BONFIGLIOLI VECTRON

Operating Instructions

ACTIVE

230V single-three phase (2 sizes)
0.55 kW - 0.75 kW - 1.1 kW
1.5 kW - 2.2 kW - 3.0 kW

400V three phase (4 sizes)
0.55 kW - 0.75 kW - 1.1 kW
1.5 kW - 2.2 kW - 3.0 kW
4.0 kW - 5.5 kW - 7.5 kW
11.0 kW - 15.0 kW - 18.5 kW

BONFIGLIOLI
Power & Control Solutions

CE UL cUL C* N3878

MANUFACTORY FACILITIES

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General points on the documentation

The present documentation applies to the frequency inverters in the output range from 0.55 kW to 18.5 kW. The entire series of devices is suited for a wide range of applications in the configuration set in the factory. The modular hardware and software structure enables customer-specific adaptation of the frequency inverters. Applications demanding high functionality and dynamism are easy to implement.

For better clarity, the user documentation is structured according to the customer-specific demands made of the frequency inverter.

Brief instructions
The brief instructions describe the fundamental steps for mechanical and electrical installation of the frequency inverter. The guided commissioning supports you in the selection of necessary parameters and the software configuration of the frequency inverter.

Operating instructions
The operating instructions document the complete functionality of the frequency inverter. The parameters necessary for specific applications for adaptation to the application and the extensive additional functions are described in detail.

Application manual
The application manual supplements the documentation for purposeful installation and commissioning of the frequency inverter. Information on various subjects connected with the use of the frequency inverter are described specific to the application.

The documentation and additional information can be requested via your local representation of the firm of VECTRON Elektronik. The following pictograms and signal words are used for the purposes of the present documentation:

Danger
means a directly threatening danger. Death, serious damage to persons and considerable damage to property will occur if the precautionary measure is not taken.

Warning
marks a possible threat. Death, serious damage to persons and considerable damage to property can be the consequence if attention is not paid to the text.

Caution
refers to an indirect threat. Damage to people or property can be the result.

Attention
refers to a possible operational behavior or an undesired condition that can occur in accordance with the reference text.

Note
marks information that facilitates handling for you and supplements the corresponding part of the documentation.

Warning: In installation and commissioning, comply with the information in the documentation. You as a qualified person must read the documentation carefully before the start of the activity and obey the safety instructions. For the purposes of the instructions, "qualified person" designates a person acquainted with the erection, assembly, commissioning and operation of the frequency inverters and possessing the qualification corresponding to the activity.

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1 General safety and application information

This documentation has been produced with the greatest of care and extensively and repeatedly checked. For reasons of clarity, not all the detailed information on all types of the product and also not every imaginable case of erection, operation or maintenance have been taken into account. If you require further information or if specific problems which are not dealt with extensively enough in the documentation exist, you can request the necessary information via the local representation of the firm of VECTRON Elektronik.
We would also point out that the contents of this documentation are not part of a previous or existing agreement, assurance or legal relationship and are not intended to amend the same. All obligations of the manufacturer result from the underlying purchase contract, which also contains the complete and solely valid warranty regulation. These contractual warranty provisions are neither extended nor limited by the production of this documentation.
The manufacturer reserves the right to correct or amend the contents and the product information as well as omissions without prior notification and assumes no kind of liability for damage, injuries or expenditure to be put down to the aforementioned reasons.

1.1 General information

Depending on their protection class, VECTRON frequency inverters can have live, also moving parts as well as hot surfaces during operation.
In the event of inadmissible removal of the necessary covers, improper use, wrong installation or operation, there is the risk of serious damage to persons or property.
In order to avoid serious physical damage or considerable damage to property, only qualified trained personnel may carry out the work for transport, installation, commissioning and maintenance. The norms EN 50178, IEC 60364 (Cenelec HD 384 or DIN VDE 0100), IEC 60664-1 (Cenelec HD 625 or VDE 0110-1), BGV A2 (VBG 4) and national provisions are to be complied with. Qualified persons within the meaning of this principal safety information are people acquainted with the erection, fitting, commissioning and operating of frequency inverters or in possession of qualifications matching their activities.

1.2 Proper use

The frequency inverters are electrical drive components intended for installation in industrial plant or machines. Commissioning and start of intended operation are not allowed until it has been established that the machine corresponds to the provisions of the EC machine directive 98/37/EEC and EN 60204. According to the CE sign, the frequency inverters additionally fulfill the requirements of the low-voltage directive 73/23/EEC and the norms EN 50178 / DIN VDE 0160 and EN 61800-2. Responsibility for compliance with the EMC directive 89/336/EEC is with the user. Frequency inverters are available in a limited way and as components exclusively intended for professional use within the meaning of the norm EN 61000-3-2.
With the issue of the UL test sign according to UL508c, the requirements of the CSA Standard C22.2-No. 14-95 have also been fulfilled.
The technical data and the information on connection and ambient conditions can be seen from the rating plate and the documentation and are to be complied with at all costs.

1.3 Transport and storage

Transport and storage are to be done in an adequate way in the original packaging. Storage shall be in dry rooms protected against dust and moisture with slight temperature fluctuations. Please observe the climatic conditions according to EN 50178 and the marking on the packaging.
The duration of storage without connection to the admissible reference voltage may not exceed one year.

1.4 Handling and positioning

The frequency inverters are to be used according to the documentation, the directives and the norms. Ensure careful handling and avoid mechanical overloading. In transport and handling, do not bend the construction elements or alter the insulation distances. Do not touch any electronic construction elements and contacts. The devices contain construction elements with a risk of electrostatic which can easily be damaged by improper handling. Damaged or destroyed components may not be put into operation as they can be a risk to your health and compliance with the applied norms is not guaranteed.

1.5 Electrical connection

In work on the frequency inverters, please observe the applicable norms BGV A2 (VBG 4), VDE 0100 and other national directives. The information in the documentation on electrical installation and the relevant directives are to be observed. Responsibility for compliance with and examination of the limit values of the EMC product norm EN 61800-3 for variable-speed electrical drive mechanisms is with the manufacturer of the industrial plant or machine.
The documentation contains information on installation correct for EMC. The wires connected to the frequency inverters may not be subjected to an insulation test with a high-test voltage without prior wiring measures.

1.6 Operation information

Before commissioning and the start of the intended operation, all the covers are to be attached and the terminals checked. Check additional monitoring and protective devices pursuant to EN 60204 and the safety directives applicable in each case (e.g. Working Machines Act, Accident Prevention Directives etc.). Before working on the frequency inverter, the latter must be switched off, and you are not allowed to touch live connections immediately as the capacitors can be charged up. Please observe the information and markings on the frequency inverter.

