Frequency Inverter

CFW-11M RB

User's Manual

CFW-11M RB

REGENERATIVE FREQUENCY CONVERTER MANUAL

Series: CFW-11M RB

Language: English

Document: 10000874747 / 02

Models: 600...2850 A / 380...480 V

470...2232 A / 500...600 V

427...2028 A / 660...690 V

04/2019

Summary of Revisions

The information below describes the reviews made in this manual.

Versión	Revision	Description
-	R00	First edition
-	R01	Updating of the tables, notes and general revision
-	R02	General revision

1 SAFETY INSTRUCTIONS

This manual provides information for the proper installation and operation of the regenerative frequency converter CFW-11M RB.

Only trained and qualified personnel should attempt to install, start-up, and troubleshoot this type of equipment.

1.1 SAFETY WARNINGS IN THE MANUAL

The following safety warnings are used in this manual:

DANGER!
The procedures recommended in this warning have the purpose of protecting the user against dead, serious injuries and considerable material damage.

ATTENTION!
The procedures recommended in this warning have the purpose of avoiding material damage.

NOTE!
The text intents to supply important information for the correct understanding and good operation of the product.

1.2 SAFETY WARNINGS IN THE PRODUCT

The following symbols are attached to the product and require special attention:

Indicates a high voltage warning.

Electrostatic discharge sensitive components.
Do not touch them.

Indicates that a ground (PE) must be connected securely.

Indicates that the cable shield must be grounded.

Indicates a hot surface warning.

1

1.3 PRELIMINARY RECOMMENDATIONS

DANGER!

Only qualified personnel familiar with the CFW-11M RB regenerative frequency converter and associated equipment should plan or implement the installation, start-up and subsequent maintenance of this equipment.

These personnel must follow all the safety instructions included in this Manual and/or defined by local regulations.

Failure to comply with these instructions may result in death, serious injury, and equipment damage.

NOTE!

For the purposes of this manual, qualified personnel are those trained and able to:

1. Install, ground, power-up and operate the CFW-11M RB according to this manual and the effective legal safety procedures.
2. Use protection equipment according to the established regulations.
3. Provide first aid.

DANGER!

Always disconnect the main power supply before touching any electrical component associated to the converter.

Several components can remain charged with high voltages and/or in movement (fans) even after the AC power supply is disconnected or switched off.

Wait at least 10 minutes to assure a total discharge of the capacitors.

Always connect the equipment frame to the protection earth (PE) at the suitable connection point.

ATTENTION!

Electronic boards have components sensitive to electrostatic discharges. Do not touch directly on components or connectors. If necessary, touch the grounded metallic frame before or use an adequate grounded wrist strap.

Do not perform any withstand voltage test!
If necessary, consult WEG.

NOTE!

Regenerative frequency converter may interfere with other electronic equipment. In order to reduce these effects, take the precautions recommended in the chapter 3 - Installation and Connection.

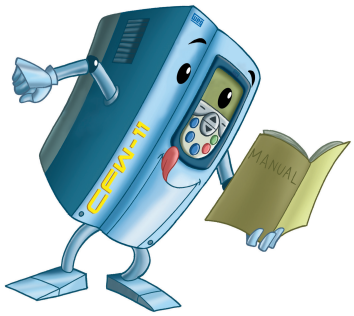
NOTE!

Read this manual completely before installing or operating the converter.

ATTENTION!

When in operation, electric energy systems – such as transformers, converters, motors and cables – generate electromagnetic fields (EMF), posing a risk to people with pacemakers or implants who stay in close proximity to them. Therefore, those people must stay at least 2 meters away from such equipment.

2 GENERAL INSTRUCTIONS



2.1 ABOUT THE MANUAL

This manual presents how to install, to start-up, the main characteristics and shows how to troubleshoot the most common problems of the CFW-11M RB converter series.

For information on other functions, accessories and operation conditions please refer to the following manuals:

ATTENTION!
The operation of this equipment requires installation instructions and detailed operation provided in the user manual, programming manual and manuals/guides for kits and accessories. The user manual and the parameters quick reference are supplied in a hard copy together with the converter. The other manuals are available at **www.weg.net**. A printed copy of the files available on WEG's website can be requested at your local WEG dealer.

- ☑ Programming Manual, with a detailed description of the parameters and advanced functions of the CFW-11M RB.
- ☑ I/O Expansion Module Manual.

2.2 TERMS AND DEFINITIONS

Regenerative Frequency Converter: three-phase switching frequency converter "boost type" (amplifier) that converts the AC voltage from the power supply to a DC voltage (DC Link). It has the capability of absorbing the energy of the power supply (AC) or to recover the energy back to the power supply, being used as a DC voltage source to supply voltage to several output inverter.

Output inverter: frequency inverter fed by the DC link bus bar supplied by the regenerative converter. It is responsible for the motor control.

Normal Duty Cycle (ND): converter duty cycle that defines the maximum continuous operation current (I_{nom-ND}) and overload current conditions (110 % for 1 minute). The ND cycle is selected by setting P0298 (Application) = 0 (Normal Duty (ND)). The inverter overload conditions are reflected in the regenerative converter.

I_{nom-ND}: converter rated current for use with the normal duty (ND) cycle.
Overload: 1.1 x I_{nom-ND} / 1 minute.

Heavy Duty Cycle (HD): converter duty cycle that defines the maximum continuous operation current (I_{nom-HD}) and overload current conditions (150 % for 1 minute). The HD cycle is selected by setting P0298 (Application) = 1 (Heavy Duty (HD)). The inverter overload conditions are reflected in the regenerative converter.

I_{nom-HD}: converter rated current for use with the heavy duty (HD) cycle.
Overload: 1.5 x I_{nom-HD} / 1 minute.

Current Imbalance (%):

$$\text{Imbalance of power unit X - phase Y} = \left| \frac{I_{YX} - I_{YAVG}}{I_{YAVG}} \right| \times 100$$

$$I_{YAVG} = \frac{I_{Y1} + I_{Y2} + ... + I_{YN}}{N}$$

2

Where:
N = number of power units.
I_{YN} = phase current Y (U, V or W) of the N power unit (P0815 to P0829).
I_{YAVG} = average current of phase Y.

Pre-charge Circuit: charges the DC bus capacitors with limited current, which avoids higher peak currents at the converter power-up.

DC Bus: converter intermediate circuit; DC voltage obtained from the AC input voltage rectification or from an external power supply; feeds the output IGBTs converter bridge.

Power modules U, V, and W: set of two IGBTs of the regenerative converter input phases R, S, and T.

IGBT: Insulated Gate Bipolar Transistor; basic component of the power modules U, V and W. The IGBT works as an electronic switch in the saturated (closed switch) and cut-off (open switch) modes.

NTC: resistor which resistance value in ohms decreases proportionally to the temperature increase; used as a temperature sensor in power modules.

HMI: Human Machine Interface: it is a device that allows the visualization and modification of the converter parameters. The CFW-11 HMI presents keys for the regenerative converter control, navigation keys and a graphic LCD display.

FLASH Memory: non-volatile memory that can be electronically written and erased.

RAM Memory: Random Access Memory (volatile).

USB: Universal Serial Bus; is a serial bus standard that allows devices to be connected using the "Plug and Play" concept.

PE: Protective Earth.

RFI Filter: Radio-Frequency Interference Filter for interference reduction in the Radio-Frequency range.

PWM: Pulse Width Modulation; pulsed voltage at the input of the regenerative converter.

Switching Frequency: frequency of the IGBTs switching, normally expressed in kHz.

General Enable: when activated, the converter controls the voltage at the DC bus. When deactivated, this function immediately blocks the PWM pulses. The General Enable function may be controlled through a digital input set to this function.

Heatsink: metal device designed to dissipate the heat generated by the power semiconductors.

Amp, A: ampères.

°C: Celsius degree.

°F: Fahrenheit degree.

AC: alternated current.

DC: direct current.

CFM: Cubic Feet per Minute; unit of flow.

cm: centimeter.

ft: foot.

hp: horse power = 746 Watts; unit of power, used to indicate the mechanical power of electrical motors.

Hz: hertz.

in: inch.

kg: kilogram = 1000 grams.

kHz: kilohertz = 1000 Hertz.

l/s: liters per second.

lb: pound.

m: meter.

mA: miliampère = 0.001 Ampère.

min: minute.

mm: millimeter.

ms: millisecond = 0.001 seconds.

N.m.: newton meter; unit of torque.

rms: root mean square; effective value.

rpm: revolutions per minute; unit of speed.

s: second.

V: volts.

Ω: ohms.

2.3 ABOUT THE CFW-11M RB

The regenerative frequency converter is a bidirectional three-phase boost type AC/DC converter that generates higher DC voltage than the line peak voltage. These converter are commonly known as AFE (Active Front End) drives. The CFW-11M RB line utilizes the "RB" sulfix which states for Regenerative Braking because it has the natural capacity of allowing the energy to flow from the converter to the power supply when the motor is braking. The DC voltage generated by the regenerative converter is used to feed other inverter power units that are controlling three-phase motors.

The CFW-11M RB regenerative converter is a high performance product that allows three-phase power supply rectification with the following advantages:

☑ Low input current harmonic distortion.

☑ Capacity of recovering energy back to the power supply (regeneration) allowing high braking torque levels.

The CFW-11M RB line presents a modular structure with the possibility of assembling up to five power units (UP11 - Books), one control unit (UC11) and interconnection cables. The control unit (UC11) is able to control up to 5 (five) UP11's.

The UP11 are directly feed via DC link bus bar and the UC11 is fed via the +24 Vdc power supply. Figure 2.1 shows an application sample.

The UP11 power units control is done by the UC11 control unit. The control unit is composed by the CFW-11M RB control rack line, the IPS1 board and the CSR11 synchronism board. The IPS1 board exchange signals with all UP11 units. The CSR11 synchronism board supervises the power supply, measuring the voltage values and synchronizing the control.

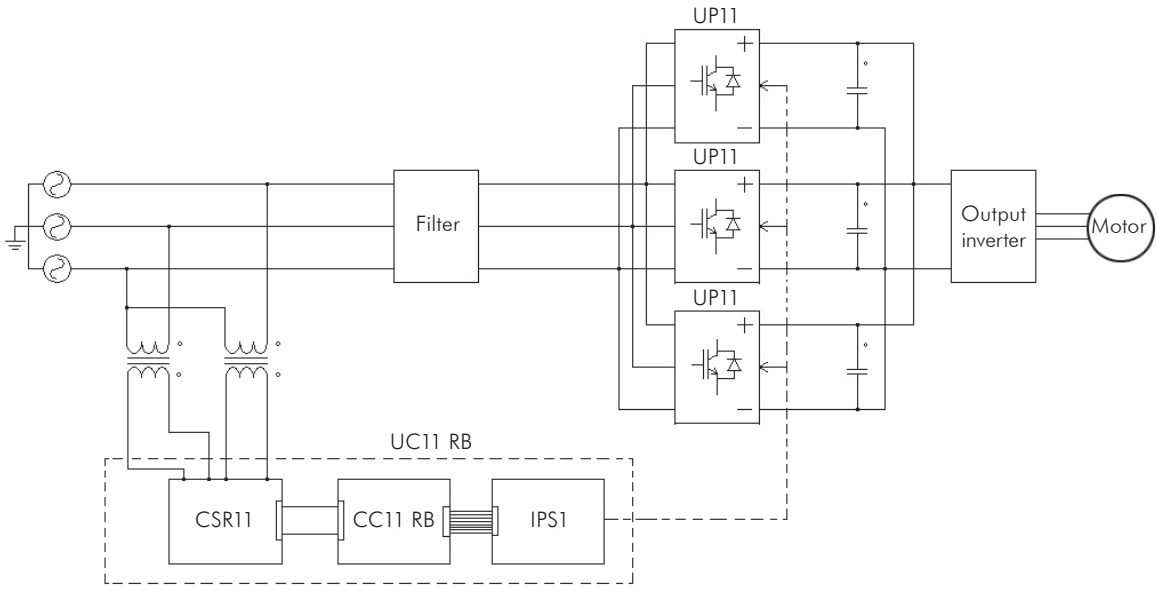


Figure 2.1 - *Configuration sample with 3 UP11*

The CFW-11M RB can be provided as a complete panel (AFW-11M RB) or as a panel mounting kit for local assembly in a panel. The output inverter stage (CFW-11M) is needed for the mounting kit assembly.

The panel mounting kit is composed by the control unit set and the power units (UP11), which quantity varies according to the CFW-11M RB model. The control unit set is composed by the control unit (UC11), the cable set needed for the connection between the IPS1 board and the power units and the ribbon cable to connect the IPS1 board to the CC11 RB board.

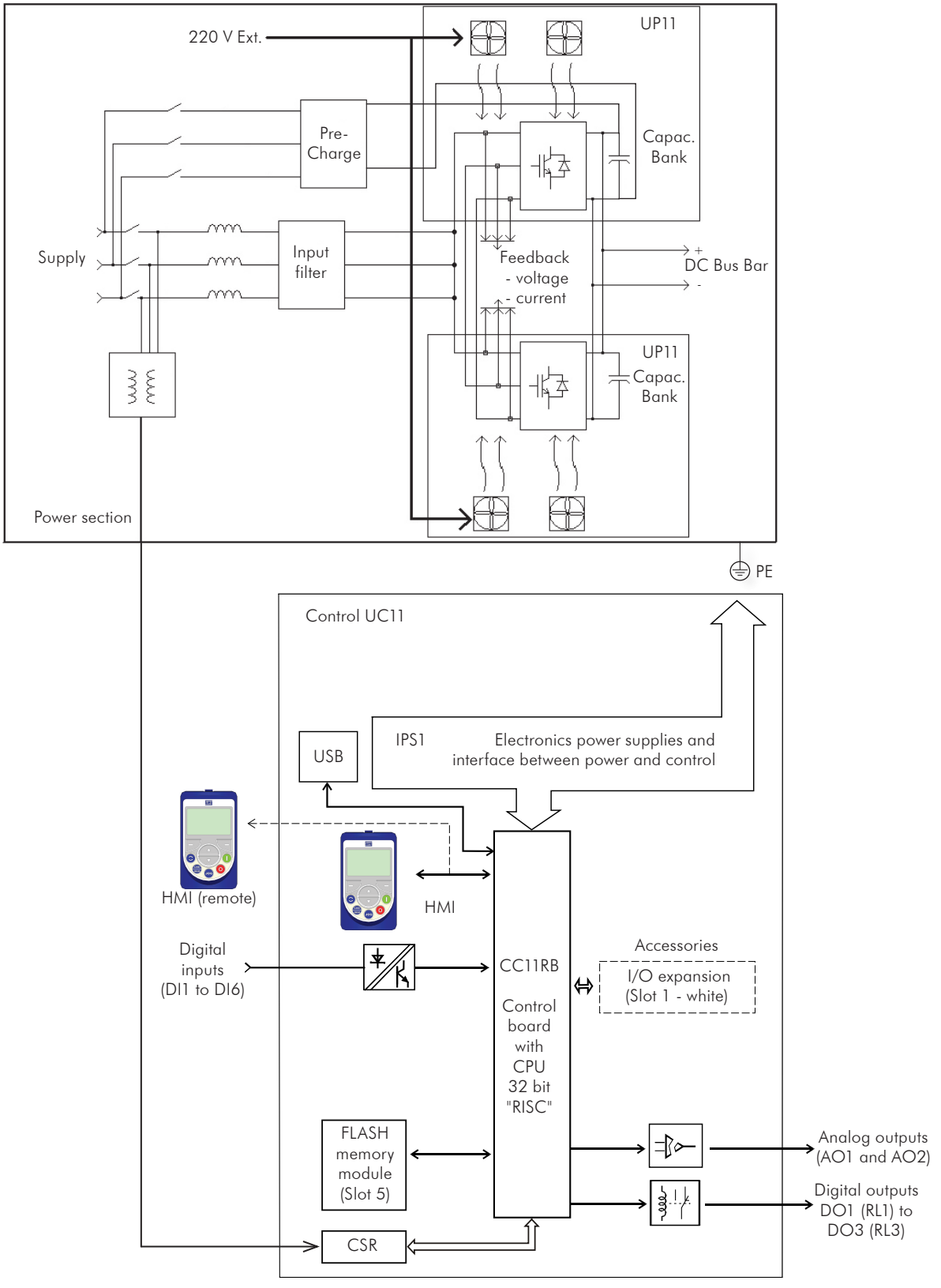


Figure 2.2 - *CFW-11M RB block diagram*

NOTE!
Additional itens are need for the assembly of the complete unit, such as output inverter, DC fuses in the DC link bus bar connection, external pre-charge circuit and filter.

NOTE!
It is not necessary to add a current transformer (CT) for output short circuit protection to the ground since each UP11 module has its own internal protection.

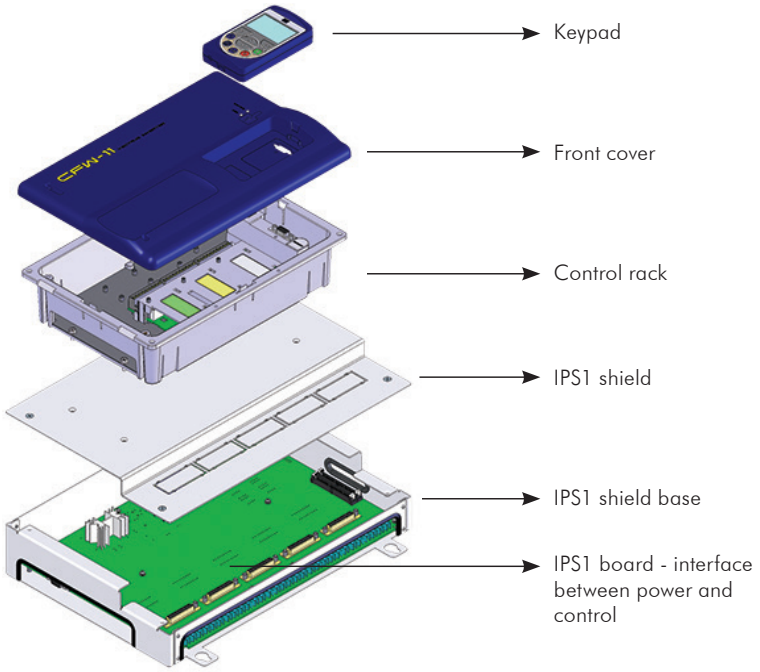


Figure 2.3 - *UC11 main components*

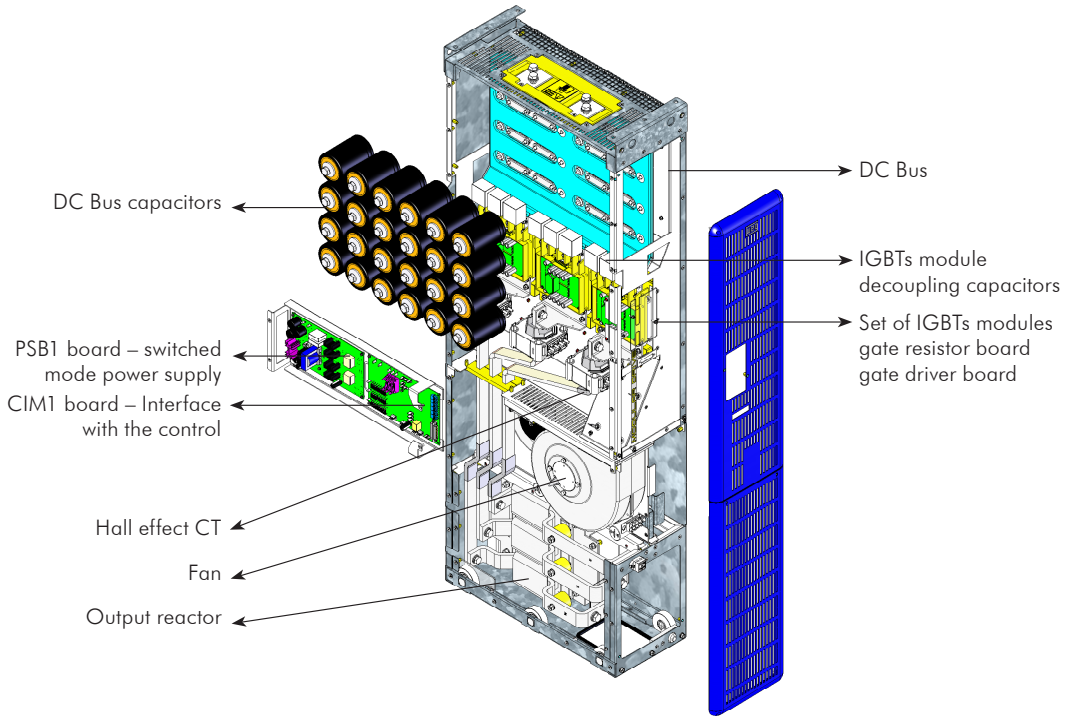
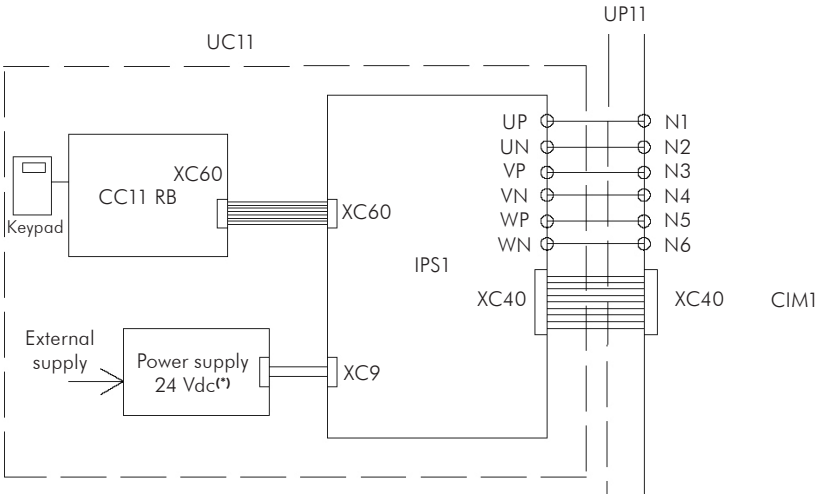


Figure 2.4 - *UP11 main components*



(*) Tolerance: ±10 %.
Current: 4 A.

Figure 2.5 - *UP11: Connections between the IPS1 and the CIM1 interface boards*

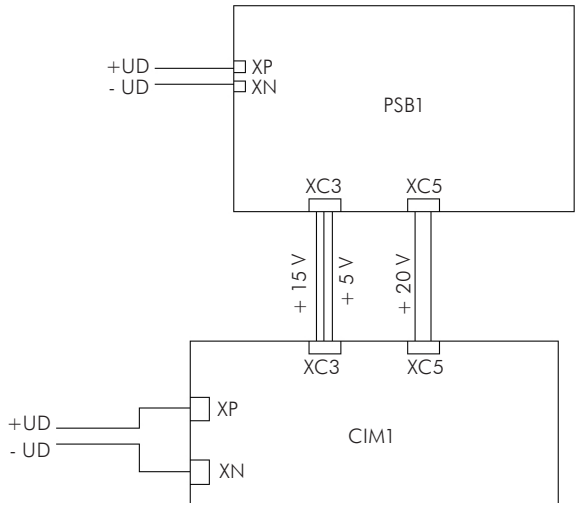


Figure 2.6 - *UP11: Connections between the CIM1 interface board and the PSB1 power supply board*

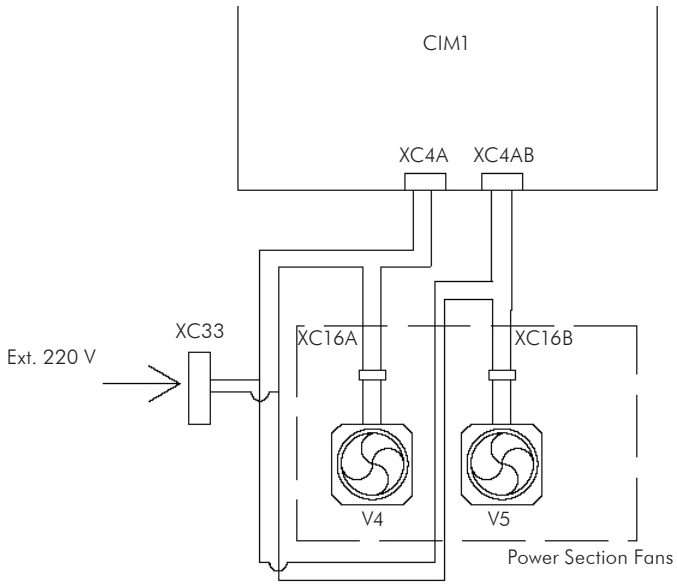


Figure 2.7 - *UP11: Connections between the CIM1 interface board and the fans*

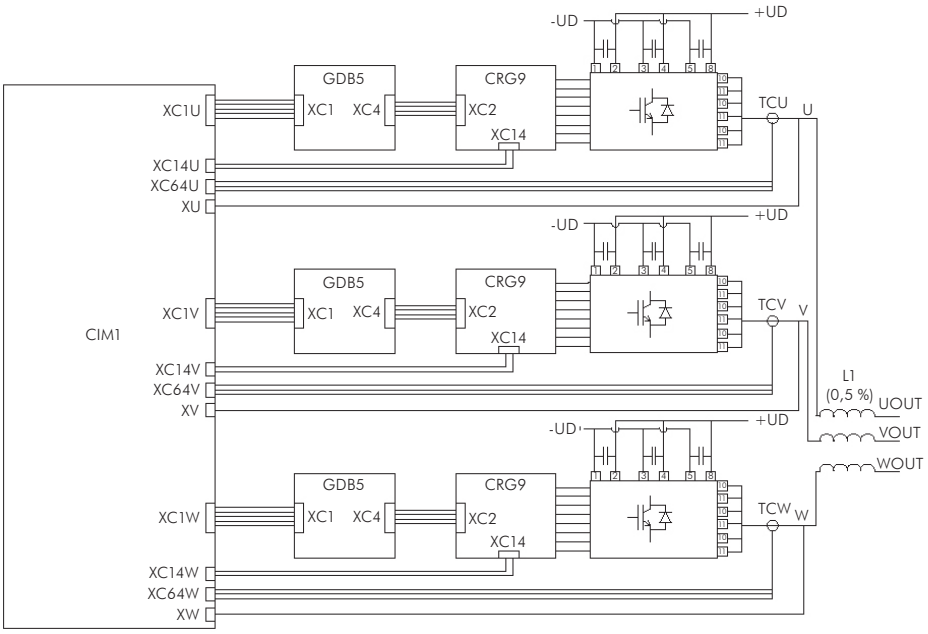


Figure 2.8 - *UP11: Connections between the CIM1 interface board, gate driver boards, modules and sensors for the output voltage and output current*

NOTE!
The synchronism connection diagram is presented at figure 3.46.

2.4 IDENTIFICATION LABELS FOR THE UC11

The UC11 identification label is located on the control rack.

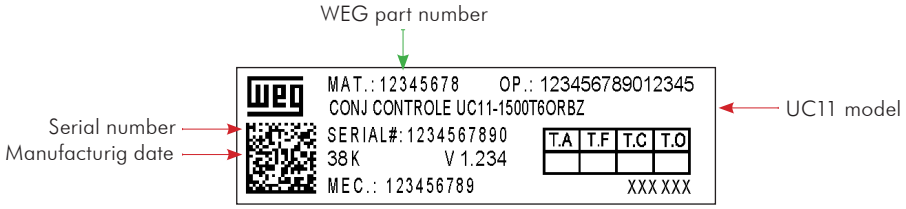


Figure 2.9 - *UC11 identification label*

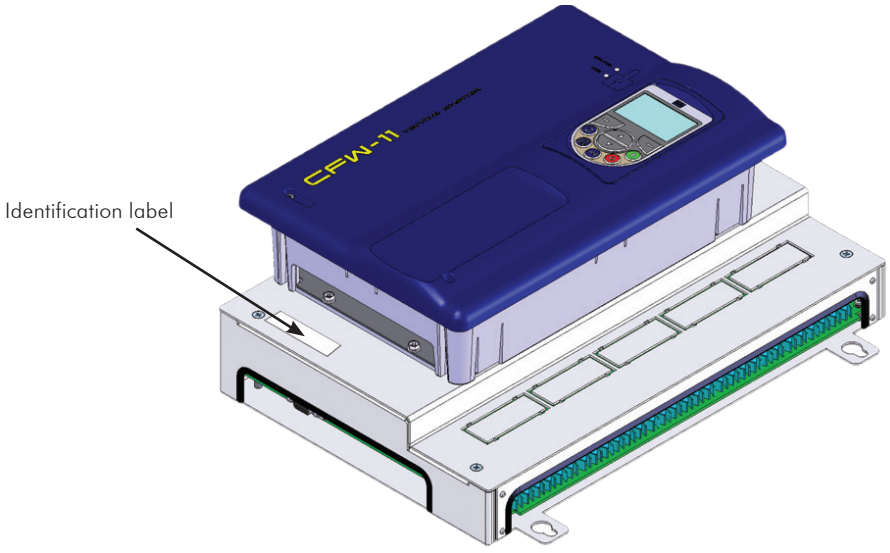


Figure 2.10 - *Location of the identification label*

2.5 IDENTIFICATION LABELS FOR THE UP11

There are two identification labels, one located at the converter front cover and another inside the UP11, close to the fans.

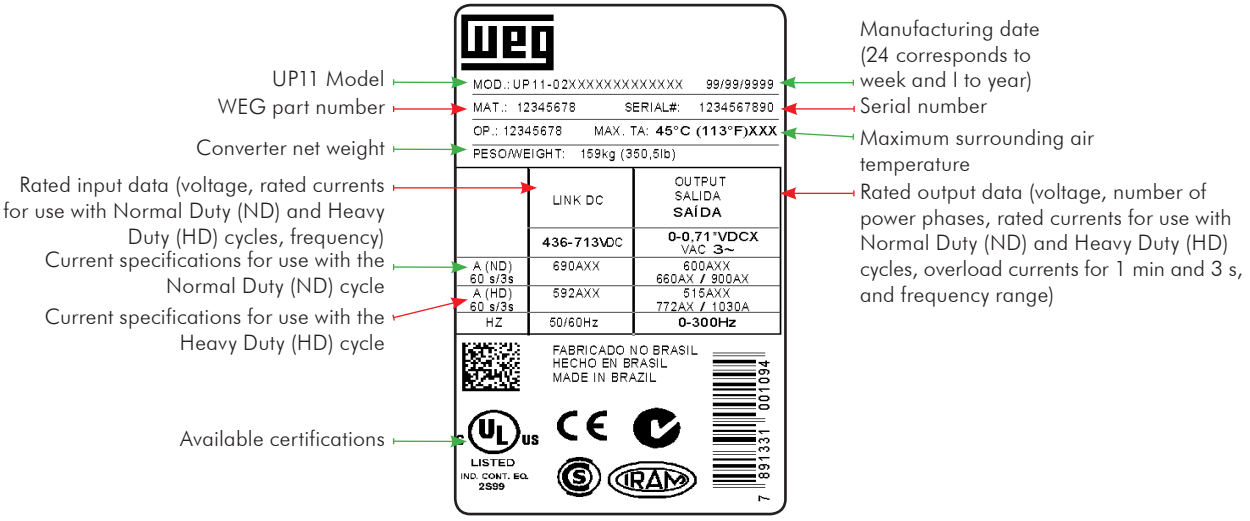


Figure 2.11 - *UP11 identification label*

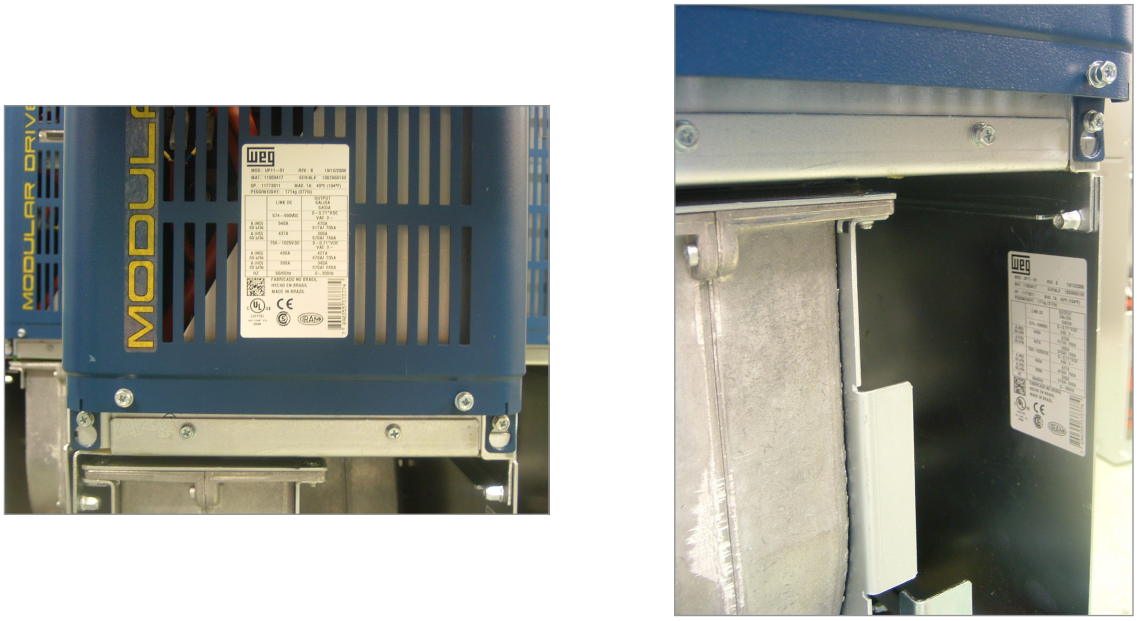


Figure 2.12 - *Location of the identification labels*

2.6 CFW-11M RB MODEL SPECIFICATION (SMART CODE)

In order to specify the CFW-11M RB it is necessary to, fill in the desired voltage and current values in the respective fields for the nominal supply voltage and the rated input current for normal duty (ND) cycle in the smart code according to the example of the table 2.1.

