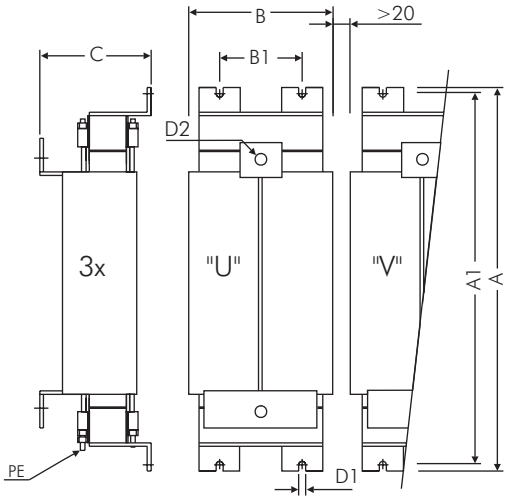
>pDRIVE<

Mounting instructions

- >pDRIVE< MX basic
- **>pDRIVE< MX plus**
- >pDRIVE< MX plus-hydro
- >pDRIVE< MX multi-basic
- >pDRIVE< MX multi-plus
- >pDRIVE< MX top
- >pDRIVE< MX top-hydro



Safety Instructions

The following symbols should assist you in handling the instructions:

General information, note exactly!

Dangerous voltages! Danger of life!

Advice, tip!

The requirements for successful commissioning are correct selection of the unit, proper projection and mounting. If you have any further questions, please contact the supplier or call the manufacturer of the unit directly.

Capacitor Discharge!

Before performing any work on or in the unit, disconnect from the mains and wait at least 5 minutes until the D.C. link capacitors have been fully discharged to make sure that the device is no longer live.

Automatic Restart!

With certain parameter settings it may happen that the frequency inverter starts up automatically when the mains supply returns after a power failure. Make sure that no persons and no other equipment is in danger.

Commissioning and Service!

Work on or in the unit must be done only by duly qualified staff and in full compliance with the appropriate instructions and pertinent regulations. Note that a fault may cause potential-free contacts and/or PCBs to carry mains potential. To avoid any risk to humans, obey the regulations concerning "Work on Live Equipment" explicitly.

Terms of delivery:

Our deliveries and services are based on the "General Terms of Delivery of the Austrian Electrical Industries" in the latest edition.

Specifications in this instruction:

We are constantly striving to improve our products and adapt them to the latest technical development. Therefore, we reserve the right to modify the specifications given in this instruction at any time, particular those referring to measures and dimensions. All planning recommendations and connection examples are non-binding suggestions for which we cannot accept any liability, particularly since the regulations to be complied with depend on the type and location of the plant and on the use of the instruments.

Regulations:

It is the user's responsibility to ensure that the instrument and its component parts are used in compliance with applicable regulations. It is not permitted to use these instruments in residential areas without special measures to suppress radio frequency interference.

Patents and trademarks:

Please note that we do not guarantee any connections, instruments or processes described herein to be free from patent or trademark rights of third parties.

Keep this instruction at hand near the unit!

Mounting the Frequency Inverter

>*pDRIVE*< *MX plus*

4 to 630 kW, 3 AC 400...500 V

Parameters and their settings refer to
software version PPL5.04 as well as PPL6.00 and higher

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This documentation covers issues on planning, mounting and connecting.
Refer to the operating instructions for details on operation and parametrisation.

In case of damage or incomplete delivery, please inform the supplier or the insurance company. The manufacturer declines responsibility for faults occurring during transport or unpacking.

CE-Marking

All units and plants with electric drive technology may cause electromagnetic interference, and may be influenced by such interference. Therefore, since 1.1.1996 they are subject to the **EMC directive 89/336/EEC**.

MX frequency inverters have an operating voltage which is clearly within the range from 50 ... 1000 V AC or 75 ... 1500 V DC. Therefore, since 1.1.1997 they are also subject to the **Low-voltage directive 73/23/EEC**.

Frequency inverters are not considered as machines with at least one mechanically moving part. Therefore, the **Machine directive 98/37/EEC** is **not** applicable.

The *>pDRIVE< MX* frequency inverters have a CE mark on the power plate.
To achieve the relevant limits, however, compliance with the installation regulations is necessary.

In combination with the available filter options CE, the *>pDRIVE< MX* frequency inverters comply with the EMC directive 89/336/EEC and the low-voltage directive 73/23/EEC, i.e. they are in conformity with:

EN 61800-3 and EN 50178

The distribution of this product is restricted in accordance with IEC 61800-3. In a residential environment, this product can cause radio frequency interference, in which case the user may be required to take suitable measures.

Installation regulations:

- Order for frequency inverter with the option "CE filter" (built-in during manufacturing for sizes 1 and 2, external for sizes 3 to 5), or use of an equivalent external filter solution
- Mounting on a properly grounded metal mounting plate with good HF connection between the screen of the motor cable and the filter
- Use and correct connection (at both ends!!) of screened motor cables, or motor cable laid in a closed and interconnected cable conduit of metal
- Use of an AMF (output motor filter) for greater motor cable lengths
- Use and correct connection of screened control cables
- Grounding of the frequency inverter with 10 mm^2 minimum for human protection
- Separation of motor cables from all other cables, especially control lines

Special Safety Instructions

Short power failures

During a power failure, the *>pDRIVE< MX* frequency inverter will continue working until the DC link voltage has fallen below the minimum working level (approx. 20% below the lowest mains supply voltage). The time depends on the mains voltage before the shut-down, and on the actual load. With control of the MX using retained contacts, the motor will start accelerating immediately after the mains supply returns. This behaviour can be blocked using the parameter E3.21 "Undervoltage Reaction". With control using the keypad or digital inputs with pushbuttons, the stored start command will be cancelled after 2 seconds.

Display of the actual speed

Due to the high-accuracy voltage measurement, the *>pDRIVE< MX* frequency inverter displays the actual speed even of a free-wheeling motor. If this information is used for protection devices, please note that the signal cannot be correct following a mains shut-down or disconnection of the motor.

Automatic restart function

- After auto-reset:
  The MX frequency inverter has a selectable automatic reset function. This function will automatically reset the drive after trip shutdowns have occurred. Check the plant concept for dangerous situations before activating this function.
- After mains undervoltages:
  If a retained start command is queued, an automatic restart is carried out each time the mains supply returns. With control using pushbuttons, the Run-State changes into a Ready-State after 2 seconds. To restart, a renewed start command is necessary. If the parameter E3.21 "Undervoltage Reaction" is set to 1 "fault during operation", the trip message "undervoltage 1" is triggered each time there is a mains failure ≥ 2 seconds. This trip condition has to be reset manually.

Locking the frequency inverter

Using the option card IO1, the frequency inverter has a digital input in closed-circuit connection. Independent of the parametrisation, this input provides a safe hardware lock of the drive.

Frequencies > 60 Hz

Check all components of the plant carefully, if the motor and the drive are to be operated above 60 Hz. Always consult the manufacturer of the motor and/or machine first. 4- to 8-pole motors are generally designed for operation up to 100 Hz.

Insulation measurements

All >pDRIVE< MX frequency inverters are tested for voltage sustaining capability and insulation resistance in accordance with EN 50178 (test voltage: 1.50 kV eff / 50 Hz @ 500 V). Insulation tests, e.g. within the scope of daily inspections, must be performed only between the main circuit and ground. For full and correct measurement, the CE filters must be disconnected or removed from the unit.

Never perform insulation measurements at the control terminals!!!

Parameter adjustments

If options requiring special parametrisation are used or the motor protection function is activated, all the necessary adjustments have to be made again after the replacement of a device, after a software update or after activating the factory defaults.

Technical Data

Size	A		B		1				2	
>pDRIVE< MX plus	04	05	07	11	15/18	18/22	22/30	30/37	37/45	45/55
Drives with high continuous load										
Motor rating										
$P_{N"P"}$ [kW]	–	–	–	–	18.5 kW	22 kW	30 kW	37 kW	45 kW	55 kW
Continuous output power										
$S_{N"P"}$ [kVA] U_N = 400 V	7.6 kVA	9.0 kVA	12.5 kVA	16.6 kVA	26 kVA	32 kVA	41 kVA	51 kVA	62 kVA	73 kVA
Continuous output current [A]										
$I_{N"P" 400}$ U_N = 400 V	11 A	13 A	18 A	24 A	38 A	46 A	59 A	73 A	90 A	106 A
$I_{N"P" 440}$ U_N = 440 V	11 A	13 A	18 A	24 A	35 A	42 A	54 A	67 A	82 A	96 A
$I_{N"P" 500}$ U_N = 500 V	11 A	13 A	18 A	24 A	31 A	37 A	47 A	59 A	72 A	85 A
Maximum torque										
T_{MAX} [%]	–		–		120...140 %				120...140 %	
Drives with high overload										
Motor rating										
$P_{N"C"}$ [kW]	4.0 kW	5.5 kW	7.5 kW	11 kW	15 kW	18.5 kW	22 kW	30 kW	37 kW	45 kW
Nominal output power										
$S_{N"C"}$ [kVA]	6.9 kVA	8.3 kVA	11.1 kVA	15.2 kVA	22 kVA	26 kVA	34 kVA	42 kVA	52 kVA	61 kVA
Nominal output current [A]										
$I_{N"C" 400}$ U_N = 400 V	10 A	12 A	16 A	22 A	32 A	38 A	49 A	61 A	75 A	88 A
$I_{N"C" 440}$ U_N = 440 V	10 A	12 A	16 A	22 A	29 A	35 A	45 A	56 A	68 A	80 A
$I_{N"C" 460}$ U_N = 460 V	10 A	12 A	16 A	22 A	27 A	34 A	40 A	52 A	65 A	77 A
$I_{N"C" 500}$ U_N = 500 V	10 A	12 A	16 A	22 A	26 A	31 A	39 A	49 A	60 A	71 A
Maximum torque										
T_{MAX} [%]	150...170 %		150...170 %		150...170 %				150...170 %	
Maximum current for 60 s in 10 min [A]										
$I_{MAX 400}$ U_N = 400 V	15 A	18 A	24 A	33 A	48 A	57 A	74 A	92 A	113 A	132 A
$I_{MAX 440}$ U_N = 440 V	15 A	18 A	24 A	33 A	44 A	53 A	68 A	84 A	102 A	120 A
$I_{MAX 460}$ U_N = 460 V	15 A	18 A	24 A	33 A	41 A	51 A	60 A	78 A	98 A	116 A
$I_{MAX 500}$ U_N = 500 V	15 A	18 A	24 A	33 A	39 A	47 A	59 A	74 A	90 A	107 A
Input current [A]										
$I_{IN"C"/IN""P" 400}$ U_N = 400 V	9 (12) A	12 (17) A	15 (24) A	22 (33) A	30 / 36 A	36 / 43 A	46 / 55 A	57 / 68 A	70 / 84 A	82 / 99 A
$I_{IN"C"/IN""P" 440}$ U_N = 440 V	9 (12) A	12 (17) A	15 (24) A	22 (33) A	27 / 33 A	33 / 39 A	42 / 50 A	64 / 77 A	64 / 77 A	75 / 90 A
$I_{IN"C"/IN""P" 460}$ U_N = 460 V	7 (10) A	9 (15) A	11 (18) A	17 (26) A	25 / – A	32 / – A	37 / – A	61 / – A	61 / – A	72 / – A
$I_{IN"C"/IN""P" 500}$ U_N = 500 V	8 (10) A	11 (15) A	13 (20) A	20 (31) A	24 / 29 A	29 / 35 A	37 / 44 A	56 / 68 A	56 / 68 A	67 / 80 A
Ambient conditions										
Working temperature [°C]	0...40°C		0...40°C		0...45°C	0...45°C	0...45°C	0...40°C	0...45°C	
Efficiency [%]	> 95 %		> 96 %		> 97 %				> 97.5 %	
Level of noise pressure	<60 dB(A)		<60 dB(A)		<60 dB(A)				<60 dB(A)	
Protection degree	IP20		IP20		IP20				IP20	

( ) ... without line choke at max. mains short circuit current of:
5 kA for *MX plus* 04 and *MX plus* 05
22 kA for *MX plus* 07 and *MX plus* 11

2		3			4				5		
55/75	75/90	90/110	110/132	132/160	160/200	200/250	250/315	315/380	315/400	400/500	500/630

Drives with high continuous load											
Motor rating											
75 kW	90 kW	110 kW	132 kW	160 kW	200 kW	250 kW	315 kW	380 kW	400 kW	500 kW	630 kW
Continuous output power											
97 kVA	118 kVA	143 kVA	173 kVA	208 kVA	270 kVA	336 kVA	395 kVA	470 kVA	513 kVA	637 kVA	752 kVA
Continuous output current [A]											
140 A	170 A	206 A	250 A	300 A	390 A	485 A	570 A	700 A	740 A	920 A	1085 A
127 A	155 A	187 A	227 A	288 A	362 A	440 A	517 A	636 A	708 A	864 A	1008 A
112 A	136 A	165 A	200 A	240 A	312 A	388 A	456 A	560 A	592 A	736 A	868 A
Maximum torque											
120...140 %		120...140 %			120...140 %				120...140 %		

Drives with high overload											
Motor rating											
55 kW	75 kW	90 kW	110 kW	132 kW	160 kW	200 kW	250 kW	315 kW	315 kW	400 kW	500 kW
Nominal output power											
81 kVA	98 kVA	119 kVA	144 kVA	173 kVA	225 kVA	280 kVA	329 kVA	395 kVA	427 kVA	531 kVA	626 kVA
Nominal output current [A]											
117 A	142 A	172 A	208 A	250 A	325 A	404 A	475 A	583 A	617 A	767 A	904 A
106 A	129 A	156 A	189 A	240 A	302 A	367 A	431 A	530 A	590 A	720 A	840 A
96 A	124 A	156 A	180 A	240 A	302 A	361 A	414 A	477 A	590 A	720 A	840 A
93 A	113 A	137 A	167 A	200 A	260 A	323 A	380 A	468 A	494 A	614 A	723 A
Maximum torque											
150...170 %		150...170 %			150...170 %				150...170 %		

Maximum current for 60 s in 10 min [A]											
176 A	213 A	258 A	312 A	375 A	488 A	606 A	713 A	875 A	926 A	1151 A	1356 A
159 A	194 A	234 A	284 A	360 A	453 A	551 A	647 A	795 A	885 A	1080 A	1260 A
144 A	186 A	234 A	270 A	360 A	453 A	542 A	621 A	716 A	885 A	1080 A	1260 A
140 A	170 A	206 A	251 A	300 A	390 A	485 A	570 A	702 A	741 A	921 A	1085 A

Input current [A]									Input current = 2 x ...		
109/131 A	133/159 A	161/193 A	194/234 A	234/281 A	304/365 A	378/453 A	444/533 A	545/655 A	289/346 A	359/430 A	423/507 A
99/119 A	121/145 A	146/175 A	177/212 A	224/269 A	282/338 A	343/411 A	403/483 A	496/595 A	276/331 A	337/404 A	393/471 A
90/– A	116/– A	146/– A	169/– A	225/– A	283/– A	338/– A	388/– A	447/– A	277/– A	338/– A	394/– A
87/105 A	106/128 A	129/155 A	157/188 A	188/226 A	244/293 A	304/365 A	357/429 A	440/526 A	232/278 A	289/346 A	340/408 A

Ambient conditions											
0...45°C	0...40°C	0...45°C	0...45°C	0...40°C	0...45°C	0...45°C	0...40°C	0...40°C	0...45°C	0...45°C	0...40°C
> 97.5 %		> 97.7 %			> 97.7 %				> 97.7 %		
<60 dB(A)		<63 dB(A)			<66 dB(A)			<67 dB(A)	<68 dB(A)		
IP20		IP00			IP00				IP00		

General Data

Input	
Voltage	400 V –15% to 500 V +10% for TT, TN or IT mains *)
Frequency	50 / 60 Hz ±5 % *)
Overvoltage class	Class III in accordance with EN 50178
De-coupling	Line choke for limitation of mains disturbances built-in (in size 1 and size 2)

Output	
Voltage	3 AC 0...100% mains voltage, dynamic voltage stabilisation
Frequency / freq. at max. vltg.	0...300 Hz / 25...300 Hz, adjustable
Short circuit protection	all-pole short circuit and earth fault detection through overcurrent switch-off

Design	built-in unit for vertical mounting
Cooling	forced
Frequency resolution, digital	0.01 Hz / 50 Hz, frequency stability: ±0.01% / 50 Hz

Ambient conditions	
Storage / transportation temp.	-25...+65°C / -25...+55°C
Humidity / environmental class	class 3K3 in accordance with DIN IEC 721-3-3 / non-condensing
Max. working temperature	increase in temperature by max. 10°C with 20% derating (size A and B: max. 10°C with 22% derating; for size A, there must be a space of at least 50 mm at the side in this case!)
Altitude	up to 1000 m, then with degrading by 1% per 100 m up to 2000 m
Allowed pollution	pollution degree 2
Protection class	class 1 in accordance with EN 50178

Standards	
Basic standard	The devices are designed, built and tested on the basis of EN 50178.
EMC immunity	in accordance with EN 61800-3 (IEC 1000-4-2; IEC 1000-4-3; IEC 1000-4-4)
EMC emission	in accordance with product standard EN 61800-3 with external CE filter option
Insulation	galvanic insulation in accordance with EN 50178 PELV (Protective Extra Low Voltage)

*) For technical data and information about mains voltages, see "Notes on Power Supply".

Options and Motor Cable Lengths

The values indicated in the tables are recommended limits. They correspond with the maximum distance between the inverter and the motor(s), based on typical motor cables, the use of cable conduits, and a maximum output frequency of 100 Hz.

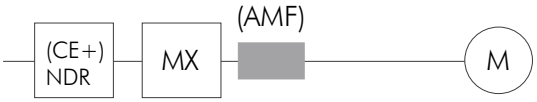
Multiplication Factors

In case of deviations from these typical values, the indicated values must be converted using the following multiplication factors.
If several multiplication factors are applicable, then they have to be multiplied.

- The switching frequency is not 2.5 kHz:

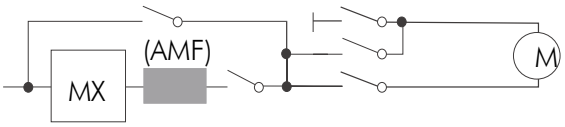
  at 5 kHz all values in the table multiplied by 0.6
  at 10 kHz all values in the table multiplied by 0.3

- One thicker cable is used instead of 2 parallel cables (e.g. sizes 3...5):



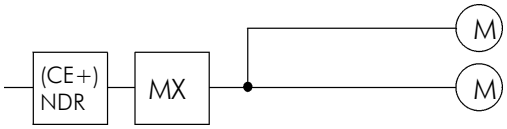
all values in the table multiplied by 1.5

- 6-pole motor cabling (e.g. for star/delta starting circuit):



all values in the table multiplied by 0.75

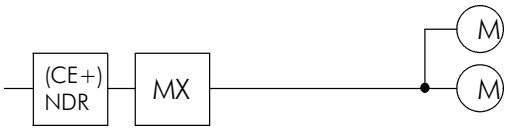
- Motors switched in parallel with the centre near the inverter must be converted in accordance with the number of motors:



If an adjusted AMF is used for each motor, the factors indicated in brackets apply.

for 2 motors all values in the table multiplied by 0.40 (0.80)
for 3 motors all values in the table multiplied by 0.25 (0.60)
for 4 motors all values in the table multiplied by 0.15 (0.40)
for 5 motors all values in the table multiplied by 0.10 (0.25)

- If the centre of the parallel motors is near the motors, the following factors apply:

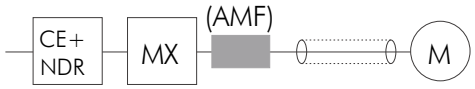
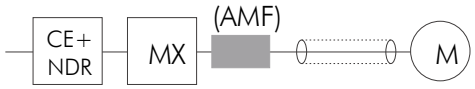
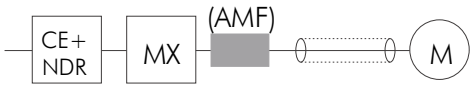
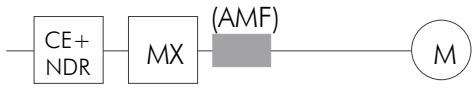


for 2 motors all values in the table multiplied by 0.80
for 3 motors all values in the table multiplied by 0.60
for 4 motors all values in the table multiplied by 0.40
for 5 motors all values in the table multiplied by 0.25

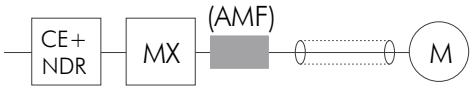
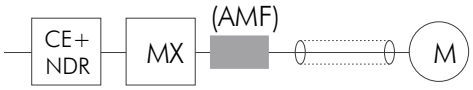
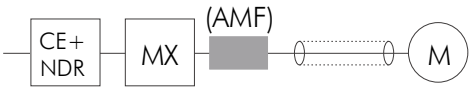
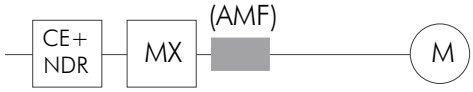
- For two motors switched in parallel, if two parallel cables are already considered in the table (e.g. size 4):

  all values in the table multiplied by 0.8

Options and Motor Cable Lengths for 400...440 V Mains Voltage

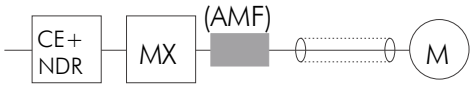
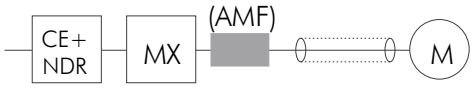
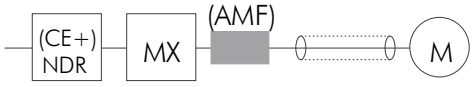
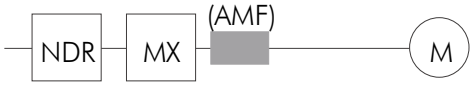
MX plus 04	MX plus 05	MX plus 07	MX plus 11	MX plus 15/18	MX plus 18/22	MX plus 22/30	MX plus 30/37	MX plus 37/45	MX plus 45/55	MX plus 55 /75
Options										
Choke FDR(-N) 1.)				Line choke						
13	13	24	24	built-in	built-in	built-in	built-in	built-in	built-in	built-in
RFI filter for grounded mains (TT, TN) CE 400/										
built-in	built-in	built-in	built-in	73	73	73	73	170	170	170
RFI filter for non-grounded mains (IT) RFI 500/										
30	30	30	30	55	55	55	130	130	130	130
Choke FDR(-A) 1.)				Output motor filter AMF 450/						
13	13	24	24	48	48	90	90	90	170-3	170-3
Typical motor cable										
3-pole + PE										
3x 2.5mm²	3x 4mm²	3x 6mm²	3x 10mm²	3x 10mm²	3x 10mm²	3x 16mm²	3x 25mm²	3x 35mm²	3x 50mm²	3x 70mm²
Maximum distance inverter – motor:										
1st environment							2nd environment			
										
1st environment (residential)										
without AMF										
20 m	20 m	20 m	20 m	—	—	—	—	—	—	—
with 1 AMF										
35 m	35 m	35 m	35 m	50 m	50 m	50 m	50 m	60 m	60 m	60 m
2nd environment (industrial)										
without AMF										
40 m	40 m	40 m	40 m	40 m	40 m	40 m	40 m	40 m	40 m	40 m
with 1 AMF										
80 m	80 m	80 m	80 m	100 m	100 m	100 m	100 m	100 m	120 m	120 m
Maximum distance without observing the standards										
screened							unscreened			
										
screened										
without AMF 2.)										
50 m	50 m	50 m	50 m	50 m	50 m	50 m	50 m	50 m	50 m	50 m
with 1 AMF										
100 m	100 m	100 m	100 m	120 m	120 m	150 m	150 m	120 m	180 m	180 m
with 1 AMF (one type higher)										
120 m	150 m	150 m	150 m	180 m	150 m	300 m	300 m	300 m	300 m	300 m
unscreened										
without AMF 2.)										
80 m	80 m	80 m	80 m	80 m	80 m	80 m	80 m	80 m	80 m	80 m
with 1 AMF										
150 m	150 m	150 m	150 m	200 m	200 m	250 m	250 m	200 m	300 m	300 m
with 1 AMF (one type higher)										
200 m	200 m	200 m	200 m	250 m	250 m	400 m	400 m	400 m	400 m	400 m

1. For the devices *MX plus 04...11* line chokes (FDR-N), motor chokes (FDR-A) and a combination of line choke and motor choke (FDR) are available. See also "Option: Chokes FDR".

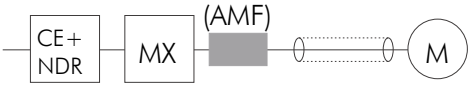
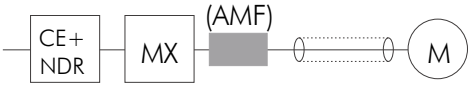
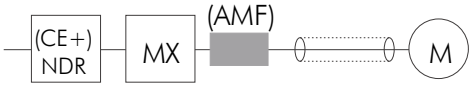
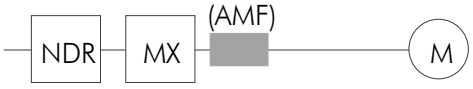
MX plus 75/90	MX plus 90/110	MX plus 110/132	MX plus 132/160	MX plus 160/200	MX plus 200/250	MX plus 250/315	MX plus 315/380	MX plus 315/400	MX plus 400/500	MX plus 500/630
Options										
Line ch.	Line choke NDU									
built-in	195	235	280	365	455	540	650	2 x 365	2 x 455	2 x 540
CE 400/	RFI filter for grounded mains (TT, TN)						CE-0 400/...-TN			
170	300	300	300	570	570	570	570	1100	1100	1100
RFI 700/	RFI filter for non-grounded mains (IT)						CE-0 500/...-IN			
180	300	300	300	570	570	570	570	1100	1100	1100
Output motor filter AMF 450/										
170-3	300-3	300-3	300-3	580-3	580-3	580-3	1100-3	1100-3	1100-3	1100-3
Typical motor cable										
3-pole + PE										
3x 95 mm^2	3x 120 mm^2	3x 185 mm^2	2x (3 x 120^2)	2x (3 x 120^2)	2x (3 x 150^2)	2x (3 x 185^2)	3x (3 x 185^2)	3x (3 x 185^2)	3x (3 x 240^2)	4x (3 x 240^2)
Maximum distance inverter – motor:										
1st environment							2nd environment			
										
1st environment (residential)										
without AMF										
—	—	—	—	—	—	—	—	—	—	—
with 1 AMF										
60 m	40 m	40 m	40 m	—	—	—	—	—	—	—
2nd environment (industrial)										
without AMF										
40 m	40 m	40 m	40 m	40 m	40 m	40 m	40 m	40 m	40 m	40 m
with 1 AMF										
120 m	150 m	150 m	100 m	120 m	120 m	120 m	100 m	100 m	100 m	100 m
Maximum distance without observing the standards										
screened							unscreened			
										
screened										
without AMF 2.)										
50 m	50 m	50 m	50 m	50 m	50 m	50 m	50 m	50 m	50 m	50 m
with 1 AMF										
180 m	200 m	180 m	180 m	250 m	250 m	200 m	300 m	250 m	250 m	200 m
with 1 AMF (one type higher)										
300 m	300 m	300 m	300 m	300 m	300 m	300 m	—	—	—	—
unscreened										
without AMF 2.)										
80 m	80 m	80 m	80 m	80 m	80 m	80 m	80 m	80 m	80 m	80 m
with 1 AMF										
250 m	300 m	300 m	250 m	300 m	300 m	250 m	350 m	300 m	300 m	250 m
with 1 AMF (one type higher)										
400 m	400 m	400 m	400 m	400 m	400 m	400 m	—	—	—	—

2. Greater distances may cause inadmissible voltage stress to the motor.

Options and Motor Cable Lengths for 460..500 V Mains Voltage

MX plus 04	MX plus 05	MX plus 07	MX plus 11	MX plus 15/18	MX plus 18/22	MX plus 22/30	MX plus 30/37	MX plus 37/45	MX plus 45/55	MX plus 55/75
Options										
Chokes FDR(-N) 1.)				Line choke						
13	13	24	24	built-in	built-in	built-in	built-in	built-in	built-in	built-in
RFI filter for grounded mains (TT, TN)										
built-in	built-in	built-in	built-in	—	—	—	—	—	—	—
RFI filter for non-grounded mains (IT) RFI 500/										
30	30	30	30	55	55	55	55	130	130	130
Chokes FDR(-A) 1.)				Output motor filter AMF 450/						
13	13	24	24	48	48	90	90	90	170-3	170-3
Typical motor cable										
3-pole + PE										
3x 2.5 mm²	3x 4 mm²	3x 6 mm²	3x 10 mm²	3x 10 mm²	3x 10 mm²	3x 16 mm²	3x 16 mm²	3x 25 mm²	3x 35 mm²	3x 50 mm²
Maximum distance inverter – motor:										
1st environment							2nd environment			
										
1st environment (residential)										
without AMF										
—	—	—	—	—	—	—	—	—	—	—
with 1 AMF										
—	—	—	—	—	—	—	—	—	—	—
2nd environment (industrial)										
without AMF										
25 m	25 m	25 m	25 m	25 m	25 m	25 m	25 m	25 m	25 m	25 m
with 1 AMF										
50 m	50 m	50 m	50 m	70 m	70 m	70 m	100 m	100 m	100 m	100 m
Maximum distance without observing the standards										
screened							unscreened			
										
screened										
without AMF 2.)										
30 m	30 m	30 m	30 m	30 m	30 m	30 m	30 m	30 m	30 m	30 m
with 1 AMF										
70 m	70 m	70 m	70 m	100 m	100 m	120 m	120 m	100 m	150 m	150 m
with 1 AMF (one type higher)										
100 m	120 m	120 m	120 m	150 m	150 m	250 m	250 m	250 m	250 m	250 m
unscreened										
without AMF 2.)										
60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m
with 1 AMF										
100 m	100 m	100 m	100 m	150 m	150 m	200 m	200 m	150 m	220 m	220 m
with 1 AMF (one type higher)										
150 m	150 m	150 m	150 m	200 m	200 m	300 m	300 m	300 m	300 m	300 m

1. For the devices *MX plus 04...11* line chokes (FDR-N), motor chokes (FDR-A) and a combination of line choke and motor choke (FDR) are available. See also "Option: Chokes FDR".

MX plus 75/90	MX plus 90/110	MX plus 110/132	MX plus 132/160	MX plus 160/200	MX plus 200/250	MX plus 250/315	MX plus 315 /380	MX plus 315/400	MX plus 400/500	MX plus 500/630
Options										
Line ch.	Line choke NDU									
built-in	195	235	280	365	455	540	650	2 x 365	2 x 455	2 x 540
	RFI filter for grounded mains (TT, TN)									
—	—	—	—	—	—	—	—	—	—	—
RFI 500/	RFI filter for non-grounded mains (IT) CE-0 500/...-IT									
130	300	300	300	570	570	570	570	1100	1100	1100
Output motor filter AMF 450/										
170-3	300-3	300-3	300-3	580-3	580-3	580-3	1100-3	1100-3	1100-3	1100-3
Typical motor cable										
3-pole + PE										
3x 70 mm^2	3x 70 mm^2	3x 120 mm^2	3x 185 mm^2	2x (3 x 120^2)	2x (3 x 120^2)	2x (3 x 150^2)	2x (3 x 185^2)	2x (3 x 185^2)	3x (3 x 185^2)	3x (3 x 240^2)
Maximum distance inverter – motor:										
1st environment							2nd environment			
										
1st environment (residential)										
without AMF										
—	—	—	—	—	—	—	—	—	—	—
with 1 AMF										
—	—	—	—	—	—	—	—	—	—	—
2nd environment (industrial)										
without AMF										
25 m	25 m	25 m	25 m	25 m	25 m	25 m	25 m	25 m	25 m	25 m
with 1 AMF										
100 m	120 m	120 m	120 m	100 m	100 m	100 m	100 m	120 m	100 m	100 m
Maximum distance without observing the standards										
screened							unscreened			
										
screened										
without AMF 2.)										
30 m	30 m	30 m	30 m	30 m	30 m	30 m	30 m	30 m	30 m	30 m
with 1 AMF										
150 m	180 m	180 m	180 m	200 m	200 m	180 m	200 m	250 m	200 m	170 m
with 1 AMF (one type higher)										
250 m	250 m	250 m	250 m	250 m	250 m	250 m	—	—	—	—
unscreened										
without AMF 2.)										
60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m
with 1 AMF										
200 m	250 m	220 m	200 m	280 m	250 m	220 m	250 m	280 m	250 m	220 m
with 1 AMF (one type higher)										
300 m	300 m	300 m	300 m	300 m	300 m	300 m	—	—	—	—

2. Greater distances may cause inadmissible voltage stress to the motor.

Notes on Power Supply

Grounded / Non-grounded Mains

Use of the *>pDRIVE< MX* frequency inverter is basically possible in all mains configurations. In the case of non-grounded mains (typical for 3 AC 500 V industrial mains), however, only special CE filters must be used (see "Option: RFI filter for IT-mains") . Furthermore, an overload protection for the inverter is recommended in case of earth faults on the motor cable or in the motor (see "Use of the MX in non-grounded Mains").

Fuses

The *>pDRIVE< MX* frequency inverters do not contain any input fuses. These must be provided externally (see table "Mains Fuses – Cable Diameters") to protect the power cables from overload, and to protect the input rectifier in the event of an internal short circuit.

Start / Stop Commands

The *>pDRIVE< MX* can be switched on/off directly with the mains contactor. If frequent start/stop commands are required, however, these should be effected via the digital inputs (or via a serial bus) directly at the electronics of the inverter. The MX is designed for a maximum of 60 starts/stops per hour.

With the MX plus, sizes A and B, the restart must be delayed for 20 seconds after every mains shut-down! Otherwise, the motor restart is delayed.

Mains Voltage

These devices are designed for the following mains voltages:

3 AC 400 V ± 15 %, 50/60 Hz ± 5 %
3 AC 440 V ± 15 %, 50/60 Hz ± 5 %
3 AC 460 V ± 15 %, 50/60 Hz ± 5 %
3 AC 500 V + 10 %, - 15 %, 50 Hz ± 5 %

The existing mains voltage must be set at the inverter using parameter B3.05 (a wrong setting can cause a trip report or, in the event of a strong mains decrease, even damage to the input rectifier).

Mains Impedance

Virtually all frequency inverters produce current harmonics on the mains side. The resulting voltage distortions can influence other consumers on the line.
With regard to the allowed mains harmonics, the *>pDRIVE< MX* frequency inverters are designed in accordance with IEC 1000-3-4. Therefore, they must always be used with a mains impedance of approx. 4% u_K (with reference to the inverter power). In most of the applications, this is not guaranteed ($u_K << 4\%$). Therefore, a line choke must be used as specified below:

approx. 100 µH for *>pDRIVE< MX* size 3

approx. 40 µH for *>pDRIVE< MX* size 4

2 x approx. 40 µH for *>pDRIVE< MX* size 5 (12-pulse operation)

Too high impedance will cause a loss in voltage, which cannot be regulated by the inverter.
For size 5 (315 to 630 kW) with normal 6-pulse rectification (3-pole supply), 2 identical line chokes are always necessary to ensure the current distribution to the parallel input rectifiers.
In sizes 1 and 2 (15 to 90 kW), the line chokes are built-in by default.
In sizes A and B, the line choke is available as an option and must be used, if the short-circuit power is higher than 5 kA for size A and higher than 22 kA for size B.

