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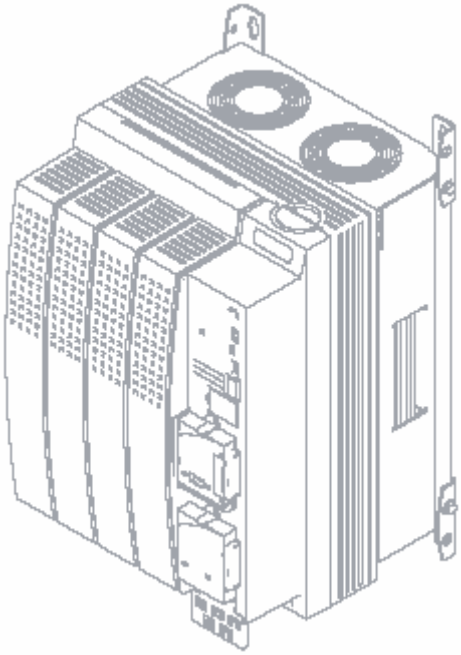
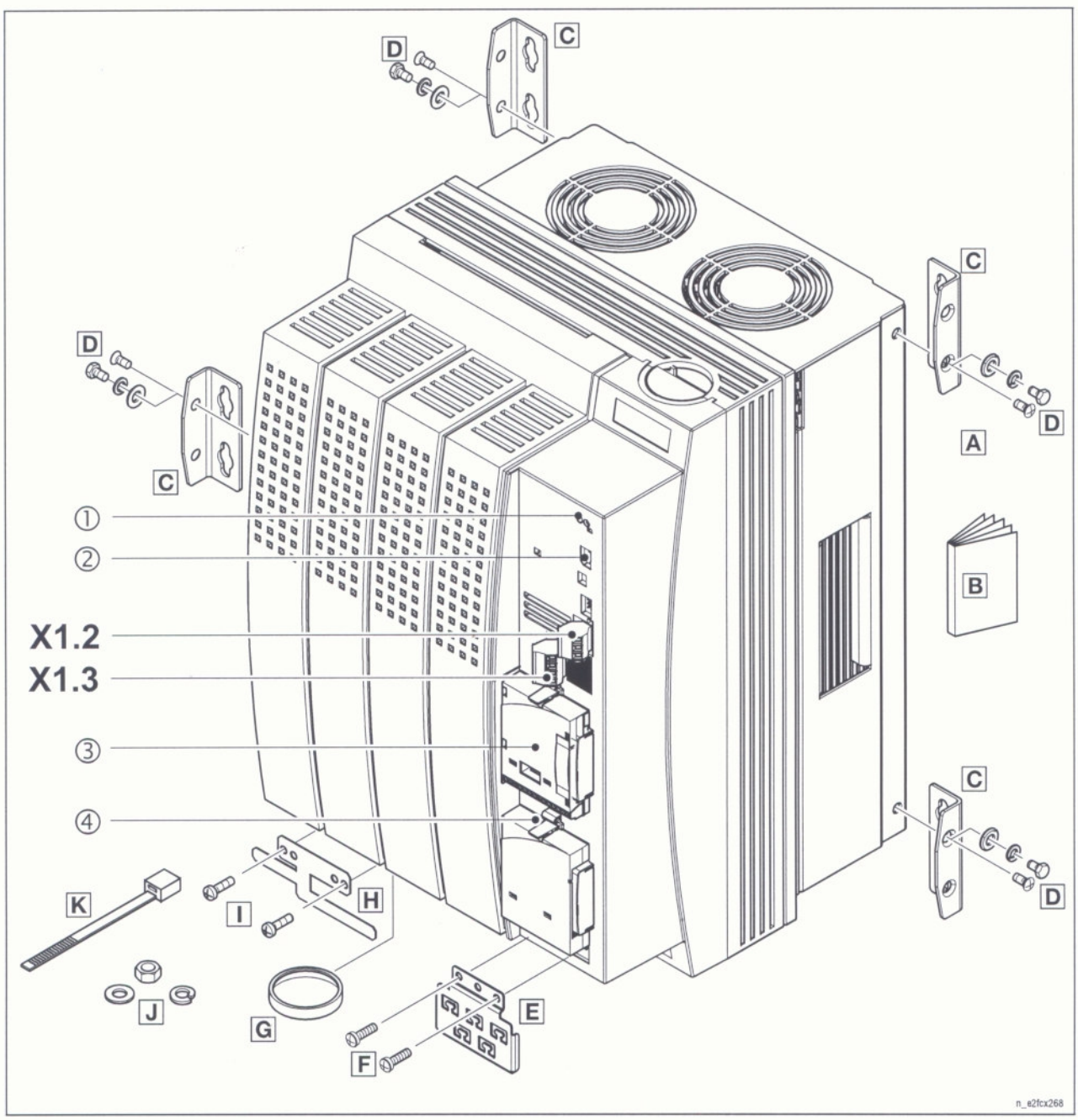
Frequency Inverter

2FC4153-2NE00 ... 2FC4453-2NE00
15 kW ... 45 kW



Operating Instructions

Read these Instructions and the Instructions concerning the lateral channel compressor before you start working! Observe the safety instructions given therein.



Scope of supply

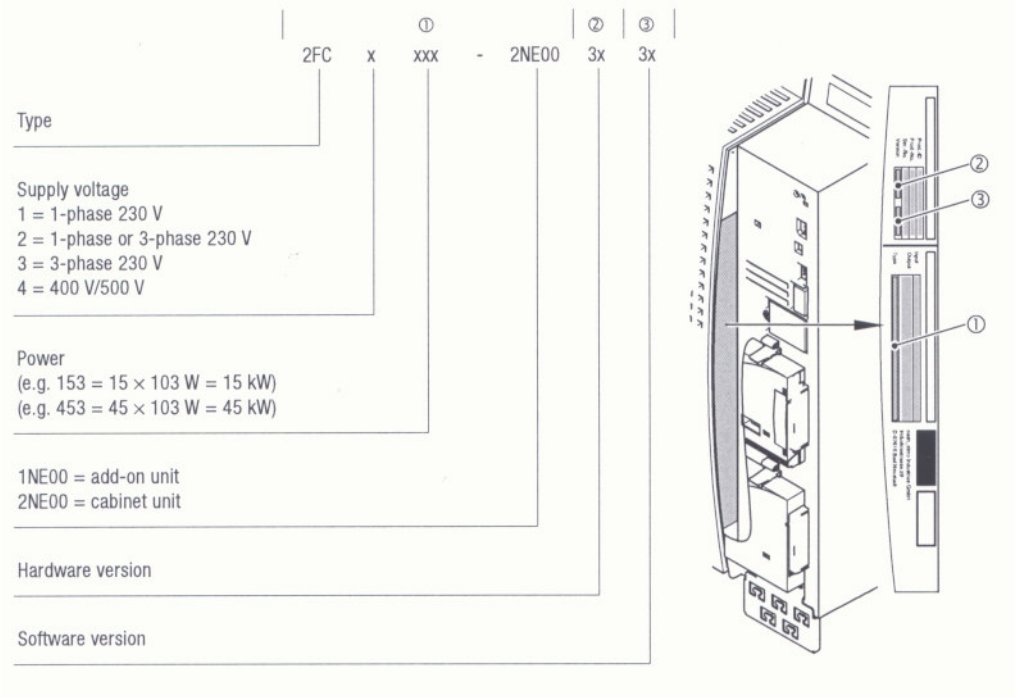
Frequency inverter 2FC4153-2NE00, 2FC4223-2NE00, 2FC4303-2NE00				
	Description		**Quantity**	
A	Frequency inverter		1	
B	Operating instructions		1	
C	Mounting angle		4	
D	Fixing screw for mounting angle	M5 x 10 mm raised countersunk head screw	4	
E	EMC shield sheet for shielded control cables	in the assembly kit	1	
F	Fixing screw for EMC shield sheet	M4 x 10 mm screw with captive washer	2	
G	Grommet for motor cable		1	
H	EMC shield sheet for shielded motor cable		1	
I	Fixing screw for EMC shield sheet	M4 x 14 mm self-tapping screw	2	
J	Fixing material for connecting the mains cable and motor cable	M6 hexagon nut Plain washer, spring lock washer	10 each	
K	-			
X1.1	Mains connection	Stud under the cover		
X1.2	3-pole terminal strip for relay output 1		1	
X1.3	4-pole terminal strip for relay output 2		1	
X2.1	Motor connection	Stud under the cover		
X2.2	PTC connection or thermal contact (NC contact) of the motor	Screw connection under the cover		

Frequency inverter 2FC4453-2NE00				
	Description		**Quantity**	
A	Frequency inverter		1	
B	Operating instructions		1	
C	Mounting angle		4	
D	Fixing screws for mounting angle	M8 x 16 mm hexagon head screw Plain washer, spring lock washer	4 each	
E	EMC shield sheet for shielded control cables	preassembled under the cover	1	
F	-			
G	-			
H	-	Integrated EMC shield sheet for motor cable under the cover		
I	-			
J	-			
K	3.6 x 150 mm cable binder	Strain relief and shield connection of motor cable	4	
X1.1	Mains connection	Stud under the cover, preassembled fixing material		
X1.2	3-pole terminal strip for relay output 1		1	
X1.3	4-pole terminal strip for relay output 2		1	
X2.1	Motor connection	Stud under the cover, preassembled fixing material		
X2.2	PTC connection or thermal contact (NC contact) of the motor	Screw connection under the cover		

Interfaces and displays

Position	Description	Function	
1	2 LEDs (red, green)	Status display	
2	Control interface	Plug-in station for e.g. keypad	
3	Control terminals	Digital and analog inputs and outputs	
4	Slot for additional module		

This documentation is valid for frequency inverters of the 2FC type, as of version:



Quick guide

The Simco frequency inverter is pre-configured for four modes of operation. Installation and commissioning just take a few steps:

Read the safety instructions

→ The safety instructions are given from page 7 onwards.

Install the frequency inverter in the control cabinet

→ The installation dimensions are given from page 13 onwards.

Wire the frequency inverter

→ The wiring schemes are given from page 15 onwards.

- Depending on the mode of operation, a minimum of wiring is required at the control terminals.

Match important process parameters

→ Changing of parameters is described from page 28 onwards.

- The acceleration time and the deceleration time must be matched to the hydraulic process via C0012 and C0013.
- The maximum output frequency must be matched to the desired maximum speed of the via C0011.

Set speed

→ The steps for commissioning are described from page 26 onwards.

A) Speed setting using a potentiometer
– The speed is set via the analog input.
– The speed can be adjusted between a minimum and a maximum value.

→ Potentiometer wiring is described from page 23 onwards.

B) Operation with several adjustable fixed speeds
– The speed of the side channel blower can be adjusted in steps of 1000/min by triggering the digital inputs E3 and E4.

→ The wiring of E3 and E4 is described from page 23 onwards.

C) Operation with one fixed speed
– Connect keypad
– Set desired fixed speed under C0140.
– Remove keypad.
– The side channel blower will be operated with this speed when switched on.

→ Keypad connection and changing of parameters is described from page 28 onwards.