Table 2.1 - *Smart code*

		Converter Model					Available Option Kits			
		Refer to Chapter 8 for the CFW-11M RB list of models and for the complete technical specifications					Refer to the chapter 7 for more details on the options.			
Example	**BR**	**CFW11M**	**0470**	**T**	**5**	**O**	**RB**	**_ _**	**_ _**	**Z**
Field description	Market identification (defines the manual language and the factory settings)	WEG CFW-11M frequency converter series	Rated current for Normal Duty (ND) cycle	Number of output phases	Nominal voltage	Option kit	Braking	Special hardware	Special software	Character that identifies the end of the code
Available options	2 characters			**T** = three-phase	**4** = 380...480 V **5** = 500...600 V **6** = 660...690 V	**O** = product with option kit	**RB** = Regenerative Braking	Blank = standard **H1** = special hardware n°1	Blank = standard **S1** = special software n°1	

Ex.: CFW11M0470T5ORBZ corresponds to a CFW-11M RB regenerative braking converter, 470 A three-phase, with power supply voltage from 500 V to 600 V. An converter for 380 / 480 V would be specified as CFW11MXXXXT4ORBZ and for 660 / 690 V voltage it would be specified as CFW11MXXXXT6ORBZ (where XXXX is replaced by the converter current). The possible options for the converter nominal current in normal duty (ND) cycle are showed in the table 2.2, according to the rated input voltage.

Table 2.2 - *Nominal currents at normal duty cycle (ND)*

380 / 480 V	500 / 600 V	660 / 690 V
0600 = 600 A	0470 = 470 A	0427 = 427 A
1140 = 1140 A	0893 = 893 A	0811 = 811 A
1710 = 1710 A	1340 = 1340 A	1217 = 1217 A
2280 = 2280 A	1786 = 1786 A	1622 = 1622 A
2850 = 2850 A	2232 = 2232 A	2028 = 2028 A

2.7 RECEIVING AND STORAGE

The CFW-11M RB power units, as well as the control sets, are supplied packed in wooden boxes (refer to the figure 2.14).

Figure 2.13 - *Power unit packing*

There are identification labels outside these boxes, the same as the ones fixed on the respective products.

In order to open the box:

1. Put the control set box on a table with the help of two people; for the power units put the box on the floor.
2. Open the wood crate.
3. Remove all the packing material (the cardboard or styrofoam protection) before removing the converter.

Check the following items once the converter is delivered:

☑ Verify that the product identification label corresponds to the model number on your purchase order.

☑ Inspect the product for external damage during transportation.

In case of any damage, immediately report it to the carrier responsible for delivering your product.

If the products are not installed immediately, store them in a clean and dry place (temperature between -25 °C (-13 °F) and 60 °C (140 °F)) with a cover to prevent the contamination with dust.

ATTENTION!
Capacitor reforming is required if the converter or power units are stored for long periods of time without power. Refer to the procedures in item 6.5 - table 6.3.

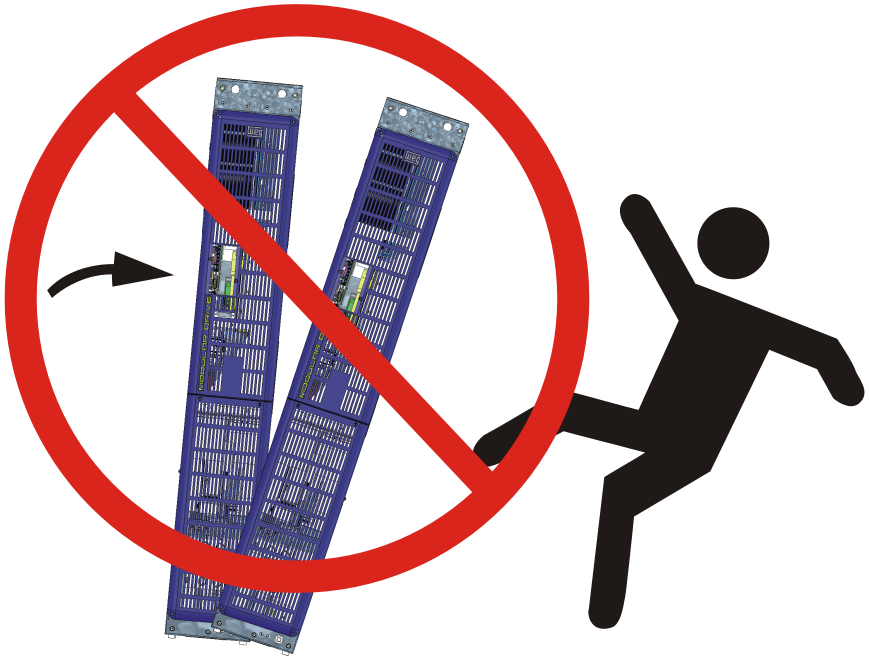
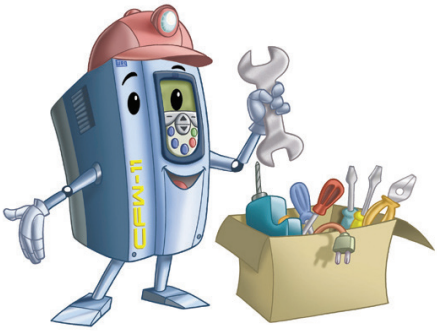


Figure 2.14 - *Do not tilt the power units*

3 INSTALLATION AND CONNECTION



This chapter provides information on installing and wiring the CFW-11M RB. The instructions and guidelines listed in this manual shall be followed to guarantee personnel and equipment safety, as well as the proper operation of the converter.

3.1 INSTALLATION ENVIRONMENT

Avoid installing the converter in an area with:

☑ Direct exposure to sunlight, rain, high humidity, or sea-air.

☑ Inflammable or corrosive gases or liquids.

☑ Excessive vibration.

☑ Dust, metallic particles, and oil mist.

Environment conditions for the proper operation of the converter:

☑ Temperature:
Models CFW11M...T4:
-10 °C to 45 °C (14 °F to 113 °F) - nominal conditions (measured around the converter).
From 45 °C to 55 °C (113 °F to 131 °F) - 2 % current reduction for every Celsius degree (or 1.11 % each °F) above 45 °C (113 °F).
Models CFW11M...T5 and CFW11M...T6:
-10 °C to 40 °C (14 °F to 104 °F) - nominal conditions (measured around the converter).
From 40 °C to 55 °C (104 °F to 131 °F) - 2 % current reduction for every Celsius degree (or 1.11 % each °F) above 40 °C (104 °F).

☑ Humidity: from 5 % to 90 % non-condensing.

☑ Altitude: up to 1000 m (3.300 ft) - standard conditions (no derating required).

☑ From 1000 m to 4000 m (3.300 ft to 13.200 ft) - 1 % of current derating for each 100 m (or 0.3 % each 100 ft) above 1000 m (3.300 ft) altitude.

☑ From 2000 m to 4000 m (6.600 ft to 13.200) - 1.1 % of maximum voltage derating for each 100 m (or 0.33 % each 100 ft) above 2000 m (6.600 ft) up to 4000 m (13.200 ft) maximum altitude.

☑ Pollution degree: 2 (according to EN50178 and UL508C) with non-conductive pollution. Condensation shall not originate conduction through the accumulated residues.

3.2 LIST OF COMPONENTS

The panel mounting kit is composed by the control set and by UP11 power units, whose number varies according to the current. The control set contains the UC11 control unit, the necessary cable sets for the connections between the IPS1 and the power units, and the flat cable that connects the IPS1 board to the CC11 RB control board.

Table 3.1 - *Currents and configuration in 380 / 480 V*

Nominal Current (A)		Number of Power Units UP11-02
ND	HD	
600	515	1
1140	979	2
1710	1468	3
2280	1957	4
2850	2446	5

Table 3.2 - *Currents and configuration in 500 / 600 V*

Nominal Current (A)		Number of Power Units UP11-01
ND	HD	
470	380	1
893	722	2
1340	1083	3
1786	1444	4
2232	1805	5

Table 3.3 - *Currents and configuration in 660 / 690 V*

Nominal Current (A)		Number of Power Units UP11-01
ND	HD	
427	340	1
811	646	2
1217	969	3
1622	1292	4
2028	1615	5

Each cable set contains one optical fiber and one DB-25 cable. Both cables are for the connections between the IPS1 board (control unit) and the CIM1 board (power unit).

Table 3.4 - *Cable sets*

Weg Part Number	Optical Fiber Length mm (in)	DB-25 Cable Length mm (in)
10411757	2350 (92.52)	2550 (100.39)
10509891	2800 (110.24)	3000 (118.11)
10411758	3400 (133.86)	3600 (141.73)
10411759	3900 (153.54)	4100 (161.42)

The cable sets that come with the control sets are described in the table 3.5.

Table 3.5 - *Number of cable sets*

Number of Power Units	Number of Cable Sets
1	1X 10411757
2	2X 10411757
3	2X 10411757 1X 10509891
4	2X 10411757 1X 10509891 1X 10411758
5	2X 10411757 1X 10509891 1X 10411758 1X 10411759

The panel integrator is responsible for the other components of the panel, such as, the power bus bars, the pre-charge circuit, the panel fans, the protection fuses, input filter, etc.

3.3 MECHANICAL INSTALLATION

The power units must be properly secured in the drive cabinet, making it possible the easy withdrawal and reinsertion in case of maintenance. The fastening must also be done so that it prevents panel transportation damage.

The "Panel Mounting Rack" accessory simplifies the mounting of the power units and allows their simple fastening and movement. Refer to the section 7.1 for more details.

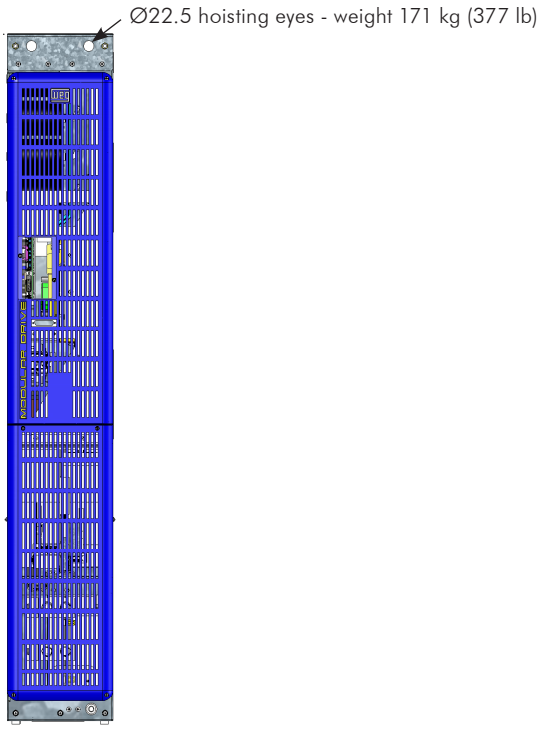


Figure 3.1 - *UP11: hoisting eyes*

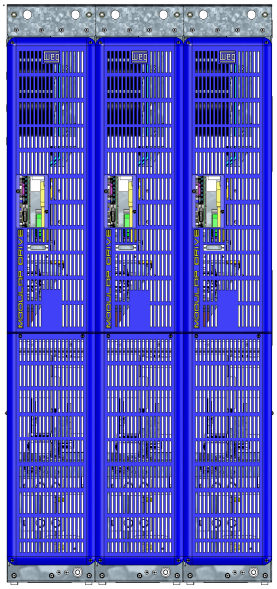
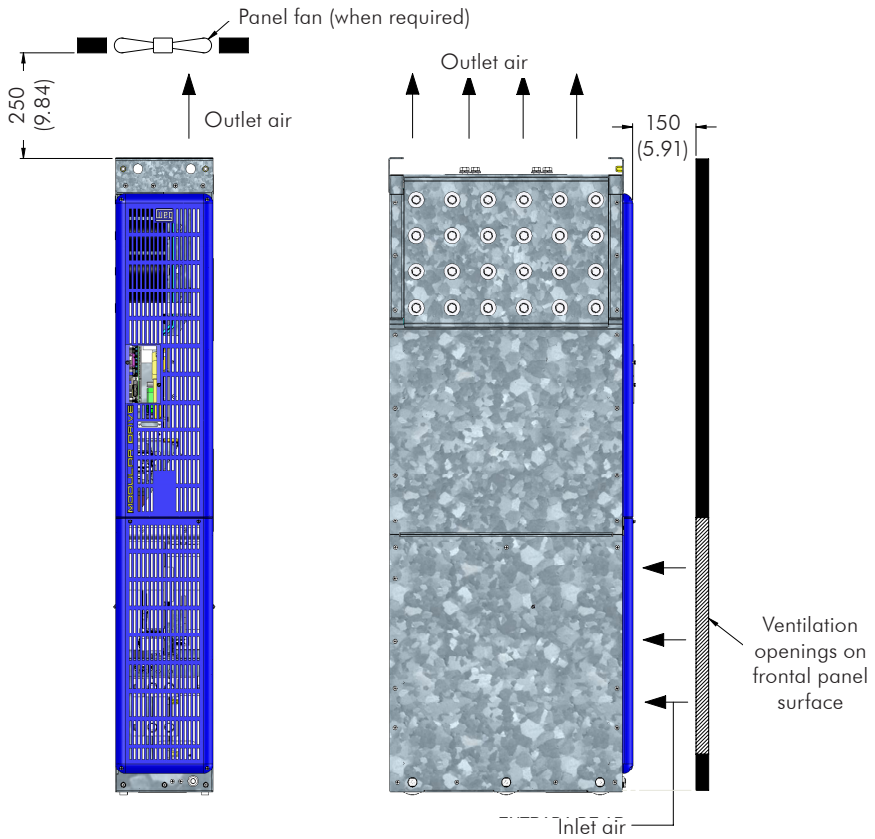


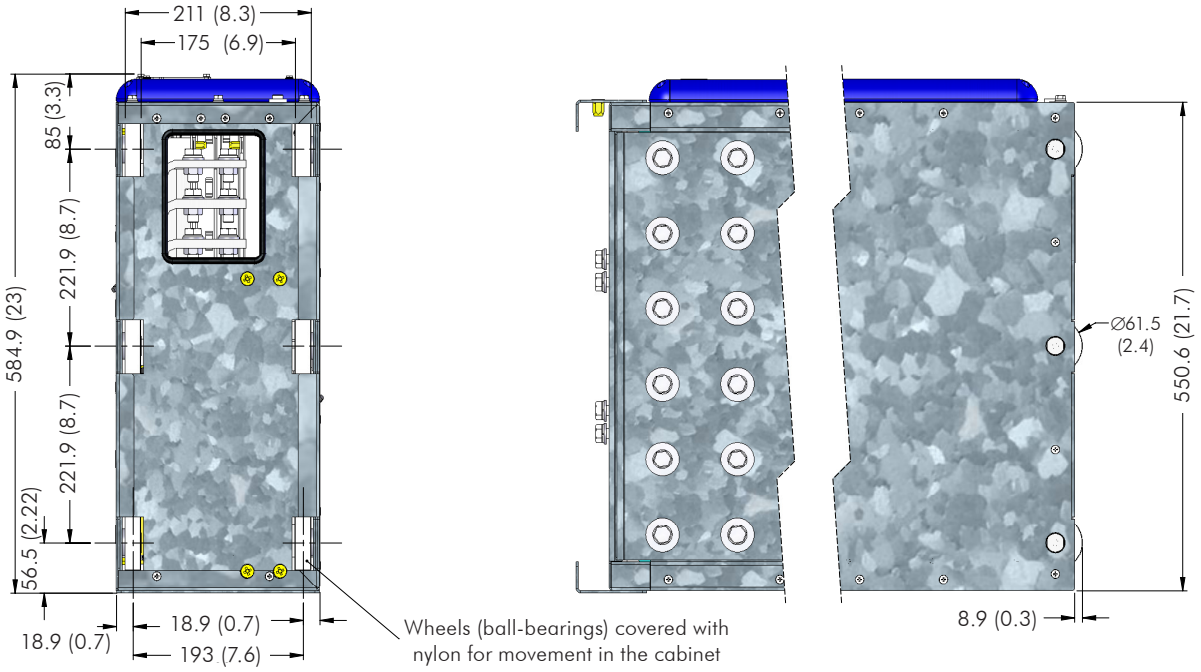
Figure 3.2 - *Mounting of the UP11 side by side without lateral spacing*



Note: dimensions in mm (in).

Figure 3.3 - *Clearance requirements for air circulation*

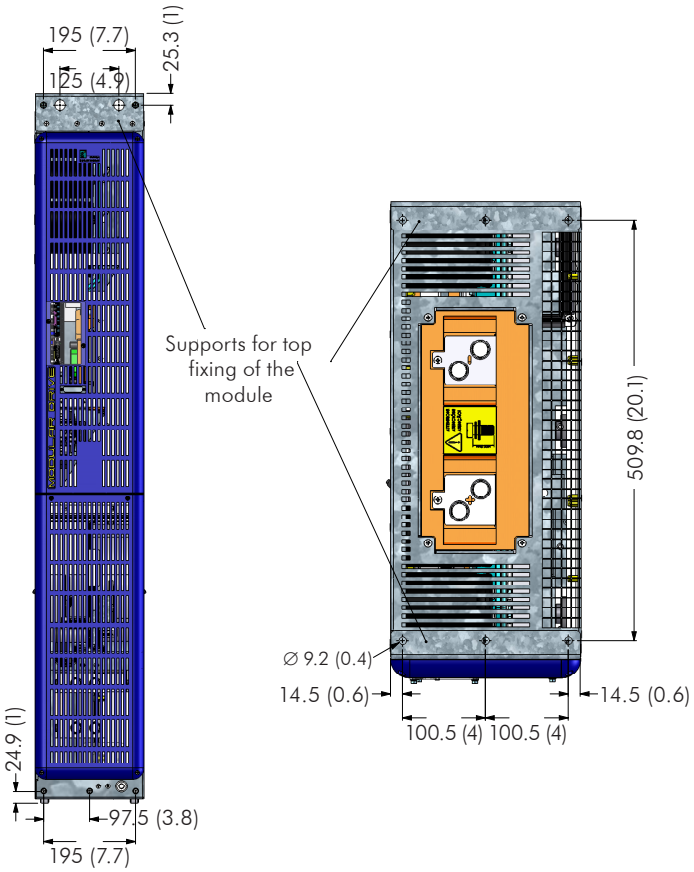
The UP11 wheels facilitate its insertion into and withdrawal from the panel (figure 3.4).



Note: dimensions in mm (in).

Figure 3.4 - *UP11: bottom view*

Figure 3.5 - *Fixing holes of the power unit*



Note: dimensions in mm (in).

Figure 3.6 - *Supports for top fixing*

Mounting of the UC11 at the panel door: Control rack with flange mounting and IPS1 module mounted inside the panel door. The control rack is secured with four M3 screws (recommended tightening torque: 0.5 N.m).

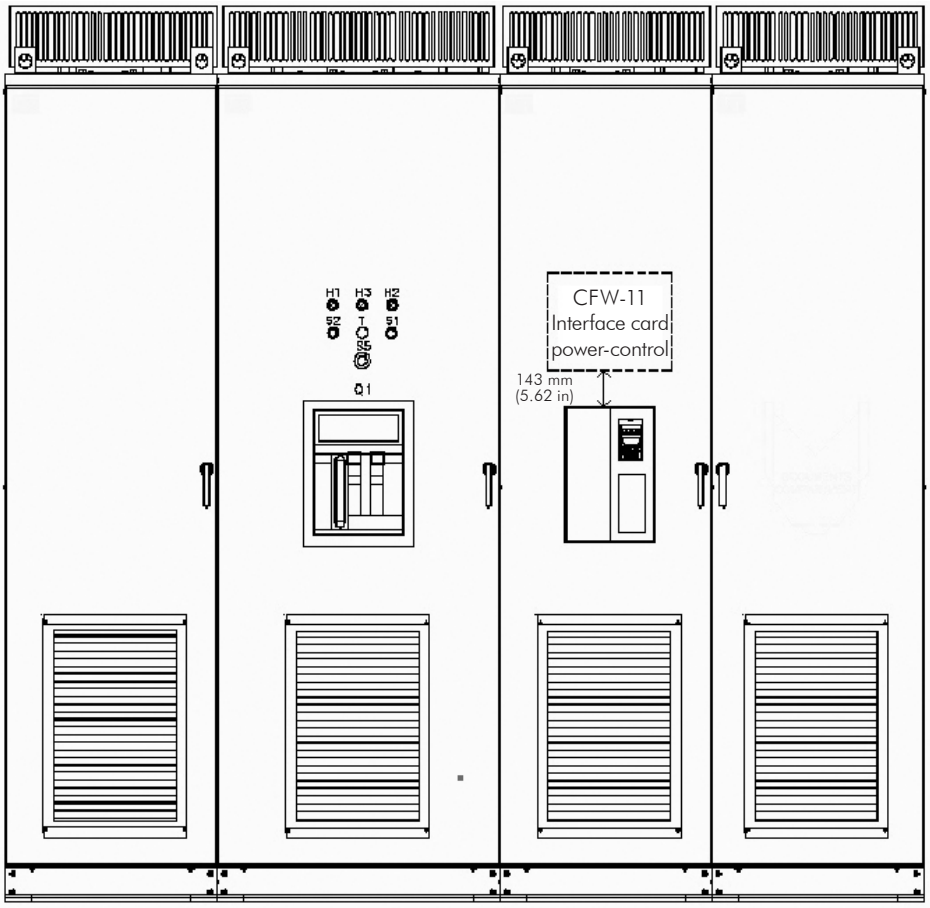
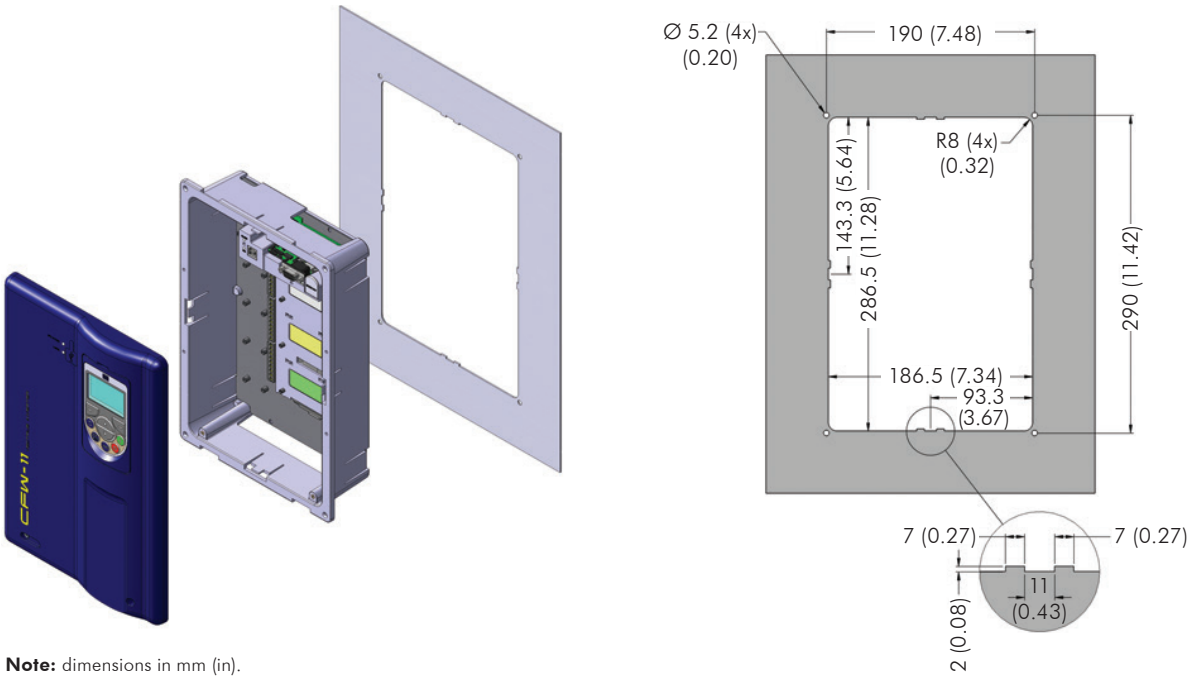


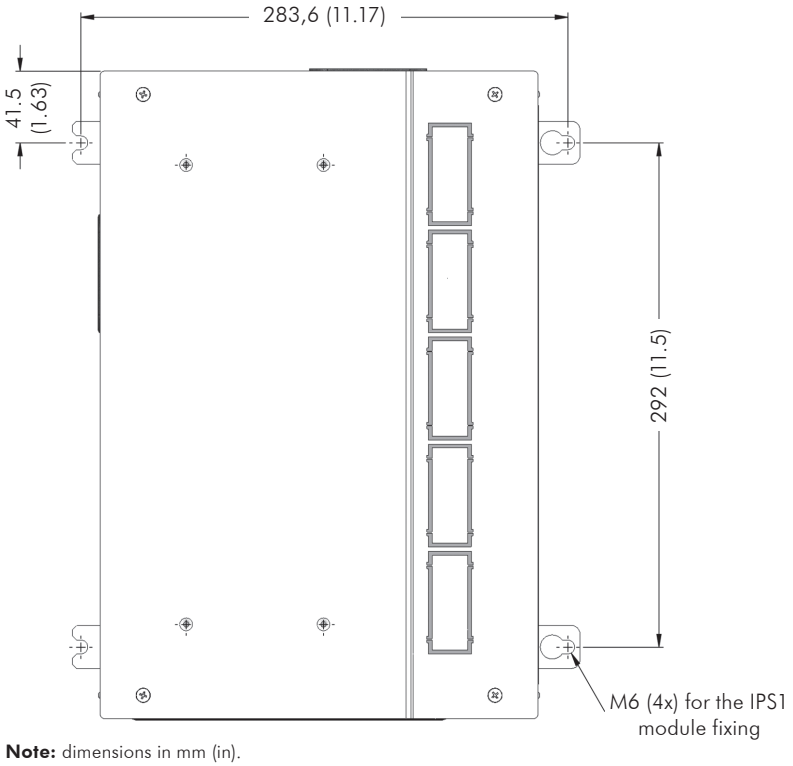
Figure 3.7 - *Example of the mounting of the control rack and its base*

Figure 3.8 - *Final mounting aspect*



Note: dimensions in mm (in).

Figure 3.9 - *Control rack fixing and the necessary cuts*



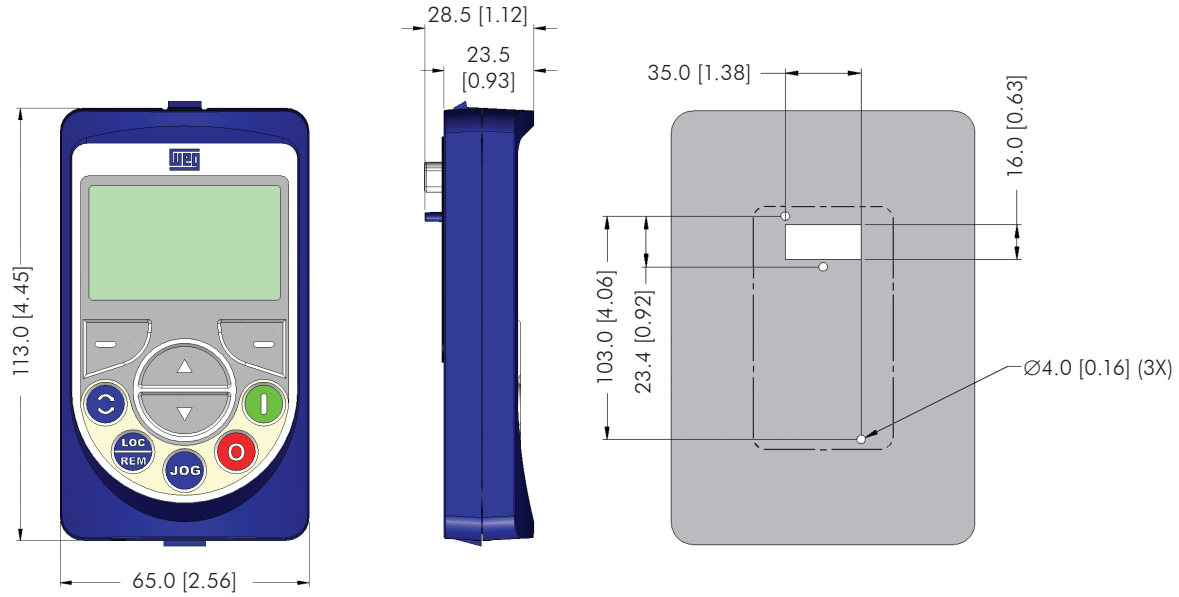
Note: dimensions in mm (in).

Figure 3.10 - *IPS1 module base fixing*

The IPS1 module base is fixed with four M6 bolts (recommended tightening torque: 8.5 N.m).

The power unit total air outflow is 1150 m^3/h (320 l/s; 677 CFM). It is recommended an outflow of 1350 m^3/h (375 l/s; 795 CFM) per power unit at the air exhaustion.

3.3.1 Keypad Installation at the Cabinet Door or Command Panel (Remote keypad)



Note: dimensions in mm [in].

Figure 3.11 - *Data for the HMI installation at the cabinet door or command panel*

The keypad frame accessory can also be used to fix the HMI as mentioned in the table 7.1.

3.4 ELECTRICAL INSTALLATION

DANGER!
The following information is merely a guide for proper installation. Comply with applicable local regulations for electrical installations.

DANGER!
Make sure the AC power supply is disconnected before starting the installation.

ATTENTION!
The CFW-11M RB can be connected in circuits with symmetrical short circuit capability up to 150000 Arms (480 V/690 V maximum).

ATTENTION!
Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with applicable local standards.

3.4.1 Pre-charge Circuit

The resistors of the pre-charge circuit must be sized according to the following criteria:
- Maximum voltage.
- Maximum energy.
- Power overload capacity of the resistors during the pre-charge period (energy dissipation capacity).

The characteristics of the resistors must be obtained with their manufacturer.

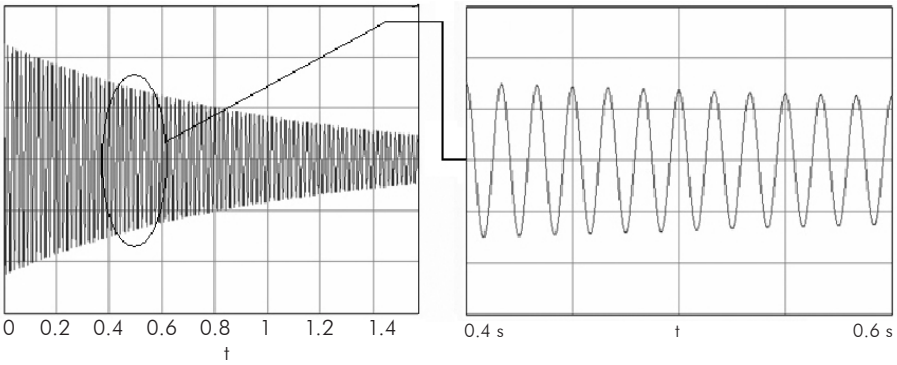


Figure 3.12 - *Current during the pre-charge*

Table 3.6 - *Sizing of the pre-charge*

Peak current during the pre-charge (A)		0,82·(Vline/R)
Energy stored in the capacitor bank (J)	400 V line	N·0.04·Vline²
	600 V line	N·0.02 Vline²
Pre-charge duration (s)	400 V line	0.09·N·R
	600 V line	0.04·N·R

Where R is the ohmic value of the resistor used for each phase and N is the number of power units.

NOTE!

☑ N corresponds to the total number of power units: the CFW11M RB power units plus the output CFW11M power units which are fed by the CFW11M RB.

☑ In case the CFW11M RB is feeding other converter, WEG must be consulted.

E.g.:

The following values are obtained with an converter composed by three power units at the CFW11M RB input and three power units at the CFW11M output, where the input line voltage is 380 Vrms (400 Vline):

- N = 6.
- Energy stored in the capacitor bank: $6 \cdot 0.04 \cdot (380)^2 = 34656$ J.
- By using three 20 Ω resistors (one per phase), each resistor must withstand 11552 J.
- The resistor manufacturer should be able to inform the power supported by the component.
- The peak current during the pre-charge would be 15,5 A and the pre-charge duration would be of 10.8 s.

