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1. General Information

1.1. Safety and General Information

1.1.1. General Warning

| | |
|---|--|
|  | <p>The voltage of the frequency converter is dangerous whenever the equipment is connected to mains. Incorrect installation of the motor or the frequency converter may cause damage to the equipment, serious personal injury or death. Consequently, the instructions in this manual, as well as national and local rules and safety regulations, must be complied with.</p> |
|---|--|

| | |
|---|--|
|  | <p>Installation in high altitudes: By altitudes above 2 km, please contact Danfoss Drives regarding PELV.</p> |
|---|--|

1.1.2. Safety Regulations

1. The frequency converter must be disconnected from mains if repair work is to be carried out. Check that the mains supply has been disconnected and that the necessary time has passed before removing motor and mains connections.
2. The [STOP/RESET] key on the control panel of the frequency converter does not disconnect the equipment from mains and is thus not to be used as a safety switch.
3. Correct protective earthing of the equipment must be established, the user must be protected against supply voltage, and the motor must be protected against overload in accordance with applicable national and local regulations.
4. The earth leakage currents are higher than 3.5 mA.
5. Protection against motor overload is not included in the factory setting. If this function is desired, set parameter 128 to data value *ETR trip* or data value *ETR warning*. For VLT 6000, VLT 8000 and VLT 4000, set parameter 117 to data value *ETR trip* or data value *ETR warning*.
Note: The function is initialised at 1.16 x rated motor current and rated motor frequency (see the Operating Instructions). The ETR functions provide class 20 motor overload protection in accordance with NEC (North America).
6. Do not remove the connections for the motor and main supply while the frequency converter is connected to mains. Check that the mains supply has been disconnected and that the necessary time has expired before removing motor and mains connections.
7. Please note that the frequency converter has more voltage inputs than L1, L2 and L3, when loadsharing (linking of DC intermediate circuit) and external 24 V DC have been installed. Check that all voltage inputs have been disconnected and that the necessary time has passed before repair work is commenced.
8. Cooling: The unit must be cooled properly. For IP 21 / NEMA 1 and IP 54 / NEMA 12 units, the gland plate at the bottom must be installed and it must be sealed properly. Not installing it correctly will affect the internal cooling of the unit and cause unintended over-temperature warnings and alarms.
9. Do not tilt the frequency converter as the centre of gravity is high. Make sure it is fixed to a floor stand, the wall, or another fixing point.

1.1.3. Warning Against Unintended Start

1. The motor can be brought to a stop by means of digital commands, bus commands, references or a local stop, while the frequency converter is connected to mains. If personal safety considerations make it necessary to ensure that no unintended start occurs, these stop functions are not sufficient.
2. While parameters are being changed, the motor may start. Consequently, the stop key [STOP/RESET] must always be activated, following which data can be modified.
3. A motor that has been stopped may start if faults occur in the electronics of the frequency converter, or if a temporary overload or a fault in the supply mains or the motor connection ceases.

1.1.4. Installation of Mechanical Brake (VLT 5000 and VLT 5000 FLUX)

Do not connect a mechanical brake to the output from the frequency converter before the relevant parameters for brake control have been defined. (Select output in parameters 319, 321, 323 or 326 and cut-in current and frequency in parameters 223 and 225).

1.1.5. Use on Isolated Mains

See section RFI Switch in the Operating Instructions regarding use on isolated mains. It is important to follow the recommendations regarding installation on IT mains, including isolated delta systems, since sufficient protection of the complete installation must be observed. Not taking care using relevant monitoring for IT mains may result in damage.

**Warning:**

Touching the electrical parts may be fatal - even after the equipment has been disconnected from mains.

Also make sure that other voltage inputs have been disconnected, such as external 24 V DC, load-sharing (linkage of DC intermediate circuit), as well as the motor connection for kinetic back-up.

D1 and D2 enclosures: Wait at least 20 minutes.

E1 enclosures: Wait at least 46 minutes.

Manual Objectives

The purpose of this manual is to provide the user with the necessary information to install and perform the basic commissioning of the frequency converters. This manual should be read thoroughly before operating, servicing or initialising the drives. This manual is intended for use along with the Operating Instructions for the relevant series of frequency converters.

Who Should Use This Manual

This manual is intended for qualified service personnel responsible for setting up and servicing frequency converters. Qualified personnel have previous experience with frequency converters and understand electrical fundamentals, programming procedures, required equipment and safety precautions.

Organisation of This Manual

This manual is arranged in sections which deal with equipment installation and connection sequence. The order of tasks is arranged as follows:

- Safety instructions
- Preinstallation
 - Selection of installation site
 - Transportation and unpacking
- Mechanical installation
- Electrical installation
 - Control cable routing
 - Power cable routing
 - Connection examples
- Electrical installation procedures (short form)
- Motor start

As the units are available in different enclosure sizes, depending on the rated output power, the structure of the instruction is based on these enclosure variants.

380-460/480/500 V variants

| Type | Voltage | Enclosure D1 | Enclosure D2 | Enclosure E1 |
|--------------------------------|--------------|---------------|---------------|---------------|
| VLT 5000 | 380-500 V AC | VLT 5122-5152 | VLT 5202-5302 | VLT 5352-5552 |
| VLT 5000 FLUX | 380-500 V AC | VLT 5122-5152 | VLT 5202-5302 | VLT 5352-5502 |
| VLT 6000 HVAC | 380-460 V AC | VLT 6152-6172 | VLT 6222-6352 | VLT 6402-6602 |
| VLT 8000 AQUA | 380-480 V AC | VLT 8152-8202 | VLT 8252-8352 | VLT 8452-8652 |
| VLT 4000 VT (North America) | 380-460 V AC | VLT 4152-4202 | VLT 4252-4352 | VLT 4452-4652 |

525-600/690 V supply

| Type | Voltage | Enclosure D1 | Enclosure D2 | Enclosure E1 |
|--------------------------------|--------------|---------------|---------------|---------------|
| VLT 5000 | 525-690 V AC | VLT 5042-5152 | VLT 5202-5352 | VLT 5402-5602 |
| VLT 6000 HVAC | 525-600 V AC | VLT 6102-6172 | VLT 6222-6402 | VLT 6502-6652 |
| VLT 8000 AQUA | 525-690 V AC | VLT 8052-8202 | VLT 8252-8402 | VLT 8502-8652 |
| VLT 4000 VT (North America) | 525-600 V AC | VLT 4102-4202 | VLT 4252-4402 | |

Detailed technical information about the product can be found in the Operating Instructions for the respective frequency converter series.

2. Preinstallation

2

2.1.1. Planning the Installation Site

Before performing the installation it is important to plan the installation of the frequency converter. Neglecting this may result in extra work during and after installation. Select the best possible operation site by considering the following (see details on the following pages, and the respective Operating Instructions and Design Guides):

- Ambient operating temperature
- Installation method
- How to cool the unit
- Position of the frequency converter
- Cable routing
- Ensure the power source supplies the correct voltage and necessary current
- Ensure that the motor current rating is within the maximum current from the frequency converter
- If the frequency converter is without built-in fuses, ensure that the external fuses are rated correctly.

2.1.2. Receiving the Frequency Converter

When receiving the frequency converter please make sure that the packaging is intact, and be aware of any damage that might have occurred to the unit during transport. In case damage has occurred, contact immediately the shipping company to claim the damage.

2.1.3. Transportation and Unpacking

Before unpacking the frequency converter it is recommended that it is located as close as possible to the final installation site.

Remove the cardboard box and handle the frequency converter on the pallet, as long it is possible. Remark: The card box cover contains a drilling master for the mounting holes.



Illustration 2.1: Mounting Template

2.1.4. Lifting

Always lift the frequency converter in the dedicated lifting eyes. Use a bar to avoid bending the lifting holes of the frequency converter.

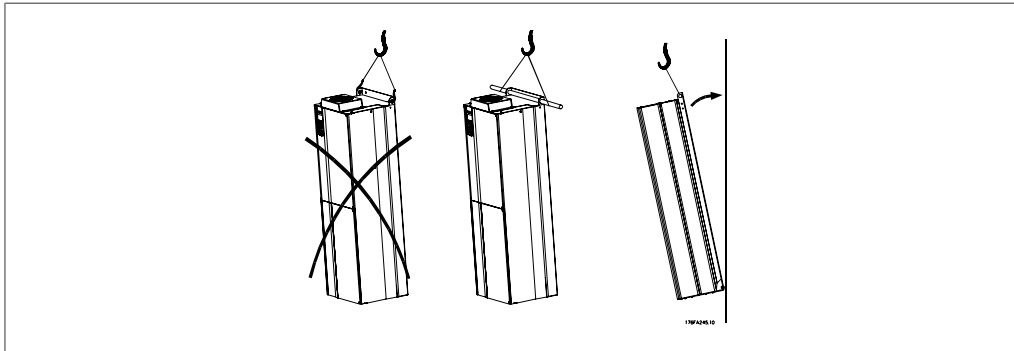


Illustration 2.2: Recommended lifting method

2.1.5. Shipping Weights and Dimensions

The weight and dimensions of the frequency converter and packaging depend on the actual unit.

| | Enclosure D1 | Enclosure D2 | Enclosure E1 |
|----------------------|--------------|--------------|--------------|
| IP 00 / Chassis | 91 (200) | 138 (304) | 277 (610) |
| IP 21 / NEMA Type 1 | 104 (229) | 151 (333) | 313 (689) |
| IP 54 / NEMA Type 12 | 104 (229) | 151 (333) | 272 (689) |

Table 2.1: Shipping weight in kg (lbs)

Weight is specified as the maximum weight with all possible options included.

| | IP00 / Chassis | IP21 / NEMA Type 1 IP54 / NEMA Type 12 |
|--------------|----------------------------------|---|
| Enclosure D1 | 1220*650*570 (48*25.6*22.4) | 1730*650*570 (53.9*25.6*22.4) |
| Enclosure D2 | 1490*650*570 (58.7*25.6*22.4) | 1730*650*570 (68.1*25.6*22.4) |
| Enclosure E1 | 1705*831*736 (67.1*32.8*29.0) | 2197*840*736 (86.5*33.1*29.0) |

Table 2.2: Card board box size. Shipping dimensions (width * height * depth in mm (in))

The units are shipped laying down, and the above dimensions are according to this. The dimensions include the skid where the box is mounted.

| | IP00 / Chassis | IP21 / NEMA Type 1 IP54 / NEMA Type 12 |
|--------------|----------------------------------|---|
| Enclosure D1 | 1046*408*373 (41*16.1*14.7) | 1208*420*373 (47.5*16.5*14.7) |
| Enclosure D2 | 1327*408*373 (52.2*16.1*14.7) | 1588*420*373 (62.5*16.5*14.7) |
| Enclosure E1 | 1499*585*506 (59.0*23.0*19.9) | 2000*6000*494 (78.7*23.6*19.5) |

Table 2.3: Drive dimensions (height * width * depth in mm (in))

3. Installation

3.1. Mechanical Installation

Preparation of the mechanical installation of the frequency converter must be done carefully to ensure a proper result and to avoid additional work during installation. Start taking a close look at the mechanical drawings at the end of this instruction to become familiar with the space demands.

3

3.1.1. Tools Needed

To perform the mechanical installation the following tools are needed:

- Drilling machine with 10 or 12 mm drill
- Tape measure
- Wrench with relevant metric sockets (7-17 mm)
- Extensions to wrench
- Sheet metal punch for conduits or cable glands in IP 21 and IP 54 units
- Lifting bar to lift the unit (rod or tube \varnothing 20 mm (0.75 inch)) able to lift minimum 400 kg (880 lbs).
- Crane or other lifting aid to place the frequency converter in position
- A Torx T50 tool is needed to install the E1 enclosure in IP21 and IP54 enclosure variants.

3.1.2. General Considerations

Space

Ensure proper space above and below the frequency converter to allow airflow and cable access. In addition space in front of the unit must be considered to open the panels.

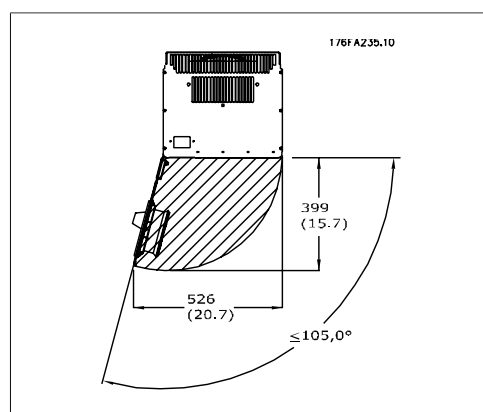


Illustration 3.1: Space in front of IP21/IP54 enclosure type D1 and D2.

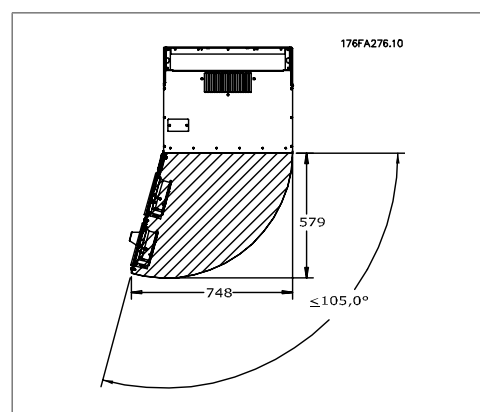


Illustration 3.2: Space in front of IP21/IP54 enclosure type E1.

3

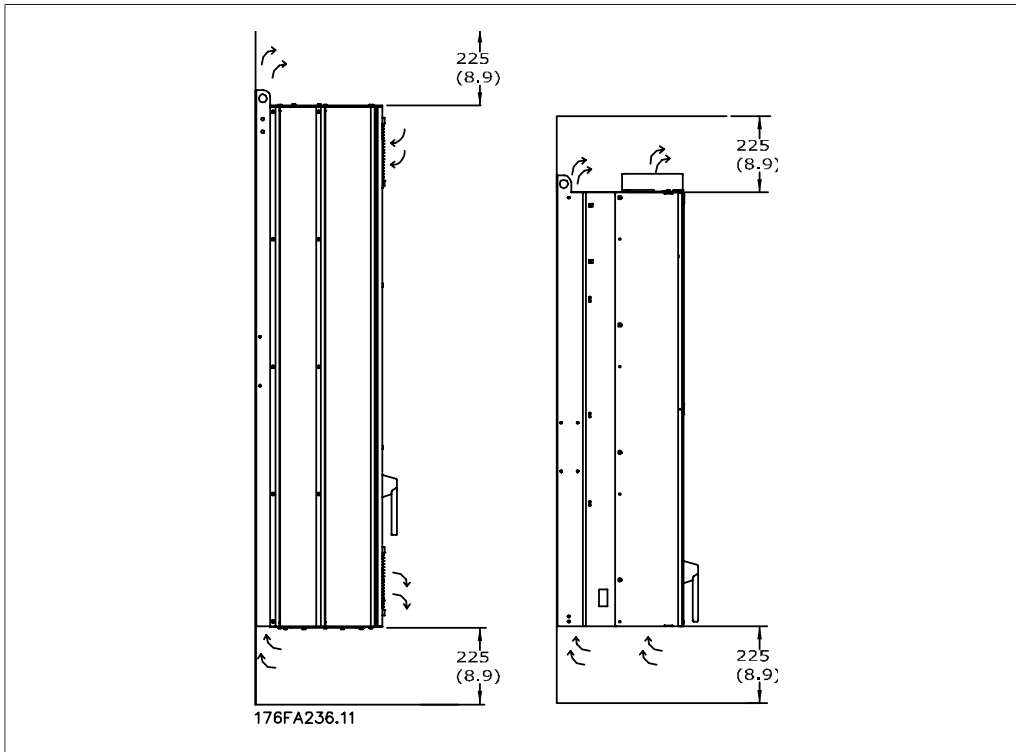


Illustration 3.3: Airflow direction and necessary space for cooling

Left: Enclosure IP21/54, D1 and D2.

Right: Enclosure IP00, D1, D2 and E1.

