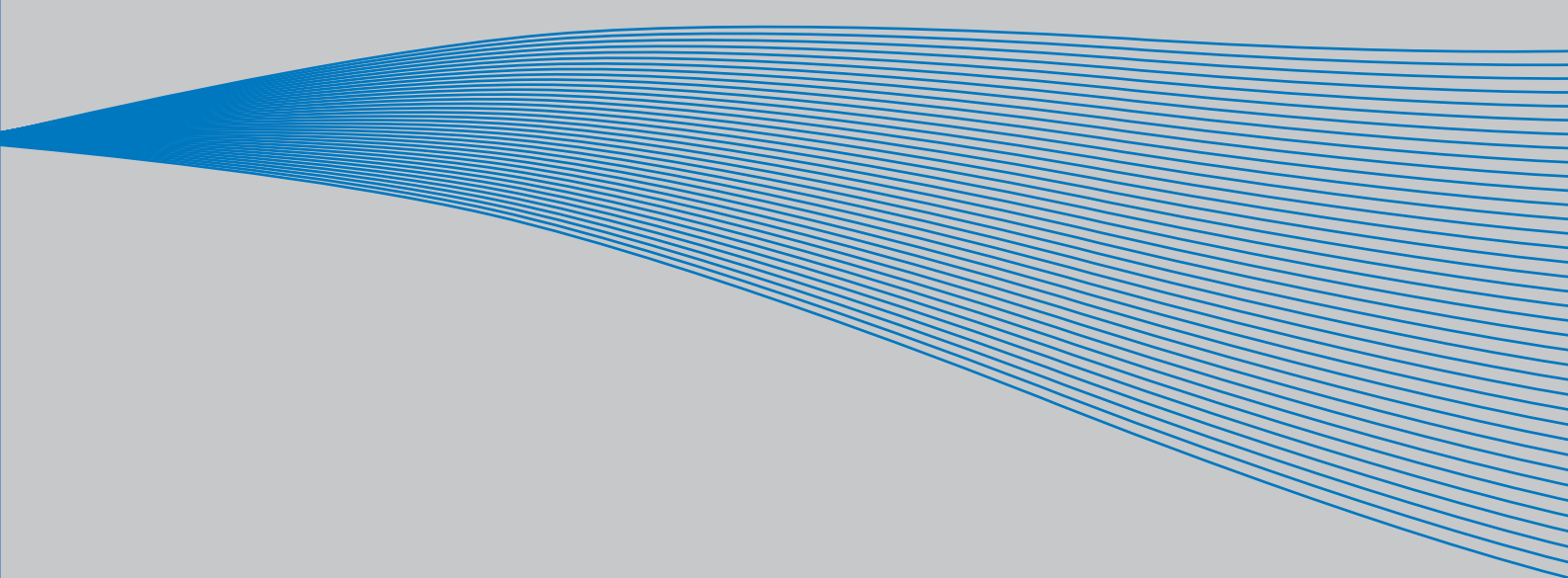


**VACON NXP**  
AC DRIVES

**IPOO MODULES**  
FRAMES FR10 TO FR14

**INSTALLATION MANUAL**



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## 1. GENERAL

This manual provides instructions for the installation of NXP FR10 to FR14 frequency converters in a cabinet, switchgear, or any other enclosure. If you wish to receive your Vacon NXP drive cabinet-mounted by the factory contact your nearest distributor.

Vacon NX drives of frames FR10 to FR12 embody 1 (FR10 and FR11) or 2 (FR12) power modules.

NX frames FR13 and FR14 are built of 2 to 4 non-regenerative front-end (NFE) units and 1 (FR13) or 2 (FR14) inverter units. Parallely mounted chokes are also included in the delivery.

The NXP modules are available as both 6-pulse (standard) and 12-pulse (optional) supply versions.

The NXP product series frames FR10...FR14 comprise the following frequency converters:

Type code (partial)	Frame size	Nominal current [I <sub>N</sub> ]	Type code (partial)	Frame size	Nominal current [I <sub>N</sub> ]
<b>Voltage range 400–500V</b>			<b>Voltage range 525–690V</b>		
NXP 0385 5	FR10	385A	NXP 0261 6	FR10	261A
NXP 0460 5	FR10	460A	NXP 0325 6	FR10	325A
NXP 0520 5	FR10	520A	NXP 0385 6	FR10	385A
NXP 0590 5	FR11	590A	NXP 0416 6	FR10	416A*
NXP 0650 5	FR11	650A	NXP 0460 6	FR11	460A
NXP 0730 5	FR11	730A	NXP 0502 6	FR11	502A
NXP 0820 5	FR12	820A	NXP 0590 6	FR11	590A*
NXP 0920 5	FR12	920A	NXP 0650 6	FR12	650A
NXP 1030 5	FR12	1030A	NXP 0750 6	FR12	750A
NXP 1150 5	FR13	1150A	NXP 0820 6	FR12	820A*
NXP 1300 5	FR13	1300A	NXP 0920 6	FR13	920A
NXP 1450 5	FR13	1450A	NXP 1030 6	FR13	1030A
NXP 1770 5	FR14	1770A	NXP 1180 6	FR13	1180A*
NXP 2150 5	FR14	2150A	NXP 1500 6	FR14	1500A
			NXP 1900 6	FR14	1900A
			NXP 2250 6	FR14	2250A*

Table 1. Vacon NXP frequency converters, frames FR10...FR14

\*Max ambient temperature +35°C

The frequency converters can be installed in any enclosure that fulfils the requirements specified in chapter 3. In the illustrations in this manual, **Rittal TS8** is used as an example enclosure.

Installing NX FR10...FR14 frequency converters in an enclosure involves the following steps:

- Installing the AC choke(s) (chapter 4)
- Installing and grounding of power module(s) (chapter 5)
- Establishing the internal power connections between
  - a) the AC choke(s) and the power module (frames FR10...FR12) (chapter 6.1) or
  - b) the AC chokes, the NFE units and the inverter units (frames FR13 and FR14)
- Installing the control unit (chapter 7)
- Preparing for input and output power connections (chapter 8)
- Arranging air-cooling and ventilation (chapter 9).

General instructions for product handling are given in chapter 2. Dimensional drawings are found in chapter 10.

For more information about the use of the products, refer to the NXC User's manual downloadable at [www.vacon.com](http://www.vacon.com). For detailed drawings of the converters installed in Rittal TS8 cabinets, please contact your local Vacon partner.

**NOTE:** The installation of the frequency converters must be done by certified electricians. Safety regulations for electrical work must be followed during the installation work.

**NOTE:** Safe operation and full service lifetime of the product can be guaranteed only if the installation instructions in this manual are followed.

**NOTE:** The product warranty is not valid if the product is handled in a way that does not comply with the instructions in this manual and the product's User's Manual.

**1.1 Type code**

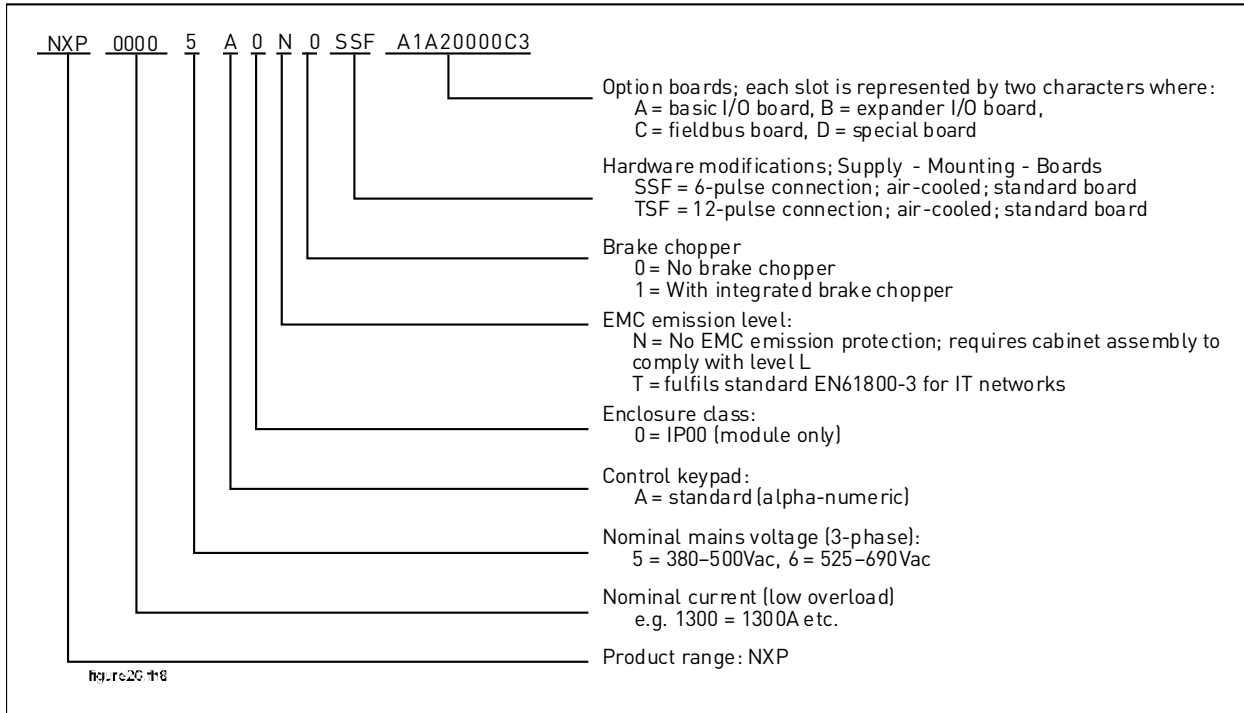


Figure 1. NXP IP00 drives type code

## 2. PRODUCT HANDLING

### 2.1 Product type designation codes

Product type designation codes are found on the power module and the control unit. For an explanation of the type designation codes, refer to the NXP/C User's Manual.

### 2.2 Receipt of delivery

#### 2.2.1 Frames FR10 to FR12

The standard delivery includes:

- Power module(s) with one integrated control unit; The power module in FR12 with the integrated control unit is referred to as *Power module 1* the other one as *Power module 2* later in this manual
- AC choke(s)
- *FR12 units only*: optical cable set for internal control connections between control unit and power modules
- IP00 Module Installation Manual
- NXP/C User's Manual.

Summary (check the type code of the components):

Mains voltage 380-500V 6-pulse units	
FC type	# of chokes
NXP0385 5	1*CHK0400
NXP0460 5	1*CHK0520
NXP0520 5	1*CHK0520
NXP0590 5	2*CHK0400
NXP0650 5	2*CHK0400
NXP0730 5	2*CHK0400
NXP0820 5	2*CHK0520
NXP0920 5	2*CHK0520
NXP1030 5	2*CHK0520

Mains voltage 380-500V 12-pulse units	
FC type	# of chokes
NXP0385 5	2*CHK0261
NXP0460 5	2*CHK0261
NXP0520 5	2*CHK0261
NXP0590 5	2*CHK0400
NXP0650 5	2*CHK0400
NXP0730 5	2*CHK0400
NXP0820 5	2*CHK0520
NXP0920 5	2*CHK0520
NXP1030 5	2*CHK0520

Table 2. Summary of components for FR10 and FR12, 380-500 V

Mains voltage 525-690V 6-pulse units	
FC type	# of chokes
NXP0261 6	1*CHK0261
NXP0325 6	1*CHK0400
NXP0385 6	1*CHK0400
NXP0416 6	1*CHK0400
NXP0460 6	1*CHK0520
NXP0502 6	1*CHK0520
NXP0590 6	2*CHK0400
NXP0650 6	2*CHK0400
NXP0750 6	2*CHK0400
NXP0820 6	2*CHK0400

Mains voltage 525-690V 12-pulse units	
FC type	# of chokes
NXP0261 6	2*CHK0261
NXP0325 6	2*CHK0261
NXP0385 6	2*CHK0261
NXP0416 6	2*CHK0261
NXP0460 6	2*CHK0400
NXP0502 6	2*CHK0400
NXP0590 6	2*CHK0400
NXP0650 6	2*CHK0400
NXP0750 6	2*CHK0400
NXP0820 6	2*CHK0400

Table 3. Summary of components for FR10 to FR12, 520-690 V

The following optional equipment is delivered on request:

- Door installation kit NXDRA02B for installing the control panel on the enclosure door.
- Control unit with fixing plate. See also chapter 7.
- Cable set, including seven optical cables and a 24V connecting cable, readily connected to the power module and the control unit. Standard length: 2.3m

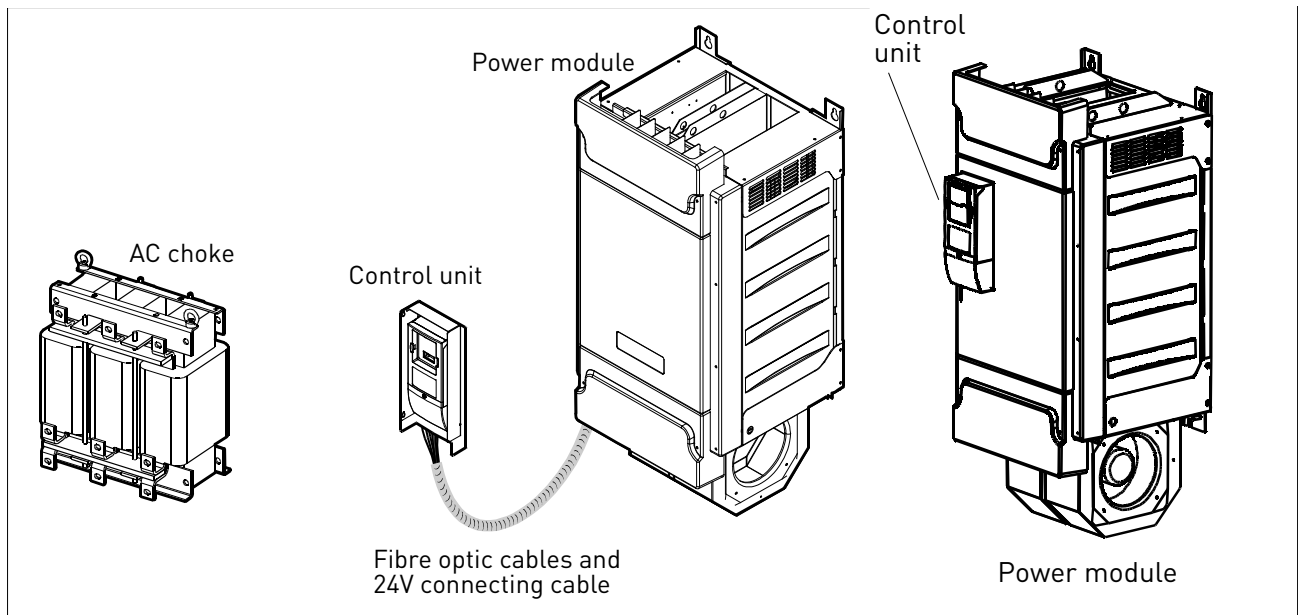


Figure 2. Parts included in delivery; Left: AC choke, Middle: Power module (1 or 2) with separate control unit, Right: Power module with integrated control unit (FR10 to FR12 only)

### 2.2.2 Frames FR13 and FR14

The standard delivery includes:

- 1 or 2 NXI inverter modules
- 2 to 4 NXN non-generative front-end (NFE) units with 2 or 3 modules mounted in brackets
- Control unit with fixing plate. See also chapter 7.
- AC choke per each NFE unit
- *FR14 only*: dU/dt filter (optional; 1 per inverter module)
- Cable set for NFE's and inverter modules
- Optical cable set for internal control connections between control unit and power modules
- IP00 Module Installation Manual
- NXP/C User's Manual.

Summary (check the type code of the components):

Mains voltage 380-500V		6-pulse units	
FC type	Inverter unit	# of NXN units	# of chokes
NXP1150 5	1*NXI1150 5	2*NXN0650 5	2*CHK0650 6
NXP1300 5	1*NXI1300 5	3*NXN0650 5	3*CHK0520 6
NXP1450 5	1*NXI1450 5	3*NXN0650 5	3*CHK0520 6
NXP1770 5	2*NXI1150 5	4*NXN0650 5	4*CHK0520 6
NXP2150 5	2*NXI1150 5	4*NXN0650 5	4*CHK0650 6
Mains voltage 380-500V		12-pulse units	
FC type	Inverter unit	# of NXN units	# of chokes
NXP1150 5	1*NXI1150 5	2*NXN0650 5	2*CHK0650 6
NXP1300 5	1*NXI1300 5	4*NXN0650 5	4*CHK0520 6
NXP1450 5	1*NXI1450 5	4*NXN0650 5	4*CHK0520 6
NXP1770 5	2*NXI1150 5	4*NXN0650 5	4*CHK0520 6
NXP2150 5	2*NXI1150 5	4*NXN0650 5	4*CHK0650 6

Table 4. Summary of components for FR13 and FR14, 380-500 V

Mains voltage 525-690V		6-pulse units	
FC type	Inverter unit	# of NXN units	# of chokes
NXP0920 6	1*NXI0920 6	2*NXN0650 6	2*CHK0520 6
NXP1030 6	1*NXI1030 6	2*NXN0650 6	2*CHK0520 6
NXP1180 6	1*NXI1180 6	2*NXN0650 6	2*CHK0650 6
NXP1500 6	2*NXI0920 6	3*NXN0650 6	3*CHK0520 6
NXP1900 6	2*NXI0920 6	4*NXN0650 6	4*CHK0520 6
NXP2250 6	2*NXI1180 6	4*NXN0650 6	4*CHK0650 6
Mains voltage 525-690V		12-pulse units	
FC type	Inverter unit	# of NXN units	# of chokes
NXP0920 6	1*NXI0920 6	2*NXN0650 6	2*CHK0520 6
NXP1030 6	1*NXI1030 6	2*NXN0650 6	2*CHK0520 6
NXP1180 6	1*NXI1180 6	2*NXN0650 6	2*CHK0650 6
NXP1500 6	2*NXI0920 6	4*NXN0650 6	4*CHK0520 6
NXP1900 6	2*NXI0920 6	4*NXN0650 6	4*CHK0520 6
NXP2250 6	2*NXI1180 6	4*NXN0650 6	4*CHK0650 6

Table 5. Summary of components for FR13 and FR14, 520-690 V

The following optional equipment is delivered on request:

- Door installation kit NXDRA02B for installing the control panel on the enclosure door.
- Cable set, including seven optical cables and a 24V connecting cable, readily connected to the power module and the control unit. Standard length: 2.3m



### 2.3 Receiving, unpacking and storing the product

The product is delivered packed in a plywood case, which can be recycled or destroyed by burning. Instructions for receiving, handling and storing the product, as well as the general warranty terms can be found in the NXP/C User’s manual.

### 2.4 Lifting the modules

The modules can be lifted by the holes on top. Place the lifting hooks symmetrically in at least two holes. The maximum allowed lifting angle is 45 degrees.

The lifting equipment must be able to carry the weight of the module. For frames FR10 to FR12, see Figure 3 and for frames FR13 and FR14 see chapter 3.2.2.

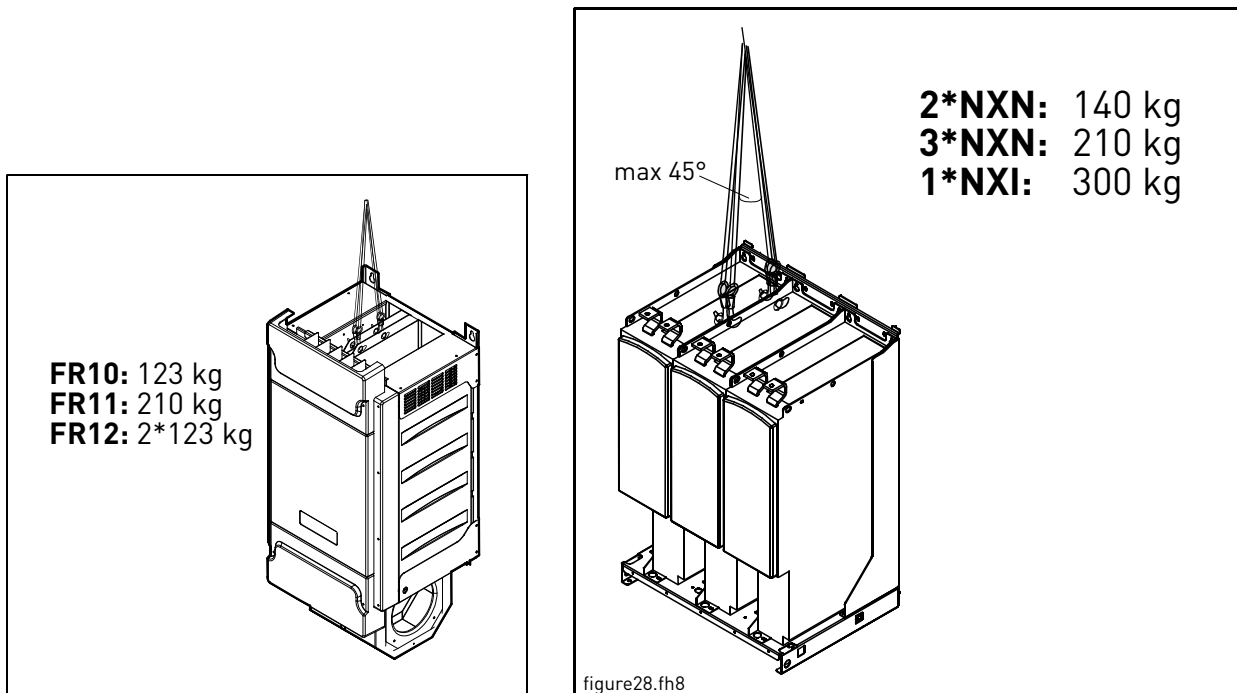


Figure 3. Lifting the power module

**NOTE!** The power module can temporarily rest on the cooling fan assembly, but shocks or non-vertical forces may cause damage to the fans.

## 2.5 Lifting AC chokes

The AC choke can be lifted by the two eyebolts on top of the unit. The weight of the AC choke varies from 53 kg to 130 kg depending on the type (see Figure 4).

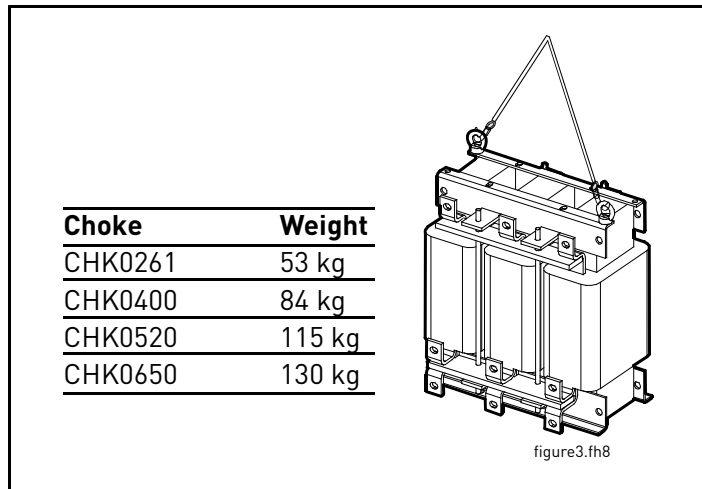


Figure 4. Lifting the AC choke

### 3. REQUIREMENTS

#### 3.1 Environmental requirements

Refer to Vacon NXP/C User's Manual (document code ud01011) for information on required operating temperature, humidity, etc. The User's Manual also states the free space required around the enclosure.

**NOTE!** EN60439-1 specifies the ambient temperature for enclosed products at 35°C (24h average)/40°C (maximum). The ventilation and cooling of the installation room must be sufficient to keep the temperature below this level.

For information on the heat dissipation of the product and the required cooling air, refer to section 9.3 and the Vacon NXP/C User's Manual.

