>pDRIVE<

# Mounting instructions

**>pDRIVE< MX basic**

>pDRIVE< MX plus

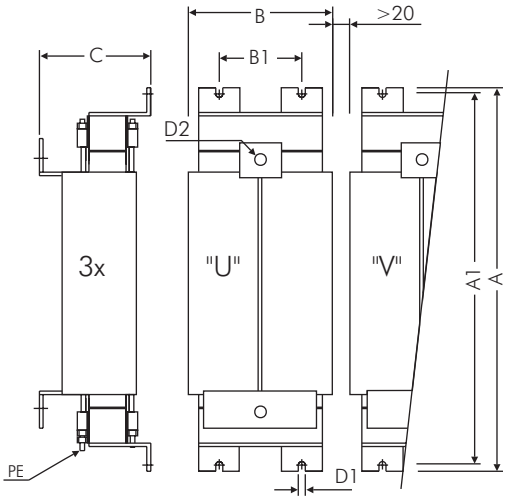
>pDRIVE< MX plus-hydro

>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 basic*

**15 to 630 kW, 3 AC 400 V**

Parameters and their settings refer to
software version PBA5.04 and higher



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: 1.35 kV eff / 50 Hz @ 400 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 | 1 | | | | 2 | | | |
|---|---|---|---|---|---|---|---|---|
| **>*pDRIVE*< *MX basic*** | 15/18 | 18/22 | 22/30 | 30/37 | 37/45 | 45/55 | 55/75 | 75/90 |
| **Drives with high continuous load** | | | | | | | | |
| Motor rating | | | | | | | | |
| $P_{N"P"}$ [kW] | 18,5 kW | 22 kW | 30 kW | 37 kW | 45 kW | 55 kW | 75 kW | 90 kW |
| Continuous output power | | | | | | | | |
| $S_{"N"P"}$ [kVA] $U_N$ = 400 V | 26 kVA | 32 kVA | 41 kVA | 51 kVA | 62 kVA | 73 kVA | 97 kVA | 118 kVA |
| Continuous output current [A] | | | | | | | | |
| $I_{N"P"\ 400}$ $U_N$ = 400 V | 38 A | 46 A | 59 A | 73 A | 90 A | 106 A | 140 A | 170 A |
| Maximum torque | | | | | | | | |
| $T_{MAX}$ [%] | 120...140 % | | | | 120...140 % | | | |
| **Drives with high overload** | | | | | | | | |
| Motor rating | | | | | | | | |
| $P_{N"C"}$ [kW] | 15 kW | 18,5 kW | 22 kW | 30 kW | 37 kW | 45 kW | 55 kW | 75 kW |
| Nominal output power | | | | | | | | |
| $S_{N"C"}$ [kVA] | 22 kVA | 26 kVA | 34 kVA | 42 kVA | 52 kVA | 61 kVA | 81 kVA | 98 kVA |
| Nominal output current [A] | | | | | | | | |
| $I_{N"C"\ 400}$ $U_N$ = 400 V | 32 A | 38 A | 49 A | 61 A | 75 A | 88 A | 117 A | 142 A |
| Maximum torque | | | | | | | | |
| $T_{MAX}$ [%] | 150...170 % | | | | 150...170 % | | | |
| **Maximum current for 60 s in 10 min [A]** | | | | | | | | |
| $I_{MAX\ 400}$ $U_N$ = 400 V | 48 A | 57 A | 74 A | 92 A | 113 A | 132 A | 176 A | 213 A |
| **Input current [A]** | | | | | | | | |
| $I_{IN"C"/IN"P"\ 400}$ $U_N$ = 400 V | 30 / 36 A | 36 / 43 A | 46 / 55 A | 57 / 68 A | 70 / 84 A | 82 / 99 A | 109 / 131 A | 133 / 159 A |
| **Ambient conditions** | | | | | | | | |
| Working temperature [°C] | 0...45°C | 0...45°C | 0...45°C | 0...40°C | 0...45°C | 0...45°C | 0...45°C | 0...40°C |
| Efficiency [%] | > 97 % | | | | > 97,5 % | | | |
| Level of noise pressure | <60 dB(A) | | | | <60 dB(A) | | | |
| Protection degree | IP20 | | | | IP20 | | | |

## General Data

| **Input** | |
|---|---|
| Voltage | 400 V ±15% 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 protection 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 |

| 3 | | | 4 | | | | 5 | | |
|---|---|---|---|---|---|---|---|---|---|
| 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 | | | | | | | | | |
| 110 kW | 132 kW | 160 kW | 200 kW | 250 kW | 315 kW | 380 kW | 400 kW | 500 kW | 630 kW |
| Continuous output power | | | | | | | | | |
| 143 kVA | 173 kVA | 208 kVA | 270 kVA | 336 kVA | 395 kVA | 470 kVA | 513 kVA | 637 kVA | 752 kVA |
| Continuous output current [A] | | | | | | | | | |
| 206 A | 250 A | 300 A | 390 A | 485 A | 570 A | 700 A | 740 A | 920 A | 1085 A |
| Maximum torque | | | | | | | | | |
| 120...140 % | | | 120...140 % | | | | 120...140 % | | |

| Drives with high overload | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Motor rating | | | | | | | | | |
| 90 kW | 110 kW | 132 kW | 160 kW | 200 kW | 250 kW | 315 kW | 315 kW | 400 kW | 500 kW |
| Nominal output power | | | | | | | | | |
| 119 kVA | 144 kVA | 173 kVA | 225 kVA | 280 kVA | 329 kVA | 395 kVA | 427 kVA | 531 kVA | 626 kVA |
| Nominal output current [A] | | | | | | | | | |
| 172 A | 208 A | 250 A | 325 A | 404 A | 475 A | 583 A | 617 A | 767 A | 904 A |
| Maximum torque | | | | | | | | | |
| 150...170 % | | | 150...170 % | | | | 150...170 % | | |

| Maximum current for 60 s in 10 min [A] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 258 A | 312 A | 375 A | 488 A | 606 A | 713 A | 875 A | 926 A | 1151 A | 1356 A |

| Input current [A] | | | | | | | Input current = 2 x ... | | |
|---|---|---|---|---|---|---|---|---|---|
| 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 |

| Ambient conditions | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 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 |
| > 97,7 % | | | > 97,7 % | | | | > 97,7 % | | |
| <63 dB(A) | | | <66 dB(A) | | | <67 dB(A) | <68 dB(A) | | |
| IP00 | | | IP00 | | | | IP00 | | |

## General Data

| 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 |
| 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.

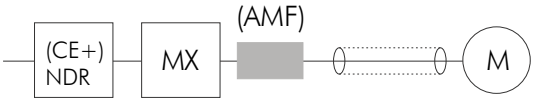
**Multiplication Factors**

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:

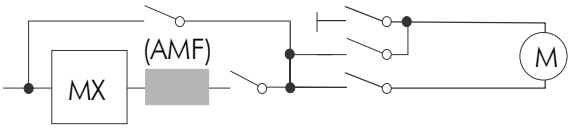
  at 5 kHz all values in the table multiplied by 0.6
  at 10 kHz all values in the table multiplied by 0.3

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



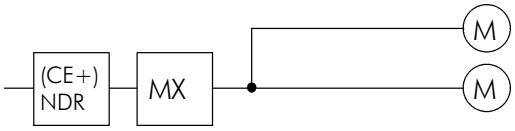

all values in the table multiplied by 1.5

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




all values in the table multiplied by 0.75

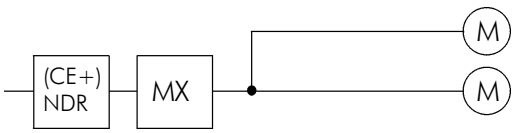
- Motors switched in parallel with the centre near the inverter must be converted in accordance with the number of motors:




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:

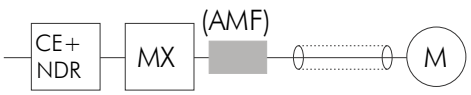
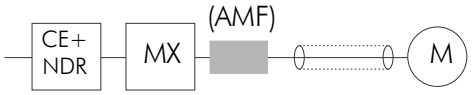
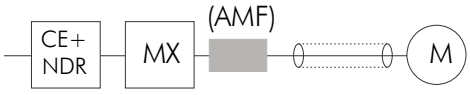
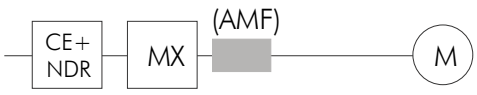



for 2 motors all values in the table multiplied by 0.80
for 3 motors all values in the table multiplied by 0.60
for 4 motors all values in the table multiplied by 0.40
for 5 motors all values in the table multiplied by 0.25

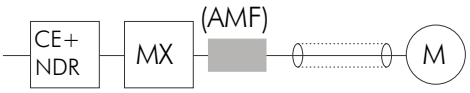
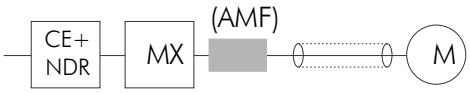
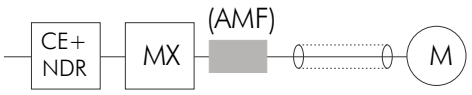
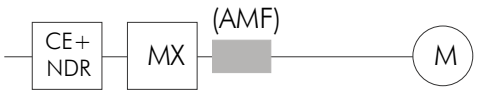
- For two motors switched in parallel, if two parallel cables are already considered in the table (e.g. size 4):

  all values in the table multiplied by 0.8

## Options and Motor Cable Lengths for 400 V Mains Voltage

| MX basic 15/18 | MX basic 18/22 | MX basic 22/30 | MX basic 30/37 | MX basic 37/45 | MX basic 45/55 | MX basic 55/75 | MX basic 75/90 |
|---|---|---|---|---|---|---|---|
| **Options** | | | | | | | |
| Line choke | | | | | | | |
| built-in | built-in | built-in | built-in | built-in | built-in | built-in | built-in |
| RFI filter for grounded mains (TT, TN) CE 400/ | | | | | | | |
| 73 | 73 | 73 | 73 | 170 | 170 | 170 | 170 |
| RFI filter for non-grounded mains (IT) RFI 500/ | | | | | | | RFI 700/ |
| 55 | 55 | 55 | 130 | 130 | 130 | 130 | 180 |
| Output motor filter AMF 450/ | | | | | | | |
| 48 | 48 | 90 | 90 | 90 | 170-3 | 170-3 | 170-3 |
| **Typical motor cable** | | | | | | | |
| 3-pole + PE | | | | | | | |
| 3 x 10mm² | 3 x 10mm² | 3 x 16mm² | 3 x 25mm² | 3 x 35mm² | 3 x 50mm² | 3 x 70mm² | 3 x 95mm² |
| **Maximum distance inverter – motor:** | | | | | | | |
| 1st environment | | | | | | | |
|  | | | | | | | |
| 2nd environment | | | | | | | |
|  | | | | | | | |
| **1st environment (residential)** | | | | | | | |
| without AMF | | | | | | | |
| — | — | — | — | — | — | — | — |
| with 1 AMF | | | | | | | |
| 50 m | 50 m | 50 m | 50 m | 60 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 |
| with 1 AMF | | | | | | | |
| 100 m | 100 m | 100 m | 100 m | 100 m | 120 m | 120 m | 120 m |
| **Maximum distance without observing the standards** | | | | | | | |
| screened | | | | | | | |
|  | | | | | | | |
| unscreened | | | | | | | |
|  | | | | | | | |
| **screened** | | | | | | | |
| without AMF 1.) | | | | | | | |
| 50 m | 50 m | 50 m | 50 m | 50 m | 50 m | 50 m | 50 m |
| with 1 AMF | | | | | | | |
| 120 m | 120 m | 150 m | 150 m | 120 m | 180 m | 180 m | 180 m |
| with 1 AMF (one type higher) | | | | | | | |
| 180 m | 150 m | 300 m | 300 m | 300 m | 300 m | 300 m | 300 m |
| **unscreened** | | | | | | | |
| without AMF 1.) | | | | | | | |
| 80 m | 80 m | 80 m | 80 m | 80 m | 80 m | 80 m | 80 m |
| with 1 AMF | | | | | | | |
| 200 m | 200 m | 250 m | 250 m | 200 m | 300 m | 300 m | 250 m |
| with 1 AMF (one type higher) | | | | | | | |
| 250 m | 250 m | 400 m | 400 m | 400 m | 400 m | 400 m | 400 m |

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

| MX basic 90/110 | MX basic 110/132 | MX basic 132/160 | MX basic 160/200 | MX basic 200/250 | MX basic 250/315 | MX basic 315/380 | MX basic 315/400 | MX basic 400/500 | MX basic 500/630 |
|---|---|---|---|---|---|---|---|---|---|
| **Options** | | | | | | | | | |
| Line choke NDU | | | | | | | | | |
| 195 | 235 | 280 | 365 | 455 | 540 | 650 | 2 x 365 | 2 x 455 | 2 x 540 |
| RFI filter for grounded mains (TT, TN) CE-0 400/...-TN | | | | | | | | | |
| 300 | 300 | 300 | 570 | 570 | 570 | 570 | 1100 | 1100 | 1100 |
| RFI filter for non-grounded mains (IT) CE-0 500/...-IT | | | | | | | | | |
| 300 | 300 | 300 | 570 | 570 | 570 | 570 | 1100 | 1100 | 1100 |
| Output motor filter AMF 450/ | | | | | | | | | |
| 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 | | | | | | | | | |
| 3 x 120mm$^2$ | 3 x 185mm$^2$ | 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 | | | | | | | | | |
| 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 |
| with 1 AMF | | | | | | | | | |
| 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 1.) | | | | | | | | | |
| 50 m | 50 m | 50 m | 50 m | 50 m | 50 m | 50 m | 50 m | 50 m | 50 m |
| with 1 AMF | | | | | | | | | |
| 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 | — | — | — | — |
| **unscreened** | | | | | | | | | |
| without AMF 1.) | | | | | | | | | |
| 80 m | 80 m | 80 m | 80 m | 80 m | 80 m | 80 m | 80 m | 80 m | 80 m |
| with 1 AMF | | | | | | | | | |
| 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 | — | — | — | — |

1. Greater distances my 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 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.

### 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.

### Mains Voltage

These devices are designed for mains voltage of 3 AC 400 V ± 15 %, 50/60 Hz ± 5 %

### 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

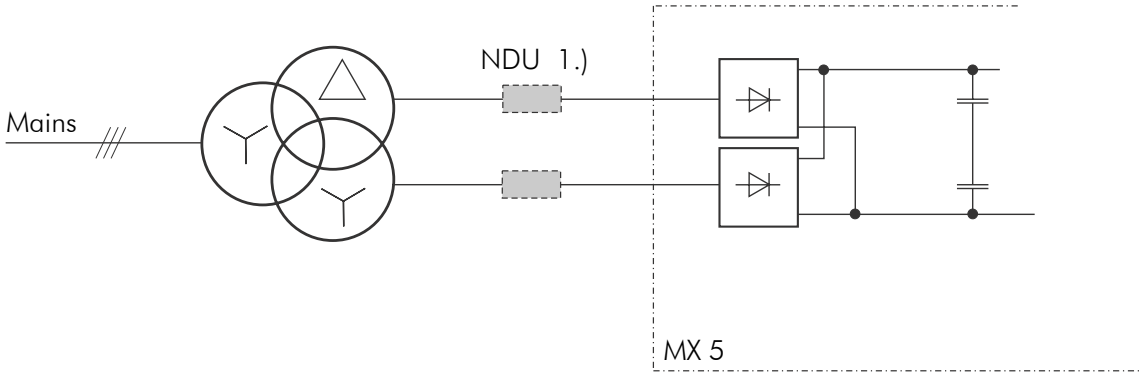
2 x approx. 40 µH for *>pDRIVE< MX* size 5 (12-pulse operation)

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.

## 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 protection does not have a current limiting function. It is a drive protection and <u>not a human protection</u>.

# Mains Fuses – Cable Diameters

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 $mm^2$ / 100m |
| 63 A | 3x16 | 7,3 V | 50 A | A | 10 | MX basic 15/18 | 39 A | Bolt M6 | 3x10 / 11,6V |
| 63 A | 3x16 | 9,7 V | 63 A | A | 10 | MX basic 18/22 | 46 A | | 3x10 / 13,7V |
| 80 A | 3x25 | 7,4 V | 63 A | B | 10 | MX basic 22/30 | 59 A | | 3x16 / 11,0V |
| 100 A | 3x35 | 6,6 V | 80 A | B | 16 | MX basic 30/37 | 73 A | | 3x25 / 8,7V |
| 125 A | 3x50 | 5,7 V | 125 A | C | 25 | MX basic 37/45 | 90 A | Bolt M8 | 3x35 / 7,7V |
| 160 A | 3x70 | 5,0 V | 125 A | C | 35 | MX basic 45/55 | 106 A | | 3x50 / 6,3V |
| 200 A | 3x95 | 4,5 V | 160 A | D | 50 | MX basic 55/75 | 140 A | | 3x70 / 6,0V |
| 250 A | 3x120 | 4,5 V | 200 A | D | 70 | MX basic 75/90 | 170 A | | 3x95 / 5,3V |
| 250 A | 3x120 | 5,1 V | 250 A | E | 95 | MX basic 90/110 | 206 A | 25x4 / Ø11 | 3x120 / 5,2V |
| 315 A | 3x185 | 4,0 V | 315 A | E | 120 | MX basic 110/132 | 250 A | | 3x185 / 4,1V |
| 400 A | 2x(3x120) | 3,7 V | 400 A | E | 2x95 | MX basic 132/160 | 300 A | | 2x(3x120) / 4,9V |
| 500 A | 2x(3x150) | 3,9 V | 500 A | F | 2x150 | MX basic 160/200 | 390 A | 80x5 / 2xØ13 | 2x(3x120) / 4,9V |
| 630 A | 2x(3x185) | 3,9 V | 630 A | F | 2x185 | MX basic 200/250 | 485 A | | 2x(3x150) / 4,8V |
| 800 A | 3x(3x185) | 3,1 V | (710) 800 A | F | 2x185 | MX basic 250/315 | 570 A | | 2x(3x185) / 4,6V |
| 1000 A | 4x(3x185) | 3,1 V | 1000 A | F | 3x150 | MX basic 315/380 | 700 A | | 3x(3x185) / 4,0V |
| 1000 A | 4x(3x185) | 3,1 V | 2x500 A 6.) | F | 2x2x150 | MX basic 315/400 | 740 A | 115x8 / 3xØ13 2xØ17 | 3x(3x185) / 4,0V |
| 1250 A | 4x(3x240) | 3,0 V | 2x630 A 6.) | F | 2x2x185 | MX basic 400/500 | 920 A | | 3x(3x240) / 3,8V |
| 1600 A | 6x(3x240) | 2,8 V | 2x800 A 6.) | F | 2x2x185 | MX basic 500/630 | 1085 A | | 4x(3x240) / 3,0V |

Key to table:

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 lengths (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 max. 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 cable with concentric protection core) is a low-price alternative to screened cables.
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 |
|---|---|---|---|---|---|
| $1{,}2.10^3$ $A^2s$ | $5{,}0.10^3$ $A^2s$ | $14.10^3$ $A^2s$ | $75.10^3$ $A^2s$ | $245.10^3$ $A^2s$ | $1000.10^3$ $A^2s$ |