D) Speed setting using the keypad
– Connect keypad
– Select C0140.
– Set the speed desired for the respective process using the keys ▲ ▼
– The side channel blower will be operated with the last set speed when switched on.

→ Keypad connection and changing of parameters is described from page 28 onwards.

Contents

1 Safety instructions

1.1 General safety notes for controllers

(in conformity with Low-Voltage Directive 73/23/EEC)

General
Controllers can - according to their enclosure - carry a voltage or parts of the controllers can move or rotate during operation. Surfaces can be hot.
If the required cover is removed, the controllers are used inappropriately or installed or operated incorrectly, severe damage to persons or material assets can occur.
For more detailed information please see the documentation.
All operations concerning transport, installation, and commissioning as well as maintenance must be carried out by qualified, skilled personnel (IEC 364 and CENELEC HD 384 or DIN VDE 0100 and IEC report 664 or DIN VDE 0110 and national regulations for the prevention of accidents must be observed).
According to this basic safety information, qualified, skilled personnel are persons who are familiar with the installation, assembly, commissioning, and operation of the product and who have the qualifications necessary for their occupation.

Intended use
Drive controllers are components which are designed for the installation into electrical systems or machinery. They are not to be used as domestic appliances, but only for industrial purposes according to EN 61000-3-2. The documentation contains information about the compliance of the limit values to EN 61000-3-2.
When installing the drive controllers in machines, commissioning (i.e. the starting of operation as directed) is prohibited until it is proven that the machine complies with the regulations of the EC Directive 98/37/EC (Machinery Directive); EN 60204 must be observed.
Commissioning (i.e. starting of operation as directed) is only allowed when there is compliance with the EMC Directive (89/336/EEC).
The drive controllers meet the requirements of the Low-Voltage Directive 73/23/EEC.
The harmonised standards EN 50178/DIN VDE 0160 apply to the controllers.
The technical data as well as the connection conditions must be obtained from the nameplate and the documentation. The instructions must be strictly observed.

Warning: Controllers are products with restricted availability according to EN 61800-3. These products can cause interferences in residential premises. If controllers are used in residential premises, corresponding measures are required.

Transport, storage
The notes on transport, storage and appropriate handling must be observed.
The climatic conditions according to EN 50178 apply.

Installation
The controllers must be installed and cooled according to the regulations given in the corresponding documentation.
Ensure careful handling and avoid mechanical overload. Do not bend any components and do not change the insulation distances during transport and storage. Electronic components and contacts must not be touched.
Controllers contain electrostatically sensitive components which can easily be damaged by inappropriate handling. Do not damage or destroy any electrical components since this could mean hazards for your health!

Electrical connection
When working on live controllers, the valid national regulations for the prevention of accidents (e.g. VBG 4)must be observed.
The electrical installation must be carried out in compliance with the corresponding regulations (e.g. cable cross-sections, fuses, PE connection). Additional notes and information can be obtained from the corresponding Instructions.
The Instructions contain notes concerning wiring according to EMC regulations (shielding, earthing, filters and cable routing). These notes must also be observed when using CE-marked controllers. The compliance with limit values required by the EMC legislation is the responsibility of the manufacturer of the machine or system.

Operation
If necessary, systems including controllers must be equipped with additional monitoring and protection devices according to the applying safety regulations (e.g. regulation for technical equipment, regulation for the prevention of accidents). The controller can be adapted to your application. Observe the corresponding information given in the Instructions.
After a controller has been disconnected from the voltage supply, all live components and power connections must not be touched immediately because capacitors can still be charged. Observe the corresponding stickers on the controller.
All protection covers and doors must be shut during operation.

Note for UL-approved systems with integrated controllers:
UL warnings are notes which only apply to UL systems. The Instructions give UL-related information.

Maintenance
The controllers are free of maintenance if the prescibed conditions of operation are observed. If the ambient air is polluted, the cooling surfaces of the controller may get dirty or the air vents may be obstructed. Under such conditions the cooling surfaces and air ventsmust be cleaned regularly. Do not use sharp or pointed tools for this purpose!

Disposal
Ensure recycling of metals and plastics and professional disposal of assembled PCBs.

The product-specific safety and application notes in these Instructions must be observed!

1.2 Residual hazards

Protection of persons
- Before working on the drive controller, check that no voltage is applied to the power terminals and the terminals of the relay outputs because
  - the power terminals U, V, W, +UG and -UG remain live for at least 3 minutes after mains switch-off.
  - the power terminals L1, L2, L3, U, V, W, +UG and -UG remain live when the motor is stopped.
  - the terminals of the relay outputs K11, K12, K14 and K21, K22, K24 may remain live for drive controllers that were disconnected from the mains.

- The heatsink of the controller has an operating temperature of > 80°C:
  - Direct skin contact with the heatsink results in burns.

Controller protection

- All pluggable connection terminals must only be connected or disconnected when no voltage is applied!
- **Cyclic** connection and disconnection of the supply voltage can overload and destroy the input current limitation of the controller:
  - Allow at least 3 minutes between disconnection and reconnection!

Motor protection

- Depending on the drive controller settings, the connected motor can overheat:
  - For instance, longer DC-braking operations.
  - Longer operation of self-ventilated motors at low speed.

Protection of machine/system

- Drives can reach dangerous overspeeds (e.g. setting of inappropriately high field frequencies):
  - The controllers do not offer any protection against these operating conditions. For this purpose use additional components.

Warnings!

- The device has no overspeed protection.
- Must be provided with external or remote overload protection.
- Suitable for use on a circuit capable of delivering not more than 5000 rms symmetrical amperes, 240 Vmaximum (240 V devices) or 500 Vmaximum (400/500 V devices) resp.
- Use 60/75 °C or 75 °C copper wire only.
- Shall be installed in a pollution degree 2 macro-environment.

1.3 Layout of the safety instructions

All safety information given in these Instructions has the same layout:

Pictograph (indicates the type of danger)

Signal word! (indicates the severity of danger)
Note (describes the danger and explains how to avoid it)

Pictograph	Signal word	Signal word Meaning	Possible consequences if the safety information is disregarded
 Dangerous electrical voltage  General danger	**Danger!**	**Impending danger for persons**	Death or most severe injuries
	Warning!	**Possible, very dangerous situation for persons**	Death or most severe injuries
	Caution!	**Possible, dangerous situation for persons**	Injuries
	**Stop!**	**Possible material damage**	Damage of the drive system or its surroundings
	**Note!**	**Useful note or tip**	If you observe it, handling of the drive system will be easier.

2 Technical data

2.1 General data/application conditions

Conformity	CE	Low-Voltage Directive (73/23/EEC)
Approvals	UL 508C	Underwriter Laboratories (File no. E224047) Power Conversion Equipment
Max. permissible motor cable length	For rated mains voltage and chopper frequency of 8 kHz without additional output filters	
shielded unshielded	50 m 100 m	For compliance with EMC regulations, the permissible cable lengths can change.
Vibration resistance	Acceleration resistance up to 0.7g (Germanischer Lloyd, general conditions)	
Climatic conditions	Class 3K3 to EN 50178 (without condensation, average relative humidity 85%)	
Degree of pollution	VDE 0110 part 2 pollution degree 2	
Packaging (DIN 4180)	Dust packaging	
Permissible temperature range		
transport	-25 °C...+70 °C	
storage	-25 °C...+60 °C	
operation	-10 °C...+55 °C	Above +40 °C, the rated output current must be reduced by 2.5 %/°C
Permissible site altitude	0 ... 4000 m amsl	Above 1000 m amsl, the rated output current is to be reduced by 5 %/1000 m
Mounting positions	Vertical	
Free space	see Dimensions	

EMC	Compliance with the requirements to EN 61800-3/A11		
Noise emission	Compliance with limit value classes A and B to EN 55011		
Noise immunity	Requirements to EN 61800-3 incl. A11		
	Requirements	**Standard**	**Severities**
	ESD	EN 61000-4-2	3, i.e. 8 kV with air discharge 6 kV with contact discharge
	High frequency in cables	EN 61000-4-6	150 kHz ... 80 MHz, 10 V/m 80 % AM (1kHz)
	HF interference (enclosure)	EN 61000-4-3	80 MHz ... 1000 MHz, 10 V/m 80 % AM (1kHz)
	Burst	EN 61000-4-4	3/4, i.e. 2 kV/5 kHz
	Surge (Surge on mains cable)	EN 61000-4-5	3, i.e. 1.2/50 ms 1 kV phase-phase, 2 kV phase-PE
Insulation strength	Overvoltage category III to VDE 0110		
Discharge current to PE (to EN 50178)	> 3.5 mA, i. e. fixed installation required, PE connection must comply with EN 50178		
Enclosure	IP20		
Protection measures against	Short circuit, earth fault (earth-fault protected during operation, limited earth-fault protection during power up), overvoltage, motor stalling, motor overtemperature (input for PTC or thermal contact, I^2t monitoring)		

Protective insulation of control circuits	Safe mains isolation: Double/reinforced insulation to EN 50178
Permissible supply form	Operation at TT systems, TN systems or systems with grounded star point without additional measures

2.2 Rating

Operation with rated power (normal operation)

Type	Power [kW]	Rated mains voltage	Mains current [A] ①	Mains current [A] ②	Output current [A] 1) I_N	Output current [A] 1) I_{max} (60 s) 2)	Mains filter Type	Mass [kg]
2FC4153-2NE00	15	3/PE 400 VAC 320 V -0 % ... 550 V +0 % 45 Hz -0 % ... 65 Hz +0 % DC 450 V -0 % ... 775 V +0 %	43	29	32	48	2FX4614-1NE00	15
2FC4223-2NE00	22		3)	42	47	70	2FX4614-1NE00	
2FC4303-2NE00	30		3)	55	59	89	2FX4615-1NE00	
2FC4453-2NE00	45		3)	80	89	134	2FX4616-1NE00	34
2FC4153-2NE00	15	3/PE 500 VAC 320 V -0 % ... 550 V +0 % 45 Hz -0 % ... 65 Hz +0 % DC 450 V -0 % ... 775 V +0 %	3)	29	32	48	2FX4614-1NE00	15
2FC4223-2NE00	22		3)	42	47	70	2FX4614-1NE00	
2FC4303-2NE00	30		3)	52	56	84	2FX4615-1NE00	
2FC4453-2NE00	45		3)	76	84	126	2FX4616-1NE00	34

① Without mains filter

② With mains filter

1) At rated mains voltage

2) Currents for periodic load cycle: 1 min overcurrent with I_{max} and 2 min base load with 75 % I_N