#### 3.2 Cabinets

##### 3.2.1 Cabinet installation for frames FR10 to FR12

Vacon IP00 power modules of frames FR10...FR12 can be installed in cabinets. The cabinets have to meet the following requirements.

Width:	Min. 600 mm
Depth:	Min. 600 mm (or min. 490 mm if the control unit is installed in another position than at the front of the power unit)
Height:	Min. 1800 mm if the AC choke is installed beneath the power module, otherwise min. 1500 mm
Mechanical requirements:	The cabinet must be able to support a total equipment weight of 275 kg (if the power module and the AC choke are installed in the same cabinet).
Protection class:	This manual applies to IP21.
Construction:	According to EN60439-1
Ventilation openings:	Refer to section 9.1.

Table 6. Cabinet data for FR10

Width:	Min. 800 mm
Depth:	See Table 6.
Height:	See Table 6.
Mechanical requirements:	The cabinet must be able to support a total equipment weight of 350 kg (if the power module and the AC choke are installed in the same cabinet).
Protection class:	This manual applies to IP21.
Construction:	According to EN60439-1
Ventilation openings:	Refer to section 9.1.

Table 7. Cabinet data for FR11

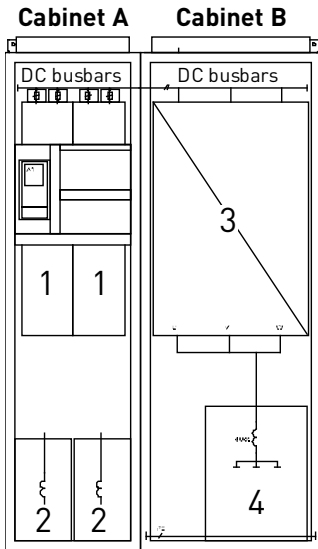
Width:	Min. 1200 mm
Depth:	See Table 6.
Height:	See Table 6.
Mechanical requirements:	The cabinet must be able to support a total equipment weight of 550 kg (if the power modules and the AC chokes are installed in the same cabinet).
Protection class:	This manual applies to IP21.
Construction:	According to EN60439-1
Ventilation openings:	Refer to section 9.1.

Table 8. Cabinet data for FR12

**3.2.2 Cabinets for frames FR13 and FR14**

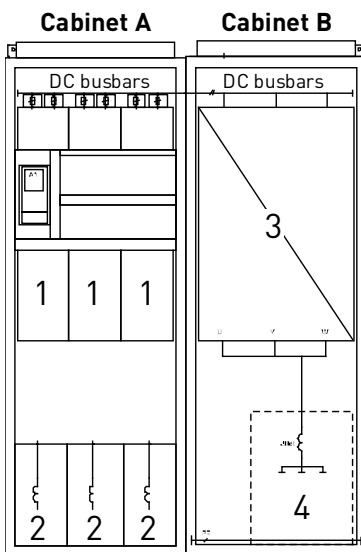
The power section of frames FR13 and FR14 comprise 2 to 4 non-generative front-end (NFE) units, AC chokes, inverter units and dU/dt-filters (required for FR14). Several cabinets are, therefore, needed. Example installations as well as cabinet requirements are presented below:

1 = NFE units    2 = AC chokes    3 = FI13 (inverter unit)    4 = dU/dt-filter



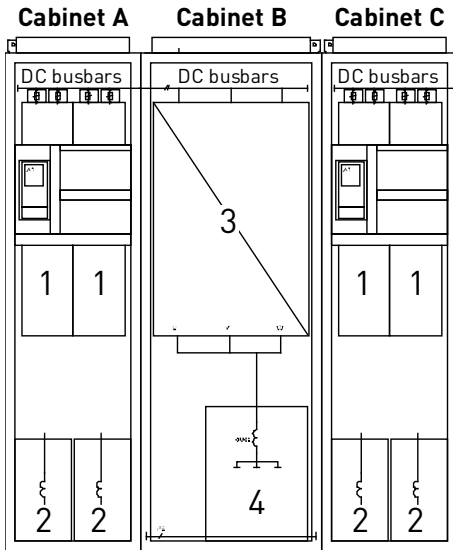
This installation applies to converter types:	NXP1150 5	NXP0920 6 NXP1030 6 NXP1180 6
Required cabinet width:	Min. 600 mm (Cabinet A) + 800 mm (Cabinet B)	
Required cabinet height:	Min. 2200 mm	
Required weight carrying capacity:	NXP1150 5: 480 kg (Cab.A); 540 kg (Cab.B) NXP0920 6: 450 kg (Cab.A); 540 kg (Cab.B) NXP1030 6: 450 kg (Cab.A); 540 kg (Cab.B) NXP1180 6: 480 kg (Cab.A); 540 kg (Cab.B)	
Protection class:	This manual applies to IP21.	
Construction:	According to EN60439-1	
Ventilation openings:	Refer to section 9.1.	

Table 9. Cabinet data



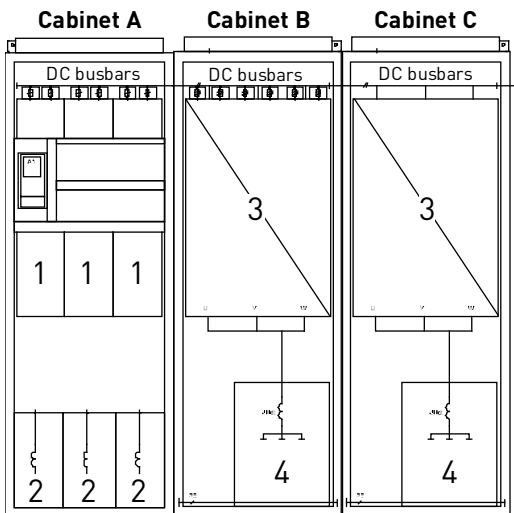
This installation applies to converter types:	NXP1300 5 (6-pulse) NXP1450 5 (6-pulse)
Required cabinet width:	Min. 800 mm (Cab.A) + 800 mm (Cab. B)
Required cabinet height:	Min. 2200 mm
Required weight carrying capacity:	635 kg (Cab.A); 590 kg (Cab.B)
Protection class:	This manual applies to IP21.
Construction:	According to EN60439-1
Ventilation openings:	Refer to section 9.1.

Table 10. Cabinet data



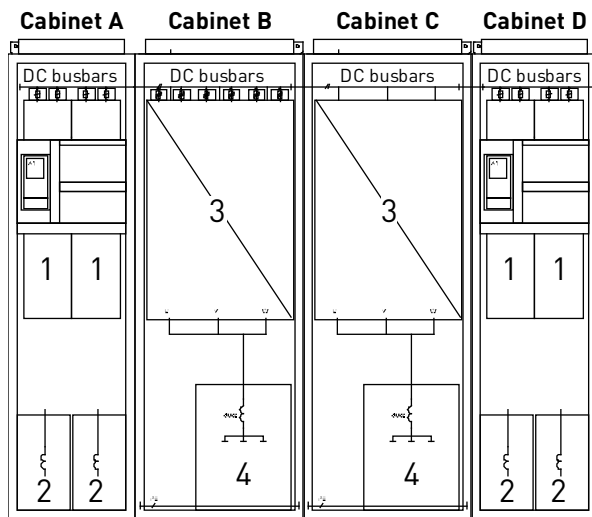
This installation applies to converter types:	NXP1300 5 (12-pulse) NXP1450 5 (12-pulse)
Required cabinet width:	Min. 600 mm (Cab.A) + 800 mm (Cab. B) + 600 mm (Cab.C)
Required cabinet height:	Min. 2200 mm
Required weight carrying capacity:	450 kg (Cab.A and C); 540 kg (Cab.B)
Protection class:	This manual applies to IP21.
Construction:	According to EN60439-1
Ventilation openings:	Refer to section 9.1.

Table 11. Cabinet data



This installation applies to converter type:	NXP1500 6 (6-pulse)
Required cabinet width:	Min. 800 mm (Cab.A) + 800 mm (Cab. B) + 800 mm (Cab. C)
Required cabinet height:	Min. 2200 mm
Required weight carrying capacity:	635 kg (Cab.A); 540 kg (Cab.B); 540 kg (Cab. C)
Protection class:	This manual applies to IP21.
Construction:	According to EN60439-1
Ventilation openings:	Refer to section 9.1.

Table 12. Cabinet data



This installation applies to converter types:	NXP1770 5 NXP2150 5	NXP1500 6 (12-pulse) NXP1900 6 NXP2250 6
Required cabinet width:	Min. 600 mm (Cab.A and D) + 800 mm (Cab. B and C)	
Required cabinet height:	Min. 2200 mm	
Required weight carrying capacity:	NXP1500 6 (12-pulse): 450 kg (Cab.A and D); 540 kg (Cab.B and C) NXP1770 5: 450 kg (Cab.A and D); 540 kg (Cab.B and C) NXP1900 6: 450 kg (Cab.A and D); 540 kg (Cab.B and C) NXP2150 5: 480 kg (Cab.A and D); 540 kg (Cab.B and C) NXP2250 6: 480 kg (Cab.A and D); 540 kg (Cab.B and C)	
Protection class:	This manual applies to IP21.	
Construction:	According to EN60439-1	
Ventilation openings:	Refer to section 9.1.	

Table 13. Cabinet data

## 4. INSTALLING AC CHOKES

Type code (partial)	Frame size	Choke type (6-pulse)	Choke type (12-pulse)
<b>Voltage range 400–500V</b>			
NXP 0385 5	FR10	CHK0400	2*CHK0261
NXP 0460 5	FR10	CHK0520	2*CHK0261
NXP 0520 5	FR10	CHK0520	2*CHK0261
NXP 0590 5	FR11	2*CHK0400	2*CHK0400
NXP 0650 5	FR11	2*CHK0400	2*CHK0400
NXP 0730 5	FR11	2*CHK0400	2*CHK0400
NXP 0820 5	FR12	2*CHK0520	2*CHK0520
NXP 0920 5	FR12	2*CHK0520	2*CHK0520
NXP 1030 5	FR12	2*CHK0520	2*CHK0520
NXP 1150 5	FR13	2*CHK0650	2*CHK0650
NXP 1300 5	FR13	3*CHK0520	4*CHK0520
NXP 1450 5	FR13	3*CHK0520	4*CHK0520
NXP 1770 5	FR14	4*CHK0520	4*CHK0520
NXP 2150 5	FR14	4*CHK0650	4*CHK0650
<b>Voltage range 525–690V</b>			
NXP 0261 6	FR10	CHK0261	2*CHK0261
NXP 0325 6	FR10	CHK0400	2*CHK0261
NXP 0385 6	FR10	CHK0400	2*CHK0261
NXP 0416 6	FR10	CHK0400	2*CHK0261
NXP 0460 6	FR11	CHK0520	2*CHK0400
NXP 0502 6	FR11	CHK0520	2*CHK0400
NXP 0590 6	FR11	2*CHK0400	2*CHK0400
NXP 0650 6	FR12	2*CHK0400	2*CHK0400
NXP 0750 6	FR12	2*CHK0400	2*CHK0400
NXP 0820 6	FR12	2*CHK0400	2*CHK0400
NXP 0920 6	FR13	2*CHK0520	2*CHK0520
NXP 1030 6	FR13	2*CHK0520	2*CHK0520
NXP 1180 6	FR13	2*CHK0650	2*CHK0650
NXP 1500 6	FR14	3*CHK0520	4*CHK0520
NXP 1900 6	FR14	4*CHK0520	4*CHK0520
NXP 2250 6	FR14	4*CHK0650	4*CHK0650

Table 14. Choke types

#### 4.1 Installing AC chokes: Frames FR10 to FR12

The recommended location for the AC choke is the bottom part of the enclosure, where it should be installed close to the rear wall. For a possible later installation of a fuse switch, it may be practical to install the AC choke somewhat to the left.

Fasten the choke on an assembly plate or using mounting rails.

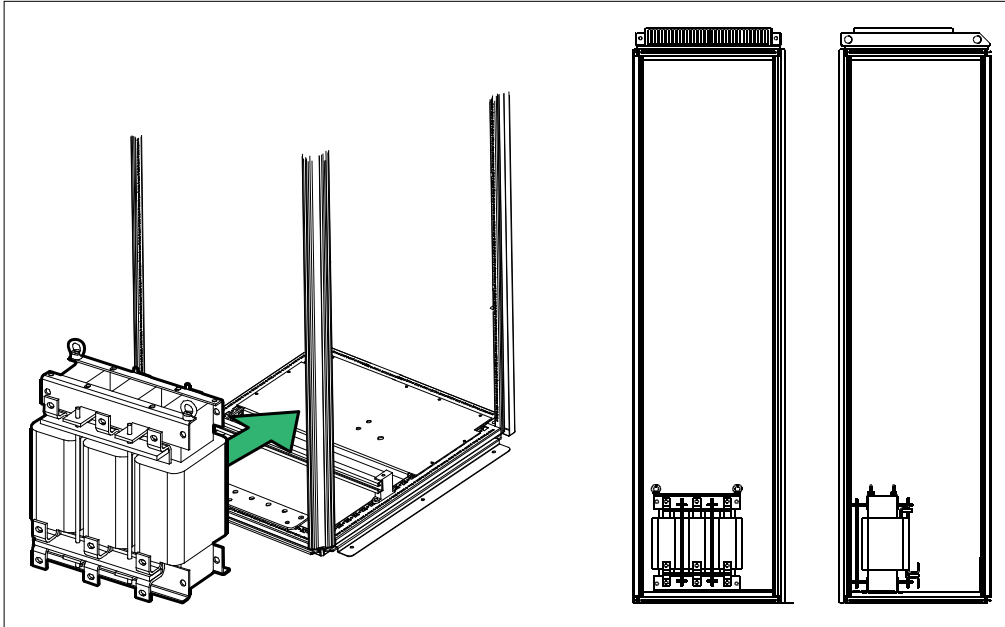


Figure 5. Installing AC choke

**NOTE!** An upper support plate must be installed above the choke if the cabinet is transported in horizontal position. A possible fixed support plate must be equipped with air circulation holes. See Figure 36 on page 45.



### 4.2 Installing AC chokes: Frames FR13 and FR14

Check the needed amount and type of chokes e.g. in Table 14 and in chapter 3.2.2. Place the chokes on the bottom of the enclosure as shown in Figure 6.

Fasten the choke on an assembly plate or using mounting rails.

**NOTE!** An upper support plate must be installed above the choke if the cabinet is transported in horizontal position. The support plate must be equipped with air circulation holes. See Figure 36 on page 45.

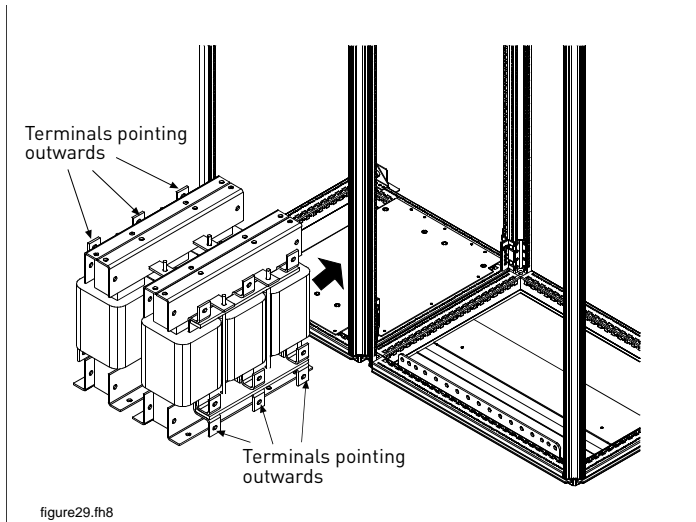


Figure 6. Installing AC choke (2 chokes); frames FR13 and FR14

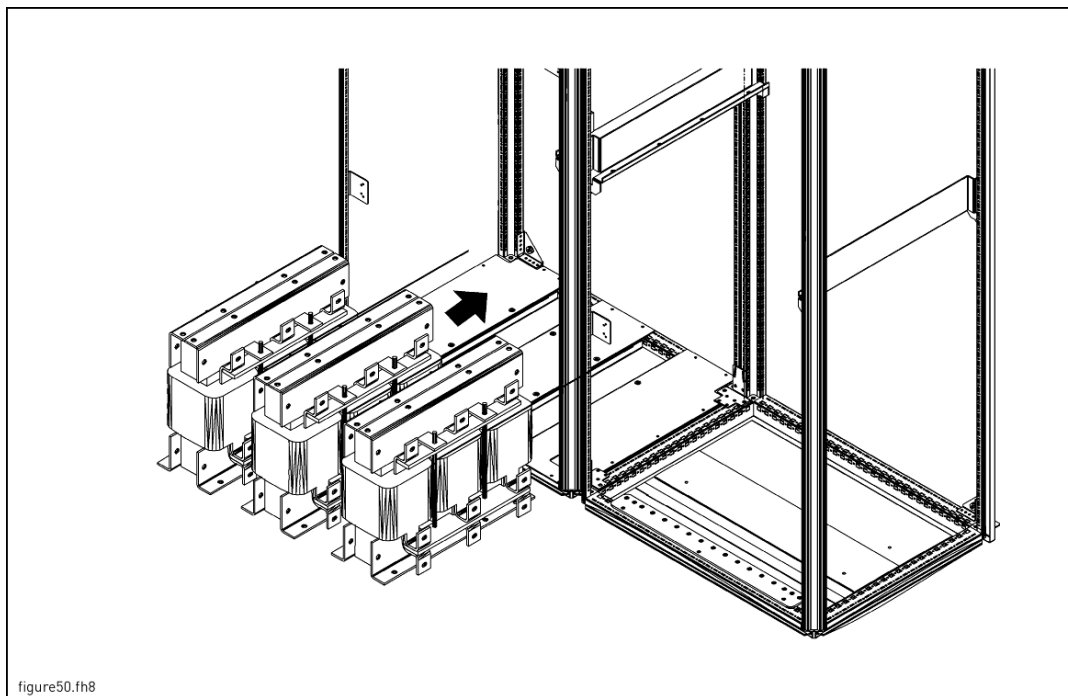


Figure 7. Installing AC choke (3 chokes); frames FR13 and FR14

## 5. INSTALLING POWER MODULE

### 5.1 Preparing the enclosure

To facilitate a possible future replacement of boards as well as other service work, it is recommended that the power module be mounted on rails.

#### 5.1.1 Mounting dimensions for frames FR10 to FR12

Fasten mounting rails to the sides of the cabinet at distances given under F (from the top) and G (from the bottom) in the table below. Leave a space (A) between the module and the walls on both sides for the internal cooling air circulation.

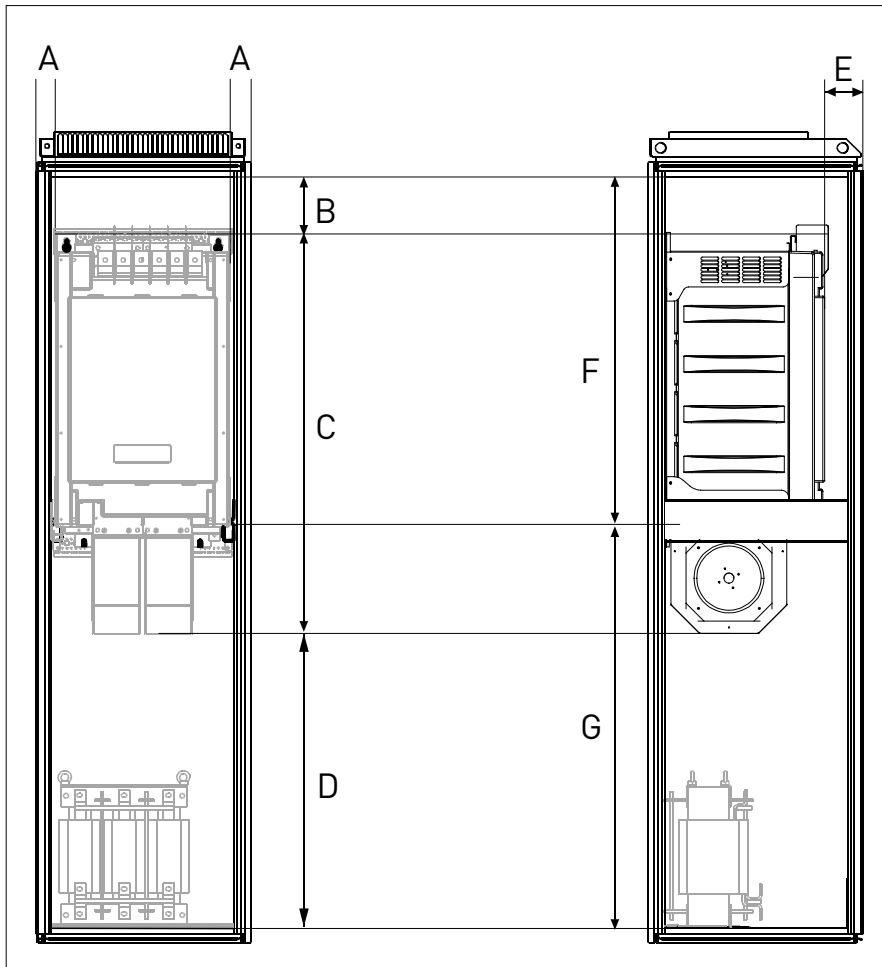


Figure 8. Preparing the enclosure for the power module

The power module should be fastened to the rear side of the enclosure as shown in Figure 10. For this purpose, install two fixing bars on the rear wall of the cabinet at appropriate levels.

Note the following dimensions that are essential for placing the power module. All dimensions in mm:

A	B	C	D	E	F	G
50*	100	1120	550 (290)	116 (44)	918	850 (590)

Table 15.

- A = Minimum distance to the side walls or adjacent components. \* = Note that the two cabinets, in which the modules of frame FR12 are installed, require no clearance between them.
- B = Minimum distance from the top of the cabinet; This space is needed for the power cables (see Figure 14).

- C = Module height
- D = Minimum distance from the bottom of the enclosure if the AC choke is installed at the bottom of the enclosure. If the choke is installed in another location, the distance must not, however, be smaller than what is given in parentheses
- E = Minimum distance from the cabinet door; This is to enable the control unit to be installed in front of the power module. The number in parentheses designates the minimum distance from the door if the control unit is installed in any other location.
- F = Minimum distance from the mounting rails to top of the cabinet.
- G = Minimum distance from the mounting rails to the bottom of the cabinet. If the choke is installed in another location, the distance must not, however, be smaller than what is given in parentheses

See also the dimensional drawings in chapter 10.