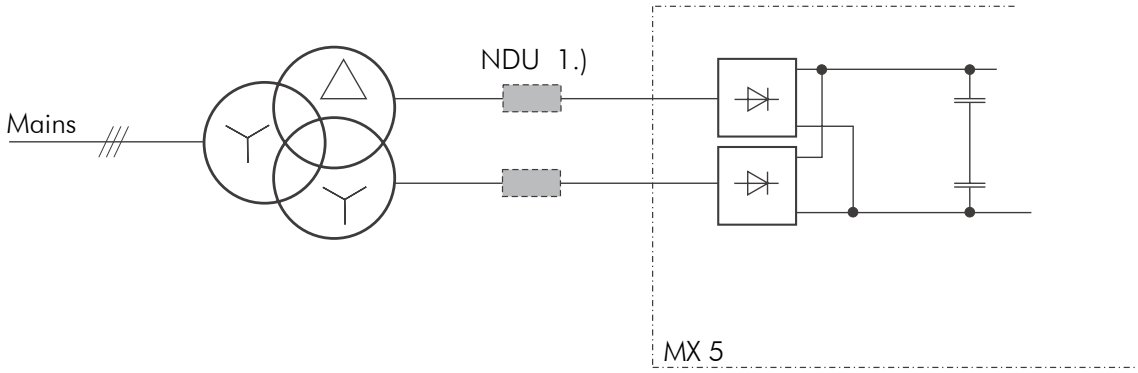
Power factor correction

Frequency inverters cause current harmonics in the supplying mains. They additionally charge the capacitors of the power factor correction. To protect against overload, we recommend the installation of chokes for this drive parts.

12-pulse Supply

The *>pDRIVE< MX* frequency inverter size 5 (315 to 630 kW) is also suitable for 12-pulse rectification. Thereby, the supply is provided using a special transformer with 2 out-of-phase secondary coils (e.g. Yy6 d5).

1.) Chokes are only necessary if <u>one</u> transformer is used for several inverters, or if the transformer power is clearly higher than the inverter power (see "Mains Impedance").



Advantage of 12-pulse supply:
On the primary side of the transformer, the 5th and 7th current harmonics are virtually non-existent, since they are cancelled by the out-of-phase coils.

To guarantee even current distribution, the transformer must comply with the following tolerances:
Tolerance for transmission rates ±0.3% of u_{NOM}
Tolerance for relative short-circuit voltage ±5.0% of $u_{K\,NOM}$

Protective Measures / Earth Leakage Circuit Breakers (FI)

Frequency inverters, especially with CE filters (RFI filters) and screened motor cables, lead an increased leakage current against earth. The leakage current depends on:

- the length of the motor cable
- the way the cable is laid, and whether it is screened or not
- the set carrier frequency
- the use of RFI filters (used or not used)
- the grounding of the motor on the site (grounded or non-grounded)

At the moment of switching on and during operation, this can cause unintended triggering of the earth leakage circuit breaker by the capacitors, especially of the filters, due to earth capacitance. On the other hand, there is the possibility to block the switch-off function through amounts of DC current with mains rectification at the inverter input. Thereby, the following should be observed:

- Only short-time-invariant and pulse current-sensitive earth leakage breakers with higher triggering current should be used.
- Other consumers should be protected with separate earth leakage circuit breakers.
- Earth leakage breakers before an inverter do not provide absolute protection in case of direct contact!! Therefore, they should always be used in combination with other protective measures.
- The *>pDRIVE< MX* frequency inverters do not have a current limiting function (in case of fault currents), therefore they do not violate the grounding.

Applications with middle cable lengths can have earth leakage currents of 500 mA and higher, depending on the ambient conditions!!

The built-in earth leakage detection does not have a current limiting function. It is a drive protection and <u>not a human protection</u>.

Mains Fuses – Cable Diameters

Mains Fuses – Cable Diameters for 400...440 V Mains Voltage

1.) 2.) 1.) 3.) 5.) 7.) 1.) 1.) 1.) 3.) 4.)

Mains supply					Frequency inverter			Motor output
Pre- or conduit fuses	Cu cable mm^2	Voltage loss	Mains fuse "inverter protection" "sf"	Lines in the cubicle mm^2 (per phase)	>*pDRIVE*< *MX*	Max. contin. current	Connection	Motor cable and voltage loss mm^2/100 m
40 A	3x6	5.5 V	16 A	2.5	MX plus 04	11 A	Terminals max. $4mm^2$	3x2.5 / 13.1V
40 A	3x6	6.5 V	20 A	2.5	MX plus 05	13 A		3x4.0 / 9.7V
50 A	3x10	5.4 V	25 A	4.0	MX plus 07	18 A	Terminals max. $10mm^2$	3x6.0 / 8.9V
50 A	3x10	7.2 V	32 A	6.0	MX plus 11	24 A		3x10 / 7.2V
63 A	3x16	7.3 V	50 A A	10	MX plus 15/18	39 A	Bolt M6	3x10 / 11.6V
63 A	3x16	9.7 V	63 A A	10	MX plus 18/22	46 A		3x10 / 13.7V
80 A	3x25	7.4 V	63 A B	10	MX plus 22/30	59 A		3x16 / 11.0V
100 A	3x35	6.6 V	80 A B	16	MX plus 30/37	73 A		3x25 / 8.7V
125 A	3x50	5.7 V	125 A C	25	MX plus 37/45	90 A	Bolt M8	3x35 / 7.7V
160 A	3x70	5.0 V	125 A C	35	MX plus 45/55	106 A		3x50 / 6.3V
200 A	3x95	4.5 V	160 A D	50	MX plus 55/75	140 A		3x70 / 6.0V
250 A	3x120	4.5 V	200 A D	70	MX plus 75/90	170 A		3x95 / 5.3V
250 A	3x120	5.1 V	250 A E	95	MX plus 90/110	206 A	25x4 / Ø11	3x120 / 5.2V
315 A	3x185	4.0 V	315 A E	120	MX plus 110/132	250 A		3x185 / 4.1V
400 A	2x(3x120)	3.7 V	400 A E	2x95	MX plus 132/160	300 A		2x(3x120) / 4.9V
500 A	2x(3x150)	3.9 V	500 A F	2x150	MX plus 160/200	390 A	80x5 / 2xØ13	2x(3x120) / 4.9V
630 A	2x(3x185)	3.9 V	630 A F	2x185	MX plus 200/250	485 A		2x(3x150) / 4.8V
800 A	3x(3x185)	3.1 V	(710) 800 A F	2x185	MX plus 250/315	570 A		2x(3x185) / 4.6V
1000 A	4x(3x185)	3.1 V	1000 A F	3x150	MX plus 315/380	700 A		3x(3x185) / 4.0V
1000 A	4x(3x185)	3.1 V	2x500 A 6.) F	2x2x150	MX plus 315/400	740 A	115x8 / 3xØ13 2xØ17	3x(3x185) / 4.0V
1250 A	4x(3x240)	3.0 V	2x630 A 6.) F	2x2x185	MX plus 400/500	920 A		3x(3x240) / 3.8V
1600 A	6x(3x240)	2.8 V	2x800 A 6.) F	2x2x185	MX plus 500/630	1085 A		4x(3x240) / 3.0V

Key to tables:

1. The cable diameters indicated in the table apply to 0...100 Hz (up to 300 Hz the cable losses increase about 25% because of the Skin-effect) and are an index for laying the cable in air at max. 40°C, based on the ÖVN EN 1 and VDE 0100 regulations.

   For other ambient conditions and different regulations, the cable diameters must be adjusted accordingly.

2. Pre-fuses calculated for DOL starting with bypass circuit.

3. Voltage loss at max. continuous current per 100 m of cable length (delta voltage). In the case of motor cables, the voltage loss should be ≤ 10 V for single drives and ≤ 5 V for groups of drives.

4. The motor cables are designed for the maximum continuous current at an ambient temperature of 40°C and laid in air. When a bypass circuit is used, the motor cable must be designed for the value of the pre- or conduit fuses!
   The use of NYCY or NYCWY cables for the motor cable (power cables with concentric protection core) is a low-price alternative to screened cables.

Mains Fuses – Cable Diameters for 460...500 V Mains Voltage

1.) 2.) 1.) 3.) 5.) 7.) 1.) 1.) 3.) 4.)

Mains supply						Frequency inverter			Motor output
Pre- or conduit fuses	Cu cable mm^2	Voltage loss	Mains fuse "inverter protection" "sf"		Lines in the cubicle mm^2 (per phase)	>*pDRIVE*< *MX*	Max. cont. current	Connection	Motor cable and voltage loss mm^2/100 m
32 A	3x4	8.2 V	16 A		2.5	MX plus 04	11 A	Terminals max. $4mm^2$	3x2.5 / 13.1V
32 A	3x4	9.7 V	20 A		2.5	MX plus 05	13 A		3x4,0 / 9,7V
40 A	3x6	8.9 V	25 A		4.0	MX plus 07	18 A	Terminals max. $10mm^2$	3x6.0 / 8.9V
40 A	3x6	11.9 V	32 A		6.0	MX plus 11	24 A		3x10 / 7.2V
50 A	3x10	9.3 V	35 A	A	6.0	MX plus 15/18	31 A	Bolt M6	3x10 / 9,2V
50 A	3x10	11.0 V	50 A	A	10	MX plus 18/22	37 A		3x10 / 11.0V
63 A	3x16	8.8 V	63 A	B	10	MX plus 22/30	47 A		3x16 / 8.8V
80 A	3x25	7.0 V	63 A	B	10	MX plus 30/37	59 A		3x16 / 11.0V
100 A	3x35	6.1 V	80 A	C	16	MX plus 37/45	72 A	Bolt M8	3x25 / 8.6V
125 A	3x50	5.1 V	100 A	C	25	MX plus 45/55	85 A		3x35 / 7.3V
160 A	3x70	4.8 V	125 A	D	35	MX plus 55/75	112 A		3x50 / 6.7V
160 A	3x70	5.8 V	160 A	D	50	MX plus 75/90	136 A		3x70 / 5.8V
200 A	3x95	5.2 V	200 A	E	70	MX plus 90/110	165 A	25x4 / Ø11	3x70 / 7.0V
250 A	3x120	5.0 V	250 A	E	95	MX plus 110/132	200 A		3x120 / 5.0V
315 A	3x185	3.9 V	315 A	E	120	MX plus 132/160	240 A		3x185 / 3.9V
400 A	2x(3x120)	3.9 V	400 A	F	185	MX plus 160/200	312 A	80x5 / 2xØ13	2x(3x120) / 3.9V
500 A	2x(3x150)	3.9 V	500 A	F	2x150	MX plus 200/250	388 A		2x(3x120) / 4.8V
630 A	2x(3x185)	3.7 V	630 A	F	2x185	MX plus 250/315	456 A		2x(3x150) / 4.5V
800 A	3x(3x185)	3.2 V	800 A	F	2x185	MX plus 315/380	560 A		2x(3x185) / 4.5V
800 A	3x(3x185)	3.2 V	2x400 A	6.) F	2x185	MX plus 315/400	592 A	115x8 / 3xØ13 2xØ17	2x(3x185) / 4.8V
1000 A	3x(3x240)	3.1 V	2x500 A	6.) F	2x2x150	MX plus 400/500	736 A		3x(3x185) / 4.0V
1250 A	4x(3x240)	2.7 V	2x630 A	6.) F	2x2x185	MX plus 500/630	868 A		3x(3x240) / 3.6V

5. In case of a trip, sf fuses protect the inverter from secondary damage to the rectifier, the charging circuit, etc.
   The mains fuses represent a secondary protection of the inverter in the case of failure of the electronic protection. However, if these fuses are blown, a primary defect has already occurred inside the unit. Therefore, changing the blown fuses and switching the inverter on again is not effective. Furthermore, it is not advantageous to use circuit breakers. This has the disadvantage of a slower switch-off.
6. 2 x 3-pole fuses for parallel supply.
7. To protect the rectifier in the event of a short circuit, and especially to protect size 5 inverters from unequal overload, the mains fuses must not exceed the following I^2t switch-off levels (with reference to 10 ms):

A	B	C	D	E	F
$1.2x10^3$ A^2s	$5.0x10^3$ A^2s	$14x10^3$ A^2s	$75x10^3$ A^2s	$245x10^3$ A^2s	$1000x10^3$ A^2s

DC Supply – Connection of Braking Unit – Mains feedback

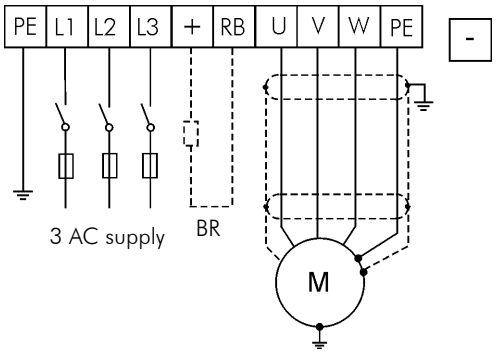
CAUTION – Risk of electric shock
- Ground equipment.
- Before servicing:
  Remove all power, wait 5 minutes. Verify no voltage is present.
- After servicing, close cover.

Failure to comply will result in injury or death!

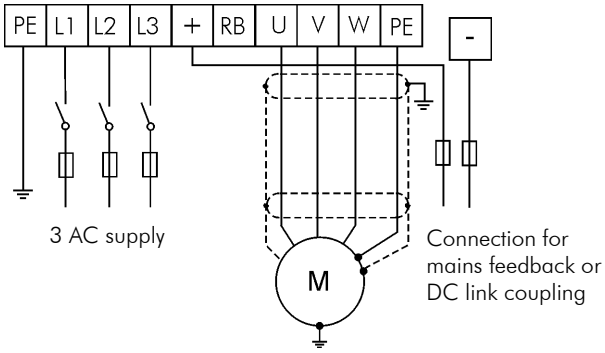
MX size A and B

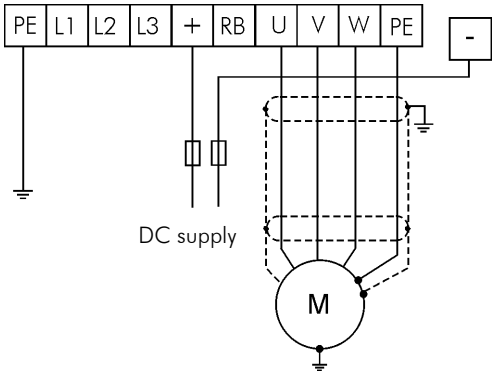
The units are fitted by default with all the necessary terminals to:
- be supplied with 3 AC mains voltage in the usual way (possibly with the use of an external braking resistor).
- provide an additional DC link coupling (see "DC Link Coupling of Several MX Inverters with 1 Mains Contactor").
- work with one DC rail (see "MX Main Drive with Slaves on the DC Link Circuit").

Max. connection diameter: size A 4 mm², size B 10 mm²



BR: braking resistor (option)

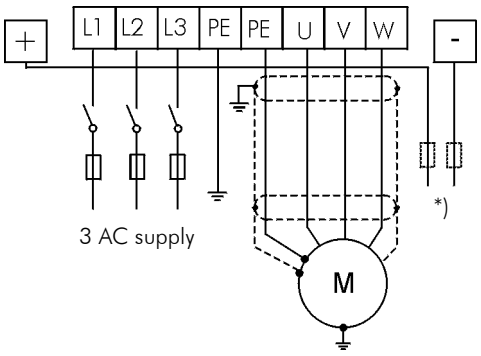




With the MX plus, sizes A and B, the restart must be delayed for 20 seconds after every mains shut-down! Otherwise, the motor restart is delayed.

MX Size 1 or 2 with Option "BU Control"

With the option "BU Control 1 and 2", all components are included in the unit, so that a DC link coupling can be created in parallel to the 3 AC mains supply.

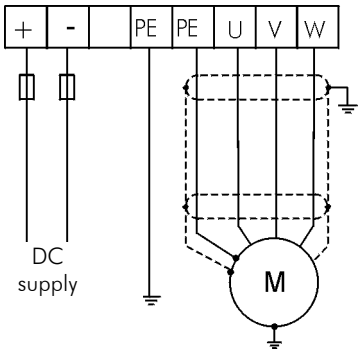


BU connection diameter
Size 1: terminal block, max. 16 mm²
Size 2: connection bolt M6, max. 70 mm²
(tightening torque 5 Nm)

*) Connection for braking unit, mains feedback or DC link coupling

MX Size 1 or 2 in DC design

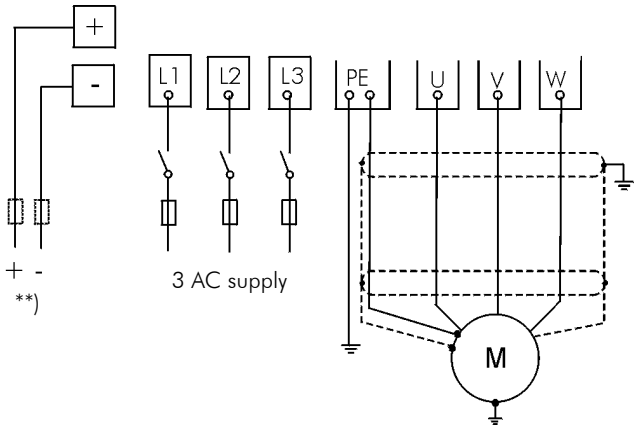
The *>pDRIVE< MX* frequency inverters of size 1 or 2 are alternatively available with the design "DC Supply" (option "DC Supply size 1 or 2"). Thereby, the line choke, CE filter and mains rectifier are not included.



DC connection diameter
Size 1: connection bolt M6, max. 70 mm²
Size 2: connection bolt M8, max. 120 mm²

MX BG 3...5

In sizes 3, 4 and 5, the option "DC Connection" is necessary for DC supply, DC link coupling, mains feedback or the connection of a braking unit.



DC connection diameter
Size 3...5: connection bolt M10
(see option "DC Connection")
(tightening torque: 40 Nm)

**) Connection for braking unit, mains feedback, DC link coupling and DC supply (option for size 3 to 5 – see "Option: DC Connection")

DC mains supply	400 V	440 V	460 V	500 V
Nominal voltage	560 V DC	620 V DC	680 V DC	710 V DC
Voltage range	405...650 V DC	450...685 V DC	490...745 V DC	490...770 V DC
Overvoltage switch-off	1.60 x U_{N-DC}	1.45 x U_{N-DC}	1.32 x U_{N-DC}	1.27 x U_{N-DC}
Nominal current DC (approx.)	1.15 x I_{Motor}	1.15 x I_{Motor}	1.15 x I_{Motor}	1.15 x I_{Motor}
Type of fuse, nominal voltage	690 V sf	690 V sf	690 V sf	800 V sf

Type of drive >*pDRIVE*< *MX*	400...440 V		460...500 V	
	Si size "sf" 1.)	Lines in the cubicle 2.)	Si size "sf" 1.)	Lines in the cubicle 2.)
MX plus 04	20 A	4 mm^2	20 A	4 mm^2
MX plus 05	25 A	4 mm^2	25 A	4 mm^2
MX plus 07	32 A	6 mm^2	32 A	6 mm^2
MX plus 11	40 A	6 mm^2	40 A	6 mm^2
MX plus 15/18	63 A	10 mm^2	63 A	10 mm^2
MX plus 18/22	63 A	10 mm^2	63 A	10 mm^2
MX plus 22/30	80 A	16 mm^2	80 A	16 mm^2
MX plus 30/37 (BU connection)	100 (80) A	25 (16) mm^2	80 A	16 mm^2
MX plus 37/45	125 A	35 mm^2	100 A	25 mm^2
MX plus 45/55	160 A	50 mm^2	125 A	35 mm^2
MX plus 55/75	200 A	70 mm^2	160 A	50 mm^2
MX plus 75/90 (BU connection)	250 (200) A	95 (70) mm^2	200 A	70 mm^2
MX plus 90/110	315 A	120 mm^2	250 A	95 mm^2
MX plus 110/132	400 A	185 mm^2	315 A	120 mm^2
MX plus 132/160	500 A	2 x 150 mm^2	400 A	185 mm^2
MX plus 160/200	630 A	2 x 185 mm^2	500 A	2 x 150 mm^2
MX plus 200/250	800 A	2 x 185 mm^2	630 A	2 x 185 mm^2
MX plus 250/315	800 A	2 x 185 mm^2	800 A	2 x 185 mm^2
MX plus 315/380	1000 A		1000 A	
MX plus 315/400	1000 A 3.)		1000 A 3.)	
MX plus 400/500	1250 A 3.)		1250 A 3.)	
MX plus 500/630	1600 A 3.)		1600 A 3.)	

1.) Only super fast (sf) fuses are suitable for DC applications!
Due to their construction, they are able to switch off both DC and AC voltages.

2.) The indicated values are an index, based on the ÖVN EN 1 and VDE 0100 regulations.

3.) The fuses are not necessary in combination with LX.

Parameter Settings for the Use of a Braking Unit

- Set parameter C1.03 to "1 ... ext. Braking unit" (when using an external braking unit)
- Set parameter C1.03 to "5 ... FI control 1 BU" (when using a braking unit *BU plus* or the built-in braking unit with size A and B)
- Set parameter C1.03 to "6 ... FI control 2 BU" (when using two braking units *BU plus*)

For more parametrisation, see the operating instructions for the braking units.

Notes on the Inverter Output

Option: AMF (Output Motor Filter)

The *>pDRIVE< MX* frequency inverters use IGBT power modules which make it possible to build compact units with a low current ripple. Thereby, they are operated at a high switching frequency of 2.5 kHz (default setting!) to 10 kHz.

However, the high-frequency earth leakage currents caused by the motor cable and its capacitance against earth are disadvantageous.
Furthermore, the high slew rate (du/dt) causes couplings to parallel lines and voltage peaks on the motor terminals.

The specific effects depend on various factors:

- A low switching frequency reduces the leakage current and thus the losses in the inverter, CE filter and AMF.
- A screened motor cable reduces the couplings to parallel lines and the disturbances, but increases the leakage current and the losses in the filter.
- A low switching frequency reduces the leakage current and thus the losses in the inverter, CE filter and AMF.
- The mode of laying the motor cable, e.g. under water, increases the leakage current and the losses in the inverter, CE filter and AMF, similar to a very long motor cable.

The use of an output motor filter (AMF) makes it possible to use greater motor cable lengths, and also protects the motor from too high voltage demand by observing the following limits:

Slew rate (du/dt) ≤ 500 V/μs (≤ 750 V/μs at 3 AC 500 V)
Peak voltage (U_{peak}) ≤ 1000 V (≤ 1300 V at 3 AC 500 V)

The tables "Options and Motor Cable Lengths" for 400...440 V and 460...500 V mains voltage in this instruction show a great number of admissible and recommended motor cable lengths. These values result from four different effects:

1.) Inverter Load

Long motor cables carry an increased earth leakage current, which the inverter has to carry in addition to the working current. For devices with lower power (< 15 kW), this can lead to a distinctive reduction in performance, or even damage to the inverter.

In devices with lower power, observance of the indicated motor cable lengths is absolutely necessary to protect the inverter!

2.) AMF Loss

The AMFs limit the slew rate of the inverter output pulses. The resulting losses load the choke.

In devices with lower power, observance of the indicated motor cable lengths is absolutely necessary to protect the AMFs!

3.) EMC Interference

Both the mains rectifier and the IGBT inverter cause high-frequency interference that drains off into the earth potential more strongly with increasing motor cable length. As a result, the line-conducted interference on the mains side increases. The attenuation of the line filters is no longer sufficient, and the admissible interference limit is exceeded.

Observance of the indicated motor cable lengths is necessary for compliance with the EMC limits!

4.) Overvoltages at the Motor

Overvoltages at the motor terminals are caused by reflection in the motor cable. For motor cable lengths between 50 and 300 m, the used motors must have an increased motor sustaining capability (thereby, the motor load is almost independent of the used inverter!).

line voltage 400 V	motor insulation for 1300 V phase-to-phase peak voltage
line voltage 440...500 V	motor insulation for 1600 V phase-to-phase peak voltage and du/dt > 8 kV/µs

In order to work in this voltage range with standard motors, the use of a "du/dt filter" is necessary. The option AMF (Output Motor Filter) acts with the cable capacity and limits both the voltage peaks at the motor and the slew rate of the output pulses.

By observing the indicated motor cable lengths, the motor life time can be extended significantly:

line voltage 400 V	max. 1000 V phase-to-phase peak voltage and du/dt < 500 V/µs
line voltage 440...500 V	max. 1300 V phase-to-phase peak voltage and du/dt < 750 V/µs

Observance of the indicated motor cable lengths is absolutely necessary to protect the motor!

Compensation Capacitors

Never connect compensation capacitors, line filters or overvoltage protection devices to the inverter outputs!!!

Switching at the Inverter's Output

Standard switching between the inverter and the motor is not admissible. This would cause an increased demand on the rectifiers and lead to a trip shutdown of the inverter!!!
The life-span of the inverter would be reduced!!!

Exceptions:

- A leading auxiliary contact locks the MX via the digital input "pulse inhibit" (e.g. DI5 of the optional PCB IO1 in slot X2), and does not unlock the unit until the contact has been closed.
- A revision switch that is only activated in very rare cases. In this case, the inverter should also be locked first, if possible.

Changing the Direction of Rotation

The use of reversing contactor circuits to change the direction of rotation is not allowed (see "Switching at the Inverter's Output"). A digital input on the control terminal strip is provided for this purpose.

Power increase at reduced ambient temperature or rather power decrease at 5 or 10 kHz switching frequency

		2,5kHz			5,0kHz			10,0kHz		
		20°C	30°C	35°C	20°C	30°C	max.	20°C	30°C	max.
>*pDRIVE*<	max. temp.	$\%I_{N"C"}/\%I_{N"P"}$	$\%I_{N"C"}/\%I_{N"P"}$	$\%I_{N"C"}/\%I_{N"P"}$	$\%I_{N"C"}/\%I_{N"P"}$	$\%I_{N"C"}/\%I_{N"P"}$	$\%I_{N"C"}/\%I_{N"P"}$	$\%I_{N"C"}/\%I_{N"P"}$	$\%I_{N"C"}/\%I_{N"P"}$	$\%I_{N"C"}/\%I_{N"P"}$
MX plus 04	40°C	100/100	100/100	100/100	100/100	100/99	95/86	100/97	92/84	80/73
MX plus 05	40°C	100/100	100/100	100/100	100/100	100/100	100/92	100/100	100/98	92/85
MX plus 07	40°C	100/100	100/100	100/100	100/100	100/99	97/86	100/95	93/83	81/72
MX plus 11	40°C	100/100	100/100	100/100	100/100	100/100	95/88	100/100	93/87	81/75
MX plus 15/18	45°C	100/110	100/110	100/110	100/110	100/110	100/110	100/110	100/110	88/105
MX plus 18/22	45°C	100/110	100/110	100/110	100/110	100/110	100/110	100/110	100/110	76/93
MX plus 22/30	45°C	100/110	100/110	100/110	100/110	100/110	96/110	100/110	84/96	60/70
MX plus 30/37	40°C	100/110	100/110	100/110	100/110	100/110	90/97	82/87	68/75	56/62
MX plus 37/45	45°C	100/110	100/110	100/110	100/110	100/110	100/110	100/110	100/110	100/110
MX plus 45/55	45°C	100/110	100/110	100/110	100/110	100/110	100/110	100/110	100/110	85/100
MX plus 55/75	45°C	100/110	100/110	100/110	100/110	100/110	88/108	90/103	73/87	60/67
MX plus 75/90	40°C	100/110	100/110	100/108	94/110	85/105	80/87	68/75	57/63	45/50
MX plus 90/110	45°C	100/110	100/110	100/110	100/110	100/110	100/110	100/110	100/109	78/87
MX plus 110/132	45°C	100/110	100/110	100/110	100/110	100/110	90/98	83/92	73/82	57/66
MX plus 132/160	40°C	100/110	100/110	100/108	100/108	88/96	78/85	64/69	54/59	44/49
MX plus 160/200	45°C	100/110	100/110	100/110	100/110	100/110	100/110	100/110	100/110	79/88
MX plus 200/250	45°C	100/110	100/110	100/110	100/110	100/110	88/98	80/89	70/78	52/58
MX plus 250/315	40°C	100/110	100/110	100/108	98/110	90/105	82/92	70/75	60/65	50/55
MX plus 315/380	40°C	100/110	100/110	100/103	80/90	73/86	67/75	—	—	—
MX plus 315/400	45°C	100/110	100/110	100/110	100/110	100/110	100/110	100/110	100/110	79/88
MX plus 400/500	45°C	100/110	100/110	100/110	100/110	100/110	88/98	80/89	70/78	52/58
MX plus 500/630	40°C	100/110	100/110	100/108	98/110	90/105	82/92	70/75	60/65	50/55

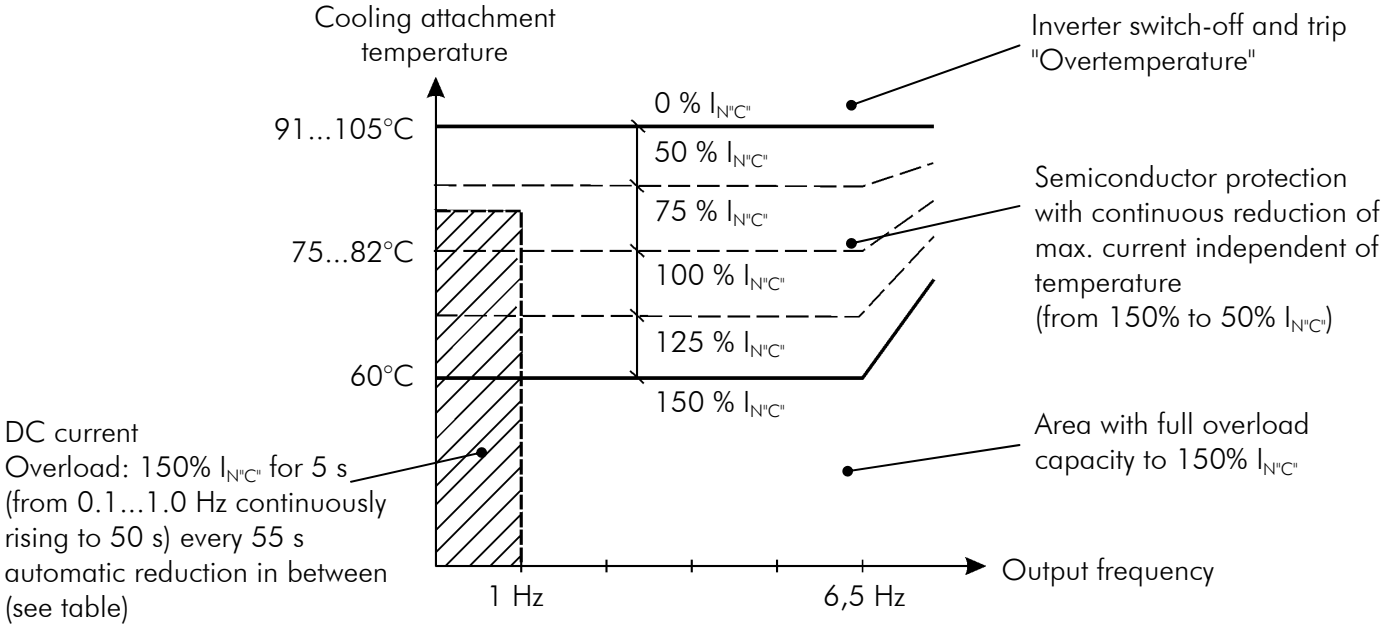
A particular advantage of the >*pDRIVE*< *MX* is the automatic backspacing (if enable) and current limitation when the temperature is too high.

Note:

1. Because of the increased earth currents, the admissible motor cable lengths are reduced to approx. 60 % at 5 kHz and 30 % at 10 kHz.
2. At I_{NC} an overload of 50% (with reference to the reduced value) for 1 minute per 10 minutes is possible. For I_{NP} no overload is possible.
3. For installation in a cubicle, an additional fan must be used to prevent thermal short circuits (see "Typical cubicle installation").
4. All power components must be designed for the higher continuous current (e.g. mains contactor), and must have forced ventilation (e.g. NDU, AMF).
5. The admissible size of motor may pass the "P"-value for max. one step of type.
6. In the range of 0...5 Hz of the output frequency the maximum switching frequency will adjust herself in dependence from the load current.

Continuous Current at Output Frequencies < 1 (6,5) Hz

For complete protection of the power semiconductors (IGBT) from thermal overload, the DC current capability of the *>pDRIVE< MX* is reduced when the temperature of the cooling unit is high.



Inverter type	Automatic reduction
MX plus 04	85 %
MX plus 05	70 %
MX plus 07	95 %
MX plus 11	70 %
MX plus 15/18	95 %
MX plus 18/22	80 %
MX plus 22/30	95 %
MX plus 30/37	80 %
MX plus 37/45	95 %
MX plus 45/55	80 %
MX plus 55/75	95 %
MX plus 75/90	80 %
MX plus 90/110	115 %
MX plus 110/132	95 %
MX plus 132/160	80 %
MX plus 160/200	115 %
MX plus 200/250	95 %
MX plus 250/315	80 %
MX plus 315/380	65 %
MX plus 315/400	115 %
MX plus 400/500	95 %
MX plus 500/630	80%

When planning drives with an operating frequency lower than 1 Hz or 6,5 Hz (over longer periods), the following conditions should be observed:

- dimensioning of the drive without including the overload capability
- verification of the drive reaction on current limitation by the inverter
- in the frequency range ±1 Hz, the available continuous current is reduced (see table)

Index for the dimensioning of hoist applications:

- static hoist power (torque) ≤ 80% of the inverter's "C" power
- hoisting and acceleration power ≤ 100% of the inverter's "C" power
- hoisting power for test load ≤ 120% of the inverter's "C" power
- operation in the DC current range (< 1 Hz) must be supported by holding brake.

Note on torque-limited drives and tape tension controllers:

- For the establishment of a continuous pull and retaining torque, only a reduced continuous current is available to the inverter in the speed range around 0 Hz (see table).

Application Notes

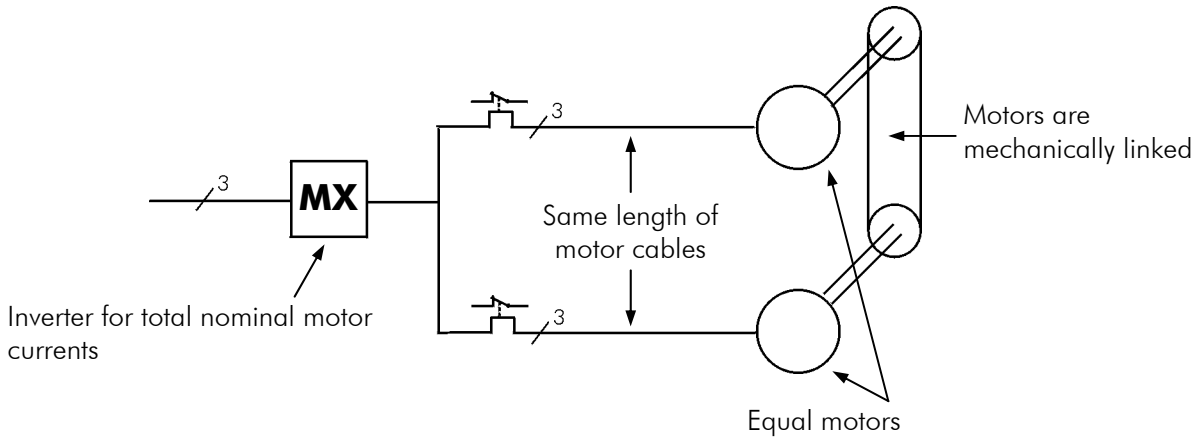
Multi-motor Operation

Basically it is possible to operate several motors with one >*pDRIVE*< *MX* inverter. For pump and fan applications, the following restrictions must be observed:

- The total nominal motor current must be smaller than the inverter nominal current.
- It is not possible to operate each motor at a different speed.
- All motor cable lengths must be added.
- A high starting torque is not possible.
- The inverter does not support individual motor overload protection.
- Autotuning is not possible (nor is it necessary).
- Single motors can only be switched on if the initial current intensity is lower than the maximum inverter current.

For applications requiring a higher starting torque (e.g. chassis drives, conveyor belts, hoisting units, etc.), the only possibility is to connect several mechanically coupled motors in parallel. In order to perform autotuning, the motors should be as equal as possible and the motor cables should have the same length.

If thermal relays or motor protection switches are used, they must be set to approx. 110% of the nominal motor current!