3) Operation only permissible with mains filter

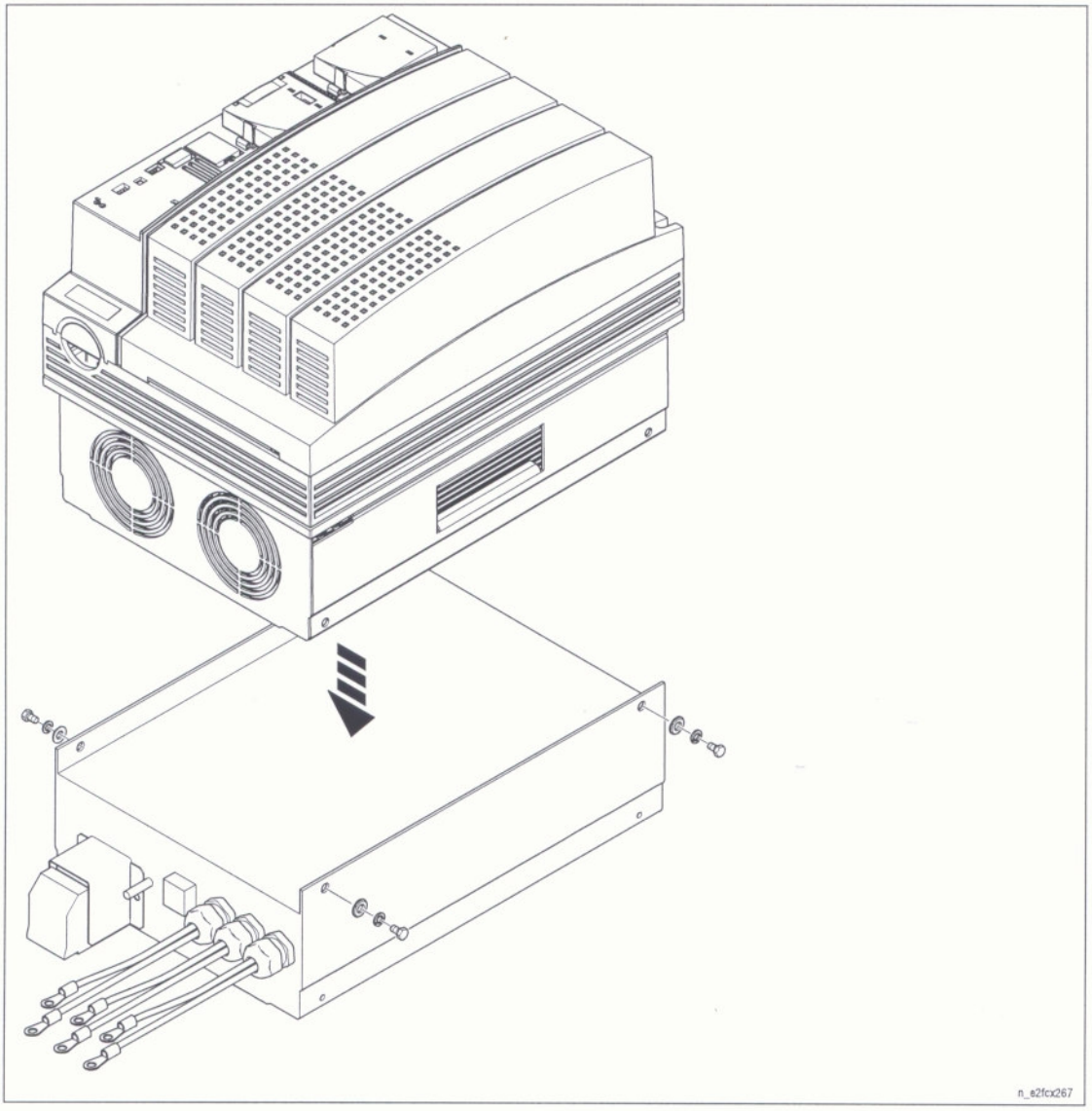
3 Mechanical installation

3.1 Installing the mains filter

Note!

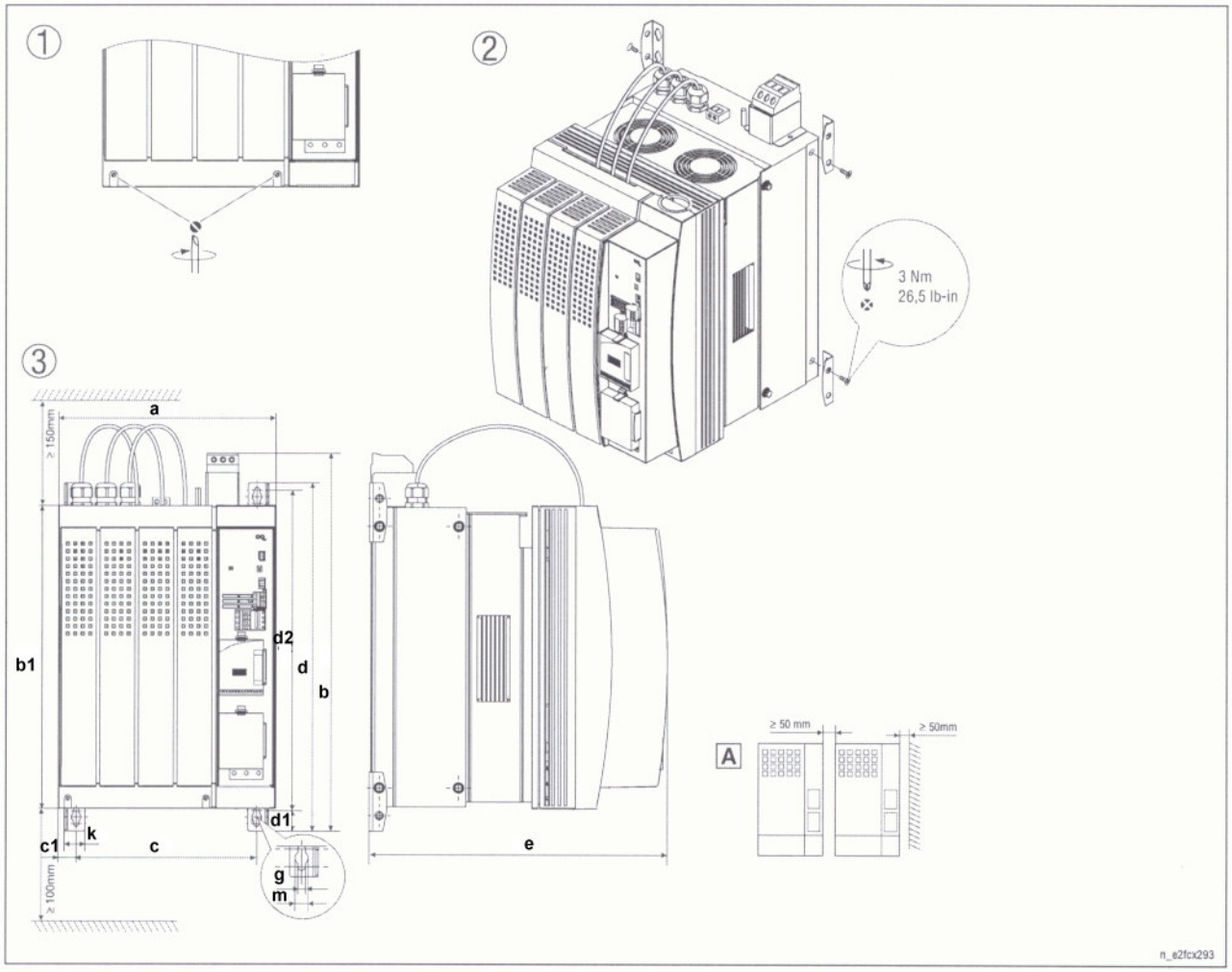
The frequency inverters starting at 15 kW may only be operated with mains filter.
Use the fixing material from the scope of supply of the mains filter for the installation.

1. Place the frequency inverter on the mains filter.
2. Fasten it to the frequency inverter using 4 hexagon screws.



3.2 Dimensions

3.2.1 Frequency inverter 15 ... 30 kW

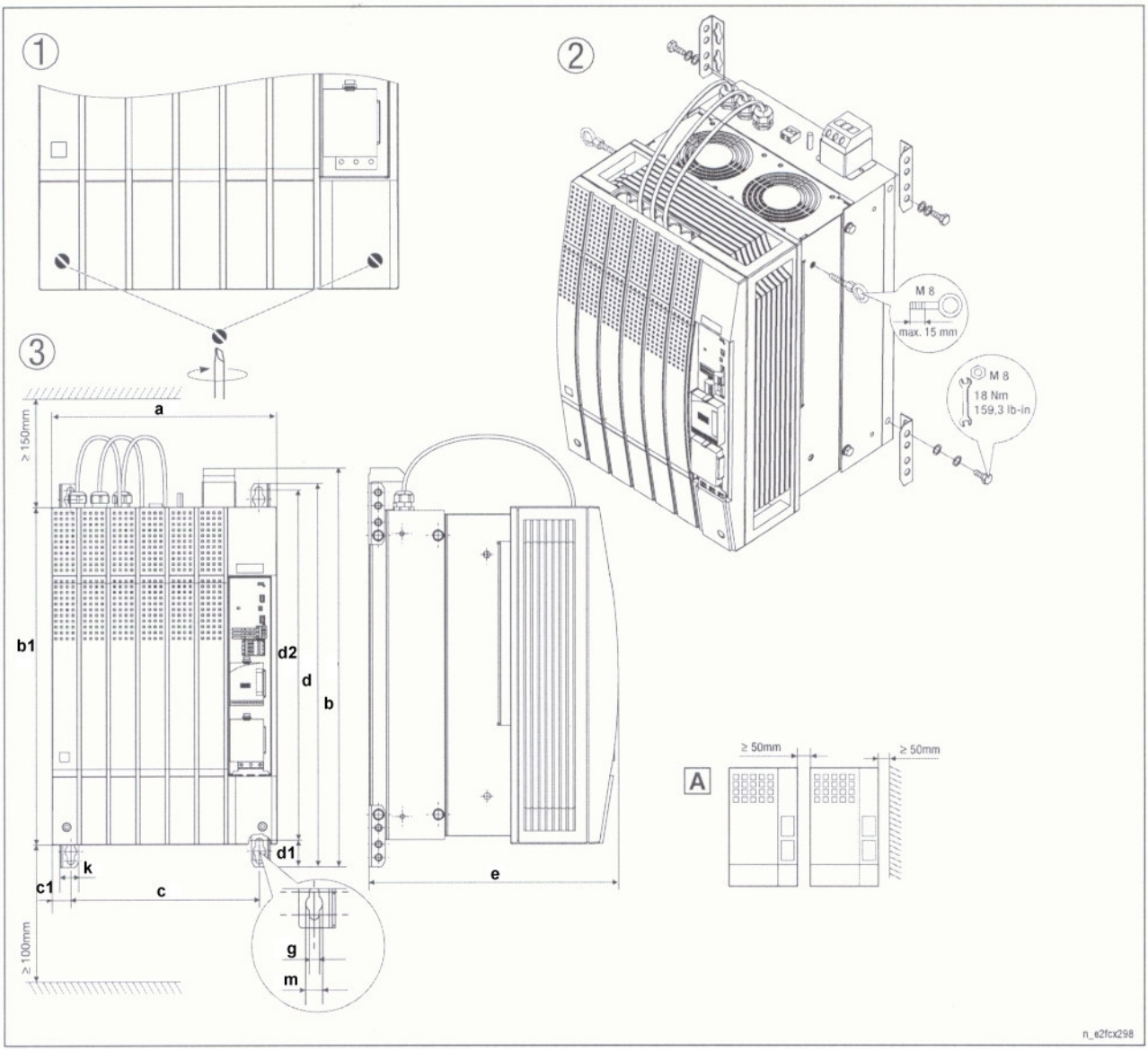


1. Loosen both screws to be able to remove the housing cover.
   The assembly kit is located under the housing cover.
2. Installation of mounting angles
3. Dimensions