# 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/$\mu$s |
| Peak voltage ($U_{peak}$) ≤ 1000 V |

The table "Options and Motor Cable Lengths" in this instruction shows 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 and<br>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<br>du/dt < 500 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 basic 15/18 | 45°C | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 88/105 |
| MX basic 18/22 | 45°C | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 76/93 |
| MX basic 22/30 | 45°C | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 96/110 | 100/110 | 84/96 | 60/70 |
| MX basic 30/37 | 40°C | 100/110 | 100/110 | 100/110 | 100/110 | 100/113 | 90/97 | 82/87 | 68/75 | 56/62 |
| MX basic 37/45 | 45°C | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 |
| MX basic 45/55 | 45°C | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 85/100 |
| MX basic 55/75 | 45°C | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 88/108 | 90/103 | 73/87 | 60/67 |
| MX basic 75/90 | 40°C | 100/110 | 100/110 | 100/108 | 94/110 | 85/105 | 80/87 | 68/75 | 57/63 | 45/50 |
| MX basic 90/110 | 45°C | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 100/109 | 78/87 |
| MX basic 110/132 | 45°C | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 90/98 | 83/92 | 73/82 | 57/66 |
| MX basic 132/160 | 40°C | 100/110 | 100/110 | 100/108 | 100/108 | 88/96 | 78/85 | 64/69 | 54/59 | 44/49 |
| MX basic 160/200 | 45°C | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 79/88 |
| MX basic 200/250 | 45°C | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 88/98 | 80/89 | 70/78 | 52/58 |
| MX basic 250/315 | 40°C | 100/110 | 100/110 | 100/108 | 98/110 | 90/105 | 82/92 | 70/75 | 60/65 | 50/55 |
| MX basic 315/380 | 40°C | 100/110 | 100/110 | 100/103 | 80/90 | 73/86 | 67/75 | — | — | — |
| MX basic 315/400 | 45°C | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 79/88 |
| MX basic 400/500 | 45°C | 100/110 | 100/110 | 100/110 | 100/110 | 100/110 | 88/98 | 80/89 | 70/78 | 52/58 |
| MX basic 500/630 | 40°C | 100/110 | 100/110 | 100/108 | 98/110 | 90/105 | 82/92 | 70/75 | 60/65 | 50/55 |

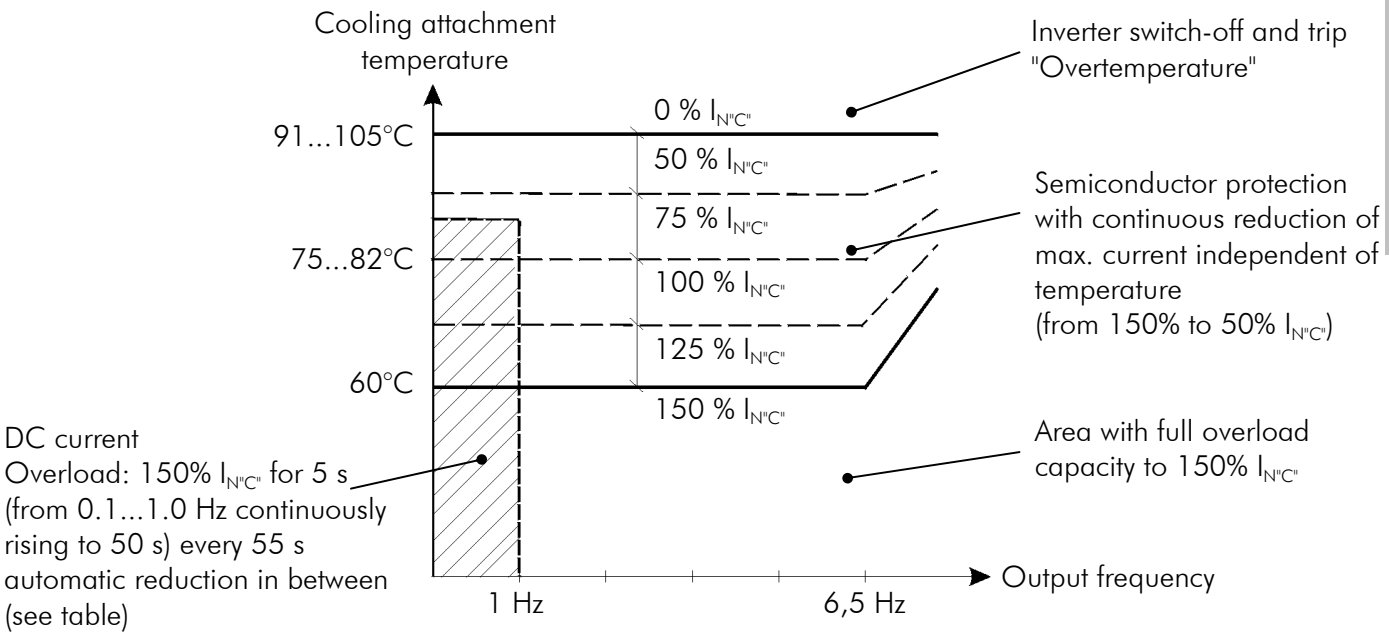
A particular advantage of the >*pDRIVE*< *MX* is the automatic backspacing (if enable) and current limitation when the temperature is too high.

**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 $I_{NC}$ on 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 basic 15/18 | 95 % |
| MX basic 18/22 | 80 % |
| MX basic 22/30 | 95 % |
| MX basic 30/37 | 80 % |
| MX basic 37/45 | 95 % |
| MX basic 45/55 | 80 % |
| MX basic 55/75 | 95 % |
| MX basic 75/90 | 80 % |
| MX basic 90/110 | 115 % |
| MX basic 110/132 | 95 % |
| MX basic 132/160 | 80 % |
| MX basic 160/200 | 115 % |
| MX basic 200/250 | 95 % |
| MX basic 250/315 | 80 % |
| MX basic 315/380 | 65 % |
| MX basic 315/400 | 115 % |
| MX basic 400/500 | 95 % |
| MX basic 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)

# Application Notes

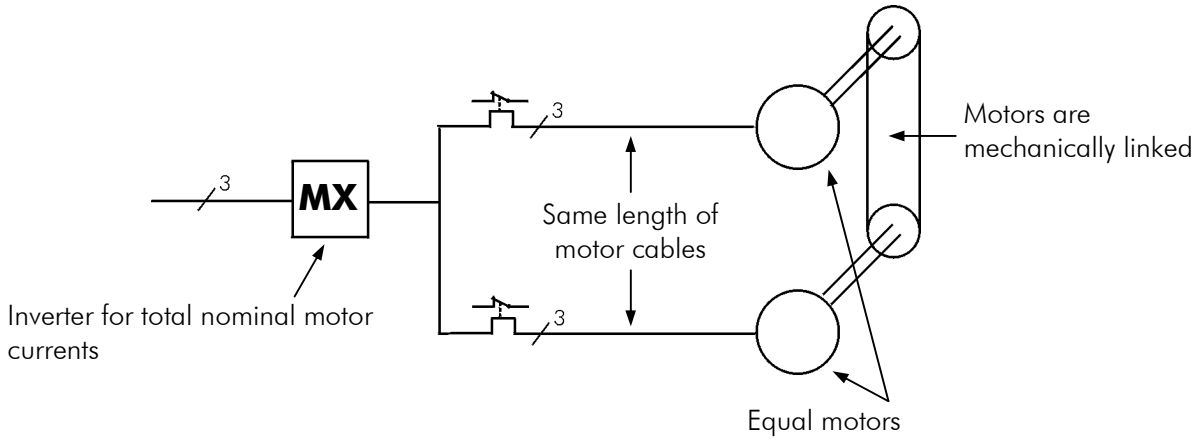
### Multi-motor Operation

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

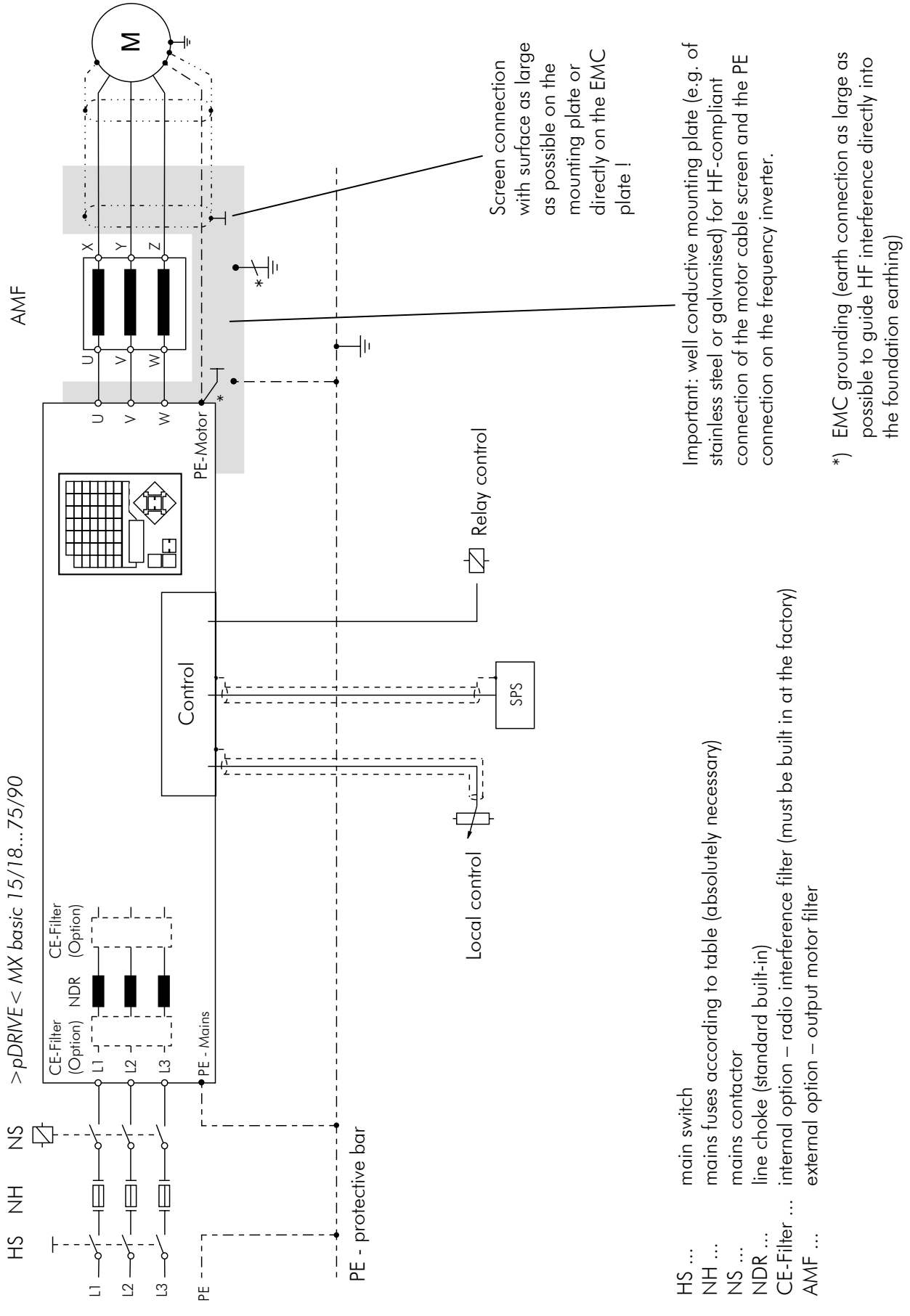
- The total nominal motor current must be smaller than the inverter nominal current.
- It is not possible to operate each motor at a different speed.
- All motor cable lengths must be added.
- A high starting torque is not possible.
- The inverter does not support individual motor overload protection.
- 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. conveyor belts, 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!

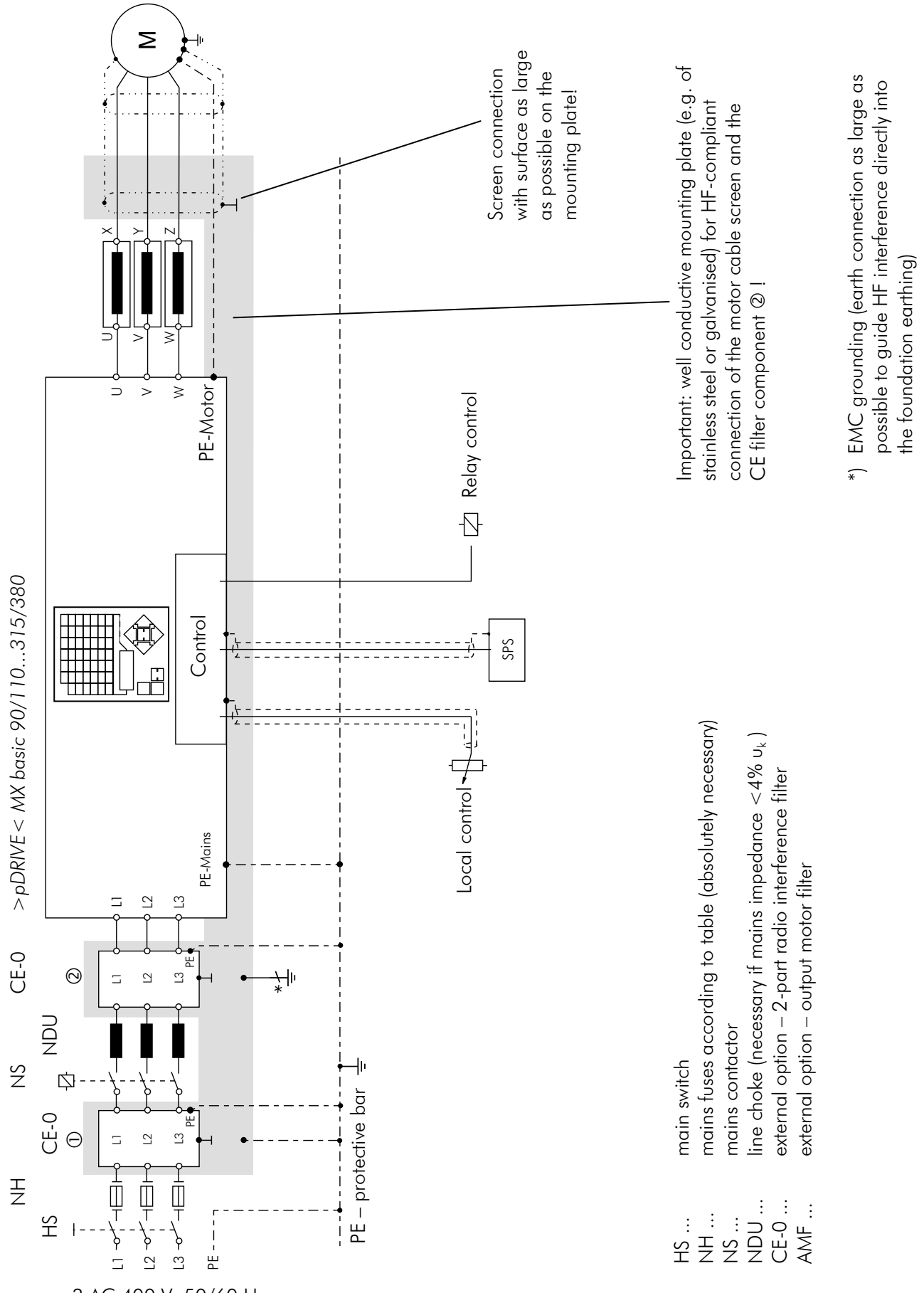


# Wiring Scheme for Sizes 1 & 2

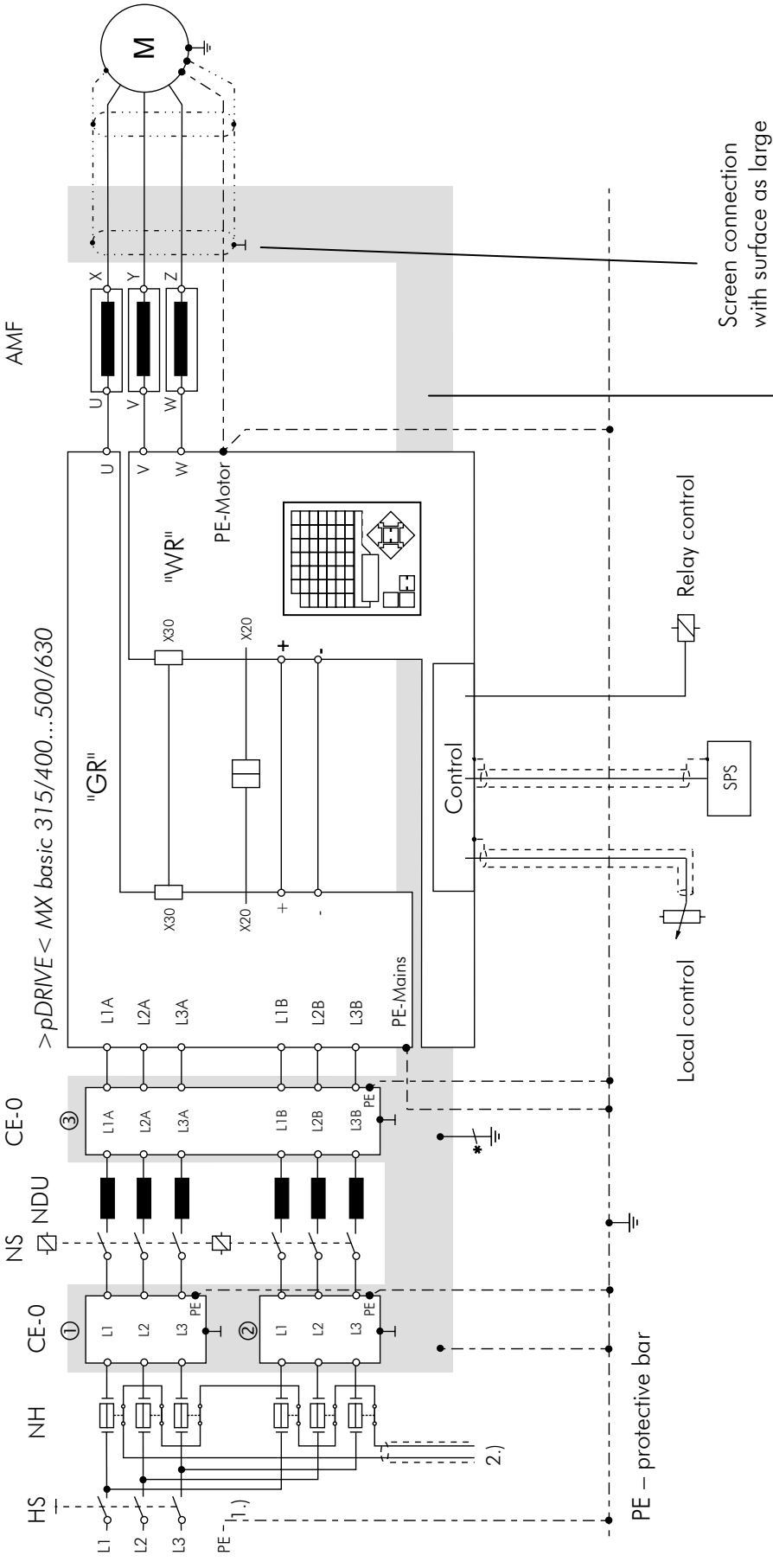



3 AC 400 V, 50/60 Hz

# Wiring Scheme for Sizes 3 & 4



# Wiring Scheme for Size 5 (6-pulse Supply)

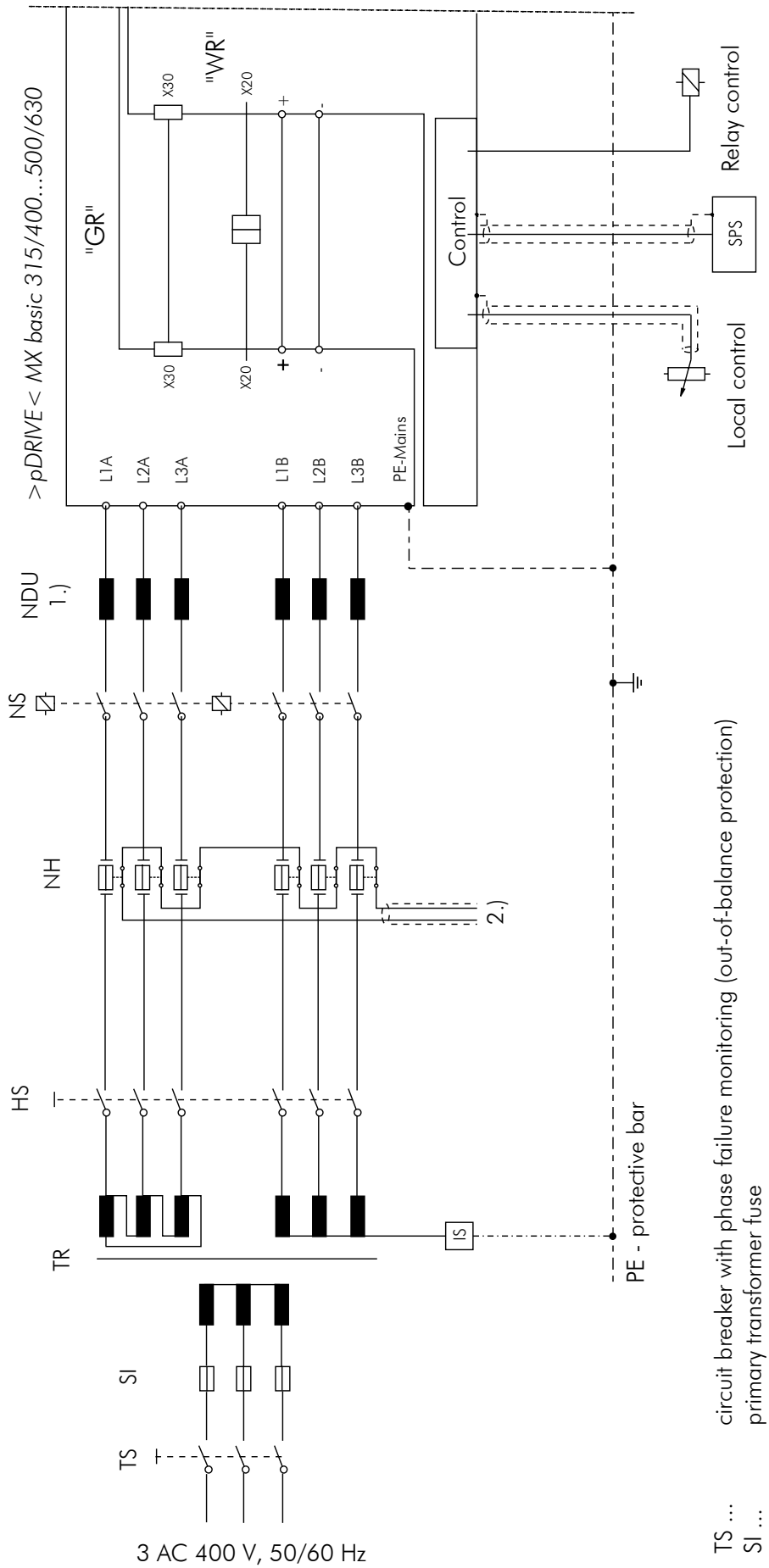



HS ... main switch
NH ... mains fuses according to table (absolutely necessary)
NS ... mains contactor (with mechanical coupling)
NDU ... line choke (2 equal 3-pole chokes necessary)
CE-0 ... option – 3-part radio interference filter
AMF ... external option – output motor filter

1.) The distribution must be before the CE filters (or line chokes)
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").