**5.1.2 Mounting dimensions for frames FR13 and FR14**

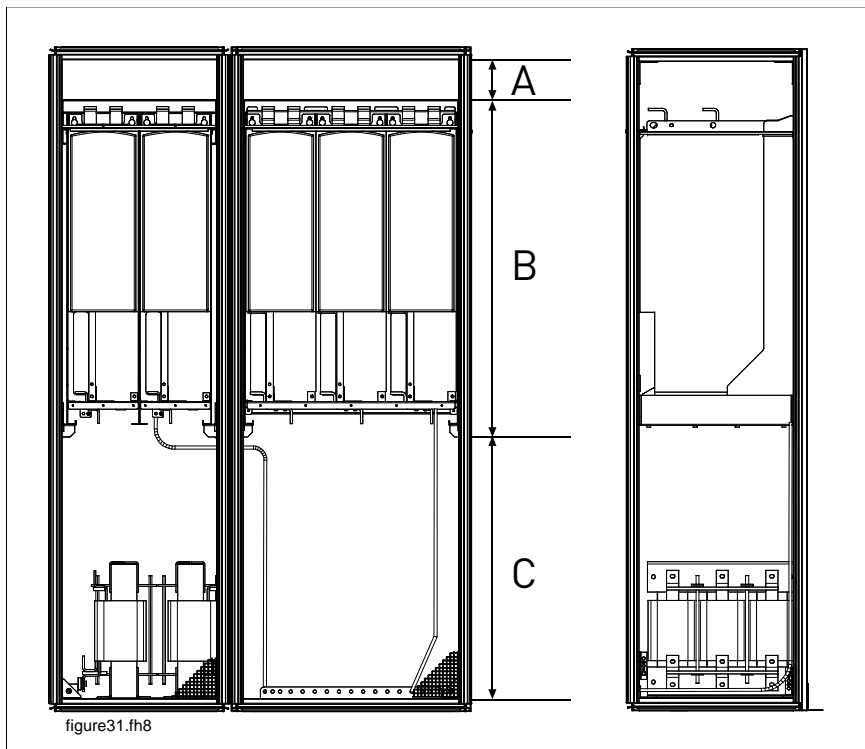


Figure 9. Preparing the enclosure for the modules

Note the following dimensions that are essential for placing the modules. All dimensions in mm:

A	B	C
175	1050	600 (300)

Table 16. Dimensions

- A = Minimum distance from the top of the cabinet; This space is needed for the fuses and busbars
- B = Module height
- C = Minimum distance from the bottom of the enclosure if the AC choke is installed at the bottom of the enclosure. If the choke is installed in another location, the distance must not, however, be smaller than what is given in parentheses

See also the dimensional drawings in chapter 10.

## 5.2 Mounting the modules

### 5.2.1 Mounting the power modules for frames FR10 to FR12

**NOTE!** If the space around the power module is narrow, lead the internal power cables along the wall and fasten them in brackets before mounting the power module. See chapter 6.1.

Fasten the power module to the rear wall of the enclosure utilising the fixing holes in the frame.

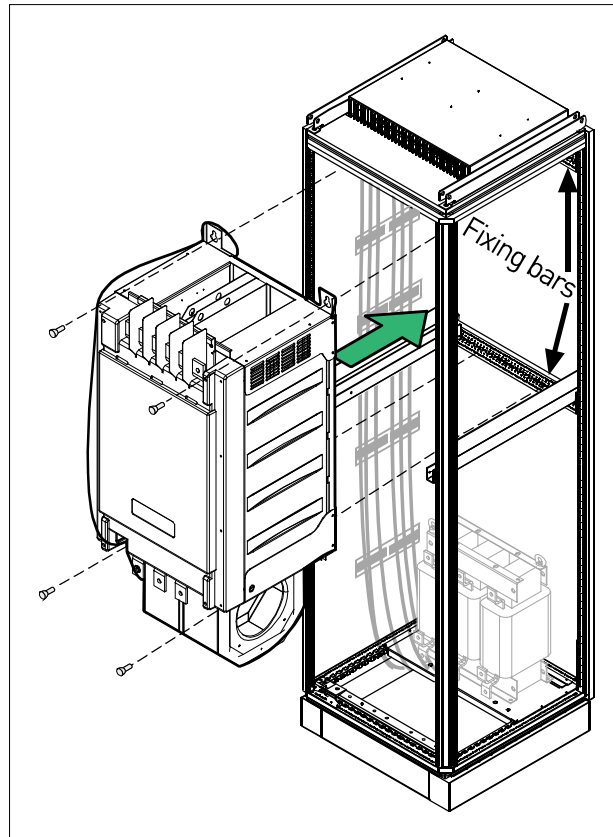


Figure 10. Mounting the power module, FR10

**NOTE!** If the power module is installed before the AC choke, the centre of gravity is very high at this stage. Support the enclosure thoroughly during the assembly.

### 5.2.2 Mounting the modules for frames FR13 and FR14

Fasten the power module to the rear wall of the enclosure utilising the fixing holes in the frame.

The modules should be fastened to the rear side of the enclosure as shown in Figure 11. For this purpose, install a fixing bar on the rear wall of the cabinet at appropriate level. Two module supports shall also be mounted on the sides. The modules are intended to rest on these supports.

**NOTE!** Support the enclosure thoroughly during the assembly.

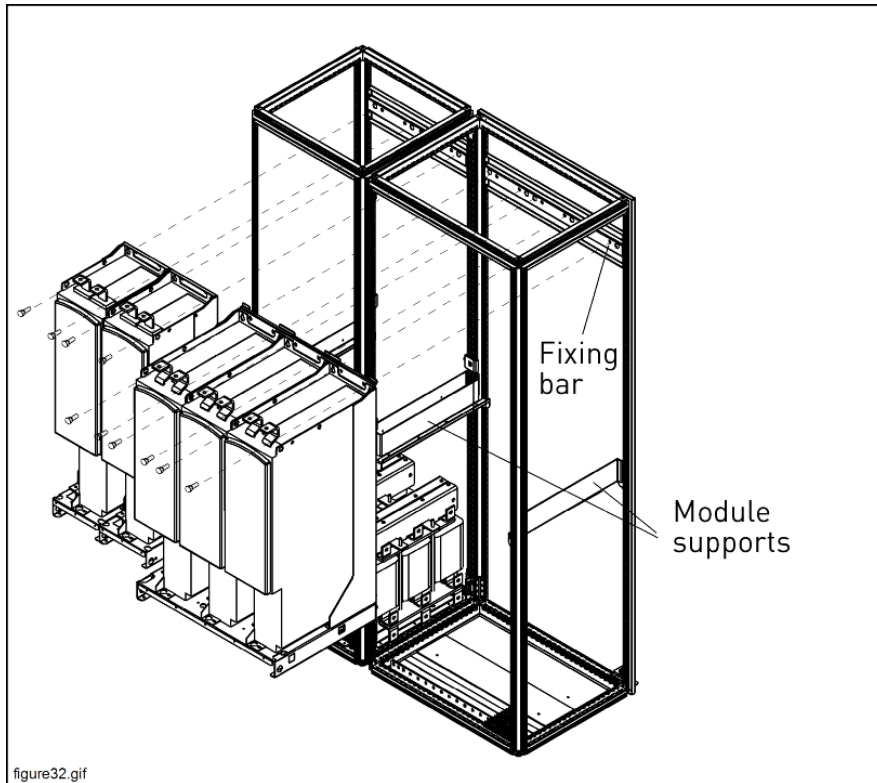


Figure 11. Mounting the modules, FR13 and FR14

### 5.3 Grounding the power modules

Install a PE rail, for instance, at the bottom front of the enclosure. See figures 12 and 13 below.

**Frames FR10 to FR12:** Connect a grounding cable from the grounding connector at the lower right hand side of the power module frame to the PE rail of the enclosure.

**Frames FR13 and FR14:** Route a grounding cable from the grounding connector of the NFE unit and the inverter unit through the cabinet wall to the PE rail of the cabinet with the inverter module.

Use a copper grounding cable with a cross-sectional area of at least  $2 \times 35 \text{ mm}^2$  per power module, which obeys the local regulations for grounding cables. See Figure 12 on page 22.

**NOTE!** The PE rail must be connected to external ground at the installation site according to local regulations.

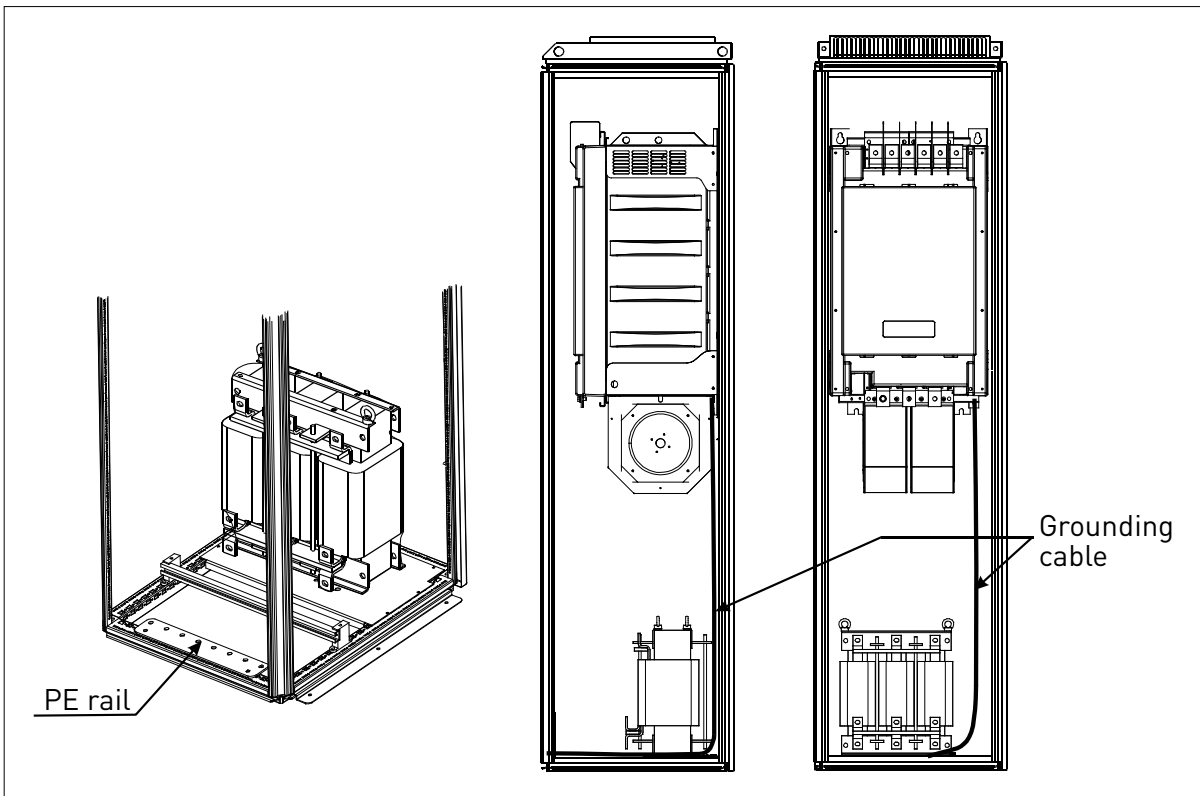


Figure 12. Grounding the power module, FR10 to FR12

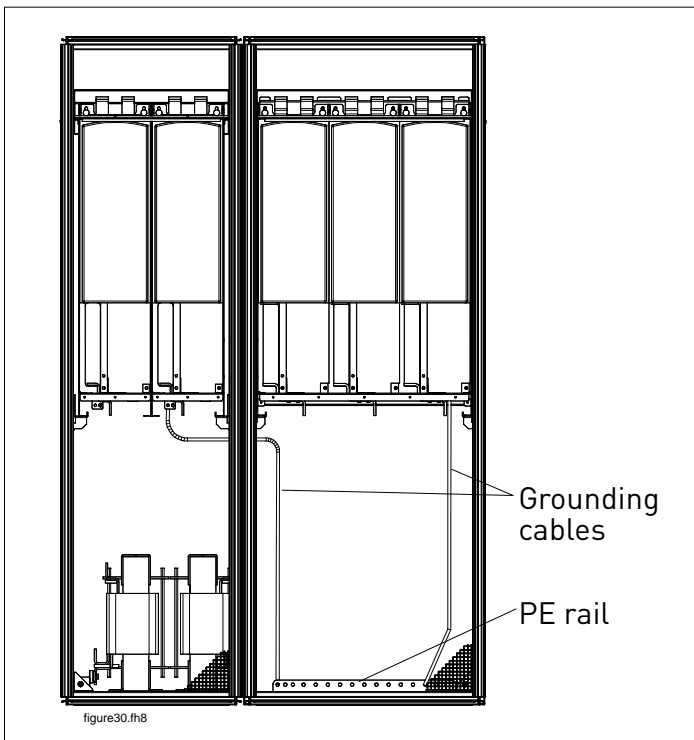


Figure 13. Grounding the modules, FR13/FR14

## 6. INTERNAL CONNECTIONS

### 6.1 Connecting internal power cables, FR10 to FR12

Connect three power cables according to Figure 14 to the output terminals of the AC choke and the input terminals of the power module. It is recommended to use cables designed for 90°C. Connect the L1 cable from the L1 terminal of the AC choke to the L1 input terminal of the power module, the L2 cable to the L2 terminal, and the L3 cable to the L3 terminal.

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

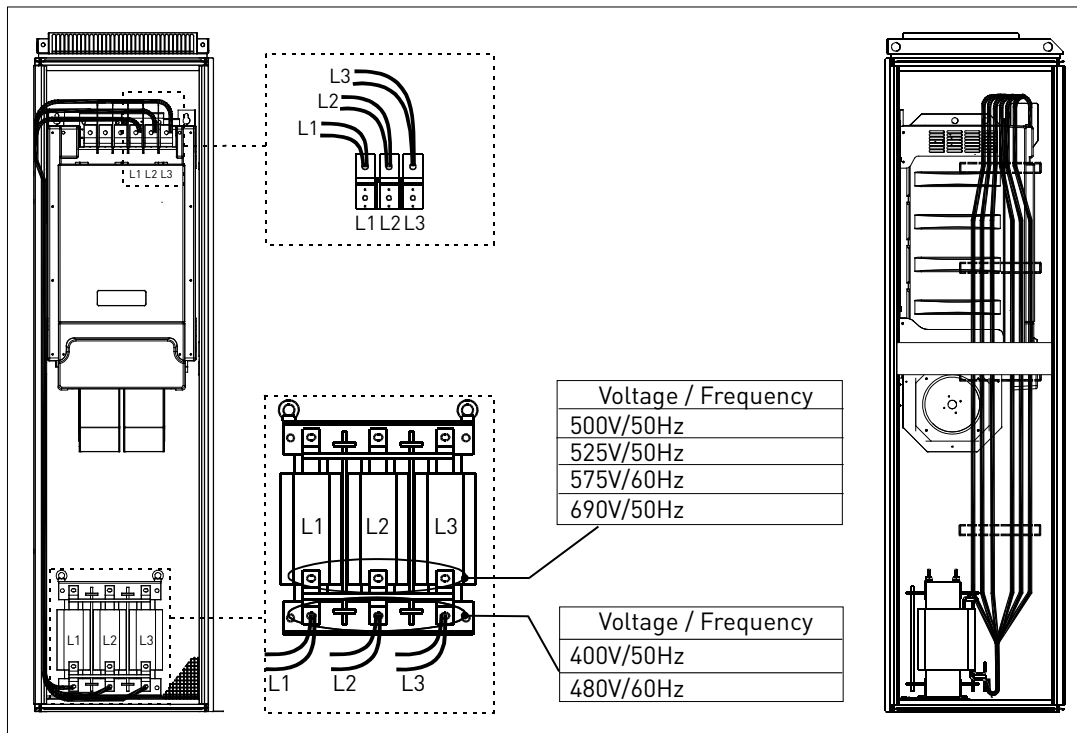


Figure 14. Connecting the power cables between the AC choke and the power unit

Product	Temp. rating	Cu cables	
		Cable size, mm <sup>2</sup> per phase	Specification
NXP 0261 NXP 0325 NXP 0385 NXP 0416	90°C	2*70	GENELEC HD 21.7 H07V2-K
	70°C	2*95	Standard
NXP 0460 NXP 0502 NXP 0520	90°C	2*95	GENELEC HD 21.7 H07V2-K
	70°C	2*120	Standard
NXP 0590 NXP 0650 NXP 0730 NXP 0750 NXP 0820 6	90°C	2*2*70	GENELEC HD 21.7 H07V2-K
	70°C	2*2*95	Standard
NXP 0820 5 NXP 0920 NXP 1030	90°C	2*2*95	GENELEC HD 21.7 H07V2-K
	70°C	2*2*120	Standard

Table 17. Required cable sizes for the internal power cables (90°C rating recommended)

### 6.2 Establishing internal busbar or cable connections, FR13 and FR14

The electrical power connections between the NFE units and the inverter module are made using busbars. However, the internal connections from the AC choke to the NFE unit can also be established using copper cable. See figures below for the correct placement of the busbars/cables and Table 18 for the recommended sizes.

Product	Busbar size NFE - INU [mm]	Busbar size/ phase <sup>1)</sup> (choke - NFE) [mm]	Cable size/ phase (choke - NFE) [mm <sup>2</sup> ]	Remarks
<b>Supply voltage 380-500V</b>				
NXP 1150 5	60*10	40*6	2*150	
NXP 1300 5	80*10	40*6	2*120	
NXP 1450 5				
NXP 1770 5	60*10	40*6	2*120	Routing: Use symmetrical construction. See pictures in chapter 3.2.2.
NXP 2150 5			2*150	
<b>Supply voltage 525-690V</b>				
NXP 0920 6	60*10	40*6	2*120	
NXP 1030 6				
NXP 1180 6			2*150	
NXP 1500 6	80*10	40*6	2*120	
NXP 1900 6	60*10	40*6	2*120	Routing: Use symmetrical construction See pictures in chapter 3.2.2.
NXP 2250 6			2*150	

Table 18.

<sup>1)</sup> Rigid copper connection

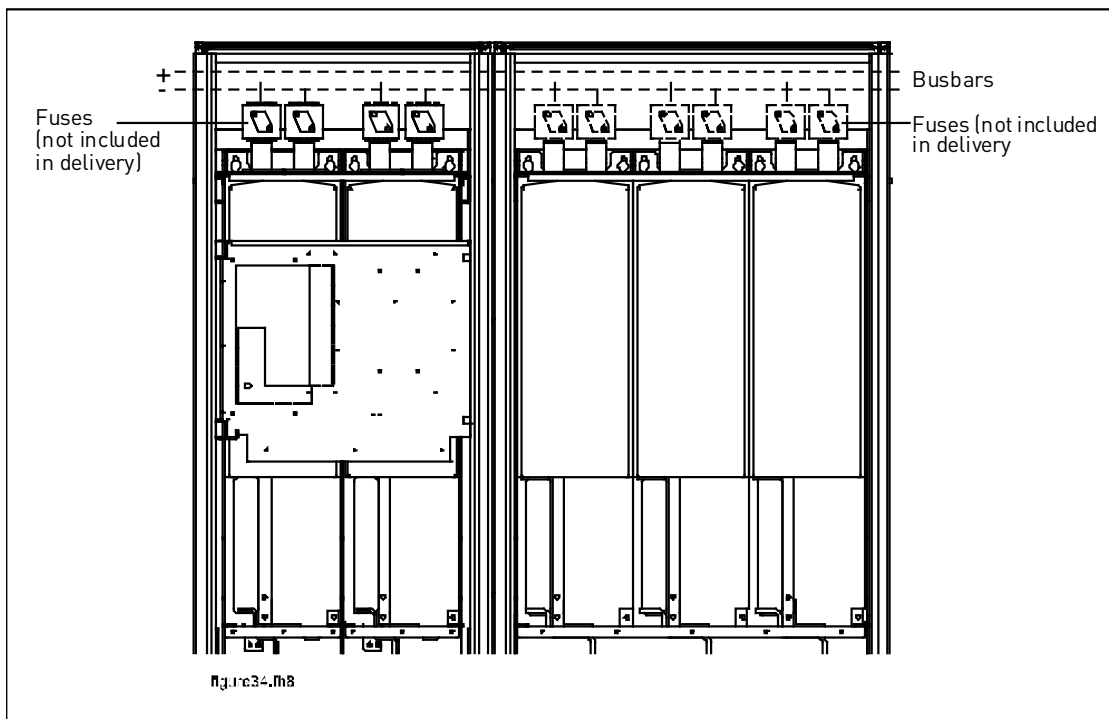


Figure 15. Placement of busbars

**NOTE:** Busbar alignment should be vertical in order to allow the maximum flow of cooling air.



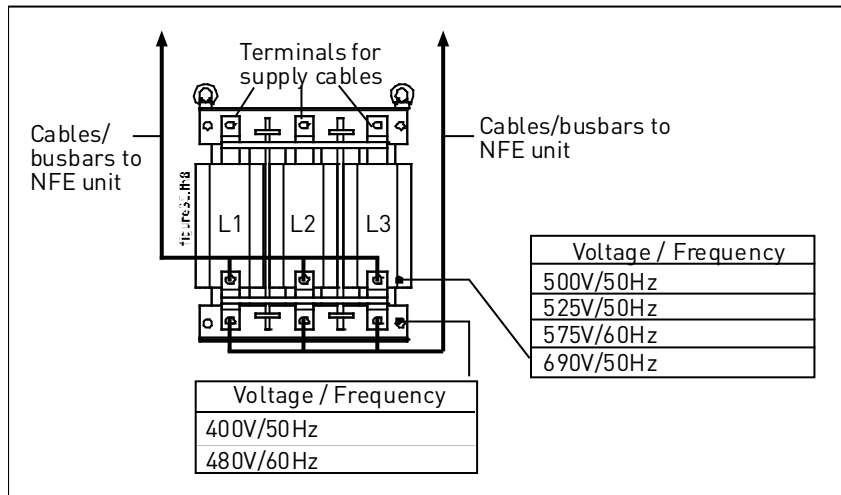


Figure 16. Cabling from choke to NFE (front picture)

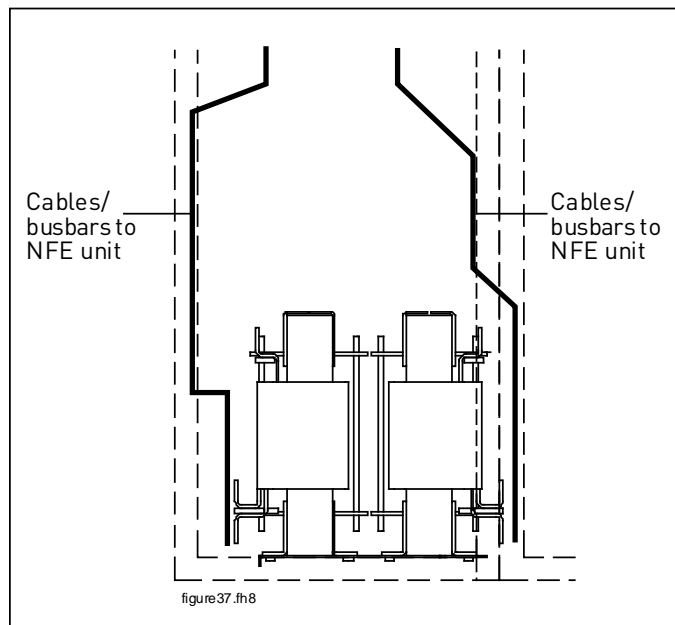


Figure 17. Cabling from choke to NFE (side picture)

## 7. INSTALLING CONTROL UNIT

**NOTE!** The Vacon NX FR10...FR12 drive can be delivered with the control unit 1) integrally mounted on the power unit or 2) separated from the power unit and fixed to the mounting box that you can install to a sidewall or the frame of the enclosure. If you have ordered your drive with the control unit separated from the power unit, see mounting instructions of the control unit in chapter 7.1 below.

The control unit for Vacon NX FR13...FR14 is always delivered separately. The mounting instructions below apply also to these drive sizes. Nevertheless, see Figure 19 for the placement of the control box. The dimensions of the control unit you will find in chapter 10.3.

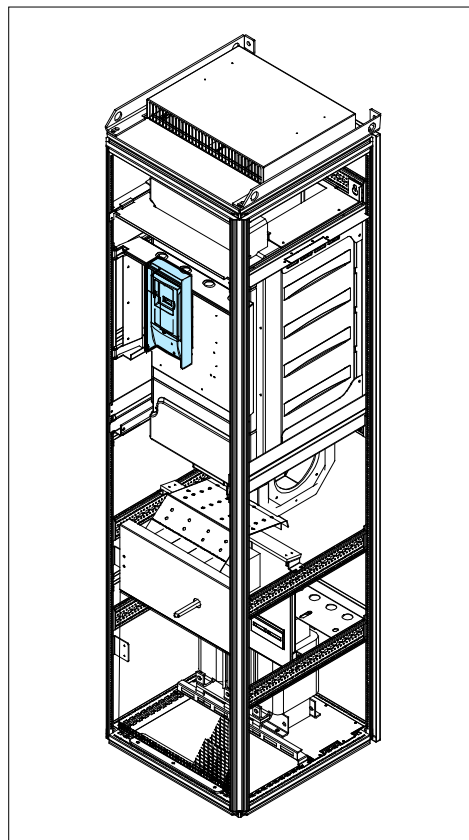
### 7.1 Mounting the control unit

**NOTE!** If needed, connect the 24V connecting cable and the fibre optic cables to the power module before mounting the control unit. See section 7.2.