A. Arrange the drive controllers side by side with spacing to be able to disassemble the eyebolts.

		Dimensions [mm]											
Type	Mains filter	a	b	b1	c	c1	d	d1	d2	e	g	k	m
2FC4153-2NE00	2FX4614-1NE00	250	456	350	205	22	402	24	370	340	6,5	24	11
2FC4223-2NE00	2FX4614-1NE00												
2FC4303-2NE00	2FX4615-1NE00												

3.2.2 Frequency inverter 45 Kw



1. Loosen both screws to be able to remove the housing cover.
2. Installation of mounting angles
3. Dimensions

A. Arrange the drive controllers with spacing to be able to disassemble the eyebolts.

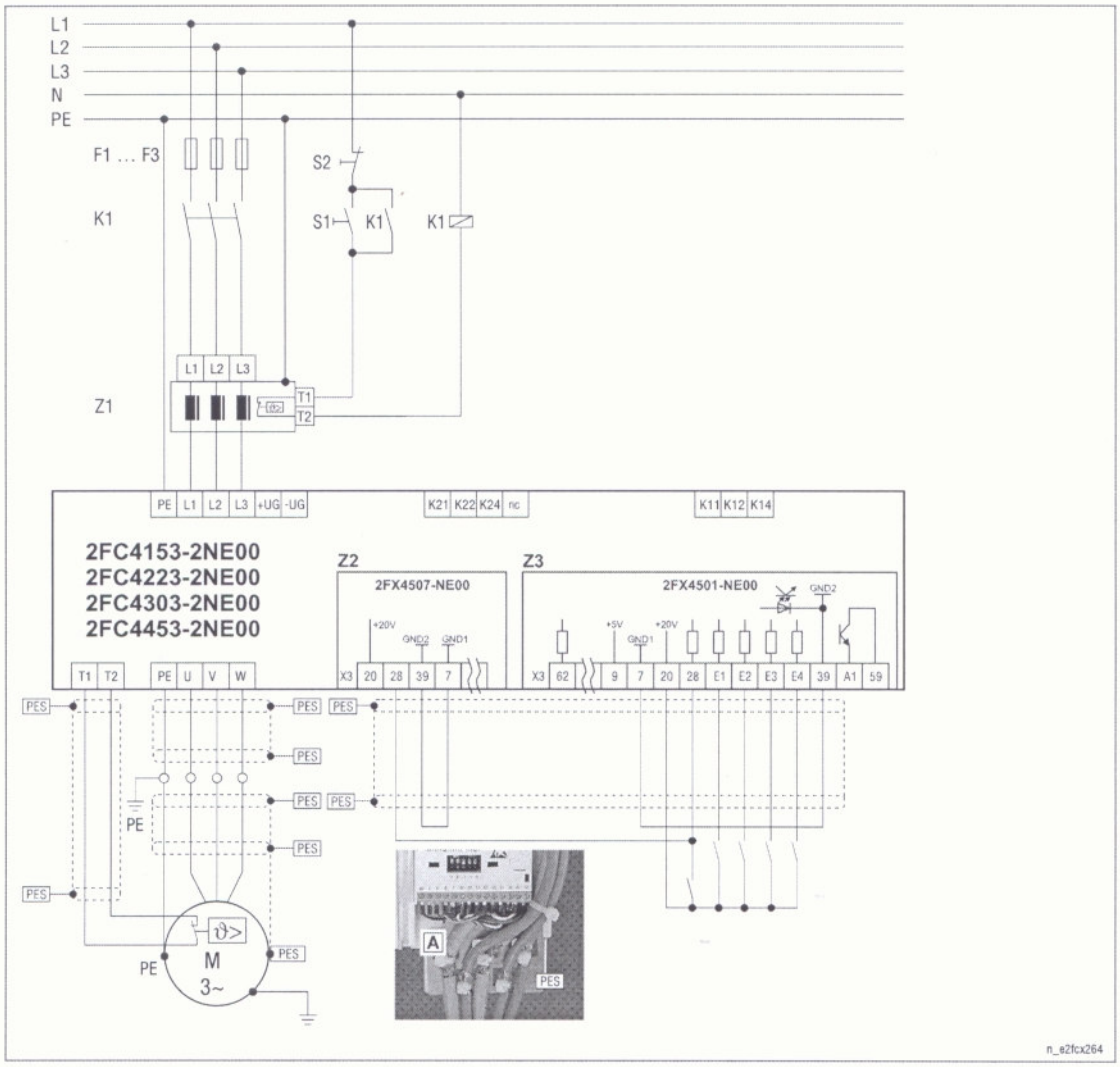
		Dimensions [mm]											
Type	Mains filter	a	b	b1	c	c1	d	d1	d2	e	g	k	m
2FC4453-2NE00	2FX4616-1NE00	340	619	510	284	28	580	38	532	375	11	28	18

4 Electrical installation

4.1 Wiring according to EMC requirements

(Design of a CE-typical drive system)

The drives meet the EU Directive on ”Electromagnetic Compatibility” if they are installed in accordance with the specifications of the CE-typical drive system. The end-user is responsible for maintaining the EU Directive in the machine application.



F1 ... F3	Protection
K1	Mains contactor
Z1	Mains filter
Z2	Profibus module on interface I
Z3	Control terminal module on interface II
PES	HF shield termination by large-area connection to PE Shield connection for control cables (firmly attach shield to plate with cable binders)

4.2 Mains connection

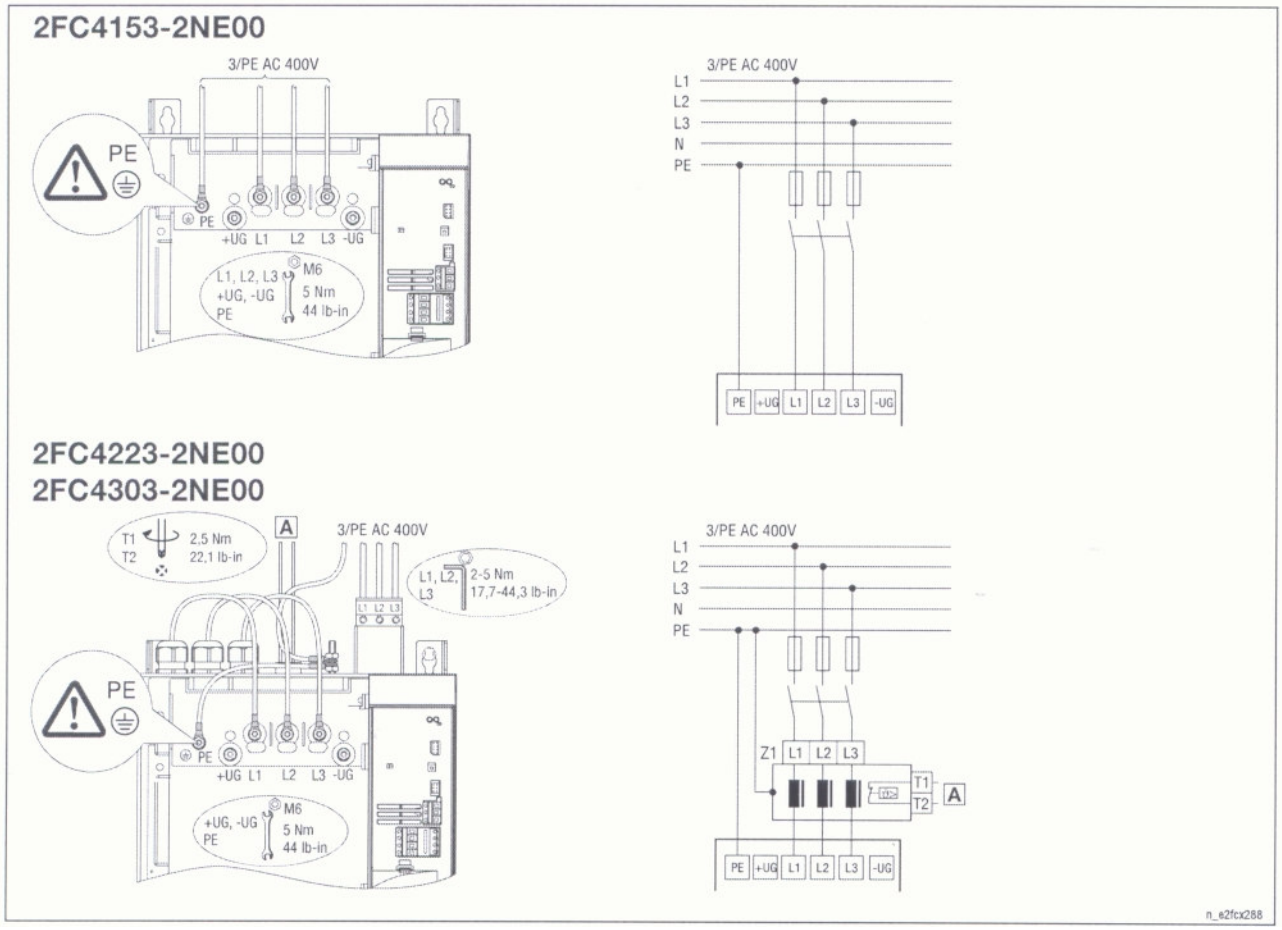
Stop!

Discharge current against earth > 3.5 mA. According to EN 50178 permanent fixed installation is required. The PE connection must be carried out in accordance with EN 50178.

Please observe the following when using e.l.c.bs:

- E.l.c.bs must only be installed between mains supply and controller.
- E.l.c.bs can trip incorrectly because of
  - capacitive leakage currents of the cable shields during operation (especially with long, shielded motor cables),
  - simultaneous connection of several controllers to the mains supply,
  - use of additional RFI filters.