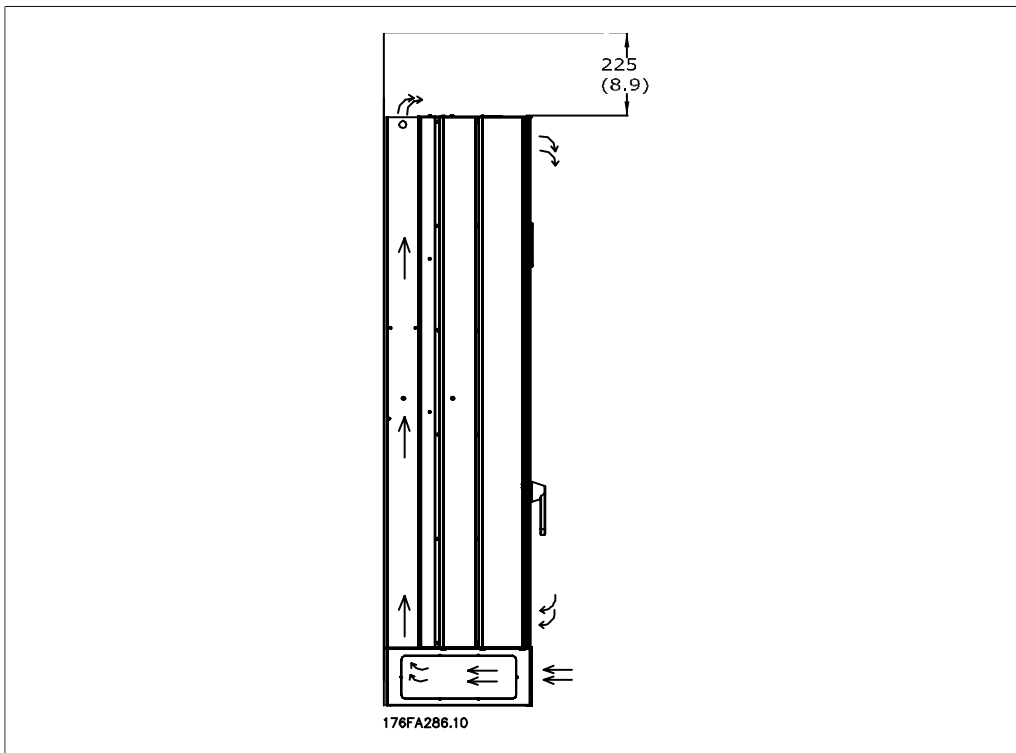


Illustration 3.4: Airflow direction and necessary space for cooling - Enclosure IP21/54, E1

Wire access

Ensure that proper wire access is present including necessary bending space. As the IP00 enclosure is open to the bottom wires must be fixed to the back panel of the enclosure where the frequency converter is mounted, i.e. by using cable clamps.

Terminal locations(D1 and D2 enclosures)

Take the following position of the terminals into consideration when you design for cables access.

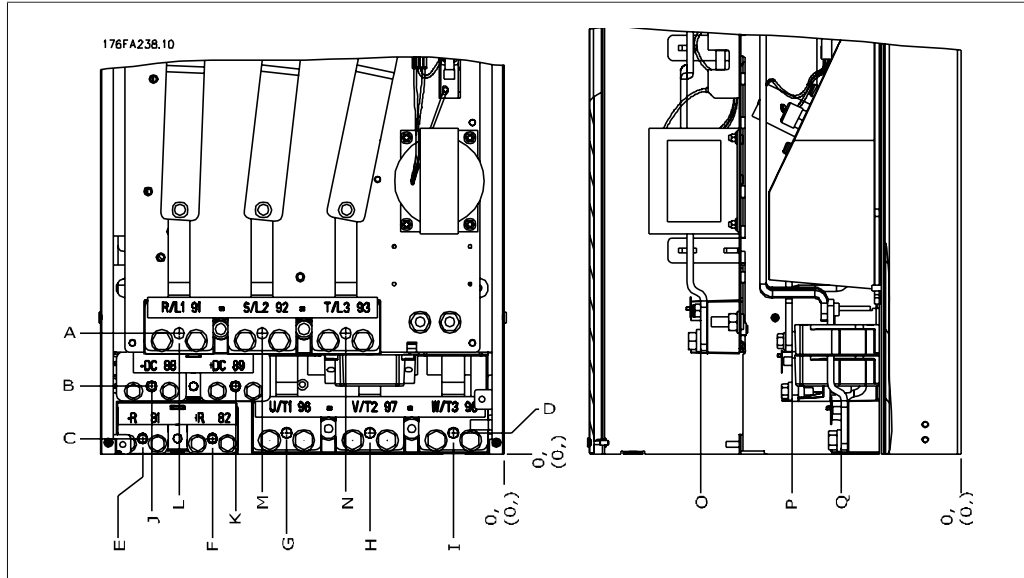


Illustration 3.5: Position of power connections

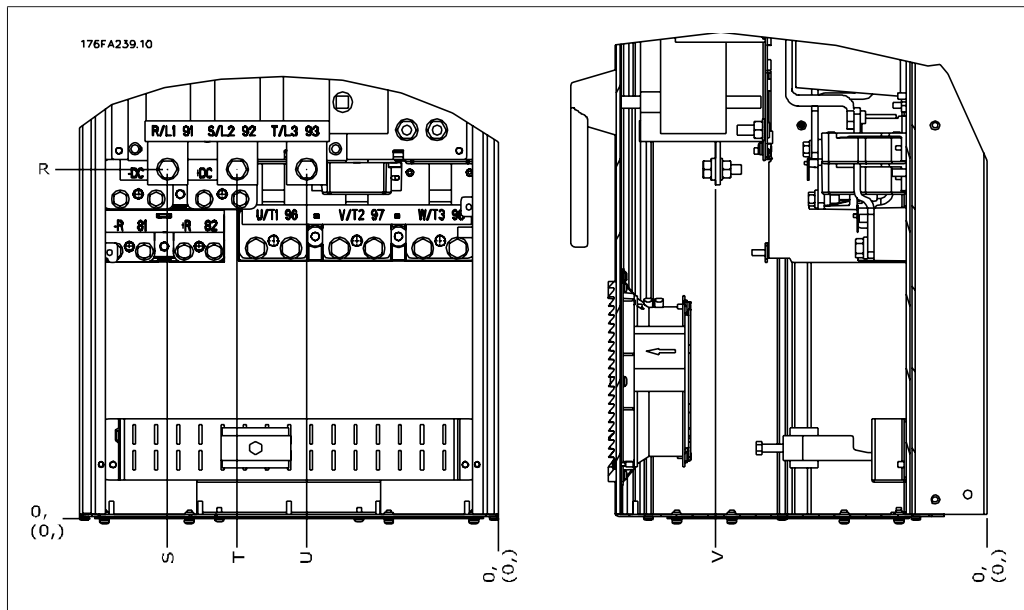


Illustration 3.6: Position of power connections - Disconnect

Be aware that the power cables are heavy and hard to bend. Consider the optimum position of the frequency converter for ensuring easy installation of the cables.

| | IP 00 / Chassis | | IP 21 (NEMA 1) / IP 54 (NEMA 12) | |
|---|-----------------|--------------|----------------------------------|--------------|
| | Enclosure D1 | Enclosure D2 | Enclosure D1 | Enclosure D2 |
| A | 119 (4.7) | 122 (4.8) | 277 (10.9) | 379 (14.9) |
| B | 68 (2.7) | 68 (2.7) | 227 (8.9) | 326 (12.8) |
| C | 15 (0.6) | 16 (0.6) | 173 (6.8) | 273 (10.8) |
| D | 20.7 (0.8) | 22 (0.8) | 179 (7.0) | 279 (11.0) |
| E | 363 (14.3) | 363 (14.3) | 370 (14.6) | 370 (14.6) |
| F | 293 (11.5) | 293 (11.5) | 300 (11.8) | 300 (11.8) |
| G | 215 (8.4) | 218 (8.6) | 222 (8.7) | 226 (8.9) |
| H | 131 (5.2) | 135 (5.3) | 139 (5.4) | 142 (5.6) |
| I | 48 (1.9) | 51 (2.0) | 55 (2.2) | 59 (2.3) |
| J | 347 (13.6) | 354 (13.9) | 354 (13.9) | 361 (14.2) |
| K | 277 (10.9) | 270 (10.6) | 284 (11.2) | 277 (10.9) |
| L | 326 (12.8) | 326 (12.8) | 334 (13.1) | 334 (13.1) |
| M | 243 (9.6) | 243 (9.6) | 250 (9.8) | 250 (9.8) |
| N | 159 (6.3) | 159 (6.3) | 167 (6.6) | 167 (6.6) |
| O | 261 (10.3) | 261 (10.3) | 261 (10.3) | 260 (10.3) |
| P | 170 (6.7) | 170 (6.7) | 170 (6.7) | 169 (6.7) |
| Q | 120 (4.7) | 120 (4.7) | 120 (4.7) | 120 (4.7) |
| R | 98 (3.8) | 93 (3.7) | 256 (10.1) | 350 (13.8) |
| S | 301 (11.8) | 324 (12.8) | 308 (12.1) | 332 (13.0) |
| T | 245 (9.6) | 255 (10.0) | 252 (9.9) | 262 (10.3) |
| U | 189 (7.4) | 185 (7.3) | 196 (7.7) | 192 (7.6) |
| V | 260 (10.2) | 273 (10.7) | 260 (10.2) | 273 (10.7) |

Table 3.1: Cable positions as shown in drawings above. Dimensions in mm (inch).

Terminal locations - E1 enclosures

Take the following position of the terminals into consideration when designing the cable access.

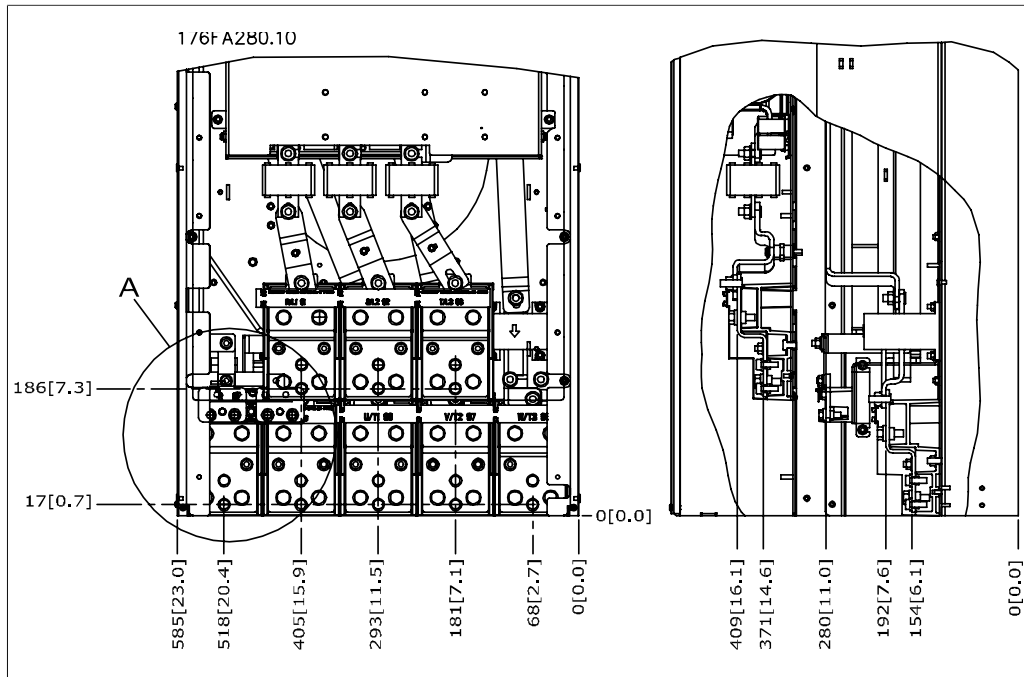


Illustration 3.7: IP00 enclosure power connection positions

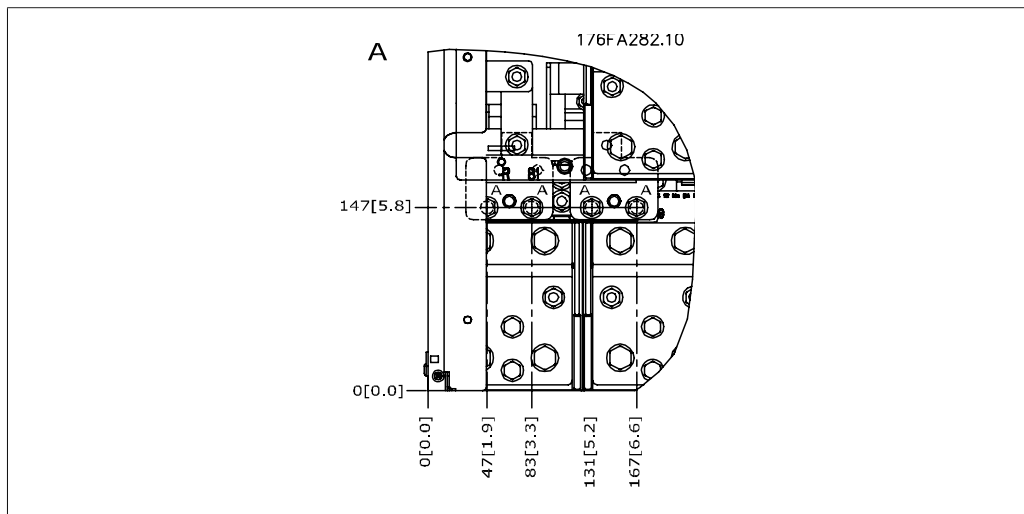


Illustration 3.8: IP00 enclosure power connection positions

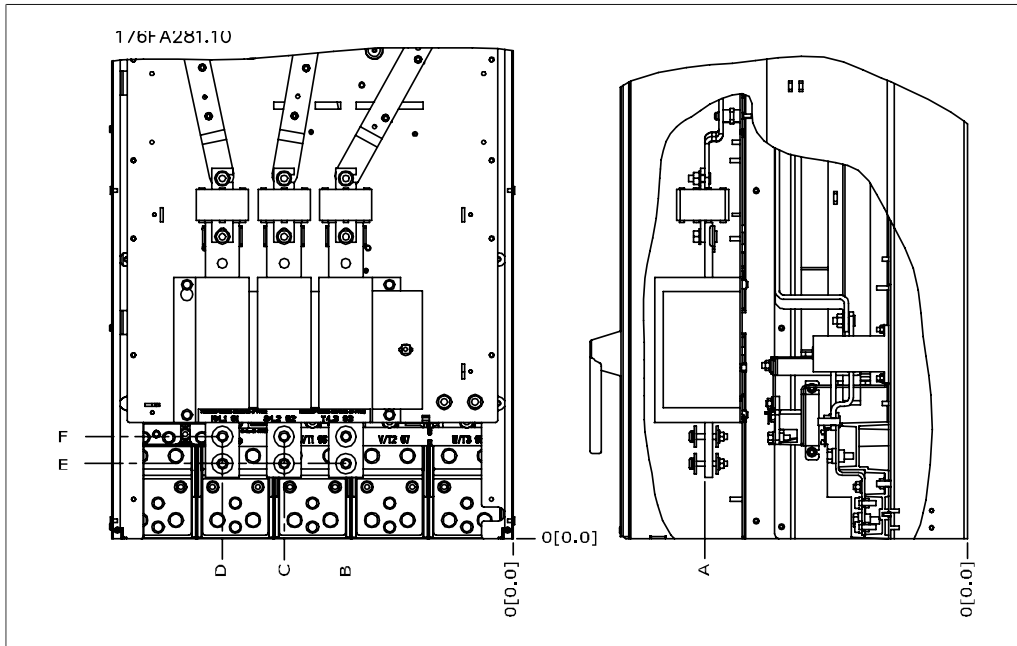


Illustration 3.9: IP00 enclosure power connections positions of disconnect switch

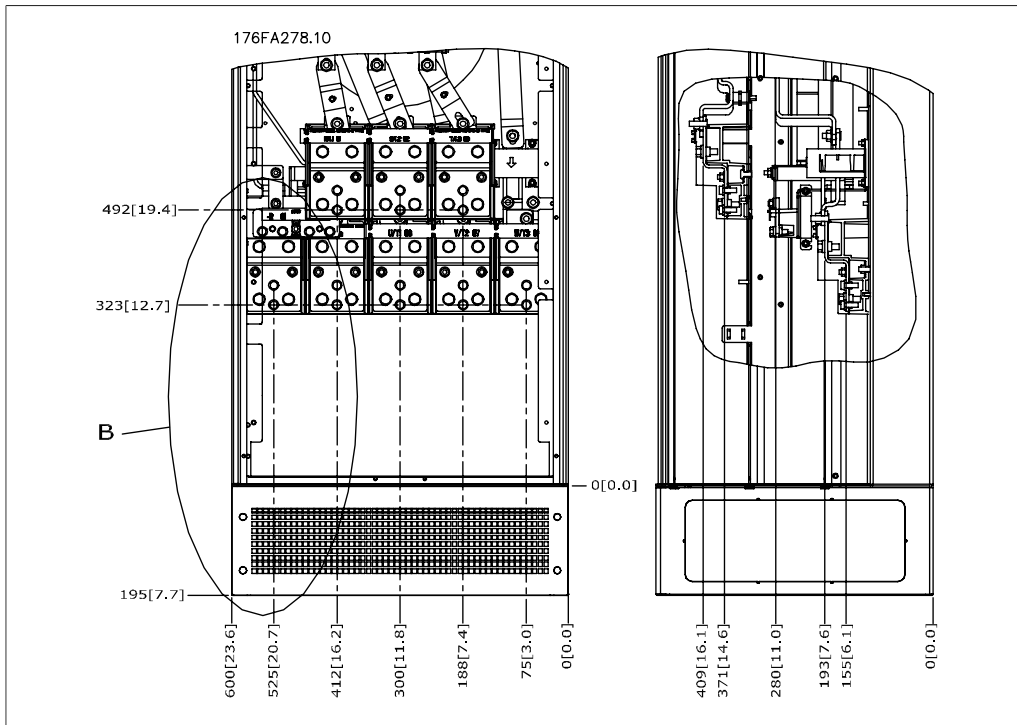


Illustration 3.10: IP21 (NEMA Type 1) and IP54 (NEMA Type 12) enclosure power connection positions