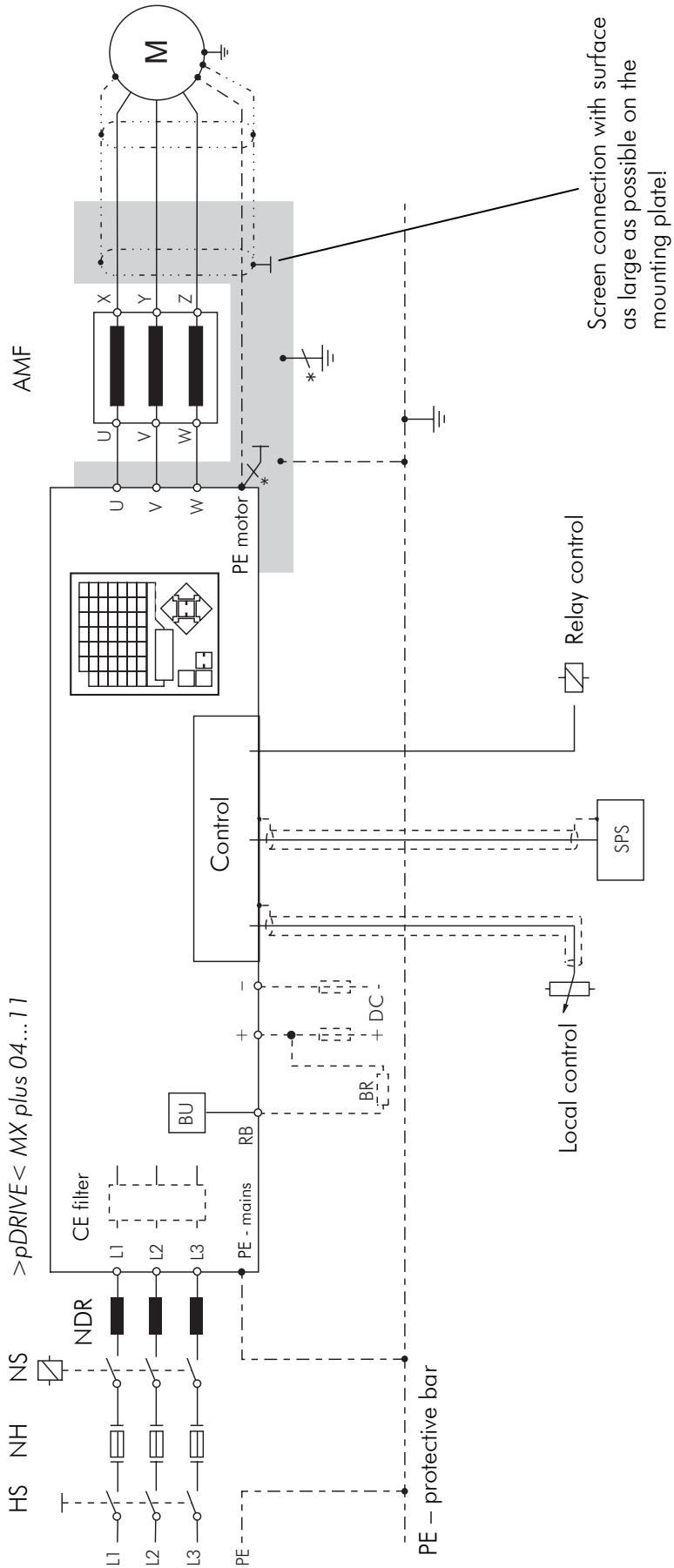
Hoisting Units – Protective Devices

Just like the control system itself, the protective function "crane overload" that is integrated in the frequency inverter can work either with or without speed feedback. For comprehensive protection of the hoisting load in the event of inverter trips, it is necessary to install an external monitoring circuit. This circuit will also act on the mechanical brake, and thus monitor all errors in the electric system. In the case of a broken shaft or torn rope, however, this protection will not be effective.

The frequency inverter is perfectly capable of taking over the full lifting load out of the brake, whereby the brake is self-controlled via the output "lift brake" once the magnetic field is built up. Only in the first half second after the pulse inhibit there is a danger of the load stalling due to magnetisation of the motor as a result of an incorrect position of the wearing off field. To overcome this, a renewed start command can be locked for approx. 1 second (e.g. via an additional IO1 card and the integrated logic block).

For dimensioning of the drive, see "Continuous Current at Output Frequencies < 1 (5) Hz".

Wiring Scheme for Sizes A & B

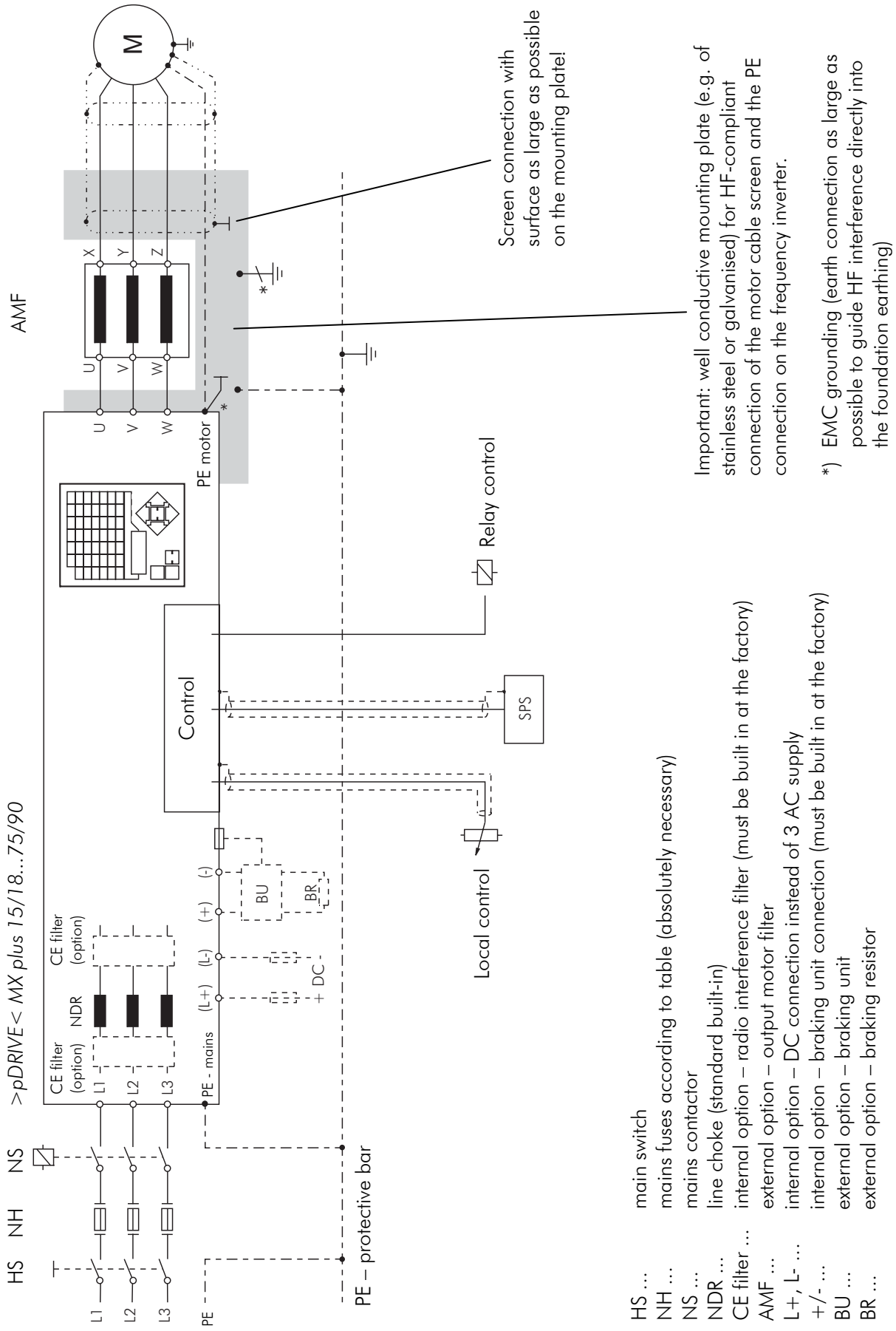


*) EMC grounding (earth connection as large as possible to guide HF interference directly into the foundation earthing)

In *MX plus* sizes A and B, the restart must be delayed for 20 s after every mains shutdown! Otherwise, the motor restart will be delayed.

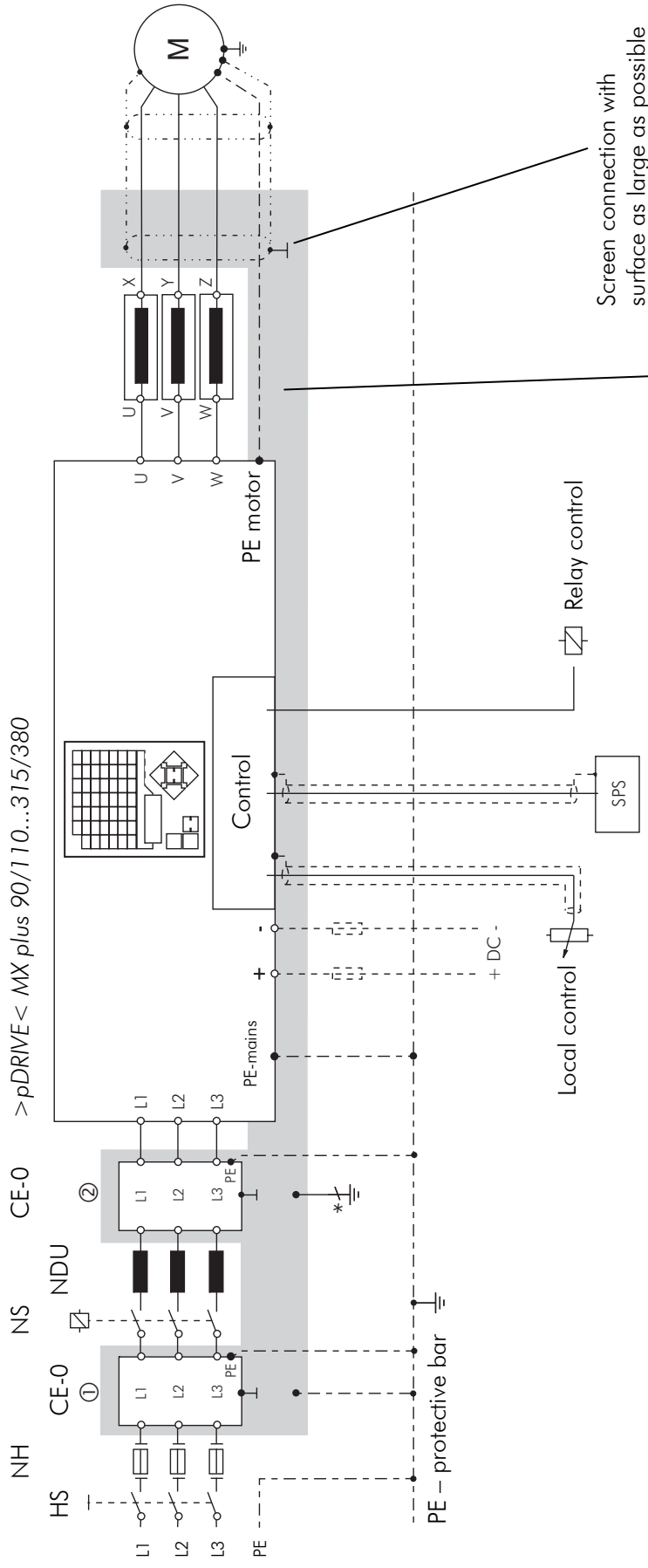
HS ...	main switch
NH ...	mains fuses according to table (absolutely necessary)
NS ...	mains contactor
FDR ...	external option – line choke (FDR or FDR-N)
CE filter ...	internal option – radio interference filter (not for IT mains)
AMF ...	external option – output motor filter (FDR or FDR-A)
+/- ...	DC connection instead of 3 AC supply
BS ...	internal braking unit
BR ...	external option – braking resistor

Wiring Scheme for Sizes 1 & 2



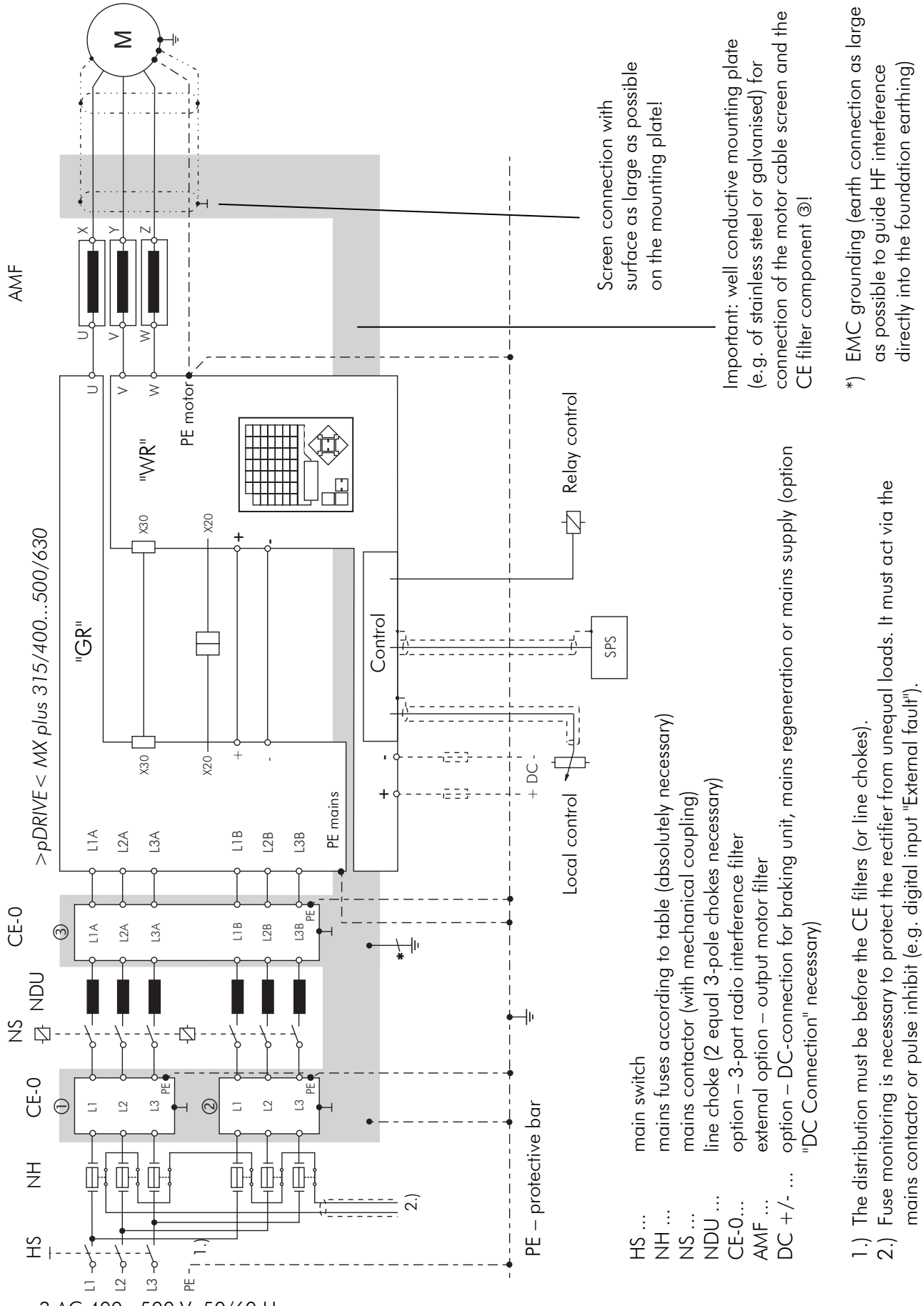
3 AC 400...500 V, 50/60 Hz

Wiring Scheme for Sizes 3 & 4

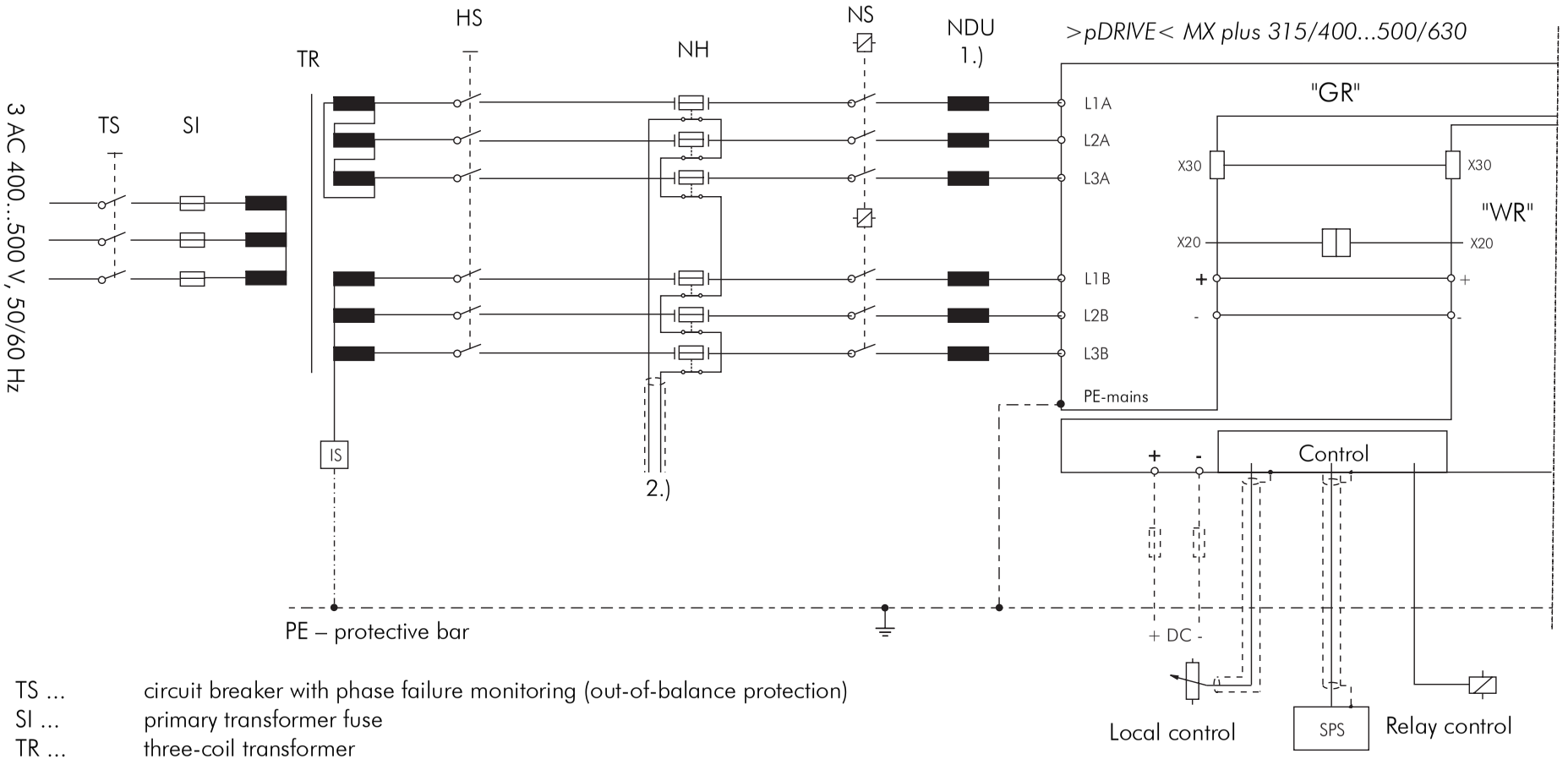


3 AC 400...500 V, 50/60 Hz

Wiring Scheme for Size 5 (6-pulse Supply)



Wiring Scheme for Size 5 (12-pulse Supply)



TS ...	circuit breaker with phase failure monitoring (out-of-balance protection)
SI ...	primary transformer fuse
TR ...	three-coil transformer
IS ...	insulation monitoring relay
HS ...	main switch
NH ...	mains fuses according to table (absolutely necessary)
NS ...	mains contactor (with mechanical coupling)
NDU ...	line choke (2 equal 3-pole chokes)
DC +/- ...	option – DC-connection for braking unit, mains regeneration or mains supply (option "DC Connection" necessary)

1.) Use of line choke NDU, see chapter "12-pulse Supply".

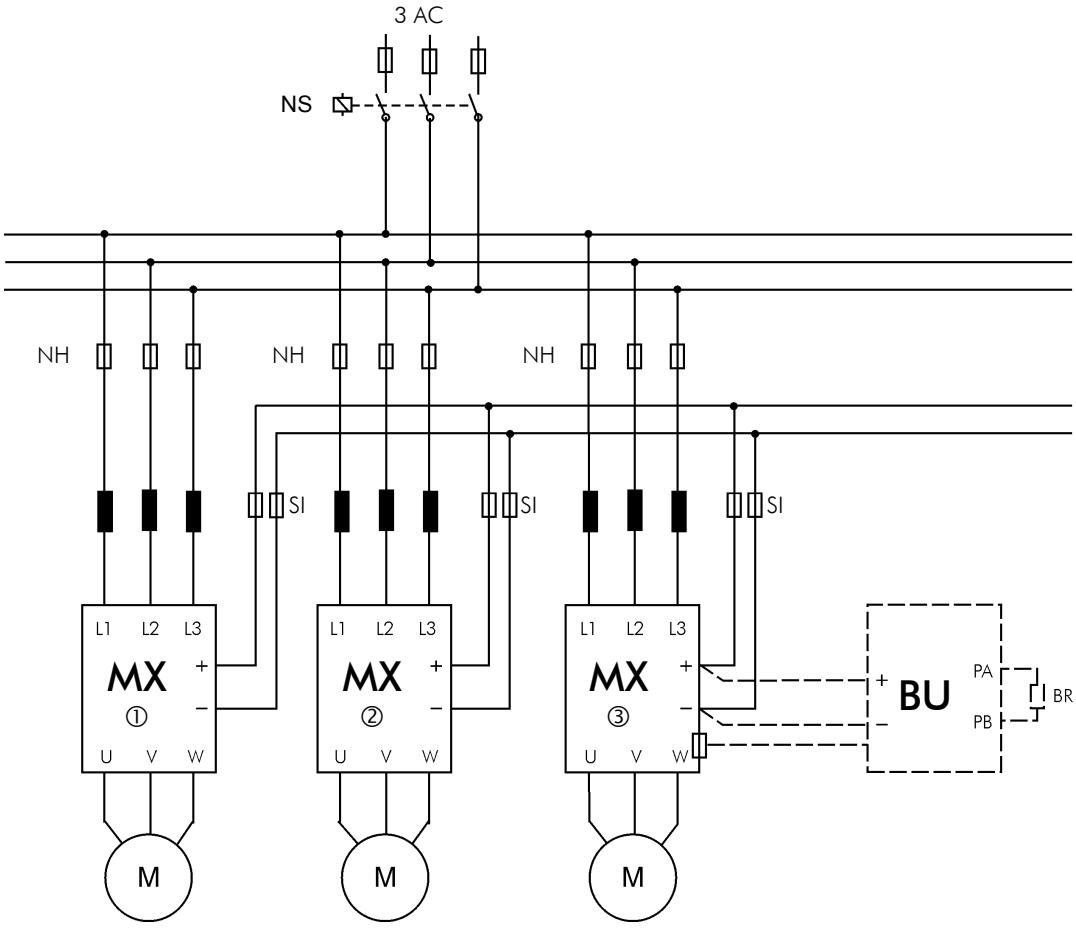
2.) Fuse monitoring is necessary to protect the rectifier from unequal loads. It must act via the mains contactor or pulse inhibit (e.g. digital input "External fault").

For more information about this wiring, see "Notes on Power Supply" and "Use of the MX in Non-grounded Mains".

Wiring Scheme

DC Coupling of Several MX Inverters with 1 Mains Contactor

DC coupling is recommended for applications where the full motor power must be provided on the one hand, and generator operation through energy exchange via the DC link should be possible on the other hand (e.g. rollers, conveyor belts, etc.)



NS ... By using one common line contactor, all charging circuits of the individual inverters will work in parallel and therefore cannot be overloaded.

If switch gears are used in the individual inverter supplies, the option "charging circuit" LS5 must be switched to each MX!!

NH ... Mains-sided unit protection. To protect the individual rectifiers from overload, the recommendations in "Mains Fuses" must be observed carefully. By using a fuse monitoring system (acting on the digital input "external fault" or on the mains contactor), consequential damage to the charging unit during mains switch-on can be avoided.

SI ... Select the fuses in the DC link in accordance with the chapter "DC Supply – Connection of Braking Unit – Mains Regeneration".

As soon as these fuses have been built in, the mains fuses must also be built-in!!

①,②,③ ... Standard MX frequency inverter (for sizes 1 and 2, the option "BU Control", and for sizes 4 and 5 the option "DC Connection" is necessary). Generally, the number and size of units is selectable, but only units of two neighbouring sizes can be combined. The line chokes are absolutely necessary (built-in in sizes 1 and 2!).

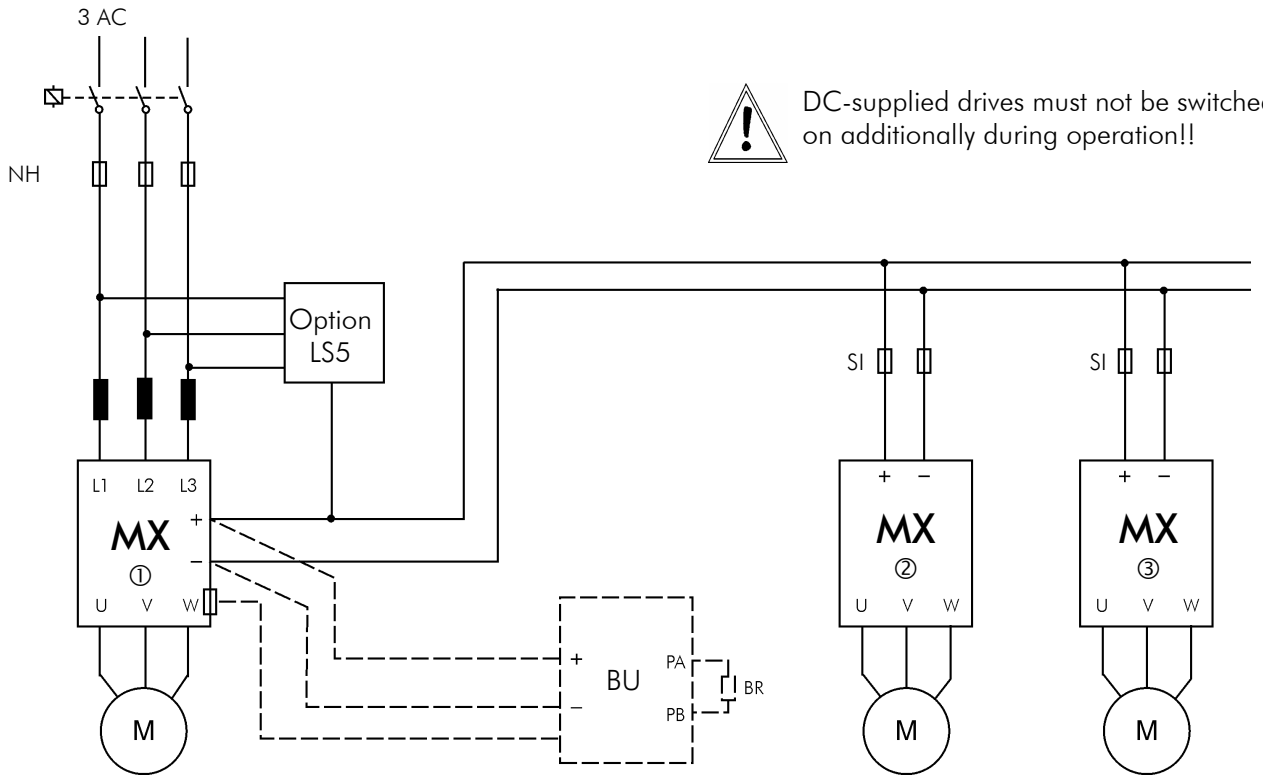
BU/BR ... Braking unit and braking resistor for short reduction of regenerative power. The use of a braking unit is not absolutely necessary. If, for instance, all drives are to be stopped at the same time, the released energy can be heated in the braking resistor. For more information about the design of braking units and resistors, see operating instruction "Braking Unit".

Wiring Scheme

MX Main Drive with Slave(s) on DC Link (e.g. MX 3 with MX 2 & LS 5)

Applications where some drives are working as generators (i.e. braking mode), while one or several other units are working as a motor, can work extremely efficiently with a DC supply (e.g. winders, directional machines, test stands, conveyor belts, hoisting units, etc.).

The motor power must never exceed the allowed limit for the rectifier of the MX ① (e.g. 132 kW + 20% for 60 seconds with >*pDRIVE*< *MX plus* 132/160)!!



① ... Standard >*pDRIVE*< *MX* frequency inverter (for sizes 1 and 2, the option "BU Control" is necessary). This inverter determines the maximum possible motor power of the whole drive group. The line choke is built-in by default in sizes 1 and 2!!

LS5 ... Option "Charging circuit" LS5. This option is necessary to avoid an overload of the charging circuit of the MX ①. Using the option LS5, frequency inverters with a total power of up to 500 kW can be charged.

②,③ ... DC-supplied inverters MX or CX. Protection must be provided with superfast fuses in accordance with the section "DC Supply". Switching gears in the DC circuit are of no use because the switching duty can lead to a triggering of the fuses as a result of high charging current. (Sizes 1 and 2 must be ordered in DC design, for sizes 3 to 5 the option "DC Connection" must be ordered.)

BU/BR ... Braking unit and braking resistor for short reduction of regenerative power. The use of a braking unit is not absolutely necessary. If, for instance, all drives are to be stopped at the same time, the released energy can be heated in the braking resistor. For more information about the design of braking units and resistors, see operating instruction "Braking Unit".

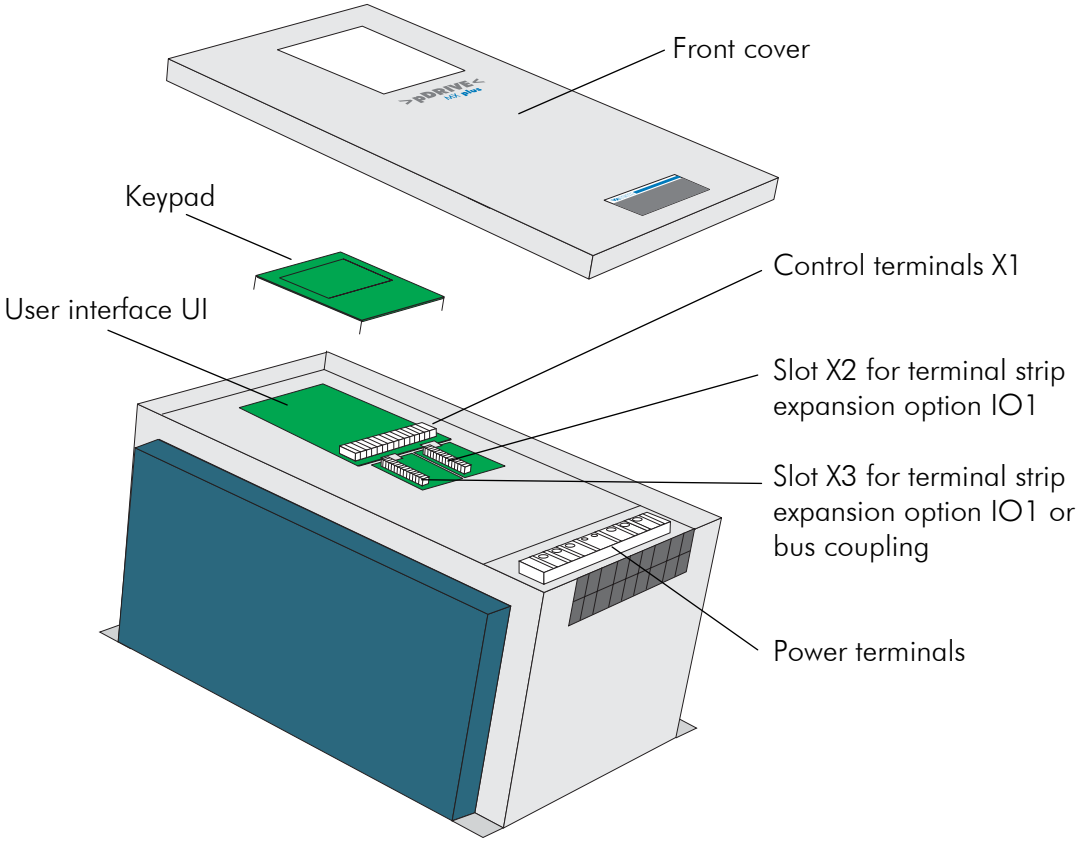
CAUTION – Risk of electric shock

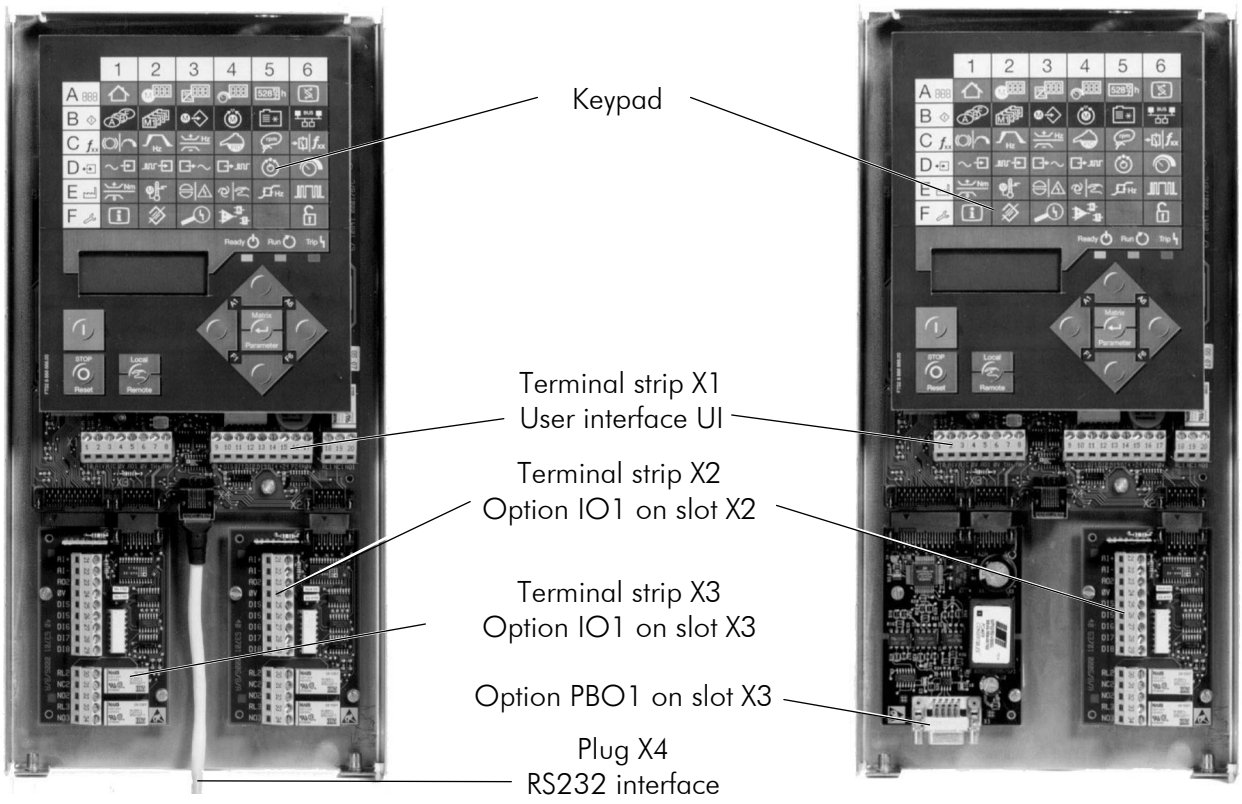
– Ground equipment.
– Before servicing:
  Remove all power, wait 5 minutes. Verify no voltage is present.
– After servicing, close cover.

Failure to comply will result in injury or death!