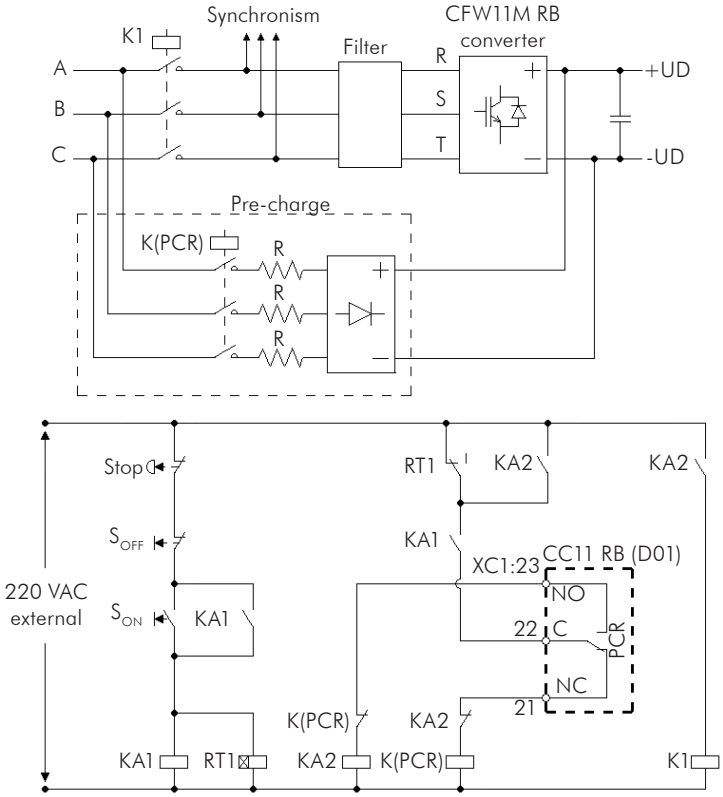


Figure 3.13 - *Pre-charge circuit example*

A contactor or a motorized circuit breaker can be installed at the input of the CFW11RB (represented by K1) and its command must be interlocked with the pre-charge contactor K(PCR) command. Figure 3.13 presents an example of the recommended pre-charge circuit for the CFW-11M RB converter with simplified power and command diagrams. There is already a relay (D01) configured as "Pre-charge OK" function in the CC11 RB board (refer to table 3.6). This relay must be used to command the pre-charge contactor and the main contactor (motorized circuit breaker). Furthermore, the pre-charge timing must be set for the protection of the auxiliary circuit (resistors, rectifier bridge). This function is carried out by a timer relay with a normally-closed on-delay contact, represented as RT1 in the figure 3.13

3.4.2 Bus Bars

The panel bus bars must be sized according to the input and output current of the converter. It is recommend the use of copper bars. In case that aluminum bars have to be used, it is necessary to clean the contacts and to apply an antioxidant compound. If the compound is not used, any copper-aluminum junction will suffer an accelerated oxidation.

3.4.3 DC Link Fuses

It is recommended the use of fuses suitable for operation with direct current at the UP11 DC output. The maximum bus voltage (IGBT overvoltage trip level) is 800 Vdc for the 400 V converter line and 1200 Vdc for the other converter lines. The fuses used in AC lines can be used; however, a derating in the AC voltage must be applied. Consult the fuse manufacturer in order to obtain the derating factor.

Fuse examples:
- 400 V line: 12,5URD73TTF900 (FERRAZ)
- Other lines: 12,5URD73TTF630 (FERRAZ)

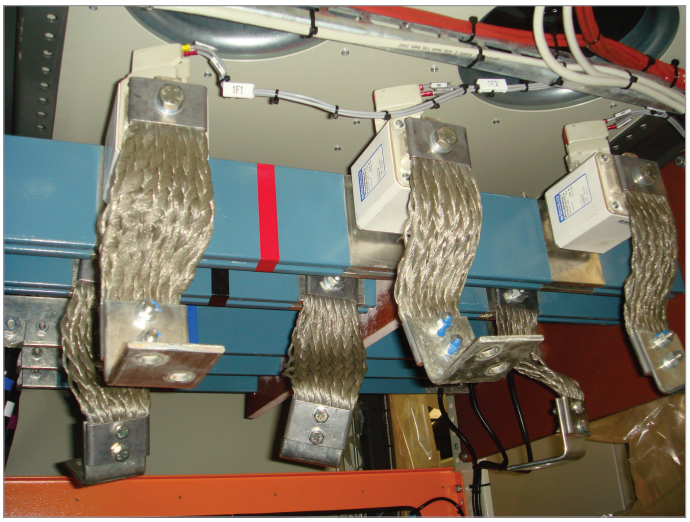


Figure 3.14 - *DC link fuses*

NOTE!
In order to increase the protection, it is possible to use fuses sized to protect and withstand the AC current of each regenerative converter power unit. Table 3.4 presents the values used by WEG.

Table 3.7 - *Rated current of the fuses according to the CFW-11M RB model*

Rated Voltage	ND Current	Fuse
380 / 480 V	600 A	900 A
500 / 600 V	470 A	700 A
660 / 690 V	427 A	700 A

Fuse examples:
- 400 V line: 6.9URD33TTF0900 (FERRAZ)
- Other lines: 6.9URD33TTF0700 (FERRAZ)

3.4.4 General Connection Diagram and Layout

Figure 3.15 presents a general diagram for a converter with five power units (UP11) composed by:

☑ Connections between Control Unit UC11 and the UPs (DB25 XC40 connectors and optical fibers).

☑ Power connections of the UPs (+UD, -UD, R, S and T, GND).

☑ Auxiliary power supply connections of the fans (220 V) and the UC11 (24 Vdc).

For a reduced number of UP11's, connect them in crescent order (A, B, C, etc.), leaving the last positions without connections.

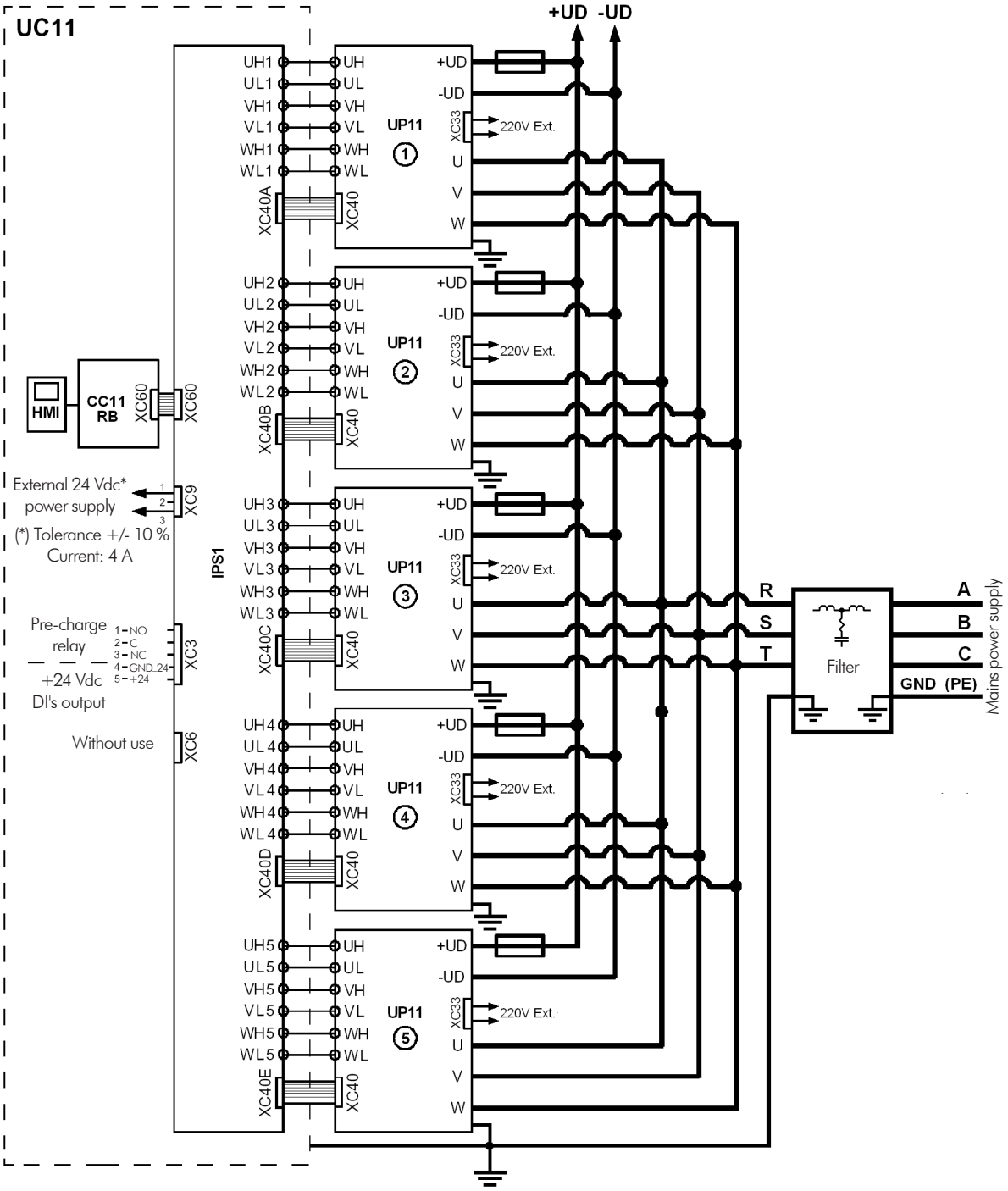


Figure 3.15 - *General diagram*

The electrical power connections of the panel must assure equal impedance at the DC bus and input connections. Refer to the example in the figure 3.16 and to the lateral section views in figures 3.17, 3.18 and 3.20. At the output (DC Bus) and the filter input busbars, the dimensions identified as A,B,C and D must be approximately equal to the dimensions A', B',C' and D', respectively, as exemplified in the figure 3.16.

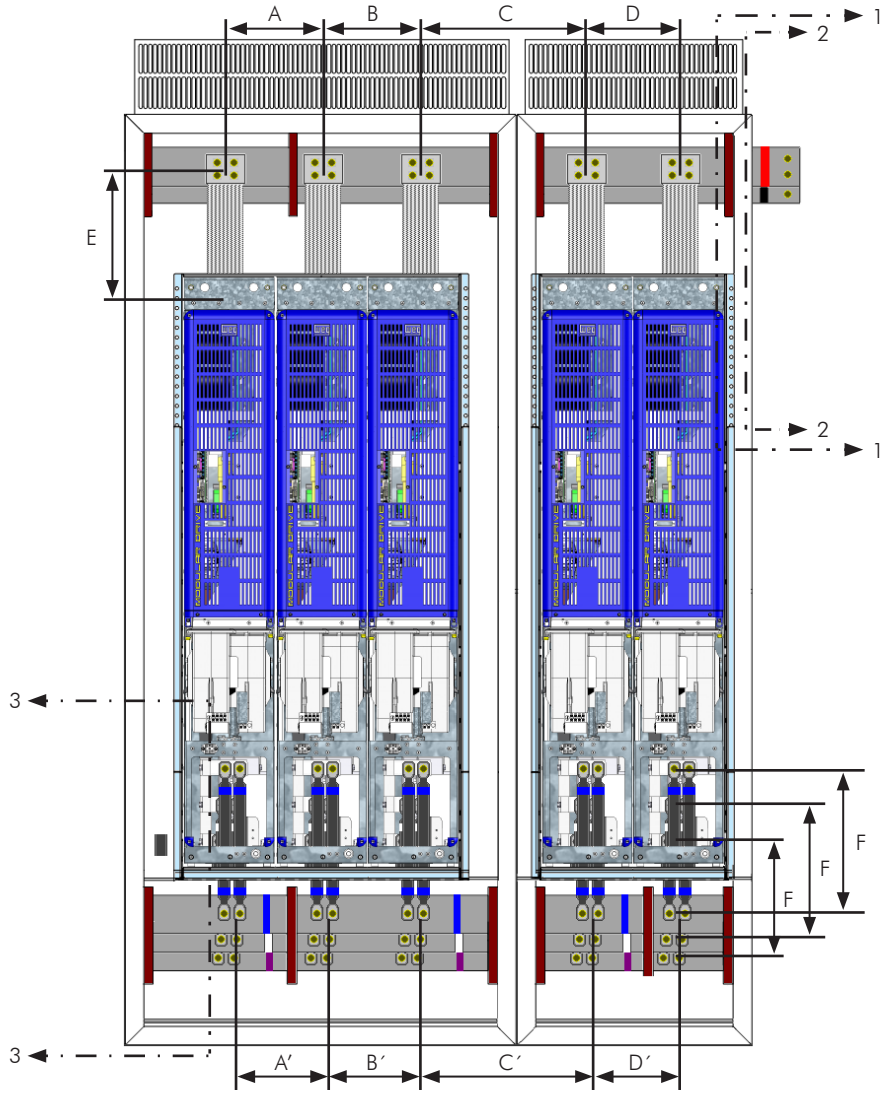


Figure 3.16 - *Symmetry details of the panel constructive layout*

The interconnection between the DC bus and each UP11 can be done with flat braided cables according to the figure 3.17. The flat braided cables are sized to withstand the DC bus current, presented at table 8.1. The figure 3.19 presents an example of flat braided cable used by WEG, using a fuse at +UD. Alternatively, fuses at both connections (+UD and –UD) can be used.

NOTE!
It is important that all the flat braided cables present the same length (defined by the dimension "E") that will depend on the panel construction, and that all the fuses mounted on the DC bus are identical and mounted on the same busbar (+UD or –UD) in all the UP11's when only one fuse per UP11 is used (in order to get more details refer to the section 3.4.3).

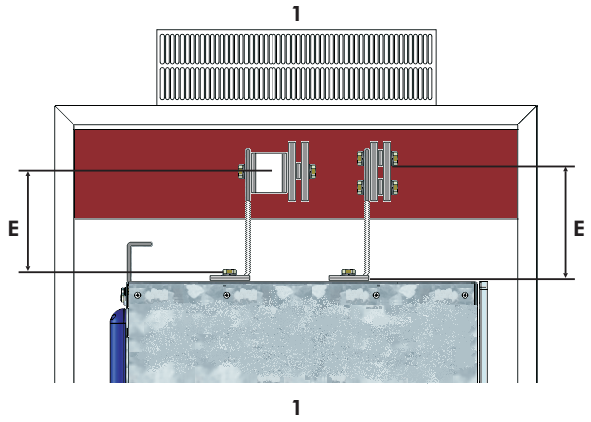


Figure 3.17 - *Lateral section view: detail of the flat braided cables and fuse connections*

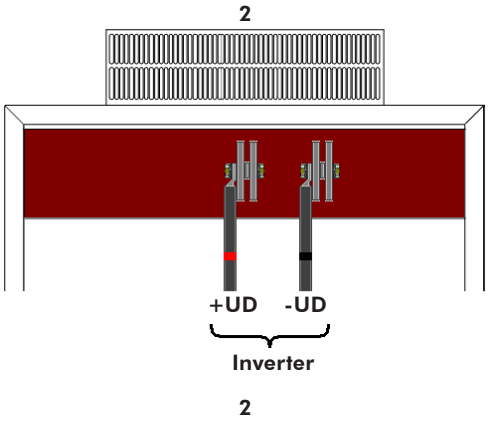
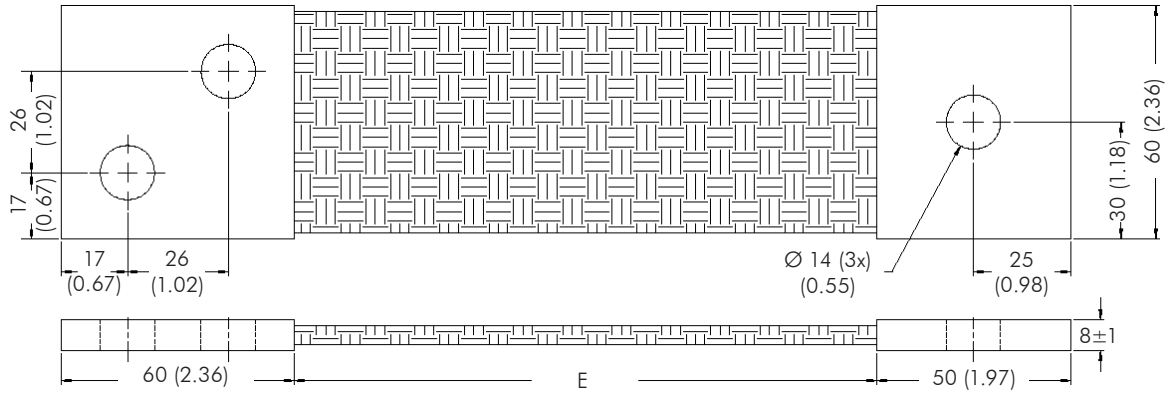


Figure 3.18 - *Lateral section view: detail of the DC bus connections*



Braided wire gauge: AWG-40 (0.08 mm)

Note: dimensions in mm (in).

Figure 3.19 - *Example of flat braided cable*

Besides the panel constructive form, some precautions must be taken regarding the connection of the input cables from the input filter in order to assure equal impedances among the UPs connected in parallel. Figures 3.18 and 3.20 present details in lateral section views of the DC bus (+UD and –UD) output connections and the input filter connections (R, S, T and GND).

NOTE!

The length of the cables that connect each of the Power Units to the input busbars, represented by the "F" dimension on the figure 3.20, must be the same for all the phases (R, S and T). Refer to the table 3.8 for more details on the cables.

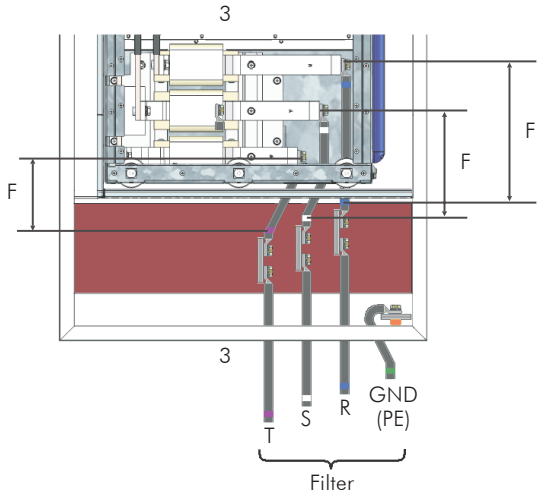


Figure 3.20 - *Lateral section view: Detail of the input to the filter connections*

The figure 3.21 presents the adequate installation layout for five Power Units.

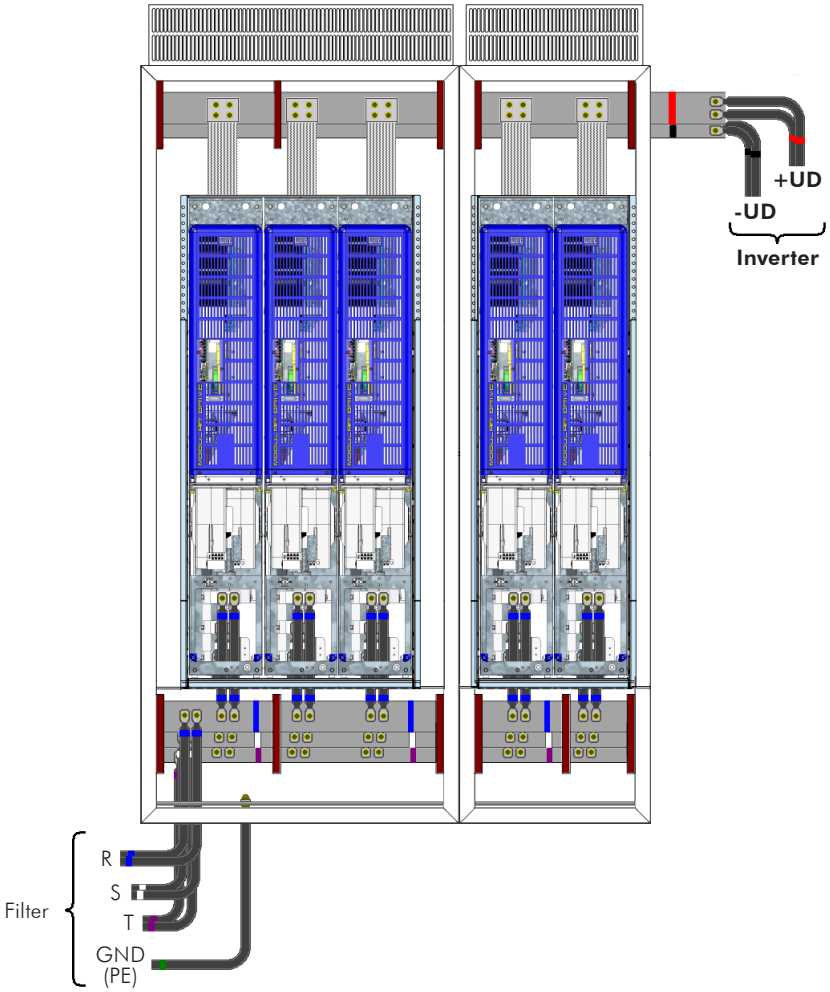


Figure 3.21 - *Example of adequate installation layout for 5 UP11*

NOTE!

The connection of the input cables from the filter at points different from the presented in the figure 3.21 (figures 3.22 and 3.23 present some inadequate connection forms) does not assure the impedance balance between the UPs connected in parallel, being able to cause current imbalance among the UPs.

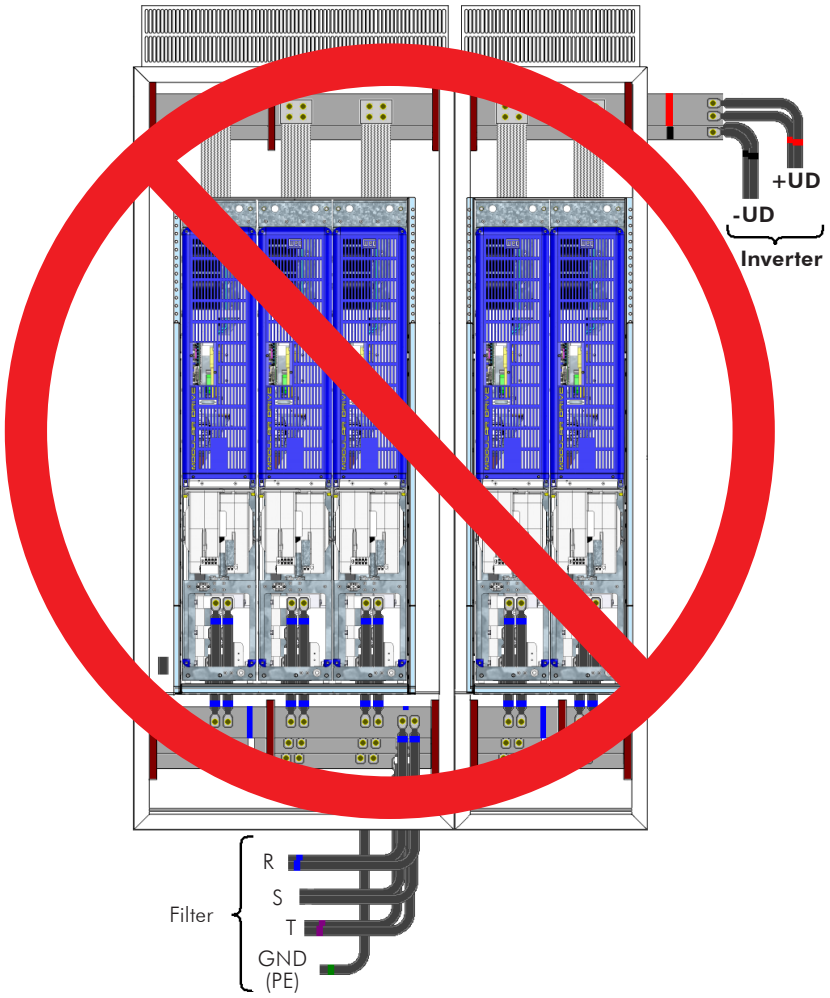


Figure 3.22 - *Example of inadequate installation layout for 5 UP11*

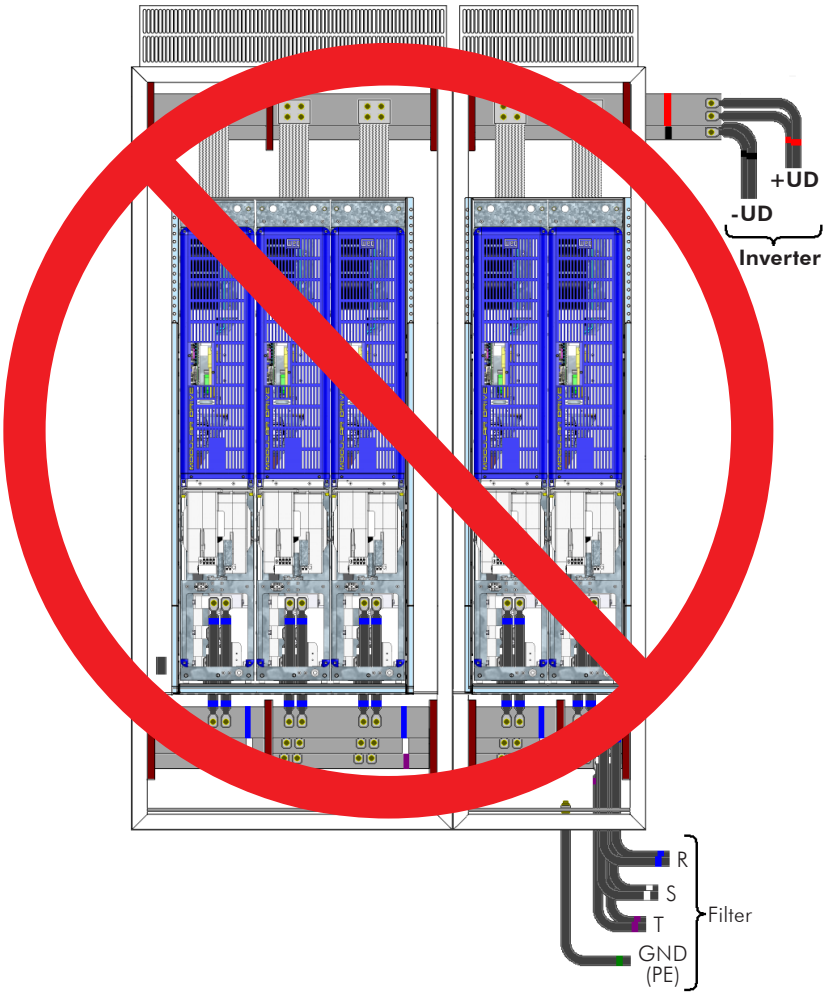


Figure 3.23 - *Example of inadequate installation layout for 5 UP11*

The figure 3.24 presents the adequate installation layout for three Power Units.

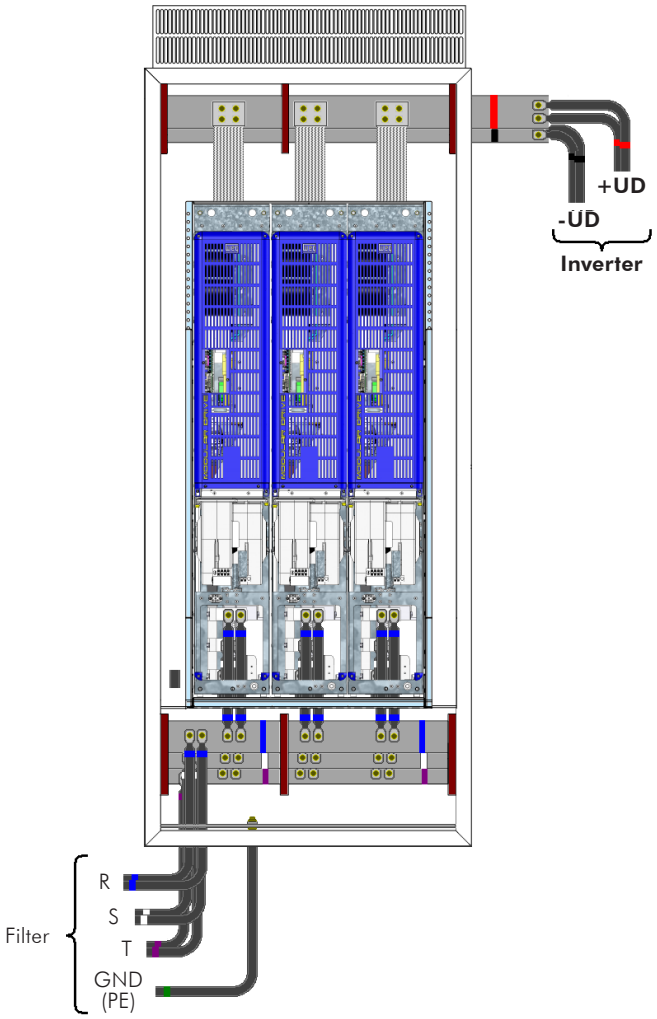


Figure 3.24 - *Example of adequate installation layout for 3 UP11*

NOTE!

The connection of the motor cables from the filter at points different from the presented in the figure 3.24 (the figure 3.25 presents an inadequate connection form) does not assure the impedance balance between the UPs connected in parallel, being able to cause current imbalance among the UPs.

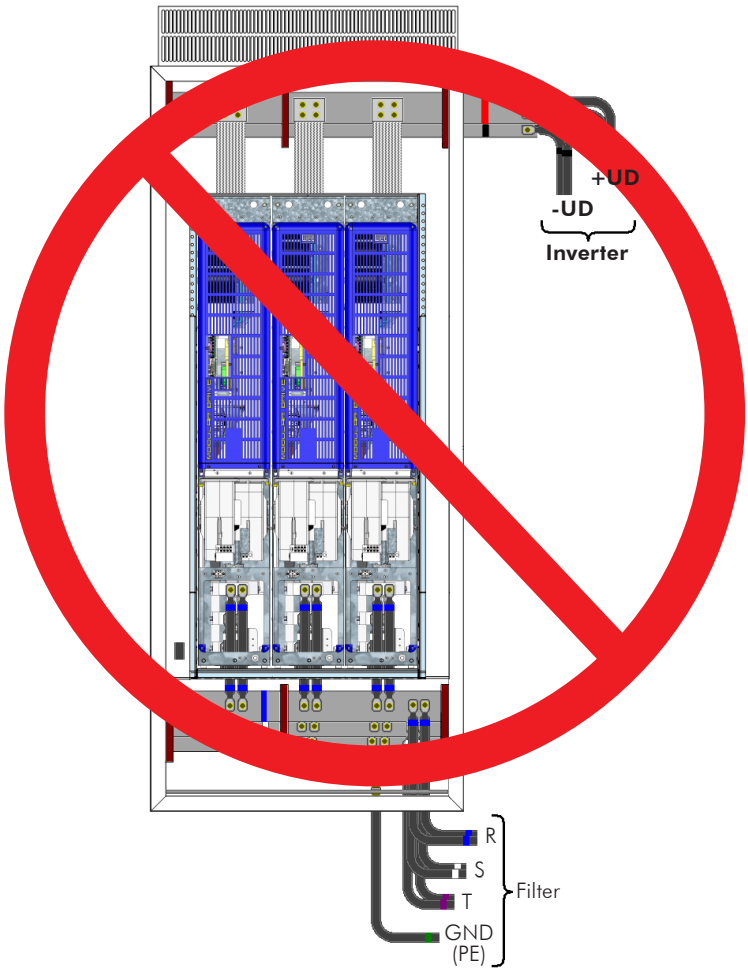
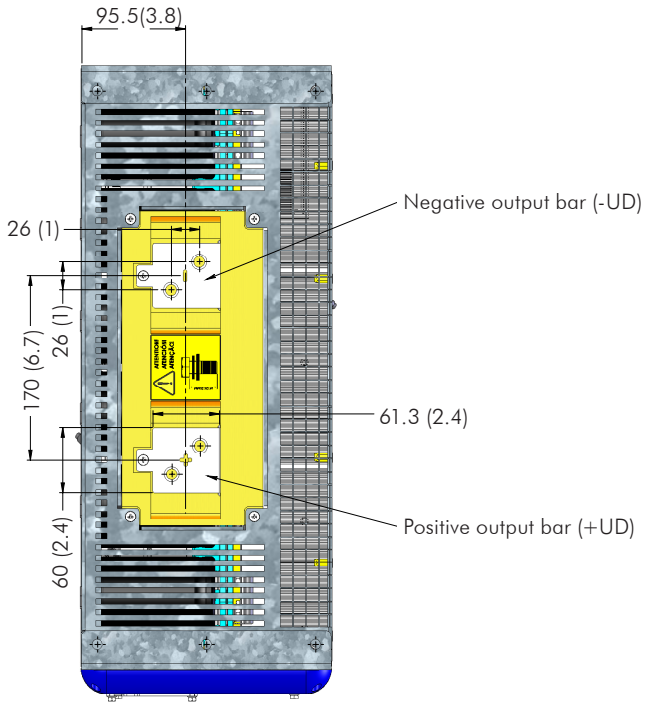


Figure 3.25 - *Example of inadequate installation layout for 3 UP11*

3.4.5 UP11 Connections

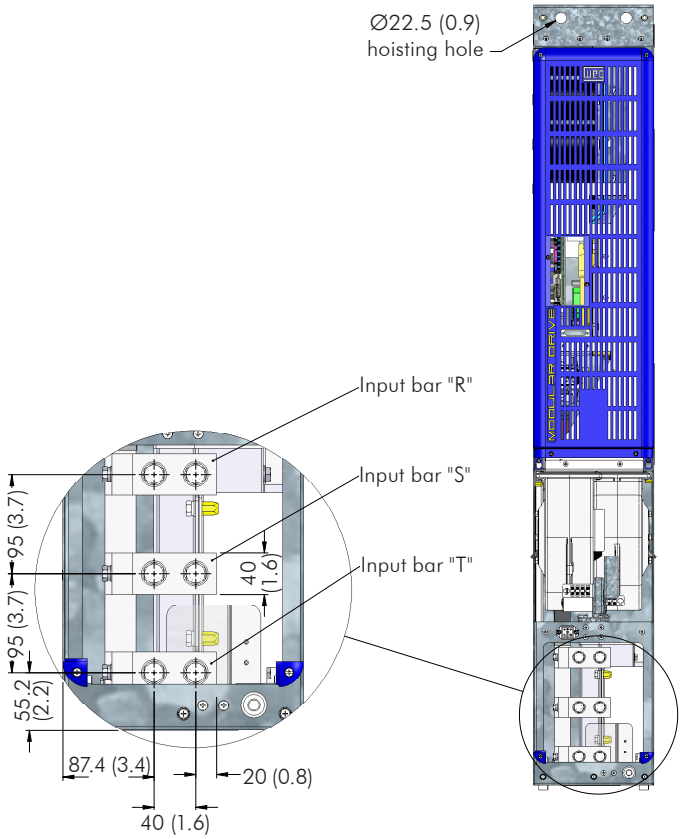
The fastening of the UP11 output connections is done by means of four M12 x 25 bolts (tightening torque: 60 Nm), refer to figure 3.26.