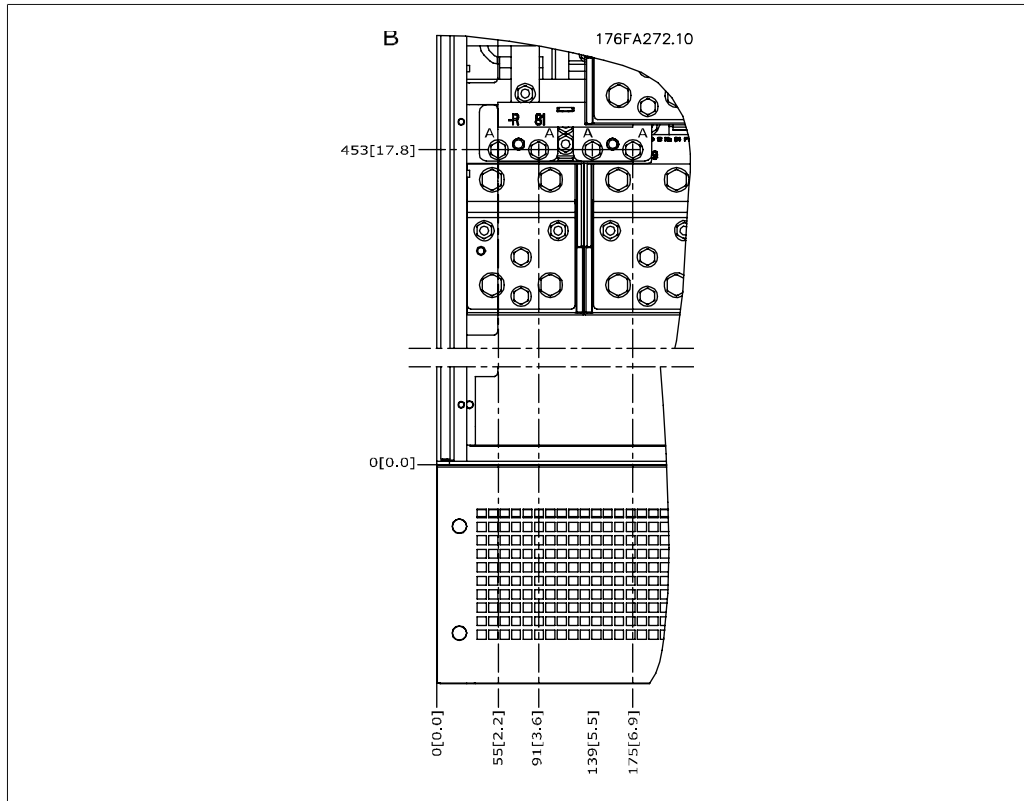


Illustration 3.11: IP21 (NEMA type 1) and IP54 (NEMA type 12) enclosure power connection positions (detail B)

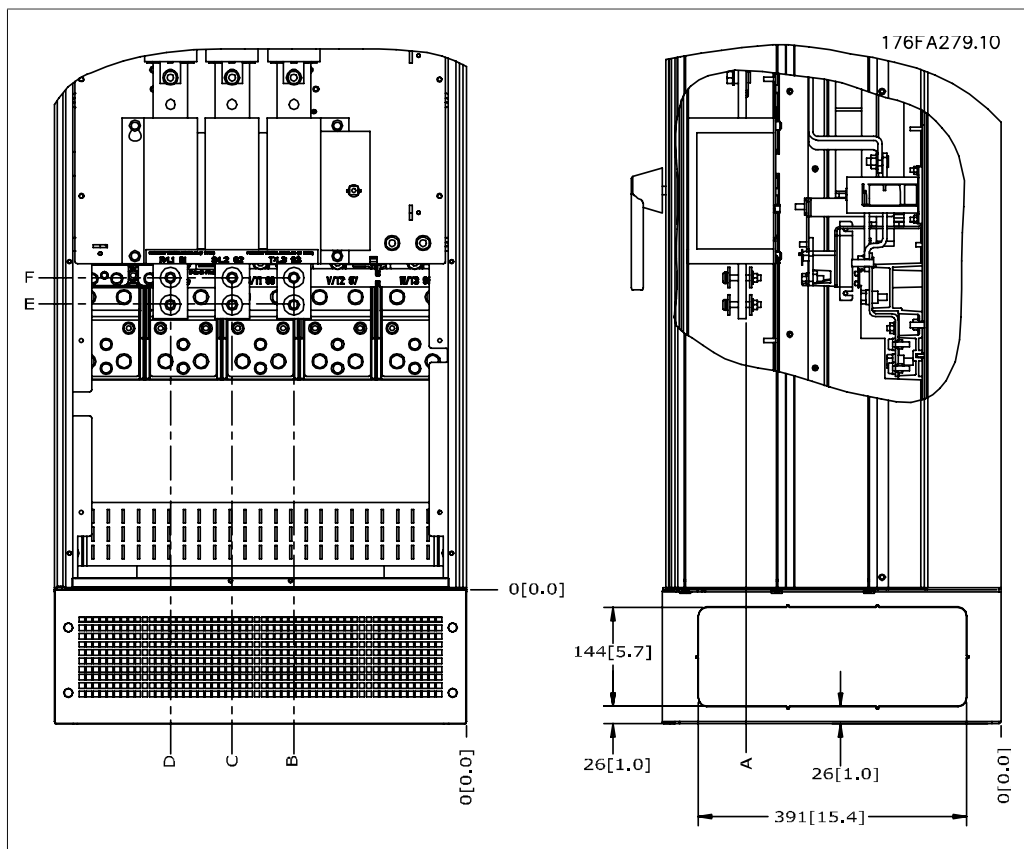


Illustration 3.12: IP21 (NEMA type 1) and IP54 (NEMA type 12) enclosure power connection position of disconnect switch

Note that the power cables are heavy and difficult to bend. Consider the optimum position of the frequency converter for ensuring easy installation of the cables.
Each terminal allows use of up to 4 cables with cable lugs or use of standard box lug. Earth is connected to relevant termination point in the drive.

3

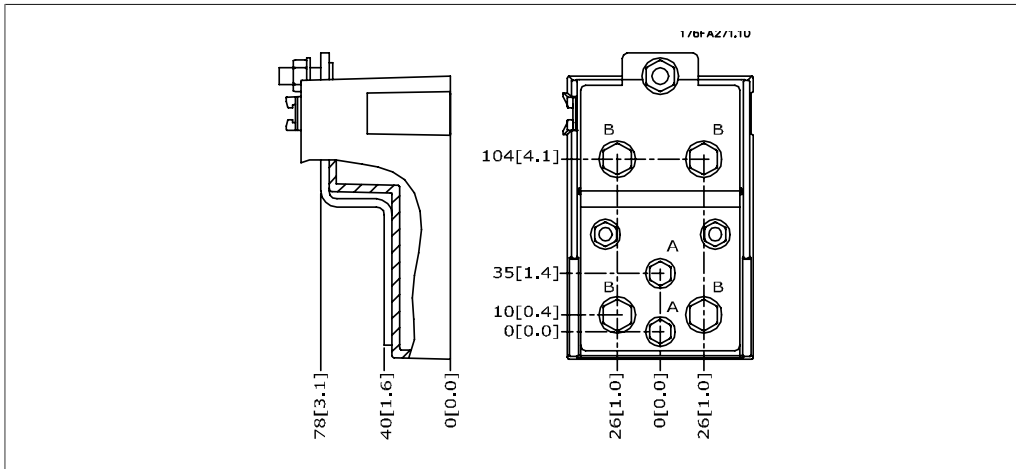


Illustration 3.13: Terminal in details

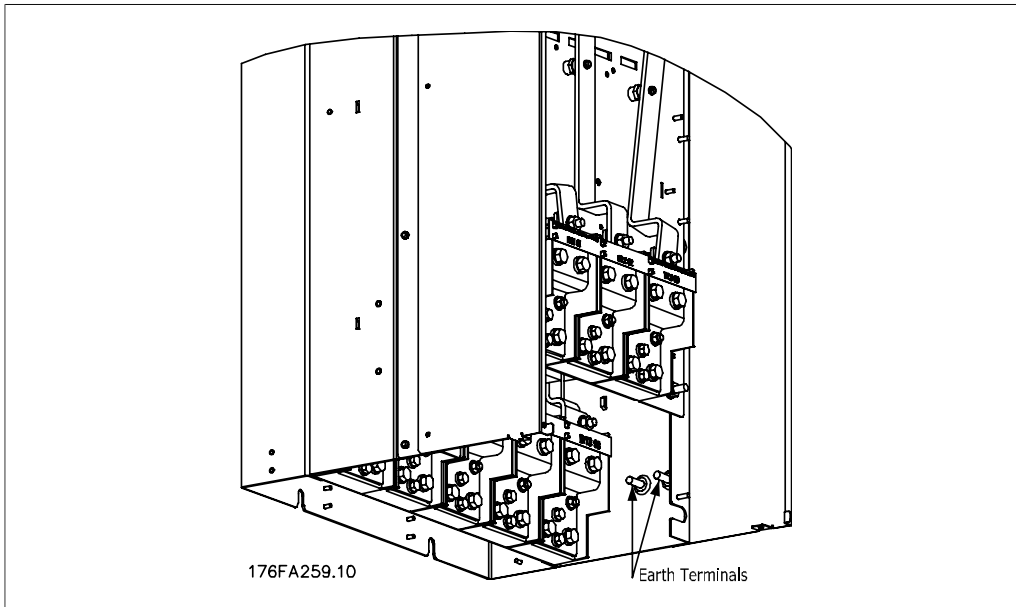


Illustration 3.14: Position of earth terminals IP00

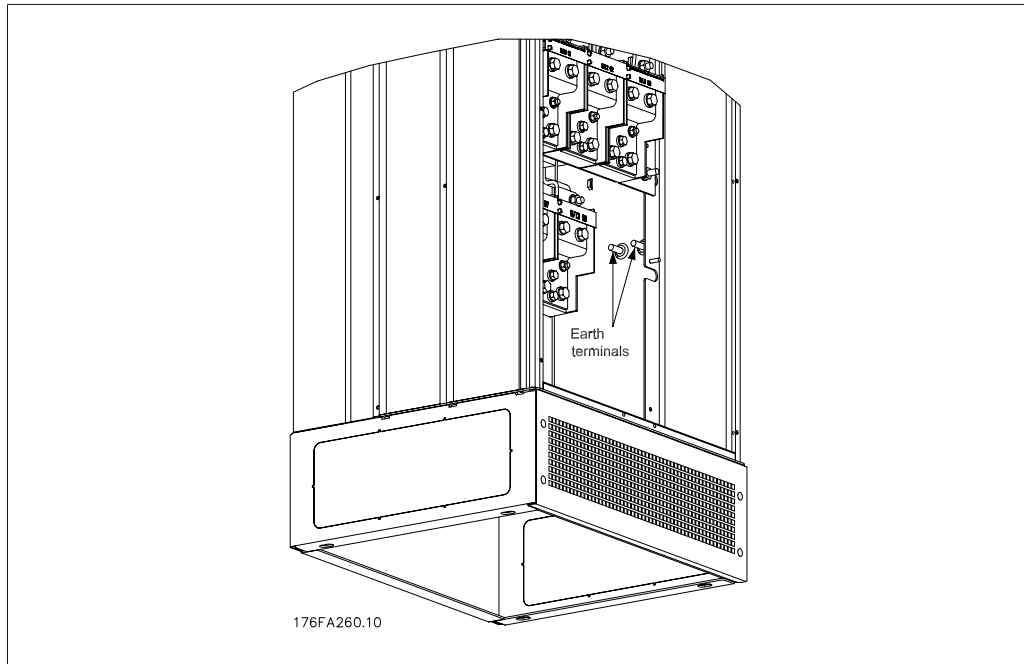


Illustration 3.15: Position of earth terminals IP21 (NEMA type 1) and IP54 (NEMA type 12)

Cooling

Cooling can be obtained in different ways, by using the cooling ducts in the bottom and the top of the unit, by using the ducts in the backside of the unit or by combining the cooling possibilities.

Airflow

The necessary airflow over the heat sink must be secured. The flow rate is shown below.

| Enclosure | | Door fan / Top fan air- Airflow over heatsink flow | |
|----------------|-----------|--|----------------------------------|
| IP00 / Chassis | D1 and D2 | 255 m ³ /h (150 cfm) | 765 m ³ /h (450 cfm) |
| | E1 | 255 m ³ /h (150 cfm) | 1444 m ³ /h (850 cfm) |
| IP21 / NEMA 1 | D1 and D2 | 170 m ³ /h (100 cfm) | 765 m ³ /h (450 cfm) |
| IP54 / NEMA 12 | E1 | 340 m ³ /h (200 cfm) | 1444 m ³ /h (850 cfm) |

Table 3.2: Heat Sink Air Flow

Duct cooling

A dedicated option has been developed to optimise installation of IP00 / Chassis enclosed frequency converters in Rittal TS8 enclosures utilising the fan of the frequency converter for forced cooling.

3

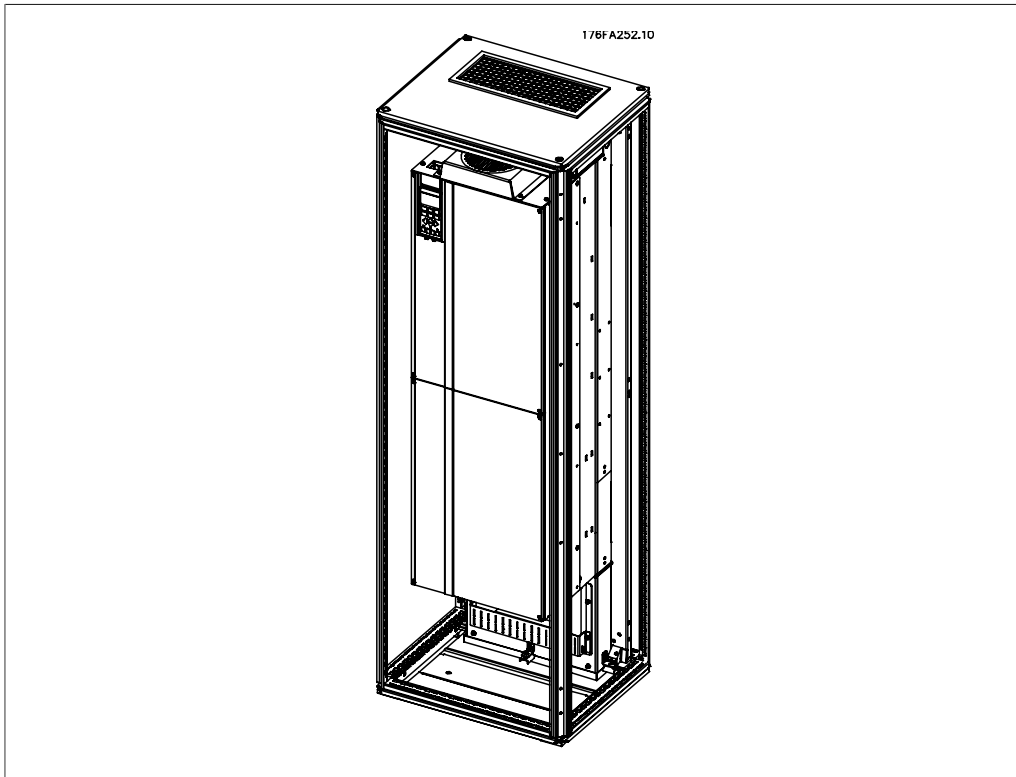


Illustration 3.16: Installation of IP00 in Rittal TS8 enclosure

| Rittal TS8 Enclosure | Frame D1 Kit Part No. | Frame D2 Kit Part No. | Frame E1 Part No. |
|----------------------|-----------------------|-----------------------|-------------------|
| 1800 mm | 176F1824 | 176F1823 | Not possible |
| 2000 mm | 176F1826 | 176F1825 | 176F1850 |

Table 3.3: Duct Kit Ordering Numbers

Back cooling

Using the channel from the back allows easy installation in for example control rooms. The unit mounted to the backside of the enclosure allows a similar easy cooling of the units as the duct cooling principle. The hot air is ventilated out of the back of the enclosure. This offers a solution where the hot cooling air from the frequency converter does not cause heating of the control room.



Illustration 3.17: Combined use of cooling principles

The above mentioned solution can of course also be combined for an optimised solution in the actual installation.

3.1.3. Installation in Enclosures - IP00 / Chassis units

As the IP00 version is intended for panel mounting, it is important to know how to install the frequency converter and utilise the possibilities for cooling the units. A detailed description of how to install the frequency converter in a Rittal TS8 enclosure by using the installation kit can be found in a later section of this Installation Guide. This can also be used as a guide for other installations.

3.1.4. Installation on the Wall - IP21 (NEMA 1) and IP54 (NEMA 12) Units

This only applies for D1 and D2 enclosures.

It must be considered where to install the unit. Take the relevant points into consideration before you select the final installation site.

- Free space for cooling
- Access to open the door
- Cable entry from the bottom

Mark the mounting holes carefully using the mounting template on the wall and drill the holes as indicated. Ensure proper distance to the floor and the ceiling for cooling. A minimum of 225 mm (8.9 in) below the frequency converter is needed. Mount the bolts at the bottom and lift the frequency converter up on the bolts. Tilt the frequency converter against the wall and mount the upper bolts. Tighten all four bolts to secure the frequency converter against the wall.

