when changing the values that are monitored with other values.

Procedure

1. In the *Security* submenu, find Multimonitoring items page (*P6.5.4*, *Multimon. items*) with the Browser buttons.

2. To go to the edit mode, push the Menu button Right.

   ⊙ *Change Enabled* starts to blink.

3. Use Browser buttons Up and Down to select *Change Enabled* or *Change Disabled*.

4. Accept the selection with the [enter] button.

8.7.7 Keypad Settings

8.7.7.1 Finding the Keypad Settings Menu

Use the Keypad settings submenu in the System menu for making changes in the control panel.

In the submenu, there are 5 pages (P#) that control the panel operation:

- *Default page* (*P6.6.1*)

- *Default page/Operating menu* (*P6.6.2*)

- *Timeout time* (*P6.6.3*)

- *Contrast adjustment* (*P6.6.4*)

- *Backlight time* (*P6.6.5*)

Procedure

1. In the *System* menu (*M6*), find the *Keypad settings* submenu (*S6.6*) with the Browser buttons.

8.7.7.2 Changing the Default Page

Use the Default page to set the location (page) to which the display automatically moves after the Timeout time or after the panel is set on.

For more information on the timeout time, see 8.7.7.4 Setting the Timeout Time.

If the Default Page value is 0, the function is not activated. When the Default page is not used, the control panel shows the page that was last showed on the display.

Procedure

1. In the *Keypad settings* submenu, find the *Default page* subpage (*P6.6.1*) with the Browser buttons.

2. To go to the edit mode, push the Menu button Right.

3. To change the number of the main menu, use the Browser buttons.

4. To edit the number of the submenu/page, push the Menu button Right. Change the number of the submenu/page with the Browser buttons.

5. To edit the third level page number, push the Menu button Right. Change the number of the third level page with the Browser buttons.

6. To accept the new default page value, push the [enter] button.

8.7.7.3 Default Page in the Operating Menu (P6.6.2)

Use this submenu to set the default page in the Operating menu. The display automatically moves to the set page after the Timeout time (see 8.7.7.4 Setting the Timeout Time) or after the control panel is set on. For instructions, see 8.7.7.2 Changing the Default Page.

The Operating menu is only available in special applications.

8.7.7.4 Setting the Timeout Time

The Timeout time sets the time after which the control panel display goes back to the *Default page* (*P6.6.1*), see 8.7.7.2 Changing the Default Page.

If the Default page value is 0, the Timeout time setting has no effect.

Procedure

1. In the *Keypad settings* submenu, find the *Timeout time* subpage (*P6.6.3*) with the Browser buttons.

2. To go to the Edit mode, push the Menu button Right.

3. To set the timeout time, use the Browser buttons.

4. To accept the change, push the [enter] button.

8.7.7.5 Contrast Adjustment (P6.6.4)

If the display is not clear, adjust its contrast with the same procedure as the one for the timeout time setting, see 8.7.7.4 Setting the Timeout Time.

8.7.7.6 Backlight Time (P6.6.5)

It is possible to set the time that the backlight stays on until it goes off. Select a value between 1 and 65535 minutes or *Forever*. For instructions on how to change the value, see 8.7.7.4 Setting the Timeout Time.

8.7.8 Hardware Settings

8.7.8.1 Finding the Hardware Setting Menu

Use the Hardware settings submenu (*S6.7*, *HW settings*) in the *System* menu to control these functions of the hardware in the AC drive:

- Internal brake resistor connection, *InternBrakeRes*

- *Fan control*

- HMI acknowledge timeout, *HMI ACK timeout*

- *HMI retry*

- Sine filter

- Pre-charge mode.

Use a password to go the Hardware settings submenu, see 8.7.6.2 Passwords.

Procedure

1. To find the Hardware settings submenu, scroll down in the *System* menu until the location indication *S6.7* shows on the first line of the display.
2. To go to the Hardware settings submenu from the *System* menu, push the Menu button Right.

8.7.8.2 Setting the Internal Brake Resistor Connection

Use this function to tell the AC drive if the internal brake resistor is connected or not.

If the AC drive has an internal brake resistor, the default value of this parameter is *Connected*. We recommend changing this value to *Not conn.* if:

- it is necessary to install an external brake resistor to increase the braking capacity

- the internal brake resistor is disconnected for some reason.

The brake resistor is available as optional equipment for all sizes. It can be installed internally in enclosure sizes FR4 to FR6.

Procedure

1. In the Hardware settings submenu, find the Internal brake resistor connection (*P6.7.1*) subpage with the Browser buttons.
2. To go to the edit mode, push the Menu button Right.
3. To change the internal brake resistor status, use the Browser buttons.
4. To accept the change, push the [enter] button.

8.7.8.3 Fan Control

Use this function to control the cooling fan of the AC drive. There are 4 options to select from:

- *Continuous* (default setting). The fan is always on when the power is on.

- *Temperature*. The fan starts automatically when the heat sink temperature goes to 60 °C (140 °F) or when the AC drive operates. The fan stops about a minute after one of the following:

  - the heat sink temperature falls to 55 °C (131 °F)

  - the AC drive stops

  - the fan control value is changed from *Continuous* to *Temperature*

- *First start*. When power is on, the fan is in the stop state. When the AC drive gets the first start command, the fan starts.

- *Calc temp*. The fan function agrees to the calculated IGBT temperature:

  - If the IGBT temperature is more than 40 °C (104 °F), the fan starts.

  - If the IGBT temperature is below 30 °C (86 °F), the fan stops.

As the default temperature at power-up is 25 °C (77 °F), the fan does not start immediately.

For instructions, see 8.7.8.4 Changing the Fan Control Settings.

8.7.8.4 Changing the Fan Control Settings

Use these instructions to change the Fan Control Settings.

Procedure

1. In the Hardware settings submenu, find the *Fan control* settings (*P6.7.2*) with the Browser buttons.
2. To go to the edit mode, push the Menu button Right.

> ➡ The parameter value starts to blink.

3. To select the fan mode, use the Browser buttons.
4. To accept the change, push the [enter] button.

8.7.8.5 HMI Acknowledge Timeout (P6.7.3)

Use this function to change the timeout of the HMI acknowledgement time. Use this function when there is more delay in the RS232 transmission, for example, when internet connection is used for communication over longer distances.

If the AC drive is connected to the PC with a cable, do not change the default values of parameters P6.7.3 and P6.7.4 (200 and 5).

If the AC drive is connected to the PC with an internet connection and the messages are transferred with a delay, set the values for parameter P6.7.3 to agree these delays.

For instructions, see <u>8.7.8.6 Changing the HMI Acknowledge Timeout</u>.

Example

For example, if the transfer delay between the AC drive and the PC is 600 ms, make these settings:

- Set the value of parameter P6.7.3 to 1200 ms (2 x 600, sending delay + receiving delay)

- Set the [Misc]-part of the file NCDrive.ini to agree with the settings:

  - Retries = 5

  - AckTimeOut = 1200

  - TimeOut = 6000

Do not use intervals shorter than the AckTimeOut-time in the NC-Drive monitoring.

8.7.8.6 Changing the HMI Acknowledge Timeout

Use these instructions to change the HMI Acknowledge Timeout.

Procedure

1. In the Hardware settings submenu, find the HMI acknowledgement time (*HMI ACK timeout*) with the Browser buttons.
2. To go to the edit mode, push the Menu button Right.
3. To change the acknowledgement time, use the Browser buttons.
4. To accept the change, push the [enter] button.

8.7.8.7 Changing the Number of Retries to Receive HMI Acknowledgement (P6.7.4)

Use this parameter to set the number of times the AC drive tries to receive acknowledgement if it does not receive it during the acknowledgement time (P6.7.3) or if the received acknowledgement is defective.

Procedure

1. In the Hardware settings submenu, find the Number of retries to receive HMI acknowledgement (*P6.7.4*) with the Browser buttons.
2. To go to the edit mode, push the Menu button Right. The value starts to blink.
3. To change the number of retries, use the Browser buttons.
4. To accept the change, push the [enter] button.

8.7.8.8 Sine Filter (P6.7.5)

When using an old motor or a motor that was not made to be used with an AC drive, it can be necessary to use a sine filter. A sine filter makes the sine form of the voltage better than a dU/dt filter.

If a sine filter is used in the AC drive, set this parameter to *Connected* to put it into operation.

8.7.8.9 Pre-charge Mode (P6.7.6)

For an FI9 or a larger inverter unit, select *Ext.ChSwitch* to control an external charge switch.

8.7.9 System Info

8.7.9.1 Finding the System Info Menu

The *System info* submenu (*S6.8*) contains information on the hardware, software, and operation of the AC drive.

Procedure

1. To find the *System info* submenu, scroll down in the *System* menu until the location indication *S6.8* shows on the first line of the display.
2. To go to the *System info* submenu from the *System* menu, push the Menu button Right.

8.7.9.2 Total Counters (S6.8.1)

The *Total counters* page (*S6.8.1*) has information on the AC drive operation times. The counters show the total number of MWh, operation days, and operation hours. The Total counters cannot be reset.

The Power On time counter (days and hours) always counts, when the AC power is on. The counter does not count when control unit runs on +24 V only.

Table 24: Total Counters

Page	Counter	Example
C6.8.1.1.	MWh counter	
C6.8.1.2.	Power On day counter	Value on display is 1.013. The drive has operated for 1 year and 13 days.
C6.8.1.3	Power On hour counter	Value on display is 7:05:16. The drive has operated for 7 hours 5 minutes and 16 s.

8.7.9.3 Trip Counters (S6.8.2)

The *Trip counters* page (*S6.8.2*) has information on resettable counters, that is, counters, for which the value can be set back to *0*. The trip counters count only when the motor is in RUN state.

Table 25: Trip Counters

Page	Counter	Example
T6.8.2.1	MWh counter	–
T6.8.2.3	Operation day counter	Value on display is 1.013. The drive has operated for 1 year and 13 days.
T6.8.2.4	Operation hour counter	Value on display is 7:05:16. The drive has operated for 7 hours 5 minutes and 16 s.

8.7.9.4 Resetting the Trip Counters

Use these instructions to reset the trip counters.

Procedure

1. In the *System info* submenu, find the *Trip counters* page (*6.8.2*) with the Browser buttons.
2. To go to the Clear MWh counter page (*6.8.2.2*, *Clr MWh cntr*) or to the Clear Operation time counter page (*6.8.2.5*, *Clr Optime cntr*), use the Menu button Right.
3. To go to the edit mode, push the Menu button Right.
4. To select Reset, push Browser buttons Up and Down.
5. To accept the selection, push the [enter] button.
6. The display shows again *Not reset*.

8.7.9.5 Software (S6.8.3)

The Software information page includes information on the AC drive software.

Page	Content
6.8.3.1	Software package
6.8.3.2	System software version
6.8.3.3	Firmware interface
6.8.3.4	System load

8.7.9.6 Applications (S6.8.4)

The *Applications* submenu (*S6.8.4*) contains information on all applications on the AC drive.

Page	Content
6.8.4.#	Name of application
6.8.4.#.1	Application ID
6.8.4.#.2	Version
6.8.4.#.3	Firmware interface

8.7.9.7 Examining the Application Page

Use these instructions to examine the *Applications* pages.

Procedure

1. In the *System info* submenu, find the *Applications* page with the Browser buttons.
2. To go to the *Applications* page, push the Menu button Right.
3. To select the application, use the Browser buttons. There are as many pages as there are applications on the AC drive.
4. To go to the Information pages, use the Menu button Right.
5. To see the different pages, use the Browser buttons.

8.7.9.8 Hardware (S6.8.5)

The Hardware information page includes information on the AC drive hardware.

Page	Content
6.8.5.1	Power unit type code
6.8.5.2	Nominal voltage of the unit
6.8.5.3	Brake chopper
6.8.5.4	Brake resistor
6.8.5.5	Serial number

8.7.9.9 Checking the Status of an Option Board

The *Expander boards* pages give information about the basic and option boards connected to the control board. See 7.1 Control Unit Components for more information on the boards.

For more information on the parameters of the option boards, see 8.8.1 Expander Board Menu.

Procedure

1. In the *System info* submenu, find the *Expander boards* page (*6.8.6*) with the Browser buttons.
2. To go to the *Expander boards* page, push the Menu button Right.
3. To select the board, use the Browser buttons.

> ➡️ If no board is connected to the slot, the display shows *no board*.
>
> If a board is connected to a slot but there is no connection, the display shows *no conn.*.

4. To see the status of the board, push the Menu button Right.
5. To see the program version of the board, push the Browser button Up or Down.

8.7.9.10 Debug Menu (S6.8.7)

The Debug menu is for advanced users and application designers. Speak to the factory to get instructions, if it is necessary.

8.8 Using the Expander Board Menu

8.8.1 Expander Board Menu

The *Expander board* menu, that is, the menu for option board information, allows to:

• see which option boards are connected to the control board
• find and edit the option board parameters.

Table 26: Option Board Parameters (Board OPTA1)

Page	Parameter	Min	Max	Default	Cust	Selections
P7.1.1.1	AI1 mode	1	5	3		1 = 0–20 mA 2 = 4–20 mA 3 = 0–10 V 4 = 2–10 V 5 = –10…+10 V
P7.1.1.2	AI2 mode	1	5	1		See P7.1.1.1
P7.1.1.3	AO1 mode	1	4	1		1 = 0–20 mA 2 = 4–20 mA 3 = 0–10 V 4 = 2–10 V

8.8.2 Examining the Connected Option Boards

Use these instructions to examine the connected option boards.

Procedure

1. To find the *Expander board* menu, scroll down in the main menu until the location indication *M7* shows on the first line of the display.
2. To go to the *Expander board* menu from the main menu, push the Menu button Right.
3. To examine the list of connected option boards, use the Browser buttons Up and Down.
4. To see the information on the option board, push the Menu button Right.

8.8.3 Finding the Option Board Parameters

Use these instructions to check the values of the option board parameters.

Procedure

1. Find the option board with the Browser and Menu buttons in the *Expander Board Menu*.
2. To see the information on the option board, push the Menu button Right. For instructions on how to examine the connected option boards, see 8.8.2 Examining the Connected Option Boards.
3. To scroll to the Parameters use the Browser buttons Up and Down.
4. To examine the parameter list, push the Menu button Right.
5. To scroll through the parameters, use the Browser buttons Up and Down.
6. To go to the edit mode, push the Menu button Right. For instructions on how to edit the parameter values, see 8.3.2 Selecting Values and 8.3.3 Editing the Values Digit by Digit.

8.9 Further Control Panel Functions

The VACON® NX control panel has more application-related functions. See VACON® NX Application Package for more information.

9 Commissioning

9.1 Safety Checks before Starting the Commissioning

Before starting the commissioning, read these warnings.

> **⚠ D A N G E R ⚠**
>
> **SHOCK HAZARD FROM POWER UNIT COMPONENTS**
>
> The power unit components are live when the drive is connected to mains. A contact with this voltage can lead to death or serious injury.
>
> – Do not touch the components of the power unit when the drive is connected to mains. Before connecting the drive to mains, make sure that the covers of the drive are closed.

> **⚠ D A N G E R ⚠**
>
> **SHOCK HAZARD FROM TERMINALS**
>
> The motor terminals U, V, W, the brake resistor terminals, or the DC terminals are live when the drive is connected to mains, also when the motor does not operate. A contact with this voltage can lead to death or serious injury.
>
> – Do not touch the motor terminals U, V, W, the brake resistor terminals, or the DC terminals when the drive is connected to mains. Before connecting the drive to mains, make sure that the covers of the drive are closed.

> **⚠ D A N G E R ⚠**
>
> **SHOCK HAZARD FROM DC LINK OR EXTERNAL SOURCE**
>
> The terminal connections and the components of the drive can be live 5 minutes after the drive is disconnected from the mains and the motor has stopped. Also the load side of the drive can generate voltage. A contact with this voltage can lead to death or serious injury.
>
> – Before doing electrical work on the drive:
>   Disconnect the drive from the mains and make sure that the motor has stopped.
>   Lock out and tag out the power source to the drive.
>   Make sure that no external source generates unintended voltage during work.
>   Wait 5 minutes before opening the cabinet door or the cover of the AC drive.
>   Use a measuring device to make sure that there is no voltage.

> **⚠ W A R N I N G ⚠**
>
> **SHOCK HAZARD FROM CONTROL TERMINALS**
>
> The control terminals can have a dangerous voltage also when the drive is disconnected from mains. A contact with this voltage can lead to injury.
>
> – Make sure that there is no voltage in the control terminals before touching the control terminals.

9.2 Commissioning the AC Drive

Follow these instructions to commission the AC drive.

Read the safety instructions in 2.2 Danger and Warnings and 9.1 Safety Checks before Starting the Commissioning and obey them.

Procedure

1. Make sure that the motor is installed correctly.
2. Make sure that the motor is not connected to mains.
3. Make sure that the AC drive and the motor are grounded.

4. Make sure to select the mains cable, the brake cable, and the motor cable correctly.

> For information on cable selections, see:
> - [6.1.3 Cable Selection and Dimensioning](#) and related tables
> - [6.1 Cable Connections](#)
> - [6.2 EMC-compliant Installation](#)

5. Make sure that the control cables are sufficiently far from the power cables. See [6.7.1 Additional Instructions for Cable Installation](#).

6. Make sure that the shields of the shielded cables are connected to a grounding terminal that is identified with the grounding symbol.

7. Do a check of the tightening torques of all the terminals.

8. Make sure that no power correction capacitors are connected to the motor cable.

9. Make sure that the cables do not touch the electrical components of the drive.

10. Make sure that the common input +24 V is connected to an external power source and the ground of the digital input is connected to ground of the control terminal.

11. Do a check of the quality and quantity of the cooling air.

> For further information on cooling requirements, see:
> - [5.2 Cooling Requirements](#)
> - [12.10 VACON® NXP IP00 Drive Modules Technical Data](#)

12. Make sure that there is no condensation on the surfaces of the AC drive.

13. Make sure that there are no unwanted objects in the installation space.

14. Before connecting the drive to mains, do a check of the installation and the condition of all the fuses (see [12.4 Cable and Fuse Sizes](#)) and other protective devices.

9.3 Measuring the Cable and Motor Insulation

Do these checks if necessary.

NOTE! AC drive is already measured at the factory.

- The insulation checks of the motor cable, see [9.3.1 Insulation Checks of the Motor Cable](#)

- The insulation checks of the mains cable, see [9.3.2 Insulation Checks of the Mains Cable](#)

- The insulation checks of the motor, see [9.3.3 Insulation Checks of the Motor](#)

9.3.1 Insulation Checks of the Motor Cable

Use these instructions to check the insulation of the motor cable.

Procedure

1. Disconnect the motor cable from the terminals U, V, and W and from the motor.

2. Measure the insulation resistance of the motor cable between phase conductors 1 and 2, between phase conductors 1 and 3, and between phase conductors 2 and 3.

3. Measure the insulation resistance between each phase conductor and the grounding conductor.

4. The insulation resistance must be >1 MΩ at the ambient temperature of 20 °C (68 °F).

9.3.2 Insulation Checks of the Mains Cable

Use these instructions to check the insulation of the mains cable.

Procedure

1. Disconnect the mains cable from the terminals L1, L2, and L3 and from mains.

2. Measure the insulation resistance of the mains cable between phase conductors 1 and 2, between phase conductors 1 and 3, and between phase conductors 2 and 3.

3. Measure the insulation resistance between each phase conductor and the grounding conductor.

4. The insulation resistance must be >1 MΩ at the ambient temperature of 20 °C (68 °F).

9.3.3 Insulation Checks of the Motor

Use these instructions to check the insulation of the motor.

> **N O T I C E**
>
> Obey the instructions of the motor manufacturer.

Procedure

1. Disconnect the motor cable from the motor.
2. Open the bridging connections in the motor connection box.
3. Measure the insulation resistance of each motor winding. The voltage must be the same or higher than the motor nominal voltage, but at least 1000 V.
4. The insulation resistance must be >1 MΩ at the ambient temperature of 20 °C (68 °F).
5. Connect the motor cables to the motor.
6. Do the final insulation check on the drive side. Put all phases together and measure to the ground.
7. Connect the motor cables to the drive.

9.4 Checks after Commissioning

9.4.1 Testing the AC Drive after Commissioning

Before starting the motor, do these checks.

- Before the tests, make sure that it is safe to do each test.
- Make sure that the other workers near know about the tests.

Procedure

1. Make sure that all the START and STOP switches that are connected to the control terminals are in the STOP position.
2. Make sure that the motor can be started safely.
3. Set the parameters of group 1 (see VACON™ NX All in One Application Manual) to agree with the requirements of the used application. To find the necessary values for the parameters, see the motor nameplate.
   Set these parameters at a minimum:

   - Motor nominal voltage
   - Motor nominal frequency
   - Motor nominal speed
   - Motor nominal current
   - Motor cos phi

4. Set the maximum frequency reference (that is, the maximum speed of the motor) to agree with the motor and the device that is connected to the motor.
5. Do the following tests in this order:
   - **a.** RUN test without the load, see 9.4.2 RUN Test without Load
   - **b.** Start-up test, see 9.4.3 Start-up Test
   - **c.** Identification run, see 9.4.4 Identification Run

9.4.2 RUN Test without Load

Do either Test A or Test B.