Note: dimensions in mm (in).

Figure 3.26 - *UP11 output bus bars: output DC connections*

The input connections at the internal reactance are done by means of six M12 x 30 bolts (tightening torque: 60 Nm), 2 bolts per phase. The bus bars are of 40 x 10 mm (1.57 x 0.39 in) and the fastening is done through M12 nuts inserted into the bar. Refer to the figure 3.27.



Note: dimensions in mm (in).

Figure 3.27 - *UP11 input bus bars: input connections*

Use two cables in parallel with the recommended gauge indicated in the table 3.7 for connecting the UP11 input reactor to the input busbar.

Table 3.8 - *Input cables*

Current (A)	Voltage (V)	Regimen	Minimum Cable Cross-Section Area (mm²)
600	380 / 480	ND	(2X) 240
515		HD	(2X) 185
470	500 / 600	ND	(2x) 150
418		HD	(2X) 120
427	660 / 690	ND	(2X) 120
340		HD	(2X) 70

The bolt used to connect the UP11 grounding cable is the M12 x 30 (tightening torque: 60 Nm). Refer to the figure 3.28.

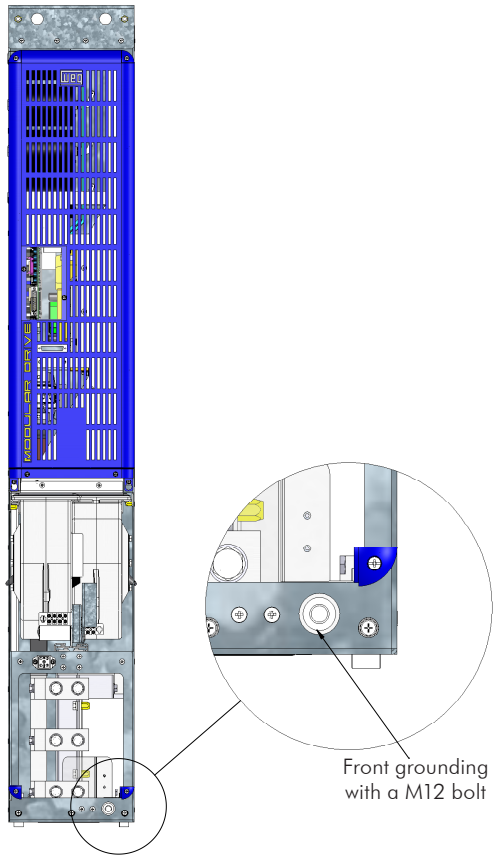


Figure 3.28 - *UP11 ground connection point*

Use cables with the recommended gauge indicated in the table 3.8 for grounding the UP11 power units.

Table 3.9 - *Grounding cables*

Current (A)	Voltage (V)	Regimen	Minimum Cable Cross-Section Area (mm²)
600	380 / 480	ND	240
515		HD	185
470	500 / 600	ND	150
418		HD	120
427	660 / 690	ND	120
340		HD	70

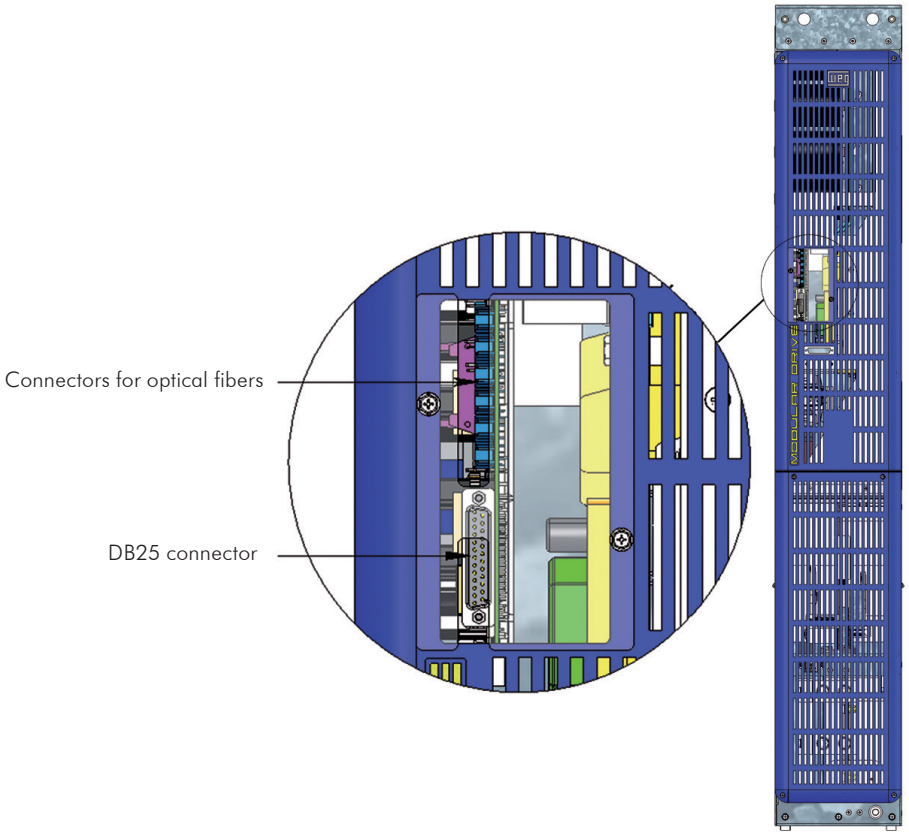


Figure 3.29 - *Connection points for the control cables on the UP11*

Keep the optic fiber bending radius bigger or equal to 35 mm (1.38 in). If the control is mounted on the panel door, let a curvature that causes a minimum stress on the optic fiber cables when the door is opened or closed.

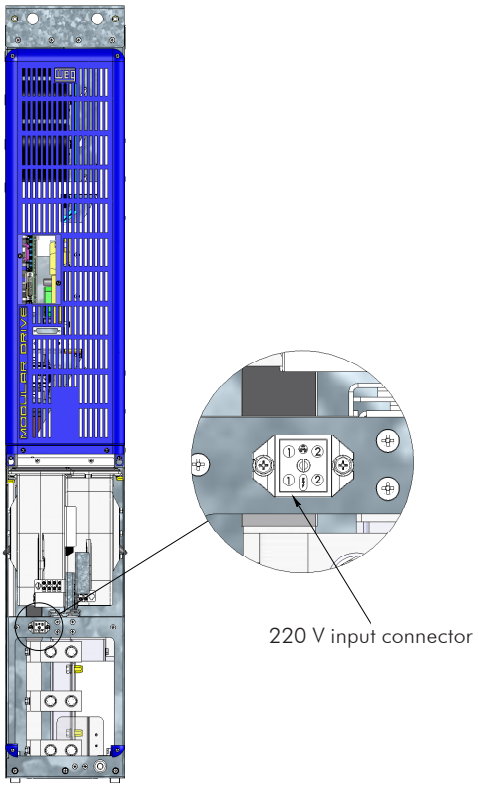
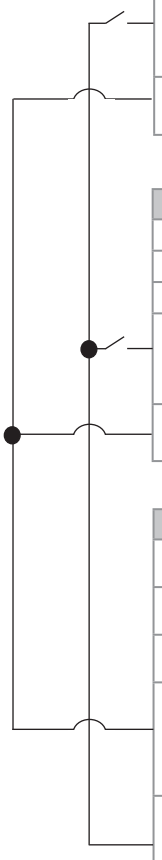


Figure 3.30 - *Fan supply terminals: 220 V/4 A*

3.4.6 UC11 Connections

The DIM1 and DIM2 digital inputs located on the IPS1 board (Figure 3.32 and 3.34) monitor F408 and F410 faults. They are CLOSED when running in normal operation and they are OPEN when the converter is under any fault condition.

- The DIM1 digital input is connected at XC1:4 and XC1:5 (common).
- The DIM2 digital input is connected at XC2:4 and XC2:5 (common).



XC1		Factory Default Function	Specifications
1	No Function	-	-
2	No Function	-	-
3	DGND	DGND Reference.	Grounded via the IPS board shield.
4	DIM1	Isolated digital input DIM1, programmable at P0832. Refer to the programming manual.	High level ≥ 18 V. Low level ≤ 3 V. Maximum input voltage: 30 V. Input current: 11 mA @ 24 Vdc.
5	COM	Common point of the IPS board digital inputs.	

XC2		Factory Default Function	Specifications
1	No Function	-	-
2	No Function	-	-
3	DGND	DGND Reference.	Grounded via the IPS board shield.
4	DIM2	Isolated digital input DIM2, programmable at P0833. Refer to the programming manual.	High level ≥ 18 V. Low level ≤ 3 V. Maximum input voltage: 30 V. Input current: 11 mA @ 24 Vdc.
5	COM	Common point of the IPS board digital inputs.	

XC3		Factory Default Function	Specifications
1	PCR1 (NO)	RL digital output with pre-charge function (PCR).	Contact capacity: 1 A. Maximum voltage: 240 Vac. NO - Normally open contact. C - Common. NC - Normally closed contact.
2	PCR2 (C)		
3	PCR3 (NC)		
4	GND_24	0 V reference for the 24 Vdc power supply.	Isolated power supply: 24 Vdc ± 8 %. Capacity: 600 mA. **Note 1:** This power supply may be used for feeding the IPS board digital inputs DIM1 (ISOL) and DIM2 (ISOL). **Note 2:** This power supply is isolated from the 24 Vdc input used to feed the IPS.
5	+24 V	24 Vdc power supply.	

Figure 3.31 - *Application example with high level at the DIs*

Table 3.10 - *Functions of the digital inputs*

Parameters	Sequential Number	Digital Input Function	Associated Fault/Alarm
P0832/P0833	0	Not Used	-
	1	Extern Fault	F410
	2	Refrigeration Fault	F408

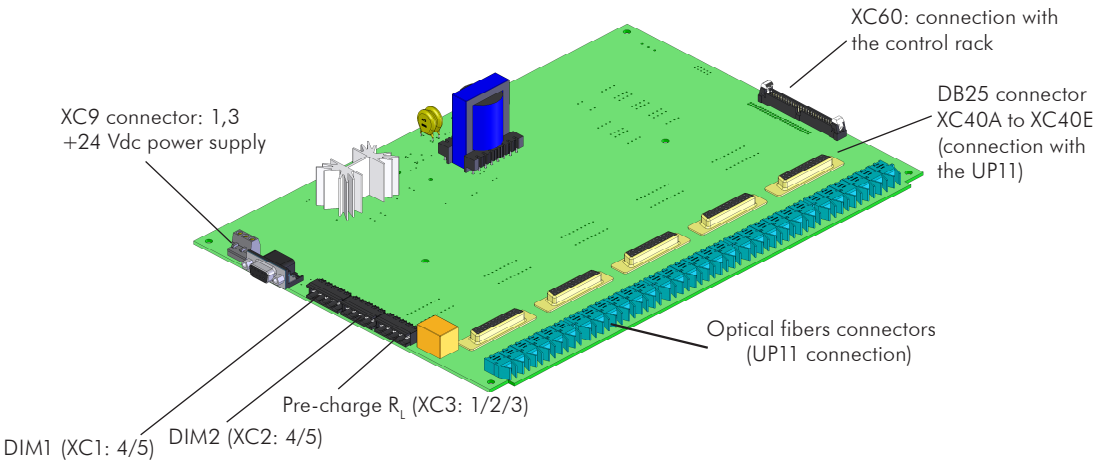


Figure 3.32 - *IPS1 connection points*

The IPS1 board mechanical installation itself makes its ground connection. This is done in several points.

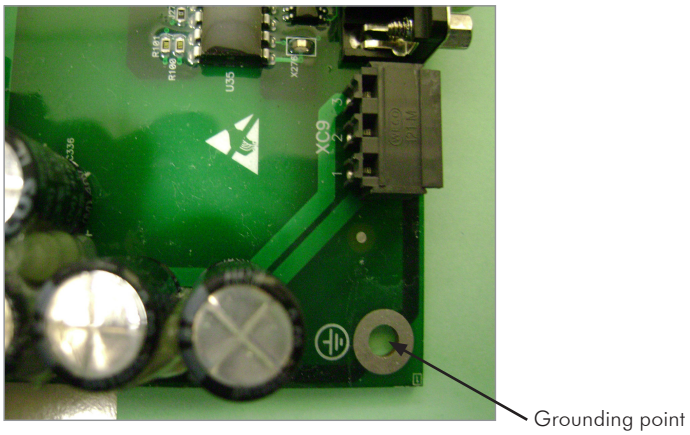


Figure 3.33 - *IPS1 board grounding*

The IPS1 shield securing screws must assure the electric contact between the shield and the panel for grounding purposes.

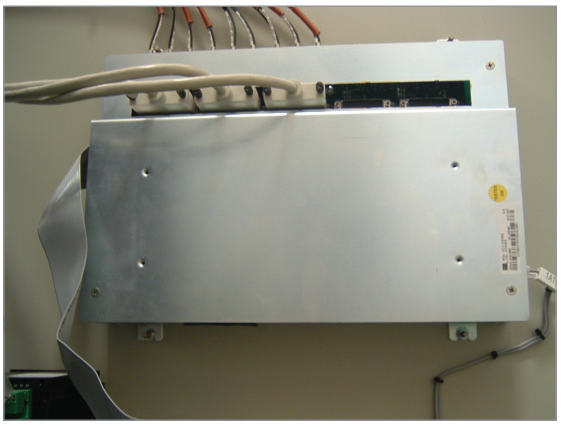


Figure 3.34 - *IPS1 shield fixed on the panel*

The control rack grounding must be done with a flat type braided ground strap with a minimum width of 5 mm (0.19 in) and a minimum cross section of 3 mm^2, with standard 6.35 mm (0.24 in) FASTON terminal (e.g., TYCO 735075-0 and 180363-2) and M4 ring terminal. Refer to the figure 3.35.

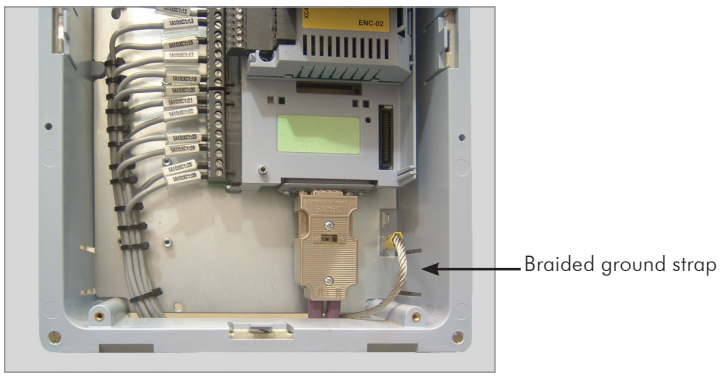


Figure 3.35 - *Control rack grounding*

The panel door must be grounded with a braided ground strap.

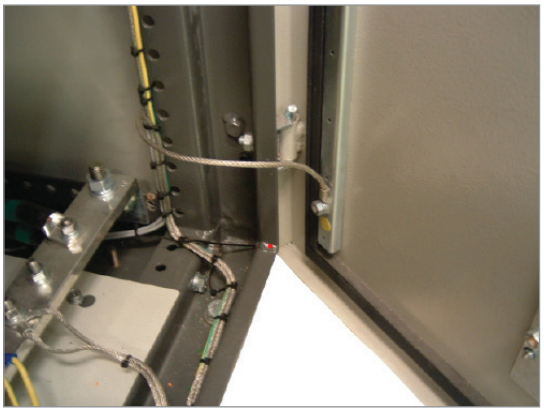


Figure 3.36 - *Panel door grounding*

The IPS1 board is fed by a +24 Vdc ±10 % power supply. This supply must have a minimum capacity of 4 Adc.

3.4.7 Input Filter

This section presents the types of filter, define criteria for their choice depending on the application and specify values and characteristics of components used in these filters.

3.4.7.1 Basic Definitions

The proper operation of the regenerative converter demands the use of a three-phase reactance between the input and the power supply. This three-phase reactance is known as LBOOST (boost reactor). In most cases, it is used an additional LC filter between the LBOOST and the power supply in order to eliminate the high frequency currents flow generated by the IGBTs switching to the power supply. In this manual, the components connected between the power supply and the regenerative converter are identified as filters.

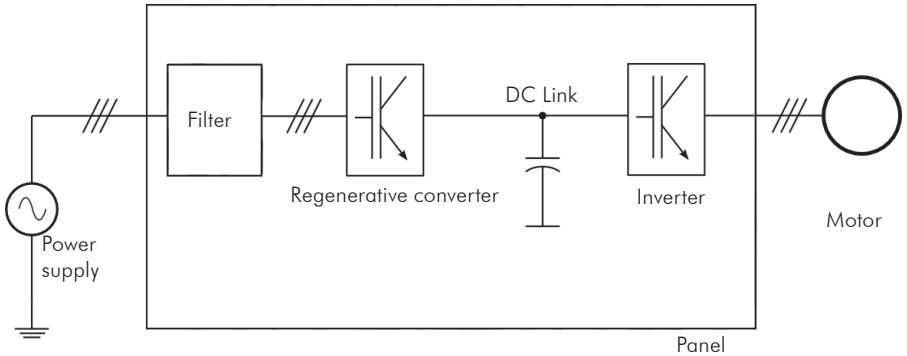


Figure 3.37 - *Regenerative converter simplified connection diagram*

3.4.7.2 Type of Filters

There are **two possible** filter configurations, which are shown as **filter 1** and **filter 2**.

3.4.7.3 Filter 1

The **filter 1** is the connection of a three-phase inductance between the power supply and the R, S and T terminals of the regenerative converter (L1).

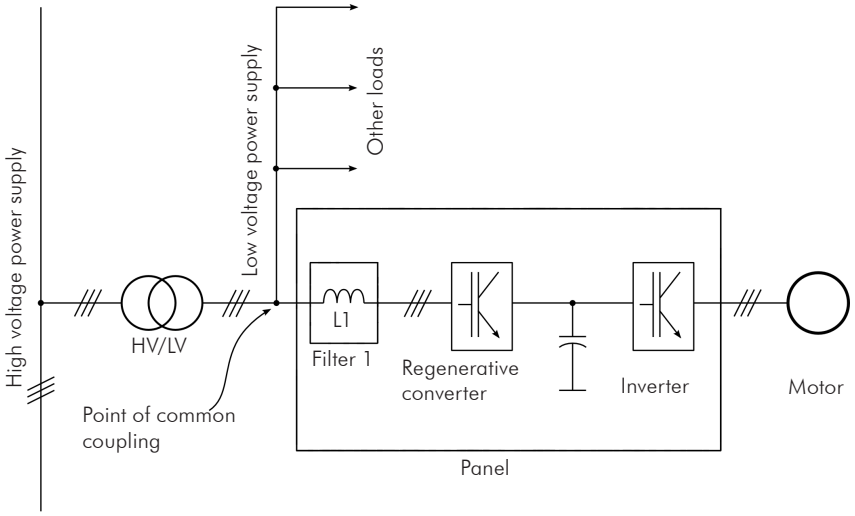


Figure 3.38 - *Filter 1 simplified connection diagram*

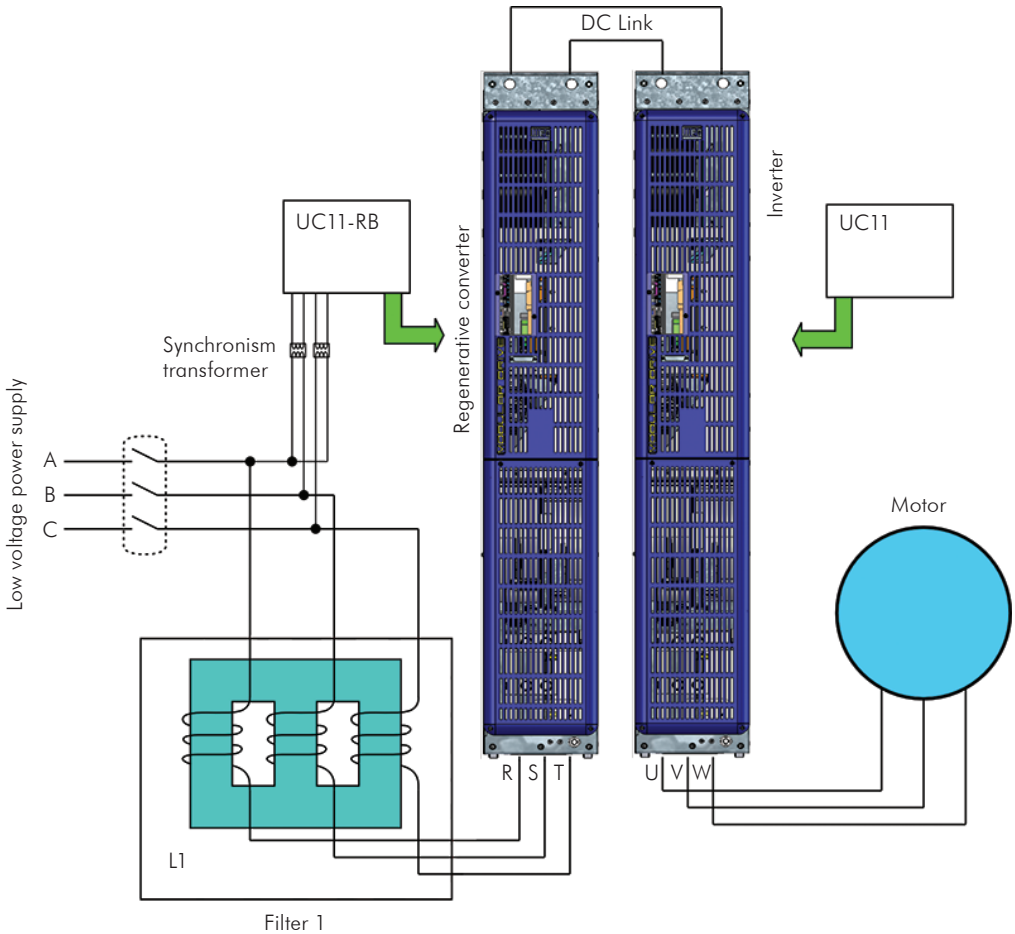


Figure 3.39 - *Simplified connection drawing of the Filter 1 with one power unit*

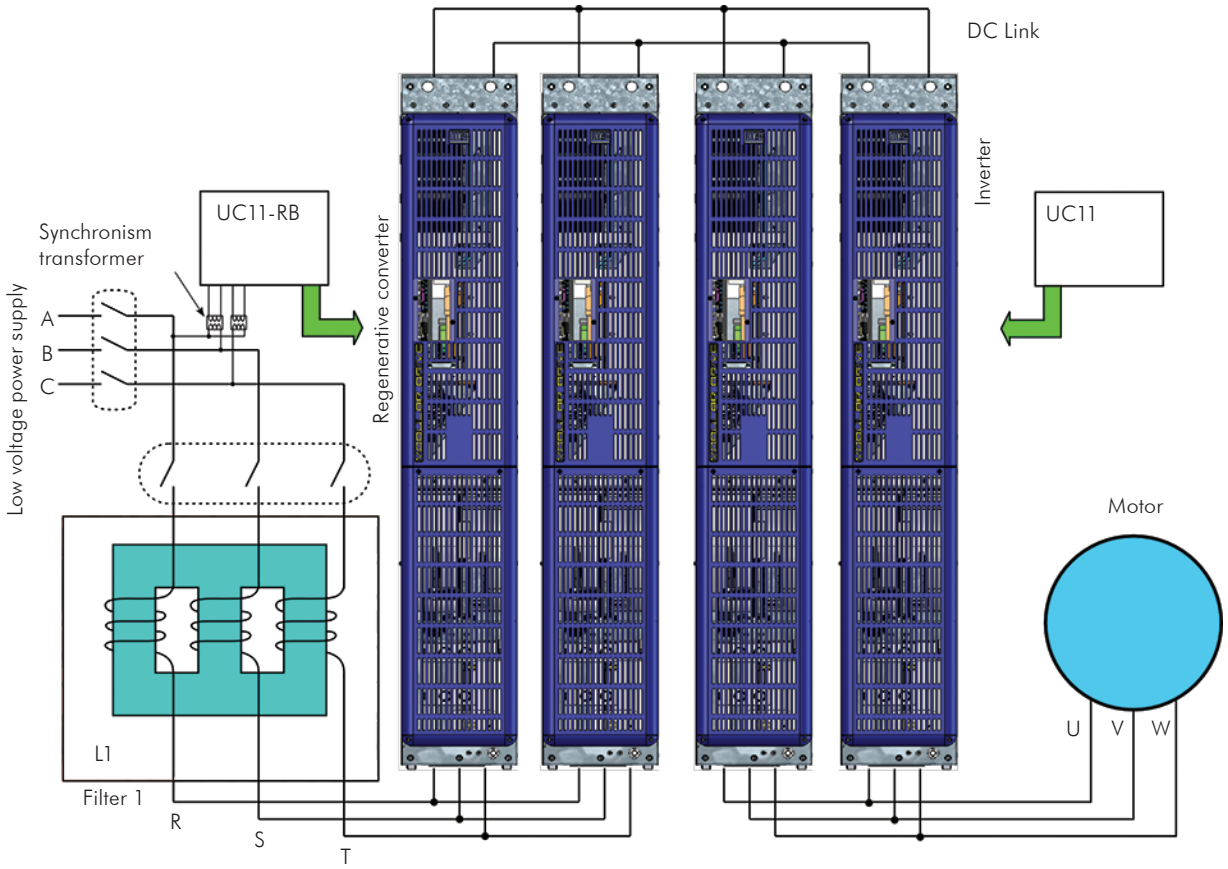


Figure 3.40 - *Simplified connection drawing of the Filter 1 with two power units*

3.4.7.4 Filter 2

The **filter 2** is the connection of two three-phase inductances (L1 and L2) between the power supply and the R, S and T terminals of the regenerative converter. Among these inductance is a branch with capacitors and damping resistors.

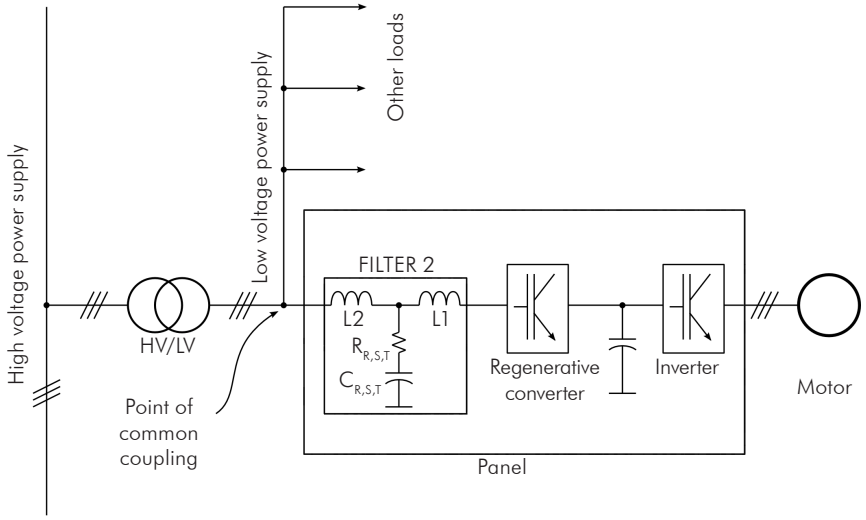


Figure 3.41 - *Filter 2 simplified connection diagram*

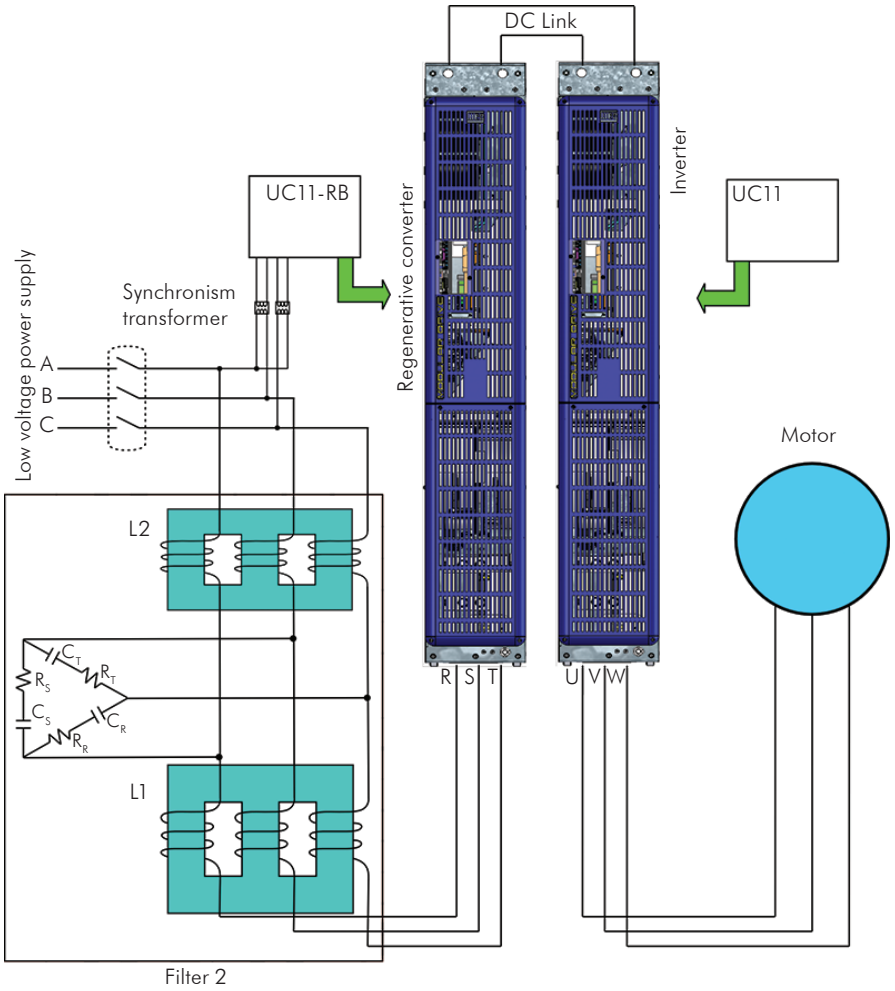


Figure 3.42 - *Simplified connection drawing of the filter 2 with one power unit*

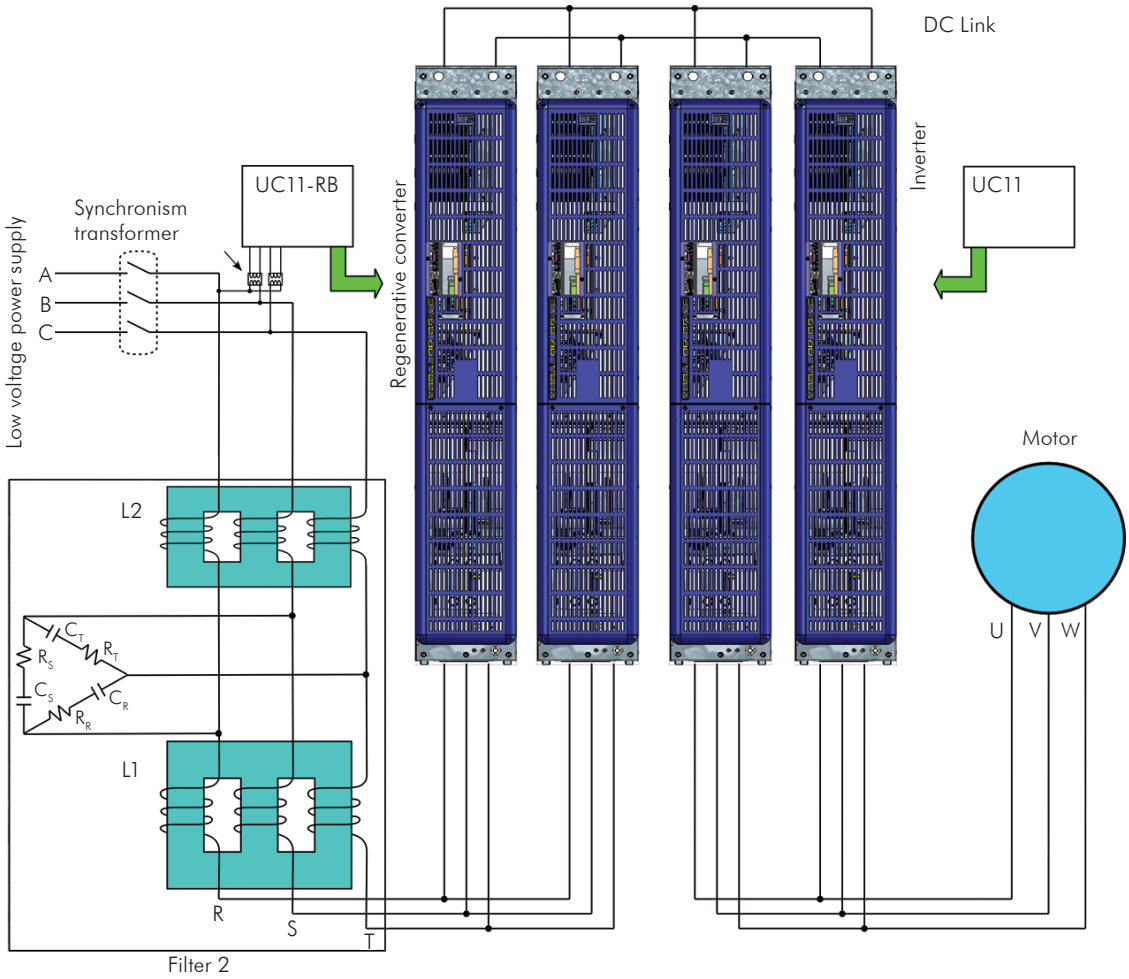


Figure 3.43 - *Simplified connection drawing of the filter 2 with two power units*

3.4.7.5 Filter Type Selection

The **filter 2** should be used whenever it is possible because it prevents high-frequency currents flow on the main power supply eliminating potential interference with other equipment.