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

# Wiring Scheme for Size 5 (12-pulse Supply)



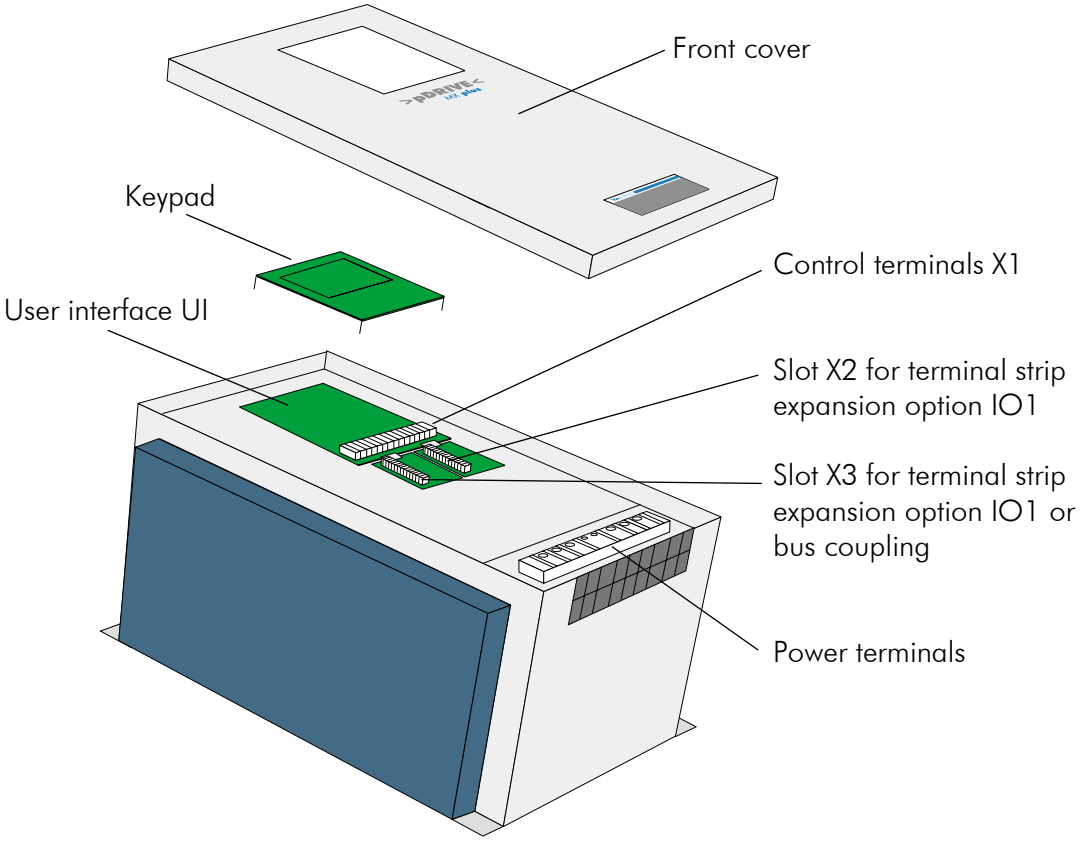

For more information about this wiring, see "Notes on Power Supply"

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)

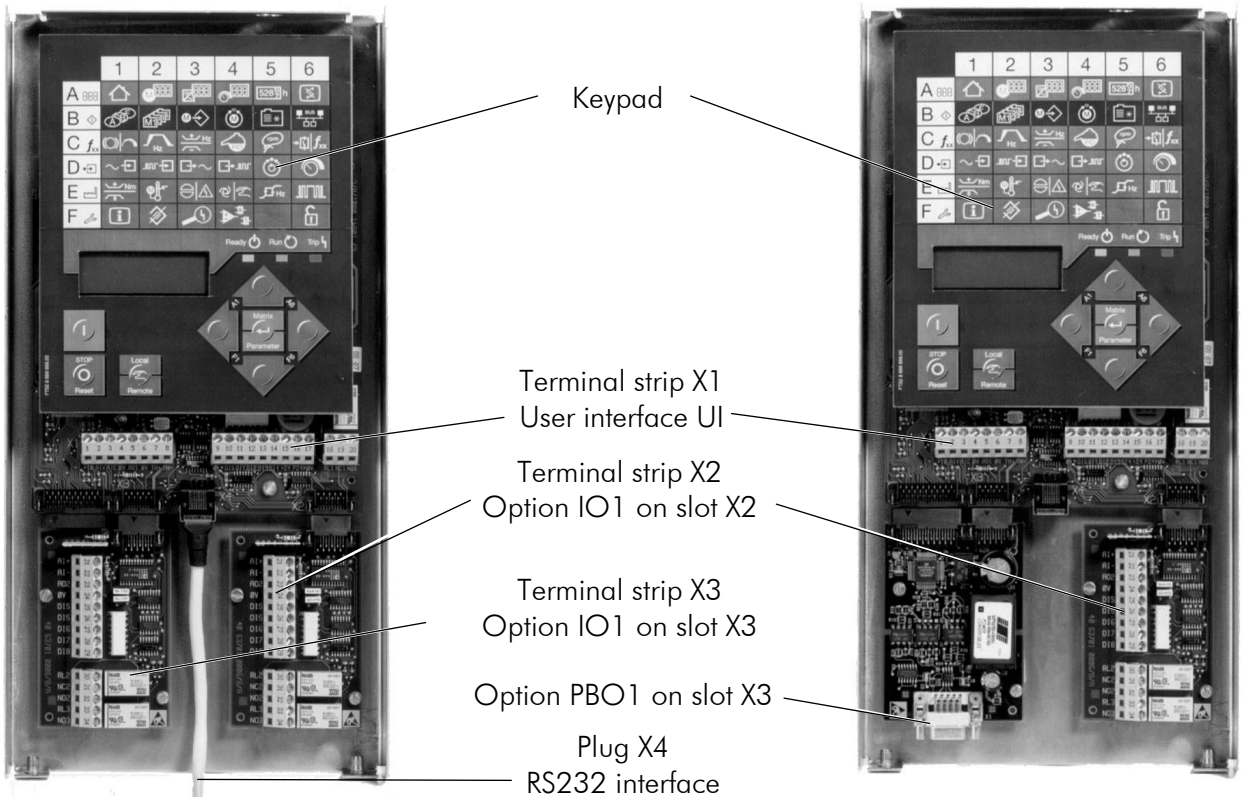
1.) Use of line choke NDU, see chapter "12-pulse Supply".
2.) Fuse monitoring is necessary to protect the rectifier from unequal loads. It must act via the mains contactor or pulse inhibit (e.g. digital input "External fault").

# Mechanical Construction

## Description of Components

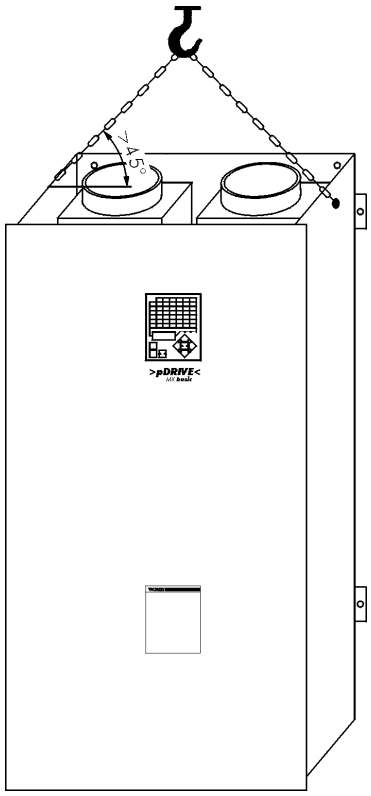





If only one option card IO1 is used, it must be installed in slot X2!

# 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 the input voltage is 3 AC 400V (380...415V ±10%), 50/60Hz ±5%.

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.

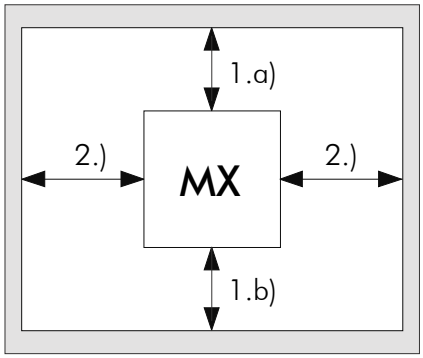
### Check-list to Ensure High Availability of Inverter Drives

- 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<br>Humidity<br>Aggressive atmosphere or<br>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

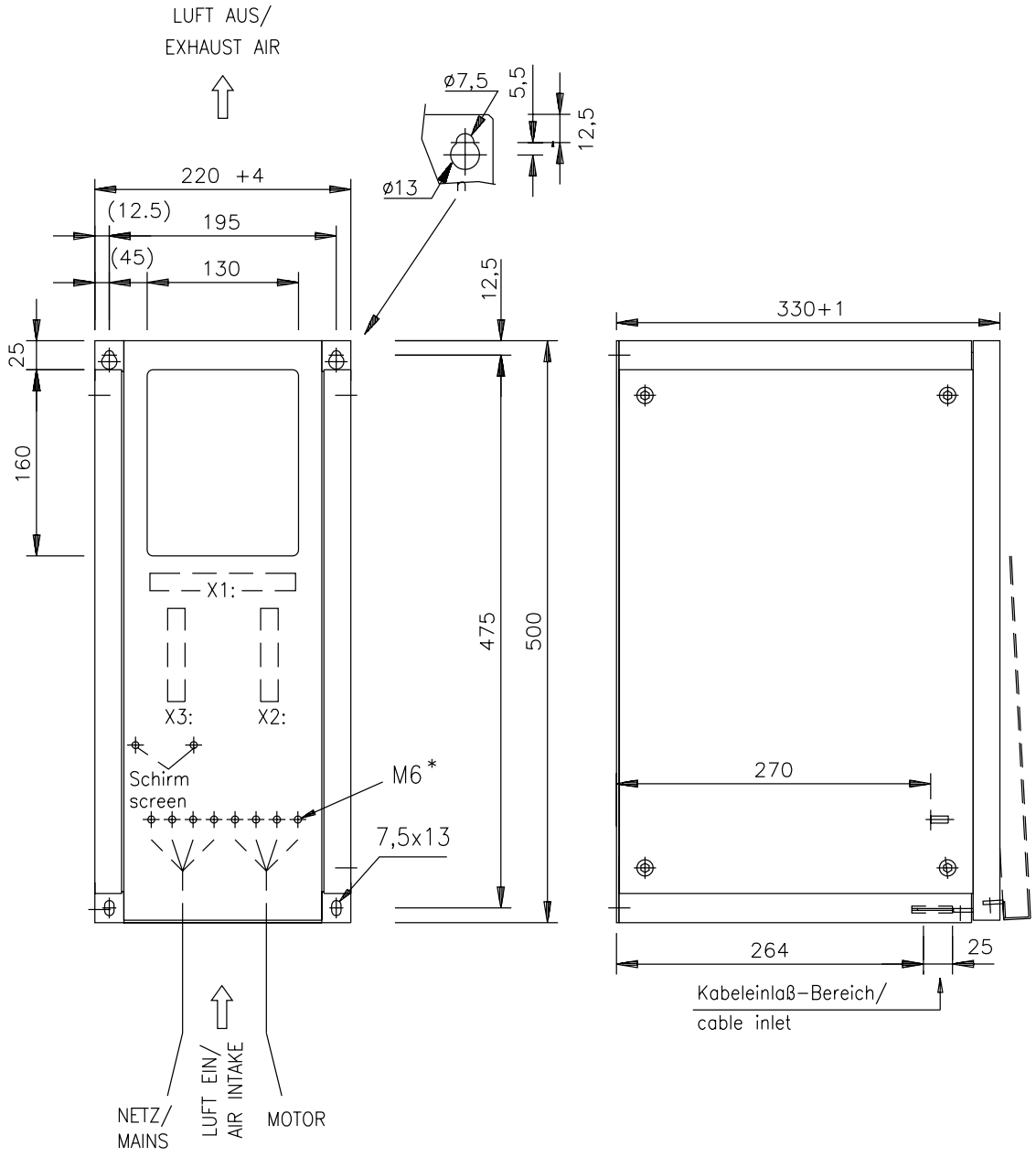
Please make sure that no objects such as e.g. cable insulation material, metal dust or dust penetrate the casing during work on the frequency inverter. Avoid this by covering the top of the frequency inverter. The permissible temperature range (0°C to +45°C or +40°C) must not be exceeded. If the maximum 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.



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!

# Dimensions MX basic 15/18 to 30/37 - Size 1

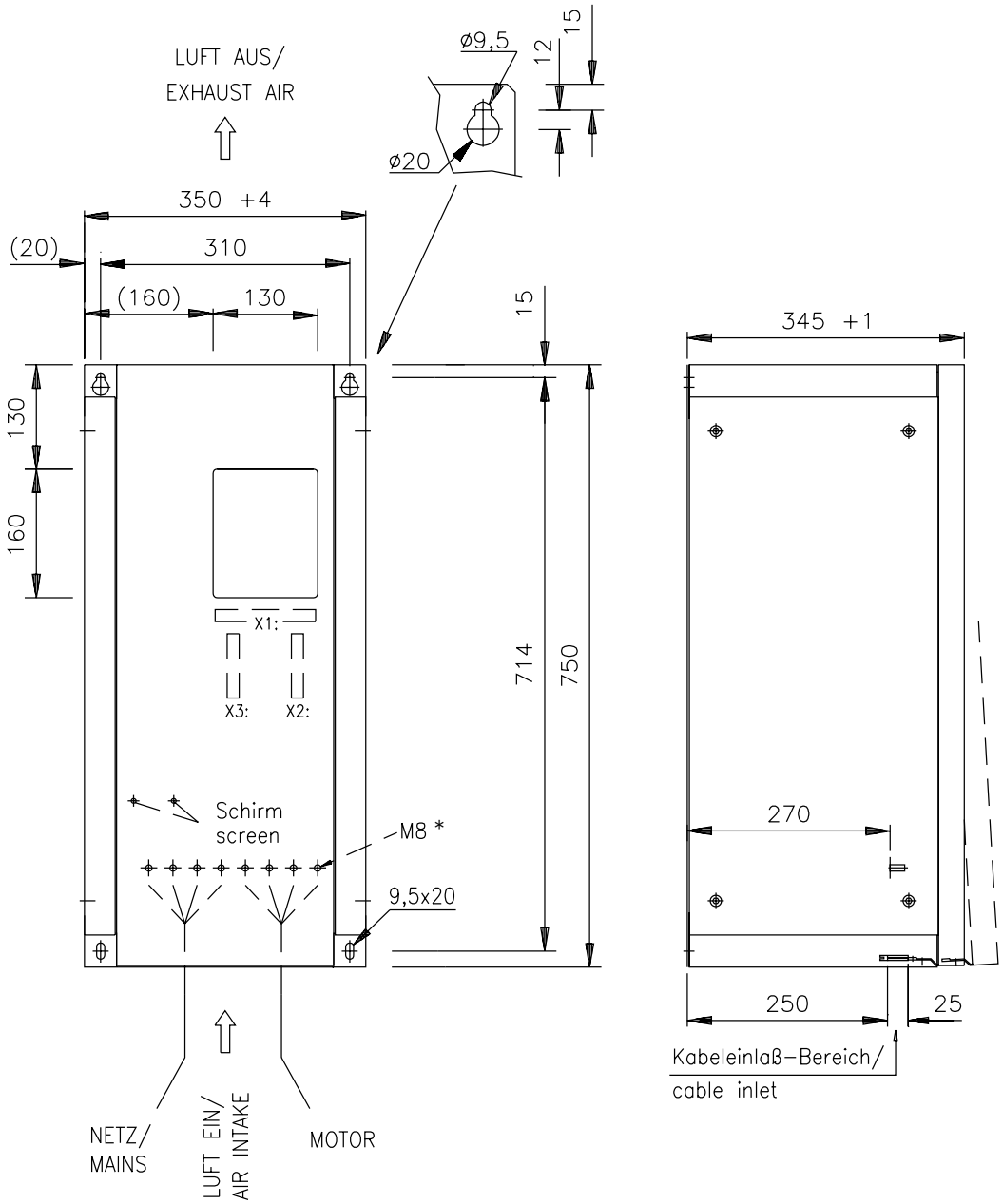



* Tightening torque for M6 bolts: 4,5...5,5 Nm

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

| | MX basic 15/18 | MX basic 18/22 | MX basic 22/30 | MX basic 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 basic 37/45 to 75/90 – Size 2