- Test A: Controls from the control terminals
- Test B: Control from the control panel

9.4.2.1 Test A: Controls from the Control Terminals

Do this RUN test when the control mode is I/O terminals.

Procedure

1. Turn the Start/Stop switch to ON position.
2. Change the frequency reference (potentiometer).

3. Do a check in the Monitoring menu *M1* that the value of output frequency changes the equivalent quantity to the frequency reference.

4. Turn the Start/Stop switch to OFF position.

9.4.2.2 Test B: Control from the Keypad

Do this RUN test when the control mode is keypad.

Procedure

1. Change the control from the control terminals to the keypad. For the instructions, see 8.4.3 Changing the Control Mode.

2. Push the Start button on the control panel.

3. Go to the Keypad control menu (*M3*) and *Keypad Reference* submenu (see 8.4.4 Keypad Reference). To change the frequency reference, use the Browser buttons.

4. Do a check in the Monitoring menu *M1* that the value of output frequency changes the equivalent quantity to the frequency reference.

5. Push the Stop button on the control panel.

9.4.3 Start-up Test

Do the start-up tests without the load, if possible. If this is not possible, make sure that it is safe to do each test before doing it. Make sure that the other workers near know about the tests.

Procedure

1. Make sure that all Start/Stop switches are in Stop positions.

2. Turn the mains switch ON.

3. Check the rotation direction of the motor.

4. If close loop control is used, make sure that the encoder frequency and direction are the same as the motor direction and frequency.

5. Do again the Run test A or B, see 9.4.2 RUN Test without Load.

6. If the motor was not connected in the start-up test, connect the motor to the process.

7. Make the identification run without the motor running. If close loop control is used, make the identification run with the motor running. See 9.4.4 Identification Run.

9.4.4 Identification Run

The Identification Run helps to tune the motor and the drive-related parameters. It is a tool to be used in commissioning to find the best possible parameter values for most drives. The automatic motor identification calculates or measures the necessary motor parameters for the best possible motor and speed control. For more information on the Identification Run, see VACON® NX All in One Application Manual, parameter ID631.

9.5 Motor Run Checklist

Do these checks before starting the motor.

Procedure

1. Check that the motor is mounted properly and ensure that the machine connected to the motor allows the motor to be started.

2. Set the maximum frequency reference (that is, the maximum speed of the motor) according to the motor and the device that is connected to the motor.

3. Before reversing the motor, make sure it can be done safely.

4. Make sure that no power correction capacitors are connected to the motor cable.

5. Make sure that the motor terminals are not connected mains potential.

10 Maintenance

10.1 Preventive Maintenance Recommendations

Generally, all technical equipment, including Danfoss AC Drives need a minimum level of preventive maintenance. Regular maintenance is recommended to ensure trouble-free operation and long life of the drive. It is also recommended, as a good service practice to record a maintenance log with counter values, date, and time describing the maintenance and service actions.

Danfoss recommends the following inspections and service intervals for VACON®NXP family drive/system.

NOTE: The service schedule for part replacements may vary depending on operation conditions. Under specific conditions, the combination of stressful operating and environment conditions work together to significantly reduce the lifetime of the components. These conditions can include, for example, extreme temperature, dust, high humidity, hours of use, corrosive environment, and loading.

For operation in stressful conditions, Danfoss offers the DrivePro® Preventive Maintenance service. DrivePro® services extend the lifetime and increase the performance of the product with scheduled maintenance including customized part replacements. Drive-Pro® services are tailored to your application and operating conditions.

Table 27: Maintenance Schedule for Air-cooled Drives

Component	Inspection interval[1]	Service schedule[2]	Preventive maintenance actions
Installation			
Visual drive inspection	1 year	–	Check for the unusual, for example, for signs of overheating, aging, corrosion, and for dusty and damaged components.
Auxiliary equipment	1 year	According to manufacturer recommendations	Inspect equipment, switchgear, relays, disconnects or fuses/circuit breakers. Examine the operation and condition for possible causes of operational faults or defects. The continuity check on fuses is performed by trained service personnel.
EMC consideration	1 year	–	Inspect the installation wiring regarding the electromagnetic capability and the separation distance between control wiring and power cables.
Cable routing	1 year	–	Check for parallel routing of motor cables, mains wiring, and signal wiring. Parallel routing must be avoided. Avoid routing cables through free air without support. Check for aging and wearing of the cable insulation.
Control wiring	1 year	–	Check for tightness, damaged or crimped wires or ribbon wires. The connections should be terminated correctly with solid crimped ends. The use of screened cables and earthed EMC plate, or a twisted pair is recommended.
Proper clearances	1 year	–	Check that the required external clearances for proper airflow for cooling are followed according to the frame designation and drive type of the drive. For clearances, refer to the local design regulations.
Seals condition	1 year	–	Check that the seals of the enclosure, the covers, and the cabinet doors are in good condition.
Corrosive environments	1 year	–	Conductive dust and aggressive gases, such as sulphide, chloride, salt mist, and so on, can damage the electrical and mechanical components. Air filters will not remove airborne corrosive chemicals. Act based on findings.
Drive			
Programming	1 year	–	Check that the AC drive parameter settings are correct according to the motor, drive application, and I/O configuration. Only trained service personnel may perform this action.
Control panel	1 year	–	Check that the display pixels are intact. Check the event log for warnings, alarms, and faults. Repetitive events are a sign of potential issues. Contact your local service center.

Component	Inspection interval[1]	Service schedule[2]	Preventive maintenance actions
Drive Cooling capacity	1 year	–	Check for blockages or constrictions in the air passages of the cooling channel. The heat sinks must be free of dust and condensation.
Capacitors, DC link	1 year	8–15+ years	The expected lifetime of the capacitors is dependent on the loading profile of the application and the environmental temperature. For applications with heavy loads in demanding environments or high ripple current, replace electrolytic capacitors every 8 years. If within specification of the drive type, replace every 10–15+ years. Only trained service personnel may perform this action.
Cleaning and Filters	1 year	–	The interior of the enclosure should be cleaned annually, and more frequently if necessary. The level of dust in the filter or inside the enclosure is an indicator for when the next cleaning or filter replacement is required.
Fans	1 year	5–10 years	Inspect the condition and operational status of all cooling fans. With the power off, the fan axis should feel tight, and spinning the fan with a finger, the rotation should be almost silent and not have abnormal rotation resistance. When in RUN mode, fan vibration, excessive or strange noise is a sign of the bearings wearing, and the fan should be replaced.
Grounding	1 year	–	The drive system requires a dedicated ground wire connecting the drive, the output filter, and the motor to the building ground. Check that the ground connections are tight and free of paint or oxidation. Daisy-chain connections are not allowed. Braided straps are recommended if applicable.
PCB	1 year	10–12 years	Visually inspect the PCBs for signs of damage or degrading due to aging, corrosive environments, dust, or environments with high temperatures. Only trained service personnel may perform the inspection and service action.
Power cables and wiring	1 year	–	Check for loose connections, aging, insulation condition, and proper torque to the drive connections. Check for proper rating of fuses and continuity check. Observe if there are any signs of operation in a demanding environment. For example, discoloration of the fuse housing may be a sign of condensation or high temperatures.
Vibration	1 year	–	Check for abnormal vibration or noise coming from the drive to ensure that the environment is stable for electronic components.
Insulator gaskets	1 year	10–15 years	Inspect the insulators for signs of degradation due to high temperature and aging. Replacement is based on findings or done at the same time as DC capacitor replacement. Only trained service personnel may perform this action.
Spare Parts			
Spare parts	1 year	2 years	Stock spares in their original boxes in a dry and clean environment. Avoid hot storage areas. Electrolytic capacitors require reforming as stated in the service schedule. The reforming is performed by trained service personnel. See 10.2 Reforming the Capacitors.
Exchange units and units stored for long periods before commissioning	1 year	2 years	Visually inspect for signs of damage, water, high humidity, corrosion, and dust within the visual field of view without disassembly. The exchange units with mounted electrolytic capacitors require reforming as stated in the service schedule. The reforming is performed by trained service personnel. See 10.2 Reforming the Capacitors.

¹ Defined as the time after the commissioning/start-up or the time from the previous inspection.

² Defined as the time after the commissioning/start-up or the time from the previous service schedule actions.

10.2 Reforming the Capacitors

The electrolytic capacitors in the DC link rely on a chemical process to provide the insulator between the two metal plates. This process can degrade over a period of years when the drive has been non-operational (stocked). The result is that the working voltage of the DC link gradually falls.

The correct course of action is to ensure that the insulation layer of the capacitor is 'reformed' by the application of a limited current using a DC supply. Current limiting ensures that the heat generated within the capacitor is kept at a sufficiently low level to prevent any damage.

> ⚠ **D A N G E R** ⚠
>
> **SHOCK HAZARD FROM CAPACITORS**
>
> The capacitors can be charged even when disconnected. Contact with this voltage can lead to death or serious injury.
>
> – If the AC drive or spare capacitors are intended to be stocked, discharge the capacitors before storage. Use a measuring device to make sure that there is no voltage. If in doubt, contact your Danfoss Drives representative.

Case 1: AC drive which has been non-operational or stocked for over 2 years.

1. Connect the DC supply to L1 and L2 **or** the B+/B terminals (DC+ to B+, DC- to B-) of the DC link or directly to the capacitor terminals. In the NX AC drives with no B+/B- terminals (FR8–FR9/FI8–FI9), connect the DC supply between 2 input phases (L1 and L2).
2. Set the current limit maximum to 800 mA.
3. Slowly increase the DC voltage to the nominal DC voltage level of the AC drive (1.35 x U_n AC).
4. Start to reform the capacitors.

The time of reforming depends on the time of storage. See Illustration 74.
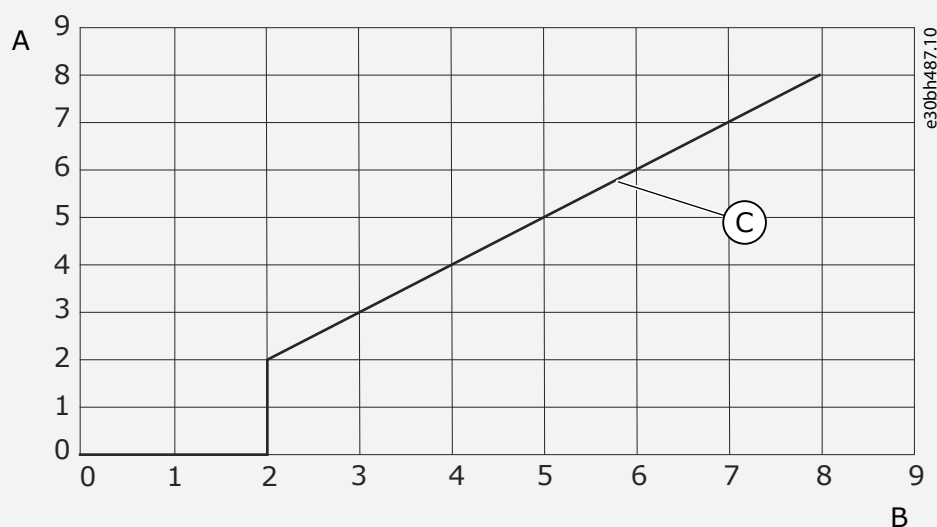
Illustration 74: Storage Time and Reforming Time

A	Storage time (years)	C	Reforming time
B	Reforming time (hours)		

5. After the reforming operation is done, discharge the capacitors.

Case 2: Spare capacitor which has been stocked for over 2 years.

1. Connect the DC supply to DC+/DC- terminals.
2. Set the current limit maximum to 800 mA.
3. Slowly increase the DC voltage to the capacitor nominal voltage level. See information from component or service documentation.
4. Start to reform the capacitors.

The time of reforming depends on the time of storage. See Illustration 74.

5. After the reforming operation is done, discharge the capacitors.

11 Fault Tracing

11.1 General Information on Fault Tracing

When the control diagnostics of the AC drive find an unusual condition in the operation of the drive, the drive shows this information:

- This information shows on the display (see 8.5.1 Finding the Active Faults Menu):

  - The location indication F1

  - The fault code, see the Faults and Alarms section

    For option board related fault codes, see the option board manual.

  - A short description of the fault

  - The fault type symbol, see Table 28

  - The *FAULT* or *ALARM* symbol

- The red LED on the control panel starts to blink (only when a fault shows).

If many faults show at the same time, examine the list of active faults with the Browser buttons.

In the VACON®NX AC drives, there are 4 different types of faults.

Table 28: Fault Types

Fault type symbol	Description
A (Alarm)	The type A fault (Alarm) tells about unusual operation on the drive. It does not stop the drive. The 'A fault' stays in the display for about 30 s.
F (Fault)	The type 'F fault' stops the drive. To start the drive again, find a solution to the problem.
AR (Fault Autoreset)	The type 'AR fault' stops the drive. The fault is reset automatically and the drive tries to start the motor again. If it cannot the start the motor again, a fault trip (see FT, Fault Trip) shows.
FT (Fault Trip)	If the drive cannot start the motor after an AR fault, an FT fault shows. The type 'FT fault' stops the AC drive.

The fault stays active until it is reset, see 11.2 Resetting a Fault. The memory of active faults can keep the maximum of 10 faults in the order in which they were shown.

Reset the fault with the [reset] button on the control panel, or through the control terminal, fieldbus, or the PC tool. The faults stay in the Fault history.

Before asking help from the distributor or the factory because of unusual operation, prepare some data. Write down all the texts on the display, the fault code, the source information, the Active Faults list, and the Fault History.

11.2 Resetting a Fault

The fault stays active until it is reset. Reset the fault using these instructions.

Procedure

1. Remove the external Start signal before resetting the fault to prevent that the drive starts again without a note.
2. There are 2 options to reset a fault:

   - Push the [reset] button on the control panel for 2 s.

   - Use a reset signal from the I/O terminal or fieldbus.

   > The display goes back to the same state it was before the fault.

11.3 Creating Service Info File

Use these instructions to create a service info file in VACON®NCDrive PC tool to help to troubleshoot in a fault situation.

Make sure the VACON®NCDrive PC tool is installed on the computer. To install it, go to our website http://drives.danfoss.com/downloads/portal/ .

Procedure

1. Open the VACON® NCDrive.

2. Go to *File* and select *Service Info...*.

   > ⮞ The service information file opens.

3. Save the service info file on the computer.

11.4 Error Message on Control Panel Display

The alphanumerical keypad memory has been upgraded from 32 kbit to 64 kbit in VACON® NX AC drives. This allows the applications with larger parameter sets to be copied to keypad memory. For more information on control panel display, see <u>3.6.2 Display</u>

If an application with larger parameter sets is uploaded into 32 kbit control panel, it shows an error message "Failed". A new control panel version with 64 kbit must be used to avoid the error message.

12 Specifications

12.1 Weights of the Units

Enclosure size	Weight [kg]	Weight [lb]
FR8	58.0	128
FR9	146	322
FR10	123	271
FR11	210	463
FR12	2*123	271
NXI	300	661
2*NXN	140	309
3*NXN	210	463

12.2 Weights of the AC Chokes

AC choke size	Weight [kg]	Weight [lb]
CHK0261	53	117
CHK0400	84	185
CHK0520	115	254
CHK0650	130	287

12.3 Dimensions

12.3.1 Mounting Dimensions, FR8–FR12
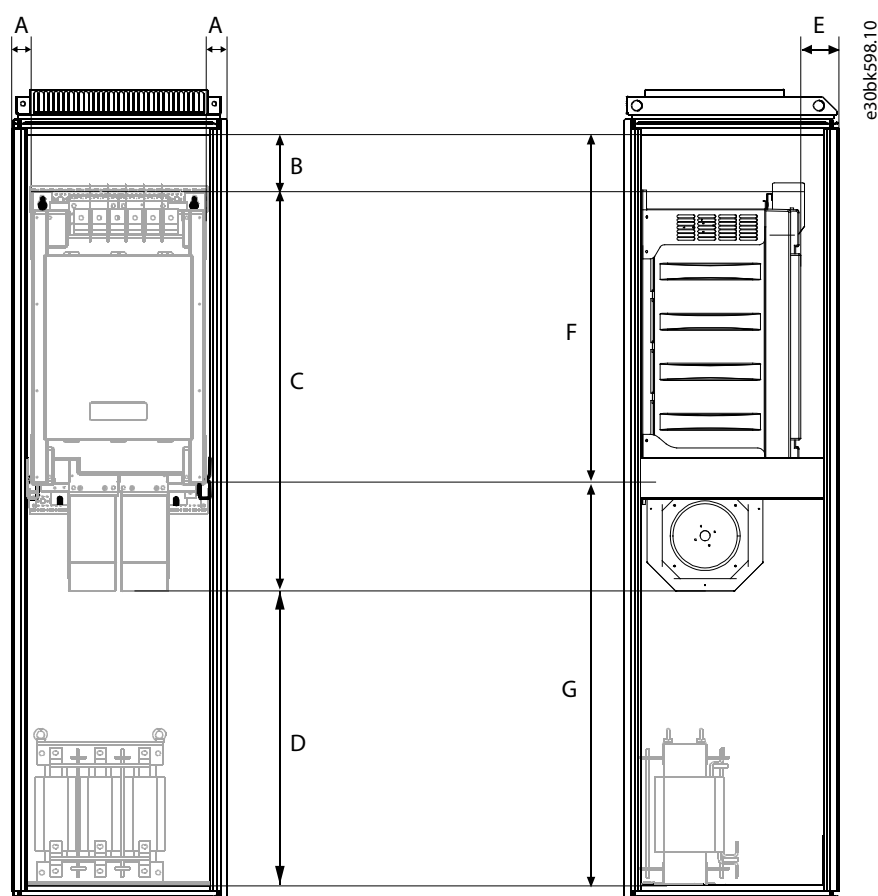
Illustration 75: Mounting Dimensions, FR8–FR12

A	Minimum distance to the side walls or adjacent components. **NOTE:** No clearance needed between the two cabinets in which the units of enclosure FR12 are mounted.	E	Minimum distance from the cabinet door. It enables the control unit to be installed in front of the power unit.
B	Minimum distance from the top of the cabinet. This space is needed for the power cables.	F	Minimum distance from the mounting rails to top of the cabinet.
C	Unit height	G	Minimum distance from the mounting rails to the bottom of the cabinet.
D	Minimum distance from the bottom of the enclosure if the AC choke is installed at the bottom of the enclosure.		

Table 29: Mounting Dimensions, mm

A	B	C	D	E	F	G
50	100	1120	550 (290)[1]	116 (44)[2]	918	850 (590)[1]

---

[1] If the AC choke is installed in another location, the distance must not, however, be smaller than what is given in parentheses.

[2] If the control unit is installed in any other location, the minimum distance from the door equals the number in parentheses.

Table 30: Mounting Dimensions, in

A	B	C	D	E	F	G
1.97	3.94	44.09	21.65 (11.42)[1]	4.57 (1.73)[2]	36.14	33.46 (23.23)[1]

[1] If the AC choke is installed in another location, the distance must not, however, be smaller than what is given in parentheses.

[2] If the control unit is installed in any other location, the minimum distance from the door equals the number in parentheses.

12.3.2 Mounting Dimensions, FR13–FR14
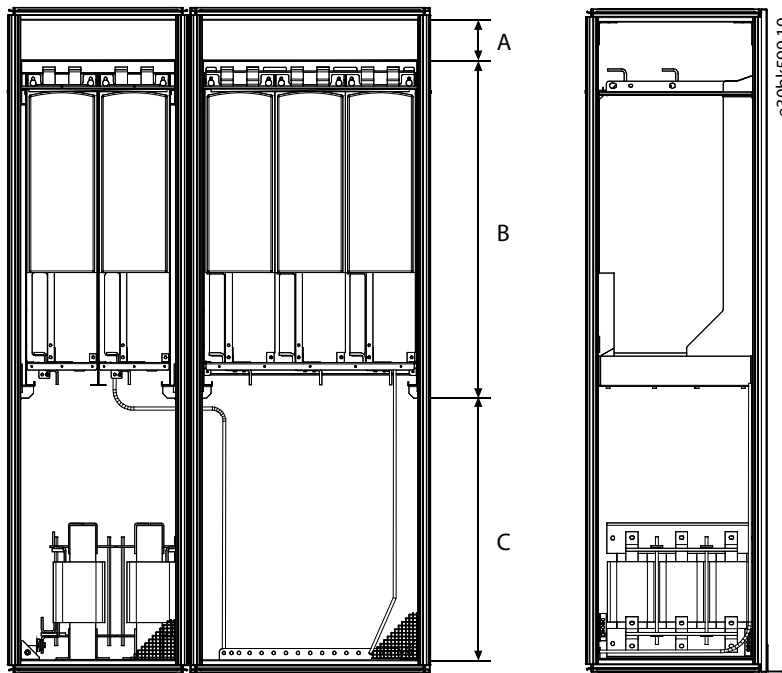
Illustration 76: Mounting Dimensions, FR13-FR14

A	Minimum distance from the top of the cabinet. This space is needed for the fuses and busbars.	C	Minimum distance from the bottom of the enclosure if the AC choke is installed at the bottom of the enclosure.
B	Unit height		

Table 31: Mounting Dimensions, mm

A	B	C
175	1050	600 (300)[1]

[1] If the AC choke is installed in another location, the distance must not, however, be smaller than what is given in parentheses.