The **filter 1** can be used only when some specific conditions are met, as stated in the figure 3.44:

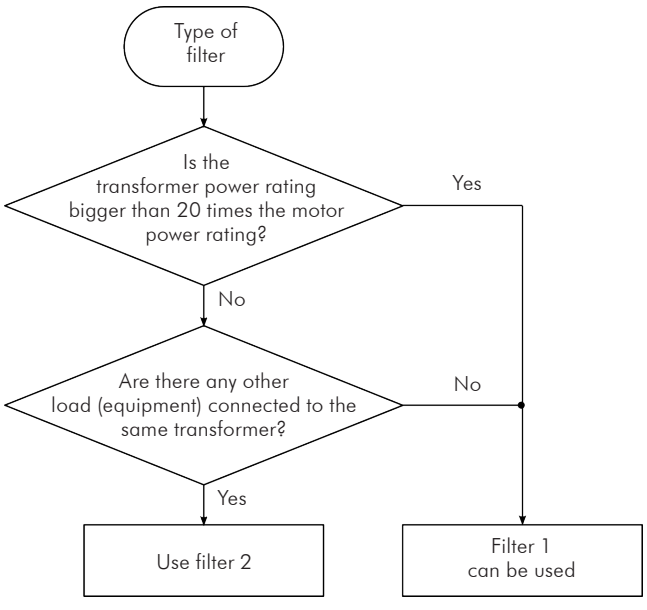


Figure 3.44 - *Filter type selection flowchart*

3.4.7.6 Filter Components

The inductor are three-phase reactors whose values of inductance, saturation inductance, rated current, and other data are presented in table 3.10.

L1:

There will be a high ripple at the switching frequency of the regenerative converter in the current that goes through the L1 inductor. This factor must be taken into consideration for the design of the inductor.

ATTENTION!

The design of the L1 inductor should consider the additional losses mainly in the iron (magnetic losses) due to current component at the switching frequency. The mechanical construction must be done in order to avoid excessive acoustic noise especially in the switching frequency.

Table 3.11 - *L1 indutor data*

Model: Current / Voltage Overload	600 / 380 / 480		1140 / 380 / 480		1710 / 380 / 480		2280 / 380 / 480		2850 / 380 / 480	
	ND	HD	ND	HD	ND	HD	ND	HD	ND	HD
Rated output current (A)	600	515	1140	979	1710	1468	2280	1957	2850	2446
L1 Inductor (L_{BOOST})										
Inductance at rated current (µH)	143.7		75.7		50.4		37.8		30.3	
Saturation Inductance (µH) @1.5x nom	71.9		37.8		25.2		18.9		15.1	
Saturation current (A)	900.0		1710.0		2565.0		3420.0		4275.0	
Thermal current (A)	630		1197		1796		2394		2993	
Fundamental frequency (Hz)	60/50 Hz		60/50 Hz		60/50 Hz		60/50 Hz		60/50 Hz	
Switching frequency (Hz)	2500 Hz		2500 Hz		2500 Hz		2500 Hz		2500 Hz	
ΔI @ 2x2500 Hz (A)	176.2		316.3		477.0		633.1		800.0	
RMS voltage over the coil - ΔVrms (V)	202.1		201.5		201.1		200.7		202.5	
Overload	150 % - 1 min/10 min		150 % - 1 min/10 min		150 % - 1 min/10 min		150 % - 1 min/10 min		150 % - 1 min/10 min	
Power units	1		2		3		4		5	

Model: Current / Voltage Overload	470 / 500 / 600		893 / 500 / 600		1340 / 500 / 600		1786 / 500 / 600		2232 / 500 / 600	
	ND	HD	ND	HD	ND	HD	ND	HD	ND	HD
Rated output current (A)	470	380	893	722	1340	1083	1786	1444	2232	1805
L1 Inductor (L_{BOOST})										
Inductance at rated current(µH)	229.3		120.7		80.5		60.4		48.3	
Saturation Inductance (µH) @1.5xInom	114.7		60.4		40.2		30.2		24.1	
Saturation current (A)	705.0		1339.5		2010.0		2679.0		3348.0	
Thermal current (A)	493.5		937.65		1407		1875.3		2343.6	
Fundamental frequency (Hz)	60/50 Hz		60/50 Hz		60/50 Hz		60/50 Hz		60/50 Hz	
Switching frequency (Hz)	2500 Hz		2500 Hz		2500 Hz		2500 Hz		2500 Hz	
ΔI @ 2x2500 Hz (A)	139.6		245.7		368.4		491.8		715.0	
RMS voltage over the coil - ΔVrms (V)	253.7		247.9		248.0		248.8		251.5	
Overload	150 % - 1 min/10 min		150 % - 1 min/10 min		150 % - 1 min/10 min		150 % - 1 min/10 min		150 % - 1 min/10 min	
Power units	1		2		3		4		5	

Model: Current / Voltage Overload	427 / 660 / 690		811 / 660 / 690		1217 / 660 / 690		1622 / 660 / 690		2028 / 660 / 690	
	ND	HD	ND	HD	ND	HD	ND	HD	ND	HD
Rated output current (A)	427	340	811	646	1217	969	1622	1292	2028	1615
L1 Inductor (L_{BOOST})										
Inductance at rated current(µH)	290.4		152.8		101.9		76.4		61.1	
Saturation inductance (µH) @1.5xInom	145.2		76.4		50.9		38.2		30.6	
Saturation current (A)	640.5		1216.5		1825.5		2433.0		3042.0	
Thermal current (A)	448.35		851.55		1277.85		1703.1		2129.4	
Fundamental frequency (Hz)	60/50 Hz		60/50 Hz		60/50 Hz		60/50 Hz		60/50 Hz	
Switching frequency (Hz)	2500 Hz		2500 Hz		2500 Hz		2500 Hz		2500 Hz	
ΔI @ 2x2500 Hz (A)	118.0		226.0		337.7		444.2		553.9	
RMS voltage over the coil - ΔVrms (V)	281.9		286.1		267.8		285.1		285.2	
Overload	150 % - 1 min/10 min		150 % - 1 min/10 min		150 % - 1 min/10 min		150 % - 1 min/10 min		150 % - 1 min/10 min	
Power units	1		2		3		4		5	

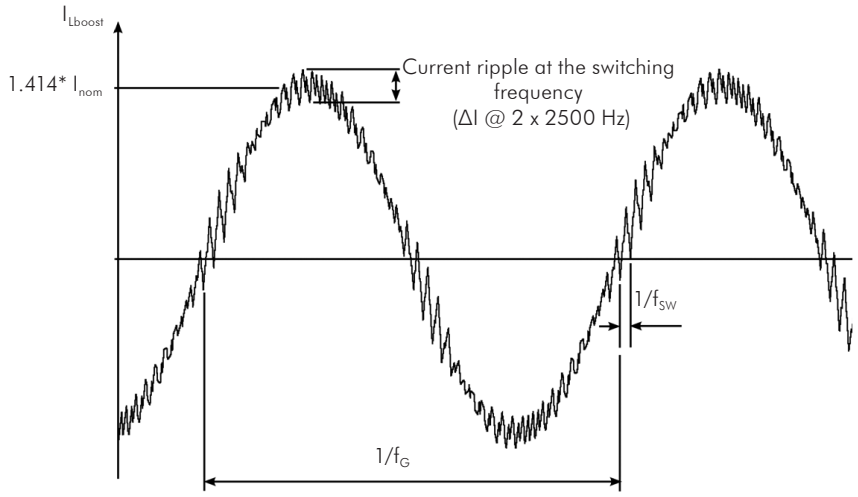


Figure 3.45 - *Typical current waveform at L1*

L2:

Table 3.11 presents L2 data to be used only if filter 2 option is chosen. This inductor does not present current components at the switching frequency.

Table 3.12 - *L2 Inductor data*

Model: Current / Voltage Overload	600 / 380 / 480 ND	600 / 380 / 480 HD	1140 / 380 / 480 ND	1140 / 380 / 480 HD	1710 / 380 / 480 ND	1710 / 380 / 480 HD	2280 / 380 / 480 ND	2280 / 380 / 480 HD	2850 / 380 / 480 ND	2850 / 380 / 480 HD
Rated output current (A)	600	515	1140	979	1710	1468	2280	1957	2850	2446
L2 Inductor (L_F)										
Inductance at rated current (µH)	47.9		25.2		16.8		12.6		10.1	
Saturation inductance (µH) @1.5xInom	24.0		12.6		8.4		6.3		5.0	
Saturation current (A)	900.0		1710.0		2565.0		3420.0		4275.0	
Thermal current (A)	630.0		1197.0		1795.5		2394.0		2992.5	
Fundamental frequency (Hz)	60/50 Hz		60/50 Hz		60/50 Hz		60/50 Hz		60/50 Hz	
Switching frequency (Hz)	N/A		N/A		N/A		N/A		N/A	
RMS voltage over the coil - ΔVrms (V)	13.4		13.0		13.1		13.3		14.6	
Overload	150 % - 1 min/10 min		150 % - 1 min/10 min		150 % - 1 min/10 min		150 % - 1 min/10 min		150 % - 1 min/10 min	
Power Units	1		2		3		4		5	

Model: Current / Voltage Overload	470 / 500 / 600 ND	470 / 500 / 600 HD	893 / 500 / 600 ND	893 / 500 / 600 HD	1340 / 500 / 600 ND	1340 / 500 / 600 HD	1786 / 500 / 600 ND	1786 / 500 / 600 HD	2232 / 500 / 600 ND	2232 / 500 / 600 HD
Rated output current (A)	470	380	893	722	1340	1083	1786	1444	2232	1805
L2 Inductor (L_F)										
Inductance at rated current (µH)	76.4		40.2		26.8		20.1		16.1	
Saturation inductance (µH) @1.5xInom	38.2		20.1		13.4		10.1		8.0	
Saturation current (A)	705.0		1339.5		2010.0		2679.0		3348.0	
Thermal current (A)	493.5		937.7		1407.0		1875.3		2343.6	
Fundamental frequency (Hz)	60/50 Hz		60/50 Hz		60/50 Hz		60/50 Hz		60/50 Hz	
Switching frequency (Hz)	N/A		N/A		N/A		N/A		N/A	
RMS voltage over the coil - ΔVrms (V)	19.1		15.9		15.8		16.2		18.1	
Overload	150 % - 1 min/10 min		150 % - 1 min/10 min		150 % - 1 min/10 min		150 % - 1 min/10 min		150 % - 1 min/10 min	
Power units	1		2		3		4		5	

Model: Current / Voltage Overload	427 / 660 / 690 ND	427 / 660 / 690 HD	811 / 660 / 690 ND	811 / 660 / 690 HD	1217 / 660 / 690 ND	1217 / 660 / 690 HD	1622 / 660 / 690 ND	1622 / 660 / 690 HD	2028 / 660 / 690 ND	2028 / 660 / 690 HD
Rated output current (A)	427	340	811	646	1217	969	1622	1292	2028	1615
L2 Inductor (L_F)										
Inductance at rated current (µH)	96.8		50.9		34.0		25.5		20.4	
Saturation inductance (µH) @1.5xInom	48.4		25.5		17.0		12.7		10.2	
Saturation current (A)	640.5		1216.5		1825.5		2433.0		3042.0	
Thermal current (A)	448.4		851.6		1277.9		1703.1		2129.4	
Fundamental frequency (Hz)	60/50 Hz		60/50 Hz		60/50 Hz		60/50 Hz		60/50 Hz	
Switching frequency (Hz)	N/A		N/A		N/A		N/A		N/A	
RMS voltage over the coil - ΔVrms (V)	17.8		18.9		19.1		18.3		18.5	
Overload	150 % - 1 min/10 min		150 % - 1 min/10 min		150 % - 1 min/10 min		150 % - 1 min/10 min		150 % - 1 min/10 min	
Power units	1		2		3		4		5	

$C_{R,S,T}$:

Table 3.12 presents the capacitor data when filter option 2 is chosen. These values are given per phase. When using an converter model that presents more than one capacitor (C2, C3 or C4), the capacitors must be connected in parallel in each phase.

Table 3.13 - *$C_{R,S,T}$ capacitors data*

Model: Current / Voltage Overload	600 / 380 / 480		1140 / 380 / 480		1710 / 380 / 480		2280 / 380 / 480		2850 / 380 / 480	
	ND	HD	ND	HD	ND	HD	ND	HD	ND	HD
Rated output current (A)	600	515	1140	979	1710	1468	2280	1957	2850	2446
C1 CAPACITOR										
Capacitance (µF)	100.0		100.0		100.0		100.0		100.0	
Current (Arms)	39.7		37.5		37.3		37.2		46.5	
Voltage	530 Vrms		530 Vrms		530 Vrms		530 Vrms		530 Vrms	
Recommended model (Epcos)	B25834-D5107-K004		B25834-D5107-K004		B25834-D5107-K004		B25834-D5107-K004		B25834-D5107-K004	
C2 CAPACITOR										
Capacitance (µF)	-		100.0		100.0		100.0		100.0	
Current (Arms)	-		37.5		37.3		37.2		46.5	
Voltage	-		530 Vrms		530 Vrms		530 Vrms		530 Vrms	
Recommended model (Epcos)	-		B25834-D5107-K004		B25834-D5107-K004		B25834-D5107-K004		B25834-D5107-K004	
C3 CAPACITOR										
Capacitance (µF)	-		-		100.0		100.0		100.0	
Current (Arms)	-		-		37.3		37.2		46.5	
Voltage	-		-		530 Vrms		530 Vrms		530 Vrms	
Recommended model (Epcos)	-		-		B25834-D5107-K004		B25834-D5107-K004		B25834-D5107-K004	
C4 CAPACITOR										
Capacitance (µF)	-		-		-		100.0		100.0	
Current (Arms)	-		-		-		37.2		46.5	
Voltage	-		-		-		530 Vrms		530 Vrms	
Recommended model (Epcos)	-		-		-		B25834-D5107-K004		B25834-D5107-K004	

Model: Current / Voltage Overload	470 / 500 / 600		893 / 500 / 600		1340 / 500 / 600		1786 / 500 / 600		2232 / 500 / 600	
	ND	HD	ND	HD	ND	HD	ND	HD	ND	HD
Rated output current (A)	470	418	893	794	1340	1191	1786	1558	2232	1985
C1 CAPACITOR										
Capacitance (µF)	47.0		68.0		68.0		68.0		68.0	
Current (Arms)	33.1		30.0		29.8		32.1		41.8	
Voltage	640 Vrms		640 Vrms		640 Vrms		640 Vrms		640 Vrms	
Recommended model (Epcos)	B25834-D6476-K004		B25834-D6686-K004		B25834-D6686-K004		B25834-D6686-K004		B25834-D6686-K004	
C2 CAPACITOR										
Capacitance (µF)	-		68.0		68.0		68.0		68.0	
Current (Arms)	-		30.0		29.8		32.1		41.8	
Voltage	-		640 Vrms		640 Vrms		640 Vrms		640 Vrms	
Recommended model (Epcos)	-		B25834-D6686-K004		B25834-D6686-K004		B25834-D6686-K004		B25834-D6686-K004	
C3 CAPACITOR										
Capacitance (µF)	-		-		68.0		68.0		68.0	
Current (Arms)	-		-		29.8		32.1		41.8	
Voltage	-		-		640 Vrms		640 Vrms		640 Vrms	
Recommended model (Epcos)	-		-		B25834-D6686-K004		B25834-D6686-K004		B25834-D6686-K004	
C4 CAPACITOR										
Capacitance (µF)	-		-		-		47.0		68.0	
Current (Arms)	-		-		-		22.2		41.8	
Voltage	-		-		-		640 Vrms		640 Vrms	
Recommended model (Epcos)	-		-		-		B25834-D6476-K004		B25834-D6686-K004	

Model: Current / Voltage Overload	427 / 660 / 690 ND	427 / 660 / 690 HD	811 / 660 / 690 ND	811 / 660 / 690 HD	1217 / 660 / 690 ND	1217 / 660 / 690 HD	1622 / 660 / 690 ND	1622 / 660 / 690 HD	2028 / 660 / 690 ND	2028 / 660 / 690 HD
Rated output current (A)	427	340	811	646	1217	969	1622	1292	2028	1615
C1 CAPACITOR										
Capacitance (µF)	68.0		68.0		68.0		68.0		68.0	
Current (Arms)	29.7		37.0		40.7		36.1		39.0	
Voltage	720 Vrms		720 Vrms		720 Vrms		720 Vrms		720 Vrms	
Recommended model (Electronicon)	E62.P17 - 683C60		E62.P17 - 683C60		E62.P17 - 683C60		E62.P17 - 683C60		E62.P17 - 683C60	
C2 CAPACITOR										
Capacitance (µF)	-		33.0		68.0		68.0		68.0	
Current (Arms)	-		18.0		40.7		36.1		39.0	
Voltage	-		720 Vrms		720 Vrms		720 Vrms		720 Vrms	
Recommended model (Electronicon)	-		E62.P10 - 333C60		E62.P17 – 683C60		E62.P17 – 683C60		E62.P17 – 683C60	
C3 CAPACITOR										
Capacitance (µF)	-		-		-		68.0		68.0	
Current (Arms)	-		-		-		36.1		39.0	
Voltage	-		-		-		720 Vrms		720 Vrms	
Recommended model (Electronicon)	-		-		-		E62.P17 - 683C60		E62.P17 - 683C60	
C4 CAPACITOR										
Capacitance (µF)	-		-		-		-		33.0	
Current (Arms)	-		-		-		-		19.0	
Voltage	-		-		-		-		720 Vrms	
Recommended model (Electronicon)	-		-		-		-		E62.P10 - 333C60	

$R_{R,S,T}$:

Table 3.13 presents the resistor data for the filter option 2. The values given in the table include the power dissipation obtained in simulation and the recommended power for these components.

Table 3.14 - $R_{R,S,T}$ Resistor data

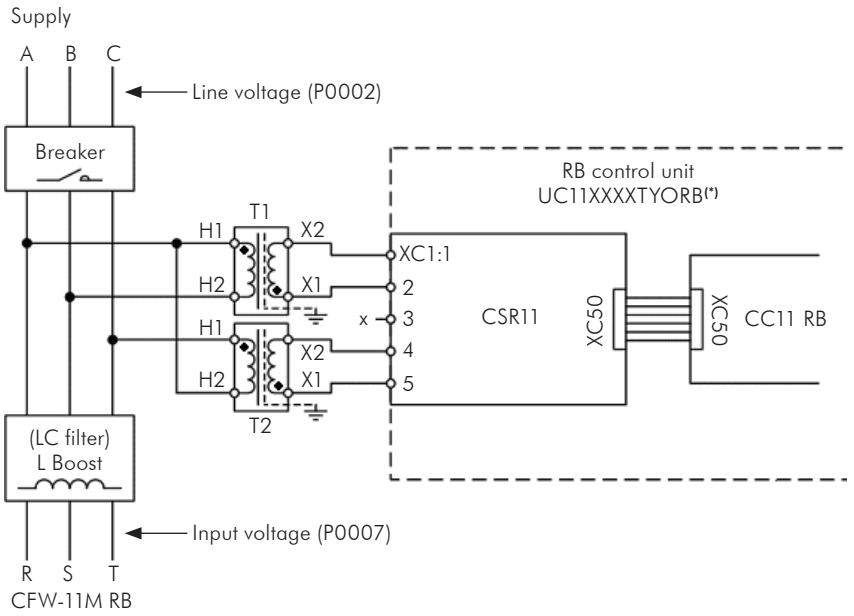
Model: Current / Voltage Overload	600 / 380 / 480 ND	600 / 380 / 480 HD	1140 / 380 / 480 ND	1140 / 380 / 480 HD	1710 / 380 / 480 ND	1710 / 380 / 480 HD	2280 / 380 / 480 ND	2280 / 380 / 480 HD	2850 / 380 / 480 ND	2850 / 380 / 480 HD
Rated output current (A)	600	515	1140	979	1710	1468	2280	1957	2850	2446
RESISTOR - one per fase										
Resistance (ohms)	0.10		0.10		0.10		0.10		0.10	
Current (Arms)	39.7		75.1		112.0		148.6		185.8	
Power dissipation (W)	157.8		563.5		1255.2		2208.1		3452.8	
Recommended power (W)	315.7		1127.0		2510.4		4416.2		6905.6	

Model: Current / Voltage Overload	470 / 500 / 600 ND	470 / 500 / 600 HD	893 / 500 / 600 ND	893 / 500 / 600 HD	1340 / 500 / 600 ND	1340 / 500 / 600 HD	1786 / 500 / 600 ND	1786 / 500 / 600 HD	2232 / 500 / 600 ND	2232 / 500 / 600 HD
Rated output current (A)	470	380	893	722	1340	1083	1786	1444	2232	1805
RESISTOR - one per fase										
Resistance (ohms)	0.10		0.10		0.10		0.10		0.10	
Current (Arms)	33.1		60.0		89.5		118.3		167.4	
Power dissipation (W)	109.2		360.1		801.1		1399.9		2801.3	
Recommended power (W)	218.5		720.2		1602.3		2799.8		5602.6	

Model: Current / Voltage Overload	427 / 660 / 690 ND	427 / 660 / 690 HD	811 / 660 / 690 ND	811 / 660 / 690 HD	1217 / 660 / 690 ND	1217 / 660 / 690 HD	1622 / 660 / 690 ND	1622 / 660 / 690 HD	2028 / 660 / 690 ND	2028 / 660 / 690 HD
Rated output current (A)	427	340	811	646	1217	969	1622	1292	2028	1615
RESISTOR - one per fase										
Resistance (ohms)	0.10		0.10		0.10		0.10		0.10	
Current (Arms)	29.7		54.3		81.3		108.2		134.8	
Power dissipation (W)	88.3		295.3		661.1		1169.7		1816.1	
Recommended power (W)	176.5		590.5		1322.2		2339.4		3632.2	

3.4.8 Synchronism

The CFW-11M RB monitors the line voltage (A, B e C) at the converter input with two transformers and a synchronism board. These signals are used for the regenerative converter control.



(*) XXXX: converter rated current.
Y: According to models 4/380-480 V, 5/500-600 V e 6/660-690 V.

Figure 3.46 - *Synchronism connection diagram*

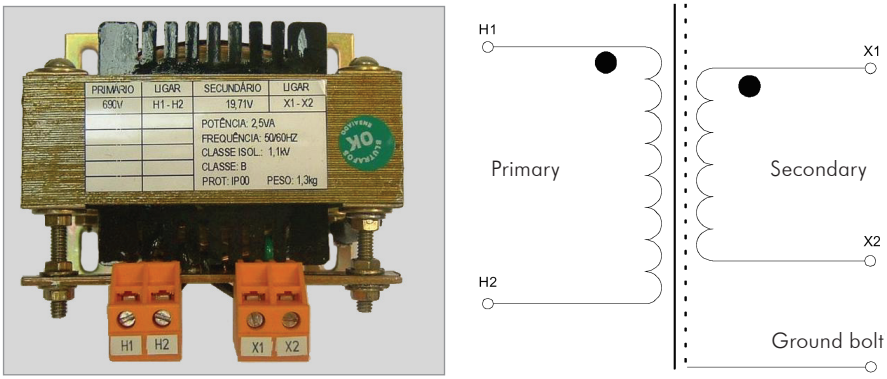


Figure 3.47 - *Synchronism transformer*

Table 3.14 shows the main characteristics for the proper specification of the synchronism transformer.

Table 3.15 - *Synchronism transformer characteristics*

CFW-11M RB Model	380 V / 480 V	500 V / 690 V
Rated voltage of the primary H1-H2	480 V	690 V
Transformer ratio N_s/N_p	1/26	1/35
f (frequency)	50 Hz/60 Hz	
S (power)	2.5 VA	
Voltage tolerance	± 1 %	
Steady state overvoltage	+10 %	
Insulation Class	1.1 kV	
Class	B	
Insulation		
Primary to secondary	3000 Vac / 1 min	
Primary to shield	3000 Vac / 1 min	
Primary to enclosure	3000 Vac / 1 min	
Be in accordance wit UL508 standard as the insulation material and manufacturing		
Keep the core with low saturation to mantain good linearity between the primary and secondary		
Shielding between the primary and secondary: metallic ribbon		

The synchronism transformers are supplied by WEG for the panel assembly together with the CFW-11M RB regenerative converter. Figure 3.48 shows this assembly.

NOTE!
Transformer shield must be grounded.

Figure 3.48 - *Example of transformer assembling*

NOTE!
Consult WEG for the complete specification of the synchronism transfomer!

Figure 3.49 shows the CSR11 synchronism board. The signals from the synchronism transformer are connected at the XC1 connector figure 3.51 shows the cable connection.The connection with the CC11 RB control board is done via XC50 connector. Figure 3.50 show the synchronism board assembly on the UC11.

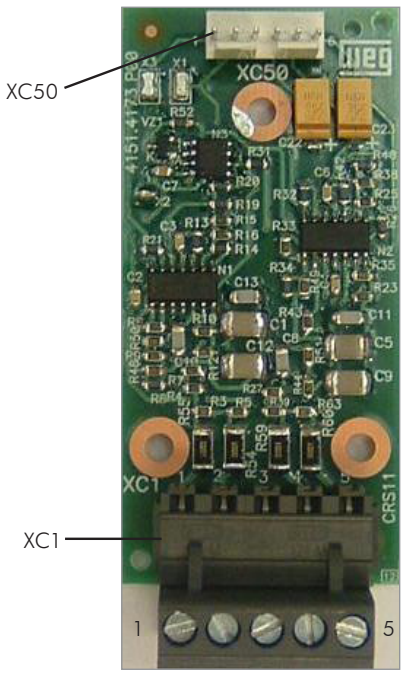


Figure 3.49 - *Synchronism board*

NOTE!
Shielded cables must be used for the signal connection of the synchronism board to the XC1 conector.
It is recommended to ground the cables shielding according to item 3.4.9.

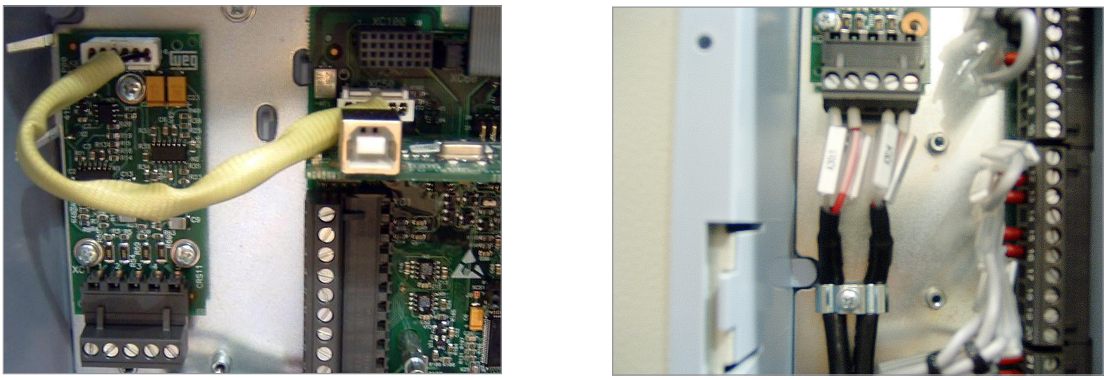


Figure 3.50 - *CSR11 syncronism board connection*

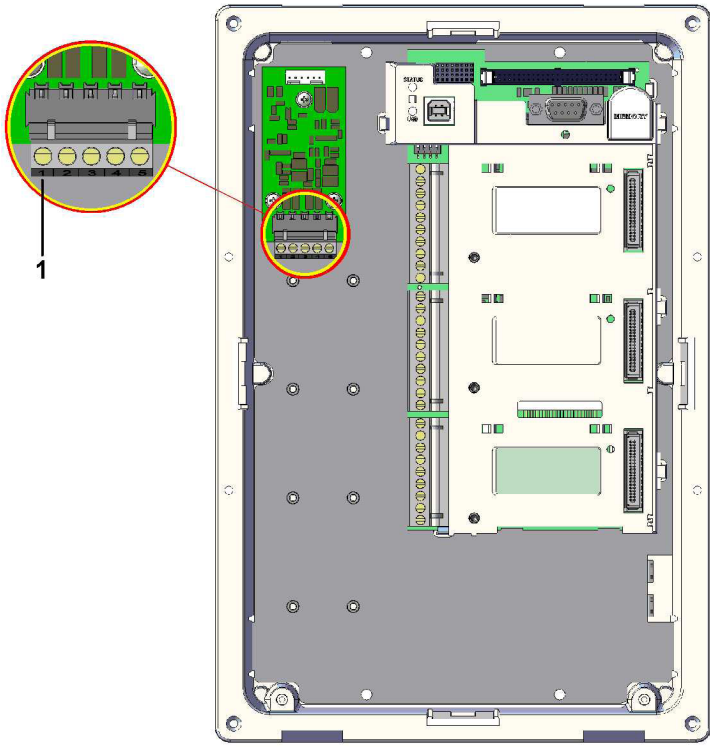
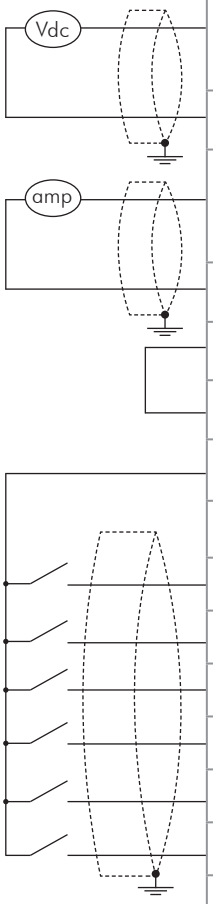


Figure 3.51 - *CSR11 assembly on the UC11*

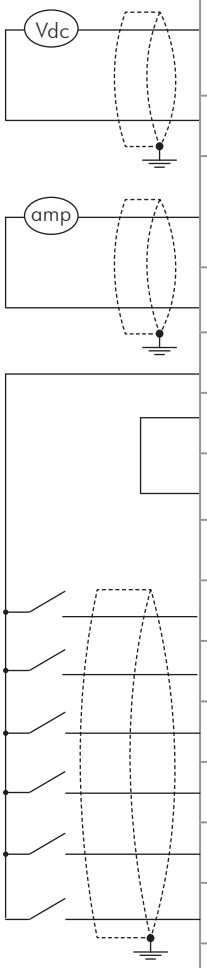
3.4.9 Control Connections

The control connections (analog inputs/outputs, and digital inputs/outputs) must be made at the electronic control board CC11 RB terminal strip XC1, at the UC11 control unit.
Functions and typical connections are presented at Figures 3.52 **(a)** and **(b)**.