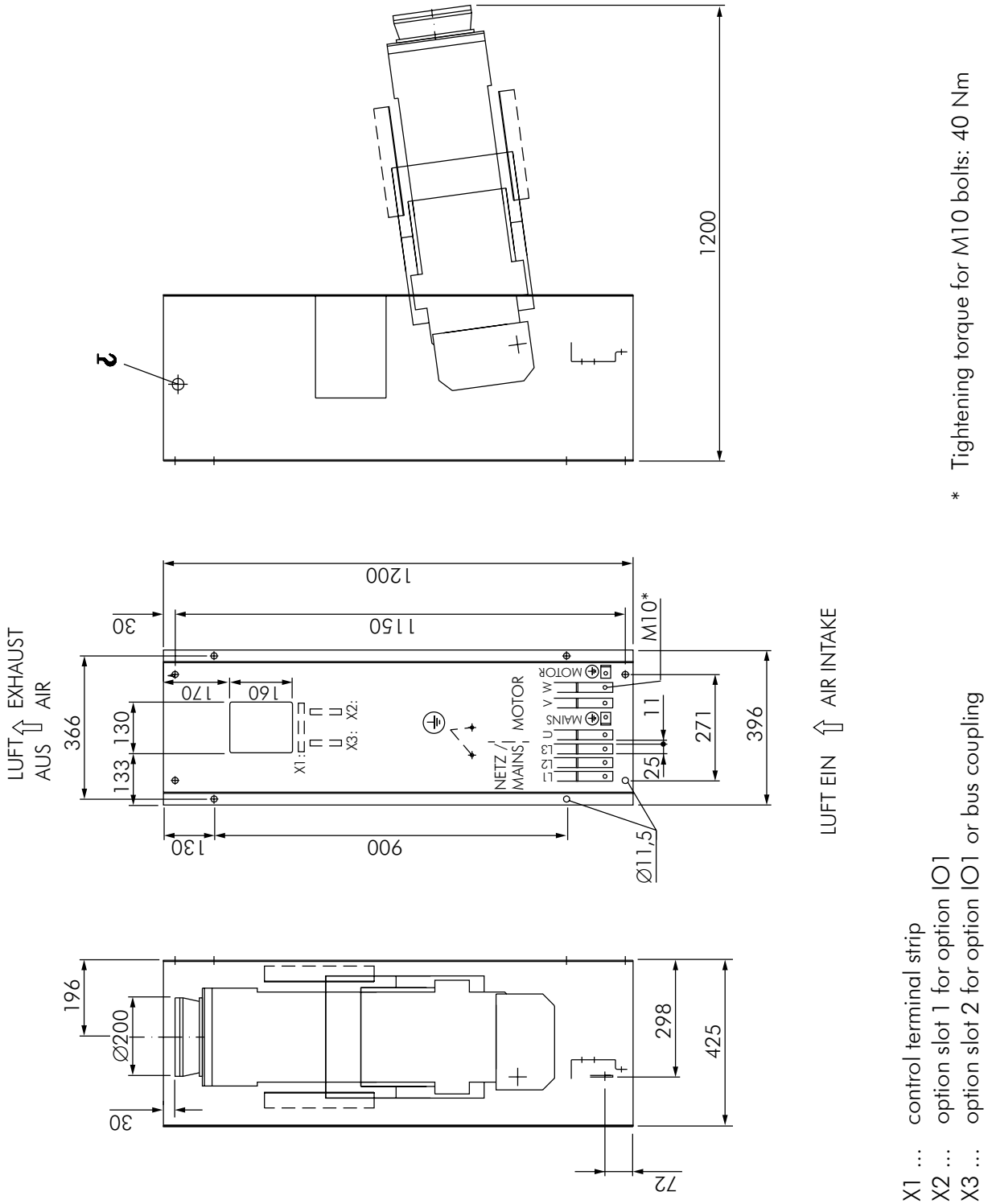



* Tightening torque for M8 bolts: 10...12 Nm

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

| | MX basic 37/45 | MX basic 45/55 | MX basic 55/75 | MX basic 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 | min. 5,0 | min. 6,0 | min. 6,0 $dm^2$ |
| **Weight incl. CE** | approx. 60 kg | approx. 60 kg | approx. 72 kg | approx. 72 kg |

# Dimensions MX basic 90/110 to 132/160 – Size 3



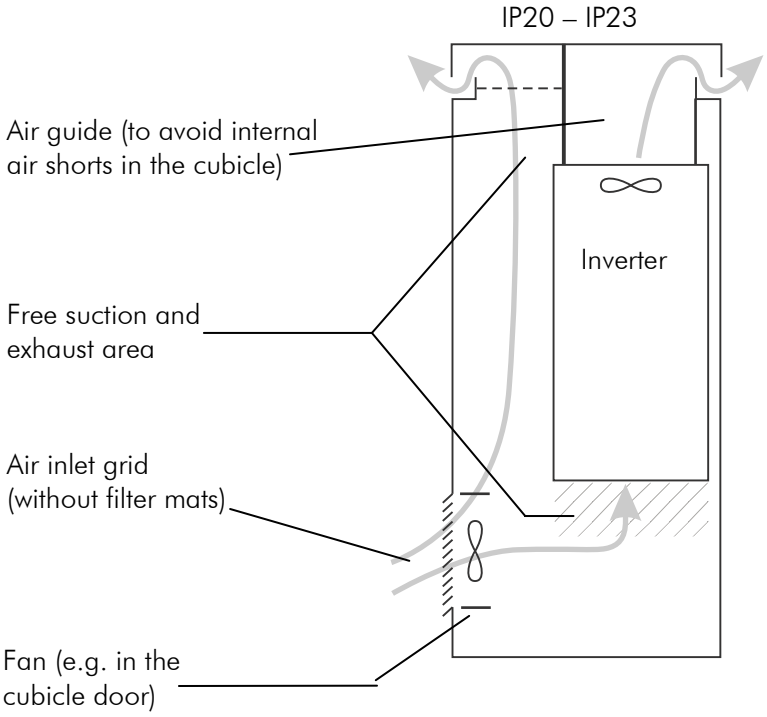

* Tightening torque for M10 bolts: 40 Nm

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

| | MX basic 90/110 | MX basic 110/132 | MX basic 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 1 to 3

### IP20 – IP23 Standard Installation





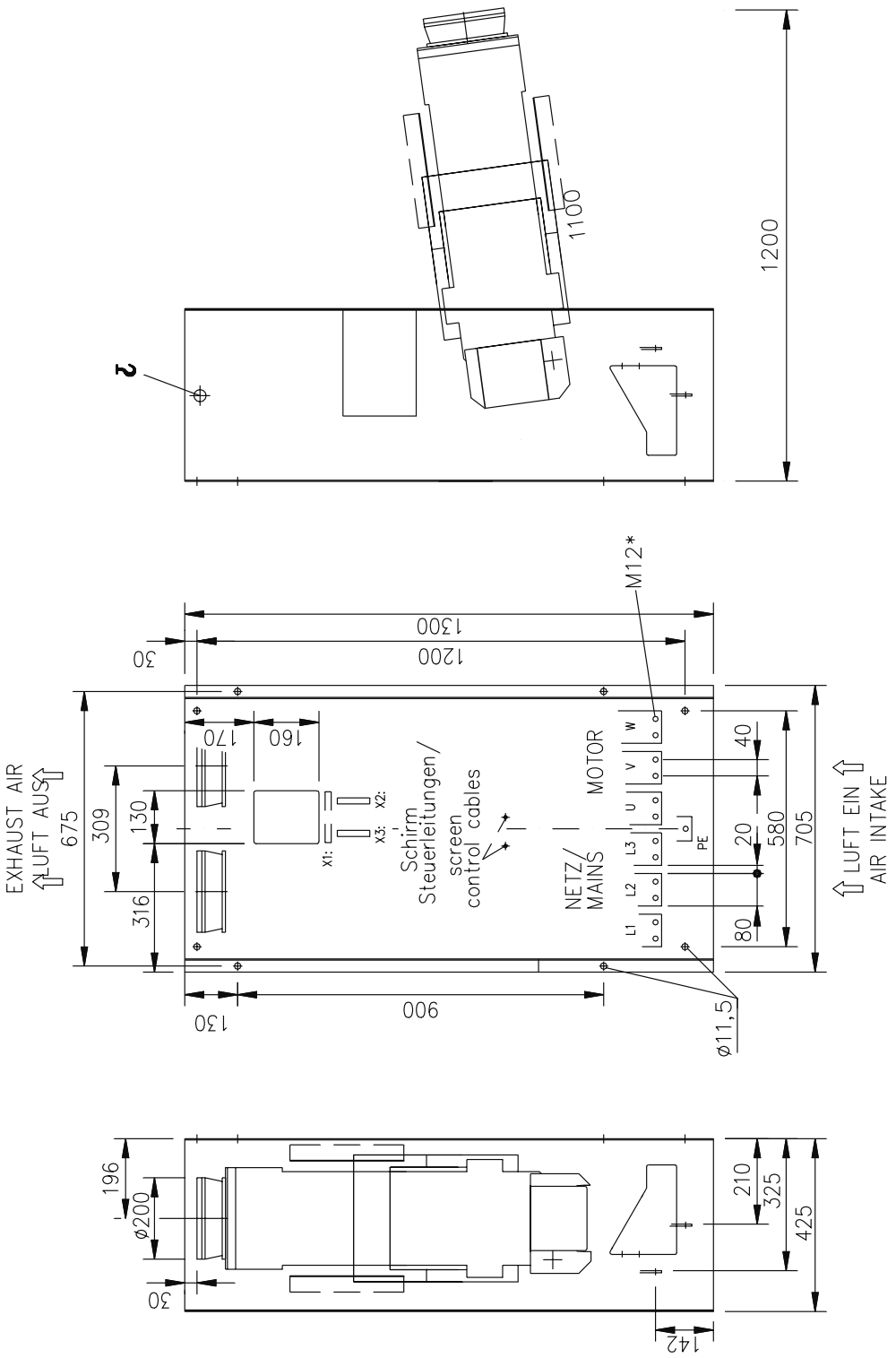

### Recommended Steps for Cooling Air Guidance

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

### Typical Cubicle Sizes for IP23

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

# Dimensions MX basic 160/200 to 315/380 – Size 4




* Tightening torque for M12 bolts: 70 Nm

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

| | MX basic 160/200 | MX basic 200/250 | MX basic 250/315 | MX basic 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*)

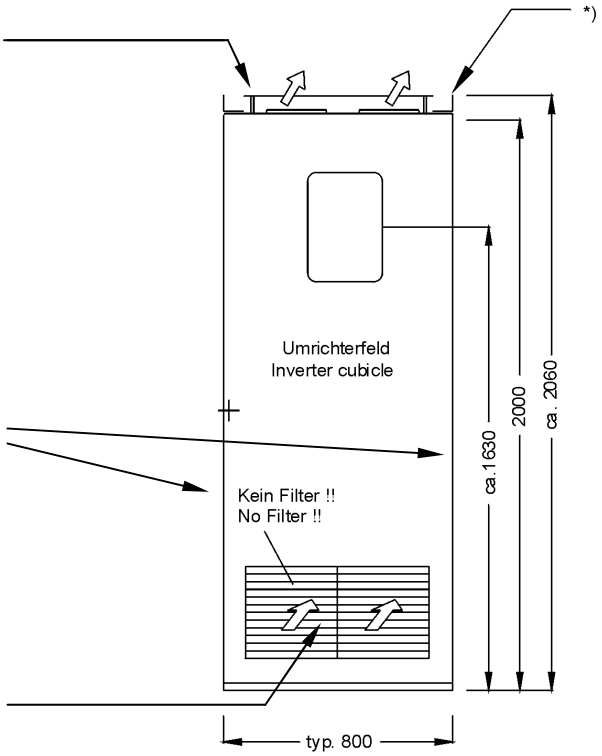
**IP20 – IP23 Standard Installation, max. Ambient Temperature +35/+40°C**

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!).

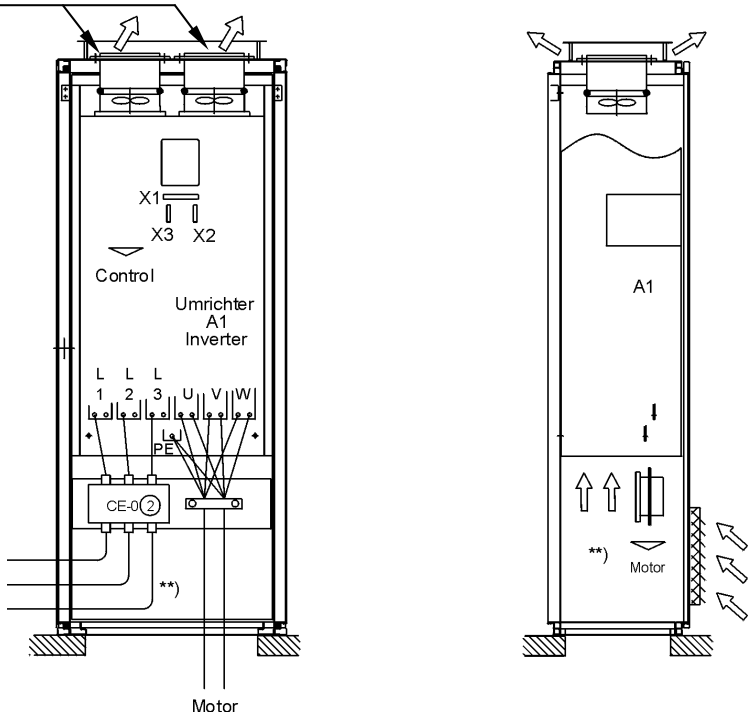
The air inlet of the inverter field must have a minimum size of 10 $dm^2$ (e.g. 2 ventilation grids)




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).

If the device is built into a cubicle, the level of noise pressure is approx. 3 dB(A) lower.

**) 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 $m^3/h$, 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 basic 250/315: max. +35°C).

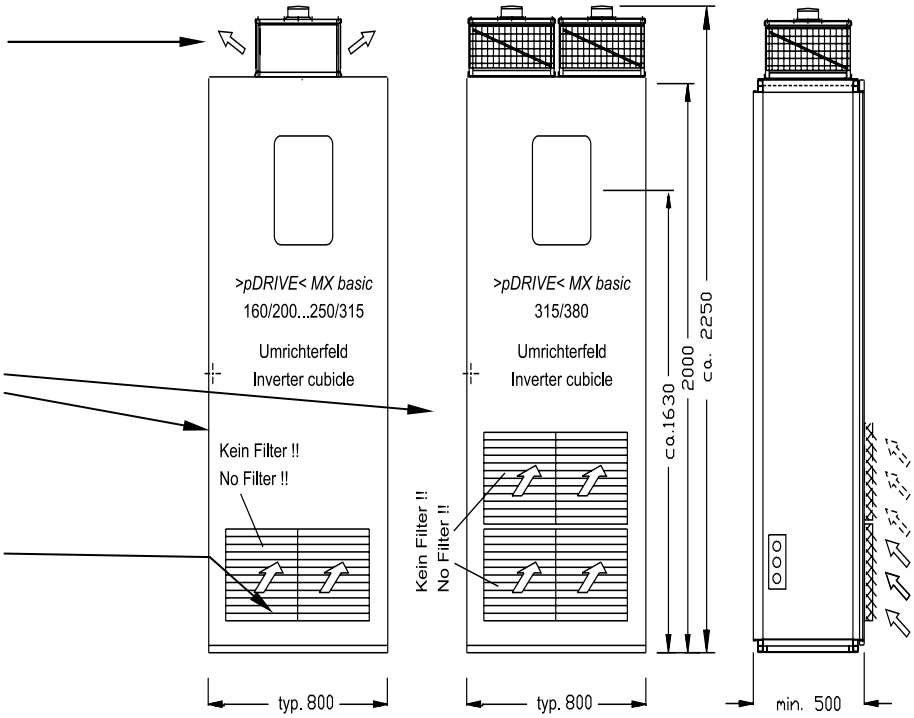
# Typical Cubicle Installation for Size 4 (incl. *MX basic 315/380*)

**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 basic 315/380)

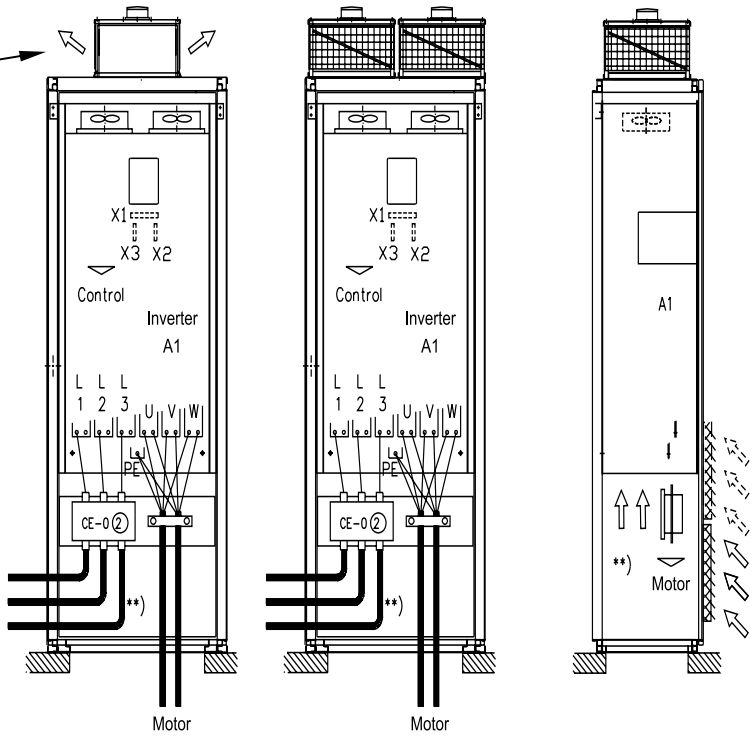
Separating wall to neighbouring cubicle (does not have to be sealed!).

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 basic 315/380; that means 4 ventilation grids)



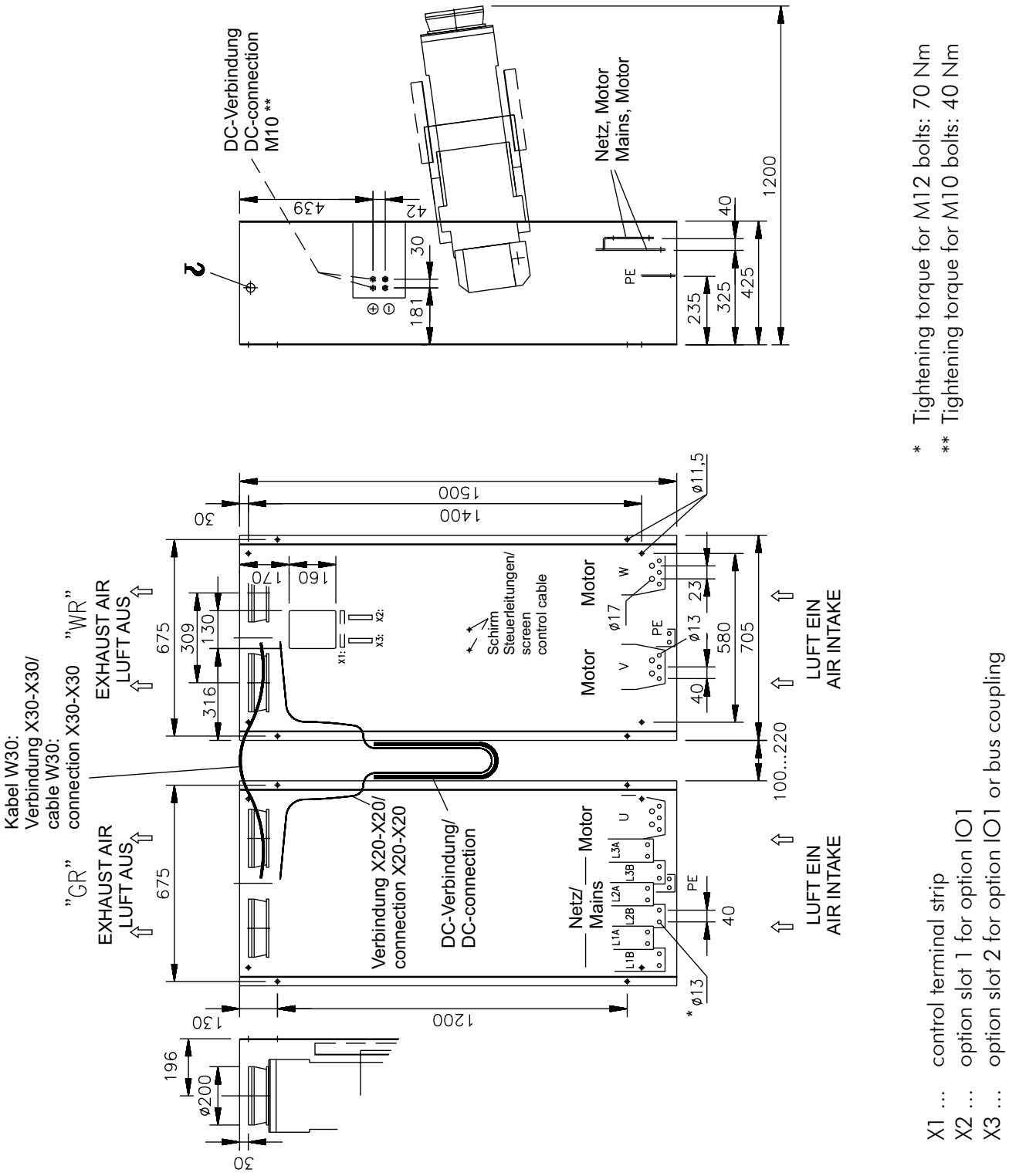

The cooling air flows out of the unit fans freely, and is extracted by the additional fan. No further air carbines are required.