4.2.1 Frequency inverter 15 ... 30 kW



Z1 Mains filter
A Connection of temperature monitoring for mains filter (thermal contact)

Fuses and cable cross sections

			Operation without mains filter				
			Installation according to EN 60204-1		Installation according to UL [1]		
Type	[kW]	Mains	①	L1, L2, L3, PE [mm²]	①	L1, L2, L3, PE [AWG]	FI
2FC4153-2NE00	15	3/PE AC	M63 A	25	63 A	4	≥ 300 mA [2]
2FC4223-2NE00	22	320 ... 550 V	Operation only permissible with mains filter				
2FC4303-2NE00	30	45 ... 65 Hz					

			Operation with mains filter				
			Installation according to EN 60204-1		Installation according to UL [1]		
Type	[kW]	Mains	①	L1, L2, L3, PE [mm²]	①	L1, L2, L3, PE [AWG]	FI
2FC4153-2NE00	15	3/PE AC	M35 A	10	35 A	8	≥ 300 mA [2]
2FC4223-2NE00	22	320 ... 550 V	M50 A	16	50 A	6	
2FC4303-2NE00	30	45 ... 65 Hz	M80 A	25	80 A	3	

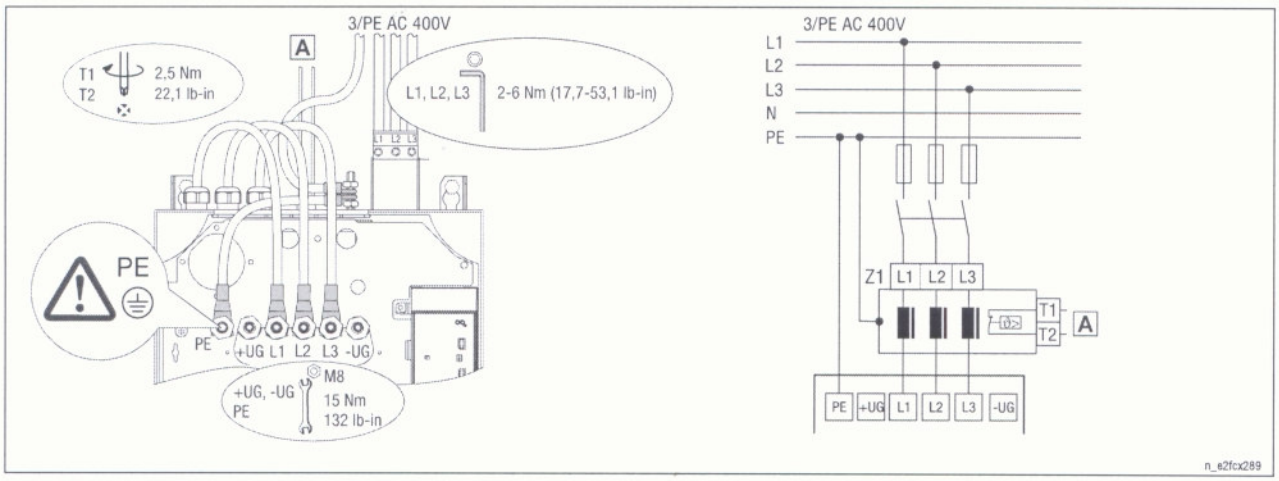
① Fuse

1) Use only UL-approved cables, fuses and fuse holders.
UL fuse: Voltage 500 ... 600 V, tripping characteristic "H" or "K5"

2) All-current sensitive e.l.c.b.

Observe national and regional regulations (e. g. VDE 0113, EN 60204)

4.2.2 Frequency inverter 45 kW



Z1 Mains filter

A Connection of temperature monitoring for mains filter (thermal contact)

Fuses and cable cross sections

			Operation without mains filter				
			Installation according to EN 60204-1		Installation according to UL 1)		
Type	[kW]	Mains	①	L1, L2, L3, PE [mm²]	①	L1, L2, L3, PE [AWG]	FI
2FC4453-2NE00	45	3/PE AC 320 ... 550 V 45 ... 65 Hz	Operation only permissible with mains filter				

			Operation with mains filter				
			Installation according to EN 60204-1		Installation according to UL 1)		
Type	[kW]	Mains	①	L1, L2, L3, PE [mm²]	①	L1, L2, L3, PE [AWG]	FI
2FC4453-2NE00	45	3/PE AC 320 ... 550 V 45 ... 65 Hz	M100 A	50	100 A	1	≥ 300 mA 2)

① Fuse

1) Use only UL-approved cables, fuses and fuse holders.
UL fuse: Voltage 500 ... 600 V, tripping characteristic "H" or "K5"

2) All-current sensitive e.l.c.b.

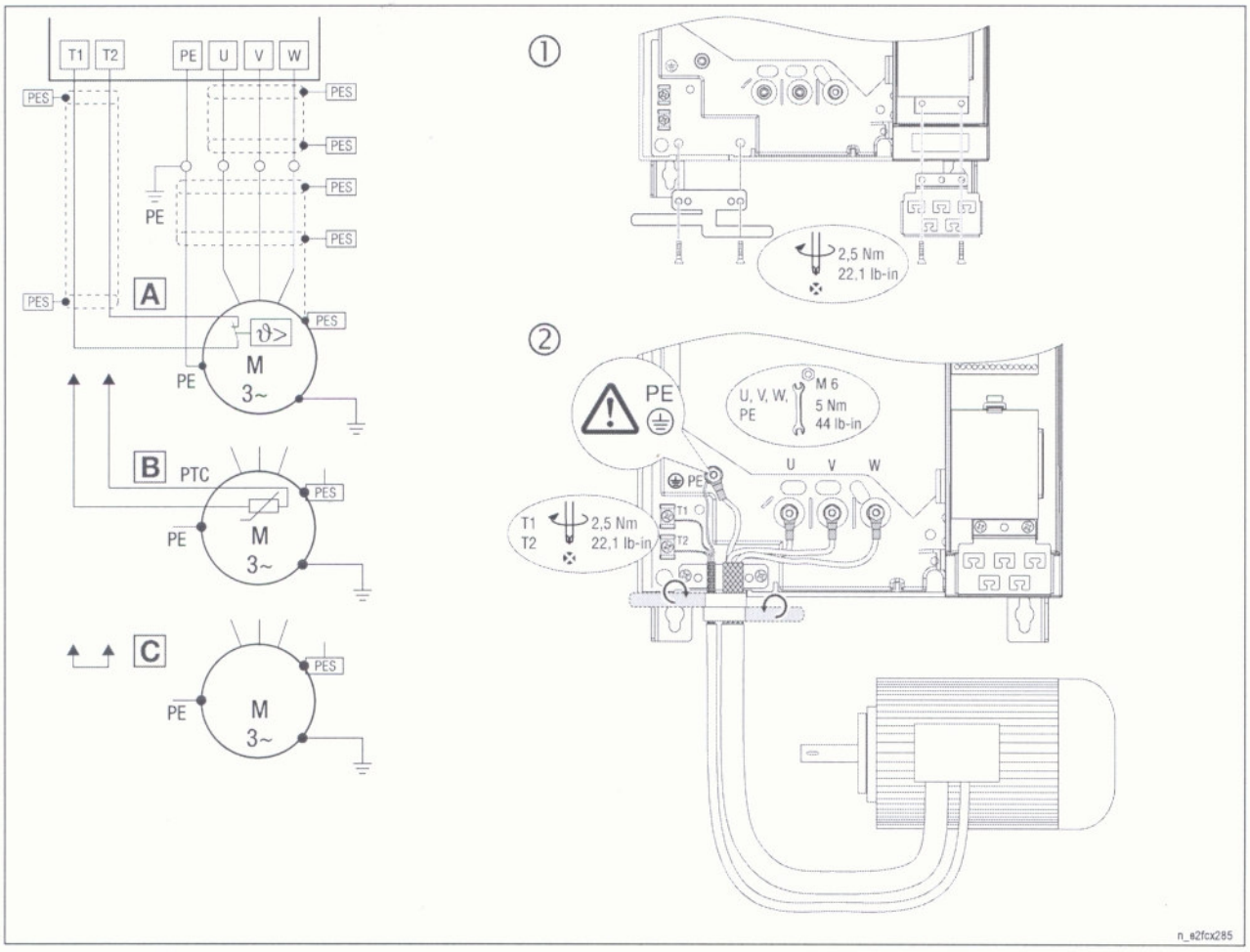
Observe national and regional regulations (e. g. VDE 0113, EN 60204)

4.3 Motor connection

Danger!

- After the connection of a PTC thermistor or thermal contact all control terminals
- only have a basic insulation (single insulating distance).
- Protection against contact in the event of a defective insulating distance can only
- be ensured by external measures (e.g. double insulation).

4.3.1 Frequency inverter 15 ... 30 kW



Use low-capacitance motor cables!

(core/core ≤ 140 pF/m, core/shield ≤ 230 pF/m)

Motor cables as short as possible improve the drive performance!

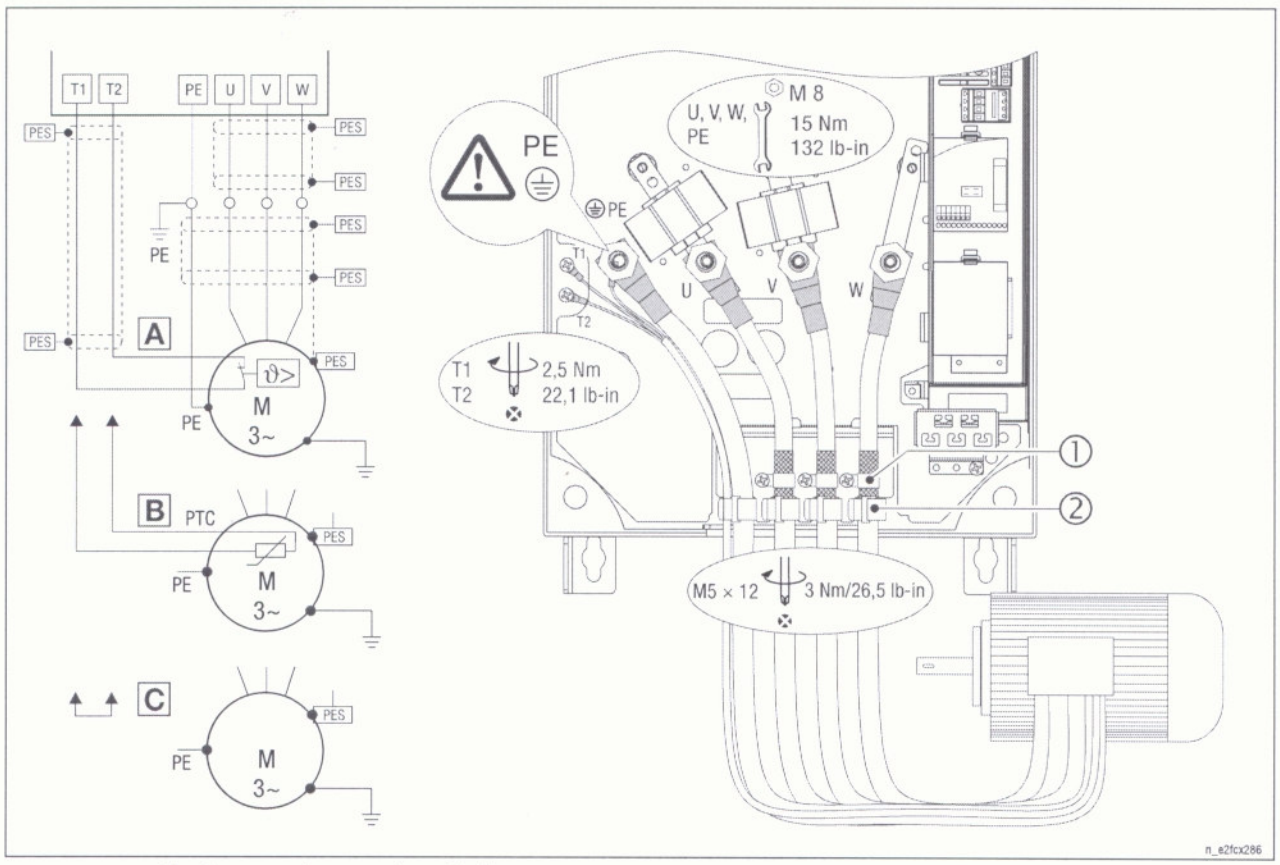
①	Installation of shield sheets
②	Bend the shield sheet for the motor cable firmly around the motor cable (shield connection and strain relief)
PES	HF shield termination through PE connection via shield clamp or EMC cable connection.
T1, T2	Terminals for motor temperature monitoring
A	Motor with thermal contact
B	Motor with PTC thermistor
C	Motor without temperature monitoring

Terminals X2.2/T1 and X2.2/T2 must be jumpered, otherwise the fault indication OH51 is triggered.