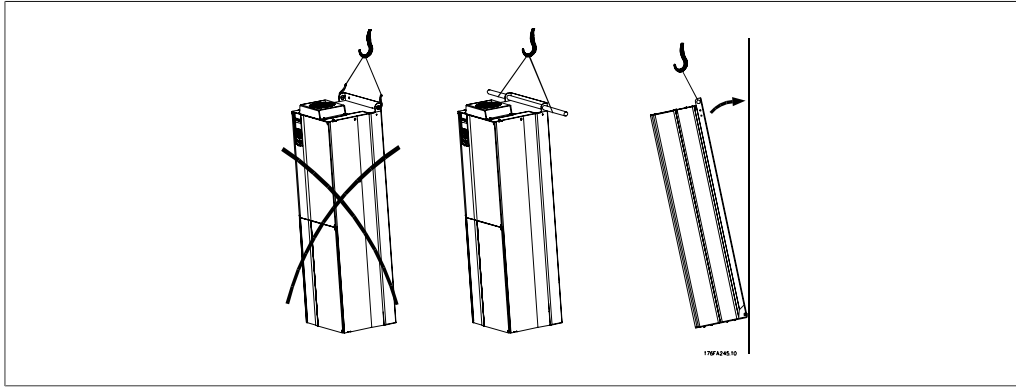


Illustration 3.18: Lifting method for mounting drive on wall

3.1.5. Floor Mounting - Pedestal Installation IP21 (NEMA1) and IP54 (NEMA12)

IP21 (NEMA type 1) and IP54 (NEMA type 12) enclosed frequency converters can also be installed on a pedestal. Details can be found later in a later section of this Installation Guide and in the information included in the Pedestal kit.

D1 and D2 enclosures
Ordering No. 176F1827



Illustration 3.19: Drive on Pedestal

The E1 enclosure is always delivered with a pedestal as standard. Install the pedestal on the floor. Fixing holes are to be drilled according to this figure:

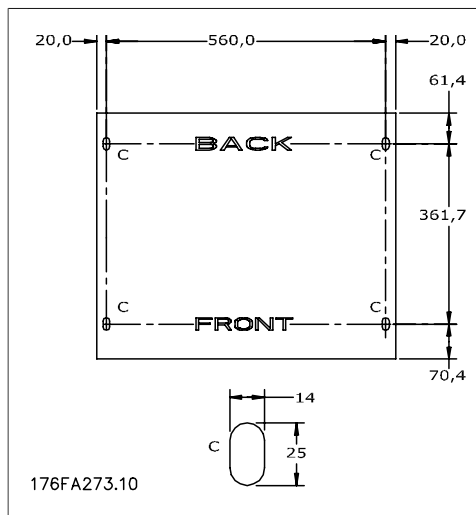


Illustration 3.20: Drill master for fixing holes in floor.

Mount the drive on the pedestal and fix it with the included bolts to the pedestal as shown on the illustration.

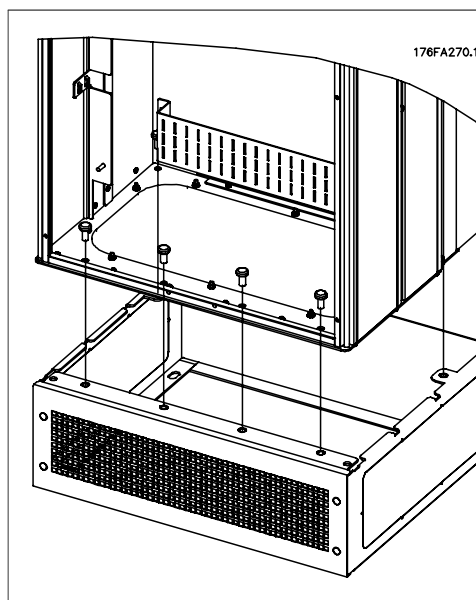


Illustration 3.21: Mounting of drive to pedestal

3.1.6. Gland/Conduit Entry - IP21 (NEMA 1) and IP54 (NEMA12)

Cables are connected through the gland plate from the bottom. Remove the plate and plan where to place the entry for the glands or conduits. Prepare holes in the marked area on the drawing.

The gland plate must be fitted to the frequency converter to ensure the specified protection degree, as well as ensuring proper cooling of the unit. If the gland plate is not mounted, it may trip the unit.

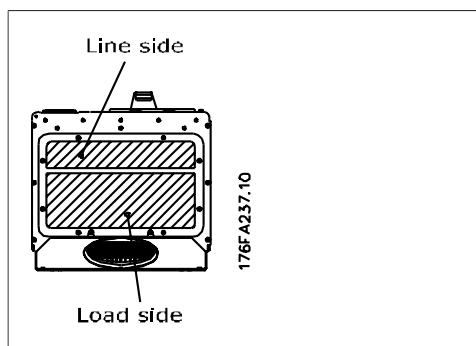


Illustration 3.22: Cable entry viewed from the bottom of the frequency converter - Enclosure D1 and D2.

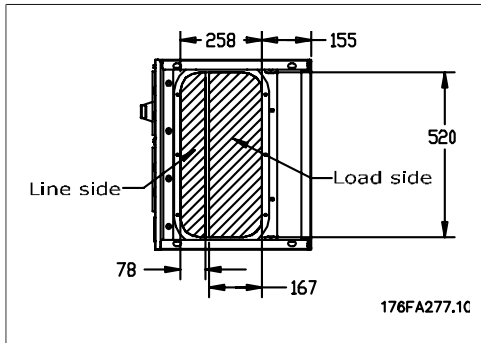


Illustration 3.23: Cable entry seen from the bottom of the frequency converter - Enclosure E1.

The bottom plate of the E1 enclosure can be mounted from either in or outside of the enclosure, allowing flexibility in the installation process, i.e. if mounted from the bottom the glands and cables can be mounted before the frequency converter is placed on the pedestal.

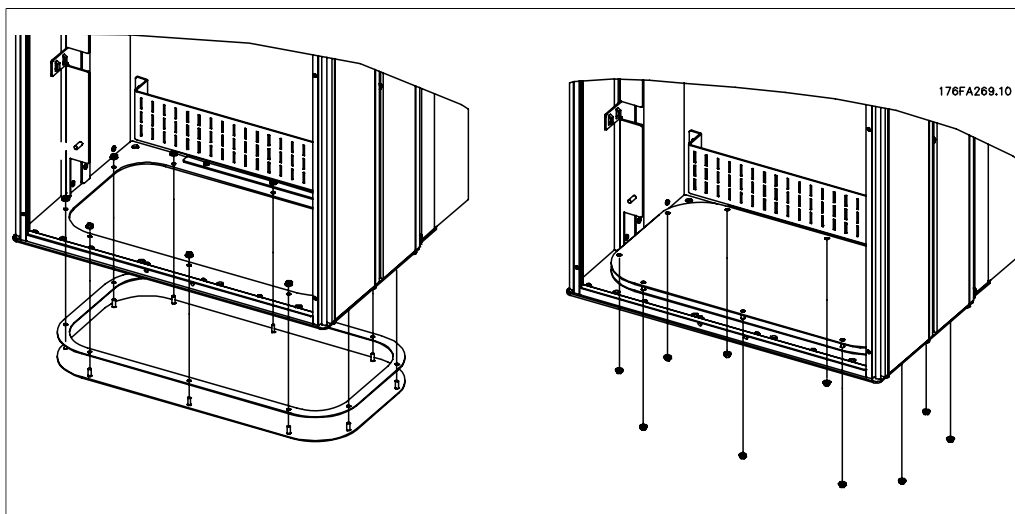


Illustration 3.24: Mounting of bottom plate, E1 enclosure.

3.1.7. IP21 Drip shield installation (D1 and D2 enclosure)

To comply with the IP21 rating, a separate drip shield is to be installed as explained below:

- Remove the two front screws
- Insert the drip shield and replace screws
- Torque the screws to 5,6 Nm (50 in-lbs)

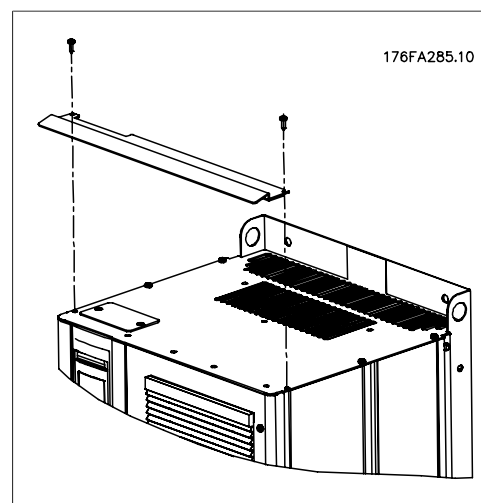


Illustration 3.25: Drip shield installation.

3.2. Electrical Installation

3.2.1. Control Wires

Connect the wires as described in the Operating Instruction for the frequency converter. Remember to connect the shields in a proper way to ensure optimum electrical immunity.

Control cable routing

Tie down all control wires to the designated control cable routing.

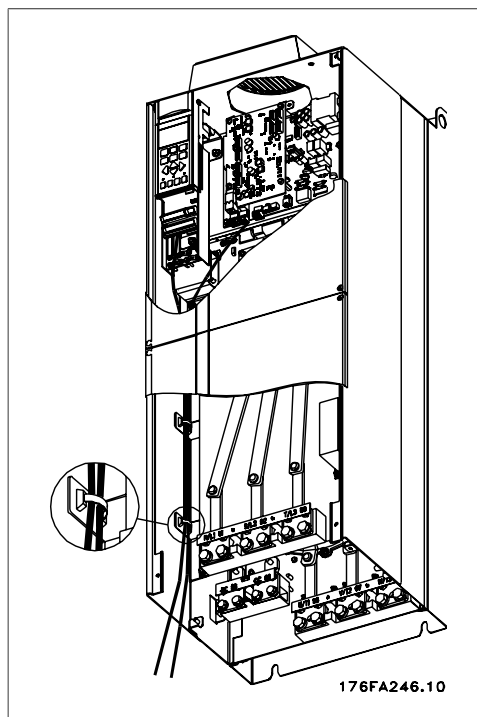


Illustration 3.26: Wire path for control wiring.

Fieldbus connection

Connections are made to the relevant options at the control card. For details see the relevant fieldbus instruction. The cable must be placed to the left inside the frequency converter and tied down together with other control wires.

In the IP 00 (Chassis) and IP 21 (NEMA 1) units it is also possible to connect the fieldbus from the top of the unit as shown on the picture below. On the IP 21 (NEMA 1) unit a cover plate must be removed.

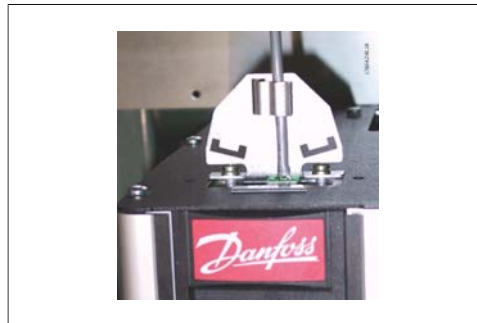


Illustration 3.27: Top connection for fieldbus.

Installation of 24 Volt external DC Supply

Torque: 0.5 - 0.6 Nm (5 in-lbs)

Screw size: M3

| No. | Function |
|--------|-------------------------|
| 35, 36 | 24 V external DC supply |

24 V external DC supply can be used as low-voltage supply to the control card and any option cards installed. This enables full operation of the LCP (incl. parameter setting) without connection to mains. Please note that a warning of low voltage will be given when 24 V DC has been connected; however, there will be no tripping. If 24 V external DC supply is connected or switched on at the same time as the mains supply, a time of min. 200 msec. must be set in parameter 120 *Start delay*.

A pre-fuse of min. 6 Amp, slow-blow, can be fitted to protect the external 24 V DC supply. The power consumption is 15-50 W, depending on the load on the control card.



Use 24 V DC supply of type PELV to ensure correct galvanic isolation (type PELV) on the control terminals of the frequency converter.

Relay output

Torque: 0.5 - 0.6 Nm (5 in-lbs)

Screw size: M3

| No. | Function |
|------|--|
| 1-3 | Relay output, 1+3 break, 1+2 make. See the Operating Instructions. |
| 4, 5 | Relay output, 4+5 make. See the Operating Instructions. |

3.2.2. Power Connections

Cabling and Fusing

The power cable connections are situated as shown below. Dimensioning of cable cross section must be done in accordance with the current ratings and local legislation. See the Operating Instructions for details.

For protection of the frequency converter the recommended fuses must be used or the unit must be with built-in fuses. Recommended fuses can be seen in the Operating Instructions. Always ensure that proper fusing is made according to local regulation.

3

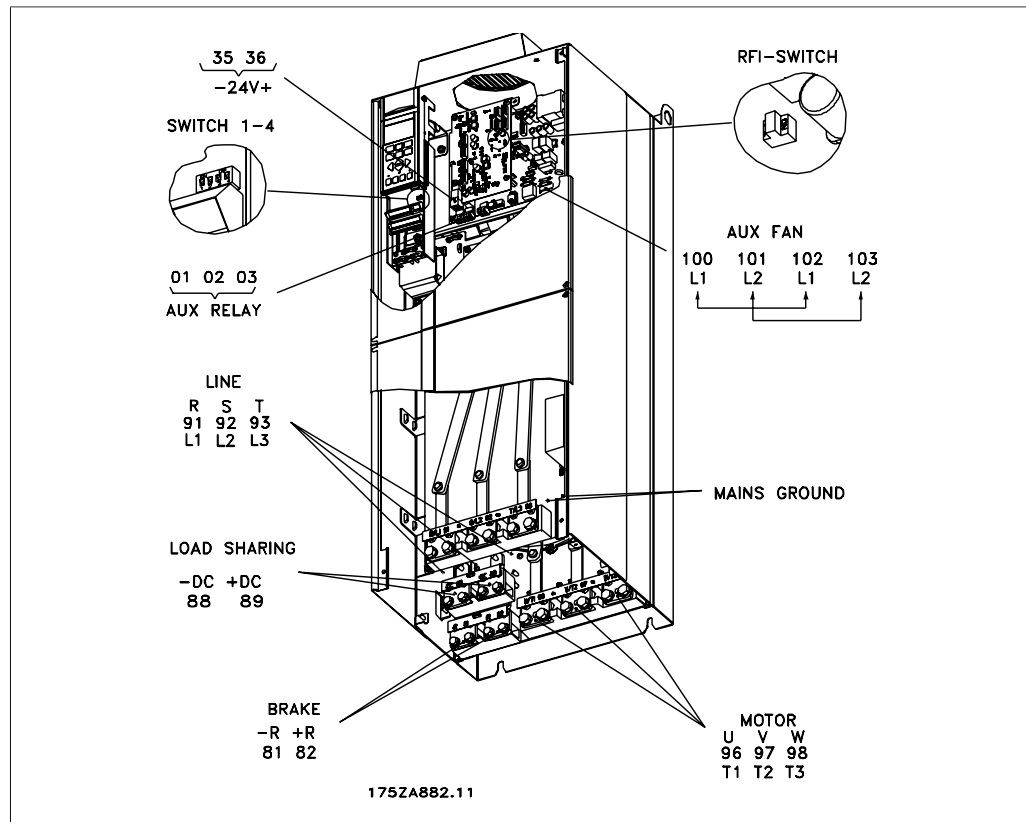


Illustration 3.28: Compact IP 00 (Chassis), enclosure D1

3

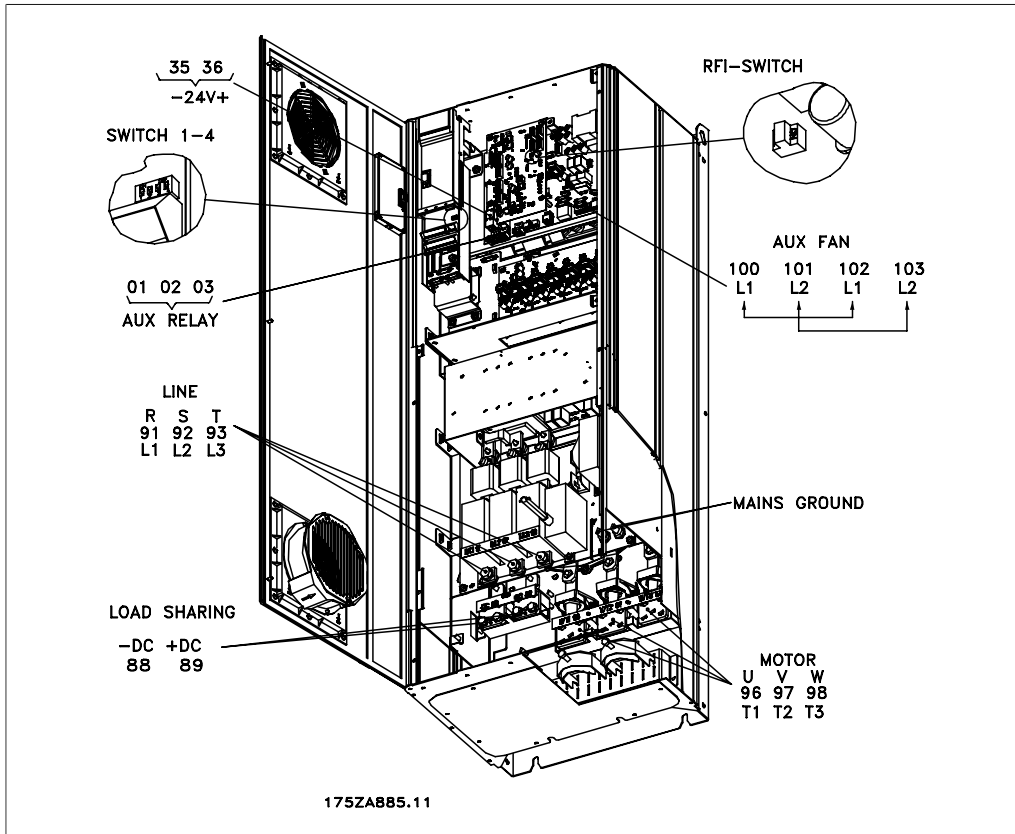


Illustration 3.29: Compact IP 21 (NEMA 1) and IP 54 (NEMA 12), enclosure D1 with disconnect fuse and RFI filter