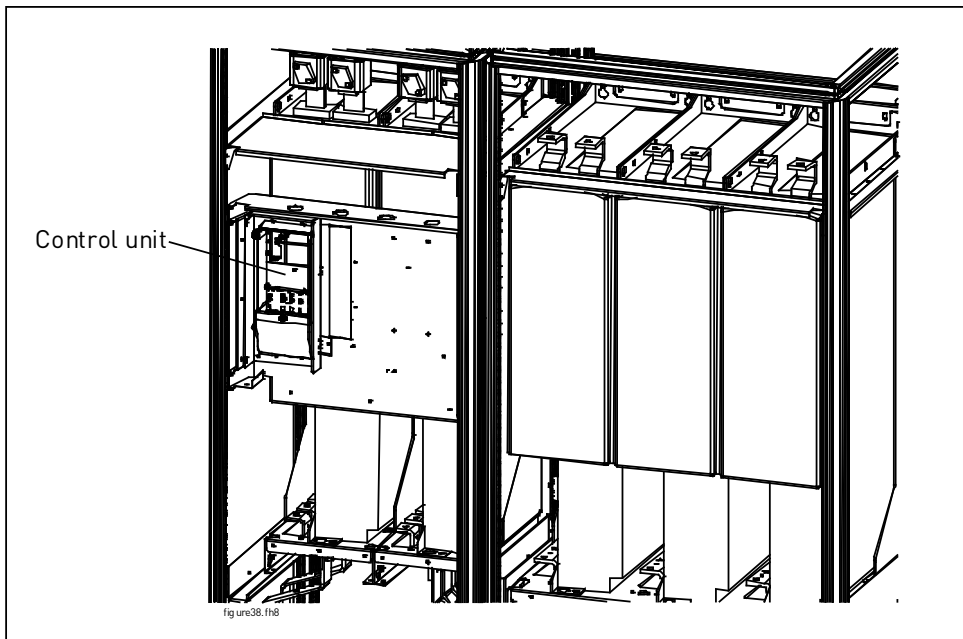
Fasten the mounting box with the control unit to a sidewall or to the frame of the enclosure. The standard length of the connecting cable and the fibre optic cables is 2.3m, which means that the control unit must be placed within this distance from the power module. Pay attention to the minimum bending radius of the fibre optic cables (see section 7.2).

**CAUTION!** Do not place the control unit close to the power cables. The power cables may disturb the data communication and cause false alarms.

To ensure a proper grounding of the control unit assembly, Vacon recommends that an additional grounding cable be drawn from the mounting box and connected to the cabinet frame. Use a braided copper cable designed for high-frequency signals.



*Figure 18. The control unit mounted on a hinged assembly box (not included in standard delivery) in front of the power module, FR10...FR12*



*Figure 19. The control unit mounted on a hinged assembly box (not included in standard delivery) on the cabinet frame, FR13/FR14*

## 7.2 Connecting power supply and internal control cables

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

### 7.2.1 Frames FR10 and FR11

The control unit uses 24 VDC supplied from the ASIC board, the location of which can be seen in the figures below. To access the board, remove the protective cover in front of the module. Connect the power supply cable to the X10 connector on the ASIC board and to the X2 connector on the rear side of the control unit.

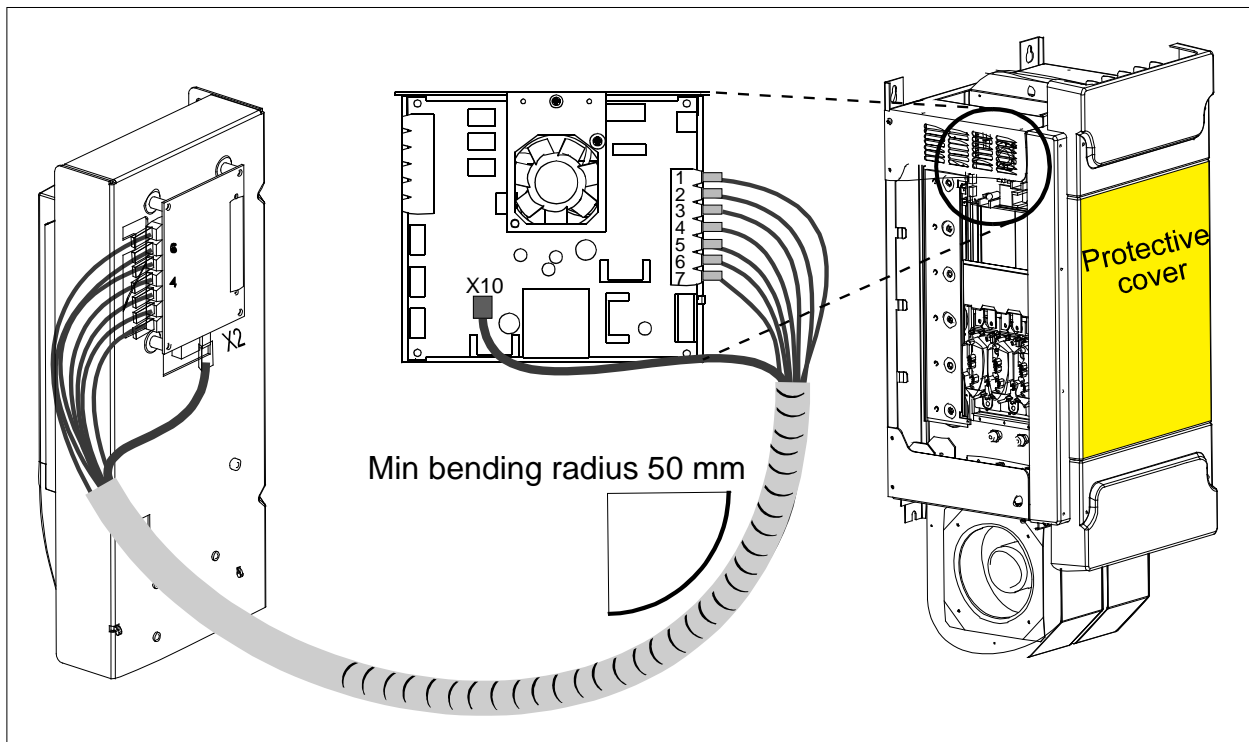


Figure 20. Connecting the power supply and control cables to the control unit, FR10 and FR11

Each fibre optic cable has a number 1...7 marked on the cable shield at both cable ends. Connect each cable to the connectors marked with the same number 1...7 on the ASIC board and on the rear side of the control unit. The list of the optic signals can be found in chapter 10.4.

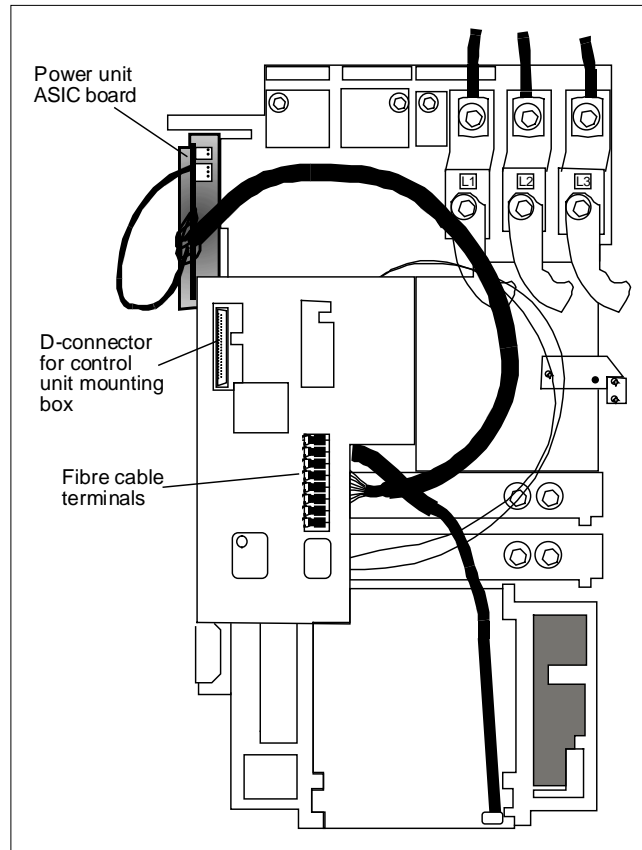


Figure 21. View behind the protective cover

**CAUTION!** Be careful when connecting the fibre optic cables! Connecting the wires incorrectly will damage power electronic components.

**NOTE!** The minimum bending radius for optical cables is 50mm.

Fix the cable bundle at two or more points, at least one at each end, to prevent damages to the cables.

Fasten the protective cover on the power unit when the work is finished.

### 7.2.2 Frame FR12

The control unit uses 24 VDC supplied from the ASIC board, which is located on the left side of the power unit 1. To access the board, remove the protective cover in front of the power module. Connect the power supply cable to the X10 connector on the ASIC board and to the X2 connector on the rear side of the control unit.

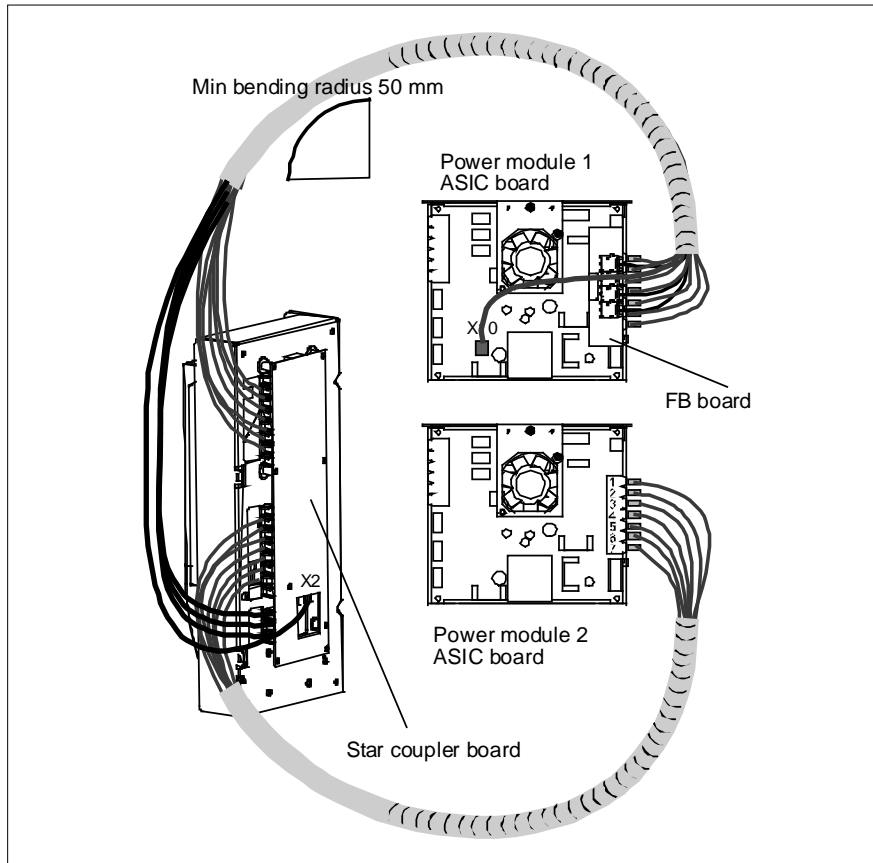


Figure 22. Connecting the power supply and control cables to the control unit, FR12

Each fibre optic cable has a number 1...8 and 11...18 marked on the cable shield at both cable ends. Connect each cable to the connectors marked with the same number on the ASIC board and on the rear side of the control unit. Additionally, you may have to connect the 4 fibre cables from the feedback board to the star coupler board. The list of the optic signals can be found in chapter 10.4.

**7.2.3 Frame FR13**

The control unit uses 24 VDC supplied from the ASIC board, the location of which can be seen in Figure 23. To access the board, remove the cover of the terminal compartment. In case you have received the power supply cable separately connect it to the X10 terminal on the ASIC board. To access the ASIC board you also have to remove the protective cover. The other end of the power supply cable connects to the X2 connector on the rear side of the control unit. See Figure 20.

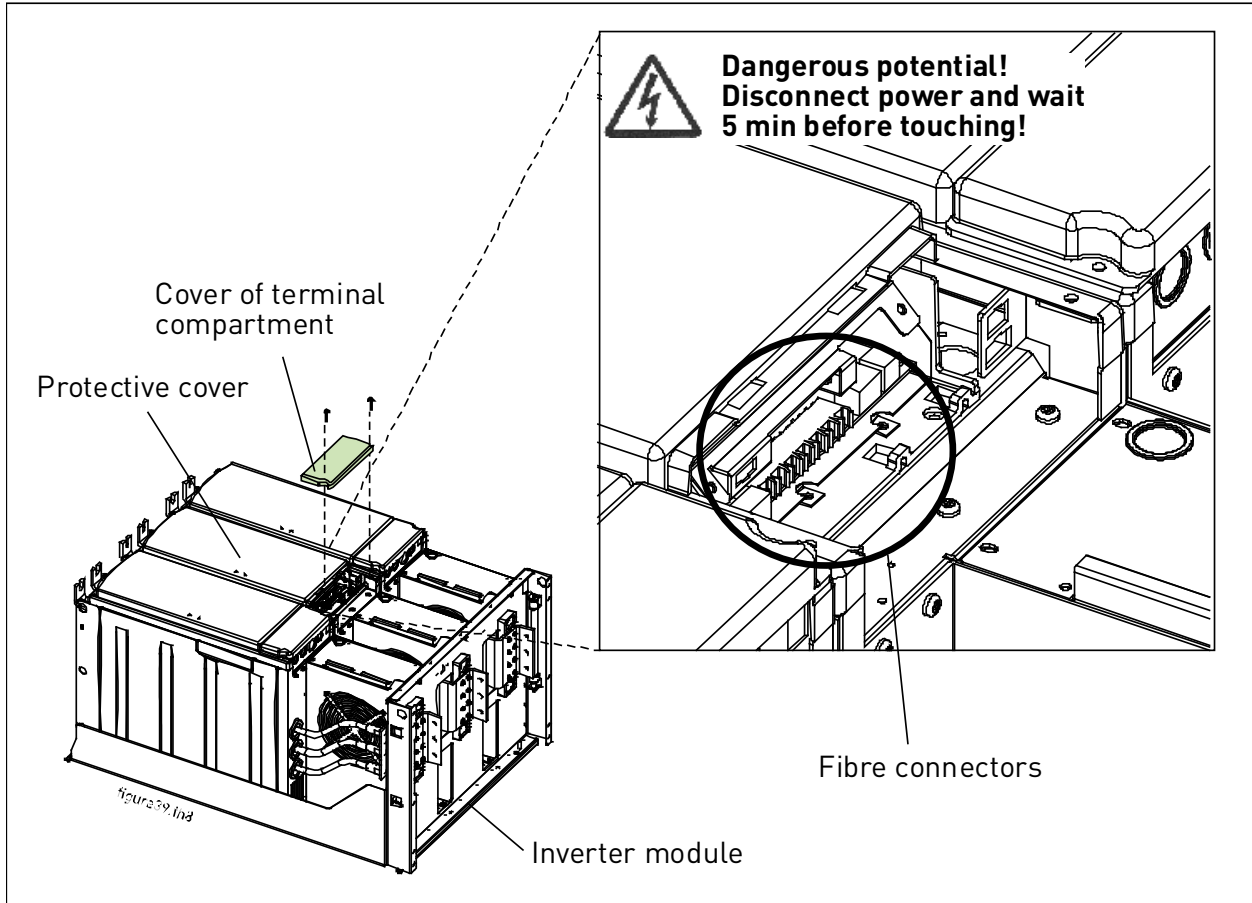


Figure 23.

Each fibre optic cable has a number 1...7 marked on the cable shield at both cable ends. Connect each cable to the connectors marked with the same number 1...7 on the ASIC board and on the rear side of the control unit. The list of the optic signals can be found in chapter 10.4.

**CAUTION!** Be careful when connecting the fibre optic cables! Connecting the wires incorrectly may damage power electronic components.

**NOTE!** The minimum bending radius for optical cables is 50mm.

Fix the cable bundle at two or more points, at least one at each end, to prevent damages to the cables.

Fasten the removed cover(s) on the inverter module when the work is finished.

### 7.2.4 Frame FR14

The control unit uses 24 VDC supplied from the ASIC board, the location of which can be seen in Figure 24. To access the board, remove the cover of the terminal compartment. In case you have received the power supply cable separately connect it to the X10 terminal on the ASIC board. To access the ASIC board you also have to remove the protective cover, see figure below. The other end of the power supply cable connects to the X2 connector on the rear side of the control unit. See Figure 22.

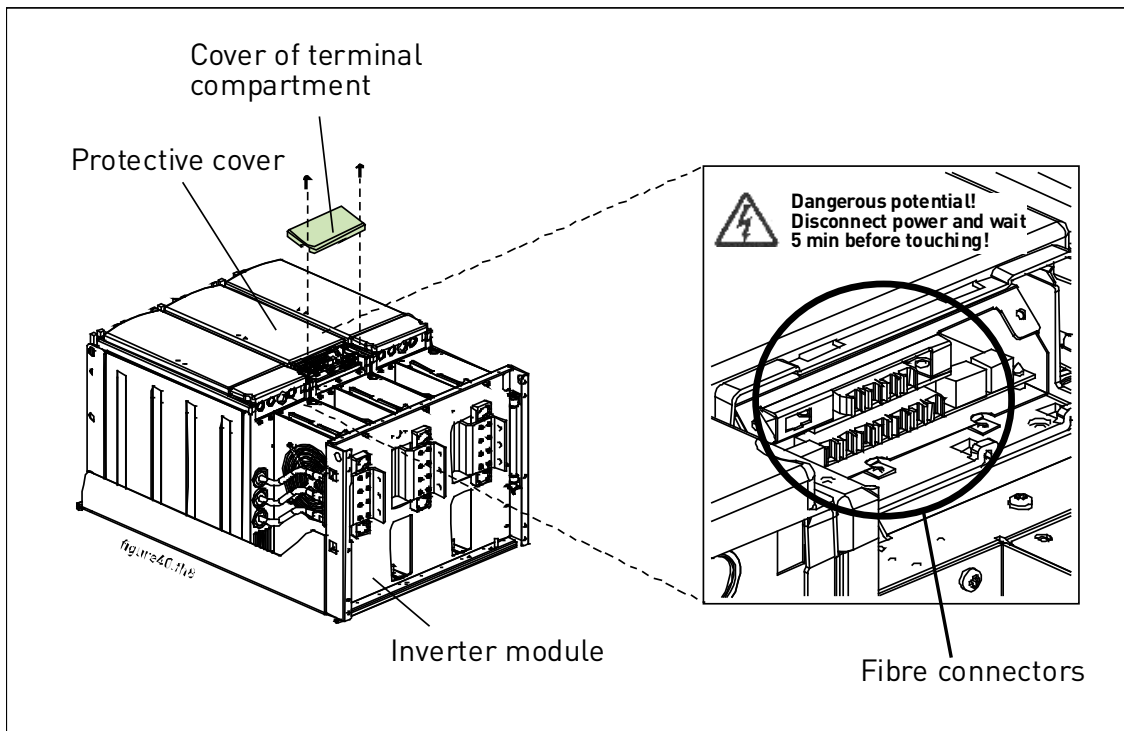


Figure 24.

Each fibre optic cable has a number 1...7 and 11...17 marked on the cable shield at both cable ends. Connect each cable to the connectors marked with the same number on the ASIC board and on the rear side of the control unit. Additionally, you may have to connect the 4 fibre cables from the feedback board to the star coupler board. The list of the optic signals can be found in chapter 10.4.

### 7.2.5 Control connections from NFE units to inverter module(s)

The delivery of FR13 and FR14 drives contains a set of conductors that are used to link the NFE units and the inverter module(s) to each other. The conductors run in a sleeving and all you have to do is to insert the connectors into appropriate terminals.

The terminals are located under the terminal compartment cover that you will have to remove first. The sleeving is then directed through the rubber grommet and finally connected to the correct terminal. See pictures on pages 33 to 35.



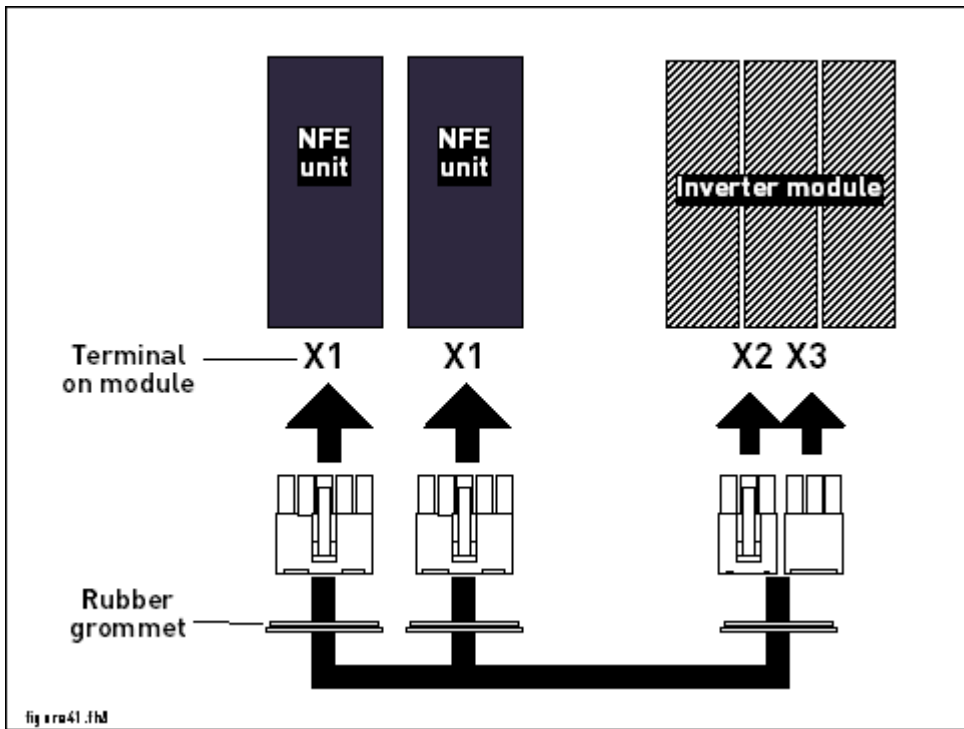


Figure 25. Linking the modules; see Figure at Table 9.