**) 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 basic 250/315 and MX basic 315/380: max. +40°C).

# Dimensions MX basic 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

| | MX basic 315/400 | MX basic 400/500 | MX basic 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

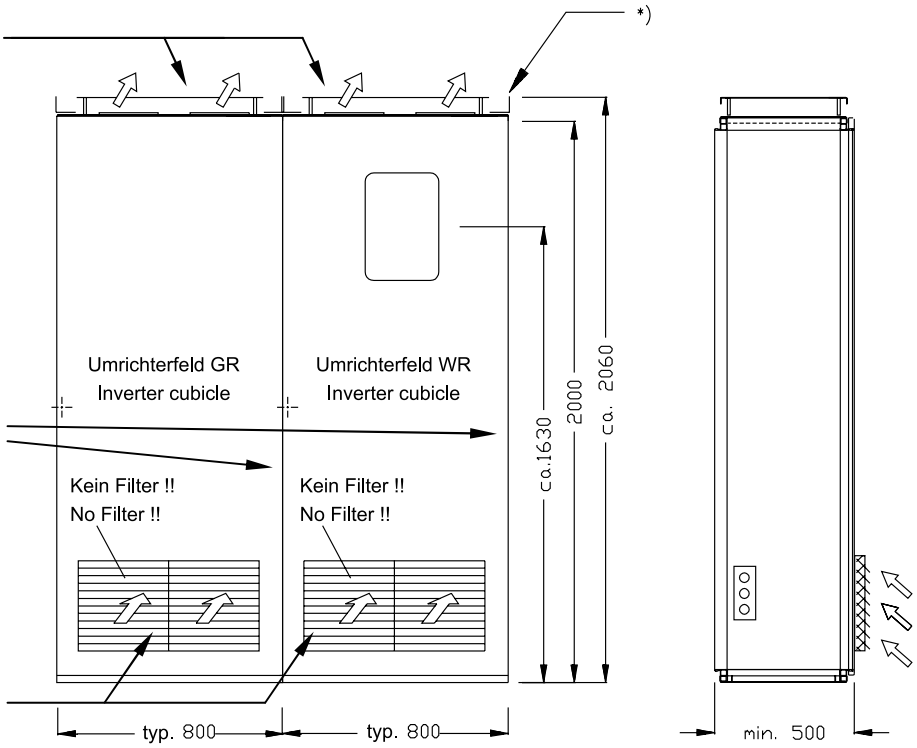
### IP20 – IP23 Standard Installation, max. Ambient Temperature +35/+40°C

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!).

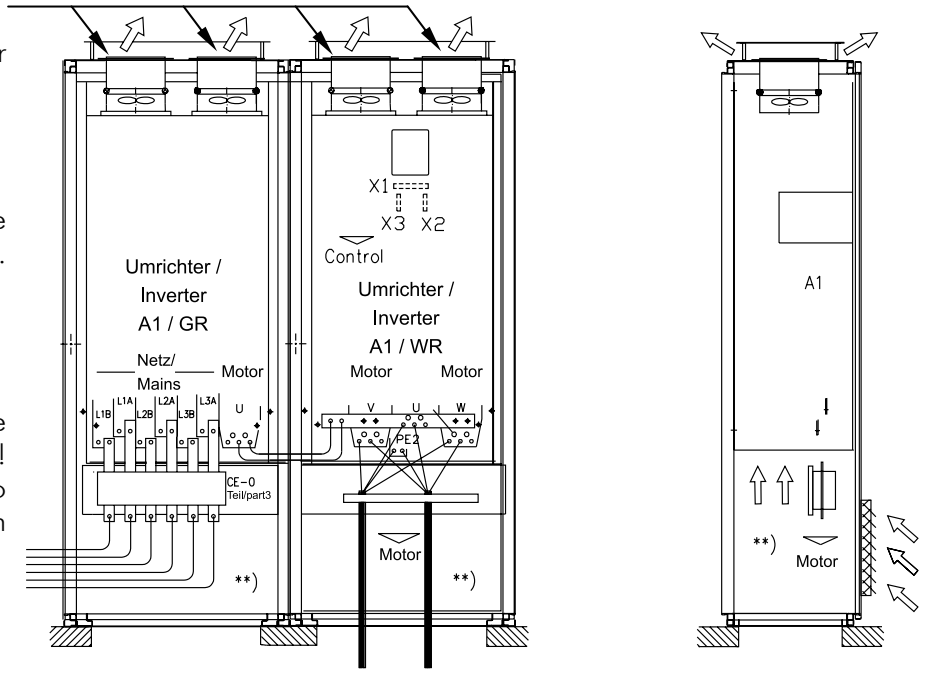
The air inlet of the inverter field must have a minimum size of 20 $dm^2$ (e.g. 4 ventilation grids)




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).

If the device is built into a cubicle, the level of noise pressure is approx. 3 dB(A) lower.

**) 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 basic 500/630: max. +35°C).

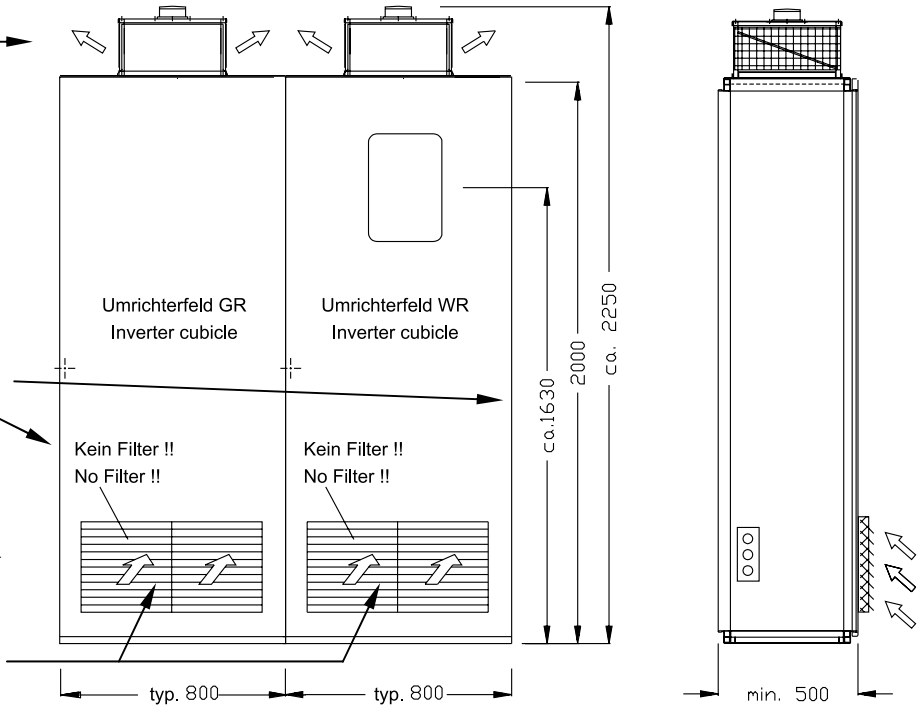
# Typical Cubicle Installation for Size 5

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

2 additional fans
(available as an option)
volume > 1500 m³/h

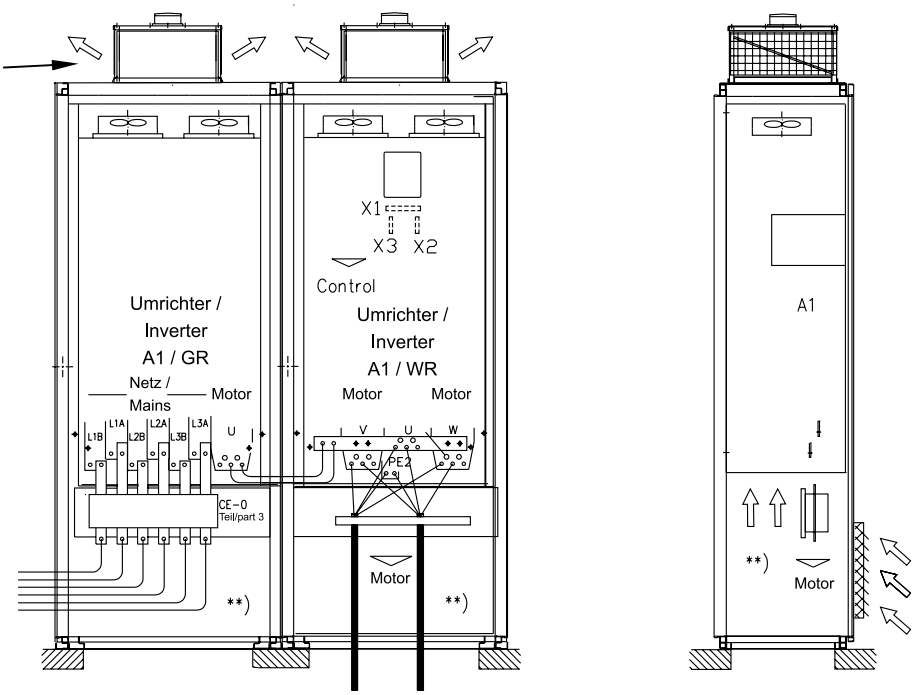
Separating wall to neighbouring cubicle (does not have to be sealed!).

The air inlet of the inverter field must have a minimum size of 20 dm² (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!

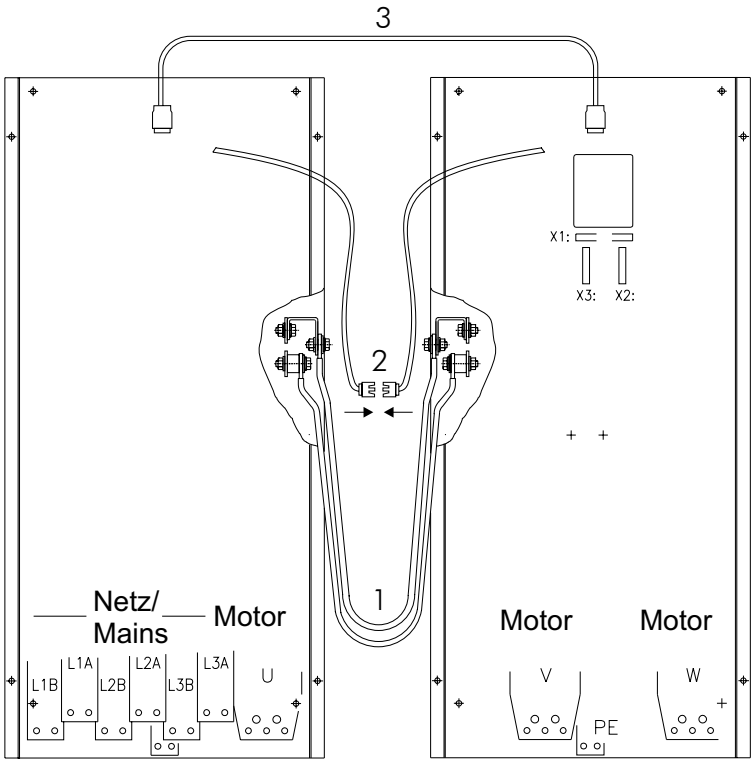



The MX size 5 needs an air flow of 2400 m³/h, which must not be obstructed by components in the in- and outlet area!!!
The maximum permissible ambient temperature (outside the cubicle) is +45°C.
(MX basic 500/630: max. +40°C).

MOUNTING

# 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

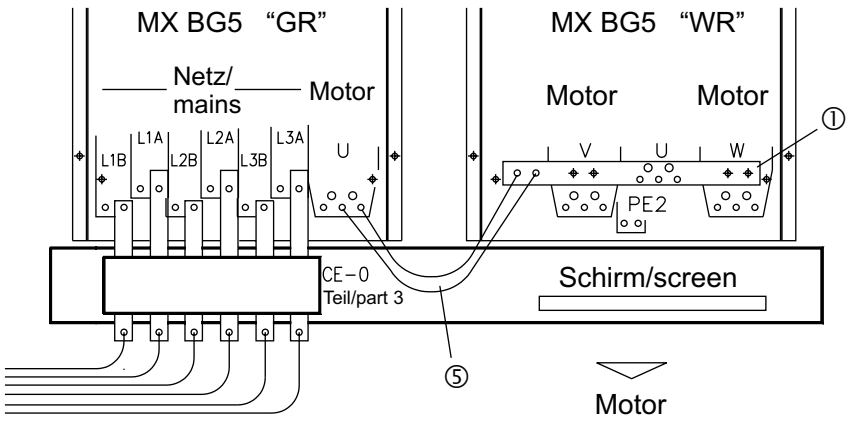
Clean the contact surfaces (e.g. with Scotch Brite).
Tightening torque: 40 Nm

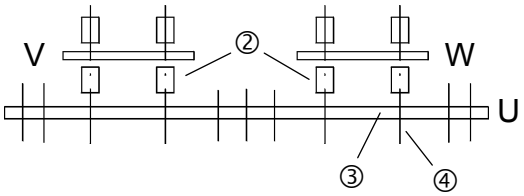
2.) Voltage measuring line, phase U
1-pole measuring line, which has to be connected using the plug connectors at both ends.

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.

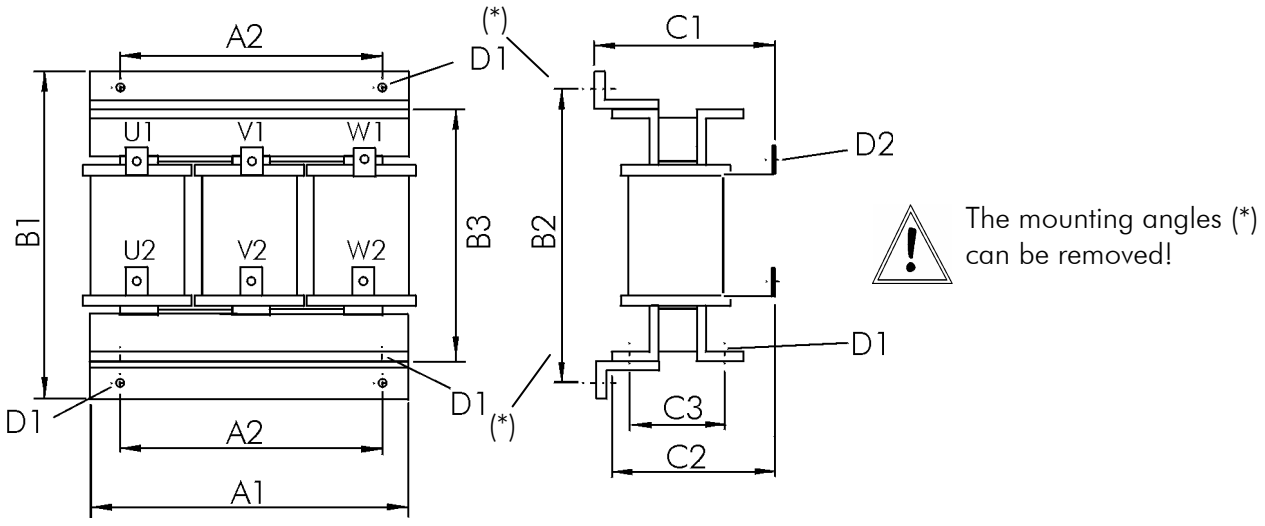
# Accessories: Line Chokes NDU

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 angles (*) can be removed!

OPTIONS

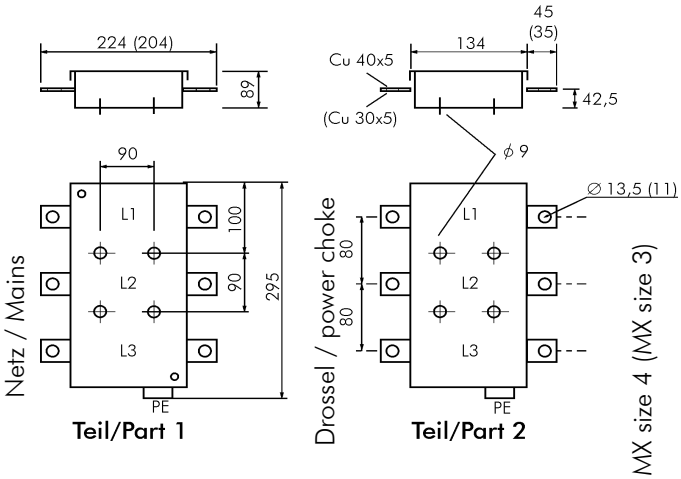
# Option: CE Filter ("Mains-sided RFI Filter") for Grounded mains 400 V

| | 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 % | | | | |
| Nominal frequency | 50/60 Hz ±5 % | | | | |
| Nominal current | 73 A | 170 A | 300 A | 570 A | 1100 A |
| Max. leakage current | appr. 400 mA | appr. 400 mA | appr. 500 mA | appr. 500 mA | appr. 1000 mA |
| Cont. leakage current | appr. 200 mA | appr. 200 mA | appr. 100 mA | appr. 100 mA | appr. 200 mA |
| Losses (approx.) | Option can only be built-in during assembly in the factory!!! | | 40 W | 60 W | 120 W |
| Max. ambient temp. | | | +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 |

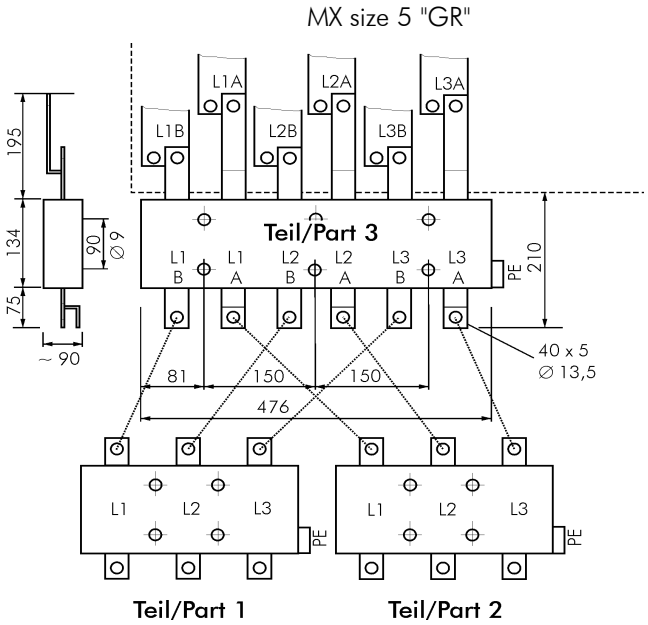
A good HF connection between the motor, motor cable screen and filter components near the inverter is imperative for the CE filter to be effective!

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)



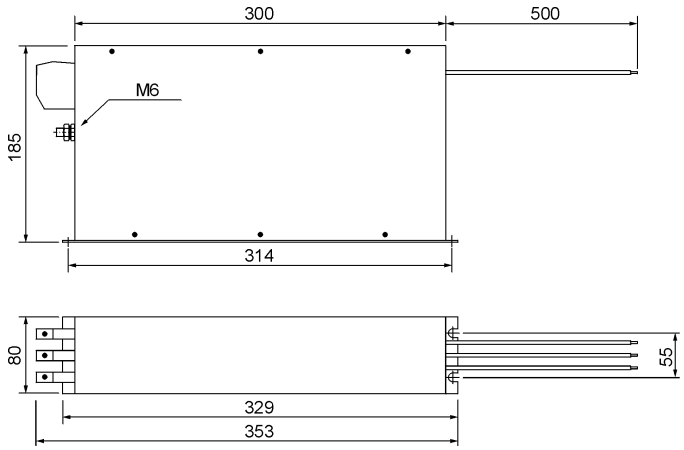

CE-0 400/1100, 3 parts
Part 3 is connected directly to the MX size 5.
(Dimensions of parts 1 and 2: see CE-0 400/570)

This CE filters are suitable only for grounded mains!