1.7 Maintenance and upkeep

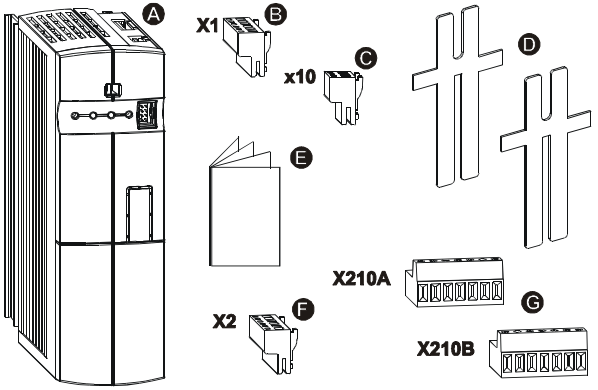
Unauthorized opening and improper interventions can lead to physical injury or damage to property. Repairs on the frequency inverters may only be done by the manufacturer or persons authorized by the latter.

2 Scope of delivery

The frequency inverters are easy to integrate into the automation concept thanks to the modular hardware components. The scope of delivery described can be supplemented by optional components and adapted to the customer-specific requirements. The plug-in type connection terminals enable safe functioning and economical assembly.

2.1 Frequency inverter (0.55 to 3.0 kW)

Power range 0.55 kW to 3.0 kW

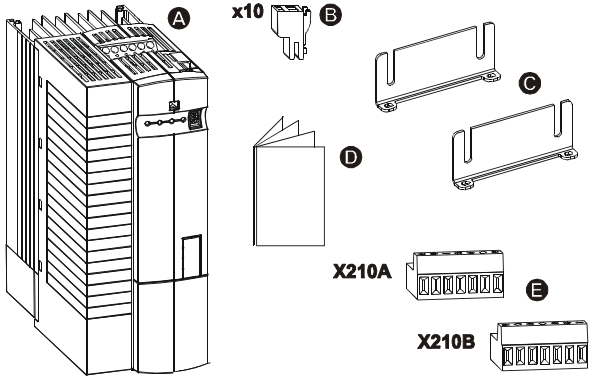


Scope of delivery	
A	Frequency inverter
B	Connection terminal strip X1 (Phoenix ZEC 1.5/..ST7.5) Plug-in terminals for mains connection and DC linking
C	Connection terminal strip X10 (Phoenix ZEC 1.5/3ST5.0) Plug-in terminals for the relay output
D	Standard fittings, for three vertical assembly variants
E	Brief instructions
F	Connection terminal strip X2 (Phoenix ZEC 1.5/..ST7.5) Plug-in terminal for brake resistor and motor connection
G	Control terminals X210A / X210B (Wieland DST85 / RM3.5) Plug-in terminal for connection of the control signals

Note: Please check incoming goods for quality, quantity and nature without delay. Apparent defects such as external damage to the packaging or the device are to be reported to the sender within seven days for insurance reasons.

2.2 Frequency inverter (4.0 to 18.5 kW)

Power range 4.0 kW to 18.5 kW



Scope of delivery

A	Frequency inverter
B	Connection terminal strip X10 (Phoenix ZEC 1.5/3ST5.0) Plug-in terminals for the relay output
C	Standard fittings with fitting screws (M4x20, M4x60), for vertical assembly
D	Brief instructions
E	Control terminals X210A / X210B (Wieland DST85 / RM3.5) Plug-in terminal for connection of the control signals

Note: Please check incoming goods for quality, quantity and nature without delay. Apparent defects such as external damage to the packaging or the device are to be reported to the sender within seven days for insurance reasons.

3 Technical data

3.1 230 V Frequency inverter (0.55 to 3.0 kW)

The following information applies to the reference point of the frequency inverter. The nominal point of the frequency inverter is defined at the admissible mains voltage of 230 V and a switching frequency of 2 kHz.

Output, motor side								
ACT200			**003**	**004**	**005**	**007**	**009**	**012**
Recommended motor shaft output	P	kW	0.4/0.55	0.55/0.75	0.75/1.1	1.1/1.5	1.5/2.2	2.2/3.0 [4]
Output current	I	A	2.4/3.0	3.0/4.0	4.0/5.5	5.5/7.0	7.0/9.5	9.5/12.5 [4]
Output voltage	U	V	3 x 0 to mains voltage					
Overload capacity	-	-	1.2 for 60s; 1.5 for 1s					
Protection	-	-	Short circuit / earth fault proof					
Rotary field frequency	f	Hz	0 to 400 depending on switching frequency					
Switching frequency	f	kHz	2 to 16					
Output, brake resistor								
Min. brake resistance	R	Ω	230	160	115	75	55	37
Protection	-	-	Short circuit proof					
Input, mains side								
Mains current [3] 3ph/PE 1ph/N/PE ; 2ph/PE	I	A	3 5.4	4 7.2	5.5 9.5 [2]	7 13.2	9.5 16.5 [2]	10.5 [1] 16.5 [2] [4]
Mains voltage	U	V	184 to 264					
Mains frequency	f	Hz	45 to 66					
Fuse 3ph/PE 1ph/N/PE ; 2ph/PE	I	A	6 10		10 16		16 20	16 20 [4]
Mechanics								
Dimensions:	HxWxD	mm	190 x 60 x 175			250 x 60 x 175		
Weight (approx.)	m	kg	1.3			1.7		
Protection class	-	-	IP20 (EN60529)					
Terminals	A	mm^2	0.2 to 1.5					
Form of assembly	-	-	vertical					
Ambient conditions								
Energy dissipation	P	W	43	53	73	84	115	170
Coolant temperature	T_n	°C	0 to 40 (3K3 DIN IEC 721-3-3)					
Storage temperature	T_L	°C	-25 to 55					
Transport temperature	T_T	°C	-25 to 70					
Relative air humidity	-	%	15 to 85; not condensing					

An increase of the switching frequency with a reduction of the output current is admissible to match the customer-specific requirements. The norms and directives in question are to be observed for this operating point.

Output current					
Frequency inverter nominal output	Switching frequency				
	2 kHz	4 kHz	8 kHz	12 kHz	16 kHz
0.55 kW	3.0 A	2.8 A	2.4 A	2.0 A	1.6 A
0.75 kW	4.0 A	3.7 A	3.0 A	2.5 A	2.0 A
1.1 kW	5.5 A [2]	5.0 A [2]	4.0 A	3.4 A	2.7 A
1.5 kW	7.0 A	6.5 A	5.5 A	4.6 A	3.7 A
2.2 kW	9.5 A [2]	8.7 A [2]	7.0 A	5.9 A	4.8 A
3.0 kW	12.5 A [1] [2]	11.5 A [1] [2]	9.5 A [2]	8.0 A [2]	6.5 A

[1] Three-phased connection demands mains commutating choke
[2] One and two-phased connection demands mains commutating choke
[3] Mains current with relative mains impedance of 1 % (see Chapter 5)
[4] One and two-phased connection demands an output limit (de-rating)

3.2 400 V Frequency inverter (0.55 to 3.0 kW)

The following information applies to the reference point of the frequency inverter. The nominal point of the frequency inverter is defined at the admissible mains voltage of 400 V and a switching frequency of 2 kHz.