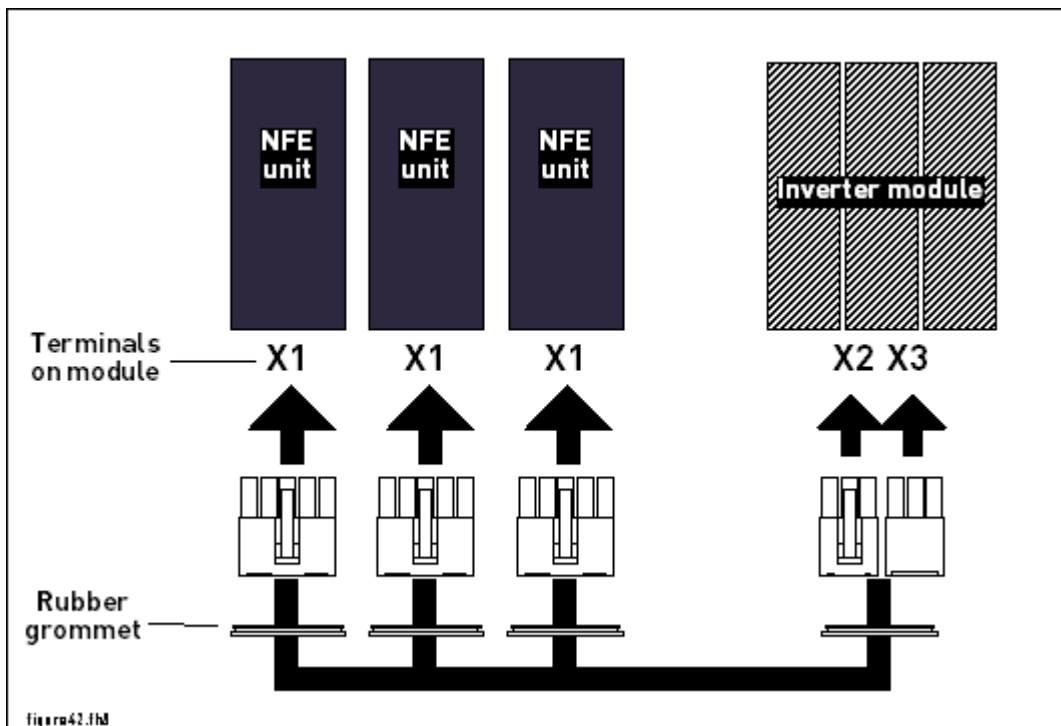


Figure 26. Linking the modules; see Figure at Table 10.

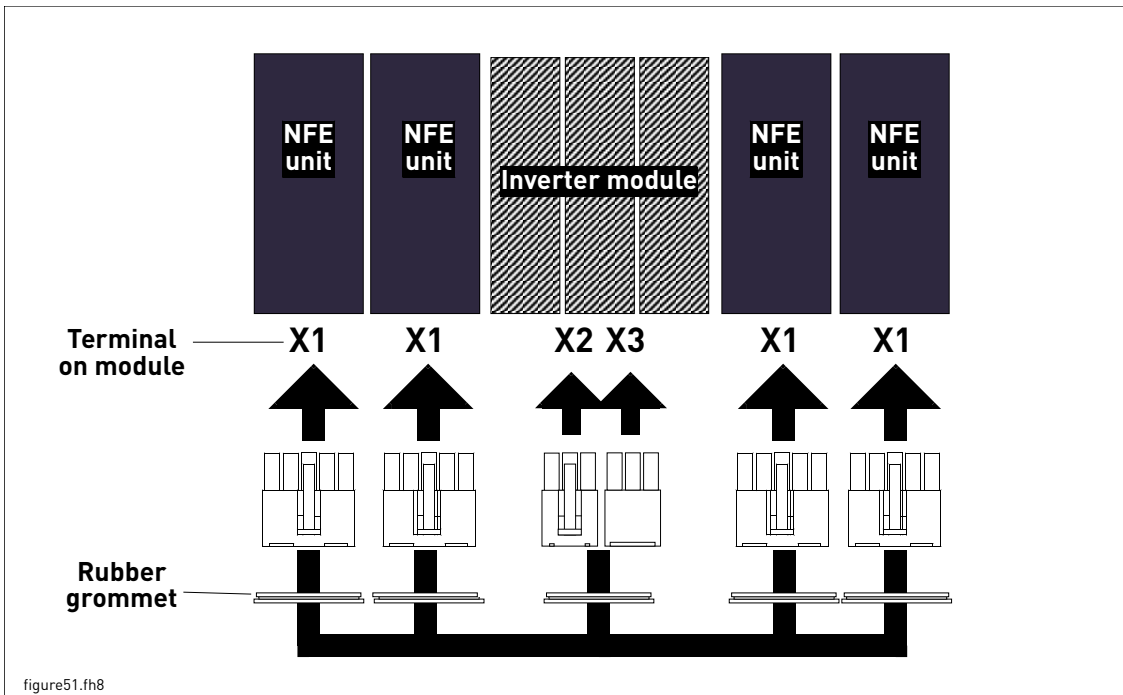


Figure 27. Linking the modules; see Figure at Table 11.

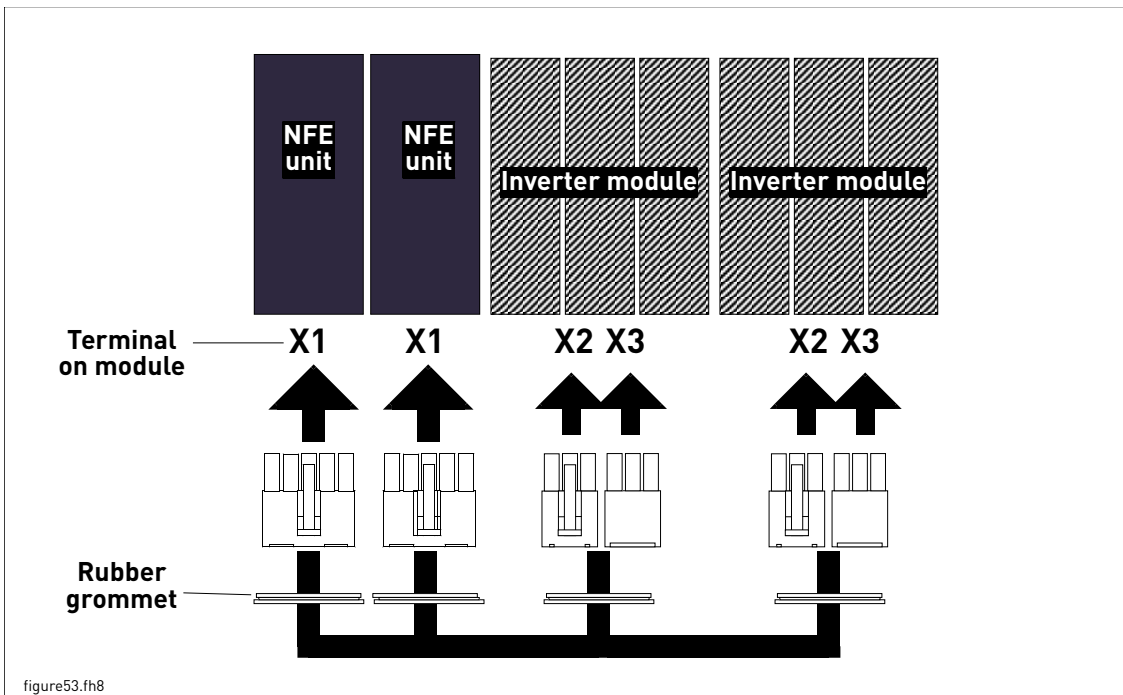


Figure 28. Linking the modules; see Figure at Table 12.

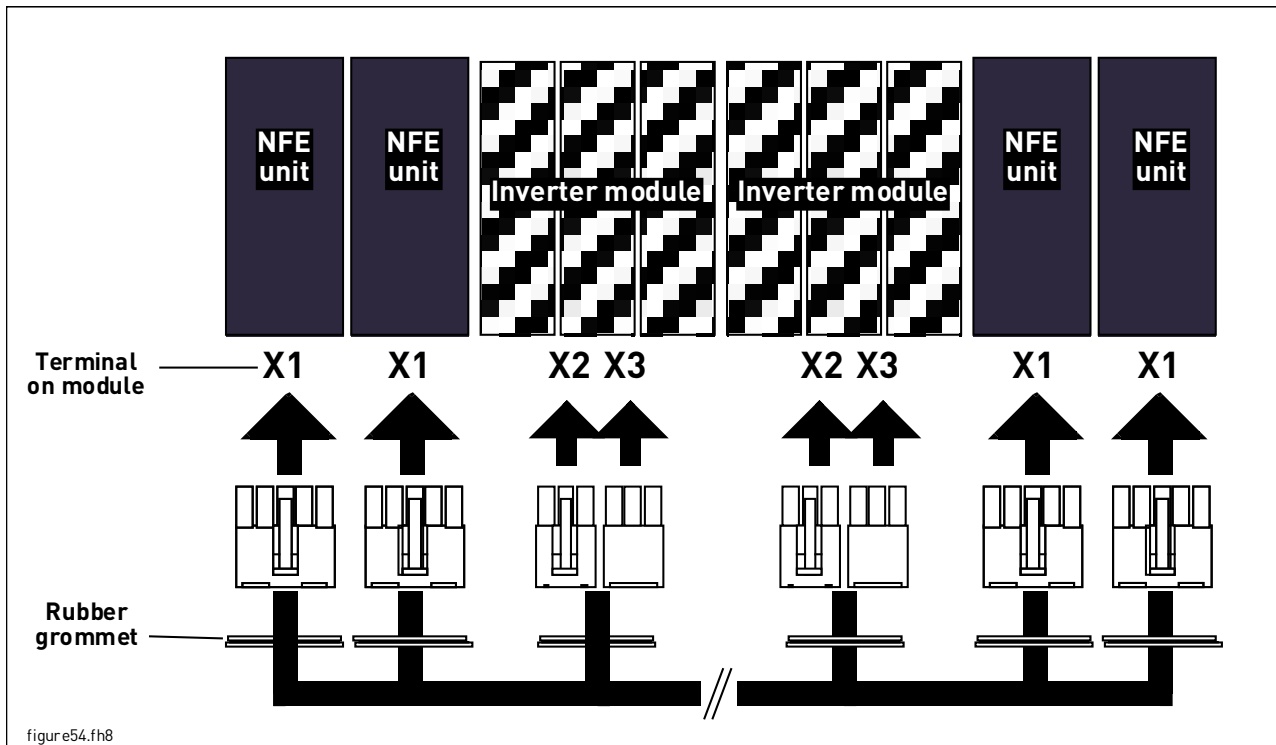


figure54.fh8

Figure 29. Linking the modules; see Figure at Table 13.

## 8. PREPARING FOR EXTERNAL POWER CONNECTIONS

### 8.1 Installing mounting plate and input terminals in frames FR10 to FR12

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. Install input terminals on the plate and connect them to the input terminals (the uppermost terminals) of the AC choke using busbars or flexible busbars according to Table 19.

Voltage range 400–500V		
Product	Cu busbar size	Busbars total
NXP0385 5	30*6 mm	3
NXP0460 5	40*6 mm	3
NXP0520 5	40*6 mm	3
NXP0590 5...NXP0730 5	30*6 mm	6
NXP0820 5...NXP1030 5	40*6 mm	6
Voltage range 525–690V		
Product	Cu busbar size	Busbars total
NXP0261 6...NXP0416 6	30*6 mm	3
NXP0460 6...NXP0502 6	40*6 mm	3
NXP0590 6...NXP0820 6	30*6 mm	6

Table 19. Copper busbar dimensions

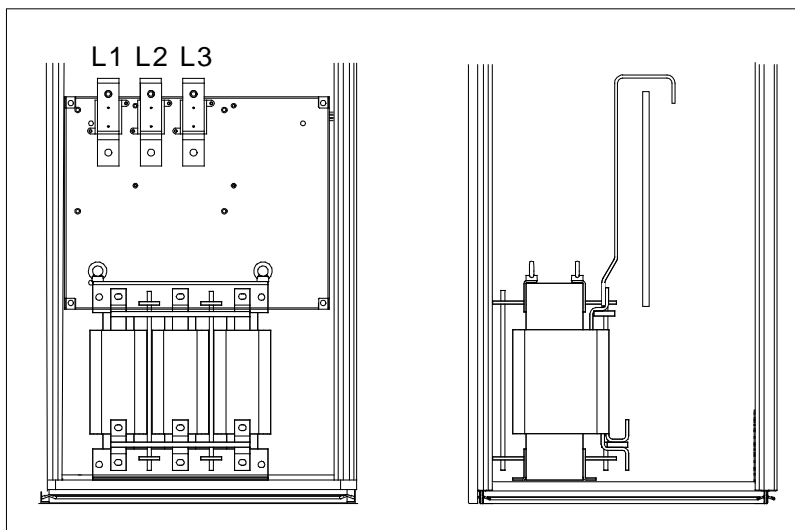


Figure 30. Power input terminals

### 8.2 Routing the supply busbars in frames FR13 and FR14

See the following pictures for how to route the incoming busbars to the AC chokes in the cabinet. Table 20 gives the dimensions for the used busbars. Install a busbar on each pole of the AC choke, see Figure 16.

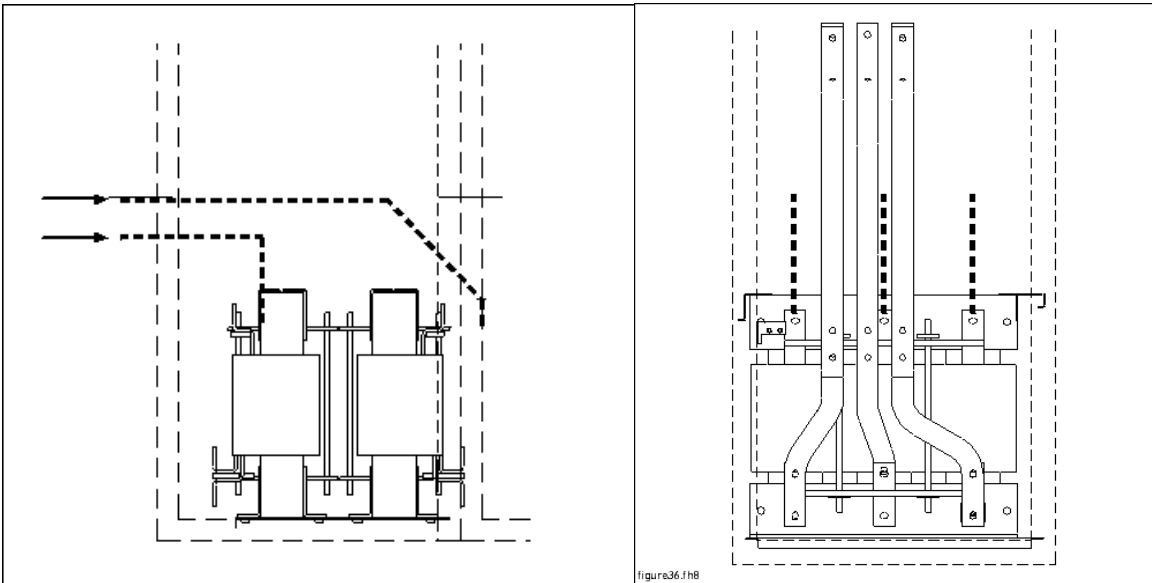


Figure 31. Route for incoming busbars seen from the front (left) and side (right)

**NOTE:** We recommend to close the cabinet wall between the NFE cabinet and the inverter cabinet in order to avoid hot air circulation and consequential overheating.

Voltage range 400–500V		
Product	Cu busbar size	Busbars total
NXP1150 5	40*6 mm	6
NXP1300 5...NXP1450 5	40*6 mm	9
<b>NXP1300 5...NXP1450 5 (12-p)</b>	<b>40*6 mm</b>	<b>12</b>
NXP1500 5	40*6 mm	9
<b>NXP1500 5 (12-p)</b>	<b>40*6 mm</b>	<b>12</b>
NXP1770 5...NXP2150 5	40*6 mm	12
Voltage range 525–690V		
Product	Cu busbar size	Busbars total
NXP0920 6...NXP1180 6	40*6 mm	6
NXP1900 6...NXP2250 6	40*6 mm	12

Table 20. Copper busbar dimensions

### 8.3 Installing fuses

The delivery of IP00 drive contains no internal fuses. To protect the device and allow the installation of a main switch in the enclosure, it is recommended that a fuse switch be installed. Use Bussman aR type fuses according to Table 21, and install them in the same enclosure as the frequency converter, or in another enclosure in the immediate vicinity. Fuse installation instructions are given on page 40. See chapter APPENDICES for recommendations on other fuse types.

Frame	Type	DIN43620		DIN43653 (110mm)		Flush end contacts (metric)		Fuse I <sub>n</sub> [A]	Qty. of fuses per drive
		aR fuse part nr.	Fuse size	aR fuse part nr.	Fuse size	aR fuse part nr.	Fuse size		
<b>Mains voltage 380-500 V</b>									
FR10	0385	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	3
<b>FR10</b>	<b>0385</b>	<b>170M5813</b>	<b>DIN 2</b>	<b>170M5213</b>	<b>2TN/110</b>	<b>170M5463</b>	<b>2BKN/50</b>	<b>700</b>	<b>6</b>
FR10	0460	170M8547	3SHT **	170M6216	3TN/110	170M6466	3BKN/50	1250	3
<b>FR10</b>	<b>0460</b>	<b>170M5813</b>	<b>DIN 2</b>	<b>170M5213</b>	<b>2TN/110</b>	<b>170M5463</b>	<b>2BKN/50</b>	<b>700</b>	<b>6</b>
FR10	0520	170M8547	3SHT **	170M6216	3TN/110	170M6466	3BKN/50	1250	3
<b>FR10</b>	<b>0520</b>	<b>170M5813</b>	<b>DIN 2</b>	<b>170M5213</b>	<b>2TN/110</b>	<b>170M5463</b>	<b>2BKN/50</b>	<b>700</b>	<b>6</b>
FR11	0590	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	6
FR11	0650	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	6
FR11	0730	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	6
FR12	0820	170M8547	3SHT **	170M6216	3TN/110	170M6466	3BKN/50	1250	6
FR12	0920	170M8547	3SHT **	170M6216	3TN/110	170M6466	3BKN/50	1250	6
FR12	1030	170M8547	3SHT **	170M6216	3TN/110	170M6466	3BKN/50	1250	6
FR12 DC-link	*	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	2
<b>Mains voltage 525-690 V</b>									
FR10	0261	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	3
<b>FR10</b>	<b>0261</b>	<b>170M5813</b>	<b>DIN 2</b>	<b>170M5213</b>	<b>2TN/110</b>	<b>170M5463</b>	<b>2BKN/50</b>	<b>700</b>	<b>6</b>
FR10	0325	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	3
<b>FR10</b>	<b>0325</b>	<b>170M5813</b>	<b>DIN 2</b>	<b>170M5213</b>	<b>2TN/110</b>	<b>170M5463</b>	<b>2BKN/50</b>	<b>700</b>	<b>6</b>
FR10	0385	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	3
<b>FR10</b>	<b>0385</b>	<b>170M5813</b>	<b>DIN 2</b>	<b>170M5213</b>	<b>2TN/110</b>	<b>170M5463</b>	<b>2BKN/50</b>	<b>700</b>	<b>6</b>
FR10	0416	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	3
<b>FR10</b>	<b>0416</b>	<b>170M5813</b>	<b>DIN 2</b>	<b>170M5213</b>	<b>2TN/110</b>	<b>170M5463</b>	<b>2BKN/50</b>	<b>700</b>	<b>6</b>
FR11	0460	170M8547	3SHT **	170M6216	3TN/110	170M6466	3BKN/50	1250	3
<b>FR11</b>	<b>0460</b>	<b>170M5813</b>	<b>DIN 2</b>	<b>170M5213</b>	<b>2TN/110</b>	<b>170M5463</b>	<b>2BKN/50</b>	<b>700</b>	<b>6</b>
FR11	0502	170M8547	3SHT **	170M6212	3TN/110	170M6466	3BKN/50	1250	3
<b>FR11</b>	<b>0502</b>	<b>170M5813</b>	<b>DIN 2</b>	<b>170M5213</b>	<b>2TN/110</b>	<b>170M5463</b>	<b>2BKN/50</b>	<b>700</b>	<b>6</b>
FR11	0590	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	6
<b>FR11</b>	<b>0590</b>	<b>170M5813</b>	<b>DIN 2</b>	<b>170M5213</b>	<b>2TN/110</b>	<b>170M5463</b>	<b>2BKN/50</b>	<b>700</b>	<b>6</b>
FR12	0650	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	6
FR12	0750	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	6
FR12	0820	170M5813	DIN 2	170M5213	2TN/110	170M5463	2BKN/50	700	6
FR12 DC-link	*	170M6202	3SHT **	170M5986	2TN/110	170M8604	3BKN/75	500	2

Table 21. Bussman fuse recommendations, FR10...FR12

\* = In FR12 12-pulse drive or if FR12 ( 6- or 12-pulse ) has internal brake; 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.)

\*\* = SHT fuses can be assembled into same size DIN fuse base

**Data written in shaded bold refer to 12-pulse drives (6-phase supply).**

The aR fuses are thermally rated into switch fuse in 50 degree ambient temperature.

Frame	Type	Fuses with flush end contact (metric)		Fuses with flush end contact (US)		Fuse I <sub>n</sub> [A]	Qty. of DC fuses per drive	Qty. of AC fuses per drive*
		Fuse part nr. (aR) (AC/DC)	Fuse size	Fuse part nr. (aR)	Fuse size			
<b>Mains voltage 380-500 V</b>								
FR13	1150	170M6466	3BKN/50	170M6566	3GKN/50	1250	4	6
<b>FR13</b>	<b>1150</b>	<b>170M6466</b>	<b>3BKN/50</b>	<b>170M6566</b>	<b>3GKN/50</b>	<b>1250</b>	<b>4</b>	<b>6</b>
FR13	1300	170M6466	3BKN/50	170M6566	3GKN/50	1250	6	9
<b>FR13</b>	<b>1300</b>	<b>170M6466</b>	<b>3BKN/50</b>	<b>170M6566</b>	<b>3GKN/50</b>	<b>1250</b>	<b>6</b>	<b>12</b>
FR13	1450	170M6466	3BKN/50	170M6566	3GKN/50	1250	6	9
<b>FR13</b>	<b>1450</b>	<b>170M6466</b>	<b>3BKN/50</b>	<b>170M6566</b>	<b>3GKN/50</b>	<b>1250</b>	<b>6</b>	<b>12</b>
FR14	1770	170M6466	3BKN/50	170M6566	3GKN/50	1250	8	12
<b>FR14</b>	<b>1770</b>	<b>170M6466</b>	<b>3BKN/50</b>	<b>170M6566</b>	<b>3GKN/50</b>	<b>1250</b>	<b>8</b>	<b>12</b>
FR14	2150	170M6466	3BKN/50	170M6566	3GKN/50	1250	8	12
<b>FR14</b>	<b>2150</b>	<b>170M6466</b>	<b>3BKN/50</b>	<b>170M6566</b>	<b>3GKN/50</b>	<b>1250</b>	<b>8</b>	<b>12</b>
<b>Mains voltage 525-690 V</b>								
FR13	0920	170M6466 (AC) 170M8610 (DC)	3BKN/50 3BKN/75	170M6566 (AC)	3GKN/50	1250 1000	4	6
<b>FR13</b>	<b>0920</b>	<b>170M6466 (AC)</b> <b>170M8610 (DC)</b>	<b>3BKN/50</b> <b>3BKN/75</b>	<b>170M6566 (AC)</b>	<b>3GKN/50</b>	<b>1250</b> <b>1000</b>	<b>4</b>	<b>6</b>
FR13	1030	170M6466 (AC) 170M8610 (DC)	3BKN/50 3BKN/75	170M6566 (AC)	3GKN/50	1250 1000	4	6
<b>FR13</b>	<b>1030</b>	<b>170M6466 (AC)</b> <b>170M8610 (DC)</b>	<b>3BKN/50</b> <b>3BKN/75</b>	<b>170M6566 (AC)</b>	<b>3GKN/50</b>	<b>1250</b> <b>1000</b>	<b>4</b>	<b>6</b>
FR13	1180	170M6466 (AC) 170M8610 (DC)	3BKN/50 3BKN/75	170M6566 (AC)	3GKN/50	1250 1000	4	6
<b>FR13</b>	<b>1180</b>	<b>170M6466 (AC)</b> <b>170M8610 (DC)</b>	<b>3BKN/50</b> <b>3BKN/75</b>	<b>170M6566 (AC)</b>	<b>3GKN/50</b>	<b>1250</b> <b>1000</b>	<b>4</b>	<b>6</b>
FR14	1500	170M6466 (AC) 170M8610 (DC)	3BKN/50 3BKN/75	170M6566 (AC)	3GKN/50	1250 1000	6	9
<b>FR14</b>	<b>1500</b>	<b>170M6466 (AC)</b> <b>170M8610 (DC)</b>	<b>3BKN/50</b> <b>3BKN/75</b>	<b>170M6566 (AC)</b>	<b>3GKN/50</b>	<b>1250</b> <b>1000</b>	<b>8</b>	<b>12</b>
FR14	1900	170M6466 (AC) 170M8610 (DC)	3BKN/50 3BKN/75	170M6566 (AC)	3GKN/50	1250 1000	8	12
<b>FR14</b>	<b>1900</b>	<b>170M6466 (AC)</b> <b>170M8610 (DC)</b>	<b>3BKN/50</b> <b>3BKN/75</b>	<b>170M6566 (AC)</b>	<b>3GKN/50</b>	<b>1250</b> <b>1000</b>	<b>8</b>	<b>12</b>
FR14	2250	170M6466 (AC) 170M8610 (DC)	3BKN/50 3BKN/75	170M6566 (AC)	3GKN/50	1250 1000	8	12
<b>FR14</b>	<b>2250</b>	<b>170M6466 (AC)</b> <b>170M8610 (DC)</b>	<b>3BKN/50</b> <b>3BKN/75</b>	<b>170M6566 (AC)</b>	<b>3GKN/50</b>	<b>1250</b> <b>1000</b>	<b>8</b>	<b>12</b>

Table 22. Fuse recommendations, FR13...FR14

Data written in shaded bold refer to 12-pulse drives (6-phase supply).