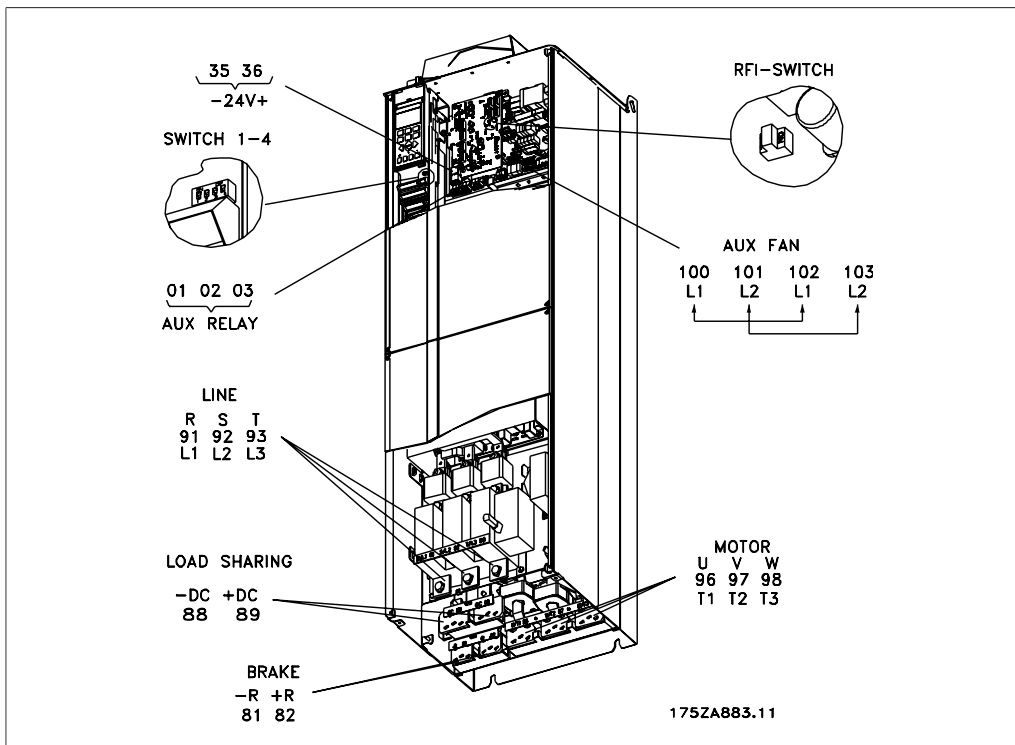


Illustration 3.30: Compact IP 00 (Chassis) with disconnect, fuse and RFI filter, enclosure D2

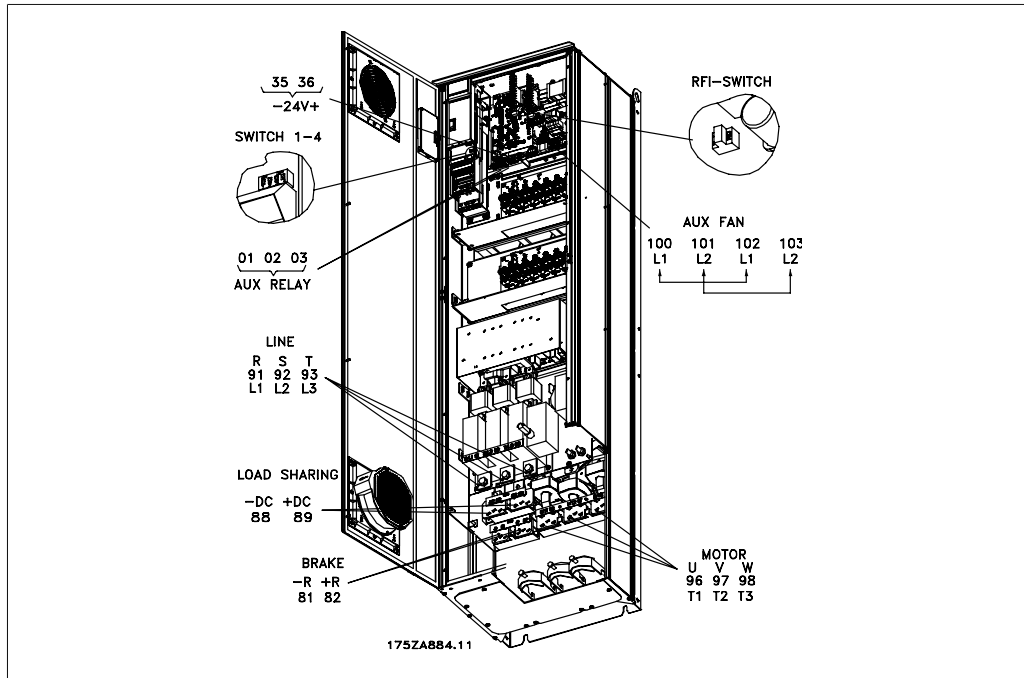


Illustration 3.31: Compact IP 21 (NEMA 1) and IP 54 (NEMA 12) with disconnect, fuse and RFI filter, enclosure D2

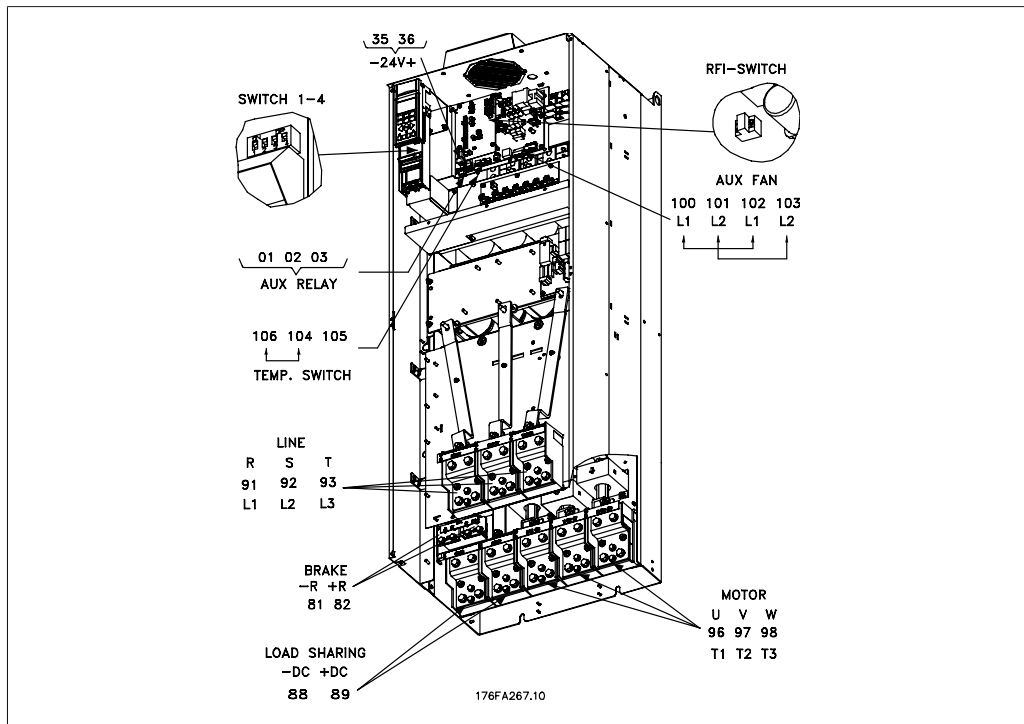


Illustration 3.32: Compact IP 00 (Chassis), enclosure E1

3

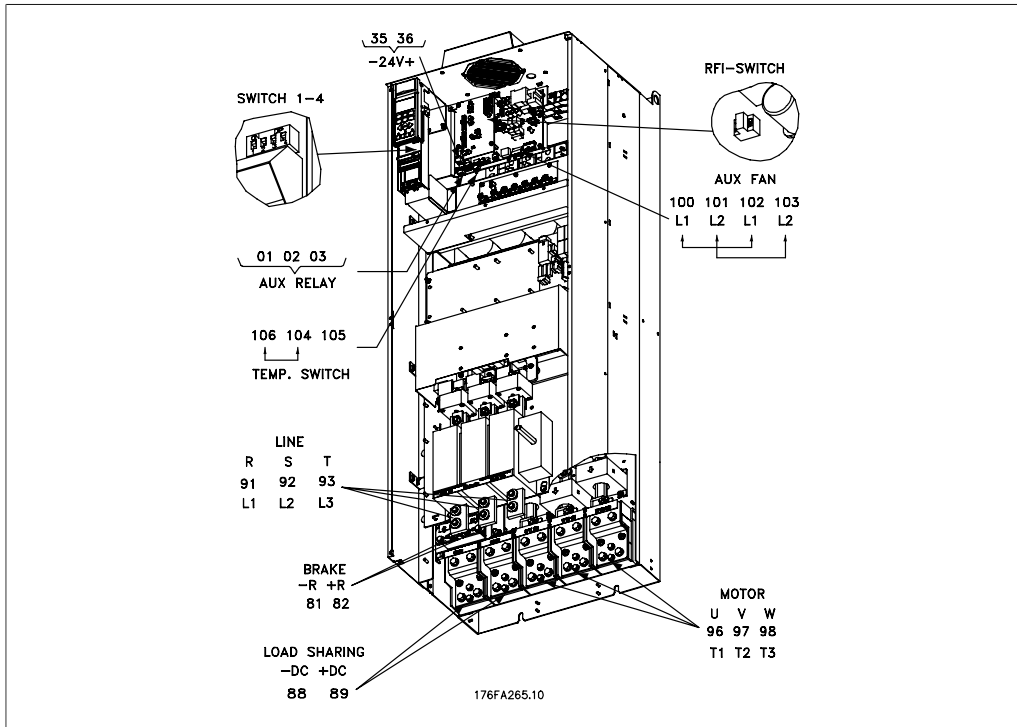


Illustration 3.33: Compact IP 00 (Chassis) with disconnect, fuse and RFI filter, enclosure E1

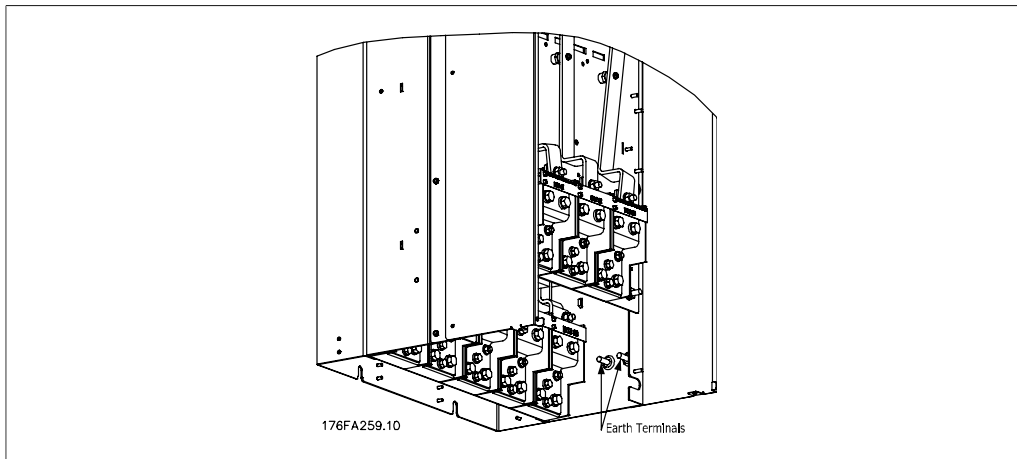


Illustration 3.34: Position of earth terminals IP00

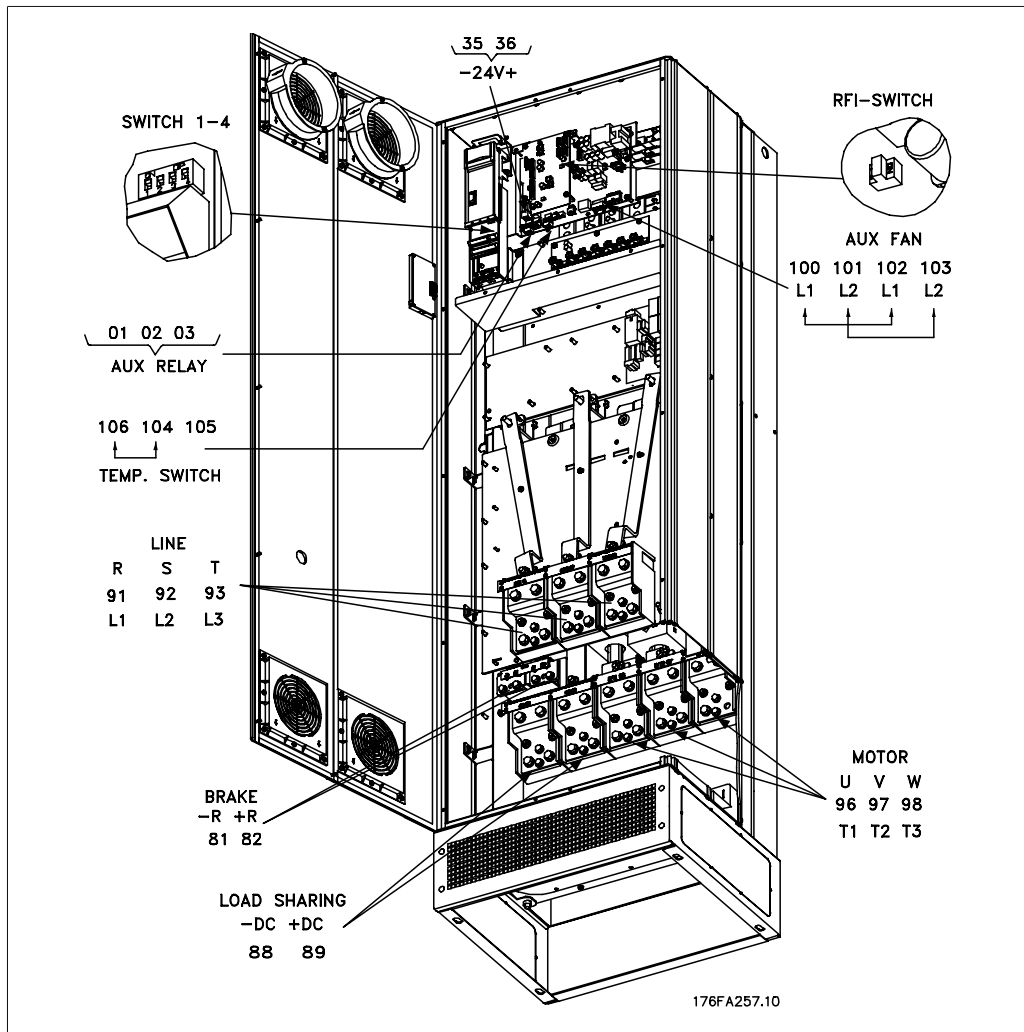


Illustration 3.35: Compact IP 21 (NEMA 1) and IP 54 (NEMA 12) enclosure E1

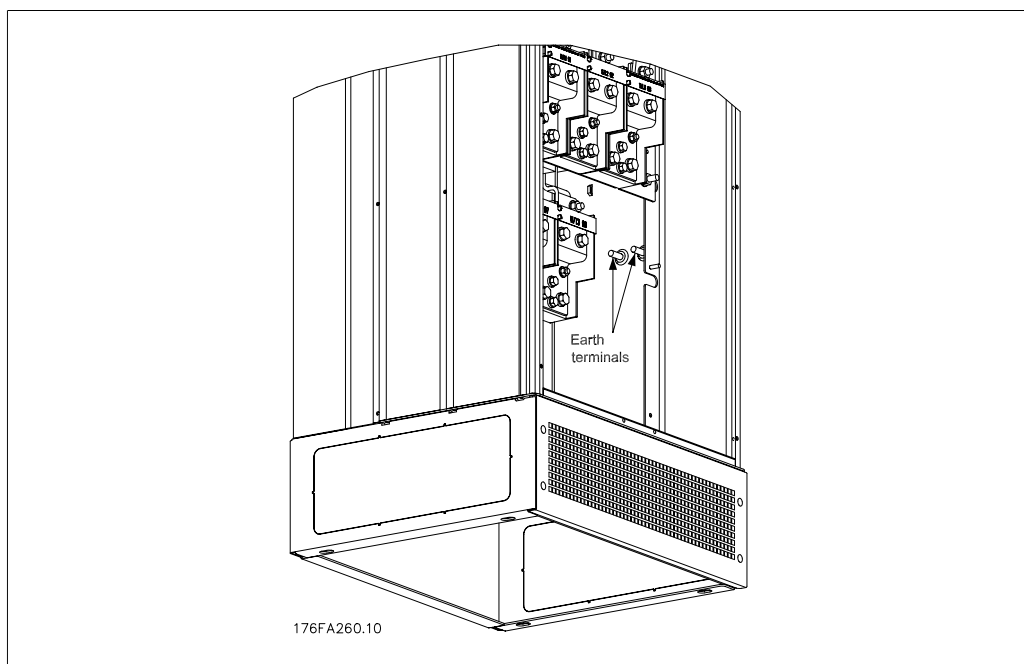


Illustration 3.36: Position of earth terminals IP21 (NEMA type 1) and IP54 (NEMA type 12)

3.2.3. Earthing

The following basic issues need to be considered when installing a frequency converter, so as to obtain electromagnetic compatibility (EMC).