Output, motor side								
ACT400			**001**	**002**	**003**	**004**	**005**	**007**
Recommended motor shaft output	P	kW	0.4/0.55	0.55/0.75	0.75/1.1	1.1/1.5	1.5/2.2	2.2/3.0
Output current	I	A	1.3/1.8	1.8/2.4	2.4/3.2	3.2/4.2	4.2/5.8	5.8/7.8
Output voltage	U	V	3 x 0 to mains voltage					
Overload capacity	-	-	1.2 for 60s; 1.5 for 1s					
Protection	-	-	Short circuit / earth fault proof					
Rotary field frequency	f	Hz	0 to 400 depending on switching frequency					
Switching frequency	f	kHz	2 to 16					
Output, brake resistor								
Min. brake resistance	R	Ω	930	634	462	300	220	148
Protection	-	-	Short circuit proof					
Input, mains side								
Mains current [2] 3ph/PE	I	A	1.8	2.4	2.8 [1]	4.2	5.8	6.8 [1]
Mains voltage	U	V	320 to 528					
Mains frequency	f	Hz	45 to 66					
Fuses 3ph/PE	I	A	6				10	
Mechanics								
Dimensions:	HxWxD	mm	190 x 60 x 175			250 x 60 x 175		
Weight (approx.)	m	kg	1.3			1.7		
Protection class	-	-	IP20 (EN60529)					
Terminals	A	mm^2	0.2 to 1.5					
Form of assembly	-	-	vertical					
Ambient conditions								
Energy dissipation	P	W	40	46	58	68	87	115
Coolant temperature	T_n	°C	0 to 40 (3K3 DIN IEC 721-3-3)					
Storage temperature	T_L	°C	-25 to 55					
Transport temperature	T_T	°C	-25 to 70					
Relative air humidity	-	%	15 to 85, not condensing					

An increase of the switching frequency with a reduction of the output current is admissible to match the customer-specific requirements. The norms and directives in question are to be observed for this operating point.

Output current					
Frequency inverter nominal output	Switching frequency				
	2 kHz	4 kHz	8 kHz	12 kHz	16 kHz
0.55 kW	1.8 A	1.6 A	1.3 A	1.1 A	0.9 A
0.75 kW	2.4 A	2.2 A	1.8 A	1.5 A	1.2 A
1.1 kW	3.2 A [1]	2.9 A [1]	2.4 A	2.0 A	1.6 A
1.5 kW	4.2 A	3.9 A	3.2 A	2.7 A	2.2 A
2.2 kW	5.8 A	5.3 A	4.2 A	3.5 A	2.9 A
3.0 kW	7.8 A [1]	7.1 A [1]	5.8 A	4.9 A	3.9 A

[1] Three-phased connection demands mains commutating choke
[2] Mains current with relative mains impedance of 1 % (see Chapter 5)

3.3 400 V Frequency inverter (4.0 to 18.5 kW)

The following information applies to the reference point of the frequency inverter. The nominal point of the frequency inverter is defined at the admissible mains voltage of 400 V and a switching frequency of 2 kHz.

Output, motor side								
ACT400			**010**	**014**	**018**	**025**	**034**	**040**
Recommended motor shaft output	P	kW	3.0/4.0	4.0/5.5	5.5/7.5	7.5/11	11/15	15/18.5
Output current	I	A	7.8/10	10/14	14/18	18/25	25/32	32/40
Output voltage	U	V	3 x 0 to mains voltage					
Overload capacity	-	-	1.2 for 60s; 1.5 for 1s					
Protection	-	-	Short circuit / earth fault proof					
Rotary field frequency	f	Hz	0 to 400 depending on switching frequency					
Switching frequency	f	kHz	2 to 16					
Output, brake resistor								
Min. brake resistance	R	Ω	106	80	58	48	32	24
Input, mains side								
Mains current [2] 3ph/PE	I	A	10	14.2	15.8 [1]	26	28.2 [1]	35.6 [1]
Mains voltage	U	V	320 to 528					
Mains frequency	f	Hz	45 to 66					
Fuses 3ph/PE	I	A	16		25	35		50
Mechanics								
Dimensions:	HxWxD	mm	250 x 100 x 200			250 x 125 x 200		
Weight (approx.)	m	kg	2.7			3.8		
Protection class	-	-	IP20 (EN60529)					
Terminals	A	mm^2	0.2 to 6			0.2 to 16		
Form of assembly	-	-	vertical					
Ambient conditions								
Energy dissipation	P	W	115	145	200	240	310	420
Coolant temperature	T_n	°C	0 to 40 (3K3 DIN IEC 721-3-3)					
Storage temperature	T_L	°C	-25 to 55					
Transport temperature	T_T	°C	-25 to 70					
Relative air humidity	-	%	15 to 85, not condensing					

An increase of the switching frequency with a reduction of the output current is admissible to match the customer-specific requirements. The norms and directives in question are to be observed for this operating point.

Output current					
Frequency inverter nominal output	Switching frequency				
	2 kHz	4 kHz	8 kHz	12 kHz	16 kHz
4.0 kW	10 A	9.3 A	7.8 A	6.6 A	5.3 A
5.5 kW	14 A	12.7 A	10 A	8.4 A	6.8 A
7.5 kW	18 A [1]	16.7 A [1]	14 A	11.8 A	9.5 A
11 kW	25 A	22.7 A	18 A	15.1 A	12.2 A
15 kW	32 A [1]	29.7 A [1]	25 A	21 A	17 A
18.5 kW	40 A [1]	37.3 A [1]	32 A [1]	26.9 A [1]	21.8 A

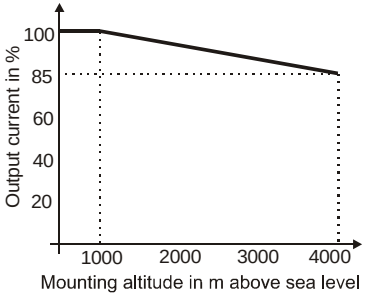
[1] Three-phased connection demands mains commutating choke
[2] Mains current with relative mains impedance of 1 % (see Chapter 5)

3.4 Operation diagrams

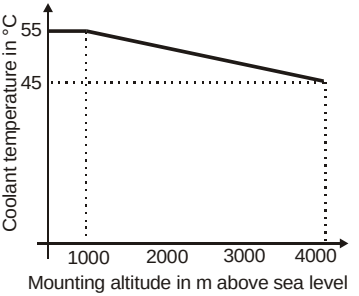
The technical data of the frequency inverters refer to the nominal point selected for a wide range of applications. Relative to the application, a safely functioning and economical dimensioning (de-rating) of the frequency inverters is possible via the following diagrams.