Cable cross sections

Cable cross sections U, V, W, PE		
Type	mm^2	AWG
2FC4453-2NE00	50	1

4.3.2 Frequency inverter 45 kW



Use low-capacitance motor cables!

(core/core ≤ 190 pF/m, core/shield ≤ 320 pF/m)

Motor cables as short as possible improve the drive performance!

①	Place the shield of the motor cables with shield clamp and M5 × 12 mm screws onto the shield sheet.
②	Strain relief with cable binders.
PES	HF shield termination through PE connection via shield clamp or EMC cable connection.
T1, T2	Terminals for motor temperature monitoring
A	Motor with thermal contact
B	Motor with PTC thermistor
C	Motor without temperature monitoring

Terminals X2.2/T1 and X2.2/T2 must be jumpered, otherwise the fault indication OH51 is triggered.

Cable cross sections

Cable cross sections U, V, W, PE		
Type	mm^2	AWG
2FC4453-2NE00	50	1

Increase the power density of the side channel blower

Depending on the motor circuit configuration, the power density of the side channel blower can be increased by adjusting the nominal V/f frequency appropriately.

Note!

- Asynchronous motors which are designed for a rated frequency of 50 Hz in star connection can be operated in delta connection up to 87 Hz when being constantly excited.
  - The motor current and the motor power are then increased by the factor √3 = 1.73.
  - The field-weakening range starts above 87 Hz.
- Advantages:
  - Higher speed-setting range
  - 73 % higher power efficiency with standard motors.
- Observe the mechanical limit speed.

Controller at 400 V mains				Controller at 230 V mains			
Motor			C0015	Motor			C0015
Voltage	Frequency	Connection		Voltage	Frequency	Connection	
230/400 V	50 Hz	⅄	50 Hz	230/400 V	50 Hz	Δ	50 Hz
220/380 V	50 Hz	⅄	52.6 Hz	220/380 V	50 Hz	Δ	52.3 Hz
280/480 V	60 Hz	⅄	50 Hz				
400/690 V 400 V	50 Hz 50 Hz	Δ	50 Hz				
230/400 V 280/480 V 400 V	50 Hz 60 Hz 87 Hz	Δ	87 Hz				
220/380 V	50 Hz	Δ	90.9 Hz				

Stop!

Excessive speeds destroy the carrying wheel of the side-channel compressor.
For this reason, operate side-channel compressor type 2BH19... with maximum output frequency 70 Hz (4200/min).

4.4 Control connections

Note!

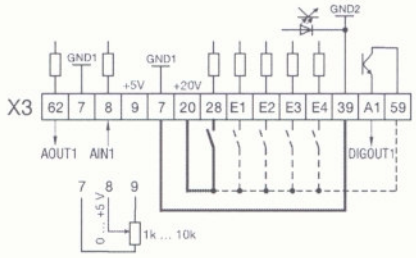
Shield control cables to avoid interferences!

Screw terminal data

Electrical connection	Terminal strip with screw connection
Possible connections	rigid: 1.5 mm² (AWG 16)
	flexible: without wire end ferrule 1.0 mm² (AWG 18)
	with wire end ferrule, without plastic sleeve 0.5 mm² (AWG 20)
	with wire end ferrule, with plastic sleeve 0.5 mm² (AWG 20)
Tightening torque	0.22 ... 0.25 Nm (1.9 ... 2.2 lb-in)
Bare end	5 mm

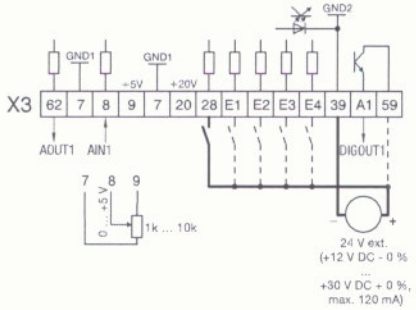
Wiring

Supply via the internal voltage source (X3/20)



n_e2fcx072

Supply via an external voltage source

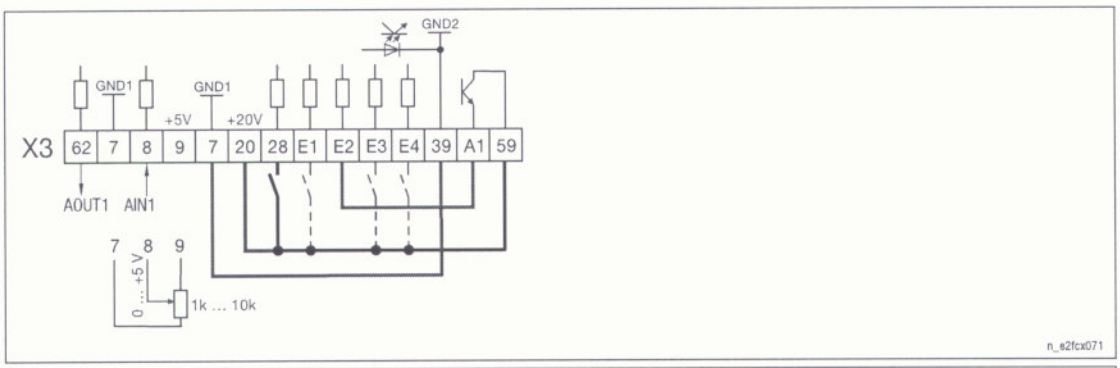


n_e2fcx073

———	Required minimum wiring for operation

Wiring example: Switching off the side channel blower in the case of motor overtemperature

When the motor gets too hot, the controller turns off the side channel blower signalling the fault indication ”EEr”.

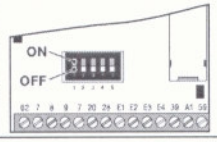


———	Required minimum wiring for operation

Terminal assignment

X3/	Signal type	Function	Level
X3/62	Analog output	Output frequency	0 ... + 6 V
X3/7	-	GND1, reference potential for analog signals	-
X3/8	Analog input	Setpoint input Change setpoint selection range via DIP switch	0 ... +5 V (default setting) 0 ... +10V 0 ... +20 mA
X3/9	-	Internal, stabilised DC voltage source for setpoint potentiometer	+5.2 V (ref.: X3/7)
X3/20	-	Internal DC voltage source to control digital inputs and digital outputs	+20 V ± 10 % (ref.: X3/7)
X3/28	Digital inputs	Controller inhibit	HIGH ⇨ START LOW ⇨ STOP
X3/E1		Reset fault (TRIP-Reset)	HIGH ⇨ Reset fault
X3/E2		External fault	HIGH ⇨ Switch-off with fault indication "EEr" LOW ⇨ No fault
X3/E3 X3/E4		Activation of fixed speeds Adjust maximum frequency C0011 in order to go through the complete speed range. Maximum value of C0011 = 87 Hz (5000/min)	E3 / E4 34 Hz (2000/min): HIGH / LOW 67 Hz (4000/min): LOW / HIGH 50 Hz (3000/min): HIGH / HIGH
X3/39	-	GND2, reference potential for digital signals	-
X3/A1	Digital output	Warning "Motor overtemperature"	
X3/59	-	DC supply for X3/A1	+20 V: Internal voltage source (jumper to X3/20) +24 V: External voltage source

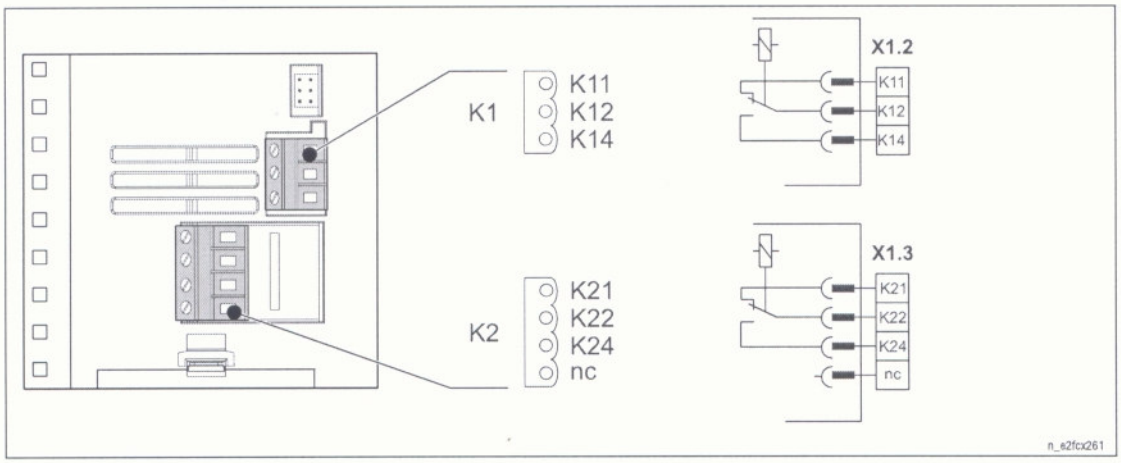
Signal at X3/8	Switch position 1	2	3	4	5
0 ... 5 V (default setting)	**OFF**	**OFF**	**ON**	**OFF**	**OFF**
0 ... 10V	OFF	OFF	ON	OFF	ON
0 ... 20 mA	OFF	OFF	ON	ON	OFF



Electrical data of the terminals

X3/		
X3/62	Resolution	10 bits
	Linearity error	±0.5 %
	Temperature error	0.3 % (0 ... +60 °C)
	Load capacity	Imax = 2 mA
X3/8	Resolution	10 bits
	Linearity error	±0.5 %
	Temperature error	0.3 % (0 ... +60 °C)
	Load capacity	Imax = 2 mA
	Input resistance	Voltage signal: > 50 kΩ Current signal: 250 Ω
X3/9	Load capacity	Imax = 10 mA
X3/7	Isolated from terminal X3/39 (GND2)	
X3/20	Load capacity	Imax = 70 mA
X3/28	Input resistance	3 3 kΩ
X3/E1… X3/E4	HIGH LOW	+12 … +30V, PLC level, HTL 0 … +3 V, PLC level, HTL
X3/39	Isolated from terminal X3/7 (GND1)	
X3/A1	Load capacity	For internal supply: Imax = 10 mA For external supply: Imax = 50 mA

4.5 Relay output connection



Relay K1

	Function	Relay position switched	Displayed message	Technical data
X1.2/K11	Relay output normally-closed contact	opened	Collective fault message (TRIP)	250 VAC/3 A 24 VDC/2 A ... 240 VDC/0.22 A
X1.2/K12	Relay mid-position contact			
X1.2/K14	Relay output normally-open contact	closed	Collective fault message (TRIP)	
PES	HF shield termination by PE connection through shield clamp.			