The aR fuses are thermally rated into switch fuse in 50 degree ambient temperature.

### 8.3.1 Fuse installation instructions

In order 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 will be better removed through a well-made connection. Follow, therefore, the given tightening torques given below. Vacon recommends a fuse connection made with busbars.

#### 8.3.1.1 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. As a general rule, 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 below:

Size/Type	Threaded hole [mm]	Tightening torque [Nm]
2B	M10	40
3B...3G	M12	50

Table 23. Tightening torques for flush end fuses

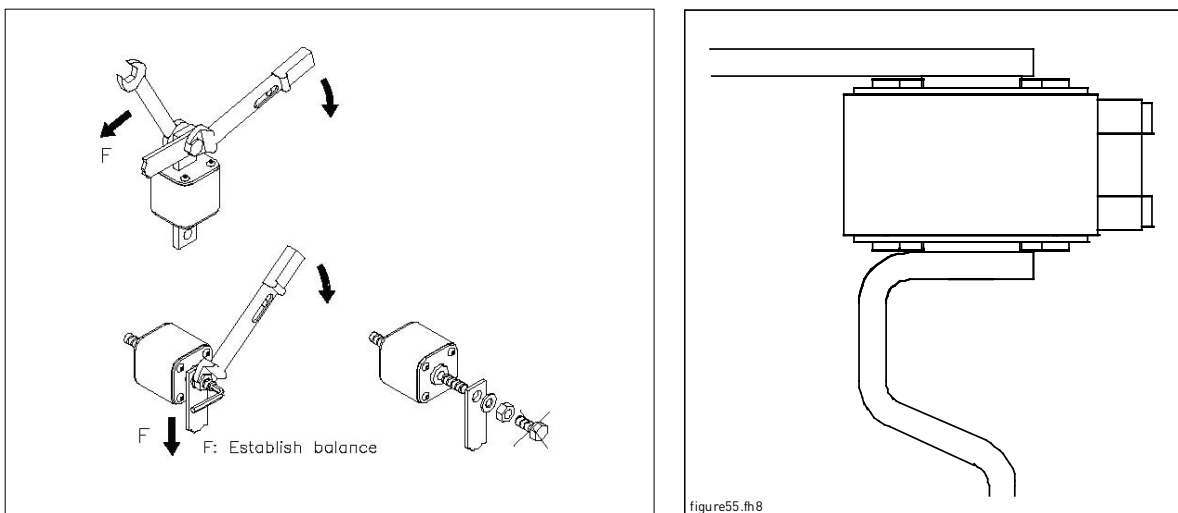


Figure 32. Installing flush end fuse; Busbar connection is recommended (right)

#### 8.3.1.2 Fuses with contact knives

Vacon recommends two types of fuses with contact knives; Fuses with slotted knives according to **DIN43653** and fuses with solid knives according to **DIN43620**. 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 DIN43653 fuses to a torque of 50Nm.

The fuses according to DIN43653 have to be tightened in accordance with the specification provided with the base.



#### 8.4 Installing EMC grounding, FR10 to FR12

The output cables to the motor must be 360° EMC earthed. The EMC grounding clamps can, for instance, be installed on the mounting plate in front of the AC choke as shown in the figure below. The EMC grounding clamps must be suited to the output cable diameter to give a 360° contact with the cables. Refer to the NXP/C User's Manual for output cable diameters.

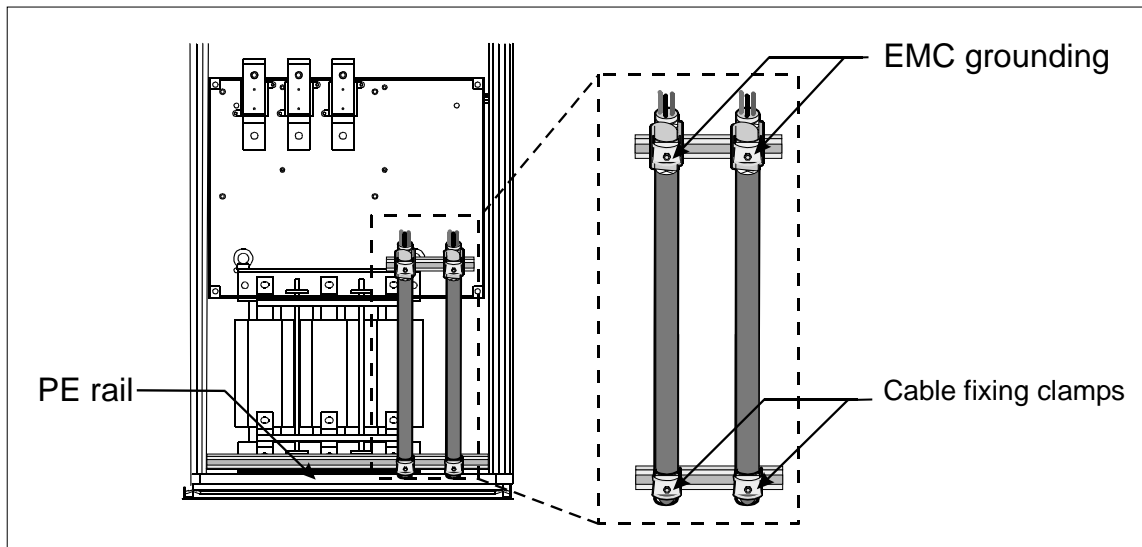


Figure 33. Installing EMC grounding

#### 8.5 Installation of ferrite rings (option) on the motor cable

Slip only the phase conductors through the window; leave the cable screen below and outside the rings, see Figure 34. Separate the PE conductor. In case of parallel motor cables, reserve an equal amount of ferrite rings for each cable and feed all the phase conductors of one cable through one set of rings. The Vacon delivery includes fixed sets of ferrite rings.

When ferrite rings are used to attenuate the risk of bearing damages, the number of ferrites has to be 6...10 for a single motor cable and 10 per cable when the motor is supplied with parallel cables.

**Note!** The ferrite rings are only additional protection. The basic protection against bearing currents is an insulated bearing.

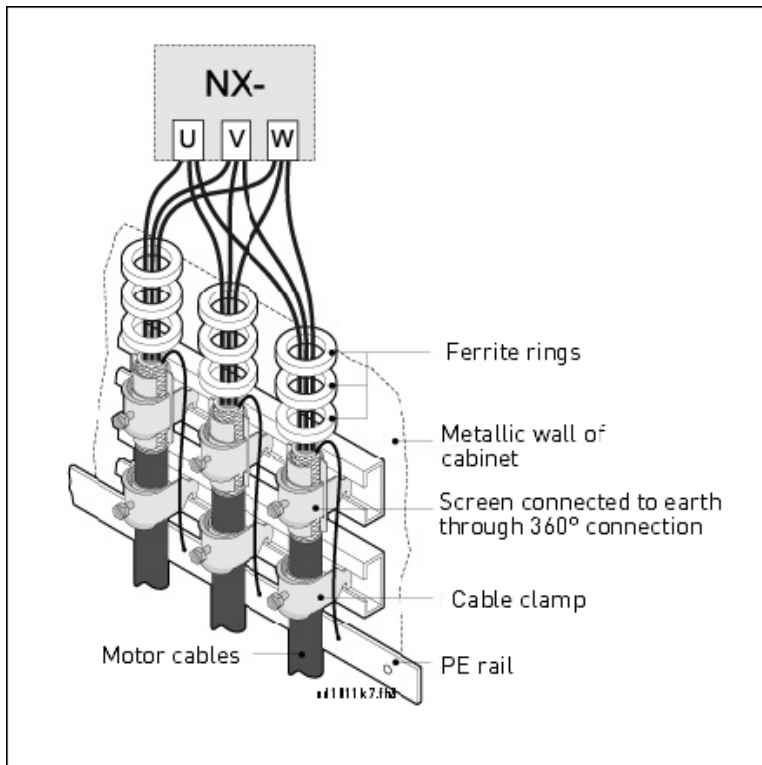


Figure 34. Installation of ferrite rings

## 8.6 Connecting input and output power

Refer to the NXP/C User's Manual, where input and output cables are specified.

## 9. AIR COOLING AND VENTILATION

**CAUTION!** 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. Repeated overheating will shorten the lifetime of the converter.

### 9.1 Arranging ventilation of the enclosure

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 24 must be followed. For instance, there could be two screened gaps as presented in Figure 35 (Vacon's recommendation). This layout ensures a sufficient air flow to the module fans as well as cooling of the additional components.

Air outlet gaps must be situated on top of the cabinet. The minimum effective air outlet area per converter frame is given in Table 24. The cooling arrangements inside the cabinet must be such that they prevent hot output air from mixing with the incoming fresh air (see page 45 below).

The ventilation gaps must fulfil the requirements set by the selected IP class. 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 will be in the mid of the cabinet, at the height of the upper ventilation grid.

See Figure 35 on page 44.

Ventilation gap	Cabinet size 600mm	Cabinet size 800mm
1	510*255 mm	765*255 mm
2	7 dm <sup>2</sup>	10.5 dm <sup>2</sup>

Table 24. Ventilation requirements (ventilation gap dimensions)

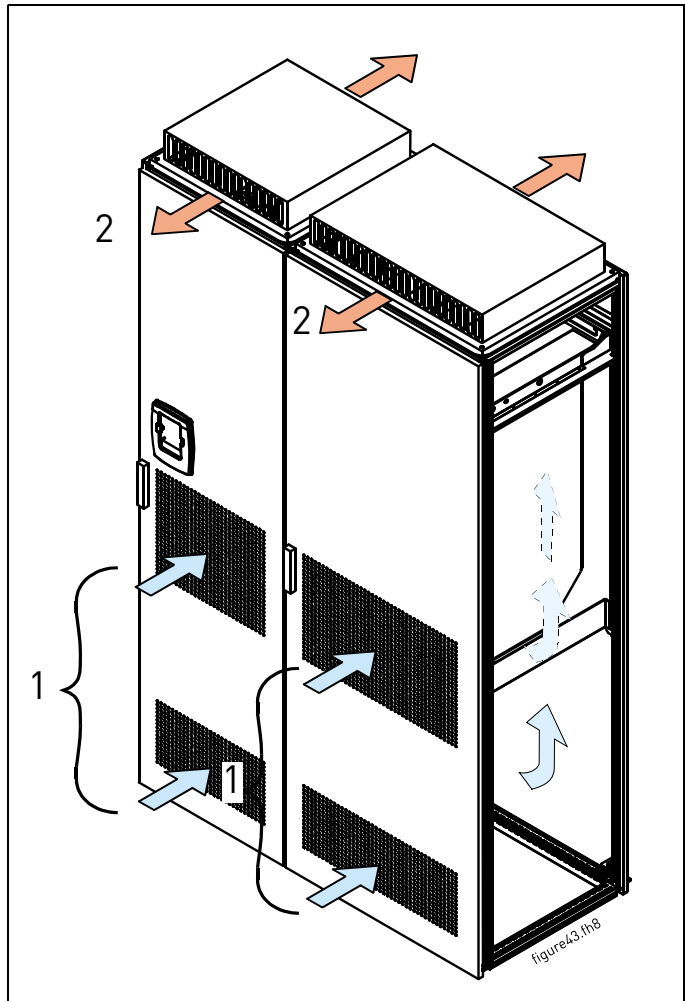
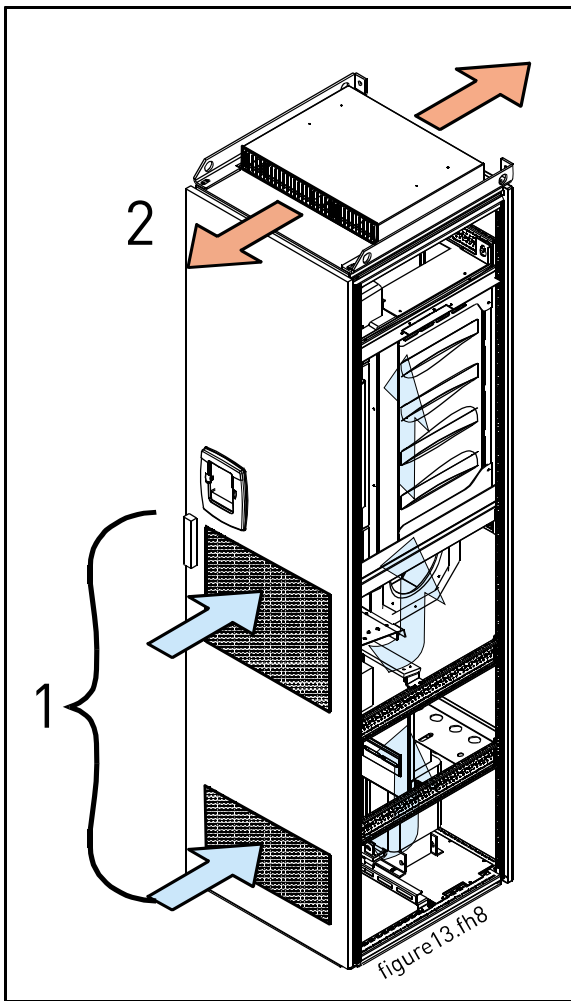


Figure 35. Ventilation arrangements on the cabinet (examples)

## 9.2 Steering the internal air flow

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 (A in figures below).
- B. Install shields in the gaps between the power unit and the cabinet walls (B in figures below). Place the shields above the air outlet gaps at the sides of the module.

In frame FR12, close the opposing gaps in the upper part of the cabinets with a sheet metal plate to ensure proper cooling.

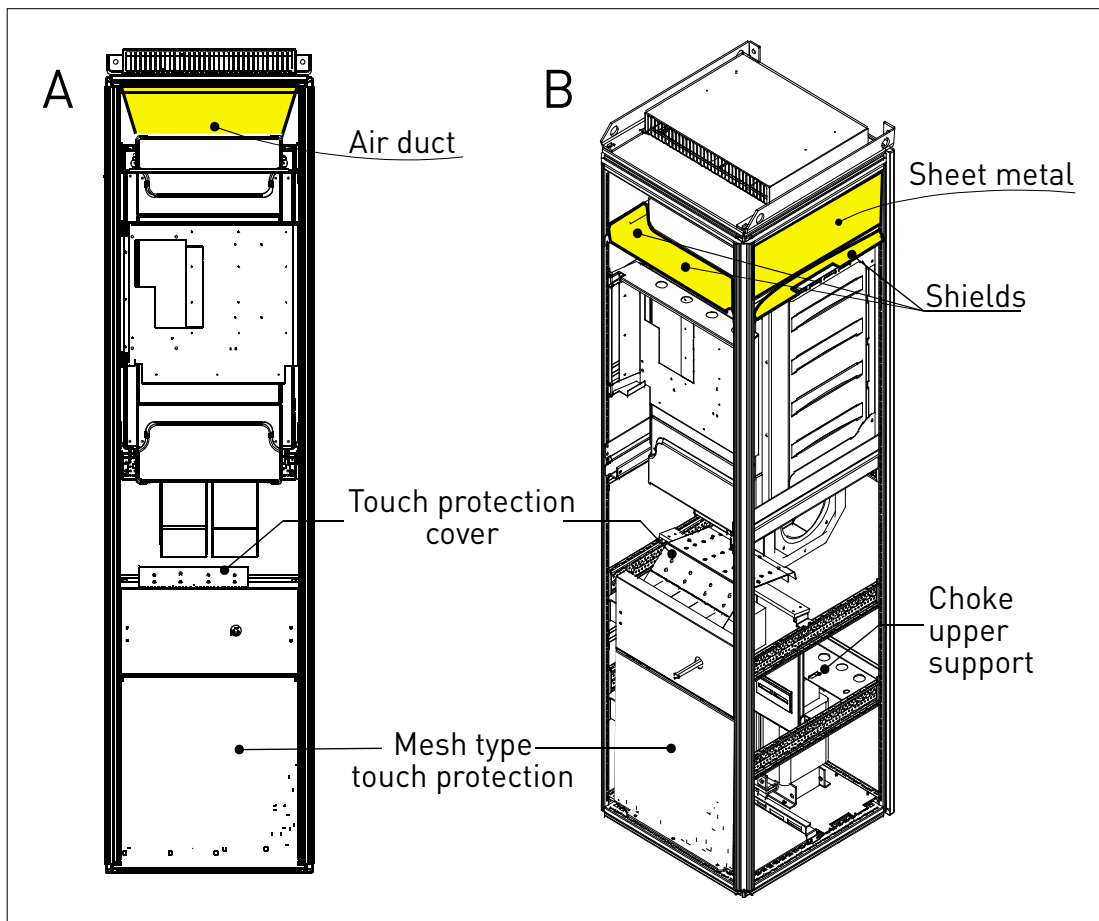


Figure 36. Arrangements for steering hot air to the outlet at the top of the cabinet, one-cabinet solution

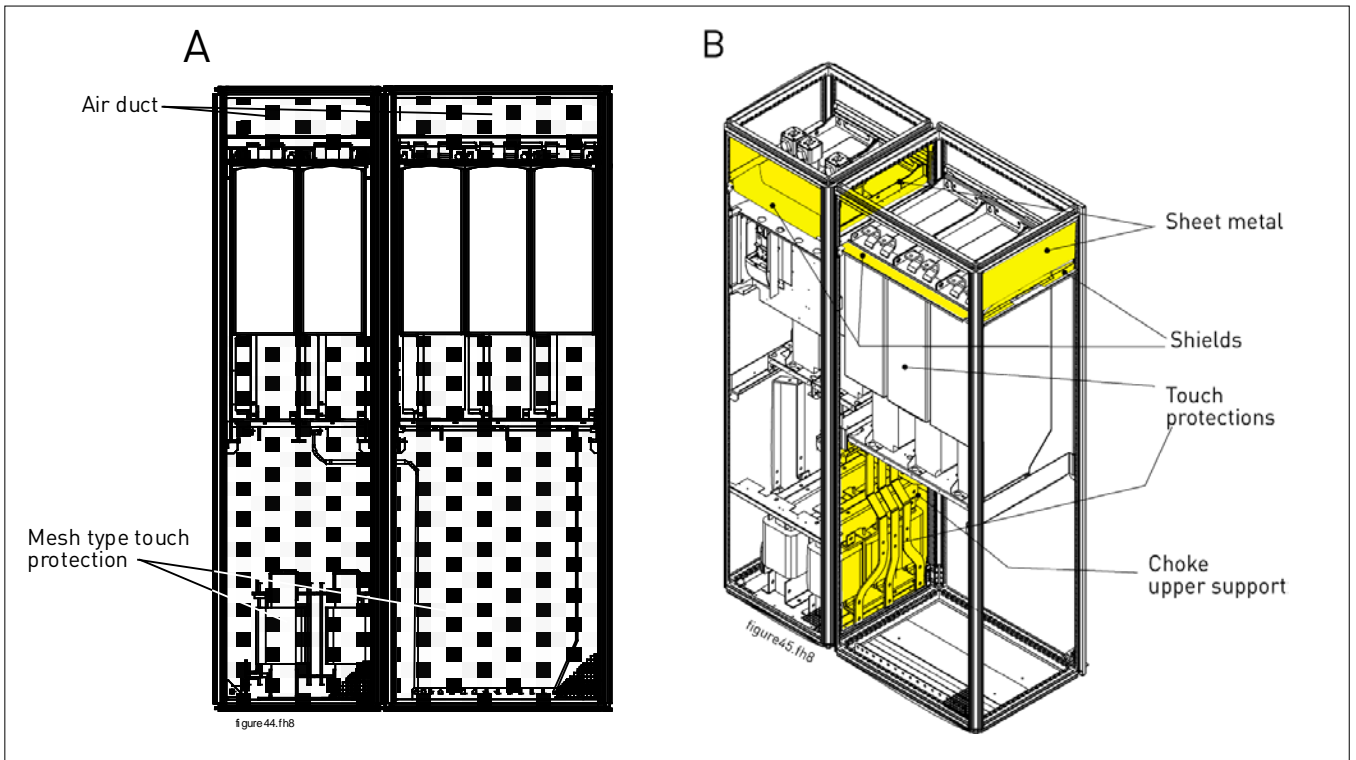


Figure 37. Arrangements for steering hot air to the outlet at the top of the cabinet, several-cabinet solution

**NOTE!** To allow free air circulation, the touch cover at the bottom of the cabinet must be of type meshed sheet metal screen. For the same reason, the busbar touch protection cover and the choke upper support must be equipped with holes. See Figure 36.

**NOTE!** If a flat roof is used, mount a V-shaped air guide on the underside of the roof to direct the air flow horizontally. See Figure 38.