Mounting altitude

Power reduction (de-rating);
5 %/1000m upper 1000 m above sea level;
hmax = 4000m

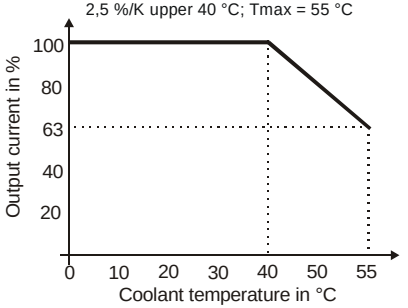


max. coolant temperature;
3.3°C/1000m upper 1000 m above sea level



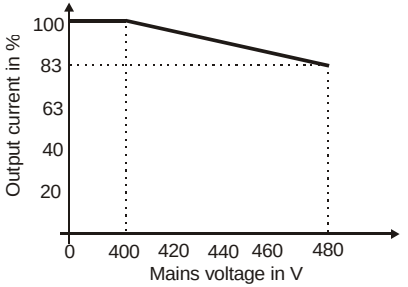
Coolant temperature

Power reduction (de-rating);
2,5 %/K upper 40 °C; Tmax = 55 °C



Mains voltage

Power reduction (de-rating);
0,22 %/V upper 400 V; Umax = 480 V



4 Mechanical Installation

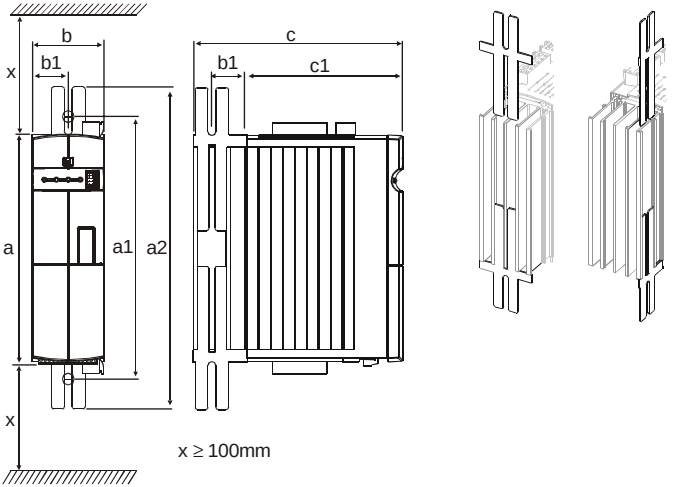
The frequency inverters in protection class IP20 are intended for installation into the electrical cabinet as a standard feature. In assembly, the installation and safety guidelines as well as the device specification are to be obeyed.

Warning: The frequency inverters only fulfill protection class IP20 with the covers and terminals attached properly.
Only then is operation admissible.

4.1 Frequency inverter (0.55 to 3.0 kW)

Assembly is done with the standard fittings in a vertical position on the assembly panel or as a feed-through model.
The following illustration shows the various possibilities of fitting.

Standard fitting



Assembly is done by pushing the long side of the fitting sheet into the heat sink and screwing it to the assembly panel.
The dimensions and assembly measures correspond to the standard device without optional components in millimeters.

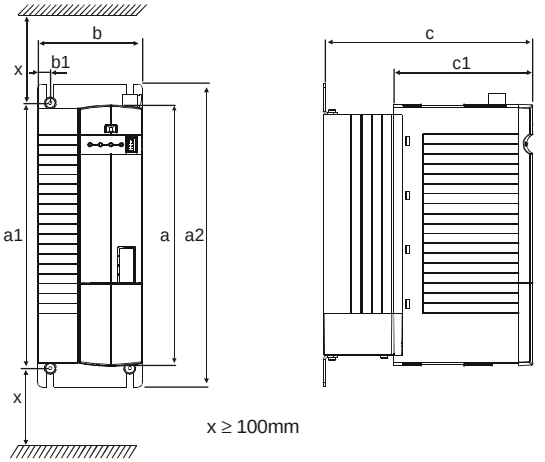
Dimensions in mm				Assembly measure in mm			
Frequency inverter	a	b	c	a1	a2	b1	c1
0.55 kW to 1.1 kW	190	60	175	210 to 230	255	30	130
1.5 kW to 3.0 kW	250	60	175	270 to 290	315	30	130

Caution: The devices are to be fitted with sufficient leeway so that the air can circulate without obstacles. Please make sure that contamination of the air such as dust, greases, aggressive gases etc. is avoided.

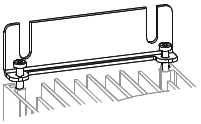
4.2 Frequency inverter (4.0 to 18.5 kW)

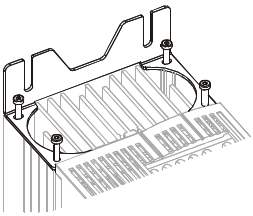
Assembly is done with the standard fittings in a vertical position on the assembly panel. The following illustration shows the standard fitting.

Standard fitting

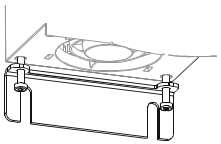


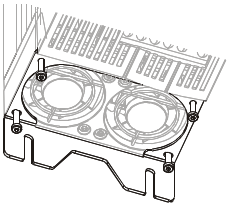
Fitting of the upper angle bracket (**M 4 x 20** screw)





Fitting of the lower angle bracket (**M 4 x 60** screw)





Assembly is done by screwing the two angle brackets to the heat sink of the frequency inverter and the assembly panel.
The frequency inverters are provided with angle brackets, which are fitted with four thread-forming screws. The dimensions and assembly measures correspond to the standard device without optional components in millimeters.

Dimensions in mm				Assembly measure in mm			
Frequency inverter	a	b	c	a1	a2	b1	c1
4.0 kW to 7.5 kW	250	100	200	270 to 290	315	12	133
11.0 kW to 18.5 kW	250	125	200	270 to 290	315	17,5	133

Caution: The devices are to be fitted with sufficient leeway so that the air can circulate without obstacles. Please make sure that contamination of the air such as dust, greases, aggressive gases etc. is avoided.

5 Electrical Installation

The electrical installation is to be done by qualified staff according to the general and regional safety and installation directives. Safe operation of the frequency inverter presupposes that the documentation and the device specification are obeyed in installation and initial commissioning. If there are specific areas of application, further directives and guidelines may possibly have to be obeyed.

Danger: The mains, direct voltage and motor terminals can be live with dangerous voltage after disconnection of the frequency inverter. Work may only be done on the device after a waiting period of some minutes until the DC link capacitors have discharged.

The mains fuses and cable cross-sections are to be designed for the nominal operating point of the frequency inverter according to EN 60204-1 or to DIN VDE 0298 part 4. According to UL/CSA, admitted Class 1 copper lines are to be used with a temperature range off 60/75°C for the power lines and the corresponding mains fuses.

Warning: The frequency inverters are to be connected expertly with the earth potential on a plane and with good conductivity. The discharge current of the frequency inverters can be > 3.5 mA and according to Norm EN 50178 a permanent connection must be provided. The protective conductor cross-section necessary to earth the installation area must be at least 10 mm², or a second protective conductor must be laid electrically parallel to the first one. In these applications, the cross-section must correspond to the recommended conductor cross-section.