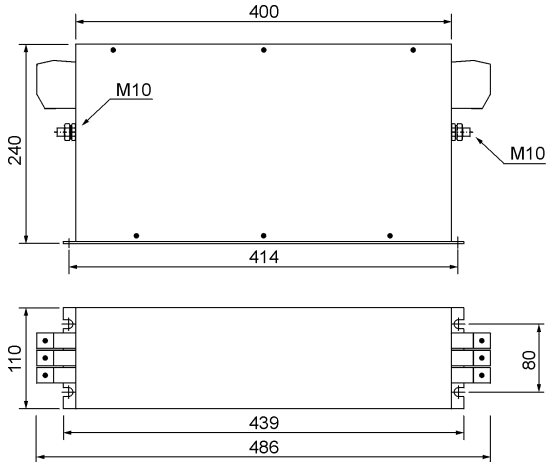
# Option: RFI filter for IT- (non-grounded) mains

| | Size 1 and 2 | | | from Size 3 CE-0 500/... | | |
|---|---|---|---|---|---|---|
| | RFI 500/55 | RFI 500/130 | RFI 700/180 | 300-IT | 570-IT | 1100-IT |
| Nominal voltage | 3 AC 380...500 V ±10 % | | | 3 AC 380...500 V ±10 % | | |
| Nominal frequency | 50/60 Hz ±5 % | | | 50/60 Hz ±5 % | | |
| Nominal current | 55 A | 130 A | 180 A | 300 A | 700 A | 1100 A |
| Max. leakage current | approx. 105 mA | | appr. 450mA | appr. 450 mA | | appr. 900 mA |
| Cont. leakage current | < 35 mA | | < 6 mA | < 6 mA | | < 6 mA |
| Losses (approx.) | 18 W | 50 W | 38 W | 40 W | 60 W | 120 W |
| Max. ambient temp. | +50 °C | | | +50 °C | | |
| Protection class | IP20 | | IP00 | IP 00 | | |
| Weight (approx.) | 3,1 kg | 7,5 kg | 6,5 kg | 5,5 kg | 6,0 kg | 11,0 kg |
| Connection | Terminals max. 25mm² or cable | Terminals max. 95mm² | Bolt M10 | Ø 11 mm | Ø 13,5 mm | Ø 13,5 mm |

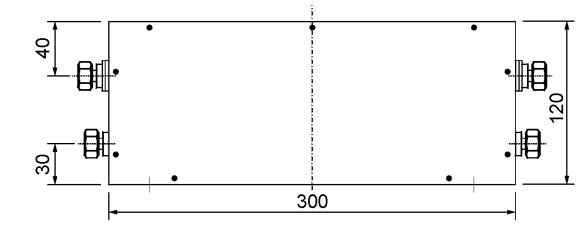
RFI 500/55

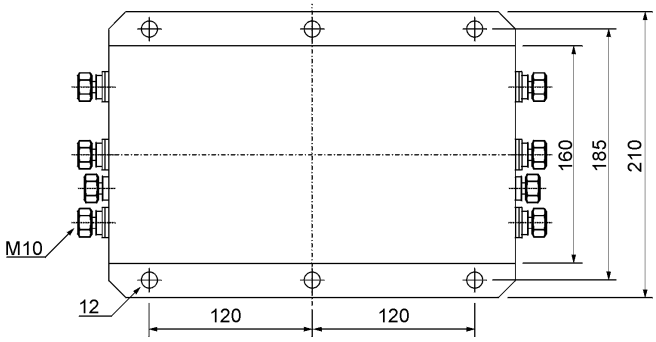



RFI 500/130




RFI 700/180




The dimensions of the CE-0 500/...-IT filters are the same as CE-0 400/...-TN filters.

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.

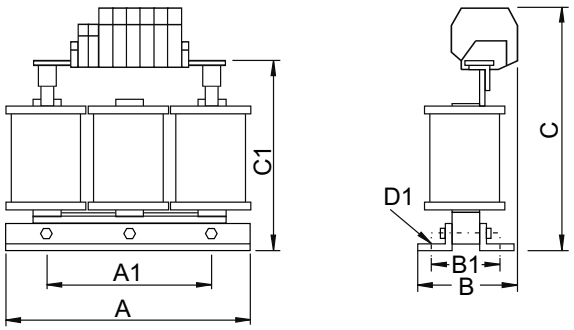
OPTIONS

# Option: AMF (Output Motor Filter)

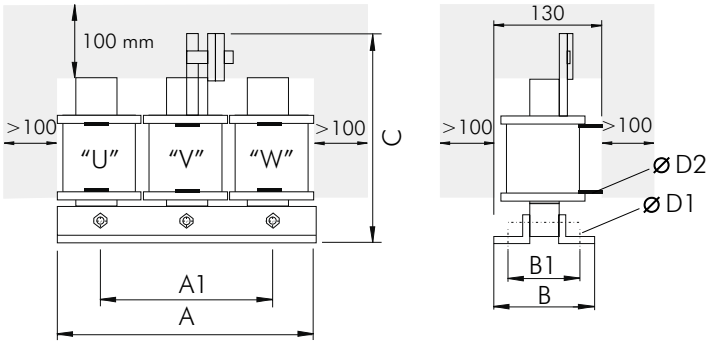
When installing the AMF filter, it is important to ensure sufficient ventilation and the necessary distance to other units and housing components! Any installation position can be chosen.

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

Dimensions AMF 450/ 48:



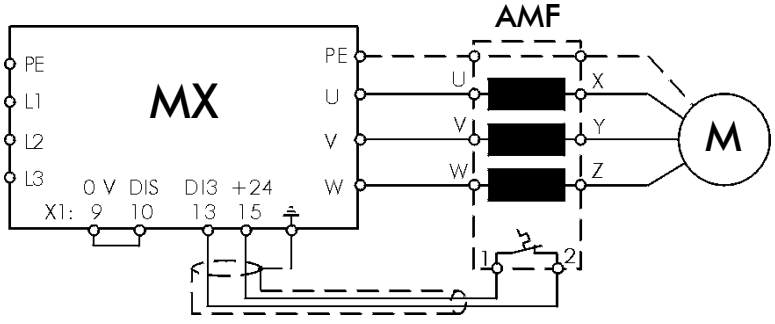

Dimensions AMF 450/90:




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.

### Integration of the Thermoclixon of the Output Motor Filter (AMF 450/48 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").



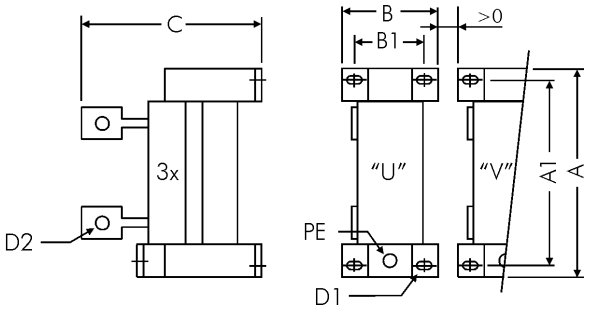

Set parameter D2.02 "DI3 selection" to 22 = "external fault", parameter E3.11 (E3.02) "external fault" to 6 = "N.C. ready", and parameter E3.13 (E3.03) "time delay" to 1.0 s.

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

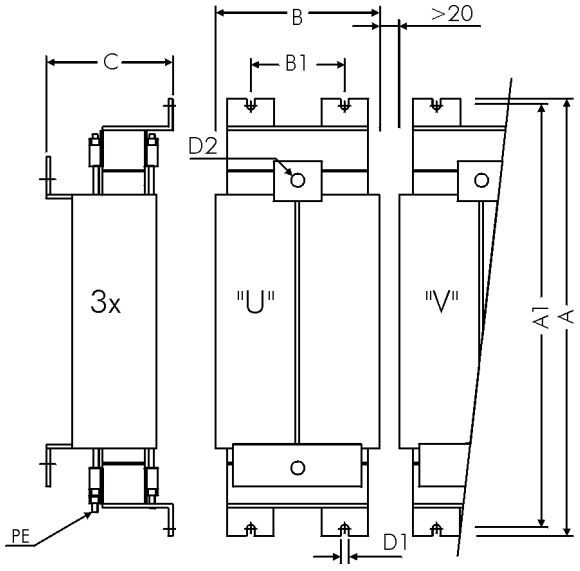
When installing the AMF filter, it is important to ensure sufficient ventilation and the necessary distance to other units and housing components! Any installation position can be chosen.
The AMF 450/170-3...1100-3 consist of three single-phase chokes that can be arranged in any order.

| 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 |

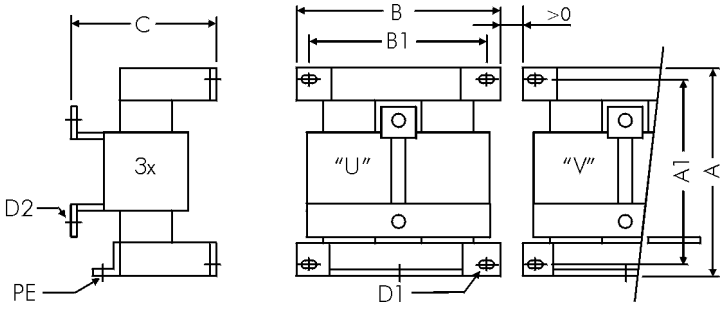
Dimensions, AMF 450/170-3:




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




Dimensions, AMF 450/300-3:

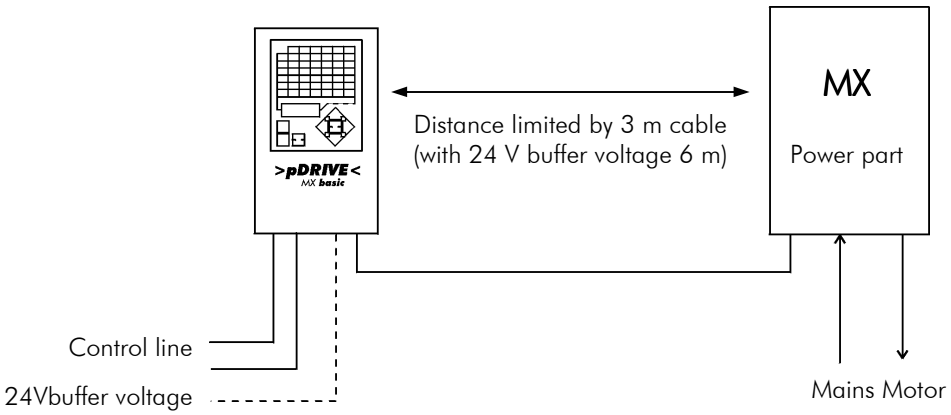



Direct mounting on a mounting plate made of steel is admissible.

OPTIONS

# 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.



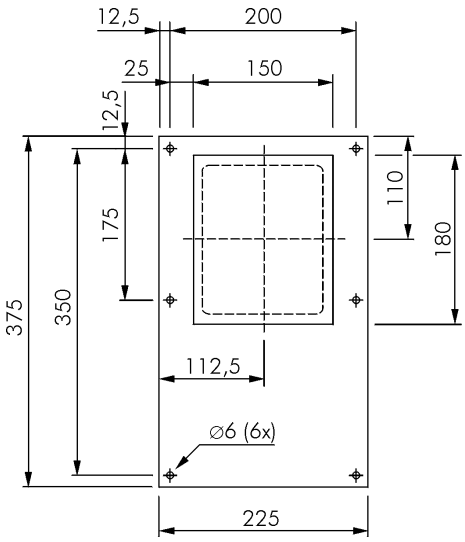

The BE5-A is installed on a metal plate of 1...2 mm thickness (e.g. inside the cubicle door) as shown on the drilling diagram (6 holes with ∅ 6 mm and one opening 150 x 180 mm).

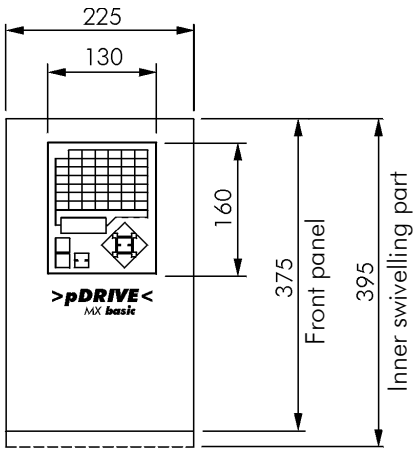
The inner swivel part is 20 mm longer than the front cover at the bottom! The cable outlets are also provided at the bottom!

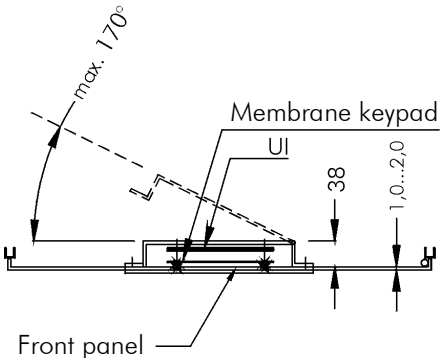
To mount the BE5-A, the front panel is inserted with the threaded bolts and screwed on from the back of the swivel frame.

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.

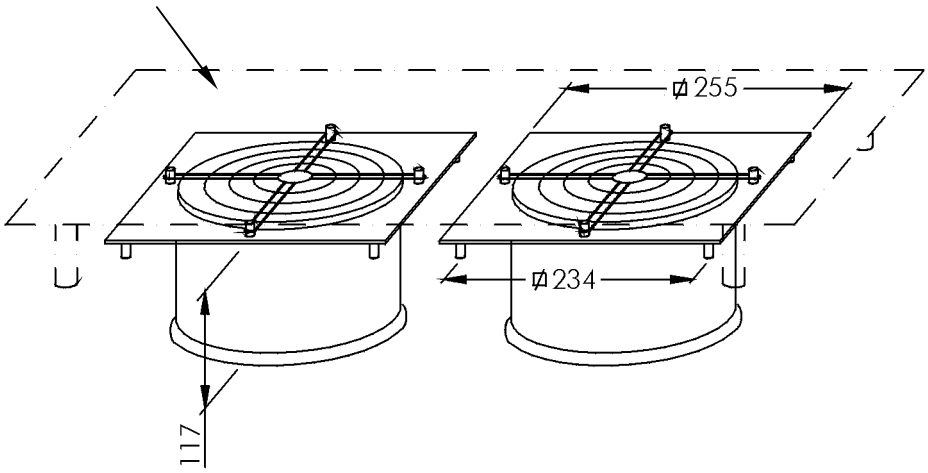
On delivery, the option BE5-A is prepared for a cubicle door hinged on the right. Conversion to a cubicle door hinged on the left is possible.

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

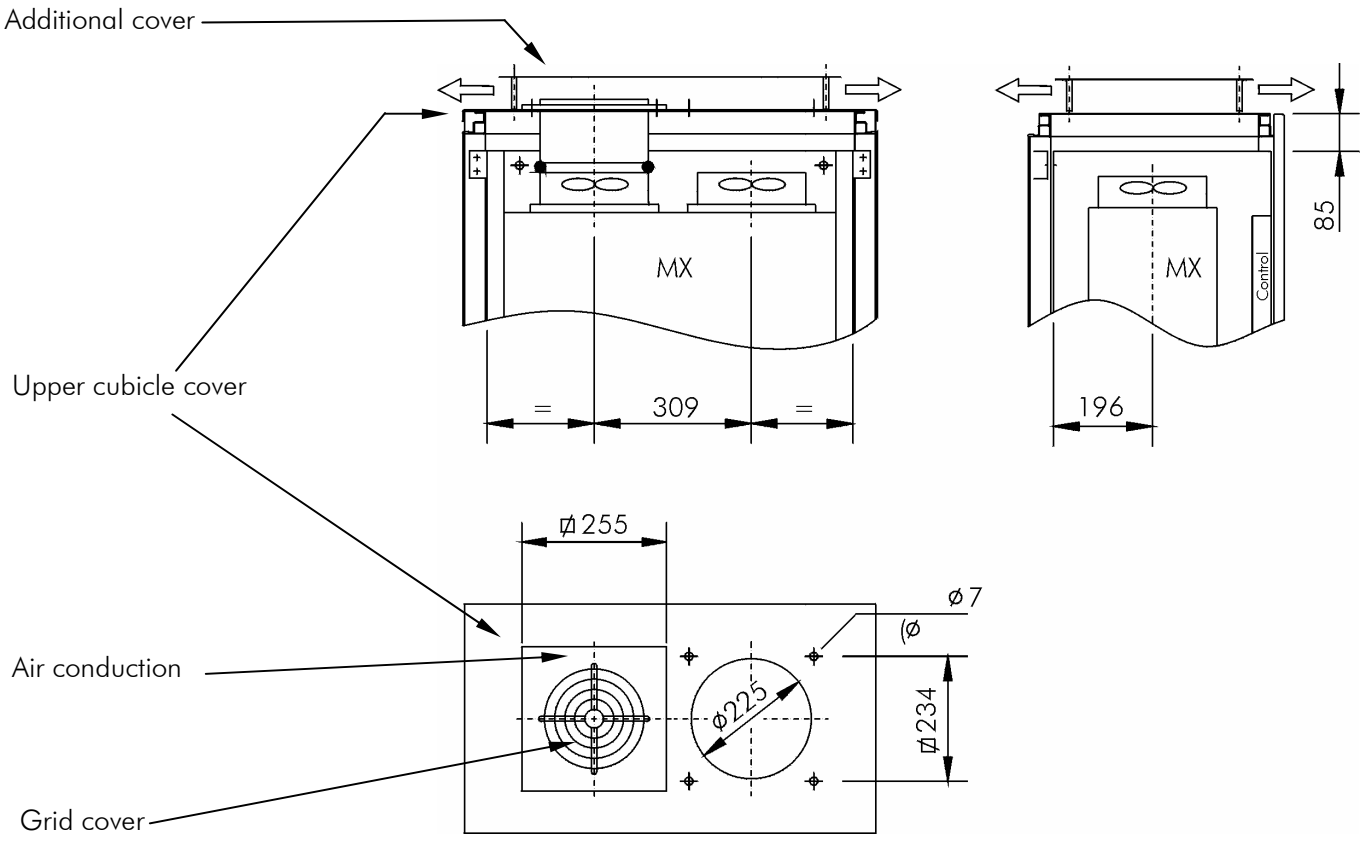
This option allows a complete extraction of the heated cooling air from the cubicle. Additionally, the level of noise pressure of the built in inverter is approx. 3 dB(A) lower. It is installed in the upper cubicle cover, 85 mm above the top edge of the inverter.
For *>pDRIVE< MX* size 3 one air conduction 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)



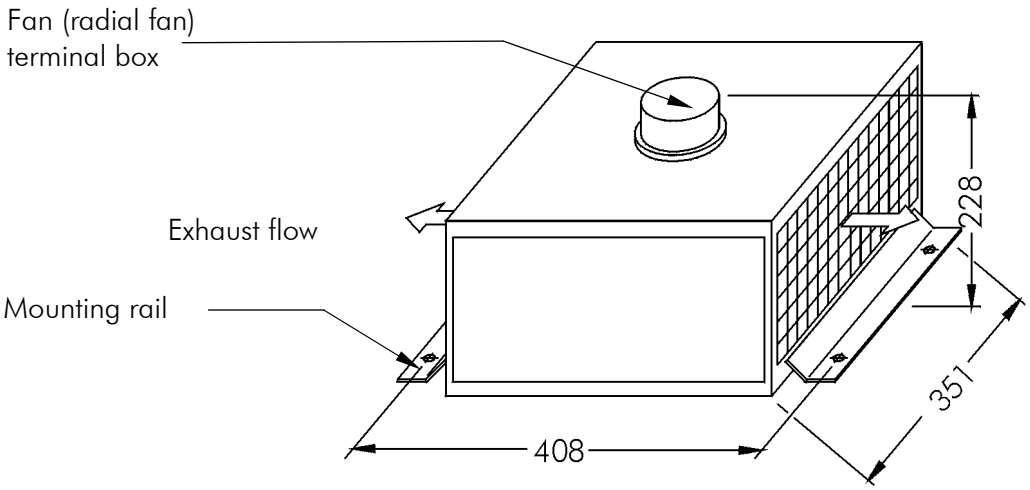

Drilling diagram for the top cubicle cover



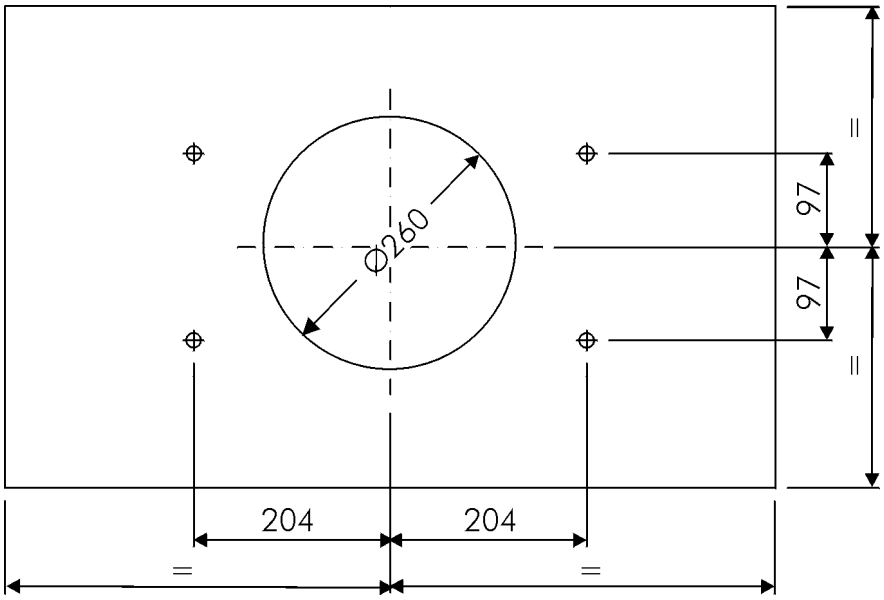
# Option: Fan Module

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)