- Safety earthing: Please note that the frequency converter has a high leakage current and must be earthed appropriately for safety reasons. Apply local safety regulations.
- High-frequency earthing: Keep the earth wire connections as short as possible.

Connect the different earth systems at the lowest possible conductor impedance. The lowest possible conductor impedance is obtained by keeping the conductor as short as possible and by using the greatest possible surface area.

The metal cabinets of the different devices are mounted on the cabinet rear plate using the lowest possible HF impedance. This avoids having different HF voltages for the individual devices and avoids the risk of radio interference currents running in connection cables that may be used between the devices. The radio interference will have been reduced.

In order to obtain a low HF impedance, use the fastening bolts of the devices as HF connection to the rear plate. It is necessary to remove insulating paint or similar from the fastening points.

3.2.4. Extra Protection (RCD)

ELCB relays, multiple protective earthing or earthing can be used as extra protection, provided that local safety regulations are complied with.

In the case of an earth fault, a DC content may develop in the faulty current.

If ELCB relays are used, local regulations must be observed. Relays must be suitable for protection of 3-phase equipment with a bridge rectifier and for a brief discharge on power-up.

See also the section *Special Conditions* in the relevant Design Guide.

3.2.5. RFI Switch

Mains supply isolated from earth:

If the frequency converter is supplied from an isolated mains source (IT mains, floating delta and grounded delta) or TT/TN-S mains with grounded leg, the RFI switch is recommended to be turned off (OFF)¹⁾. For further reference, see IEC 364-3. In case optimum EMC performance is needed, parallel motors are connected or the motor cable length is above 25 m, it is recommended to set the switch in ON position.

In OFF position, the internal RFI capacities (filter capacitors) between the chassis and the intermediate circuit are cut off to avoid damage to the intermediate circuit and to reduce the earth capacity currents (according to IEC 61800-3).

Please also refer to the application note *VLT on IT mains*, MN.90.CX.02. It is important to use isolation monitors that are capable for use together with power electronics (IEC 61557-8).



The RFI switch is not to be operated with mains connected to the unit. Check that the mains supply has been disconnected before operating the RFI switch.



Open RFI switch is only allowed at factory set switching frequencies.

The RFI switch connects the capacitors galvanically to earth.

1) Not required with 525-600/690 V drives; therefore not possible.

3.2.6. Torque

When tightening all electrical connections it is very important to tighten with the correct torque. Too low or too high torque result in a bad electrical connection. Use a torque wrench to ensure correct torque

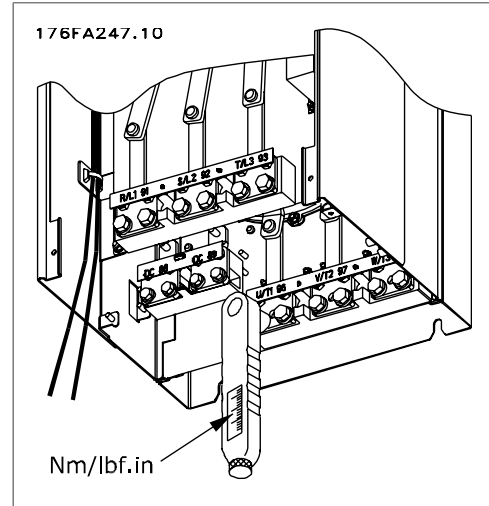


Illustration 3.37: Always use a torque wrench to tighten the bolts.

| Enclosure | Terminal | Torque | Bolt size |
|-----------|-----------------------|--------------------|-----------|
| D1 and D2 | Mains | 19 Nm (168 in-lbs) | M10 |
| | Motor | | |
| | Load sharing Brake | 9.5 (84 in-lbs) | M8 |
| E1 | Mains | 19 NM (168 in-lbs) | M10 |
| | Motor | | |
| | Load sharing | | |
| | Brake | 9.5 (84 in-lbs) | M8 |

Table 3.4: Torque for terminals

3.2.7. Shielded Cables

It is important that shielded and armoured cables are connected in a proper way to ensure high EMC immunity and low emissions. Connection can be made with either cable glands or clamps.

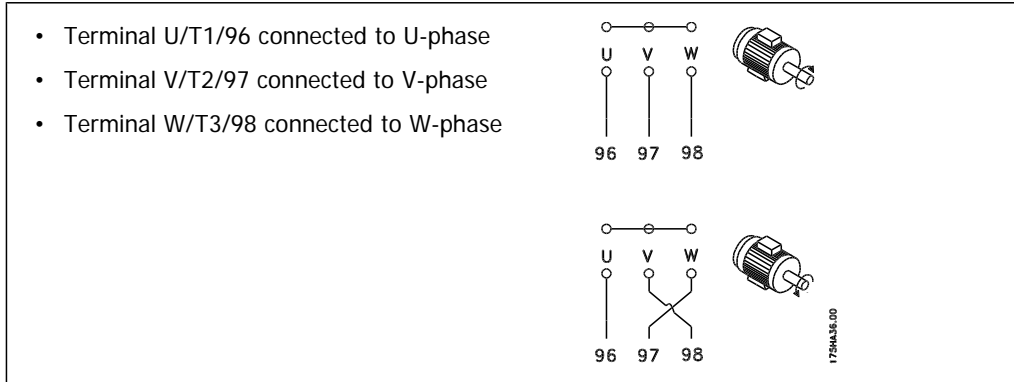
- EMC cable glands: Generally available cable glands can be used to ensure an optimum EMC connection.
- EMC cable clamp: Clamps allowing easy connection are supplied with the frequency converter.

3.2.8. Motor cable

The motor must be connected to terminals U/T1/96, V/T2/97, W/T3/98. Earth to terminal 99. All types of three-phase asynchronous standard motors can be used with a frequency converter unit.

The factory setting is for clockwise rotation with the VLT frequency converter output connected as follows:

| Terminal No. | Function |
|--------------|------------------------|
| 96, 97, 98, | Mains U/T1, V/T2, W/T3 |
| 99 | Ground/Earth |



The direction of rotation can be changed by switching two phases in the motor cable.

3.2.9. Brake Cable

(Only standard with brake and extended with brake. Typecode: SB, EB, DE, PB).

| Terminal No. | Function |
|--------------|--------------------------|
| 81, 82 | Brake resistor terminals |

The connection cable to the brake resistor must be screened. Connect the screen by means of cable clamps to the conductive back plate at the frequency converter and to the metal cabinet of the brake resistor.

Size the brake cable cross-section to match the brake torque. See also Brake instructions, MI.90.FX.YY and MI.50.SX.YY for further information regarding safe installation.

Please note that voltages up to 1099 V DC, depending on the supply voltage, may occur on the terminals.

3.2.10. Brake Resistor Temperature Switch

Torque: 0.5-0.6 Nm (5 in-lbs)
Screw size: M3

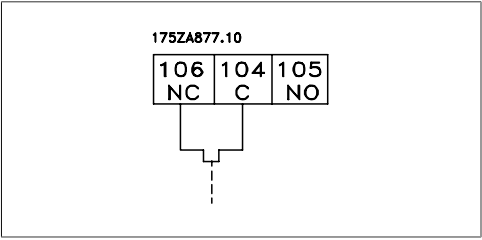
This input can be used to monitor the temperature of an externally connected brake resistor. If the input between 104 and 106 opens, the frequency converter will trip on alarm 29. If the connection is closed between 104 and 105, the frequency converter will trip on alarm 29.

Normally closed: 104-106 (factory installed jumper)

Normally open: 104-105

| Terminal No. | Function |
|---------------|------------------------------------|
| 106, 104, 105 | Brake resistor temperature switch. |

! If the temperature of the brake resistor gets too high and the thermal switch drops out, the frequency converter will stop braking. The motor will start coasting. A KLIXON switch must be installed that is 'normally closed'. If this function is not used, 106 and 104 must be short-circuited together.



3.2.11. Load Sharing

(Only extended with typecode EB, EX, DE, DX).

| Terminal No. | Function |
|--------------|-------------|
| 88, 89 | Loadsharing |

The connection cable must be screened and the max. length from the frequency converter to the DC bar is 25 metres (82 feet).

Load sharing enables linking of the DC intermediate circuits of several frequency converters.

! Please note that voltages up to 1099 V DC may occur on the terminals. Load sharing calls for extra equipment. For further information please consult Load-sharing Instructions MI.50.NX.XX.

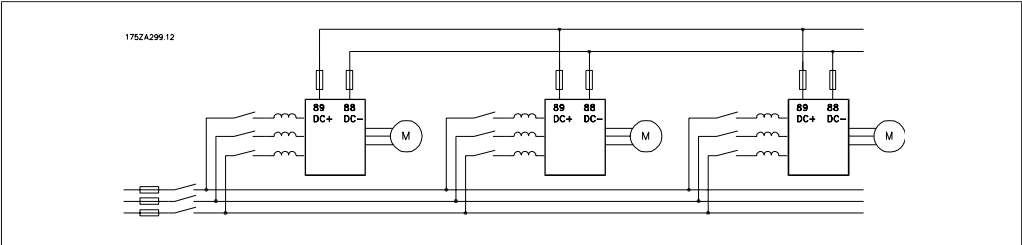


Illustration 3.38: Load sharing connection.

3.2.12. Shielding against Electrical Noise

Before mounting the mains power cable, mount the EMC metal cover to ensure best EMC performance.

NOTE: The EMC metal cover is only included in units with an RFI filter.



Illustration 3.39: Mounting of EMC shield.

3.2.13. Mains connection

Mains must be connected to terminals 91, 92 and 93. Earth/ground is connected to the terminal to the right of terminal 93.

| Terminal No. | Function |
|--------------|------------------------|
| 91, 92, 93 | Mains R/L1, S/L2, T/L3 |
| 94 | Ground/Earth |



Check the name plate to ensure that the mains voltage of the VLT frequency converter matches the power supply of your plant.

Ensure that the power supply can supply the necessary current to the VLT frequency converter.

If the unit is without built-in fuses, ensure that the appropriate fuses have the correct current rating.

3.2.14. External Fan Supply

In case DC supplies the frequency converter or the fan must run independently of the power supply, an external power supply can be applied. The connection is done to the power card.

| Terminal No. | Function |
|--------------|-----------------------|
| 100, 101 | Auxiliary supply S, T |
| 102, 103 | Internal supply S, T |

The connector located on the power card provides the connection of line voltage for the cooling fans. The fans are connected from factory to be supplied from a common AC line (jumpers between 100-102 and 101-103). If external supply is needed, the jumpers are removed and the supply is connected to terminals 100 and 101.

4. Duct Work Cooling Kit for IP00 Units

4

This chapter deals with the installation of IP00 / chassis enclosed frequency converters with duct work cooling kits in Rittal enclosures. These kits are designed and tested to be used with Rittal TS8 enclosures 1800 mm (Frame D1 and D2 only) and 2000 mm height. Other enclosure heights are not supported. In addition to the enclosure a 200 mm base/plinth is required.

The minimum enclosure dimension is:

- D1 and D2 frame: Depth 500 mm and width 600 mm.
- E1 frame: Depth 600 mm and width 800 mm.

The maximum depth and width are as required by the installation. When using multiple frequency converters in one enclosure it is recommended that each drive is mounted on its own back panel and supported along the mid-section of the panel. These duct work kits do not support the “in frame” mounting of the panel (see Rittal TS8 catalogue for details). The duct work cooling kits listed in the table below are suitable for use only with IP 00 / Chassis frequency converters in Rittal TS8 IP 20 and UL and NEMA 1 and IP 54 and UL and NEMA 12 enclosures.

The duct work shown is for D1 and d2 enclosures. The duct work for E1 enclosures has a different look, but is installed in the same way.

For the E1 enclosures it is important to mount the plate at the absolute rear of the Rittal enclosure due to the weight of the frequency converter.

Ordering Information

| Rittal TS-8 Enclosure | Frame D1 Kit Part No. | Frame D2 Kit Part No. | Frame E1Part No. |
|-----------------------|-----------------------|-----------------------|------------------|
| 1800 mm | 176F1824 | 176F1823 | Not possible |
| 2000 mm | 176F1826 | 176F1825 | 176F1850 |

Kit Contents

- Ductwork components
- Mounting hardware
- Gasket material
- Delivered with D1 and D2 frame kits:
 - 175R5639 - Mounting templates and top/bottom cut out for Rittal enclosure.
- Delivered with E1 frame kits:
 - 175R1036 - Mounting templates and top/bottom cut out for Rittal enclosure.

All fasteners are either:

- 10 mm, M5 Nuts torque to 2.3 Nm (20 in-lbs)
- T25 Torx screws torque to 2.3 Nm (20 in-lbs)

4

This illustration shows the full size template included with the kit and two drawings that may be used to locate the cutouts for the enclosure top and bottom plates. The duct work may also be used to locate the openings.



Illustration 4.1: Templates

Install gasket material on the back openings of the frequency converter prior to installation on the enclosure back panel. Use the template provided with the kit (shown above) and install the frequency converter on the back panel of the Rittal enclosure. The template is referenced to the top-left corner of the back panel. Therefore the template may be used with any size back panel and both the 1800 mm and 2000 mm high enclosures.



Illustration 4.2: Openings on rear not used in this application

Before installing the back panel in the enclosure assemble the gasket on both sides of the bottom duct adapter as shown below, and install on the bottom of the frequency converter.



Illustration 4.3: Bottom duct adapter



Illustration 4.4: Bottom duct adapter with gasket installed



Illustration 4.5: Bottom duct adapter installed

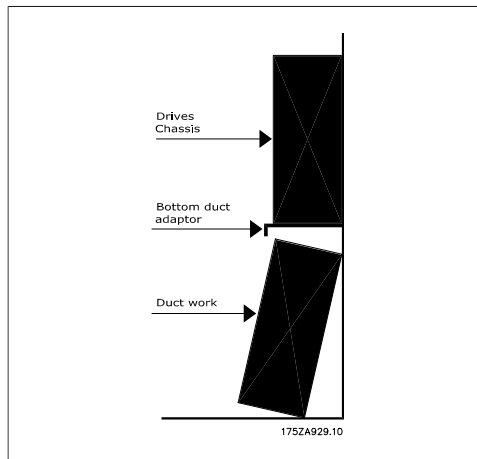


Illustration 4.6: Side view



NB!

Install the bottom plate after the frequency converter has been installed on the back to assure proper gasket coverage.

Install the two mounting brackets on the frequency converter chassis and then install the bottom duct adapter on the bottom of the frequency converter as shown below.

The installation of the bottom plate is easier while the back panel is outside the enclosure. The curved leading edge of the bottom duct adapter is to the front of the frequency converter and down.

Before installing the back panel with the frequency converter in the Rittal TS8 enclosure remove and discard the rearmost 5 screws (see illustration below) located on the top cover of the frequency converter. The holes will be used to fasten the top ductwork with longer screws provided with the kit.



Illustration 4.7: Top of IP 00 / Chassis frequency converter

Install the back panel in the enclosure, see illustration below. Use Rittal PS4593.000 brackets (minimum one per side at the middle of the frequency converter) with appropriate support strip for additional support of the back panel. For the D2 and E1 frame use two supports per side. If additional components are mounted on the same back panel, consult Rittal manual for additional support requirements.

4



Illustration 4.8: Frequency converter installed in cabinet

The top ductwork cover is composed of the following pieces as shown below. From left to right: 1. top duct closing plate, 2. frequency converter bracket, 3. duct, 4. duct vented top cover.



Illustration 4.9: Top duct assembly



Illustration 4.10: Top duct work and enclosure top installed

Temporarily install the top duct section as shown above. Use the top duct cover piece to mark the enclosure top for the opening. Alternatively the mounting template (supplied drawing) can be used to make the enclosure cut-out.