Connection conditions

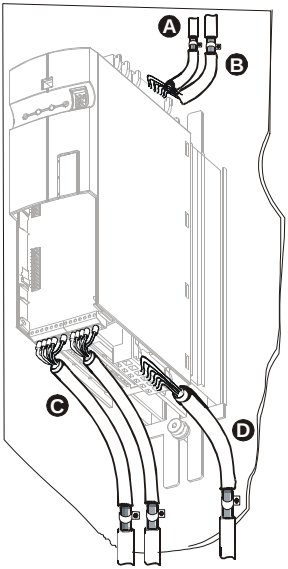
- According to the technical data, the frequency inverter is suited for connection to the public or industrial supply network. If the transformer output of the supply network is ≤ 500 kVA, the optional commutating choke is only necessary for the frequency inverters identified in the technical data. The further frequency inverters are suitable for connection without a commutating choke at a relative mains impedance of ≥ 1 %.
- Connection to the public electricity supply without further measures is to be checked according to the provisions of norm EN 61000-3-2. Frequency inverters ≤ 7.5 kW with integrated EMC filters fulfill the emission limit values according to product norm EN 61800-3 up to a motor line length of 10 m without additional measures. Increased demands as a result of the field of application of the frequency inverter are to be fulfilled by optional components. Commutating chokes and EMC filters are optionally available for the series of devices.
- Operation on an unearthed mains (IT mains) is admissible after disconnection of the Y capacitors in the interior of the device.
- Interference-free operation with fault current protective devices is guaranteed at a triggering current ≥ 30 mA if the following points are observed:
  - Pulse and direct current sensitive fault current protective devices (Type A to EN 50178) in connection of frequency inverters to single-phase mains connections (L1/N)
  - All-current sensitive fault current protective devices (Type B to EN 50178) in connection of frequency inverters to two-phased mains connections (L1/L2) or three-phased mains connections (L1/L2/L3)
  - The fault current protective device protects a frequency inverter with discharge current reduced filter or without EMC filter.
  - The length of the screened motor line is ≤ 10 m and there are no additional capacitive components between the mains and motor lines and PE.

5.1 EMC information

The frequency inverters are designed according to the requirements and limit values of product norm EN 61800-3 with an interference immunity factor (EMI) for operation in industrial applications. The electromagnetic interference is to be avoided by expert installation and observation of the specific product information.

Measures

- Frequency inverters and commutating chokes are to be assembled on a plane on a metallic assembly panel – ideally galvanized.
- Please ensure a good equipotential bonding within the system or the plant. Plant parts such as electrical cabinets, control panels, machine frames etc. are to be connected with PE lines on a plane and with good conductivity.
- Make sure that the frequency inverter, the commutating choke, external filters and further components are connected with a grounding point via short lines.
- Unnecessary line lengths and floating laying are to be avoided in installation.
- Contractors, relays and solenoids in the electrical cabinet are to be provided with suitable interference suppression components.



A Mains connection

The mains supply line can be any length, although it must be laid separate from the control, data and motor line.

B DC link connection

The frequency inverters are to be connected with the same mains potential or with a joint direct voltage source. Line lengths > 300 mm are to be screened and connected with the assembly panel on both sides.

C Control connection

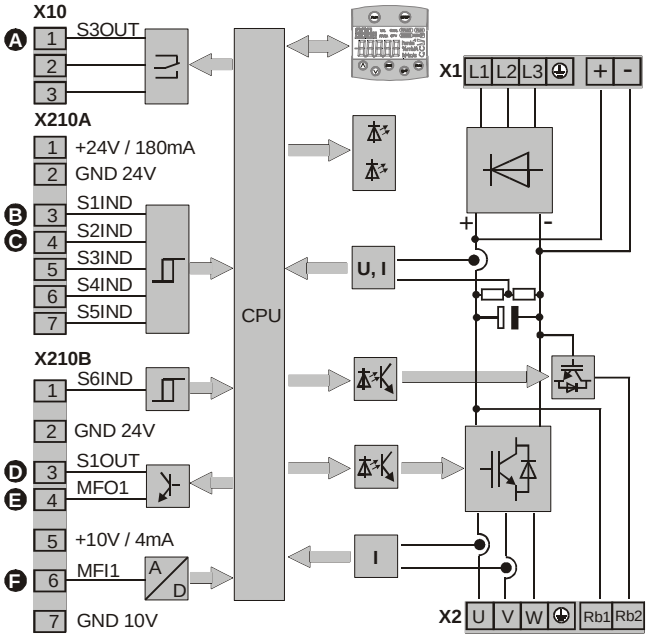
The control and signal lines are to be laid physically separate from the power lines. The screen of the control lines is to be connected to ground on both sides on a large area and with good conductivity. Analogue signal lines are to be connected with the screen potential on one side.

D Motor and brake resistor

The shielded motor line is to be connected with the earth potential on the motor with a metallic PG screw connection and on the frequency inverter with a suitable shielding clip with good conductivity. The signal line to monitor the motor temperature is to be laid separate from the motor line. The shield of this line is to be applied on both sides. When a brake resistor is used, its connection line is also to be shielded and the shield to be applied on both sides.

Attention: The frequency inverters fulfill the requirements of the low-voltage directive 73/23/EEC and the requirements of the EMC directive 89/336/EEC. The EMC product norm EN 61800-3 refers to the drive system. The documentation gives information about how the norms to be applied can be fulfilled if the frequency inverter is a component of the drive system. The declaration of conformity is to be provided by the person setting up the drive system.

5.2 Block diagram



A **Relay connection S3OUT**

Changer contact, response time approx. 40 ms, 240 V AC / 5 A, 24 V DC / 5 A (ohmic)

B **Digital input S1IND**

Digital signal, response time approx. 16 ms (on), 10 µs (off),
U_{max} = 30 V, 10 mA at 24 V, PLC compatible

C **Digital input S2IND to S6IND**

Digital signal, response time approx. 16 ms, U_{max}= 30 V, 10 mA at 24 V, PLC compatible,
Frequency signal, 0 to 30 V, 10 mA at 24 V, f_{max} = 150 kHz

D **Digital output S1OUT**

PLC compatible, overload and short-circuit proof,
Digital signal, 24 V, I_{max} = 40 mA

E **Multifunctional output MFO1**

PLC compatible, overload and short-circuit proof,
Digital signal, 24 V, I_{max} = 40 mA,
Frequency signal, 0 to 24 V, I_{max} = 40 mA, f_{max} = 150 kHz

F **Multifunctional input MFI1**

Analogue signal, resolution 12Bit, 0 to 10 V (R_i = 70 kΩ), 0 to 20 mA (R_i = 500 Ω),
Digital signal, response time approx. 16 ms, U_{max}=30 V, 0 to 4 mA at 24 V, PLC compatible

5.3 Mains power connection

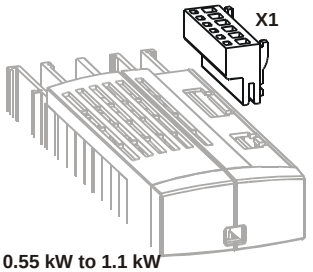
The mains fuses and wiring cross-sections are to be designed according to EN 60204-1 and to DIN VDE 0298 part 4 for the nominal operating point of the frequency inverter. According to UL/CSA, admitted Class 1 copper lines with a temperature range of 60/75°C are to be used for the power lines and the corresponding mains fuses. The electrical installation is to be done according to the device specification, the applicable norms and directives.