Table 32: Mounting Dimensions, in

A	B	C
6.89	41.34	23.62 (11.81) [1]

[1] If the AC choke is installed in another location, the distance must not, however, be smaller than what is given in parentheses.

12.3.3 List of Dimension Information

This topic gives a list of dimension information for different types of VACON® NXP IP00 Drive Modules.

Power units, see:

For AC chokes, see:

For control unit, see:

12.3.4 Dimensions for Power Units

12.3.4.1 Dimensions for Power Unit, FR8
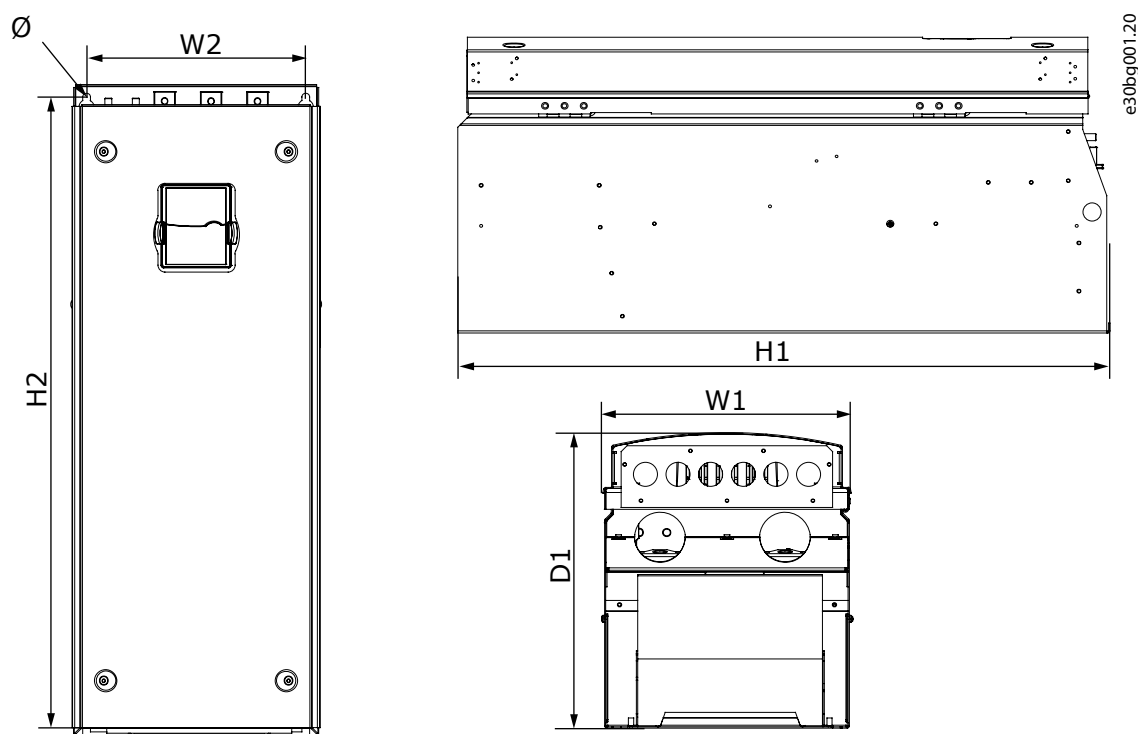
Illustration 77: Dimensions of the VACON® NXP IP00 AC Drive, FR8

Table 33: Dimensions in mm (in inch) of the VACON⁄E NXP IP00 AC Drive, FR8

Drive type	W1	W2	H1	H2	D1	Ø
• 0140 2–0205 2 • 0140 5–0205 5 • 0062 6–0100 6	291 (11.47)	255 (10.04)	758 (29.88)	732 (28.81)	344 (13.54)	9 (0.35)

12.3.4.2 Dimensions for Power Unit, FR9
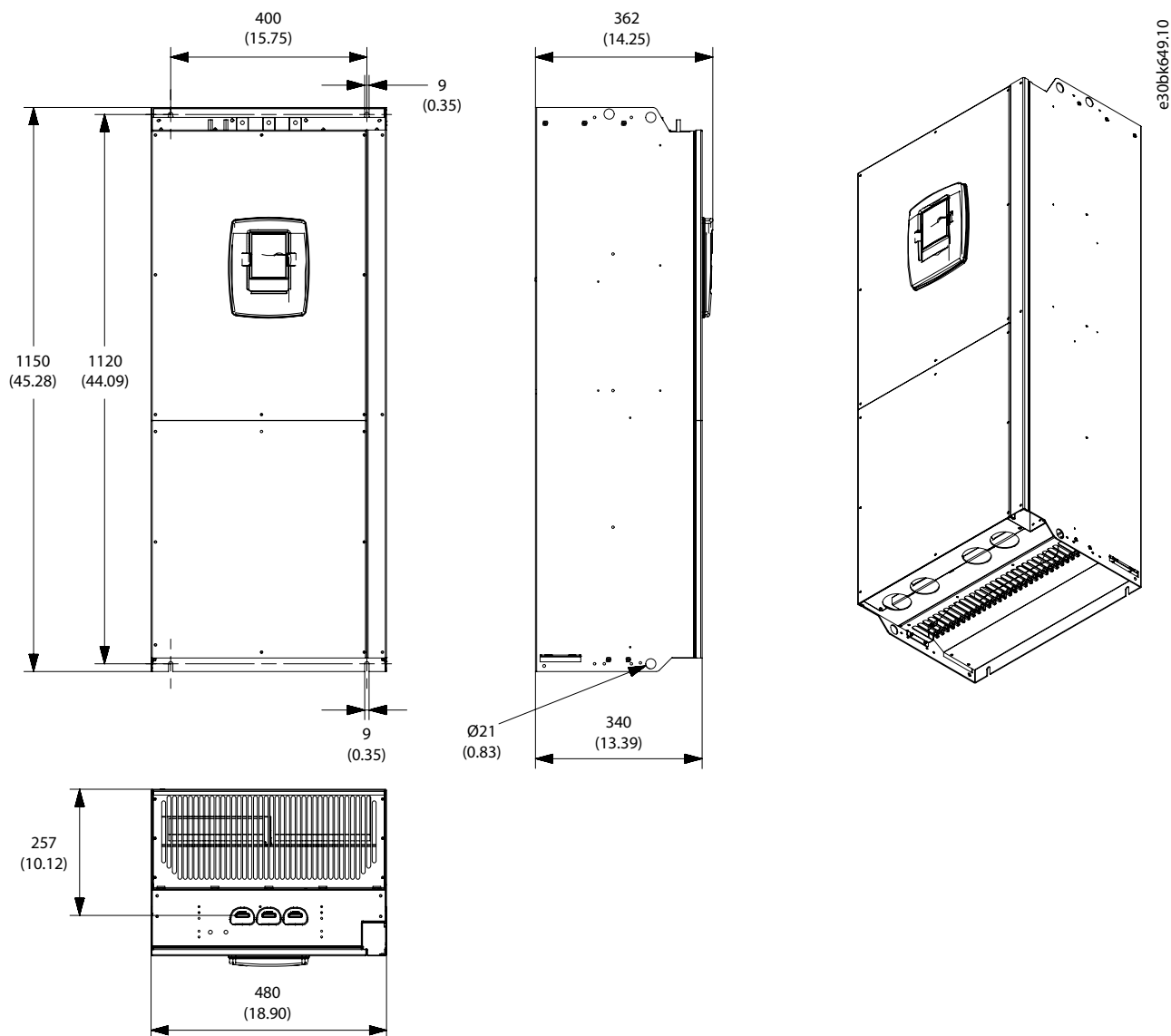
Illustration 78: Power Unit Dimensions, FR9

12.3.4.3 Dimensions for Power Unit, FR10

NOTE! VACON® NXP AC drive enclosure size FR12 is built of two FR10 units.
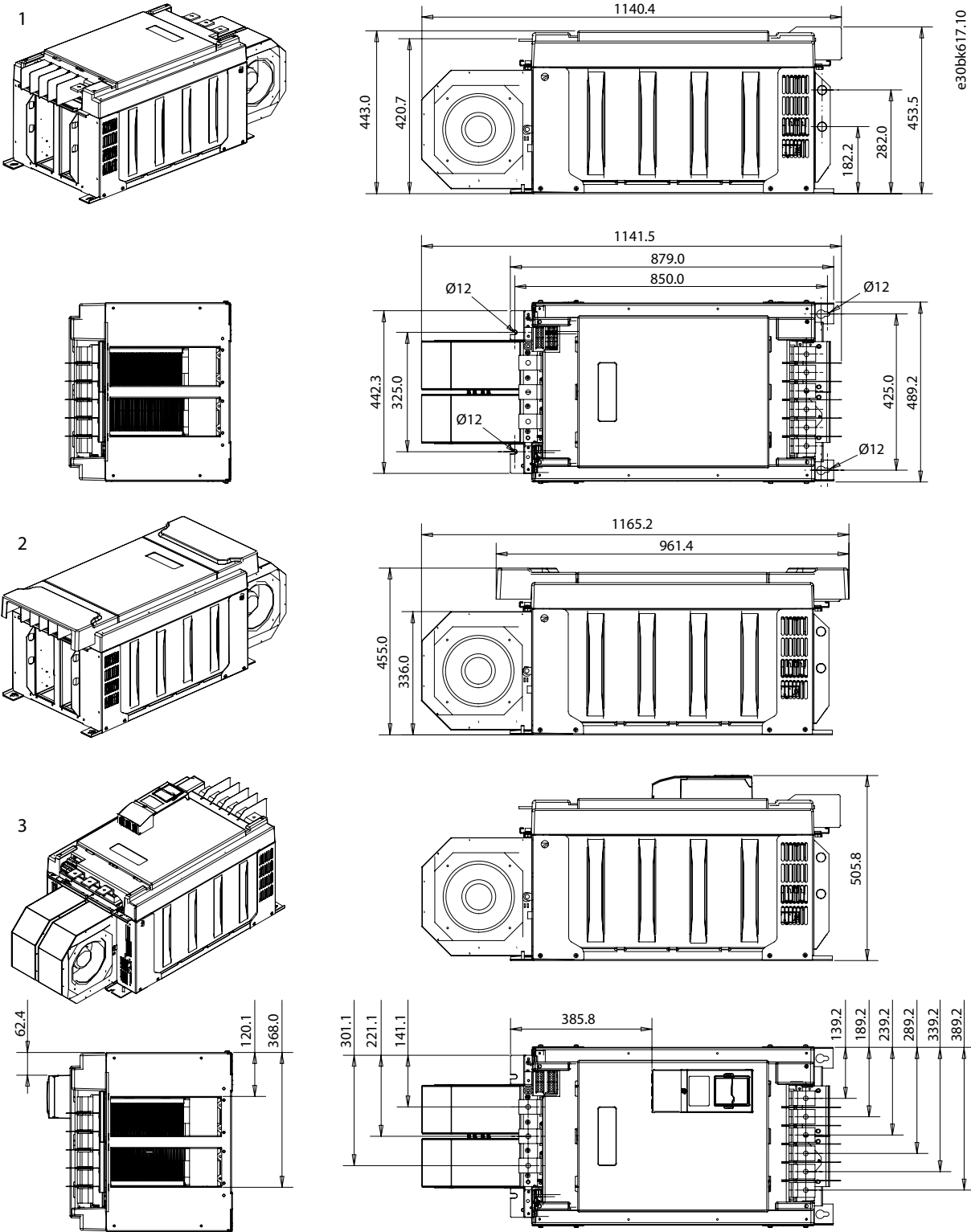
Illustration 79: Power Unit Dimensions, FR10

1	Without terminal covers and without control unit	3	With integrated control unit
2	With terminal covers		

12.3.4.4 Dimensions for Power Unit, FR11
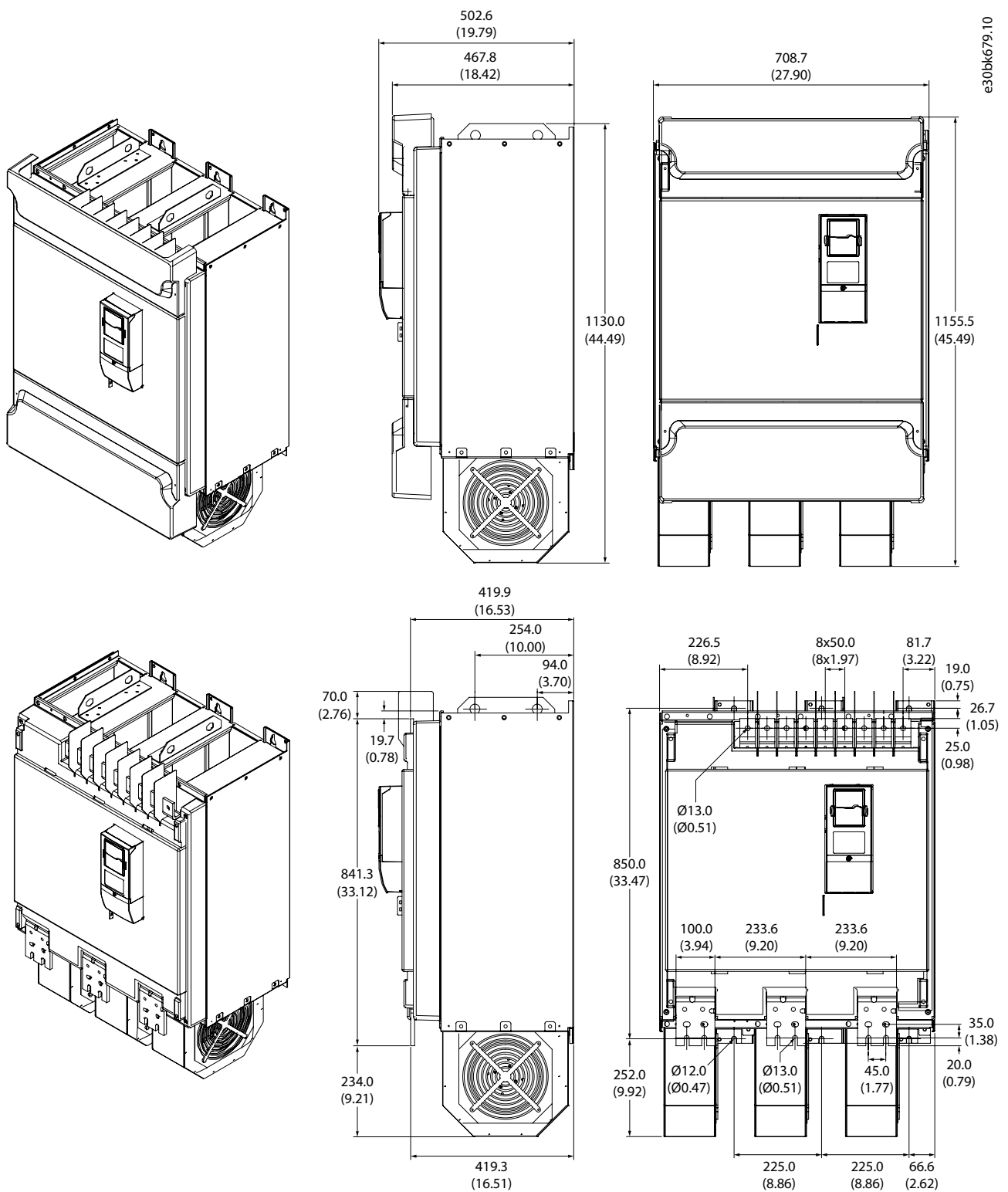
Illustration 80: Power Unit Dimensions, FR11

12.3.4.5 Dimensions for 2 NFE Units (FR13/FR14)
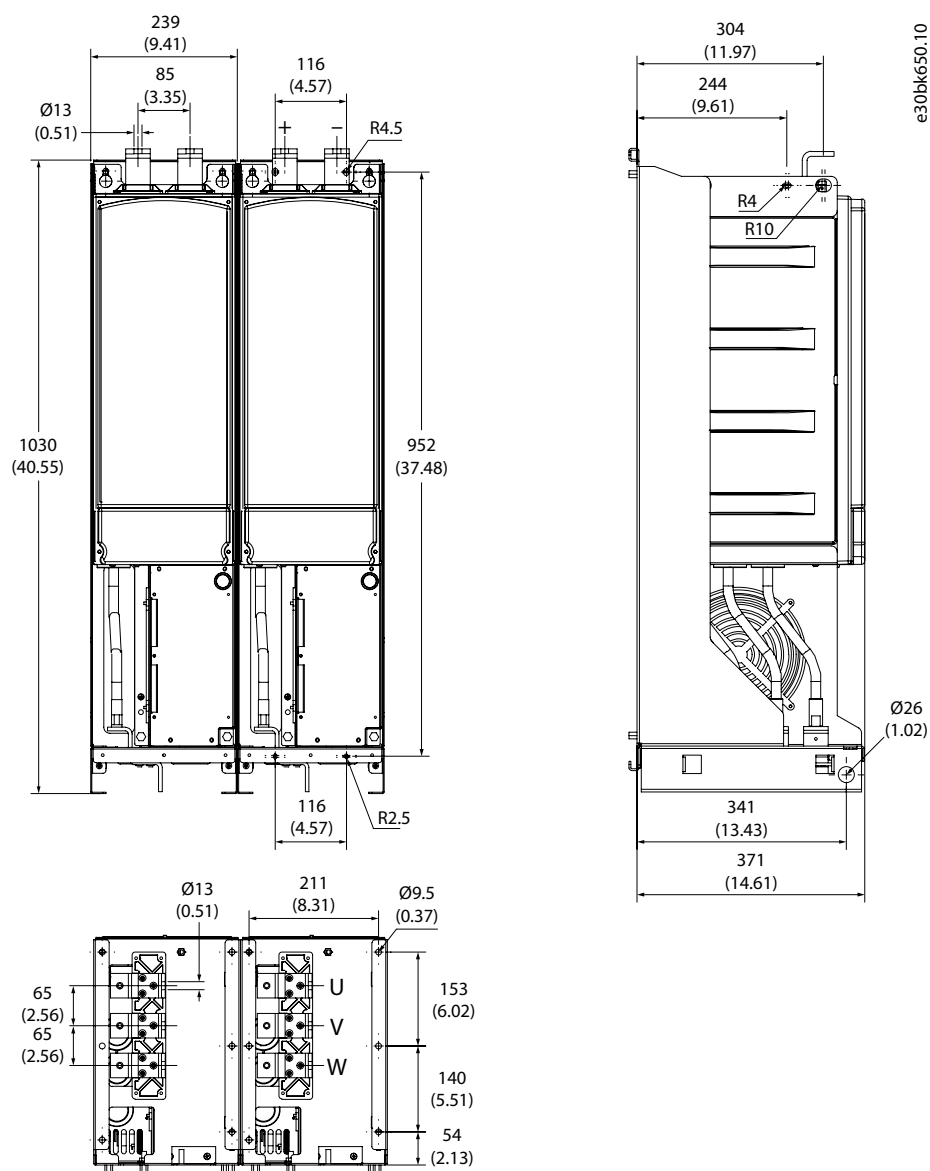
Illustration 81: Dimensions, 2 NFE Units