Illustration 4.11: The top duct work partially assembled with frequency converter bracket



Illustration 4.12: Rittal enclosure top with cutout
Standard Rittal enclosures top is cut. Gasket is not used on the cutout. Gasket is part of duct work.



Illustration 4.13: Gasket folds over the edge to form seal between the duct and top vented cover



Illustration 4.14: Top duct installed



Illustration 4.15: Gasket applied to both sides of the frequency converter bracket and duct vented top cover.



Illustration 4.16: Top duct ready to be installed on the frequency converter

For the final installation of the duct work, assemble the top duct as shown above.

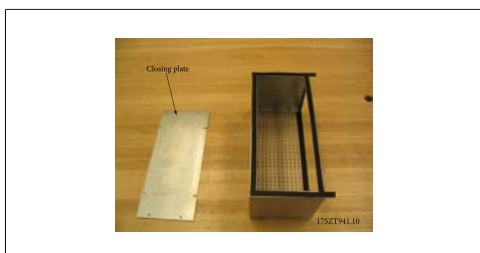


Illustration 4.17: Top duct assembled with gasket

Gasket is applied to several surfaces as shown (see exploded view of components) The top duct closing plate is left off for the installation of the duct work on the frequency converter. The top duct work is attached to the frequency converter using existing holes on the top cover of the frequency converter. Use the longer T25 screws provided with the kit in the existing frequency converter top cover holes. The duct work will fit over the frequency converter mounting bolts.

Once the ductwork is attached to the frequency converter, the duct closing plate can be attached. The top ductwork assembly is complete.

Apply the gasket to the top duct closing plate and install. Install the enclosure top. Top duct installation is complete.



Illustration 4.18: Top duct installed



Illustration 4.19: Top duct closing plate with gasket

4

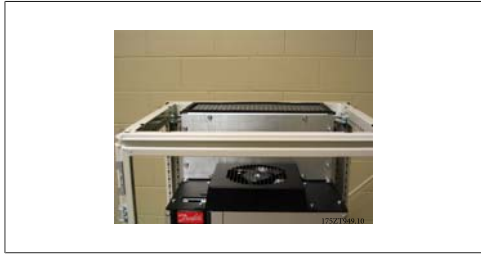


Illustration 4.20: Top duct closing plate installed



Illustration 4.21: Enclosure top installed



Illustration 4.22: Top view of Rittal enclosure

The bottom duct assembly pieces. Refer to drawing showing exploded view of duct work components. Gasket is installed as shown. Assemble the bottom duct less the cover. Assembly includes the mounting of 3 angle brackets on the front and sides of the partially assembled bottom duct. The bottom duct collar is bolted to the duct using 3 - T25 screws in the outermost holes of the brackets. Tighten the screws to compress the gasket.



Illustration 4.23: Bottom ductwork pieces



Illustration 4.24: Bottom ductwork partially assembled



Illustration 4.25: Completely assembled bottom duct work

The duct assembly is used to mark the bottom cutout. Temporarily install the bottom duct work as shown to the right. Use the inside of the ductwork to mark the bottom of the enclosure for the opening.



Illustration 4.26: Temporarily install duct work to mark cutout on the gland

The cutout is made on the innermost gland plate. The remaining two gland plates must be removed for the installation of the bottom duct assembly.



Illustration 4.27: Enclosure bottom cutout

The bottom duct work is rotated into place as shown. The bottom ductwork is a tight fit by design. The upper part of the duct fits under the bottom duct adapter and requires a tight fit which with the gasket material maintains the IP 54 and UL and NEMA 12 rating.



Illustration 4.28: Bottom ductwork installed

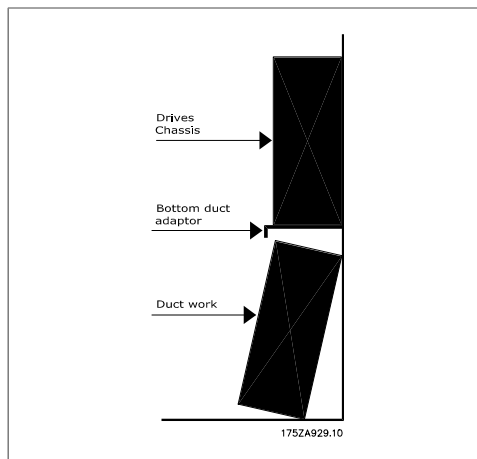


Illustration 4.29: Installation of bottom duct

After the bottom ductwork has been positioned in place, remove the three T25 screws from the outer holes in the mounting brackets on the sides and front of ductwork and move them to the inner holes of the same brackets. Tighten the three screws to the specified torque. The bottom duct work is not fastened to Rittal enclosure.



Illustration 4.30: Move mounting screws from the outer hole to the inner hole

Install the front cover of the duct and the cable clamp base if used. Install the two remaining gland plates.



Illustration 4.31: Bottom duct installed.

5. Installation on Pedestal - IP 21 / IP 54 Units

The frequency converter can also be installed on the floor. A dedicated floor stand is designed for that purpose. It can only be used for units produced after week 50, 2004 (serial number XXXXXG504).

This section describes the installation of a pedestal unit available for the VLT series frequency converters frames D1 and D2. This is a 200 mm high pedestal that allows these frames to be floor mounted. The front of the pedestal has openings for input air to the power components.

The frequency converter gland plate must be installed to provide adequate cooling air to the control components of the frequency converter via the door fan and to maintain the IP21/NEMA 1 or IP54/NEMA 12 degrees of enclosure protections.

There is one pedestal that fits both frames D1 and D2.

Required Tools

Required Tools:

- Socket wrench with 7-17 mm sockets
- T30 Torx Driver

Torques:

- M6 - 4.0 Nm (35 in-lbs)
- M8 - 9.8 Nm (85 in-lbs)
- M10 - 19.6 Nm (170 in-lbs)

Kit Contents:

- Pedestal parts
- Instruction manual



Illustration 5.1: Drive on pedestal.

The kit contains a U-shaped piece, a vented front cover, 2-side covers, two front brackets and the required hardware to assemble. See the exploded view of the installation (drawing 175R5641).

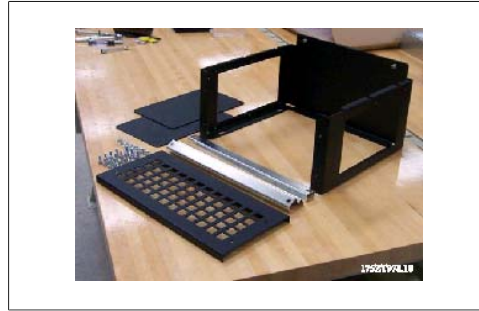


Illustration 5.2: Pedestal parts

The pedestal has been partially assembled. Before installing the drive on to the pedestal it is important to anchor the pedestal to the floor using the four pedestal mounting holes. The holes can accommodate up to M12 bolts (not included in the kit).

CAUTION: The drives are top heavy and may fall over if the pedestal is not anchored to the floor.

The entire assembly may also be supported by using the drive top mounting holes to anchor to a wall structure.



Illustration 5.3: Pedestal partially assembled

The completely assembled pedestal with vented front cover and two side covers installed. Multiple frequency converters may be mounted side by side. The interior side closing plates are left off.

NOTE: The front and side cover mounting screws are now recessed M6 Torx socket flat head screws.



Illustration 5.4: Final assembled pedestal.

Install the frequency converter by lowering on to the pedestal. The frequency converter must overhang the front of the pedestal to clear the retaining bracket on the rear of the pedestal. After the frequency converter has been placed on the pedestal, slide the frequency converter engages the retaining bracket on the pedestal and mount screws as shown.

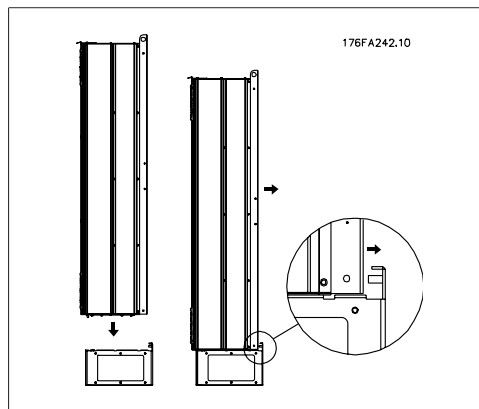


Illustration 5.5: Mounting of drive to pedestal.

5

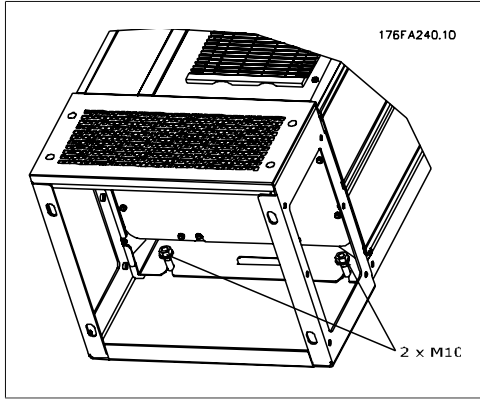


Illustration 5.6: Two nuts at rear side.

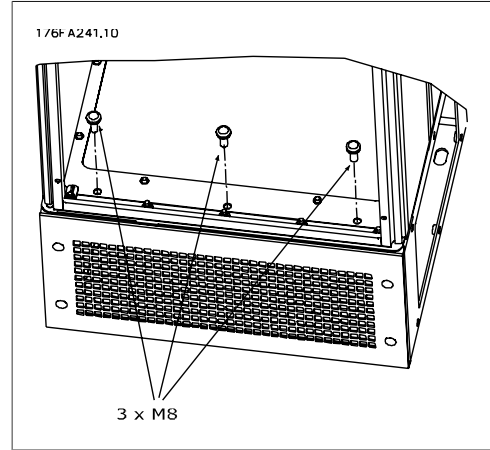


Illustration 5.7: Three front screws.

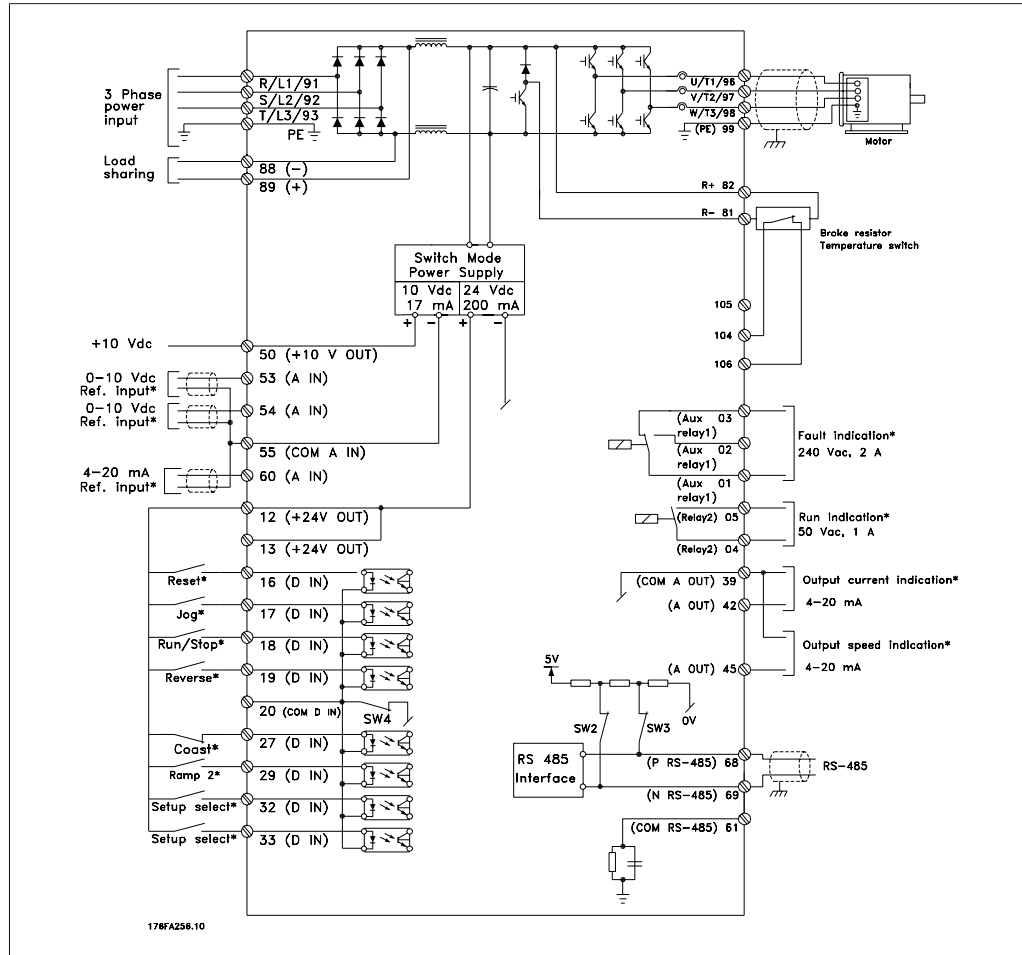


Illustration 5.8: Frame D2 with pedestal installed

6. Start-Up Check

6.1.1. Connection Examples

For details see the Operating Instructions of the specific frequency converters.



Brake terminals 81 and 82 are not available in VLT 6000, VLT 8000 and VLT 4000 series.

* Depends on parameter settings.

6.1.2. Electrical Installation Procedures

The following procedure will guide you through a correct electrical installation of your VLT frequency converter.

Before you start, please read the safety instructions on the first page of this instruction.

Note that the user is responsible, that the VLT frequency converter, motor and other units are installed according to recognized local regulations. Pay special attention to cable dimensioning, pre-fuses, earthing and over-current protection.

1. Mechanical installation check

Check the following before the electrical installation:

1. Check for proper ambient operating conditions. See *Derating for ambient temperature* in the relevant Design Guide.
2. Check for free flow of cooling air.
3. Check that no visible damage has occurred to the crate and drive during transport.

2. Load sharing connection

1. Install the wire for DC+ to terminal 89.
2. Install the wire for DC- to terminal 88.



Note that voltages up to 1099 V DC will occur on the terminals when power is connected.

3. Brake resistor (only VLT 5000)

1. Install the wire for R+ to terminal 82.
2. Install the wire for R- to terminal 81.

4. Motor connection

1. Install earth from the motor to the earthing point.
2. Install W from the motor to terminal W/T3/98.
3. Install V from the motor to terminal V/T2/97.
4. Install U from the motor to terminal U/T1/96.

5. EMC shield

1. Mount the EMC shield between the motor and mains supply connections.
NOTE: Only supplied on drives with an RFI filter.

6. Mains connection

1. Check that the mains voltage matches the VLT frequency converter nominal input voltage.
2. Ensure that the power supply can supply the necessary current to the VLT frequency converter, see *Technical data* in the relevant Operating Instructions.
3. Install earth from the power supply to the earthing point.
4. Install line 1 from the power supply to terminal R/L1/91.
5. Install line 2 from the power supply to terminal S/L2/92.
6. Install line 3 from the power supply to terminal T/L3/93.

7. Power up

Check the following before you power up the VLT frequency converter:

1. Check for proper mains fuses. See *Technical data* in the relevant Operating Instructions.
2. Check for a proper earthing.
3. Check for proper mains, load sharing, brake and motor connection.
4. Check that there are no tools in the enclosure.

Close the doors and connect the power to the VLT frequency converter. The green voltage indicator lamp (ON) on the control panel is activated when the VLT frequency converter receives voltage.

The VLT frequency converter can now be programmed via the control panel.

Note that in parameter 620 *Operating mode* you can select *Function with de-activated inverter* [1]. After cycling the power the parameter is active. This means that without the motor shaft running you can control the influence of the control signal on the control card.

NOTE: Not a safety function.

| | |
|--|---|
| | Wait at least 20 minutes (D1 and D2 frames) and 46 minutes (E1 frames) before you open the doors, after the VLT frequency converter has been disconnected from mains. |
|--|---|

6.1.3. Programming Procedures - VLT 5000

Programming the VLT 5000

The frequency converter is programmed over the control panel.

Press [QUICK MENU].

The Quick Menu appears in the display. Choose parameters by means of ↑ and ↓.

Press [CHANGE DATA] to change parameter value. Data values are changed using ↑ and ↓.

Press → or ← to move the cursor.

Press [OK] to save parameter setting.

Set the desired language in parameter 001.

Set motor parameters according to the motor plate:

| | |
|-------------------|---------------|
| Motor power | Parameter 102 |
| Motor voltage | Parameter 103 |
| Motor frequency | Parameter 104 |
| Motor current | Parameter 105 |
| Rated motor speed | Parameter 106 |

Set frequency interval and ramp times.

| | |
|----------------|---------------|
| Min. reference | Parameter 204 |
| Max. reference | Parameter 205 |
| Ramp up time | Parameter 207 |
| Ramp down time | Parameter 208 |

Set Operation site, parameter 002 for Local.

6.1.4. Programming Procedures - VLT 6000 HVAC, VLT 8000 AQUA and VLT 4000

The frequency converter is programmed over the control panel.

Press [QUICK MENU].

The Quick Menu appears in the display. Choose parameters by means of ↑ and ↓.

Press [CHANGE DATA] to change parameter value. Data values are changed using ↑ and ↓.

Press → or ← to move the cursor. Press [OK] to save your parameter setting.

Set the desired language in parameter 001.