XC1 Connector		Factory Default Function	Specifications
7	AO1	Analog output 1: DC Link voltage	Galvanic Isolation Resolution: 11 bits. Signal: 0 to 10 V ($R_L \geq 10$ kΩ) / 0 to 20 mA / 4 to 20 mA ($R_L \leq 500$ Ω). Protected against short-circuit.
8	AGND (24 V)	Reference (0 V) for the analog outputs	Connected to the ground (frame) through impedance: 940 Ω resistor in parallel with a 22 nF capacitor.
9	AO2	Analog output 2: AC Current	Galvanic Isolation Resolution: 11 bits. Signal: 0 to 10 V ($R_L \geq 10$ kΩ) / 0 to 20 mA / 4 to 20 mA ($R_L \leq 500$ Ω). Protected against short-circuit.
10	AGND (24 V)	Reference (0 V) for the analog outputs	Connected to the ground (frame) through impedance: 940 Ω resistor in parallel with a 22 nF capacitor.
11	DGND*	Reference (0 V) for the 24 Vdc power supply	Connected to the ground (frame) through impedance: 940 Ω resistor in parallel with a 22 nF capacitor.
12	COM	Digital inputs common point connection	
13	24 Vdc	24 Vdc power supply	24 Vdc power supply, ±8 %. Capacity: 500 mA.
14	COM	Digital inputs common point connection	
15	DI1	Digital input 1: General enable	6 isolated digital inputs High level ≥ 18 V. Low level ≤ 3 V. Maximum input voltage = 30 V. Input current: 11 mA @ 24 Vdc.
16	DI2	Digital input 2: No function	
17	DI3	Digital input 3: No function	
18	DI4	Digital input 4: No function	
19	DI5	Digital input 5: No function	
20	DI6	Digital input 6: No function	
21	NC1	Digital output 1 DO1 (RL1): Pre-charge OK	Contact rating: Maximum voltage: 240 Vac. Maximum current: 1 A. NC - Normally closed contact. C - Common. NO - Normally open contact.
22	C1		
23	NO1		
24	NC2	Digital output 2 DO2 (RL2): RUN	
25	C2		
26	NO2		
27	NC3	Digital output 3 DO3 (RL3): No fault	
28	C3		
29	NO3		

(a) Digital inputs as 'Active High'



XC1 Connector		Factory Default Function	Specifications
7	AO1	Analog output 1: DC Link voltage	Galvanic Isolation Resolution: 11 bits. Signal: 0 to 10 V ($R_L \geq 10$ kΩ) / 0 to 20 mA / 4 to 20 mA ($R_L \leq 500$ Ω). Protected against short-circuit.
8	AGND (24 V)	Reference (0 V) for the analog outputs	Connected to the ground (frame) through impedance: 940 Ω resistor in parallel with a 22 nF capacitor.
9	AO2	Analog output 2: AC Current	Galvanic Isolation Resolution: 11 bits. Signal: 0 to 10 V ($R_L \geq 10$ kΩ) / 0 to 20 mA / 4 to 20 mA ($R_L \leq 500$ Ω). Protected against short-circuit.
10	AGND (24 V)	Reference (0 V) for the analog outputs	Connected to the ground (frame) through impedance: 940 Ω resistor in parallel with a 22 nF capacitor.
11	DGND*	Reference (0 V) for the 24 Vdc power supply	Connected to the ground (frame) through impedance: 940 Ω resistor in parallel with a 22 nF capacitor.
12	COM	Digital inputs common point connection	
13	24 Vdc	24 Vdc power supply	24 Vdc power supply, ±8 %. Capacity: 500 mA.
14	COM	Digital inputs common point connection	
15	DI1	Digital input 1: General enable	6 isolated digital inputs High level ≥ 18 V. Low level ≤ 3 V. Maximum input voltage = 30 V. Input current: 11 mA @ 24 Vdc.
16	DI2	Digital input 2: No function	
17	DI3	Digital input 3: No function	
18	DI4	Digital input 4: No function	
19	DI5	Digital input 5: No function	
20	DI6	Digital input 6: No function	
21	NF1	Digital output 1 DO1 (RL1): Pre-charge OK	Contact rating: Maximum voltage: 240 Vac. Maximum current: 1 A. NC - Normally closed contact. C - Common. NO - Normally open contact.
22	C1		
23	NA1		
24	NF2	Digital output 2 DO2 (RL2): RUN	
25	C2		
26	NA2		
27	NF3	Digital output 3 DO3 (RL3): No fault	
28	C3		
29	NA3		

(b) Digital inputs as 'Active Low'

Figure 3.52 - *(a) and (b) XC1 connector signals*

NOTE!

Remove the jumper between XC1:11 and 12 and install it between XC1:12 and 13 to use the digital inputs as 'Active Low'.

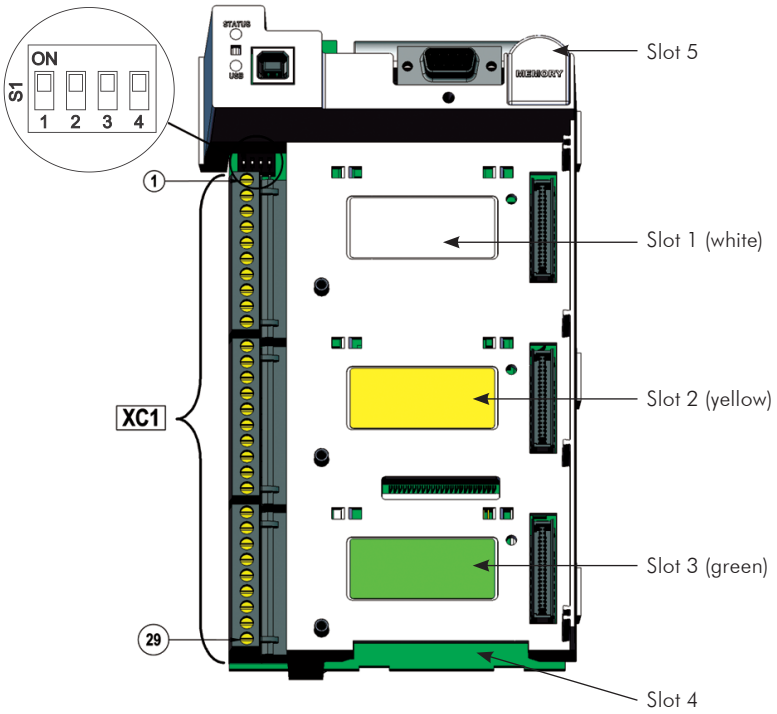


Figure 3.53 - *Connector XC1 and DIP-switches for selecting the signal type of the analog inputs and outputs*

The analog inputs and outputs are factory set to operate from 0 to 10 V; this setting may be changed by using DIP-switch S1.

Table 3.16 - *DIP-switches configuration for selecting the signal type of the analog outputs*

Signal	Factory Default Function	DIP-Switch	Selection	Factory Setting
AO1	DC Link Voltage	S1.1	OFF: 4 to 20 mA / 0 to 20 mA ON: 0 to 10 V (factory setting)	ON
AO2	Input current	S1.2	OFF: 4 to 20 mA / 0 to 20 mA ON: 0 to 10 V (factory setting)	ON

Parameters related to the analog outputs (AO1 and AO2) shall also be programmed according to the DIP-switches settings and desired values.

Follow instructions below for the proper installation of the control wiring:

1. Wire gauge: 0.5 mm² (20 AWG) to 1.5 mm² (14 AWG).
2. Maximum tightening torque: 0.5 Nm (4.50 lbf.in).
3. Use shielded cables for the XC1 connections and run the cables separated from the remaining circuits (power, 110 V / 220 Vac control, etc.) as presented in table 3.16. If control wiring must cross other cables (power cables for instance), make it cross perpendicular to the wiring and provide a minimum separation of 5 cm (1.9 in) at the crossing point.

Table 3.17 - *Minimum separation distances between wiring*

Cable Length	Minimum Separation Distance
≤ 30 m (100 ft) > 30 m (100 ft)	≥ 10 cm (3.94 in) ≥ 25 cm (9.84 in)

4. The proper connection of the cable shield is shown in figure 3.54. Figure 3.55 shows how to connect the cable shield to the ground.

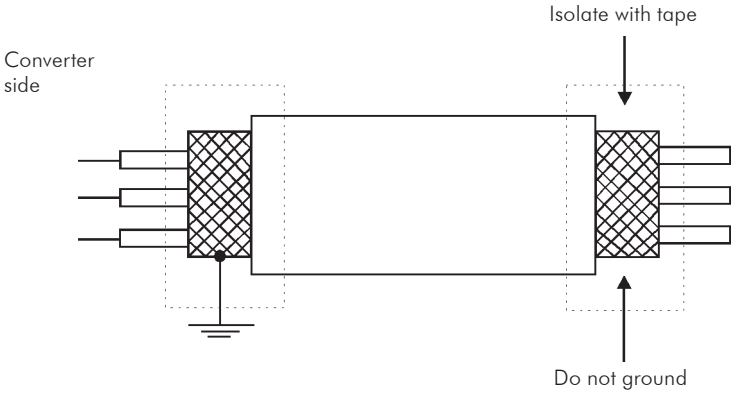
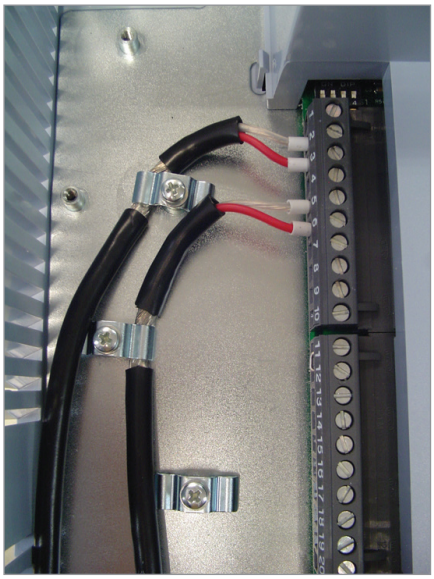


Figure 3.54 - *Shield connection*

5. Relays, contactors, solenoids or coils of electromechanical brakes installed close to the converter may eventually create interferences in the control circuit. To eliminate this effect, RC suppressors (with AC power supply) or free-wheel diodes (with DC power supply) shall be connected in parallel to the coils of these devices.



Example of connection of control cable shield

Figure 3.55 - *Example of shield connection for the control wiring and synchronism*

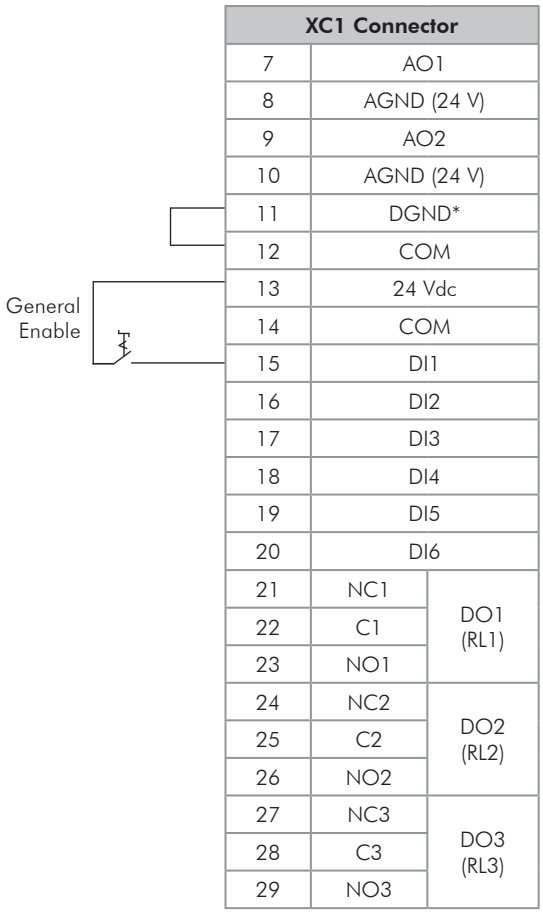
3.4.10 Typical Control Connection

Control connection 1 - Control via Keypad (HMI) with General Enable function.

The factory default settings allows the converter to operate in local mode. This operation mode is recommended for first-time users due to its easiness of implementation.

For the start-up in this operation mode, please follow instructions listed in chapter 5.

DI1 is already set to General Enable as factory default (P0263 = 2).



XC1 Connector		
7	AO1	
8	AGND (24 V)	
9	AO2	
10	AGND (24 V)	
11	DGND*	
12	COM	
13	24 Vdc	
14	COM	
15	DI1	
16	DI2	
17	DI3	
18	DI4	
19	DI5	
20	DI6	
21	NC1	DO1 (RL1)
22	C1	
23	NO1	
24	NC2	DO2 (RL2)
25	C2	
26	NO2	
27	NC3	DO3 (RL3)
28	C3	
29	NO3	

Figure 3.56 - *XC1 wiring for control connection 1*

3.5 INSTALLATION ACCORDING TO THE EUROPEAN DIRECTIVE OF ELECTROMAGNETIC COMPATIBILITY

The CFW-11M RB converters, when properly installed, meet the requirements of the electromagnetic compatibility directive - "EMC Directive 2004 / 108 / EC".

3.5.1 Conformal Installation

For the conformal installation use:

1. Input filter - filter 2 for emission levels in accordance with IEC/EN 61800-3 "Adjustable Speed Electrical Power Drive Systems", C4 category.

2. Input filter - filter 2 and RFI in order to comply with the conducted emission levels C2 or C3 categories.

3. Shielded control cables, keeping them separate from the other cables as described at item 3.4.9.

4. Converter grounding according to the instructions on items 3.4.5, 3.4.6 and 3.4.9.

5. Instruction for conformal installations applicable to inverters controlling motors.

3.5.2 Standard Definitions

IEC/EN 61800-3: "Adjustable Speed Electrical Power Drives Systems"

- Environment:

First Environment: includes domestic premises. It also includes establishments directly connected without intermediate transformer to a low-voltage power supply network which supplies buildings used for domestic purposes.
Example: houses, apartments, commercial installations, or offices located in residential buildings.

Second Environment: includes all establishments other than those directly connected to a low-voltage power supply network which supplies buildings used for domestic purposes.
Example: industrial area, technical area of any building supplied by a dedicated transformer.

- Categories:

Category C1: converters with a voltage rating less than 1000 V and intended for use in the First Environment.

Category C2: converters with a voltage rating less than 1000 V, intended for use in the First Environment, not provided with a plug connector or a movable installations, and installed and commissioned by a professional.
Note: a professional is a person or organization familiar with the installation and/or commissioning of converters, including the EMC aspects.

Category C3: converters with a voltage rating less than 1000 V and intended for use in the Second Environment only (not designed for use in the First Environment).

Category C4: converters with a voltage rating equal to or greater than 1000 V, or with a current rating equal to or greater than 400 Amps, or intended for use in complex systems in the Second Environment.

EN 55011: "Threshold values and measuring methods for radio interference from industrial, scientific and medical (ISM) high-frequency equipment"

Class B: equipment intended for use in the low-voltage power supply network (residential, commercial, and light-industrial environments).

Class A1: equipment intended for use in the low-voltage power supply network. Restricted distribution.
Note: it must be installed and commissioned by a professional when applied in the low-voltage power supply network.

Class A2: equipment intended for use in industrial environments.

3.5.3 Emission and Immunity Levels

Table 3.18 - *Emission and immunity levels*

EMC Phenomenon	Basic Standard	Level
Emission:		
Mains Terminal Disturbance Voltage Frequency Range: 150 kHz to 30 MHz)	IEC/EN61800-3	- Without external filter: C4 Category. - With external filter: C2 or C3 Category.
Eletromagmetic Radiation Disturbance Frequency Range: 30 kHz to 1 GHz)		
Immunity:		
Electrostatic Discharge (ESD)	IEC/EN61000-4-2	4 kV for contact discharge and 8 kV for air discharge.
Fast Transient-Burst	IEC/EN61000-4-4	2 kV/5 kHz (coupling capacitor) power input cables. 1 kV/5 kHz control cables, and remote keypad cables. 2 kV/5 kHz (coupling capacitor) motor output cables.
Conduced Radio-Frequency Common Mode	IEC/EN61000-4-6	0.15 to 80 MHz; 10 V; 80 % AM (1 kHz). Control cables and remote keypad cables.
Surge Immunity	IEC/EN61000- 4-5	1.2/50 μs, 8/20 μs. 1 kV line-to-line coupling. 2 kV line-to-ground coupling.
Radio-Frequency Electromagnetic Field	IEC/EN61000-4-3	80 to 1000 MHz. 10 V/m. 80 % AM (1 kHz).

3.5.4 External RFI Filters

To be used only if necessary to comply with conducted emission levels Category C2 or C3 according to IEC/EN61800-3. The models bellow are from the manufacturer Epcos. It is necessary to use the input filter F2 when the external RFI filter is used.

Table 3.19 - *Filters for 380 / 480 V lines*

Converter Model	Rating	Filter Model
600	ND	B84143-B600-S20
	HD	B84143-B600-S20
1140	ND	B84143-B1600-S20
	HD	B84143-B1000-S20
1710	ND	B84143-B2500-S20
	HD	B84143-B1600-S20
2280	ND	B84143-B2500-S20
	HD	B84143-B2500-S20
2850	ND	- - - -
	HD	B84143-B2500-S20

Table 3.20 - *Filters for 500 / 600 V lines*

Converter Model	Rating	Filter Model
470	ND	B84143-B600-S21
	HD	B84143-B600-S21
893	ND	B84143-B1000-S21
	HD	B84143-B1000-S21
1340	ND	B84143-B1600-S21
	HD	B84143-B1600-S21
1786	ND	B84143-B2500-S21
	HD	B84143-B1600-S21
2232	ND	B84143-B2500-S21
	HD	B84143-B2500-S21

Table 3.21 - *Filters for 660 / 690 V lines*

Converter Model	Rating	Filter Model
427	ND	B84143-B600-S21
	HD	B84143-B600-S21
811	ND	B84143-B1000-S21
	HD	B84143-B1000-S21
1217	ND	B84143-B1600-S21
	HD	B84143-B1000-S21
1622	ND	B84143-B2500-S21
	HD	B84143-B1600-S21
2028	ND	B84143-B2500-S21
	HD	B84143-B2500-S21

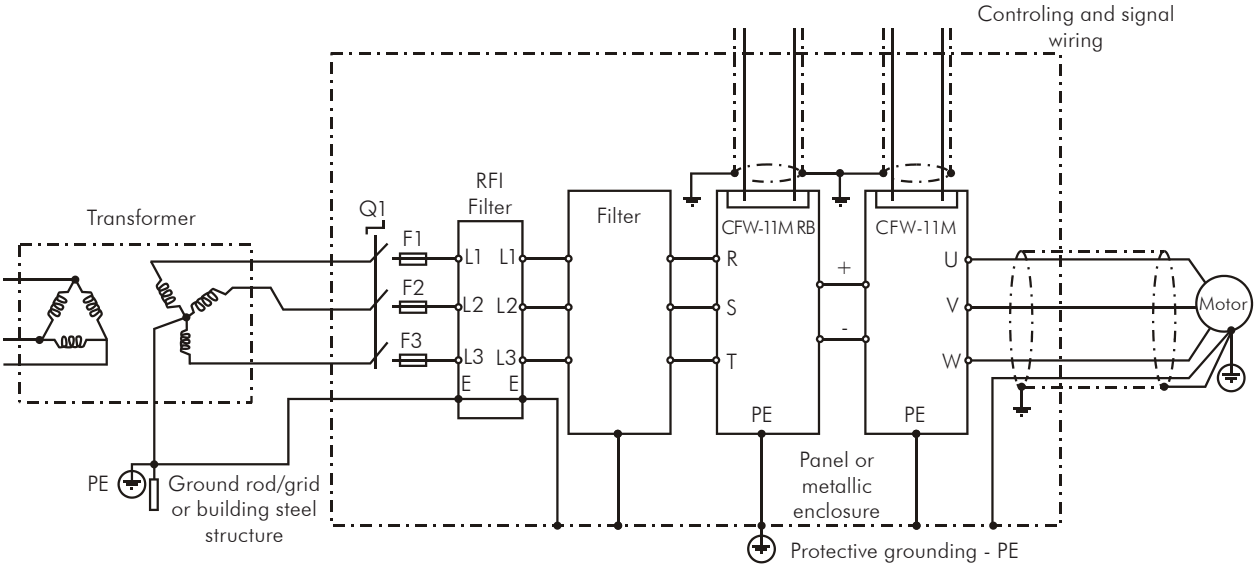


Figure 3.57 - *External RFI filter connections*

Use only listed filters in lines with solid grounded neutral point. Do not use RFI filtes in IT networks, lines not grounded or grounded via a high impedance.

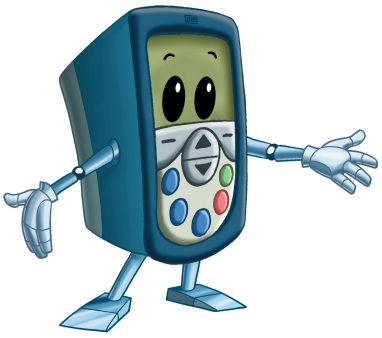
Take the usual precautions for EMC filters installation: do not cross the filter input cables with the output cables, mount the filter on a metallic plate assuring the biggest possible contact surface between the filter and the plate, connect this plate to the ground via cordage.

Filter technical data:

Table 3.22 - *Filter characteristics*

Filter	Rated Current [A]	Watt Losses [W]	Weight [kg]
B84143-B600-S20	600	57	22
B84143-B1000-S20	1000	99	28
B84143-B1600-S20	1600	169	34
B84143-B2500-S20	2500	282	105
B84143-B600-S21	600	57	22
B84143-B1000-S21	1000	99	28
B84143-B1600-S21	1600	169	34
B84143-B2500-S21	2500	282	105

4 KEYPAD AND DISPLAY



This chapter describes:
- The operator keys and their functions.
- The indications on the display.
- Parameters organization.

4.1 INTEGRAL KEYPAD - HMI - CFW11

The integral keypad can be used to operate and program (view / edit all parameters) of the converter. The converter keypad navigation is similar to the one used in cell phones and the parameters can be accessed in numerical order or through groups (Menu).

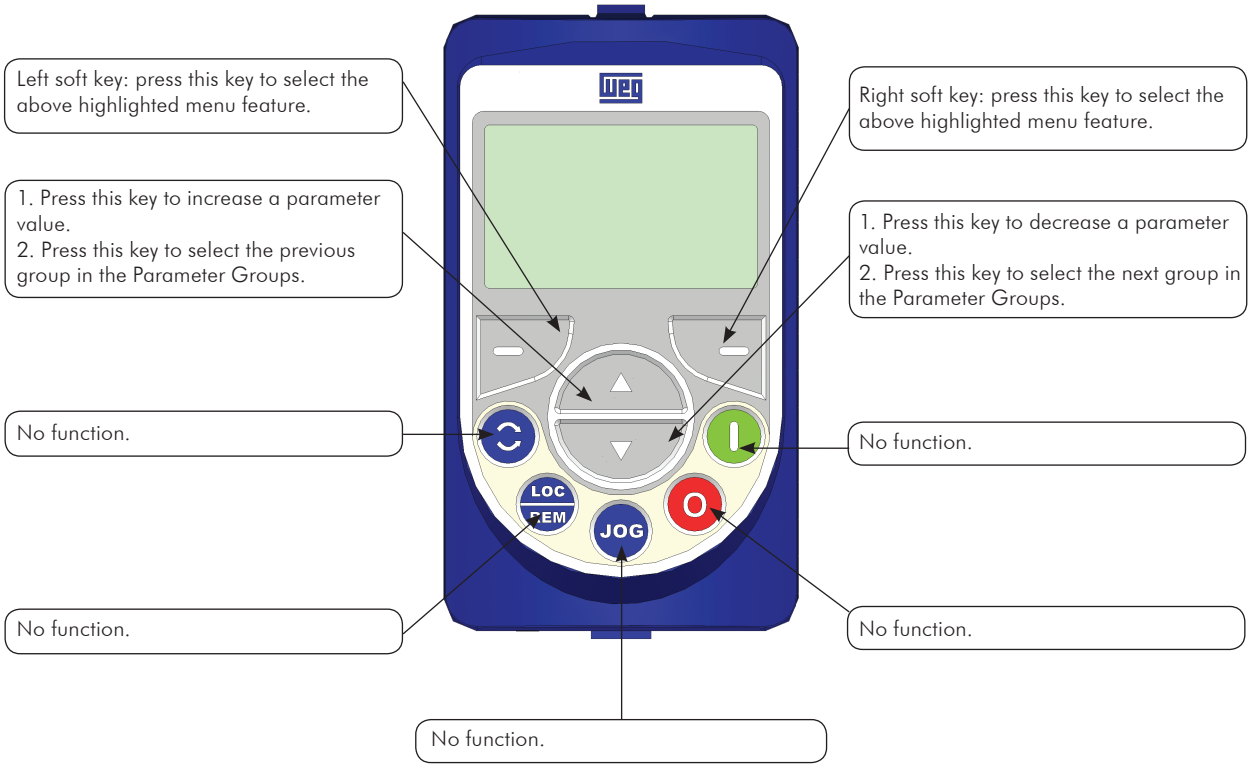
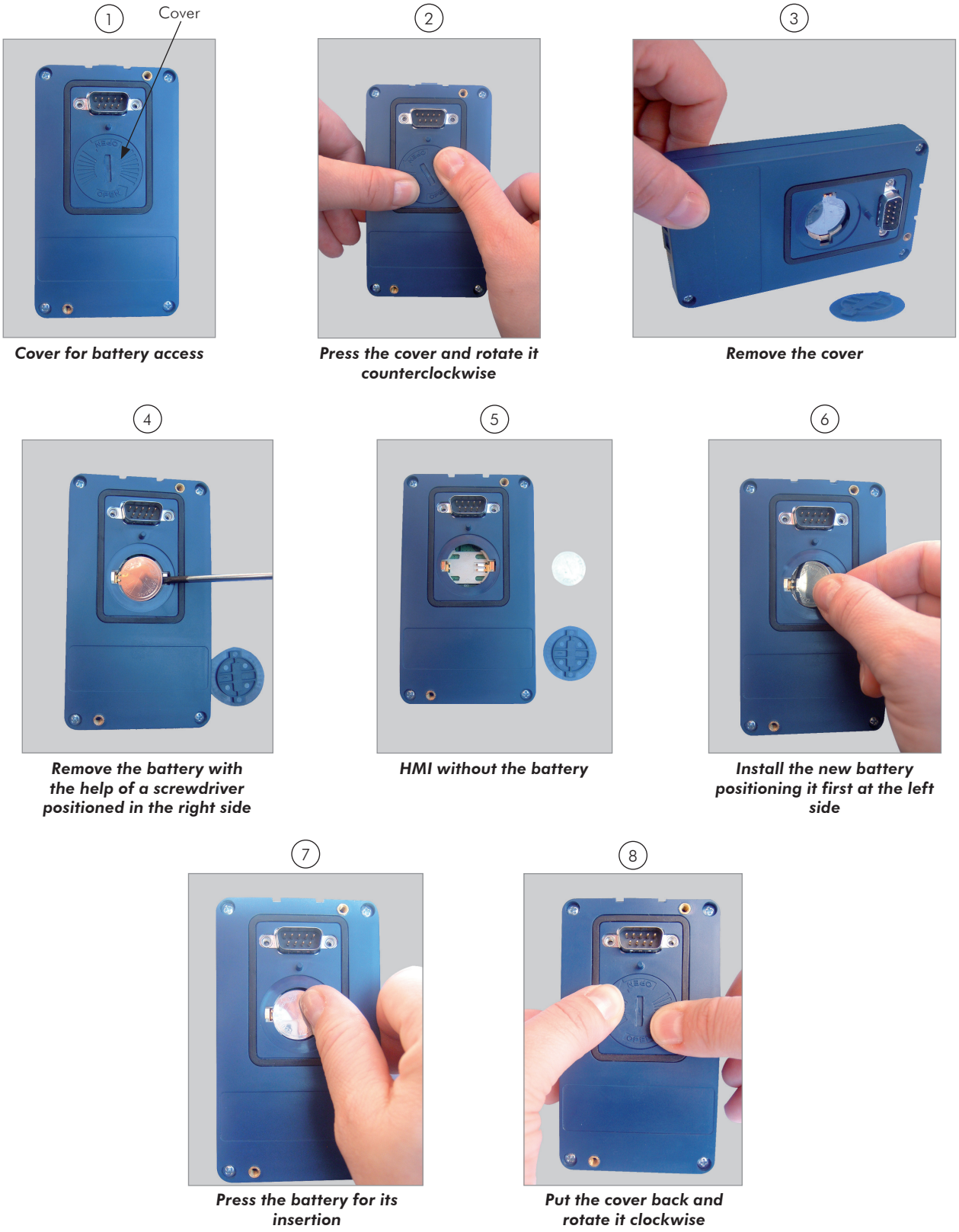


Figure 4.1 - *Keypad keys*

Battery:

NOTE!
The battery is necessary only to keep the internal clock operation when the converter stays without power. If the battery is completely discharged or if it is not installed in the keypad, the displayed clock time will be invalid and an alarm condition A181 - Invalid clock time will be indicated whenever the AC power is applied to the converter.

The battery life expectancy is of approximately 10 years. When necessary, replace the battery by another of the CR2032 type.



1 – *Cover for battery access*

2 – *Press the cover and rotate it counterclockwise*

3 – *Remove the cover*

4 – *Remove the battery with the help of a screwdriver positioned in the right side*

5 – *HMI without the battery*

6 – *Install the new battery positioning it first at the left side*

7 – *Press the battery for its insertion*

8 – *Put the cover back and rotate it clockwise*

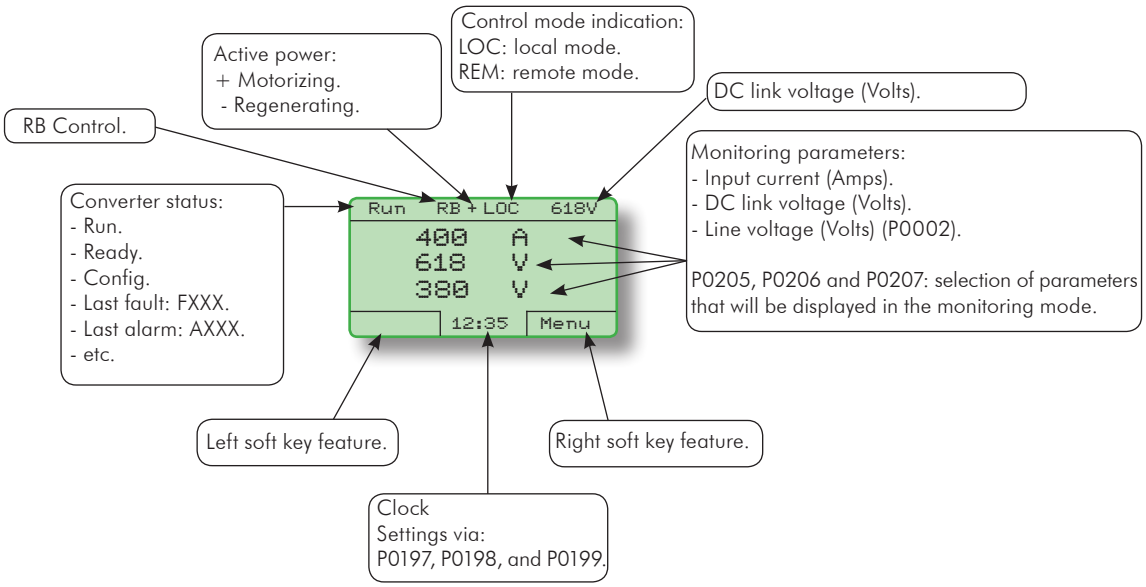
Figure 4.2 - *HMI battery replacement*

NOTE:
At the end of the battery useful life, please do not discard batteries in your waste container, but use a battery disposal site.

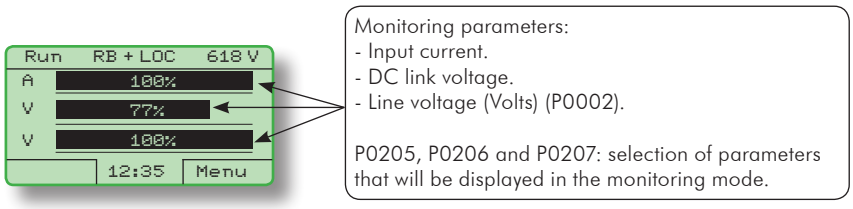
☑ The HMI can be installed or removed from the converter with or without AC power applied to the converter.

☑ The HMI supplied with the product can also be used for remote command of the converter. In this case, use a cable with male and female D-Sub9 (DB-9) connectors wired pin to pin (mouse extension type) or a market standard Null-Modem cable. Maximum cable length: 10 m (33 ft). It is recommended the use of the M3 x 5.8 standoffs supplied with the product. Recommended torque: 0.5 N.m (4.5 lbf.in).

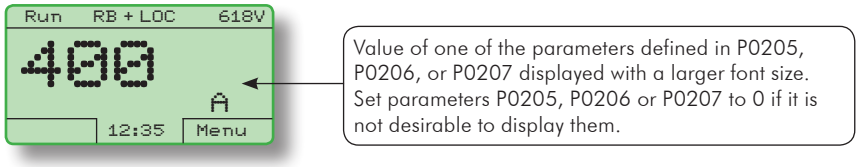
When power is applied to the converter, the display automatically enters the monitoring mode. Figure 4.3 **(a)** presents the monitoring screen displayed for the factory default settings. By properly setting specific converter parameters, other variables can be displayed in the monitoring mode or the value of a parameter can be displayed using bar graphs or with larger characters as presented in figures 4.3 **(b)** and **(c)**.



(a) Monitoring screen with factory default settings



(b) Example of a monitoring screen with bar ghaphs



(c) Example of a monitoring screen displaying a parameter with a larger font size

Figure 4.3 - *(a) to (c) Monitoring modes*

4.2 PARAMETERS ORGANIZATION

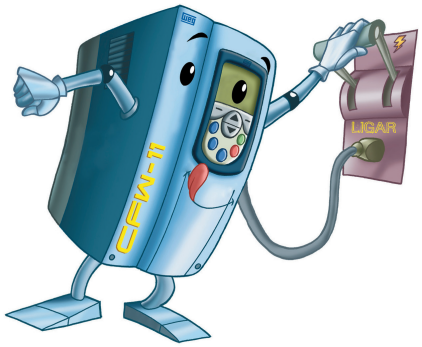
When the right soft key ("MENU") is pressed in the monitoring mode, the display shows the first 4 groups of parameters. Table 4.1 shows an example of parameter groups and how they are organized. The number

and name of the groups may change depending on the firmware version used. For further details on the existent groups for the firmware version used, please refer to the programming manual.

Table 4.1 - *CFW-11M RB parameters organization*

Level 0	Level 1	Level 2	Level 3
Monitoring	00 ALL PARAMETERS		
	01 PARAMETER GROUPS	20 DC Link Voltage	
		21 Control	90 Current Regulator
			91 Reactive Regulator
			92 Current Limiting
			93 DC Link Regulator
		22 HMI	
		24 Analog Outputs	
		25 Digital Inputs	
		26 Digital Outputs	
		27 Converter Data	
		28 Protections	
	02 ORIENTED START-UP		
	03 CHANGED PARAMETERS		
	04 BACKUP PARAMETERS		
	05 I/O CONFIGURATION	24 Analog Outputs	
		25 Digital Inputs	
		26 Digital Outputs	
	06 FAULT HISTORY		
	07 READ ONLY PARAMETERS		

5 FIRST TIME POWER-UP AND START-UP



This chapter describes how to:
- Check and prepare the converter before power-up.
- Power-up the converter and check the result.