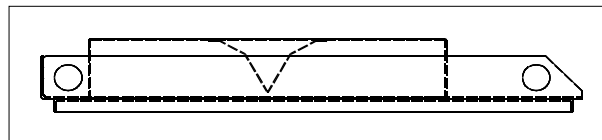


Figure 38. Roof structure seen from the side

### 9.3 Heat dissipation

The efficiency of the frequency converter is a function of switching frequency, operating frequency and load (see NXP/C User’s manual). Based on this information, heat dissipation can be calculated at a certain operating point. For most cases the following general formula based on frequency converter load can be used to estimate the heat dissipation of the power module:

$$P_{loss} [kW] = P_{mot} [kW] * 0.025$$

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

Choke	Heat dissipation
CHK0261	460 W
CHK0400	570 W
CHK0520	810 W
CHK0650	890 W

Table 25. Heat dissipation from the AC choke

#### 9.4 Temperatures measured during test run

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

Measurement	Temperature [°C]	Note
Ambient air	30	Outside enclosure
Fan intake air	36	
Module input terminal	59	L2-phase
Output terminal	65	V-phase
AC choke	92	L2 winding surface

Table 26. Temperatures measured during an accepted test run

10. APPENDICES

10.1 Dimensional drawings, Power modules

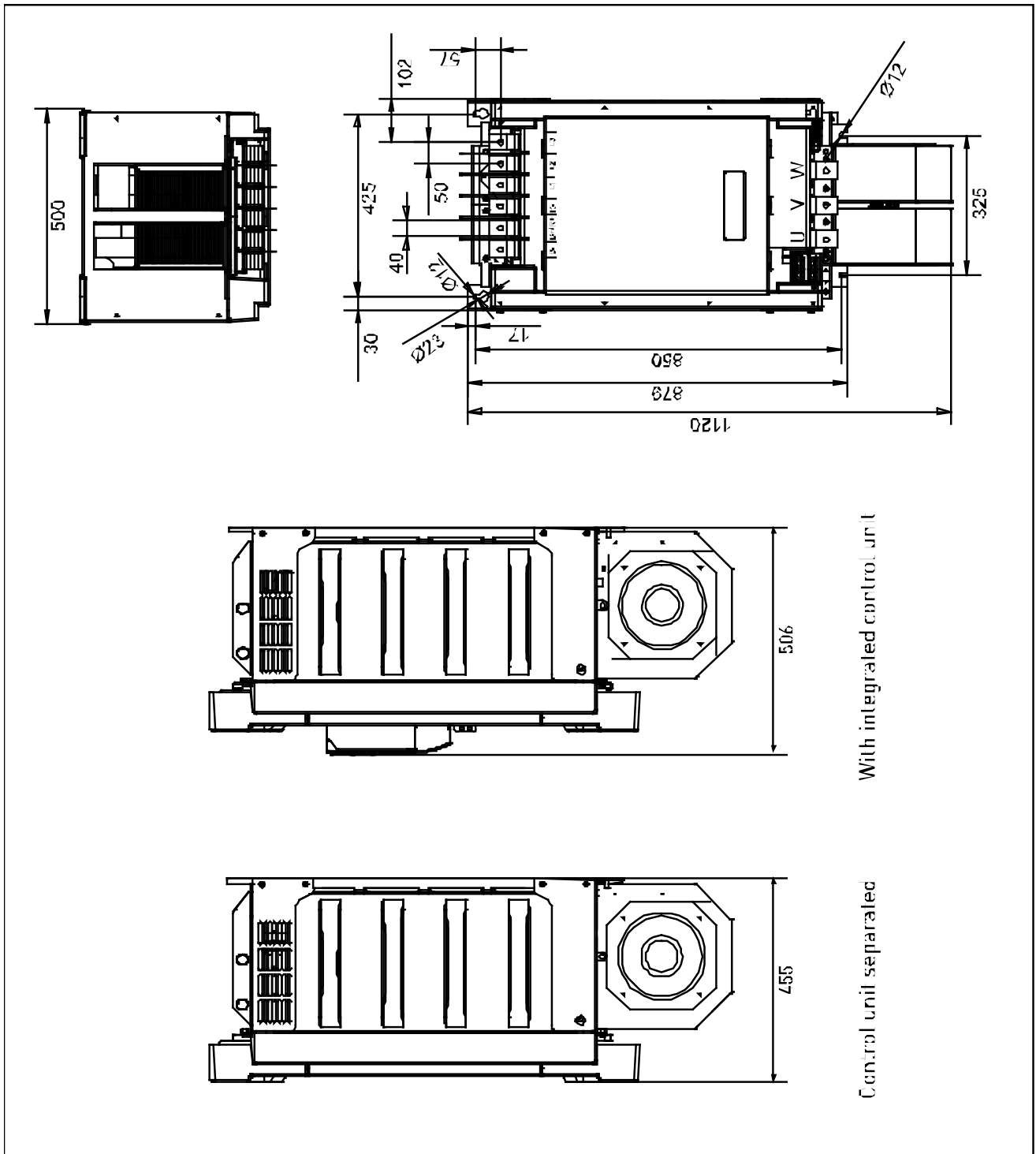


Figure 39. Power module dimensions, FR10

Vacon NXP frequency converter frame FR12 is built of two FR10 modules.



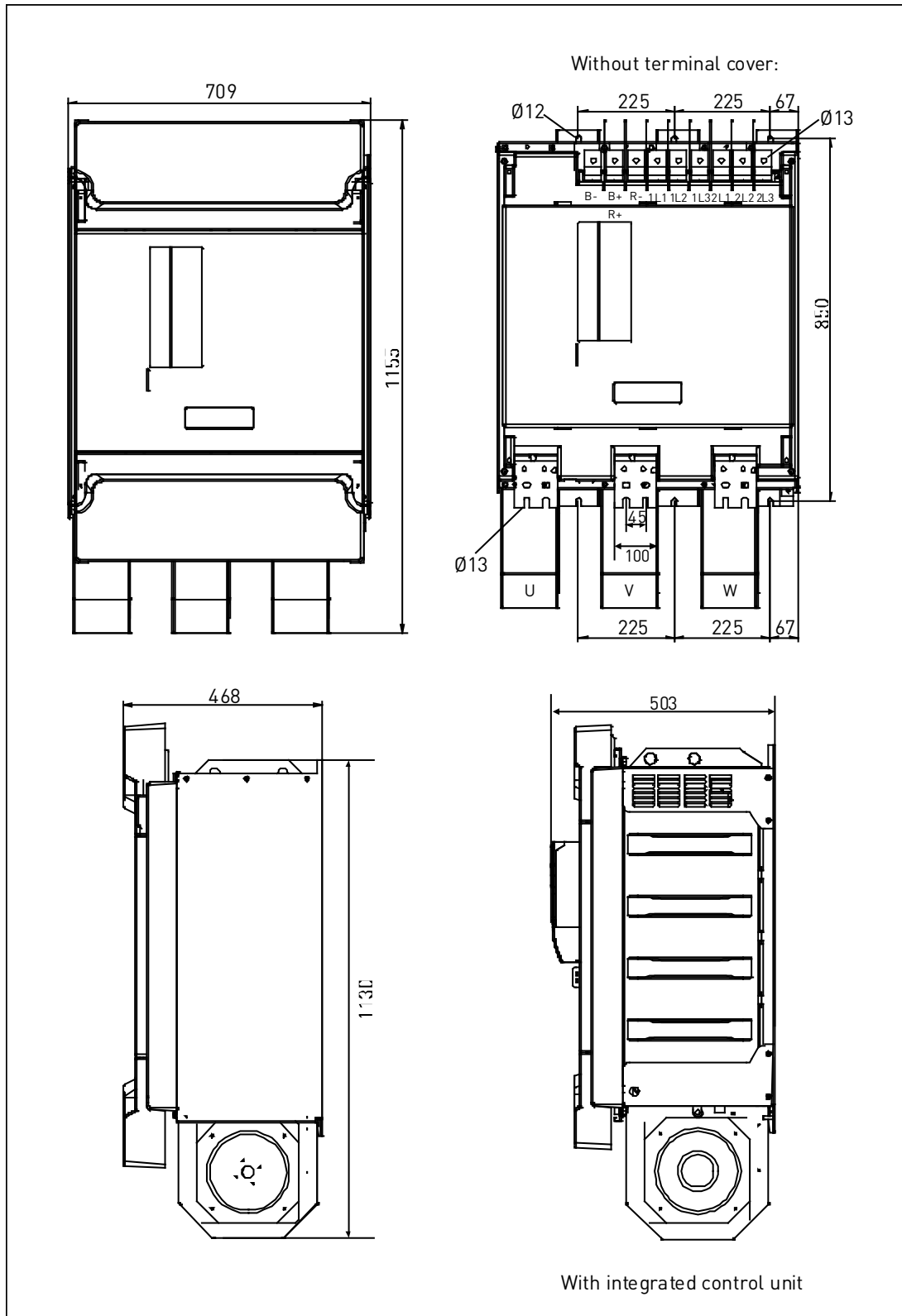


Figure 40. Power module dimensions, FR11

Vacon NXP frequency converter frame FR12 is built of two FR10 modules.

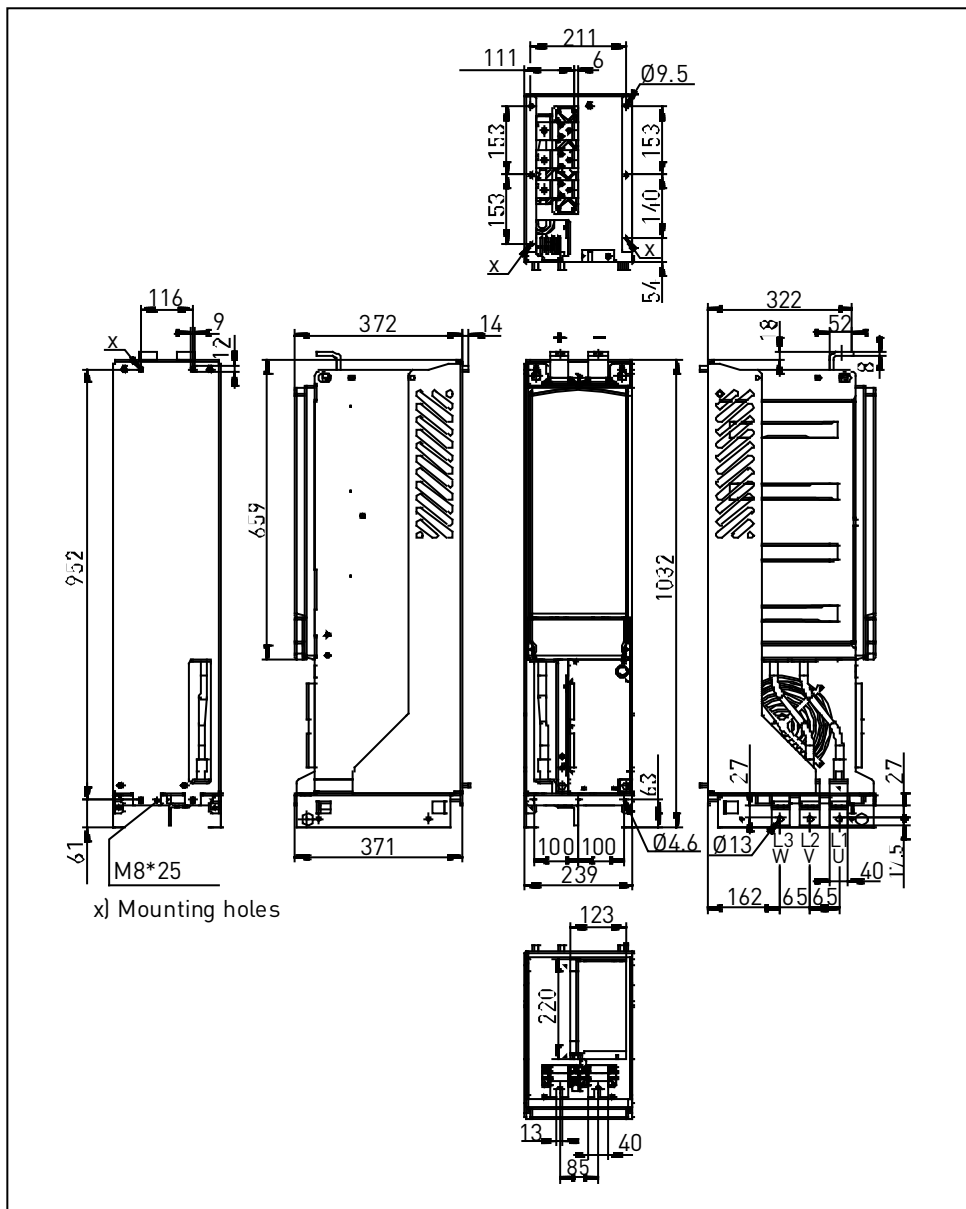


Figure 41. Dimension drawing; NFE unit

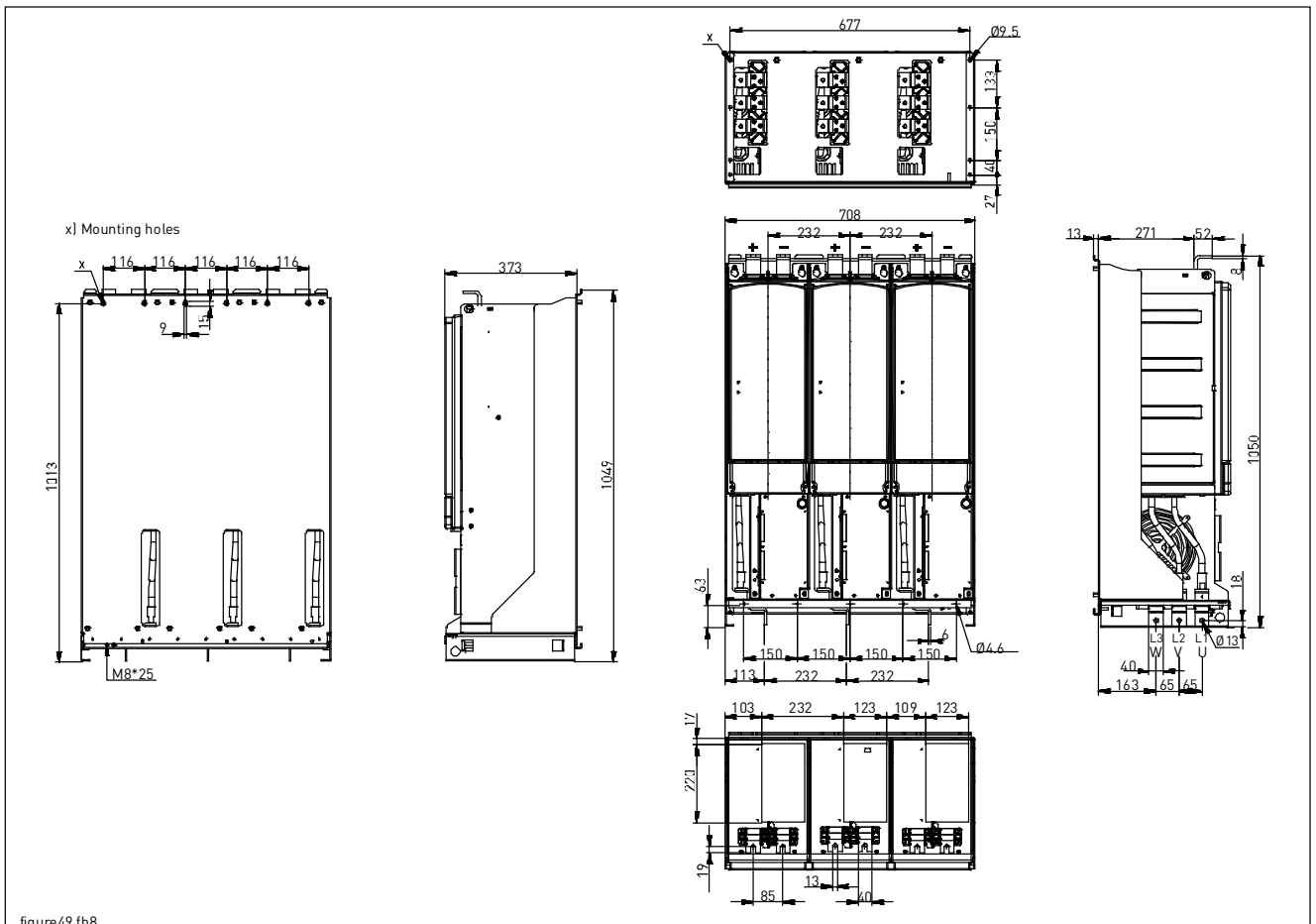


figure49.fh8

Figure 42. Dimensional drawing; 3 NFE units

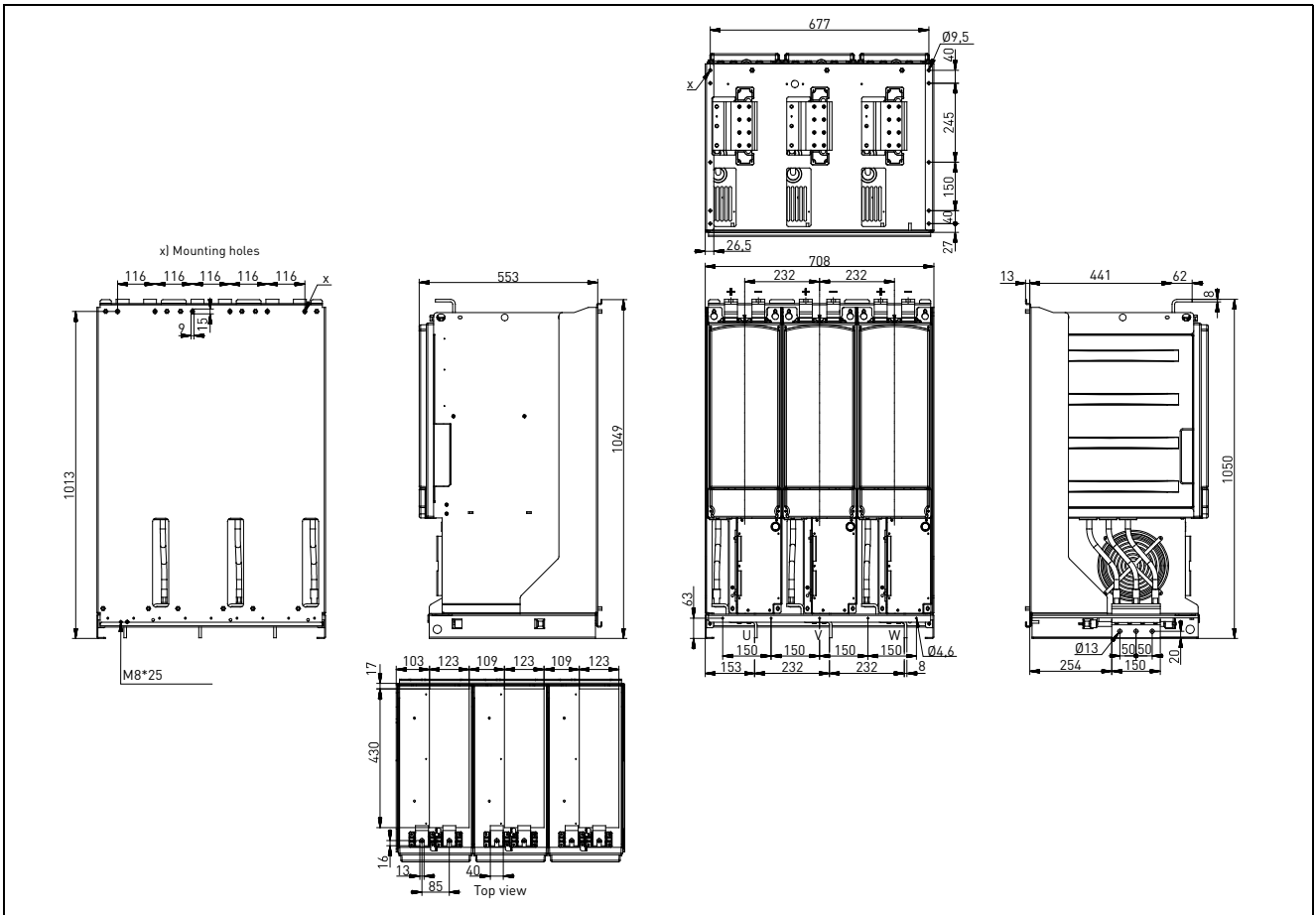


Figure 43. Dimensional drawing; inverter unit (FR13/14)