Caution: The control, mains and motor lines must be laid separately. The cables connected to the frequency inverters may not be subjected to an isolation test with a high-test voltage without previous circuit measures.

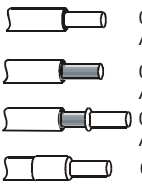
5.3.1 Frequency inverter (0.55 to 3.0 kW)

The mains connection of the frequency inverter is via plug-in terminal X1. Protection class IP20 (EN60529) is only guaranteed if terminal X1 is connected.

Mains power connection 0.55 kW to 3.0 kW



Phoenix ZEC 1,5/ .. ST7,5



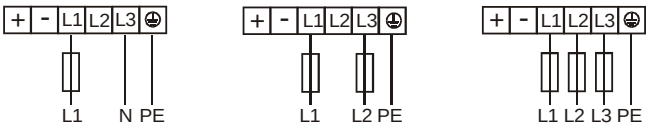
0.2 … 1.5 mm²
AWG 24 … 16

0.2 … 1.5 mm²
AWG 24 … 16

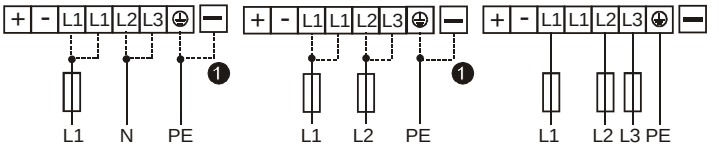
0.25 … 1.5 mm²
AWG 22 … 16

0.25 … 1.5 mm²
AWG 22 … 16

0.55 kW to 1.1 kW



1.5 kW to 3.0 kW

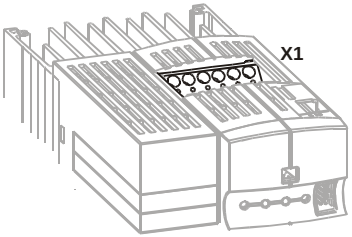


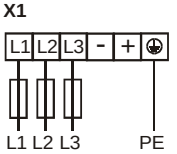
❶ The 230V mains power connection 1ph/N/PE and 2ph/PE is to be done on two terminals with mains current above 10A.

Danger: The reverse-protected plug-in terminal X1 must be connected and separated free of output. The mains terminals and the DC terminals can have dangerous voltages after the safe separation of the frequency inverter. The activity may only take place after a waiting period of some minutes until the DC link capacitors have discharged.

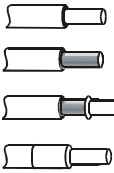
5.3.2 Frequency inverter (4.0 to 18.5 kW)

Mains power connection 4.0 kW to 18.5 kW





4.0 kW to 7.5 kW
WAGO Serie 745 / 6qmm / RM7,5



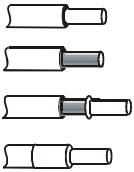
0.2 … 6 mm²
AWG 24 … 10

0.2 … 6 mm²
AWG 24 … 10

0.25 … 4 mm²
AWG 22 … 12

0.25 … 4 mm²
AWG 22 … 16

11 kW to 18.5 kW
WAGO Serie 745 / 16qmm / RM10+15



0.2 … 16 mm²
AWG 24 … 6

0.2 … 16 mm²
AWG 24 … 6

0.25 … 10 mm²
AWG 22 … 8

0.25 … 10 mm²
AWG 22 … 8

Danger: The plug-in terminal X1 must be connected and separated free of output. The mains terminals and the DC terminals can have dangerous voltages after the safe separation of the frequency inverter. The activity may only take place after a waiting period of some minutes until the DC link capacitors have discharged.

5.4 Motor power connection

The connection of motor and brake resistor to the frequency inverter is to be done with shielded cables, which are to be connected to the PE potential on both sides with good conductivity. The control, mains and motor lines must be laid separately. The threshold values of national and international directives are to be observed as a function of the application, the length of the motor cable and the switching frequency.

Motor cable lengths without output filter		
Frequency inverter	**unshielded cable**	**shielded cable**
0.55 kW to 3.0 kW	50 m	25 m
4.0 kW to 18.5 kW	100 m	50 m

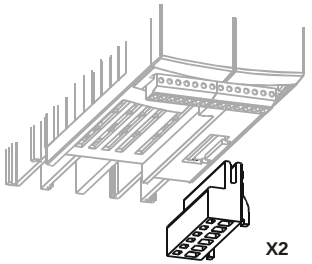
The motor cable lengths without output filter stated in the table may not be exceeded. The motor cable lengths can be extended upon request by corresponding technical measures such anti-capacitance cables and output filters.

Attention: The frequency inverters ≤ 7.5 kW with integrated EMC filter fulfill the emission thresholds according to the product norm EN 61800-3 with a motor cable length of up to 10 m. The specific requirements of the customer in question are to be fulfilled with an optional filter.

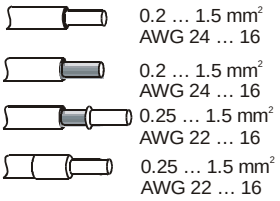
5.4.1 Frequency inverter (0.55 to 3.0 kW)

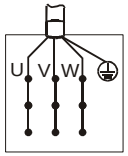
The connection of motor and brake resistor to the frequency inverter is done via plug-in terminal X2. Protection class IP20 (EN60529) is only guaranteed if terminal X2 is connected.

Motor power connection 0.55 kW to 3.0 kW

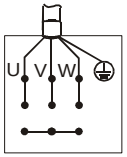


Phoenix ZEC 1,5/ .. ST7,5

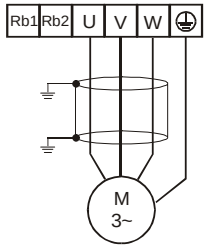




Delta connection



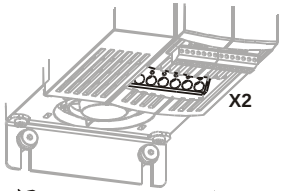
Star connection

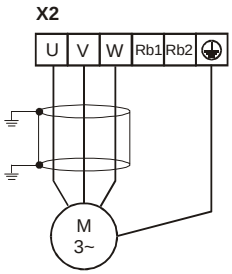


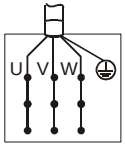
Danger: The reverse-protected plug-in terminal X2 must be connected and separated free of output. The motor terminals and the terminals of the brake resistor can have dangerous voltages after the disconnection of the frequency inverter. Work may only be done on the device after a waiting period of some minutes until the DC link capacitors have discharged.