Mechanical Construction

Description of Components

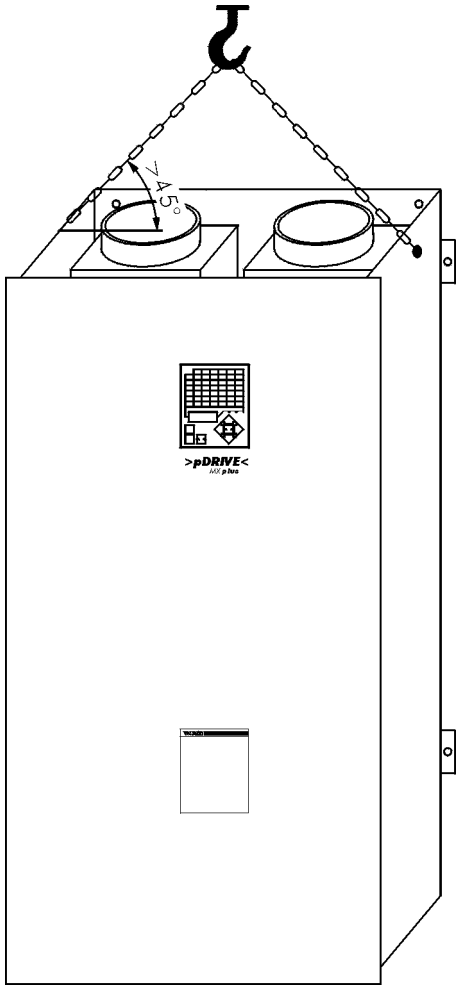




If only one option card IO1 is used, it must be installed in slot X2!

Handling of Frequency Inverters

In case of damage or incomplete delivery, please inform the supplier or the insurance company. The manufacturer declines responsibility for faults occurring during transport or unpacking.



Units of size 3 and greater are fitted with stable lugs. They allow easy handling with hoisting units.

Please make sure that no objects such as e.g. cable insulation material, metal dust or dust penetrate the casing during work on the frequency inverter. Avoid this by covering the frequency inverter.

General Mounting Information

Make sure that parameter B3.05 is set in accordance with the input voltage

0 .... 400 V; 50/60 Hz	*for line voltage*	*3 AC 400V (380...415V ±10%), 50/60Hz ±5%*
1 .... 440 V; 50/60 Hz		*3 AC 440V ±10%, 50/60Hz*
2 .... 460 V; 50/60 Hz		*3 AC 460V(460...480V ±10%), 50/60Hz*
3 .... 500 V; 50 Hz		*3 AC 500V +10% -15%, 50Hz*

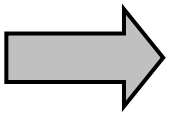
Ambient factors such as high temperatures or high humidity must be avoided, like dust, dirt and aggressive gases. The installation site must be well ventilated and protected from direct sunlight. Install the unit on a non-flammable, vertical wall that does not transmit vibrations.

Like many other built-in electronic devices, the *>pDRIVE< MX* frequency inverter is designed in accordance with the soiling class 2, EN 50178. If the environment does not correspond with these conditions, the necessary soiling class must be guaranteed e.g. by installation in a cubicle.

Check-list to Ensure High Availability of Inverter Drives

- Is the cooling air free of conductive dust?
- Is the cooling air nearly dust-free and dry?
- Is condensation avoided, or a switch-on in condensed condition made impossible?
- Is the air temperature immediately below the inverter within the admissible range?
- Is there a guarantee that an air short cannot occur (the inverter sucks in the exhaust air)?
- Do the air in- and outlets have the correct minimum diameters?
- Is the necessary amount of air blown in, if filter mats are used?
- Are the air in- and outlets free and the air flow unobstructed?

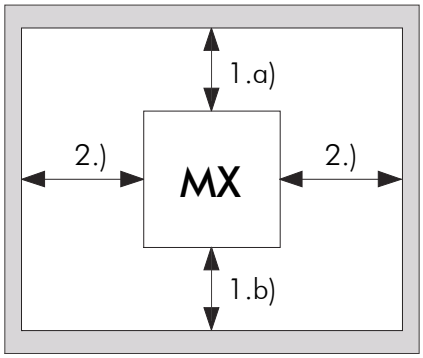
Conductive dust
Humidity
Aggressive atmosphere or
Operation beyond the
temperature limits



If the inverter is operated out of specifications, any warranty claims will be rendered void!!

Distances to other Units or from the Wall

For cooling reasons, the *>pDRIVE< MX* frequency inverters are designed for vertical wall mounting. Please note the specified minimum distances to other units - especially if the inverter is mounted in a niche.

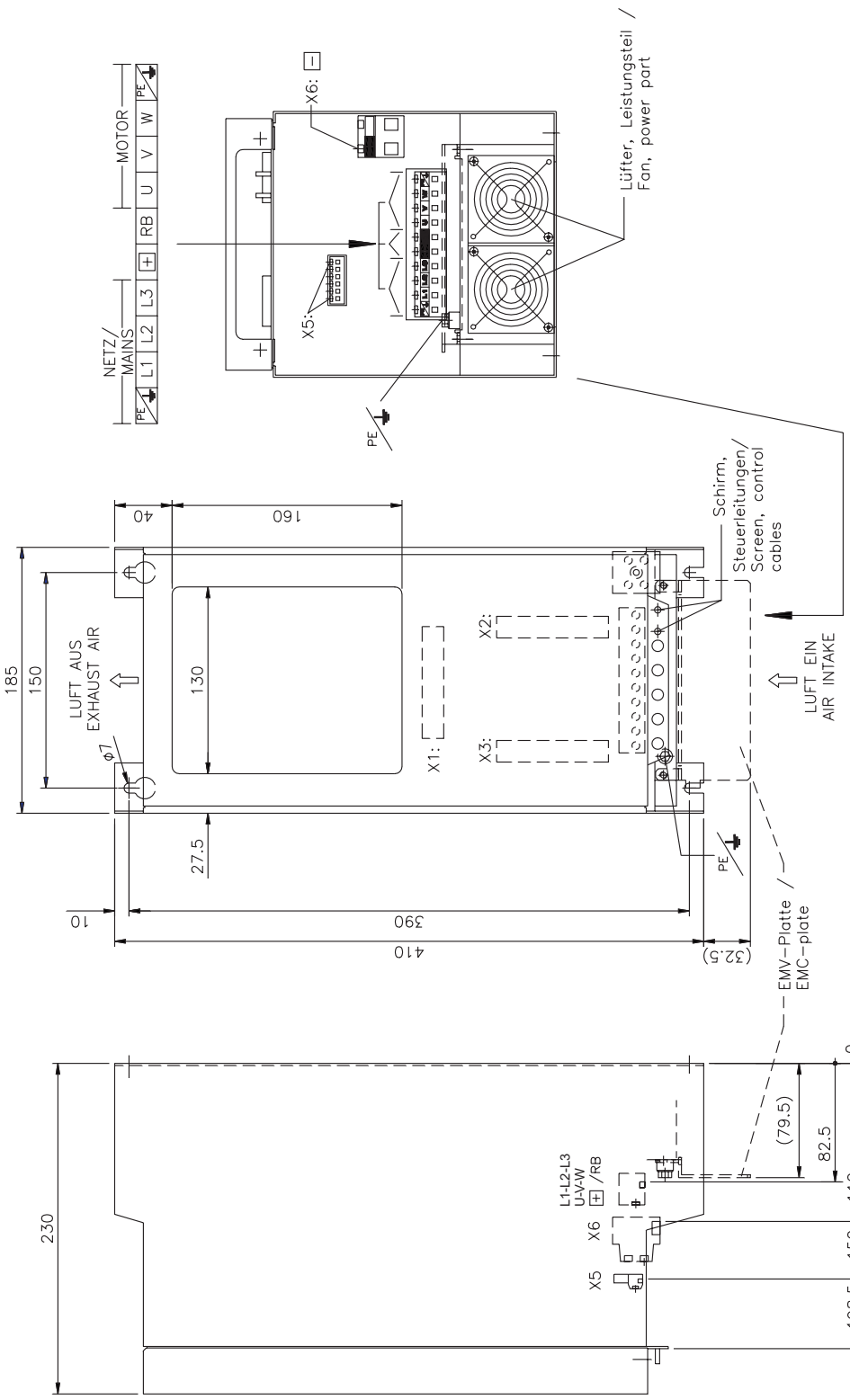


1.) CAUTION: If mounting the inverter in a cubicle, a free air flow must be guaranteed and air shorts must be avoided → see "Typical Installation in a Cubicle"
2.) The distances on the sides of the inverter are only necessary for maintenance (service) purposes. If the unit can be removed for these purposes, these distances are not necessary.

1.a) min. 200 mm
1.b.) min. 100 mm (min. 200 mm for size 3...5)
2.) min. 150 mm

Please make sure that no objects such as e.g. cable insulation material, metal dust or dust penetrate the casing during work on the frequency inverter. Avoid this by covering the top of the frequency inverter. The permissible temperature range (0°C to +45°C or +40°C) must not be exceeded. If the maximum cooling temperature is exceeded, the frequency inverter will automatically reduce the switching frequency and - if this is not sufficient - reduce the current limitation. The higher the ambient temperature is, the shorter the lifetime of the frequency inverter. Do not install the frequency inverter near heat generating units.

Dimensions MX plus 04 and 05 - Size A

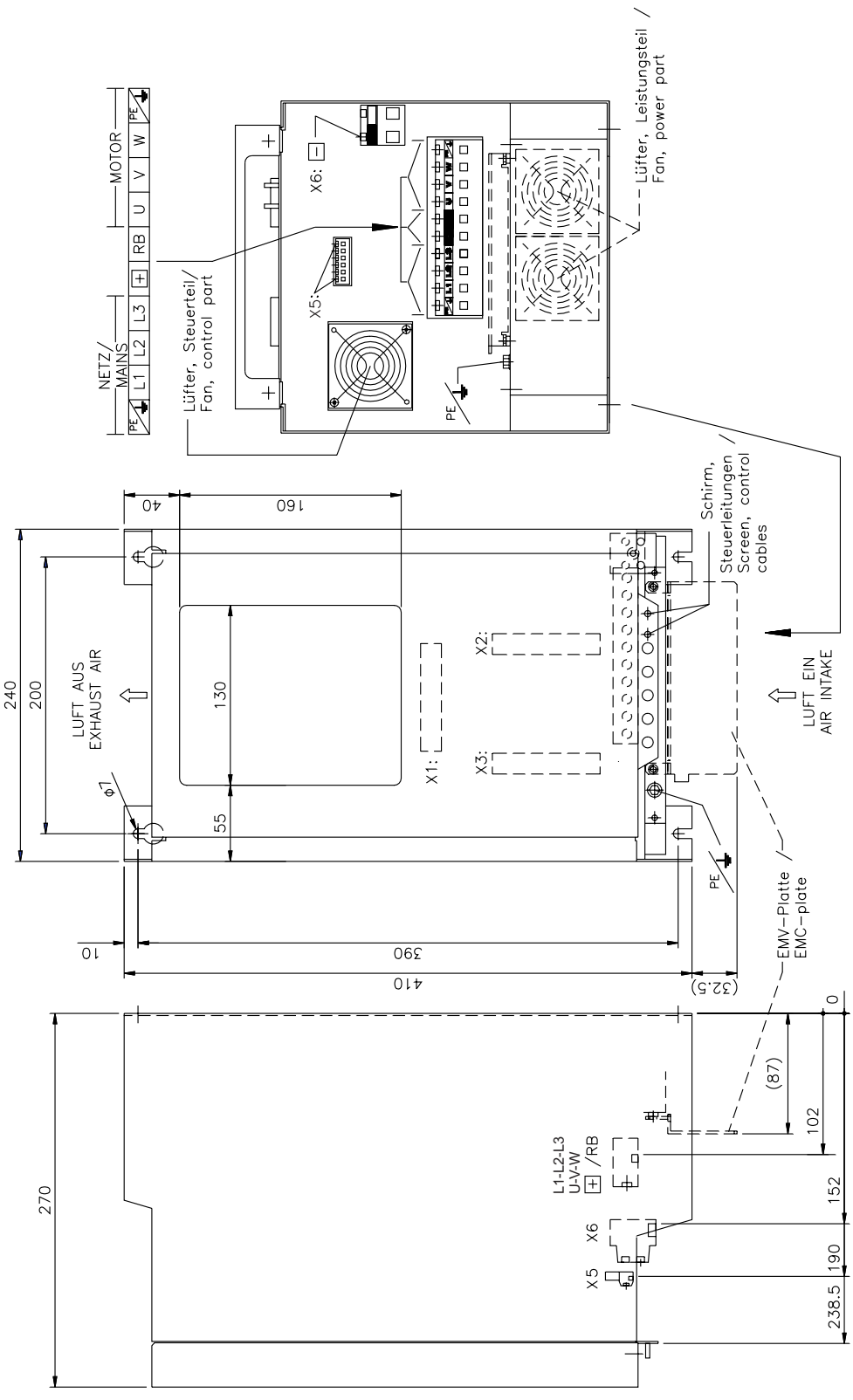


Distance between units at sides: 0 mm at an ambient temperature of 0...+40°C (for 0...50°C, a distance of > 50 mm is necessary)

X1 ... control terminal strip
X2 ... option slot 1 for option IO1
X3 ... option slot 2 for option IO1 or bus coupling
X5 ... encoder
X6 ... DC connection
⏚ / RB braking resistor

	MX plus 04	MX plus 05
Losses		
100 % "C"	220 W	250 W
Cooling air volume	72 m^3/h	72 m^3/h
Air in-/outlet	min. 1 dm^2	min. 1 dm^2
Weight incl. CE	approx. 10 kg	approx. 10 kg

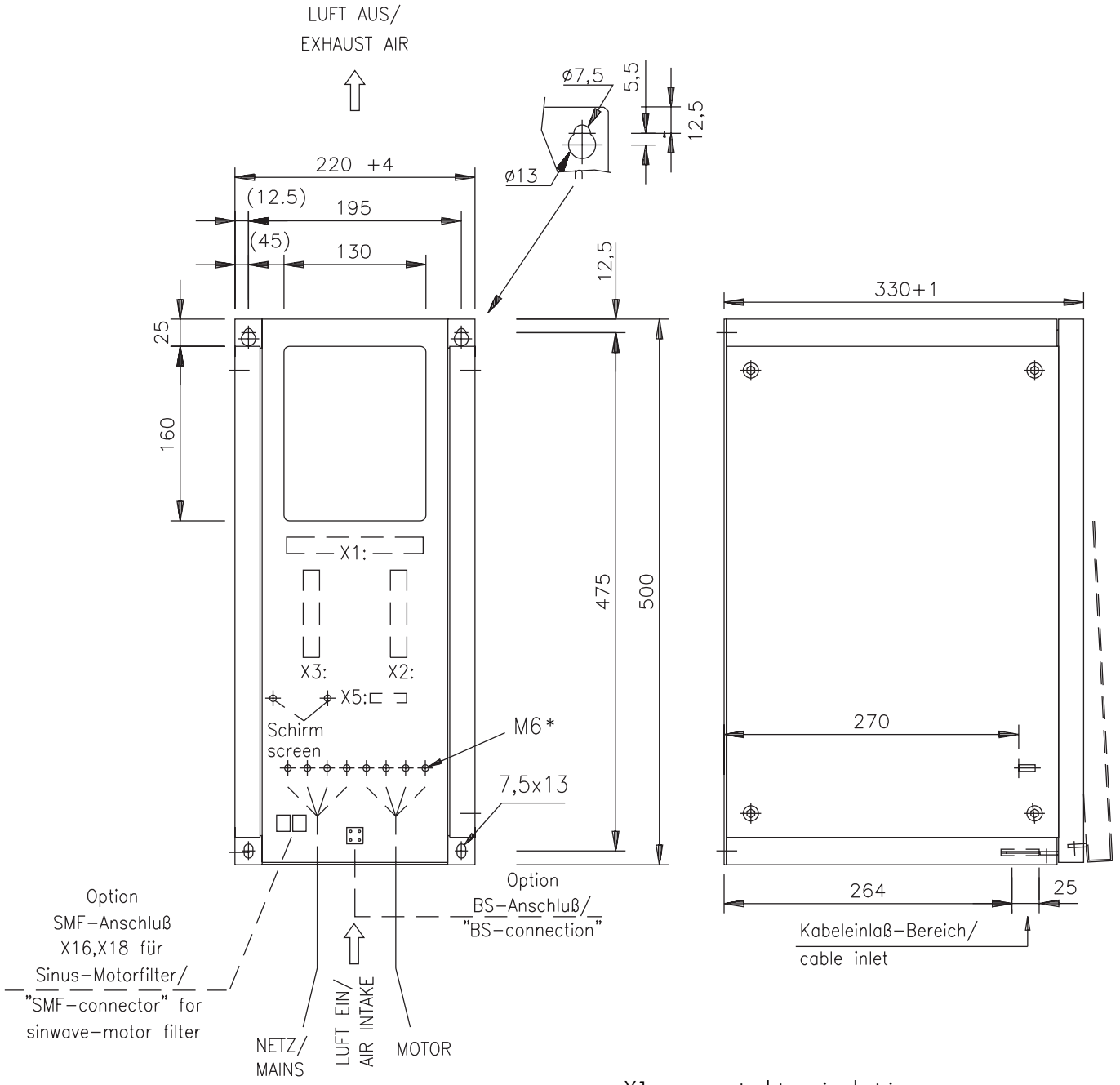
Dimensions MX plus 07 and 11 - Size B



X1 ... control terminal strip
X2 ... option slot 1 for option IO1
X3 ... option slot 2 for option IO1 or bus coupling
X5 ... encoder
X6 ... DC connection
+ / RB braking resistor

	MX plus 07	MX plus 11
Losses		
100 % "C"	300 W	400 W
Cooling air volume	108 m^3/h	108 m^3/h
Air in-/outlet	min. 1.5 dm^2	min. 1.5 dm^2
Weight incl. CE	approx. 16 kg	approx. 16 kg

Dimensions MX plus 15/18 to 30/37 - Size 1



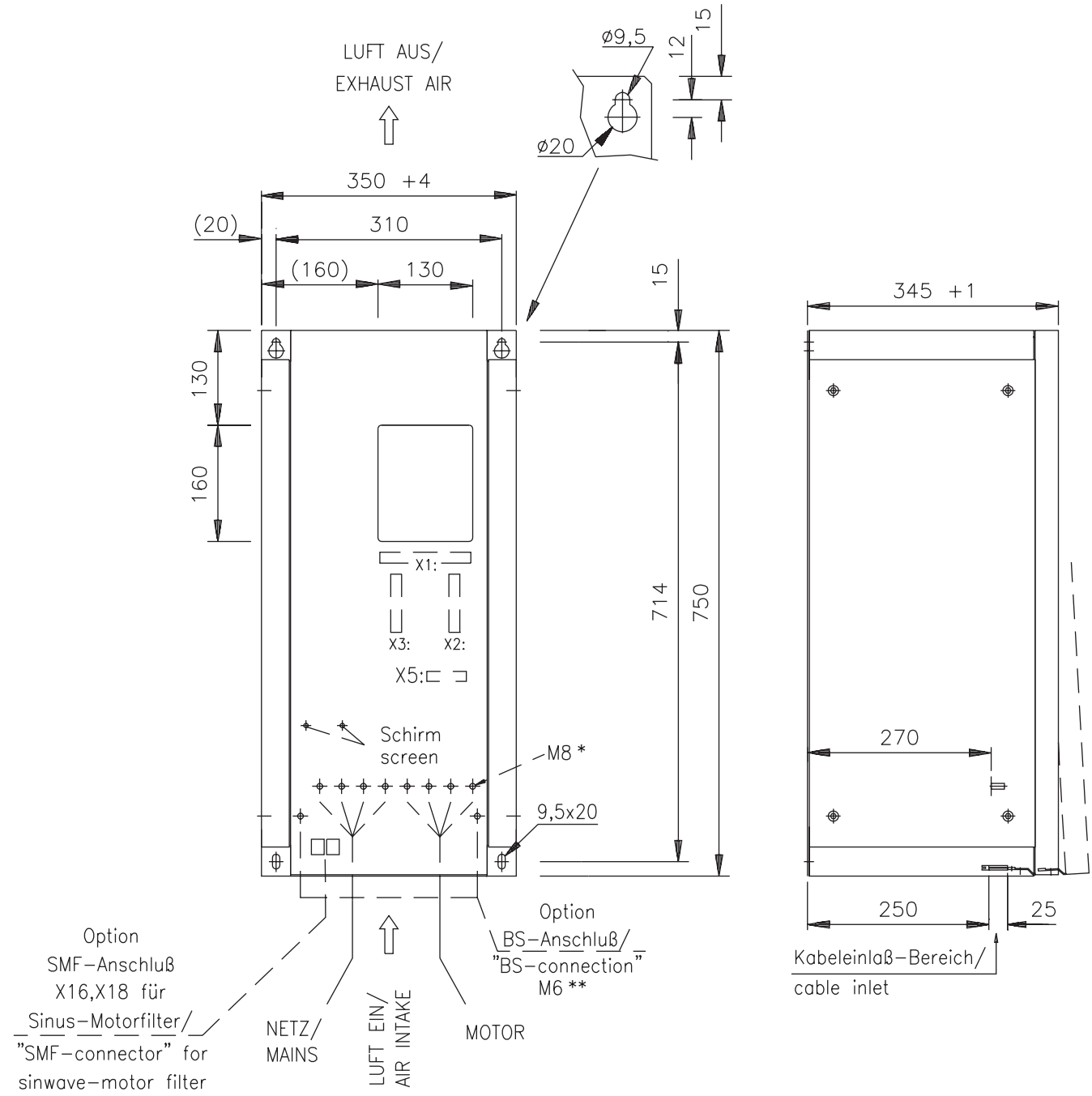
MOUNTING

X1 ... control terminal strip
X2 ... option slot 1 for option IO1
X3 ... option slot 2 for option IO1 or bus coupling
X5 ... option SFB1

* Tightening torque for M6 bolts: 4.5...5.5 Nm

	MX plus 15/18	MX plus 18/22	MX plus 22/30	MX plus 30/37
Losses				
100 % "C"	550 W	650 W	850 W	980 W
100 % "P"	650 W	790 W	940 W	1150 W
Cooling air volume	200 m^3/h	200 m^3/h	250 m^3/h	250 m^3/h
Air in-/outlet	min. 2.0 dm^2	min. 2.0 dm^2	min. 3.0 dm^2	min. 3.0 dm^2
Weight incl. CE	approx. 32 kg	approx. 32 kg	approx. 35 kg	approx. 35 kg

Dimensions MX plus 37/45 to 75/90 - Size 2

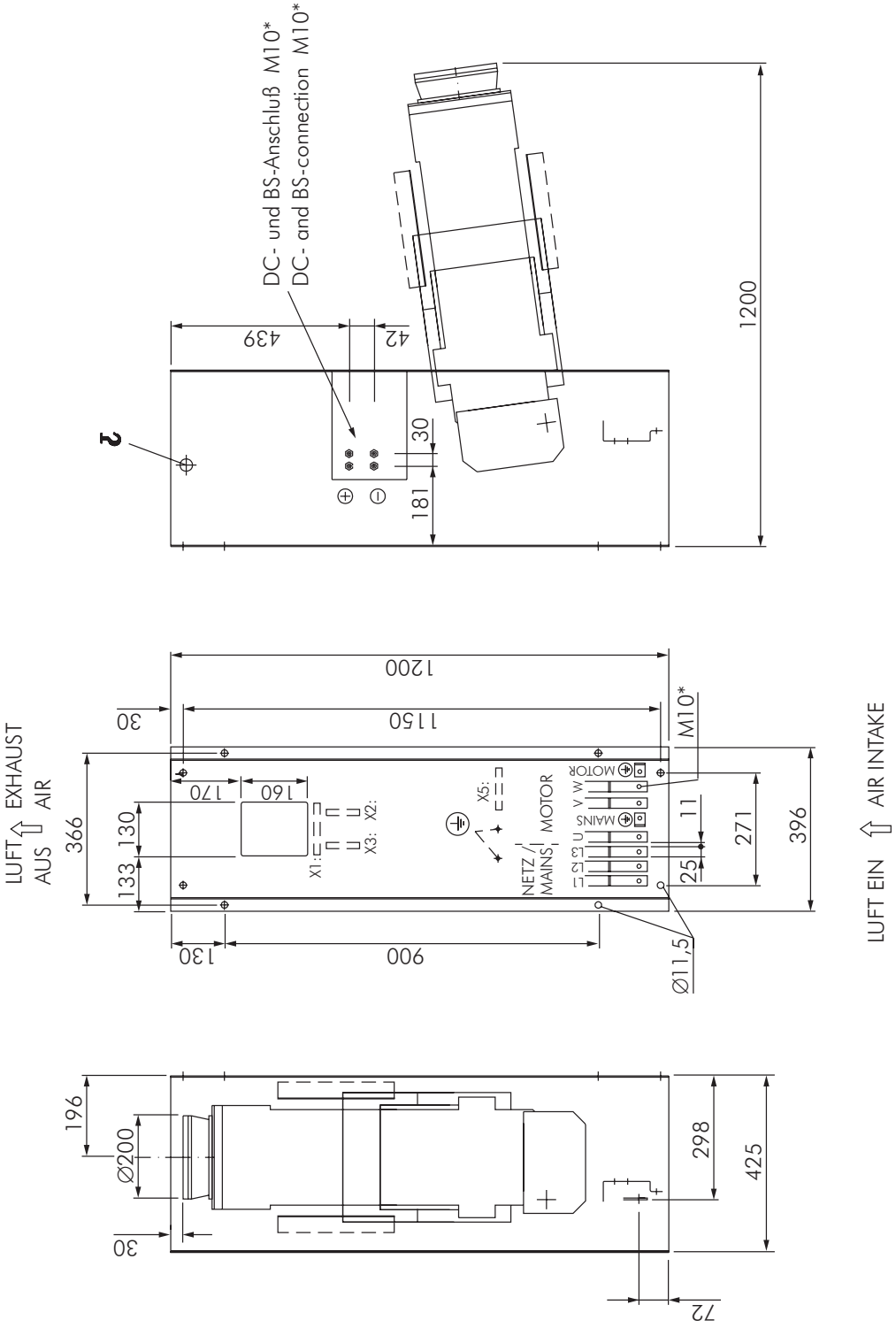


* Tightening torque for M8 bolts: 10...12 Nm
** Tightening torque for M6 bolts: 5 Nm

X1 ... control terminal strip
X2 ... option slot 1 for option IO1
X3 ... option slot 2 for option IO1 or bus coupling
X5 ... option SFB2

	MX plus 37/45	MX plus 45/55	MX plus 55/75	MX plus 75/90
Losses				
100 % "C"	1100 W	1250 W	1500 W	2050 W
100 % "P"	1250 W	1400 W	2050 W	2400 W
Cooling air volume	350 m^3/h	350 m^3/h	450 m^3/h	450 m^3/h
Air in-/outlet	min. 5.0 dm^2	min. 5.0 dm^2	min. 6.0 dm^2	min. 6.0 dm^2
Weight incl. CE	approx. 60 kg	approx. 60 kg	approx. 72 kg	approx. 72 kg

Dimensions MX plus 90/110 to 132/160 - Size 3



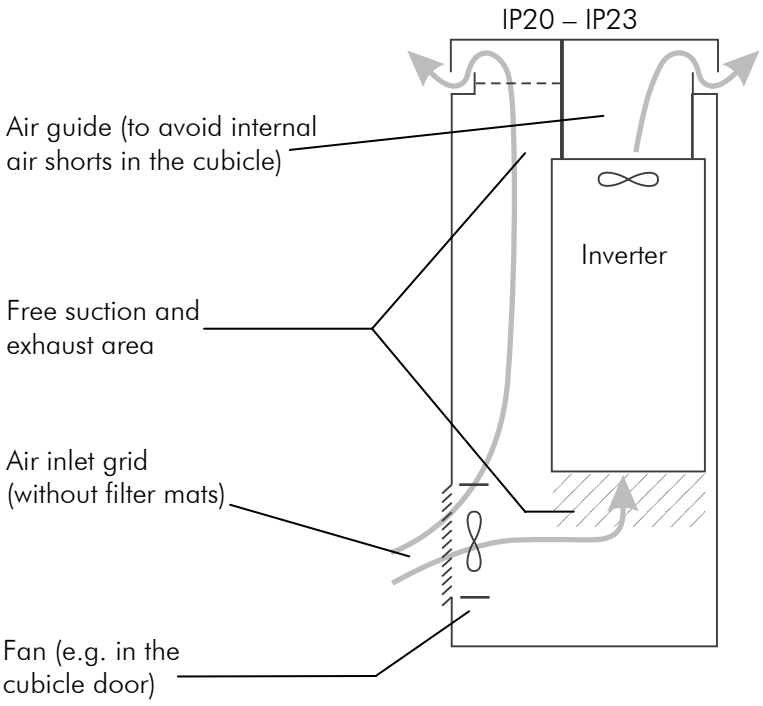
* Tightening torque for M10 bolts: 40 Nm

X1 ... control terminal strip
X2 ... option slot 1 for option IO1
X3 ... option slot 2 for option IO1 or bus coupling
X5 ... Option SFB3B
+/- ... DC and BU connection (only on left)

	MX plus 90/110	MX plus 110/132	MX plus 132/160
Losses			
100 % "C"	2400 W	2800 W	3250 W
100 % "P"	2800 W	3250 W	3800 W
Cooling air volume	600 m^3/h	600 m^3/h	600 m^3/h
Air in-/outlet	min. 7.0 dm^2	min. 7.0 dm^2	min. 7.0 dm^2
Weight	approx. 100 kg	approx. 100 kg	approx. 100 kg

Typical Cubicle Installation for Sizes A to 3

IP20 – IP23 Standard Installation



Recommended Steps for Cooling Air Guidance

>*pDRIVE*< *MX plus*	max. temperature outside cubicle	Design
04 to 11	40°C	Min. cross-section for air in-/outlet, provide for free suction/exhaust space
15/18 to 18/22 37/45P to 45/55 90/110 to 110/132	40°C	Min. cross-section for air in-/outlet, provide for free suction/exhaust space
22/30 55/75	40°C	as above, but air guidance necessary
132/160	35°C	as above, but air guidance necessary
30/37 75/90	40°C	no air guidance, but additional ventilator in cubicle door (supply volume: see "Cooling Air Volume")

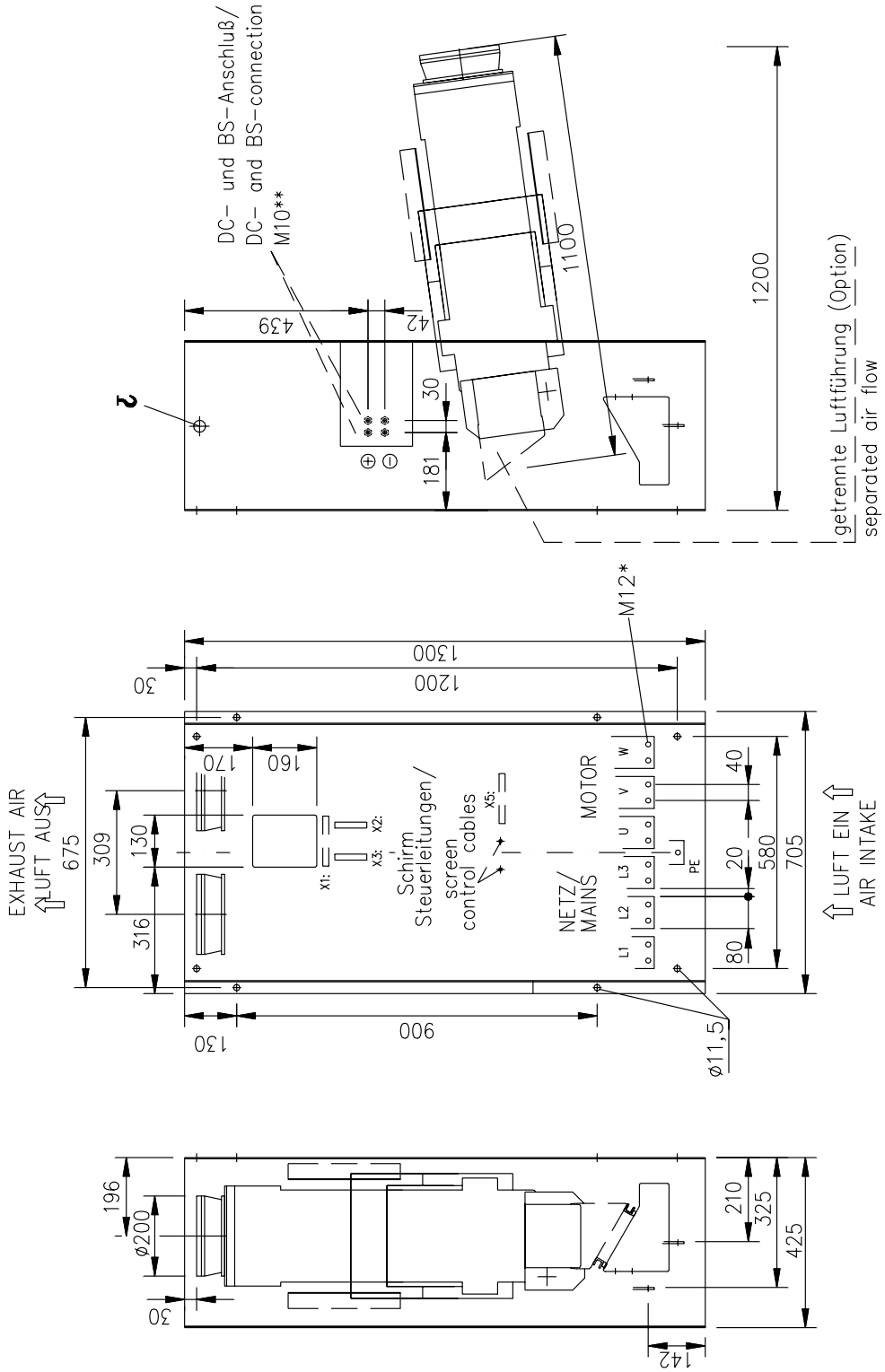
Typical Cubicle Sizes for IP23

>*pDRIVE*< inverter	Cubicle	Notes
Size A (2 units side by side)	W x H x D = 600 x 2000 x 400 mm	
Size B (2 units side by side)	W x H x D = 600 x 2000 x 400 mm	
Size 1 (2 units side by side)	W x H x D = 600 x 2000 x 400 mm	The mounting plate must be inserted in the rear frame!
Size 2 (2 units side by side)	W x H x D = 800 x 2000 x 500 mm	
Size 3	W x H x D = 600 x 2000 x 500 mm	The mounting plate must be inserted in the rear frame! Supply field as required, e.g. 400 mm
Size 4	W x H x D = 800 x 2000 x 500 mm	+ Supply field as required, e.g. 400 mm
Size 5	W x H x D = (800+800) x 2000 x 500 mm	+ Supply field as required, e.g. 400 mm

IP44 – IP54 Extended Protection Class

When using frequency inverters of sizes A to 3 in areas where protection class IP44 of IP54 is required, we recommend the use of the developed and tested cubicle design.

Dimensions MX plus 160/200 to 315/380 - Size 4



* Tightening torque for M12 bolts: 70 Nm
** Tightening torque for M10 bolts: 40 Nm

X1 ... control terminal strip
X2 ... option slot 1 for option IO1
X3 ... option slot 2 for option IO1 or bus coupling
X5 ... option SFB4/5

	MX plus 160/200	MX plus 200/250	MX plus 250/315	MX plus 315/380
Losses				
100 % "C"	4000 W	5000 W	6200 W	7500 W
100 % "P"	4700 W	5800 W	7300 W	8700 W
Cooling air volume	1200 m^3/h	1200 m^3/h	1200 m^3/h	1600 m^3/h
Air in-/outlet	min. 10.0 dm^2	min. 10.0 dm^2	min. 10.0 dm^2	min. 14.0 dm^2
Weight	approx. 190 kg	approx. 190 kg	approx. 190 kg	approx. 200 kg

Typical Cubicle Installation for Size 4 (not for *MX plus 315/380*)

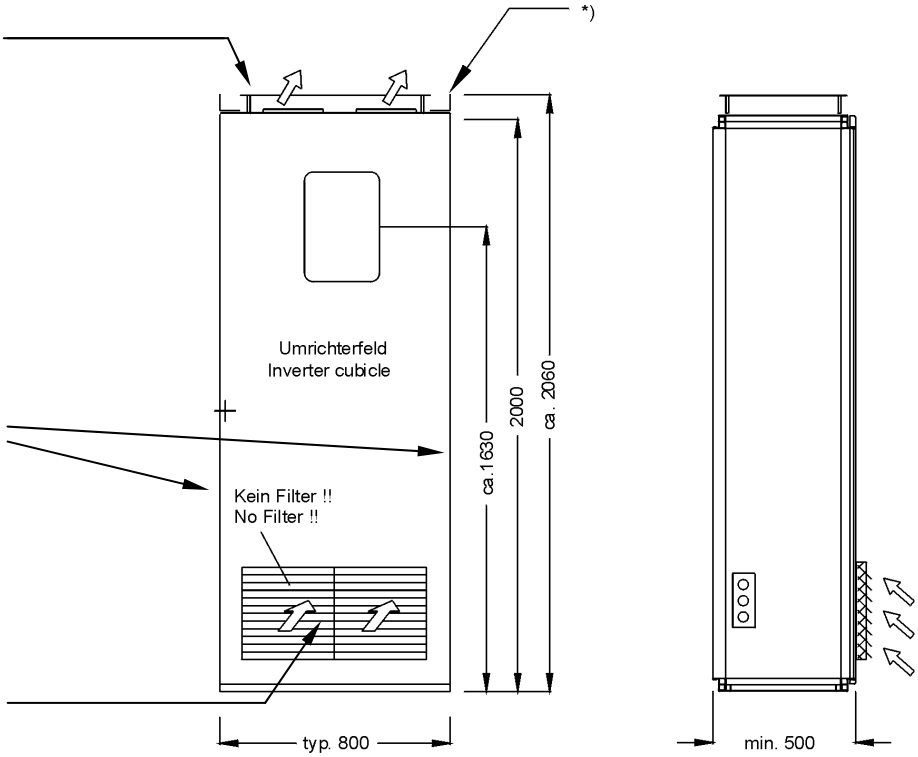
IP20 – IP23 Standard Installation, max. Ambient Temperature +35/+40°C

The cover plate must be spaced at a minimum of 60 mm and must allow a free air outlet on all sides.