12.3.4.6 Dimensions for 3 NFE Units (FR13/FR14)
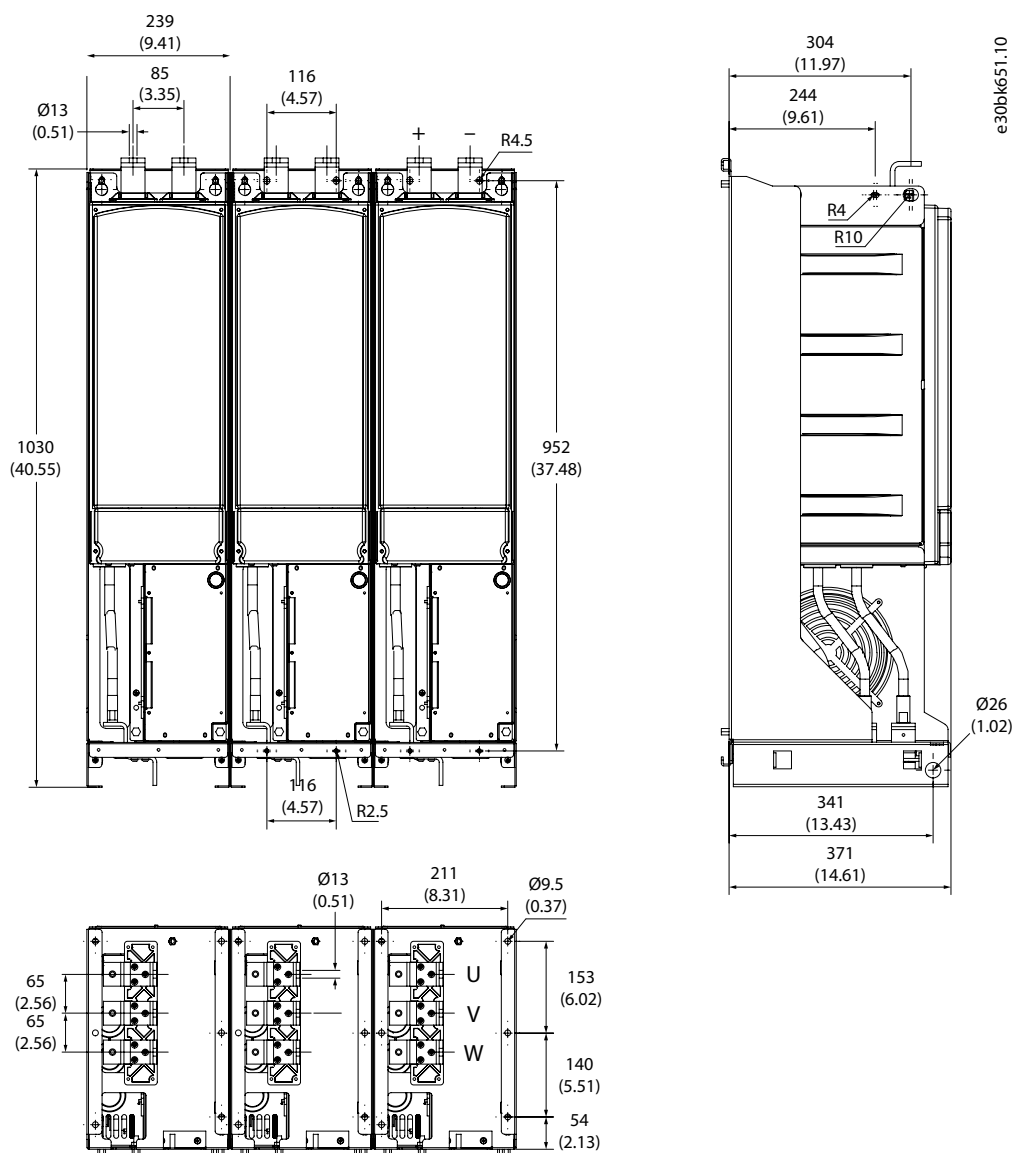
Illustration 82: Dimensions, 3 NFE Units

12.3.4.7 Dimensions for Inverter Unit (FR13/FR14)
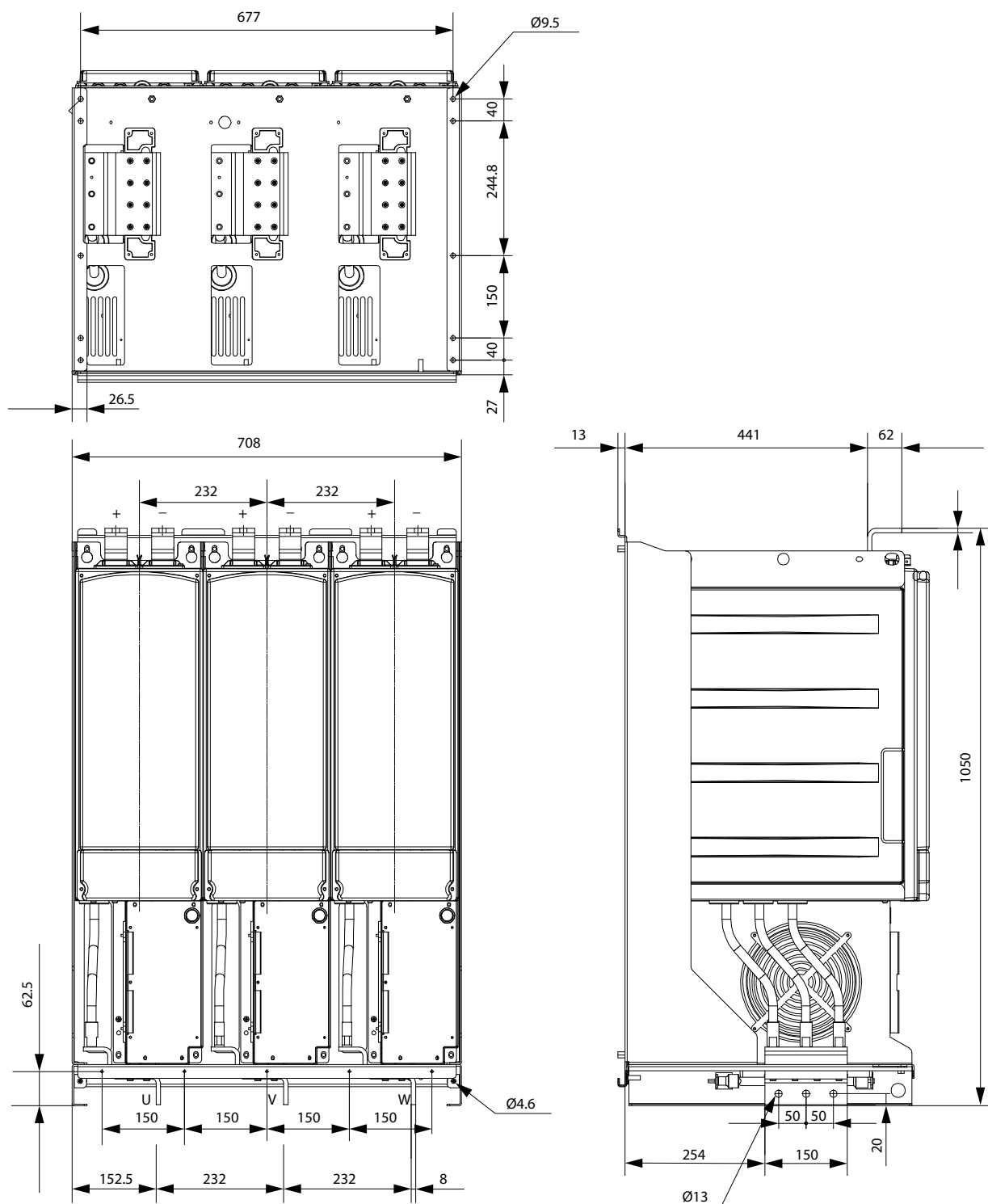
Illustration 83: Dimensions for Inverter Unit FR13, Front View
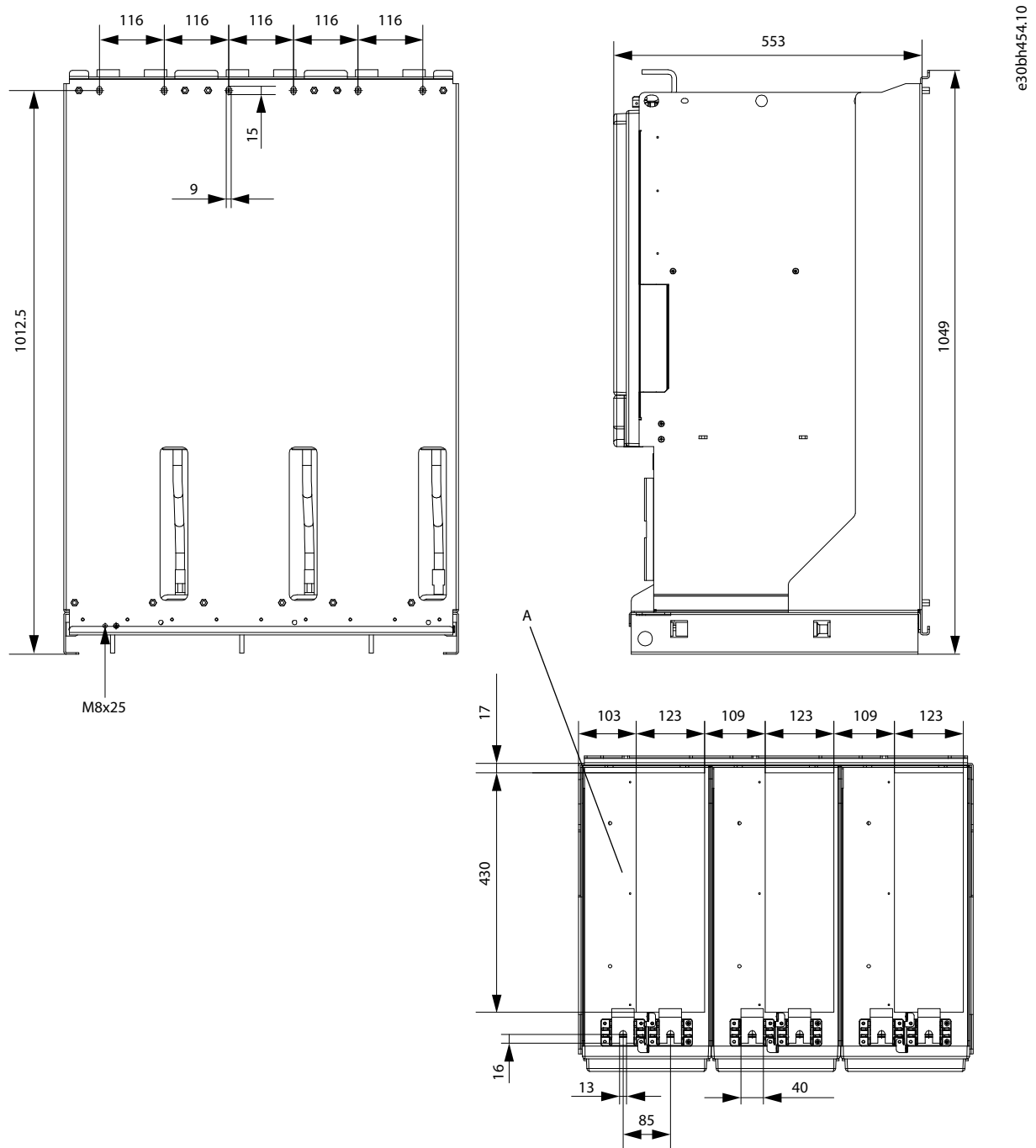
Illustration 84: Dimensions for Inverter Unit FR13, Back View

12.3.5 Dimensions for AC Chokes

12.3.5.1 Dimensions for AC Choke, CHK0650
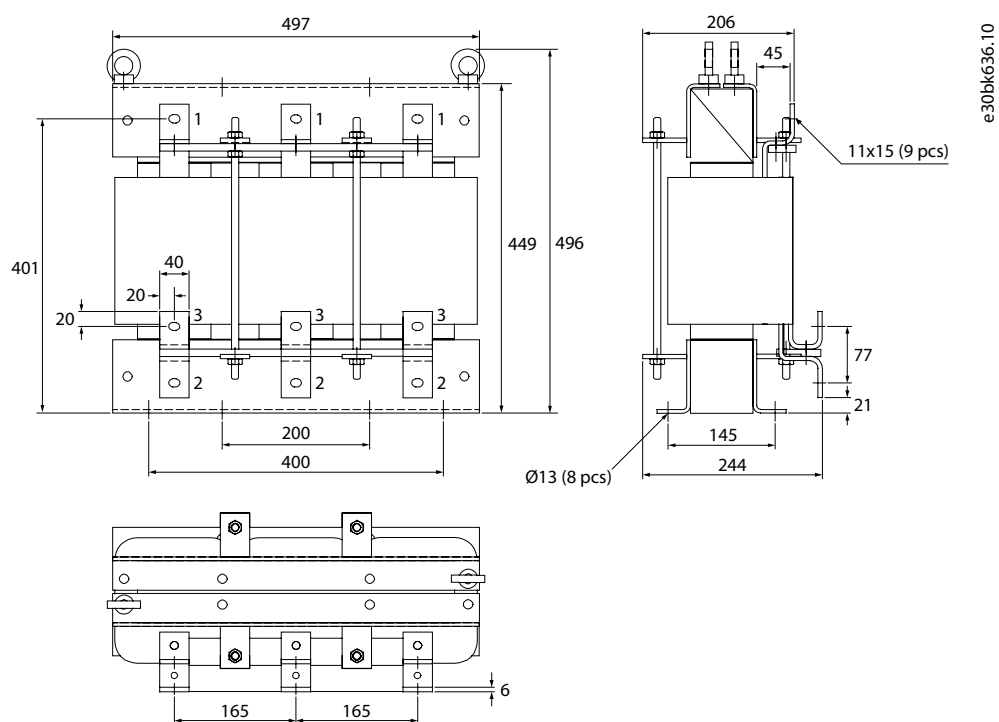
Illustration 85: AC Choke Dimensions, CHK0650

12.3.5.2 Dimensions for AC Choke, CHK0520
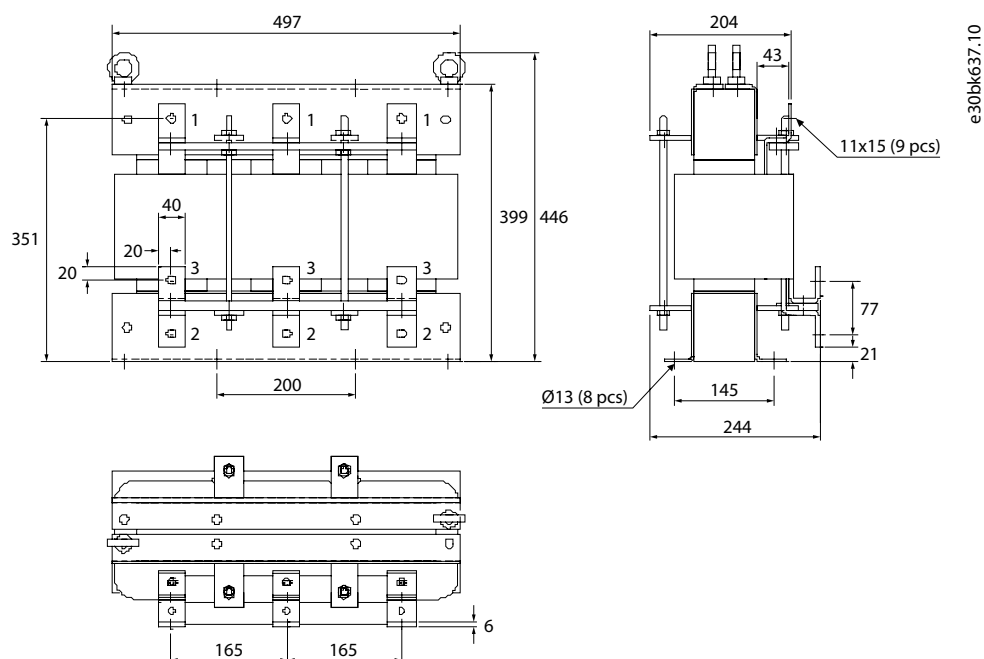
Illustration 86: AC Choke Dimensions, CHK0520

12.3.5.3 Dimensions for AC Choke, CHK0400
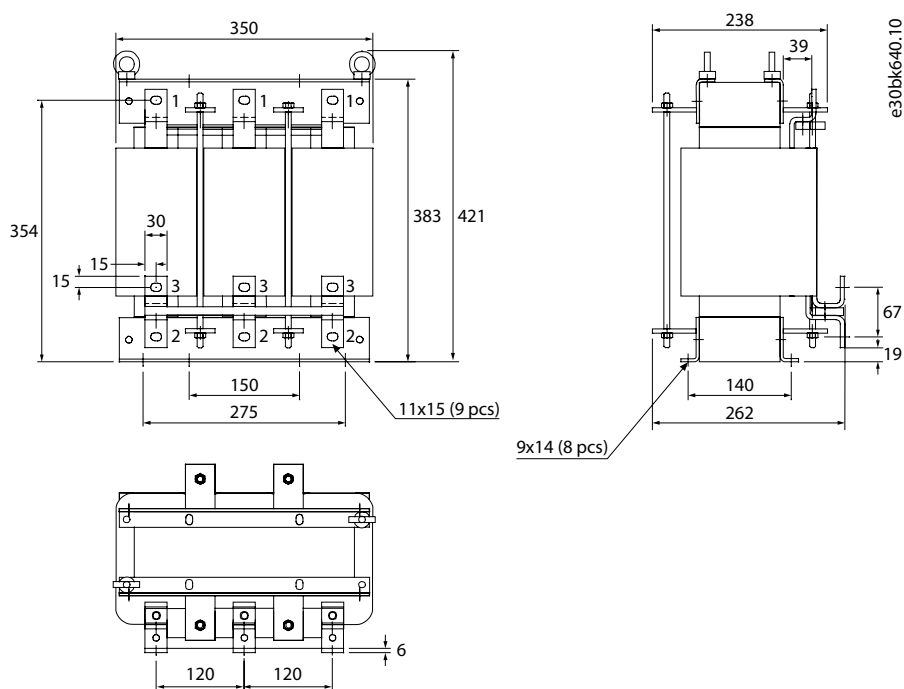
Illustration 87: AC Choke Dimensions, CHK0400

12.3.5.4 Dimensions for AC Choke, CHK0261
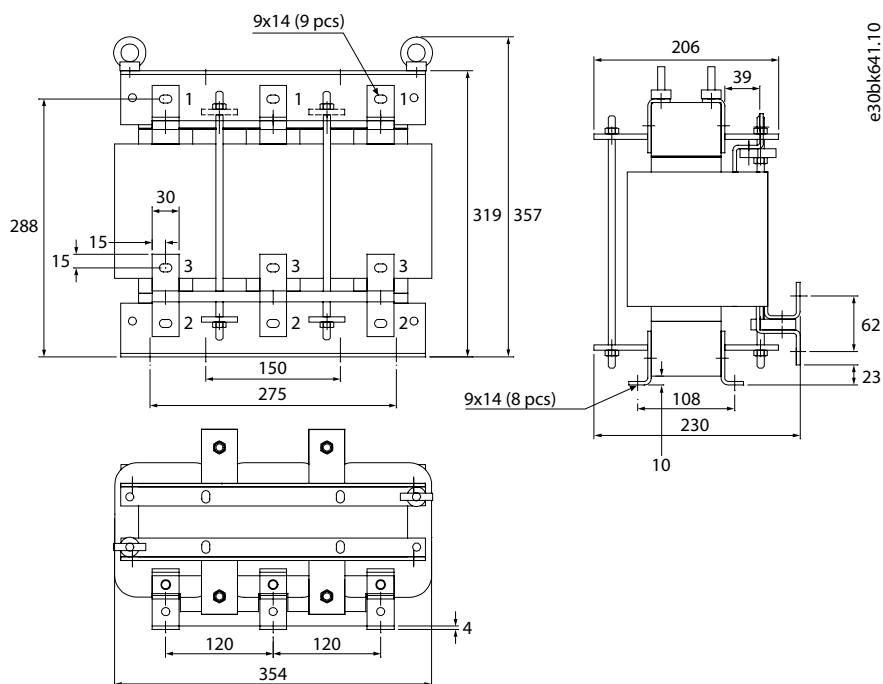
Illustration 88: AC Choke Dimensions, CHK0261

12.3.6 Dimensions for Control Unit
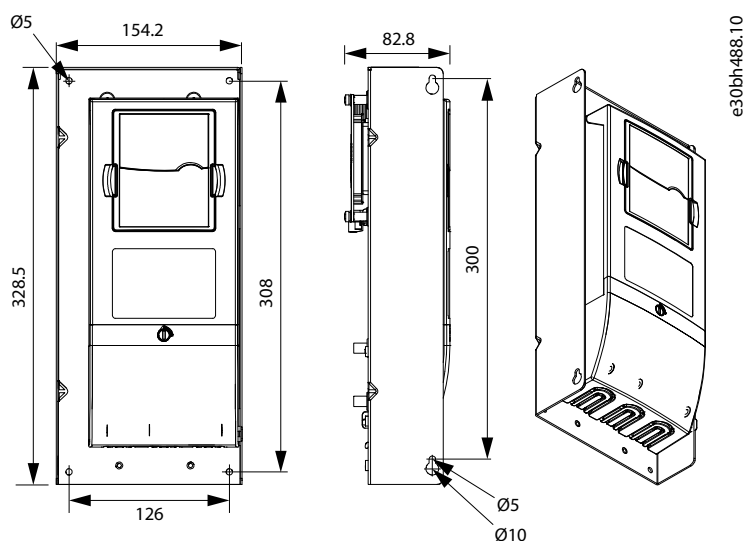
Illustration 89: Control Unit Dimensions

12.4 Cable and Fuse Sizes

For cable, and fuse size information, see the following topics:

- 380–500 V AC:
  -
  -
  -
  -
- 525–690 V AC:
  -
  -
  -
  -

12.4.1 Internal Cable Sizes for 380–500 V AC

Table 34: Cable Sizes for 380–500 V AC, FR8–FR12

Enclosure size	Drive type	Temperature rating[1]	Internal cable/phase [mm^2]
FR8	NXP 0140 5	90 ℃ (194 ℉)	70
		70 ℃ (158 ℉)	95
	NXP 0168 5	90 ℃ (194 ℉)	70
		70 ℃ (158 ℉)	95
	NXP 0205 5	90 ℃ (194 ℉)	95
		70 ℃ (158 ℉)	120
FR9	NXP 0261 5	90 ℃ (194 ℉)	2*70
		70 ℃ (158 ℉)	2*95
	NXP 0300 5	90 ℃ (194 ℉)	2*70
		70 ℃ (158 ℉)	2*95

Enclosure size	Drive type	Temperature rating[1]	Internal cable/phase [mm^2]
FR10	NXP 0385	90 °C (194 °F)	2*70
		70 °C (158 °F)	2*95
	NXP 0460-0520	90 °C (194 °F)	2*95
		70 °C (158 °F)	2*120
FR11	NXP 0590-0730	90 °C (194 °F)	2*2*70
		70 °C (158 °F)	2*2*95
FR12	NXP 0820-1030	90 °C (194 °F)	2*2*95
		70 °C (158 °F)	2*2*120

[1] 70C PVC/90C XLPE Cu cable

Table 35: Cable Sizes for 380–500 V AC, FR13–FR14

Enclosure size	Drive type	Busbar size NFE-INU [mm]	Busbar size/phase[1] (AC choke–NFE) [mm]	Cable size/phase (AC choke–NFE) [mm]	Remarks
FR13	NXP 1150 5	60*10	40*6	2*150	-
	NXP 1300-1450	80*10	40*6	2*120	-
FR14	NXP 1770 5	60*10	40*6	2*120	Routing: Use symmetrical construction. See pictures in 5.4 Cabinet Requirements for FR13–FR14.
	NXP 2150 5			2*150	

[1] Rigid copper connection

12.4.2 Busbar and Terminal Dimensions for 380–500 V AC

Table 36: Terminal Dimensions for 380–500 V AC, FR8–FR9

Enclosure size	Drive type	Mains terminal [mm^2]	Grounding terminal [mm^2]
FR8	NXP 0140	25–95 Cu/Al	6–95
	NXP 0168 –0205	95–185 Cu/Al	
FR9	NXP 0261–0300	95–185 Cu/Al	6–95

Table 37: Busbar Dimensions for 380–500 V AC, FR8–FR12

Enclosure size	Drive type	Cu busbar size	Busbars total
FR10	NXP 0385	30*6 mm	3
	NXP 0460–0520	40*6 mm	3
FR11	NXP 0590–0730	30*6 mm	6
FR12	NXP 0820–1030	40*6 mm	6

Table 38: Busbar Dimensions for 380–500 V AC, FR13–FR14

Enclosure size	Drive type	Cu busbar size	Busbars total
FR13	NXP1150	40*6 mm	6
	NXP1300-1500 (6-p)	40*6 mm	9
	NXP1300-1500 (12-p)	40*6 mm	12
FR14	NXP1770-2150	40*6 mm	12

12.4.3 Fuse Sizes for 380–500 V AC, 6-pulse

The aR fuses are thermally rated into switch fuse in 50 °C (122 °F) ambient temperature.