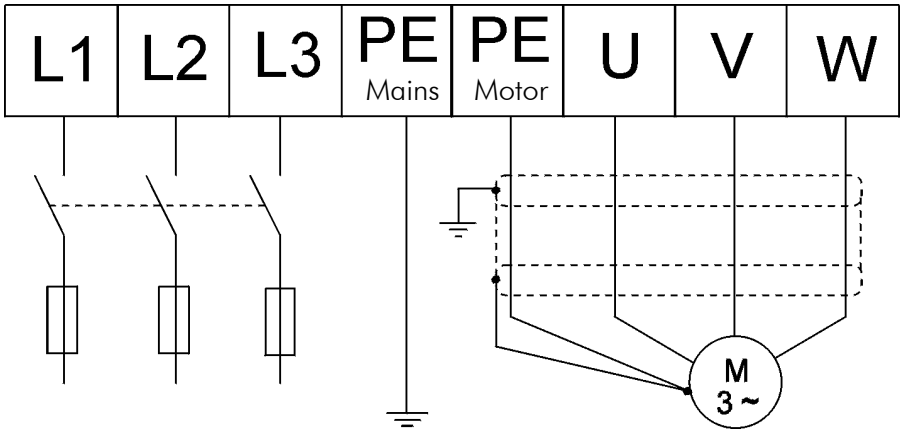

Drilling diagram



# Power Connections

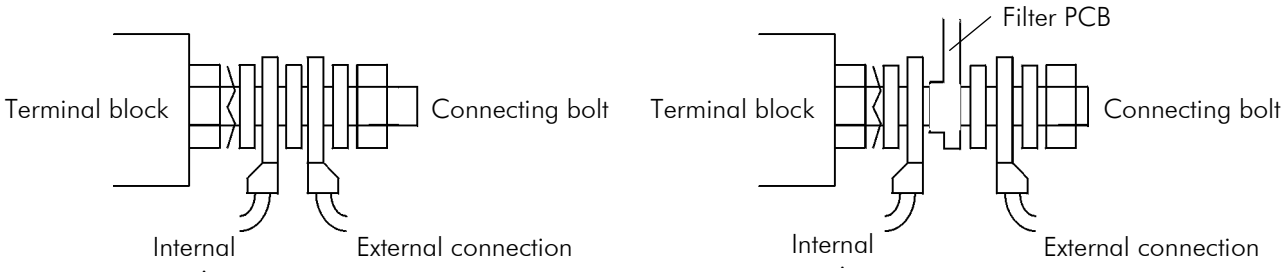
Electronic installation work must be performed only by properly qualified staff. The use of switching gears before the inverter must be in full compliance with the pertinent regulations.

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.




| 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) |

**Connection to Sizes 1 and 2**




Without CE filter

With CE filter

**Do not apply current to the steel nut!**

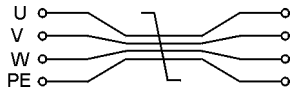
CAUTION – Risk of electric shock
- Ground equipment.
- Before servicing:
  Remove all power, wait 5 minutes. Verify no voltage is present.
- After servicing, close cover.

Failure to comply will result in injury or death!

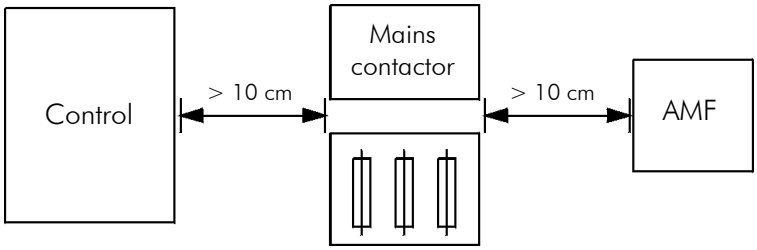
CONNECTION

## 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.

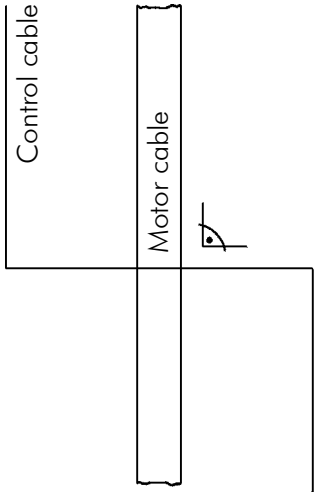


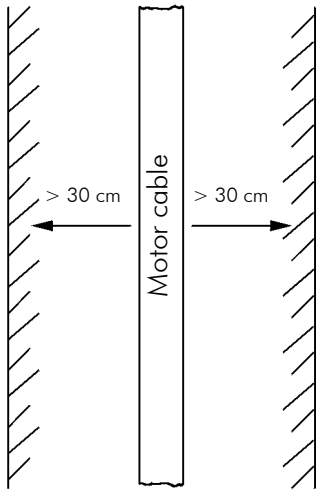

2.) Control cables, mains supply and motor lines should be separated from each other, if possible.




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.

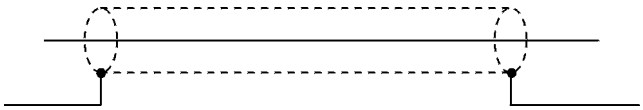



Control lines should have a minimum distance of 30 cm from motor cables.

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

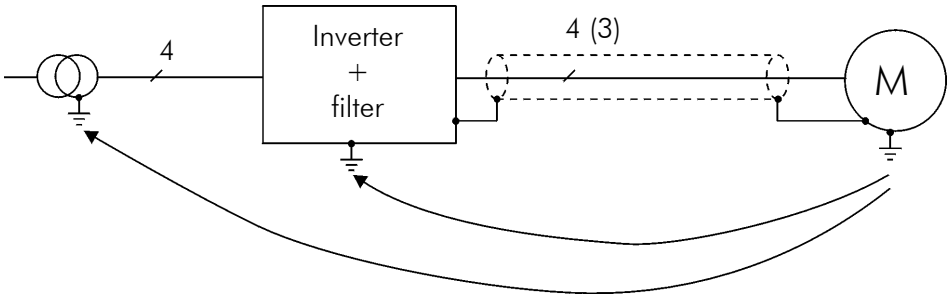
4.) Use only screened control cables (*exception*: relay contacts and possibly digital inputs, if they are completely separate from the power lines). Always earth the screen at both ends (*exception*: in case of problems with earth loops caused by offset currents that heat the screen, earth only on the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

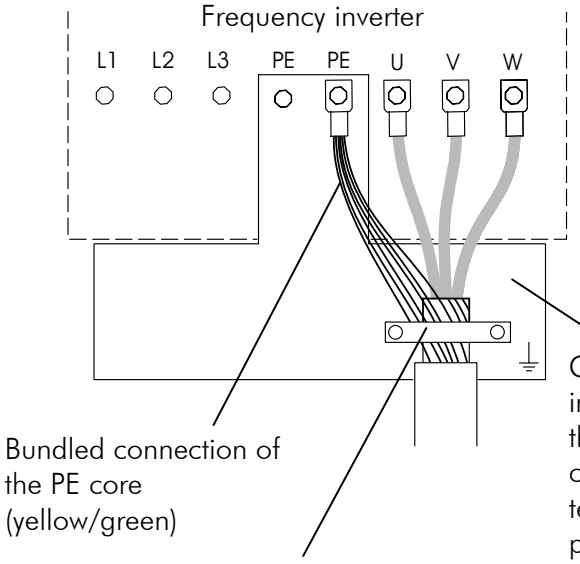



An advantageous possibility (for use in industrial environments) for large cable diameters is the use of power cables with a concentric protection core (e.g. NYCY or NYCWY cables). Thereby, the protective core has the same function as the PE core, as well as the screening function.

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 1...2:

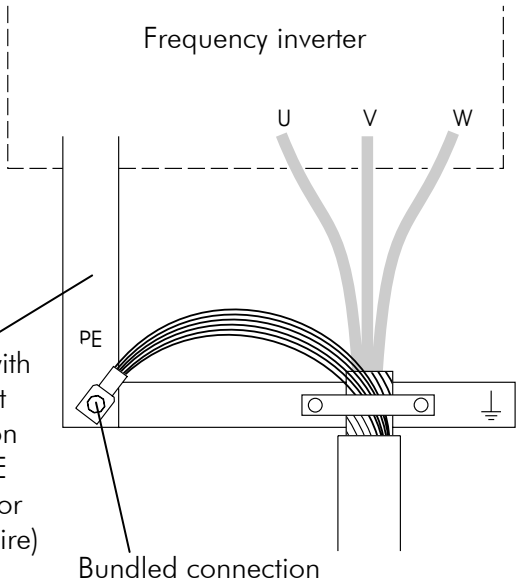



Bundled connection of the PE core (yellow/green)

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:



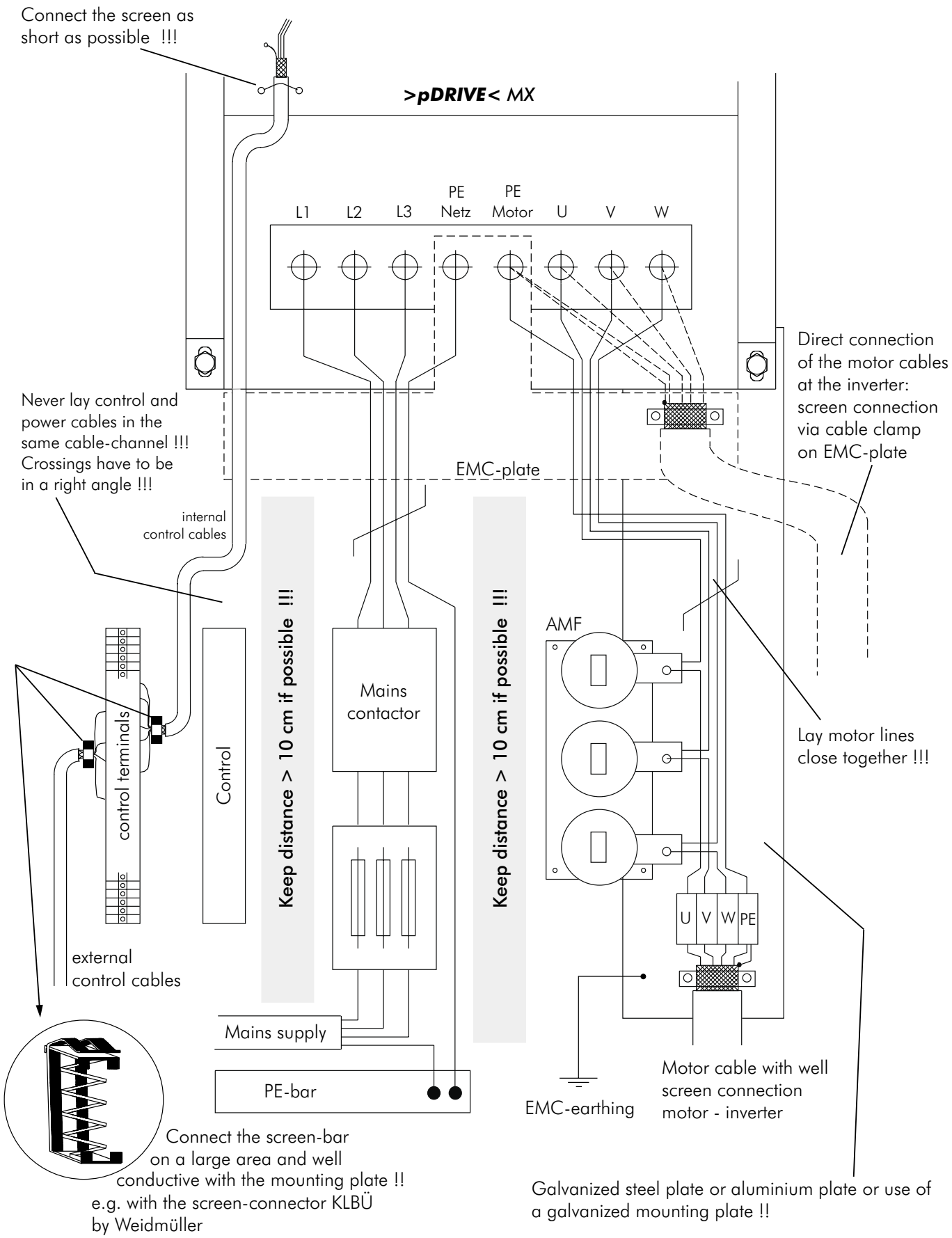

Bundled connection of the PE core (green/yellow)

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

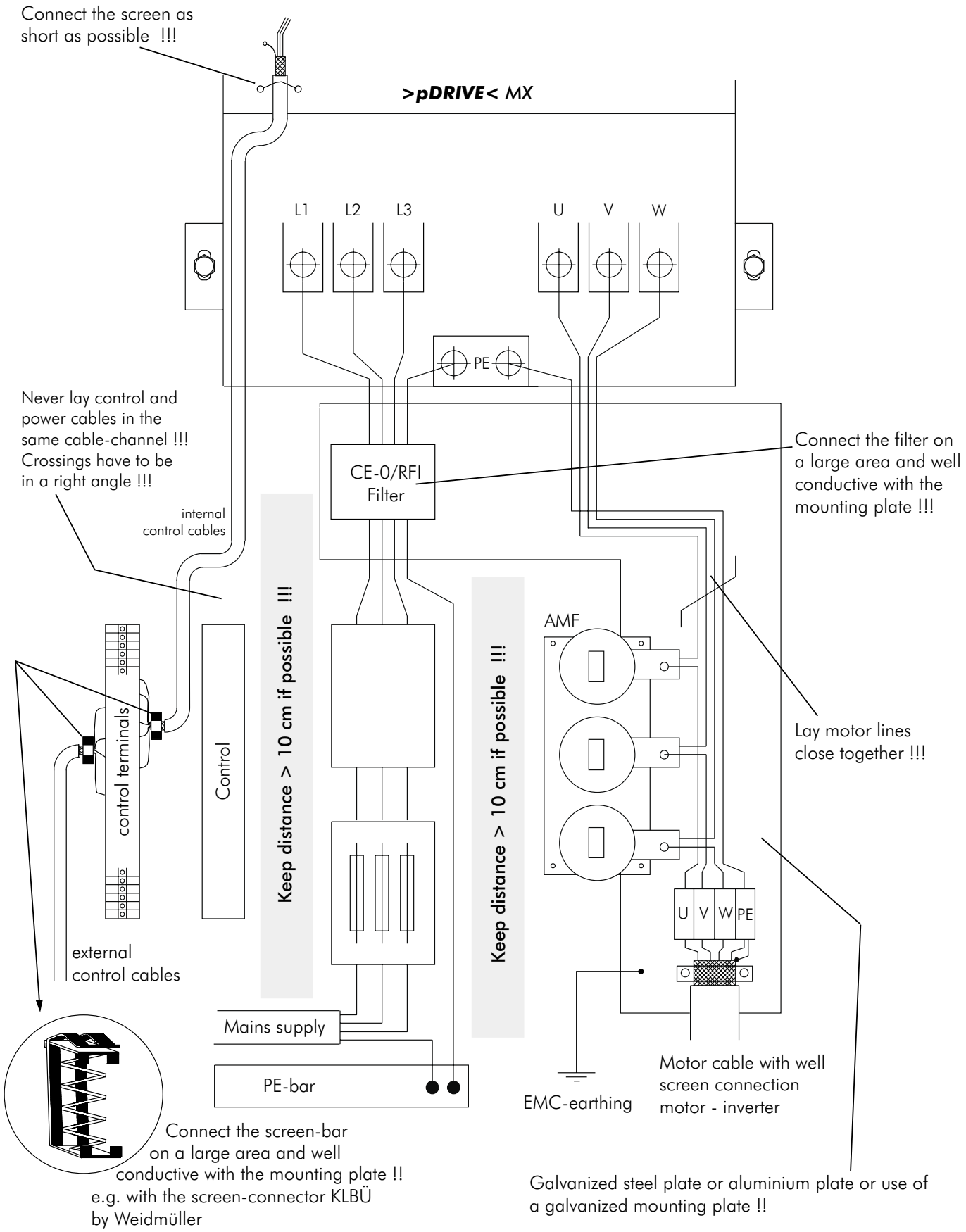
Screen function: Large-scale connection of the PE core for low HF resistance with good induction of the interfering currents into the CE filter, e.g. using a clamp