*) Cut-off grating must be provided if an air counter-pressure is possible due to the fans in neighbouring fields.

Separating wall to neighbouring cubicle (does not have to be sealed!).

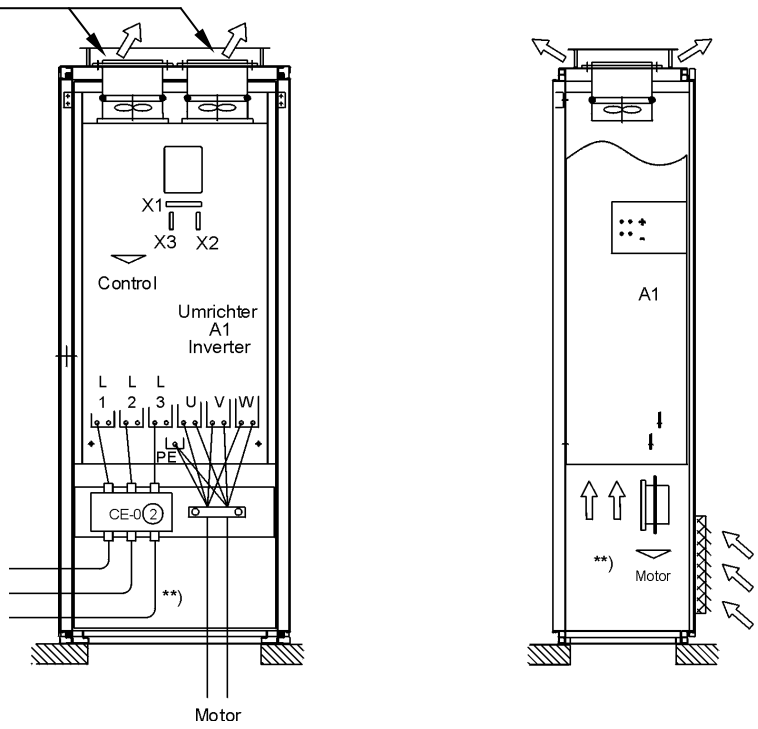
The air inlet of the inverter field must have a minimum size of 10 dm² (e.g. 2 ventilation grids)



2 air carbines (see options) inserted in the upper cubicle cover to prevent an air short
(inside diameter 195 mm with rubber washer to the fan).

Because of the installation in a cubicle the level of noise pressure of the device is reduced by approx. 3dB(A).

**) The air flow must not be obstructed by built-in devices! (CE filters and cable allowed). Do not mount heat sources beneath the inverter!



The MX size 4 needs an air flow of 1200 m³/h, which must not be obstructed by components in the in- and outlet area!
The flow rate in the outlet area is approx. 10 m/s (approx. 35 km/h), i.e. any air diversion will cause a great counter-pressure.
The maximum permissible ambient temperature (outside the cubicle) is +40°C.
(MX plus 250/315: max. +35°C).

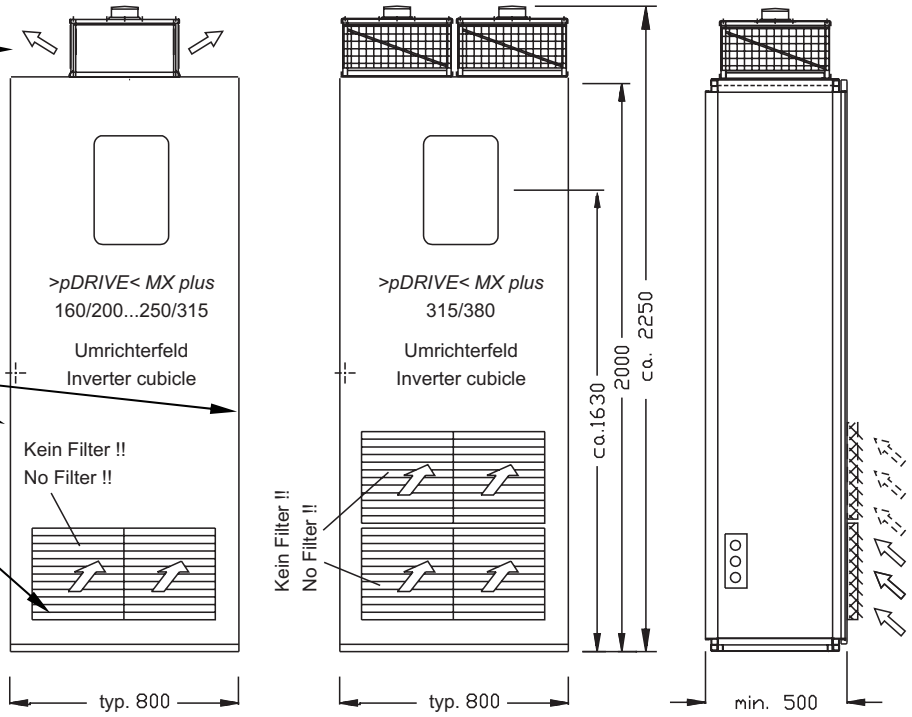
Typical Cubicle Installation for Size 4 (incl. *MX plus 315/380*)

IP20 – IP23 Standard Installation, max. Ambient Temperature +40/+45°C

Additional fan
(available as an option)
volume > 1200 m^3/h
(or > 2x 1200 m^3/h for
MX plus 315/380)

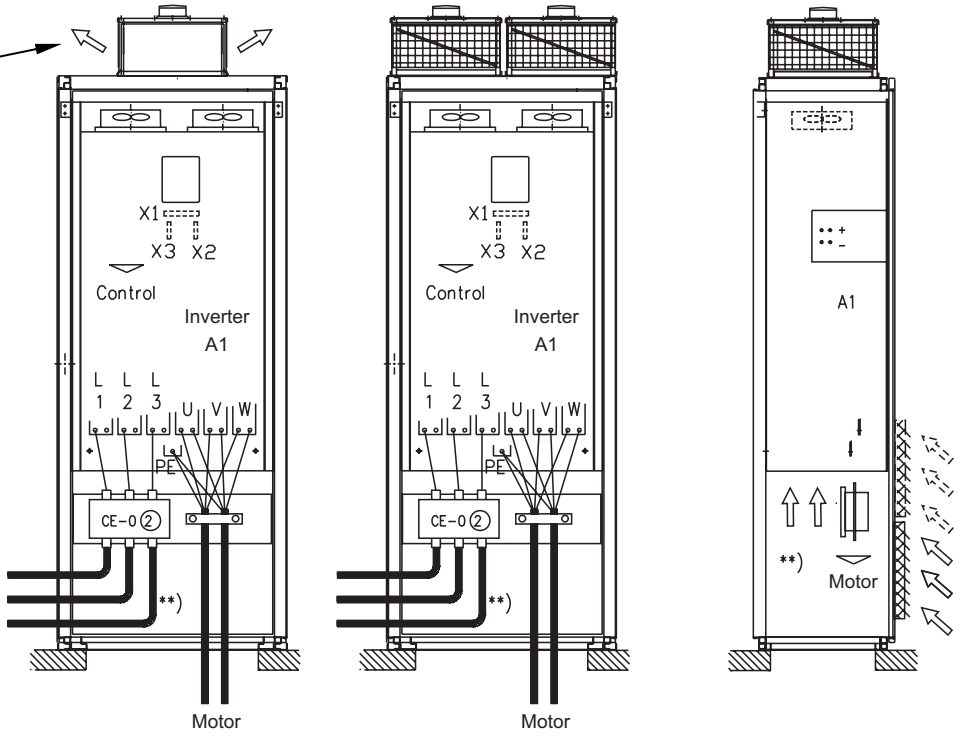
Separating wall to neighbouring cubicle (does not have to be sealed!).

The air inlet of the inverter field must have a minimum size of 10 dm^2 (e.g. 2 ventilation grids) (or 20 dm^2 for MX plus 315/380; that means 4 ventilation grids)



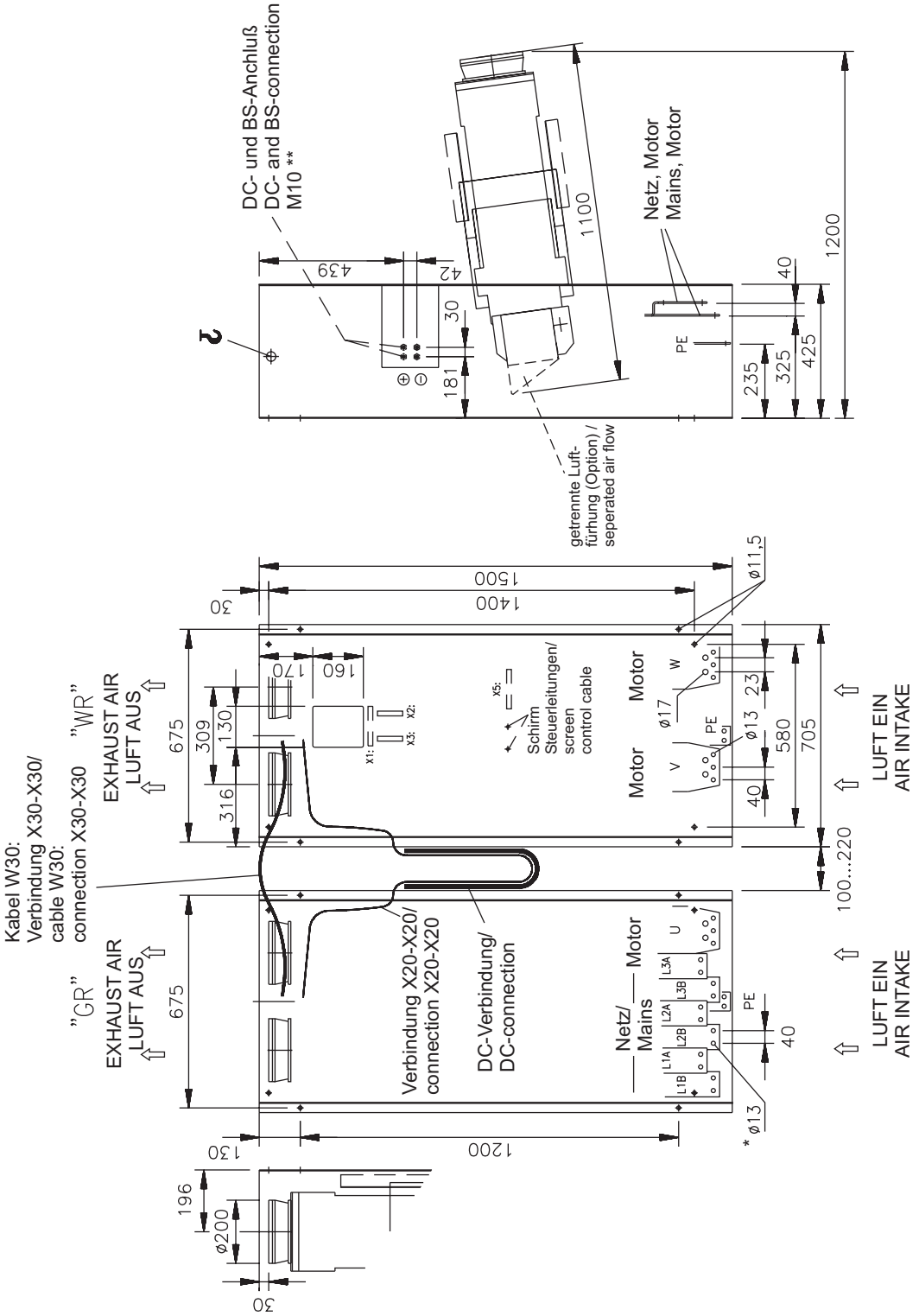
The cooling air flows out of the unit fans freely, and is extracted by the additional fan. No further air carbines are required.

**) The air flow must not be obstructed by built-in devices! (CE filters and cable allowed). Do not mount heat sources beneath the inverter!



The MX size 4 needs an air flow of 1200 m^3/h (or 2x 1200 m^3/h), which must not be obstructed by components in the in- and outlet area!!!
The maximum permissible ambient temperature (outside the cubicle) is +45°C.
(MX plus 250/315 and 315/380: max. +40°C).

Dimensions MX plus 315/400 to 500/630 - Size 5



* Tightening torque for M12 bolts: 70 Nm
** Tightening torque for M10 bolts: 40 Nm

X1 ... control terminal strip
X2 ... option slot 1 for option IO1
X3 ... option slot 2 for option IO1 or bus coupling
X5 ... option SFB4/5

	MX plus 315/400	MX plus 400/500	MX plus 500/630
Losses			
100 % "C"	7800 W	9700 W	12000 W
100 % "P"	9100 W	11300 W	14000 W
Cooling air volume	2400 m^3/h	2400 m^3/h	2400 m^3/h
Air in-/outlet	min. 20.0 dm^2	min. 20.0 dm^2	min. 20.0 dm^2
Weight	approx. 2 x 250 kg	approx. 2 x 250 kg	approx. 2 x 250 kg

Typical Cubicle Installation for Size 5

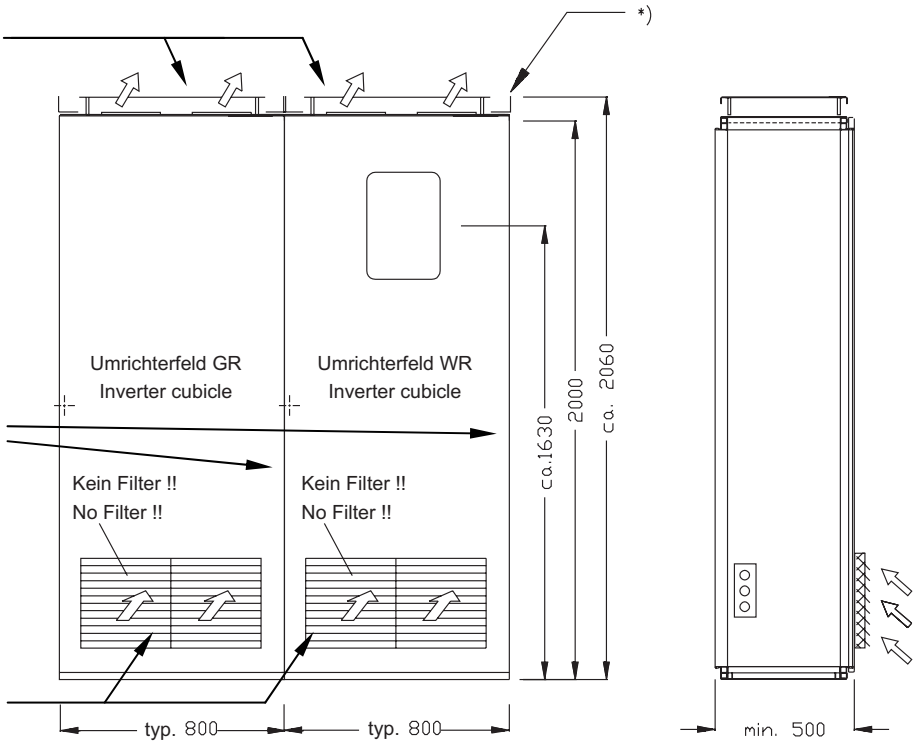
IP20 – IP23 Standard Installation, max. Ambient Temperature +35/+40°C

The cover plate must be spaced at a minimum of 60 mm and must allow a free air outlet on all sides.

*) Cut-off grating must be provided if an air counter-pressure is possible due to the fans in neighbouring fields.

Separating wall to neighbouring cubicle (does not have to be sealed!).

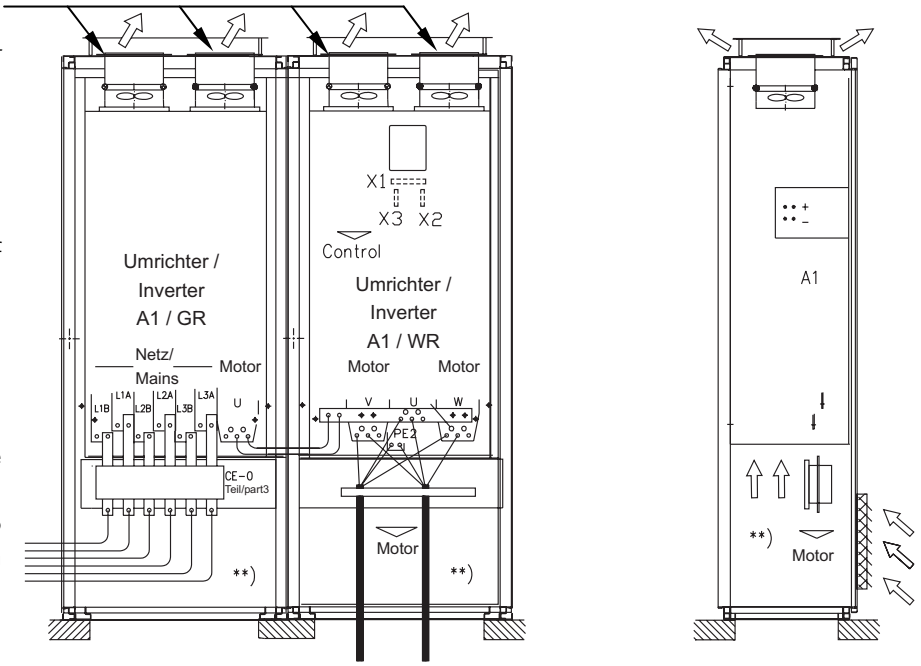
The air inlet of the inverter field must have a minimum size of 20 dm^2 (e.g. 4 ventilation grids)



2 air carbines (see options) inserted in the upper cabinet cover to prevent an air short
(inside diameter 195 mm with rubber washer to the fan).

Because of the installation in a cubicle the level of noise pressure of the device is reduced by approx. 3dB(A).

**) The air flow must not be obstructed by built-in devices! (CE filters and cable allowed). Do not mount heat sources beneath the inverter!



The MX size 5 needs an air flow of 2400 m^3/h, which must not be obstructed by components in the in- and outlet area!!!
The flow rate in the outlet area is approx. 10 m/s (approx. 35 km/h), i.e. any air diversion will cause a great counter-pressure.
The maximum permissible ambient temperature (outside the cubicle) is +40°C.
(MX plus 500/630: max. +35°C).

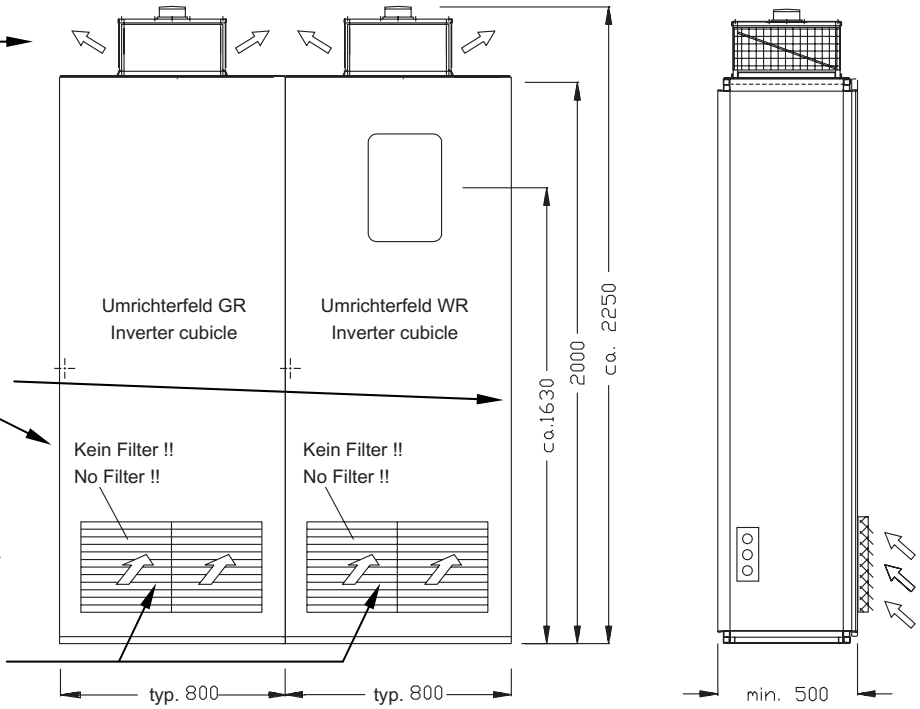
Typical Cubicle Installation for Size 5

IP20 – IP23 Standard Installation, max. Ambient Temperature +40/+45°C

2 additional fans
(available as an option)
volume > 1500 m^3/h

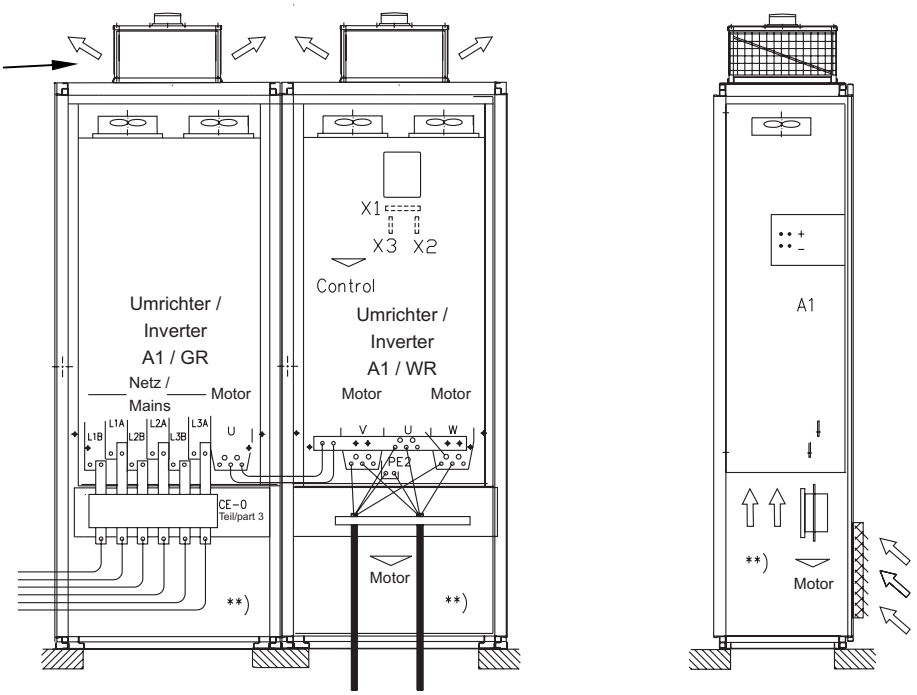
Separating wall to neighbouring cubicle (does not have to be sealed!).

The air inlet of the inverter field must have a minimum size of 20 dm^2 (e.g. 4 ventilation grids)



The cooling air flows out of the unit fans freely, and is extracted by the additional fan. No further air carbines are required.

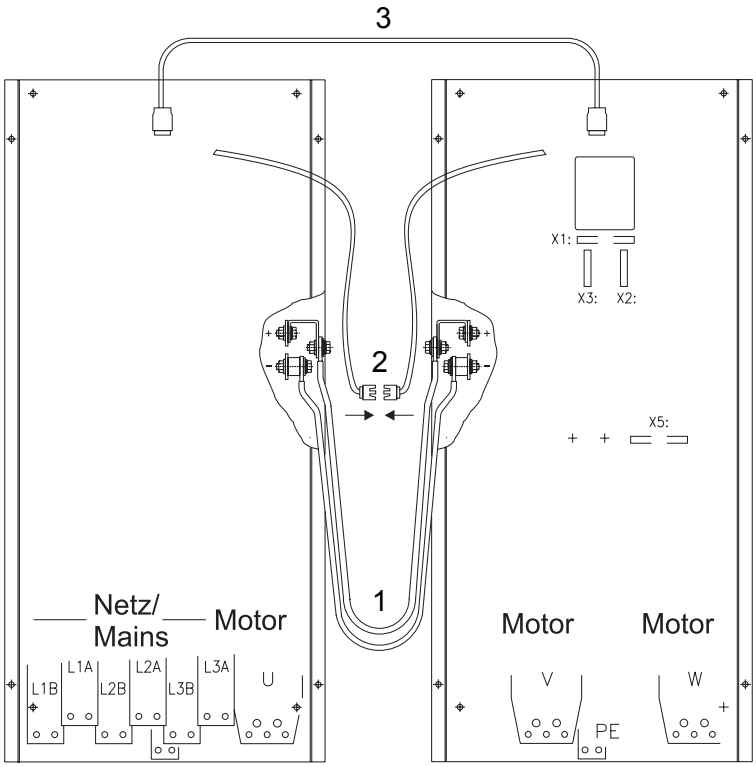
**) The air flow must not be obstructed by built-in devices! (CE filters and cable allowed). Do not mount heat sources beneath the inverter!



The MX size 5 needs an air flow of 2400 m^3/h, which must not be obstructed by components in the in- and outlet area!!!
The maximum permissible ambient temperature (outside the cubicle) is +45°C.
(MX plus 500/630: max. +40°C).

Mounting and Connection of Size 5

Frequency inverters of size 5 consist of 2 components that have to be connected electrically after mounting (allowed distance 100...200 mm).



1.) DC power connection

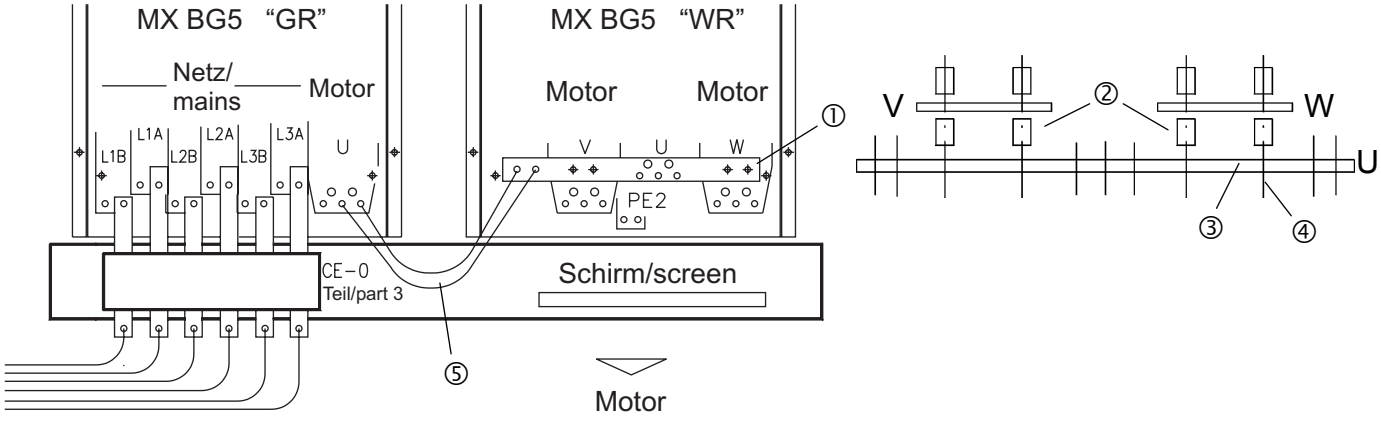
Clean the contact surfaces (e.g. with Scotch Brite). Tightening torque: 40 Nm

2.) Voltage measuring line, phase U
1-pole measuring line, which has to be connected using the plug connectors at both ends.

3.) Multi-pole control cable W30
Connects the slot X30 on PCB PB5 of the left unit with slot X30 on the central component ZB5 of the right unit.

Option: Motor Bar MX Size 5 Phase U

Remove the four fastening screws ① of phases V and W (nut + bolt).
Screw on the four insulated supports ② with the screwed-in threaded bolts.
Place bar (phase U) ③ across, and fasten with the enclosed M8 hex screws ④.
Fasten connection cables ⑤ to left part of unit (GR).



Highly conductive (large surface) connection between CE filter part 3 and motor cable bars.

Notes – Sizes 4 and 5

IP44 – IP54 Extended Protection Class

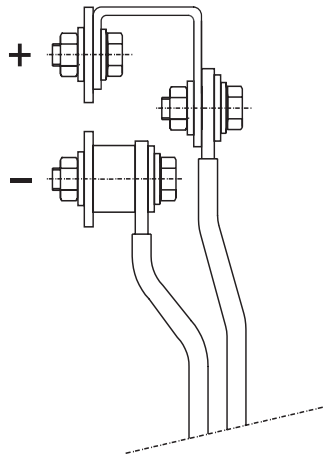
The frequency inverters of sizes 4 and 5 are designed for separate air guide. However, it is absolutely necessary to compensate for every additional loss of pressure.
When using these frequency inverters in areas where protection class IP44 of IP54 is required, we recommend the use of the developed and tested cabinet design.

In this case, however, only the factory-installed option "separate air guide" needs to be ordered.

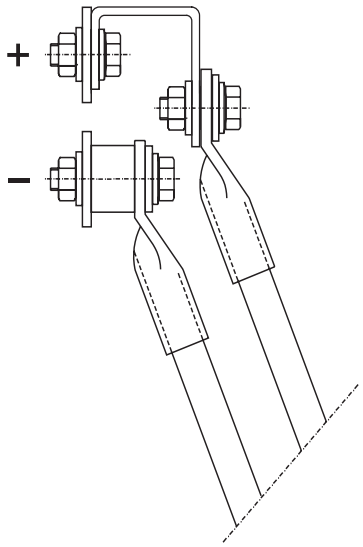
Option: DC Connection

For sizes 3, 4 and 5, the connection of a braking unit, mains regeneration and DC supply is possible at the side of the unit (left and/or right). For the connection of cables or flex-bars, the option "DC Connection" is necessary.
The connection is made accessible by removing the side cover.
The option consists of 2 long and 4 short connection bolts. Thus, DC connections can be mounted on both sides of the inverter (only on the left in *MX plus* size 3).

Design with bars



Design with round conductors



Option: Chokes FDR

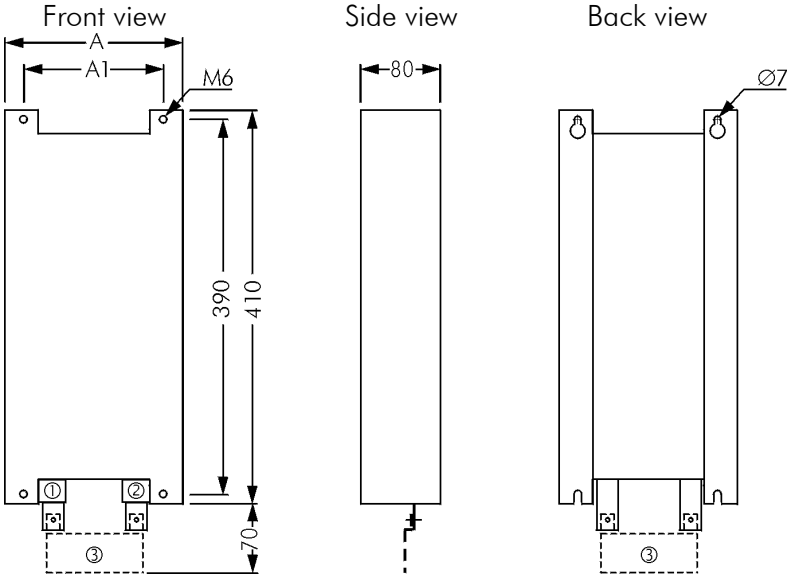
Use: By the use of the option FDR a practical variant in respect to mounting and connection of line choke and/or output motor filter AMF is available for frequency inverters of size A and B (*MX plus 04...11*).

Mutations:
Option >*pDRIVE*< *FDR-N* "Line choke"
for applications with short and medium motor cable lengths
Option >*pDRIVE*< *FDR* "Line choke + AMF" (combination of FDR-N and FDR-A)
for applications with medium and long motor cable lengths
Option >*pDRIVE*< *FDR-A* "Output motor filter AMF"
for mains supply with low short-circuit current and for DC supply

Note: During operation with full load, the voltage loss on the choke cannot be compensated by the inverter, i.e. the output voltage is 3% lower than the connected line voltage before the choke.
The maximum allowed mains short-circuit current without line choke is 5 kA for size A and 22 kA for size B !

Mounting: The option >*pDRIVE*< *FDR* hase to be mounted directly behind the frequency inverter. Above and below a space of min. 100 mm is necessary.

	FDR-N13	FDR 13	FDR-A13	FDR-N24	FDR 24	FDR-A24
Line choke						
Operating voltage	3 AC 400...500 V ±10%			3 AC 400...500 V ±10%		
Nom. frequency	50/60 Hz ±5%		no line choke built-in	50/60 Hz ±5%		no line choke built-in
Nom. current (therm.)	12 A			22 A		
Nom. current (magn.)	25 A			45 A		
Nom. inductivity	2 mH			1,25 mH		
Motor choke						
Operating voltage	no motor choke built-in	400...500 V		no motor choke built-in	400...500 V	
Nom. frequency		0...100 Hz			0...100 Hz	
Nom. current		13 A			24 A	
General data						
Protection degree	IP20			IP20		
Connection terminals	10 mm²			10 mm²		
Connection cable	2,5 mm²			4 mm²		
Losses	40 W	140 W	100 W	80 W	185 W	105 W
Weight	6,0 kg	8,5 kg	5,5 kg	10,5 kg	12,5 kg	9,0 kg
Dimension A	185 mm			240 mm		
DimensionA1	150 mm			200 mm		



① Terminals for mains connection (exists at FDR and FDR-N)

② Terminals for motor conneciton (exists at FDR and FDR-A)

③ EMV plate to connect the motor cable screen

OPTIONS

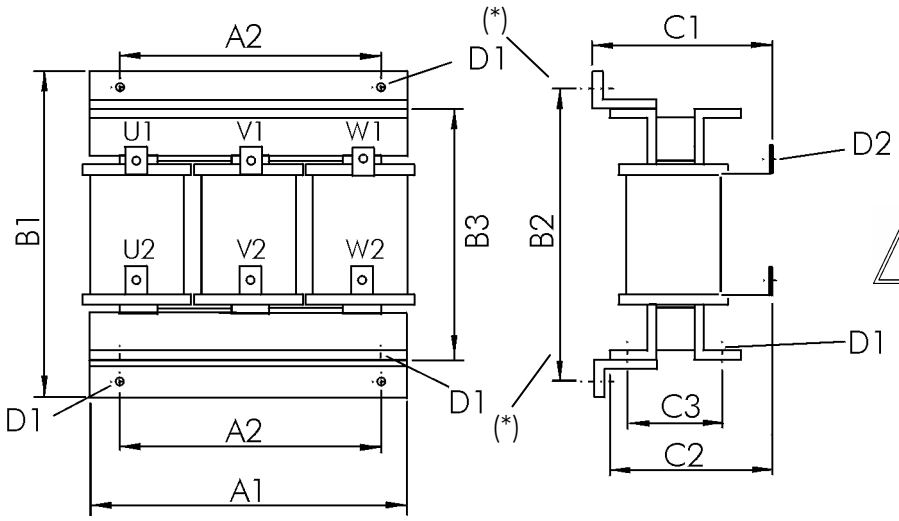
Accessories: Line Chokes NDU

Use: The line choke NDU is used to reduce the current harmonics caused by the DC link.