Table 39: Fuse Sizes for 380–500 V AC, FR8–FR9, 6-pulse

Enclosure size	Drive type	Fuse (gG/gL) [A]	Fuse Class Fast Acting (T/J) [A]
FR8	0140	160	175
	0168	200	250
	0205	250	250
FR9	0261	315	350
	0300	315	400

Table 40: Fuse Sizes (Bussmann) for 380–500 V AC, FR10–FR12, 6-pulse

Enclo-sure size	Drive type	DIN 43620		DIN 43653 (110 mm)		Flush end contacts (met-ric)		Fuse [A]	Fuses per drive
		aR fuse part nr.	Fuse size	aR fuse part nr.	Fuse size	aR fuse part nr.	Fuse size		
FR10	385	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	3
	460	170M8547	3SHT [1]	170M6216	3TN/110	170M6466	3BKN/50	1250	3
	520	170M8547	3SHT [0]	170M6216	3TN/110	170M6466	3BKN/50	1250	3
FR11	590	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	6
	650	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	6
	730	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	6
FR12	820	170M8547	3SHT [0]	170M6216	3TN/110	170M6466	3BKN/50	1250	6
	920	170M8547	3SHT [0]	170M6216	3TN/110	170M6466	3BKN/50	1250	6
	1030	170M8547	3SHT [0]	170M6216	3TN/110	170M6466	3BKN/50	1250	6
FR12 DC-link	[2]	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	2

[1] SHT fuses can be assembled into same size DIN fuse base

SHT fuses can be assembled into same size DIN fuse base

[2] In FR12 (12-pulse drive) or in FR12 (6- or 12-pulse) with internal brake, the DC-links between units are connected together. If connected together, there must be DC-link fuses in DC-minus and DC-plus poles between the units. (In 6-pulse drive without internal brake, DC-links between units are separate and there is no need for fuses.)

Table 41: Fuse Sizes (Bussmann) for 380–500 V AC, FR13–FR14, 6-pulse

Enclosure size	Drive type	Fuses with flush end contact (metric)		Fuses with flush end contact (US)		Fuse In [A]	DC fuses per drive	AC fuses per drive
		Fuse part nr. (aR) (AC/DC)	Fuse size	Fuse part nr. (aR)	Fuse size			
FR13	1150	170M6466	3BKN/50	170M6566	3GKN/50	1250	4	6
	1300	170M6466	3BKN/50	170M6566	3GKN/50	1250	6	9
	1450	170M6466	3BKN/50	170M6566	3GKN/50	1250	6	9
FR14	1770	170M6466	3BKN/50	170M6566	3GKN/50	1250	8	12
	2150	170M6466	3BKN/50	170M6566	3GKN/50	1250	8	12

Table 42: Fuse Sizes (Ferraz Shawmut) for 380–500 V AC, FR10–FR12, 6-pulse

Enclosure size	Drive type	Fuse size	DIN 43620	DIN 43653 (80 mm)	DIN 43653 (110 mm)	Threaded end contacts (metric)	Fuse In [V]	Fuses per drive
FR10	385	2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	3
	460	3	3 PV 1000	33 D08A 1000	33 D11A 1000	33 TTF 1000	1000	3
	520	3	3 PV 1000	33 D08A 1000	33 D11A 1000	33 TTF 1000	1000	3
FR11	590	2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	6
	650	2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	6
	730	2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	6
FR12	820	3	3 PV 1000	33 D08A 1000	33 D11A 1000	33 TTF 1000	1000	6
	920	3	3 PV 1000	33 D08A 1000	33 D11A 1000	33 TTF 1000	1000	6
	1030	3	3 PV 1000	33 D08A 1000	33 D11A 1000	33 TTF 1000	1000	6
FR12 DC-link [0]		2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	2

In FR12 (12-pulse drive) or in FR12 (6- or 12-pulse) with internal brake, the DC-links between units are connected together. If connected together, there must be DC-link fuses in DC-minus and DC-plus poles between the units. (In 6-pulse drive without internal brake, DC-links between units are separate and there is no need for fuses.)

12.4.4 Fuse Sizes for 380–500 V AC, 12-pulse

The aR fuses are thermally rated into switch fuse in 50 °C (122 °F) ambient temperature.

Table 43: Fuse Sizes (Bussmann) for 380–500 V AC, FR10, 12-pulse

Enclosure size	Drive type	DIN 43620		DIN 43653 (110 mm)		Flush end contacts (metric)		Fuse In [A]	Fuses per drive
		aR fuse part nr.	Fuse size	aR fuse part nr.	Fuse size	aR fuse part nr.	Fuse size		
FR10	385	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	6
	460	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	6
	520	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	6

Table 44: Fuse Sizes (Bussmann) for 380–500 V AC, FR13–FR14, 12-pulse

Enclosure size	Drive type	Fuses with flush end contact (metric)		Fuses with flush end contact (US)		Fuse In [A]	Fuses per drive	Fuses per drive
		Fuse part nr. (aR) (AC/DC)	Fuse size	Fuse part nr. (aR)	Fuse size			
FR13	1150	170M6466	3BKN/50	170M6566	3GKN/50	1250	4	6
	1300	170M6466	3BKN/50	170M6566	3GKN/50	1250	6	12
	1450	170M6466	3BKN/50	170M6566	3GKN/50	1250	6	12
FR14	1770	170M6466	3BKN/50	170M6566	3GKN/50	1250	8	12
	2150	170M6466	3BKN/50	170M6566	3GKN/50	1250	8	12

Table 45: Fuse Sizes (Ferraz Shawmut) for 380–500 V AC, FR10–FR12, 12-pulse

Enclosure size	Drive type	Fuse size	DIN 43620	DIN 43653 (80 mm)	DIN 43653 (110 mm)	Threaded end contacts (metric)	Fuse In [V]	Fuses per drive
FR10	385	2	2 PV 0450	32 D08A 0450	32 D11A 0450	32 TTF 0450	450	6
	460	2	2 PV 0450	32 D08A 0450	32 D11A 0450	32 TTF 0450	450	6
	520	2	2 PV 0450	32 D08A 0450	32 D11A 0450	32 TTF 0450	450	6

12.4.5 Internal Cable Sizes for 525–690 V AC

Table 46: Cable Sizes for 525–690 V AC, FR8–FR12

Enclosure size	Drive type	Temperature rating[1]	Internal cable/phase [mm^2]
FR8	NXP 0062	90 °C (194 °F)	25
		70 °C (158 °F)	35
	NXP 0080	90 °C (194 °F)	25
		70 °C (158 °F)	35
	NXP 0100	90 °C (194 °F)	35
		70 °C (158 °F)	50
FR9	NXP 0125	90 °C (194 °F)	50
		70 °C (158 °F)	70
	NXP 0144	90 °C (194 °F)	70
		70 °C (158 °F)	95
	NXP 0170	90 °C (194 °F)	70
		70 °C (158 °F)	95
	NXP 0208	90 °C (194 °F)	95
		70 °C (158 °F)	120
FR10	NXP 0261–0416	90 °C (194 °F)	2*70
		70 °C (158 °F)	2*95

Enclosure size	Drive type	Temperature rating[1]	Internal cable/phase [mm^2]
FR11	NXP 0460–0590	90 °C (194 °F)	2*95
		70 °C (158 °F)	2*120
FR12	NXP 0650–0820	90 °C (194 °F)	2*2*70
		70 °C (158 °F)	2*2*95

[1] 70C PVC/90C XLPE Cu cable

Table 47: Cable Sizes for 525–690 V AC, FR13–FR14

Enclosure size	Drive type	Busbar size NFE- INU [mm]	Busbar size/phase[1] (AC choke–NFE) [mm]	Cable size/phase (AC choke–NFE) [mm^2]	Remarks
FR13	NXP 0920–1030	60*10	40*6	2*120	-
	NXP 1180 6			2*150	
FR14	NXP 1500 6	80*10	40*6	2*120	-
	NXP 1900–2250	60*10	40*6	2*120	Routing: Use symmetrical construction See pictures in 5.4 Cabinet Requirements for FR13–FR14.
				2*150	

[1] Rigid copper connection

12.4.6 Busbar and Terminal Dimensions for 525–690 V AC

Table 48: Terminal Dimensions for 525–690 V AC, FR8–FR9

Enclosure size	Drive type	Mains terminal [mm^2]	Grounding terminal [mm^2]
FR8	NXP 0062–0100	25–95 Cu/Al	6–95
FR9	NXP 0125–0205	95–185 Cu/Al	6–95

Table 49: Busbar Dimensions for 525–690 V AC, FR10–FR12

Enclosure size	Drive type	Cu busbar size	Busbars total
FR10	NXP 0261–0416	30*6 mm	3
FR11	NXP 0460–0502	40*6 mm	3
	NXP 0590	30*6 mm	6
FR12	NXP 0650–0820	30*6 mm	6

Table 50: Busbar Dimensions for 525–690 V AC, FR13–FR14

Enclosure size	Drive type	Cu busbar size	Busbars total
FR13	NXP 0920–1180	40*6 mm	6
FR14	NXP 1900–2250	40*6 mm	12

12.4.7 Fuse Sizes for 525–690 V AC, 6-pulse

The aR fuses are thermally rated into switch fuse in 50 °C (122 °C) ambient temperature.

Table 51: Fuse Sizes for 525–690 V AC, FR8–FR9, 6-pulse

Enclosure size	Drive type	Fuse (gG/gL) [A]	Fuse Class Fast Acting (T/J) [A]
FR8	0062	80	80
	0080	80	100
	0100	100	125
FR9	0125	160	200
	0144	160	200
	0170	200	250
	0208	250	300

Table 52: Fuse Sizes (Bussmann) for 525–690 V AC, FR10–FR12, 6-pulse

Enclo-sure size	Drive type	DIN 43620		DIN 43653 (110 mm)		Flush end contacts (met-ric)		Fuse In [A]	Fuses per drive
		aR fuse part nr.	Fuse size	aR fuse part nr.	Fuse size	aR fuse part nr.	Fuse size		
FR10	261	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	3
	325	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	3
	385	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	3
	416	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	3
FR11	460	170M8547	3SHT [1]	170M6216	3TN/110	170M6466	3BKN/50	1250	3
	502	170M8547	3SHT [1]	170M6212	3TN/110	170M6466	3BKN/50	1250	3
	590	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	6
FR12	650	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	6
	750	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	6
	820	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	6
FR12 DC-link	[2]	170M6202	3SHT [1]	170M5986	2TN/110	170M8604	3BKN/75	500	2

---

[1] SHT fuses can be assembled into same size DIN fuse base

[2] In FR12 (12-pulse drive) or in FR12 (6- or 12-pulse) with internal brake, the DC-links between units are connected together. If connected together, there must be DC-link fuses in DC-minus and DC-plus poles between the units. (In 6-pulse drive without internal brake, DC-links between units are separate and there is no need for fuses.)

Table 53: Fuse Sizes (Bussmann) for 525–690 V AC, FR13–FR14, 6-pulse

Enclo-sure size	Drive type	Fuses with flush end contact (metric)		Fuses with flush end contact (US)		Fuse In [A]	DC fuses per drive	AC fuses per drive
		Fuse part nr. (aR) (AC/DC)	Fuse size	Fuse part nr. (aR)	Fuse size			
FR13	920	170M6466 (AC) 170M8610 (DC)	3BKN/50 3BKN/75	170M6566 (AC)	3GKN/50	1250 1000	4	6
	1030	170M6466 (AC) 170M8610 (DC)	3BKN/50 3BKN/75	170M6566 (AC)	3GKN/50	1250 1000	4	6
	1180	170M6466 (AC) 170M8610 (DC)	3BKN/50 3BKN/75	170M6566 (AC)	3GKN/50	1250 1000	4	6
FR14	1500	170M6466 (AC) 170M8610 (DC)	3BKN/50 3BKN/75	170M6566 (AC)	3GKN/50	1250 1000	6	9
	1900	170M6466 (AC) 170M8610 (DC)	3BKN/50 3BKN/75	170M6566 (AC)	3GKN/50	1250 1000	8	12
	2250	170M6466 (AC) 170M8610 (DC)	3BKN/50 3BKN/75	170M6566 (AC)	3GKN/50	1250 1000	8	12

Table 54: Fuse Sizes (Ferraz Shawmut) for 525–690 V AC, FR10–FR12, 6-pulse

Enclo-sure size	Drive type	Fuse size	DIN 43620	DIN 43653 (80 mm)	DIN 43653 (110 mm)	Threaded end contacts (metric)	Fuse In [V]	Fuses per drive
FR10	261	2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	3
	325	2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	3
	385	2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	3
	416	3	3 PV 1000	33 D08A 1000	33 D11A 1000	33 TTF 1000	1000	3
FR11	460	3	3 PV 1000	33 D08A 1000	33 D11A 1000	33 TTF 1000	1000	3
	502	3	3 PV 1000	33 D08A 1000	33 D11A 1000	33 TTF 1000	1000	3
	590	2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	6
FR12	650	2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	6
	750	2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	6
	820	3	3 PV 1000	33 D08A 1000	33 D11A 1000	33 TTF 1000	1000	6
FR12 DC-link	[1]	2	NA	NA	12.5 URD 72D11A 0500	12.5 URD 72 TTF 0500	500[0]	2

[1] In FR12 (12-pulse drive) or in FR12 (6- or 12-pulse) with internal brake, the DC-links between units are connected together. If connected together, there must be DC-link fuses in DC-minus and DC-plus poles between the units. (In 6-pulse drive without internal brake, DC-links between units are separate and there is no need for fuses.)

Fuse Un=1000V/1250V

12.4.8 Fuse Sizes for 525–690 V AC, 12-pulse

The aR fuses are thermally rated into switch fuse in 50 °C (122 °F) ambient temperature.

Table 55: Fuse Sizes (Bussmann) for 525–690 V AC, FR10–FR12, 12-pulse

Enclo-sure size	Drive type	DIN 43620		DIN 43653 (110 mm)		Flush end contacts (metric)		Fuse In [A]	Fuses per drive
		aR fuse part nr.	Fuse size	aR fuse part nr.	Fuse size	aR fuse part nr.	Fuse size		
FR10	385	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	3
	460	170M8547	3SHT [1]	170M6216	3TN/110	170M6466	3BKN/50	1250	3
	520	170M8547	3SHT [1]	170M6216	3TN/110	170M6466	3BKN/50	1250	3
FR11	590	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	6
	650	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	6
	730	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	6
FR12	820	170M8547	3SHT [1]	170M6216	3TN/110	170M6466	3BKN/50	1250	6
	920	170M8547	3SHT [1]	170M6216	3TN/110	170M6466	3BKN/50	1250	6
	1030	170M8547	3SHT [1]	170M6216	3TN/110	170M6466	3BKN/50	1250	6
FR12 DC-link	[2]	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	2

[1] SHT fuses can be assembled into same size DIN fuse base

[2] In FR12 (12-pulse drive) or in FR12 (6- or 12-pulse) with internal brake, the DC-links between units are connected together. If connected together, there must be DC-link fuses in DC-minus and DC-plus poles between the units. (In 6-pulse drive without internal brake, DC-links between units are separate and there is no need for fuses.)

Table 56: Fuse Sizes (Bussmann) for 525–690 V AC, FR13–FR14, 12-pulse

Enclosure size	Drive type	Fuses with flush end contact (metric)		Fuses with flush end contact (US)		Fuse In [A]	DC fuses per drive	AC fuses per drive
		Fuse part nr. (aR) (AC/DC)	Fuse size	Fuse part nr. (aR)	Fuse size			
FR13	1150	170M6466	3BKN/50	170M6566	3GKN/50	1250	4	6
	1300	170M6466	3BKN/50	170M6566	3GKN/50	1250	6	9
	1450	170M6466	3BKN/50	170M6566	3GKN/50	1250	6	9
FR14	1770	170M6466	3BKN/50	170M6566	3GKN/50	1250	8	12
	2150	170M6466	3BKN/50	170M6566	3GKN/50	1250	8	12

Table 57: Fuse Sizes (Ferraz Shawmut) for 525–690 V AC, FR10–FR12, 12-pulse

Enclo-sure size	Drive type	Fuse size	DIN 43620	DIN 43653 (80 mm)	DIN 43653 (110 mm)	Threaded end contacts (metric)	Fuse In [V]	Fuses per drive
FR10	385	2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	3
	460	3	3 PV 1000	33 D08A 1000	33 D11A 1000	33 TTF 1000	1000	3
	520	3	3 PV 1000	33 D08A 1000	33 D11A 1000	33 TTF 1000	1000	3
FR11	590	2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	6
	650	2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	6

Enclo- sure size	Drive type	Fuse size	DIN 43620	DIN 43653 (80 mm)	DIN 43653 (110 mm)	Threaded end contacts (metric)	Fuse In [V]	Fuses per drive
	730	2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	6
FR12	820	3	3 PV 1000	33 D08A 1000	33 D11A 1000	33 TTF 1000	1000	6
	920	3	3 PV 1000	33 D08A 1000	33 D11A 1000	33 TTF 1000	1000	6
	1030	3	3 PV 1000	33 D08A 1000	33 D11A 1000	33 TTF 1000	1000	6
FR12 DC- link	(1)	2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	2

[1] In FR12 (12-pulse drive) or in FR12 (6- or 12-pulse) with internal brake, the DC-links between units are connected together. If connected together, there must be DC-link fuses in DC-minus and DC-plus poles between the units. (In 6-pulse drive without internal brake, DC-links between units are separate and there is no need for fuses.)