# Wiring of the Power Terminals

### Cubicle Installation for Sizes 1...2

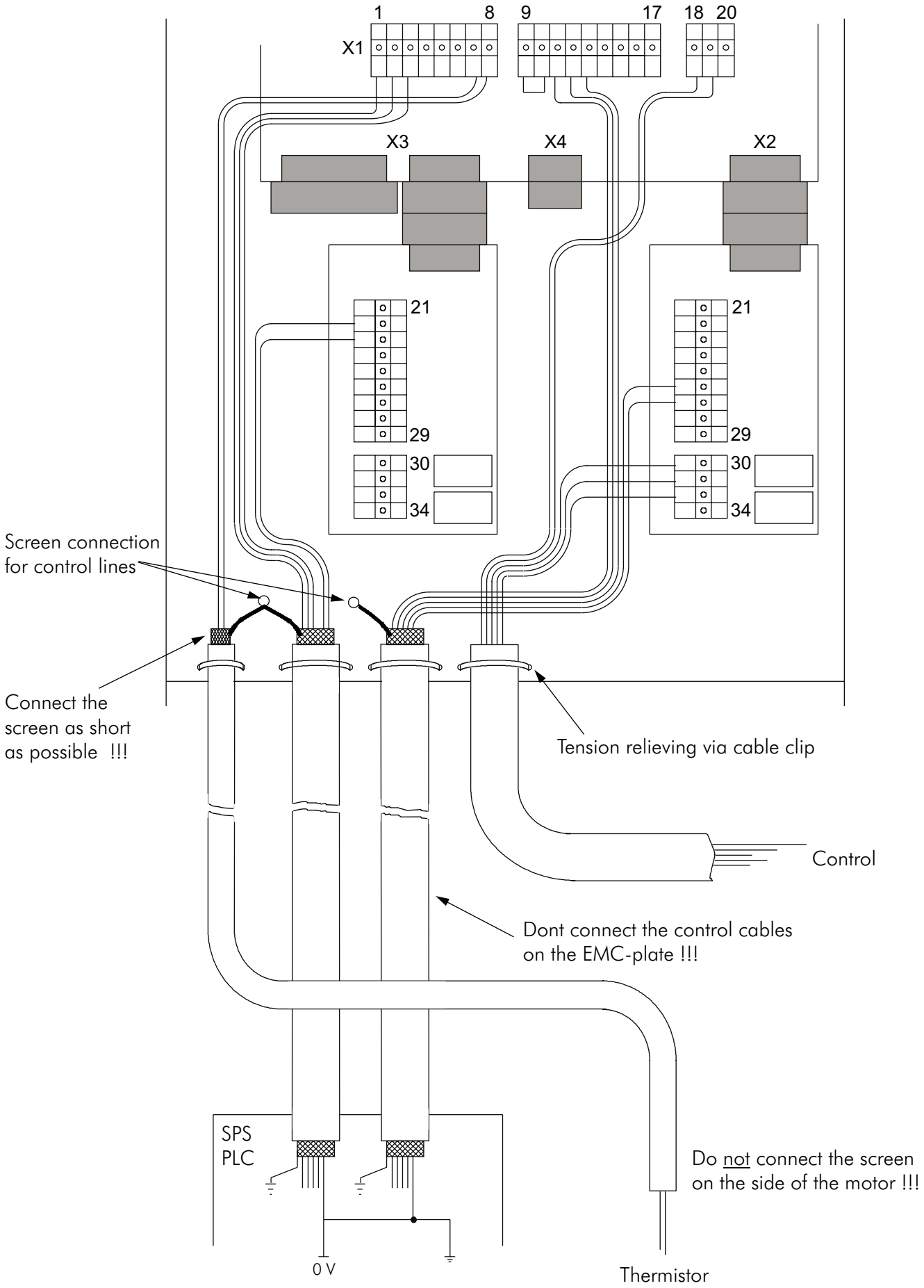


## Cubicle Installation for Sizes 3...5

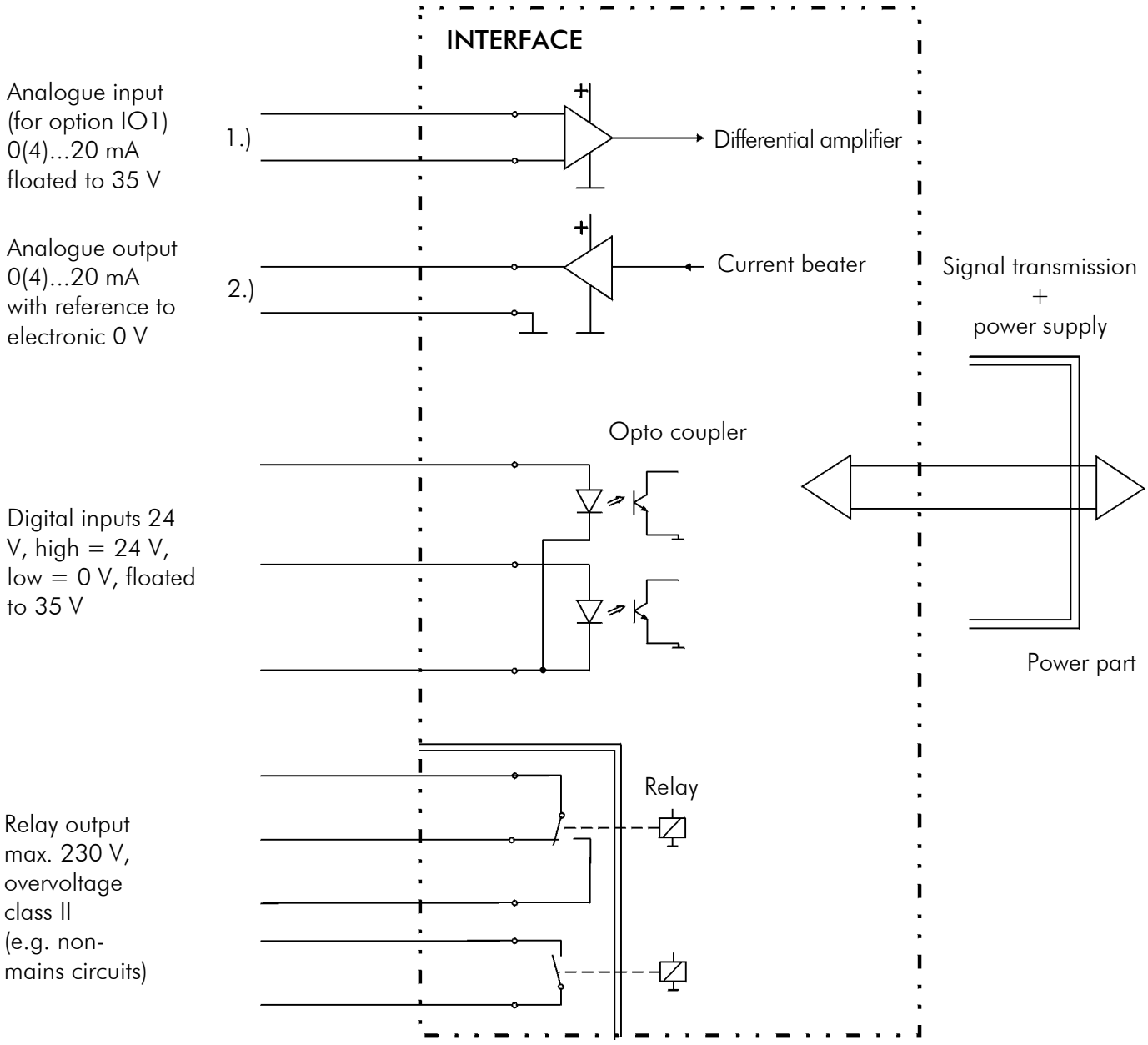



CONNECTION

# 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).

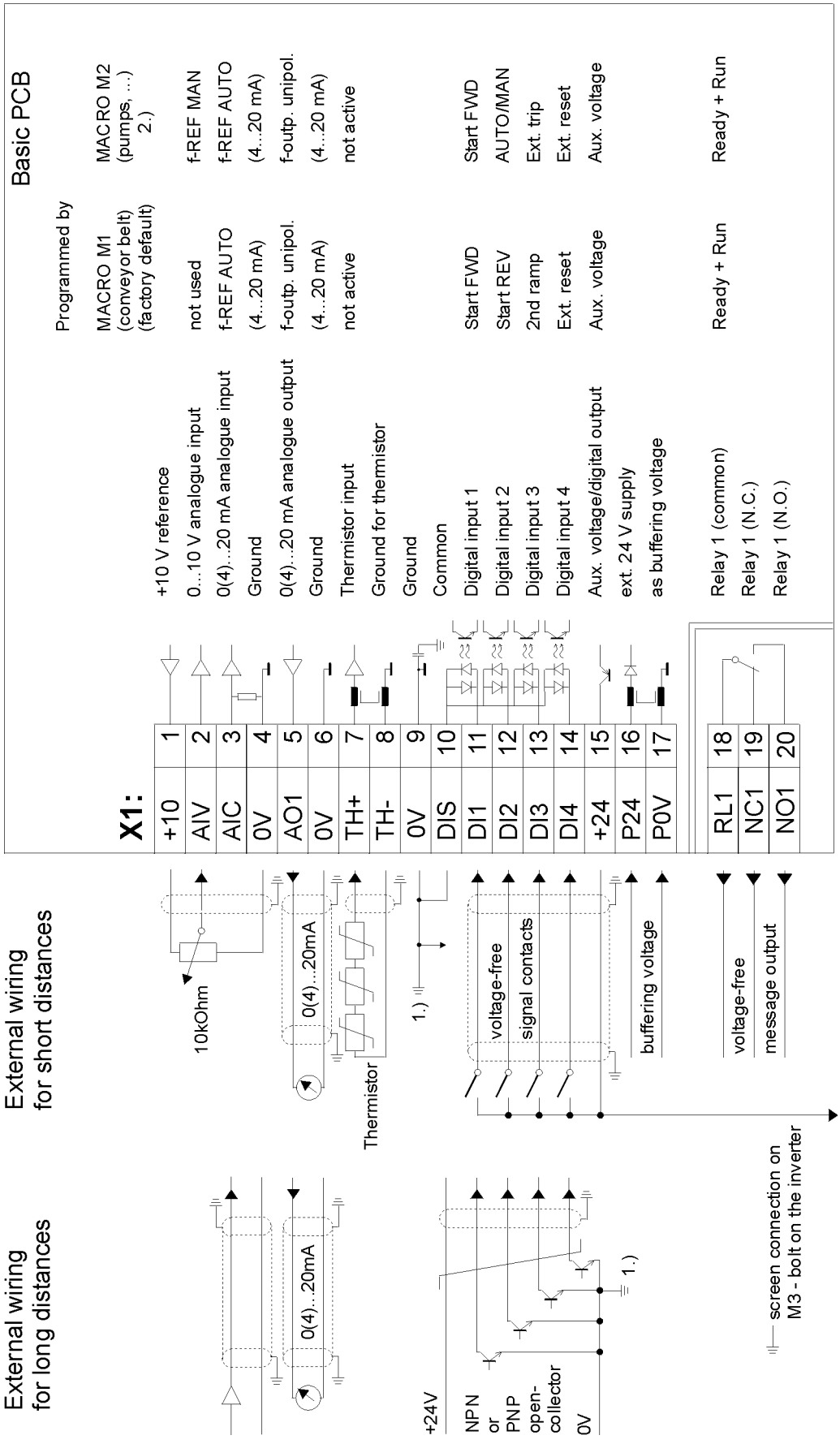
2.) All inputs and outputs are completely decoupled from each other (if the analogue input from the IO1 and the external 24 V for digital inputs are used).

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

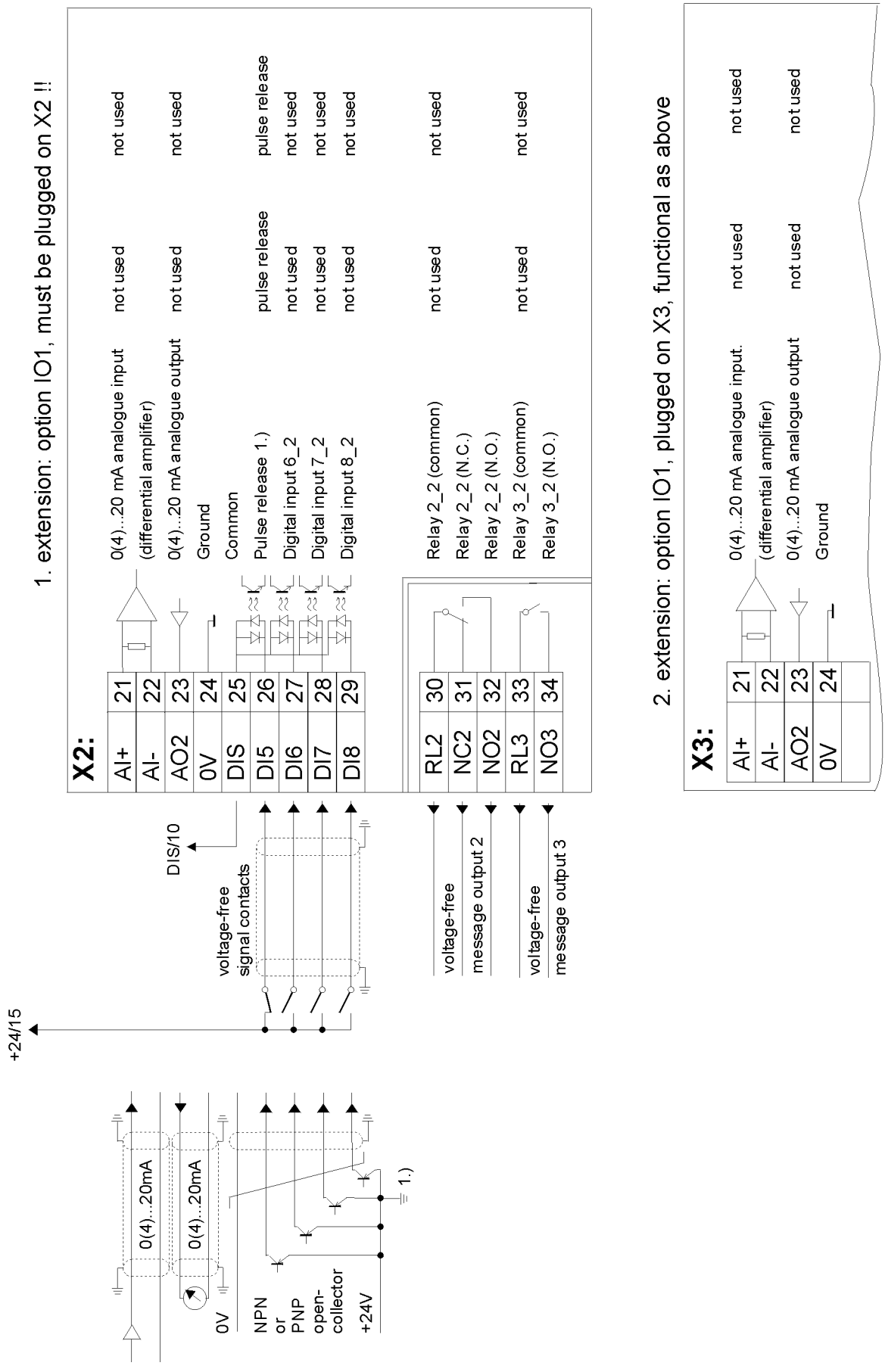
The control lines must be separated from the mains and motor cables or other power cables. They should not exceed a length of 20 m, and they must be screened.




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

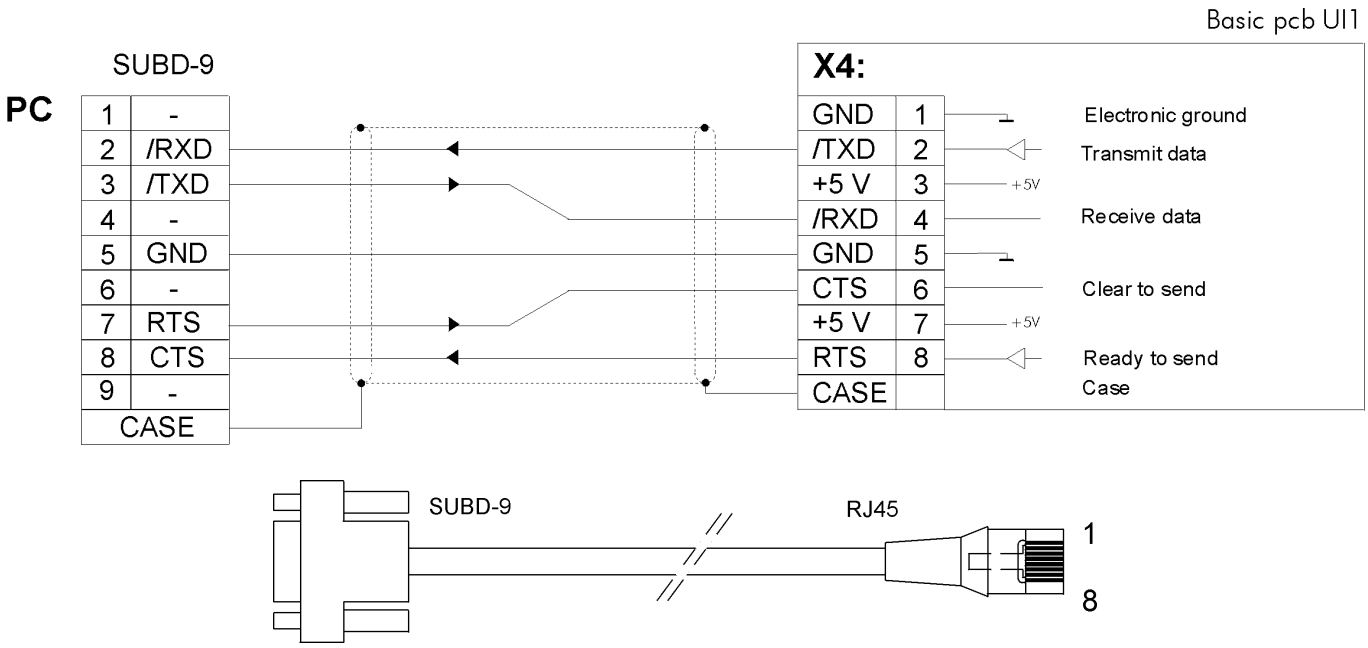
If the crossing of mains and/or motor cables and control cables cannot be avoided, they must be crossed at right angles.




1.) Sobald die Option IO1 gesteckt ist, hat der Digitaleingang DI5 die Funktion "Impulsfreigabe" und benötigt unbedingt ein 1-Signal damit der Umrichter laufen kann (auch für Autotuning notwendig !!). z.B. durch Drahtbügel DIS (Kl. X1:10) - DIS (Kl. X2:25) und +24 (Kl. X1:15) - DI5 (Kl. X2:26)

# Serial Interface

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.




**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 |

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

# 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 | Kl. 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+<br>TH - | T X1: 7<br>T X1: 8 | **Thermistor input +**<br>**Thermistor input -** | for max. 6 thermistors in series, wiring must be screened and separated from the motor cable!<br>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<br>P0V | T X1: 16<br>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<br>switching power max. 1250 VA, 150 W<br>continuous current max. 3 A<br>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** | |

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

## Option Card (IO1) in Slot X2

| | | | |
|---|---|---|---|
| AI+<br>AI- | T X2: 21<br>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 changeable and not selectable<br>For operation of the inverter, a 1-signal is always necessary, e.g. by connecting with +24 (T X1: 15)!<br>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<br>NO2 | T X2: 31<br>T X2: 33 | **N.C. contact**<br>**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+<br>AI- | T X3: 21<br>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<br>NO2 | T X3: 31<br>T X3: 32 | **N.C. contact**<br>**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.

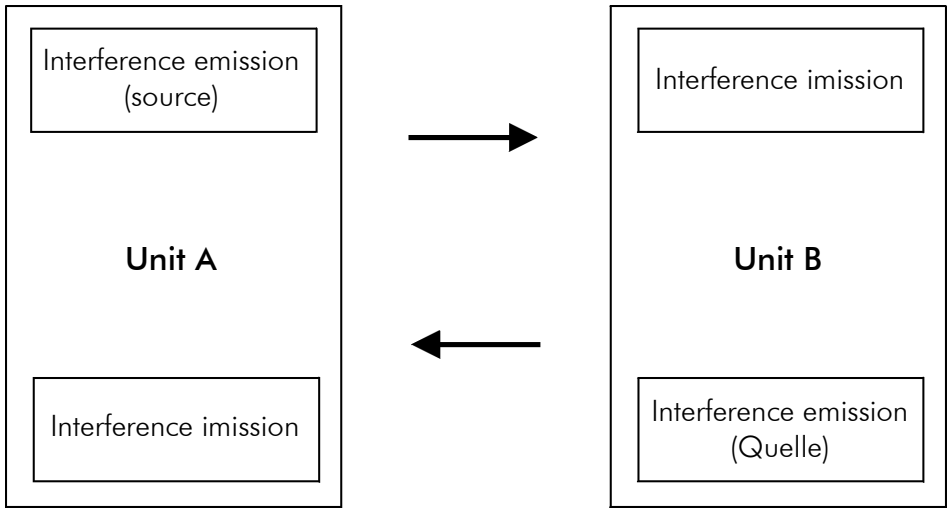
# EMC Product Standard for PDS (Power Drive Systems) EN 61800-3

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.

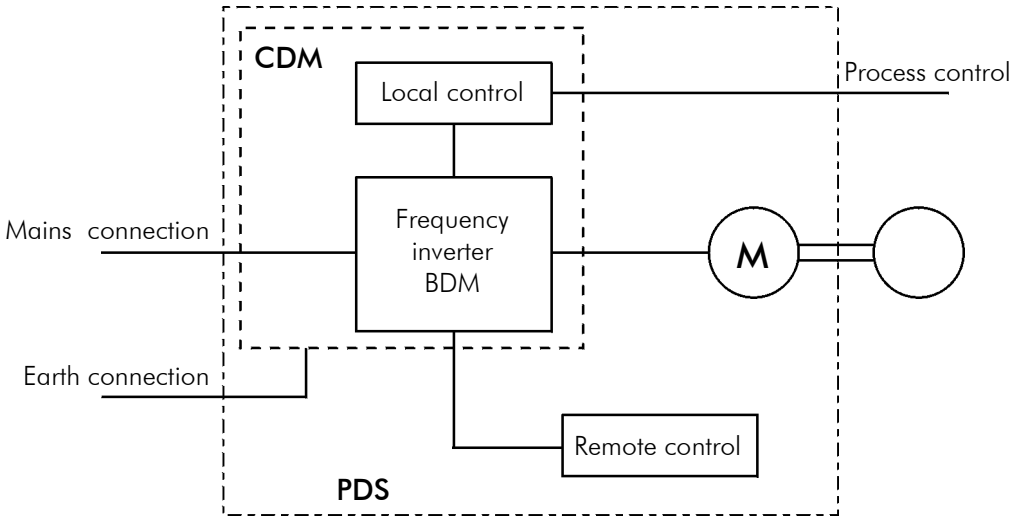
> The aim of the EMC directive 89/336/EEC is the ability of electric and electronic installations to function properly in their electromagnetic environment without influencing the environment or other consumers therein.

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 (mV/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.

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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