Note: During operation with full load, the voltage loss on the choke cannot be compensated by the inverter, i.e. the output voltage is 3% lower than the connected line voltage before the choke.

Mounting: The line chokes can be mounted in any position, but good ventilation must always be ensured. The transport angles also allow for mounting on the mounting plate.

	NDU 195	NDU 235	NDU 280	NDU 365	NDU 455	NDU 540	NDU 650
Operating voltage	400 V –15% to 690 V +10%						
Nominal frequency	50/60 Hz ±5%						
Nom. current (therm.)	195 A	235 A	280 A	365 A	455 A	540 A	650 A
Nom. current (magn.)	370 A	445 A	530 A	685 A	855 A	1025 A	1150 A
Nominal inductivity	155 µH	120 µH	98 µH	66 µH	49 µH	38 µH	38 µH
Protection class	IP00						
Connection	using connection lugs						
Losses	200 W	220 W	240 W	260 W	270 W	280 W	310 W
Weight	30 kg	35 kg	40 kg	43 kg	46 kg	55 kg	62 kg
Dimension A1	280 mm	320 mm	320 mm	320 mm	320 mm	320 mm	360 mm
Dimension A2	200 mm	225 mm	225 mm	225 mm	225 mm	225 mm	300 mm
Dimension B1	330 mm	380 mm	380 mm	380 mm	380 mm	380 mm	440 mm
Dimension B2	300 mm	350 mm	350 mm	350 mm	350 mm	350 mm	400 mm
Dimension B3	260 mm	300 mm	300 mm	300 mm	300 mm	300 mm	310 mm
Dimension C1	210 mm	210 mm	210 mm	250 mm	250 mm	250 mm	250 mm
Dimension C2	200 mm	200 mm	200 mm	230 mm	230 mm	230 mm	230 mm
Dimension C3	125 mm	150 mm	150 mm	150 mm	150 mm	150 mm	150 mm
Fastening D1	∅ 9 mm	∅ 9 mm	∅ 9 mm	∅ 11 mm	∅ 11 mm	∅ 11 mm	∅ 13 mm
Connection D2	∅ 11 mm	∅ 11 mm	∅ 11 mm	∅ 13 mm	∅ 13 mm	∅ 13 mm	2x ∅13mm
Connection PE	M10	M10	M10	M12	M12	M12	M12



The mounting bracket (*) can be removed!

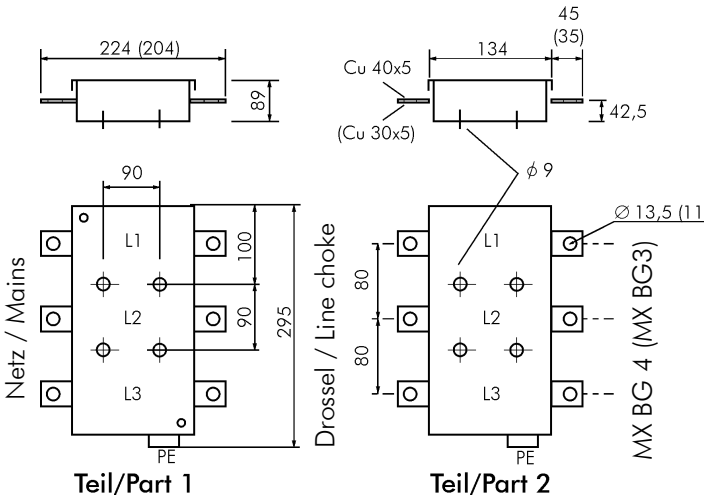
Option: CE Filter ("Mains-sided RFI Filter") for Grounded mains 400 V

	CE 400/73	CE 400/170	CE-0 400/300-TN	CE-0 400/570-TN	CE-0 400/1100-TN
Nominal voltage	3 AC 380...415 V ±10 %				
Nom. frequency	50/60 Hz ±5 %				
Nominal current	73 A	170 A	300 A	700 A	1100 A
Max. leakage current	appr. 400 mA	appr. 400 mA	approx. 500 mA	approx. 500 mA	approx. 1000 mA
Cont. leakage current	appr. 200 mA	appr. 200 mA	approx. 100 mA	approx. 100 mA	approx. 200 mA
Losses (approx.)	Option can only be built-in during assembly in the factory !!!		40 W	60 W	120 W
Ambient temp.			max. +50°C		
Protection class			IP00		
Weight (approx.)			5,5 kg	6,0 kg	11,0 kg
Connection			∅ 11 mm	∅ 13,5 mm	∅ 13,5 mm

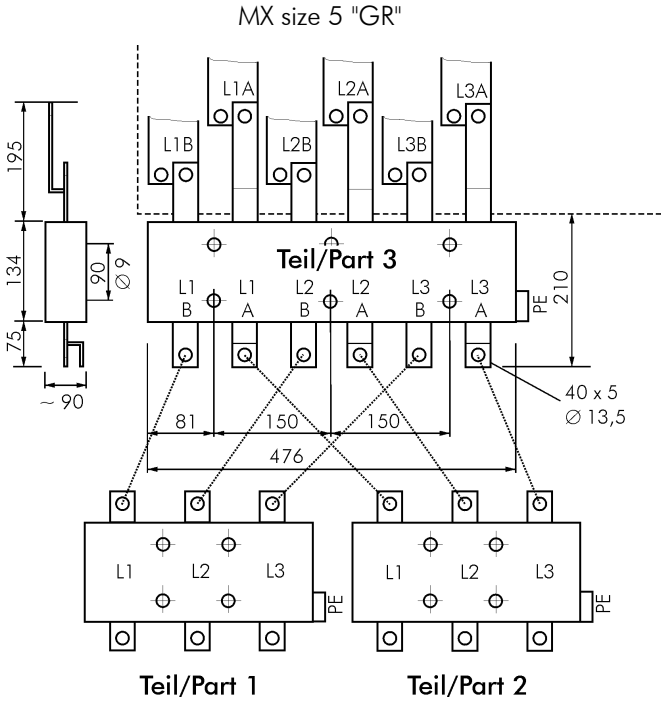
A good HF connection between the motor, motor cable screen and filter components near the inverter is imperative for the CE filter to be effective!

The filters CE-0 400/300 and 570 consist of 2 parts, the filter CE-0 400/1100 consists of 3 parts. They are located in front of the power choke and immediately in front of the inverter (see wiring scheme for sizes 3 to 5)!

The filter components for mains side and inverter side must not be exchanged.



CE-0 400/570; 2 parts
(values in brackets for CE-0 400/300)



CE-0 400/1100; 3 parts
Part 3 is connected directly to the MX size 5.
(dimensions of parts 1 and 2 see CE-0 400/570)

The CE filters are suitable only for grounded mains! See "Using the MX with Non-grounded mains"!

OPTIONS

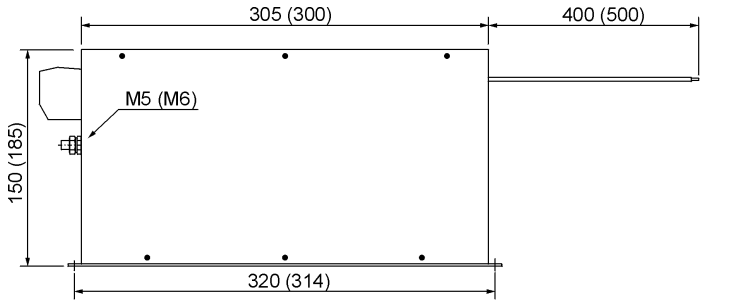
Option: RFI filter for IT- (non-grounded) mains

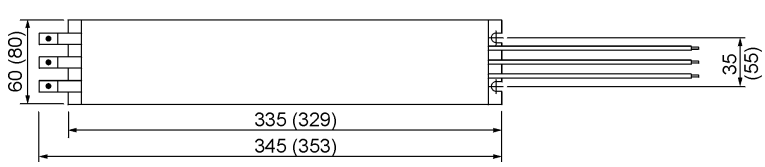
RFI 500 (Sizes A to 2)

	RFI 500/30	RFI 500/55	RFI 500/130
Nominal voltage	3 AC 380...500 V ±10 %		
Nominal frequency	50/60 Hz ±5 %		
Nominal current	30 A	55 A	130 A
Max. leakage current	approx. 60 mA	approx. 105 mA	approx. 105 mA
Cont. leakage current	< 17 mA	< 35 mA	< 35 mA
Losses (approx.)	12 W	18 W	50 W
Max. ambient temperature	+50 °C	+50 °C	+50 °C
Protection class	IP20	IP20	IP20
Weight (approx.)	1.8 kg	3.1 kg	7.5 kg
Connection	Terminals max. 10 mm², or cable	Terminals max. 25 mm², or cable	Terminals max. 95 mm²

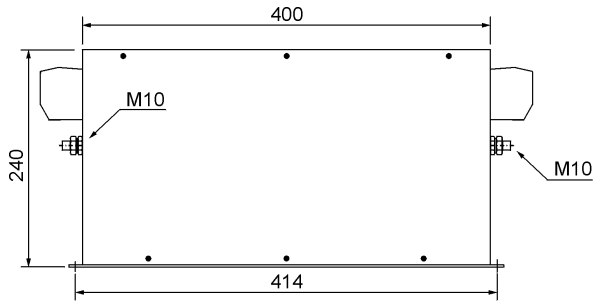
A good HF connection between the motor, motor cable screen and filter is imperative for the RFI filter to be effective!

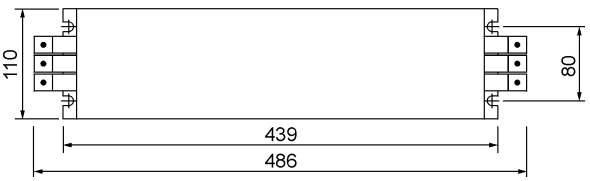
RFI 500/30
(values in brackets for RFI 500/55)





RFI 500/130

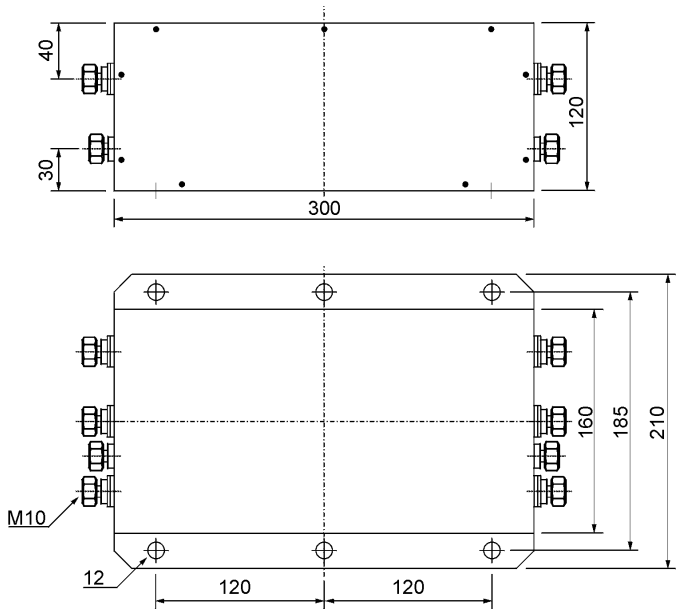




The RFI filters are suitable for non-grounded mains!
They can be integrated before or after the line choke.

RFI 700 (size 3)

	RFI 700/180
Nom. voltage	3 AC 380...690 V ±10 %
Nom. frequency	50/60 Hz ±5 %
Nom. current	180 A
Max. leakage current	approx. 450 mA
Cont. leakage current	< 6 mA
Losses (approx.)	38 W
Ambient temperature	max. +50 °C
Protection class	IP00
Weight (approx.)	6,5 kg
Connection	Bolt M10



A good HF connection between the motor, motor cable screen and filter is imperative for the RFI filter to be effective!

The RFI filters are suitable for non-grounded mains!
They can be integrated before or after the line choke.

CE-0 500/...-IT (size 3...5)

	CE-0 500/300-IT	CE-0 500/570-IT	CE-0 500/1100-IT
Nominal voltage	3 AC 380...500 V ±10 %		
Nominal frequency	50/60 Hz ±5 %		
Nominal current	300 A	700 A	1100 A
Max. leakage current	approx. 450 mA		approx. 900 mA
Cont. leakage current	< 6 mA		< 6 mA
Losses (max.)	40 W	60 W	120 W
Ambient temperature	max. +50 °C		
Protection class	IP 00		
Weight (approx.)	5,5 kg	6,0 kg	11,0 kg
Connection	Ø 11 mm	Ø 13,5 mm	Ø 13,5 mm

The dimensions of the CE-0 500/...-IT filters are identical with the dimensions of the CE-0 400/...-TN filters.

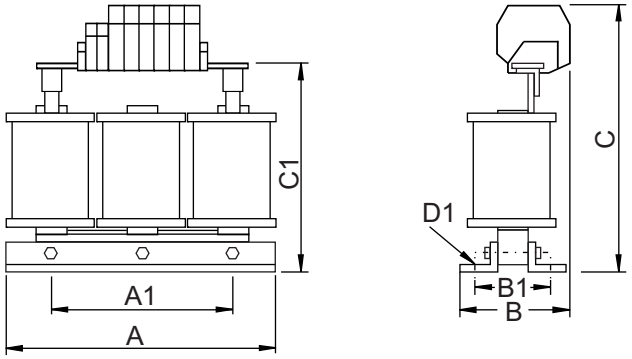
CE-0 filters "-IT" are designed for higher voltages and for non-grounded mains. The "-TN" filters are only suitable for 3 AC 400 V grounded mains !

Option: AMF (Output Motor Filter)

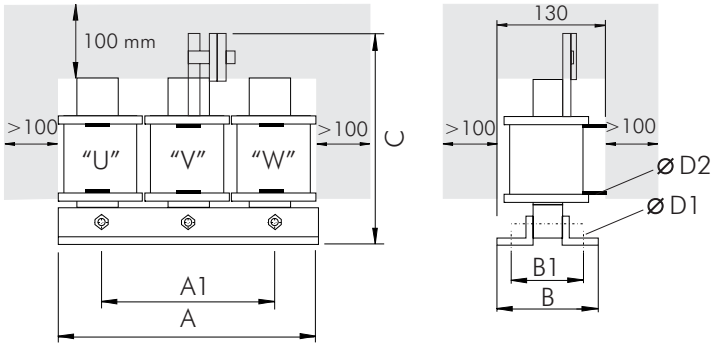
When installing the AMF filter, it is important to ensure sufficient ventilation and the necessary distance to other units and housing components! Any installation position can be chosen.

	AMF 450/12	AMF 450/48	AMF 450/90
Nominal voltage	400...500 V		
Nominal frequency	0...100 Hz		
Nominal current	12 A	48 A	90 A
Max. losses	150 W	250 W	350 W
Protection class	IP00		
Weight	5.5 kg	8 kg	10 kg
Dimension A	190 mm	200 mm	240 mm
Dimension B	90 mm	130 mm	100 mm
Dimension C	200 mm	235 mm	200 mm
Dimension A1	170 mm	170 mm	180 mm
Dimension B1	45 mm	48 mm	78 mm
Fastening D1	8 x 12 mm	8 x 12 mm	8 x 12 mm
Connection D2	max. 10 mm^2	max. 16 mm^2	∅ 11 mm
Connection PE	—	—	—

Dimensions, AMF 450/12 and 48:



Dimensions, AMF 450/90



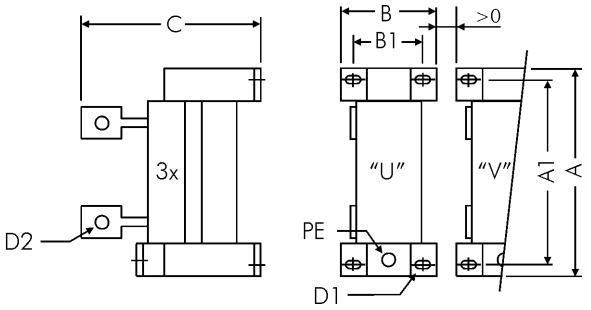
Due to the magnetic stray field of the AMF filter, the recommended distances above and on the sides must be observed, i.e. no mounting plates, steel bars, control lines, electronic components, etc.

Direct mounting on a mounting plate made of steel is admissible.

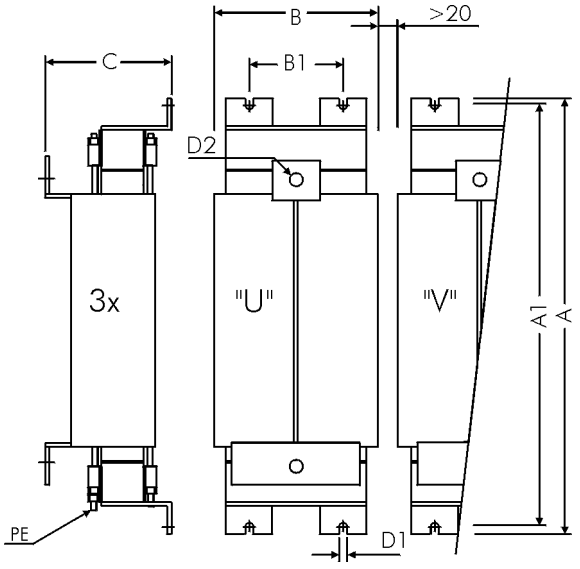
When installing the AMF filter, it is important to ensure sufficient ventilation and the necessary distance to other units and housing components! Any installation position can be chosen.
The AMF 450/170-3...1100-3 consist of three single-phase chokes that can be arranged in any order.

AMF 450/	170-3	300-3	580-3	1100-3
Nominal voltage	400...500 V			
Nominal frequency	0...100 Hz			
Nominal current	170 A	300 A	580 A	1085 A
Max. losses	500 W	650 W	800 W	1000 W
Protection class	IP00			
Weight	10 kg	17 kg	40 kg	110 kg
Dimension A	160 mm	160 mm	375 mm	475 mm
Dimension B	80 mm	160 mm	185 mm	210 mm
Dimension C	175 mm	135 mm	155 mm	210 mm
Dimension A1	130 mm	135 mm	335 mm	435 mm
Dimension B1	60 mm	140 mm	75 mm	125 mm
Fastening D1	9 x 13 mm	9 x 13 mm	9 x 20 mm	9 x 20 mm
Connection D2	Ø 9 mm	Ø 11 mm	Ø 13 mm	2 x Ø 13 mm
Connection PE	Ø 9 mm	Ø 11 mm	M8	M12

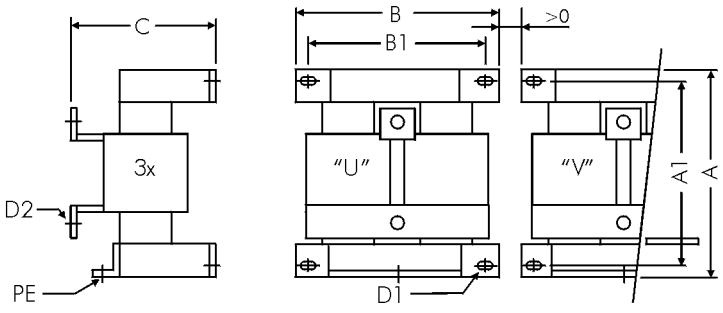
Dimensions, AMF 450/170-3:



Dimensions, AMF 450/580...1100-3:



Dimensions, AMF 450/300-3:



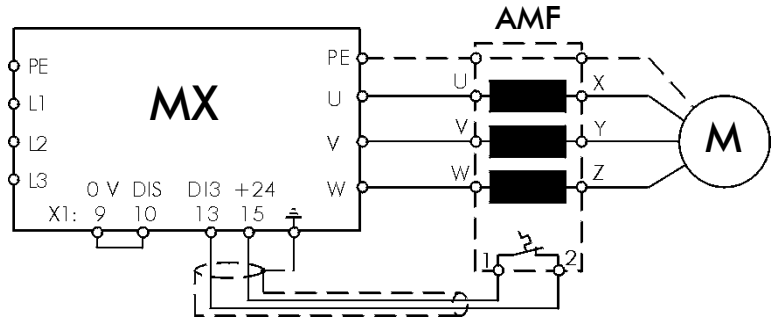
Due to the magnetic stray field of the AMF filter, the recommended distances above and on the sides must be observed, i.e. no mounting plates, steel bars, control lines, electronic components, etc.

Direct mounting on a mounting plate made of steel is admissible.

OPTIONS

Integration of the Thermoclixon of the Output Motor Filter (AMF 450/12, 48 and 90 only)

For a switch-off in the event of overheating of the choke, a thermoclixon can be integrated in the external trip circuit of the inverter (e.g. digital input DI3 (terminal 13) is set to "external fault").



Necessary parameter settings:

D2.02 DI3 selection set to "22...External fault"
E3.11 External fault Activation set to "6...N.C. Run"
E3.12 External fault Reaction set to "0...Trip" and
E3.13 External fault Time delay set to 1,0 s.

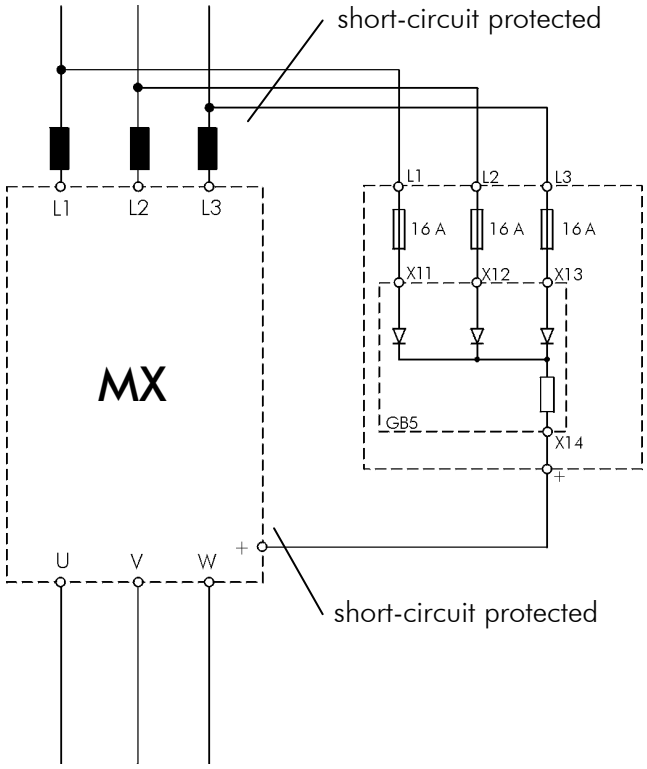
Opening the clixon during operation will lead to a trip with the message "external fault".

Option: External Charging Circuit LS5

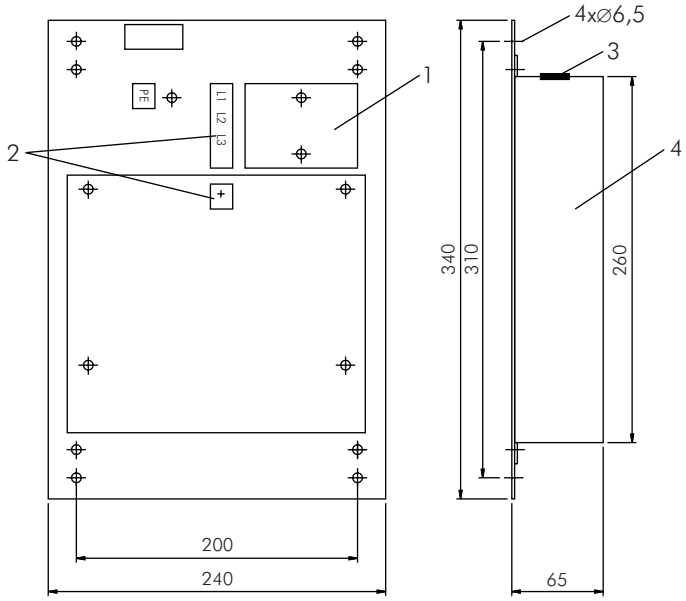
In order to prevent an overload and thus failure of the internal charging circuit in DC-coupled drives, the external charging device LS5 should be used as shown in the following wiring scheme.

The LS5 device can be used with all sizes and operating voltages. It can charge inverters with a total power of 500 kW. The mains-sided connection can be implemented before or after the line choke.

Wiring scheme



Dimensions



1 ... Fuse (mains-sided) 3 x 16 A
2 ... Connection for mains and DC link
3 ... Cable entry
4 ... Casing of punched metal

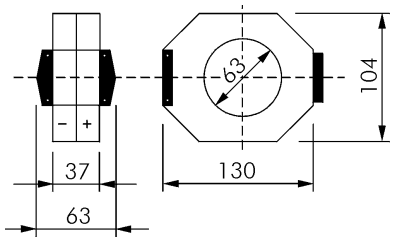
The LS5 can be mounted in any position, but the heat dissipation must be taken into account (approx. 50 W)!!

OPTIONS

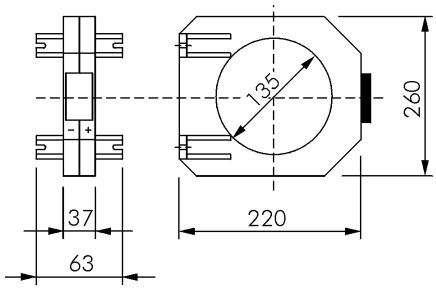
Option: Earth Fault Detection 1 and 2

As described in "Use of the MX in non-grounded Mains", a fault current detection is necessary to protect the inverter in case of insulation faults on the output side. The option "Earth Fault Detection" makes use of one of the comparator blocks available in the inverter to evaluate the measured leakage current. In the following wiring example, the measured leakage current is supplied to the software comparator for evaluation via the analogue input, and is evaluated as "insulation current".

Earth fault detection 1



Earth fault detection 2



Wiring and Parameter Settings

The earth fault detection in IT mains absolutely requires a certain wiring and specific parameter settings on the control card UI or on one of the option cards IO1.

Parameter settings for option "Earth fault detection 1 and 2"

	Variant 1	Variant 2	Variant 3
Configuration of the analogue input			
D1.04 AIC selection	= 0 not used		
D1.05 AIC signal type	= 0 0...20mA		
D1.08 AIC filter time	= 1.00s		
D1.09 AI_2 selection		= 0 not used	
D1.10 AI_2 signal type		= 0 0...20mA	
D1.13 AI_2 filter time		= 1.00s	
D1.14 AI_3 selection			= 0 not used
D1.15 AI_3 signal type			= 0 0...20mA
D1.18 AI_3 filter time			= 1.00s
Setting for trigger level			
F4.08 C2 signal on E1	= 16 AIC	= 17 AI_2	= 18 AI_3
F4.09 C2 filter for E1	= 1.0s	= 1.0s	= 1.0s
F4.10 C2 comp. Reference	= +5.0% *	= +5.0% *	= +5.0% *
F4.11 C2 comp. Function	= 0 E1 > E2	= 0 E1 > E2	= 0 E1 > E2
F4.12 C2 comp. hyst/band	= 1.0%	= 1.0%	= 1.0%
F4.13 C2 time function	= 0 ON-delay	= 0 ON-delay	= 0 ON-delay
F4.15 C2 destination	= 24 insulation fault	= 24 insulation fault	= 24 insulation fault
E3.18 Insulation fault Activ.	= 3 N.O. run	= 3 N.O. run	= 3 N.O. run
E3.19 Insulation fault Resp.	= 0 Trip	= 0 Trip	= 0 Trip
E3.20 Insulation fault time d.	= 10.0s **	= 10.0s **	= 10.0s **

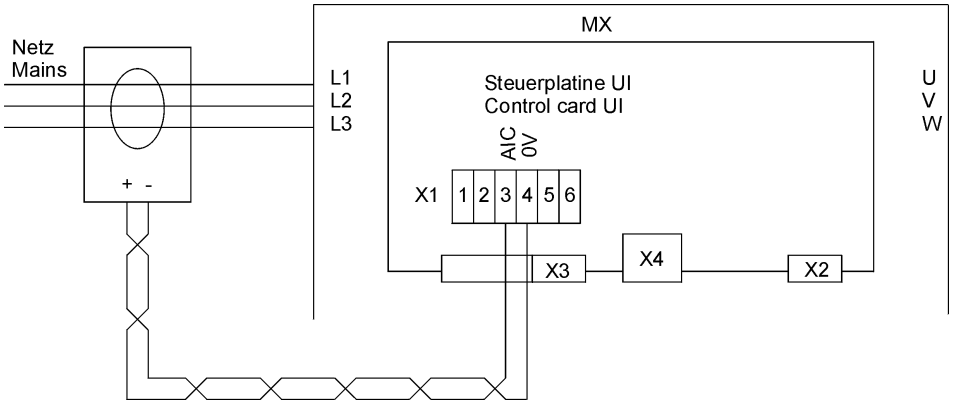
* ... Setting for leakage current trigger level a leakage current of 50A with earth fault detection 1 or 100A with earth fault detection 2 corresponds with an analogue signal of 20 mA and is displayed internally as 100%.

** ... In IT mains of small dimension (low capacitance against earth), this value can also be set higher. In the event of an earth fault (in the inverter, motor cable or motor), a trip shutdown occurs with the error message "Insulation fault".

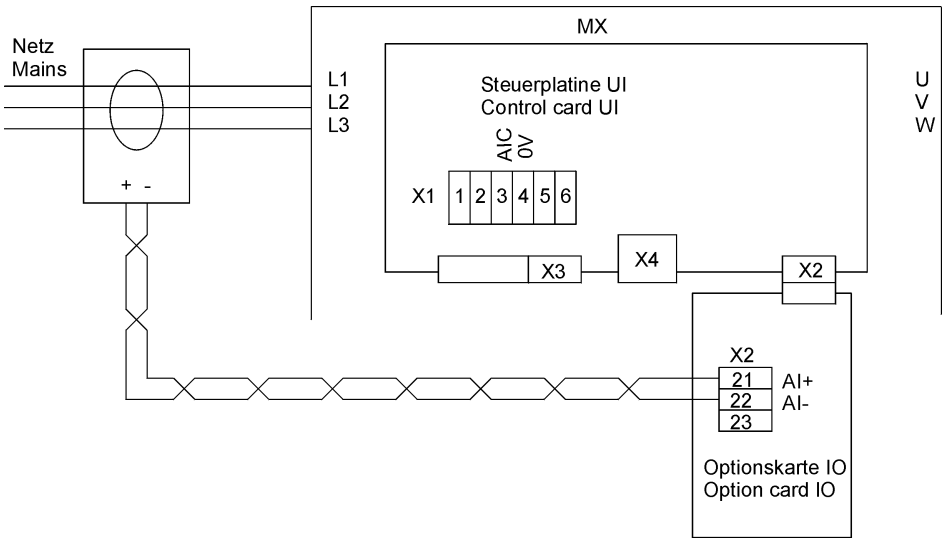
Leakage current for earth fault detection 1 (for earth fault detection 2)		Analogue signal	Internal value
1 A	(2 A)	0.4 mA	2 %
2.5 A	(5 A)	1 mA	5 % *)
5 A	(10 A)	2 mA	10 %
10 A	(20 A)	4 mA	20 %
50 A	(100 A)	20 mA	100 %

*) Typical setting

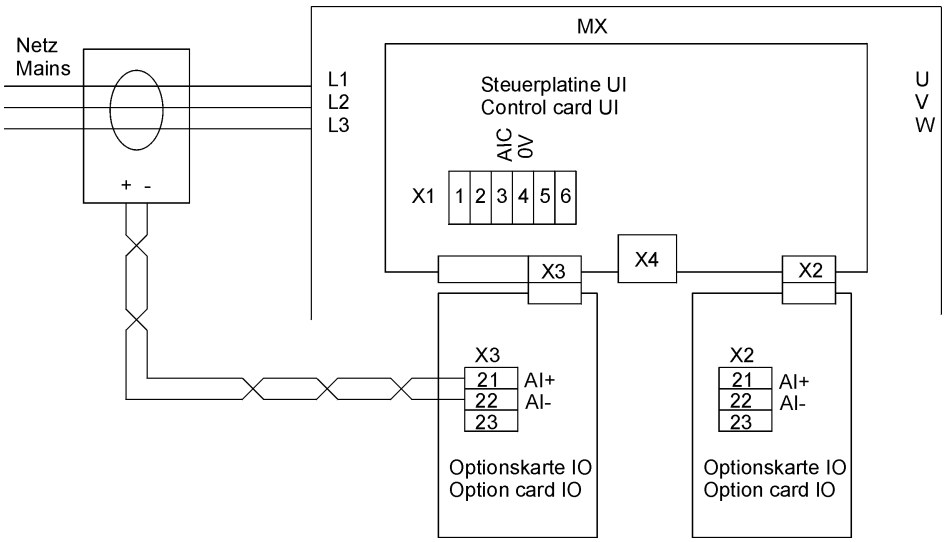
Variant 1: Destination of the analogue input AIC on the UI



Variant 2: Destination of the analogue input AI_2 on the IO1 (X2)



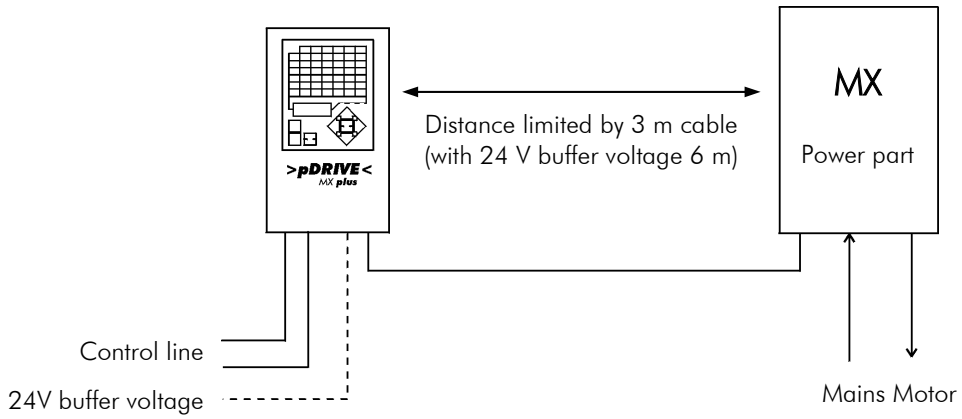
Variant 3: Destination of the analogue input AI_2 on the IO1 (X3)



CAUTION!
After every return to default parameter settings, the indicated parameter settings must be restored!

Option: BE5-A (External Operating Panel)

This option makes remote use of the control PCB of the inverter, including the option cards, LCD display and membrane keypad, possible. The panel can be swivelled, thus guaranteeing access to the control terminals at any time when the cubicle door is open.



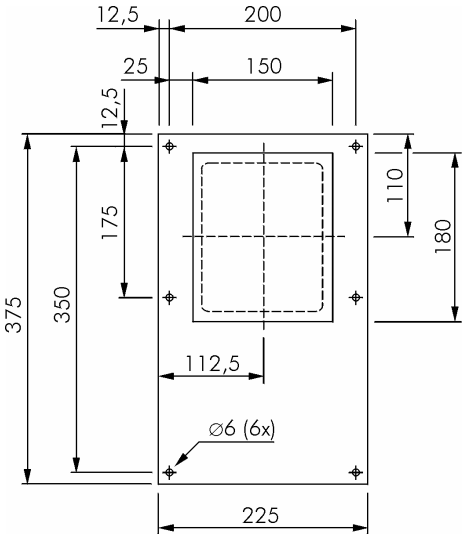
The BE5-A is installed on a metal plate of 1...2 mm thickness (e.g. inside the cubicle door) as shown on the drilling diagram (6 holes with ∅ 6 mm and one opening 150 x 180 mm).

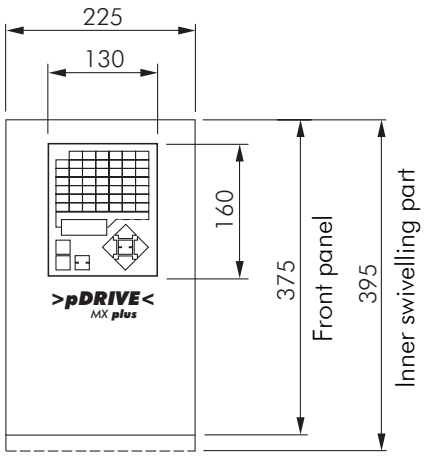
The inner swivel part is 20 mm longer than the front cover at the bottom! The cable outlets are also provided at the bottom!