12.5 AC Chokes

Table 58: AC Chokes for 380–500 V AC

Enclosure size	Drive type	AC choke type	
		(6-pulse)	(12-pulse)
FR10	NXP 0385 5	CHK0400	2*CHK0261
	NXP 0460 5	CHK0520	2*CHK0261
	NXP 0520 5	CHK0520	2*CHK0261
FR11	NXP 0590 5	2*CHK0400	2*CHK0400
	NXP 0650 5	2*CHK0400	2*CHK0400
	NXP 0730 5	2*CHK0400	2*CHK0400
FR12	NXP 0820 5	2*CHK0520	2*CHK0520
	NXP 0920 5	2*CHK0520	2*CHK0520
	NXP 1030 5	2*CHK0520	2*CHK0520
FR13	NXP 1150 5	2*CHK0650	2*CHK0650
	NXP 1300 5	3*CHK0520	4*CHK0520
	NXP 1450 5	3*CHK0520	4*CHK0520
FR14	NXP 1770 5	4*CHK0520	4*CHK0520
	NXP 2150 5	4*CHK0650	4*CHK0650

Table 59: AC Chokes for 525–690 V AC

Enclosure size	Drive type	AC choke type	
		(6-pulse)	(12-pulse)
FR10	NXP 0261 6	CHK0261	2*CHK0261
	NXP 0325 6	CHK0400	2*CHK0261
	NXP 0385 6	CHK0400	2*CHK0261

Enclosure size	Drive type	AC choke type	
		(6-pulse)	(12-pulse)
	NXP 0416 6	CHK0400	2*CHK0261
FR11	NXP 0460 6	CHK0520	2*CHK0400
	NXP 0502 6	CHK0520	2*CHK0400
	NXP 0590 6	2*CHK0400	2*CHK0400
FR12	NXP 0650 6	2*CHK0400	2*CHK0400
	NXP 0750 6	2*CHK0400	2*CHK0400
	NXP 0820 6	2*CHK0400	2*CHK0400
FR13	NXP 0920 6	2*CHK0520	2*CHK0520
	NXP 1030 6	2*CHK0520	2*CHK0520
	NXP 1180 6	2*CHK0650	2*CHK0650
FR14	NXP 1500 6	3*CHK0520	4*CHK0520
	NXP 1900 6	4*CHK0520	4*CHK0520
	NXP 2250 6	4*CHK0650	4*CHK0650

12.6 Cable Stripping Lengths

See Illustration 90 for parts of cables to be stripped and check the corresponding stripping length in the table.
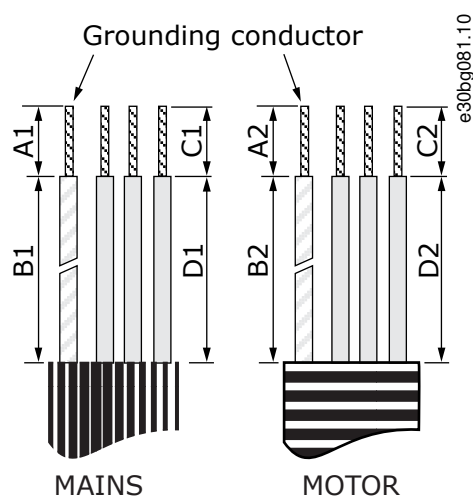
Illustration 90: Cable Stripping

Table 60: Cable Stripping Lengths [mm]

Enclosure size	A1	B1	C1	D1	A2	B2	C2	D2
FR8, 0140 FR8, 0168–0205	23 28	240 240	23 28	240 240	23 28	240 240	23 28	240 240
FR9	28	295	28	295	28	295	28	295

Table 61: Cable Stripping Lengths [in]

Enclosure size	A1	B1	C1	D1	A2	B2	C2	D2
FR8, 0140 FR8, 0168–0205	0.91 1.10	9.45 9.45	0.91 1.10	9.45 9.45	0.91 1.10	9.45 9.45	0.91 1.10	9.45 9.45
FR9	1.10	11.61	1.10	11.61	1.10	11.61	1.10	11.61

12.7 Tightening Torques for Cover Screws

Enclosure size and class	Cable cover screws (Nm)	Screws on the cover of the AC drive (Nm)
FR8	0.8 Nm[1]	0.8
FR9	0.8	0.8

[1] The cover of the power unit.

12.8 Tightening Torques of the Terminals

Table 62: Tightening Torques of the Mains and Motor Terminals

Enclosure size	Drive type	Tightening torque (Nm)	Tightening torque (in-lb)
FR8	0140 5	20	177.01
	0168 5–0205 5	40	354.03
FR9	0261 5–0300 5 0125 6–0208 6	40/22[1]	354.03/194.72[1]
FR10–FR14	0385 5–1450 5	40[2]	354.03[2]
FR10–FR14	0261 6–1180 6	40[2]	354.03[2]

[1] Tightening torque of terminal connection to the isolative base in Nm/in-lb. **NOTE:** This value is needed only if the motor connection is made directly to the AC drive (no devices between AC drive and motor).

[2] Apply counter torque to the nut on the other side of the terminal when tightening or loosening the terminal screw to avoid damage to the terminal

12.9 Power Ratings

12.9.1 Overload Capability

The **low overload** means that if 110% of the continuous current (I_L) is required for 1 minute every 10 minutes, the remaining 9 minutes must be approximately 98% of I_L or less. This is to make sure that the output RMS current is not more than I_L during the duty cycle.
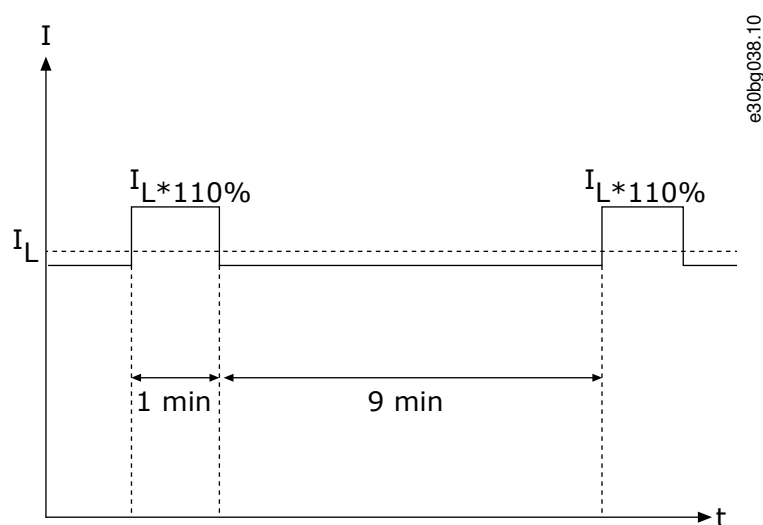
Illustration 91: Low Overload

The **high overload** means that if 150% of the continuous current (I_H) is required for 1 minute every 10 minutes, the remaining 9 minutes must be approximately 92% of I_H or less. This is to make sure that the output RMS current is not more than I_H during the duty cycle.
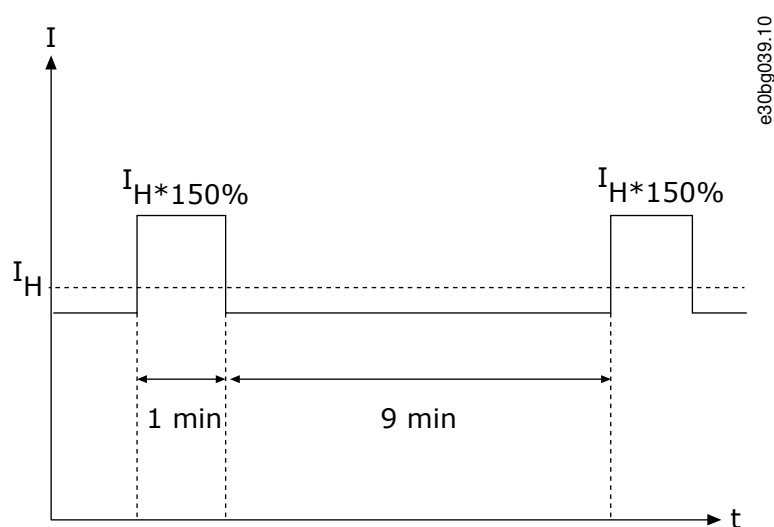
Illustration 92: High Overload

For more information, refer to the standard IEC61800-2.

12.9.2 Power Ratings for Mains Voltage 380–500 V

Table 63: Power Ratings in Mains 380–500 V, 50/60 Hz, 3~

Enclo-sure size	Drive type	Loadability[1]					Motor shaft power			
		Low		High			400 V supply		500 V supply	
		Rated continu-ous cur-rent I_L (A) [2]	Rated over-load current (A)	Rated continu-ous cur-rent I_H (A)	Rated over-load current (A)	Max current I_S	Low over-load P (kW)	High over-load P (kW)	Low over-load P (kW)	High over-load P (kW)
FR8	NXP0140 5	140	154	105	158	210	75	55	90	75
	NXP0168 5	170	187	140	210	280	90	75	110	90

Enclo-sure size	Drive type	Loadability[1]					Motor shaft power			
		Low		High			400 V supply		500 V supply	
		Rated continu-ous cur-rent I_L (A) [2]	Rated over-load current (A)	Rated continu-ous cur-rent I_H (A)	Rated over-load current (A)	Max current I_S	Low over-load P (kW)	High over-load P (kW)	Low over-load P (kW)	High over-load P (kW)
	NXP0205 5	205	226	170	255	340	110	90	132	110
FR9	NXP0261 5	261	287	205	308	349	132	110	160	132
	NXP0300 5	300	330	245	368	444	160	132	200	160
FR10	NXP0385 5	385	424	300	450	540	200	160	250	200
	NXP0460 5	460	506	385	578	693	250	200	315	250
	NXP0520 5	520	572	460	690	828	250	250	355	315
FR11	NXP0590 5	590	649	520	780	936	315	250	400	355
	NXP0650 5	650	715	590	885	1062	355	315	450	400
	NXP0730 5	730	803	650	975	1170	400	355	500	450
FR12	NXP0820 5	820	902	730	1095	1314	450	400	560	500
	NXP0920 5	920	1012	820	1230	1476	500	450	630	560
	NXP1030 5	1030	1133	920	1380	1656	560	500	710	630
FR13	NXP1150 5	1150	1265	1030	1545	1620	630	560	800	710
	NXP1300 5	1300	1430	1150	1725	2079	710	630	900	800
	NXP1450 5	1450	1595	1300	1950	2484	800	710	1000	900
FR14	NXP1770 5	1770	1947	1600	2400	2880	1000	900	1200	1100
	NXP2150 5	2150	2365	1940	2910	3492	1200	1100	1500	1300

[1] See 12.9.1 Overload Capability

[2] The currents in given ambient temperatures are achieved only when the switching frequency is the same or smaller than the factory default.

12.9.3 Power Ratings for Mains Voltage 500–690 V

Table 64: Power Ratings in Mains 500–690 V, 50/60 Hz, 3~

Enclo-sure size	Drive type	Loadability[1]					Motor shaft power			
		Low		High			690 V supply		575 V supply	
		Rated continu-ous cur-rent I_L (A) [2]	Rated overloa d cur-rent (A)	Rated continu-ous cur-rent I_H (A)	50 % over-load current (A)	Max current I_S	Low over-load P (kW)	High over-load P (kW)	Low over-load P (kW)	High over-load P (kW)
FR8	NXP0062 6	62	68	52	78	104	55	45	60	50
	NXP0080 6	80	88	62	93	124	75	55	75	60

Enclosure size	Drive type	Loadability[1]					Motor shaft power			
		Low		High			690 V supply		575 V supply	
		Rated continuous current I_L (A) [2]	Rated overload current (A)	Rated continuous current I_H (A)	50 % overload current (A)	Max current I_S	Low overload P (kW)	High overload P (kW)	Low overload P (kW)	High overload P (kW)
	NXP0100 6	100	110	80	120	160	90	75	100	75
FR9	NXP0125 6	125	138	100	150	200	110	90	125	100
	NXP0144 6	144	158	125	188	213	132	110	150	125
	NXP0170 6	170	187	144	216	245	160	132	150	150
	NXP0208 6	208	229	170	255	289	200	160	200	150
FR10	NXP0261 6	261	287	208	312	375	250	200	250	200
	NXP0325 6	325	358	261	392	470	315	250	300	250
	NXP0385 6	385	424	325	488	585	355	315	400	300
	NXP0416 6[3]	416	416	325	488	585	400	315	450	300
FR11	NXP0460 6	460	506	385	578	693	450	355	450	400
	NXP0502 6	502	552	460	690	828	500	450	500	450
	NXP0590 6[3]	590	649	502	753	904	560	500	600	500
FR12	NXP0650 6	650	715	590	885	1062	630	560	650	600
	NXP0750 6	750	825	650	975	1170	710	630	800	650
	NXP0820 6[3]	820	902	650	975	1170	800	630	750	650
FR13	NXP0920 6	920	1012	820	1230	1410	900	800	900	800
	NXP1030 6	1030	1130	920	1380	1755	1000	900	1000	900
	NXP1180 6[3]	1180	1298	1030	1463	1755	1150	1000	1100	1000
FR14	NXP1500 6	1500	1650	1300	1950	2340	1500	1300	1500	1350
	NXP1900 6	1900	2090	1500	2250	2700	1800	1500	2000	1500
	NXP2250 6[3]	2250	2475	1900	2782	3335	2000	1800	2300	2000

[1] See 12.9.1 Overload Capability

[2] The currents in given ambient temperatures are achieved only when the switching frequency is the same or smaller than the factory default.

[3] Maximum ambient temperature +35 °C (+95 °F).

12.10 VACON® NXP IP00 Drive Modules Technical Data

Table 65: Technical Data

Technical item or function		Technical data
Connection of mains	Input voltage U_{in}	380–500 V; 500–690 V; −10%…+10%

Technical item or function		Technical data
		380–500 V; 525–690 V; –10%…+10% (low harmonic drives)
	Input frequency	45–66 Hz
	Connection to mains	Once per minute or less (normal case)
	Supply grounding system	TN-S, TN-C, TN-CS, TT or IT
	Short circuit ratings	Defined by ratings of installed fuses or circuit breakers. Maximum permitted values 50 kA at 380–500 V AC, 40 kA at 525–690 V AC. Refer to cabinet specific documentation for more details
Motor connection	Output voltage	$0—U_{in}$
	Continuous output current	Ambient temperature maximum +40 °C (+104 °F), up to +50 °C (+122 °F) with current derating 1.5% per 1°. See 12.9.2 Power Ratings for Mains Voltage 380–500 V and 12.9.3 Power Ratings for Mains Voltage 500–690 V.
	Starting current	Is for 2 s every 20 s
	Output frequency	0–320 Hz; (higher with special software)
Control qualities	Control performance	• Open Loop Vector Control (5–150% of basic speed): Speed control 0.5%, dynamic 0.3%/s, torque lin. <2%, torque rise time ~5 ms • Closed Loop Vector Control (entire speed range): Speed control 0.01%, dynamic 0.2%/s, torque lin. <2%, torque rise time ~2 ms
	Switching frequency	NX_5: 1–6 kHz; Factory default 3.6 kHz[1]
		NX_6: 1–6 kHz; Factory default 1.5 kHz
	Frequency reference • Analog input • Panel reference	• Resolution 0.1% (10-bit), accuracy ±1% • Resolution 0.01 Hz
	Field weakening point	8–320 Hz
	Acceleration time	0.1–3000 s
	Deceleration time	0.1–3000 s
	Braking	DC brake: 30% x T_N (without brake option); flux braking
Ambient conditions	Ambient operating temperature	–10 °C (no frost)…+40 °C (+14 °F (no frost)...+104 °F)
	Storage temperature	–40 °C…+70 °C (-140 °F...+158 °F)
	Relative humidity	0–95% RH, non-condensing, non-corrosive, no dripping water
	Air quality: • chemical vapors • mechanical particles	Designed according to • IEC 60721-3-3 Edition 2.2, AC drive in operation, class 3C3 • IEC 60721-3-3 Edition 2.2, AC drive in operation, class 3S2
	Cabinet surface treatment	Nano ceramic pretreatment. Anodic dip-coat priming and textured powder-coating.

Technical item or function		Technical data
	Altitude	100% load capacity (no derating) up to 1000 m 1-% derating for each 100 m above 1000; maximum 3000 m (690 V max 2000 m).
	Vibration: EN50178/EN60068-2-6	Displacement amplitude 0.25 mm (peak) at 5–31 Hz Max acceleration 1 G at 31–150 Hz. Use anti-vibration mountings under the drive if extra vibration resistance is required.
	Shock: EN50178, EN60068-2-27	UPS Drop Test (for applicable UPS weights) Storage and shipping: max 15 G, 11 ms (in package)
	Protection rating	IP21/NEMA1 standard in entire kW/HP range IP54/NEMA12 option in entire kW/HP range.
	Pollution degree	PD3
EMC (at default settings)	Immunity	Fulfills all EMC immunity requirements
	Emissions	EMC level L: EN 61800-3 (2004), Category C3 EMC level T: Low earth-current solution for IT-networks, EN 61800-3 (2004), Category C4 (can be modified from level L units.
Noise level	Average noise level (cooling fan) in dB(A)	The sound pressure depends on the cooling fan speed, which is controlled in accordance with the drive temperature. FR8: 58 FR9–FR13: 76 FR14: 78
Functional safety	Hardware based 'Safe Torque Off' safety function to prevent the drive from generating torque on the motor shaft. STO safety function has been designed for use in accordance with the following standards	• EN 61800-5-2 Safe Torque Off (STO) SIL3 • EN ISO 13849-1 PL "e" Category 3 • EN 62061 SILCL3 • IEC 61508 SIL3 • The function also corresponds to an uncontrolled stop in accordance with stop category 0, EN 60204-1. • EN 954-1, Category 3
	SS1 safety function is realized in compliance with type C of the drives safety standard EN61800-5-2 (Type C: "The PDS(SR) initiates the motor deceleration and initiates the STO function after an application specific time delay"). SS1 safety function has been designed for use in accordance with the following standards:	• EN 61800-5-2 Safe Stop 1 (SS1) SIL3 • EN ISO 13849-1 PL "e" Category 3 • EN 62061 SILCL3 • IEC 61508 SIL3 • The function also corresponds to a controlled stop in accordance with stop category 1, EN60204-1.
	ATEX thermistor input	2014/34/EU, CE 0537 Ex 11 (2) GD
Approvals	-	EN 50178 (1997), EN 60204-1 (1996), EN 60950 (2000, 3rd edition) (as relevant), CE, UL, CUL, EN 61800-5; (see unit nameplate for more detailed approvals). IEC 60664-1 and UL840 in overvoltage category III.
Efficiency	-	See http://ecosmart.danfoss.com/
Control connections (factory default I/O)	Analog input voltage	0…+10 V, R_i = 200 kW, (–10 V…+10 V joystick control) Resolution 0.1%, accuracy ±1%

Technical item or function		Technical data
	Analog input current	0(4)…20 mA, R_i = 250 W differential; Resolution 0.1%, accuracy ±1%
	Digital inputs (6)	Positive or negative logic; 18…30 V DC
	Auxiliary voltage	+24 V, ±15%, max volt. ripple < 100 m Vrms; maximum 250 mA Dimensioning: Maximum 1000 mA/control box
	Output reference voltage	+10 V, ±3%, maximum load 10 mA
	Analog output	0(4)…20 mA; RL maximum 500 W; Resolution 10 bit; Accuracy ±2%
	Digital outputs	Open collector output, 50 mA/48 V
	Relay outputs	2 programmable change-over relay outputs Switching capacity: 24 VDC/8 A, 250 VAC/8 A, 125 VDC/0.4 A Min. switching load: 5 V/10 mA
	Thermistor input (OPTA3)	Galvanically isolated, Rtrip = 4.7 kΩ
Protections	Overvoltage trip limit	NX_5: 911 V DC; NX_6: 1200 V DC
	Undervoltage trip limit	NX_5: 333 V DC; NX_6: 460 V DC
	Ground fault protection	If there is a ground fault in motor or motor cable, only the AC drive is protected
	Mains supervision	Trips if any of the input phases is missing
	Motor phase supervision	Trips if any of the output phases is missing
	Overcurrent protection	Yes
	Unit overtemperature protection	Yes
	Motor overload protection	Yes[2] Motor overload protection provided at 110% of full load current
	Motor stall protection	Yes
	Motor underload protection	Yes
	Short-circuit protection of +24 V and +10 V reference voltages	Yes
Drive enclosure materials	-	Dark grey = NCS 7010-R90B (Pantone 7546C)

[1] The rated currents in given ambient temperatures are achieved only when the switching frequency is equal to or less than the factory default. Thermal management can reduce the switching frequency.

[2] System software version NXP00002V186 (or newer) must be used for the motor thermal memory and memory retention functionality to conform to UL 508C requirements. If an older system software version is used, motor overtemperature protection is required at installation to comply with UL requirements.

12.11 Brake Chopper Ratings

12.11.1 Brake Chopper Ratings for Mains Voltage 208–240 V

Table 66: Brake Chopper Ratings for VACON⁄ℰ NXP Drive Modules, Mains Voltage 208–240 V, 50/60 Hz, 3~

Enclosure size	Drive type	The minimum brake resistance [Ω]	Brake power @405 V DC [kW] [1]
FR8	0140	1.4	37.0
	0170	1.4	45.0
	0205	1.4	55.0
FR9	0261	1.4	75.0
	0300	1.4	90.0

[1] When using recommended resistor types. Peak power capability of the brake chopper can be calculated with DC-link voltage (Udc) and brake resistor resistance Rb by Udc^2/Rb.

12.11.2 Brake Chopper Ratings for Mains Voltage 380–500 V

Table 67: Brake Chopper Ratings for VACON⁄ℰ NXP IP00 Drive Modules, Mains Voltage 380–500 V, 50/60 Hz, 3~

Enclosure size	Drive type	The minimum brake resistance [Ω]	Brake power @845 V DC [kW] [1]
FR8	0140	3.3	90.0
	0168	3.3	110.0
	0205	3.3	132.0
FR9	0261	2.5	160.0
	0300	2.5	200.0
FR10	0385	1.4	250.0
	0460	1.4	315.0
	0520	1.4	355.0
FR11	0590	0.9	400.0
	0650	0.9	450.0
	0730	0.9	500.0

[1] When using recommended resistor types. Peak power capability of the brake chopper can be calculated with DC-link voltage (Udc) and brake resistor resistance Rb by Udc^2/Rb; $P=U^2/R$.