5.4.2 Frequency inverter (4.0 to 18.5 kW)

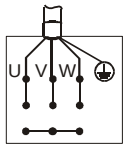
Motor power connection 4.0 kW to 18.5 kW





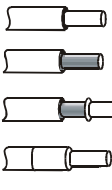


Delta connection



Star connection

4.0 kW to 7.5 kW
WAGO series 745 / 6qmm / RM7,5



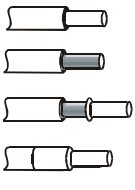
0.2 … 6 mm²
AWG 24 … 10

0.2 … 6 mm²
AWG 24 … 10

0.25 … 4 mm²
AWG 22 … 12

0.25 … 4 mm²
AWG 22 … 16

11 kW to 18.5 kW
WAGO series 745 / 16qmm / RM10+15



0.2 … 16 mm²
AWG 24 … 6

0.2 … 16 mm²
AWG 24 … 6

0.25 … 10 mm²
AWG 22 … 8

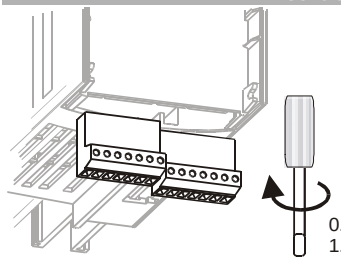
0.25 … 10 mm²
AWG 22 … 8

Danger: The plug-in terminal X2 must be connected and separated free of output. The motor terminals and the terminals of the brake resistor can have dangerous voltages after the disconnection of the frequency inverter. Work may only be done on the device after a waiting period of some minutes until the DC link capacitors have discharged.

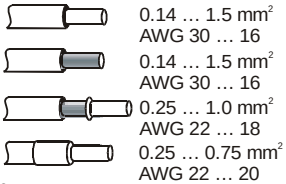
5.5 Control terminals

The control and software functionality can be freely configured for safely functioning and economical operation. The operating instructions describe the factory setting of the standard connections in the *Configuration* **30** in question and also the software parameters for the setting.

Control terminals



Wieland DST85 / RM3,5



0.14 … 1.5 mm²
AWG 30 … 16

0.14 … 1.5 mm²
AWG 30 … 16

0.25 … 1.0 mm²
AWG 22 … 18

0.25 … 0.75 mm²
AWG 22 … 20

0.2 … 0.3 Nm
1.8 … 2.7 lb-in

Caution: The reverse connection protected control inputs and outputs must be connected and separated free of power.

Control terminal X210A

Cl.	Description
1	Voltage output 24 V, I_{max} = 180 mA [1)]
2	Ground / GND 24 V
3	Digital input S1IND, U_{max} = 30 V, 10 mA at 24 V, PLC compatible, response time approx. 16ms (on), 10 µs (off)
4	Digital input S2IND, U_{max} = 30 V, 10 mA at 24 V, PLC compatible, response time approx. 16ms
5	Digital input S3IND, U_{max} = 30 V, 10 mA at 24 V, PLC compatible, response time approx. 16ms
6	Digital input S4IND, U_{max} = 30 V, 10 mA at 24 V, PLC compatible, frequency signal, 0 to 30 V, 10 mA at 24 V, f_{max} = 150 kHz
7	Digital input S5IND, U_{max} = 30 V, 10 mA at 24 V, PLC compatible, frequency signal, 0 to 30 V, 10 mA at 24 V, f_{max} = 150 kHz

Control terminal X210B

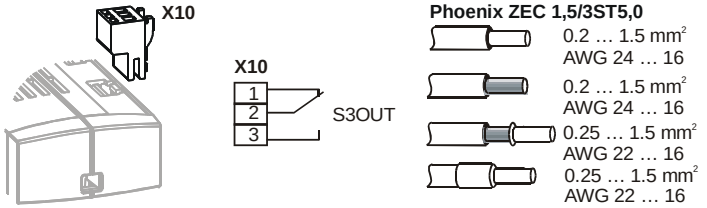
Cl.	Description
1	Digital input S6IND, , U_{max} = 30 V, 10 mA at 24 V, PLC compatible, response time approx. 16ms
2	Masse / GND 24 V
3	Digital output S1OUT, U = 24 V, I_{max} = 40 mA, overload and short circuit proof
4	Multifunctional output MFO1, Digital signal U = 24 V, I_{max} = 40 mA, overload and short circuit proof frequency signal, 0 to 24 V, I_{max} = 40 mA, f_{max} = 150 kHz
5	Reference output 10 V, I_{max} = 4 mA
6	Multifunctional input MFI1, Analog signal, resolution 12Bit, 0 to 10 V (R_i = 70 kΩ), 0 to 20 mA (Ri = 500 Ω), Digital signal, response time approx. 16 ms, U_{max} = 30 V, 0 to 4 mA at 24 V, PLC compatible
7	Masse / GND 10V

[1)] The voltage supply at terminal X210A.1 is to be loaded with a maximum current of I_{max} = 180 mA. Relative to the application, the maximum available current is reduced by the digital output S1OUT and multifunctional output MFO1.

5.5.1 Relay output

The freely programmable relay output has been connected with the monitoring function in the factory. The logical connection with various functions can be freely configured via the software parameters. The connection of the relay output is not absolutely necessary for the function of the frequency inverter.

Relay output



Control terminal X10

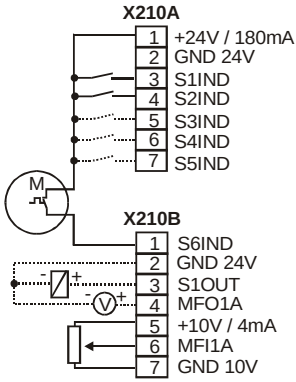
Cl.	Description
1 to 3	Relay output, floating changeover contact, response time approx. 40ms, maximum contact load 240V AC / 5A, 24V DC / 5A (ohmic)

5.5.2 Control terminals – connection plan

The control hardware and the software of the frequency inverters are practically freely configurable, i.e. certain functions can theoretically be assigned to the control connections and you are practically free in the selection of the software modules used and their internal programming. Thus, the modular concept allows adaptation of the frequency inverter to various drive tasks.
The demands made of the control hardware and software are known for established drive tasks. Thus, certain function allocations of the control connections as well as the internal programming of the software modules have been configured. These allocations can be selected via the parameter *Configuration* **30 (CONF)**.

5.5.2.1 Configuration 110 – Sensor-less control

Configuration 110 contains the functions for variable-speed controls of a 3-phase machine in a large number of standard applications. The motor speed is set according to the set ratio of reference frequency and the necessary voltage.