5.1 PREPARATIONS FOR THE START-UP

The converter shall have been already installed according to the recommendations listed in Chapter 3 – Installation and Connection.
The following recommendations are applicable even if the application design is different from the suggested control connections.

DANGER!
Always disconnect the main power supply before performing any converter connection.

5.1.1 Procedures for the First Time Power-up/Start-up

1. Verify all the panel connections.
2. Search for short-circuits at the input, DC link, etc.
3. Make sure all the cables are correctly connected between the control and power units.
4. Verify the condition of all the fuses.
5. Inspect all the ground connections (panel, the door where the control is installed, etc.).
6. Remove all the material rests from the converter or panel interior.
7. Close the converter or panel covers.
8. Energize the control (+24 Vdc power supply).
9. The HMI must indicate undervoltage with the control energized and the power units deenergized. The electronics of the power units stay without power (SMPS off) and the DC link monitoring signal remains at 0 V.
10. Measure the line voltage making sure it is inside the permitted range.
11. Verify if the automatic hardware identification has correctly recognized the converter current and voltage. The converter current must be compatible with the number of installed power units.
12. Command the drive, perform the DC link pre-charge and close the main contactor/circuit breaker keeping the converters always connected to the DC link with the PWM pulses disabled.
13. Verify the proper operation of the fans. The fan control configuration is done via software through the parameter P0352 (refer to the CFW-11 RB programming manual). The power units do not have internal

fans at the electronics, only at the heatsinks. At the factory default the fans stay on for a while during the energization and then they are switched off. They will only be switched on again if the heatsink temperature reaches 70 °C (158 °F), and off if the temperature drops below 60 °C (140 °F).

14. Observe the existence of faults/alarms. In case that a fault or alarm occurs, verify the possible causes and solve the problem.

15. Enable the converter PWM pulses via DI. Verify the input current of each power unit phase by programming the password 637 at the parameter P0000 (refer to the item 5.2.1), which makes the visualization of the parameters from P0815 to P0829 possible.

16. Verify if the DC link voltage at P0004 presents a value close to P0151.

17. Disable the converter.

18. Verify if the temperature reading parameters of the installed power units, P0800 to P0814 according to the case, indicate values close to the ambient temperature.

19. Follow the start-up routine of the output inverter according to the instructions described at the specific manual.

20. Deenergize the drive and wait until the complete discharge of the DC link capacitors. Then connect a motor with power close to 100 HP (75 kW) or the application motor with no load. Verify the motor connection and if its current and voltage match with the inverter. If the motor of the application is going to be used, decouple it mechanically from the load. If the motor cannot be decoupled, make sure that the rotation in any direction (clockwise or counterclockwise) will not cause damage to the machine or accident risks.

21. Command the drive, perform the DC link pre-charge and close the main contactor.

22. Enable the converter PWM pulses. Verify the input current of each CFW-11M RB power unit phase: the current unbalance (P0815 to P0829) must be at most 10 %, considering that the maximum current of the power units is respected individually.

5.2 START-UP

The start-up procedure is described in three simple steps by using the existing parameter groups, **Oriented Start-up** routine and the **Basic Application** group.

Steps:

(1) Set the password for parameter modification.

(2) Execute the **Oriented Start-up** routine.

(3) Set the parameters of the **Basic Application** group.

5.2.1 Password Setting in P0000

Step	Action/Result	Display Indication
1	- Monitoring Mode. - Press **"Menu"** (rigth soft key).	Run RB + LOC 618 V 400 A 618 V 380 V 15:45 Menu
2	- Group **"00 ALL PARAMETERS"** is already selected. - Press **"Select"**.	Run RB + LOC 618V 00 ALL PARAMETERS 01 PARAMETER GROUPS 02 ORIENTED START-UP 03 CHANGED PARAMETERS Return 15:45 Selec.
3	- Parameter **"Access to Parameters P0000: 0"** is already selected. - Press **"Select"**.	Run RB + LOC 618V Access to Parameters P0000: 0 Line Voltage P0002: 380 V Return 15:45 Selec.
4	- To set the password, press the Up Arrow until number **5** is displayed in the keypad.	Run RB + LOC 618V P0000 Access to Parameters 0 Return 15:45 Save
5	- When number **5** is displayed in the keypad, press **"Save"**.	Run RB + LOC 618V P0000 Access to Parameters 5 Return 15:45 Save
6	- If the setting has been properly performed, the keypad should display **"Access to Parameters P0000: 5".** - Press **"Return"** (left soft key).	Run RB + LOC 618V Access to Parameters P0000: 5 Line Voltage P0002: 380V Return 15:45 Selec.
7	- Press **"Return"**.	Run RB + LOC 618V 00 ALL PARAMETERS 01 PARAMETER GROUPS 02 ORIENTED START-UP 03 CHANGED PARAMETERS Return 15:45 Selec.
8	- The display returns to the Monitoring Mode.	Run RB + LOC 618V 400 A 618 V 380 V 15:45 Menu

Figure 5.1 - *Steps for allowing parameters modification via P0000*

5.2.2 Oriented Start-Up

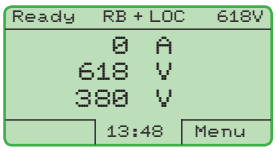
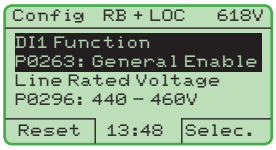
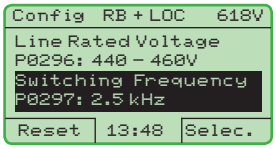
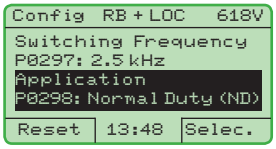
There is a group of parameters named "Oriented Start-up" that makes the converter settings easier. Within this group there is a parameter P0317, through which it is possible to enter in the Oriented Start-Up routine.

The Oriented Start-Up routine presents the main parameters on the HMI in a logical sequence, so that their setting, according to the operation conditions, prepares the converter for the operation with the used line and motor.

In order to enter into the Oriented Start-up routine, follow the steps presented in figure 5.2, first modifying parameter P0317 to 1 and then, setting all remaining parameters as they are prompted in the display.

The use of the Oriented Start-up routine for setting the converter parameters may lead to the automatic modification of other internal parameters and/or variables of the converter.

During the Oriented Start-up routine, the message "Config" will be displayed at the left top corner of the keypad.

Step	Action/Result	Display Indication
1	- Monitoring Mode. - Press **"Menu"** (right soft key).	
3	- Group **"01 PARAMETER GROUPS"** is selected. 	
5	- Parameter **"Oriented Start-Up P0317: No"** is already selected. - Press **"Select"**.	
7	- The parameter value is modified to **"P0317 = [001] Yes"**. - Press **"Save"**.	
9	- If needed, change the value of P0263 according to the application. To do so, press **"Select"**. - It is necessary to have one DI set to General Enable in order the regenerative converter can be enabled. 	
11	- If needed, change the value of P0298 according to the application. To do so, press **"Select"**. The time and the activation level of the IGBT's overload protection will be affected as well. - To complete the Oriented Start-Up routine, press **"Reset"** (left soft key).	 

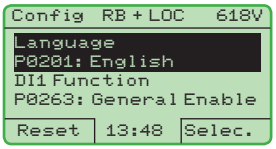
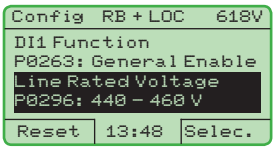
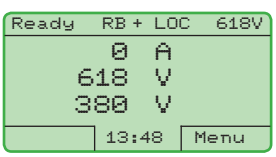
Step	Action/Result	Display Indication
2	- Group **"00 ALL PARAMETERS"** is already selected. 	
4	- Group **"02 ORIENTED START-UP"** is then selected. - Press **"Select"**.	
6	- The value of **"P0317 = [000] No"** is displayed. 	
8	- At this point the Oriented Start-up routine starts and the "Config" status is displayed at the top left corner of the keypad. - The parameter **"Language P0201: English"** is already selected. - If needed, change the language by pressing **"Select"**. Then, press  or  to scroll through the available options and press **"Save"** to select a different language. 	
10	- If needed, change the value of P0296 according to the line voltage. To do so, press **"Selec."**. This change will affect P0151. 	
12	- After few seconds, the display returns to the Monitoring Mode.	

Figure 5.2 - *Oriented Start-up*

5.3 SETTING DATE AND TIME

Step	Action/Result	Display Indication
1	- Monitoring Mode. - Press **"Menu"** (right soft key).	Run RB + LOC 618V 400 A 618 V 380 V 16:10 Menu
2	- Group **"00 ALL PARAMETERS"** is already selected.	Run RB + LOC 618V 00 ALL PARAMETERS 01 PARAMETER GROUPS 02 ORIENTED START-UP 03 CHANGED PARAMETERS Return 16:10 Selec.
3	- Group **"01 PARAMETER GROUPS"** is selected. - Press **"Select"**.	Run RB + LOC 618V 00 ALL PARAMETERS 01 PARAMETER GROUPS 02 ORIENTED START-UP 03 CHANGED PARAMETERS Return 16:10 Selec.
4	- A new list of groups is displayed and group **"20 DC Link Voltage"** is selected. - Press until you reach group **"22 HMI"**.	Run RB + LOC 618V 20 DC Link Voltage 21 Control 22 HMI 23 Analog Inputs Return 16:10 Selec.
5	- Group **"22 HMI"** is selected. - Press **"Selec."**.	Run RB + LOC 618V 20 DC Link Voltage 21 Control 22 HMI 23 Analog Inputs Return 16:10 Selec.
6	- Parameter **"Day P0194"** is already selected. - If needed, set P0194 according to the actual day. To do so, press **"Select"** and then, or to change P0194 value. - Follow the same steps to set parameters **"Month P0195"** to **"Seconds P0199"**.	Run RB + LOC 618V Day P0194: 06 Month P0195: 10 Return 16:10 Selec.
7	- Once the setting of P0199 is over, the Real Time Clock is now updated. - Press **"Return"** (left soft key).	Run RB + LOC 618V Minutes P0198: 11 Seconds P0199: 34 Return 18:11 Selec.
8	- Press **"Return"**.	Run RB + LOC 618V 20 DC Link Voltage 21 Control 22 HMI 23 Analog Inputs Return 18:11 Selec.
9	- Press **"Return"**.	Run RB + LOC 618V 00 ALL PARAMETERS 01 PARAMETER GROUPS 02 ORIENTED START-UP 03 CHANGED PARAMETERS Return 18:11 Selec.
10	- The display returns to the Monitoring Mode.	Run RB + LOC 618V 400 A 618 V 380 V 18:11 Menu

Figure 5.3 - *Setting date and time*

5.4 BLOCKING PARAMETERS MODIFICATION

To prevent unauthorized or unintended parameters modification, parameter P0000 should be set to a value different from 5. Follow the same procedures described in item 5.2.1. Refer to P0200 at the programming manual to know how to change the password.

5.5 HOW TO CONNECT TO A PC

NOTES!

- Always use a standard host/device shielded USB cable. Unshielded cables may lead to communication errors.
- Recommended cables: Samtec:

USBC-AM-MB-B-B-S-1 (1 meter) (39.36 in).
USBC-AM-MB-B-B-S-2 (2 meter) (78.73 in).
USBC-AM-MB-B-B-S-3 (3 meter) (118.10 in).

- The USB connection is galvanically isolated from the mains power supply and from other high voltages internal to he converter. However, the USB connection is not isolated from the Protective Ground (PE). Use an isolated notebook for the USB connection or a desktop connected to the same Protective Ground (PE) of the converter.

5.6 FLASH MEMORY MODULE

Features:

- Stores a copy of the converter parameters.
- Transfers the parameters stored in the FLASH memory to the converter.
- Transfers the firmware stored in the FLASH memory to the converter.

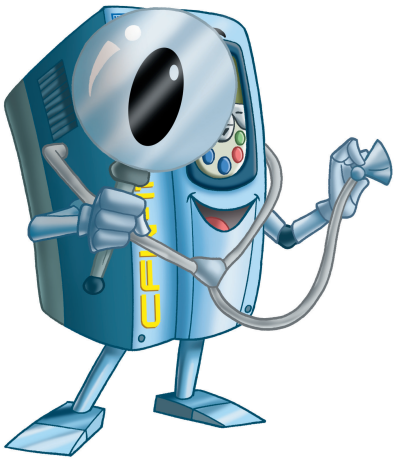
Whenever the converter is powered up, this program is transferred to the RAM memory located in the converter control board and executed.

Refer to the CFW-11 RB programming manual for further details.

ATTENTION!

Before installing or removing the FLASH memory module, first disconnect the converter power supply and wait for the complete discharge of the capacitors and then disconnect the +24 V control voltage.

6 TROUBLESHOOTING AND MAINTENANCE



This chapter presents the following:
- Lists all faults and alarms that may occur.
- Indicates the possible causes of each fault and alarm.
- Lists most frequent problems and corrective actions.
- Presents instructions for periodic inspections and preventive maintenance in the equipment.

6.1 OPERATION OF THE FAULTS AND ALARMS

When a fault is detected fault (FXXX):

☑ The PWM pulses are blocked.

☑ The keypad displays the fault code and description.

☑ The "STATUS" LED starts flashing red.

☑ The output relay set to "NO FAULT" opens.

☑ Some control circuitry data is saved in the EEPROM memory:
- The fault or alarm code that occurred (shifts the last nine previous faults and alarms).
- The state of the operating hours counter (P0043) and the powered-up hours counter (P0042).

Reset the converter to return the drive to a "READY" condition in the event of a fault. The following reset options are available:

☑ Removing the power supply and reapplying it (power-on reset).

☑ Pressing the operator key O (manual reset).

☑ Through the "Reset" soft key.

☑ Automatically by setting P0340 (auto-reset).

☑ Through a digital input: DIx = 20 (P0263 to P0270).

When an alarm situation alarm (AXXX) is detected:

☑ The keypad displays the alarm code and description.

☑ The "STATUS" LED changes to yellow.

☑ The PWM pulses are not blocked (the converter is still operating).

6.2 FAULTS, ALARMS, AND POSSIBLE CAUSES

Table 6.1 - *Faults, alarms and possible causes*

Fault/Alarm	Description	Possible Causes
F006: Imbalance or Input Phase Loss	Phase missing in the input power supply or wrong phase sequency.	☑ CSR11 board connections. ☑ Synchronism transformer connections. ☑ Power supply connections.
F021: DC Bus Undervoltage	DC bus undervoltage condition occurred.	☑ The input voltage is too low and the DC bus voltage dropped below the minimum permitted value (monitor the value at Parameter P0004): Ud < 223 V - For a 200 / 240 V input voltage (P0296 = 0). Ud < 385 V - For a 380 V input voltage (P0296 = 1). Ud < 405 V - For a 400 / 415 V input voltage (P0296 = 2). Ud < 446 V - For a 440 / 460 V input voltage (P0296 = 3). Ud < 487 V - For a 480 V input voltage (P0296 = 4). Ud < 530 V - For a 500 / 525 V input voltage (P0296 = 5). Ud < 580 V - For a 550 / 575 V input voltage (P0296 = 6). Ud < 605 V - For a 600 V input voltage (P0296 = 7). Ud < 696 V - For a 660 / 690 V input voltage (P0296 = 8). ☑ Phase loss in the input power supply. ☑ Pre-charge circuit failure. ☑ Parameter P0296 was set to a value above of the power supply rated voltage.
F022: DC Bus Overvoltage	DC bus overvoltage condition occurred.	☑ The input voltage is too high and the DC bus voltage surpassed the maximum permitted value: Ud > 400 V - For 220 / 230 V input models (P0296 = 0). Ud > 800 V - For 380 / 480 V input models (P0296 = 1, 2, 3 or 4). Ud > 1000 V - For 500 / 600 V input models (P0296 = 5, 6 or 7). Ud > 1200 V - For 660 / 690 V input models (P0296 = 8). ☑ Inertia of the driven-load is too high or deceleration time is too short. ☑ Wrong settings for parameters P0151, or P0153, or P0185.
F030(*): Power Module U Fault	Desaturation of IGBT occured in Power Module U.	☑ Short-circuit between motor phases U and V or U and W.(1)
F034(*): Power Module V Fault	Desaturation of IGBT occured in Power Module V.	☑ Short-circuit between motor phases V and U or V and W.(1)
F038(*): Power Module W Fault	Desaturation of IGBT occured in Power Module W.	☑ Short-circuit between motor phases W and U or W and V.(1)
A047: IGBT Overload Alarm	A IGBT overload alarm occurred. **Note:** It may be disabled by setting P0350 = 0 or 2.	☑ Converter input current is too high.
F048: IGBT Overload Fault	A IGBT overload fault occurred.	☑ Converter input current is too high.

(*) For the Modular Drive it is not indicated in the HMI in which book happened the fault. For such, it is necessary to check the LED's at the IPS1 board (refer to note **(1)**).

Fault/Alarm	Description	Possible Causes
A050: IGBT High Temperature U	A high temperature alarm was detected by the NTC temperature sensors located on the IGBTs. **Note:** It may be disabled by setting P0353 = 2 or 3.	☑ Surrounding air temperature is too high (> 40 °C or 45 °C (104 °F or 113 °F) depending on the converter model - refer to item 3.1) and output current is too high. ☑ Blocked or defective fan. ☑ Very dirty heatsink.
F051: IGBT Overtemperature U	Overtemperature fault on the IGBTs of phase U.	
A053: High Temperature on IGBTs V	Alarm of high temperature measured at the temperature sensors (NTC) of the IGBTs. **Note:** It can be disabled by setting P0353 = 2 or 3.	
F054: Overtemperature on IGBTs V	Overtemperature fault on the IGBTs of phase V.	
A056: High Temperature on IGBTs W	Alarm of high temperature measured at the temperature sensors (NTC) of the IGBTs. **Note:** It can be disabled by setting P0353 = 2 or 3.	
F057: Overtemperature on IGBTs W	Overtemperature fault on the IGBTs of phase W.	
F070: Overcurrent /Short-circuit	Overcurrent or short-circuit detected at the input, DC link.	☑ IGBT modules are shorted.
F071: Input Overcurrent	The converter input current was too high for too long.	☑ Input reactance too low. ☑ P0169 and P0170 settings are too high.
F074: Ground Fault	A ground fault occured. **Note:** It may be disabled by setting P0343 = 0.	☑ +UD or -UD short-circuit to ground.
F080: CPU Watchdog	Microcontroller watchdog fault.	☑ Electrical noise.
F082: Copy Function Fault	Fault while copying parameters.	☑ An attempt to copy the keypad parameters to an converter with a different firmware version.
F084: Auto-diagnosis Fault	Auto-diagnosis Fault.	☑ Defect in the converter internal circuitry.
A088: HMI Communication Lost	Indicates a problem with the keypad and control board communication.	☑ Loose keypad cable connection. ☑ Electrical noise in the installation.
A090: External Alarm	External alarm via digital input. **Note:** It is required to set a digital input to "No external alarm".	☑ Wiring was not connected to the digital input (DI1 to DI8) set to "No external alarm".
F091: External Fault	External fault via digital input. **Note:** It is required to set a digital input to "No external fault".	☑ Wiring was not connected to the digital input (DI1 to DI8) set to "No external fault".
F099: Invalid Current Offset	Current measurement circuit is measuring a wrong value for null current.	☑ Defect in the converter internal circuitry.
F101: Invalid Voltage Offset	Offset calculation error when reading the input voltage (synchronism).	☑ Main contactor closed before the pre-charge is complete. ☑ CPU has reset and the main contactor did not open.
A105: Reactive Injection in the Power Supply	Alarm for the reactive current injection in the power supply.	☑ Voltage power supply much higher than the rated voltage. ☑ P0180 too low.
F151: FLASH Memory Module Fault	FLASH Memory Module fault (MMF-01).	☑ Defective FLASH memory module. ☑ Check the connection of the FLASH memory module.
A152: Internal Air High Temperature	Alarm indicating that the internal air temperature is too high. **Note:** It may be disabled by setting P0353 = 1 or 3.	☑ Surrounding air temperature too high (>40 °C or 50 °C (104 °F or 122°F) according to the model - refer to item 3.1) and excessive output current. ☑ Blocked or defective fan. ☑ Fins of the book heatsink too dirty, impairing the air flow.
F153: Internal Air Overtemperature	Internal air overtemperature fault.	
F156: Undertemperature	Undertemperature fault below -30 °C (-22 °F) in the IGBTs or rectifier measured by the temperature sensors.	☑ Surrounding air temperature ≤ -30 °C (-22 °F). ☑ Defective internal circuitry of the power modules (supply, cables).
A177: Fan Replacement	Fan replacement alarm (P0045 > 50000 hours). **Note:** This function may be disabled by setting P0354 = 0.	☑ Maximum number of operating hours for the heatsink fan has been reached.
F179: Heatsink Fan Speed Fault	Fan speed is under the minimum limit.	☑ The fan is dirt or blocked.
A181: Invalid Clock Value	Invalid clock value alarm.	☑ It is necessary to set date and time at parameters P0194 to P0199. ☑ Keypad battery is discharged, defective, or not installed.

Fault/Alarm	Description	Possible Causes
F182: Pulse Feedback Fault	Indicates a fault on the PWM pulses feedback.	☑ Defective converter internal circuitry. ☑ Defect in the optical fiber. ☑ Defect in cables XC10 A, B, C, D or E.
F183: IGBT Overload + Temperature	Overtemperature related to the IGBTs overload protection.	☑ Surrounding air temperature too high. ☑ Operation with frequencies < 10 Hz under overload.
A300: High temperature at IGBT U B1	High temperature alarm measured with the temperature sensor (NTC) of the book 1 U phase IGBT.	☑ Surrounding air temperature too high (>40 °C or 50 °C (104 °F or 122°F) according to the model - refer to item 3.1) and excessive output current. ☑ Blocked or defective fan. ☑ Fins of the book heatsink too dirty, impairing the air flow.
F301: Overtemperature at IGBT U B1	Overtemperature fault measured with the temperature sensor (NTC) of the book 1 U phase IGBT.	
A303: High temperature at IGBT V B1	High temperature alarm measured with the temperature sensor (NTC) of the book 1 V phase IGBT.	☑ Surrounding air temperature too high (>40 °C or 50 °C (104 °F or 122°F) according to the model - refer to item 3.1) and excessive output current. ☑ Blocked or defective fan. ☑ Fins of the book heatsink too dirty, impairing the air flow.
F304: Overtemperature at IGBT V B1	Overtemperature fault measured with the temperature sensor (NTC) of the book 1 V phase IGBT.	
A306: High temperature at IGBT W B1	High temperature alarm measured with the temperature sensor (NTC) of the book 1 W phase IGBT.	
F307: Overtemperature at IGBT W B1	Overtemperature fault measured with the temperature sensor (NTC) of the book 1 W phase IGBT.	
A309: High temperature at IGBT U B2	High temperature alarm measured with the temperature sensor (NTC) of the book 2 U phase IGBT.	
F310: Overtemperature at IGBT U B2	Overtemperature fault measured with the temperature sensor (NTC) of the book 2 U phase IGBT.	
A312: High temperature at IGBT V B2	High temperature alarm measured with the temperature sensor (NTC) of the book 2 V phase IGBT.	
F313: Overtemperature at IGBT V B2	Overtemperature fault measured with the temperature sensor (NTC) of the book 2 V phase IGBT.	
A315: High temperature at IGBT W B2	High temperature alarm measured with the temperature sensor (NTC) of the book 2 W phase IGBT.	
F316: Overtemperature at IGBT W B2	Overtemperature fault measured with the temperature sensor (NTC) of the book 2 W phase IGBT.	
A318: High temperature at IGBT U B3	High temperature alarm measured with the temperature sensor (NTC) of the book 3 U phase IGBT.	
F319: Overtemperature at IGBT U B3	Overtemperature fault measured with the temperature sensor (NTC) of the book 3 U phase IGBT.	
A321: High temperature at IGBT V B3	High temperature alarm measured with the temperature sensor (NTC) of the book 3 V phase IGBT.	
F322: Overtemperature at IGBT V B3	Overtemperature fault measured with the temperature sensor (NTC) of the book 3 V phase IGBT.	
A324: High temperature at IGBT W B3	High temperature alarm measured with the temperature sensor (NTC) of the book 3 W phase IGBT.	
F325: Overtemperature at IGBT W B3	Overtemperature fault measured with the temperature sensor (NTC) of the book 3 W phase IGBT.	
A327: High temperature at IGBT U B4	High temperature alarm measured with the temperature sensor (NTC) of the book 4 U phase IGBT.	
F328: Overtemperature at IGBT U B4	Overtemperature fault measured with the temperature sensor (NTC) of the book 4 U phase IGBT.	
A330: High temperature at IGBT V B4	High temperature alarm measured with the temperature sensor (NTC) of the book 4 V phase IGBT.	
F331: Overtemperature at IGBT V B4	Overtemperature fault measured with the temperature sensor (NTC) of the book 4 V phase IGBT.	
A333: High temperature at IGBT W B4	High temperature alarm measured with the temperature sensor (NTC) of the book 4 W phase IGBT.	
F334: Overtemperature at IGBT W B4	Overtemperature fault measured with the temperature sensor (NTC) of the book 4 W phase IGBT.	
A336: High temperature at IGBT U B5	High temperature alarm measured with the temperature sensor (NTC) of the book 5 U phase IGBT.	
F337: Overtemperature at IGBT U B5	Overtemperature fault measured with the temperature sensor (NTC) of the book 5 U phase IGBT.	
A339: High temperature at IGBT V B5	High temperature alarm measured with the temperature sensor (NTC) of the book 5 V phase IGBT.	
F340: Overtemperature at IGBT V B5	Overtemperature fault measured with the temperature sensor (NTC) of the book 5 V phase IGBT.	
A342: High temperature at IGBT W B5	High temperature alarm measured with the temperature sensor (NTC) of the book 5 W phase IGBT.	
F343: Overtemperature at IGBT W B5	Overtemperature fault measured with the temperature sensor (NTC) of the book 5 W phase IGBT.	

Fault/Alarm	Description	Possible Causes
A345: High Load at IGBT U B1	Overload alarm at book 1 U phase IGBT.	☑ High current at the converter output (see Table 8.1).
F346: Overload at IGBT U B1	Overload fault at book 1 U phase IGBT.	
A348: High Load at IGBT V B1	Overload alarm at book 1 V phase IGBT.	
F349: Overload at IGBT V B1	Overload fault at book 1 V phase IGBT.	
A351: High Load at IGBT W B1	Overload alarm at book 1 W phase IGBT.	
F352: Overload at IGBT W B1	Overload fault at book 1 W phase IGBT.	
A354: High Load at IGBT U B2	Overload alarm at book 2 U phase IGBT.	
F355: Overload at IGBT U B2	Overload fault at book 2 U phase IGBT.	
A357: High Load at IGBT V B2	Overload alarm at book 2 V phase IGBT.	
F358: Overload at IGBT V B2	Overload fault at book 2 V phase IGBT.	
A360: High Load at IGBT W B2	Overload alarm at book 2 W phase IGBT.	
F361: Overload at IGBT W B2	Overload fault at book 2 W phase IGBT.	
A363: High Load at IGBT U B3	Overload alarm at book 3 U phase IGBT.	
F364: Overload at IGBT U B3	Overload fault at book 3 U phase IGBT.	
A366: High Load at IGBT V B3	Overload alarm at book 3 V phase IGBT.	
F367: Overload at IGBT V B3	Overload fault at book 3 V phase IGBT.	
A369: High Load at IGBT W B3	Overload alarm at book 3 W phase IGBT.	
F370: Overload at IGBT W B3	Overload fault at book 3 W phase IGBT.	☑ High current at the converter output (see Figure 8.1).
A372: High Load at IGBT U B4	Overload alarm at book 4 U phase IGBT.	
F373: Overload at IGBT U B4	Overload fault at book 4 U phase IGBT.	
A375: High Load at IGBT V B4	Overload alarm at book 4 V phase IGBT.	
F376: Overload at IGBT V B4	Overload fault at book 4 V phase IGBT.	
A378: High Load at IGBT W B4	Overload alarm at book 4 W phase IGBT.	
F379: Overload at IGBT W B4	Overload fault at book 4 W phase IGBT.	
A381: High Load at IGBT U B5	Overload alarm at book 5 U phase IGBT.	
F382: Overload at IGBT U B5	Overload fault at book 5 U phase IGBT.	
A384: High Load at IGBT V B5	Overload alarm at book 5 V phase IGBT.	
F385: Overload at IGBT V B5	Overload fault at book 5 V phase IGBT.	
A387: High Load at IGBT W B5	Overload alarm at book 5 W phase IGBT.	
F388: Overload at IGBT W B5	Overload fault at book 5 W phase IGBT.	

Fault/Alarm	Description	Possible Causes
A390: Current Unbalance at Phase U B1	Phase U book 1 current unbalance alarm. It indicates a 20 % unbalance in the current distribution between this phase and the smallest current of the same phase in other book, only when the current in this phase is higher than 75 % of its nominal value.	☑ Bad electric connection between the DC bus and the power unit. ☑ Bad electric connection between the power unit output and the power supply. **Note:** In case of fast acceleration or braking, this alarm may be indicated momentarily, disappearing after a few seconds. This is not an indication of any anomaly in the converter. If this alarm persists when the motor is operating at a constant speed, it is an indication of an anomaly in the current distribution among the power units.
A391: Current Unbalance at Phase V B1	Phase V book 1 current unbalance alarm. It indicates a 20 % unbalance in the current distribution between this phase and the smallest current of the same phase in other book, only when the current in this phase is higher than 75 % of its nominal value.	
A392: Current Unbalance at Phase W B1	Phase W book 1 current unbalance alarm. It indicates a 20 % unbalance in the current distribution between this phase and the smallest current of the same phase in other book, only when the current in this phase is higher than 75 % of its nominal value.	
A393: Current Unbalance at Phase U B2	Phase U book 2 current unbalance alarm. It indicates a 20 % unbalance in the current distribution between this phase and the smallest current of the same phase in other book, only when the current in this phase is higher than 75 % of its nominal value.	
A394: Current Unbalance at Phase V B2	Phase V book 2 current unbalance alarm. It indicates a 20 % unbalance in the current distribution between this phase and the smallest current of the same phase in other book, only when the current in this phase is higher than 75 % of its nominal value.	
A395: Current Unbalance at Phase W B2	Phase W book 2 current unbalance alarm. It indicates a 20 % unbalance in the current distribution between this phase and the smallest current of the same phase in other book, only when the current in this phase is higher than 75 % of its nominal value.	
A396: Current Unbalance at Phase U B3	Phase U book 3 current unbalance alarm. It indicates a 20 % unbalance in the current distribution between this phase and the smallest current of the same phase in other book, only when the current in this phase is higher than 75 % of its nominal value.	
A397: Current Unbalance at Phase V B3	Phase V book 3 current unbalance alarm. It indicates a 20 % unbalance in the current distribution between this phase and the smallest current of the same phase in other book, only when the current in this phase is higher than 75 % of its nominal value.	
A398: Current Unbalance at Phase W B3	Phase W book 3 current unbalance alarm. It indicates a 20 % unbalance in the current distribution between this phase and the smallest current of the same phase in other book, only when the current in this phase is higher than 75 % of its nominal value.	
A399: Current Unbalance at Phase U B4	Phase U book 4 current unbalance alarm. It indicates a 20 % unbalance in the current distribution between this phase and the smallest current of the same phase in other book, only when the current in this phase is higher than 75 % of its nominal value.	
A400: Current Unbalance at Phase V B4	Phase V book 4 current unbalance alarm. It indicates a 20 % unbalance in the current distribution between this phase and the smallest current of the same phase in other book, only when the current in this phase is higher than 75 % of its nominal value.	
A401: Current Unbalance at Phase W B4	Phase W book 4 current unbalance alarm. It indicates a 20 % unbalance in the current distribution between this phase and the smallest current of the same phase in other book, only when the current in this phase is higher than 75 % of its nominal value.	
A402: Current Unbalance at Phase U B5	Phase U book 5 current unbalance alarm. It indicates a 20 % unbalance in the current distribution between this phase and the smallest current of the same phase in other book, only when the current in this phase is higher than 75 % of its nominal value.	
A403: Current Unbalance at Phase V B5	Phase V book 5 current unbalance alarm. It indicates a 20 % unbalance in the current distribution between this phase and the smallest current of the same phase in other book, only when the current in this phase is higher than 75 % of its nominal value.	

Fault/Alarm	Description	Possible Causes
A404: Current Unbalance at Phase W B5	Phase W book 5 current unbalance alarm. It indicates a 20 % unbalance in the current distribution between this phase and the smallest current of the same phase in other book, only when the current in this phase is higher than 75 % of its nominal value.	☑ Bad electric connection between the DC bus and the power unit. ☑ Bad electric connection between the power unit output and the power supply. **Note:** In case of fast acceleration or braking, this alarm may be indicated momentarily, disappearing after a few seconds. This is not an indication of any anomaly in the converter. If this alarm persists when the motor is operating at a constant speed, it is an indication of an anomaly in the current distribution among the power units.
F408: Refrigeration System Fault	Indications related to P0832 and P0833 parameters settings. ☑ DIM 1 input function. ☑ DIM 2 input function.	☑ Electrical connection failure between the digital input and the sensor. ☑ Failure of the corrensponding sensor. ☑ Failure of the device whose sensor is monitoring.
F410: External Fault		

Obs.:
(1) In case of the faults F030 (U Arm Fault), F034 (V Arm Fault) and F038 (W Arm Fault), the indication of which book has caused the fault is done by IPS1 board LEDs. The indication is done is done via LEDs that remain on when the failure occurs. When a RESET is performed the LEDs are switched off, going on again if the fault persists (see Figure 6.1).