12.11.3 Brake Chopper Ratings for Mains Voltage 525–690 V

Table 68: Brake Chopper Ratings for VACON℗NXP IP00 Drive Modules, Mains Voltage 525–690 V, 50/60 Hz, 3~

Enclosure size	Drive type	The minimum brake resistance [Ω]	Brake power @1166 V DC [kW] [1]
FR8	0062	9	55.0
	0080	9	75.0
	0100	9	90.0
FR9	0125	6.7	110.0
	0144	6.7	132.0
	0170	6.7	160.0
	0208	6.7	194.2
FR10	0261	2.5	250.0
	0325	2.5	315.0
	0385	2.5	355.0
	0416	2.5	400.0
FR11	0460	1.7	450.0
	0502	1.7	500.0
	0590	1.7	560.0

[1] When using recommended resistor types. Peak power capability of the brake chopper can be calculated with DC-link voltage (Udc) and brake resistor resistance Rb by Udc^2/Rb.

12.12 Faults and Alarms

12.12.1 Fault 1 - Overcurrent, Subcode S1 - Hardware trip

Cause
There is too high a current in the motor cable. Its cause can be 1 of the following:

- A sudden heavy load increase

- A short circuit in the motor cables

- The motor is not the correct type

Troubleshooting

- Check the load.

- Check the motor.

- Check the cables and connections.

- Make an identification run.

12.12.2 Fault 1 - Overcurrent, Subcode S3 - Current limit controller supervision

Cause

There is too high a current in the motor cable. Its cause can be 1 of the following:

- A sudden heavy load increase

- A short circuit in the motor cables

- The motor is not the correct type

Troubleshooting

- Check the load.

- Check the motor.

- Check the cables and connections.

- Make an identification run.

12.12.3 Fault 1 - Overcurrent, Subcode S4 - Software-based overcurrent fault

Cause

There is too high a current in the motor cable. Its cause can be 1 of the following:

- A sudden heavy load increase

- A short circuit in the motor cables

- The motor is not the correct type

Troubleshooting

- Check the load.

- Check the motor.

- Check the cables and connections.

- Make an identification run.

12.12.4 Fault 2 - Overvoltage, Subcode S1 - Hardware trip

Cause

The DC-link voltage is higher than the limits.

- Too short a deceleration time

- High overvoltage spikes in the supply

- Start/Stop sequence too fast

Troubleshooting

- Set the deceleration time longer.

- Use the brake chopper or the brake resistor. They are available as options.

- Activate the overvoltage controller.

- Do a check of the input voltage.

12.12.5 Fault 2 - Overvoltage, Subcode S2 - Overvoltage control supervision

Cause

The DC-link voltage is higher than the limits.

- Too short a deceleration time

- High overvoltage spikes in the supply

- Motor load is generative

- Start/Stop sequence too fast

Troubleshooting

- Set the deceleration time longer.

- Use the brake chopper or the brake resistor. They are available as options.

- Activate the overvoltage controller.

- Do a check of the input voltage.

12.12.6 Fault 3 - Earth fault

Cause
The measurement of current tells that the sum of the motor phase current is not zero.

- Insulation malfunction in the cables or in the motor.

It is possible to set different responses in the application for this fault. See parameter group Protections.

Troubleshooting
Do a check of the motor cables and the motor.

12.12.7 Fault 5 - Charging switch

Cause
The charging switch is open, when the START command is given.

- Operation malfunction

- Defective component

Troubleshooting

- Reset the fault and start the drive again.

- If the fault shows again, ask instructions from the local distributor.

12.12.8 Fault 6 - Emergency stop

Cause
Stop signal has been given from the option board.

Troubleshooting
Do a check of the emergency stop circuit.

12.12.9 Fault 7 - Saturation trip

Cause

- Defective component

- Brake resistor short circuit or overload

Troubleshooting
This fault cannot be reset from the control panel.

- Switch off the power.

- DO NOT RESTART THE DRIVE OR CONNECT THE POWER!

- Ask instructions from the factory. If this fault shows at the same time with Fault 1, do a check of the motor cable and the motor.

12.12.10 Fault 8 - System fault, Subcode S1 - ASIC phase feedback

Cause

- Operation malfunction

- Defective component

Troubleshooting

- Reset the fault and start the drive again.

- If the fault shows again, ask instructions from the local distributor.

12.12.11 Fault 8 - System fault, Subcode S4 - ASIC trip

Cause

- Operation malfunction

- Defective component

Troubleshooting

- Reset the fault and start the drive again.

- If the fault shows again, ask instructions from the local distributor.

12.12.12 Fault 8 - System fault, Subcode S5 - Disturbance in VaconBus

Cause

- Operation malfunction

- Defective component

Troubleshooting

- Reset the fault and start the drive again.

- If the fault shows again, ask instructions from the local distributor.

12.12.13 Fault 8 - System fault, Subcode S6 - Feedback of charging switch

Cause

- Operation malfunction

- Defective component

Troubleshooting

- Reset the fault and start the drive again.

- If the fault shows again, ask instructions from the local distributor.

12.12.14 Fault 8 - System fault, Subcode S7 - Charging switch

Cause

- Operation malfunction

- Defective component

Troubleshooting

- Reset the fault and start the drive again.

- If the fault shows again, ask instructions from the local distributor.

12.12.15 Fault 8 - System fault, Subcode S8 - No power to driver card

Cause

- Operation malfunction

- Defective component

Troubleshooting

- Reset the fault and start the drive again.

- If the fault shows again, ask instructions from the local distributor.

12.12.16 Fault 8 - System fault, Subcode S9 - Power unit communication (TX)

Cause

- Operation malfunction

- Defective component

Troubleshooting

- Reset the fault and start the drive again.

- If the fault shows again, ask instructions from the local distributor.

12.12.17 Fault 8 - System fault, Subcode S10 - Power unit communication (Trip)

Cause

- Operation malfunction

- Defective component

Troubleshooting

- Reset the fault and start the drive again.

- If the fault shows again, ask instructions from the local distributor.

12.12.18 Fault 8 - System fault, Subcode S11 - Power unit comm. (Measurement)

Cause

- Operation malfunction

- Defective component

Troubleshooting

- Reset the fault and start the drive again.

- If the fault shows again, ask instructions from the local distributor.

12.12.19 Fault 8 - System fault, Subcode S12 - System bus fault (slot D or E)

Cause
Error in system bus option board (OPTD1 or OPTD2) in slot D or E.

- Operation malfunction

- Defective component

Troubleshooting

- Reset the fault and start the drive again.

- If the fault shows again, ask instructions from the local distributor.

- Check the cables and connections.

12.12.20 Fault 8 - System fault, Subcode S30 - OPTAF: STO channels are different from each other

Cause
The Safe Disable inputs are in different states. It is not allowed according to EN954-1, category 3. This fault occurs when the Safe Disable inputs are in different states for more than 5 s.

Troubleshooting

- Check the S1 switch.

- Check the cabling to the OPTAF board.

- If the fault shows again, ask instructions from the local distributor.

12.12.21 Fault 8 - System fault, Subcode S31 - OPTAF: Thermistor short circuit detected

Cause
Thermistor short circuit detected.

Troubleshooting

- Correct the cable connections.

- Check the jumper for the thermistor short circuit supervision, if the thermistor function is not used and the thermistor input is short-circuited.

12.12.22 Fault 8 - System fault, Subcode S32 - OPTAF board has been removed

Cause
OPTAF board has been removed. It is not allowed to remove the OPTAF board once the software has recognized it.

Troubleshooting
The system requires a manual acknowledgement using *System* menu parameter P6.5.5 OPTAF Remove. Ask help from the local distributor.

12.12.23 Fault 8 - System fault, Subcode S33 - OPTAF: EEPROM error

Cause
OPTAF board EEPROM error (checksum, not answering and so on).

Troubleshooting
Change the OPTAF board.

12.12.24 Fault 8 - System fault, Subcode S34 - OPTAF: Voltage problem

Cause
OPTAF supply voltage hardware problem detected.

Troubleshooting
Change the OPTAF board.

12.12.25 Fault 8 - System fault, Subcode S35 - OPTAF: Overvoltage

Cause
OPTAF supply voltage hardware problem detected.

Troubleshooting
Change the OPTAF board.

12.12.26 Fault 8 - System fault, Subcode S36 - OPTAF: Undervoltage

Cause
OPTAF supply voltage hardware problem detected.

Troubleshooting
Change the OPTAF board.

12.12.27 Fault 8 - System fault, Subcode S37 - OPTAF: Test pulse is not detected in both STO channels

Cause
Single hardware problem detected in Safe Disable inputs.

Troubleshooting

• Change the OPTAF board.

• Change the control board.

12.12.28 Fault 8 - System fault, Subcode S38 - OPTAF: Test pulse is not detected in STO channel 1

Cause
Single hardware problem detected in Safe Disable inputs.

Troubleshooting

• Change the OPTAF board.

• Change the control board.

12.12.29 Fault 8 - System fault, Subcode S39 - OPTAF: Test pulse is not detected in STO channel 2

Cause
Single hardware problem detected in Safe Disable inputs.

Troubleshooting

• Change the OPTAF board.

• Change the control board.

12.12.30 Fault 8 - System fault, Subcode S40 - OPTAF: ASIC trip ETR is not set, even if STO channel 1 is active

Cause
Single hardware problem detected in Safe Disable inputs.

Troubleshooting

• Change the OPTAF board.

• Change the control board.

12.12.31 Fault 8 - System fault, Subcode S41 - OPTAF: STO channels are not active when the thermistor trip is active

Cause

Single hardware problem detected in the thermistor input.

Troubleshooting

Change the OPTAF board.

12.12.32 Fault 8 - System fault, Subcode S42 - OPTAF: Test pulse low is not detected on thermistor

Cause

Single hardware problem detected in the thermistor input.

Troubleshooting

Change the OPTAF board.

12.12.33 Fault 8 - System fault, Subcode S43 - OPTAF: Test pulse high is not detected on thermistor

Cause

Single hardware problem detected in the thermistor input.

Troubleshooting

Change the OPTAF board.

12.12.34 Fault 8 - System fault, Subcode S44 - OPTAF: STO channel 1 is not active, even if the analog input supervision indicates

Cause

Single hardware problem detected in Safe Disable inputs or in the thermistor input.

Troubleshooting

- Change the OPTAF board.

- Change the control board.

12.12.35 Fault 8 - System fault, Subcode S45 - OPTAF: STO channel 2 is not active, even if the analog input supervision indicates

Cause

Single hardware problem detected in Safe Disable inputs or in the thermistor input.

Troubleshooting

- Change the OPTAF board.

- Change the control board.

12.12.36 Fault 8 - System fault, Subcode S46 - OPTAF: Thermistor or analog input is not set, even if STO is active

Cause

Single hardware problem detected in Safe Disable inputs or in the thermistor input.

Troubleshooting

- Change the OPTAF board.

- Change the control board.

12.12.37 Fault 8 - System fault, Subcode S47 - OPTAF: Board mounted in old NXP control board with no safety hardware

Cause

OPTAF board mounted in old VACON® NXP control board, which is not equipped with the Safe Disable function.

Troubleshooting

Change the control board to VB00561 revision H or newer.

12.12.38 Fault 8 - System fault, Subcode S48 - OPTAF: Mismatch between Therm Trip (HW) parameter and jumper setting

Cause

The parameter Expander boards/ SlotB/ Therm Trip(HW) is set to OFF even though the jumper X12 is not cut.

Troubleshooting

Correct the parameter P7.2.1.1 Therm Trip (HW) to match the X12 jumper setting.

12.12.39 Fault 8 - System fault, Subcode S50 - OPTAF: Filter discharge resistor fault

Cause

Problem with the control board.

Troubleshooting

Ask instructions from the local distributor.

12.12.40 Fault 8 - System fault, Subcode S70 - False fault activated

Cause

Fault in application.

Troubleshooting

Ask instructions from the local distributor.

12.12.41 Fault 9 - Undervoltage, Subcode S1 - DC-link too low during run

Cause

The DC-link voltage is lower than the limits.

- Too low a supply voltage

- AC drive internal fault

- A defective input fuse

- The external charge switch is not closed.

Troubleshooting

- If there is a temporary supply voltage break, reset the fault and start the drive again.

- Do a check of the supply voltage. If the supply voltage is sufficient, there is an internal fault.

- Ask instructions from the local distributor.

12.12.42 Fault 9 - Undervoltage, Subcode S2 - No data from power unit

Cause

The DC-link voltage is lower than the limits.

- Too low a supply voltage

- AC drive internal fault

- a defective input fuse

- the external charge switch is not closed.

Troubleshooting

- If there is a temporary supply voltage break, reset the fault and start the drive again.

- Do a check of the supply voltage. If the supply voltage is sufficient, there is an internal fault.

- Ask instructions from the local distributor.

12.12.43 Fault 9 - Undervoltage, Subcode S3 - Undervoltage control supervision

Cause

The DC-link voltage is lower than the limits.

- Too low a supply voltage

- AC drive internal fault

- A defective input fuse

- The external charge switch is not closed.

Troubleshooting

- If there is a temporary supply voltage break, reset the fault and start the drive again.

- Do a check of the supply voltage. If the supply voltage is sufficient, there is an internal fault.

- Ask instructions from the local distributor.

12.12.44 Fault 10 - Input line supervision, Subcode S1 - Phase supervision diode supply

Cause

The input line phase is missing.

Troubleshooting

Do a check of the supply voltage, the fuses, and supply cable.

12.12.45 Fault 11 - Output phase supervision, Subcode S1 - Common output phase supervision

Cause

The measurement of current tells that there is no current in 1 motor phase.

It is possible to set different responses in the application for this fault. See parameter group Protections.

Troubleshooting

Do a check of the motor cable and the motor.

12.12.46 Fault 11 - Output phase supervision, Subcode S2 - Additional closed loop control output phase fault

Cause

The measurement of current tells that there is no current in 1 motor phase.

It is possible to set different responses in the application for this fault. See parameter group Protections.

Troubleshooting

Do a check of the motor cable and the motor.

12.12.47 Fault 11 - Output phase supervision, Subcode S3 - Additional open loop control output phase fault during start DC brake

Cause

The measurement of current tells that there is no current in 1 motor phase.

It is possible to set different responses in the application for this fault. See parameter group Protections.

Troubleshooting

Do a check of the motor cable and the motor.

12.12.48 Fault 11 - Output phase supervision, Subcode S4 - Additional closed loop output phase fault during PM StartAngleID run

Cause

The measurement of current tells that there is no current in 1 motor phase.

It is possible to set different responses in the application for this fault. See parameter group Protections.

Troubleshooting

Do a check of the motor cable and the motor.

12.12.49 Fault 12 - Brake chopper supervision

Cause

- There is no brake resistor.

- The brake resistor is broken.

- A defective brake chopper.

Troubleshooting

- Do a check of the brake resistor and the cabling.

- If they are in good condition, there is a fault in the resistor or the brake chopper. Ask instructions from the local distributor.

12.12.50 Fault 13 - AC drive undertemperature

Cause

Too low a temperature in the heat sink of the power unit or in the power board. The heat sink temperature is below -10 °C (14 °F).

Troubleshooting

Add an external heater near the AC drive.

12.12.51 Fault 14 - AC drive overtemperature, Subcode S1 - Overtemperature warning in unit, board, or phases

Cause
Overheating detected in AC drive.

Heat sink temperature is over 90 °C (194 °F). Overtemperature alarm is issued when the heat sink temperature goes over 85 °C (185 °F).

In 525–690 V, FR6: Heat sink temperature is over 77 °C (170.6 °F). Overtemperature alarm is issued when the heat sink temperature goes over 72 °C (161.6 °F).

Troubleshooting

- Do a check of the actual amount and flow of cooling air.

- Examine the heat sink for dust.

- Do a check of the ambient temperature.

- Make sure that the switching frequency is not too high in relation to the ambient temperature and the motor load.

- For FR10-FR11 Standalone: check door filters, and clean or replace if needed.

12.12.52 Fault 14 - AC drive overtemperature, Subcode S2 - Overtemperature in power board

Cause
Overheating detected in AC drive.

Heat sink temperature is over 90 °C (194 °F). Overtemperature alarm is issued when the heat sink temperature goes over 85 °C (185 °F).

In 525–690 V, FR6: Heat sink temperature is over 77 °C (170.6 °F). Overtemperature alarm is issued when the heat sink temperature goes over 72 °C (161.6 °F).

Troubleshooting

- Do a check of the actual amount and flow of cooling air.

- Examine the heat sink for dust.

- Do a check of the ambient temperature.

- Make sure that the switching frequency is not too high in relation to the ambient temperature and the motor load.

- For FR10-FR11 Standalone: check door filters, and clean or replace if needed.

12.12.53 Fault 14 - AC drive overtemperature, Subcode S4 - Overtemperature on ASIC board or driver boards

Cause
Overheating detected in AC drive.

Heat sink temperature is over 90 °C (194 °F). Overtemperature alarm is issued when the heat sink temperature goes over 85 °C (185 °F).

In 525–690 V, FR6: Heat sink temperature is over 77 °C (170.6 °F). Overtemperature alarm is issued when the heat sink temperature goes over 72 °C (161.6 °F).

Troubleshooting

- Do a check of the actual amount and flow of cooling air.

- Examine the heat sink for dust.

- Do a check of the ambient temperature.

- Make sure that the switching frequency is not too high in relation to the ambient temperature and the motor load.

- For FR10-FR11 Standalone: check door filters, and clean or replace if needed.

12.12.54 Fault 15 - Motor stalled

Cause
The motor stalled.

It is possible to set different responses in the application for this fault. See parameter group Protections.

Troubleshooting

- Check the motor and the load.

- Insufficient motor power, check motor stall protection parameterization.

12.12.55 Fault 16 - Motor overtemperature

Cause
There is too heavy a load on the motor.

It is possible to set different responses in the application for this fault. See parameter group Protections.

Troubleshooting

- Decrease the motor load.

- If there is no motor overload, do a check of the temperature model parameters.

12.12.56 Fault 17 - Motor underload

Cause
Motor underload protection has tripped.

It is possible to set different responses in the application for this fault. See parameter group Protections.

Troubleshooting

- Check the load.

- Check underload protection parameterization.

12.12.57 Fault 18 - Unbalance, Subcode S1 - Current unbalance

Cause
Unbalance between power modules in paralleled power units.

This fault is type A fault (Alarm).

Troubleshooting
If the fault occurs again, ask instructions from the local distributor.

12.12.58 Fault 18 - Unbalance, Subcode S2 - DC voltage unbalance

Cause
Unbalance between power modules in paralleled power units.

This fault is type A fault (Alarm).

Troubleshooting
If the fault occurs again, ask instructions from the local distributor.

12.12.59 Fault 19 - Current overload

Cause
Motor current overload warning.

Troubleshooting
Ask instructions from the local distributor.

12.12.60 Fault 22 - Parameter fault, Subcode S1 - Firmware interface power down variable check-sum error

Cause
Parameter save fault.

- Operation malfunction

- defective component

Troubleshooting
If the fault occurs again, ask instructions from the local distributor.

12.12.61 Fault 22 - Parameter fault, Subcode S2 - Firmware interface variable check sum error

Cause
Parameter save fault.

- Operation malfunction

- defective component

Troubleshooting
If the fault occurs again, ask instructions from the local distributor.

12.12.62 Fault 22 - Parameter fault, Subcode S3 - System power down variable check sum error

Cause
Parameter save fault.

- Operation malfunction

- defective component

Troubleshooting
If the fault occurs again, ask instructions from the local distributor.

12.12.63 Fault 22 - Parameter fault, Subcode S4 - System parameter checksum error

Cause
Parameter save fault.

- Operation malfunction

- defective component

Troubleshooting
If the fault occurs again, ask instructions from the local distributor.

12.12.64 Fault 22 - Parameter fault, Subcode S5 - Application-defined power-down, variable checksum error

Cause
Parameter save fault.

- Operation malfunction

- defective component

Troubleshooting
If the fault occurs again, ask instructions from the local distributor.

12.12.65 Fault 22 - Parameter fault, Subcode S6 - Application-defined power-down, variable checksum

Cause
Parameter save fault.

- Operation malfunction

- defective component

Troubleshooting
If the fault occurs again, ask instructions from the local distributor.

12.12.66 Fault 22 - Parameter fault, Subcode S10 - System parameter checksum error

Cause
Parameter save fault.

- Operation malfunction

- defective component

Troubleshooting
If the fault occurs again, ask instructions from the local distributor.

12.12.67 Fault 22 - Parameter fault, Subcode S13 - Checksum error in application-specific parameter set

Cause
Parameter save fault.

Troubleshooting

- Recommission the application.

- Check parameters.

12.12.68 Fault 24 - Counter fault

Cause

Values that showed on the counters are incorrect.