10.2 Dimensional drawings, AC chokes

CHK0650

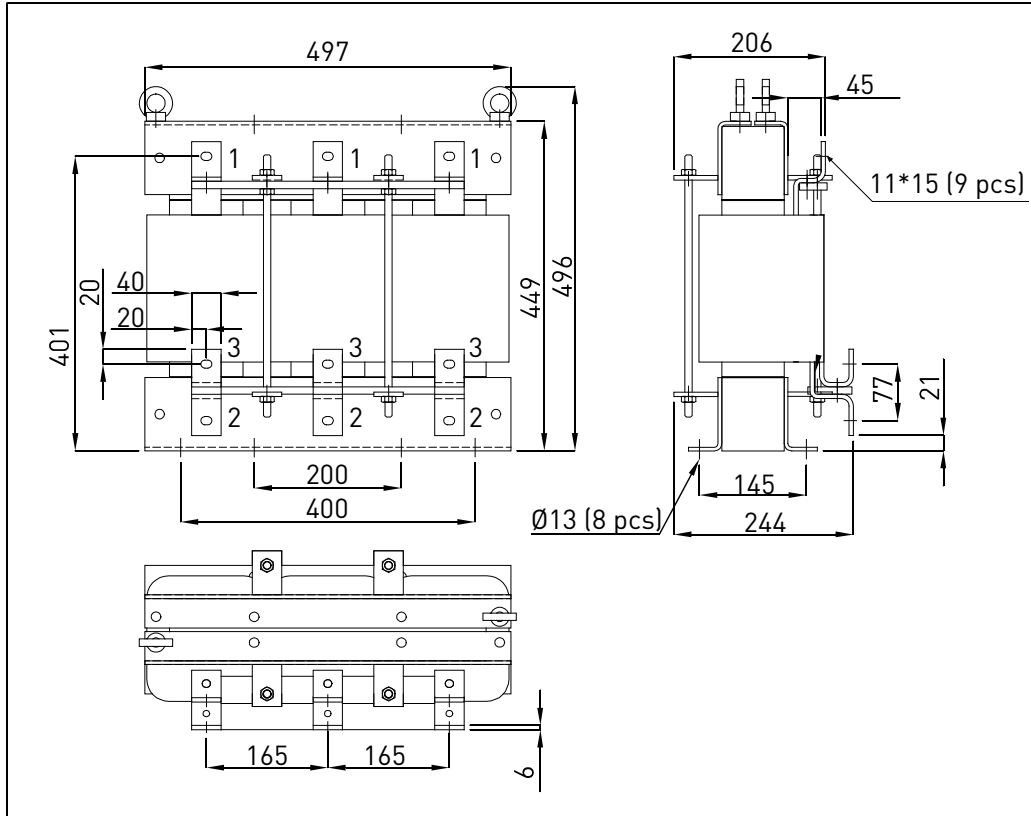


Figure 44. Dimensions of AC choke CHK0650

CHK0520

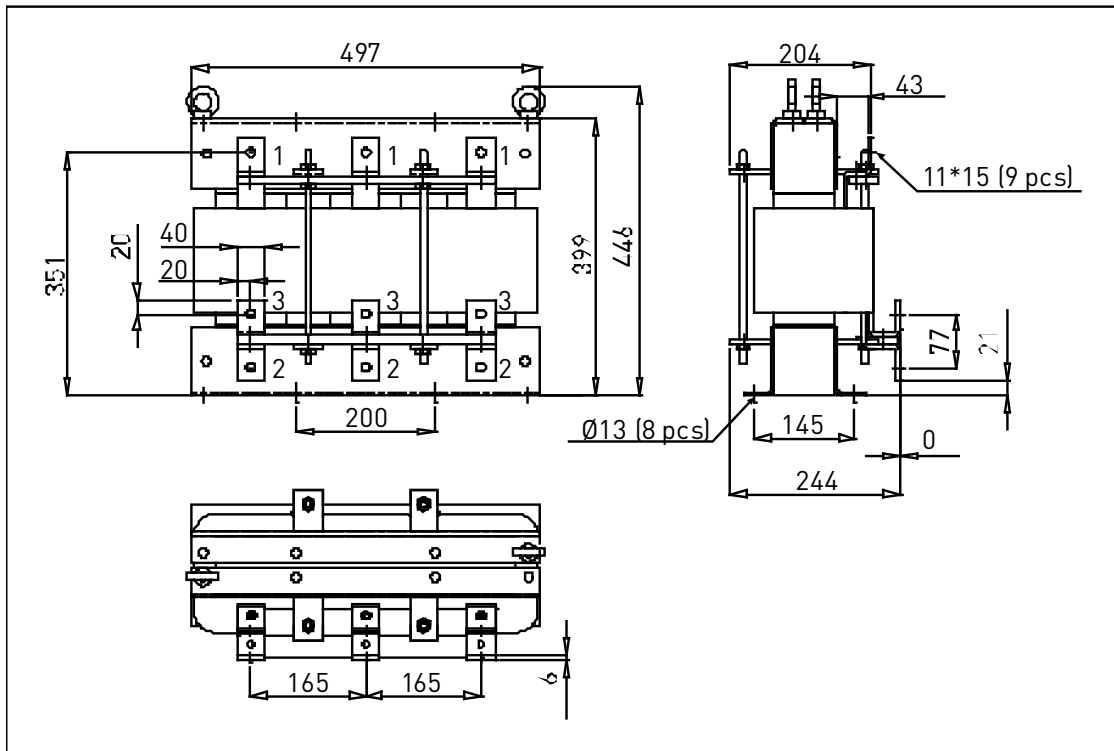


Figure 45. Dimensions of AC choke CHK0520

**CHK0400**

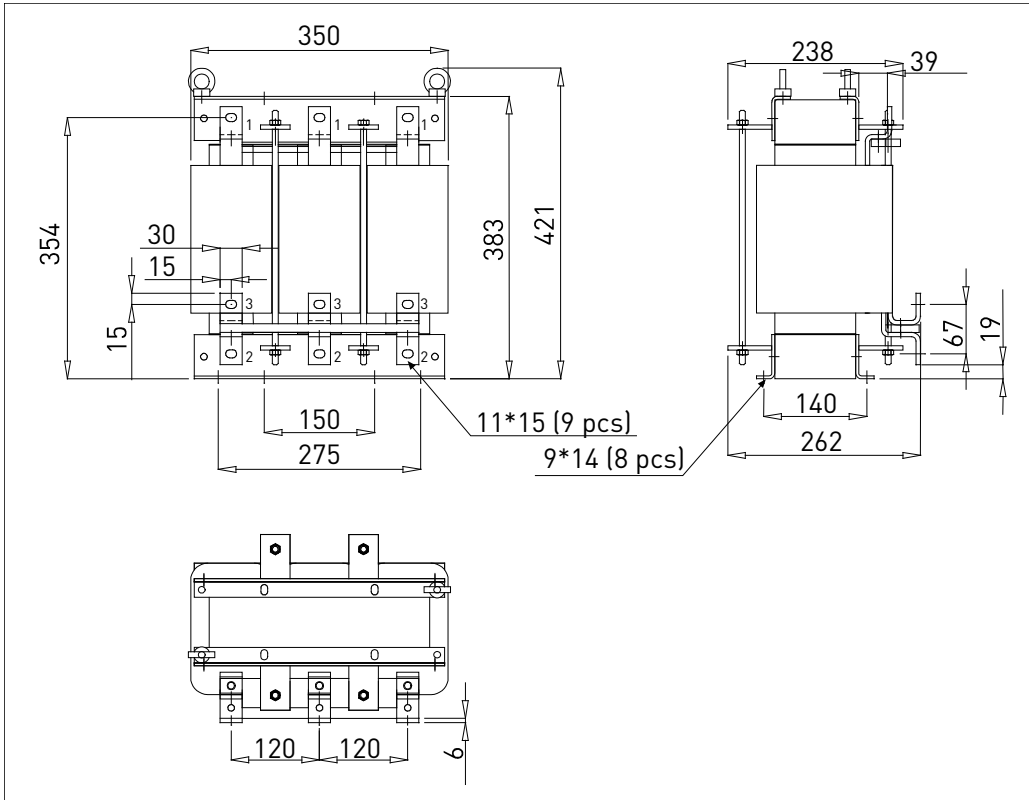


Figure 46. Dimensions of AC choke CHK0400

**CHK0261**

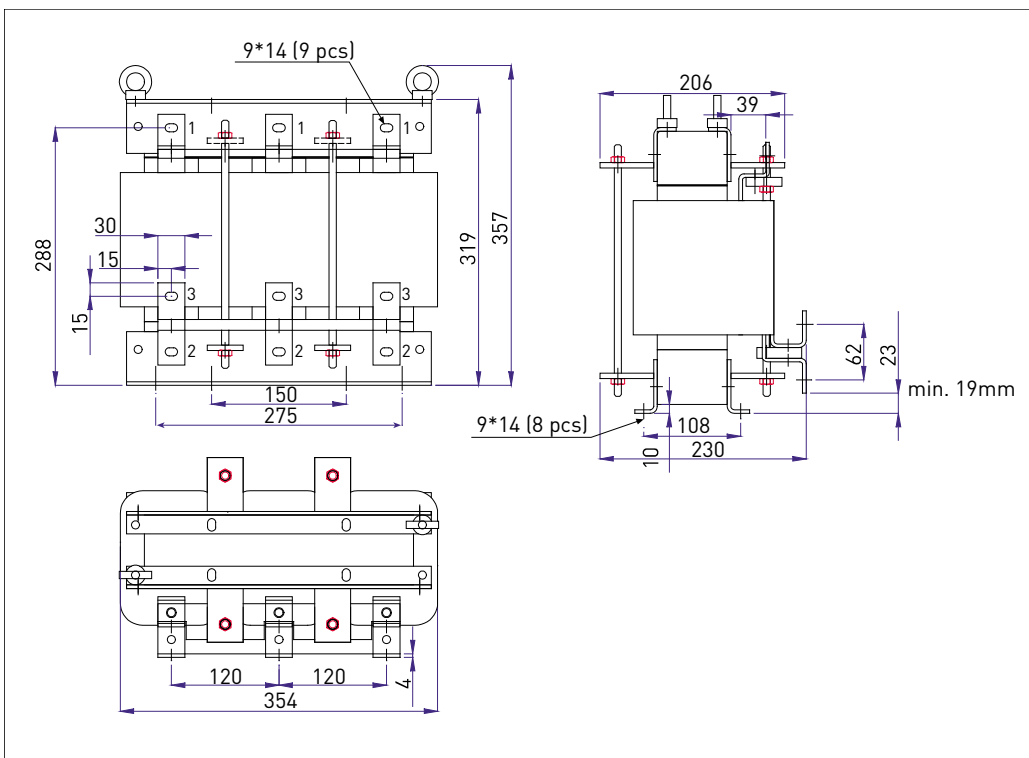


Figure 47. Dimensions of AC choke CHK0261

10.3 Control unit

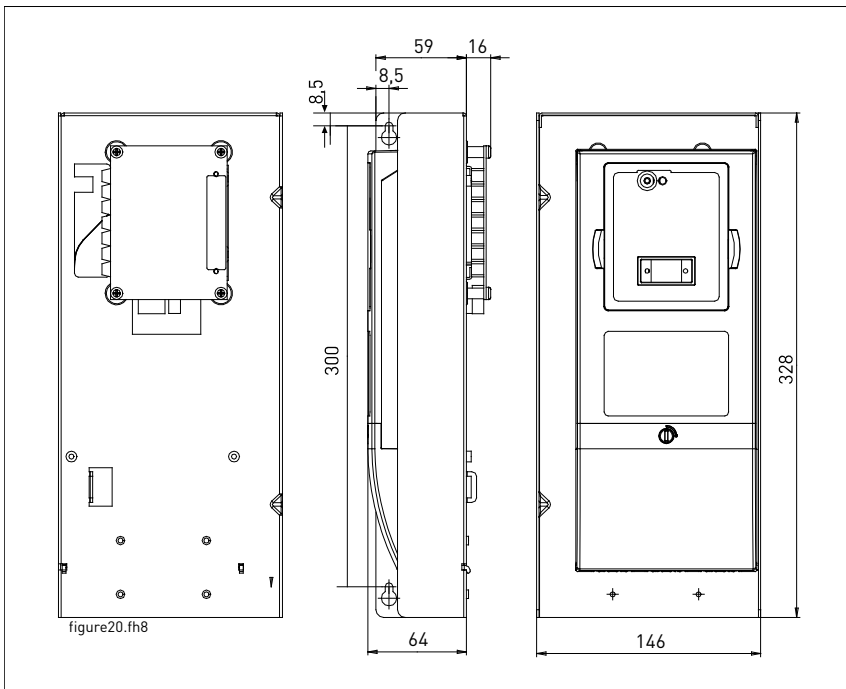


Figure 48. Control unit dimensions (with fibre adapter board connected)

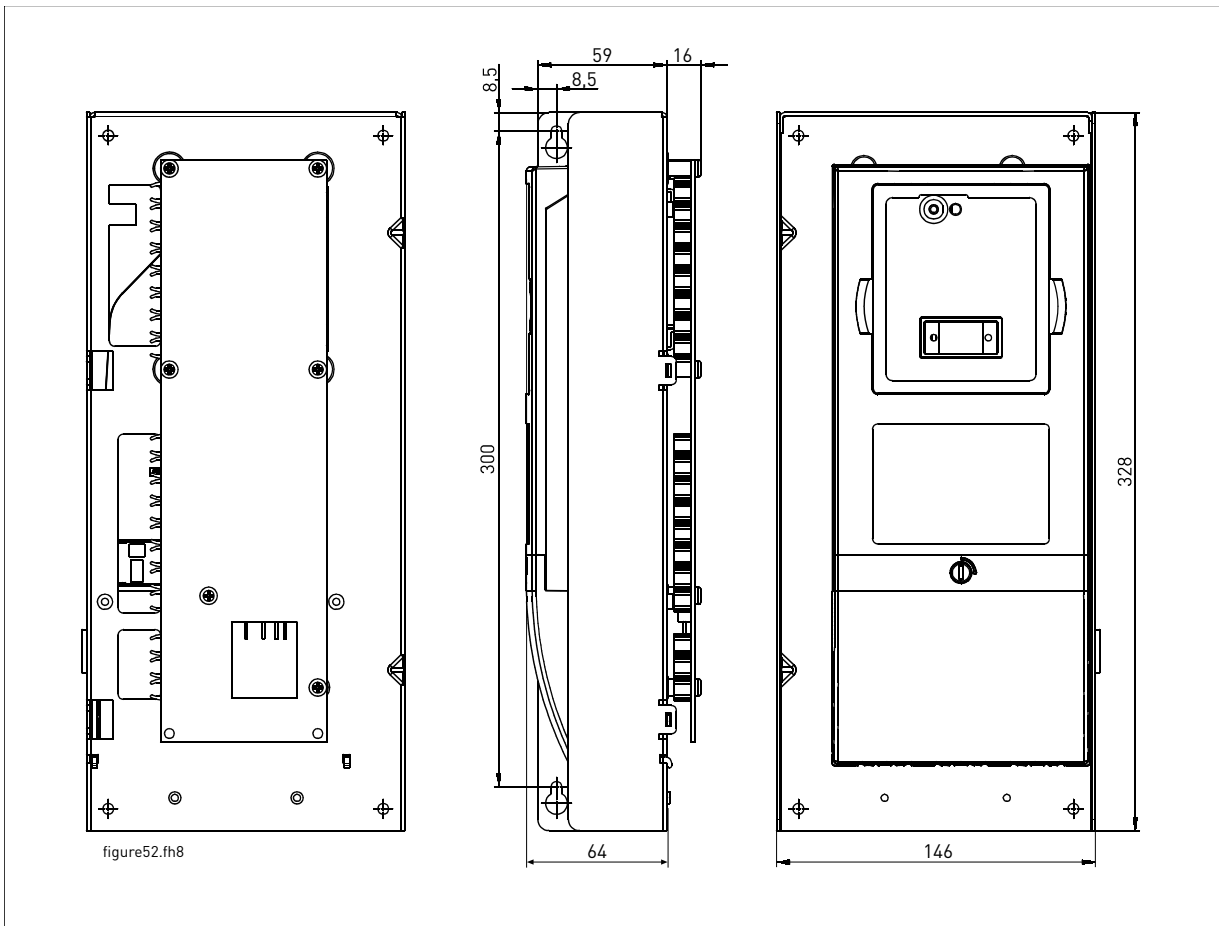


Figure 49. Control unit dimensions (with star-coupler board connected; FR12 or FR14 only)

### 10.4 Optic fibre cables, signal listing and connections

You might need to connect or re-connect the internal fibre cables if you have ordered your NXP frequency converter frame FR10 or FR11 with the control unit separated from the power module. In frame FR12 consisting of two power modules, you will have to establish the fibre cable connections from the star coupler board to the other power module. See chapter 2.2. Connect the cables according to the figures below.

#### 10.4.1 FR10, FR11 and FR13

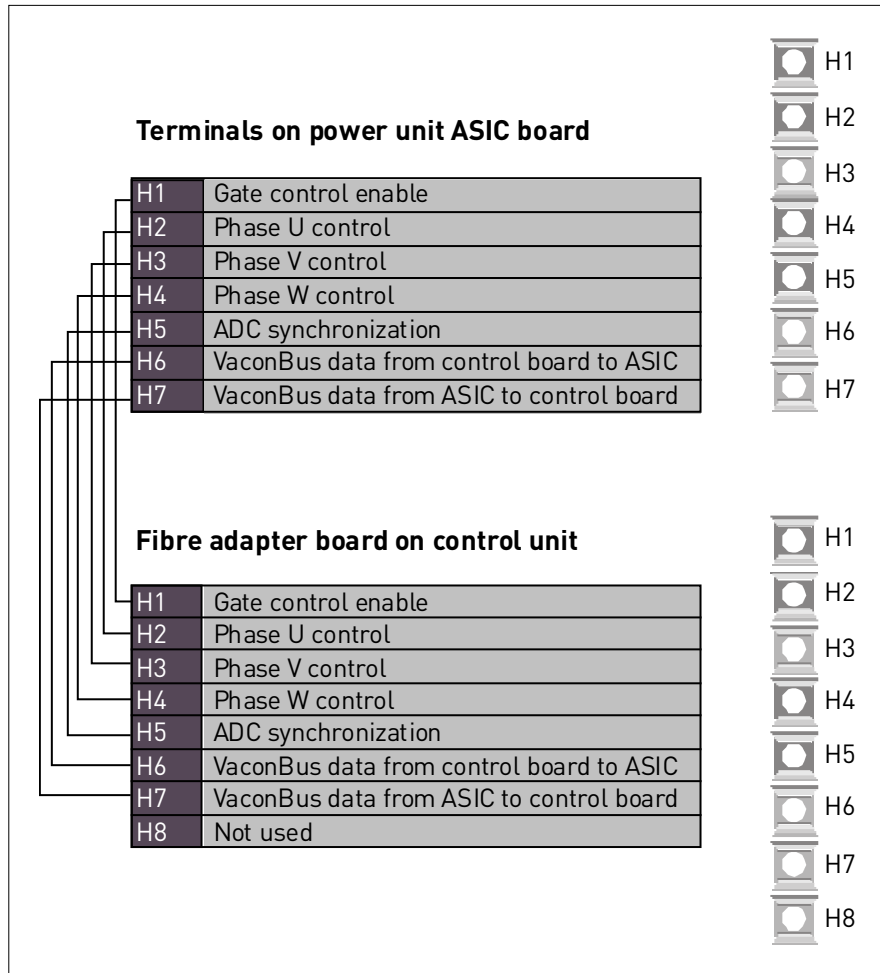


Figure 50. Internal fibre cable connections, FR10, FR11 and FR13



10.4.2 FR12 and FR14

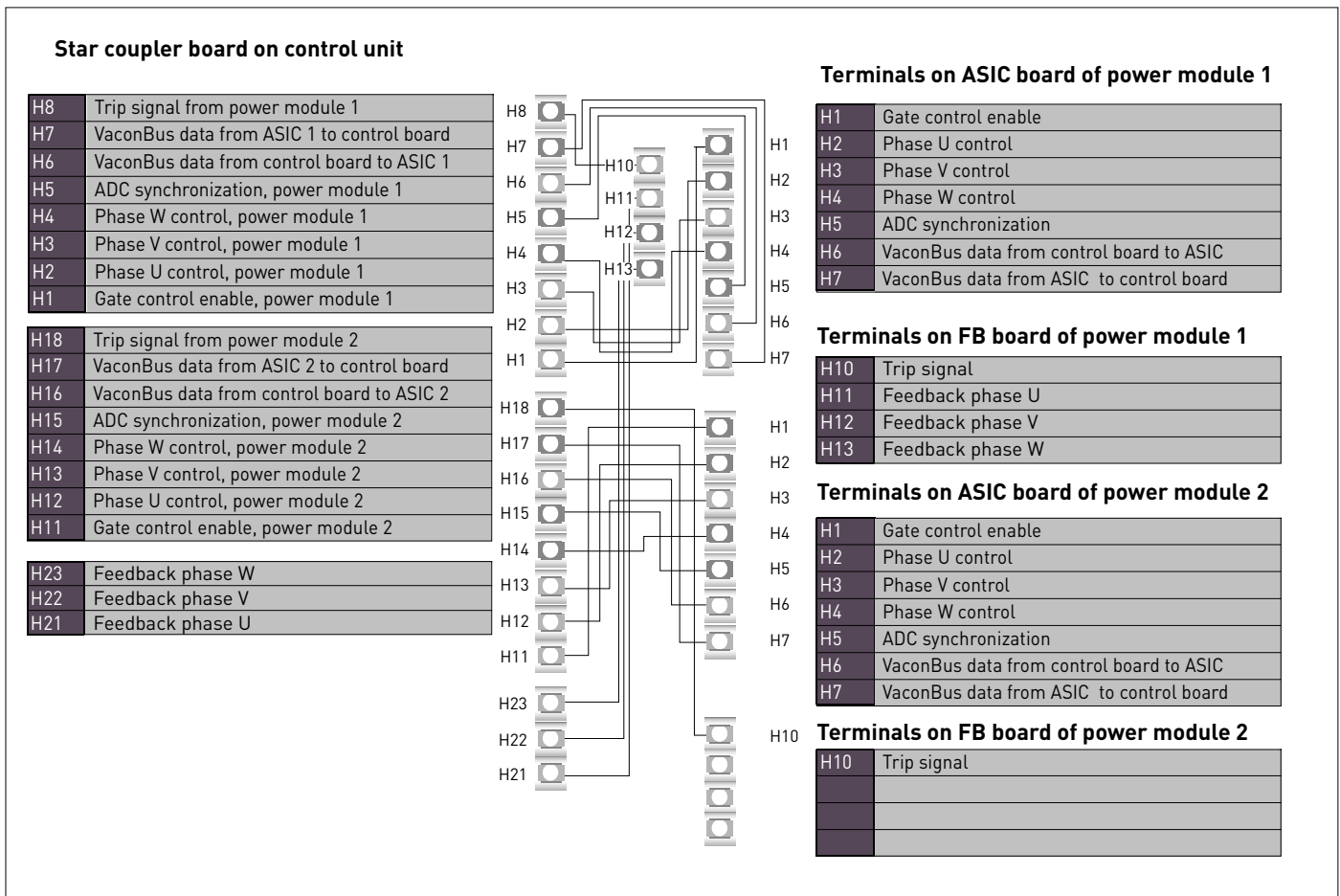


Figure 51. Internal fibre cable connections, FR12 and FR14

## 10.5 Additional fuse recommendations (Ferraz Chawmut)

Frame	Type	Fuse size	DIN43620	DIN43653 (80mm)	DIN43653 (110mm)	Threaded end contacts (metric)	Fuse I <sub>n</sub> [V]	Qty. of fuses per drive
<b>Mains voltage 380-500 V</b>								
FR10	0385	2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	3
FR10	<b>0385</b>	<b>2</b>	<b>2 PV 0450</b>	<b>32 D08A 0450</b>	<b>32 D11A 0450</b>	<b>32 TTF 0450</b>	<b>450</b>	<b>6</b>
FR10	0460	3	3 PV 1000	33 D08A 1000	33 D11A 1000	33 TTF 1000	1000	3
FR10	<b>0460</b>	<b>2</b>	<b>2 PV 0450</b>	<b>32 D08A 0450</b>	<b>32 D11A 0450</b>	<b>32 TTF 0450</b>	<b>450</b>	<b>6</b>
FR10	0520	3	3 PV 1000	33 D08A 1000	33 D11A 1000	33 TTF 1000	1000	3
FR10	<b>0520</b>	<b>2</b>	<b>2 PV 0450</b>	<b>32 D08A 0450</b>	<b>32 D11A 0450</b>	<b>32 TTF 0450</b>	<b>450</b>	<b>6</b>
FR11	0590	2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	6
FR11	0650	2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	6
FR11	0730	2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	6
FR12	0820	3	3 PV 1000	33 D08A 1000	33 D11A 1000	33 TTF 1000	1000	6
FR12	0920	3	3 PV 1000	33 D08A 1000	33 D11A 1000	33 TTF 1000	1000	6
FR12	1030	3	3 PV 1000	33 D08A 1000	33 D11A 1000	33 TTF 1000	1000	6
FR12 DC-link	*	2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	2
<b>Mains voltage 525-690 V</b>								
FR10	0261	2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	3
FR10	<b>0261</b>	<b>2</b>	<b>2 PV 0450</b>	<b>32 D08A 0450</b>	<b>32 D11A 0450</b>	<b>32 TTF 0450</b>	<b>450</b>	<b>6</b>
FR10	0325	2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	3
FR10	<b>0325</b>	<b>2</b>	<b>2 PV 0450</b>	<b>32 D08A 0450</b>	<b>32 D11A 0450</b>	<b>32 TTF 0450</b>	<b>450</b>	<b>6</b>
FR10	0385	2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	3
FR10	<b>0385</b>	<b>2</b>	<b>2 PV 0450</b>	<b>32 D08A 0450</b>	<b>32 D11A 0450</b>	<b>32 TTF 0450</b>	<b>450</b>	<b>6</b>
FR10	0416	3	3 PV 1000	33 D08A 1000	33 D11A 1000	33 TTF 1000	1000	3
FR10	<b>0416</b>	<b>2</b>	<b>2 PV 0450</b>	<b>32 D08A 0450</b>	<b>32 D11A 0450</b>	<b>32 TTF 0450</b>	<b>450</b>	<b>6</b>
FR11	0460	3	3 PV 1000	33 D08A 1000	33 D11A 1000	33 TTF 1000	1000	3
FR11	<b>0460</b>	<b>2</b>	<b>2 PV 0700</b>	<b>32 D08A 0700</b>	<b>32 D11A 0700</b>	<b>32 TTF 0700</b>	<b>700</b>	<b>6</b>
FR11	0502	3	3 PV 1000	33 D08A 1000	33 D11A 1000	33 TTF 1000	1000	3
FR11	<b>0502</b>	<b>2</b>	<b>2 PV 0700</b>	<b>32 D08A 0700</b>	<b>32 D11A 0700</b>	<b>32 TTF 0700</b>	<b>700</b>	<b>6</b>
FR11	0590	2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	6
FR11	<b>0590</b>	<b>2</b>	<b>2 PV 0700</b>	<b>32 D08A 0700</b>	<b>32 D11A 0700</b>	<b>32 TTF 0700</b>	<b>700</b>	<b>6</b>
FR12	0650	2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	6
FR12	0750	2	2 PV 0700	32 D08A 0700	32 D11A 0700	32 TTF 0700	700	6
FR12	0820	3	3 PV 1000	33 D08A 1000	33 D11A 1000	33 TTF 1000	1000	6
FR12 DC-link	*	2	NA	NA	12,5 URD 72D11A 0500	12,5 URD 72 TTF 0500	500**	2

Table 27. Ferraz Chawmut fuse recommendations

Data written in shaded bold refer to 12-pulse drives (6-phase supply).

The aR fuses are thermally rated into switch fuse in 50 degree ambient temperature.

\* In FR12 12-pulse drive or if FR12 ( 6- or 12-pulse ) has internal brake; 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



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