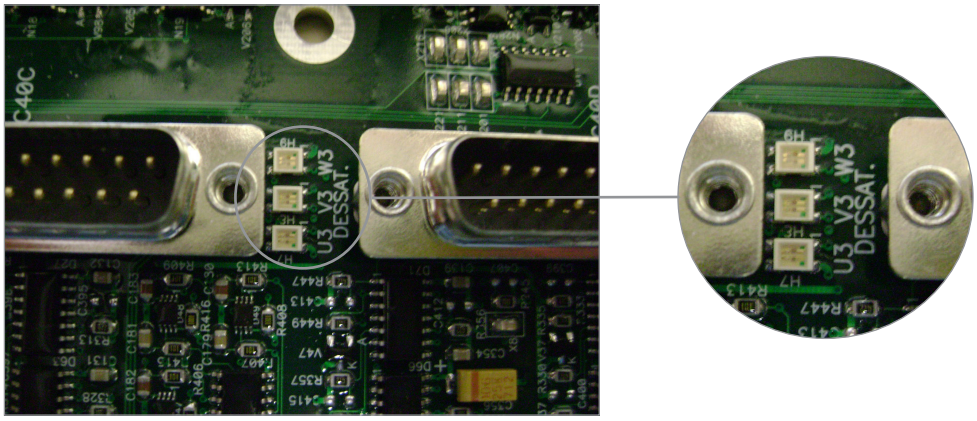


Figure 6.1 - *Power unit arm fault (desaturation) indication LEDs*

6.3 SOLUTIONS FOR THE MOST FREQUENT PROBLEMS

Table 6.2 - *Solutions for the most frequent problems*

Problem	Point to be Verified	Corrective Action
DC Bus Bar does not reach the value set in P0151	Incorrect wiring connection	1. Check all power and control connections. For instance, the digital inputs set to start/stop, general enable, or no external fault shall be connected to the 24 Vdc or to DGND* terminals (refer to figure 3.52).
	Incorrect settings	1. Check if parameters are properly set for the application.
	Fault	1. Check if the converter is not blocked due to a fault condition. 2. Check if terminals XC1:13 and XC1:11 are not shorted (short-circuit at the 24 Vdc power supply).
Off display	Keypad connections	1. Check the external keypad connections.
	Open power supply fuse(s)	1. Replace fuses.
	24 Vdc power supply voltage	1. Check if the 24 Vds control voltage is proper connected and turned on.

6.4 INFORMATION FOR CONTACTING TECHNICAL SUPPORT

NOTE!

For technical support and servicing, it is important to have the following information in hand:

- ☑ Converter model.
- ☑ Serial number, manufacturing date, and hardware revision that are listed in the product nameplate (refer to item 2.5).
- ☑ Installed software version (check parameter P0023).
- ☑ Application data and converter settings.

6.5 PREVENTIVE MAINTENANCE

DANGER!

- ☑ Always turn off the mains power supply before touching any electrical component associated to the converter.
- ☑ High voltage may still be present even after disconnecting the power supply.
- ☑ To prevent electric shock, wait at least 10 minutes after turning off the input power for the complete discharge of the power capacitors.
- ☑ Always connect the equipment frame to the protective ground (PE). Use the adequate connection terminal in the converter.

ATTENTION!

The electronic boards have electrostatic discharge sensitive components.
Do not touch the components or connectors directly. If needed, first touch the grounded mettalic frame or wear a ground strap.

Do not perform any withstand voltage test!
If needed, consult WEG.

The converter require low maintenance when properly installed and operated. Table 6.3 presents main procedures and time intervals for preventive maintenance. Table 6.4 provides recommended periodic inspections to be performed every 6 months after converter start-up.

Table 6.3 - *Preventive maintenance*

Maintenance		Interval	Instructions
Fan replacement		After 50000 operating hours.(1)	Replacement procedure shown in Figure 6.2.
Keypad battery replacement		Every 10 years.	Refer to chapter 4.
Electrolytic capacitors	If the converter is stocked (not being used): "Reforming"	Every year from the manufacturing date printed in the converter identification label (refer to item 2.5).	Supply the UP11 (at the +UD and -UD terminal) with a voltage 250 to 350 Vdc, during 1 hour at least. Then, disconnect the power supply and wait at least 24 hours before using the converter (reapply power).
	Converter is being used: replace	Every 10 years.	Contact WEG technical support to obtain replacement procedures.

Note:
(1) The converter are factory set for automatic fan control (P0352=2), which means that they will be turned on only when the heatsink temperature exceeds a reference value. Therefore, the operating hours of the fan will depend on the converter usage conditions (input current, cooling air temperature, etc.). The converter stores the number of operating hours of the fan in parameter P0045. When this parameter reaches 50000 operating hours, the keypad display will show alarm A177.

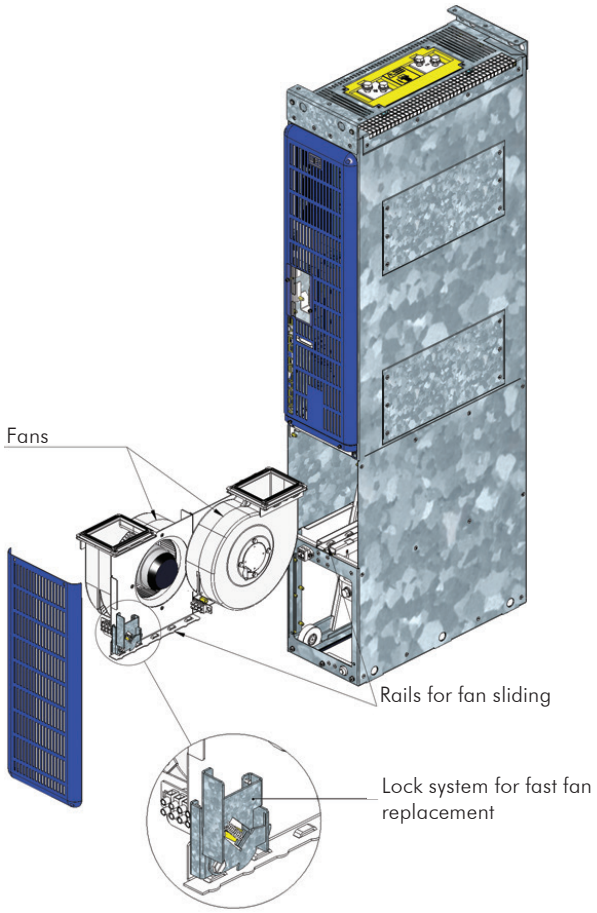


Figure 6.2 - *Fan replacement*

Table 6.4 - *Recommended periodic inspections - Every 6 months*

Component	Problem	Corrective Action
Terminals, connectors	Loose screws	Tighten
	Loose connectors	
Fans / Cooling system	Dirty fans	Cleaning
	Abnormal acoustic noise	Replace fan. Refer to figure 6.2. Check the fan connection.
	Blocked fan	
	Abnormal vibration	
	Dust in the cabinet air filter	Cleaning or replacement
Printed circuit boards	Accumulation of dust, oil, humidity, etc.	Cleaning
	Odor	Replacement
Power module / Power connections	Accumulation of dust, oil, humidity, etc.	Cleaning
	Loose connection screws	Tighten
DC bus capacitors (DC Link)	Discoloration / odor / electrolyte leakage	Replacement
	Expanded or broken safety valve	
	Frame expansion	
Power resistors	Discoloration	Replacement
	Odor	
Heatsink	Dust accumulation	Cleaning
	Dirty	

6.5.1 Cleaning Instructions

When it becomes necessary to clean the converter, follow the instructions below:

Ventilation system:

☑ Cut off the converter supply and wait 10 minutes.

☑ Remove the dust accumulated at the ventilation inlets with a plastic brush or a flannel.

☑ Remove the dust accumulated on the heatsink fins and on fan blades using compressed air.

Electronic boards:

☑ Cut off the converter supply and wait 10 minutes.

☑ Remove the dust accumulated on the boards using an anti-static brush or ionized compressed air (E.g.: Charges Burtes Ion Gun (non nuclear) reference A6030-6DESCO).

☑ If necessary, remove the boards from the converter.

☑ Use always an ESD wrist strap.

Inspect the heatsink fins of the power units regularly verifying if there is any dirt accumulation that could impair the converter cooling. Therefore, remove the power unit side cover.

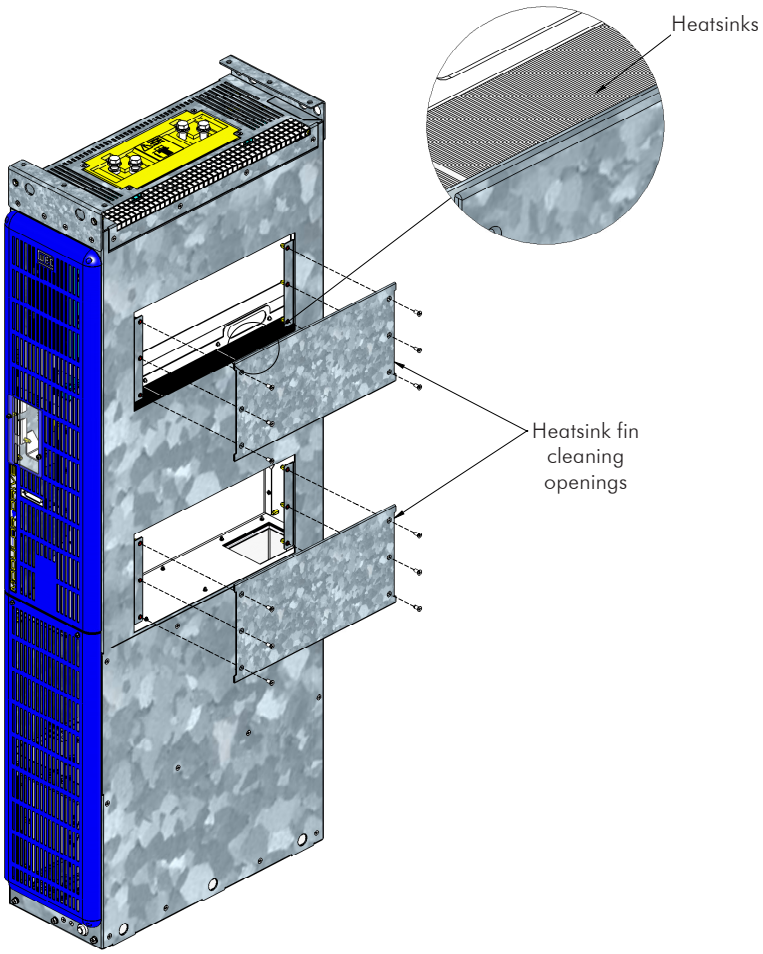


Figure 6.3 - *Covers to get access for inspection/cleaning of the heatsink fins*

7 ACCESSORIES

This chapter presents:

☑ The accessories that can be incorporated to the converter.

Details for the installation, operation, and programming of the accessories are described in their own manuals and were not included in this chapter.

7.1 ACCESSORIES

The accessories are installed to the converter easily and quickly using the "Plug and Play" concept. Once the accessory is connected to the slot, the control circuitry identifies the model and displays the installed accessory code in P0027 or P0028. The accessory shall be installed with the converter power supply off.

The code and model of each available accessory is presented in the following table. The accessories can be ordered separately and will be shipped in an individual package containing the components and the manual with detailed instructions for the product installation, operation, and programming.

ATTENTION!
Only one module can be fitted at once in each slot (1, 2, 3, 4, or 5).

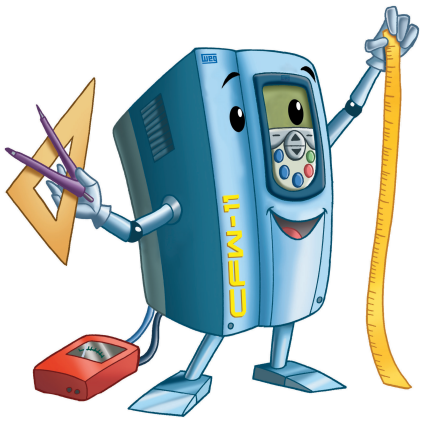
Table 7.1 - *CFW-11M RB Accessories*

WEG Part Number	Name	Description	Slot	Identification Parameters	
				P0027	P0028
11008162	IOA-01	IOA module: 1 voltage/current analog input (14 bits); 2 digital inputs; 2 voltage/current analog outputs (14 bits); 2 open-collector digital outputs.	1	FD--	----
11008099	IOB-01	IOB module: 2 isolated analog inputs (voltage/current); 2 digital inputs; 2 isolated analog outputs (voltage/current) (the programming of the outputs is identical as in the standard CFW-11); 2 open-collector digital outputs.	1	FA--	----
11008913	HMI-01	Keypad. (2)	HMI	-	-
11010521	RHMIF-01	Remote keypad frame Kit (IP56).	-	-	-
11010298	HMID-01	Blank cover for the keypad slot.	HMI	-	-
11008912	MMF-01	FLASH memory module.	5	----	--xx(1)
10960847	CCS-01	Kit for the shielding of the control cables (supplied with the product).	-	-	-
11077222	RACK 2	Rack for mounting 2 UP11 units in panel. (3)	-	-	-
11077221	RACK 3	Rack for mounting 3 UP11 units in panel. (3)	-	-	-

(1) Refer to the CFW11 RB Programming Manual.
(2) Use DB-9 pin, male-to-female,straight-through cable (serial mouse extension type)for connecting the keypad to the converter or Null-Modem standard cable. Maximum cable length: 10 m (33 ft).
Examples:
- Mouse extension cable – 1.80 (6 ft); Manufacturer: Clone.
- Belkin pro series DB9 serial extension cable 5 m (17 ft); Manufacturer:Belkin.
- Cables Unlimited PCM195006 cable, 6 ft DB9 m/f;Manufacture:Cables Unlimited.

(3) Refer to the rack assembly guide.

8 TECHNICAL SPECIFICATIONS



This chapter describes the technical specifications (electrical and mechanical) of the CFW-11M RB converter series.

8.1 POWER DATA

Power supply:

- ☑ Maximum rated line voltage: 480 V for models 380...480 V, 600 V for models 500...600 and 690 V for models 660...690 V, for altitude up to 2000 m. For higher altitudes, the voltage derating will be 1.1 % for each 100 m above 2000 m – maximum altitude: 4000M.
- ☑ Voltage tolerance: - 15 % to + 10 %.
- ☑ Frequency: 50/60 Hz (48 Hz to 62 Hz).
- ☑ Phase imbalance: ≤ 3 % of the rated phase-phase input voltage.
- ☑ Overvoltage according to Category III (EN 61010/UL 508C).
- ☑ Transient voltages according to Category III.
- ☑ Typical efficiency: ≥ 97 %.
- ☑ Typical input power factor: 0.99 at rated condition.
- ☑ Typical Total Harmonic Distortion of the input current: 4 % at rated condition.

ATTENTION!
When an output inverter is fed by the CFW-11M RB, it is necessary to reduce the rated current of the output inverter by 5 %.

Table 8.1 - *Technical specification for the CFW-11M RB*

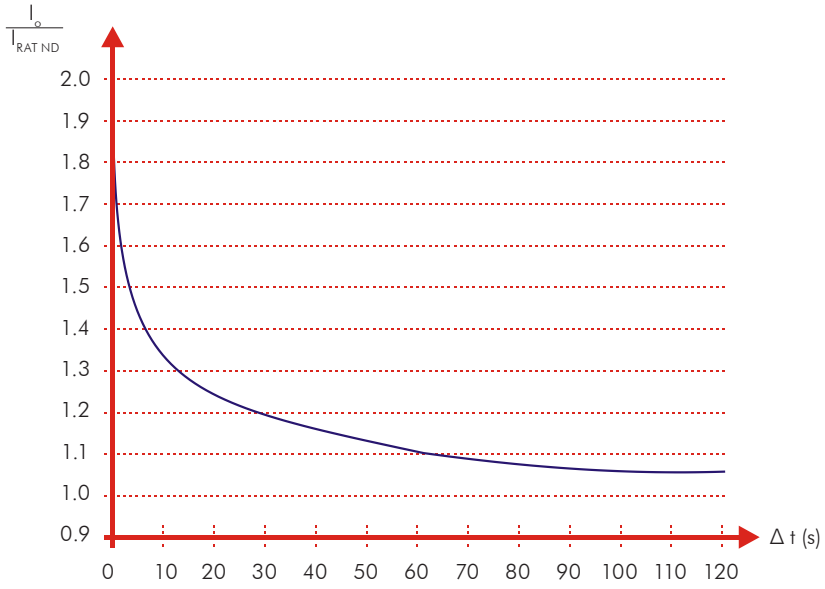
Model	Power Supply [Vac]	Use with Normal Duty (ND) cycle						Use with Heavy Duty (HD) cycle					
		Rated Input Current [Arms]	Overload Current [3] [Arms]		Switching Frequency [kHz]	Rated Output Current [Acc]	Dissipated Power [kW] [4]	Rated Input Current [Arms]	Overload Current [3] [Arms]		Switching Frequency [kHz]	Rated Output Current [Acc]	Dissipated Power [kW][4]
			1 min	3 s					1 min	3 s			
CFW11M 0600 T 4ORB		600 [1]	660	900	2.5	690	4.8	515 [1]	773	1030	2.5	592	4
CFW11M 1140 T 4ORB		1140 [1]	1254	1710	2.5	1311	9.6	979 [1]	1468.5	1958	2.5	1126	8
CFW11M 1710 T 4ORB	380...480	1710 [1]	1881	2565	2.5	1967	14.4	1468 [1]	2202	2936	2.5	1688	12
CFW11M 2280 T 4ORB		2280 [1]	2508	3420	2.5	2622	19.2	1957 [1]	2935.5	3914	2.5	2251	16
CFW11M 2850 T 4ORB		2850 [1]	3135	4275	2.5	3278	24	2446 [1]	3669	4892	2.5	2813	20
CFW11M 0470 T 5ORB		470 [2]	517	705	2.5	541	6	380 [2]	570	760	2.5	437	5
CFW11M 0893 T 5ORB		893 [2]	982,3	1340	2.5	1027	12	722 [2]	1083	1444	2.5	830	8
CFW11M 1340 T 5ORB	500...600	1340 [2]	1474	2010	2.5	1541	18	1083 [2]	1624	2166	2.5	1245	12
CFW11M 1786 T 5ORB		1786 [2]	1965	2679	2.5	2054	24	1444 [2]	2166	2888	2.5	1660	19
CFW11M 2232 T 5ORB		2232 [2]	2455	3348	2.5	2567	30	1805 [2]	2707	3610	2.5	2075	24
CFW11M 0427 T 6ORB		427 [2]	469,7	641	2.5	491	6.2	340 [2]	510	680	2.5	391	5
CFW11M 0811 T 6ORB		811 [2]	892,1	1217	2.5	933	12.4	646 [2]	969	1292	2.5	743	10
CFW11M 1217 T 6ORB	660...690	1217 [2]	1339	1826	2.5	1400	18.6	969 [2]	1453.5	1938	2.5	1114	15
CFW11M 1622 T 6ORB		1622 [2]	1784	2433	2.5	1865	24.8	1292 [2]	1938	2584	2.5	1486	20
CFW11M 2028 T 6ORB		2028 [2]	2232	3042	2.5	2332	31	1615 [2]	2422.5	3230	2.5	1857	25

Note:

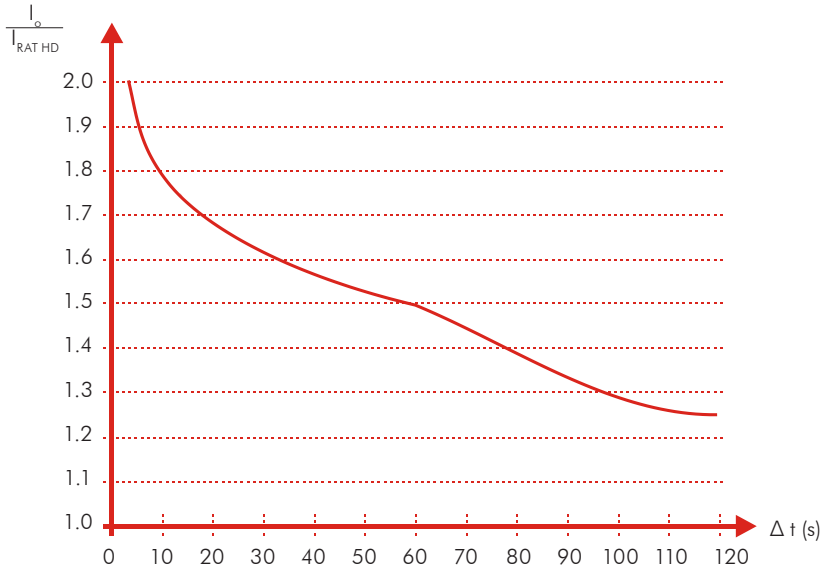
(1) Steady-state rated current in the following conditions:
- Surrounding air temperature: -10 °C to 45 °C (14 °F to 113 °F). The converter is capable of operating with an maximum surrounding air temperature of 55 °C (131 °F) if an output current derating of 2 % is applied for each °C (or 1.11 % each °F) above 45 °C (113 °F).
- Relative air humidity: 5 % to 90 % non-condensing.
- Altitude: 1000 m (3.300 ft). Above 1000 m (3.300 ft) up to 4000 m (13.200 ft) the output current shall be derated by 1 % for each 100 m (or 0.3 % each 100 ft) above 1000 m (3.300 ft).
- From 2000 m to 4000 m (6.600 ft to 13.200) - 1.1 % of maximum voltage derating for each 100 m (or 0.33 % each 100 ft) above 2000 m (6.600 ft) up to 4000 m (13.200 ft) maximum altitude.
- Ambient with pollution degree 2 (according to EN50178 and UL508C).

(2) Nominal current in permanent regimen at the following conditions:
- Temperature around the converter: -10 °C to 40 °C (14 °F to 104 °F). The converter is able to operate in environments with temperatures up to 55 °C (131 °F), if a reduction of 2 % in the output current is applied for each Celsius degree (or 1.11 % each °F) above 40 °C (104 °F).
- Relative humidity: 5 % to 90 % without condensation.
- Altitude: 1000 m (3.300 ft). Above 1000 m up to 4000 m (3.300 ft to 13.200 ft) the output current must be reduced in 1% for each 100 m (or 0.3 % each 100 ft) above 1000 m (3.300 ft).
- From 2000 m to 4000 m (6.600 ft to 13.200) - 1.1 % of maximum voltage derating for each 100 m (or 0.33 % each 100 ft) above 2000 m (6.600 ft) up to 4000 m (13.200 ft) maximum altitude.
- Environment with pollution degree 2 (according to EN50178 and UL508C).

(3) Table 8.1 presents only two points of the overload curve (activation time of 1 min and 3 s). The complete information about the IGBTs overload for Normal and Heavy Duty Cycles is presented below.



(a) IGBTs overload curve for the Normal Duty (ND) cycle



(b) IGBTs overload curve for the Heavy Duty (HD) cycle

Figure 8.1 - *(a) and (b) Overload curves for the IGBTs*

(4) The information provided about the converter losses is valid for the rated operating condition, i.e., for rated output current and rated switching frequency.

8.2 ELECTRICAL / GENERAL SPECIFICATIONS

CONTROL	METHOD	☑ Type of control: - Vector control. ☑ PWM SVM (Space Vector Modulation). ☑ Current, DC link voltage and reactive regulators..
INPUTS (CC11 RB board)	DIGITAL	☑ 6 isolated differential inputs, 24 Vdc, programmable functions.
OUTPUTS (CC11 RB board)	ANALOG	☑ 2 isolated analog outputs, (0 to 10) V, RL ≥ 10 kΩ (maximum load), 0 to 20 mA / 4 to 20 mA (RL ≤ 500 Ω) resolution: 11 bits, programmable functions.
	RELAY	☑ 3 relay outputs with NO/NC contacts, 240 Vac, 1 A, programmable functions.
SAFETY	PROTECTION	☑ Input Overcurrent/Short-circuit. ☑ Under/Overvoltage. ☑ Overtemperature. ☑ IGBTs overload. ☑ External Fault/Alarm. ☑ CPU or memory fault. ☑ DC link phase-ground short-circuit.
INTEGRAL KEYPAD (HMI)	STANDARD KEYPAD	☑ 4 active keys: Up Arrow, Down Arrow, Right Soft Key and Left Soft Key. 5 disabled keys: General Enable/Disable, Direction of Rotation, JOG, Local/Remote. ☑ Graphical LCD display. ☑ View/edition of all parameters. ☑ Indication accuracy: - current: 5 % of the rated current. ☑ Possibility of remote assembly.
ENCLOSURE	IP00	
PC CONNECTION FOR CONVERTER PROGRAMMING	USB CONNECTOR	☑ USB standard Rev. 2.0 (basic speed). ☑ Type B (device) USB plug. ☑ Interconnection cable: standard host/device shielded USB cable.

8.2.1 Codes and Standards

SAFETY STANDARDS	☑ UL 508C - Power conversion equipment. ☑ UL 840 - Insulation coordination including clearances and creepage distances for electrical equipment. ☑ EN61800-5-1 - Safety requirements electrical, thermal and energy. ☑ EN 50178 - Electronic equipment for use in power installations. ☑ EN 60146 (IEC 146) - Semiconductor converters. ☑ EN 61800-2 - Adjustable speed electrical power drive systems - Part 2: General requirements - Rating specifications for low voltage adjustable frequency AC power drive systems.
ELECTROMAGNETIC COMPATIBILITY (EMC)	☑ EN 61800-3 - Adjustable speed electrical power drive systems - Part 3: EMC product standard including specific test methods. ☑ EN 55011 - Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment. ☑ CISPR 11 - Industrial, scientific and medical (ISM) radio-frequency equipment - Electromagnetic disturbance characteristics - Limits and methods of measurement. ☑ EN 61000-4-2 - Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 2: Electrostatic discharge immunity test. ☑ EN 61000-4-3 - Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 3: Radiated, radio-frequency, electromagnetic field immunity test. ☑ EN 61000-4-4 - Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 4: Electrical fast transient/burst immunity test. ☑ EN 61000-4-5 - Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 5: Surge immunity test. ☑ EN 61000-4-6 - Electromagnetic compatibility (EMC)- Part 4: Testing and measurement techniques - Section 6: Immunity to conducted disturbances, induced by radio-frequency fields.
MECHANICAL STANDARDS	☑ EN 60529 - Degrees of protection provided by enclosures (IP code). ☑ UL 50 - Enclosures for electrical equipment.

8.3 MECHANICAL DATA

UP11

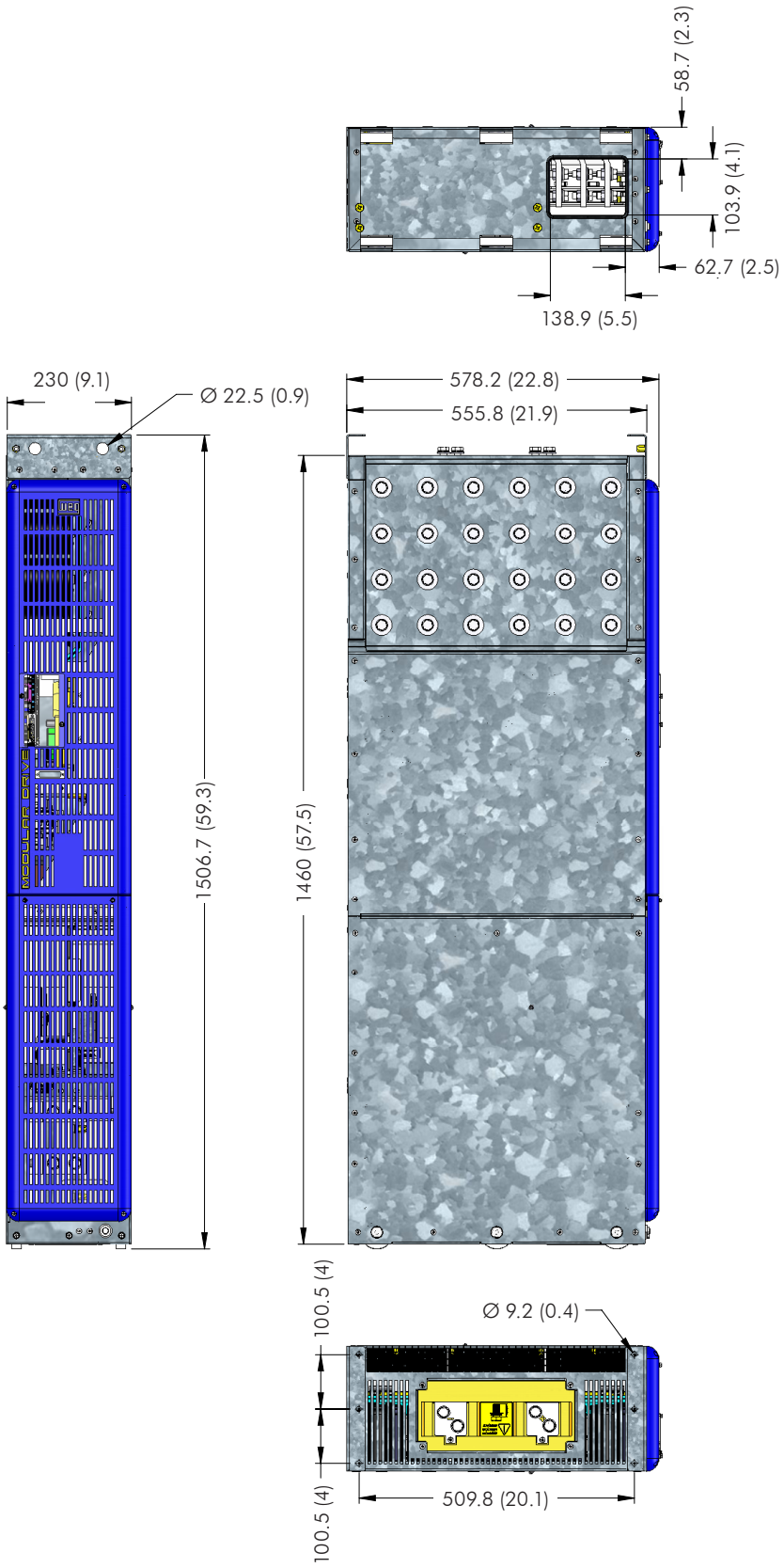


Figure 8.2 - *UP11 dimensions in mm (in)*

Control Rack

Figure 8.3 - *Control rack dimensions in mm (in)*

IPS1 Shielding Metal Case

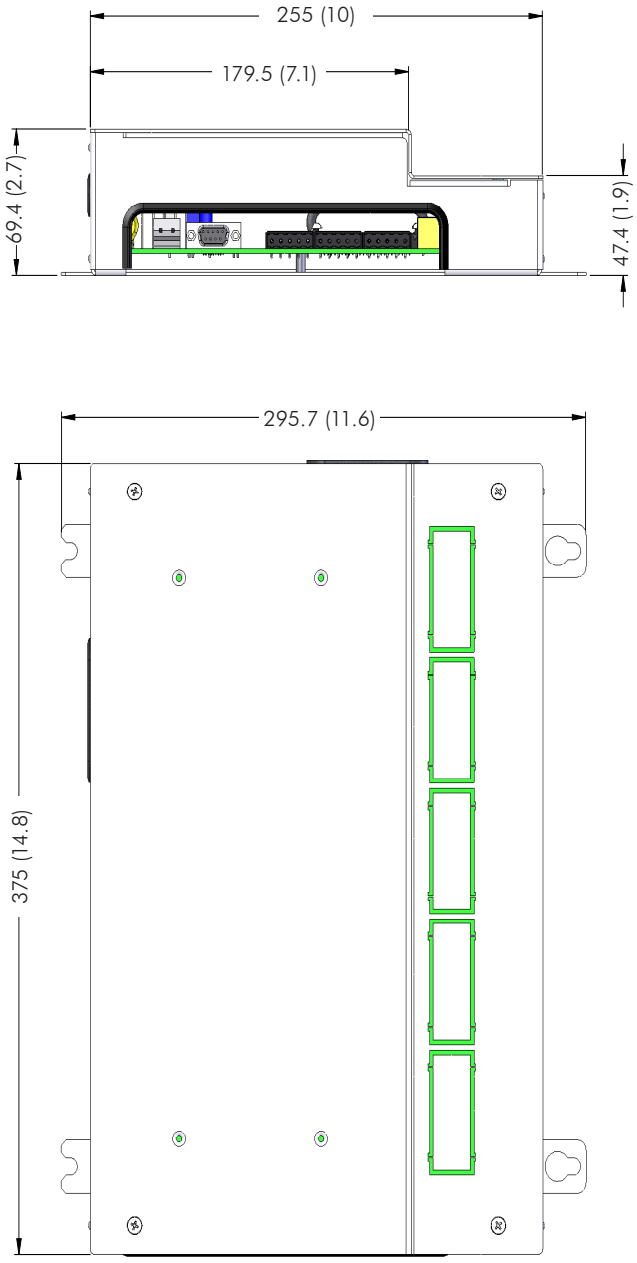


Figure 8.4 - *IPS1 board metallic case dimensions in mm (in)*