Troubleshooting

Have a critical attitude towards values shown on counters.

12.12.69 Fault 25 - Microprocessor watchdog fault, Subcode S1 - CPU watchdog timer

Cause

- operation malfunction

- defective component

Troubleshooting

- Reset the fault and start the drive again.

- If the fault shows again, ask instructions from the local distributor.

12.12.70 Fault 25 - Microprocessor watchdog fault, Subcode S2 - ASIC reset

Cause

- operation malfunction

- defective component

Troubleshooting

- Reset the fault and start the drive again.

- If the fault shows again, ask instructions from the local distributor.

12.12.71 Fault 26 - Start-up prevented, Subcode S1 - Prevention of accidental start-up

Cause

Start-up of the drive has been prevented. Run request is ON when new application is downloaded to the drive.

Troubleshooting

- Cancel prevention of start-up if it can be done safely.

- Remove Run request.

12.12.72 Fault 26 - Start-up prevented, Subcode S2 - RUN request is kept active after drive returns to READY state from safe state

Cause

Start-up of the drive has been prevented. START command is ON when returning to READY state after Safe Disable has been active.

Troubleshooting

- Cancel prevention of start-up if it can be done safely.

- Remove Run request.

12.12.73 Fault 26 - Start-up prevented, Subcode S30 - RUN request given too quickly

Cause

Start-up of the drive has been prevented. START command is ON after system software or application was downloaded, or after application was changed.

Troubleshooting

- Cancel prevention of start-up if it can be done safely.

- Remove Run request.

12.12.74 Fault 29 - Thermistor fault, Subcode S1 - Thermistor input activated on OPTAF board

Cause

The thermistor input of option board has detected increase of the motor temperature.

It is possible to set different responses in the application for this fault. See parameter group Protections.

Troubleshooting

- Do a check of the motor cooling and loading.

- Do a check of the thermistor connection.

- (If thermistor input of the option board is not in use it has to be short-circuited).

12.12.75 Fault 29 - Thermistor fault, Subcode S2 - Special application

Cause
The thermistor input of option board has detected increase of the motor temperature.

It is possible to set different responses in the application for this fault. See parameter group Protections.

Troubleshooting

- Do a check of the motor cooling and loading.

- Do a check of the thermistor connection.

- (If thermistor input of the option board is not in use it has to be short-circuited).

12.12.76 Fault 30 - Safe disable

Cause
The input on OPTAF board has opened.

STO inputs SD1 and SD2 are activated through the OPTAF option board.

Troubleshooting
Cancel Safe Disable if it can be done safely.

12.12.77 Fault 31 - IGBT temperature (hardware)

Cause
IGBT Inverter Bridge overtemperature protection has detected too high a short-term overload current.

Troubleshooting

- Check the load.

- Check the motor frame size.

- Make an identification run.

12.12.78 Fault 32 - Fan cooling

Cause
Cooling fan of the AC drive does not start, when ON command is given.

Troubleshooting
Ask instructions from the local distributor.

12.12.79 Fault 34 - CAN bus communication

Cause
Sent message not acknowledged.

Troubleshooting
Make sure that there is another device on the bus with the same configuration.

12.12.80 Fault 35 - Application

Cause
Problem in application software.

Troubleshooting

- Ask instructions from the local distributor.

- For an application programmer: do a check of the application program.

12.12.81 Fault 36 - Control unit

Cause

- The software needs newer version of the control unit.

Troubleshooting

- Change the control unit.

12.12.82 Fault 37 - Device changed (same type), Subcode S1 - Control board
Cause
A new option board has replaced the old one in the same slot. The parameters are available in the drive.
Troubleshooting
Reset the fault. The device is ready for use. The drive starts to use the old parameter settings.

12.12.83 Fault 38 - Device added (same type), Subcode S1 - Control board
Cause
The option board was added. The same option board has been used in the same slot before. The parameters are available in the drive.
Troubleshooting
Reset the fault. The device is ready for use. The drive starts to use the old parameter settings.

12.12.84 Fault 39 - Device removed
Cause
An option board was removed from the slot.
Troubleshooting
The device is not available. Reset the fault.

12.12.85 Fault 40 - Device unknown, Subcode S1 - Unknown device
Cause
An unknown or mismatching device was connected (the power unit or option board).
Troubleshooting
Ask instructions from the local distributor.

12.12.86 Fault 40 - Device unknown, Subcode S2 - StarCoupler: power sub units are not identical
Cause
An unknown or mismatching device was connected (the power unit or option board).
Troubleshooting
Ask instructions from the local distributor.

12.12.87 Fault 40 - Device unknown, Subcode S3 - StarCoupler is not compatible with the control board
Cause
An unknown or mismatching device was connected (the power unit or option board).
Troubleshooting
Ask instructions from the local distributor.

12.12.88 Fault 40 - Device unknown, Subcode S4 - Wrong PropertiesType in control board EEPROM
Cause
An unknown or mismatching device was connected (the power unit or option board).
Troubleshooting
Ask instructions from the local distributor.

12.12.89 Fault 40 - Device unknown, Subcode S5 - Wrong VACON® NXP control board EEPROM size detected
Cause
An unknown or mismatching device was connected (the power unit or option board).
Troubleshooting
Ask instructions from the local distributor.

12.12.90 Fault 40 - Device unknown, Subcode S6 - Old power unit (Asic) and new software mismatch

Cause

An unknown or mismatching device was connected (the power unit or option board).

Troubleshooting

Ask instructions from the local distributor.

12.12.91 Fault 40 - Device unknown, Subcode S7 - Old ASIC detected

Cause

An unknown or mismatching device was connected (the power unit or option board).

Troubleshooting

Ask instructions from the local distributor.

12.12.92 Fault 41 - IGBT temperature, Subcode S1 - Calculated IGBT temperature too high

Cause

IGBT Inverter Bridge overtemperature protection has detected too high a short-term overload current.

Troubleshooting

- Check the load.

- Check the motor frame size.

- Make an identification run.

12.12.93 Fault 41 - IGBT temperature, Subcode S3 - Calculated IGBT temperature too high (long-term protection)

Cause

IGBT Inverter Bridge overtemperature protection has detected too high a short-term overload current.

Troubleshooting

- Check the load.

- Check the motor frame size.

- Make an identification run.

12.12.94 Fault 41 - IGBT temperature, Subcode S4 - Peak current too high

Cause

IGBT Inverter Bridge overtemperature protection has detected too high a short-term overload current.

Troubleshooting

- Check the load.

- Check the motor frame size.

- Make an identification run.

12.12.95 Fault 41 - IGBT temperature, Subcode S5 - BCU: Filtered current too high for some time

Cause

IGBT Inverter Bridge overtemperature protection has detected too high a short-term overload current.

Troubleshooting

- Check the load.

- Check the motor frame size.

- Make an identification run.

12.12.96 Fault 41 - IGBT temperature, Subcode S6 - BCU: Current momentarily too high

Cause

IGBT Inverter Bridge overtemperature protection has detected too high a short-term overload current.

Troubleshooting

- Check the load.

- Check the motor frame size.

- Make an identification run.

- Check brake resistor resistance.

12.12.97 Fault 42 - Brake resistor overtemperature, Subcode S1 - Internal brake chopper overtemperature

Cause

Brake resistor overtemperature protection has detected too heavy braking.

Troubleshooting

- Reset unit.

- Set the deceleration time longer.

- Dimensioning of the brake chopper is not correct.

- Use external brake resistor.

12.12.98 Fault 42 - Brake resistor overtemperature, Subcode S2 - Brake resistance too high (BCU)

Cause

Brake resistor overtemperature protection has detected too heavy braking.

Troubleshooting

- Reset unit.

- Set the deceleration time longer.

- Dimensioning of the brake chopper is not correct.

- Use external brake resistor.

12.12.99 Fault 42 - Brake resistor overtemperature, Subcode S3 - Brake resistance too low (BCU)

Cause

Brake resistor overtemperature protection has detected too heavy braking.

Troubleshooting

- Reset unit.

- Set the deceleration time longer.

- Dimensioning of the brake chopper is not correct.

- Use external brake resistor.

12.12.100 Fault 42 - Brake resistor overtemperature, Subcode S4 - Brake resistance not detected (BCU)

Cause

Brake resistor overtemperature protection has detected too heavy braking.

Troubleshooting

- Reset unit.

- Set the deceleration time longer.

- Dimensioning of the brake chopper is not correct.

- Use external brake resistor.

12.12.101 Fault 42 - Brake resistor overtemperature, Subcode S5 - Brake resistance leakage (earth fault) (BCU)

Cause

Brake resistor overtemperature protection has detected too heavy braking.

Troubleshooting

- Reset unit.

- Set the deceleration time longer.

- Dimensioning of the brake chopper is not correct.

- Use external brake resistor.

12.12.102 Fault 43 - Encoder fault, Subcode S1 - Encoder 1 channel A is missing

Cause
Problem detected in encoder signals.

Encoder channel A is missing.

Troubleshooting

- Do a check of the encoder connections.

- Do a check of the option board.

- Measure the encoder pulses.

    - If the pulses are correct, the option board is faulty.

    - If the pulses are not correct, the encoder/cabling is faulty.

12.12.103 Fault 43 - Encoder fault, Subcode S2 - Encoder 1 channel B is missing

Cause
Problem detected in encoder signals.

Encoder channel B is missing.

Troubleshooting

- Do a check of the encoder connections.

- Do a check of the option board.

- Measure the encoder pulses.

    - If the pulses are correct, the option board is faulty.

    - If the pulses are not correct, the encoder/cabling is faulty.

12.12.104 Fault 43 - Encoder fault, Subcode S3 - Both encoder 1 channels are missing

Cause
Problem detected in encoder signals.

Encoder channels A and B are missing.

Troubleshooting

- Do a check of the encoder connections.

- Do a check of the option board.

- Measure the encoder pulses.

    - If the pulses are correct, the option board is faulty.

    - If the pulses are not correct, the encoder/cabling is faulty.

12.12.105 Fault 43 - Encoder fault, Subcode S4 - Encoder reversed

Cause
Problem detected in encoder signals.

The encoder is reversed. The output frequency has been set to the positive value, but the encoder signal is negative.

Troubleshooting
Change the frequency value polarity so that the encoder signal is positive. With some encoders, interchanging the encoder channels can be used to change the indicated rotation direction.

12.12.106 Fault 43 - Encoder fault, Subcode S5 - Encoder board missing

Cause
The encoder board is missing.

Troubleshooting

- Do a check of the encoder board.
- Do a check of the terminals.
- Do a check of the board connections.

12.12.107 Fault 43 - Encoder fault, Subcode S6 - Serial communication fault

Cause
Problem detected in encoder signals.

Serial communication fault. The encoder cable is not connected or there are interferences in the cable.

Troubleshooting

- Check cabling between encoder and OPTBE, especially Data and Clock signals.
- Check that actual encoder type matches with OPTBE "Operating mode" parameter.

12.12.108 Fault 43 - Encoder fault, Subcode S7 - Ch A / Ch B Mismatch

Cause
Problem detected in encoder signals.

Encoder channels A and B are mismatched.

Troubleshooting
Do a check of the cable connections and terminals.

12.12.109 Fault 43 - Encoder fault, Subcode S8 - Resolver/Motor pole pair mismatch

Cause
Problem detected in parameterization of option board.

There is a mismatch of the resolver/ motor pole pair number. Resolver pole pair number (if >1) is not matching the motor pole pair number.

Troubleshooting
Check that OPTBC parameter "Resolver Poles" and possible Gear Ratio parameters in application match motor pole count.

12.12.110 Fault 43 - Encoder fault, Subcode S9 - Missed Start Angle

Cause
Encoder zero positioning identification run has not been made.

The encoder start angle is missing.

Troubleshooting
Make encoder identification run.

12.12.111 Fault 43 - Encoder fault, Subcode S10 - Sin/Cos encoder feedback is missing

Cause
Problem detected in encoder signals.

For the closed loop control, encoder modes "EnDat only" or "SSI only" (absolute channel only) are not allowed.

Troubleshooting

- Do a check of the wiring, jumper settings, and encoder mode.
- Change OPTBE "Operating mode" parameter is either "EnDat+SinCos", "SSI+SinCos" or "SinCos only", or avoid using closed loop control.

12.12.112 Fault 43 - Encoder fault, Subcode S11 - Encoder angle is drifting

Cause
Error angle between the angle read from the absolute channel and the angle calculated from the incremental channels.

Troubleshooting

- Check the encoder cable, cable shield, and grounding of the cable shield.
- Check the mechanical mounting of the encoder and make sure that the encoder is not slipping.
- Check the encoder parameters (for example, encoder ppr).

12.12.113 Fault 43 - Encoder fault, Subcode S12 - Dual speed supervision fault

Cause

Encoder speed supervision. The difference between the encoder speed and estimated speed is too large. Dual speed supervision: Estimated speed and encoder speed difference is too high ($0.05 \times f_n$ or minimum motor nominal slip frequency). See variable EstimatedShaftFrequency.

Troubleshooting

- Check the encoder speed signal ShaftFrequency vs. EstimatedShaftFrequency.

- If the ShaftFrequency is incorrect, check the encoder, cable, and encoder parameters.

- If the EstimatedShaftFrequency is incorrect, check the motor parameters.

12.12.114 Fault 43 - Encoder fault, Subcode S13 - Encoder angle supervision fault

Cause

The estimated shaft position error (estimated angle - encoder angle) is more than 90° electrical.

See variable EstimatedAngleError.

Troubleshooting

- Repeat the encoder ID run (absolute encoders).

- Check the mechanical mounting of the encoder and make sure that the encoder is not slipping.

- Check the encoder ppr number.

- Check the encoder cable.

12.12.115 Fault 43 - Encoder fault, Subcode S14 - Encoder estimated missing pulse fault, switch from the CL ctrl to the OL sensorl

Cause

Problem detected in encoder signals.

Software has detected too many missing pulses in the encoder. Closed loop control is switched to sensorless open loop control.

Troubleshooting

- Do a check of the encoder.

- Do a check of the encoder cable, cable shield, and grounding of the cable shield.

- Do a check of the mechanical mounting of the encoder.

- Do a check of the encoder parameters.

12.12.116 Fault 44 - Device changed (different type), Subcode S1 - Control board

Cause

- Option board or power unit changed.

- New device of different type or different power rating.

Troubleshooting

- Reset.

- If option board was changed, set the option board parameters again.

- If power unit was changed, set AC drive parameters again.

12.12.117 Fault 45 - Device added (different type), Subcode S1 - Control board

Cause

Option board of different type added.

Troubleshooting

- Reset.

- Set the power unit parameters again.

12.12.118 Fault 49 - Division by zero in application

Cause

Division by zero has occurred in application program.

Troubleshooting

- If the fault shows again while the AC drive is in run state, ask instructions from the local distributor.

- For an application programmer: do a check of the application program.

12.12.119 Fault 50 - Analogue input Iin < 4 mA (sel. signal range 4 to 20 mA)

Cause
Current at the analog input is < 4 mA.

- Control cable is broken or loose

- signal source has failed.

Troubleshooting
Do a check of the current loop circuitry.

12.12.120 Fault 51 - External fault 1

Cause
Digital input fault.

Digital input has been programmed as external fault 1 input and this input is active.

Troubleshooting

- Check the programming.

- Check the device which the error message indicates.

- Check the cabling for the respective device.

12.12.121 Fault 52 - Keypad communication fault

Cause
The connection between the control panel (or VACON Æ NCDrive) and the drive is defective.

Troubleshooting
Do a check of the control panel connection and the control panel cable.

12.12.122 Fault 53 - Fieldbus fault

Cause
The data connection between the fieldbus master and the fieldbus board is defective.

Troubleshooting

- Do a check of the installation and fieldbus master.

- If the installation is correct, ask instructions from the local distributor.

12.12.123 Fault 54 - Slot fault

Cause
Defective option board or slot.

Troubleshooting

- Do a check of the board and slot.

- Ask instructions from the local distributor.

12.12.124 Fault 56 - Measured Temperature

Cause
Shows temperature measurement fault for option board OPTBH or OPTB8.

- Temperature exceeded set limit.

- Sensor disconnected.

- Short circuit.

Troubleshooting
Find the cause of temperature rise.

12.12.125 Fault 57 - Identification

Cause
Identification run has failed.

This fault is type A fault (Alarm).

Troubleshooting

- Run command was removed before completion of identification run.

- The motor is not connected to the AC drive.

- There is load on motor shaft.

12.12.126 Fault 58 - Brake

Cause
Actual status of the brake is different from the control signal.

It is possible to set different responses in the application for this fault. See parameter group Protections.

Troubleshooting
Do a check of the mechanical brake state and connections.

12.12.127 Fault 59 - Follower communication

Cause
SystemBus or CAN communication is broken between Master and Follower.

Troubleshooting

- Do a check of the option board parameters.

- Do a check of the optical fiber cable or CAN cable.

12.12.128 Fault 60 - Cooling

Cause
External cooling has failed.

Normally this fault comes from the heat exchanger unit.

Troubleshooting
Do a check of the reason for the failure on the external system.

12.12.129 Fault 61 - Speed error

Cause
Motor speed is unequal to reference.

Troubleshooting

- Do a check of the encoder connection.

- PMS motor has exceeded the pull-out torque.

12.12.130 Fault 62 - Run disable

Cause
Run enable signal is low.

Troubleshooting
Do a check of the reason for the Run enable signal.

12.12.131 Fault 63 - Quick stop

Cause
Command for quick stop received from digital input or fieldbus.

This fault is type A fault (Alarm).

Troubleshooting
Reset the fault.

12.12.132 Fault 64 - Input switch open

Cause
Drive input switch is open.

This fault is type A fault (Alarm)

Troubleshooting
Do a check of the main power switch of the drive.

12.12.133 Fault 65 - Measured Temperature

Cause
Shows temperature measurement fault for option board OPTBH or OPTB8.

- Temperature exceeded set limit.

- Sensor disconnected.

- Short circuit.

Troubleshooting
Find the cause of temperature rise or sensor malfunction.

12.12.134 Fault 70 - Active filter fault

Cause
Fault triggered by digital input (see param. P2.2.7.33).

It is possible to set different responses in the application for this fault. See parameter group Protections.

Troubleshooting
Remove fault situation on active filter.

12.12.135 Fault 74 - Follower fault

Cause
When using normal Master Follower function this fault code is given if one or more follower drives trips to fault.

Troubleshooting
Correct the fault cause on follower and reset fault.

12.12.136 Fault 85 - Baseline Run

Cause
There was a failure during the baseline run.

Troubleshooting
Check parameters in the baseline run settings.

12.12.137 Fault 86 - Condition-based Monitoring, Subcode A1 - Motor Stator Winding Current Fault

Cause
Current unbalance has exceeded the detection high limit.

Troubleshooting
Check motor stator windings.

12.12.138 Fault 86 - Condition-based Monitoring, Subcode A2 - Motor Stator Winding Voltage Fault

Cause
Voltage unbalance has exceeded the detection high limit.

Troubleshooting
Check motor stator windings.

12.12.139 Fault 86 - Condition-based Monitoring, Subcode A3 - Motor Stator Winding Current Warning S2

Cause
Current unbalance has exceeded the detection high limit.

Troubleshooting
Check motor stator windings.

12.12.140 Fault 86 - Condition-based Monitoring, Subcode A4 - Motor Stator Winding Voltage Warning S2

Cause
Voltage unbalance has exceeded the detection high limit.

Troubleshooting
Check motor stator windings.

12.12.141 Fault 86 - Condition-based Monitoring, Subcode A5 - Motor Stator Winding Current Warning S1

Cause
Current unbalance has exceeded the detection high limit.

Troubleshooting
Check motor stator windings.

12.12.142 Fault 86 - Condition-based Monitoring, Subcode A6 - Motor Stator Winding Voltage Warning S1

Cause
Voltage unbalance has exceeded the detection high limit.

Troubleshooting
Check motor stator windings.

12.12.143 Fault 86 - Condition-based Monitoring, Subcode A7 - Vibration Fault

Cause
Vibration has exceeded the detection high limit.

Troubleshooting
Check root cause for increased vibration.

12.12.144 Fault 86 - Condition-based Monitoring, Subcode A8 - Vibration Warning S2

Cause
Vibration has exceeded the detection high limit.

Troubleshooting
Check root cause for increased vibration.

12.12.145 Fault 86 - Condition-based Monitoring, Subcode A9 - Vibration Warning S1

Cause
Vibration has exceeded the detection high limit.

Troubleshooting
Check root cause for increased vibration.

12.12.146 Fault 86 - Condition-based Monitoring, Subcode A10 - Load Fault

Cause
Load outside of the window limits.

Troubleshooting
Check root cause for excessive overload or underload.

12.12.147 Fault 86 - Condition-based Monitoring, Subcode A11 - Load Warning S2

Cause
Load outside of the window limits.

Troubleshooting
Check root cause for excessive overload or underload.

12.12.148 Fault 86 - Condition-based Monitoring, Subcode A12 - Load Warning S1

Cause
Load outside of the window limits.

Troubleshooting
Check root cause for excessive overload or underload.

Index