Set motor parameters according to the motor plate:

| | |
|-------------------|---------------|
| Motor power | Parameter 102 |
| Motor voltage | Parameter 103 |
| Motor frequency | Parameter 104 |
| Motor current | Parameter 105 |
| Rated motor speed | Parameter 106 |

Set frequency interval and ramp times.

| | |
|------------------|---------------|
| Min. reference | Parameter 204 |
| Max. reference | Parameter 205 |
| Ramp up time | Parameter 207 |
| Ramp down time | Parameter 208 |
| Relay 1 function | Parameter 323 |
| Relay 2 function | Parameter 326 |

6

6.1.5. Motor Start

| | |
|----------|---------------------------------------|
| VLT 5000 | Press [START] to start the motor |
| VLT 4000 | Press [HAND START] to start the motor |
| VLT 6000 | |
| VLT 8000 | |

Set motor speed in parameter 003 by VLT 5000.

Set motor speed with the +/- keys on LCP of VLT 6000, VLT 8000 and VLT 4000.

Check if the direction of rotation is as shown in the display. It can be changed by swapping two phases of the motor cable.

| | |
|----------|------------------------------------|
| VLT 5000 | Press [STOP] to stop the motor |
| VLT 4000 | Press [OFF/STOP] to stop the motor |
| VLT 6000 | |
| VLT 8000 | |

Select total or reduced Automatic Motor Adaptation (AMA) in parameter 107. For further description of AMA, please see the manual.

Press [START] to start the Automatic Motor Adaptation (AMA).

Press [DISPLAY/STATUS] to leave the Quick Menu.

7. Service During Use

Preventive maintenance

To ensure a long and problem-free use of the frequency converter we recommend that you perform preventive maintenance.

Cleaning of filters IP 54 (NEMA 12)

Filters in the door must be serviced on a regular basis. The interval must be defined from installation to installation to ensure proper function based on the dust contents in the air.

Cleaning of the heat sink

During normal use it is not necessary to clean the heat sink. The forced airflow will keep the fins free from dust and other substances. In case the environment is very dusty, the heat sink can be cleaned by blowing compressed air over the heat sink from the top or the bottom of the frequency converter.

Remember to switch off the frequency converter before cleaning.

Checking connections

Measuring the temperature on power connections with a thermal camera or infrared meter is recommended as a preventive maintenance activity. Early detection of changes in the power connections to the frequency converter allows relevant action to avoid overheating connections and in worst case stops.

Checking temperatures and running conditions

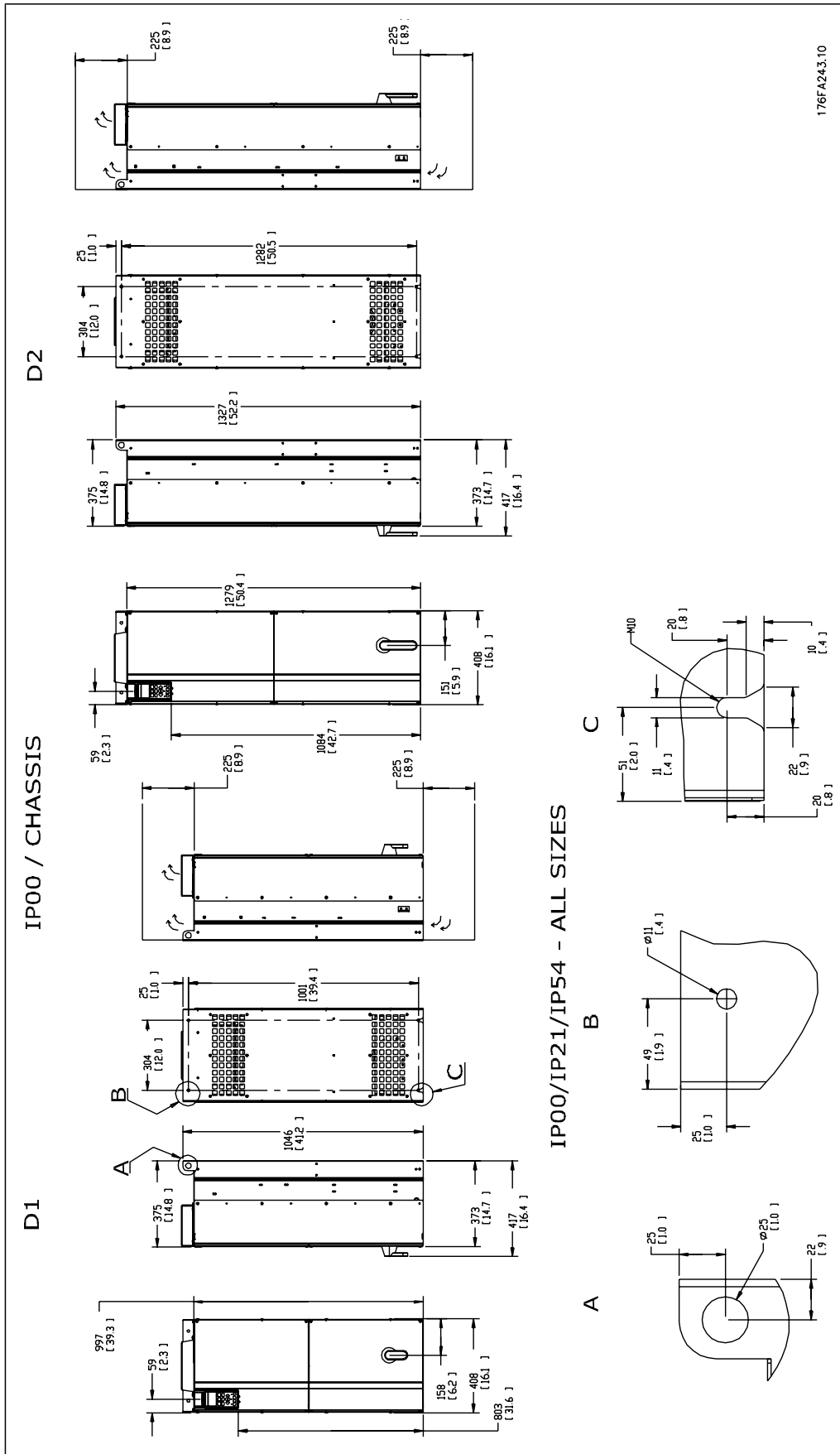
We recommend that you note the typical data during operation like:

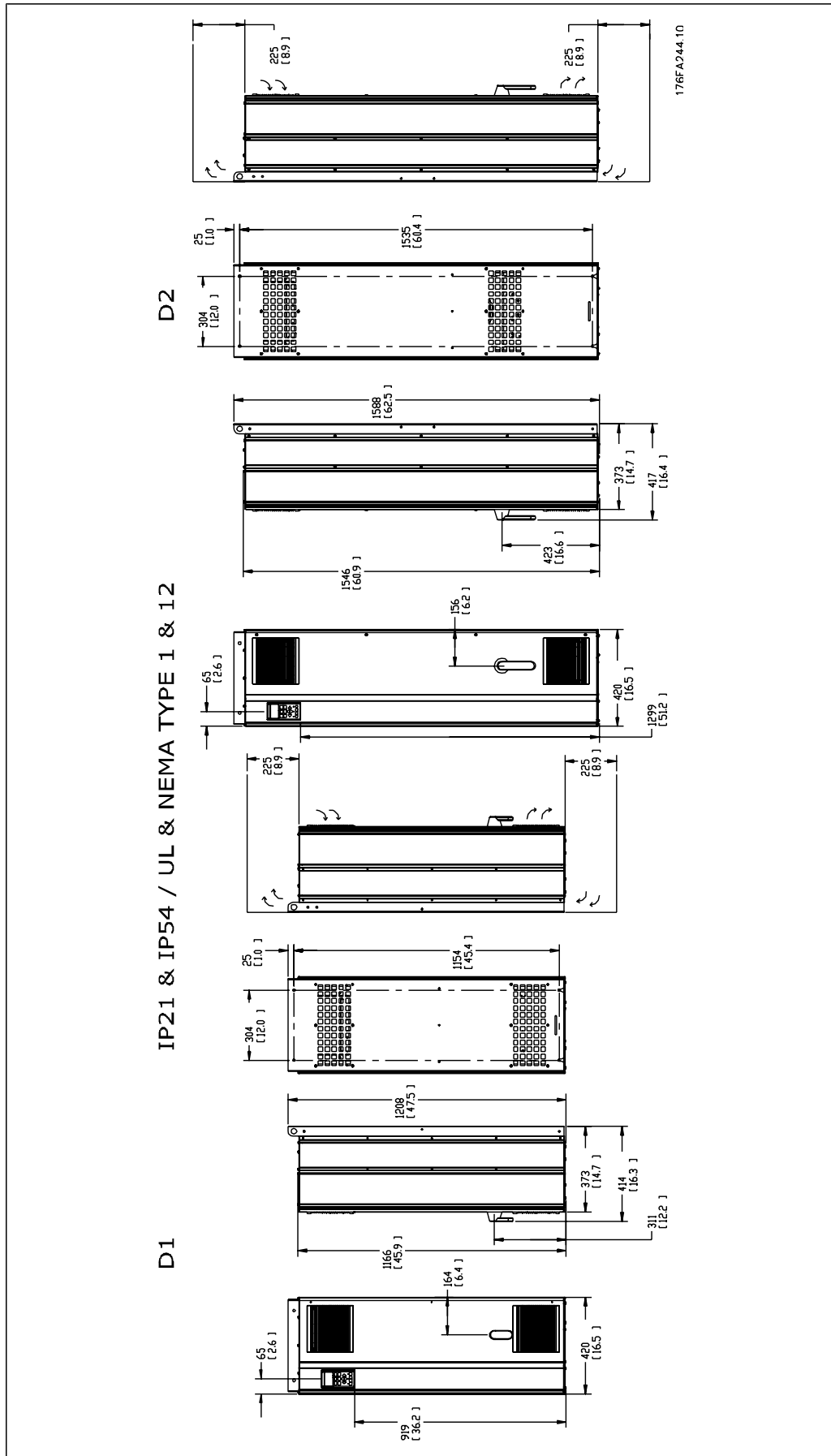
- Motor current at specified frequencies, i.e. 40 and 50 Hz
- Heat sink temperature at a defined ambient temperature
- Intermediate voltage
-

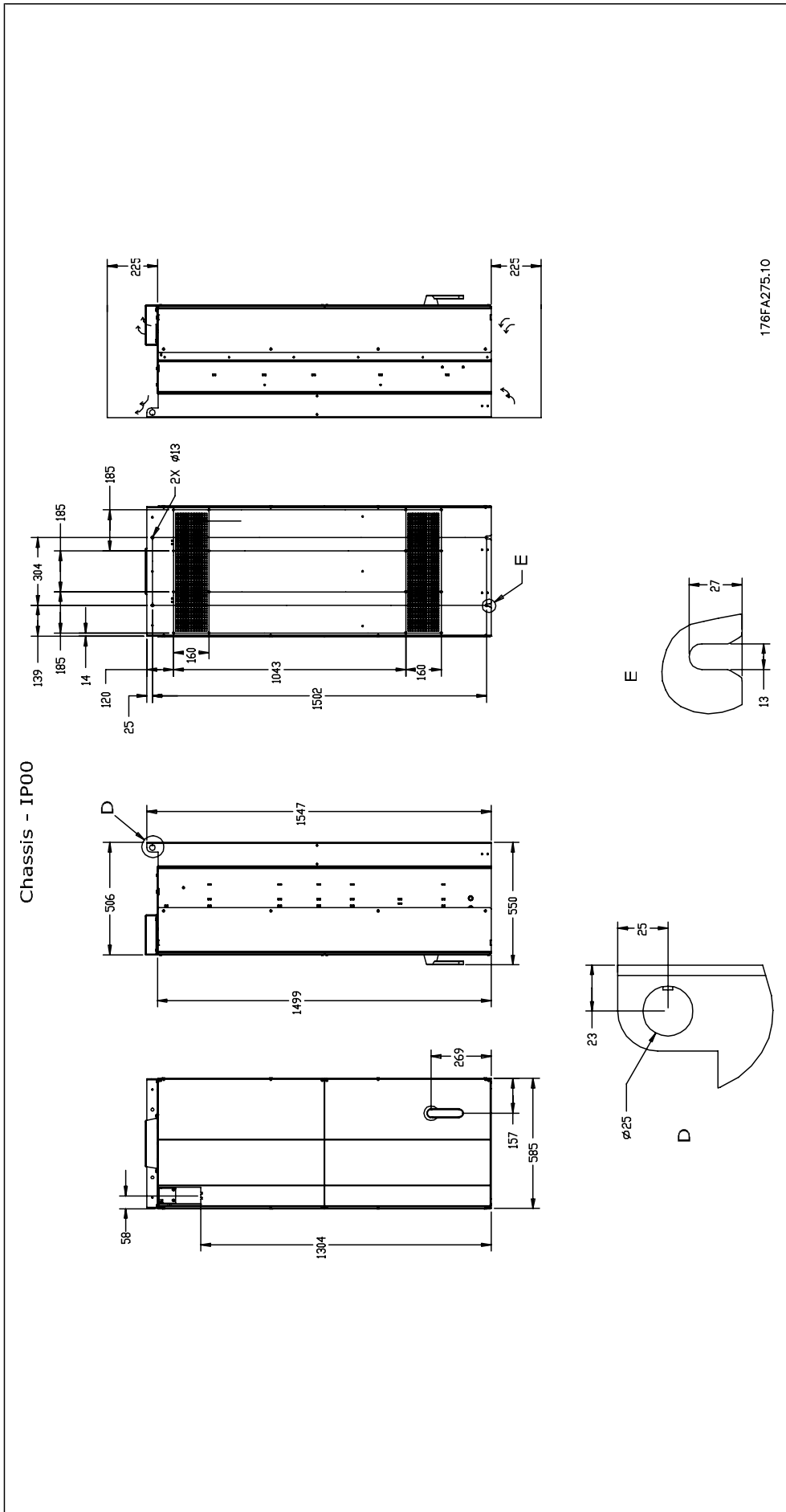
Based on these registrations it is possible to follow trends that indicate if maintenance is necessary or other changes to the operating conditions.

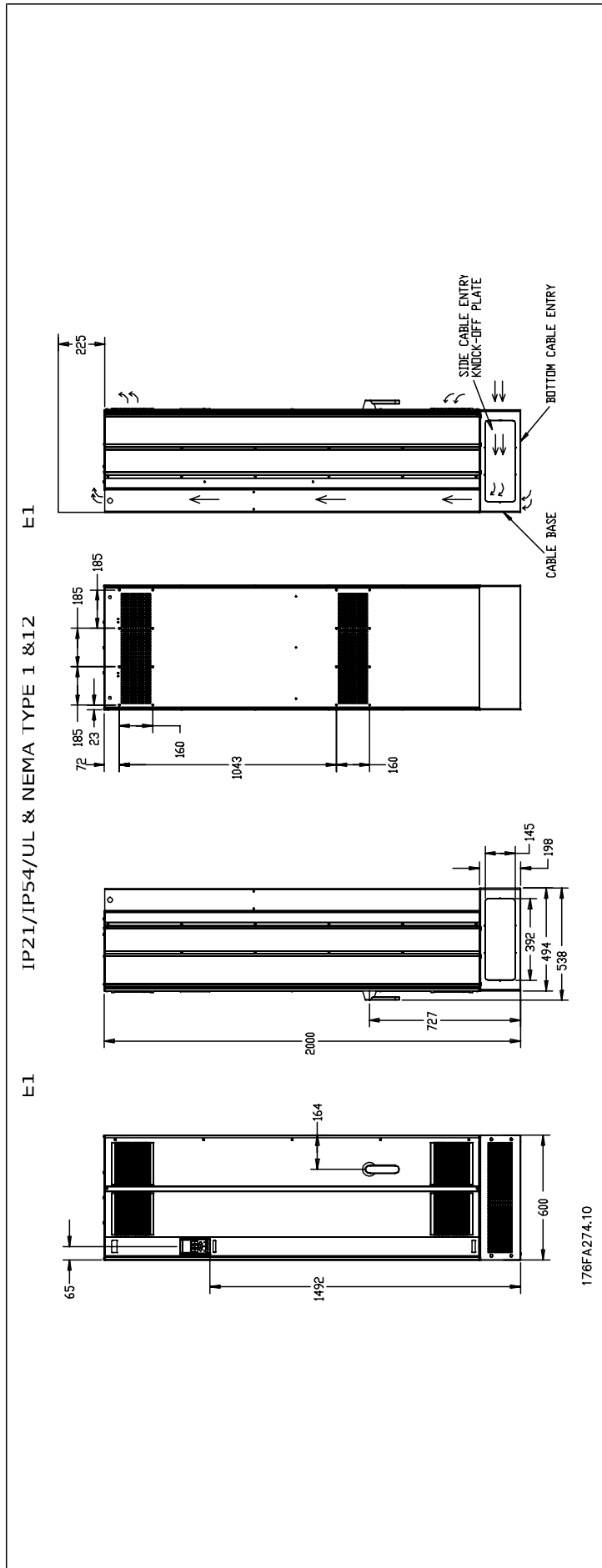
8. Drawings

- Mechanical detailed drawing









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