Relay K2

	Function	Relay position switched	Displayed message	Technical data
X1.3/K21	Relay output normally-closed contact	opened	Ready for operation (RDY)	AC 250 V/3 A 24 VDC/2 A ... 240 VDC/0.22 A
X1.3/K22	Relay mid-position contact			
X1.3/K24	Relay output normally-open contact	closed	Ready for operation (RDY)	
PES	HF shield termination by PE connection through shield clamp.			

Note!

- For switching of control signals use shielded cables and ensure HF shield termination through PE connection.
- For mains potential switching unshielded cables are sufficient.
- The service life of the relay depends on the type of load (ohmic, inductive or capacitive) and the value of the switching capacity.

5 Commissioning

5.1 Before switching on

Note!

- Do not change the switch-on sequence.
- In the event of faults or errors during commissioning, see chapter ”Troubleshooting and fault elimination”.

In order to avoid personal injuries or material damage, check ...
... before the mains voltage is connected:

- Check the wiring for completeness, short circuit and earth fault
- Check the ”emergency-off” function of system
- The motor connection (star/delta) must be adapted to output voltage of controller.

... the most important drive parameter settings before the controller is enabled:

- Are the drive parameters relevant for your application set correctly?

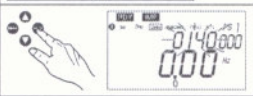
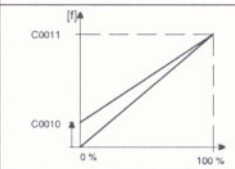
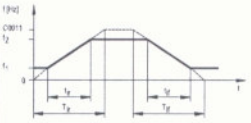
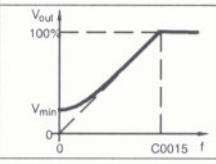
5.2 Step by step

The following description applies to the controller in conjunction with a three-phase asynchronous motor of corresponding power.

How to change pre-set parameters using the keypad is described in chapter 6.

Note!

- When no setpoint has been entered, the drive rotates with the minimum frequency set under C0010!
- The setpoint set under C0140 is stored and will be active at each switch-on.
- The setpoint set under C0140 has an additive effect on all other setpoints! This effect can be used, for example, to set speeds between fixed speeds:
  - Fixed speed via terminal = 67 Hz (4000/min)
  - C0140 = -7 Hz
  - Resulting speed = 60 Hz (3600/min)

Switch-on sequence			Note
1.	Connect keypad.		
2.	Ensure that controller inhibit is active after mains connection.		Terminal X3/28 = LOW
3.	Switch on the mains.		
4.	The keypad is in "Disp" mode after approx. 2 s and indicates the additional setpoint (C0140).		
5.	Change to Code mode in order to set drive parameters.		*0140* is blinking in the display.
6.	Press ▲ ▲ ▲.		Thus, you skip the display codes for output frequency (C0050), motor voltage (C0052) and apparent motor current (C0054).
7.	Set the minimum output frequency (C0010). Default setting: 10.00 Hz (600/min)		**After controller enabling, the motor at least rotates with the frequency set under C0010!**
8.	Set the maximum output frequency (C0011). Default setting: 50.00 Hz (3000/min)		
9.	Set acceleration time T_{ir} (C0012). Default setting: 10.00 s: controllers up to 5.5 kW 25.00 s: controllers 7.5 ... 15 kW 30.00 s: controllers 22 ... 45 kW		$T_{ir} = t_{ir} \cdot \frac{C0011}{f_2 - f_1}$ t_{ir} = desired acceleration time
10.	Set deceleration time T_{if} (C0013). Default setting: 10.00 s: controllers up to 5.5 kW 20.00 s: controllers 7.5 ... 15 kW 25.00 s: controllers 22 ... 45 kW		$T_{if} = t_{if} \cdot \frac{C0011}{f_2 - f_1}$ t_{if} = desired deceleration time
11.	Set the V/f-rated frequency (C0015) Default setting: 50.00 Hz		Set C0015 depending on the motor circuit configuration and the mains voltage. 📖 62
12.	Set V_{min} boost (C0016) Default setting: depending on the device		The default setting is suitable for all common applications.

The basic settings are now completed and the drive can be started:				
Start drive			**Note**	
13.	Enter the setpoint.			
	A) Using the keypad		Set desired output frequency under C0140.	
	B) Using the potentiometer via the terminals 7, 8, 9			
	C) Enter fixed speed via terminal	Terminal	E3	E4
		34 Hz (2000/min)	HIGH	LOW
		67 Hz (4000/min)	LOW	HIGH
		50 Hz (3000/min)	HIGH	HIGH
14.	Enable controller.		Terminal X3/28 = HIGH	
15.	The drive now operates with the set frequency. The current output frequency is indicated under C0050.		If the drive does not start, press RUN in addition.	

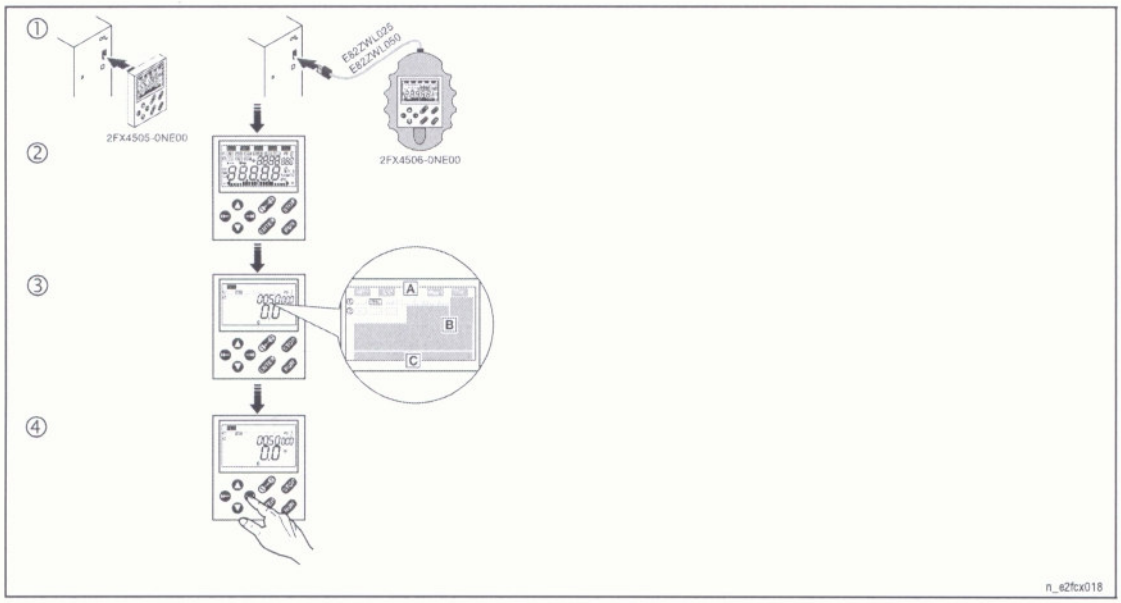
6 Parameter setting

6.1 The 2FX4505-0NE00 keypad

Description
The keypad is available as accessories. A complete description is part of the Instructions supplied with the keypad.

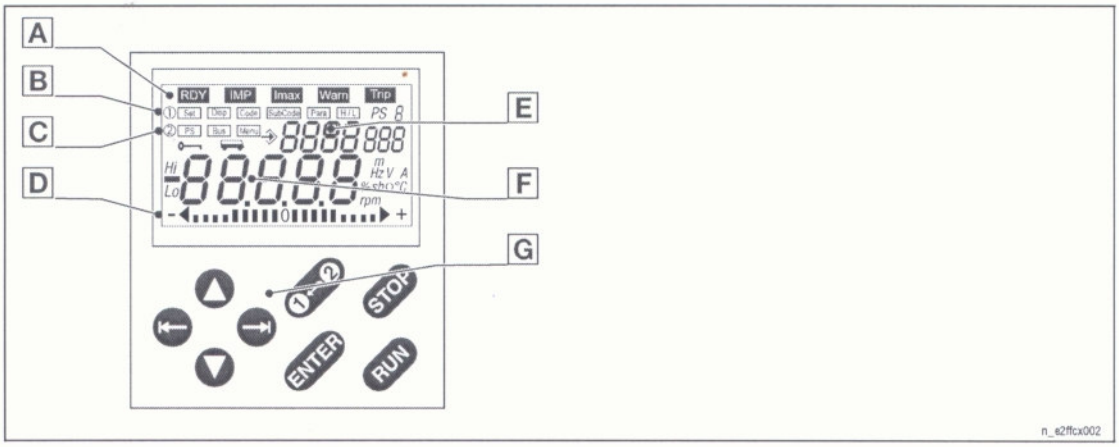
Attach keypad
It is possible to plug the keypad onto the control interface or to remove it during operation.
As soon as a voltage supply is connected to the keypad, a self-test is started.
The keypad is ready for operation when it is in the display mode.

6.1.1 Installation and commissioning



① Connect keypad to the control interface at the front of the controller.
It is possible to attach and detach the keypad during operation.
② As soon as the keypad is supplied with voltage, it carries out a short self-test.
③ The keypad is ready for operation, if it is in display mode Disp:
A Current state of the controller
B First code in the menu
C Controller load (each graduation mark = 20 %)
④ Press ⊖ to leave the Disp mode

6.1.2 Display elements and function keys



A	**Status displays**		
		Meaning	**Explanation**
	RDY	Ready	
	IMP	Pulse inhibit active	Power outputs inhibited
	Imax	Adjusted current limitation is exceeded in motor-mode or generator-mode	C0022 (motor mode) or C0023 (generator mode)
	Warn	Warning active	
	Trip	Fault active	
B	**Function bar 1**		
		Meaning	**Explanation**
	Set	Without function	Display = LOC
	Disp	Display of first code in the menu	Active after every mains connection
	Code	Code selection	Four-digit display of the active code number
	SubCode	Without function	Is skipped
	Para	Change of parameter value of a code	Five-digit display of the current value
	H/L	Without function	
C	**Function bar 2**		
		Not active	
D	**Bar graph display**		
		Controller load	Display range: -180 % ... +180 % (each graduation mark = 20 %)
E	**Display of code number**		
F	**Display of parameter value or fault message**		
G	**Function keys**		
		Function	**Explanation**
	RUN	Enable controller	Terminal X3/28 must additionally be at HIGH level
	STOP	Inhibit controller	
	①↔②	Change function bar 1 ↔function bar 2	Function bar 2 not active
	←→	To right/left in active function bar	The active function is framed
	▲▼	Increase/decrease value Fast change: Keep respective key pressed	Only blinking values can be changed
	ENTER	Store parameters when → is blinking Confirmation by STOrE in display	

6.1.3 Changing and saving parameters

All parameters for parameterization or monitoring of the controller are stored in codes. The codes are numbered and marked with a ”C” in the documentation. The available codes are listed in the code table.