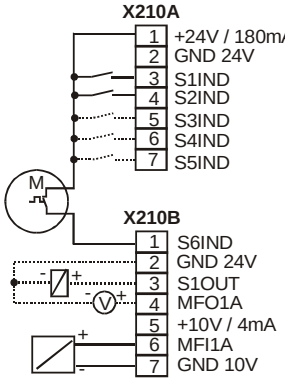


Control terminal X210A	
X210A.1	Supply voltage
X210A.2	-
X210A.3	Controller release / Error acknowledgment
X210A.4	Start clockwise
X210A.5	Start anticlockwise
X210A.6	Data set change-over 1
X210A.7	Data set change-over 2

Control terminal X210B	
X210B.1	Motor thermal contact
X210B.2	-
X210B.3	Operating message
X210B.4	Analog signal proportional to the actual frequency
X210B.5	Supply, ref. value potentiometer
X210B.6	Reference speed 0 to +10V
X210B.7	-

5.5.2.2 Configuration 111 – Sensor-less control with technology controller

Configuration 111 extends the sensor-less control by software functions that facilitate customer-specific adaptation in various applications. The technology controller, the volume flow control and the V-belt monitoring.

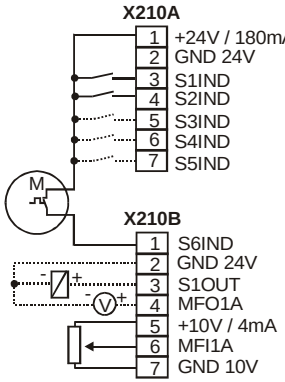


Control terminal X210A	
X210A.1	Supply voltage
X210A.2	-
X210A.3	Controller release / Error acknowledgment
X210A.4	Fixed percentage value change-over 1
X210A.5	Fixed percentage value change-over 2
X210A.6	Data set change-over 1
X210A.7	Data set change-over 2

Control terminal X210B	
X210B.1	Motor thermal contact
X210B.2	-
X210B.3	Operating message
X210B.4	Analog signal proportional to the actual frequency
X210B.5	Supply voltage
X210B.6	Actual percentage value 0 to +10V
X210B.7	-

5.5.2.3 Configuration 410 – Sensor-less field-oriented control

Configuration 410 contains the functions for sensor-less, field-oriented control of a 3-phase machine. The present motor speed is determined from the present currents and voltages in combination with the machine parameters. Separate control of torque and flux-forming current enables a high drive dynamism with a high moment of load.

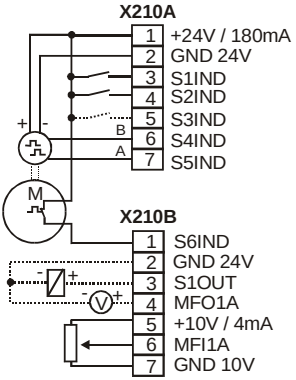


Control terminal X210A	
X210A.1	Supply voltage
X210A.2	-
X210A.3	Controller release / Error acknowledgment
X210A.4	Start clockwise
X210A.5	Start anticlockwise
X210A.6	Data set change-over 1
X210A.7	Data set change-over 2

Control terminal X210B	
X210B.1	Motor thermal contact
X210B.2	-
X210B.3	Operating message
X210B.4	Analog signal proportional to the actual frequency
X210B.5	Supply reference value potentiometer
X210B.6	Reference speed 0 to +10V
X210B.7	-

5.5.2.4 Configuration 210 – Field-oriented control, speed-controlled

Configuration 210 contains the functions for speed-controlled, field-oriented control of a 3-phase machine with speed sensor feedback. The separate control of torque and flux-forming current enables a high drive dynamism with a high moment of load. The necessary speed sensor feedback leads to a precise speed and torque behavior.

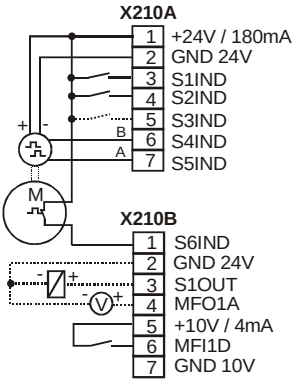


Control terminal X210A	
X210A.1	Supply voltage
X210A.2	-
X210A.3	Controller release / Error acknowledgment
X210A.4	Start clockwise
X210A.5	Start anticlockwise
X210A.6	Speed sensor track B
X210A.7	Speed sensor track A

Control terminal X210B	
X210B.1	Motor thermal contact
X210B.2	-
X210B.3	Operating report
X210B.4	Analog signal proportional to the actual frequency
X210B.5	Supply reference value potentiometer
X210B.6	Reference speed 0 to +10V
X210B.7	-

5.5.2.5 Configuration 230 – Field-oriented control, speed and torque controlled

Configuration 230 extends configuration 210 by functions for torque-dependent field-oriented control. The reference torque is represented as a percentage and transmitted to a corresponding operating behavior of the application. The switch-over between variable-speed control and torque-dependent control is done via a digital control input.



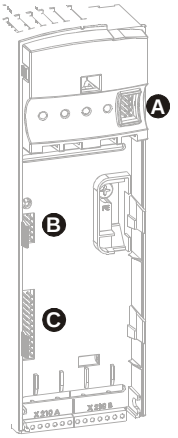
Control terminal X210A	
X210A.1	Supply voltage
X210A.2	-
X210A.3	Controller release / Error acknowledgment
X210A.4	Start clockwise
X210A.5	Change-over control function
X210A.6	Speed sensor track B
X210A.7	Speed sensor track A

Control terminal X210B	
X210B.1	Motor thermal contact
X210B.2	-
X210B.3	Operating report
X210B.4	Analog signal proportional to the actual frequency
X210B.5	Supply voltage
X210B.6	Fixed percentage 1 value change-over
X210B.7	-

5.6 Optional components

The frequency inverters are easy to integrate into the automation concept thanks to the modular hardware components. The modules available as a standard feature or customer-specifically are recognized upon initialization and the control functionality automatically adapted. The necessary information of installation and handling of the optional extensions can be found in the matching documentation.

Hardware modules



A Operating unit KP500

Connection of the optional operating unit KP500 or an interface adapter KP232.

B Communication module CM

Plug-in section for a connection to various communication protocols:

- CM-232, RS232 interface
- CM-485, RS485 interface
- CM-LON, LON interface
- CM-PDP, Profibus–DP interface
- CM-CAN, CANopen interface

C Extension module EM

Plug-in section for customer-specific adaptation of the control inputs and outputs to various applications:

- EM-ENC, extended speed sensor evaluation,
- EM-I/O, analog and digital inputs and outputs
- EM-SYS, system bus
  (System bus in combination with the CM-CAN communication module on request)

Danger: Assembly and dismantling the hardware modules at plug-in sections B and C may only be done if the frequency inverter has been safely switched off. Work may only be done after a waiting time of some minutes until the DC link capacitors are discharged.