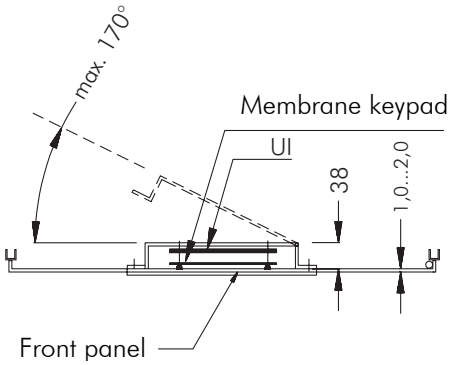
To mount the BE5-A, the front panel is inserted with the threaded bolts and screwed on from the back of the swivel frame.

For proper potential connection, 3 toothed disks have to be inserted between the cubicle door and the hinge angle!

Drilling diagram







For the electric connection, the control PCB (UI) and any option cards (IO1 or PBO1) as well as the membrane keypad have to be removed from the inverter and inserted into the BE5-A.

The connection is implemented with the enclosed 3 m control cable.

A fitting cover is enclosed for the remaining opening in the inverter's front cover.

On delivery, the option BE5-A is prepared for a cubicle door hinged on the right. Conversion to a cubicle door hinged on the left is possible.

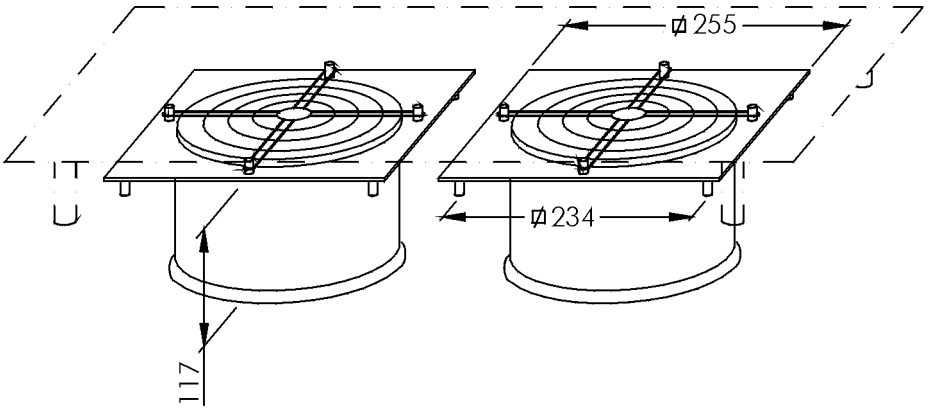
OPTIONS

Option: Air conduction, MX Size 3 to 5, at the top

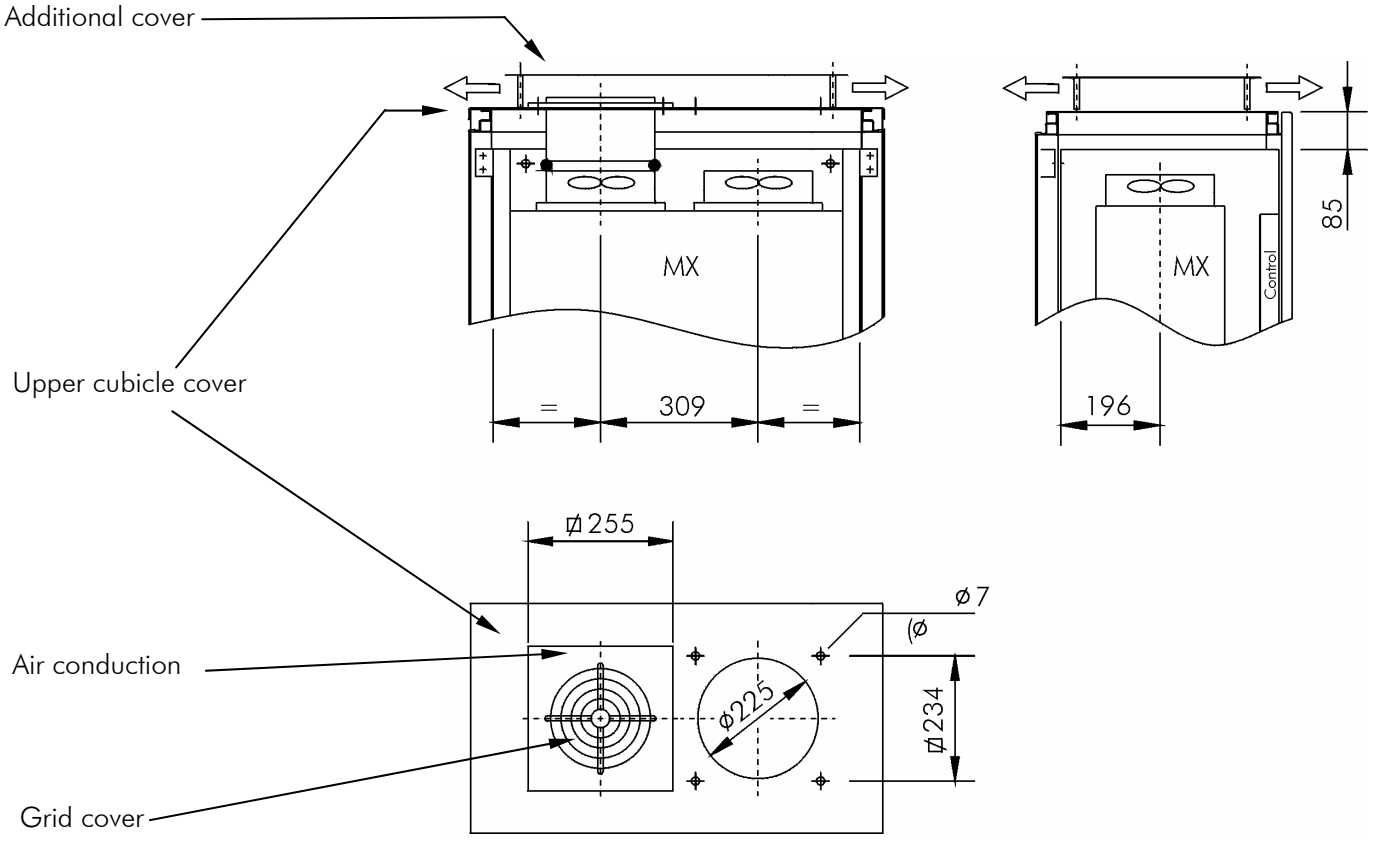
This option allows a complete extraction of the heated cooling air from the cubicle. Additionally, the level of noise pressure of the inverter built-in is reduced by approx. 3dB(A). The option is installed in the upper cubicle cover, 85 mm above the top edge of the inverter.
For *>pDRIVE< MX* size 3 one air conduction is necessary, size 4 requires 2, and size 5 requires 4 pieces of air conduction.

For compliance with protection class IP20, the option includes a ventilation grid at the top of the air conduction.

With an additional cover, the protection class IP 23 is achieved.
(recommended dimensions: 700 x 400 mm, 60 mm from the upper cubicle cover)



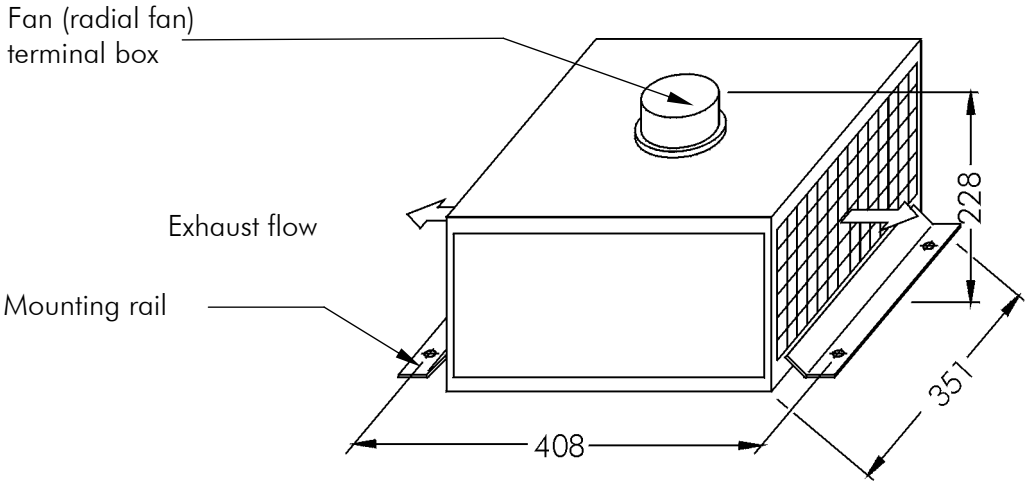
Drilling diagram for the top cubicle cover



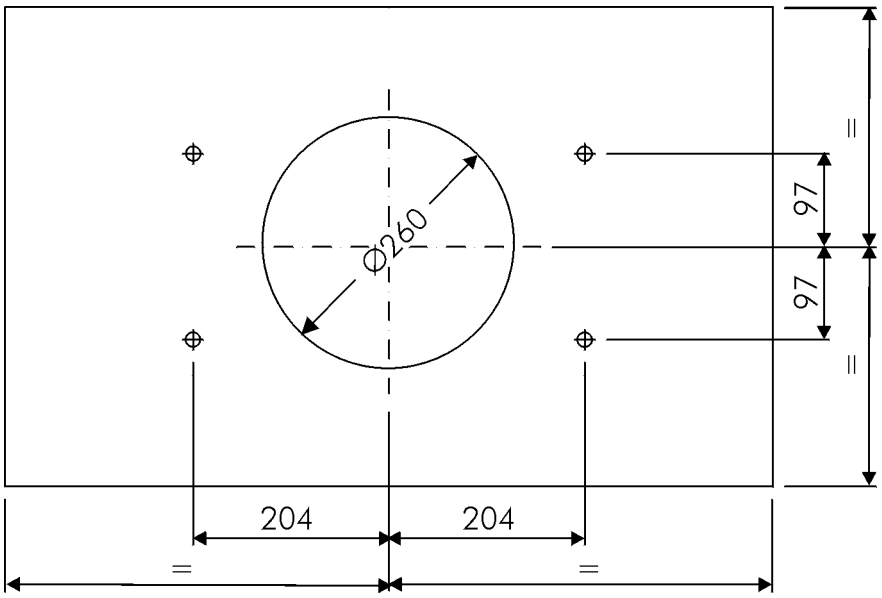
Option: Fan Module

By using the fan module, the heated cooling air is extracted from the cubicle. The capacity is clearly higher than the volume flow of the device fans, and additional air guide channels are not necessary.

Technical data:
- 1200 m^3/h capacity at 110 Pa counter-pressure
- Nominal voltage: 3 AC 400 V, 50 Hz
- Nominal current: 0.3 A
- Sound pressure level: approx. 73 dB (A)
- Connection: in the terminal box on U1, V1, W1 (star point on U2 – V2 – W2)



Drilling diagram



CAUTION – Risk of electric shock

– Ground equipment.
– Before servicing:
  Remove all power, wait 5 minutes. Verify no voltage is present.
– After servicing, close cover.

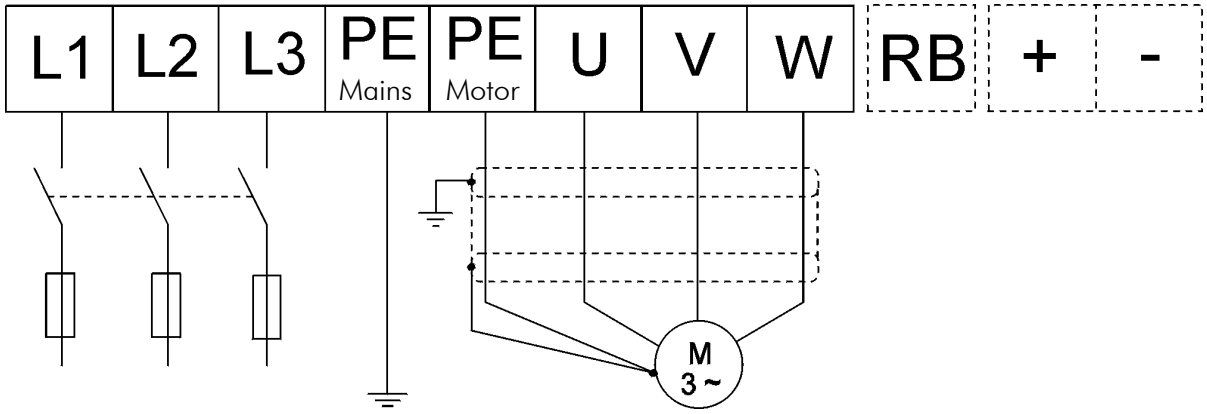
Failure to comply will result in injury or death!

Power Connections

Electronic installation work must be performed only by properly qualified staff. The use of switching gears before the inverter must be in full compliance with the pertinent regulations.

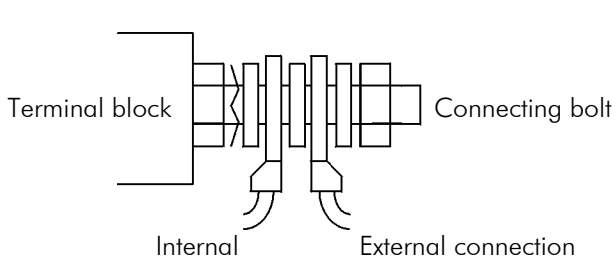
The front cover must be removed before connecting the power and control terminals. Do not apply any mains voltage to the terminals U, V and W, since this may damage the frequency inverter.

MX plus 04 to 500/630

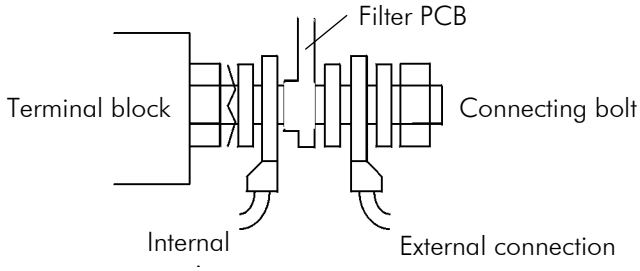


Terminal	Function	Description
L1, L2, L3	Mains connection	3 AC 400 V -15% to 500 V +10 %, 50/60 Hz ± 5 % for TT, TN or IT mains
U, V, W	Motor connection	3 AC 0...U_{Mains}
PE mains	Earth connection	for mains supply
PE motor	Earth connection	for motor cable (and motor cable screen, if CE filter is built in)
RB	Braking resistor	for connection of a braking resistor (sizes A and B only)
+, –	DC link	for connection of the braking unit, mains regeneration, DC link coupling and DC supply (standard in sizes 3...5, optional in sizes 1 and 2)

Connection to Sizes 1 and 2



Without CE filter



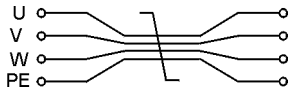
With CE filter

Do not apply current to the steel nut!

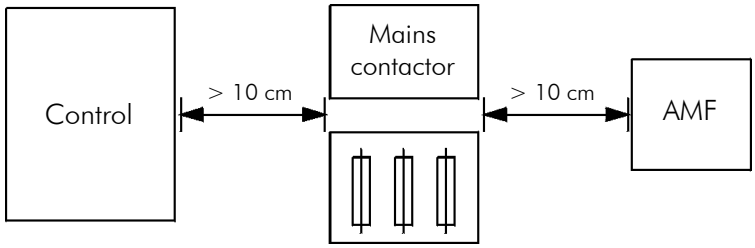
CONNECTION

General Connection Information

1.) Power lines with single wires, especially motor lines, should always be layed as close to the corresponding PE line as possible.

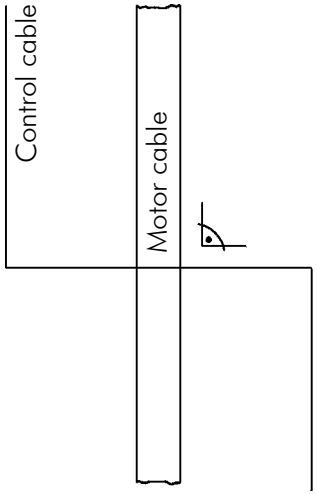


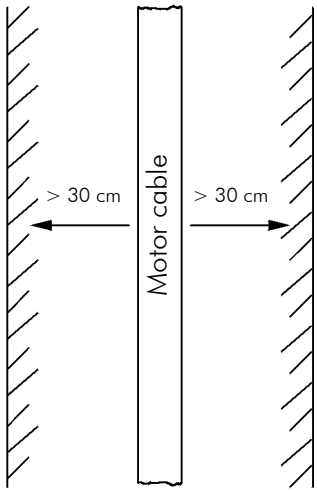
2.) Control cables, mains supply and motor lines should be separated from each other, if possible.



3.) **Never lay control, mains and motor cable in the same cable conduit!**

If the crossing of cables cannot be avoided, make sure they cross at right angles.

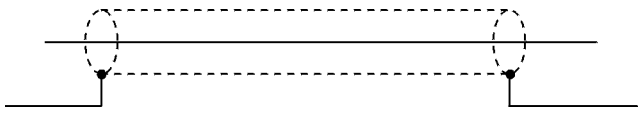




Control lines should have a minimum distance of 30 cm from motor cables.

If the distance is smaller, e.g. inside a cubicle, smaller distances are permissible.

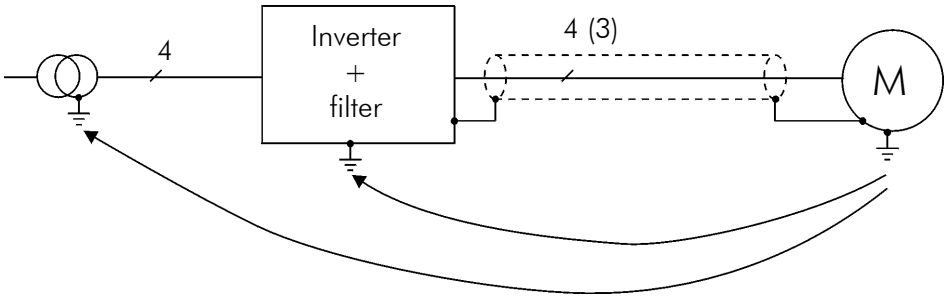
4.) Use only screened control cables (*exception*: relay contacts and possibly digital inputs, if they are completely separate from the power lines). Always earth the screen at both ends (*exception*: in case of problems with earth loops caused by offset currents that heat the screen, earth only on the signal input side or use a parallel offset line).



5.) Implement EMC earthing of the CE filter, the mounting plate and the cubicle.
Since power failures and the actual influence on other consumers are measured with reference to the earth potential, the inductivity of the "earthing" is extremely significant. This means that large-surface earth connections, which can run parallel to the yellow/green protection earthing PE, are very important.

6.) Free wires in the motor cable (e.g. a blue N core) must be clamped to the PE motor at least on the inverter side. Otherwise they could lead to dangerous voltages.

7.) The motor cable screen serves to prevent the dissipation of interfering currents via the earthed motor (motor foundation). It leads them back to the line filter of the inverter.
Its second task is to reduce the stray radiation and to reduce coupling with neighbouring lines.
Therefore, a screened 4-pole motor cable should be used, and the screen should be connected at both ends in accordance with the valid HF rules. The type of screen material (copper or steel) is less important than a good connection at both ends. Alternatively, a closed, conductive metal cable conduit that is connected all the way can also be used.

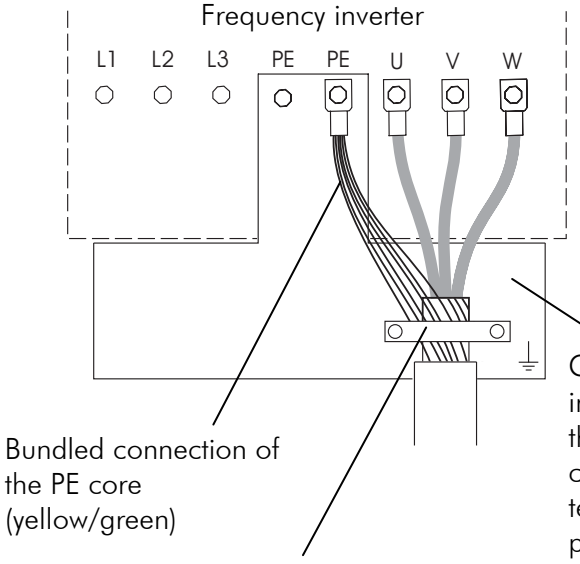


An advantageous possibility (for use in industrial environments) for large cable diameters is the use of power cables with a concentric protection core (e.g. NYCY or NYCWY cables). Thereby, the protective core has the same function as the PE core, as well as the screening function.

Connection model for NYCY motor cables:

Because of the dual function of the PE core, it is necessary to implement the cable connection at the inverter and the motor end correctly.

Size A...2:

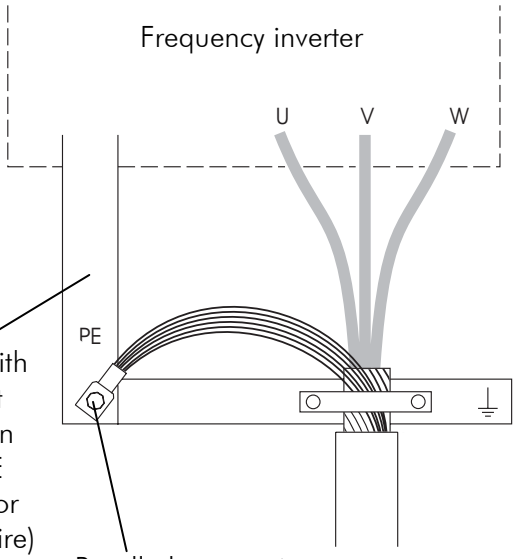


Bundled connection of the PE core (yellow/green)

Large-surface connection for diversion of HF currents

Good HF connection with inverter CE filter, and at the same time protection core connection with PE terminal (green/yellow or parallel green/yellow wire)

Size 3...5:



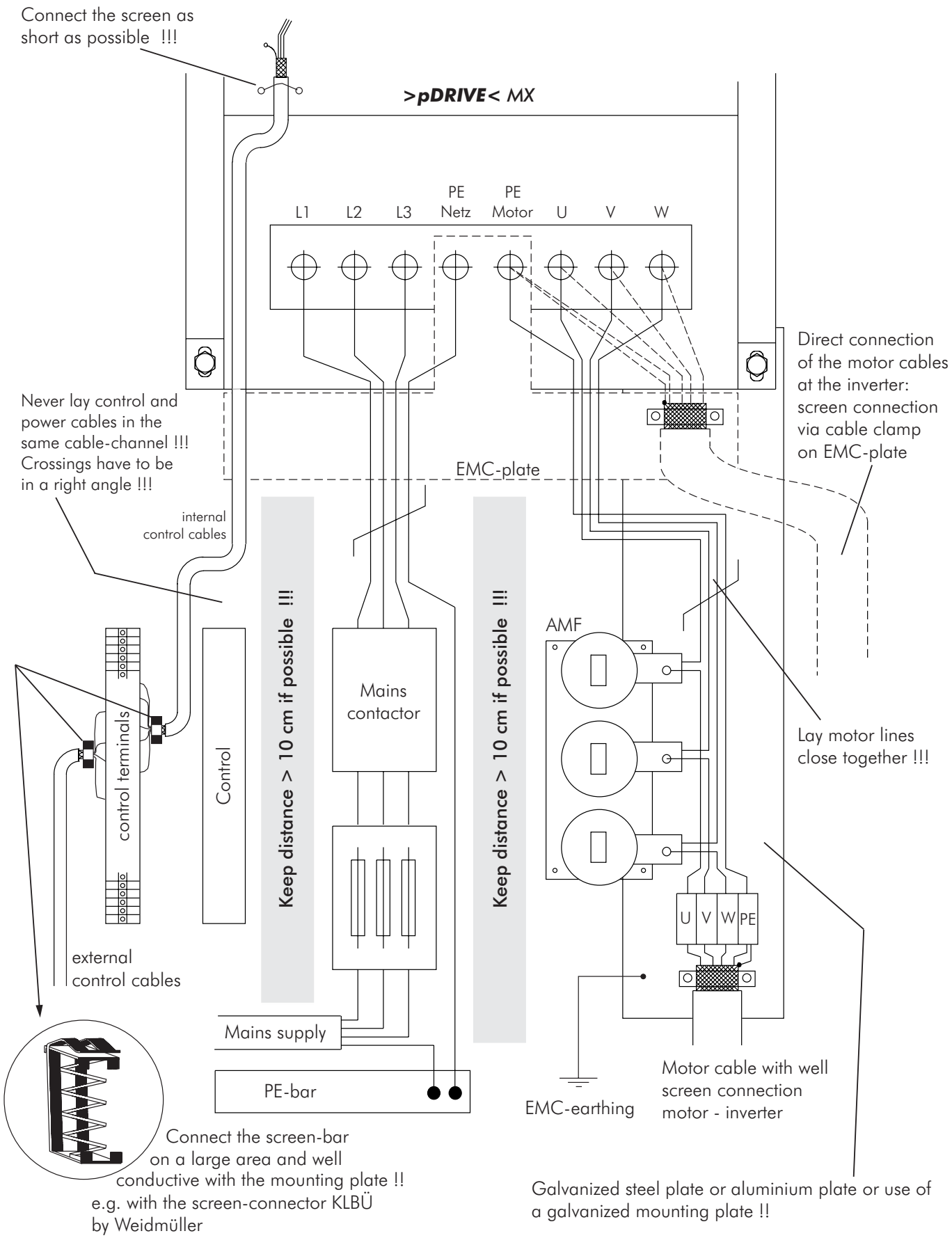
Bundled connection of the PE core (green/yellow)

Protection core function: Bundled connection of the PE core for a safe and corrosion-proof connection, e.g. using a cable lug

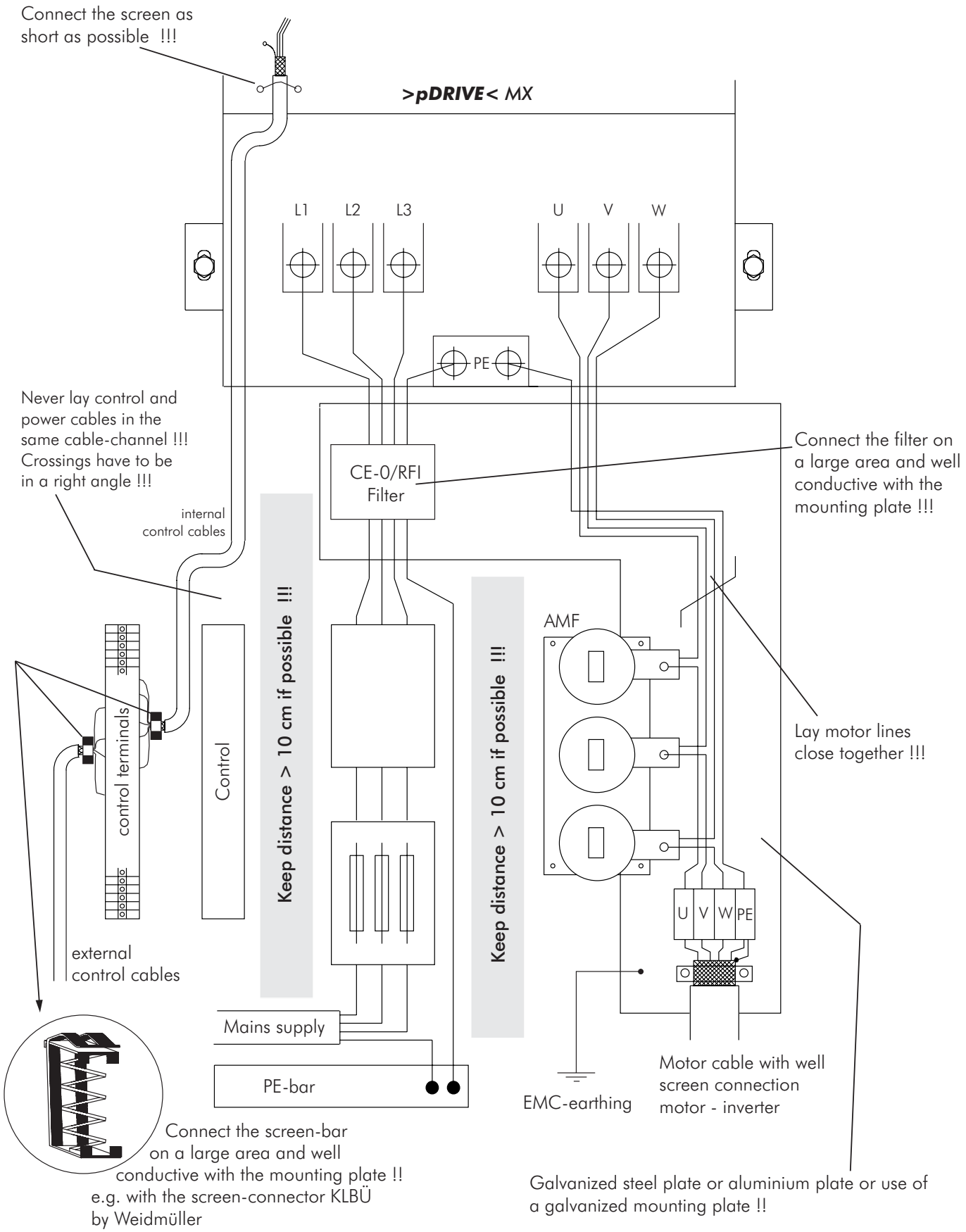
Screen function: Large-scale connection of the PE core for low HF resistance with good induction of the interfering currents into the CE filter, e.g. using a clamp

Wiring of the Power Terminals

Cubicle Installation for Sizes A...2

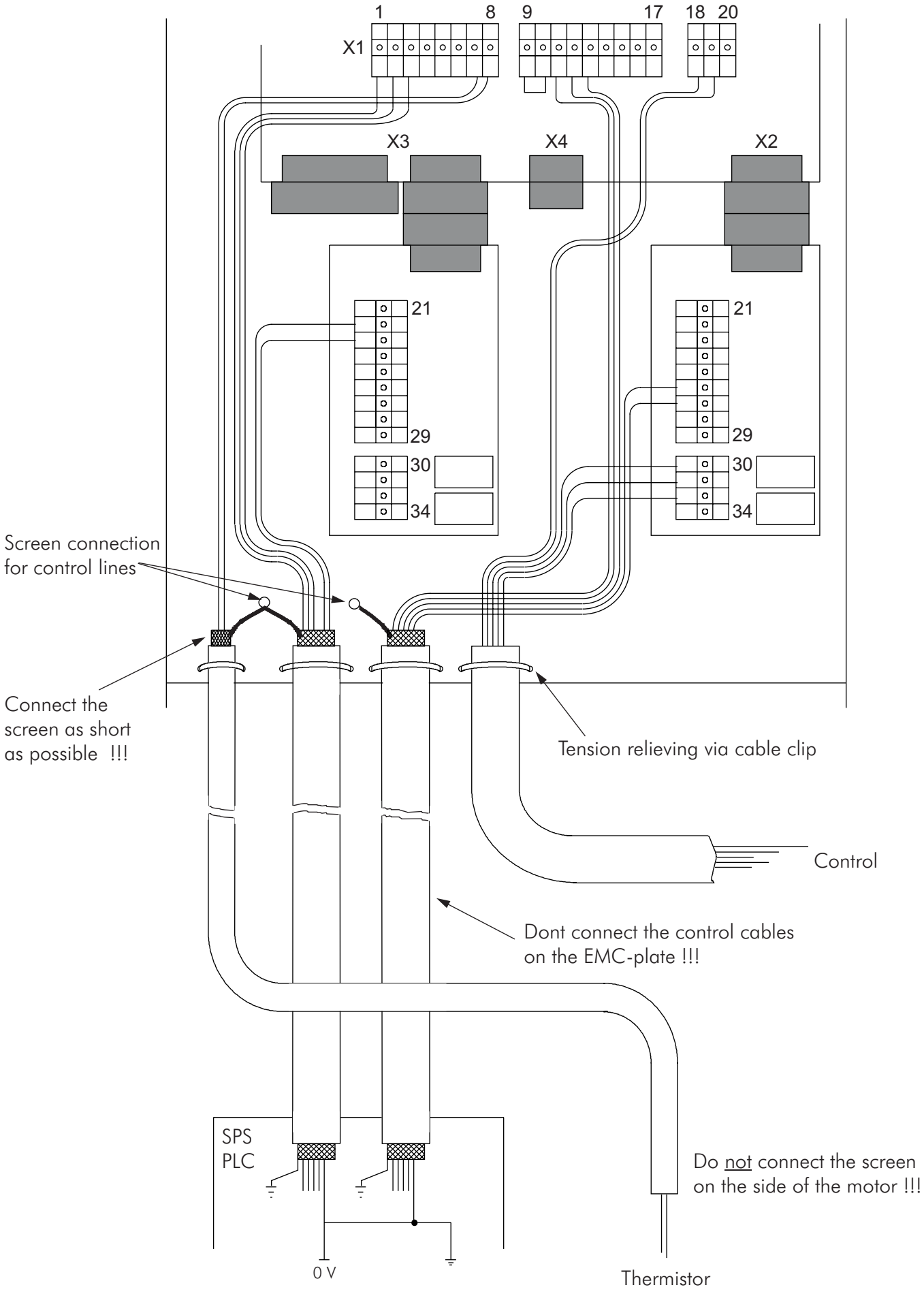


Cubicle Installation for Sizes 3...5

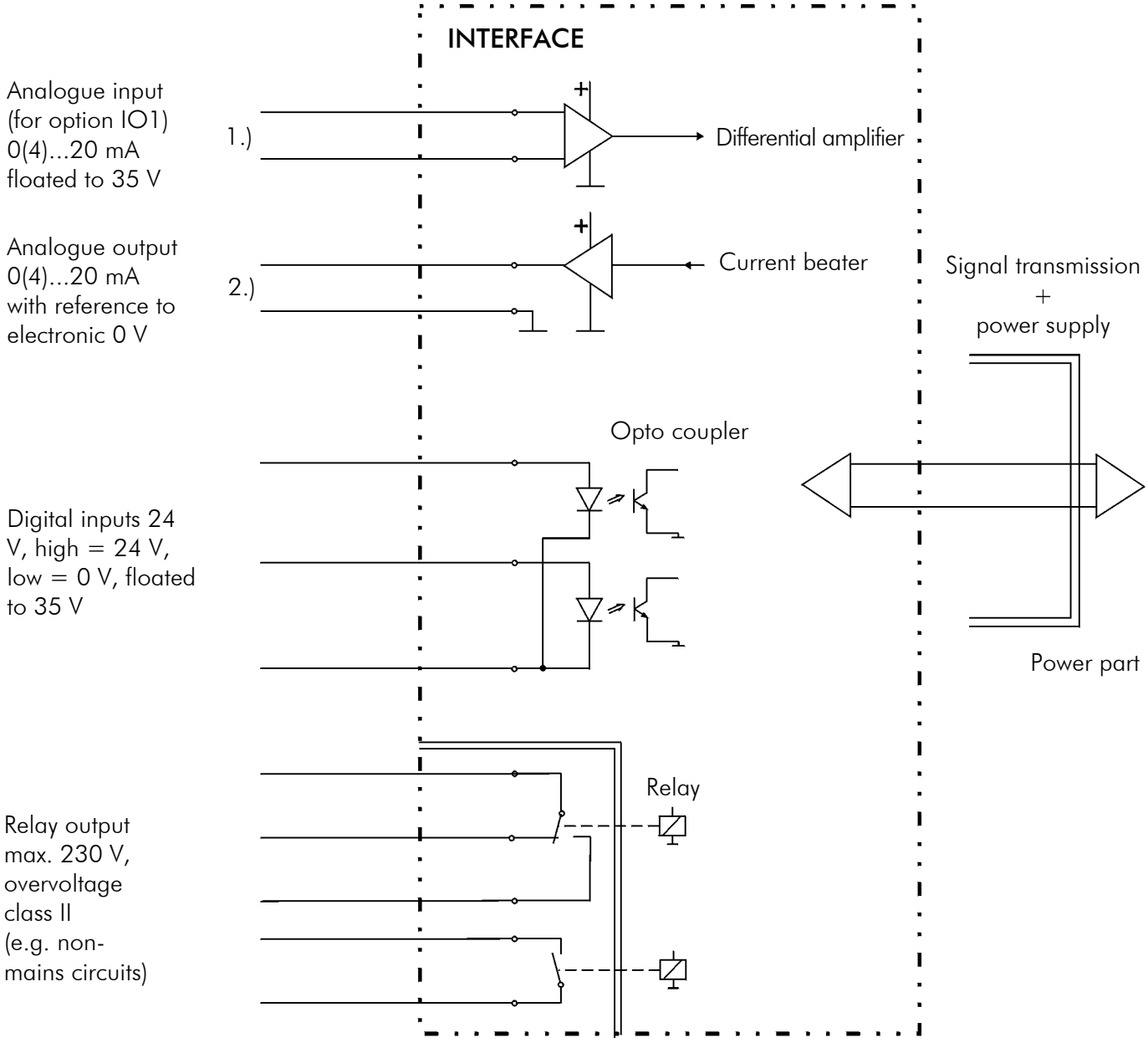


CONNECTION

Wiring of the Control Terminals



Specification of the Control Terminals



1.) Electronic ground (0 V) may float up to 35 V against PE. The connection 0 V – earth necessary to limit the voltage can therefore be implemented remotely, e.g. in the PLC (possibly using the analogue output with reference to 0 V).