Step		Keys	Result	Action
1.	Connect keypad		Disp XX.XX Hz	The function Disp is active. C0140 = setpoint is indicated via keypad.
2.	Set parameters	⊖⊖	Code	Select mode Code.
3.		▽△	XXXX	Select code.
4.		⊖	Para	Select mode Para.
5.		▽△	XXXXX	Set parameters.
6.		ENTER	STOrE	Confirm entry when → is blinking.
		⊖		Confirm entry when →is not blinking ENTER is inactive.
7.				Start "loop" again at 2. for further parameter setting.
	Changed parameters are stored in the non-volatile memory of the controller.			

6.2 Code table

How to read the code table

Column	Abbreviation	Meaning	
Code	Cxxxx	Code number Cxxxx	The parameter value is accepted immediately (ONLINE)
	ENTER	Changed parameter of the code will be accepted after pressing ENTER	
	STOP	Changed parameter of the code will be accepted after pressing ENTER if the controller is inhibited	
Designation		Name of the code	
		Default setting (value at delivery or after restoring default setting via C0002)	
	→	Further information can be obtained from "IMPORTANT"	
Selection	1 {%} 99	Min. value {unit} max. value	
IMPORTANT	-	Brief, important explanations	

Code		Possible settings				IMPORTANT
No.	Designation	nash elmo	Selection			
C0140	Setpoint via keypad	0.00	-650.00	{0.02 Hz}	650.00	• Has an additive effect on all other setpoints • Value will be stored when switching the mains or removing the keypad
C0050	Output frequency		-650.00	{Hz}	650.00	Display only: Output frequency without slip compensation
C0052	Motor voltage		0	{V}	1000	Display only
C0054	Apparent motor current		0.0	{A}	2000.0	Display only
C0010	Minimum output frequency	10.00	0.00	{0.02 Hz}	650.00	C0010 only limits the analog input 1
C0011	Maximum output frequency	50.00	7.50	{0.02 Hz}	650.00	**Maximum permissible value: 87 Hz (5000/min)!**
C0012	Acceleration time main setpoint	→	0.00	{0.02s}	1300.00	→ Depends on the device – 10.00 s: controllers up to 5.5 kW – 25.00 s: controllers 7.5 ... 15 kW – 30.00 s: controllers 22 ... 45 kW Reference: frequency change 0 Hz ... C0011
C0013	Deceleration time main setpoint	→	0.00	{0.02 s}	1300.00	→ Depends on the device – 10.00 s: controllers up to 5.5 kW – 20.00 s: controllers 7.5 ... 15 kW – 25.00 s: controllers 22 ... 45 kW Reference: frequency change 0 Hz ... C0011
C0015	V/f-rated frequency	50.00	7.50	{0.02 Hz}	960.00	Setting applies to all possible mains voltages
C0016	V_{min} boost	→	0.00	{0.01%}	40.00	→ Depends on the device Load-independent rise of motor voltage at low speeds The selected setting applies to all possible mains voltages

7 Troubleshooting and fault elimination

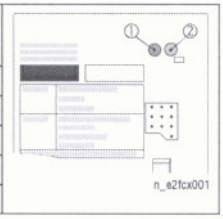
7.1 Malfunctions at side channel blower

Malfunction	Cause	Remedy
Side channel blower does not operate	DC-bus voltage too low. (Red LED is blinking quickly, keypad display: *LU*)	Check mains voltage.
	Controller inhibited (Green LED is blinking, keypad display: IMP)	Remove controller inhibit. Controller inhibit can be set through several sources.
	Setpoint = 0.	Enter the setpoint.
	Active fault	Eliminate fault.
Side channel blower rotates unsteadily	Defective motor cable	Check motor cable.
	Motor underexcited or overexcited.	Check parameter setting (C0015, C0016)
Side channel blower does not come up to the desired speed	Setpoint range wrongly adjusted at DIP switch.	Adjust setting of DIP switch to the analog signal.
	Setting of maximum output frequency too low.	Increase C0011. Maximum permissible value = 87 Hz (5000/min)
Side channel blower operates, setpoints = "0"	Minimum output frequency > 0 Hz. (Default setting = 10 Hz)	Change drive characteristics only in special circumstances! (Set C0010 = 0 Hz)
	In C0140 a setpoint has been set. (Setting of C0140 stored in non-volatile memory)	Set C0140 = 0 Hz if necessary.
Current consumption of motor too high	Setting of C0016 too high.	Correct setting.
	Setting of C0015 too small.	Correct setting.

7.2 Status signals at controller

The status of the controller is indicated by two LEDs:

LED		Controller status
red ①	**green ②**	
off	on	Controller enabled
on	on	Mains switched on and automatic start inhibited
off	slowly blinking	Controller inhibited
fast blinking	off	Undervoltage or overvoltage
slowly blinking	off	Active fault



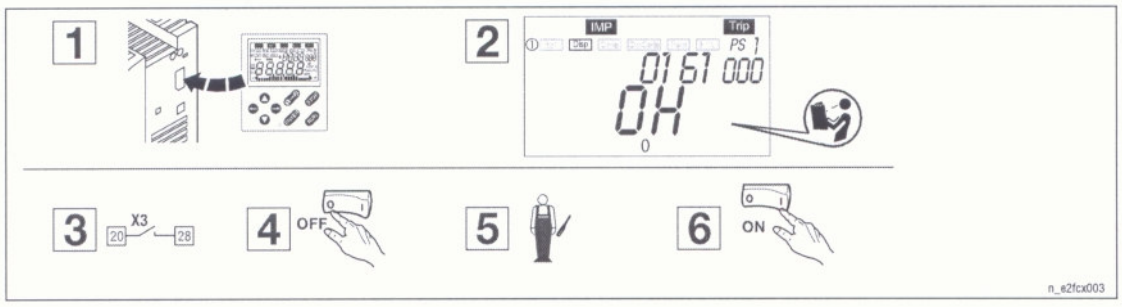
7.3 Fault indication at keypad

Keypad	PC [1]	Malfunction	Cause	Remedy
ccr Trip	71	System fault	Strong interferences on control cables	Shield control cables
			Ground or earth loops in the wiring	Remove ground or earth loops.
cE1 Trip	62	Communication fault to CAN-IN1 with Sync control	CAN-IN1 object receives faulty data or communication is interrupted	• Check if the bus module is correctly plugged on. • Check transmitter
cE2 Trip	63	Communication error to CAN-IN2	CAN-IN2 object receives faulty data or communication is interrupted	• Check if the bus module is correctly plugged on. • Check transmitter
cE3 Trip	64	Communication error to CAN-IN1 with event or time control	CAN-IN1 object receives faulty data or communication is interrupted	• Check if the bus module is correctly plugged on. • Check transmitter
cE4 Trip	65	BUS-OFF (many communication errors occured)	Controller has received too many incorrect telegrams via the system bus and has been disconnected	• Check if there is a bus termination. • Check shield contact of the cables • Check PE connection • Check bus load, if necessary, reduce the baud rate
cE5 Trip	66	CAN time-out	For remote parameter setting via system bus (C0370): Slave does not reply. The communication check time has been exceeded	• Check system bus wiring • Check system bus configuration
cE6 Trip	67	Function module system bus (CAN) is set to "Warning" or "BUS-OFF"	CAN controller sets "Warning" or "BUS OFF"	• Check if there is a bus termination. • Check shield contact of the cables • Check PE connection • Check bus load, if necessary, reduce the baud rate
cE7 Trip	68	Communication fault during remote parameter setting via system bus (C0370)	Participant does respond or is not available	• Check if there is a bus termination. • Check shield contact of the cables • Check PE connection • Check bus load, if necessary, reduce the baud rate
EEr Trip	91	External fault	External encoder signals an error (terminal X3/= LOW)	Remove external error. Then reset error *EEr* by: • Mains disconnection • or X3/E1 = HIGH (TRIP-Reset)
ErP0 ... ErP19 Trip	-	Communication abort between keypad and basic device	Various	Contact manufacturer
HOS Trip	105	Internal fault		Contact manufacturer
LU IMP	-	DC-bus undervoltage	Mains voltage too low	Check mains voltage
			DC-bus voltage too low	Check supply module
			400 V controller connected to 230 V mains	Connect controller to the appropriate mains voltage
OC1 Trip	11	Short-circuit	Short-circuit	• Search for cause of short-circuit; Check motor cable. • Check brake resistor and cable for brake resistor
			Excessive capacitive charging current of the motor cable	Use shorter motor cable with lower charging current.
OC2 Trip	12	Earth fault	Grounded motor phase	Check motor, check motor cable
			Excessive capacitive charging current of the motor cable	Use shorter motor cable with lower charging current.
OC3 Trip	13	Controller overload during acceleration or short circuit	Acceleration time too short (C0012)	• Increase acceleration time • Check drive dimensioning
			Differential pressure too high	Check differential pressure of the system.
			Side channel blower starts at half throttle	• Increase acceleration time • Open valves.
			Running wheel jammed	Repair side channel blower.
			Defective motor cable	Check wiring.
			Interturn fault in the motor	Check motor.
OC4 Trip	14	Controller overload during deceleration	Deceleration time set too short (C0013)	• Increase deceleration time • Check size of external brake resistor
			Energy backflow in generator mode operation too high	Increase deceleration time

Keypad	PC [1]	Malfunction	Cause	Remedy
OC5 Trip	15	Controller overload in stationary operation	Frequent and too long overload	Check drive dimensioning
OC6 Trip	16	Motor overload (I^2 x t - overload)	Motor is thermally overloaded, for instance, because of • impermissible continuous current • frequent or too long acceleration processes	Check drive dimensioning
OH Trip	50	Heatsink temperature > +85 °C	Ambient temperature too high	Allow controller to cool off and ensure better ventilation
OH Warn	-	Heatsink temperature > +80 °C	Heatsink strongly polluted	Clean heatsink
			Impermissibly high currents or too frequent and too long acceleration	• Check drive dimensioning. • Check load, if necessary, replace defective bearings
OH4 Trip	54	Controller overtemperature	Controller too hot inside	• Reduce controller load. • Improve cooling • Check fan in the controller
OH51	203	Temperature monitoring of the motor has been triggered	Motor too hot because of excessive currents or frequent and too long accelerations	Check drive dimensioning
			Running wheel jammed	Repair side channel blower.
			No PTC or temperature switch connected to X2.2	Connect PTC or temperature switch or jumper terminals X2.2/T1 and X2.2/T2.
OU IMP	-	DC-bus overvoltage	Mains voltage too high	Check voltage supply
			Braking operation	• Increase deceleration times. • Operation with external brake resistor: – Check dimensioning, connection and cable of the brake resistor. – Increase deceleration times.
			Earth leakage at motor side	Check motor cable and motor for earth faults (separate motor and controller)
PrS Trip	79	Internal fault	Defective EEPROM	Contact manufacturer

1) Fault number, PC display of parameter setting program (in preparation)

7.4 Reset of fault indications



Reset the drive controller in this way, if a fault occurs (TRIP-Reset):
1. Plug the keypad onto the AIF interface during operation.
2. Read and take down fault message of the keypad display.
3. Inhibit controller.
4. Separate controller from the mains.
5. Carry out a fault analysis and eliminate the faults.
6. Restart the controller.

Note!

The fault indication ”EEr” triggered by an external encoder can also be reset via a HIGH-LOW signal at terminal E1 if the fault has been eliminated in advance.