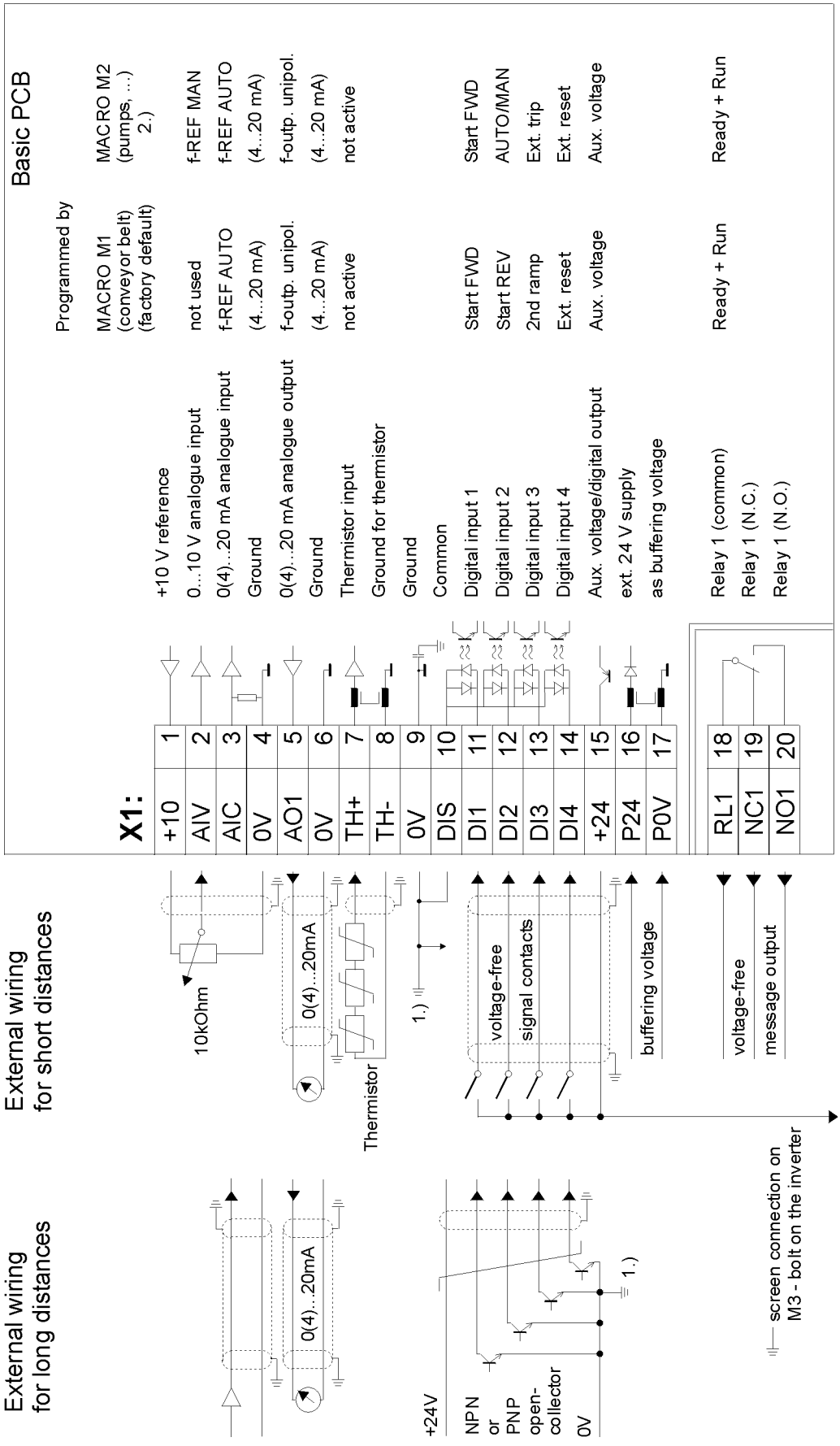
2.) All inputs and outputs are completely decoupled from each other (if the analogue input from the IO1 and the external 24 V for digital inputs are used).

3.) The entire electronic system is galvanically separated from the power part in accordance with EN 50178 PELV (Protective Extra Low Voltage) and "Safe Separation" by a double insulation.

The two relays on the optional card IO1 must be interrogated with the same voltage level. They are not separated in accordance with PELV!

Control Terminals on the Basic PCB UI

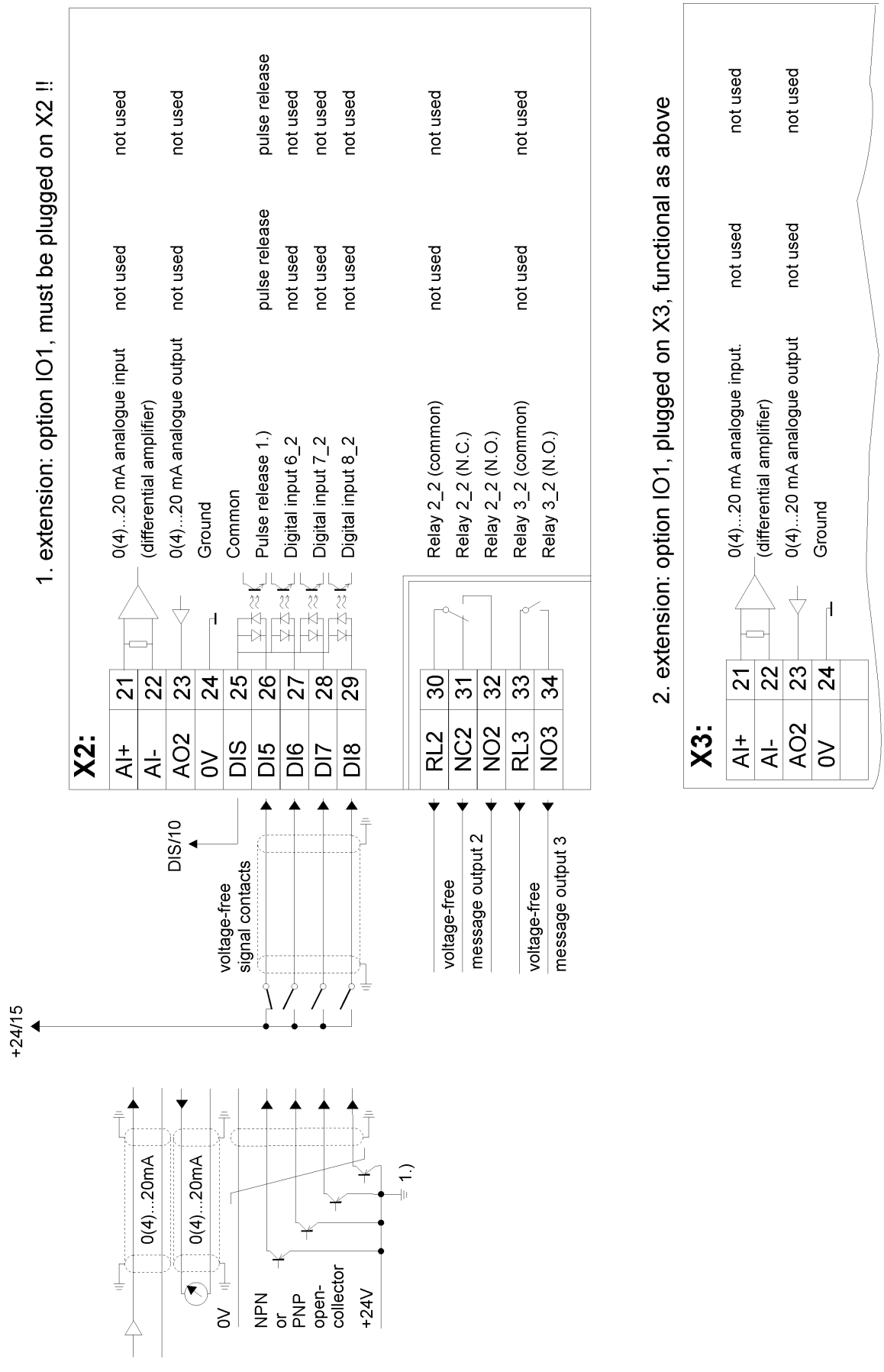
The control lines must be separated from the mains and motor cables or other power cables. They should not exceed a length of 20 m, and they must be screened.



1.) For human protection against direct touching it has to be observed that the ground of the electronic cards does not float with more than 35 V. This can be effected either by an earth connection on the inverter or by an earth connection e.g. of the analogue output in the PLC.
2.) More macros you can find in the operating and service instructions.

Option Card(s) IO1

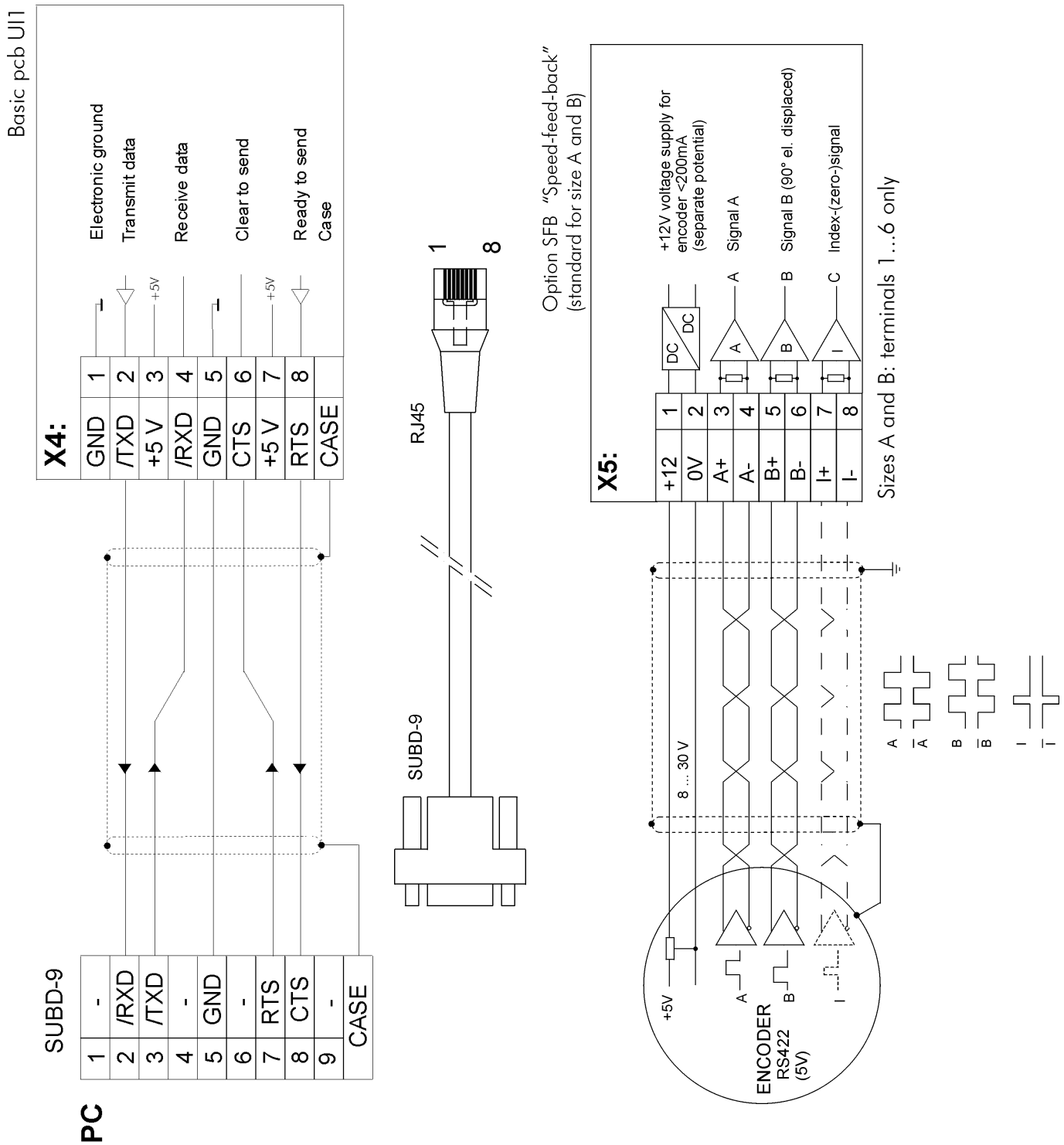
If the crossing of mains and/or motor cables and control cables cannot be avoided, they must be crossed at right angles.



1.) As soon as the option IO1 is plugged-in, the digital input DI5 has the function "Pulse enable" and a 1-signal is necessary to run the inverter (also necessary for Autotuning !!). e.g. wiring of DIS (T. X1:10) - DIS (T. X2:25) and +24 (T. X1:15) - DI5 (T. X2:26)

Serial Interface and Option SFB

The basic PCB UI has a plug for serial data transmission. The electrical design corresponds with RS232 and is therefore suitable for direct connection of a PC. The software program MATRIX is available for operation, diagnosis and recording.



Specification of the Control Terminals

Basic PCB (UI1) – Terminal Strip X1

+10	T X1: 1	**Reference voltage**	+10 V, +2% -0%, at 0...10 mA; short-circuit protected
AIV	T X1: 2	**Analogue input AIV**	0...10 V, impedance approx. 100 kΩ, accuracy ±0.6%, linear fault < -0.15% with 1 kΩ reference potentiometer, resolution 10 bit (~ 10 mV), limits and destination selectable with parameters, interrogation time 5 ms
AIC	T X1: 3	**Analogue input AIC**	0(4)...20 mA, burden 250 Ω, accuracy ±0.9%, resolution 10 bit (~ 20 µA), stability ±0.2% at 10 K temperature change, 3 mA LiveZero monitoring, limits and destination selectable with parameters, interrogation time 5 ms
0 V	T X1: 4	**Ground**	electronic ground 1.)
AO1	T X1: 5	**Analogue output AO1**	0(4)...20 mA, external burden max. 600 Ω, resolution 10 bit, accuracy f, I, U: ±1.5%; M, S; P: ±5 %
0 V	T X1: 6	**Ground**	electronic ground 1.)
TH+ TH -	T X1: 7 T X1: 8	**Thermistor input +** **Thermistor input -**	for max. 6 thermistors in series, wiring must be screened and separated from the motor cable! Nominal thermistor value < 1.5 kΩ, trip resistance 3 kΩ, reset value 1.8 kΩ, short-circuit protection < 50 Ω, test current approx. 1 mA, test voltage > 12 V
0 V	T X1: 9	**Ground**	electronic ground 1.)
DIS	T X1: 10	**Common**	common terminal for all digital inputs on the basic PCB, can float with max. 35 V against earth and against 0 V
DI1	T X1: 11	**Digital input DI1**	opto coupler input for 24 V, min. hold state 10 ms, bipolar, therefore for positive and negative logic (high > 15 V, low < 4V), approx. 8 mA at 24 V, destination selectable with parameters
DI2	T X1: 12	**Digital input DI2**	specification as for terminal X1: 11
DI3	T X1: 13	**Digital input DI3**	specification as for terminal X1: 11
DI4	T X1: 14	**Digital input DI4**	specification as for terminal X1: 11
+24	T X1: 15	**Aux. voltage / digital output**	+24 V voltage source, max. 150 mA (short-circuit protected), selectable as constant auxiliary voltage for digital outputs, or as digital output with selectable information, tolerance: +25 %, -15 %
P24 P0V	T X1: 16 T X1: 17	**Supply buffer voltage**	external 24 V supply for electronic system in case of mains OFF, tolerance +25%, -10% incl. Residual ripple (UI and IO1), current demand approx. 0.5 A (without BUS), separated from the internal 24 V by a diode
RL1	T X1: 18	**Relay output 1**	switching voltage max. 250 V AC, 30 V DC switching power max. 1250 VA, 150 W continuous current max. 3 A min. switching capacity (new relay) 24 V DC, 3 mA
NC1	T X1: 19	**N.C. contact**	voltage must be in accordance with overvoltage class II in order not to violate PELV conditions for the remaining terminals
NO1	T X1: 20	**N.O. contact**	

1.) Electronic ground may float up to 35 V against PE.

Option Card (IO1) in Slot X2

AI+ AI-	T X2: 21 T X2: 22	**Analogue input AI2-2**	0(4)...20 mA, differential amplifier, floating up to max. ±35 V against earth and against electronic ground (0 V), accuracy ±1.1% (up to 2% at 35 V), stability ±0.2% / 10 K, resolution 10 bit, burden 250 Ω, input protection for –60 V to +60 V, 3 mA LiveZero monitoring, limits and destination selectable with parameters
AO2	T X2: 23	**Analogue output AO_2**	specification as for terminal X1: 5
0 V	T X2: 24	**Ground**	electronic ground 1.)
DIS	T X2: 25	**Common**	common terminal for digital inputs DI5...DI8, if voltage-free contacts are used: connect with 0 V (T X1: 9)!
DI5	T X2: 26	**Digital input DI5_2**	pulse release – not changable and not selectable For operation of the inverter, a 1-signal is always necessary, e.g. by connecting with +24 (T X1: 15)! Specification as for terminal X1: 11
DI6	T X2: 27	**Digital input DI6_2**	programmable, specification as for terminal X1: 11
DI7	T X2: 28	**Digital input DI7_2**	programmable, specification as for terminal X1: 11
DI8	T X2: 29	**Digital input DI8_2**	programmable, specification as for terminal X1: 11
RL2	T X2: 30	**Relay output 2_2**	specification as for terminal X1: 18 to X1: 20
NC2 NO2	T X2: 31 T X2: 33	**N.C. contact** **N.O. contact**	voltage must be in accordance with PELV in order for remaining control terminals to comply with PELV
RL3	T X2: 33	**Relay output 3_2**	specification as for terminal X2: 30 to X2: 32,
NO3	T X2: 34	**N.O. contact**	but only N.O. contact

Option Card (IO1) in Slot X3

AI+ AI-	T X3: 21 T X3: 22	**Analogue input AI2-3**	specification as for terminal X2: 21
AO2	T X3: 23	**Analogue output AO2_3**	specification as for terminal X1: 5
0 V	T X3: 24	**Ground**	electronic ground 1.)
DIS	T X3: 25	**Common**	common terminal for digital inputs DI5...DI8, if voltage-free contacts are used: connect with 0 V (T X1: 9)!
DI5	T X3: 26	**Digital input DI5_3**	programmable, specification as for terminal X1: 11
DI6	T X3: 27	**Digital input DI6_3**	programmable, specification as for terminal X1: 11
DI7	T X3: 28	**Digital input DI7_3**	programmable, specification as for terminal X1: 11
DI8	T X3: 29	**Digital input DI8_3**	programmable, specification as for terminal X1: 11
RL2	T X3: 30	**Relay output 2_3**	specification as for terminal X1: 18 to X1: 20
NC2 NO2	T X3: 31 T X3: 32	**N.C. contact** **N.O. contact**	voltage must be in accordance with PELV in order for remaining control terminals to comply with PELV
RL3	T X3: 33	**Relay output 3_3**	specification as for terminal X2: 30 to X2: 32,
NO3	T X3: 34	**N.O. contact**	but only N.O. contact

1.) Electronic ground may float up to 35 V against PE.

Basic PCB UI1 – Slot X4 – Serial Interface

GND	T X4: 1	**Ground**	electronic ground 1.)
/TXD	T X4: 2	**Transmit data**	In accordance with RS232 (data rate 9.6 or 19.2 kBaud)
+5V	T X4: 3	**Supply**	+5 V voltage source (4.75...5.25 V) max. current 50 mA
/RXD	T X4: 4	**Receive data**	in accordance with RS232
GND	T X4: 5	**Ground**	electronic ground 1.)
CTS	T X4: 6	**Clear to send**	in accordance with RS232
+5V	T X4: 7	**Supply**	+5 V voltage source (4.75...5.25 V) max. current 50 mA
RTS	T X4: 8	**Ready to send**	in accordance with RS232
PE	CASE	**Earth**	earthing point

Option SFB – Speed Feedback
(Standard in Sizes A and B)

+12	T X5: 1	**Encoder supply**	supply voltage + 12 V ±7% / max. 200 mA (incl. load)
0 V	T X5: 2	**Ground**	potential separation from control electronics 1.)
A+	T X5: 3	**Encoder signal A**	signal in accordance with RS422, min. period 3 μs
A-	T X5: 4	**Signal A inverted**	frequency max. 300 kHz, connection 121 Ω with 22 nF in series
B+	T X5: 5	**Encoder signal B**	signal B is displaced by 90° for detecting the direction of rotation
B-	T X5: 6	**Signal B inverted**	
I+	T X5: 7	**Index (zero) signal**	signal for distance measurement, etc. (not required for speed
I-	T X5: 8	**Signal I inverted**	control) – not in sizes A and B

1.) Electronic ground may float up to 35 V against PE.

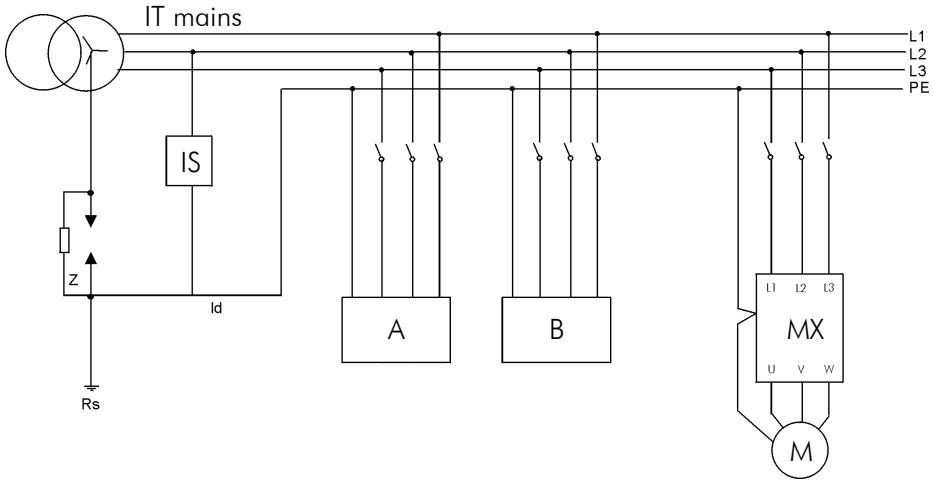
Note: The used encoder, e.g. Thalheim ITD40A4, shoult have an input voltage range of 8...30 V (recommended). Using an AWG24 (0.2 mm²) cable, a maximum distance of 100 m at 100 kHz (50 m at 300 kHz or 200 m at 50 kHz) is therefore possible for the encoder.
Cable type: TP (twisted pair) with screen
Output configuration: RS422 (power beater), 5V
Output signals: A, $\overline{A}$, B, $\overline{B}$ (I and $\overline{I}$)
Recommended number of pulses:

motor	2-pole:	30 to 2048 increments per rotation
	4-pole:	60 to 4096 increments per rotation
	from 6-pole:	90 to 4096 increments per rotation

Use of the MX in non-grounded Mains

1. General

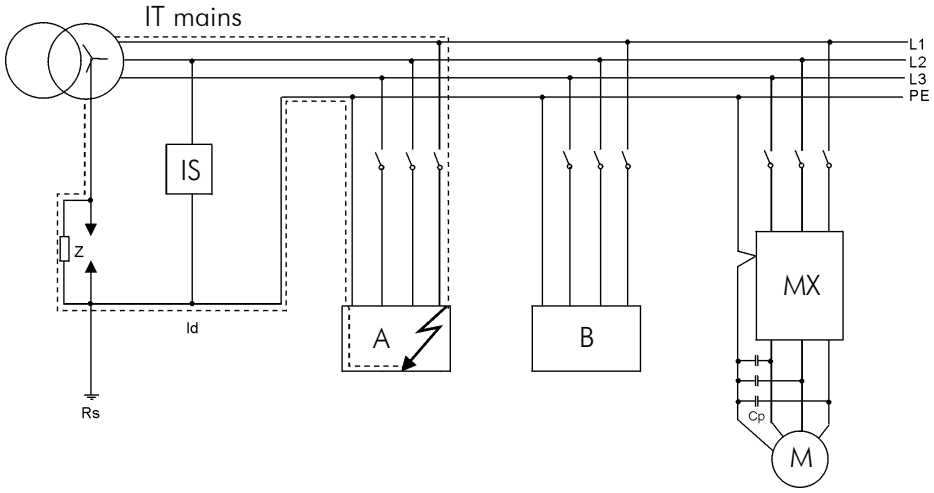
The reason for non-grounded (IT) mains is the increase in availability, since an immediate switch-off is not absolutely necessary in the event of a one-phase earth fault.
For human protection, such mains are fitted with an insulation monitoring relay that detects and reports an earth fault by measuring the resistance.



Z ... earth impedance
IS ... insulation monitoring relay
A, B ...consumers on the mains
MX ...frequency inverter MX
M ... motor

2. Insulation Faults in the Mains

The MX frequency inverter is designed in such a way that its operation is not impaired by an insulation fault in the mains.



The fault current depends on the value of the operative earth impedance Z. If the impedance is high, the fault current and voltage will be low.

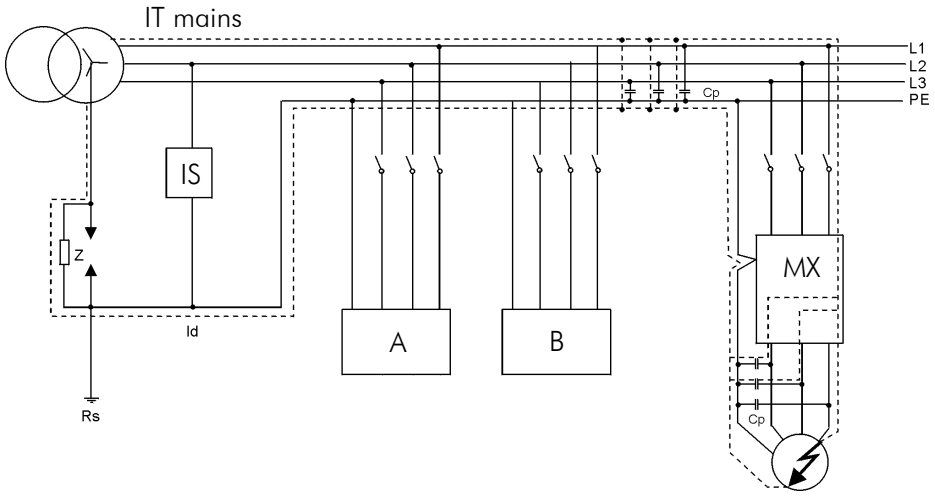
An automatic switch-off is not required.

The fault must be indicated, detected on site and repaired.

If a second insulation fault occurs, it will cause an overcurrent that is switched off by the installed fuses. As a result, some parts of the plant will be out of order.

3. Insulation Fault on the Inverter Output

In the event of an earth fault on the output of an inverter (motor cable or motor), the whole mains will be subject to very high du/dt values due to the pulsed output frequency (in MX with 2.5...10 kHz). As a result of the potential displacement in the DC link, all the earth capacitances C_P in the mains will be recharged with the pulse frequency. Depending on the mains situation and the connected consumers, this may cause high earth leakage currents. Both the inverter (choke, rectifier, capacitors, IGBT, ...) and the other consumers will be subjected to a considerable load. It is necessary to switch off the inverter using an additional earth leakage detection!



C_p ... parasitical capacitances between the lines and earth in the mains and in the motor cable

Not all insulation monitoring relays are suitable for detecting earth faults in or on the output of an inverter. In some cases, very different measuring methods are used. The injection of a direct or alternating current is typical.

Other systems work with an open transducer circuit, which offers the advantage of freely linkable mains. However, these devices are unable to measure through a rectifier bridge.

4. Protection of Inverter and Drive – Option "Earth Fault Detection"

Depending on the situation, a suitable protection method must be provided:

Separate transformer for the drive (e.g. with 12-pulse supply)	⇨	Operation with an insulation fault on the inverter output is admissible for max. 1 hour (line chokes and AMF filters may become hot)
Low mains expansion (i.e. low parasitical capacitances)	⇨	"Earth fault detection" necessary, switch-off must be realised within 10 minutes
Wide mains expansion, possibly with other inverter drives	⇨	"Earth fault detection" necessary, switch-off must be realised within 2 minutes

An external earth leakage detection relay can be used as an additional protection.
It will work in the IT mains due to the existing earth capacitances.
(e.g. Bender type RCM 470LY with external transducer, adjustable trigger time and value).

⇨ see "Option: Earth Fault Detection 1 and 2" in this manual!

5. Use of RFI Filters

For human protection, only the use of special RFI filters is permissible in IT mains (increased earth capacitances, ...). Therefore, there are no limits for the interference voltage defined in the powerdrive standard for IT mains.

In non-grounded mains, only the use of special RFI filters is permissible!

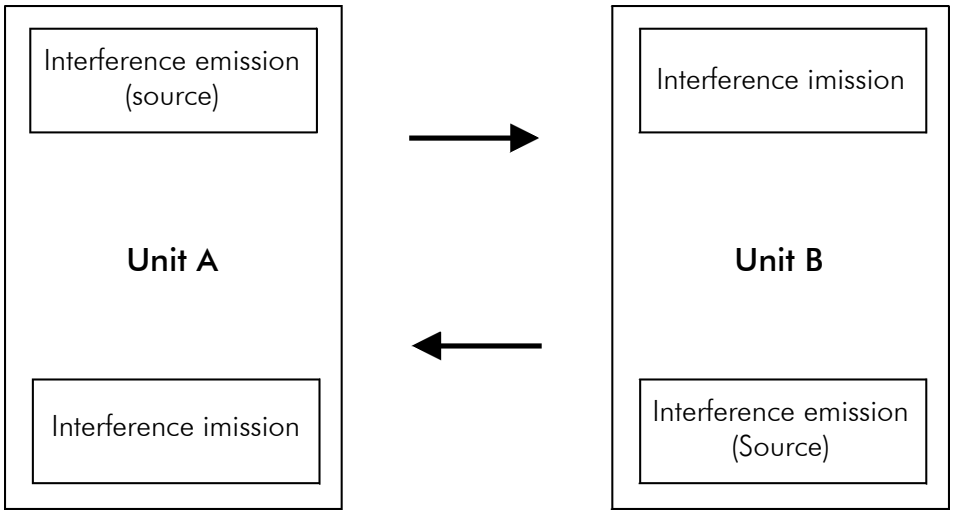
EMC Product Standard for PDS (Power Drive Systems) EN 61800-3

In June 1996, the product standard EN 61800-3 (IEC 61800-3) for frequency inverter drives was released. It has priority over the existing general standards (generic standards). If a drive is installed in another device for which a separate EMC product standard exists, then this standard applies.

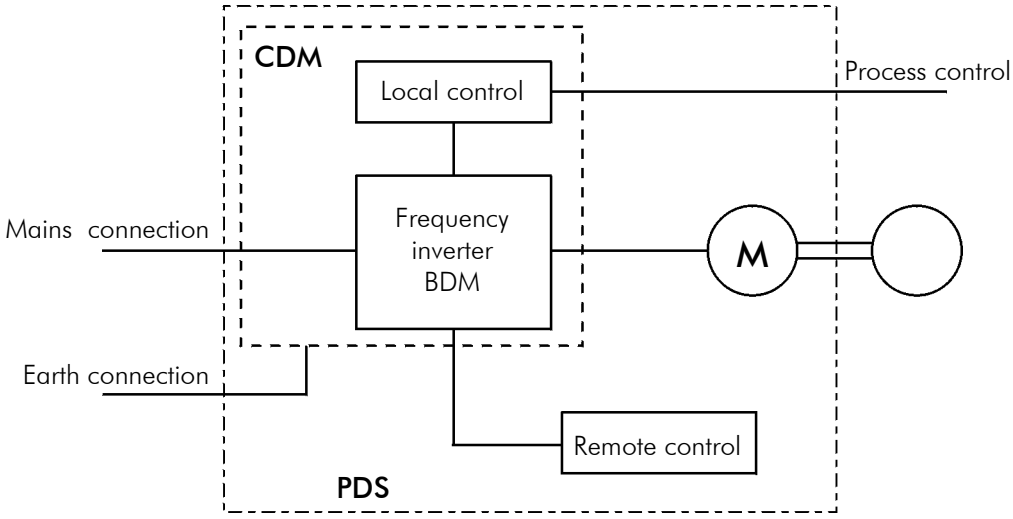
> The aim of the EMC directive 89/336/EEC is the ability of electric and electronic installations to function properly in their electromagnetic environment without influencing the environment or other consumers therein.

Therefore, the PDS product standard contains both limits for admissible interference and requirements for the necessary suppression measures.

Dual Nature of the EMC



The power drive standard EN 61800-3 covers the complete drive from the mains supply to the motor shaft.



BDM:	Base Drive Module	Basic drive unit consisting of the power part and the control electronics (e.g. frequency inverter – built-in unit)
CDM:	Complete Drive Module	Drive modules consisting of the BDM (basic unit) and possible extensions (e.g. cabinet including RFI filter, AMF, mains contactor, ...)
PDS:	Power Drive System	Drive system consisting of CDM (drive module) and motor, motor cable, remote control, mains transformer, ... (e.g. the complete electric drive of a machine)

The main distinction in the use of frequency converters results from different views of the sales method and the application:

1. *Use in residential environments with general sales (unrestricted to every person)*

   The admissible interference levels comply with the applied standard EN 55011 Class B, i.e. 66-56/56/60 dB (µV) quasi-peak and 30/37 dB (µV/m) at 10 m distance.

2. *Use in residential environments with restricted sales (only to qualified EMC resellers)*

   All drives must comply with the interference limits of the former Class A.
   I.e. 79/73/73 dB (µV) quasi-peak and 30/37 dB (µV/m) at 30 m distance.

3. *Use in industrial environments*
   For drives with a size of ≤100 A, the admissible interference limits are 100/86/90-70 dB (µV) quasi-peak and 40/50 dB (µV/m) at 30 m distance.
   For drives with a size of >100 A, the admissible interference limits are 130/125/115-70 dB (µV) quasi-peak and 40/50 dB (µV/m) at 30 m distance.

Residential environment: The standard refers to such environments as "first environment".
Drives that are connected without an intermediate transformer to the public power network supplying residential areas.
The valid interference limits are very low and can only be observed by compliance with all the installation requirements.

Industrial environment: The standard refers to such environments as "second environment".
These are areas that are separated from the public power network by separate transformers.
The user must ensure that the suppression elements recommended by the manufacturer are used, and that the manufacturer's recommendations are followed. Moreover, the user must ensure that strong interferences do not couple into neighbouring low-voltage supply networks.

If the neighbouring network is a public network for residential areas, the stricter limits 66-56/56/60 dB (µV) quasi-peak must be complied with. In industrial networks, the higher limits 79/73/73 dB (µV) quasi-peak can be used.

Moreover, in the case of an influence on other devices, suppression of the interference is required. This suppression is the plant owner's responsibility.

The limits for immunity are much stricter, since a higher level of interference has to be assumed.

In non-grounded mains, compliance with the limits is usually not possible. Filter capacitors complicate the detection of insulation faults, and thus interfere with the concept of an earth-free energy supply. Filters that have been developed specifically for IT mains can however be used, and will provide a clear reduction of the line-bound mains feedback even in non-grounded mains.

See "Use of the MX in non-grounded Mains".

The basic requirement for compliance with the relevant limits is the observance and compliance with the installation requirements and the use of the recommended options.

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